US Army Corps
of Engineers
Kansas City District

FEASIBILITY REPORT
AND
ENVIRONMENTAL ASSESSMENT
WITH APPENDICES

MISSOURI RIVER LEVEE SYSTEM
UNITS R471-460 AND L-455
ST. JOSEPH, MISSOURI / ELWOOD, KANSAS

SEPTEMBER 2006

HEARTLAND ENGINEERS

MRLS R471-460 AND L455
FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

SEPTEMBER 2006

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MRLS L455 AND R460-471
FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

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The metropolitan area of St Joseph, Missouri is protected by a federal levee system constructed in the mid-1960s. This system consists of two separate units. Unit R471-460 is located on the right bank of the Missouri River and protects the cities of Elwood and Wathena, Kansas, as well as the Rosecrans Memorial Airport and Missouri Air National Guard facilities. Unit L-455 is located on the left bank of the Missouri River and protects portions of the City of St. Joseph. Both units also protect significant agricultural property and unincorporated areas. Both units are part of the Missouri River Levee System authorized by the 1944 Flood Control Act.

While this flood damage reduction system is designated as a Federal project, it has long been turned over to the local sponsors for operation and maintenance. The Corps of Engineers continues to conduct regular inspections and technical review of significant modifications to the system. These non-Federal sponsors are: the South St. Joseph Levee District, the St. Joseph Airport Levee District, and the Elwood-Gladden Drainage District.

During the Missouri River Flood of 1993, the right bank unit failed flooding homes, businesses, and infrastructure. The left bank unit passed the flood but was near to overtopping. As a result, there was a concern that the levees may provide less than the design level of flood damage reduction. At the request of the local levee districts, a review of the levees was initiated in 1999 to evaluate the existing level of flood damage reduction and determine alternatives for possible improvement. Section 216 of the 1970 Flood Control Act provided the study authority to investigate the performance of the levee system and the potential for improvements.

Comparison of the existing conditions with the original design and construction determined that the current levee system was not properly designed to provide the authorized level of flood damage reduction. The feasibility study evaluated various improvement alternatives using a risk-based analysis, including the no-action plan. The recommended plan calls for raising a significant reach of unit R471-460 up to 3.37 feet above the existing elevation and raising a short reach of unit L-455 up to 0.94 feet above the existing elevation. The plan also includes improvements to the geotechnical and structural features of the existing project. The levee alignment will remain the same although there will be an increase in portions of the base width. This will minimize local disruptions to both the populace and the environment. Borrow areas have been identified close to the existing levee and will require minor mitigation.

The recommended plan is the National Economic Development (NED) plan which maximizes the net benefits of the project. Proposed modifications to the two units are individually and collectively economically justified. The NED plan is also the locally preferred plan.

There are no significant direct or cumulative environmental impacts of the NED plan primarily because it sustains the existing levee rather then encumbering additional resources for a “new” flood damage reduction project. The long-term environmental and cultural consequences of plan implementation are positive as the increased reliability of the units act to guard the social and environmental fabric that has developed within the protected areas for the last 40 years. A minimal amount of wetlands would be lost; however mitigation is planned accordingly.

In December 1999, the Federal Emergency Management Agency determined that the right bank unit no longer provided the minimum level of flood damage reduction required for inclusion in the National Flood Insurance Program. The unit was formally decertified. This has created an economic hardship to the communities in the study area due to higher flood insurance costs and restrictions on development. The recommended plan will provide for the base level of flood damage reduction and allow certification of unit R471-460 by FEMA.

The total estimated implementation cost of the NED plan is $32,686,000 shared between the Corps and three non-Federal levee sponsors. The average annual costs of the NED plan are $2,008,900; benefits, $6,635,800; net benefits, $4,626,900. The resulting benefit to cost ratio is 3.3 to 1. The sponsors would receive credit for any necessary lands, easements, rights-of-way, relocations or disposal areas (LERRD). The total Federal share of the plan is $21,246,000 or 65 percent of the total cost and the sponsors share is $11,440,000 or 35 percent. The sponsors will take ownership of project improvements and assume all operation, maintenance, repair, and replacement costs of the completed works.

MRLS L455 AND R460-471
FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

I. Introduction

The Missouri River Levee System (MRLS) Units R471-460 and L-455 (Figure 1) are located on opposite sides of the Missouri River and provide local flood damage reduction for the metropolitan area of St. Joseph, Missouri, and surrounding communities. Both levee units are a part of the comprehensive MRLS, authorized by the Federal Flood Control Act of 1944 (Public Law 534, 78th Congress). The design of the St. Joseph levee system is described in "Missouri River Levees, Sioux City, Iowa, to the Mouth, Definite Project Report," dated 17 March 1947. The Chief of Engineers approved the report on 21 April 1947.

These units were designed by the Corps of Engineers, Kansas City District (Corps) and constructed between 1962 and 1968. The two units combine to provide flood damage reduction to approximately 21,000 acres of rural and urban land; including the Cities of St. Joseph, Missouri, and Elwood and Wathena, Kansas. Significant investment in the protected area includes the Rosecrans Memorial Airport and Missouri Air National Guard Base.

Unit R471-460 was overtopped and subsequently breached during the flood of 1993. Following the failure of that unit, and the subsequent repairs under P.L. 84-99, the following local communities and organizations sent letters requesting a study of the levee system:

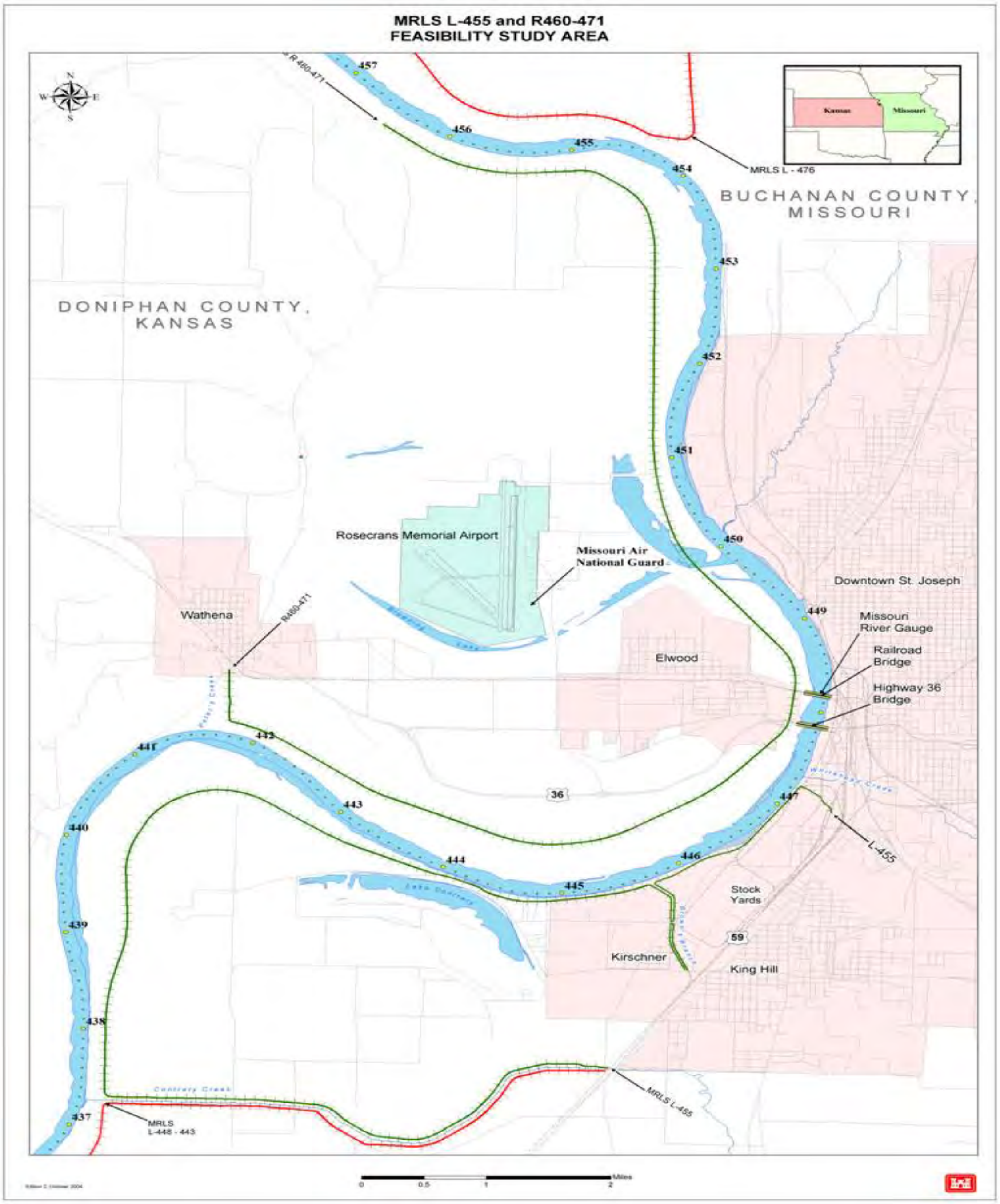
South St. Joseph Drainage and Levee District, April 13, 1994
The City of Wathena, Kansas, April 18, 1994
St. Joseph Area Chamber of Commerce, April 21, 1994
The City of Elwood, Kansas, April 21, 1994
Elwood-Gladden Drainage District, May 13, 1994

In response to these requests, Congress provided funding for a Reconnaissance Study in the Energy and Water Appropriation Act of 1995, P.L. 103-316 (August 26, 1994). The study began in May 1995 and was completed in May 1996. It concluded that there was at least one economically feasible alternative in which there was a Federal interest to proceed with a Feasibility Study.

The Feasibility Study was initiated in May 1999 with the signing of a Feasibility Cost Sharing Agreement. It is financed on a cost-share basis in accordance with the Water Resources Development Act of 1986. The Federal Sponsor is the U.S. Army Corps of Engineers, Kansas City District. The non-Federal Sponsors are the South St. Joseph Drainage District, the St. Joseph Airport Levee District, and the Elwood-Gladden Drainage District. The cost of the study is shared between the Corps (50%) and the non-Federal Sponsors (50%).

In December 1999, the Federal Emergency Management Agency (FEMA) determined that unit R471-460 no longer provided the minimum base flood level of flood damage reduction and formally decertified the unit. This action has subjected the properties protected by this unit to higher insurance premiums under the National Flood Insurance Program (NFIP).

Figure 1 – Study Area Map



A significant delay occurred when the local sponsors and the Corps agreed to delay the Feasibility Study for overall updated hydraulic information. A broader and separately authorized study, the Upper Mississippi and Missouri River Flow Frequency Study (UMMRFFS), developed updated estimates of flows and water surface profiles for the entire Missouri River using updated gage records and state of the art technology – the UNET model. The UNET model results were not finally published until June 2003. The feasibility study used this updated hydraulic information.

II. Study Authority

This Feasibility Study is authorized by Section 216 of the 1970 Flood Control Act. Section 216 reads as follows:

> *The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects, the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to the significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying structures or their operation, and for improving the quality of the environment in the overall public interest.*

A Reconnaissance Study was completed in May 1996 and identified a Federal interest for continuing into the feasibility phase. A Feasibility Cost Sharing Agreement was signed with the local sponsors in 1999.

III. Study Purpose and Scope

The purpose of the feasibility study is twofold. First, the study serves to update and verify data on the reliability of the existing flood damage reduction units. Secondly, the study provides a means to examine and develop alternative plans (including a review of the "no Federal action" alternative) to restore the reliability of the units to reduce damages from potential flooding on the Missouri River in the vicinity of St. Joseph, Missouri, with the ultimate aim of a final recommended plan for authorization and implementation. The recommended plan for increasing the reliability of the system will be selected through the basic tests of technical effectiveness & completeness, economic feasibility, and environmental acceptability.

IV. Prior Project Documents, Studies, and Reports

Several studies and reports have been completed pertaining to the study area and surrounding areas. These reports were used to gather information regarding the levee units and past flood events:

- Missouri River Levees (Sioux City, Iowa to the Mouth) Definite Project Report, March 1947
- General Design Memorandum – Levee Unit L-455, September 1959
- Missouri River Agricultural Levee Restudy Program Hydrology Report, March 1962
- General Design Memorandum – Levee Unit R471-460, December 1965
- Operations and Maintenance Manual – MRLS Unit L-455, 1969
- Missouri River Flood Plain Pilot Study, St. Joseph to Kansas City, November 1977
- Operation and Maintenance Manual – MRLS Unit R471-460, December 1986
- Reconnaissance Study, St. Joseph, Missouri, December 1987
- Project Information Report, MRLS, South St. Joseph Unit, Levee Unit L-455, October 1993
- Project Information Report, MRLS, Elwood-Gladden Unit, Levee Unit R471-460, January 1994
- Emergency Levee Repair, MRLS Unit 471-460, Doniphan County, Kansas and Buchanan County, Missouri, Construction Plans and Specifications, February 1994
- The Great Flood of 1993 Post-Flood Report, Lower Missouri River Basin, September 1994
- Reconnaissance Report, MRLS Units L-455 and R460-471, May 1996
- Upper Mississippi River System Flow Frequency Study (UMRFFS), 2003

V. Existing Projects

Units R471-460 and L-455 were constructed as part of the comprehensive Missouri River Levee System (MRLS) authorized by the Flood Control Act of 1944. Additional MRLS units are located immediately up and down stream on the Missouri River. During the flood of 1952, the river cut across the French Bottoms, the area where Rosecrans Airport is located, leaving behind an oxbow lake (Browning Lake) on the right bank. Levee unit R471-460 was later constructed along the new channel alignment.

These units were originally designed and constructed to provide flood damage reduction for a flow of 325,000 cfs with 2 feet of freeboard, plus 1 foot for dynamic effects such as super-elevation on the outside of bends and pile-up on exposed flanks. The levee freeboard was above the constant flow profile of the original design hydraulics and included 0.15 foot per mile slope for the effect of a rising hydrograph.

There are six major Federal reservoirs on the main stem of the Missouri River in the Dakotas and Montana. The reservoir furthest downstream is the Gavins Point Dam in southern South Dakota, which is approximately 360 river miles upstream of the St. Joseph area. This system of reservoirs provides flood damage reduction benefits all along the Missouri River, but the system is difficult to operate specifically for the St. Joseph area because of the four to five day travel lag between a release at Gavins Point and the arrival of that water at St. Joseph. Review of the Missouri River lakes is not specifically addressed by this study; however, the effects of lakes on river hydrology are incorporated into the models used in this study.

VI. Problem Identification

A. Existing Conditions and Flood History

1.0 Study Area

The Missouri River has a drainage basin of 424,300 square miles upstream from St. Joseph. Hills and bluffs that rise from 100 to 200 feet above the relatively wide and flat Missouri River bottomland characterize the topography in the study area. Numerous creeks and tributaries that dissect the bluffs bounding the Missouri River provide interior drainage in the study area. The broad alluvial flood plain is three to five miles wide and consists of low-lying nearly level terrain. The Missouri River borders the eastern bluffs in the northern part of the study area and then crosses over to border the western bluffs in the southern part of the study area. In the crossover, the river is funneled between levee units R471-460 on the north and L-455 on the south.

The study area (Figure 1) includes the flood plain of the Missouri River and tributaries protected by units R471-460 and L-455. This area encompasses the southwestern portion of St. Joseph, Missouri, the entire town of Elwood, Kansas, and the southeast edge of Wathena, Kansas. St. Joseph, the Buchanan County seat, is located in northwest Missouri on the east bank of the Missouri River. Elwood and Wathena are located in northeast Kansas, in Doniphan County, across the river from St. Joseph.

The area protected by levee unit R471-460 on the right bank of the river is 13,524 acres. It includes the towns of Elwood, Kansas, (2000 pop. 1,145), Wathena, Kansas, (2000 pop. 1,348) and unincorporated rural areas. This area includes 3,374 acres situated in the State of Missouri, which was cut off as a result of the 1952 flood and subsequent realignment of the Missouri River. The cut-off area is the former French Bottoms and contains Rosecrans Memorial Airport and Missouri Air National Guard Base. Total investment protected by R471-460 is estimated at over $500 million.

The area protected by levee unit L-455, located on the left bank of the river immediately downstream and south of levee unit R471-460, is 7,500 acres. It includes the southern portion of St. Joseph, Missouri, (2000 pop. 73,990) and unincorporated areas. Important features of the protected area include the stockyards and old central industrial district; home to several large companies and public facilities including the St. Joseph water treatment plant. Total investment protected by L-455 is estimated at over $1.4 billion.

2.0 Existing Flood Threat

Prior to the construction of the levee units, this reach of the Missouri River had an approximate channel capacity of 110,000 cfs and routinely flooded river bottomland in the vicinity of St. Joseph, Missouri. Also, without the levees, flood stages in excess of 15 feet caused significant flood damage to St. Joseph, Missouri. For this study, a detailed update of the hydraulics was completed with current state of the art hydraulic modeling, utilizing calibration to the 1993 flood event. The discharges for this study were taken from the UMRFFS study completed in 2003. The UMRFFS currently estimates the 1-percent event discharge to be 261,000 cfs and the 0.2-percent event discharge as 324,000 cfs.

In 1994, FEMA initiated a flood insurance study of Buchanan County encompassing protected areas behind both R460-471 and L-455. In 1996, the Natural Resources Conservation Service (NRCS), working as a technical agent for FEMA in conducting the flood insurance study, asked the Corps of Engineers to verify certification of the R460-471 levee unit. After a process of hydraulic evaluations made in conjunction with the reconnaissance study, the Kansas City District determined that the R460-471 levee unit could not pass the 1 percent chance flood with 90 percent reliability nor did it have adequate freeboard. In December 1999, the R460-471 unit was formally decertified.

3.0 Historic Floods and Damages

Floods on the Missouri River are caused by widespread storm systems over several days or weeks, sometimes combined with runoff of spring snowmelt in Wyoming, Montana, and the Dakotas. Floods in the Missouri River Basin carry great quantities of silt and debris, and are of comparatively low velocity and of several days duration. The table below lists the estimates of the five largest annual peaks at the location of the U.S. Geological Survey (USGS) gauge at St. Joseph.

TABLE 1
HISTORIC FLOODS AT ST. JOSEPH

Year	Measured Discharge (cfs)
1952	397,000
1881	370,000
1844	350,000
1993	335,000
1903	252,000

Note: The 1993 event is the only historic event that occurred under the influence of full main stem reservoir control, which was completed in the mid 1960’s.

The 1844 event is considered the greatest known event in the lower Missouri Basin, but there was little development in the area to be impacted. On April 1, 1881, a large ice jam on the Missouri River near Yankton, South Dakota, broke apart releasing floodwaters down the Missouri valley. This event caused widespread damage in several communities up and downstream, but little information is available regarding specific impacts at St. Joseph.

Flood of 1952

On April 22, 1952, the Missouri River crested at a new record stage of 26.8 feet. Flood Stage at St. Joseph is 17 feet. Rapid snowmelt in northern Montana caused the river to swell, causing massive devastation in Nebraska and Iowa. After passing St. Joseph, the flood dissipated down the valley, receiving little tributary flow. The 1952 flood still stands as the flood of record for most locations on the Missouri River, with the highest measured discharge.

Despite the efforts of the town to protect Rosecrans Airport, the airport eventually flooded, damaging many of the temporary World War II buildings beyond economical repair. During the flood, the Missouri River scoured a new channel across the neck of the French Bottoms, east of the airport. After the flood, the U.S. Army Corps of Engineers constructed a new cut-off channel for the river between river miles 449.4 and 452.0. An oxbow lake (Browning Lake) was formed in the old Bellemont Bend and Elwood Bend portions of the river channel. The cut-off channel modified portions of Bon Ton Bend and St. Joseph Ben, and separated the city from the airport. A highway bridge was later constructed to connect the two.

The 1952 Flood also severely damaged the Lake Contrary Amusement Park, which never fully recovered from the damage and later closed (see Figure 2).

Figure 2 - Contrary Lake Amusement Park during the Flood of 1952

Flood of 1993

Heavy rains in the Missouri and upper Mississippi River valleys during June 1993 caused flooding of both rivers that eventually engulfed portions of nine states and caused billions of dollars in damages. Figures 3 and 4 present photos of the study area during the flood.

Unit R460-471 failed from overtopping on July, 26, 1993, causing over $65 million in damages. Virtually the whole town of Elwood, Kansas was devastated. An estimated 450 homes, and more than 100 businesses, in the town of 1,079 people were inundated. The average depth of floodwaters in Elwood was six feet. Rosecrans Memorial Airport, serving the St. Joseph area and housing a Missouri Air National Guard Base, suffered an estimated $16 million dollars in flood damages. Repairs were made to return unit R471-460 to pre-flood conditions under Public Law 84-99.

During the 1993 event, Unit L-455 protected 7,500 acres of industrial, residential, and farmland, preventing approximately $176 million in damages. However, floodwaters were close to overtopping the levee, which would have caused catastrophic damages to an industrial area estimated to contain assets of over $1 billion and an annual payroll in excess of $50 million. Businesses closed down because of concern for the safety of the levee, resulting in lost wages, productivity, and sales.

Figure 3 – Breach of Unit R471-460 during and after the Flood of 1993

Figure 4 – Photos of Study Area during Flood of 1993

Clockwise from top left: Looking west where U.S. Highway 36 crosses the Missouri River and disappears into flooded Elwood, Kansas; floodwaters surround the St. Joseph water treatment plant; floodwaters in Wathena, Kansas; Rosecrans Memorial Airport terminal building.

One exception was the St. Joseph electric power plant located behind the left bank levee. Alternative sources of power in the region had shut down because of high floodwaters and, despite low levels of flooding from interior drainage, the plant continued to supply power to the region avoiding serious brownouts. Two sewage treatment plants and the St. Joseph's water treatment plant are also protected by L-455. The water pump system on the Missouri River water intake was flooded, eliminating the water source to the water treatment plant for a nearly a week. The 1993 flood established a new record stage at St. Joseph of 32.1 feet, on July 26, 1993.

4.0 Floodplain Conditions

The communities of St. Joseph, Missouri, and Elwood and Wathena, Kansas, all participate in the National Flood Insurance Program (NFIP). Property owners in a participating community within the 1 percent chance flood zone, and other specially designated zones, can obtain flood insurance. Any proposed construction in the 1 percent chance flood plain must generally be elevated above the 1 percent chance flood elevation, or in compliance with local ordinances. The floodway is an area hydraulically defined that must be reserved in an unobstructed condition in order to pass the base (1 percent chance) flood without increasing flood levels more than one foot. Existing floodplain ordinances generally prohibit construction or development within the floodway.

The FEMA regulatory floodway and floodplain boundaries in the study area are currently indicated by the Flood Insurance Rate Map (FIRM), Buchanan County, Missouri, Panels 0075 B and 0125 B and Doniphan Co., Kansas, Panels 0075 B and 0125 B, all dated August 1, 1983; and City of St. Joseph, Missouri, Panel 0020 C, dated Sept. 19, 1984. New maps reflecting the decertification of Unit R471-460 have not been issued at the time of this report.

By letter of May 19, 2000, FEMA notified the City of St. Joseph that they were preparing to update the NFIP mapping for Buchanan County, Missouri. As part of their process, they had previously requested the Corps to verify that the levee units shown on the Buchanan County FIRM would pass a flood having a one-percent chance of being exceeded in any given year (base flood). The Corps responded that unit R471-460 did not meet the criteria to pass the base flood. A meeting was held June 6, 2000, at Rosecrans Memorial Airport with representatives of the City of St. Joseph, the local levee districts, Kansas City District, and FEMA Region VII. At this meeting, FEMA presented the details of the "AR Zone" designation for areas where a Federal flood damage reduction system no longer passes the base flood but restoration is underway. The AR Zone designation recognizes that flood hazards are temporary until restoration is complete. In order to be placed in an AR Zone a community must petition FEMA, develop a restoration plan, and commit to cost-shared levee restoration within ten years.

If an AR Zone is not established, then the alternative is an AE Zone designation, which applies to all areas subject to the one-percent chance flood. Both AR and AE designations require mandatory purchase of flood insurance and new construction standards. However, floodplain management requirements and insurance rates are reduced in the AR Zone. Furthermore, properties currently covered by flood insurance will not have their rates raised by an AR Zone designation as long as coverage is continuously maintained.

5.0 Geotechnical Conditions

The Engineering Appendix presents the results of the geotechnical evaluation of the existing conditions performed as part of the feasibility flood study of the Missouri River Flood Levee System at St. Joseph, Missouri. The flood damage reduction project within the study area was designed by the Kansas City District U. S. Army Corps of Engineers and was constructed under its supervision.

The left bank unit is operated and maintained by the South St. Joseph Levee District and the right bank unit is operated and maintained by the Elwood-Gladden Drainage District and the St. Joseph Airport Levee District

The primary goal of this phase of the geotechnical evaluation was to gather and review all available data and develop an assessment of the existing conditions of each levee unit by identifying the critical reaches for each unit and their probability of failure for different river stages. Additionally, the past performance of the levee system was evaluated. This information is to assist in an assessment of the future performance of the levee during flood events. In particular, the following tasks were performed for this study:

- Review of existing sources of information,
- Description of each existing levee unit including design features and subsurface conditions.
- Reliability analyses of each unit and identification of critical reaches of each unit

The evaluation of the existing condition was based on the original subsurface investigation performed for the design of the project. This was supplemented with additional investigations, such as cone penetrometer tests and laboratory testing performed on selected samples collected from borings drilled in some areas considered critical.

6.0 Economic Setting

Economic development in the contemporary study area is focused on a cluster of life science manufacturing concerns located in the St. Joseph Stockyards and extending across the river into the Elwood area. This cluster of firms ties into other such firms elsewhere in St. Joseph and in Kansas City to the south. Major industries in the study area include pork and soybean processing, veterinary drug manufacturing, herbicide manufacturers, animal food and supplements manufacturers, and leather manufacturing.

Other major industries in the L-455 area include food container and packaging manufacturers, battery manufacturing, and steel building frame manufacturers. Major utilities include wastewater treatment and electric power.

In the R471-460 area, Rosecrans Airport and the Missouri Air Guard base are the key economic components. Other major industries in the right bank area include grocery wholesaling, warehousing and storage, home supply retail, boom manufacturing, construction, and truck chassis and components manufacturing.

Agriculture is a major land use in the study area. Farmed crop acreage accounts for about 5,100 of 7,219 total acres in the L-455 area (71% of the total) and about 7,200 of 13,424 total acres in the R471-460 area (54%). Agricultural land uses are found primarily in the western portion of L-455 and the northern portion of R471-460.

7.0 Environmental Setting

High stages in the Missouri River generally occur in the spring and fall. Runoff may be coincident with the months of heaviest precipitation (total average annual precipitation is 34 inches), but Missouri River flows are greatly influenced by snow melt runoff from the Rocky Mountains.

The Missouri River runs generally from north to south through the study reach and has been extensively channelized. Riparian woodlands exist as narrow strips along the river. The dominant vegetation in the riparian areas is a mix of cottonwood, sycamore, maple, oak, and hickory trees. Wetlands exist within the study area as small pockets and old meander scars and in the riparian strips. Table 2 lists the types and amounts of various land types found in the study area.

TABLE 2 – LAND TYPES IN STUDY AREA			
Type	**Total Acres**	**Type**	**Total Acres**
Side Channels	0.13	Grassland	234.76
Tributary Rivers/Streams	2.17	Cultivated	846.3
Developed	7.35	Cultivated with Levee	25.72
Naturally Bare	2.77	Emergent Wetland	131
Deciduous Trees	388.32	Scrub Shrub Wetland	65
Shrubland	153.08	Forested Wetland	545

An old oxbow of the Missouri River (the French Bottoms) was cut off when the river changed course during the flood of 1952. Remnants of the oxbow remain as Browning Lake, and are protected by unit R471-460. Lake Contrary located at approximately river mile 443 in the area protected by unit L-455. Both of these lakes provide recreational opportunities to the study area..

8.0 Fish and Wildlife

Wildlife found in the study area includes various deer, squirrel, beaver, mink, muskrat, opossum, coyote, raccoon, and striped skunk. Smaller mammals, such as mice, voles, rats, and bats account for the majority of the species present. Numerous amphibians and reptiles are common to the study area including multiple species of frogs, turtles, lizards, snakes.

The project area provides year-around habitat for approximately 31 bird species, with nearly 80 additional species using the project area for seasonal nesting and residency. Over 110 species use the corridor over the study area for seasonal migration.

The rivers' fishery is characterized by species typical of large, turbid rivers, including game fish species such as the smallmouth, buffalo, common carp, river carpsucker, shortnose and longnose gar, channel, flathead, and blue catfish, white crappie, freshwater drum, green sunfish, and bluegill. Forage species present include gizzard shad and various minnows and shiners.

The U.S. Fish and Wildlife Service lists the following Federally-listed threatened and endangered species as possibly occurring in the vicinity of the Missouri River in Doniphan County, Kansas, and Buchanan County, Missouri: piping plover, bald eagle, least tern, pallid sturgeon, and Indiana bat.

In addition to Federally-listed species, the Kansas Department of Wildlife and Parks also lists the following State-listed threatened and endangered species as possibly occurring in Doniphan County: American burying beetle, chestnut lamprey, eastern spotted skunk, silverband shiner, snowy plover, western earth snake, and white-faced ibis.

The Missouri Department of Conservation lists the pied-billed grebe as a sensitive species possibly occurring in the vicinity of the project.

Additional information on fish & wildlife species found in the study area including threatened and endangered species can be found in the Environmental Assessment.

The Corps of Engineers Missouri River Fish & Wildlife Mitigation Program is currently pursuing the purchase of land from willing sellers throughout the Missouri River corridor to implement habitat restoration efforts. Land has recently been purchased in the St. Joseph Study Area for inclusion in this program and additional land purchases are in negotiation. The planning and design of projects under this program are separate from the efforts and recommendations of this Feasibility Study; however, any proposed project under this program authority is expected to complement the recommendations herein and will be coordinated during project implementation.

9.0 Wetlands

National Wetlands Inventory Maps and NRCS soils maps have been reviewed. Site visits, including a Corps of Engineers wetland determination in the study area, were conducted. Numerous wetlands exist within the project area as small pockets, old meander scars, and within the riparian strips. Primarily, wetlands in this area are forested, followed by emergent and scrub-shrub. More information on the wetland determination methods used, and the results of the review, is included in the Environmental Assessment.

The Corps of Engineers Missouri River Enhancement Program is pursuing a project at Lake Contrary for restoration of the lake and its surrounding wetland and riparian habitat features. The planning and design of this proposed project is separate from the efforts and recommendations of this Feasibility Study; however, any proposed project under this program authority is expected to complement the recommendations herein and will be coordinated during project implementation.

10.0 Cultural Resources

A literature and background review of the study area was completed in 1996 and 2001. The review included the National Register of Historic Places, site records from the Kansas and Missouri State Historic Preservation Officers, archeological reports from projects in the region, and appropriate historical documents. The cultural resource review found no archeological sites or historic structures recorded within the study area. Since the 1996 review, no additional sites have been recorded within the study area.

The Corps also conducted an accreted land study of the area of potential effect to help determine the potential for archeological sites within the study area. The study was undertaken by using GIS to overlay historic Corps of Engineer Missouri River channel maps from 1804, 1879, 1892, 1926, 1954, as well as current maps to show the various locations of the river channel. The former channel locations are considered accreted land. The study found that much of the proposed project area is comprised of land accreted after 1879. These results along with the results of the background literature review were coordinated with the appropriate SHPO, and it was determined that no historic properties would be affected by the project.

11.0 Hazardous, Toxic, and Radioactive Waste

A Feasibility Study Hazardous, Toxic, and Radiological Waste (HTRW) assessment of levee units L-455 and R471-460 was completed in 1999. This assessment included a search and review of the Environmental Protection Agency's database covering the St. Joseph and Elwood corridors and a site visit and interview with a local sponsor representative.

Potential HTRW sites on both levee units were review and resolved as not being of concern to the feasibility study. The completed assessment, including a summary of each site and how they were addressed, is included in Appendix E.

B. Future Conditions Without Project

1.0 Future Flooding

By current estimates, unit R471-460 has a 51.3-percent chance of passing a 1-percent chance (100-year) flood event. Large areas of existing residential, business and industrial development are now in a zone no longer afforded 100-year level of flood damage reduction, and increased economic hardship is expected to result. Modifications or improvements to businesses are constrained. New investment within the area would be constrained due to flood insurance requirements. The cities and infrastructure protected by R471-460 will enter into an economic decline with less viability for improvement or enhancement and increasing economic blight. If a project is not authorized to restore certification to the right bank, FEMA will enact a major zoning change that will greatly increase flood insurance requirements and greatly degrade the economic health of the area. Currently, mission essential upgrades to the Missouri Air National Guard Base at the airport are being jeopardized by the status of the levee. Some increases in investment are likely to take place including the expansion of the Air National Guard base but at much greater cost to the users. If the project recommended by this study is not implemented by the Federal government, then the non-Federal Sponsors will be faced with a significant financial burden of trying to implement the project themselves, or they will have to rely on flood-fighting to protect the area from future floods.

Current analysis shows that Unit L-455 currently has a 93.6-percent chance of containing a 1-percent chance flood. Potential expansion of the City of St. Joseph to the south will result in existing agricultural property being converted to residential, commercial, or industrial uses. As new investment increases, damages associated with flooding will increase.

2.0 Socioeconomic Considerations

Approximately 60 percent of the flood plain in the study area is agricultural, comprising about

12,300 acres. Residential and industrial uses make up about 25 percent of the floodplain, totaling approximately 1,968 homes and 290 businesses and facilities. Total investment for the study area is $2 billion. The remaining land uses in the area are public and transportation infrastructure, woodlands, and wetlands.

Numerous city streets, county roads, State and Federal highways, and railroads cross the floodplain. Rosecrans Memorial Airport and the Missouri Air National Guard base are located in the floodplain. The wastewater treatment facilities for St. Joseph, Elwood, and Wathena are all located in the floodplain as well as other public utilities. In addition, there is agricultural land protected by the levees that could be developed for commercial and industrial uses. However, there is also an abundance of undeveloped land in the St. Joseph area that is not in the floodplain. Continuing industrial, commercial, residential, and transportation development is expected and, while much of the development will take place outside of the floodplain, pressures for floodplain use are expected to intensify.

The entire study area is part of the St. Joseph Metropolitan Statistical Area (MSA) (2000 pop. 102,490). Relative to the States of Missouri and Kansas as well as the nation, the population of the St. Joseph MSA is significantly older, more racially/ethnically homogeneous, and less educated. Home values are lower in the MSA than for the two states and the nation, per capita income is smaller, and the poverty rate is greater.

3.0 Environmental Considerations

Future conditions regarding the natural environment would likely be much as they are under the current condition. Natural growth of riparian and wetland habitats may occur subsequent to any changes in the current agricultural practices in the area. Without project implementation, the study area will remain under strict floodplain ordinances limiting new development, thus limiting environmental impacts such development might impose. However, potential increased flood-fighting, flood damage, and/or flood damage restoration efforts may temporarily impact the environmental setting.

C. Planning Problems and Opportunities

The primary study area problem is that the existing levees no longer provide the design level of flood damage reduction. This is supported by their performance during the 1993 flood and updated analysis performed using current criteria and modeling capabilities with a levee in place at this location.

This study presents the opportunity to restore the local flood damage reduction system to the design level and thereby minimize damages from future flood events. By doing so, there is the opportunity to provide the communities affected by previous floods with the confidence to continue with future economic development. Opportunities for protection or enhancement of the natural resources of the area also exist and may be addressed by this study or by other related activities currently taking place in the study area.

VII. Hydrology and Hydraulics

A. General

Hydrologic and hydraulic analyses were performed on the Missouri River by the Corps to produce water surface profiles for the Missouri River near St. Joseph, Missouri. The study area consists of approximately 56 river miles on the Missouri River, from RM 428 to RM 484. The existing conditions model was calibrated to the Upper Mississippi River Flow Frequency Study (UMRFFS) flood profiles for the study reach.

Hydrology for the Missouri River was originally evaluated and published in a Hydrology Report dated March, 1962. Since that time, the data presented in that report has been used by the Corps to estimate flood flows for subsequent flood damage reduction studies, FEMA flood insurance studies, and similar purposes**.** The UMRFFS study produced a detailed analysis of the effects of reservoir regulation on the main stem of the Missouri River and determined regulated flow frequency estimates applicable to the St. Joseph Feasibility Study. These discharges have been used to establish the existing conditions flow frequency data used in this study. A comparison of the two discharges is shown in Table 3.

TABLE 3
COMPARISON OF MISSOURI RIVER FLOW STUDIES

Frequency (% Chance of Exceedance)	Return Interval (years)	1962 Missouri River Discharge at St. Joseph Gage (cfs)	UMRFFS Missouri River Discharge at St. Joseph Gage (cfs)
0.2	500	330,000	324,000
1	100	270,000	261,000
2	50	246,000	233,000
10	10	185,000	174,000

Expressing discharge probability in percent chance exceedance (occurrence) is currently used in lieu of a flood return interval expressed in years. Percent chance exceedance expresses the probability of the discharge occurring each year. A return interval is the period of time over which, on average, one flood event will equal or exceed that discharge. For example, a 1% chance exceedance flood event has a one-in-one-hundred chance of being equaled or exceeded in any given year. If a 1% chance exceedance flood event were to occur this year, the probability of occurring next year and the year after is still the same, 1%. On average, only one flood event would equal or exceed the 1% chance event during a 100-year time period, thus the term a 100-year flood event. For this document, discharge will be expressed as a percent chance of exceedance followed by the equivalent return interval. All profiles presented herein represent the “most probable” or “nominal” estimates of water surface elevations. It is possible that actual water surface elevations may be higher or lower than those shown.

The Hydrology and Hydraulic section of the Engineering Appendix documents development of water surface profiles through the existing St. Joseph reach and evaluates alternatives for improving the integrity of the existing flood damage reduction system. The models developed in this study were used to model existing conditions, future conditions without project, and future conditions with project alternatives.

In addition, results from other studies are presented that characterize the existing conditions. These additional studies include: an analysis of levee tiebacks (levees along tributary streams that provide connection to higher ground); development of interior floodwater/exterior water surface elevation relationships; and impacts due to any proposed improvements.

B. Hydrologic Modeling

The overall hydrology and flow frequencies on the Missouri River in the St. Joseph area have been estimated in three major studies: *Missouri River Levees, Sioux City, Iowa to the Mouth* (1947); the *Missouri River Agriculture Levee Restudy Program* (1962); and *Upper Mississippi River System Flow Frequency Study* (2003). A discussion of each of those study results is provided in the Hydrology and Hydraulic chapter of the Engineering Appendix.

C. Hydraulic Modeling

The basis for the hydraulic analysis was the development of an existing and future conditions HEC-RAS model. HEC-RAS, version 3.1.3, as developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, was used in the analysis. This model attempted to calibrate to the flood event of 1993 from measured high-water marks and corresponding instantaneous discharge estimates. Since the St. Joseph reach was subject to a large levee failure on R471-460, the steady state HEC-RAS model had difficulty in calibrating to the 1993 profile. However, the UMRFFS included the use of an unsteady hydraulic model, UNET, for generation of flood profiles calibrated to the 1993 high water marks. The unsteady UNET model is capable of modeling the significant flow lost through the R471-460 breach in 1993 to be able to reproduce the 1993 flood profile through the St. Joseph study reach. Therefore, the HEC-RAS model used for the current St. Joseph study was calibrated to the UNET profiles generated for UMRFFS. Once the model was calibrated, a series of steady flow water surface profiles was created based on the flood discharges previously discussed. More detail of the hydraulic modeling efforts and results is provided in the Hydrology and Hydraulics section of the Engineering Appendix.

D. Authorized vs. Existing Performance

The general comprehensive plan for the Missouri River Levee System approved by Congress in the Flood Control Act of 1944 (P.L. 534, 78th Congress). The detailed plan for local flood damage reduction at St. Joseph, Missouri, was later published in *Missouri River Levees, Sioux City, Iowa to the Mouth, Definite Project Report*, 17 March 1947. This report assigns a design flood discharge of 325,000 cfs at St. Joseph. The 1947 report does not assign a frequency to the design discharge.

By the time the two St Joseph projects (R460-471 and L455) were constructed, the *Missouri River Agricultural Levee Restudy Program – Hydrology Report* had been published (March 1962). This report re-addressed flood frequencies on the Missouri River. The flood frequencies generated in the 1962 Restudy provided the basis for flood damage reduction studies, flood insurance studies, and FEMA maps, for the next 40 years. The 1962 Restudy, taking into account the Missouri River main stem reservoirs, reported that at the St. Joseph gage the 500-year discharge was 330,000 cfs and the 100-year discharge was 270,000 cfs. Thus before the projects were constructed the anticipated level of flood damage reduction was nearly 500-year.

As presented previously in Table 3, the UMRFFS results indicate that flow frequencies in the St. Joseph area have not changed much from the 1962 study. The UMRFFS discharges are 324,000 cfs for the 0.2% chance (500-year) event and 260,000 cfs for the 1% chance (100-year) event. However, in the preparation of this feasibility study analysis, a detailed and technologically current hydraulic model of this specific project location has been prepared. This model has had the benefit of updated data such as cross sectional information and data provided by the UMRFFS study, and especially the experience of a major flood event with a levee actually in place, the 1993 flood, for calibration purposes. After development and calibration of the hydraulic model for the St. Joseph area, the estimate of the nominal 1 percent chance profile has increased.

Current analysis indicates that unit R460-471 currently has only a 51.3% probability of successfully passing the 1-percent chance (100-yr) discharge and would likely overtop at a discharge of 276,000 cfs. The St. Joseph levee system will not currently pass the original design discharge of 325,000 cfs.

Based on the determination that the system could not pass the authorized design flow, and in response to the observed events of 1993, additional research of the original design was conducted. Although cross-sections and channel geometry at the time of design (1965) were not available, detailed mapping of the Missouri River created in 1974 (six years following the completion of levee construction) was accessible. The original 1965 design was based on the authorized flow of 325,000 cfs and a comparison of levee crest elevations shows that the existing levee is at or above the design elevations. When the 1965 design parameters and the 1974 channel cross-sections were modeled together, the resulting water surface profile elevation was higher than the existing crest of unit R471-460. Greater detail of this analysis is provided in Section 2 of Appendix B.

The Corps of Engineers has determined that although MRLS Unit R471-460 was constructed as designed, the original design was not sufficient to provide the flow discharge capacity originally authorized by Congress. Improvements recommended later in this report will be categorized as corrections of a design deficiency and should not require additional Congressional authorization for implementation. It should be noted that this study has formulated and evaluated alternatives under current criteria and guidance for risk and reliability analysis and optimization of economic benefits. The recommendations of this report may not fully restore the levee to the original design authorization but will provide for a system that functions in a safe, viable, and reliable manner, as was intended by its original designers.

E. Overtopping Location

No flood damage reduction project can guarantee total elimination of flooding. Corps of Engineers suggested guidance in Engineering Technical Letter (ETL) 1110-2-299 recommends the inclusion of design features into levee systems to attempt to control overtopping. This is so that if the discharge capacity of a project is exceeded, overtopping of the levee will occur at a known location along the unit. This allows the local community to anticipate where flooding impacts will first occur and theoretically lessens the flooding hazard. The selection of the preferred overtopping location per the guidance focuses on identifying the “least hazardous location” within the protected area.

Per the guidance, the least hazardous location is the location at which an overtopping failure will cause the least hazard to life and property within the protected area. This can include open areas such as golf courses, agricultural fields, or other undeveloped areas, oxbow lakes or other interior ponding, or the downstream end of a levee unit. Designing a levee system to initially overtop in a designated least hazardous location can prevent loss of life due to sudden levee failure, allow for increased warning time of impending flooding, and protect evacuation routes that may be needed during a flood event.

In the 1993 flood event, unit R460-471 failed due to overtopping in the northern (upstream) portion of the unit. This area consists of open agricultural fields and lies some five miles upstream of the intensely developed communities and areas of Elwood and Wathena, Kansas. There are no developed properties adjacent to the levee at this location, the area is upstream of an existing oxbow lake that can absorb some of the flow, and the distance to existing communities provides added warning time to existing infrastructure that may be used for evacuation.

Often, the least hazardous overtopping location in levees is at the downstream end. However, in this situation, moving the overtopping location further downstream from that previously experienced will place the residents and infrastructure of these communities at an increased hazard of quicker overtopping and inundation. Thus, the overtopping location in the northern undeveloped areas of the R460-471 Unit, the same overtopping location as experienced in the 1993 flood, lessens the threat of sudden inundation to intensely developed areas, and to the lines of communication infrastructure and evacuation routes of the unit. A comparison of this overtopping location to other possible locations, and the anticipation that the northern zone of the unit will remain in agricultural use of the foreseeable future, indicates that the 1993 overtopping point is the least hazardous location for this study area.

Based on the hazard review and determination, the hydraulic modeling conducted for this feasibility study assumed an overtopping location in the northern zone similar to that which occurred in the 1993 flood. Furthermore, minor refinements with very limited or no net cost increases to the project may be considered during the project design phase to ensure controlled overtopping in the northern area of Unit R460-471.

Unit L-455 has not shown any risk of overtopping during past events and therefore an overtopping location analysis was not conducted.

VIII. Economic Flood Damage Estimates

A. Economic Damage Analysis Methodology

The economic structure inventory in this study is categorized in terms of four basic land uses: residential, non-residential (including businesses, non-profit institutions such as churches and schools, public facilities and utilities), roads and streets, and agriculture (crops – farm sets are categorized in residential). Inundation damages to these property categories are the focus of the economic analysis. The price level for this analysis is October 2005. The Federal interest rate of 5.125 percent was used in annualizing costs and benefits over the 50-year period of analysis

The study area was divided into four reaches for the economic analysis, including two on each bank, as summarized in Table 4. The L-455 protected area extends from the downstream end at Contrary Creek at Missouri RM (River Mile) 437.35 to the upstream end at Whitehead Creek at RM 447.3. This area is divided into two reaches by the tiebacks along Brown's Branch at RM 445.7. The upstream reach is a densely developed urban area which includes the central industrial district in the old stockyards as well as part of the King Hill neighborhood. The more rural downstream reach includes an extension of the central industrial district along Lower Lake Road, the residential areas of Kirschner-Purtell and Lake Contrary (the latter is an unincorporated area immediately southwest of St. Joseph's city limits), and farmed land to the west and south of Lake Contrary. The two L-455 reaches are not hydraulically independent; flooding in the upstream reach could enter the downstream reach. However, flooding that begins downstream cannot back up into the upstream reach, and the overtopping point and critical geotechnical section for L-455 both are on the downstream segment of the levee.

TABLE 4
ECONOMIC ANALYSIS REACHES

Reach	Levee unit	Downstream river mile	Upstream river mile	Econ index point	Areas included
LB-US	L-455	445.70	447.30	446.32	Urban SW portion of St. Joseph; Stockyards & King Hill neighborhood
LB-DS	L-455	437.35	445.70	441.39	Lake Contrary; surrounding ag areas; Kirschner-Purtell neighborhood
RB-US	R-471-460	449.50	456.50	449.99	Rosecrans Airport; Air Guard base; ag area
RB-DS	R-471-460	441.80	449.50	449.44	Town of Elwood; town of Wathena (portion); Hwy. 36

On the right bank, the R471-460 area also is divided into downstream and upstream components, although there is no physical feature that clearly delineates the two reaches. The protected area extends from Peters Creek at RM 441.8 to the upstream tieback near Treece Road at RM 456.5. This area is divided into two reaches at RM 449.5, a somewhat arbitrary point highlighting differences in the water surface profiles affecting the upstream and downstream portions of the levied area. The downstream right bank area includes the town of Elwood, Kansas, a portion of the town of Wathena, Kansas, and the commercial and industrial area along U.S. Highway 36 connecting the two towns. The upstream reach includes the Rosecrans Airport area, the Missouri Air National Guard base, a large farming region north of the airport, and a number of rural residences. The airport and Air Guard base are in the Missouri portion of the reach, while the farmed areas are primarily in the Kansas portions.

A structure-by-structure field survey was carried out by economics staff in 2004. Each structure in the protected areas within the 0.2% floodplain (and slightly beyond in some areas) was surveyed, accounting for more than 2,200 structures. Information noted for each structure included address; identification of business/facility and industry at non-residential properties; type of home (single, duplex, multiple, mobile home); construction type and quality; with or without basement; number of stories; first floor elevations relative to ground elevations; condition; and estimated age. Significant outbuildings and outdoor inventory or equipment also were noted. 1998 GIS mapping was obtained from the city of St. Joseph and the Corps' Missouri River floodplain mapping. The available maps were contoured at intervals of four feet and also contained many spot elevations. In addition, square footage for each building was estimated by Corps staff from the footprint of each building in the protected areas.

The other major data collection task involved extensive on-site interviews with major companies and facilities in the study area for the purpose of collecting detailed values and depth-damage data. It was not possible within the study scope to interview all or most businesses in the study area. Therefore, emphasis was placed on those businesses and facilities with the largest investments in the protected areas. In this study area, a large percentage of total property value is accounted for by a few very large facilities. Ultimately, 20 extensive interviews were carried out, including 14 in the L-455 area and six in the R471-460 area. Based on the final economic database values, the interviewed firms and facilities accounted for 57% of all non-residential investment and 47% of total investment in the study area.

Appendix C contains a detailed account of how values, damage potential, and elevations were assigned to businesses and facilities, homes, roads and streets, and crop acreage. The damage analysis employs the HEC-FDA software (Hydrologic Engineering Center's Flood Damage Reduction Analysis program), a risk analysis software product that is the Corps standard for flood damage reduction analyses. HEC-FDA integrates economic data with hydraulic/hydrologic and geotechnical/structural engineering data, including uncertainty factors for each type of data, to produce estimates of project economic and engineering performance under existing without-project conditions and alternatives

Engineering inputs for the model include water surface profiles with stages and discharges for a range of eight selected flood events. In this analysis, profiles were obtained for eight events: 50%, 20%, 10%, 5%, 2%, 1%, 0.5%, and 0.2% chance events, plus invert stages. Sets of profiles were prepared for both the 2013 and 2038 analysis years. Discharge-probability and stage-discharge relationships were provided for each reach, including uncertainty factors. Top of levee stages based on critical levee low points were translated to each index point, as were exterior-interior stage relationships. Geotechnical probability of failure curves were developed for one critical section on each levee and then adjusted to the appropriate index points.

The economic damage analysis evaluates without and with project conditions based on a 50-year period of analysis, the standard assumption for a Federal levee. In addition to the existing conditions analysis which represents conditions as of 2006, the analysis also assumes a base year of 2013, the approximate year any project would become operational, and a future condition year of 2038, which is the midpoint of the 50-year period beginning in 2013. No additional, separate analysis for the present or existing condition was prepared since there would be no known differences relative to the 2013 base year in terms of either economic development or hydrologic/ hydraulic conditions. Therefore, the analysis for 2013 should adequately portray both existing and base year conditions.

B. Study Area Investment

The economic structure inventory for this analysis, as defined in the field survey and subsequently developed and refined, is summarized in Table 5.

TABLE 5
STUDY AREA INVESTMENT TOTALS

In $1,000s	L-455		R471-460		TOTAL	
RESIDENTIAL						
# Homes	**1,301**	66.1%	**667**	33.9%	**1,968**	
Structure Value	$68,066.5		$37,905.3		$105,971.8	
Contents Value	$47,646.5		$26,533.7		$74,180.2	
Total Value	$115,713.0	64.2%	$64,439.0	35.8%	$180,152.0	9.0%
NON-RESIDENTIAL						
# Businesses / Facilities	**166**	57.2%	**124**	42.8%	**290**	
Structure Value	$322,262.8		$196,012.3		$518,275.1	
Contents Value	$877,551.2		$245,813.5		$1,123,364.7	
Total Value	$1,199,814.0	73.1%	$441,825.8	26.9%	$1,641,639.0	82.2%
ROADS						
Miles	52.9	66.4%	26.8	33.6%	79.7	
Total Value	$102,698.9	65.4%	$54,235.1	34.6%	$156,934.0	7.9%
CROPS						
Acres	5,100	41.5%	7,200	58.5%	12,300	
Total Value	$7,650.0	41.5%	$10,800.0	58.5%	$18,450.0	0.9%
GRAND TOTAL	**$1,425,875.9**	71.4%	**$571,299.9**	28.6%	**$1,997,175.0**	100.0%

Total investment in homes, businesses and facilities, roads, and crop acreage is an estimated $2 billion. The L-455 area accounts for 71% of the total, or $1.426 billion. R471-460 area investment is an estimated $571 million, accounting for the remaining 29% of the study area. There are 1,968 homes and 290 businesses and facilities in the study area. The L-455 area contains two-thirds of the homes (1,301) and 57% of the non-residential properties (165). L-455 also contains 53 miles of roads, streets and railroad track (about two-thirds of the study area total) and 5,100 crop acres (about 41% of the total). The R471-460 area contains 667 homes and 125 non-residential properties, as well as 27 miles of roads and 7,200 crop acres.

Dividing up the investment by category, residential accounts for 9%, non-residential comprises 82.2%, roads account for 7.9%, and crops make up the remaining 0.9% of total investment.

C. Damage Results

This section summarizes results of the economic analysis as they pertain to beginning damage points and selected flood events. A more detailed analysis and discussion of the with and without project condition damages is presented in Appendix C.

Expected Annual Damages – Existing and Base Year Conditions Without Project

Expected annual damages (EAD) under existing and base year conditions are summarized in Table 6. Total study area EAD is an estimated $7.84 million. About 77% of this total, or $6.06 million, is associated with the R471-460 unit. The L-455 unit accounts for the remaining EAD total of $1.77 million. The R471-460 levee has greater EAD than L-455 despite having a much smaller property base because the decertified right bank levee is not as high and has more significant geotechnical issues.

TABLE 6
EXPECTED ANNUAL DAMAGES BY CATEGORY
EXISTING / BASE YEAR CONDITIONS - WITHOUT PROJECT

in $1,000's	Residential	Non-Residential	Roads	Crops	Total
L-455					
Downstream	$101.5	$1,078.8	$40.5	$2.3	$1,223.1
Upstream	$2.3	$542.5	$5.9	$0.0	$550.7
L-455 Total	$103.8	$1,621.3	$46.4	$2.3	$1,773.8
R471-460 Total					
Downstream	$738.4	$2,726.0	$232.8	$5.1	$3,702.3
Upstream	$20.5	$2,319.3	$4.3	$18.2	$2,362.4
R471-460 Total	$758.9	$5,045.3	$237.2	$23.3	$6,064.7
Study Area Total	$862.7	$6,666.6	$283.6	$25.6	$7,838.5

Expected Annual Damages – Future Conditions Without Project

As shown in Table 7, EAD increases from $7.84 million in the existing and base conditions to $9.03 million in the future conditions of 2038. This is an increase of 15%. The increase in EAD is disproportionately due to L-455, where EAD increases almost 33%. The increase in the R471-460 area is only about 10%. Note: R471-460 upstream reach shows drop in EAD from base to future conditions due to relocation of Missouri Air Guard base to higher ground by future condition.

TABLE 7 EXPECTED ANNUAL DAMAGES FUTURE WITHOUT-PROJECT CONDITION (2038)				
Damage in $1,000's	**2013**	**2038**	**% Change**	**EAD**
L-455				
Downstream				
Residential	$101.5	$109.3	7.7%	$105.5
Non-Residential	$1,078.8	$1,159.5	7.5%	$1,120.6
Roads	$40.5	$44.7	10.4%	$42.7
Crops	$2.3	$2.4	6.1%	$2.4
Total	$1,223.1	$1,315.9	7.6%	$1,271.1
Upstream				
Residential	$2.3	$5.1	120.3%	$3.8
Non-Residential	$542.5	$1,022.9	88.6%	$790.9
Roads	$5.9	$11.5	94.2%	$8.8
Crops	$0.0	$0.0	0.0%	$0.0
Total	$550.7	$1,039.4	88.7%	$803.4
L-455 TOTAL	**$1,773.8**	**$2,355.3**	**32.8%**	**$2,074.5**
R471-460				
Downstream				
Residential	$738.4	$919.1	24.5%	$831.9
Non-Residential	$2,726.0	$3,415.8	25.3%	$3,082.7
Roads	$232.8	$294.2	26.3%	$264.5
Crops	$5.1	$6.0	19.6%	$5.6
Total	$3,702.3	$4,635.1	25.2%	$4,184.6
Upstream				
Residential	$20.5	$34.6	68.2%	$27.8
Non-Residential	$2,319.3	$1,964.1	-15.3%	$2,135.6
Roads	$4.3	$7.4	71.0%	$5.9
Crops	$18.2	$30.0	64.4%	$24.3
Total	$2,362.4	$2,036.0	-13.8%	$2,193.6
R471-460 TOTAL	**$6,064.7**	**$6,671.1**	**10.0%**	**$6,378.3**
STUDY AREA TOTAL	**$7,838.5**	**$9,026.5**	**15.2%**	**$8,452.8**

The primary distinction between existing/base and future conditions in this study involves increases in Missouri River stages. Water surface profiles prepared for the future condition in this study reflect stage increases over existing/base year conditions for all events analyzed. Stages increase by up to 0.7 feet in the largest events. The stage increases, based on published historical analysis of Missouri River stages over time, are believed to be caused by the effects of sedimentation. More information on the hydraulic data and its assumptions can be found in Appendix B to this report.

Beginning Damage Elevations

Under existing conditions of 2006 or base year conditions of 2013, the R471-460 area could suffer flood damage in an event smaller than the 1% chance event – specifically, in an event within the range of 2% chance (50-year) to 1.33% chance (75-year). Damage to the L-455 area, on the other hand, would require a flood of a 0.2% chance magnitude. These probabilities take into account both overtopping and failure. The probabilities are approximate since risk analysis outputs are furnished only for a few selected events.

Single Event Damages

Table 8 presents the damages for specific flood magnitudes under existing conditions.

TABLE 8
SINGLE EVENT DAMAGES - EXISTING CONDITIONS (2006)
(in 1000's)

	L-455	R471-460	Total
1% Event			
Total Damage	$0.0	$304,332.8	$304,332.8
Homes Affected	0	663	663
Businesses Affected	0	121	121
Average Depths	0.0	6.7	
Maximum Depths	0.0	17.7	
0.5% Event			
Total Damage	$0.0	$343,429.5	$343,429.5
Homes Affected	0	666	666
Businesses Affected	0	124	124
Average Depths	0.0	8.1	
Maximum Depths	0.0	19.0	
0.2% Event			
Total Damage	$316,015.1	$369,501.6	$685,516.7
Homes Affected	590	666	1,256
Businesses Affected	23	124	147
Average Depths	9.8	10	
Maximum Depths	20.8	20.8	

A 1%-chance (or 100-year) flood under existing conditions would be associated with a discharge of 261,000 cubic feet per second (cfs). A flood of this magnitude would result in damages of $304.3 million, all in the R471-460 area. L-455 would not be flooded. All but 4 of the 667 homes in the R471-460 area and all but 4 of the 125 businesses and facilities would be affected. Depths in the flooded areas would average 6.7 feet and would reach as much as 17.7 feet.

A 0.5%-chance, or 200-year flood, under existing conditions would be associated with a discharge of 287,000 cfs. The L-455 area would not be flooded, but the R471-460 area would suffer damages of $343.4 million. All but one of the 125 businesses and facilities and all but 1 of the 667 homes in the right bank area would be affected by depths averaging 8.1 feet and reaching as much as 19 feet.

A 0.2% or 500-year flood, under existing conditions, would reach a discharge of 324,000 cfs. Damages in the R471-460 area would total $369.5 million or 54% of total damage in the study area. In the right bank area, 666 homes and 124 businesses and facilities would be damaged by depths of up to 20.8 feet and averaging about 10 feet. The L-455 area's downstream reach would experience similar depths, resulting in damage of $316 million or 46% of the total study area damage. Twenty-three businesses and facilities and 590 homes would be affected, all in the downstream left bank area. The upstream reach of L-455 would not flood. Damage in the study area overall would total $685.5 million.

In a 0.2% chance event under 2038 conditions, flooding would occur in both units. Damages would top $1 billion, almost two-thirds of which would be sustained in the L-455 area.

Nonexceedance Probability Ratings

Key results for each unit are summarized in Tables 9 and 10, under existing and future conditions respectively.

TABLE 9
LEVEE ENGINEERING PERFORMANCE RATINGS
EXISTING / BASE WITHOUT-PROJECT CONDITON (2013)

	R471-460			**L-455**		
	overall	downstream	upstream	overall	downstream	upstream
Top of levee elevations						
Reference river mile		449.4	450.0		441.4	446.3
Existing (without-project) TOL		822.1	822.8		816.0	821.2
Annual Exceedance Probability						
Median (as %)	1.4%	1.4%	1.4%	0.1%	0.1%	0.1%
Expected (as %)	1.7%	1.7%	1.7%	0.1%	0.3%	0.1%
Long-Term Risk (years)						
10 years						
Exceedance probability	16.1%	16.2%	16.1%	2.5%	2.5%	1.2%
Exceedance chance over period	1 in 6.2	1 in 6.2	1 in 6.2	1 in 39.8	1 in 39.8	1 in 83.3
25 years						
Exceedance probability	35.6%	35.6%	35.6%	6.2%	6.2%	3.0%
Exceedance chance over period	1 in 2.8	1 in 2.8	1 in 2.8	1 in 16	1 in 16	1 in 38.5
50 years						
Exceedance probability	58.5%	58.6%	58.5%	12.1%	12.0%	5.9%
Exceedance chance over period	1 in 1.7	1 in 1.7	1 in 1.7	1 in 8.4	1 in 8.4	1 in 17.1
1%-chance flood event context						
Levee height superiority (feet)						

Reference flood elevation		821.2	821.9		812.9	817.5
Without-project	0.9	0.9	0.9	3.1	3.1	3.7
Nonexceedance probability (as %)						
Without-project	51.3%	51.4%	51.3%	93.6%	93.6%	97.3%
Overtopping only	67.8%	67.9%	67.8%	95.0%	95.0%	97.3%
0.2%-chance flood event context						
Levee height superiority (feet)						
Reference flood elevation		824.7	825.5		815.8	820.7
Without-project	-2.7	-2.7	-2.7	0.2	0.2	0.6

TABLE 10
LEVEE ENGINEERING PERFORMANCE RATINGS
FUTURE WITHOUT-PROJECT CONDITION (2038)

	R471-460			L-455		
	overall	downstream	upstream	overall	Downstream	upstream
Top of levee elevations						
Reference river mile		449.4	450.0		441.4	446.3
Existing (without-project) TOL		822.1	822.8		816.0	821.2
Annual Exceedance Probability						
Median (%)	1.70%	1.70%	1.70%	0.10%	0.10%	0.20%
Expected (%)	2.10%	2.10%	2.10%	0.30%	0.30%	0.30%
Long-Term Risk (years)						
10 years	19.38%	19.38%	19.03%	2.68%	2.68%	2.51%
25 years	41.64%	41.64%	41.01%	6.56%	6.56%	6.15%
50 years	65.94%	65.94%	65.20%	12.69%	12.69%	11.92%
1%-chance flood event context						
Levee height superiority (feet)						
Reference flood elevation		821.8	822.5		812.9	818.0
Without-project	0.3	0.3	0.4	3.1	3.1	3.7
Nonexceedance probability (as %)						
Without-project	41.8%	41.8%	42.9%	92.8%	92.8%	94.0%
Overtopping only	56.6%	56.6%	57.6%	94.0%	94.1%	94.0%
0.2%-chance flood event context						
Levee height superiority (feet)						
Reference flood elevation		825.5	826.2		815.8	821.3
Without-project	-3.4	-3.4	-3.4	0.2	0.2	0.6

The main results of the risk analysis pertaining to each unit are as follows:

R471-460

- The R471-460 unit has only a 67.8% chance of containing a 1%-chance flood event under existing/base year conditions and a 56.6% chance under future conditions; well below the 90% or better reliability required for FEMA levee certification. Under future conditions, the non-exceedance probability drops to 41.8%. These non-exceedance probabilities account for damage due to either overtopping or levee failure.

- R471-460 has a margin above the nominal 1% chance flood elevation of 0.9 feet under existing or base year conditions, compared to the three foot margin that is necessary to meet the criterion for FEMA certification of levees. The margin drops to 0.3 feet under future conditions.

- If overtopping alone is considered without geotechnical or structural considerations, the R471-460 unit has a 67.8% chance of containing the 1% flood under existing/base conditions, still well below the 90% standard even without adding geotechnical risk factors

- In its current condition, a 0.2% chance flood would exceed the R471-460 top of levee by 2.7 feet.

- Over 10 years, under existing/base year conditions, the chance of overtopping or failure would be 16%; over 25 years, 36%; over 50 years, 58%.

L-455

- The L-455 levee would have a 93.6% chance of containing a 1% chance flood event under existing or base year conditions, considering risk of both overtopping and failure. Under future conditions, the nonexceedance probability becomes 92.8%.

- If geotechnical considerations are left aside, L-455 would have a 95% chance of containing a 1% chance overtopping event.

- The levee has a margin of 3.1 feet over the nominal 1% chance flood elevation.

- L-455's height exceeds the nominal 0.2% chance flood elevation, although only by 0.2 feet.

- Long term risk of overtopping or failure is about 2.5% over 10 years; 6% over 25 years; and 12% over 50 years.

IX. Plan Formulation

A. Planning Constraints

The following planning constraints affect many decisions related to study execution:

- The study shall be conducted in accordance with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies,* as approved by President Ronald Reagan, February 3, 1983 and accepted by the United States Water Resources Council on February 22, 1983. These guidelines are contained in the U.S. Army Corps of Engineers Engineering Regulation (ER) 1105-2-100, *Policy and Planning, Guidance for Conducting Civil Works Planning Studies.*

- Feasible projects will comply with the principles of Executive Order 11988 which addresses floodplain management and Section 404 of the Clean Water Act concerning the protection of wetlands. Project planning must be accomplished to minimize project effects on floodplains in general, and wetlands and other environmental features. Mitigation must be considered where applicable

- Project formulation will adhere to FEMA guidelines adopted by the State of Missouri regarding the regulatory floodway. These guidelines require that construction in the base flood plain be accomplished in such a manner as to limit any resulting increase in the 1.0-percent-chance flood elevation to less than one foot.

- Project Design alternatives recognize the provisions of Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act and the Hazard Mitigation Grant Program administered by FEMA and the Missouri State Emergency Management Agency.

- Relationships between the levee units will be maintained. For this feasibility study, the examination of measures to increase the performance of the system will be guided by an overarching principle that seeks to achieve a relatively consistent level of performance throughout the system. This essentially means that the study should <u>avoid</u> recommending:
    - Any measures which would directly or indirectly exacerbate any performance weaknesses (or relative weaknesses) of either unit.
    - Any measures that would contribute to increasing the level of performance of one unit without a commensurate increase or at the expense of the other unit.

- Project alternative screening will consider the financial capability of the local sponsors. Feasibility phase financial constraints play a very significant role in the execution of this study. Sponsor affordability and associated financial constraints demand that feasibility analysis, scoping, and planning decisions must first focus on those areas, measures and solutions which address pressing needs or significant performance weaknesses within the overall system as these will provide the greatest relative opportunity for reliability improvements.

- All other items of the study will be in accordance with the standards of the U.S. Army Corps of Engineers.

B. Planning Objectives

A primary objective of Corps feasibility studies is to comply with the national objective of water and related land resources planning. This includes contributing to the National Economic Development (NED) consistent with protecting the Nation's environment. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. The NED Plan is that alternative that maximizes net benefits over the period of analysis.

Following the decision by FEMA in 1999 to de-certify the levee, it became imperative to the communities within the protected zone to restore the ability of the system to pass the FEMA Base Flood and regain certification. FEMA defines the Base Food as the 1.0% chance (100-yr) flood, and requires that a levee pass this flood with a minimum 90% reliability. At the request of the sponsors, restoring the FEMA certification of Unit R471-460 was established as an additional primary planning objective for the Feasibility Study.

Other planning objectives for the Feasibility Study include:

- Update and verify data on the reliability of the existing project performance under flood conditions.

- Develop alternative plans (to include a review of the "no Federal action" alternative) for reestablishing the overall reliability of the existing system, increasing economic flood damage reduction benefits over the existing condition, and provide a final recommended plan for implementation that is technically sound and economically feasible.

- Reduce the potential for loss of life and human suffering caused by flooding within the project area.

- Minimize the impact of any proposed project within the project area and surrounding areas.

- Maintain the current environmental conditions and preserve the cultural and historical resources within the project area and surrounding areas.

C. Measures Considered for Plan Formulation

Traditional Corps analyses for identification of the NED plan (the plan with the highest net benefits) involve identifying an array of measures (structural and non-structural) to achieve the stated objectives and then determining the most cost-effective combination of those measures that fully addresses the identified problems.

1.0 Non-Structural Measures

Flood Warning System with Temporary Evacuation Plan. This alternative would provide study area businesses and residences with warning of a predicted flood. Additionally, those having the capability to relocate would have the opportunity to do so. Typically, a rain and/or stream gage infrastructure is required to monitor hydrologic conditions in the basin and serve as a basis for providing early prediction and warning of impending high water at pre-designated areas prone to flooding. A key requirement is a realistic and funded/resourced response plan implemented by jurisdictional governing agencies.

Flood Proofing. Flood proofing existing structures consists of several strategies or methods depending upon structure types. These include raising them to place the first flood elevation above the level of threatened flooding; waterproofing of structures up to maximum or specified flood height; providing closure gaps for opening below flood levels; or building flood walls or levees around individual structures. These measures would reduce flood damages and benefit only those properties treated.

Permanent Evacuation / Floodplain Buy Out. Permanent evacuation is the relocation of damageable investment to areas that are not within a flood hazard zone. Then, the remaining properties (and abandoned structure if applicable) must be converted to a land use purpose compatible with flood plain conditions (e.g. parks and recreation or agriculture).

Modification of Missouri River Water Levels. A change in the average water surface profile of the Missouri River might be accomplished by changes in the operation of upstream dams.

2.0 Structural Measures

Channel Modification. Channel Modification would consist of widening, deepening, or otherwise realigning the existing river. In this manner, hydraulic efficiency is improved and water surfaces are reduced to eliminate or lessen flooding.

Realignment of Levee. Realignment of an existing flood damage reduction project could expand the floodplain and provide more space for the river to spread out during a flood, thus lowering the local flood profile. This would require considerable additional real estate, new levee and drainage structure construction, and would cause some areas currently protected to be exposed to lower flood events.

Raise the Existing Levee. Increasing the height of an existing flood damage reduction project will increase the ability and reliability of the project to pass a flood event of specific magnitude. The height of the raise will depend upon the chosen design flood profile. Multiple flood profiles should be evaluated to determine the optimal height.

D. Screening of Measures

Plans consist of measures or combinations of measures with the greatest potential to reduce damages. The initial screening process allows only plans that have the potential to be technically and economically feasible and environmentally sound to be carried forward for economic screening. The initial screening was accomplished on the first array of plans developed from the available measures retained for formulation. For the initial formulation and screening, detailed quantification of performance and effects was not required. Professional judgment and obvious critical adverse factors were used to narrow the alternative plans to a smaller array for detailed screening. The "No Federal Action" plan is retained throughout for comparison.

Each of the proposed alternatives is identified as retained for, or eliminated from, further plan formulation.

Flood Warning System - Eliminated

A flood warning system is not considered useful to address the concerns of this study area. Floods on the Missouri River are affected by conditions hundreds of miles upstream and take a considerable amount of time to develop. Adequate warning is available via television and other media outlets for Missouri River flood events.

Flood Proofing - Eliminated

The large number and diversity of structures, types, sizes, and construction of facilities would make it infeasible to modify these to a consistent level of flood damage reduction.

Permanent Evacuation – Eliminated

The size of the affected population and amount of development in the study area preclude consideration of permanent evacuation of the study area.

River Level Changes – Eliminated

The closest dam that could be operated for river level changes is 360 miles upstream. The complex Missouri River system is unable to be managed to the necessary level to measure effects at a single levee unit.

Channel Modification - Eliminated

The existing levees and the size and magnitude of flow of the Missouri River present significant limitations to modification. Furthermore, these types of features would have detrimental effects upon the aquatic, riparian, and woodland habitat in the river corridor. Channel modification could significantly change the stage frequency relationship downstream. The Federal government is currently under Congressional mandate to mitigate for impacts from past channel modification activities. Further channel modification would be counter to this mandate.

Levee Setback/Realignment - Eliminated

Two options are available for possible realignment of Unit R471-460. At approximately river mile 448 the levee moves closer to the river, narrowing the floodway and creating a constriction (or "pinch point") during high flow events. This constriction could be reduced by realignment of the levee in this location, or the unit could be realigned further upstream to provide a wider floodway upstream of the narrow point for increased floodplain storage during high flow events.

Levee Setback

The narrow point in the levee alignment at approximately river mile 448 coincides with the river bend immediately upstream of Unit L-455. Setting back Unit R471-460 at this location would provide for a wider floodway during high flow events. This location also coincides with an active Union Pacific railroad bridge and the double-span bridge carrying US Highway 36. There is significant business development, including a large construction company, located between the two bridges immediately inside the protected area. Both bridges would likely require extensive modification and the existing businesses would have to be relocated to achieve significant levee setback. A levee setback in this location could lower the general water surface profile in this vicinity up to half a foot. This is not enough to offset the overtopping concern for the remainder of the unit. Bridge modification, real estate acquisition, business demolition and relocation, and new levee construction would all contribute to a significantly higher cost for this alternative.

Environmental benefits would be only marginally enhanced by the creation of a short reach of new riverside floodplain habitat relative to the currently existing resources in the area. The economic benefits of the alternative would be negatively impacted by the loss of businesses in the area and the increased cost. Based on preliminary analysis, the marginal hydraulic and environmental benefits of a levee setback in the vicinity of river mile 448 do not offset the significant adverse economic, engineering, transportation, and social impacts that would be incurred to the project. Levee setback options were not considered further in this area.

Levee Realignment in Upstream Portion of Unit R471-460

Upstream of the narrow point, consideration was given to methods to expand the floodway to provide storage during high flow events. In this area, the levee could be realigned toward the bluffs and existing levee alignment removed, providing increased floodplain volume and connectivity to the river. Alternatively, the old levee alignment could remain, and be allowed to overtop and fail during high flows, providing some increment of additional storage during large floods. In order to achieve levee certification for the communities and facilities in the study area, the new section of levee could be constructed north of Rosecrans Airport starting near river mile 452 to connect the existing levee with the bluff to the west. Requirements and anticipated impacts of this new levee are as follows:

- The existing levee cannot likely be removed without specific authorization from Congress. Removal of the remaining existing levee section would likely be politically and socially unacceptable. The remaining existing levee section would likely still be maintained in operation by the local entities. If maintained in accordance with the program, it would be eligible for flood disaster relief under the provision of Public Law 84-99. Future claims for Federal assistance for flood fighting and damage restoration would likely increase. With the existing levee section still in place, the incremental floodplain benefits associated with a realignment of the Federal project in the north would be marginal.

- The new alignment would cross the flight path in close proximity to the airport creating a right-of-way encroachment and safety issue that likely would not be acceptable to the Air Guard or the Federal Aviation Administration.

- Formulating an alternative that allows for the overtopping and failure of an existing levee does not meet the stated planning objectives of this study.

- Nearly three miles of new levee would be constructed, requiring significant real estate acquisition, additional material borrow sites, new drainage structures, and possible road closure structure at the tie-in to the bluff. This feature would involve a significant cost increase.

- There is no guarantee that real estate agreements would be easily reached with existing land owners and condemnation might be necessary. Such negotiations, and additional construction time, would likely cause a protracted delay that would prolong the exposure of residents to impacts and risk from the currently decertified levee.

- Approximately six miles of the existing levee downstream of river mile 452 would still be subject to an overtopping concern that would need to be addressed to restore FEMA certification.

- The introduction of a new levee section into an existing levee system will increase the annual operation and maintenance costs.

- The new alignment would permanently remove some agricultural ground from production due to construction and would allow significant additional acreage of productive agricultural property to remain subject to impact from lesser floods. Some existing benefits of the existing project would be lost by removing this property from the certified area.

- No additional environmental benefits would be realized if the existing levee stays in place and existing agricultural land remains in production. To realize any environmental benefits from realignment, the existing levee would have to be removed entirely and the land allowed to revert to a natural riparian state. This may require the government to buy out the existing agricultural property at considerable additional expense to the project.

- Significant political and public protest would result from any proposal to remove property from the protected area or physically remove any existing section of levee.

- Implementation of changes to existing levee alignment would require additional Congressional authorization

A point-by-point consideration of the cost impacts to construct a new levee section, including all aspects discussed herein, indicated that realignment options would be greater than the cost of other alternatives proposed in the same area. Due to anticipated higher costs, a decrease in existing project benefits, and serious concerns over the social impacts of the proposal to the area communities, the levee realignment alternative was not carried forward for additional analysis

Levee Raise – Retained

Raising the existing project to provide a higher reliability against overtopping is considered economically and technically feasible and is retained for further consideration.

E. Initial Plan Formulation and Screening Results

Based on the initial screening of alternatives, the non-structural alternatives were not found to be potentially effective to offset the magnitude of flooding expected in such a large study area. None of the proposed non-structural alternatives were retained for further analysis. Only the structural levee raise alternative was considered to meet the planning objectives and be economically, environmentally, and socially acceptable for continued analysis.

In addition to a series of levee raise alternatives, the no action plan was retained for continued evaluation.

1.0 No Action Alternative

The "No Action" alternative will not reduce existing flood damage potential. Flood-fighting and reliance on flood insurance will be the only recourse for the affected communities. The National Flood Insurance Program (NFIP) helps to minimize the creation of additional damages within the areas covered by flood insurance through continued compliance with the flood plain zoning ordinances. The NFIP can also help reduce financial losses incurred during a flood event through flood insurance payments for actual flood damages sustained. However, this measure in itself does not prevent flood damages nor does it present a long-term solution for flood damage reduction. Without increased flood damage reduction over the existing condition, Unit R471-460 will remain uncertified by FEMA. If restoration of the levee is not complete within ten years of an AR Zone designation the study area will be given an AE Zone designation, NFIP premiums will be raised, and limitations on future development will be imposed. These higher insurance costs and limitations will create significant economic hardship on the communities that have been developing in the protected areas. Plans for future expansion of the Air National Guard base and other industrial/business facilities near Rosecrans Airport will be jeopardized.

2.0 Structural Alternatives

Raise Existing Levee

Several potential design floods were analyzed for levee raise alternatives:

- 1% (100-yr) flood plus one and one-half feet (100+1.5)
- 1% flood plus three feet (100+3). This is minimum flood level needed for FEMA certification.
- The observed 1993 flood event
- 0.2% (500-yr) flood event (500+0)
- 0.2% flood event plus one and one-half feet (500+1.5)
- 0.2% flood event plus three feet (500+3)

The existing condition evaluation of each of the levee units determined that Unit R471-460 has a higher overtopping exceedance probability than Unit L-455. Therefore it was determined that for each alternative, necessary raises would be developed first for Unit R471-460 and then for Unit L-455 as needed to mitigate any potential across river induced damages or provide consistent level of performance for the system. Furthermore, geotechnical and structural features located within the horizontal limits of raise would be analyzed for probability of failure and would be improved concurrently as needed.

To establish a basis for comparison and screening, the nominal 1-percent flood event water surface profile plus three feet (100+3) was developed and used to establish the benchmark horizontal and vertical limits of raise that would be necessary for Unit R471-460. The additional three feet is the necessary amount to provide 90% reliability to pass the 1-percent event and regain certification of Unit R471-460. Within the determined horizontal limits, this profile is very close to the estimated level of the 1993 flood as determined by high water mark calibration.

Further, the differences between the modeled 100+3 and 500+0 profiles were determined to be insignificant. Thus, separate analysis of these flood profiles is not necessary and they can be eliminated.

Raises in the levee height will cause higher hydraulic pressures on the levee, its foundation, and drainage features. Modifications to the existing underseepage berms and pressure relief wells may be needed to counteract these additional forces. Consideration of expansion of the underseepage berms, additional relief well installation, or replacement of the existing wells, is required as part of each raise alternative analysis. Existing drainage structures, pipes, utilities, and manholes located in or near the levee will require evaluation to determine their ability withstand higher hydraulic and soil load pressures.

3.0 Summary of Initial Plan Screening

Five alternative plans are retained for further detailed analysis:

No Federal Action – It is required to retain this plan for comparison purposes throughout the screening process.

Structural Plans

Alternative 1. 100+3 – This plan would raise both units as needed to allow passage of the 1% flood (100 yr) event with minimum 90% reliability against failure.

Alternative 2. 500+1.5 – This plan would raise both units as needed to allow passage of the 0.2% flood (500 yr) event with approximately 50% reliability against failure

Alternative 3. 500+3.0 – This plan would raise both units as needed to allow passage of the 0.2% (500 yr) flood event with approximately 90% reliability against failure

Alternative 4. 100+1.5 – This plan would raise only unit R471-460 as needed to allow passage of the 1% flood (100 yr) event with approximately 75% reliability. No raise of Unit L-455 would be included.

F. Detailed Plan Formulation – Final Array of Plans

1.0 No Federal Action

No additional flood damage reduction would be provided under the "No Action" Alternative. Without modification to the existing flood damage reduction system, the study area would continue to be at risk from large flooding events; Unit R471-460 would remain decertified; and the affected communities would be faced with continuing economic decline. The problem would worsen with time if no action is taken because high flood-insurance rates will prevent new development and may force existing development out of the area.

2.0 Structural Plans

The structural plans consist of levee raises to different flood levels and modification to the underseepage and drainage control features as needed. These plans are all confined to the existing levee alignment.

Levee Raise

The limits of raise for the 100+3 alternative were previously determined for Unit R471-460. It was further determined that for the 100+3 event, to provide equal flood damage reduction benefits on the opposite bank, a short reach of Unit L455 would need a small increase in height for mitigation of hydraulic impact to maintain its reliability. The impacts of the raise to the structural and geotechnical features of the units were analyzed.

Screening analysis and cost estimating was performed on the two higher raise alternatives (500+1.5 and 500+3) for both levee units and the lower raise alternative (100+1.5) for unit R471-460. For the 100+1.5 alternative, no raise is required for unit L-455 since the levee is above this level under existing conditions. At the higher event levels, the raise required for Unit L-455 was no longer based on mitigation of the raise of Unit R471-460, but on the expected flood elevations of the river.

As each unit is raised, more drainage structures are affected. While some may require only a top platform raise at a lower raise, they may also require a complete replacement with a higher raise due to added hydraulic and soil pressures. Table 11 in the next section of this report summarizes the approximate horizontal and vertical impacts of each raise alternative and the number of affected drainage structures.

Underseepage Berms

An underseepage berm consists of a continuous strip of additional soil placed on the ground surface adjacent to the landside of the levee. Its purpose is to counteract the hydraulic pressures that will force water to seep underneath the levee during a high flow event and surface on the landside. The height of the raise to unit R471-460 will cause these hydraulic pressures to increase and thus requires extension of the existing berms within area that will be subjected to a height increase.

The minimal height raise proposed for L-455 in Alternative 1 (100+3) will not significantly alter the hydraulic pressures encountered during a high flow event and does not necessitate an extension of the existing berm. Furthermore, it should be noted that underseepage problems were not observed during the 1993 flood so the existing berms are considered to be in adequate condition. However, despite their observed successful performance during a significant flood event, the widths of the berms are not in accordance with current berm construction criteria now in use by the Corps of Engineers. Therefore, it is proposed that in the area subject to raise in unit

L-455 for Alternative 1, the underseepage berms will be extended as needed to comply with current construction criteria. Berms in other areas of the unit, where the levee is not being disturbed, will remain as is based on their past performance. For the 0.2% event raise alternatives, significant raises are proposed and underseepage berm extensions would be required relative to the increase in height.

R471-460 Relief Wells

The intended purpose of the wells is to relieve excessive uplift pressure during high river levels at the toe of the levee where the impervious blanket is thin and variable. The twenty original pressure relief wells located between levee stations 292+00 and 327+00 are 8-inch diameter assembled wood stave screens and risers wrapped with stainless steel wire. Current day pressure relief well construction materials no longer include wood assemblies and have been replaced with the more reliable and durable steel riser and screen assemblies. Wood stave well assemblies cannot withstand aggressive pressure relief well testing, development, and treatments. The pressure relief wells were installed in 1967, and all indications are that individual well efficiencies have decreased requiring development and treatment that the wood stave well assemblies may not be able to withstand. Throughout the pressure relief well field there will be a 2.5 feet minimum increase in differential hydrostatic head across the levee attributed to the top of levee raise. This will provide additional stress to the pressure relief well field with well assemblies of uncertain structural integrity.

L-455 Relief Wells

The existing relief well field is located upstream of the area of the proposed Alternative 1 (100+3) raise and will not be affected by this alternative. Due to the limited raise necessary for the 100+3 raise alternative, installation of new relief wells in the project area is not necessary. Implementation of the Alternative 2 (500+1.5) or Alternative 3 (500+3) alternatives will affect a greater length of levee and cause higher underseepage pressures.

3.0 Summary of Plan Features

Table 11 summarizes the features of the plans carried forward for detailed cost estimating and screening. All raise alternatives will require replacement of the R471-460 relief well field and extension of the underseepage berms in the area subject to raise.

TABLE 11
PLAN FEATURES FOR DETAILED PLAN SCREENING

Alternative	Levee Unit	Horizontal Length of Levee	Maximum Height of Raise	Drainage Structures	
				Modify	Replace
No Action	NA	NA	NA	NA	NA
Alternative 1	R471-460	54,675 ft.	3.37 ft.	6	1
Raise to 100 +3	L-455	8,929 ft.	< 1 ft.	NA	NA

Alternative 2	R471-460	70,240 ft.	5.0 ft.	3	5
Raise to 500+ 1.5	L-455	48,740 ft.	1.5 ft.	8	2
Alternative 3	R471-460	70,240 ft.	6.5 ft.	1	7
Raise to 500 + 3	L-455	58,441 ft.	3.0 ft.	8	2
Alternative 4	R471-460	41,850 ft.	1.2 ft.	6	1
Raise to 100 + 1.5	L-455	NA	NA	NA	NA

G. Economic Analysis and Screening of Plans

A more detailed discussion of the economic analysis process is presented in Appendix C.

The raise alternatives were evaluated in the economic screening analysis. All are different scales of levee raises focused on the R471-460 unit which currently is decertified by FEMA, and the alternatives include any L-455 raises necessary to achieve equal reliability on the left bank. All protect essentially the same land and properties:

The raises required for each alternative are described below in terms of the raise required at the economic index points. The exact amount of the raise will vary along different sections of the levee.

- Alternative 1 is a levee raise of about 2 and 2/3 feet for the R471-460 unit, bringing it up to a level 3 feet above the nominal 1%-chance flood elevation. Essentially no raise would be required for the L-455 at the economic index point. (This also coincides with the nominal 0.2%-chance profile plus zero overtopping margin.)
- Alternative 2 is a levee raise bringing R471-460 up to an elevation 1.5 feet above the nominal 0.2%-chance flood, requiring a raise of almost 5 feet. L-455 would be raised approximately 1.5 feet.

- Alternative 3, the largest in scale of the alternatives, raises R471-460 about 6.5 feet, with a 3 foot raise for L-455. The raise would bring the top of levee elevations to about 3 feet above the nominal 0.2%-chance flood.

- Alternative 4, the smallest alternative, raises R471-460 to a level 1.5 feet above the nominal 1%-chance flood elevation. A raise of about 1.2 feet is required. L-455 would not be modified in any way under this alternative.

For screening of plans, a detailed estimate was prepared and other estimates were parametrically proportioned based upon that. Alternative 1, the 100+3 plan, is the alternative closest to the existing site and levee conditions that still meets the sponsor's objectives and was therefore selected as the most logical benchmark for initial plan screening. Detailed analysis was conducted of the geotechnical, hydraulic, and structural aspects of Alternative 1 and a detailed cost estimate prepared using MCACES (Micro Computer Assisted Cost Estimating System). Based on this benchmark and using the modeled elevations of the design hydraulic profiles, the relative increase or decrease in project scope was calculated for the remaining three alternatives.

Factors included in this relativity analysis included the horizontal and vertical limits of raise, the number of impacted drainage structures and the degree of impact, and the quantities of material needed for the raise and underseepage berms. Based on the impacts associated with each alternative plan when compared to the selected benchmark, a parametric cost estimate was prepared for each alternative. This process is sufficient for screening of plans for this type of levee modification of low complexity and straightforward increase in size, with relatively small structural and utility components. There are very few utility, structural, or real estate issues that would tend to cause spikes in the cost estimate that would adversely affect the proportionality assumptions of quantities/unit pricing. This type of estimating for this project provides a good representation of the range of estimated costs of the alternatives for screening purposes. If the screening level economic analysis indicated that the NED plan was an alternative other than the selected benchmark, or if the plans were too close together in terms of net benefits to clearly identify the NED plan, additional detailed MCACES cost estimates would be prepared.

Interest during construction (IDC) was computed for these costs assuming a design and construction period ending in mid-2012 and the FY06 Federal interest rate of 5.125 percent. Costs including IDC were then annualized over a 50-year period of analysis. The annualized costs were compared with the benefits for each alternative emerging from HEC-FDA, and a benefit-cost ratio and net benefits were computed. All damages are expressed as equivalent annual damages that account for both base and future year conditions.

Operations, maintenance, repair, rehabilitation, and replacement (OMRR&R) costs are not included in this analysis. Geotechnical and Operations staff determined that no additional costs over and above present levels would be incurred for any of the alternatives under consideration (i.e., OMRR&R costs associated with any of the alternatives would continue at the current levels). Even if new OMRR&R costs did exist, they would be too small to affect economic justification and would not differ enough among alternatives to affect the rankings from this analysis.

The main results from the risk-based screening analysis are:

- The NED plan - the plan with the greatest net benefits - is Alternative 1, which consists of a raise of the R471-460 unit to 3 feet above the 0.1%-chance flood elevation. The screening level economic analysis indicates that this plan has estimated net benefits of $4.11 million and a benefit-cost ratio of 3.2.

- The NED plan has a margin of superiority of 15% in net benefits over the second-ranking alternative, Alternative 4. Alternative 4, the smallest alternative, has net benefits of $3.58 million. The NED plan has an 89% margin of superiority over Alternative 2 and a 391% margin over Alternative 3. These are the two largest alternatives. Therefore, Alternative 1, as the NED plan, is bracketed by both smaller and larger-scaled alternatives over which the NED plan has clear superiority in economic efficiency.

- All alternatives are economically justified. Benefit-cost ratios are strong for Alternatives 1 (3.2) and 4 (4.1), while the justification for Alternatives 2 and 3 would be more marginal with benefit-cost ratios of 1.4 and 1.1 respectively.

- Benefit-cost ratios for R471-460 by itself would be at least fairly strong in all four alternatives. In contrast, Alternative 1 is the only alternative that produces positive net benefits for the L-455 unit by itself.

Based on the screening analysis, the NED plan is Alternative 1, a raise to an elevation of 3.0 feet above the nominal 1% chance flood elevation. This plan is also the Locally Preferred Plan (LPP). A comparison of the resulting net benefits for each alternative is displayed in Figure 5 and the economic analysis calculations are summarized in Table 12.

FIGURE 5
NET BENEFITS FOR ALTERNATIVES

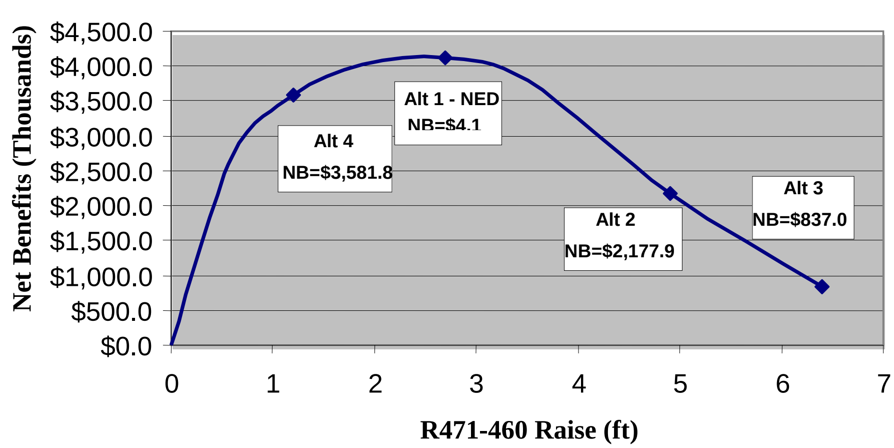


TABLE 12 NED SCREENING BENEFIT-COST DATA FOR ALTERNATIVES								
October 2005 prices; 5.125% interest rate In thousands of dollars								
Alternative	**First Cost**	**Total Annual Costs**	**Total Annual Damages**	**Residual Annual Damage**	**Total Benefits**	**BCR**	**Net Benefits**	**Superiority of NED Plan**
ALTERNATIVE 4 - R471 RAISE TO 1% EVENT + 1.5 FT.								
L455								
Reach 1			$1,271.1	$1,271.1				
Reach 2			$803.4	$803.4				
Total L455	$0.0	$0.0	$2,074.5	$2,074.5	$0.0	0.0	$0.0	
R460								
Reach 1			$4,184.6	$1,035.6				
Reach 2			$2,193.6	$593.8				
Total R460	$18,917.6	$1,167.0	$6,378.3	$1,629.4	$4,748.9	4.1	$3,581.9	
Total	**$18,917.6**	**$1,167.0**	**$8,452.8**	**$3,703.9**	**$4,748.8**	**4.1**	**$3,581.8**	14.8%

ALTERNATIVE 1 - R471 RAISE TO 1% EVENT + 3 FT.								
L455								
Reach 1			$1,271.1	$851.7				
Reach 2			$803.4	$803.4				
Total L455	$3,051.9	$187.2	$2,074.5	$1,655.1	$419.4	2.2	$232.2	
R460								
Reach 1			$4,184.6	$520.3				
Reach 2			$2,193.6	$268.1				
Total R460	$27,793.7	$1,709.4	$6,378.3	$788.4	$5,589.8	3.3	$3,880.4	
Total	**$30,845.6**	**$1,896.6**	**$8,452.8**	**$2,443.5**	**$6,009.2**	**3.2**	**$4,112.6**	*NED*
ALTERNATIVE 2 - R471 RAISE TO 0.2% EVENT + 1.5 FT.								
L455								
Reach 1			$1,271.1	$209.3				
Reach 2			$803.4	$185.6				
Total L455	$44,389.9	$2,719.2	$2,074.5	$394.8	$1,679.6	0.6	-$1,039.6	
R460								
Reach 1			$4,184.6	$76.3				
Reach 2			$2,193.6	$32.2				
Total R460	$49,742.9	$3,052.2	$6,378.3	$108.6	$6,269.7	2.1	$3,217.5	
Total	**$94,132.8**	**$5,771.4**	**$8,452.8**	**$503.4**	**$7,949.3**	**1.4**	**$2,177.9**	88.8%
ALTERNATIVE 3 - R471 RAISE TO 0.2% EVENT + 3 FT.								
L455								
Reach 1			$1,271.1	$19.4				
Reach 2			$803.4	$19.7				
Total L455	$58,929.0	$3,608.2	$2,074.5	$39.0	$2,035.5	0.6	-$1,572.7	
R460								
Reach 1			$4,184.6	$7.8				
Reach 2			$2,193.6	$3.4				
Total R460	$65,075.0	$3,957.4	$6,378.3	$11.1	$6,367.1	1.6	$2,409.7	391.3%
Total	**$124,004.0**	**$7,565.6**	**$8,452.8**	**$50.1**	**$8,402.6**	**1.1**	**$837.0**	

H. Environmental Considerations

1.0 No Federal Action

The “No Action” alternative would have no effect on fish and wildlife resources, the aquatic ecosystem, recreation, or floodplain values in the project area. Existing habitat conditions would continue as they currently exist.

2.0 Structural Alternatives

Raising the height of the existing levee will result in a widening of the levee toe and extensions to the landside underseepage berm, causing minimal intrusion into the adjacent natural environment. Much of this adjacent area is already cleared for agricultural purposes or development, but there would be some additional clearing of terrestrial and woodland habitat. Birds and mammals would be temporarily affected by construction activities. The specific impacts are summarized in this report and discussed in more detail in the attached Environmental Assessment.

Alternative 1 (100 + 3). The raise of levee R471-460 will result in an increase of horizontal width impacting approximately 285 acres landward and approximately 77 acres riverward of the existing levee. The L-455 width increase will impact approximately 43 acres landward of the levee and approximately 54 acres riverward. Expanding the levees would result in the permanent removal of approximately 1.6 acres of secondary tree growth and 4.7 acres of shrubland landward of the levees and 5.4 acres of secondary growth trees and 8.0 acres of shrublands riverward of the levees. Modifying the two levees would also permanently impact a total of approximately 4.4 acres of emergent wetlands landward of the levees and approximately 0.5 acre of forested wetlands riverward of the two levees.

Alternative 2 (500 + 1.5). Increasing the height and width of R471-460 will impact approximately 385 acres landward of the levee and approximately 81 acres riverward of the existing levee. The L-455 width increase will impact approximately 46 acres landward of the levee and approximately 54 acres riverward. Expanding the levees would result in the permanent impact of approximately 2.2 acres of secondary tree growth and 6.4 acres of shrubland landward of the levees and approximately 5.4 acres of secondary growth trees and 8 acres of shrubland riverward of the levees. Modifying the two levees would also impact approximately 5.6 acres of wetlands and associated vegetation landward of the levees and 0.6 acre of wetlands associated vegetation riverward of the two levees.

Alternative 3 (500 + 3). The overall width increase of R471-460 will impact approximately 336 acres landward and approximately 81 acres riverward of the existing levee. The L-455 width increase will impact approximately 46 acres landward and approximately 54 acres riverward of the existing levee. The project boundary was set at no more than 500 feet from the center line of the existing levee. The impacts from the 500 + 3.0 feet alternative exceed this boundary, but are only reported to the boundary limit. Expanding the levees would result in the permanent impact of 2.7 acres of secondary tree growth and 8 acres of shrubland landward of the levees and 5.4 acres of secondary growth trees and 8 acres of shrubland riverward of the levees. Modifying the two levees would also impact approximately 6.7 acres of wetlands and associated vegetation landward of the levees and 0.6 acre of wetlands and associated vegetation riverward of the two levees.

Alternative 4 (100 + 1.5). The raise of levee R471-460 will result in an increase of horizontal width impacting approximately 229.5 acres landward and approximately 77 acres riverward of the existing levee. Expanding the levee would result in the permanent removal of approximately 1.3 acres of secondary tree growth and 4.5 acres of shrubland landward of the levees and 4.5 acres of secondary growth trees and 6.2 acres of shrublands riverward of the levees. Modifying the levee would also permanently impact a total of approximately 3.7 acres of emergent wetlands landward of the levees and approximately 0.5 acre of forested wetlands riverward of the levee. There is no impact to unit L-455 from this alternative.

I. Hydraulic and Floodplain Considerations

Implementation of any right bank raise alternative would cause some limited amount of increased damages to L-455, located just across the river. The 100+3 alternative includes a small raise to the left bank that is sufficient to offset these impacts.

Water surface profiles will be affected upstream of St. Joseph and possibly as far downstream as Kansas City. Analysis was conducted to determine potential impacts to other levee units in those areas. It was determined that hydraulic effects of the 100+3 alternative raise are minimal upstream and downstream but do effect the L-455 unit across the River. The two higher levee raise alternatives will likely have significant impacts to other levee units upstream and downstream. These impacts were qualitatively considered in the alternative screening process.

J. HTRW Considerations

A HTRW site assessment of the study area was completed in September 1999. Conditions at the site since then have not likely changed relative to HTRW. Since the focus of the assessment was on the existing levee corridor and since that alignment is not proposed to be changed, the preliminary site assessment applies to all alternatives. The preliminary assessment addressed all potential contamination concerns. There are no known HTRW concerns within the project areas. The No Action plan would not involve any HTRW activity.

K. Engineering Considerations

There are no engineering features associated with the No Action plan. The structural plans have virtually the same engineering characteristics with minor variations. Other than different levels of raise requiring different amounts of materials and different levels of impacts to the same structures there are no major engineering differences between alternatives.

L. Plan Selection

Based upon consideration of all pertinent factors, the 100+3 structural alternative was selected as the recommended plan for implementation. It is both the NED plan and the Locally Preferred Plan (LPP), meeting the planning objectives, the National Economic objectives, and the local needs for levee certifications and affordability.

Implementation of the project will reestablish the design flood damage reduction to several local communities and significant economic investment. Negative impacts from the project would be minimal. Some disruption during construction could be expected, affecting traffic and agricultural activities. No relocation of homes or businesses is required. Induced damages are expected to be minimal.

The evaluation results show strong economic justification for a project in the St. Joseph area. The existing project would be raised to 3 feet above the nominal 1 percent chance flood elevation, providing over 90% reliability against damages from the base flood.

Plans Considered and Eliminated

The 100+1.5, 500+1.5 and 500+3 plans were eliminated since they produce lower levels of net benefits over the period of analysis. Furthermore, the higher raises are not preferred by the local sponsor. Reliability against the 1% flood and FEMA re-certification are the sponsors' priorities and they are financially unable to participate in cost sharing for more detailed study or construction of higher levels of flood damage reduction. The "No Action" alternative would not resolve the continuing flooding problems to which the area is subject. The no action plan would have detrimental long term effects to the business and home owners in the area and to the economy of the protected communities.

X. Description of the Selected Plan

A. Selected Plan Components

Locations and details of the NED plan features are shown on plates R-01 thru R-11 and L-01 thru L-02, for the right and left banks respectively. These plates are located at the end of this report.

The NED plan will protect from the nominal one-percent chance discharge event with 91.6% reliability on Unit R471-460 and 94% reliability on Unit L-455. The plan includes a raise of Unit R471-460 starting near Station 93+00 and ending near station 640+00. Approximately 54,675 ft of levee will be raised with a maximum raise of 3.37 feet. The proposed raise of unit L-455 will begin near station 210+00 and end near station 300+00. Approximately 8,929 feet of levee will be raised with a maximum raise of 0.94 feet. Typical cross sections of a levee raise are provided in the drawing plates included in Appendix B.

Six existing drainage structures in the right bank levee will be modified by raising their top elevations. One existing drainage structure will be replaced and a temporary levee will be required during the excavation. Typical cross sections of drainage structure modification and a temporary levee are provided in the drawings located in Appendix B. No drainage structures are affected on the left bank L455 unit.

Existing underseepage berms will be extended in the reaches of the raise for both levee units. The average berm width increase on unit R471-460 is 141 feet with a maximum increase of 225 feet. The average berm width increase on unit L-455 is 95 feet with a maximum increase of 265 feet. The twenty existing pressure relief wells in unit R471-460 will be abandoned in-place and new relief wells installed. Typical cross sections of underseepage berm extensions and a relief well field layout are provided in the drawings located in Appendix B.

There are three utility crossings that will be affected by the proposed plan on the R471-460 unit only. The modifications to the L455 unit will not affect any utilities. One utility is a 16 inch water line located at station 300+00 running over the levee. This line will be relocated over the top of the raised levee affecting about 300 feet of line. There is an 8 inch gas line at approximate station 417+65 running over the top of the levee. This gas line will be relocated over the top of the raised levee, affecting about 288 feet of line. There is a telephone cable located at approximate station 418+15 buried in the levee about 3.5 feet deep. This line will be relocated over the top of the levee including an overbuild for cover of about 2 feet, affecting about 191 feet of line. More detailed information is included in the Civil Design section of the Appendix B, the locations of these are shown on the "R" plates at the end of this report.

B. Economic Performance and Risk of the Selected Plan

1.0 Economic Performance

Alternative 1 raises the R471-460 levee to an elevation three feet above the nominal 1% chance flood elevation. The L-455 levee also will undergo a small raise (< one foot) to maintain reliable flood damage reduction. Modifications to the underseepage and drainage control features are included in the selected plan for each respective unit. The selected plan is both the NED plan and the Locally Preferred Plan. . Table 13 displays the benefit-cost calculation.

TABLE 13 BENEFIT-COST RATIO FOR NED PLAN			
In $1,000s; Oct. 2005 prices; Equivalent annual damages			
BENEFITS	**TOTAL**	**R471-460**	**L-455**
EAD Without-Project	$8,452.8	$6,378.3	$2,074.5
EAD With Project (Residual)	$2,443.5	$788.4	$1,655.1
EAD Reduced	$6,009.3	$5,589.9	$419.4
Emergency Cost Savings	$540.8	$503.1	$37.7
Relocation and Reoccupation Cost Savings	$78.0	$61.3	$16.7
Flood Insurance Administrative Cost Savings	$7.7	$7.7	$0.0
TOTAL ANNUAL BENEFITS	**$6,635.8**	**$6,162.0**	**$473.8**
% by unit		92.9%	7.1%
COSTS	**TOTAL**	**R471-460**	**L-455**
First Costs by Account			
01 Lands & Damages			
0101 Land Values	$2,754.4	$2,620.7	$133.7
0102 Labor	$182.4	$108.6	$73.7
02 Relocations	$354.5	$354.5	$0.0
06 Fish & Wildlife Facilities			
0603 Wildlife Facilities & Sanctuaries	$56.5	$56.5	$0.0
11 Levees & Floodwalls			
1101 Levees	$25,126.4	$22,684.7	$2,441.7
1102 Floodwalls	$0.0	$0.0	$0.0
13 Pumping Plants			
1300 Pumping Plants	$0.0	$0.0	$0.0
30 Planning, Engineering & Design (PED)	$2,553.6	$2,309.6	$244.0
31 Construction Management	$1,658.0	$1,498.9	$159.1
Total PED	$2,553.6	$2,309.6	$244.0
Total LERRD	$3,291.3	$3,083.8	$207.5
Total E&D	$1,658.0	$1,498.9	$159.1
Total Construction	$25,182.9	$22,741.2	$2,441.7
Total First Costs	**$32,685.7**	**$29,633.4**	**$3,052.3**
Annual costs			
First Costs	$32,685.7	$29,633.4	$3,052.3
I.D.C.	$3,291.9	$2,991.8	$300.1
Economic Costs	$35,977.6	$32,625.2	$3,352.4
Interest & Amortization Factor	0.05584	0.05584	0.05584
Annual costs	$2,008.9	$1,821.7	$187.2
Annual O & M Costs (increased)	$0.0	$0.0	$0.0
TOTAL ANNUAL COSTS	**$2,008.9**	**$1,821.7**	**$187.2**
% by unit		90.7%	9.3%
BENEFITS & COSTS	**TOTAL**	**R471-460**	**L-455**
TOTAL ANNUAL BENEFITS	**$6,635.8**	**$6,162.0**	**$473.8**

TOTAL ANNUAL COSTS	**$2,008.9**	**$1,821.7**	**$187.2**
BENEFIT-COST RATIO	**3.3**	**3.4**	**2.5**
NET BENEFITS	**$4,626.9**	**$4,340.3**	**$286.6**
% by unit		93.8%	6.2%

The plan shows strong economic justification with a benefit-cost ratio of 3.3. The first cost of the plan is $32,686,000 and the annualized cost is $2,008,900. Annual benefits total $6,635,800. This plan has net annual benefits exceeding $4.6 million.

If the project is divided into two elements (i.e., R471-460 vs. L-455), both portions are economically justified (see Table 13). For R471-460, the resulting benefit-cost ratio is 3.4, while unit L-455 result in a benefit-cost ratio of 2.5. There is strong economic justification for each portion of the project as well as for the total project.

Table 14 shows a probabilistic assessment of NED benefits for the total project. The annual benefits produced by the risk analysis are $6,009,200. There is a 75% probability that the true benefits exceed $2,470,000, a 50% probability that they exceed $4,550,000, and a 25% probability that they exceed $7,576,000.

TABLE 14
DAMAGE REDUCED FOR NED PLAN

Damage in $1,000's

Damage Reach Name	Total Without Project	Total With Project	Damage Reduced	Probability Damage Reduced Exceeds Indicated Values		
				0.75	**0.50**	**0.25**
L-455						
Left Bank - Downstream	$1,271.1	$851.7	$419.4	$57.6	$70.4	$251.1
Left Bank - Upstream	$803.4	$803.4	$0.0	$0.0	$0.0	$0.0
l-455 Total	$2,074.5	$1,655.1	**$419.4**	$57.6	$70.4	$251.1
R471-460						
Right Bank - Downstream	$4,184.6	$520.3	$3,664.3	$1,572.5	$2,932.3	$4,811.5
Right Bank - Upstream	$2,193.6	$268.1	$1,925.5	$840.0	$1,547.4	$2,513.6
R471-460 Total	$6,378.3	$788.4	$5,589.8	$2,412.4	$4,479.7	$7,325.1
Total	$8,452.8	$2,443.5	$6,009.2	$2,470.1	$4,550.1	$7,576.2

2.0 Engineering Performance

The selected plan would restore a margin of at least three feet above the nominal 1% chance flood elevation for both levee units. Under future conditions of 2038, the nonexceedance probability for R471-460 would rise to 91.6% compared to its nonexceedance probability of 51.3% under existing condition without project. Table 15 describes the engineering performance of the selected plan

TABLE 15 ENGINEERING PERFORMANCE RATINGS FOR NED PLAN						
For future conditions (2038)						
	R471-460			L-455		
	OVERALL	downstream	upstream	OVERALL	downstream	upstream
Top of levee elevations						
Reference river mile		449.4	450.0		441.4	446.3
New TOL		824.8	825.5		816.0	821.2
Annual Exceedance Probability						
Median (as %)	0.30%	0.30%	0.30%	0.10%	0.10%	0.20%
Expected (as %)	0.30%	0.30%	0.30%	0.20%	0.20%	0.30%
Long-Term Risk (years)						
10 years						
Exceedance probability	3.32%	3.14%	3.32%	2.51%	2.26%	2.51%
Exceedance chance over period	1 in 30.1	1 in 31.9	1 in 30.1	1 in 39.8	1 in 44.3	1 in 39.8
25 years						
Exceedance probability	8.09%	7.67%	8.09%	6.15%	5.55%	6.15%
Exceedance chance over period	1 in 12.4	1 in 13.0	1 in 12.4	1 in 16.2	1 in 18.0	1 in 16.2
50 years						
Exceedance probability	15.53%	14.75%	15.53%	11.92%	10.80%	11.92%
Exceedance chance over period	1 in 6.4	1 in 6.8	1 in 6.4	1 in 8.4	1 in 9.3	1 in 8.4
1% Event Context						
Levee height margin						
Reference flood elevation		821.8	822.5		812.9	818.0
Margin (ft.)	3.0	3.0	3.0	3.1	3.1	3.2
Nonexceedance probability (as %)	91.6%	91.7%	91.6%	94.0%	94.1%	94.0%
0.2% Event Context						
Levee height margin						
Reference flood elevation		825.5	826.2		815.8	821.3
Margin (ft.)	-0.7	-0.7	-0.7	-0.1	0.2	-0.1

3.0 Induced Damages

Hydraulic investigations for this study concluded that the project is not expected to have any significant impact in terms of raising water surface profiles. The water surface profile for the 1%-chance event is not affected by the project. The profiles for events larger than the 1%-chance event would be somewhat increased downstream of the project area as well as across the river at the L-455 area. The purpose of the L-455 portion of the project is to offset the increases at that location. However, as discussed above, the L-455 portion of the project is economically justified on its own independent terms - i.e., it is justified by the damages it would prevent within the L-455 area under without-project conditions, even without additional consideration of its efficacy in alleviating incremental damage potential contributed by the project. Downstream economic damages were not quantified for this analysis but would necessarily be minimal since the increased stages occur only in the most infrequent events and affect downstream areas with primarily agricultural impacts. Although minimal, the induced damages, if quantified, would be greater than zero and would serve to slightly reduce the estimated annual benefits for the project. Economic justification would not be affected.

4.0 Residual Risk

Although floodplain users and occupants may desire total protection from flooding, this is an unachievable goal. No flood damage reduction project can guarantee total elimination of flooding. The selected plan has substantial economic benefits and reduces equivalent annual damages in the study area by about 71% over without project conditions. But this means that there remains a significant residual equivalent annual damage in excess of $2.4 million. There still would be a 10% to 16% chance of exceedance over a 50-year period under 2038 conditions (Table 15).

With any flood damage reduction project, it is important for floodplain users and occupants to be aware of the level of flood risk that remains even after implementation of a recommended project (Table 15). The probability and occurrence of flooding will be less frequent with the implementation of the recommended plan in the study area. However, during major flood events, residents and other floodplain occupants may still be ordered to evacuate and move to higher ground. And in very rare large events, the Federal levees could be overwhelmed, resulting in large flood depths inside the levied areas. Because the areas within the levee units are relatively flat, most of the study area could be affected.

Floodplain tenants should not be led to believe that they have near-total protection against flooding and give up their flood insurance policies. They might find it advisable to keep their flood insurance policies, which are fairly inexpensive in areas with certified levees. Meanwhile, local leadership and emergency operations staff will need to design plans for these flood events which may be infrequent, but would hold the potential for catastrophe if they occurred. Effective emergency planning in advance is the best way to protect communities and minimize the damage from these rare flood events.

5.0 Regional Economic Development Impacts

The benefit evaluation process involves analysis of the economic losses to the subject study area from flooding as well as the potential gains to the study area from the successful prevention of flooding. Some impacts with and without a flood damage reduction project may be of major significance to a metropolitan area or community but may not have any net impact on the national economy. For example, if a flood interrupts production at a given business in one community, that community suffers a loss. However, if the lost production is replaced by production at another plant elsewhere in the country the loss to the local community does not represent a net loss to the national economy. These regional impacts are not included in determining the NED benefits and costs but do receive consideration in the decision-making process.

Construction of the selected plan would contribute to the long-term stability of both the R471-460 and L-455 areas and neighboring areas. Plans considered do not require acquisition or relocation of residents or businesses. There would be no impacts to the local tax bases due to demolition or removal of structures. With increased levee unit reliability and performance, existing businesses would be expected to continue their existing occupancy and new businesses and investment would be more easily attracted to the study area in the future if vacancies occur, retaining and possibly increasing tax base. With continued industrial and commercial stability enhanced by the increased reliability against flooding, existing neighborhoods and populations would also be expected to remain relatively stable, barring impacts from other sources. Temporary increases in employment would be expected during construction. The temporary presence of construction workers for the project could bring a temporary increase in demand for some services in the local area, but also a temporary increase in business volume, profits and sales tax receipts at the local retail and service establishments.

C. Environmental and Cultural Considerations

1.0 Fish and Wildlife Resources

Construction of the NED plan would result in the raising of the existing levees up to 3.37 feet. This requires an increase to the levee toe width and an extension to the seepage berms associated with the levee. Borrow excavation is needed within approximately 1,139 acres riverward of R-471-460 and approximately 30 acres riverward of L-455. Expanding the levees would result in the permanent removal of approximately 1.6 acres of secondary tree growth and 4.7 acres of shrubland landward of the levees, and 5.4 acres of secondary growth trees and 8.0 acres of shrublands riverward of the levees. This habitat would be kept from growing on the levee areas through normal levee maintenance practices, and the habitat values they provide would be permanently lost. Therefore, measures to mitigate their loss would be required. A total of 7.0 acres of “in-kind” trees and 12.7 acres of shrubland vegetation will be planted on site immediately following construction activities.

Impacts within the 1,139 acres (R471-460) and 30 acres (L-455) of secondary tree growth and shrubland at the borrow sites would be considered temporary in nature and is expected to be less than significant. Additionally, steps will be taken in these borrow areas to minimize effects to this habitat. Minimization measures include but are not limited to varying bottom depths of excavated borrow sites, creating islands within the borrow site through avoidance of specified areas, spacing borrow areas apart from one another by approximately 500 feet to provide areas of no disturbance, and avoiding where possible any larger “old growth” trees.

Modifying the two levees would also permanently impact approximately 4.4 acres of emergent wetlands landward of the levees and approximately 0.5 acre of forested wetlands riverward of the two levees.   These wetlands will be created on site and adjacent to the impacted wetlands concurrently with construction activities, resulting in no net loss to wetlands. Wetland impacts would be offset through the scraping and reshaping of the impacted areas to expand the existing wetland area equal to that which was lost. Some of the wetlands along both levees may consist of acreage enrolled in the Wetland Reserve Program. Wetland area impacts and mitigation have been coordinated with the NRCS, state agencies, and the USFWS. To the extent possible, these areas will be avoided and lands outside these protected areas will be used for borrow sites.

Impacts associated with the excavation of borrow material includes potential increases in erosion and sediment deposition in the Missouri River immediately downstream from the construction activities and temporary loss of wetland functions and values.   Standard construction site erosion and sediment control practices will be employed to decrease this impact. Additionally, the riverward borrow areas impacted will likely revert to wetlands over time, thus offsetting construction related impacts and increasing water filtration and water quality in the project area.

Construction of the NED plan would result in temporary impacts to wildlife. These impacts would be caused by the increased human activity and noise associated with the construction efforts, and impacts to grassland, wetland vegetation, and terrestrial habitat resulting from the increased toe width of the levee, the increased width of seepage berms, and activities associated with obtaining borrow material. Construction activities would not be conducted along the entire length of the levee all at once, so wildlife would only avoid those areas where construction is occurring to the extent that they feel threatened. Where appropriate, revegetation through seeding of grasses, planting of trees, and reshaping of borrow areas would be done as soon as practical after completion of, or concurrent with, construction activities. This would minimize the length of time soils are exposed and area habitat is unusable. In time, these areas would revert to pre-construction conditions and area wildlife could once again feed, breed, and shelter in these areas.

Construction of the NED Plan is not expected to result in significant impacts to fisheries in the Missouri River because the levees under consideration are between ¼ to ½ mile from the river, the proposed modification to the levee is not expected to alter the thalweg or any part of the river itself (including shallow water habitat), and the extensions to the levee toe and seepage berms would occur mainly on the landside of the levee

Detailed ecosystem mitigation is described in Chapter 4 of the attached environmental assessment. A mitigation plan has been prepared and is included in Appendix J of the attached environmental assessment. This plan has been coordinated with local and federal agencies including the U.S. Fish & Wildlife Service, Natural Resources Conservation Service, the Missouri Department of Conservation and the Kansas Department of Wildlife and Parks.

2.0 Cultural Resources

Literature reviews and background studies were performed for the project area on the left and right bank of the River. An accreted land study was also performed to determine any potential archeological sites. All cultural reviews in the project area in Kansas and Missouri have determined that there are no cultural, historic, or archeological sites of any significance that would be affected by the proposed project. A Section 106 review finding on November 6, 2001 by the State of Missouri SHPO states that the project area has a low potential for the occurrence of cultural resources. A cultural resource survey is not warranted. In a letter dated March 23, 2006, the State of Kansas SHPO concurs with our findings that there will be no effect of the proposed plan on historic properties and has no objection to the project. The potential extent of project features is the same at this time as presented to the agencies prior to the findings, and no changes in formulation of the project have occurred subsequently to affect these findings.

3.0 Cumulative Impacts

The Section entitled "Cumulative Impacts" of the Environmental Assessment provides a detailed assessment of potential cumulative impacts of the levee raises associated with the selected plan. Based on the analysis conducted, the recommended plan of constructing flood damage reduction reliability improvements within the St. Joseph metropolitan area will not result in substantial impacts to river reaches upstream or downstream of the project area. As such, cumulative impacts of the recommended plan are not considered significant.

4.0 Environmental Justice

Executive Order 12898 on Environmental Justice requires consideration of social equity issues, particularly any potential disproportionate impacts to minority or low-income groups. The study evaluated demographic and census data for the project area and analyzed the potential effects of the proposed project on minority and low-income groups. The proposed modifications to the levee systems will uniformly provide increased economic benefit to populations living and working behind the levee systems on both sides of the Missouri River in the project area. There are no significant induced hydraulic or other adverse impacts to the largely agricultural based levee systems located upstream and downstream of the project area that would result from the proposed plan. Public involvement processes will continue to reach out and provide information to the communities and populace affected by the proposed plan as implementation proceeds. Based upon the analysis, the proposed plan meets the intent of Executive Order 12898 and does not provide any imbalance or disproportionate affects to minority or low-income populations within the project area.

5.0 Environmental Operating Principles

Under the Environmental Operating Principles, the Corps of Engineers is mandated to be proactive in seeking and considering ways to improve and sustain the environment. Since the start of this study, the Kansas City District has been proactively considering several options to bring significant environmental benefits to the project area including both the R471-460 and L-455 Units. This project under the Section 216 Authority and several other programs were considered as vehicles for environmental improvements.

After review of the options and consideration of the conditions in this project area, it was decided that several programs would be best suited to improve the environment of the project area. First, under the authority of this project the direct affects of this levee modification will be mitigated. Under the Missouri River Fish and Wildlife Mitigation Program, a significant area adjacent to unit R471-460 will be restored. The Missouri River Mitigation Program is currently planning a mitigation site to be located along the right over bank of the Missouri River between the approximate river miles of 442 to 448. The site would be located in the State of Kansas, between the towns of Elwood and Wathena, lying between the MO River and south of U.S. Hwy. 36, located on both sides of the federal levee. Currently this project is in the final real estate acquisition phase of purchasing four tracts of land from willing sellers in this area. This would create an initial site of approximately 1,000 acres. Future tracts in this area would be acquired on a willing seller basis as they become available. Restoration and mitigation activities that will be focused on will include creation of additional Missouri River shallow water habitat, wetland restoration, increases in forested areas, wet prairie restoration with native grass plantings, and food plot establishment for wildlife. The Kansas Department of Wildlife and Parks is the primary partner in this activity and will have management responsibilities for the area. Other river stakeholders will also be participating in this venture. This activity is also being coordinated with the levee districts that are the sponsors on the levee modification.

On the left bank behind Unit L-455, the Corps is initiating a project under Section 514 of the Water Resources Development Act (WRDA) of 1999, the Missouri and Upper Mississippi Rivers Enhancement Program, to bring environmental benefits to an oxbow lake; Lake Contrary. The Corps of Engineers and the non-Federal sponsor, the Buchanan County Commission, are proposing a diversity of restoration activities for Lake Contrary. These include, but may not be limited to: a) improvement of aquatic habitat by measures to improve water quality, bottom diversity, aquatic species spawning and rearing habitat; b) planting wetland vegetation to improve wetlands associated with the lake and to serve as a functional sediment filter; c) improving hydraulic connection between the lake and the Missouri River to provide periodic flushing and increased habitat connectivity; and d) restoring and re-connecting adjacent sloughs and Contrary Creek with the Lake and/or the Missouri River to enhance aquatic and terrestrial species and the habitats upon which they depend. This project may also assist the sponsors and other stakeholders in bringing additional compatible recreation opportunities to the area, and providing a linkage to comprehensive recreation master plans involving the City of St. Joseph and areas south to the Kansas City area.

D. Hydraulic and Flood Plain Considerations

Both existing levees currently pass the nominal 1% (100-year) chance of exceedance flood profile without overtopping; R471-460 with 53% reliability and L-455 with 92.8% reliability. Therefore, there are no impacts to the profile for the 1% (100-year) chance of exceedance event for any raise alternative. This is an important designation as there are no impacts to the FEMA Base Flood Elevations along the Missouri River at any point as a result of any raise alternative. The impacts due to the proposed alternatives impact only profiles for events larger than the 1% (100-year) chance of exceedance event.

E. HTRW Considerations

There are no known HTRW considerations associated with the selected plan.

F. Engineering and Construction Considerations

There are no unusual engineering/design or construction issues associated with this project. Conventional construction methods will be used, and space is sufficient on site to provide for contractor mobilization and staging of construction.

G. Real Estate Considerations

The non-Federal Sponsors currently hold permanent easements sufficient for the existing levees and these are available for implementation of the selected alternative. Additional permanent easements will be acquired as needed for increases in levee to width in the areas affected by the levee raise. Temporary easements will be acquired and used for extension of the underseepage berms, borrow areas, equipment storage, access roads, construction vehicles, and staging areas. The width of the work area easements will vary along the levee, as additional lands are required.

A detailed description of the Lands, Easements, Relocations, Rights-of-Way, and Disposal (LERRD) requirements is outlined in the Real Estate Plan (Appendix D). This includes acreage, estate required, estimated land values, borrow areas, non-fed incidental costs and in-house government cost.

The proposed borrow areas are extensive in size and scope of soil removal and will be refined as the project moves into Pre-Construction Engineering and Design (PED). The areas have been reviewed by environmental staff to identify Wetland Reserve Program and Conservation Reserve Program lands within its reaches. Some borrow could come from land recently purchased by the Corps of Engineers under the authority of the Missouri River Fish and Wildlife Mitigation Program along the Elwood Gladden Levee Unit, saving on cost of proposed permanent easement.

H. Operations and Maintenance Considerations

No significant increase in operations and maintenance activities would occur with implementation of the preferred plan. Future O&M practices would remain the same as current operations including mowing, vegetation control, outfall cleaning, maintenance of wells, etc.

I. Value Engineering

A Value Engineering study appropriate to the feasibility phase, as required by Corps regulations, was conducted and completed in May 2006. This value engineering process identified two potentially beneficial improvements that might be implemented to realize significant cost savings for the project.

The first involves the potential use of dredged material from the Missouri River to use or supplement random fill for the levee modification. If there is sufficient suitable borrow material in the sediment from the River at the project location, and the impacts of sediment removal are not significant, then it will likely be a method to realize significant cost savings. The evaluation of sediment availability and the effects of dredging on the Missouri River are to some extent timing dependent. Also, further data and analysis is required on the environment and river degradation that were beyond the scope of this study. The determination on dredging will require additional surveys, sampling, testing, and analysis closer to the time of actual removal. Thus, the value engineering process must continue early in the design phase to reach a final conclusion. If dredging is deemed feasible; would result in a significant cost savings; and does not have significant environmental effects, the EA will be supplemented or revised and re-coordinated with the public and agencies.

The second value engineering opportunity identified is the potential avoidance of complete replacement of a large drainage structure. A filter drain installed under the structure's box could sufficiently reduce the hydrostatic pressures external to the box and eliminate the need for complete replacement of this structure. This would be a significant cost savings to the project. In order to come to a final conclusion on this potential recommendation, the structure will need to be thoroughly inspected and more detailed soil testing conducted. These activities are proposed to be conducted in conjunction with surveys and other on-site activities during the project design phase.

XI. Plan Implementation

A. Cost Sharing Requirements

The project cost allocation is 100% Flood Damage Reduction. The non-Federal cost share is determined according to the cost sharing prescribed in the Water Resources Development Act of 1986 (WRDA 86). In accordance with the typical allocation, the Federal government will be responsible for 65% of implementation costs and the Non-Federal sponsors for the remaining 35%. During the feasibility study, the three local sponsors provided their 50% cost share through the use of an inter-local agreement to which the Corps was not a party. It is anticipated that the 35% cost share for project implementation will be provided in the same manner. Table 16 presents the estimated project costs and cost sharing portions divided by levee. Future prices are inflated to the anticipated midpoint of construction (2011) using the current Federal interest rate of 5.125%. Detailed cost estimates are provided in Appendix F.

TABLE 16
PROJECT COST SHARING

In 1000's of dollars	October 2005 prices			Fully Funded		
NED Plan Feature Summary	**R471-460**	**L-455**	**Total**	**R471-460**	**L-455**	**Total**
Planning, Engineering, and Design (PED)	$ 2,310	$ 244	$ 2,554	$ 2,473	$ 261	$ 2,734
Construction	$22,742	$2,442	$25,183	$24,989	$2,682	$27,671
Construction Management	$ 1,499	$ 159	$ 1,658	$ 1,711	$ 181	$ 1,892
LERRD	$ 3,084	$ 208	$ 3,290	$ 3,284	$ 220	$ 3,504
Total NED Project Cost	$29,634	$ 3,052	$32,686	$32,457	$3,344	$35,801
NED Project Cost Sharing and Credit						
Non-Federal Share:						
Cash Contribution	$ 7,677	$ 883	$ 8,560	$ 8,502	$ 974	$ 9,476
LERRD	$ 2,695	$ 185	$ 2,880	$ 2,858	$ 196	$ 3,054
Total Non-Federal Share (35%)	$10,372	$1,068	$11,440	$11,360	$1,170	$12,530
Total Federal Share (65%)	$19,262	$1,984	$21,246	$21,097	$2,174	$23,271

B. Sponsor's Intent

The sponsor's intent to participate in the feasibility study was originally stated in several letters received after the Flood of 1993 requesting the initiation of the study. The sponsors committed to the study financially by signing the original Feasibility Cost Sharing Agreement (FCSA) in 1999. A revised FCSA was executed by all parties in April 2006, further reinforcing the sponsor involvement in the study and commitment to the project. The sponsors have shown every indication that they fully intend to progress into the design and construction phase of the project with the same support given to this Feasibility Study.

C. Project Financing and Sponsor Capability

The majority of the proposed work will occur on the right bank, unit R471-460. Costs of the

NED plan for R471 total $29,634,000, or 90% of total project NED costs. The Elwood-Gladden Drainage District and the St. Joseph Airport Levee District will share in these costs. It is expected that the two districts will execute an inter-local agreement to allocate the funding between them. The South St. Joseph Levee District will be responsible for financing of the proposed work on the left bank. The L-455 share of total project costs is $3,052,000, about 10% of total NED costs.

The project and local cost sharing requirements have been discussed with all three sponsors during the study. They are legally constituted bodies under State statutes with taxing authority, and the Corps' assessment indicates that they have the necessary financial basis to cost share a project of this magnitude. The districts, in conjunction with other local funding partners, have expressed their intent to fund the non-Federal share and are expected to issue general obligation bonds under authority granted them by the State. Financing of the L-455 project may involve a levy on property owners and/or additional contributions by selected large facilities in the protected area. Businesses and facilities in the L-455 area have estimated assets of $1.2 billion. The sponsors have continually expressed very strong support for the project.

It is expected that the City of St. Joseph, Missouri will be a local funding partner for a portion of the local share, as they have been during feasibility phase. Their extensive infrastructure and property interests in both protected areas include the L-455 stockyards area with its city water treatment facility and many of the largest businesses in the region, as well as the R471-460 Rosecrans Airport area, including the 139th Airlift Wing of the Missouri Air National Guard. The ANG is one of the region's largest employers. Any issuance of general obligation bonds would be backed by a city budget currently approaching $100 million. In addition, the city has a 5-year Capital Improvements Program supported by a half-cent sales tax, and the tax revenues often are used to attract matching grants from other state, local and Federal agencies. St. Joseph voters have consistently displayed their backing of the CIP in recent years when asked to vote on extensions of the sales tax. Increased CIP activity in recent years has helped bring about a 200% increase in grant funding received by the city from other agencies. The city's property tax base, which has benefited greatly in recent years from a growing regional concentration of life science businesses, also should be greatly enhanced by both the direct and indirect effects of the recent opening of Triumph Foods, a new pork processing facility that is one of the largest such facilities in the nation. The seventh-largest Missouri city has a range of possible options it could turn to in providing support of this project.

D. Summary of Coordination and Public Views

1.0 Study Coordination

The non-Federal sponsors strongly support the Recommended Plan. On a daily basis, each of the sponsors accomplish the numerous actions necessary for keeping the project in good condition as evidenced by recent annual inspection reports and by the evaluations undertaken in the feasibility study. The sponsors will continue to provide full cooperation and are prepared to meet the necessary financial obligation associated with the recommendations contained in the

Feasibility Report.

Extensive coordination with several State and Federal agencies took place during development and evaluation of the Recommended Plan and the Environmental Assessment. The following agencies were coordinated with and in some cases have provided comments or participated in the review of this project:

- Federal Emergency Management Agency
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- Natural Resources Conservation Service
- Missouri Air National Guard
- Missouri Department of Natural Resources
- Missouri State Historic Preservation Office
- Kansas Department of Wildlife & Parks
- Kansas Department of Health and Environment
- Kansas State Historic Preservation Office
- City of St. Joseph, Missouri
- City of Elwood, Kansas
- City of Wathena, Kansas
- Buchanan County, Missouri
- Doniphan County, Kansas

2.0 Public Involvement

The initial public involvement was conducted during the fall of 1995 and early 1996. It included meetings with local, state and Federal agencies, organizations and the general public. On October 29, 2002, the Corps and FEMA held a public meeting in Elwood, Kansas at the Elwood Community Center to explain to the residents the increased risk of flooding in the area. A similar meeting was held on October 30, 2002 in Wathena, Kansas, at the Wathena Community Center. These meetings also addressed the feasibility study process, alternatives, and likely outcomes as best understood at that time. Additional information regarding these meetings is included in Appendix A. The Corps' Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) was published in the Federal Register on November 20, 2003. The Corps, in accordance with NEPA, actively solicited input on the project. No comments were received as a result of the NOI from either government agencies or the general public. Based on receiving no comments on the NOI and information resulting from an Internal Technical Review, a decision was made that the impacts of the proposed project were not significant and an EIS was not required. As such, the Corps reverted to preparing the included EA.

On August 1, 2006, a description of the proposed project was circulated to the public and resource agencies through Public Notice No. 200501489 issued jointly by the Corps and the Missouri Department of Natural Resources, Water Pollution Control Program and the Kansas

Department of Health and Environment. The public notice included a thirty-day comment period ending on August 31, 2006, and provided instructions for the public to provide comments on the proposed project. The public notice also included information on the Corps preliminary determination to prepare a Finding of No Significant Impact (FONSI) for the project and a draft Section 404(b)(1) Evaluation. The public notice was mailed to the non-Federal Sponsors, adjacent landowners and businesses, local, State, and Federal elected officials, and state and Federal agencies. A copy of the public notice and list of recipients can be found in the EA.

On August 28, 2006, a public meeting was held in Elwood, Kansas, to present the recommendations of the feasibility study and obtain public comment. The meeting was advertised in the St. Joseph, Missouri and Doniphan County, Kansas newspapers and notices of the meeting were sent to the mailing list found in the Environmental Assessment. The meeting was attended by members of the public, local elected officials, the local sponsors, representatives of the levee districts up and downstream of St. Joseph, and state resource agencies. Written comments were received during the meeting and following the meeting by mail. The comments and responses are included in Appendix A of this report.

XII. Conclusions

The Recommended Plan (NED Plan) reduces the risk of flooding through project improvements and remedies planned within the two units examined in this Feasibility Report. In general, the Recommended Plan would raise the top-of-levee elevation of Units R471-460 and L-455 and modify existing appurtenant drainage and underseepage control structures.

This plan helps to correct a design deficiency and restore a uniform level of flood damage reduction for the study area. The NED plan does not fully restore the system to pass the original authorized flow. To do so would require significant additional cost and have a much greater impact to the existing levee systems both upstream and downstream on the Missouri River. The NED plan will provide a project that functions in a safe, viable, and reliable manner, as was initially intended by its designers. It is not required as a result of changed conditions or inadequate maintenance, is generally limited to the existing features and does not change the scope or function of the authorized project. It is also economically justified.

There are no significant long-term social or environmental impacts. Design considerations of the plan include avoidance of environmental resources, cultural resources, and HTRW where possible. The long-term environmental and cultural consequences of plan implementation are positive as the increased reliability of the units act to guard the social and environmental fabric that has developed within the protected areas for the last 40 years. A minimal amount of wetlands would be lost and mitigation is planned accordingly.

The Recommended Plan carries no increase in OMRR&R. The sponsors have sufficiency to provide all real estate requirements.

XIII. Recommendation

Upon considering the economic, environmental, social, and engineering aspects of making improvements to the existing Missouri River Levee System Units R471-460 and L-455, it has been determined that a project to reduce the risk of flooding and correct design deficiencies is in the public interest. Accordingly, the Corps of Engineers recommends that the Recommended Plan, as described in this report, be authorized for implementation with such modifications as the Chief of Engineers may find advisable, and in accordance with existing cost sharing and financing requirements.

The estimated implementation cost of the Recommended Plan is $21,246,000 Federal and $11,440,000 Non-Federal for a total estimated cost of $32,686,000 at October 2005 price levels. The NED benefits of the Recommended Plan are in excess of $4.6 million. The average annual flood damage reduction benefits of the Recommended Plan exceed the average annual cost by a ratio of 3.3 to 1.

Implementation of the Recommended Plan will use existing project authority. All items included in the Recommended Plan are necessary to continue providing the flood damage reduction benefits as intended by Congress.

Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to:

a. Provide a minimum of 35 percent, but not to exceed 50 percent of total project costs as further specified below:

    1. Provide 25 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

    2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs;

    3. Provide, during construction, a contribution of funds equal to 5 percent of total project costs;

    4. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project;

5. Provide, during construction, any additional funds necessary to make its total contribution equal to at least 35 percent of total project costs;

b. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

c. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

d. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;

e. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within one year after the date of signing a project cooperation agreement, and to implement such plan not later than one year after completion of construction of the project;

f. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

g. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

h. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

i. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

j. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

k. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

l. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

m. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*);

n. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

o. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

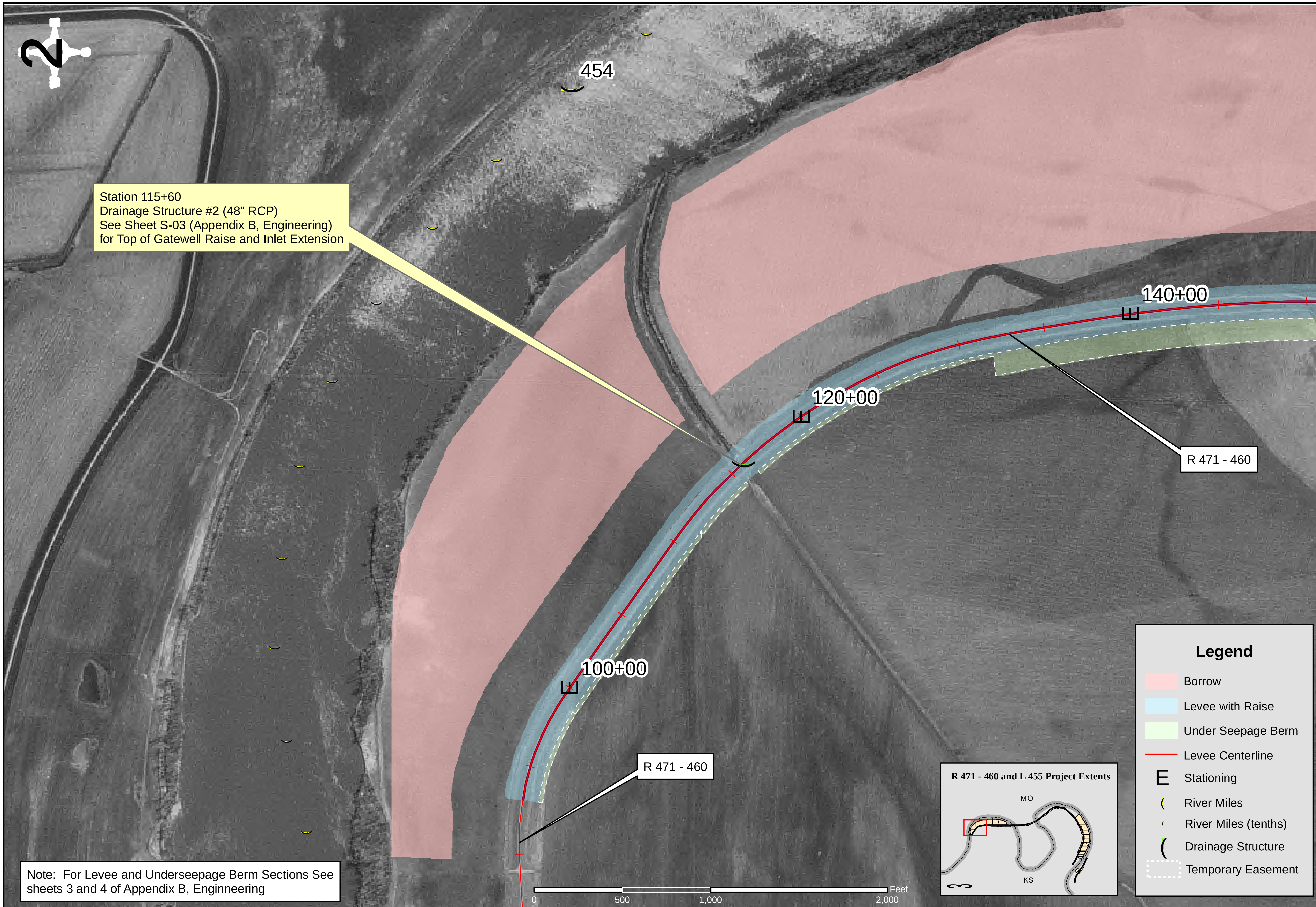
p. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and

q. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

This recommendation is contingent upon such discretionary modifications as deemed necessary by the Chief of Engineers and funding requirements satisfactory to the Administration and Congress. The recommendations contained herein reflect the information available at the time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendation may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the project partner, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Michael A. Rossi (date)
Colonel, Corps of Engineers
District Engineer

End of Feasibility Report



U.S. Army Corps of Engineers
Kansas City District

Symbol | Description | Date | Appr.

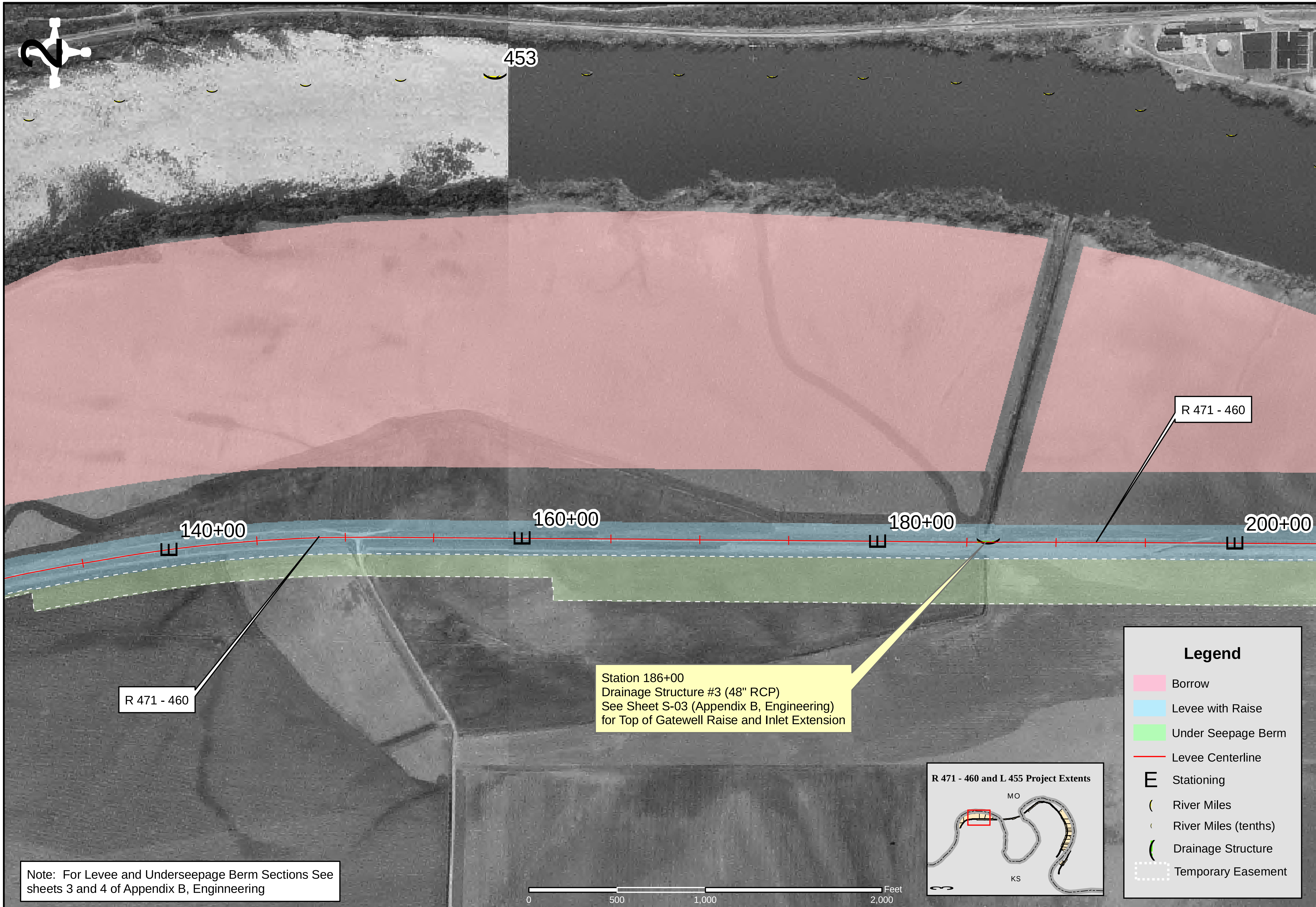
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by:
Drawn by: CTS
Checked by:
Submitted by:
Date: July 18, 2006
File no.
Plot scale: 500 : 1
CADD File Name: No1

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 100+00 thru Station 140+00

Sheet reference number
R-01



U.S. Army Corps of Engineers
Kansas City District

Symbol	Description	Date	Appr.

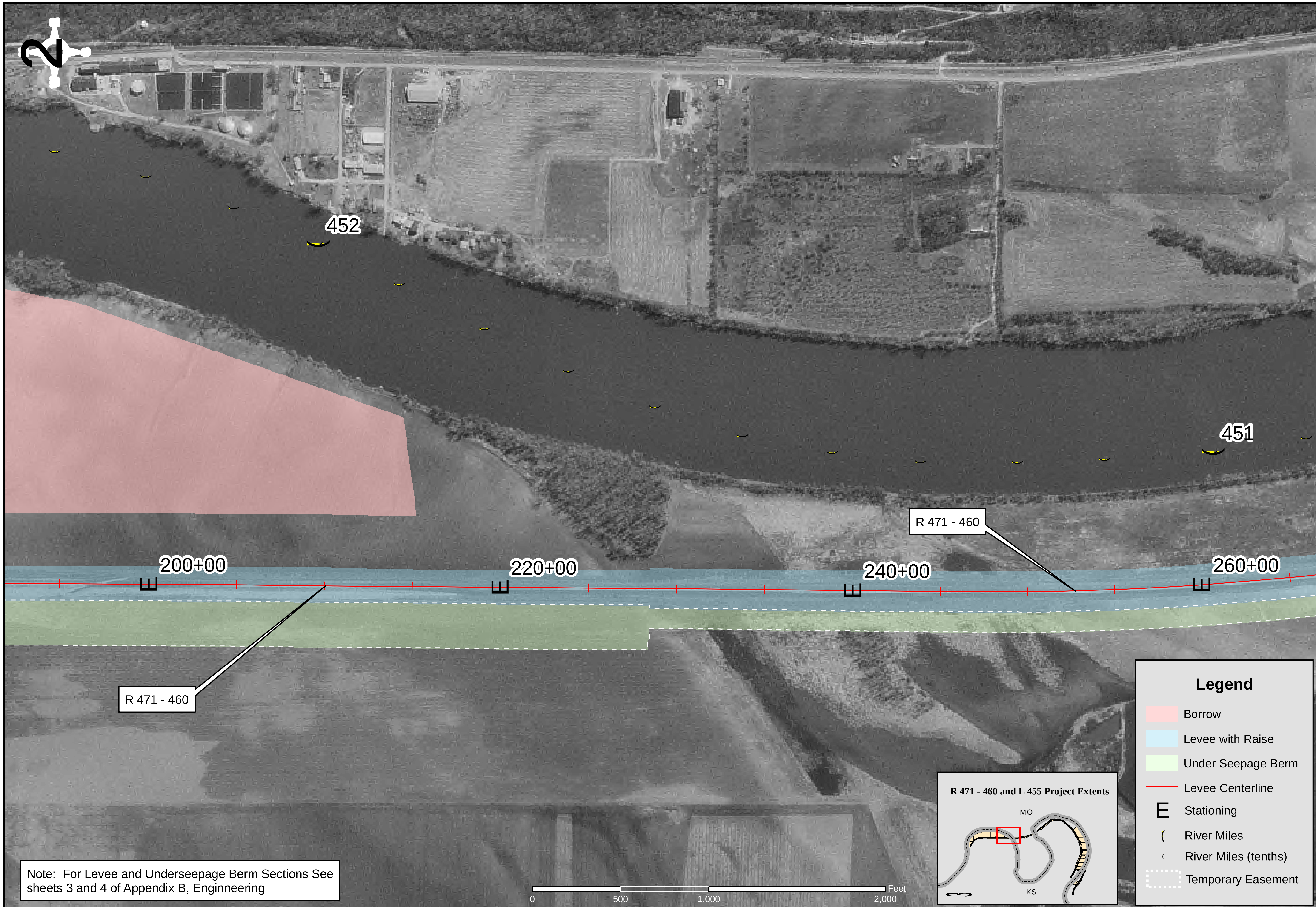
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by:	Date: July 18, 2006
Drawn by: CTS	File no.
Checked by:	Plot scale: 500 : 1
Submitted by:	CADD File Name: No2

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 140+00 thru Station 200+00

Sheet reference number
R-02



U.S. Army Corps of Engineers
Kansas City District

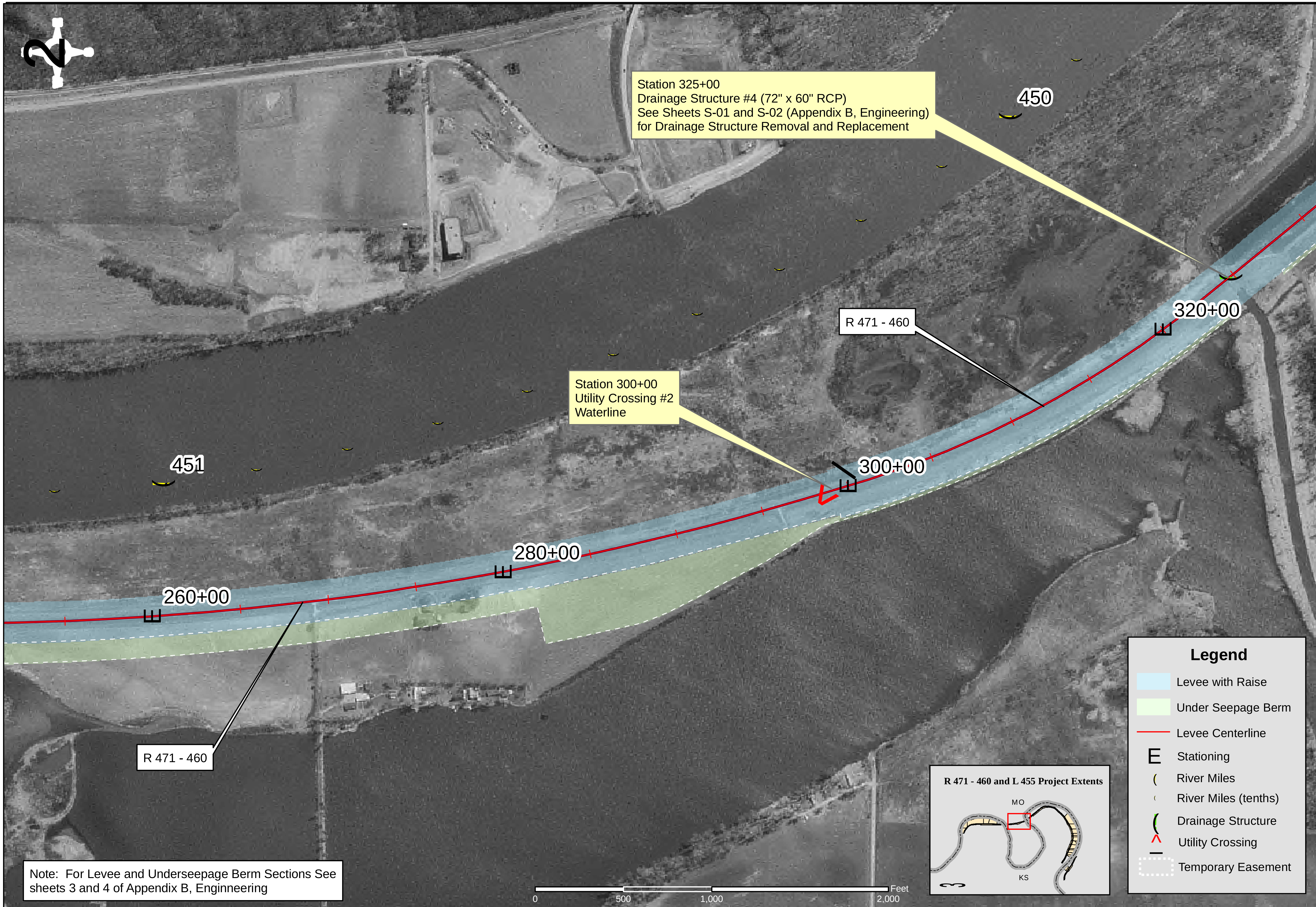
Date: July 18, 2006
File no.
Plot scale: 500 : 1
CADD File Name: No3
Designed by:
Drawn by: CTS
Checked by:
Submitted by:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 200+00 thru Station 260+00

Sheet reference number
R-03



Note: For Levee and Underseepage Berm Sections See sheets 3 and 4 of Appendix B, Enginneering

U.S. Army Corps of Engineers
Kansas City District

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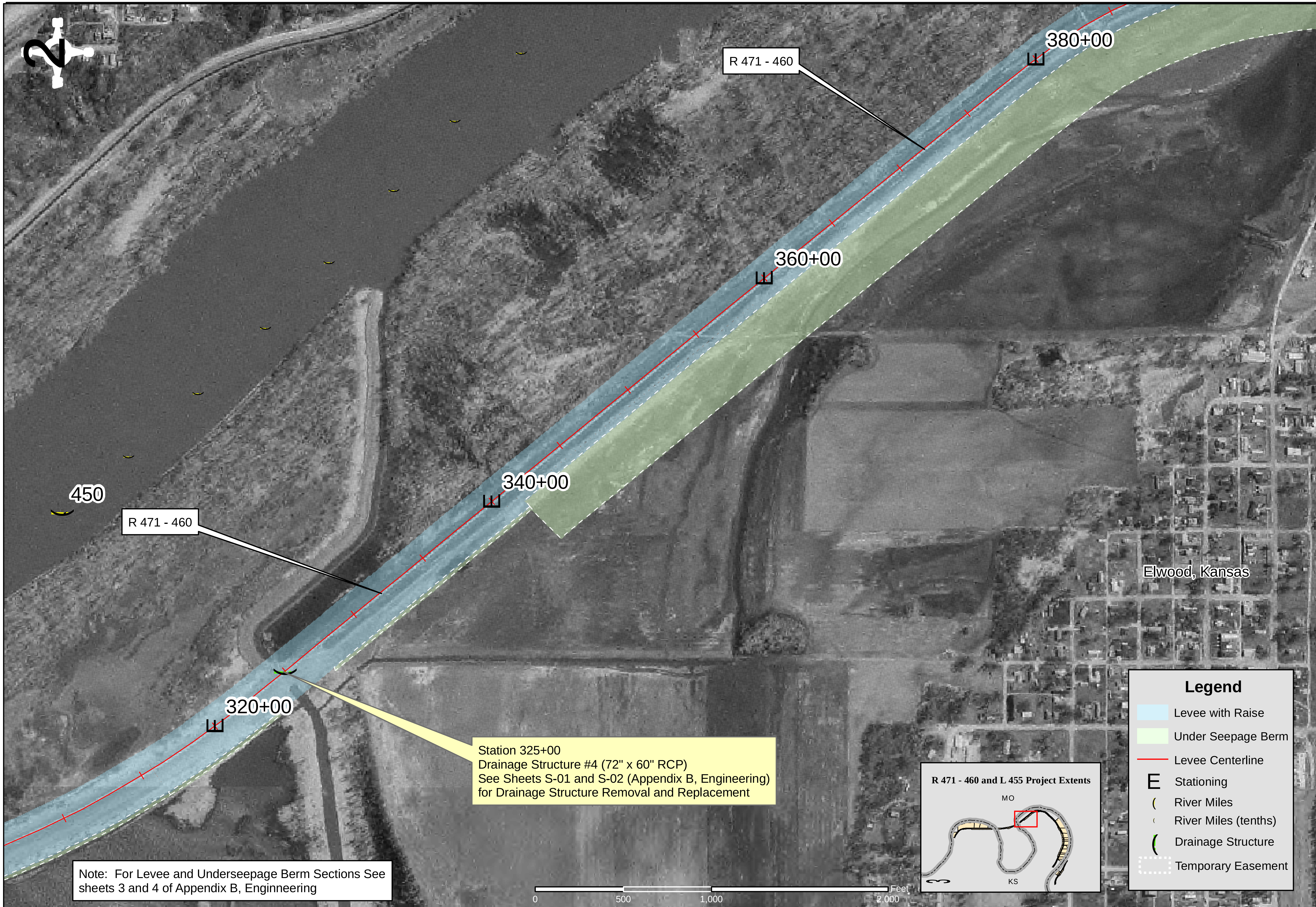
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 260+00 thru Station 320+00

Sheet reference number
R-04



U.S. Army Corps of Engineers
Kansas City District

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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

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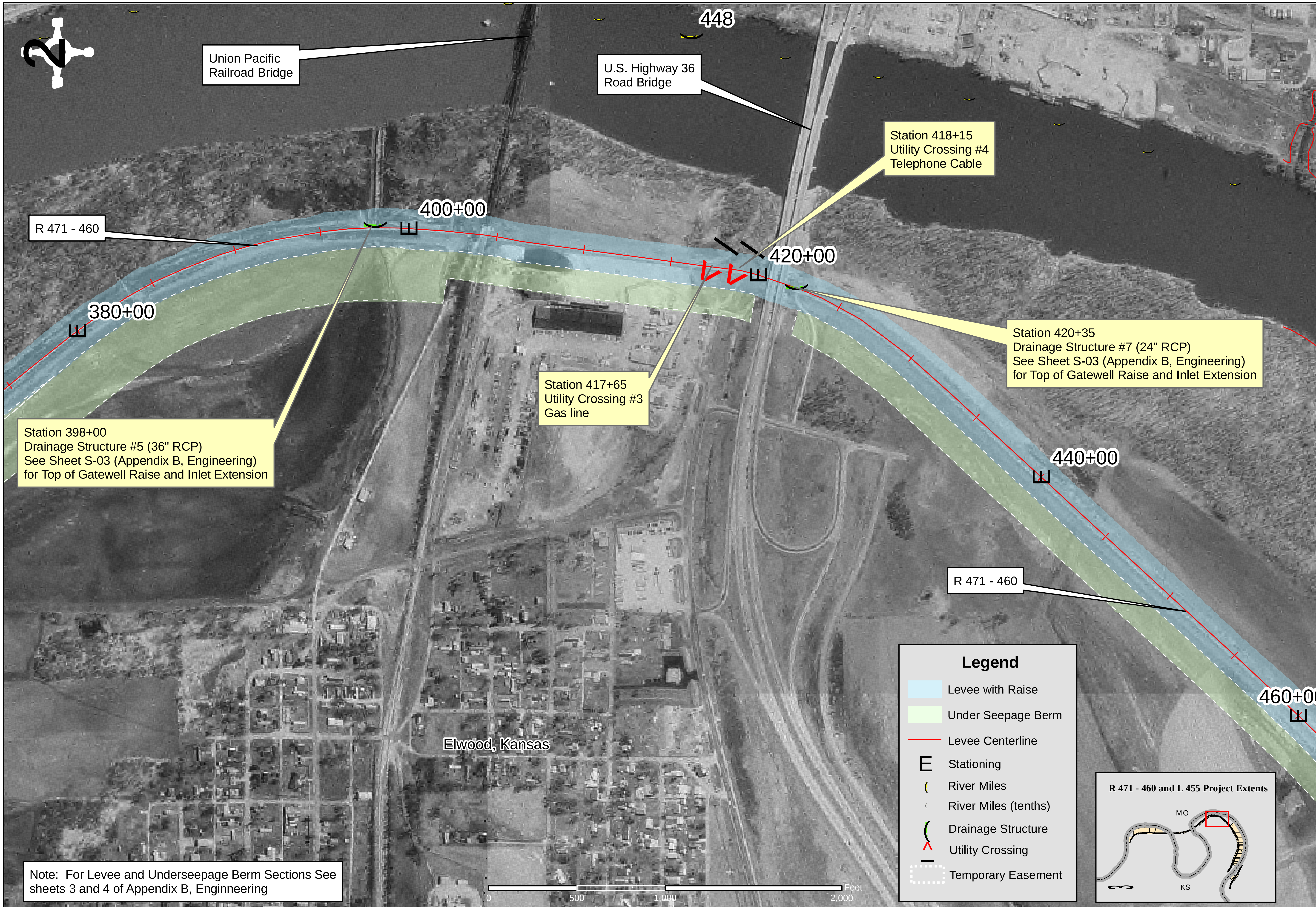
Submitted by:
Date: July 18, 2006
File no.
Plot scale: 500 : 1
CADD File Name: No5

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 320+00 thru Station 380+00

Sheet reference number
R-05



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Kansas City District

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CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

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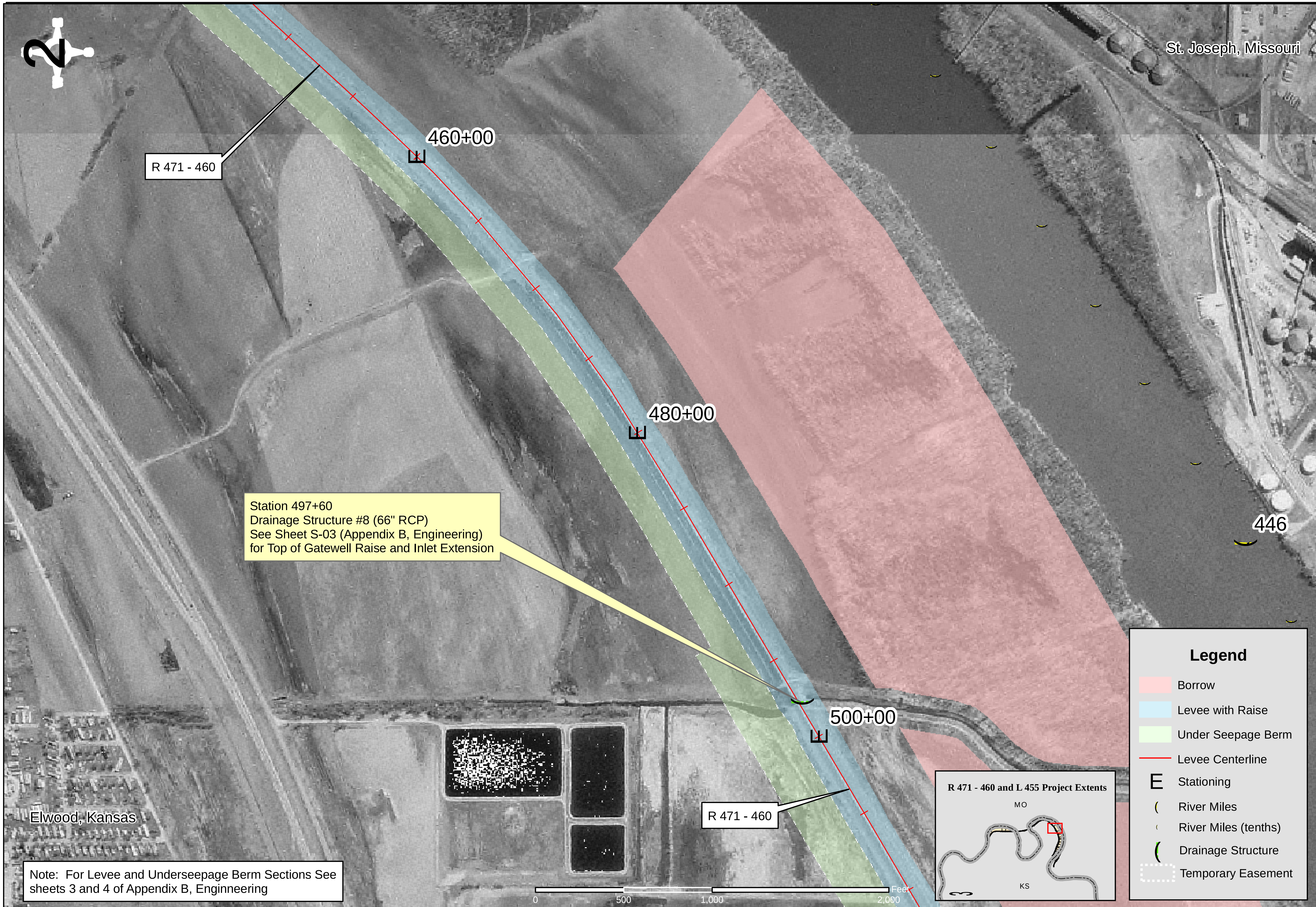
Submitted by:
Date: July 18, 2006
File no.
Plot scale: 500 : 1
CADD File Name: No6

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 380+00 thru Station 460+00

Sheet reference number
R-06



U.S. Army Corps of Engineers
Kansas City District

Symbol	Description	Date	Appr.

Date: July 18, 2006
File no.
Plot scale: 500 : 1
CADD File Name: No7
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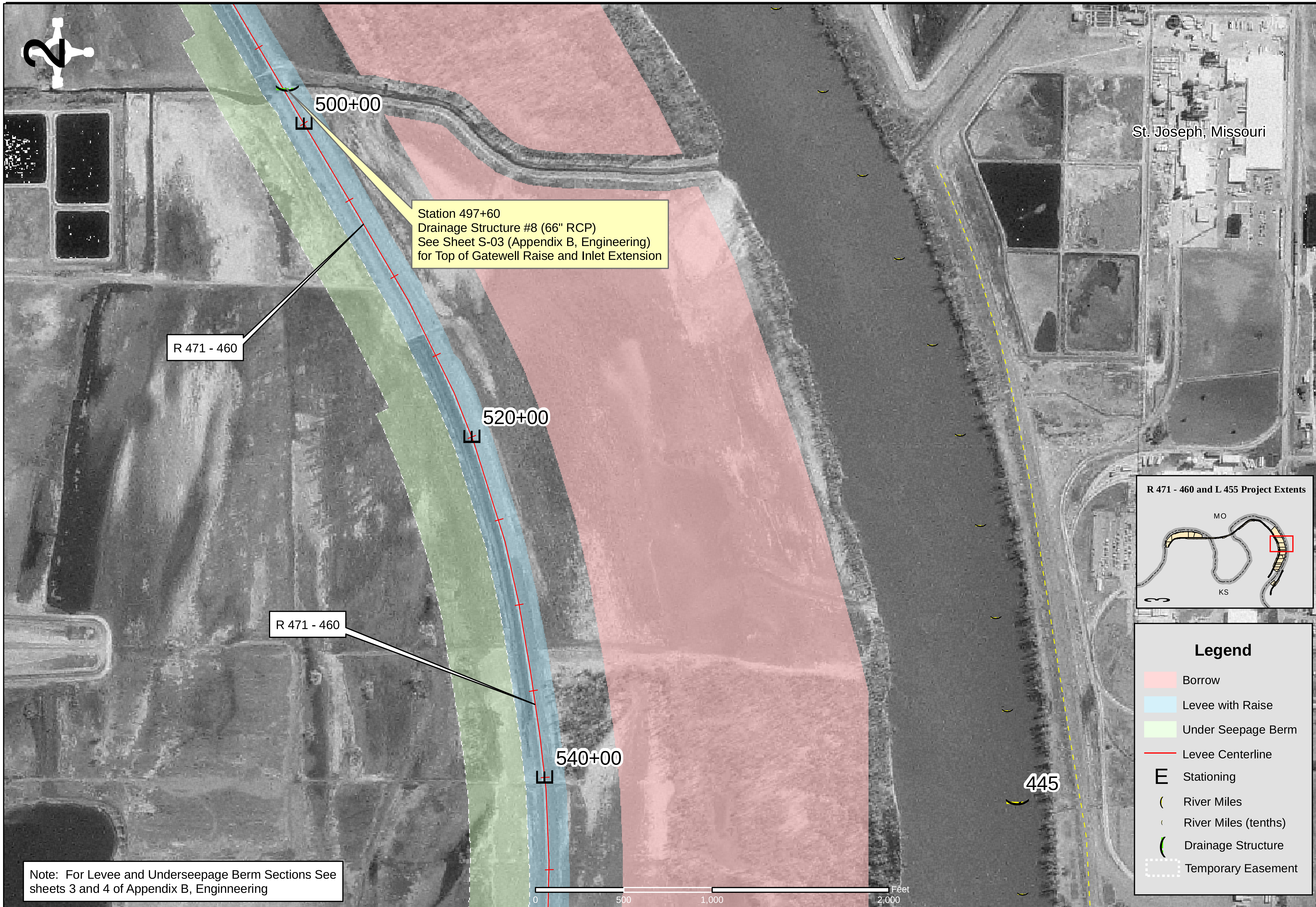
Submitted by:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 460+00 thru Station 500+00

Sheet reference number
R-07



U.S. Army Corps of Engineers
Kansas City District

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CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

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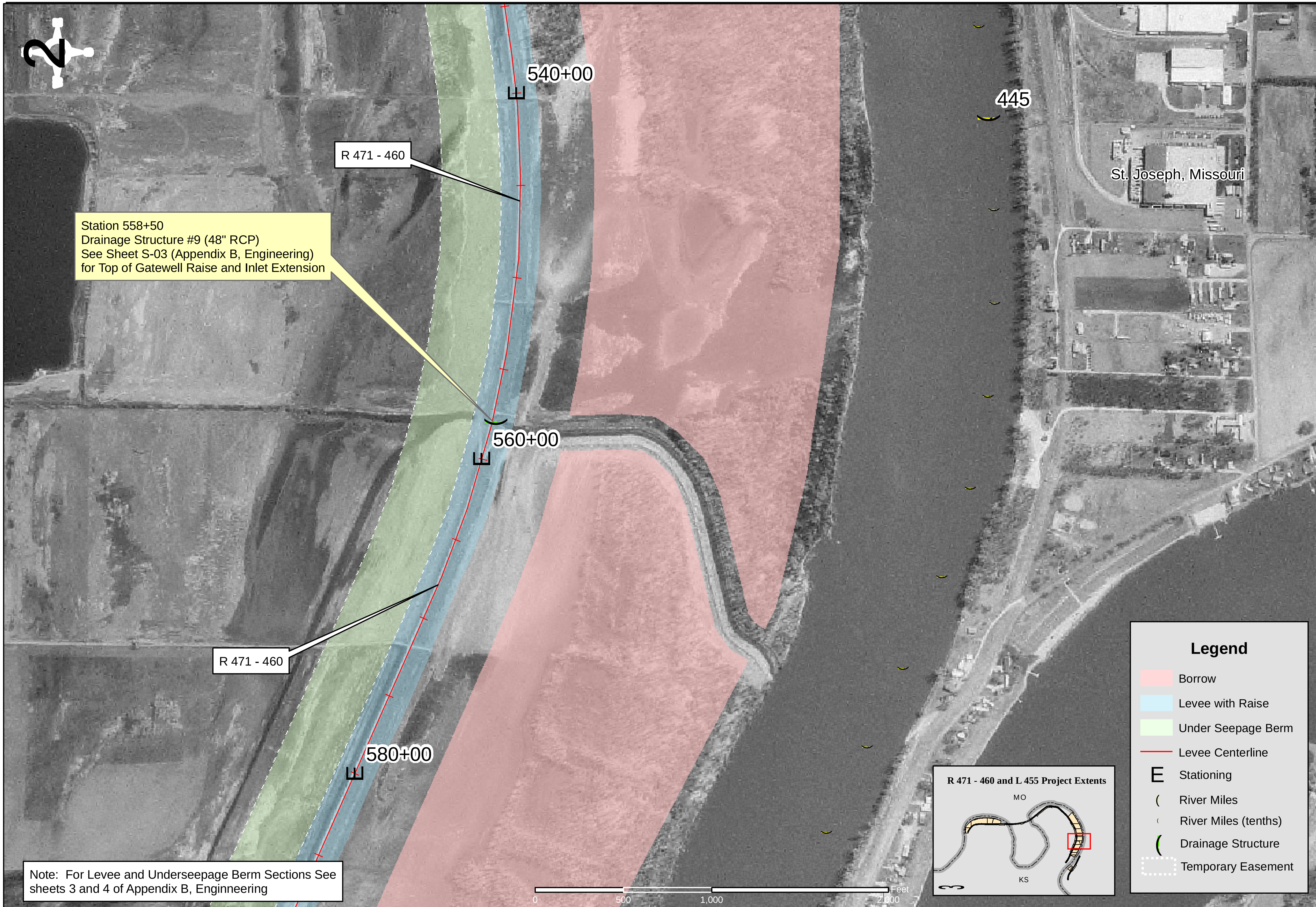
MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 500+00 thru Station 540+00

Sheet reference number
R-08



U.S. Army Corps of Engineers
Kansas City District

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Drawn by: CTS
Checked by:
Submitted by:

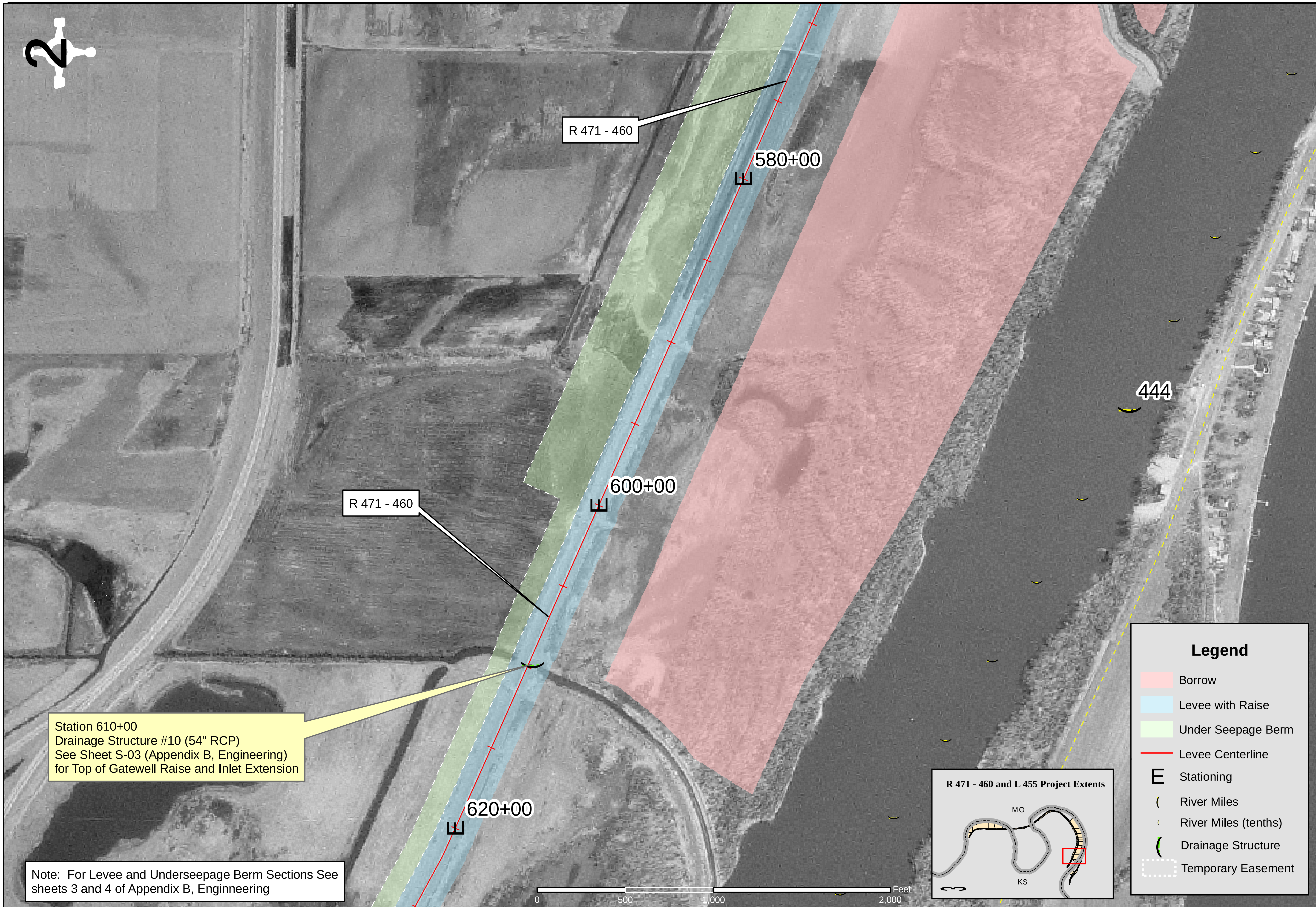
Date: July 18, 2006
File no.
Plot scale: 500 : 1
CADD File Name: No9

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 540+00 thru Station 580+00

Sheet reference number
R-09



U.S. Army Corps of Engineers
Kansas City District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 580+00 thru Station 620+00

Sheet reference number
R-10

Note: For Levee and Underseepage Berm Sections See sheets 3 and 4 of Appendix B, Engineering

U.S. Army Corps of Engineers
Kansas City District

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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by:	Date: July 18, 2006
Drawn by: CTS	File no.
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Submitted by:	CADD File Name: No11

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

R 471-460
Plan Sheet
Station 620+00 thru Station 660+00

Sheet reference number
R-11

U.S. Army Corps of Engineers
Kansas City District

Symbol	Description	Date	Appr.

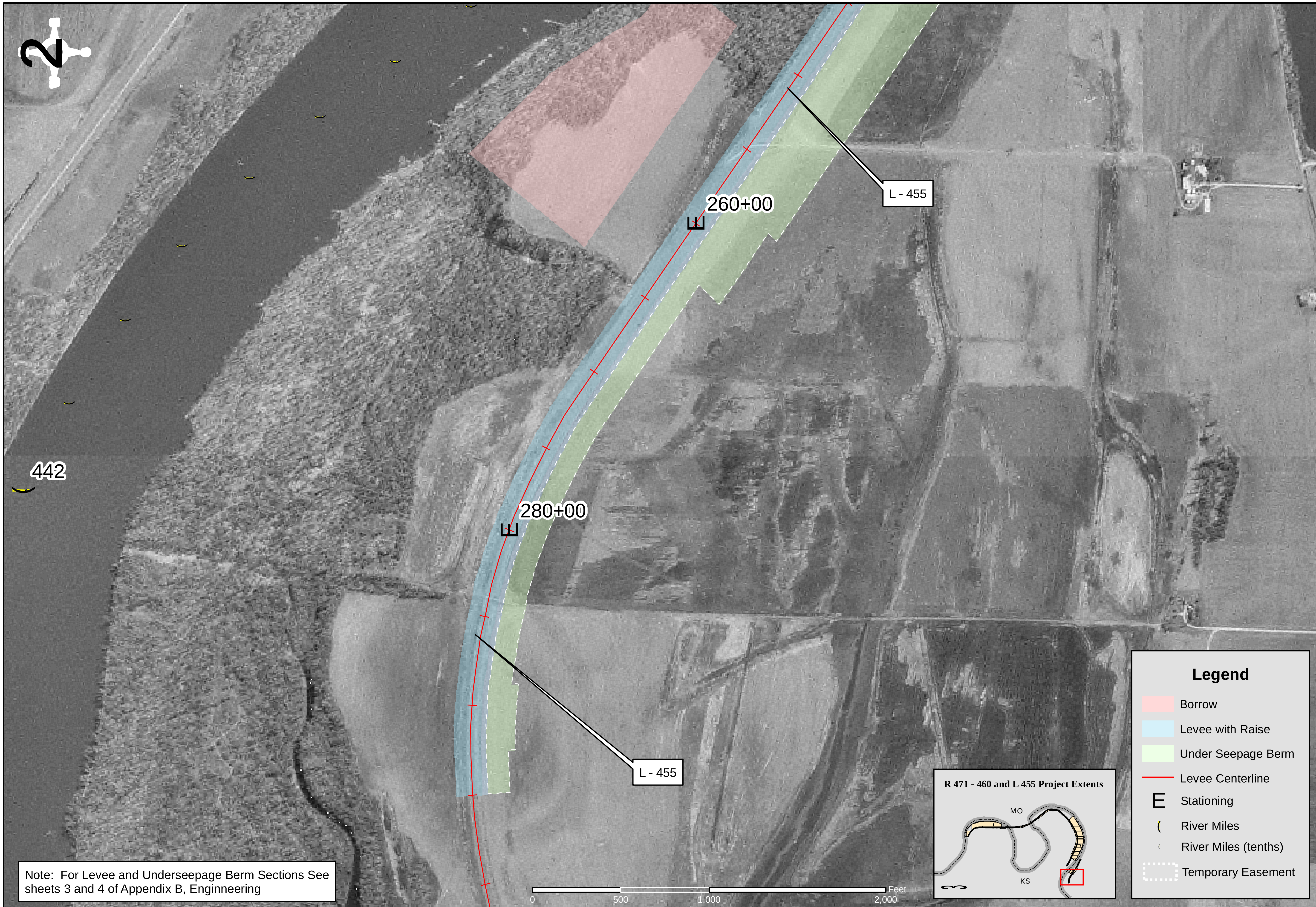
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by:	Date: July 15, 2006
Drawn by: CTS	File no.
Checked by:	Plot scale: 500 : 1
Submitted by:	CADD File Name: L1

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

L - 455
Plan Sheet
Station 220+00 thru Station 260+00

Sheet reference number
L-01



Note: For Levee and Underseepage Berm Sections See sheets 3 and 4 of Appendix B, Engineering

U.S. Army Corps of Engineers
Kansas City District

Symbol	Description	Date	Appr.

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CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

Designed by:
Drawn by: CTS
Checked by:
Submitted by:

Date: July 15, 2006
File no.
Plot scale: 500: 1
CADD File Name: L2

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

L - 455
Plan Sheet
Station 260+00 thru Station 280+00

Sheet reference number
L-02

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896

Finding of No Significant Impact

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
Kansas and Missouri

Project Summary

Under the authority of Section 216 of the 1970 Flood Control Act, the U.S. Army Corps of Engineers (Corps) at the request and with the cooperation of the project sponsors Elwood-Gladden Drainage District (right bank, Kansas), St. Joseph Airport Levee District (right bank, Missouri), and South St. Joseph Drainage District (left bank, Missouri), proposes to construct Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Project. The proposed project is located on opposite sides of the Missouri River in the St. Joseph, Missouri metropolitan area between River Miles 437 and 457. It involves a raise to the right bank levee unit using earthen material to an elevation sufficient to pass the one-hundred year flood event with 90 percent reliability and a corresponding raise to the left bank levee unit in specified areas to accommodate the slight rise in water surface elevations resulting from the initial right bank construction. The project purpose is to restore the reliability of the units to reduce damages from potential flooding on the Missouri River in the vicinity of St. Joseph, Missouri, and to allow the Federal Emergency Management Agency (FEMA) to re-certify the levees. The units are located within Buchanan County, Missouri and Doniphan County, Kansas and provide flood damage reduction benefits to the cities of St. Joseph, Missouri, and Elwood and Wathena, Kansas.

Alternatives

Five alternatives were considered; four build alternatives and the “No Action” alternative. These alternatives include: a raise to the right-bank levee unit using earthen material to an elevation sufficient to pass the one-hundred year flood event with 90 percent reliability, along with a corresponding raise to the left-bank levee unit in specific areas to accept the slight rise in water surface elevations resulting from the initial raise (Alternative 1 – 100-year event plus 3.0 feet of margin); a raise to the right-bank levee to an increased level of flood damage reduction (Alternative 2 - 500-year event plus 1.5 feet of margin), with a corresponding raise to the left-bank levee unit; a raise to the right-bank levee to a further increased level of flood damage reduction (Alternative 3 - 500-year event plus 3.0 feet of margin), with a corresponding raise to the left-bank levee unit; a raise to the right-bank levee only using earthen fill to the 100-year level of flood damage reduction with 75 percent reliability (Alternative 4 – 100 year-event plus 1.5 feet of margin) and; the “No Action” alternative.

1) Alternative 1 (100-year event plus 3.0 feet of margin). This alternative consists of raising the R471-460 from zero to 3.37 feet at specific points along its entire length, with corresponding raises to L-455 as required to accept the slight rise in surface water elevations, to pass the one-hundred year flood event with 90 percent reliability.

2) Alternative 2 (500-year event plus 1.5 feet of margin). This alternative consists of raising the R471-460 an average of two feet along its entire length, with corresponding raises to L-455 as required to accept the slight rise in surface water elevations.

3**) Alternative 3 (500-year event plus 3.0 feet of margin)**. This alternative consists of raising the R471-460 approximately three and one half feet along its entire length, with corresponding raises to L-455 as required to accept the slight rise in surface water elevations.

4) Alternative 4 (100-year event plus 1.5 feet of margin). This alternative consists of raising the R471-460 anywhere from zero to 1.2 feet at specific points along its entire length, with no raise to L-455, to pass the one-hundred year flood event with approximately 75 percent reliability.

All of the build alternatives will obtain borrow material from accreted lands riverward of the levee units. The borrow lands consist of 1,139 acres in Kansas between River Miles 454.9 to 451.9 and from River Miles 446.7 to 443.4. A smaller area in Missouri of 30.4 acres will be used between River Miles 442.6 to 442.9. The amount of borrow material needed depends upon the necessary levee height increase, and each alternative incorporates the same minimization measures to reduce and off-set impacts to area vegetation.

As each unit is raised, drainage structures would be affected. While some may require only a top platform raise at a lower raise, they may require a complete replacement with a higher raise due to added hydraulic and soil pressures. Extensions to underseepage berms and modifications to relief wells will be required. The scope of extensions and modifications is increased as the level of flood damage reduction is increased.

5) No Action Alternative. This represents the alternative of no action by the Federal government. It would not reduce existing flood damage potential. Additionally, this alternative does not provide a long-term solution for flood damage reduction, nor assurance that the levee will be re-certified by FEMA. If the levee remains de-certified, the economic impact of a flood event will be of considerable expense to the local communities in terms of flood insurance, flood damage, flood fighting, and flood related injuries.

Recommended Plan

The recommended plan is Alternative 1 and is described in detail in the Environmental Assessment. Of the five (5) alternatives considered, this plan is recommended because it will allow the system to pass the 1% chance (100-year) flood event with 92% reliability (greater than the minimum FEMA criteria); reduce economic hardship; allow modifications and improvements to local businesses; promote new investment; and allow FEMA to re-certify the right bank levee unit. Re-certification of the levee will prevent increases in flood insurance premiums; reduce sponsors' costs for flood fighting; and, allow mission essential upgrades to the Missouri Air National Guard Base from being jeopardized. Although this alternative impacts slightly more environmental resources over that of Alternative 4, it provides for greater economic development through recertification of the levee. Further, this alternative avoids impacts to cultural resources and results in no significant adverse impacts to the human environment.

Summary of Environmental Impacts

For the construction of the preferred alternative approximately 7.0 acres of secondary trees (willow/cottonwood), 13.0 acres of shrubland, and 4.9 acres of wetlands (farmed) would be permanently impacted. The completed project will create habitat to offset losses as a result of the increased levee footprint (see "Mitigation Measures" below). Other environmental impacts include noise, minor increases in exhaust and fugitive dust, and localized disturbance to area wildlife from construction equipment and construction workers during the construction phase of the project. However, the impacts associated with construction of the project are short term, minor, and less than significant.

Mitigation Measures

The proposed project will avoid, minimize, and offset impacts to habitat with on-site mitigation. When obtaining borrow material, existing wetlands will be scraped and reshaped along their edges equal to or greater than those areas filled under the levee footprint to increase their functions and values, and ensure no net loss of wetland habitat. Borrow areas with secondary tree growth will be dug as deep as possible to minimize the amount of disturbance while leaving enough blanket material to ensure water retention. In addition, between borrow areas, undisturbed buffers of up to 500 feet will be maintained to keep existing habitat and provide diversity. Other borrow areas will be contoured with uneven bottom elevations and islands of habitat to increase habitat diversity. Grassland areas disturbed during levee reshaping will be re-seeded with native grass species to the extent practicable and mulched following construction. However, the Kansas City District requirements for seeding and mulching of levee embankments dictate the use of grass species (such as fescue, brome, and rye) that sprout quickly to limit erosion, that can be readily mowed in order to facilitate levee inspection to ensure levee stability, and that help prevent the burrowing of animals that could disrupt levee integrity. Best Management Practices will be used to prevent the introduction of fuel and chemicals from construction equipment into the surrounding area. Additionally, these measures will include operational limitations to reduce the loss of soils, petroleum products, or other deleterious material into the waterway and adjacent resources.

Public Availability

The proposed project was circulated to the public and resource agencies through Public Notice 200501489 (August 1, 2006), with a thirty-day comment period ending on August 31, 2006. The notice was published in area newspapers and mailed to adjacent landowners, state and federal resources agencies and other interested parties. In addition, the public notice was available for public agency review and comment on the Corps' Kansas City District Regulatory Branch webpage (http://www.nwk.usace.army.mil/regulatory/public_notices.htm).

Conclusion

After evaluating the anticipated environmental, economic, and social effects of the proposed activity, it is my determination that construction of the proposed Missouri River

Levee System Units L-455 and R471-460 Flood Damage Reduction Study in Kansas and Missouri does not constitute a major Federal action that would significantly affect the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.

Date: ____________________ ____

Michael A. Rossi
Colonel, Corps of Engineers
District Engineer

Environmental Assessment
Final

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
Saint Joseph, Missouri / Elwood, Kansas

September 2006

U.S. Army Corps of Engineers
Kansas City District
601 E 12th St.
Kansas City, Missouri 64106-2896

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DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896

EXECUTIVE SUMMARY

In accordance with the National Environmental Policy Act, the U.S. Army Corps of Engineers (Corps/USACE), Kansas City District has prepared an Environmental Assessment (EA), for the St. Joseph, Missouri and Elwood and Wathena, Kansas Flood Damage Reduction Study, Missouri River. This EA considers the environmental impacts of proposed alternatives identified to address whether one or more plans for increasing the level of flood damage reduction is technically viable, economically feasible, and environmentally acceptable, or if no action is warranted.

The St. Joseph levee units evaluated in this EA are L-455 and R471-460. These units collectively comprise the protective works that provide flood damage reduction for St. Joseph Metropolitan Area, Buchanan and Andrew Counties, Missouri and Elwood and Wathena, Doniphan County, Kansas.

The Corps' "Notice of Intent to prepare an Environmental Impact Statement (EIS)" was published in the Federal Register on November 20, 2003 (Appendix A). The Corps initial scoping workshops were conducted during the fall of 1995 and included meetings with local, state and Federal agencies, organizations and the general public. On 13 September 1995, the Corps held a public information workshop in St. Joseph, Missouri to provide public notification that a Federal study had been initiated, and to solicit information and views about water resource problems and potential solutions in the study area. Comments were solicited from the public at this meeting in which approximately 50 people attended. No substantial opposition or controversial comments were received as a result of the public scoping meeting.

On 19 March 1996, a meeting in St. Joseph was held with the potential sponsors from the levee districts and representatives of the cities of St. Joseph, Elwood, and Wathena to disseminate the results of the study and to solicit views concerning the study findings. As a result of this meeting, the local sponsors expressed an interest in proceeding to feasibility studies. On October 29, 2002, the Corps and the Federal Emergency Management Agency held a public meeting in Elwood, Kansas at the Elwood Community Center to explain to residents the increased risk of flooding in the area. A similar meeting was held on October 30, 2002 in Wathena, Kansas.

A draft EIS was prepared and provided to resource agencies for review as well as to Corps personnel for internal technical review. Based on comments received and after evaluating them the impacts were deemed not significant and readily mitigated. Therefore, the determination was made to revert to preparation of an Environmental Assessment (EA). Thus, the Corps is proceeding with this EA.

The five alternatives considered were: raise the right levee section using earthen material to the 1% chance (100-yr) flood event plus 3.0 feet margin, and a corresponding raise to the left levee section in specific areas to accept the slight rise in water surface elevations resulting from the initial raise (Alternative 1 - **Preferred**); raise the right bank levee unit to the elevation of the 0.2% chance (500-yr) event plus 1.5 feet of margin, with a corresponding raise to the left bank levee unit (Alternative 2); raise the right bank levee unit to a the elevation of the 0.2% chance (500-yr) event plus 3.0 feet of margin, with a corresponding raise to the left bank levee unit (Alternative 3), raise the right bank levee unit only using earthen fill to the 1% (100-yr) event level event plus 1.5 feet of margin (Alternative 4); and, a "No Action" Alternative. The Final EA represents a detailed study of the environmental impacts associated with each of the alternatives.

The draft EA and corresponding Feasibility Study were released to the public in a Public Notice (200501489) dated August 1, 2006 with a 30-day comment period ending on August 31, 2006. The Corps also held an additional public meeting on 28 August 2006 at the Elwood Community Center in Elwood, Kansas to bring the public up-to-date on the proposed project since it has been ten years since the last public meeting. For further information concerning the St. Joseph Levees Feasibility Study, the EA or public meetings, please contact Mr. Eric S. Lynn, Project Manager for the St. Joseph Levees Study at the above address or by telephone at 816-389-3258.

Environmental Assessment

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
St. Joseph, Missouri / Elwood, Kansas

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Appendices

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Environmental Assessment

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
St. Joseph, Missouri / Elwood, Kansas

1.0 Introduction

1.1 Project Location and History

The City of St. Joseph, the county seat of Buchanan County, is located adjacent to the Missouri River from river mile 445 to 452, in northwest Missouri. The Missouri River has played an important role in the development and growth of the city serving as a major transportation route before the arrival of railroads and the automobile. In the middle of the 19th century, St. Joseph was on the western frontier and served as a point of departure for westbound wagon trains and the Pony Express.

The Missouri River, one of the largest rivers in the United States, drains 424,300 square miles above St. Joseph. The topography of the study area is generally represented by hills and uplands, which rise from 100 feet to 200 feet above the Missouri River floodplain. The Missouri River borders the eastern bluffs in the northern part of the city, and then crosses over to border the western bluffs opposite the southern part of the city. Its floodplain is three to five miles wide at Saint Joseph.

1.2 Levee Unit Descriptions

1.2.1 Unit L-455

The Missouri River Levee System (MRLS) Unit L-455 is a part of a Federal flood damage reduction project. Its sponsor is the South St. Joseph Drainage and Levee District. This unit is located on the left bank of the Missouri River in Buchanan County, Missouri. The levee extends from the mouth of Whitehead Creek (Missouri River mile marker 447.3) ten miles downstream to Contrary Creek (Missouri River mile marker 437.3) and provides flood damage reduction for a flood prone area within the southwest section of the city of St. Joseph.

The levee was constructed in three phases. Phase I was completed by Grosshans & Petersen, Inc., between March, 1962 and August, 1964. Phase II was begun in September 1963, with work completed by December 1964. The final phase (Brown's Branch Pumping Plant) was completed by the Luhr Construction Company in February, 1967. Some rehabilitation work on the levee was completed in 1985; however, no project modifications have been made since then. The levee sustained minor damage during the 1993 flood and the U.S. Army Corps of Engineers (Corps) under the PL84-99 program repaired the damages.

Levee Unit L-455 was designed and constructed to provide flood damage reduction for a flow of 325,000 cubic feet per second (cfs) with two feet of freeboard plus one foot for dynamic effects such as super-elevation on the outside of bends. The levee freeboard was above the constant flow backwater profile of the original design hydraulics and included 0.15 foot per mile for the effect of a rising hydrograph. The protected area includes approximately 7,519 acres of which about 5,100 are cropland. The remainder of the protected area includes a state highway, several railroads; as well as industrial, residential, and recreational areas located in the southwest sections of the city of St. Joseph.

The current design of Levee L-455, based on the Corps hydrologic and hydraulic modeling, shows that the levee will pass the one percent event (100-year flood), under both existing and future conditions. When taking into account an additional design profile incorporating a three-foot margin (to ensure minimum 90 percent reliability), the model shows that unit L-455 would continue to contain the flood event.

1.2.2 R471-460

Levee Unit R471-460 is also part of a Federal flood damage reduction project. Its sponsors are the Elwood Gladden Drainage District (Kansas) and the St. Joseph Airport Levee District (Missouri). This unit is located on the right bank of the Missouri River between river miles 441.7 and 456.6, in eastern Doniphan County Kansas, and northwestern Buchanan County, Missouri.

The unit was constructed by List and Clark Construction Company between June, 1966 and June, 1968. It was designed and constructed to provide flood damage reduction for a maximum flow of 325,000 cubic feet per second (cfs) with two feet of freeboard plus one foot for dynamic effects such as super-elevation on the outside of bends. The levee freeboard was above the constant flow backwater profile of the original design hydraulics and included 0.15 foot per mile for the effect of a rising hydrograph. Some rehabilitation work was done in 1984. The levee unit sustained damage from high floodwaters both prior to and after overtopping on July 26, 1993. When it was overtopped, floodwaters eroded and breached the levee embankment at two locations, causing extensive damage to the remaining levee before receding into the channel on August 8, 1993.

Alternatives considered for repair of damaged areas ranged from no action (no repair) to restoration of the damaged portion to its original pre-flood condition. The alternative that was implemented included the repair of levee breaches and scour holes on the top, sides, and toe of the levee. The protected area comprises 13,524 acres; 10,150 acres in Kansas including the town of Elwood. The remaining 3,374 acres are in Missouri, including Rosecrans Memorial Airport and a Missouri Air National Guard base.

The current design of Levee Unit R471-460, based on the Corps of Engineers' hydrologic and hydraulic modeling, shows that the levee will pass the one percent event or the 100-year flood, under both existing and future conditions. When taking into account an additional design profile incorporating a three-foot margin construction, necessary to provide minimum 90 percent reliability, the model shows that Levee Unit R471-460 would not contain the flood rise nor provide additional flood damage reduction to specific locations along the levee. Based on the modeling results, parts of Unit R471-460 would need to be raised by zero to as much as 3.37 feet to provide similar damage reduction benefits.

1.3 Purpose and Need

1.3.1 Background

Flood of 1993 The flooding experienced in the St. Joseph area during 1993 was part of a widespread pattern of flooding experienced throughout the lower Missouri River Basin. Above average precipitation was recorded in the region from the fall of 1992 into the spring of 1993. This caused saturated soil conditions and high stream flows in the lower Missouri River Basin by the spring of 1993. A severe weather pattern with associated thunderstorms and heavy rains followed in June and July 1993. The above average precipitation, saturated soil conditions, high stream flows, and excessive runoff, were the primary cause of the flooding experienced in the St. Joseph region in the summer of 1993.

At Missouri River Mile 448.2 near Elwood, the Missouri River was at or above flood stage (17 feet) from June 26 to August 6, 1993 (43 days). On July 23, the entire town of Elwood, Kansas was evacuated as a result of potential overtopping of the Missouri River Levee Unit R471-460. On July 24 the levee was overtopped near the old Missouri River Channel, east of Rosecrans Memorial Airport. On the Missouri side, the city of St. Joseph also began having problems keeping floodwaters out of its water supply system and was forced to shut down the system to prevent contamination. The water supply system is upstream of Levee Unit L-455 and is not protected by the levee. On July 26, the Missouri River crested at 15 feet above flood stage (32 feet) with a discharge of 335,000 cubic feet per second (cfs).

Elwood, Kansas, and the surrounding area were inundated with water up to 12 feet in depth when Unit R471-460 was overtopped and breached. The entire Elwood business district and an estimated 450 residences were flooded with an average of six feet of water. Urban damages, which include residential, commercial, and industrial damages, were estimated at $92,305,000 for Elwood. Urban damages for the city of Wathena, Kansas, also within Levee Unit R471-460, were estimated at $5,188,000.

Other key facilities in the Elwood area that were flooded when Levee Unit R471-460 was overtopped included the Rosecrans Memorial Airport and Missouri Air National Guard Base. Damages to the Air Guard base were estimated at $16,000,000 and damages to the airport were estimated at over $1,000,000.

The 1993 flood was considered a major flood in the Missouri River basin and caused serious damage to public and private property throughout the basin. Short-term effects included temporary loss of housing, loss of public utility service, transportation detours and delays, and loss of business due to temporary closings. Long-term effects include negative economic impacts to the region and nation.

This flood raised a concern that the levees may provide less than the level of flood damage reduction for which they were designed. Section 216 of the 1970 Flood Control Act provides continuing authority to examine completed Federal projects to determine whether the projects are providing benefits as intended.

1.3.2 Purpose

Purpose: The purpose of the Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Project in Kansas and Missouri is to reduce damages from potential flooding on the Missouri River in the vicinity of St. Joseph, Missouri. The sponsor-preferred purpose is to provide flood damage reduction equal to, or greater than, the one percent event with 90 percent reliability, under both the existing and future conditions, in order to provide for re-certification of the right-bank levee by the Federal Emergency Management Agency (FEMA).

1.3.3 Need

Need: The need of the Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Project in Kansas and Missouri is to improve the adequacy and reliability of the levee units to reduce damages from potential flooding on the Missouri River in the vicinity of St. Joseph, Missouri. Also in December 1999, FEMA formally de-certified Unit R471-460 because it was determined that the levee would not pass the base flood. The de-certification subjects the properties protected by this unit to higher insurance premiums under the National Flood Insurance Program. The sponsor-preferred need is to allow passing of the one percent flood event with 90 percent reliability under both existing and future conditions, and to allow FEMA to re-certify the right-bank levee. If the right-bank levee remains de-certified, the economic impact of a flood event will be of considerable expense to the local communities in terms of flood insurance, flood damage, flood fighting, and flood related injuries.

1.4 Authority

This study is being conducted under the authority provided by Section 216 of the 1970 Flood Control Act. This act provides authority to reexamine completed civil works projects:

> *Section 216. The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects, the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to the significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying structures or their operation, and for improving the quality of the environment in the overall public interest.*

Section 216 provided continuing authority to examine completed Federal projects to determine whether the projects are providing benefits as intended. The results of this examination indicate that raising the level of flood damage reduction provided by the St. Joseph levee unit system may be technically and economically feasible without unacceptable environmental or social impacts. Accordingly, a Federal interest exists in designing and constructing improvements because of the potential to benefit the National economy.

1.5 Prior Studies

The below studies and reports have been completed pertaining to the study area and surrounding areas. These were used to gather information regarding the levee units and past flood events:

- Missouri River Levees (Sioux City, Iowa to the Mouth) Definite Project Report, March 1947.
- General Design Memorandum – Levee Unit L-455, September 1959.
- General Design Memorandum – Levee Unit R471-460, December 1965.
- Operations and Maintenance Manual, MRLS Unit L-455, 1969.
- Missouri River Flood Plain Pilot Study, St. Joseph to Kansas City, November 1977.
- Operation and Maintenance Manual, MRLS Unit R471-460, December 1986.
- Saint Joseph, Missouri December 1987 Reconnaissance Report.
- Project Information Report, Missouri River Levee System, South St. Joseph Unit, Levee Unit L-455, October 1993.
- Project Information Report, Missouri River Levee System, Elwood-Gladden Unit, Levee Unit R471-460, January 1994.
- Emergency Levee Repair, MRLS Unit R471-460, Doniphan County, Kansas and Buchanan County, Missouri, Construction Plans and Specifications, February 1994.
- The Great Flood of 1993 Post-Flood Report, Lower Missouri River Basin, September 1994.
- Missouri River Levee System Units L-455 and R461-471 Engineering and Technical Appendices A-I, May 1996.
- Reconnaissance Report, MRLS Units L-455 and R-460-471, May 1996.

1.6 Public Involvement/Scoping

The Corps' initial scoping process was conducted during the fall of 1995 and early 1996 and included meetings with local, state and Federal agencies, organizations and the general public. On 13 September 1995, the Corps held a public information workshop in St. Joseph, Missouri to provide notification to the public that a Federal study had been initiated, and to solicit information and views about water resource problems and potential solutions in the study area. Comments were solicited from the public at this meeting in which approximately 50 people attended. No substantial opposition or controversial comments were received as a result of the public scoping meeting.

On 19 March 1996, a meeting in St. Joseph was held with the potential sponsors from the levee districts and representatives of the cities of St. Joseph, Elwood, and Wathena to disseminate the results of the study and to solicit views concerning the study findings. As a result of this meeting, the local sponsors expressed an interest in proceeding to feasibility studies.

On October 29, 2002, the Corps and FEMA held a public meeting in Elwood, Kansas at the Elwood Community Center to explain to the residents the increased risk of flooding in the area. A similar meeting was held on October 30, 2002 in Wathena, Kansas at the Wathena Community Center.

The Corps, in accordance with NEPA, actively solicited input on the project in its Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) (Appendix A), which was published in the Federal Register on November 20, 2003. No comments were received as a result of the NOI from either government agencies or the general public. Based on receiving no comments on the NOI and an Internal Technical Review, the decision was made that the impacts of the proposed project were not significant and an EIS was not required. Therefore, the Corps determined that it was only necessary to prepare an Environmental Assessment (EA).

On August 1, 2006, a description of the proposed project was circulated to the public and resource agencies through Public Notice No. 200501489 issued jointly by the Corps and the Missouri Department of Natural Resources, Water Pollution Control Program. The public notice included a thirty-day comment period that ended on August 31, 2006 and provided instructions for the public to provide comments on the proposed project. The public notice also included information on the Corps preliminary determination to prepare a Finding of No Significant Impact (FONSI) for the project and a draft Section 404(b)(1) Evaluation. The public notice was mailed to adjacent landowners, individual, agencies, and businesses listed on the NWK-Regulatory Branch’s general mailing list; state of Missouri and Buchanan County mailing lists, and the state of Kansas and Doniphan County mailing lists. A copy of the public notice and list of recipients is found in Appendix G. An additional public meeting was held (August 28, 2006) during preparation of the draft EA to update the public since the last meetings were held about ten years ago. Comments received as a result of this meeting are included in Appendix C.

1.7 Project Sponsors

Sponsorship for the Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Study, Kansas and Missouri is provided by the Elwood-Gladden Drainage District (right bank in Kansas), the St. Joseph Airport Levee District (right bank in Missouri), and the South St. Joseph Drainage District (left bank).

2.0 Alternatives

The alternatives formulated for the two individual levee units were primarily based upon the existing conditions of each levee unit, and the results of hydraulic, geotechnical, structural, economic, and environmental analyses. Prior to, and throughout the scoping process, the Corps has attempted to identify a comprehensive range of project alternatives, based upon the aforementioned analyses.

2.1 Alternatives Originally Studied but Removed from Further Consideration in this EA

2.1.1 Nonstructural

Nonstructural measures generally do not restrict or alter floodwaters; rather they involve protection of structures within the flood plain through modification to withstand flooding with minimal damage. Nonstructural measures may also include the regulation of existing uses and future development within the flood plain so they are compatible with the flood hazard or advance flood-warning systems. Examples of the nonstructural measures considered included:

- Floodproofing. This could involve various techniques such as: elevation of the structure’s windows and doors with water resistant materials or even the construction of small ring levees or walls around flood susceptible structures. This measure is feasible for a small number of existing structures but likely not for the St. Joseph metropolitan area given the number and types of buildings and facilities located within the protected area of R471-460. Additionally, this non-structural alternative would not restore FEMA certification to the levee.

- Permanent evacuation, relocation, floodplain buyout. This would require the acquisition of existing property and either relocation, demolition, or conversion to parks and recreation, or agriculture, of the structures. This is feasible for a small number of existing structures but likely not for the St. Joseph metropolitan area given the number and types of buildings and facilities located within the protected area of R471-460. Additionally, this non-structural alternative would not restore FEMA certification to the levee.

- Flood Warning System with Temporary Evacuation Plan. After the devastating 1984 flood, the city of St. Joseph installed a flood warning system on Blacksnake Creek and Whitehead Creek. Increased consideration was given to developing a coordinated system of precipitation stations, gages, and a computer network to interpret data from the other tributaries; however, this has not yet been developed. This alternative would provide study area businesses and residences with warning of a predicted flood. Additionally, those having the capability to relocate would have the opportunity. Typically, a rain and/or stream gage infrastructure is required to monitor hydrologic conditions in the basin, and serve as a basis for providing early prediction and warning of impending high water at pre-designed areas prone to flooding. A realistic and funded/resourced response plan to be implemented by jurisdictional governing agencies is also a key requirement.

This measure as a stand-alone project would not be feasible for the St. Joseph area but may be considered as an additional measure in conjunction with the preferred alternative.

- Flood plain regulation. Regulatory controls are imposed at the state and/or local level to restrict the development of structures and the use of flood prone lands. St. Joseph, and Andrew and Buchanan counties Missouri and Wathena and Doniphan counties, Kansas participate in the National Flood Insurance Program, evaluating potential construction and certifying compliance to appropriate regulations. However, existing structures are still in need of protection and this alternative would not address those structures.

- River Level Changes. This measure may provide reduction of flood damages by limiting or delaying excessive runoff, thereby reducing downstream flows and flood stages. A flood damage reduction reservoir is designed to impede the flow of water when runoff is high and release it gradually after the threat of flooding has passed. The closest dam that could be operated for river level changes is 360 miles upstream. The complex Missouri River system is unable to be managed to the necessary level to measure effects at a single levee unit.

2.1.2 Structural

Typical structural measures reduce the frequency of damaging overflows by altering the natural flow of the watercourse through one or more of the following considered measures:

- Channel Modifications. Diversion, channelization, or other hydraulic improvements are designed to increase flow capacity. In general, hydraulic improvements decrease the water surface elevation associated with a flood event, resulting in less overbank flow and a reduced potential for flooding in adjacent areas. Typical improvements include dredging, diversion, island clearing and removal, channel straightening, bridge modifications, and concrete channel lining. The costs and impacts associated with channel modifications are far beyond the scope of this study, and the environmental impacts that would result are far greater than the preferred alternative; therefore, this alternative was not considered for future study.

- Levee Setback/Realignment. Two options are available for possible realignment of Unit R471-460. At approximately river mile 448 the levee moves closer to the river, narrowing the floodway and creating a constriction, called by some a “pinch point”, during high flow events. This constriction could be reduced by realignment of the levee in this location, or the unit could be realigned further upstream to provide a wider floodway upstream of the pinch point for increased floodplain storage during high flow events.

Levee Setback

The narrow point in the levee alignment at approximately river mile 448 coincides with the river bend immediately upstream of Unit L-455. Setting back Unit R471-460 at this location would provide for a wider floodway during high flow events. This location also coincides with the locations of an active Union Pacific railroad bridge and the double-span bridge carrying US Highway 36. There is significant business development, including a large construction company, located between the two bridges immediately inside the protected area. Both bridges would likely require extensive modification and the existing businesses would have to be relocated to achieve significant levee setback.

The Corps estimates that a levee setback in this location could lower the general water surface profile in this vicinity up to half a foot; however, this is not enough to offset the overtopping concern for the remainder of the unit. Bridge modification, real estate acquisition, business demolition and relocation, and new levee construction would all contribute to a significantly higher cost for this alternative comparative to other proposed alternatives. Environmental benefits would be marginally enhanced by the creation of a short reach of new riverside floodplain habitat relative to the currently existing resources in the area. The economic benefits of the alternative would be negatively impacted by the loss of businesses in the area and the increased cost. It is clear from preliminary analysis that the marginal hydraulic and environmental benefits of a setback of the levee in the vicinity of river mile 448 would not offset the significant adverse economic, engineering, transportation, and social impacts that would be incurred to the project.

Levee Realignment in Upstream Portion of Unit R471-460

Upstream of the pinch point, consideration was given to methods to expand the floodway to provide storage during high flow events. In this area, the levee could be realigned toward the bluffs and existing levee alignment removed, providing increased floodplain volume and connectivity to the river. Alternatively the old levee alignment could remain and allowed to overtop and fail during high flows, providing some increment of additional storage during large floods. In order to achieve certified flood damage reduction for the communities and facilities in the study area, the new section of levee could be constructed north of Rosecrans Airport starting near river mile 452 to connect the existing levee with the bluff to the west. Requirements and anticipated impacts of this new levee are as follows:

- The existing levee cannot be removed without specific authorization from Congress. Removal of the remaining existing levee section would likely be politically, and socially unacceptable. The remaining existing levee section would likely still be maintained in operation by the local entities and if maintained in accordance with the program, would be eligible for flood disaster relief under the provision of Public Law 84-99. Future claims for Federal assistance for flood fighting and damage restoration would likely increase. With the existing levee section still in place, the incremental floodplain benefits associated with a realignment of the Federal project in the north would be marginal.

- Formulating an alternative that allows for the overtopping and failure of an existing levee does not meet the stated planning objectives of this study.

- Nearly three miles of new levee would need to be constructed, requiring significant real estate acquisition, additional material borrow sites, new drainage structures, and possible a road closure structure at the tie-in to the bluff. This feature would involve a significant cost increase.

- There is no guarantee that real estate agreements would be easily reached with existing land owners and condemnation may be necessary. Such negotiations, and additional construction time, would likely cause a protracted time delay that would prolong the exposure of residents to impacts and risk from the currently decertified levee.

- Approximately six miles of the existing levee downstream of river mile 452 would still be subject to overtopping that would need to be addressed to restore FEMA certification.

- The introduction of a new levee section into an existing levee system will increase the annual operation and maintenance costs.

- The new alignment would permanently remove some agricultural ground from production due to construction and would allow significant additional acreage of productive agricultural property to remain subject to impact from lesser floods. Some existing benefits of the existing project would be lost by removing this property from the certified area.

- The new alignment would cross the flight path in close proximity to the airport creating a right-of-way encroachment and safety issue that likely would not be acceptable to the Air Guard or the Federal Aviation Administration.

- No additional environmental benefits would be realized if the existing levee would stay in place and the existing agricultural land would remain in production. To realize any environmental benefits from realignment, the existing levee would have to be removed entirely and the land reverting to a natural riparian state, which may require the government to buy-out the existing agricultural property at considerable additional expense to the project.

- Significant political and public protest likely would be encountered by any proposal to remove property from the protected area or physically remove any existing section of levee.

- Implementation of changes to existing levee alignment would require additional Congressional authorization

A point-by-point consideration of the cost impacts to construct a new levee section, including all aspects discussed herein, indicated that realignment options would likely be greater than the cost of other alternatives proposed in the same area. Due to anticipated higher costs, a potential decrease in existing project benefits, and serious concerns over the social impacts of the proposal to the area communities, the levee realignment alternative was not carried forward for additional analysis.

2.2 Alternatives for further consideration in the EA

2.2.1 Alternative 1 (**Preferred Alternative** - 100-year level plus 3.0 feet)

Existing levees can be modified to provide a higher level of flood damage reduction than that which currently exists. In this instance, modification is accomplished by raising the existing levee using earth fill. A substantial portion of Levee Unit R471-460 would be raised to a level sufficient to pass the one percent (100-year) flood with a 90 percent level of reliability, allowing for re-certification of the levee by FEMA. The anticipated right bank raise varies along the levee's length from zero to 3.37 feet. Increases in levee height would result in corresponding increases in levee toe width and seepage/stability berm width. Additionally, a raise to the right bank levee would require minor raises (less than one foot) at specific locations along the left bank levee to accommodate the increased rise in water surface elevation resulting from the initial work. The engineering drawings in Appendix B of the feasibility report and plates at the end of the feasibility report illustrate levee alignments, cross-sections, and area foot-prints.

Borrow areas currently identified for the proposed levee raise include riverward areas in both Kansas and Missouri. For Kansas, the borrow areas consist of approximately 1,139 acres located from river mile 454.9 to 451.9 and from river mile 446.7 to 443.4. For Missouri, the borrow area consists of approximately 30.4 acres from river Mile 442.6 to 442.9. The feasibility report color plates detail these areas.

<u>The Preferred Mitigation Plan</u> A variety of avoidance, minimization, and offset measures will be implemented to reduce and off-set impacts to area habitat that results from construction of the proposed project. These measures include:

- best management practices (BMP) with construction equipment to avoid engine fluids from entering the area soils and waterways (ensuring grease and oil are cleaned off equipment before entering the construction area, checking drain pan bolts to ensure tight fits, ensuring other fluid containers are secure, etc.) ;
- BMP to prevent the transport of invasive species to and from the construction sites equipment shall be sprayed of with high powered sprayers with hot water before entering and when leaving the work sites);
- BMP to prevent the transport of invasive species to and from the construction sites from footwear, other clothing, and sampling equipment used during monitoring shall be enforced,
- BMP to minimize adverse water quality effects, such as erosion, through revegetation with native grass species to the extent practicable and mulching as soon as practicable following construction. However, the Kansas City District requirements for seeding and mulching of levee embankments dictate the use of grass species (such as fescue, brome, and rye) that sprout quickly to limit erosion, that can be readily mowed in order to facilitate levee inspection to ensure levee stability, and that help prevent the burrowing of animals that could disrupt levee integrity;
- planting a total of 7.0 acres of trees and 12.7 acres of shrubland vegetation immediately following construction activities to help offset the impact from the removal of floodplain habitat, increase water filtration, and minimize the long-term transport of sediment from the site (list of species contained within the Mitigation Plan, Appendix J);

- avoiding “high value” species habitat by first using bare and/or cropland areas for borrow material rather than forested or wetland areas;
- varying bottom depths of excavated borrow sites; creating islands within the borrow sites to maximize diversity of habitat;
- spacing borrow areas apart from one another by approximately 500 feet to provide areas of no disturbance and border habitat;
- avoiding any larger old growth trees (24-inches dbh, 50 feet or taller, 100 feet or closer to the waters edge) to reduce impacts to area wildlife; and,
- restoring a total of 4.9 acres of wetlands through the scraping and reshaping of wetlands equal to that which was lost (outside of the Elwood Bottoms area but within the other project area borrow area);
- monitoring and adaptive management as required.

With the implementation of the above measures, impacts to species habitat will be sufficiently offset and the net adverse effects will be insignificant; thus, no additional mitigation is proposed. The following alternative mitigation plans were considered by the project team, discussed with the various Resource Agencies, and not selected for the stated reasons.

<u>Off-Site Mitigation Plan</u> The Off-Site Mitigation Plan included a proposal to purchase off-site lands for the creation of new wetlands and the establishment of terrestrial vegetation. This plan would require planting 7.0 acres of trees and 12.7 acres of shrubs, creating 4.9 acres of wetlands following construction activities, monitoring, and adaptive management as required to ensure performance standards are met. This plan was not selected based on the cost needed to purchase additional real estate, the cost associated with the excavation of the wetland areas, the cost to seed and plant the wetland areas with appropriate vegetation, and the cost of increased monitoring and maintenance to ensure success of the wetlands.

<u>On-site Mitigation Plan with Upland Wetlands</u> A second mitigation plan included the planting of 7.0 acres of trees and 12.7 acres of shrubs with like species at the area of impact, and included the use of larger sized individuals. This alternative also sought to create 7.4 acres of wetlands in areas of bare upland habitat to provide diversity. Using upland areas for wetland mitigation usually requires a higher mitigation ratio (1:1.5) based on the reduced likelihood that the area will develop and provide the intended functions and values. Additionally, this alternative would require the use of an artificial hydrology source to ensure adequate wetland growth (e.g., pumps and culverts). This alternative was not selected because the cost of each individual tree was substantially higher than the cost of the individual trees in the preferred mitigation plan, the trees would not have provided diversity nor mast to the benefit of resident wildlife, and the placement of trees did not seek to diversify overall area habitat by planting in bare areas or in areas containing invasive species, such as reed canary grass. The use of culverts and pumps needed to provide the necessary hydrology to the wetlands was deemed un-natural and would have resulted in substantial costs to construct, operate, and maintain. The newly constructed wetlands would have required planting with appropriate vegetation as no seed bank would have been available, the upland mitigation required a higher mitigation ratio, and the upland sites would require additional monitoring to ensure success. This alternative resulted in substantially higher costs with a decreased chance of success.

No-Action Mitigation Plan This plan would not require any mitigation to off-set impacts. No trees, shrubs, or wetlands would have been replanted nor enhanced. This plan would have ignored the intent of the Environmental Operating Principles, the December 24, 2002, Regulatory Guidance Letter on Compensatory Mitigation, the recommendations of the US Fish and Wildlife Service, the recommendations of Kansas and Missouri state resource agencies, and professional judgment. Additionally, this plan likely would have required formal consultation under the Endangered Species Act, which could have resulted in higher overall mitigation ratios and costs. Thus, this plan was not selected.

Based on the types of habitats impacted, the belief that the off-set habitat would regenerate on its own with existing seed banks, the reduced costs in combining wetland off-set with borrow construction, the ability to replace impacted trees with higher value species at a lower individual cost, the physical placement of trees to diversify area habitat, and through coordination with the resource agencies, and professional judgment, the preferred mitigation plan is the least costly alternative and was therefore selected. The preferred mitigation plan consists of planting 7.0 acres of trees and 12.7 acres of shrubs, restoring 4.9 acres of wetlands concurrent with borrow excavation, monitoring, and adaptively managing as required to ensure performance standards are met. The Mitigation Plan is described in more detail in Appendix J to this Environmental Assessment.

Under the Corps' Missouri River Fish & Wildlife Mitigation Program land is purchased from willing sellers throughout the Missouri River corridor to implement habitat restoration efforts. Land has recently been purchased in the St. Joseph Study Area for inclusion in this program and additional land purchases are being negotiated. The planning and design of projects under this program are separate from the efforts and recommendations of this feasibility study. However, any proposed project under this program authority will complement the proposed mitigation recommendations in this report and will be coordinated during project implementation.

The Corps of Engineers Missouri River Enhancement Program (Section 514) is designing a project at Lake Contrary for restoration of the lake and its surrounding wetland and riparian habitat. This project is separate from the efforts and recommendations of this feasibility study; however, any proposed project under this program authority is expected to complement these recommendations and will be coordinated during project implementation.

2.2.2 Alternative 2 (500-year level plus 1.5 feet)

Comparative economic and cost factors will be applied to the one-percent flood level analysis to estimate the benefits and costs of raising the level of flood damage reduction. Points of interest will include the level of the 1993 Missouri River flood event and the 0.2 percent (500-year) flood event. These additional data points will be used to develop the cost-benefit curve and show how the preferred alternative compares to the National Economic Development (NED) plan. In the interest of time and sponsor funding, detailed engineering analysis of these additional points will be kept to a minimum.

2.2.3 Alternative 3 (500-year level plus 3.0 feet)

Comparative economic and cost factors will again be applied to the one-percent flood level analysis to estimate the benefits and costs of raising the level of flood damage reduction to this increased level. Points of interest will include the level of the 1993 Missouri River flood event and the 0.2 percent (500-year) flood event. These additional data points also will be used to develop the cost-benefit curve and show how the preferred alternative compares to the NED plan. In the interest of time and sponsor funding, detailed engineering analysis of these additional points will be kept to a minimum.

2.2.4 Alternative 4 (100-year level plus 1.5 feet)

The existing right-bank levee would be modified to provide a higher level of flood damage reduction. Modification is done by raising the existing levee using earth fill. The right levee unit would be raised to a level sufficient to pass the one percent (100-year) flood with a 75 percent level of reliability. This raise would not allow for re-certification of the right bank levee by the Federal Emergency Management Agency (FEMA). The anticipated right bank raise would vary along its length from zero to 1.2 feet and would not require a raise to the left-bank levee. Increases in levee height would result in corresponding increases in levee toe width and seepage/stability berm width and were determined to be approximately 16 percent less than that of the preferred alternative.

Borrow areas identified for the above alternatives are the same areas identified in Alternative 1. Also, the same avoidance, minimization, and offset measures as identified in Alternative 1 would be implemented for each build alternative to reduce impacts to habitat that would result from construction.

As each unit is raised, drainage structures would be affected. While some may require only a top platform raise at a lower levee raise, they may require a complete replacement with a higher levee raise due to additional hydraulic and soil pressures.

Underseepage Berms

An underseepage berm consists of a continuous strip of soil placed on the ground adjacent to the landside of the levee. Its purpose is to counteract the hydraulic pressures that will force water to seep underneath the levee during a high flow event and surface on the landside. The height of the raise to Unit R471-460 will cause these hydraulic pressures to increase and thus requires extension of the existing berms within area that will be subjected to a height increase.

The minimal height raise proposed for L-455 in Alternative 1 (100+3) will not significantly alter the hydraulic pressures encountered during a high flow event and does not require an extension of the existing berm. Under seepage problems were not observed during the 1993 flood, so the existing berms are considered to adequate. However, despite their observed successful performance during a significant flood event, the widths of the berms are not in accordance with current berm construction criteria now in use by the Corps. Therefore, it is proposed that in the area subject to raise in Unit L-455 for Alternative 1, the underseepage berms will be extended as needed to comply with current construction criteria. Berms in other areas of the unit, where the levee is not being disturbed, will remain as is based on their past performance. For the 500-year event raise alternatives, significant raises are proposed and underseepage berm extensions would be required relative to the increase in height.

R471-460 Relief Wells

The intended purpose of the wells is to relieve excessive uplift pressure during high river levels at the toe of the levee where the impervious blanket is thin and variable. The twenty original pressure relief wells located between levee stations 292+00 and 327+00 are 8-inch diameter assembled wood stave screens and risers wrapped with stainless steel wire. Current day pressure relief well construction materials no longer include wood assemblies and have been replaced with the more reliable and durable steel riser and screen assemblies. Wood stave well assemblies cannot withstand aggressive pressure relief well testing, development, and treatments. The pressure relief wells were installed in 1967, and all indications are that individual well efficiencies have decreased requiring development and treatment of the wood stave well assemblies. Throughout the pressure relief well field there will be a 2.5 feet minimum increase in differential hydrostatic head across the levee attributed to the top of levee raise. This will provide additional stress to the pressure relief well field with well assemblies of uncertain structural integrity.

L-455 Relief Wells

The existing relief well field is located upstream of the area of the proposed Alternative 1 (100+3) raise and will not be affected by this alternative. Due to the limited raise necessary for the 100+3 raise alternative, installation of new relief wells in the project area is not necessary. Implementation of Alternative 2 (500+1.5) or Alternative 3 (500+3) will affect a greater length of levee and cause higher underseepage pressures.

2.2.5 No Action.

Levee units R471-460 and L-455 would remain in their current condition. This measure would not reduce existing flood damage potential. Additionally, this measure does not provide a long-term solution for flood damage reduction, nor assurance that the levee will be re-certified by FEMA. If the levee remains de-certified, the economic impact of a flood will be of considerably expense to the local communities in terms of increased flood insurance premiums, flood damage, flood fighting, and flood related injuries.

Additionally, if the project is not authorized to restore certification to the right bank, FEMA will eventually enact a major zoning change that will greatly increase flood insurance costs and requirements and greatly degrade the economic health of the area. Currently, mission essential upgrades to the Missouri Air National Guard Base at the airport are being jeopardized by the status of the levee. Some increases in investment are likely to take place including the expansion of the Air National Guard Base, but at much greater cost to the users. If the project is not implemented by the federal government, then the local sponsors will be faced with the significant financial burden of trying to implement the project themselves; or they will have to rely on flood-fighting to protect the investments in the area from future floods.

3. Affected Environment

3.1 Physical-Chemical Environment

3.1.1 Geology, Minerals and Soils

The project area is predominantly an alluvial flood plain underlain by bedrock of the Pennsylvanian System, Kansas City Group. Pennsylvania strata generally consist of inter-bedded sandstone, shale, limestone, clay, and coal. Limestone is the most abundant resource present and it is mined for materials primarily used for road and highway construction.

In addition to limestone, sand and gravel are locally important mineral resources. The historic production of these resources is from flood plain and in-channel deposits of major streams. Crushed limestone has replaced stream gravels as the predominant coarse aggregate in cement. Upland terrace and glacial deposits are important sources of sand and gravel in the southeastern and northwestern portions of Missouri.

Soils within the project area have primarily developed as a result of the wind-borne deposition of fine-grained material (loess) and the deposition of material on land by streams (alluvium). Loess deposits are visible on the exposed valley walls adjacent to the Missouri River. Missouri River floodplain soils belong to the Haynie-Urban Land-Leta association. Soils of the upland, loess hills are of the Knox-Judson-McPaul and the Marshall-Ladoga-Gara associations. The soil associations generally consist of deep, nearly level, well drained to somewhat poorly drained soils comprised of river-deposited sand, silt, and clay.

The flood plain or bottoms area is three to five miles wide in the St. Joseph study area and is characterized by low-lying, nearly level terrain. The uplands are composed of steep to moderately sloping hills composed of loess or loamy soils. Buchanan County and Doniphan County consist of several soils types, which are either hydric, prime farmland, or both.

3.1.2 Water Quality

In accordance with the Clean Water Act, individual states are responsible for adopting water quality standards for their jurisdictions. Water quality standards are used to establish water quality criteria to protect and maintain the identified designated uses of water resources. Section 305(b) of the Clean Water Act requires states to produce "Water Quality Inventories" that assess progress in achieving water quality objectives.

Water quality impacts to the Missouri River originate from point and nonpoint sources of pollution. Point sources enter the river from discrete water conveyance systems (e.g., pipes, culverts, trenches). Point sources include discharges form Publicly Owned Treatment Works such as sewage treatment plants, and industrial facilities. Nonpoint sources enter the river in overland runoff or subsurface percolation, and can originate from land use activities associated with agriculture, mining, urban areas, and other sources.

Section 303(d) of the CWA requires that each state identify waters that are not meeting water quality standards and for which adequate water pollution controls have not been required.

The Missouri River segment within the vicinity of the project area is currently 303(d) listed as "impaired" due to excess levels of chlordane and polychlorinated biphenyls (PCBs).

Water quality of the Missouri River tributaries in St. Joseph has been severely impacted by urban development. Significant segments of five out of the seven tributaries in the study area have been placed underground in conduits and are used as a combined sanitary/storm water sewer system. The remaining two tributaries, Roy's Branch and Contrary Creek, drain relatively undeveloped areas. The Missouri River near St. Joseph is classified as "Class P - permanent flow general warm water fishery resource." A general warm water resource provides protection to both game and non-game fish occurring in the area. The river provides a water source for irrigation, livestock/wildlife watering, aquatic life protection, boating, drinking water supply, and industrial withdrawal.

3.1.3 Air Quality

In accordance with the Clean Air Act, the US Environmental Protection Agency (EPA) set National Ambient Air Quality Standards for pollutants considered harmful to the environment and public health. The six principal pollutants, also known as "criteria" pollutants are: ozone, lead, inhalable particles, carbon monoxide, nitrogen dioxide, and sulfur dioxide.

Both the states of Missouri and Kansas air quality generally meet the EPA's accepted levels of criteria pollutants. Fluctuations in air quality constituents are not uncommon; however, St. Joseph consistently experiences generally good air quality throughout the metropolitan area and is in attainment with the air quality standards.

3.1.4 Noise

Sound is the sensation produced in the hearing organs when waves are created in the surrounding air by the vibration of some material body. Noise is defined as unwanted sound or sound in the wrong place at the wrong time. A sound-level meter is the basic instrument of noise measurement and the outputs are provided in the form of decibels. Table 3-1 provides noise levels common to our everyday activities.

Existing sound levels throughout the St. Joseph metropolitan area are highly variable depending on location. Sound levels range from relatively loud noises associated with urban and industrial activities to very quiet rural environments. Noise sources include agricultural and industrial activities, traffic on roads, aircraft over-flights, and natural sounds such as wind through trees and water falling over rocks. It is highly unlikely that noise standards in the St. Joseph metropolitan area would be exceeded under existing conditions. In portions of the metropolitan area, especially near industrial areas, sound levels could occasionally exceed noise standards under certain conditions.

Table 3-1. Common Noise Levels

Common Noise Levels	**Noise Levels in Decibels (dB)**
Rock Band at 16 Feet	110
Jet Flyover at 985 Feet	105
Gas Lawn Mower at 3 Feet	95
Diesel Truck at 50 Feet	85
Normal Speech at 3 Feet	65
Average Residence	35
Leaves Rustling	15
Threshold of Hearing	0

Ambient noise levels are generally dependent upon the level of urban development and associated activities conducted within a given area. Land use within the project area is dominated by agricultural land, residential, commercial, and industrial uses. Sensitive noise receptors include residences, schools, hospitals, wildlife, and others.

3.1.5 Visual Quality

The project area contains features attributable to both low to moderate and high aesthetic value. The majority of the landscape is dominated by agriculture adjacent to the existing levee system. Areas containing established communities are located near industrial development. The project area contains floodplain forest, wetlands, open vistas, and bluffs, which provides natural diversity to the river corridor landscape. Cropland and grassland is established in portions of the rivers' floodplain.

Existing levees and flood damage reduction mechanisms that have been installed to prevent bank or levee erosion interrupt the natural character of the river system. However, flood damage reduction features have been in-place for many years and in many instances, blend into the river-view and adjacent development. Armoring with rock rip-rap is an example of introducing materials that do not naturally occur within the river corridor and may be considered aesthetically displeasing to that portion of the population that utilize the rivers for recreation. The contrast of rip-rap and other flood damage reduction features within the river corridor has become less evident over time with the process of weathering and the establishment of vegetation.

3.1.6 Hazardous Waste Management

The Resource Conservation and Recovery Act of 1976, as amended by the Hazardous and Solid Waste Amendments of 1984, sets the requirements for reduction, control, management, and disposal of solid and hazardous waste. Solid waste management and disposal, including mixed municipal solid waste landfills, industrial, and special waste landfills, ash landfills, and construction and demolition material landfills, is regulated by the states of Missouri and Kansas. Management of industrial wastewater, with its associated solid waste, may be managed through National Pollutant Discharge Elimination System permits or state approved permits.

Past contamination from releases of hazardous materials and waste is being addressed through the Comprehensive Environmental Response, Comprehensive Environmental Response, Compensation, and Liability Act, commonly known as “Superfund” and enacted by Congress in 1980. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. Revenues collected went to a trust fund for cleaning up abandoned or uncontrolled hazardous waste sites. CERCLA established prohibitions and requirements concerning closed and abandoned hazardous waste sites; provided for liability of persons responsible for releases of hazardous wastes at these sites, and established a trust fund to provide for cleanup when no responsible party could be identified.

Before the feasibility study phase of this project, a complete reconnaissance report that included Hazardous, Toxic, and Radiological Waste (HTRW) evaluation was preformed in May 1996 by HDR Engineering, Inc. This was preformed to re-examine the levee areas and further investigate several areas outlined in the Feasibility Study Scope of Work. A site visit was conducted on August 12, 1999 during which a local member of the levee board was questioned about the sites in the feasibility study scope of work. On levee R-460-471, the only potential HTRW concern is at the Herzog Hot Mix Plant north of Highway 36. Stockpiles of what appears to be recycled asphalt are in contact with the landside toe of the levee. On levee L-455, three potential HTRW concerns were identified. One is the proximity of underground gas pipelines near station 55+00 to station 85+00. The second concern is industrial sewage pipes crossing the west side of the levee along Brown’s Branch Creek. The third concern is sediment ponds near station 110+00. Although the ponds are within 500 feet of the levee centerline, they are at least 100 feet from the toe of the levee. This distance makes it unlikely that they would be disturbed for a levee raise of five feet or less, but the existence of the ponds will be considered during design.

All sites mentioned in the feasibility study scope of work were eliminated as items of concern. No additional information concerning HTRW was obtained during the interview with the levee board member, a site visit, and a thorough database search. A complete summary of each potential site and how they were addressed is included in the HTRW Appendix of the feasibility report.

3.2 Biological Environment

3.2.1 Vegetation

Three vegetation types generally dominate the project area: floodplain forest (*Populus-Salix*), oak-hickory-maple forest (*Quercus-Carya-Acer*), and openings of bluestem prairie

(*Andropogon-Panicum-Sorghastrum*). Although the project area's floodplains have been largely cleared for development, there are bands of riparian forest habitat located riverward of the levee units. Predominant tree species found in these riparian bands include eastern cottonwood, willows, box elder, green ash, silver maple, and American sycamore. The understory includes reproduction of these species, plus some redbud, dogwood, black cherry, and various shrubs. The ground layer in the riparian bands varies from sparse to dense vegetation and contains primarily poison ivy, Virginia creeper, honeysuckle, greenbrier, and gooseberry, and various other species.

Remnants of the oak-hickory-maple upland forest vegetation type are present on the steep hillsides adjacent to the Missouri River floodplains. In addition to sugar maple, white and black oak, and hickories for which this upland vegetation type is named; other hardwood species present include American sycamore, beech, black walnut, bur and chinkapin oak, hackberry, American and slippery elm, hawthorn, honeylocust, redbud, and dogwood. The understory consists of regeneration of the above species and the ground layer includes: violets, poison ivy, Virginia creeper, greenbrier, and honeysuckle and other species.

Most of the vegetation in the study area has been greatly impacted by urban development. In general, the upper reaches of the tributaries draining the area are located in the more established residential neighborhoods and the lower reaches are located in the intensively developed business district and croplands. The banks along Roy’s Branch, Contrary Creek, and limited areas along the upper reaches of the other tributaries contain tracts of riparian timber. A mix of sycamore, cottonwood, maple, oak, and hickory dominates these areas. Other areas along the upper reaches of the tributaries are in residential development, parkland, or various stages of successional recovery.

3.2.2 Wildlife

Mammals associated with the remaining wooded riparian habitat include the white-tailed deer, eastern cottontails, and red and gray squirrels. Aquatic and terrestrial furbearers are important parts of the ecosystem, and those present in the area include the beaver, mink, and muskrat (dependent on the aquatic habitat) and opossum, coyote, raccoon, and striped skunk (dependent on terrestrial habitat). However, small mammals, such as mice, voles, rats, and bats account for the majority of the species present. The white-tailed deer is the only naturally occurring large mammal still common in developed urban areas. Eastern wild turkeys are present in the open, less developed floodplain areas.

The avifauna of the study area includes permanent residents, summer residents, transients, and winter residents. The project area provides year-round habitat for approximately 31 bird species, with another 67 species using the project area for nesting and another 14 species only as winter residents. Over 110 species use the corridor over the study area for fall migration. Summer resident species associated with aquatic habitats include waterfowl, wading birds, and selected passerines. Summer waterfowl are dominated by wood ducks which nest in wooded bottomlands and rear their young in nearby aquatic habitats. Nesting by other waterfowl, primarily mallards, is minor. Wading birds, such as the great blue heron and green heron, utilize shallow areas as foraging habitat.

Waterfowl and shorebirds dominate transient species associated with aquatic habitats. The most numerous and impressive migration is that of the snow goose, particularly in the spring. Other migrating species include the Canada goose, mallard, and pintail.

Common amphibians found in the study area include the American toad, Rocky Mountain toad, Blanchard's cricket frog, Cope's gray treefrog, Great Plains toad, Woodhouse's toad, northern cricket frog, eastern gray treefrog, boreal chorus frog, western chorus frog, smallmouth salamander, plains spadefoot toad, plains leopard frog, bullfrog, and Great Plains narrowmouth toad. Common reptiles that may be found in the study area include the snapping turtle, painted turtle, false map turtle, ornate box turtle, slider, smooth and spiny soft-shelled turtles, five-lined skink, Great Plains skink, northern prairie skink, six-lined racerunner, western worm snake, ringneck snake, eastern hognose snake, racer, rat snake, prairie kingsnake, red milksnake, gophersnake, northern water snake, brown snake, western ribbon snake, common garter snake, copperhead, and timber rattlesnake. The northern leopard frog and western fox snake also may be present in the study area (Collins 1993).

3.2.3 Aquatic Ecosystem (including fisheries and wetlands)

Missouri River fish populations have been greatly affected by channel alterations in the project area. Most indigenous fish species still remain, but have suffered serious population declines. The rivers' fishery is characterized by species typical of large, turbid rivers. These species include the dominant game fish species such as the smallmouth, buffalo, common carp, river carpsucker, shortnose gar, and channel catfish. Gizzard shad is the dominant forage species. Other game species present are the flathead and blue catfish, white crappie, freshwater drum, longnose gar, green sunfish, and bluegill. Other forage and nongame species present include various minnows and shiners.

Numerous wetlands exist within the project area as small pockets, old meander scars, and within the riparian strips. An old oxbow of the Missouri River (French Bottoms) was cut off when the river charged its course during the flood of 1952. Remnants of the oxbow remain as Browning Lake, an area protected by Levee Unit R471-460. Lake Contrary is in the area protected by levee L-455. It is currently being studied by the Corps for a restoration project. With the assistance of the Corps of Engineers Regulatory Branch, many wetlands have been delineated along the levees in the Buchanan County, Missouri and Doniphan County, Kansas project area.

National Wetland Inventory (NWI) database maps for the project area indicate that there were many wetlands in the project area. Classification of the wetlands has been divided into those occurring on the Kansas side of the Missouri River and those on the Missouri side of the river. These wetlands are permanently flooded, seasonally flooded, temporarily flooded, or semi-permanently flooded and include forested, broad leaved deciduous, and scrub shrub vegetation. In addition, there are areas classified as palustrine unconsolidated bottom, intermittently exposed (PUBG) which are typically mud or sand flats. Some of the wetlands are natural and some are man-made. Table 3-2 illustrates types and acreages of wetlands occurring in Kansas, and Table 3-3 illustrates types and acreages of wetland in Missouri.

Historically, wet mesic bottomland forest was the most extensive bottomland forest natural community in Missouri (Nelson 1987). This community has a diversity of tree species such as pin oak, cottonwood, river birch, green ash, hackberry, cherry, sweetgum, hawthorn, dogwood, hickories, wildplum, persimmon, maples, elm, and sassafras. A well-developed understory is often present, containing poison ivy, elm, nettle, and honeysuckle. These communities provide habitat for a wide variety of resident and migratory wildlife. Forested wetlands have been found to support significantly higher abundance and diversity of bird species compared to upland forests (Brinson 1981).

The majority of the Kansas state wetlands are forested (71%) followed by emergent (17%), scrub-shrub (11%), and those classified as other wetlands (1%) (Table 3-2).

Table 3-2. Kansas Study Area Wetlands

Wetland Type	**Classification**	**Acreage**
Forested	PFO	402.56
Emergent	PEM	95.23
Scrub-shrub	PSS	64.16
Other Wetlands	PUS	5.54

The majority of the Missouri state wetlands are forested (75%) followed by emergent (19%), and scrub-shrub (6%) (Table 3-3). The Missouri State side of the river contained no wetlands identified as “other” within the project area.

Table 3-3. Missouri Study Area Wetlands

Wetland Type	**Classification**	**Acreage**
Forested	PFO	143.03
Emergent	PEM	36.72
Scrub-shrub	PSS	1.74

In addition to the NWI maps, Corps staff conducted a detailed wetland determination of the proposed project area following the process outlined by the “Kansas Wetland Conventions, A Technical Document for Wetland Determinations/Delineations in Kansas.” Please see Appendix I for a detailed description on the methods used to make this determination and resulting data.

The regulatory office completed the review of the wetland delineation, and concurred with the methods employed to complete the determination and field verification of the wetland areas on 6 May 2005. Subsequently, the Regulatory Office provided a Jurisdictional Determination (file number 200501489) for the overall wetland delineation and mapping (Appendix I). Based on these findings, the Corps has used this more detailed information as a basis in determining impacts resulting from the proposed project.

3.2.4 Threatened and Endangered Species

The U.S. Fish and Wildlife Service Kansas office was consulted about threatened and endangered species that could occur in the project area. They provided a list of the following species as possibly occurring in the vicinity of the Missouri River in Doniphan County.

- Piping plover (*Charadrius melodus*). This small threatened shorebird may be a seasonal spring and fall migrant through portions of Kansas, particularly along the Missouri River. Plovers are associated with unvegetated shorelines, sandbars, and mudflats and commonly feed upon aquatic invertebrates.

- Bald eagle (*Haliaeetus leucocephalus*). This large threatened raptor may occur along any river or at any reservoir in Kansas during winter. Eagles are commonly found in areas where large trees provide perch sites in proximity to open water where they feed on fish and waterfowl.

- Least tern (*Sterna antillarum*). This endangered shorebird can be found in similar habitat as the piping plover, which is unvegetated wetland habitat, feeding primarily on small fish. It occurs as a spring and fall migrant through Kansas, and also nests in central and southwest Kansas.

- Pallid sturgeon (*Scaphirhynchus albus*). The endangered sturgeon is a moderately large, bottom-dwelling fish historically occurring in portions of the Missouri River. It requires sandbars, chutes, and backwater areas for reproduction.

- Indiana bat (*Myotis sodalist*). From late fall through winter, the endangered Indiana bat in Missouri hibernates in caves in the Ozarks and Ozark Border Natural Divisions. During the spring and summer, Indiana bats utilize living, injured (e.g., split trunks and broken limbs from lightening strikes or wind), dead or dying trees for roosting throughout the state. Indiana bat roost trees tend to be greater than nine inches diameter at breast height (dbh) (optimally greater than 20 inches dbh) with loose of exfoliating bark. Most important are structural characteristics that provide adequate space for bats to roost. Preferred roost sites are located in forest openings, at the forest edge, or where the overstory canopy allows some sunlight exposure to the roost tree, which is usually within one kilometer (0.61 mile) of water. Indiana bat forage for flying insects (particularly moths) in and around the tree canopy of floodplain, riparian, and upland forests.

The U.S. Fish and Wildlife Service office in Missouri also was consulted concerning threatened and endangered species that could occur in the project area on the Missouri side of the project. They noted that the pallid sturgeon (*Scaphirhynchus albus*), a federally listed endangered species, may occur throughout the Missouri River reach and recent records are on file for this species occurring in the project area. Sturgeons have been captured in tributary mouths, over sandbars, along main channel borders, and in deep holes elsewhere in the Missouri River. Small sturgeons have been captured in off-channel backwaters.

Wintering populations of the threatened bald eagle (*Haliaeetus leucocephalus*) are common along the Missouri River and, in recent years, eagles have successfully nested or attempted nesting at several locations along the river. There are no known active bald eagle nests in the project area. Wintering eagles usually occupy river habitats between November 15 and March 1, depending on the availability of open water in the river and floodplain lakes and wetlands. Larger diameter (greater than 12-inch diameter at breast height) cottonwoods, sycamores, and other large riparian trees are preferred daytime perches and nighttime roosts.

There were no records of the endangered Indiana bat (*Myotis sodalist*) from Buchanan County; however, summering bats have been found throughout much of northern Missouri and may occur in suitable habitat along the river during the summer.

Important fish and wildlife habitats within the project area are associated with the river and are generally riverward of the main levees. Habitats include the river, side channels and chutes, cut-off islands and sloughs, tributary confluences, floodplain scour lakes and blow holes created by past floods, floodplain forests, emergent wetlands, and former borrow areas. The highest value habitats on the Missouri side of the river are located riverward of the levee or around Lake Contrary between river miles 437 and 444.

The Missouri Department of Conservation was consulted during preparation of the reconnaissance report and informed the Corps that state listed sensitive species or communities are known to occur in the vicinity of the project site. The pied-billed grebe (Podilymbus podiceps) is considered rare in this area and the skeleton plant (Lygodesmia juncea) is on a watch list in the state of Missouri.

The Kansas Department of Wildlife and Parks provided the following list of state listed species in addition to the species provided by the Kansas U.S. Fish and Wildlife Service.

- American burying beetle (Nicophorus americanus). This beetle has been found in the Midwest in mixed agricultural lands, including pastures and mowed fields, and riparian forests. Humus and loose topsoil suitable for burying carrion is essential for this species.

- Chestnut lamprey (Ichthyomyzon castaneus). This species is known to occur in the Missouri River main stem and spawns over clean gravel in small tributary streams. This species is considered threatened in the State of Kansas and critical habitat has been designated.

- Eastern spotted skunk (Spilogale putorius interrupta). This species prefers brushy grasslands and woodland edges and may also inhabit abandoned or seldom used farm buildings. The eastern spotted skunk is considered threatened in Kansas.

- Silverband shiner (Notropis shumardi). This species may occur in the Missouri River main stem and prefers moderately deep areas of water flowing over sand or gravel substrate. Critical habitat has been designated for the silverband shiner.

- Snowy plover (Charadrius alexandrinus). The snowy plover may occur as an occasional seasonal transient or summer visitant at sparsely vegetated wetlands and impoundment shorelines. It is a state listed threatened species.

- Western earth snake (Virginia valeriae elegans). This species prefers rocky hillsides in or near moist woodlands where rocks, logs, or leaf litter provide cover. It is a state listed threatened species.

- White-faced ibis (Plegadis chihi). This species may occur as an occasional seasonal transient or summer visitant at wetlands and impoundments. It is a state listed threatened species.

3.3 Socio-Economic Environment

3.3.1 Demography

Buchanan County, Missouri

As of the census of 2000 there are 85,998 people, 33,557 households, and 21,912 families residing in the county. There are 36,574 housing units at an average density of 34/km² (89/mi²). The racial makeup of the county is 92.73% White, 4.36% Black or African American, 2.43% Hispanic or Latino, 0.42% Native American, 0.45% Asian, 0.02% Pacific Islander, 0.65% from other races, and 1.37% from two or more races.

Of the 33,557 households, 30.60% have children under the age of 18 living with them, 49.30% are married couples living together, 12.00% have a female householder with no husband present, and 34.70% are non-families. Twenty-eight point nine percent of all households are made up of individuals and 12.50% have someone living alone who is 65 years of age or older. The average household size is 2.42 and the average family size is 2.98.

In the county, the population is spread out with 24.30% under the age of 18, 11.00% from 18 to 24, 28.50% from 25 to 44, 21.20% from 45 to 64, and 15.00% who are 65 years of age or older. The median age is 36 years. For every 100 females there are 96.70 males. For every 100 females age 18 and over, there are 93.90 males.

The median income for a household in the county is $34,704, and the median income for a family is $42,408. Males have a median income of $31,697 versus $21,827 for females. The per capita income for the county is $17,882. Twelve point two percent of the population and 8.50% of families are below the poverty line. Out of the total population, 15.00% of those under the age of 18 and 9.60% of those 65 and older are living below the poverty line.

Andrew County, Missouri

As of the census of 2000, there are 16,492 people, 6,273 households, and 4,635 families residing in the county. There are 6,662 housing units at an average density of 6/km² (15/mi²). The racial makeup of the county is 98.38% White, 0.42% Black or African American, 0.84%

Hispanic or Latino, 0.34% Native American, 0.22% Asian, 0.01% Pacific Islander, 0.18% from other races, and 0.45% from two or more races.

Of the 6,273 households, 34.50% have children under the age of 18 living with them, 62.70% are married couples living together, 7.40% have a female householder with no husband present, and 26.10% are non-families. Twenty-two point three percent of all households are made up of individuals and 10.50% have someone living alone who is 65 years of age or older. The average household size is 2.59 and the average family size is 3.03.

In the county, the population is spread out with 26.40% under the age of 18, 7.90% from 18 to 24, 27.60% from 25 to 44, 23.70% from 45 to 64, and 14.40% who are 65 years of age or older. The median age is 38 years. For every 100 females there are 95.00 males. For every 100 females age 18 and over, there are 93.00 males.

The median income for a household in the county is $40,688, and the median income for a family is $46,067. Males have a median income of $32,955 versus $22,586 for females. The per capita income for the county is $19,375. Eight point two percent of the population and 6.40% of families are below the poverty line. Out of the total population, 10.50% of those under the age of 18 and 8.00% of those 65 and older are living below the poverty line.

Doniphan County, Kansas

As of the census of 2000, there are 8,249 people, 3,173 households, and 2,183 families residing in the county. There are 3,489 housing units at an average density of 3/km² (9/mi²). The racial makeup of the county is 94.85% White, 2.00% Black or African American, 1.16% Hispanic or Latino, 1.21% Native American, 0.25% Asian, 0.00% Pacific Islander, 0.40% from other races, and 1.29% from two or more races.

Of the 3,173 households, 32.60% have children under the age of 18 living with them, 56.40% are married couples living together, 8.70% have a female householder with no husband present, and 31.20% are non-families. Twenty-seven point six percent of all households are made up of individuals and 14.20% have someone living alone who is 65 years of age or older. The average household size is 2.48 and the average family size is 3.03.

In the county, the population is spread out with 25.30% under the age of 18, 11.80% from 18 to 24, 24.70% from 25 to 44, 22.00% from 45 to 64, and 16.20% who are 65 years of age or older. The median age is 37 years. For every 100 females there are 98.60 males. For every 100 females age 18 and over, there are 96.20 males.

The median income for a household in the county is $32,537, and the median income for a family is $39,357. Males have a median income of $28,096 versus $19,721 for females. The per capita income for the county is $14,849. Eleven point nine percent of the population and 9.00% of families are below the poverty line. Out of the total population, 13.30% of those under the age of 18 and 12.50% of those 65 and older are living below the poverty line.

3.3.2 Development and Economy

St. Joseph originally developed in the early nineteenth century as a fur-trading post on the Missouri River. It came to prominence in the 1840s and 1850s as a “jumping off” point where Oregon and California-bound travelers ended their journeys by water and began their trek by land to Oregon and California. The Pony Express and the railroads began to play dominant roles in St. Joseph during the Civil War. Subsequently, the livestock industry (specifically meat packinghouses), was critical to the area’s economy from approximately the mid-nineteenth to the mid-twentieth century.

The area’s long-standing agricultural concentration continues to be reflected in the contemporary St. Joseph area economy’s growing emphasis on life sciences. This network of industries includes health care, animal pharmaceuticals, agricultural chemicals, seed production, food processing, and animal research and development. The old stockyards area (protected by Unit L-455) is home to a number of large manufacturing concerns in the animal pharmaceuticals and agricultural chemicals industries as well as a major new pork processing plant.

The area across the Missouri River in and around Elwood, Kansas, (protected by Unit R471-460), also hosts a few similar businesses in the same industries. At present, life sciences account for an estimated 6,837 jobs in the metro area. Many of these jobs are connected with agriculture-related sectors of the life sciences. City leaders have formed a network of life science executives in a long-term effort to develop this emerging strength, and this local emphasis increasingly is tied in regionally to aggressive efforts in the Kansas City area to encourage life sciences growth.

According to the St. Joseph Area Chamber of Commerce, the largest individual employers in the St. Joseph metropolitan area include: Heartland Health (2,900 employees); St. Joseph School District (1,650 employees); Triumph Foods (a new pork processing facility with an estimated 1,000 employees); American Family Insurance (841 employees); Altec Industries (840 employees); city of St. Joseph (655 employees); and, Boehringer Ingelheim Vetmedica (animal pharmaceuticals with 607 employees). Other employers accounting for more than 500 employees in the Metropolitan Statistical Area include Systems and Services Technology (loan servicing); Western Reception Diagnostic and Correctional Center; Missouri Western State University; Wal-Mart; Sara Lee Foods; and, Johnson Controls battery division. The Missouri Air National Guard 139th Airlift Unit base north of Elwood, Kansas has a base population currently estimated at 360.

U. S. Census Bureau 2002 statistics on county business patterns indicate a total of 2,654 businesses in Buchanan County. Of this total, 463 retail sector businesses accounted for 17.4 percent of the total and 287 construction sector businesses accounted for 10.8 percent of the total. Other industries accounting for more than 5 percent of the total included other services except public administration, 12.8 percent; health care and social assistance, 9.8 percent; construction, 9.5 percent; finance and insurance, 7.7 percent; accommodation and food services, 7.4 percent; professional, scientific and technical services, 6.7 percent; wholesale trade, 5.2 percent. Doniphan County statistics indicated 162 businesses active in the 2002 survey. Of these, 25, or 15.4 percent, were retail, and 26, or 16 percent, were in the other services except public administration grouping. Other industries accounting for more than 5 percent of the total included transportation and warehousing (8.6 percent); health care and social assistance (8.6 percent); construction (8 percent); finance and insurance (8 percent); wholesale trade (7.4 percent); manufacturing (6.8 percent); and, accommodation and food services (5.6 percent).

Both Buchanan and Doniphan Counties are predominantly rural and are characterized by substantial agricultural land uses. Within the study area some 7,200 crop acres are protected by the R471-460 levee, and most of this land is in the northern half of the protected area. The L-455 levee protects about 5,100 crop acres in an area immediately southwest of St Joseph. According to the 2002 Census of Agriculture, each county had just over 200,000 acres in farm uses. While Buchanan County had 848 farms averaging 236 acres each; Doniphan County farms were much larger with 469 farms averaging 439 acres each.

Buchanan County accounted for nearly $28 million in production in 2002, while Doniphan County production was valued at approximately $32 million. In both counties, slightly over three-fourths of total production value was accounted for by crop sales, while the remaining amounts were accounted for by livestock sales. Soybeans and corn are the dominant crops in both counties, and this is particularly true in the Missouri River bottomlands protected by the L-455 and R471-460 levee units where virtually nothing else is grown. Soybeans in Buchanan County account for 29.4 percent of total land in farms; while in Doniphan County beans made up 45.2 percent of the total. Corn accounted for 47.7 percent of total land in farms in Doniphan County and 21.6 percent in Buchanan County.

Flood insurance has emerged as an increasingly serious economic concern in the Levee Unit R471-460 area. This levee unit failed in the 1993 Missouri River flood, resulting in devastating damage in and around the town of Elwood. Subsequently, this levee was judged unable to contain a 1 percent-chance flood event with at least 90 percent confidence, and its current height was found to be deficient in providing adequate margin above the 1 percent-chance event. Consequently, the R471-460 unit was decertified by FEMA in 1999. The area was designated by FEMA as an “AR” zone, which is a temporary category that assumes imminent improvement of the levee to certification standards and is designed to minimize economic impacts to the community during the implementation period of the repair or improvements.

Failure to take steps needed to recertify the levee would eventually result in forcing residents and business owners in the area to buy costly flood insurance. Meanwhile, any new development will face new legal requirements including elevation, imposing additional costs on developers and potentially discouraging new development as well as growth of existing businesses. The most serious impact probably would involve the Missouri Air National Guard base located immediately north of Elwood, Kansas. The base was heavily damaged in the 1993 flood, and the Air Guard currently plans to relocate to higher ground within the protected area.

The new site for the base would be about nine feet higher than the present site, which would not entirely remove the base from the floodplain but obviously would greatly reduce the damage potential in the event of another flood. The timeline is unclear because of Federal funding exigencies but should be gradually implemented within the next 15 years. However, if it becomes clear that the levee will not be recertified, the Air National Guard almost certainly would simply close the base and pull out of the area altogether at some point. The loss of a military base would be a major hardship for Elwood, a small town with few large employers. An economic impact would be felt in the St. Joseph-area economy as a whole.

The L-455 levee unit currently meets FEMA certification standards, but any future move to decertify the levee based on subsequent analyses would harm economic development in the city of St. Joseph and in the rural area southwest of St. Joseph. The entire central industrial district of the city, containing many large businesses, would be subjected to regulatory requirements that would discourage new businesses and growth by existing businesses and possibly result in the loss of one or more major area employers.

3.3.3 Land Use

The land use within the project area boundaries can be separated into approximately 12 categories. These range from fully natural settings to fully developed. The land cover types and acreages are provided in Table 3-4 below. The land cover type identified is not the region of influence should the levees fail, but rather the land use within the footprint of the proposed project.

Table 3-4. Land Cover Types in the St. Joseph Levee Project Area.

Land Cover Type	Total Acres
Side channels	0.13
Tributary rivers/streams	2.17
Developed	7.35
Naturally bare	2.77
Deciduous trees	388.32
Shrubland	153.08
Grassland	234.76
Cultivated	846.3
Cultivated with levee	25.72
Emergent wetland	131
Scrub shrub wetland	65
Forested wetland	545

3.3.4 Transportation

The study area for the evaluation of transportation and traffic is the existing road network in the St. Joseph Metropolitan Area in both Missouri and Kansas. The primary east-west transport route through the study area is U.S. Highway 36. U.S. Highway 59, a primary north-south route, borders the study area of unit L-455. Interstate highways adjacent to the study area include I-29, and I-229. Local arteries and roads connected to these major routes could be impacted by large volumes of traffic, and could be traveled upon by construction vehicles during project construction. The Union Pacific Railroad provides for transportation of freight in the area and is also considered in this analysis.

3.3.5 Utilities/Water Supply

The utilities in the project area consist of five known utility lines within the right bank unit. There are no known utility lines within the area of the left bank unit subject to a raise.

A small above ground power line runs on six poles adjacent to the landside levee toe from approximately levee station 280+00 to levee station 300+00. A high tension power transmission line crosses the levee at approximately levee station 301+20. A telephone cable, known as “UL-4”, as identified in the levee Operation & Maintenance manual crosses up and over the levee at station 418+15. A gas line, known as “UL-3”, as identified in the levee Operation & Maintenance manual crosses under the levee at station 417+65. A 16-inch diameter water line, known as “UL-2”, as identified in the levee Operation & Maintenance Manual crosses up and over the levee at station 300+00.

3.3.6 Flood Damage Reduction

Flood damage reduction along the Lower Missouri River is primarily accomplished by constructed levees, storage capacity of the Missouri River Mainstem Reservoir System, tributary flood damage reduction structures and impoundments, and the controlled release of water from Gavins Point Dam. Major Missouri River floods have occurred in 1844, 1881, 1903, 1908, 1943, 1947, 1951, 1952, 1993, and 1997.

The protective works that provide local flood damage reduction for the metropolitan areas of St. Joseph, Missouri and Elwood and Wathena, Kansas are described in section 1.1 *Project Location and History*, and section 1.2 *Levee Unit Descriptions*. Please refer to these sections for a detailed account of the areas’ flood damage reduction levees.

3.3.7 Recreation

Land within the floodplain of the proposed project is mostly privately owned. Recreation on the Missouri River within the project area is access limited, and primarily involves boating and fishing, with some hiking, canoeing, and wildlife/bird watching. Drought or low water levels can shorten the seasonal timeframe for boat-oriented recreation because some boat ramps are inaccessible during non-navigation periods.

St. Joseph’s park system encompasses more than 1,500 acres of city parks connected by a 26-mile parkway system. Public recreation facilities include golf courses, baseball fields, ice-skating rinks, swimming pools, and tennis courts. The parkway system, developed in 1918, was one of the first comprehensive parkway plans implemented in the United States. The completed greenbelt of hiking and biking trails connects the principal parks and recreational facilities throughout the city.

3.3.8 Archaeological and Historic Resources

Section 106 of the National Historic Preservation Act (NHPA) of 1966 (amended June 17, 1999) requires federal agencies to take into account the effects of their undertakings on historic properties. By definition, historic properties are those that are eligible for or listed on the National Register of Historic Places. Federal undertakings refer to any federal involvement including funding, permitting, licensing, or approval. Federal agencies are required to define and document the Area of Potential Effect for undertakings. It is the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if such properties exist.

The Advisory Council on Historic Preservation (ACHP) issues regulations that implement Section 106 of NHPA at 36 CFR Part 800, Protection of the Historic Properties. Section 106 sets up the review process whereby a federal agency consults with the State Historic Preservation Officers (SHPO), Native American tribes, and other interested parties including the public to identify, evaluate, assess effects, and mitigate adverse impacts on any historic properties affected by their undertaking.

3.3.8.1 Background Review

A literature and background review of the proposed Missouri River Levee System Units L-455 and R-460-471 study area was completed in 1996 and 2001. The background search consisted of a review of the National Register of Historic Places; site records from the Kansas and Missouri SHPO's, archeological reports from projects in the region, and appropriate historical documents. The review found no archeological sites or historic structures recorded within the study area. Since the 1996 review, no additional sites have been recorded within the study area.

A review of the Kansas City District's Abandoned Shipwrecks on Missouri River Channel Maps of 1879 and 1954 identified nine shipwrecks in the vicinity of the study area. These ships and the year they sank include the Dan Converse (1858), the Watosa (1858), Jennie (1890), Bertha (1873), Denver No.1 (1867), Denver City (1867), Dorothy (1920), Mt. Sterling (1918), and Pathfinder (unknown). The wrecks were briefly described in *The Report of the Chief of Engineers, U.S. Army, Appendix D, Report on Steamboat Wrecks on Missouri River* by Captain H.M. Chittenden, Corps of Engineers in 1897 and the Dr. E.B. Trail Collection, 1858-1965.

The Corps also conducted an accreted land study of the APE to help determine the potential for archeological sites within the study area. The study was undertaken by using GIS to overlay historic Corps of Engineer Missouri River channel maps from 1804, 1879, 1892, 1926, 1954, as well as current maps to show the various locations of the river channel. The former channel locations are considered accreted land. The study found that much of the proposed project area is comprised of land accreted after 1879. These results along with the results of the background literature review were coordinated with the appropriate SHPO.

3.3.9 Environmental Justice

The Executive Order on Environmental Justice (Executive Order 12898) requires consideration of social equity issues, particularly any potential disproportionate impacts to minority or low-income groups. This is to ensure that issues such as cultural and dietary differences are taken into consideration to ensure that adequate risk is evaluated (EPA, 2004). To determine potential impacts to minority or low-income groups, the racial and income composition of the individual census tracts within, and adjacent to the study area, were examined using 2000 census data.

For Census 2000, the Office of Management and Budget (OMB) considered race and Hispanic origin to be separate and distinct concepts, and the terms "Hispanic" and "Latino" synonymous for reporting purposes. The OMB defines Hispanic or Latino as "a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race." Therefore, Hispanics/Latinos may be of any race and are not defined as an individual race category by the OMB. Persons who reported Hispanic/Latino origin are included within the seven mutually exclusive race categories used by the OMB to sum the total population, which include: (1) White; (2) Black or African American; (3) American Indian & Alaska Native; (4) Asian; (5) Native Hawaiian and Other Pacific Islander; (6) Some other race; (7) Two or more races.

Table 3-5 represents the racial composition of the proposed project area. Comparison data provides insight into the demographics of an area overall while providing an understanding of areas that are often overlooked in general population data. The percentage of persons who reported "some other race" and "two or more races" were combined, and are represented in the "Other Races" column. Racial composition and Hispanic or Latino origin percentages were calculated from the census tract population data reported in section 3.3.

Table 3-5. Project Area Racial Composition.

County	%White	%Black	%Native American/ Alaskan	%Asian	%Pacific Islander	%Other Races*	%Hispanic /Latino
Buchanan	92.73	4.36	0.42	0.45	0.02	2.02	2.43
Andrew	98.38	0.42	0.34	0.22	0.01	0.63	0.84
Doniphan	94.85	2.00	1.21	0.25	0.00	1.69	1.16

Source: Census 2000

*Percentages are calculated from the sum of persons who reported "some other race" or "two or more races".

The majority of the persons in the proposed project area reported their race as "White." This is followed by Blacks, Hispanic/Latino, Other races, Native American/Alaskan, Asian, and finally Pacific Islander. When the total of the other than white races are summed, one can see that only a very small percent of the racial composition consists of "minority" races.

The core of Executive Order 12898 provides for the protection of both minority and low-income groups. Therefore, income data and racial composition data from Section 3.3 were used to provide an overview of the proposed project area in terms of the minority make-up and the residents living below the poverty line. This information is based on the percent of the total population for each county. Table 3-6 represents this data. The poverty line is defined as the level of income below which one cannot afford to purchase all the resources one requires to live. By definition, people below the poverty line have no disposable income.

Table 3-6. Percentage of Minority Residents and Residents Living Below the Poverty Line in the Project Area.

County	%Minority Residents	% Living Below the Poverty Line
Buchanan	9.7	12.2
Andrew	2.46	8.2
Doniphan	6.31	11.9

Additional environmental justice indicators such as education level, languages spoken, and percent children and elderly reveal trends about the socio-demographic aspects of a community that may be used to make generalizations about the population and the capacity of residents to cope with potential additional environmental stresses.

The level of education and/or literacy rates for the adult population provides a critical measure of the likelihood and the ability of the community to know about and participate in public meetings, to comment on written proposals and to otherwise participate in the decision-making process. If tools used to encourage public participation are not tailored to local education rates, or perceived rates, the outreach process may be ineffectual (USEPA, 2004). From the Census 200 data, over 80% of residents in each county are high school graduates.

Information on whether languages other than English are spoken among the population, and percentage distribution of these languages, is important in determining effective public participation processes. According to the U.S. Census Bureau (2000), the most common language spoken at home, by individuals age five and over, is English with an average of 96%. The percent of language other than English that is spoken in the area averages to about 2.8%.

Children under age five and elderly populations above age 65 are considered to be sensitive populations that may experience disproportionate impacts from environmental stressors. Table 3-7 below provides insight into a subpopulation that exists within the various counties within the study area. The counties in the proposed project area contain a slightly higher percent of elderly individuals over that which occurs state-wide.

Table 3-7. Percent of Sensitive Populations within the Proposed Project Area.

County	%Children under 5/ % throughout State	%Elderly over Age 65/ % throughout State
Buchanan	6.3/6.6	15.0/13.5
Andrew	6.3/6.6	14.4/13.5
Doniphan	6.4/7.0	16.2/13.3

After the levee was decertified in 1999, FEMA and the Corps of Engineers collaborated to use a deliberate communication strategy to ensure broad community awareness of the AR interim flood re-zoning process for the right bank levee unit (R460-471). FEMA is mandated to conduct outreach to all possible communities affected by re-zoning actions and they developed a process that encompasses all of the potentially affected communities. The Corps was not just a "by-stander" in this process, but was actively engaged in partnership with FEMA in releasing information and making presentations at the meetings. This is because a critical component of the AR interim re-zoning process is the remedy to corrective action being developed to address the re-zoning. In this case, the corrective action central to the process was this feasibility study and eventual authorization and funding of a Corps project to improve the levee system. Thus, the Corps participated in the AR zoning outreach process and events by presenting the feasibility study planning process, the status of the study, and the most likely recommendations of the study. This process was followed and reported on periodically by the media serving the communities.

Region VII of the U.S. Environmental Protection Agency reviewed data and associated information used for the consideration of environmental justice. No concentrated blocks of ethnic or minority communities occur within the project area. Given the demographic characteristics of the project area, (96 percent English speaking and over 80 percent high school graduates), the public involvement process used communication methods appropriate to communicate the information about the proposed flood damage reduction project. Information was provided via public notices mailed to homeowners and business owners in the area, legal notices in area newspapers, and on the Corps web site. Information about the project was mailed to adjacent landowners, area organizations, area businesses, Native American tribes, USEPA identified contacts, and federal, state, and local government agencies. Also, at the most recent public meeting held on August 28, 2006, in the town of Elwood, Kansas, a local community affected by the proposed project, the meeting was attended by a diverse group of local citizens and was considered by all measurements a successful meeting. Indications from the meeting are of broad support for the project which is needed to avert current and future adverse economic impacts to the affected communities.

4. Environmental Effects of the Proposed Alternatives

4.1 Introduction

This chapter presents the potential effects on the various resources that could result from implementation of the preferred alternative, Alternative 2, Alternative 3, Alternative 4, and the No Action Alternative. It is organized by resource. Each resource section includes a brief discussion of what was included in the resource being analyzed. The potential short-term effects of construction and the long-term operational effects are presented for all alternatives. Measures to minimize adverse effects are also presented where appropriate. Please reference Table 5 – Summary of Impacts at the end of this document for a quick assessment of impacts resulting from each alternative. Also, note that the preferred alternative will require the placement of fill material in area wetlands, that a section 404(b)(1) evaluation has been prepared pursuant to the Clean Water Act, and that a 401 Water Quality Certification will be obtained prior to project construction.

The Environmental Effects chapter uses three levels of impacts to describe the anticipated impacts: no impact, less than significant impact, and significant impact. Under the no impact category, the analysis of the resource would no perceptible impact would be anticipated. A less than significant impact would be an anticipated perceptible beneficial or adverse impact that does not meet the standard for being significant. A significant impact would be an anticipated perceptible impact that meets or exceeds the general standard for significance as defined by Council on Environmental Quality (CEQ) implementing regulations as discussed below.

The CEQ guidelines indicate the significance of an impact is determined by the intensity and the context of the impact evaluated. Intensity refers to the severity or extent of an impact and context relates to the environmental circumstances at the location of impact. The CEQ regulations for impacting the procedural provisions of NEPA (40 CFR 1508.27) specify that the following intensity and context criteria should be considered as general guidelines when determining the significance of impacts.

Intensity Evaluation should consider:

- Both beneficial and adverse impacts;
- The degree to which the proposed action would affect public health or safety;
- Unique characteristics of the geographic area such as proximity to historic or cultural resources, parklands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas;
- The degree to which the effects on the quality of the human environment are likely to be highly controversial;
- The degree to which the possible effects on the human environment are highly uncertain or could involve unique or unknown risks;
- The degree to which the action may establish a precedent for future actions with significant effects;
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts;

- The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in, or eligible for listing in, the NRHP or may cause loss or destruction of significant scientific, cultural, or historical resources;
- The degree to which the action may adversely affect an endangered or threatened species, or its habitat, that has been designated to be critical under the Endangered Species Act; and,
- Whether the action threatens a violation of Federal, state, or local law or requirements imposed for the protection of the environment.

Context Evaluation should consider:

- The area or quantity of an affected resource relative to the available area or quantity of that resource;
- The potential for change in reproductive success of a species and maintenance of a population at pre-project levels; and,
- The period or recovery.

A determination of significance for a particular impact may be based on one or more of the intensity criteria and the context in which the impact would occur. The context refers to the significance of an impact to society as a whole, the affected region, the affected interests, and the locality.

This chapter also presents the potential for cumulative impacts, which are the impacts on the environment that result from the incremental impact of the project when added to the impacts of other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions.

After the level of impacts has been defined, measures to minimize adverse impacts are considered in this chapter using the following guidelines:

- Avoiding the impact altogether by modifying or not taking a certain action or parts of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impact over time by preservation and maintenance of operations during the life of the action; and/or,
- Compensating for the impact by replacing or providing substitute resources or environments.

The use of measures to minimize adverse impacts and the effectiveness of these measures will be used, in general, by decision makers when evaluating the alternatives and balancing the projects overall merits with its potential impacts.

4.2 Future Conditions without the Project – No Action

4.2.1 Baseline

The future conditions without project incorporates projects planned to be completed within the study reach, and any long term natural river processes that may affect future stages. For the purposes of this study, future conditions are defined as conditions reasonably expected to be present in 2030. A critical assumption of this analysis is that hydrologic conditions along the Missouri River are relatively static. This assumption was also implemented in the *Upper Mississippi River System Flow Frequency Study* (UMRSFFS) (2003), which was based on the study of 100 years of gage records along the Missouri River. The UMRSFFS superseded the previous Missouri River hydrology study titled *Missouri River Agricultural Levee Restudy Program* (1962). It is therefore reasonable to assume that the newly published flows in the UMRSFFS will still be applicable at the future conditions date.

By current estimates, Unit R471-460 has a 51.3 percent chance of passing a one percent event and an 8.2 percent chance of passing a 0.2 percent chance event. Large areas of existing residential, business and industrial development are now in a zone no longer afforded 100-year level of flood damage reduction, and increasing economic hardship is expected to result. Modifications or improvements to businesses are constrained. New investment of any kind is now questionable. The area will enter into an economic decline with less viability for improvement or enhancement, and increasing economic blight. If a project is not authorized to restore certification to the right bank, FEMA will eventually enact a major zoning change that will greatly increase flood insurance requirements and greatly degrade the economic health of the area.

Currently, mission essential upgrades to the Missouri Air National Guard Base at the airport are being jeopardized by the status of the levee. Some increases in investment are likely to take place including the expansion of the Air National Guard base, but at much greater cost to the users. If the project recommended by this study is not implemented by the Federal government, then the local sponsors will be faced with a substantial financial burden of trying to implement the project themselves; or, they will have to rely on flood-fighting to protect the investment in the area from future floods. Without recertification of the levee, economic development could be stymied and population could decline in the area. This in turn could result in no future development in the area and current buildings being abandoned and demolished. This could have a substantial benefit to area habitat and wildlife species in the long term.

Current analysis shows that Unit L-455 currently has a 93.6 percent chance of containing a one percent flood and a 65.8 percent chance of containing a 0.2 percent chance flood. Potential expansion of the city of St. Joseph to the south will result in existing agricultural property being converted to residential, commercial, or industrial uses. As new investment increases, damages associated with flooding will increase. Increased development in this levee unit, over the long-term, will likely result in adverse effects to area habitat and wildlife species.

4.2.2 Missouri River

The Missouri River has been subject to many natural processes that have affected river stages. A general decline in river stage is anticipated to occur during low flows (20,000 cfs to 100,000 cfs), and a general increase in river stage is anticipated to occur during high flows (<100,000 cfs). These flow and stage fluctuations are primarily attributed to the accretion of land and subsequent vegetation establishment behind dikes placed for navigation channel alignment. Vegetation stabilizes the accreted land from erosion and allows the accretion and vegetation cycle to continue further into the channel. Future conditions without the project will lead to increased flooding of the project area during the one percent flood flows; no re-certification by FEMA of the project area levees; decreased economic viability in the project area overall; and, potential for increased natural habitat conditions as the river re-connects to its historic flood plain.

4.3 Physical-Chemical Environment

4.3.1 Geology, Minerals and Soils

The potential geology, mineral, and soil impacts are discussed in this section in terms of impacts on the area bedrock which may in turn cause sink holes or other changes to the area condition.

Geology and minerals would not be impacted by any of the build alternatives because the excavation of borrow materials and the construction activities associated with levee raises and widening would be conducted within the soil layers well above bedrock. No post-construction impacts to geology or minerals would be anticipated from the operation of the two levee units. Area soils will be used to provide fill for the levee raises and will be disturbed. Coordination with both Kansas and Missouri NRCS was conducted (Appendix D) using the Farmland Conversion Impact Rating Form AD-1006 to determine prime farmland values. The Kansas NRCS stated that prime farmland soils will be converted by the proposed project; however, the relative value of the farmland conversion is zero. Thus, the impacts to prime farmland in Kansas are believed to be insignificant. The Missouri NRCS stated that prime farmland soils also will be converted by the proposed project and that the relative value of the farmland to be converted was high. However, based on the percentage (.001 percent) of farmland being converted compared to that within the county, the impacts to prime farmland resulting from the proposed project are believed to be insignificant. Soils used for the levee raises will be compacted and seeded in order to remain in place. The No Action Alternative would have no impact on geology, minerals, or soils.

4.3.2 Water Quality

Potential impacts to the quality of the surface water and groundwater are addressed in this section. Water quality of surface water bodies and groundwater can be indirectly affected by changing the quantity or volume of water in the water body or groundwater. Additionally, water quality may be affected by loss of area vegetation, or by leakage of fluids from construction related equipment.

Preferred Alternative

The preferred alternative consists of raising the right bank levee (R471-460) anywhere from zero to 3.37 feet at specific points along its entire length, with corresponding raises to the left bank levee (less than one foot) as needed. These anticipated raises will result in increases to both the toe width and seepage berms. The overall width increase from the expanded levee and seepage berms will range from approximately 35 feet to 372.5 feet landward of the right bank levee unit and approximately 29 feet to 50 feet riverward of this same levee unit. Extension of the levee toe width and seepage berms will impact a total of approximately 285 lineal acres landward of the levee and approximately 77 lineal acres riverward of the existing levee.

The increased elevations to the left bank levee (L-455) will also increase toe width and seepage berms by approximately 136.5 feet to 356.5 feet landward of the levee, and approximately 41.5 feet riverward of the existing levee. Extension of the levee toe width and seepage berms will impact a total of approximately 43 lineal acres of land landward of the levee and approximately 54 lineal acres of land riverward of the existing levee.

Over the entire project area, when considering borrow material excavation and riverward berm expansion, temporary and permanent impacts to secondary tree growth and shrubland will occur. However, various minimization measures as described in the Vegetation Section (4.4.1) below will be implemented. Removal of trees and shrubs has the potential to affect water quality by reducing the filtering effects that these habitat types provide, and increasing the chances for erosion of soils. Additionally, because the levee is being raised, the potential for Missouri River overtopping is decreased. This decreased overtopping will limit Missouri River water from spreading over its historic floodplain, thereby incrementally decreasing the opportunity for river water filtration and purification.

Borrow areas currently identified for the proposed levee raise include riverward areas in both Kansas and Missouri. For Kansas, two borrow areas were identified and consist of a total of approximately 1,139 acres located from river mile 454.9 to 451.9 and from river mile 446.7 to 443.4. For Missouri, the borrow area consists of approximately 30.4 acres from river mile 442.6 to 442.9. After implementation of the preferred alternative, vegetation in the borrow areas will be allowed to reestablish naturally over time. Some adaptive management may be necessary if invasive species, such as reed canary grass, begin to dominate the areas. These impacts are believed to be short-term, less than significant, and construction related.

During excavation, best management practices will be implemented to minimize adverse water quality effects. Where appropriate, revegetation with native species to the extent practicable and mulching will be done as soon as practical after completion of activities to minimize the length of time soils are exposed to erosion. Planting trees and/or other vegetation would be done as appropriate to help increase water filtration, minimize the long-term transport of sediment from the site, and offset the impact to floodplain habitat.

Best management practices to minimize and avoid impacts from construction related equipment would also be implemented to reduce and avoid construction equipment fluids from entering the area soils and, subsequently, the waterway. There may be a temporary increase in turbidity levels in the project area during construction. Turbidity will be short-term and localized and no significant adverse impacts are expected. State standards for turbidity will not be exceeded. Therefore, the construction related impacts are expected to be less than significant.

Alternative 2 (500 plus 1.5 feet of margin)

Alternative 2 consists of raising the right bank levee (R471-460) approximately 3.5 feet along its entire length, with corresponding raises to the left bank levee. These anticipated raises will result in increases to both the toe width and seepage berms. The overall width increase (levee and seepage berms) will maximize the project boundaries of 500 feet landward and spread approximately 37 to 60 feet riverward of the right bank levee unit. Extension of the levee toe width and seepage berms will impact approximately 385 lineal acres of land landward of the levee and approximately 81 lineal acres of land riverward of the existing levee.

The increased elevations to the left bank levee (L-455) will also increase toe width and seepage berms by approximately 500 feet landward of the levee, and approximately 41.5 feet riverward of the existing levee. Extension of the levee toe width and seepage berms will impact approximately 46 lineal acres of land landward of the levee and approximately 54 lineal acres of land riverward of the existing levee.

Borrow areas currently identified for this alternative include the same riverward areas as the preferred alternative in both Kansas and Missouri. An increased amount of borrow material for this alternative would be required and impacts to vegetation throughout the entire borrow area would be expected. However, it is anticipated that a greater adverse impact to vegetation and, subsequently, on water quality over that of the preferred alternative would be expected.

During construction, similar best management practices as the described in the preferred alternative would be implemented to minimize adverse water quality effects. Therefore, the construction related impacts are expected to be less than significant.

Alternative 3 (500 plus 3.0 feet of margin)

Alternative 3 consists of raising the right bank levee (R471-460) up to five feet along its entire length, with corresponding raises to the left bank levee (average of 2.5 feet). These anticipated raises will result in increases to both the toe width and seepage berms. The overall width increase (levee and seepage berms) will maximize the project boundaries of 500 feet landward and spread approximately 37 feet to 60 feet riverward of the right bank unit. Extension of the levee toe width and seepage berms will impact approximately 336 lineal acres of land landward of the levee and approximately 81 lineal acres of land riverward of the existing levee.

The increased elevations to the left bank levee (L-455) will also increase toe width and seepage berms by approximately 500 feet landward of the levee, and approximately 54 feet riverward of the existing levee. Extension of the levee toe width and seepage berms will impact approximately 46 lineal acres of land landward of the levee and approximately 54 lineal acres of land riverward of the existing levee. It should be noted that the project boundary was set at no more than 500 feet from the center line of the existing levee. The impacts from Alternative 3 exceed this boundary, but were only reported to the boundary limit.

Borrow areas currently identified for this Alternative include the same riverward areas as the preferred alternative in both Kansas and Missouri. An increased amount of borrow material for this alternative would be required and impacts to vegetation throughout the entire borrow area would be expected. This would, in turn, have a greater adverse impact on water quality over that of the Alternative 2.

During construction, similar best management practices as the described in the preferred alternative will be implemented to minimize adverse water quality effects. Therefore, the construction related impacts are expected to be less than significant.

Alternative 4 (100 plus 1.5 feet of margin)

Alternative 4 consists of raising the right bank levee (R471-460) anywhere from zero to 1.2 feet at specific points along its entire length, with no raise required to the left bank levee. These anticipated raises will result in increases to both the toe width and seepage berms. The overall width increase from the expanded levee and seepage berms will range from approximately 35 feet to 307.5 feet landward of the right bank levee unit and approximately 29 feet to 50 feet riverward of this same levee unit. Extension of the levee toe width and seepage berms will impact a total of approximately 271 lineal acres of land landward of the levee and approximately 65 lineal acres of land riverward of the existing levee.

Borrow areas currently identified for this alternative include the same riverward areas as the preferred alternative in both Kansas and Missouri. A decreased amount of borrow material (approximately 16%) would be required for this alternative and impacts to vegetation as described for the preferred alternative above would be expected. These impacts, although similar in type, are expected to be reduced given that a decreased amount of fill material would be required.

During construction, similar best management practices as the described in the preferred alternative will be implemented to minimize adverse water quality effects. Thus these impacts are believed to be short-term, less than significant, and construction related.

“No Action” Alternative

The “No Action” alternative would involve no construction activity and no change in project operations. Because Levee Unit R471-460 is not FEMA certified to contain the 100-year flood event, flows of this magnitude would overtop the banks and cause flooding to surrounding industrial and residential areas, thereby, incrementally affecting water quality as it comes into contact with these facilities and household products. However, because the majority of the area protected by the levee is agricultural, these impacts are believed to be insignificant. River water contact with agricultural land could provide some benefits to water quality through filtration depending on timing and the amount of pesticides and herbicides used.

4.3.3 Air Quality

The potential air quality impacts are discussed in this section in terms of short-term construction impacts and long-term operations impacts, meaning those after project implementation.

Preferred Alternative

Construction related air quality impacts would tend to be localized and temporary in nature. Such impacts would be due to relatively minor amounts of combustion related emissions from vehicle engine exhausts, and fugitive dust from earthmoving operations. Most of the affected landward area is currently farmed and, therefore, has these same types of emissions, but on a more on-going basis. During construction, best management practices (such as watering roads and construction sites) would be implemented to minimize fugitive dust and pollutant emissions. The construction related impacts are expected to be short-term and less than significant, in comparison to the current land use activities.

After implementation of the preferred alternative, the combustion related emissions and fugitive dust would return to the level of existing conditions. Farming and tilling would continue, and air quality would again reach pre-construction levels. This analysis indicates that construction related air quality impacts would be less than significant.

Alternative 2 (500 plus 1.5 feet of margin)

Under Alternative 2, construction related air quality impacts would tend to be similar to those of the preferred alternative. It can be assumed that because this alternative requires a higher level of flood damage reduction, additional construction over a longer period of time would be required which; in turn would increase combustion related emissions and fugitive dust slightly over that of the preferred alternative.

After implementation of this alternative, the combustion related emissions and fugitive dust would return to the level of existing conditions. Farming and tilling would continue, and air quality would reach pre-construction levels. This analysis indicates that construction related air quality impacts would be less than significant. During construction, best management practices (such as watering roads and construction sites) would be implemented to minimize fugitive dust and pollutant emissions.

Alternative 3 (500 plus 3.0 feet of margin)

Under Alternative 3, construction related air quality impacts would tend to be similar to those of the preferred alternative. It can be assumed that because this alternative requires a still higher level of flood damage reduction than Alternative 2, additional construction over a longer period of time would be required which; in turn, would increase combustion related emissions and fugitive dust slightly over that of the increased level of flood damage reduction alternative.

After implementation of this alternative, the combustion related emissions and fugitive dust would return to the level of existing conditions. Farming and tilling would continue, and air quality would reach pre-construction levels. This analysis indicates that construction related air quality impacts would be less than significant. During construction, best management practices (such as watering roads and construction sites) would be implemented to minimize fugitive dust and pollutant emissions.

Alternative 4 (100 plus 1.5 feet of margin)

Under Alternative 4, construction related air quality impacts would tend to be similar to those of the preferred alternative. It can be assumed that because this alternative requires a lower level of flood damage reduction, less construction over a shorter period of time would be required which; in turn, would incrementally decrease combustion related emissions and fugitive dust under that of the preferred alternative.

After implementation of this alternative, the combustion related emissions and fugitive dust would return to the level of existing conditions. Farming and tilling would continue, and air quality would reach pre-construction levels. This analysis indicates that construction related air quality impacts would be less than significant. During construction, best management practices (such as watering roads and construction sites) would be implemented to minimize fugitive dust and pollutant emissions.

"No Action" Alternative

The "No Action" alternative would involve no construction activity and no change in project operations. Therefore, effects to air quality resources would remain status quo in the study area.

4.3.4 Noise

The principal source of noise in the project area is from farming activities, motor vehicle traffic along major highways and in urban areas, industry, and to a lesser extent from railroad traffic. Project related impacts to noise would be from operation of construction related equipment and increased construction related traffic on area roads.

The evaluation and control of construction noise must be considered during the course of the proposed project. During design and construction, every effort will be made to ensure the community is aware of the project. Additionally, source control, site noise emissions, and work hours will be managed on the construction sites to minimize noise emissions.

Preferred Alternative

Construction activities related to modifying the existing levee under the preferred alternative will require the use of heavy earthmoving equipment and mobilization of equipment on area roads. This equipment would produce some noise during construction periods. However, it is not anticipated that construction activities would increase noise levels beyond that typical of farming operations or area traffic in the vicinity. Additionally, construction related activities would be preformed during "normal business hours" and not during sensitive periods (i.e., night). Therefore, construction related noise effects are anticipated to be less than significant.

After project completion, noise levels would return to the level of existing conditions. Farming and tilling would continue, and noise levels would reach pre-project conditions. Because adverse noise impacts are not anticipated, additional measures to minimize adverse effects are not necessary beyond those previously mentioned.

Alternative 2 (500 year plus 1.5 feet of margin)

Construction activities to modify the existing levees under Alternative 2 would require the use of heavy earthmoving equipment. This equipment would produce the same noise during construction periods as the preferred alternative; and it is anticipated that construction activities would extend over a longer period of time due to the increased levee construction needed to raise both levees to the increased level of flood damage reduction. However, it is not anticipated that construction activities would increase noise levels beyond that typical of farming operations in the vicinity. Additionally, construction related activities would be preformed during normal business hours and not during sensitive periods (i.e., night). Therefore, construction related noise effects are anticipated to be less than significant.

After implementation of this alternative, the noise levels return to the level of existing conditions. Farming and tilling would continue, and noise would reach pre-construction levels. This analysis indicates that construction related noise impacts would be less than significant. Because adverse noise impacts are not anticipated, measures to minimize adverse effects are not necessary beyond those previously mentioned.

Alternative 3 (500 year plus 3.0 feet of margin)

Construction activities to modify the existing levees under Alternative 3 would be similar to that of Alternative 2, only over a slightly longer period of time.

Alternative 4 (100 plus 1.5 feet of margin)

Construction activities to modify the existing levees under Alternative 4 would require the use of heavy earthmoving equipment. This equipment would produce the same amount of noise during construction periods as the preferred alternative. Construction related noise is anticipated over a shorter period of time due to the decreased levee construction needed to raise the right-bank levee and would be avoided all together at the left-bank levee since no construction would be required at that location. It is not anticipated that construction activities would increase noise levels beyond that typical of farming operations in the vicinity. Additionally, construction related activities would be preformed during "normal business hours" and not during sensitive periods (i.e., night). Therefore, construction related noise effects are anticipated to be less than significant.

After implementation of this alternative, the noise levels return to the level of existing conditions. Farming and tilling would continue, and noise would reach pre-construction levels. This analysis indicates that construction related noise impacts would be less than significant. Because adverse noise impacts are not anticipated, measures to minimize adverse effects are not necessary beyond those previously mentioned.

"No Action" Alternative

The "No Action" alternative would involve no construction activity and no change in project operations. Therefore, no effects to noise in the study area would be expected.

4.3.5 Visual Quality

The potential visual quality impacts are discussed in this section in terms of impacts that the area population may perceive or interpret as pleasing or displeasing characteristics of the proposed project.

Preferred Alternative

Construction of the preferred alternative will require the use of construction related equipment for the clearing, grubbing, and sloping of the existing levee, the raising and widening of the existing levee and berms, and the vegetation clearing of trees to obtain borrow material for the proposed project. Additional construction related impacts include the stockpiling of soil and other materials needed to construct the levee upgrade. These impacts will be construction related, short term, and less than significant. The Corps will incorporate minimization measures into the proposed project to ensure the effects to area visual quality are quickly offset. Minimization measures will include regrading, reseeding, mulching, and to the extent required, replanting of trees following construction activities in an effort to return the area to visually pleasing conditions.

The contrast between natural landforms and the engineering features of the upgraded levee will be minimal as existing levees are within the proposed project area. Additionally, much of this area is access limited and; therefore, out of view for most of the area public. The completed project will not block, eliminate, or screen existing views or vistas, is not adjacent to critical environmental areas, will not open new access to the site, or change plans to maintain the existing natural setting of the project area; thus, the changes to the visual quality from the proposed project is believed to be short-term, mostly construction related and less than significant.

Alternative 2 (500 year plus 1.5 feet of margin)

Construction of Alternative 2 would require similar construction related work as that of the preferred alternative. The construction related operations would require a longer period of time to complete due to the increased extent of construction, so equipment would be in the area longer. However, the visual quality impacts would be no greater than that of the preferred alternative and thus would be considered less than significant. Similar minimization measure as the preferred alternative would be implemented.

Alternative 3 (500 year plus 3.0 feet of margin)

Construction of Alternative 3 would result in similar effects to the visual quality of the project area as that described above.

Alternative 4 (100 plus 1.5 feet of margin)

Construction of Alternative 4 would require similar construction related work as that of the preferred alternative. The construction related operations would require a shorter period of time to complete due to the decreased amount of construction, so equipment would not be in the area of the right-bank unit as long as in the preferred alternative. Construction equipment would not occur in the area of Unit L-455 at all since no levee raise is proposed in this area. These impacts are considered construction related and short term; thus, these impacts are believed to be less than significant.

"No Action" Alternative

The "No Action" alternative would involve no construction activity and no change in project operations. Therefore, no effects to the visual quality in the study area would be expected over status quo.

4.3.5 Hazardous Waste Management

The potential impacts to hazardous waste sites are discussed in this section in terms of impacting known sites during times of obtaining borrow soils and constructing and operating the two levee units.

Hazardous waste areas would not be impacted by any of the build alternatives because the excavation of borrow materials and the construction activities associated with levee raise and widening would be conducted outside of areas known to contain hazardous wastes. No post-construction impacts to hazardous wastes site would be anticipated from the operation of the two levee units. The No Action Alternative would have no impacts on hazardous waste.

4.4 Biological Environment

Comments from the U.S. Fish and Wildlife Service were received on 30 June 2006 and August 9, 2006 (Appendix D). The Corps' responses to these draft and final Coordination Report recommendations have been incorporated in this EA. Comments from the Kansas Department of Wildlife and Parks (undated letter and letter dated 25 April 2006) and the Missouri Department of Conservation (letters dated 27 September 1995 and 12 May 2006) also are included in Appendix D, along with the Corps' responses.

Engineering Regulation 1105-2-100, Section C-3(d) (5), page C-15 directs that ecological resources be evaluated using a habitat-based methodology. It also requires that mitigation features be incrementally justified. However, due to the temporary and minor effects on the stated resources and given the limited extent and type of effects associated with the proposed project; along with the avoidance, minimization, and offset features incorporated into the proposed project description, it was determined that this level of analysis was not needed.

4.4.1 Vegetation

Preferred Alternative

Construction of the preferred alternative would result in the raising of the right bank levee by zero to 3.37 feet; an increase to the levee toe width; an extension to the seepage and stability berms associated with the levee; and, borrow excavation within an area of approximately 1,139 acres riverward of R471-460, and approximately 30 acres riverward of L-455. Lateral expansion of levee R471-460 and seepage berm is estimated at 35 feet to 372.5 feet landward and approximately 29 feet to 46.5 feet riverward of the existing levee. Lateral expansion of levee L-455 and seepage berm is estimated at 136.5 to 356.5 feet landward and approximately 41.5 feet riverward of the existing levee. Expanding the levees would result in the permanent removal of approximately 1.6 acres of secondary tree growth and 4.7 acres of shrubland landward of the levees and 5.4 acres of secondary growth trees and 8.0 acres of shrubland riverward of the levees. The impact to these habitats will be permanent because this habitat would be kept from growing on the levee areas through normal levee maintenance practices. Although this secondary growth vegetation is of lesser value when compared to more mature forests, it still provides a measure of habitat important to resident species. Thus, based on professional judgment, measures to offset its loss are needed in order to aid resident species that were temporarily displaced, to be consistent with the Environmental Operating Principles, and overall to be a fair and reasonable in the Corps efforts to protect the environment. Thus, a total of 7.0 acres of trees and 12.7 acres of shrubland vegetation will be planted on site immediately following construction activities. Based on the type of vegetation removed, coupled with offset, the impacts are believed to be short-term, and less than significant.

Impacts within the 1,139 acres (R471-460) and 30 acres (L-455) to secondary tree growth and shrubland at the borrow sites would be considered temporary in nature and is therefore, expected to be less than significant. Considerable amounts of other secondary growth willow trees and shrublands are found adjacent to these areas; and, over time these areas are expected to reestablish/revert to existing habitat as the Missouri River flows onto the floodplain. Additionally, steps will be taken in these borrow areas to minimize effects to this habitat. Minimization measures include, but are not limited to, avoiding this habitat by first using bare and/or cropland areas, excavating as deep as possible in treed areas to minimize lateral impacts, and avoiding any larger older growth trees (greater than 50 feet tall and/or 24-inches diameter of breast height within 100 feet of the water's edge). Additional minimization techniques to be used in borrow areas include varying bottom depths of excavated borrow sites, creating islands within the borrow site through avoidance of specified areas, and spacing borrow areas apart from one another by approximately 500 feet to provide areas of no disturbance.

Construction work to extend the landward seepage berms also would result in temporary impacts to approximately 274 acres of primarily agricultural land with minor amounts of secondary tree growth and shrubland on the right-bank levee, and 44 acres of similar land use on the left-bank levee. Following construction, these areas would be replanted with a similar number of trees and shrubs that were removed and allowed to revert back to their existing conditions as no levee maintenance activities will be conducted on seepage berm areas. Coordination with Corps representatives of the Missouri River Fish and Wildlife Mitigation Program has been done to ensure that obtaining borrow material, (particularly from the Elwood Bend site) is conducted in an appropriate manner so that the area is not diminished in value. Further coordination among mitigation program specialists will be done to design other possible methods for borrow excavation as the project gets closer to the construction phase. Thus, these impacts are expected to be short-term and less than significant.

Modifying the two levees would also permanently impact approximately 4.4 acres of farmed wetlands landward of the levees and approximately 0.5 acre of farmed wetlands riverward of the two levees. Impacts to these wetlands, and their associated vegetation, would result as the areas are filled and sloped, thereby inhibiting the ponding of water. The permanent loss of wetlands would contradict the Corps' policy of "no net loss of wetland habitat" unless measures to avoid, minimize, and mitigate their loss is implemented. Therefore, 4.9 acres of wetlands will be restored onsite and adjacent to existing riverward wetlands concurrently with construction activities. Wetland impacts would be offset through the scraping and reshaping of the wetland areas to expand these areas equal to that which was lost. Wetland offset will be conducted to meet the no net loss of wetland habitat, to be consistent with the Environmental Operating Principles, and overall to be a fair and reasonable in the Corps efforts to protect the environment. Although farmed wetlands are of lower value than emergent or forested wetlands, they none-the-less provide essential functions and values. With the offset proposed, the impacts to the farmed wetlands are considered less than significant.

Some of the wetlands along both levees consist of acreage enrolled in the U. S. Natural Resources Conservation Service's (NRCS) Wetland Reserve Program. Wetland impacts have been coordinated with the NRCS, relevant state agencies, and the USFWS. To the extent possible, these areas will be avoided and lands outside these protected areas will be used for borrow. Where necessary, the Corps will use minimization and mitigation measures described in the NRCS Engineering Field Handbook, May 1997, Chapter 13 "Wetland Restoration, Enhancement, or Creation" and the "Erodible Land and Wetland Conservation and Reserve Program" provisions of the Food Security Act of 1985, as amended, to avoid/reduce impacts and to provide for a more natural setting following construction. These minimization measures would be similar to those identified above.

During construction, BMP would be used and minimization measures would be employed. Utilizing these minimization measures will help to reduce impacts; and, in time will reestablish as Missouri River floods modify this area. Also, construction BMP will be used to help prevent the transport of invasive species to and from the construction sites.

Grassland strips occurring on and adjacent to the levee and the toe would be impacted during construction by grading, sloping, and grubbing as the width of the levee and seepage berm expands. Impacts to grassland vegetation would be temporary but would cease to provide habitat to existing wildlife (insects, small mammals, etc.) during project construction and for approximately two to three years after project completion; or until the grassland vegetation becomes well established. This impact is considered temporary as the completed levee side slopes would be seeded and mulched with a "levee" seed mix following project completion. This will reduce erosion; and would in turn provide habitat, loafing, and forage areas for these species.

Also, grassland strips are found along a considerable portion of the project area and would provide habitat to any wildlife species temporarily displaced during construction activities. Therefore, impacts to area grasslands are considered less than significant.

Alternative 2 (500 plus 1.5 feet of margin)

Construction of Alternative 2 would result in the raising of the right bank levee by an average of 3.5 feet along its entire length, an increase to the levee toe width, an extension to the seepage berms associated with the levee, and the excavation of approximately 1,139 acres riverward of R471-460, and 30 acres riverward of L-455 of borrow material. Lateral expansion of levee R471-460 will maximize the project boundaries of 500 feet landward and spread 37 feet to 60 feet riverward of the existing levee. Lateral expansion of levee L-455 is estimated at 500 feet landward and approximately 41.5 feet riverward of the existing levee.

Expanding the levees would permanently impact approximately 2.2 acres of secondary tree growth and 6.4 acres of shrubland landward of the levees and approximately 5.4 acres of secondary growth trees and 8 acres of shrubland riverward of the levees. Impacts to the secondary tree growth and shrubland within the levee expansion areas, both landward and riverward, would be considered permanent as trees would be kept from growing in these areas through normal levee maintenance practices. Although this secondary growth vegetation is of lesser value when compared to more mature forests, it still provides a measure of habitat important to resident species. Therefore, measures to offset their loss would be required to aid resident species that were temporarily displaced, to be consistent with the Environmental Operating Principles, and overall to be a fair and reasonable in the Corps efforts to protect the environment. A total of approximately 7.6 acres of secondary tree growth and 14.4 acres of shrubland is anticipated to be lost as a result of this alternative; therefore, approximately 7.6 and 14.4 acres of "in-kind" habitat would be offset on site. Based on the type of vegetation removed, coupled with offset, the impacts are believed to be short-term, and less than significant.

Impacts to the secondary tree growth and shrubland at borrow sites would be temporary and is expected to be less than significant as considerable amounts of other secondary growth willow trees are found adjacent to these areas. Over time these areas are expected to reestablish as the Missouri River flows onto the floodplain. The minimization techniques would be the same as the preferred alternative.

Modifying the two levees would also impact approximately 5.6 acres of farmed wetlands and their associated vegetation landward of the levees and 0.6 acre of farmed wetlands and their associated vegetation riverward of the two levees. Impacts to these wetlands, and their associated vegetation, would result as the areas are filled and sloped, thereby inhibiting the ponding of water. The permanent loss of wetlands would contradict the Corps' policy of "no net loss of wetland habitat" unless measures to avoid, minimize, and mitigate their loss is implemented. Therefore, 6.2 acres of wetlands will be restored onsite and adjacent to existing riverward wetlands concurrently with construction activities. Wetland impacts would be offset through the scraping and reshaping of the wetland areas to expand these areas equal to that which was lost. Wetland offset will be conducted to meet the no net loss of wetland habitat, to be consistent with the Environmental Operating Principles, and overall to be a fair and reasonable in the Corps efforts to protect the environment. Although farmed wetlands are of lower value than emergent or forested wetlands, they none-the-less provide essential functions and values. With the offset proposed, the impacts to the farmed wetlands are considered less than significant.

Impacts to the wetlands at borrow sites would be temporary and is expected to be less than significant. During construction, BMP would be utilized and the minimization measures as described above would be employed. Using these minimization measures would reduce impacts; and, with time these areas are expected to reestablish as the Missouri River regularly flows onto the floodplain. In addition, coordination with Corps representatives of the Missouri River Fish and Wildlife Mitigation Program will continue to ensure that obtaining borrow material, particularly from the Elwood Bend site, is conducted in an appropriate manner such that the area is not diminished in value and is consistent with future plans.

Grassland strips occurring on and adjacent to the toe of the levee would be impacted as the width of the levee and seepage berm expands. Impacts to grassland vegetation would be temporary but would cease to provide habitat to existing wildlife (e.g. insects, small mammals) during project construction and for approximately two to three years after project completion, or until the vegetation is well established. This impact is considered temporary as the levee side slopes and seepage berms would be seeded and mulched with a “levee” seed mix following project completion to help reduce erosion; and, this would provide habitat, loafing, and forage areas for these species. Also, grassland strips are found along a considerable portion of the levees and would provide habitat to any wildlife species temporarily displaced during construction activities. Therefore, impacts to area grasslands are considered less than significant.

Alternative 3 (500 plus 3.0 feet of margin)

Construction of Alternative 3 would result in the raising of the right bank levee by approximately five feet along the entire levee, an increase to the levee toe width, an extension to the seepage berms associated with the levee, and the excavation of approximately 1,139 acres riverward of R471-460, and 30 acres riverward of L-455 of borrow material. The project boundary was set at no more than 500 feet from the center line of the existing levee. The impacts from the 500 plus 3.0 feet of margin alternative exceed this boundary, but were only reported to the boundary limit. Thus, lateral expansion of levee R471-460 was set at 500 feet landward and would spread approximately 60 feet riverward of the existing levee. Lateral expansion of levee L-455 was set at 500 feet landward and would spread approximately 54 feet riverward of the existing levee.

Expanding the levees would result in the permanent impact to 2.7 acres of secondary tree growth and 8 acres of shrubland landward of the levees and 5.4 acres of secondary growth trees and 8 acres of shrubland riverward of the levees. Although this secondary growth vegetation is of lesser value when compared to more mature forests, it still provides a measure of habitat important to resident species. Therefore, measures to offset their loss would be required to aid resident species that were temporarily displaced, to be consistent with the Environmental Operating Principles, and overall to be a fair and reasonable in the Corps efforts to protect the environment. Thus, a total of 8.1 acres of secondary tree growth and 16 acres of shrubland would be planted to offset the impact. Based on the type of vegetation removed, coupled with offset, the impacts are believed to be short-term, and less than significant.

Impacts to secondary tree growth at borrow sites would be temporary and is expected to be less than significant as considerable amounts of other secondary growth willow trees are found adjacent to these areas. Over time these areas are expected to reestablish as the Missouri River flows onto the floodplain. The minimization techniques would be the same as the preferred alternative.

Modifying the two levees would also impact approximately 6.7 acres of wetlands and their associated vegetation landward of the levees and 0.6 acre of wetlands and their associated vegetation riverward of the two levees. Impacts to these wetlands, and their associated vegetation, would result as the areas are filled and sloped, thereby inhibiting the ponding of water. The permanent loss of wetlands would contradict the Corps' policy of "no net loss of wetland habitat" unless measures to avoid, minimize, and mitigate their loss is implemented. Therefore, 7.3 acres of wetlands will be restored onsite and adjacent to existing riverward wetlands concurrently with construction activities. Wetland impacts would be offset through the scraping and reshaping of the wetland areas to expand these areas equal to that which was lost. Wetland offset will be conducted to meet the no net loss of wetland habitat, to be consistent with the Environmental Operating Principles, and overall to be a fair and reasonable in the Corps efforts to protect the environment. Although farmed wetlands are of lower value than emergent or forested wetlands, they none-the-less provide essential functions and values. With the offset proposed, the impacts to the farmed wetlands are considered less than significant.

Impacts to the wetlands at borrow sites would be temporary and is expected to be less than significant. During construction, BMP would be used and the minimization measures described above would be employed. Utilizing these measures would reduce impacts and with time, these areas are expected to reestablish as the Missouri River flows onto the floodplain. In addition, coordination with Corps representatives of the Missouri River Fish and Wildlife Mitigation Program has been done to ensure that obtaining borrow material, particularly from the Elwood Bend site, is conducted in an appropriate manner such that the area is not diminished in value and is consistent with future plans.

Grassland strips occurring on and adjacent to the toe of the levee would be impacted as the width of the levee and seepage berm expands. Impacts to grassland vegetation would be temporary but would cease to provide habitat to existing wildlife (e.g. insects, small mammals) during project construction and for approximately two to three years after project completion, or until the vegetation is well established. This impact is considered temporary as the levee side slopes and seepage berms would be seeded and mulched with a "levee" seed mix following project completion to help reduce erosion. This would provide habitat, loafing, and forage areas to these species. Also, grassland strips are found along a considerable portion of the levees and would provide habitat to any wildlife species temporarily displaced during construction activities. Therefore, impacts to area grasslands are considered less than significant.

Alternative 4 (100 plus 1.5 feet of margin)

Construction of Alternative 4 would result in the raising of the right bank levees by zero to 1.2 feet, an increase to the levee toe width, an extension to the seepage and stability berms associated with the levee, and borrow excavation within an area of approximately 1,139 acres riverward of R471-460, and approximately 30 acres riverward of L-455. Lateral expansion of levee R471-460 and seepage berms is estimated at 35 feet to 307.5 feet landward and approximately 29 feet to 46.5 feet riverward of the existing levee. Expanding the levee would result in the permanent removal of approximately 1.3 acres of secondary tree growth and approximately 4.0 acres of shrubland landward of the levees, and approximately 4.5 acres of secondary growth trees and 6.2 acres of shrublands riverward of the levee. The impact to these habitats is expected to be permanent because this habitat would be kept from growing on the levee areas through normal levee maintenance practices. Although this secondary growth vegetation is of lesser value when compared to more mature forests, it still provides a measure of habitat important to resident species. Therefore, measures to offset their loss would be required to aid resident species that were temporarily displaced, to be consistent with the Environmental Operating Principles, and overall to be a fair and reasonable in the Corps efforts to protect the environment. Thus, a total of 5.8 acres of "in-kind" trees and 10.2 acres of shrubland vegetation will be planted on site after construction. Based on the type of vegetation removed, coupled with offset, the impacts are believed to be short-term, and less than significant.

Impacts within the 1,139 acres (R471-460) and 30 acres (L-455) of secondary tree growth and shrubland at the borrow sites are temporary in nature and is expected to be less than significant. Considerable amounts of other secondary growth willow trees and shrublands are found adjacent to these areas, and over time, these areas are expected to reestablish/revert to existing habitat as the Missouri River flows onto the floodplain. Additionally, steps will be taken in these borrow areas to minimize effects to this habitat. Minimization measures are identical to those listed for the preferred alternative.

Construction work to extend the seepage berms also would result in temporary impacts to approximately 229.5 acres of primarily agricultural land with minor amounts of secondary tree growth and shrubland on the right-bank levee. Following construction, these areas would be allowed to revert back to their existing conditions as no levee maintenance activities will be conducted over the top of seepage berm areas. Coordination with Corps representatives of the Missouri River Fish and Wildlife Mitigation Program will continue to ensure that obtaining borrow material, particularly from the Elwood Bend site, is conducted in an appropriate manner such that the area is not diminished in value and is consistent with future plans.

Modifying the levee would also permanently impact a total of approximately 3.7 acres of farmed wetlands landward of the levees and approximately 0.5 acre of farmed wetlands riverward of the two levees. Impacts to these wetlands, and their associated vegetation, would result as the areas are filled and sloped, and thereby inhibit the ponding of water. The permanent loss of wetlands would contradict the Corps' policy of "no net loss of wetland habitat" unless measures to avoid, minimize, and mitigate their loss is implemented. Therefore, 4.2 acres of wetlands will be restored onsite and adjacent to existing riverward wetlands concurrently with construction activities. Wetland impacts would be offset through the scraping and reshaping of the wetland areas to expand these areas equal to that which was lost. These wetlands require offset to meet the no net loss of wetland habitat, to be consistent with the Environmental Operating Principles, and overall to be a fair and reasonable in the Corps efforts to protect the environment.

During construction, BMP would be used and minimization measures would be employed. Using these minimization measures will help to reduce impacts and with time, these areas will reestablish as the Missouri River floods onto the floodplain reverting this area to pre-construction conditions. Additionally, construction BMP will be used to help prevent the transport of invasive species to and from the construction sites.

Grassland strips occurring on and adjacent to the levee and the toe would be impacted during construction by grading, sloping, and grubbing as the width of the levee and seepage berm expands. Impacts to grassland vegetation would be temporary but would cease to provide habitat to existing wildlife (insects, small mammals, etc.) during project construction and for approximately two to three years after project completion, or until the grassland vegetation becomes well established. This impact is considered temporary as the completed levee side slopes would be seeded and mulched with a “levee” seed mix following project completion to help reduce erosion. In turn this would provide habitat, loafing, and forage areas for these species. Additionally, grassland strips are found along a considerable portion of the levees and would provide habitat to any wildlife species temporarily displaced during construction activities. Thus, impacts to area grasslands are considered less than significant.

“No Action” Alternative

The “No Action” alternative would involve no construction activity and no change in project operations so no wetlands would be impacted. No borrow material would be obtained so no impacts to forested areas or shrub habitat would occur. Additionally, because the borrow areas would not be used, no riverward areas would be disturbed and no increased functions of existing wetland acreage and fishery habitat would be provided.

4.4.2 Wildlife

Impacts to wildlife were assessed by determining whether the alternatives under consideration would cause a loss of wildlife habitat, or cause temporary or permanent avoidance of the area. In this evaluation, wildlife was considered as all the species of mammals, birds, reptiles, and amphibians known to occur in the project area.

Preferred Alternative

Construction of the preferred alternative would result in temporary impacts to wildlife. These impacts would be caused by the increased human activity and noise associated with the construction efforts and impacts to grasslands, wetland vegetation, and terrestrial habitat resulting from the increased toe width of the levee, the increased width of seepage berms, and while obtaining borrow material. Construction activities would not be conducted along the entire length of the levee all at once; so wildlife would only avoid those areas where construction is occurring to the extent that they feel threatened. Decreased loafing would occur in areas adjacent to construction activities.

Wildlife which normally traverses the areas under construction would have to travel greater distances during hunting and foraging; which would in turn increase wildlife use and competition in neighboring areas. Loss of area habitat types would affect area wildlife by temporarily and permanently removing summer and winter habitat used by a variety of local and migratory species, and suitable trees used by squirrel, raccoon, opossum, and various species of passerines. Wetlands, grasslands, young trees and the associated buds and seeds that provide a staple food source for area wildlife would be removed. Cottontail rabbits that feed on plants in open areas along the levees and within the forested areas, and mice that are associated with the areas grasslands that would be grubbed and reshaped would be left in the open and forced to find alternative shelter. Rabbits and mice provide a prey base for larger carnivores such as snakes, coyotes, foxes, and raptors. The temporary absence of the prey species would cause a temporary absence of the predatory species. Because of the variety of species affected in the immediate area of construction, this impact could be considered substantial if long-term. However, the construction related impacts would be temporary in nature, and many of these species would immediately return to the site following construction. Therefore, the impacts to area wildlife are considered minor, temporary, and less than significant.

Where appropriate, revegetation through seeding of grasses, planting of trees, and reshaping of wetland areas would be done as soon as practical after completion of, or concurrent with, construction activities. This in turn would minimize the length of time soils are exposed and area habitat is unusable. In time, these areas would revert to pre-construction conditions and area wildlife could once again feed, breed, and shelter in these areas.

Alternative 2 (500 plus 1.5 feet of margin)

Construction of Alternative 2 would result in temporary impacts to wildlife similar to the preferred alternative but would likely occur for an extended period of time due to the increased construction time need to complete the project. These impacts would be caused by the increased human activity and noise associated with the construction efforts, and the permanent and temporary loss of grassland, wetland vegetation, and/or terrestrial habitat resulting from the increased toe width of the levee, the increased width of seepage berms, and when obtaining borrow material. Because of the variety of species affected in the immediate area of construction, this impact could be considered substantial if long-term. However, the construction related impacts would be temporary in nature, and many of these species would immediately return to the site following construction. Therefore, the impacts to area wildlife are considered minor, temporary, and less than significant.

Where appropriate, revegetation through seeding of grasses, planting of trees, and reshaping of borrow areas would be done as soon as practical after completion of, or concurrent with, construction activities. This in turn would minimize the length of time soils are exposed and area habitat is unusable.

Alternative 3 (500 plus 3.0 feet of margin)

Construction of Alternative 3 would result in temporary impacts to wildlife similar to those for the action above. These impacts would be caused by the increased human activity and noise associated with the construction efforts, and the permanent and temporary loss of grassland, wetland vegetation, and terrestrial habitat resulting from the increased toe width of the levee, the increased width of seepage berms, and when obtaining borrow material. Because of the variety of species affected in the immediate area of construction, this impact could be considered substantial if long-term. However, the construction related impacts would be temporary in nature, and many of these species would immediately return to the site following construction. Therefore, the impacts to area wildlife are considered minor, temporary, and less than significant.

Where appropriate, revegetation through seeding of grasses, planting of trees, and reshaping of borrow areas would be done as soon as practical after completion of, or concurrent with, construction activities. This in turn would minimize the length of time soils are exposed and area habitat is unusable.

Alternative 4 (100 plus 1.5 feet of margin)

Construction of Alternative 4 would result in temporary impacts to wildlife. These impacts would be caused by the increased human activity and noise associated with the construction efforts, and impacts to grassland, wetland vegetation, and terrestrial habitat resulting from the increased toe width of the levee, the increased width of seepage berms, and when obtaining borrow material. Construction activities would not be conducted along the entire length of the levee all at once, so wildlife would only avoid those areas where construction is occurring to the extent that they feel threatened. Decreased loafing would occur in adjacent areas during construction activities.

Wildlife which normally traverses the areas under construction would have to travel greater distances during hunting and foraging, which would in turn increase wildlife use and competition in neighboring areas. Loss of area habitat types would affect area wildlife by temporarily and permanently removing summer and winter habitat used by a variety of local and migratory species, and suitable trees used by squirrel, raccoon, opossum, and various species of passerines. Wetlands, grasslands, young trees and the associated buds and seeds that provide a staple food source for area wildlife would be removed. Cottontail rabbits that feed on plants in open areas along the levees and within the forested areas, and mice that are associated with the areas grasslands that would be grubbed and reshaped would be left in the open and forced to find alternative shelter. Rabbits and mice provide a prey base for larger carnivores such as snakes, coyotes, foxes, and raptors. The temporary absence of the prey species would cause a temporary absence of the predatory species. Because of the variety of species affected in the immediate area of construction, this impact could be considered substantial if long-term. However, the construction related impacts would be temporary in nature, and many of these species would immediately return to the site following construction. Therefore, the impacts to area wildlife are considered minor, temporary, and less than significant.

Where appropriate, revegetation through seeding of grasses, planting of trees, and reshaping of borrow areas would be done as soon as practical after completion of, or concurrent with, construction activities. This in turn would minimize the length of time soils are exposed and area habitat is unusable. In time, these areas would revert to pre-construction conditions and area wildlife could once again feed, breed, and shelter in these areas.

"No Action" Alternative

The "No Action" alternative would involve no construction activity, no impacts to area vegetation, and no change in project operations. Therefore, no effects on wildlife resources in the study area would be expected.

4.4.3 Aquatic Ecosystem (including fisheries and wetlands)

Impacts to aquatic resources, including fisheries and wetlands, were assessed by determining whether the alternatives under consideration would result in the loss of these aquatic resources.

Preferred Alternative

Construction of the preferred alternative is not expected to result in significant impacts to fisheries, including the pallid sturgeon, in the Missouri River because the levees under consideration are from one quarter to one half mile from the river. The proposed modification to the levee is not expected to alter the thalweg or any part of the river itself (including shallow water habitat), and the extensions to the levee toe and seepage berms would occur mainly on the landside of the levee. The proposed project will remove young trees and modify wetland areas which provide leaf drop and nutrients to the surrounding area and to the river itself during times of out-of-bank flows. This nutrient load is made available to Missouri River fishes when river waters flood onto the floodplain. Lands adjacent to the area will provide this function during the construction phase of the project, and impacted areas will re-establish/revert to existing conditions over time. Therefore, the proposed project is expected to have less than significant effects on Missouri River fisheries.

A total of 4.9 acres of farmed wetlands will be permanently impacted as the width of the levee toe is increased. Wetlands provide numerous functions and values such as temporary storage of surface water, maintenance of subsurface hydrology, cycling of nutrients, removal of "hazardous" elements and compounds, detainment of particulates, export of organic carbon, varied plant communities, habitat for wildlife, unique areas of open space, and opportunity for research and pleasure. Impacts to wetlands riverward of the existing levees and within borrow areas will be short-term, minimal, and less than significant as these areas will quickly revegetate after completion of construction. Impacts to landward wetlands and those within the riverward areas of levee expansion will be permanent. This permanent loss of wetlands would contradict the Corps' policy of "no net loss of wetland habitat" unless measures to avoid, minimize, and mitigate their loss is implemented. Sufficient mitigation to offset the impacts to wetland habitat resulting from this alternative has been proposed as part of the proposed alternative to provide a no net loss of wetland habitat and is detailed above in the Vegetation section. Therefore, impacts to area wetlands are considered less than significant.

To offset the loss of approximately 4.9 acres of farmed wetlands occurring along the toe of the existing levee units, similar amounts of wetlands will be re-established onsite in accordance with the Corps of Engineers Regulatory Guidance Letter dated December 24, 2002. Re-establishment will require the manipulation of the physical, chemical, and biological characteristics of existing areas within the borrow sites. This will be accomplished through the reshaping and scraping of borrow sites in order to expand their size equal to, or greater than, that which was lost. This will serve multiple purposes. First, borrow sites will be located in close proximity to where material is needed; thereby reducing haul time and expense. Second, obtaining borrow in the manner previously described will offset construction related impacts with like habitat and reduce mitigation costs.

Alternative 2 (500 plus 1.5 feet of margin)

Construction of Alternative 2 is not expected to result in significant impacts to fisheries in the Missouri River because the levee under consideration is from one quarter to one half mile from the river. The proposed modification to the levee is not expected to alter the thalweg or the river itself, and the extensions to the levee width and seepage berms would occur mainly on the landside of the levee. The proposed project will remove young trees and modify wetland areas which provide leaf drop and nutrients to the surrounding area. This nutrient load is made available to Missouri River fishes when river waters flow onto the floodplain. Lands adjacent to the area will provide this function during the construction phase of the project, and impacted areas will re-establish over time. Therefore, the proposed project is expected to have less than significant effects on fisheries.

A total of 6.2 acres of wetland habitat will be impacted as the width of the levee toe and seepage berms are increased. Wetlands provide numerous functions and values such as temporary storage of surface water, maintenance of subsurface hydrology, cycling of nutrients, removal of elements and compounds, detainment of particulates, export of organic carbon, varied plant communities, habitat for wildlife, unique areas of open space, and opportunity for research. Impacts to wetlands riverward of the existing levees and within borrow areas, will re-establish over time so these impacts will be minimal. However, landward wetlands and those within the riverward areas of levee expansion will be permanently lost. Sufficient mitigation to offset the impacts to wetland habitat resulting from this alternative has been proposed as part of the proposed alternative to provide a no net loss of wetland habitat and is detailed above in the Vegetation section. Therefore, impacts to area wetlands are considered less than significant.

Alternative 3 (500 plus 3.0 feet of margin)

Construction of Alternative 3 is not expected to result in significant impacts to fisheries in the Missouri River because the levee under consideration is from one quarter to one half mile from the river. The proposed modification to the levee is not expected to alter the thalweg or the river itself, and the extensions to the levee width and seepage berms would occur on the landside of the levee. The proposed project will remove young trees and modify wetland areas which provide leaf drop and nutrients to the surrounding area. This nutrient load is made available to Missouri River fishes when river waters flow onto the floodplain. Lands adjacent to the area will provide this function during the construction phase of the project, and impacted areas will re-establish over time. Therefore, the proposed project is expected to have less than significant effects on fisheries.

A total of 7.3 acres of wetland habitat will be impacted as the width of the levee toe and seepage berms are increased. Wetlands provide numerous functions and values such as temporary storage of surface water, maintenance of subsurface hydrology, cycling of nutrients, removal of elements and compounds, detainment of particulates, export of organic carbon, varied plant communities, habitat for wildlife, unique areas of open space, and opportunity for research. Impacts to wetlands riverward of the existing levees and within borrow areas, will be temporary and re-establish over time so are considered minimal. However, landward wetlands and those within the riverward areas of levee expansion will be permanently lost. Sufficient mitigation to offset the impacts to wetland habitat resulting from this alternative has been proposed as part of the proposed alternative and is detailed above under the Vegetation section. Therefore, impacts to area wetlands are considered less than significant.

Alternative 4 (100 plus 1.5 feet of margin)

Construction of Alternative 4 is not expected to result in significant impacts to fisheries in the Missouri River because the levees under consideration are from one quarter to one half mile from the river. The proposed modification to the levee is not expected to alter the thalweg or any part of the river itself (including shallow water habitat), and the extensions to the levee toe and seepage berms would occur mainly on the landside of the levee. The proposed project will remove young trees and modify wetland areas which provide leaf drop and nutrients to the surrounding area and to the river itself during times of out-of-bank flows. This nutrient load is made available to Missouri River fishes when river waters flood onto the floodplain. Lands adjacent to the area will provide this function during the construction phase of the project, and impacted areas will re-establish/revert to existing conditions over time. Therefore, this alternative is expected to have less than significant effects on Missouri River fisheries.

A total of 4.2 acres of wetland habitat will be permanently impacted as the width of the levee toe is increased. Wetlands provide numerous functions and values such as temporary storage of surface water, maintenance of subsurface hydrology, cycling of nutrients, removal of "hazardous" elements and compounds, detainment of particulates, export of organic carbon, varied plant communities, habitat for wildlife, unique areas of open space, and opportunity for research and pleasure. Impacts to wetlands riverward of the existing levees within borrow areas will be short-term, minimal, and less than significant. However, landward wetlands and those within the riverward areas of levee expansion will be permanently lost. This permanent loss of wetlands would contradict the Corps' policy of "no net loss of wetland habitat" unless measures to avoid, minimize, and mitigate their loss is implemented. Sufficient mitigation to offset the impacts to wetland habitat resulting from this alternative would be similar to preferred alternative and is detailed above under the Vegetation section. Therefore, impacts to area wetlands are considered less than significant.

“No Action” Alternative

The “No Action” alternative would involve no construction activity and no change in project operations. Effects on the aquatic ecosystem would be similar as described above in the vegetation section under this alternative.

4.4.4 Threatened and Endangered Species

Impacts to Federal and state listed threatened and endangered species were assessed as to the potential for the project to modify or destroy critical habitat, jeopardize the continued existence of a listed species, or result in the taking of an individual or the habitat upon which they depend. Important fish and wildlife habitats for listed species within the project area are associated with the river and are generally riverward of the main levees. Important threatened and endangered species habitats include the river, side channels and chutes, cut-off islands and sloughs, tributary confluences, floodplain scour lakes and blow holes created by past floods, floodplain forests, emergent wetlands, and former borrow areas. The highest value habitats are located on the Missouri side of the river around Lake Contrary between river mile 437 and 444 and outside of the proposed project area.

Preferred Alternative

The species listed in table 4-1 below were evaluated for impacts because suitable habitat for these species occurs within the project site and may be altered as a result of construction activities. The other species that were previously described in Section 3 were not evaluated because no documented occurrence of these species was found in the immediate project area. A total of 4.9 acres of wetland habitat and 19.7 acres of terrestrial habitat will be permanently impacted by the proposed project. The impact to these habitats will be limited to the amount necessary to complete the levee raise, and any impacts to wetlands and trees landward and within the berm extension areas riverward of the levee will be mitigated. A sufficient amount of similar habitat occurs adjacent to the proposed project site for use by these species so impacts are considered to be less than significant.

Table 4-1. Species Considered by the Proposed Project.

Species	Status	Preferred habitat
American burying beetle	Kansas State Endangered	Agricultural lands, mowed areas, riparian forests
Eastern spotted skunk	Kansas State Threatened	Brushy grasslands and woodland edges
Snowy plover	Kansas State Threatened	Sparsely vegetated wetlands and impoundment shorelines
White-faced ibis	Kansas State Threatened	Wetlands and impoundments

Construction of the preferred alternative is not expected to result in adverse impacts to fisheries in the Missouri River, including the pallid sturgeon, because the levees under consideration are from one quarter to one half mile from the river. The proposed modification to the levee is not expected to alter the thalweg or any part of the river itself (including shallow water habitat), and the extensions to the levee toe and seepage berms would occur mainly on the landside of the levee. No adverse effects to bald eagles are expected as construction of the preferred alternative will not substantially reduce habitat used for feeding, breeding, or sheltering of this species (avoidance of any larger older growth trees greater than 50 feet tall and/or 24-inches diameter of breast height within 100 feet of the water's edge). After coordinating with the USFWS and the relevant state agencies, it is the Corps' determination that the proposed action would have no adverse effect on federally listed or State listed threatened or endangered species.

Alternative 2 (500 plus 1.5 feet of margin)

The species listed in table 4-1 were considered because suitable habitat for these species occurs within the project site and may be altered as a result of construction activities. A total of 6.2 acres of wetland habitat and 22 acres of terrestrial habitat will be impacted by this alternative. The impact to these habitats will be limited to the amount necessary to complete the levee raise and any impacts to wetlands landward and within the berm extension areas riverward, of the levee will be mitigated. A sufficient amount of similar habitat occurs adjacent to the proposed project site for use by these species so impacts are considered to be less than significant.

Alternative 3 (500 plus 3.0 feet of margin)

The species listed in table 4-1 were considered because suitable habitat for these species occurs within the project site and may be altered as a result of construction activities. A total of 7.3 acres of wetland habitat and 24.1 acres of terrestrial habitat will be impacted by this alternative. The impact to these habitats will be limited to the amount necessary and any impacts to wetlands landward and within the berm extension areas riverward, of the levee will be mitigated. A sufficient amount of similar habitat occurs adjacent to the proposed project site for use by these species so impacts are considered to be less than significant.

Alternative 4 (100 plus 1.5 feet of margin)

The species listed in table 4-1 were considered because suitable habitat for these species occurs within the project site and may be altered as a result of construction activities. A total of 4.2 acres of wetland habitat and 16 acres of terrestrial habitat will be impacted by this alternative. The impact to these habitats will be limited to the amount necessary to complete the levee raise and any impacts to wetlands landward and within the berm extension areas riverward of the levee will be mitigated. A sufficient amount of similar habitat occurs adjacent to the proposed project site for use by these species so impacts are considered to be less than significant.

"No Action" Alternative

The "No Action" alternative would involve no construction activity and no change in project operations. No reshaping of riverward wetland areas would occur so increases in their functions would not be provided. Effects on threatened and endangered species in the study area would remain status quo.

4.5 Socio-Economic Environment

4.5.1 Demography

Any alternative allowing the R471-460 levee to regain certification would help avert an otherwise likely population decline in the right bank Elwood/Wathena area as well as help stabilize population levels in the entire study area, possibly even setting the stage for modest future population increases. Recertification would be accomplished by Alternatives 1, 2, and 3 but not by Alternative 4. Normal operations would continue at the Missouri Air Guard base, resulting in the continued presence in the right bank area of several hundred trainees and employees. Besides directly supporting population levels in the Elwood/Wathena area, the presence of the National Guard and their spending on area retail and services would help maintain the healthy economic climate that is vital to long term population maintenance and growth. Recertification also would reduce costs to residents and business owners due to increased flood insurance premiums and stricter building code requirements, removing disincentives that might cause businesses and residents to relocate from the Elwood area and result in a sharp population reduction.

Although effects in the L-455 area would be more modest, the maintenance of one of the metro area's largest employers along with the retail and service demand associated with the base should be a stabilizing influence on the population of St. Joseph. In additional to the benefits of levee recertification, reduced flood damage potential also would remove another possible source of future population decline in the Elwood/Wathena area. All four of the build alternatives would provide increased flood damage reduction in the R471-460 area, with the greatest benefits provided by alternative 3, 2, 1, and 4 respectively. Alternatives 3 and 2 also would produce additional flood damage reduction in the L-455 area, while Alternatives 1 and 4 would not. Finally, modest transitory population increases could occur in both the right and left bank areas in connection with project construction. Alternatives 1, 2, and 3 would be beneficial to the Demography of the St. Joseph metropolitan area. Alterative 4 could have adverse affects to the area.

"No Action" Alternative

If the levee is not improved and returned to certification standards, the Missouri Air Guard base that dominates the R471-460 area probably would be closed. This would reduce both the right bank and the St. Joseph metropolitan area population by removing several hundred trainees from the study area. The Elwood/Wathena area, which already struggles to attract economic development, would be saddled with additional burdens, greater flood damage potential, and increased costs due to flood insurance premiums and building elevation requirements in its efforts to retain and strengthen its economic base. The lost jobs and incomes would depress retail activity around Elwood and Wathena, and these effects could be felt even in the left bank urban area. A declining population in the Elwood/Wathena area would be the likely result. Population growth in the L-455 area also would probably be adversely affected in the long term. The "no Action" alternative could have adverse affects to the project area.

4.5.2 Development and Economy

Implementation of alternatives to improve the R471-460 and L-455 levee units would result in direct and indirect economic benefits to the entire study area. First, costly flood damage for business owners and residents would be prevented in all but the most catastrophic flood events. In the R471-460 area, all four alternatives considered would increase physical flood damage reduction, with the greatest damage prevention provided by (in order) alternatives 3, 2, and 1. Alternative 4 also would provide significant flood damage reduction, although less than the other three alternatives. In the L-455 area, alternatives 2 and 3 produce physical flood damage reduction benefits in the industrial, residential and agricultural portions of the area, while alternatives 1 and 4 produce no such benefits on the left bank. The L-455 area also would indirectly benefit from flood damage reduction in the R471-460 area since the St. Joseph airport would be better protected.

Second, the regulatory burdens of decertification in the right bank area, including flood insurance expenses and requirements to elevate new buildings, would be eliminated; making it easier to build new homes, expand existing businesses and facilities and open new ones. Alternatives 1, 2 and 3 would allow R471-460 to regain certification, while alternative 4 would not. In addition, recertification would greatly reduce the likelihood of losing the Air National Guard base as well as other businesses and facilities in the right bank area. Continued operation of these facilities in and around Elwood would keep hundreds of jobs and incomes in the study area and would provide continued consumer demand that would bolster retail and service concerns on both the left and right banks. Prospects for progressive future economic development in the study area, particularly in and around Elwood, would be greatly strengthened. Finally, construction of any of the four alternatives would provide short and medium term study area impacts in terms of additional jobs, incomes and spending.

"No Action" Alternative

Failure to implement any of the four construction alternatives would result in a continuing potential for catastrophic flood damage in the R471-460 area. The rural Elwood/Wathena area, which already struggles to attract economic development, would be saddled with additional burdens – continuing potential for catastrophic economic losses due to physical flood damage affecting all properties in the protected area as well as increased regulatory costs due to stricter building codes and new flood insurance premiums. The Missouri Air National Guard base almost certainly would relocate from the study area, and other large businesses and facilities in the R471-460 area also could flee the ongoing flood risk. Expansion of existing businesses would be discouraged. Many current residents would relocate from the Elwood/Wathena area and few new residents would replace them. On the left bank, residual annualized economic flood losses in the L-455 area, while much less severe than on the right bank, would continue to be an issue in the no action case. Loss of the ANG base on the right bank would be detrimental to the left bank area since several hundred area jobs would be lost along with associated consumer demand for retail and services. The main St. Joseph area airport would continue to be subject to severe flood damage and operational interruptions, adversely affecting businesses on the left bank. Retail and service businesses in St. Joseph would be hurt by the decline of the nearby Elwood area.

4.5.3 Land Use

The following applies equally to alternatives 1, 2, and 3. Land use in the area following construction of the levee project will convert portions of existing land use types to permanently unusable area. As the levee is expanded, deciduous trees, shrubland, grassland, wetlands, naturally bare areas, and cultivated lands will be replaced with fill. The resulting impacts to area wildlife habitat have been minimized and offset to the maximum extent as described earlier in this EA. Impacts on developed areas will be minimal, temporary, and construction related. Increased development could occur within the area floodplain but would be subject to future floodplain management plans. Construction will require the Herzog Sand and Gravel Company to temporarily move current stockpiles of material so that the seepage berms may be constructed. Following construction, the stockpiles may be returned to their original "resting spots". This impact is believed to be short-term, construction related, and insignificant. Impacts resulting from Alternative 4 would be similar to the No Action Alternative below.

No Action" Alternative

The "No Action" alternative would involve no construction activity and no change in project operations. This condition would likely not change land use from existing conditions and thereby limit increases in economic development. This could have a substantial impact to the area economy but would likely be a less than significant impact overall.

4.5.4 Transportation

Preferred Alternative

Construction of the preferred alternative will result in slight disruptions of traffic through the St. Joseph metropolitan area. These disruptions would result from an increase in the use of roads and byways by construction related equipment. The disruption is expected to be less than significant.

After project completion, area roads are expected to experience minimal to no flooding during the 100-year event. Thus, operation of the completed project will have a substantial beneficial affect to area roads and byways.

Alternative 2 (500 plus 1.5 feet of margin)

Construction of Alternative 2 will result in slight disruptions of traffic through the St. Joseph metropolitan area. These disruptions would result from an increase in the use of roads and byways by construction related equipment. Traffic under this alternative is expected to be slightly greater than the preferred alternative because the increased level of flood damage reduction would likely require an increase in the usage of the roads and byways by construction related equipment over a longer period of time. However, the disruption is expected to be less than significant.

After project completion, area roads are expected to experience minimal to no flooding during the 500-year event. Thus, operation of the completed project will have a substantial beneficial affect to area roads and byways.

Alternative 3 (500 plus 3.0 feet of margin)

Construction of Alternative 3 will result in slight disruptions of traffic through the St. Joseph metropolitan area. These disruptions would result from an increase in the use of roads and byways by construction related equipment. Traffic under this alternative is expected to be slightly greater than the preferred alternative because the increased level of flood damage reduction would likely require an increased in the usage of the roads and byways by construction related equipment over a longer period of time. However, the disruption is expected to be less than significant.

After project completion, area roads are expected to experience minimal to no flooding during the 500-year event. Thus, operation of the completed project will have a substantial beneficial affect to area roads and byways.

Alternative 4 (100 plus 1.5 feet of margin)

Construction of Alternative 4 would result in slight disruptions of traffic through the St. Joseph metropolitan area. These disruptions would result from an increase in the use of roads and byways by construction related equipment. The disruption is expected to be less than significant.

After project completion, area roads will still experience minimal flooding during the 100-year event. Thus, operation of the completed project could pose a negative effect to area roads and byways.

"No Action" Alternative

The "No Action" alternative would involve no construction activity and no change in project operations. This condition could pose a problem to transportation during a 100-year flood event. Area roads could be flooded impairing evacuation and rescue of the local population. As such, negative impacts to transportation could occur as a result of the no action alternative.

4.5.5 Utilities/Water supply

Preferred Alternative

The utilities in the project area consist of five known utility lines within the right bank unit. These lines will be subject to a raise as a result of the proposed project. The utility lines will be protected during relocation with no or minimal anticipated interruption in service. There are no known utility lines within the area of the left bank unit subject to a raise. As such, the impacts to utilities and water supply lines from the proposed project are believed to be less than significant.

Alternative 2 (500 plus 1.5 feet of margin)

The impacts under this alternative would be similar to those listed for the preferred alternative.

Alternative 3 (500 plus 3.0 feet of margin)

The impacts under this alternative would be similar to those listed for the preferred alternative.

Alternative 4 (100 plus 1.5 feet of margin)

The impacts under this alternative would be similar to those listed for the preferred alternative.

"No Action" Alternative

The "No Action" alternative would involve no construction activity and no change in utility relocation. The No Action Alternative would have no significant impact on the utilities and water supply lines in the St. Joseph metropolitan area.

4.5.6 Flood damage reduction

Preferred Alternative

Construction of the preferred alternative would result in an increased level of flood damage reduction for the St. Joseph metropolitan area by allowing passage of the one percent flood event with 90 percent reliability. Additionally, the preferred alternative would allow for FEMA to re-certify the existing levee. FEMA re-certification could result in lower flood insurance policies, increased flood damage reduction to the St. Joseph metropolitan area infrastructure, and increased economic growth. The preferred alternative would have a substantial beneficial impact to the St. Joseph metropolitan area.

Alternative 2 (500 plus 1.5 feet of margin)

Construction of alternative 2 would result in an increased level of flood damage reduction for the St. Joseph metropolitan area over that of the preferred alternative. This alternative would allow passage of the 0.2 percent (500-year plus 1.5 feet of margin) flood event with 90 percent reliability. Additionally, the increased level of flood damage reduction alternative would allow FEMA to re-certify existing levees. FEMA re-certification could result in lower flood insurance policies, increased flood damage reduction to the St. Joseph area infrastructure, and increased economic growth. The increased level of flood damage reduction alternative would have a substantial beneficial impact to the St. Joseph metropolitan area over that of the preferred alternative.

Alternative 3 (500 plus 3.0 feet of margin)

Construction of alternative 3 would result in an increased level of flood damage reduction for the St. Joseph metropolitan area over that of the preferred alternative. This alternative would allow passage of the 0.2 percent (500-year plus 3.0 feet of margin) flood event with 90 percent reliability. Additionally, the increased level of flood damage reduction alternative would allow FEMA to re-certify existing levees. FEMA re-certification could result in lower flood insurance policies, increased flood damage reduction to the St. Joseph area infrastructure, and increased economic growth. The further increased level of flood damage reduction alternative would have a substantial beneficial impact to the St. Joseph metropolitan area over that of the preferred alternative.

Alternative 4 (100 plus 1.5 feet of margin)

Construction of Alternative 4 would result in an increased level of flood damage reduction for the St. Joseph metropolitan area by allowing passage of the one percent flood event with 75 percent reliability. However, this alternative would not allow FEMA to re-certify the levee. This in-turn would not allow lower flood insurance policies, would only slightly increase flood damage reduction to the St. Joseph metropolitan area infrastructure, and could possibly stymie economic growth. It could have a negative impact to the St. Joseph metropolitan area through decreased economic development.

"No Action" Alternative

The "No Action" alternative would involve no construction activity and no change in project operations. This alternative would not allow FEMA re-certification of the area levees, would increase chances of area flooding, and could potentially stymie economic development in the area. The alternative would have a substantial negative impact on the St. Joseph metropolitan area.

4.5.7 Recreation

The following applies equally to all four of the build alternatives. Recreational use in the project area primarily involves boating and fishing. Most of the land in the project area is privately owned and access limited. Some hiking and wildlife viewing is conducted within the project area, and these activities could be temporarily impacted during construction periods. It is believed that hiking and wildlife viewing will be returned to their pre-construction state following construction; thus the impacts will be short-term, construction related, and insignificant.

"No Action" Alternative

The "No Action" alternative would involve no construction activity and no change in project operations. Therefore, no effects to recreational resources in the study area would be expected.

4.5.8 Archaeological & Historic Resources

All Build Alternatives

The Corps initiated Section 106 coordination with the Kansas and Missouri State Historic Preservation Officers (SHPO's) in 2001. At that time, the Corps recommended that no archeological survey be required for a majority of the proposed levee work, because the proposed levee was to be constructed on accreted land and on land previously disturbed by the construction of the existing levee. A small segment of the study area in Kansas was recommended for survey. Both SHPO's concurred with these recommendations. The archeological survey was conducted in 2002. No archeological sites or materials were identified during the survey and no further archeological investigations on the levee alignment are recommended. The Kansas SHPO concurred with this recommendation on July 8, 2002; with the stipulation that any additional ground disturbing activities (e.g. borrow areas), be submitted for review prior to construction.

In 2006, the Corps identified the general location of potential borrow areas for the proposed project. All of these areas were located in portions of the project adjacent to the levees. In a letter to the SHPO (March 7, 2006), the Corps recommended that based on their findings that no survey be conducted for the potential borrow areas because they are located on accreted land, land previously disturbed by past borrowing activity, and land that has very low potential for containing intact archeological sites. The SHPO concurred with these recommendations in a letter dated March 23, 2006. As required, the Corps will coordinate the project with affiliated Native American tribes potentially impacted by the proposed work.

If additional ground disturbing activities are needed for the project, further coordination with the SHPO's and Native American tribes will be required. Also, in the unlikely event that archeological deposits or other cultural resources are encountered during construction, work in the area of discovery would cease and the discovery investigated and coordinated with the appropriate SHPO and federally recognized Native American tribes.

No historic properties are recorded within the area of the proposed alternatives. These alternatives, all following the same alignment but with differing footprint widths, were found to have a low potential for unrecorded archeological sites because they are primarily situated on accreted land and land previously disturbed by construction of the existing levee. Based on those factors, the Corps recommended no further investigations be conducted for any of the alternatives. The Kansas and Missouri SHPO's have concurred with these recommendations.

The locations of the recorded shipwrecks will be avoided during borrow or dredge material acquisition. If these areas cannot be avoided, then additional investigations and SHPO coordination will be done. Also, if a new alignment is chosen or different borrow locations are selected for the project, further coordination with SHPO and Native American tribes will be conducted. For all of the build alternatives, no impacts to archaeological or historic resources are anticipated.

"No Action" Alternative

The "No Action" alternative would result in no ground disturbances and would not have an effect on cultural resources.

4.5.9 Environmental Justice

Preferred Alternative

The majority of the persons in the proposed project area reported their race as "White". This is followed by Blacks, Hispanic/Latino, Other races, Native American/ Alaskan, Asian, and finally Pacific Islander. When the total populations of the other than white races are summed, only a very small percentage consists of "minority" races. There is no reason to believe that the St. Joseph flood damage reduction study would have a disproportionate adverse effect on minority populations in the study area.

The level of education and/or literacy rates for the adult population provides a critical measure of the likelihood and the ability of the community to know about and participate in public meetings, to comment on written proposals and to otherwise participate in the decision-making process. From the Census 2000 data, over 80% of residents in each county are high school graduates. Thus, there are generally no reasons to believe that the educational levels of the residents within these counties would prohibit them from engaging in the public decision-making process.

Information on whether languages other than English are spoken among the population, and percentage distribution of these languages, is important in determining effective public participation processes. According to the U.S. Census Bureau (2000), 96% of individuals age five and over speak English. The percent of language other than English that is spoken in the area is about 2.8%. Thus, there are generally no reasons to believe that the language of the residents within these counties would prohibit them from engaging in the public decision-making process.

Children under age five and elderly populations above age 65 are considered to be sensitive populations that may experience disproportionate impacts from environmental stressors. From the data presented in Section 3.3.10 above, there is no reason to believe that the proposed flood damage reduction project would have a disproportionate adverse impact on this sector of the sensitive population. Overall, the impacts from the proposed project are equally shared across racial and economic spectrums, thus, the impacts are not considered to be disproportionate.

Alternative 2 (500 plus 1.5 feet of margin)

Alternative 2 would have the same effects on the "sensitive population indicators" as the preferred alternative described above.

Alternative 3 (500 plus 3.0 feet of margin)

Alternative 3 would have the same effects on the "sensitive population indicators" as the preferred alternative described above.

Alternative 4 (100 plus 1.5 feet of margin)

Alternative 4 would have the same effects on the "sensitive population indicators" as the preferred alternative described above.

"No Action" Alternative

The No Action Alternative could make the St. Joseph metropolitan area more susceptible to area flooding during the 100-year flood event. Because the area population contains more minorities over that of the State average; a negative, but less than significant impact, could occur to the sensitive population indicators within the project area.

4.6 Cumulative Impacts

The combined incremental effects of human activity are referred to as cumulative impacts. While these effects may be insignificant on their own, accumulated over time and from various sources can result in serious degradation of the environment. The analysis must consider past, present and reasonably foreseeable actions in the study area. The analysis must include consideration of actions outside of the Corps, to include other State and Federal agencies. As required by NEPA, the Corps has prepared the following assessment of cumulative impacts related to the alternatives being considered in this EA.

The potential impacts resulting from the no action alternative have been analyzed and; for the most part, there will be no significant impacts to most of the human environment. Exception to this analysis can be found in the areas of human safety and economic development. The overall potential impacts of the proposed project have been analyzed; and are considered minimal because the actions consist primarily of improvements to an already existing flood damage reduction system.

The methodology used to determine the potential for substantial cumulative impacts included the following:

1. Identify the location and extent of impacts resulting from the proposed flood damage reduction action during both the construction and operational phase.

2. Identify all past, present, and reasonably foreseeable future public and private actions from existing reports and through interviews with local planning agencies that may result in cumulative impacts. These actions are defined as actions occurring regionally or in the project boundary area and includes demographic trends, land use changes, Corps programs, other governmental agency actions, and past and current private development in the area surrounding the proposed project. Foreseeable future actions include plans that have been identified and defined with respect to a future timeframe and general location for the proposed development or activity.

3. Determine the cumulative impact zone. The boundary of the cumulative impact analysis zone varies according to the resource evaluation category considered. For many of the resource categories considered, the impacts of the proposed action are not expected to extend beyond the footprint of the project boundaries.

4. Determine the substantial impacts. The determination of substantial impacts for the cumulative analysis is defined in 40 CFR, §1508.27 (Regulations for Implementing the National Environmental Policy Act). It requires consideration of both the intensity and context of the impacts evaluated.

5. The impacts of past, present, and reasonably foreseeable future actions, in association with implementation of the proposed activity, are discussed with respect to each of the resource evaluation categories. The discussion of the no action alternative focuses on identifying the anticipated impacts of not implementing the proposed action.

Past Actions

Rosecrans Air National Guard Base

Rosecrans Air National Guard Base consists of approximately 302 acres of land located between Kansas and Missouri on an oxbow island just west of the Missouri River and St. Joseph, Missouri. There are four sites in this area that have soil or groundwater contamination requiring further characterization and possible remedial actions. Primary contaminants of concern are: aircraft fuels, chlorinated solvents, strippers, waste oils, toluene, polynuclear aromatic hydrocarbons, various organic chemicals, arsenic and cadmium. The underground storage tank site has one or more tanks known to have leaked fuel.

Rosecrans Field Rifle Range

This 59.3 acre site is in St. Joseph, Missouri. The Department of Defense began using this site in 1942. The former rifle range is now divided between private owners, the Park Department of the city of St. Joseph and the State Highway Commission. There is possible contamination of heavy metals at this site.

Missouri River

Man-made features and natural processes have affected the Missouri River conditions. A major man-made feature that effects water surface elevations includes the Missouri River Levee System.

The Missouri River has been subject to many natural processes that have affected river stage. A general decline river stage is anticipated to occur during low flows (20,000 cfs to 100,000 cfs), and a general increase in river stage is anticipated to occur during high flows (<100,000 cfs). These flow and stage fluctuations are primarily attributed to the accretion of land and subsequent vegetation establishment behind dikes placed for navigation channel alignment.

The establishment of woody vegetation, primarily trees, stabilizes the accreted land from erosion and allows the accretion and vegetation cycle to continue further into the channel. Substantial accretion and tree establishment within the project area has occurred along both banks of the Missouri River.

Accreted land tree growth leads to rising stages for a given flow as conveyance area is decreased and over bank roughness is substantially increased. The accretion/vegetation cycle is also partially responsible for the decreasing stages of less than bank-full events. The existing dikes and accreted land has confined flow to the navigation channel, thereby inducing higher velocities and a general decline in the bed elevation.

In accordance with the *USFWS 2003 Amendment to the 2000 Biological Opinion on the Operation of the Missouri Mainstem Reservoir System and the Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project*, the Corps is working on the restoration of shallow water habitat (SWH) for the federally endangered pallid sturgeon along the Missouri River. Restoration includes excavating notches, pilot channels and chutes, dredging, and dike modifications.

By constructing these river control modifications, accreted land is either removed or allowed to erode. The accreted lands removed by these modifications are replaced with shallow slack water areas that provide a rich environment for the pallid sturgeon as well as other wildlife. While providing an ecological benefit through diversifying the Missouri River ecosystem, the SWH program also helps deter the accretion/vegetation cycle contributing to the upward stage trends of high flows in the Missouri River. The design of these dike/bank modifications discourages further accretion at that location and encourages bank loss at each site, thereby increasing conveyance. With the ongoing SWH work along the Missouri River it is assumed that this continued widening of the channel will negate any further effects due to accretion and vegetation of those accreted lands. The 1993 flood calibration fully accounted for all changes in the fluvial geomorphology of the Missouri River that affect high stages in the project area.

Population growth has occurred in almost all of the project area, especially within established urban areas. Expansion of these urban areas and associated habitat loss probably represents the most serious threat to fish and wildlife resources in the project area. Urban areas continue to expand onto traditionally agricultural lands and on the floodplain. The Federal Emergency Agency's National Flood Insurance Program currently regulates development on the floodplain. Although minimizing development within the mapped 100-year flood plain, this program does not prevent development on the natural floodplain outside of the 100-year floodplain boundary.

Per FEMA mapping, the areas currently protected by the existing levees are outside of the 100-year floodplain. Development that occurs within the floodplain would not be in violation of Executive Order 11988. These protected areas are urbanized and development has been in place for many years. Development induced by the levees is expected to occur because open space remains.

These actions have resulted in substantial changes in land use and in adverse effects on water quality, vegetation, and riparian and riverine habitat. Groundwater quality from the contamination at the Air National Guard Base and Field Rifle Range are of general concern. However, based on the scope and associated construction of the proposed project, no cumulative effects are anticipated.

Present Actions:

The Mid-America Regional Council (MARC), bi-state, and regional economic development agencies will continue to develop a growth management plan and program focused on:

- Developing a consistent set of planning and development policies, and zoning and building code regulations to be applied equally to the cities and surrounding areas.
- Working with homebuilders to stimulate the construction of affordable single and multi-family housing.
- Working with federal, state and local agencies to coordinate expansion/augmentation of public streets, water and sewerage systems serving the areas surrounding the project site; improve schools, commercial services, quality of life programs, and job opportunities for residents.
- Promoting the use of Best Management Practices and other environmental controls during construction activities, which have reduced the potential impact of these activities on surface waters.
- Constructing roadways and other facilities, which may have resulted in short- and long-term increases in:
    - Levels of particulate matter released into the atmosphere.
    - Noise levels in the surrounding area.
    - Soil displacement and subsequent erosion leading to an increase in sediment load in surface waters.
- Existing dredging operations near project sites may have resulted in:
    - The release of particulate matter and carbon monoxide to the atmosphere.
    - Increased noise levels in the surrounding community.
    - Modification in the sediment load, contaminants and debris within the surface waters of the Missouri River within the region.

- Industrial operations in the area, which have resulted in the release of pollutants into the atmosphere, including particulate matter.
- Vehicle-related air emissions and noise associated with traffic.
- Prior levee and water control construction activities which have altered the natural flow of the river during both normal flow and flood flow conditions.
- Activities associated with the annual maintenance of the Missouri River Bank Stabilization and Navigation Project.
- The effects of prior flooding and borrow activities in the foreshore area.
- Past industrial activities in the area that have resulted in groundwater contamination.
- Development in the floodplain that has resulted in increased impermeable surfaces such as buildings, roadways, and parking lots. The increase in impermeable surface has resulted in a decrease in recharge to the alluvial aquifer, and a corresponding increase in the amount of surface water runoff.
- Development and road building may have resulted in run off containing petroleum compounds that could infiltrate groundwater, resulting in potential degradation of groundwater quality.
- Development and road construction, which has resulted in soil being removed or disturbed, which has led to localized erosion.
- Vehicle and equipment use, which could have resulted in the absorption by sediment of petroleum compounds contained in run-off from roads and parking lots.
- Construction activities included in the consideration of past and present actions include the existing facilities on-site, plus construction projects currently in progress. The construction, alteration, repair, rehabilitation and maintenance of buildings, structures, site improvements, and utility systems, as required, to ensure that properties are capable of meeting the requirements of changing initiatives and programs.
- Fuel and petroleum product storage and dispensing operations including the operation of remotely located fuel and petroleum product storage and dispensing facilities, as well as the past operation of petroleum wells in the area.
- The routine, ongoing maintenance of federal, state, county, and local highways, roads, and bridges. Contacts with the State of Missouri Department of Transportation, county and local officials confirmed that emphasis is being placed on maintenance and repair of existing transportation systems.
- Utility system construction, installation, operation, maintenance and repair actions within the area. These actions include electrical, water, and gas distribution systems; storm and sanitary sewer collection systems; solid waste collection; and communications systems that must be operated and maintained to support continued operational requirements.
- The continued use and maintenance of numerous features which affect the natural flow of the Missouri River near the project area.
- Natural resources management including the continuation of activities designed to enhance the existing fish, wildlife and plant habitats present within the floodplain and the Missouri River.

- Protection and enhancement of threatened and endangered species.
- The establishment and maintenance of wildlife water units and sedimentation basins; improving water quality by maintaining vegetative cover and minimizing soil losses.
- Identification and mapping of known or potential jurisdictional wetland areas.
- Creation of wetland mitigation sites as part of legally required wetland mitigation for filling / destroying wetlands.
- Habitat changes as a result of river flooding and development in the area.
- Past and present archeological and cultural surveys and reconnaissance of the project area.
- The continuation of various activities intended to support the recreation needs of the entire community within established and enforced limits.
- Population growth.
- A net regional in-migration of population stimulated by industrial development, and the recreation and retirement industries.
- An increase in the tourist and recreational industry in the region.
- New housing construction.
- Increase in school enrollments.
- Expansion of the local municipal and regional service delivery systems such as health care, fire and police protection, etc.
- Private sector activities in manufacturing, retail and commercial development around the boundaries of the project area that have specifically impacted the natural and human environment include: 1) small manufacturing and major industrial plant activity, 2) the operation of commercial and retail outlets 3) quarry operations, 4) power plant operations, and 5) the maintenance, repair and construction of facilities required to support these activities. The interaction of these different private sector projects and activities in the past has resulted in:
    - Warehousing and supply storage operations including the maintenance, operation and execution of central warehousing and supply storage functions on-site, including the receipt of deliveries, off-loading of materials, inspection of materials, inventory, marking of materials, storage, maintenance in storage, issue, turn-in, packing, crating and shipping of all classes of supply materials.
    - Vehicle and equipment maintenance in the area has also had a past and present impact on the environment.

These actions have resulted in substantial changes in land use and in adverse effects on water quality, vegetation, and riparian and riverine habitat. However, it appears that based on the intensity and extent of the effects of the proposed project, there would be no appreciable cumulative effects on natural resources or on cultural resources in the project area. Improved flood damage reduction may result in possible cumulative effects on the socio-economic resources in the area.

Reasonably Foreseeable Future Actions:

The Transportation Equity Act for the 21st Century provides authorizations for highways, highway safety, and public transportation. In this act, Congress re-emphasized the need and importance of conducting metropolitan transportation planning activities. To accomplish these planning activities, the Saint Joseph Metropolitan Planning Organization, in cooperation with the Missouri Department of Transportation, is planning for and developing surface transportation plans and program for the Saint Joseph metropolitan area.

The Long Range Transportation Plan is a 20-year forecast which must consider a wide range of social, environmental, energy, and economic factors in determining overall regional goals and how transportation can best meet these goals. One of the major goals of the plan is to incorporate environmental planning early in overall plan formulation.

These actions will likely result in changes in land use and in adverse effects on water quality, vegetation, and riparian and riverine habitat. However, it appears that based on the intensity and extent of the effects of the proposed project, there would be no appreciable cumulative effects on natural resources or on cultural resources in the project area. Improved flood damage reduction may result in possible cumulative effects on the socio-economic resources in the area.

The proposed project would allow the right-bank unit to be in compliance with FEMA and certified. With potential for payment for flood damages and many people believing that the likelihood of flooding is diminished, more floodplain and flood-prone land landward of the levees could be developed. This would result in more wildlife habitat being converted and more habitat fragmentation. However, because the intent of the proposed project is to provide reliability in passing the 100-year event (as originally constructed), no plans are immediately in place to convert these areas to increased development. Any changes in land use and subsequent development would be based on and in coordination with floodplain development ordinances.

Conclusions

Based on the analysis of past, present and foreseeable future activities along the Missouri River system, the changes of the existing line of flood damage reduction within the St. Joseph metropolitan area reach under the recommended plan cause minor changes within existing project boundaries. These changes involve raises of the existing levee units R471-460 and L-455, expansion of the adjacent underseepage control features, and modification of structural drainage features. These improvements will provide a system that will pass the 1% chance (100-yr) flood event with 92% reliability, greater than the minimum needed for FEMA certification. This increase will be affected without creating substantive changes in river morphology or hydrology, habitat changes along the river, or impacts to terrestrial or aquatic resources.

Hydraulic changes along the Missouri River analyzed using the HEC-RAS model showed no impacts to the flood stage height under 1% event flood conditions. Stage height increases may occur for the extreme events (greater than 0.5% event) with the impacts ranging from 0.40 feet to 0.80 feet. The location of these impacts would range from river miles 454 to 370 with the maximum impacts seen between river mile 325 and 335. These magnitudes of impacts were determined using a hydrograph similar to that seen in the Flood of 1993. A change in hydrograph shape may cause these impacts to vary slightly. Impacts to wetlands, trees and scrub-shrub habitat would occur. However, these impacts along with onsite measures to offset these impacts would not result in substantial changes to the local or regional habitat or a loss of natural resources to the river and the public using those resources.

Based on the analysis provided in this EA, the recommended plan of constructing flood damage reduction reliability improvements within the St. Joseph metropolitan area will not result in significant impacts to river reaches upstream or downstream of the project area. As such, cumulative impacts of the recommended plan are not considered significant.

5. List of Preparers

NAME	TITLE	AREA OF EXPERTISE
Eric S. Lynn, P.E.	Project Manager	Overall Study Manager/ Plan Formulation
Allan Holland	Economist	Economics
Eric Shumate, P.E.	Hydrologist	Hydrology and Hydraulic Modeling
Chuck Sellmeyer	Geospatial Analyst	Geographical Information Systems/Mapping
Stephanie Voss	Mechanical Engineer	Hazards, Toxics, and Radioactive Wastes
Mary Lucido Tim Meade	Cultural Resource Specialists	Cultural Resources
Lora Vacca	Real Estate Specialist	Real Estate Requirements and Transactions
Bob Finneran	Operations Technician	Operations Management and Inspections
Pat Miramontez	Cost Estimator	Cost Estimating and Engineering
Matthew Vandenberg	Environmental Resource Specialist	NEPA Compliance and EA Development
Marvin Parks	Structural Engineer	Structural Engineering and Analysis
John Giacomo	Mechanical Engineer	Mechanical Engineering
Charles Detrick	Geotechnical Engineer	Geotechnical Engineering and Local Protection
Steve Jirousek	Geologist	Geology
Ken Luetkemeyer	Construction Specialist	Construction

Ron Jansen, P.E.	Civil Engineer	Civil Engineering and Pump Station Analysis
John Grothaus, P.E.	Chief, Plan Formulation Section	Project Formulation and Policy

7. Glossary

Emergency Action Plan - a predetermined plan of action to be taken to reduce the potential for property damage and loss of life in an area affected by a dam break.

Failure - the uncontrolled release of water from a dam.

Floodplain - an area adjoining a body of water or natural stream that has been or may be covered by floodwater.

Flood routing - the determination of the attenuating effect of storage on a flood passing through a valley, channel, or reservoir.

Foundation of levee - the natural material on which the dam structure is placed.

Freeboard - the vertical distance between a stated water level and the top of the levee/floodwall.

Grout cutoff - a barrier produced by injecting grout into a vertical zone, usually narrow horizontally, in the foundation to reduce seepage under a dam.

Hydrograph - a graphic representation of discharge, stage, or other hydraulic property with respect to time for a particular point on a stream.

I Outlet - an opening through which water can be freely discharged from a reservoir.

Peak flow - the maximum instantaneous discharge that occurs during a flood.

Piping - the progressive development of internal erosion by seepage.

PMF (Probable Maximum Flood) - a flood that would result from the most severe combination of critical meteorological and hydrologic conditions possible in the region.

Pressure relief well and collector system - the pressure relief well is a vertical well or borehole, usually downstream of impervious cores and/or cutoffs, designed to collect and direct seepage through or under a levee to reduce uplift pressure under or within a levee. The well is designed to prevent piping of the foundation soil. A line of such wells forms a drainage curtain that generally discharges the collected water into a collector ditch.

Riprap - a layer of large un-coursed stones, broken rock, or precast blocks placed in random fashion on the upstream slope of an embankment dam as bank protection.

Seepage - the interstitial movement of water that may take place through a dam, its foundation, or its abutments.

Under-seepage - the interstitial movement of water through a foundation.

8. Acronyms

DCAR – Draft Coordination Act Report
cfs – cubic feet per second
COE – Corps of Engineers
CWA – Clean Water Act
DEIS – Draft Environmental Impact Statement
EA – Environmental Assessment
EAP – Emergency Action Plan
EPA – U.S. Environmental Protection Agency
ER – Engineering Regulation
ESA – Endangered Species Act
FCAR-Final Coordination Act Report
GLO – Government Land Office
KCD – Kansas City District (Corps)
KDA – Kansas Department of Agriculture
KDHE – Kansas Department of Health and Environment
KDWP – Kansas Department of Wildlife and Parks
KGS – Kansas Geological Survey
KSR – Kansas River
KWO – Kansas Water Office
NEPA – National Environmental Policy Act
NHPA – National Historic Preservation Act
NOA – Notice of Availability
NOI – Notice of Intent
PAR – Population at Risk
PMF – probable maximum flood
ROD – Record of Decision
USACOE – U.S. Army Corps of Engineers
USFWS – U.S. Fish and Wildlife Service
USGS – United States Geological Service

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U.S. Army Corps of Engineers, Kansas City District

APPENDICES

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
Kansas and Missouri
Final Environmental Assessment

Table 5
Missouri River Levee System, Units L-455 and R471-460, Flood Damage Reduction Study – Summary of Impacts

ALTERNATIVES ► FACTORS ▼	"No Action" Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Costs	$190,650,916* (2006 dollars) *Damage from 1993 flood was $114,500,000 in 1993 dollars. This was compounded at 4% over 13 years.	$32,686,000 (2005 dollars).	$91,928,504 (2005 dollars).	$120,485,125 (2005 dollars).	$18,500,000 (2005 dollars).
Time To Complete	Represents the current operation.	The approximate time to complete this alternative is estimated at	The approximate time to complete this alternative is estimated at	The approximate time to complete this alternative is estimated at	The approximate time to complete this alternative is estimated at
Geology, Minerals, And Soils	No effects to geology, minerals, or soils are expected under this alternative.	No effects to geology, minerals, or soils are expected under this alternative.	No effects to geology, minerals, or soils are expected under this alternative.	No effects to geology, minerals, or soils are expected under this alternative.	No effects to geology, minerals, or soils are expected under this alternative.
WATER QUALITY	No effects to water quality under this alternative.	Insignificant adverse effects resulting from vegetation removal, reduced filtering effects, and reduced levee overtopping (contact with historic floodplain). Short-term, minor construction related erosion impacts.	Insignificant adverse effects resulting from vegetation removal, reduced filtering effects, and reduced levee overtopping (contact with historic floodplain). Short-term, minor construction related erosion impacts. These impacts would be slightly increased over the preferred alternative due to the increased size of the project and time to complete.	Insignificant adverse effects resulting from vegetation removal, reduced filtering effects, and reduced levee overtopping (contact with historic floodplain). Short-term, minor construction related erosion impacts. These impacts would be slightly increased over Alternative 2 due to the increased size of the project and time to complete.	Insignificant adverse effects resulting from vegetation removal, reduced filtering effects, and reduced levee overtopping (contact with historic floodplain). Short-term, minor construction related erosion impacts. These impacts would be slightly decreased from the preferred alternative due to the decreased size of the project and time to complete.
Air Quality	No effects to air quality would be expected under this alternative.	Insignificant, localized, temporary, and construction related adverse impacts including combustion related emissions from vehicle engine exhaust and fugitive dust from earthmoving operations.	Insignificant, localized, temporary, and construction related adverse impacts including combustion related emissions from vehicle engine exhaust and fugitive dust from earthmoving operations. These impacts are expected to be slightly higher than the preferred alternative due to the increased size of the project and time to complete.	Insignificant, localized, temporary, and construction related adverse impacts including combustion related emissions from vehicle engine exhaust and fugitive dust from earthmoving operations. These impacts are expected to be slightly higher than Alternative 2 due to the increased size of the project and time to complete.	Insignificant, localized, temporary, and construction related adverse impacts including combustion related emissions from vehicle engine exhaust and fugitive dust from earthmoving operations.

ALTERNATIVES ► FACTORS ▼	"No Action" Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Noise	No effects to area noise would be expected under this alternative.	Insignificant, localized, temporary, and construction related adverse impacts resulting from heavy earthmoving equipment use at the project site and on area roads during mobilization.	Insignificant, localized, temporary, and construction related adverse impacts resulting from heavy earthmoving equipment use at the project site and on area roads during mobilization. These impacts are expected to be slightly higher than Alternative 1 due to the increased size of the project and time to complete.	Insignificant, localized, temporary, and construction related adverse impacts resulting from heavy earthmoving equipment use at the project site and on area roads during mobilization. These impacts are expected to be slightly higher than Alternative 2 due to the increased size of the project and time to complete.	Insignificant, localized, temporary, and construction related adverse impacts resulting from heavy earthmoving equipment use at the project site and on area roads during mobilization. These impacts are expected to be slightly less than Alternative 1 due to the decreased size of the project and time to complete.
Visual Quality	No effects to visual quality would be expected under this alternative.	Insignificant, localized, temporary, and construction related adverse impacts resulting from construction equipment, stockpiling of materials, and the clearing, grubbing, and sloping of the existing levee and during borrow operations. No increased visual quality effects upon project completion as a levee currently exists on the project site.	Insignificant, localized, temporary, and construction related adverse impacts resulting from construction equipment, stockpiling of materials, and the clearing, grubbing, and sloping of the existing levee and during borrow operations. These impacts are expected to be slightly higher than Alternative 1 due to the increased size of the project and time to complete. No increased visual quality effects upon project completion are expected as a levee currently exists on the project site.	Insignificant, localized, temporary, and construction related adverse impacts resulting from construction equipment, stockpiling of materials, and the clearing, grubbing, and sloping of the existing levee and during borrow operations. These impacts are expected to be slightly higher than Alternative 2 due to the increased size of the project and time to complete. No increased visual quality effects upon project completion are expected as a levee currently exists on the project site.	Insignificant, localized, temporary, and construction related adverse impacts resulting from construction equipment, stockpiling of materials, and the clearing, grubbing, and sloping of the existing levee and during borrow operations. These impacts are expected to be slightly less than Alternative 1 due to the decreased size of the project and time to complete. No increased visual quality effects upon project completion are expected as a levee currently exists on the project site.
Hazardous Waste Management	No effects to hazardous waste management would be expected under this alternative.	No effects to hazardous waste management would be expected under this alternative.	No effects to hazardous waste management would be expected under this alternative.	No effects to hazardous waste management would be expected under this alternative.	No effects to hazardous waste management would be expected under this alternative.

ALTERNATIVES ► FACTORS ▼	"No Action" Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Vegetation	No effects to vegetation would be expected under this alternative.	Insignificant, temporary, and construction related impacts to 1,139 (likely less) acres of accreted secondary trees and shrublands resulting from borrow excavation. Insignificant, temporary, and construction related impacts to existing levee grasslands. Permanent loss of 7.0 acres of secondary trees and 12.7 acres of shrublands resulting from the levee footprint. Offset proposed.	Insignificant, temporary, and construction related impacts to 1,139 acres of accreted secondary trees and shrublands resulting from borrow excavation. Insignificant, temporary, and construction related impacts to existing levee grasslands. Permanent loss of 7.6 acres of secondary trees and 14.4 acres of shrublands resulting from the levee footprint. Offset proposed.	Insignificant, temporary, and construction related impacts to 1,139 acres of accreted secondary trees and shrublands resulting from borrow excavation. Insignificant, temporary, and construction related impacts to existing levee grasslands. Permanent loss of 8.1 acres of secondary trees and 16 acres of shrublands resulting from the levee footprint. Offset proposed.	Insignificant, temporary, and construction related impacts to 1,139 (likely less) acres of accreted secondary trees and shrublands resulting from borrow excavation. Insignificant, temporary, and construction related impacts to existing levee grasslands. Permanent loss of 5.8 acres of secondary trees and 10.2 acres of shrublands resulting from the levee footprint. Offset proposed.
Wildlife	No effects to wildlife would be expected under this alternative.	Temporary effects to the variety and numbers of local and migrating species as a result of the temporary, construction related impacts from increased human activities and noise associated with construction; the temporary grassland, wetland, and terrestrial habitat effects associated with levee construction and borrow operations; and the permanent loss of 7.0 acres of secondary tree growth, 12.7 acres of shrubland and 4.9 acres of wetlands from levee footprint. Offset proposed.	Temporary effects due to the variety and numbers of local and migrating species as a result of the temporary, construction related impacts from increased human activities and noise associated with construction; the temporary grassland, wetland, and terrestrial habitat effects associated with levee construction and borrow operations; and the permanent loss of 7.6 acres of secondary tree growth, 14.4 acres of shrubland and 6.2 acres of wetlands from levee footprint. Offset proposed.	Temporary effects due to the variety and numbers of local and migrating species as a result of the temporary, construction related impacts from increased human activities and noise associated with construction; the temporary grassland, wetland, and terrestrial habitat effects associated with levee construction and borrow operations; and the permanent loss of 8.1 acres of secondary tree growth, 16 acres of shrubland, and 7.3 acres of wetlands from levee footprint. Offset proposed.	Temporary effects due to the variety and numbers of local and migrating species as a result of the temporary, construction related impacts from increased human activities and noise associated with construction; the temporary grassland, wetland, and terrestrial habitat effects associated with levee construction and borrow operations; and the permanent loss of 5.8 acres of secondary tree growth, 10.2 acres of shrubland and 4.2 acres of wetlands from levee footprint. Offset proposed.
Aquatic Ecosystem (Including Wetlands And Fish)	No effects to the aquatic ecosystem, including wetlands and fish, would be expected under this alternative.	No effects to fish would be expected under this alternative. Insignificant, temporary, and construction related impacts to wetlands within the 1,139 acres (likely less) of accreted lands resulting from borrow excavation. Permanent loss of 4.9 acres of wetlands resulting from the levee footprint. Offset proposed.	No effects to fish would be expected under this alternative. Insignificant, temporary, and construction related impacts to wetlands within the 1,330 acres of accreted lands resulting from borrow excavation. Permanent loss of 6.2 acres of wetlands resulting from the levee footprint. Offset proposed.	No effects to fish would be expected under this alternative. Insignificant, temporary, and construction related impacts to wetlands within the 1,330 acres of accreted lands resulting from borrow excavation. Permanent loss of 7.3 acres of wetlands resulting from the levee footprint. Offset proposed.	No effects to fish would be expected under this alternative. Insignificant, temporary, and construction related impacts to wetlands within the 1,139 acres (likely less) of accreted lands resulting from borrow excavation. Permanent loss of 4.2 acres of wetlands resulting from the levee footprint. Offset proposed.

ALTERNATIVES ► FACTORS ▼	"No Action" Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Threatened And Endangered Species	No effects to threatened and endangered species would be expected under this alternative.	Alternative 1 will not adversely affect any threatened or endangered species or result in adversely modifying or destroying critical habitat. Some adverse effects will result during construction and through wetland and terrestrial habitat loss. These adverse effects will be minimized and off-set, thus no significant impacts are expected.	Alternative 2 will not adversely affect any threatened or endangered species or result in adversely modifying or destroying critical habitat. Some adverse effects will result during construction and through wetland and terrestrial habitat loss. These adverse effects will be minimized and off-set, thus no significant impacts are expected.	Alternative 3 will not adversely affect any threatened or endangered species or result in adversely modifying or destroying critical habitat. Some adverse effects will result during construction and through wetland and terrestrial habitat loss. These adverse effects will be minimized and off-set, thus no significant impacts are expected.	Alternative 4 will not adversely affect any threatened or endangered species or result in adversely modifying or destroying critical habitat. Some adverse effects will result during construction and through wetland and terrestrial habitat loss. These adverse effects will be minimized and off-set, thus no significant impacts are expected.
Demographics	Substantial adverse effects to demographics could result under the No Action Alternative. The Missouri Air Guard base would likely close. The Elwood area would fail to attract economic development, could be flooded, residents could expect higher flood insurance expense and building elevation requirements, and would likely lose area population. Similar adverse effects could be expected in portions of Wathena and St. Joseph.	Substantial beneficial effects to Elwood and Wathena, Kansas and St. Joseph, Missouri in the form of economic development, reduced flooding potential, reduced insurance expense, and possible increase to population resulting in increased tax revenues and further economic development.	Substantial beneficial effects to Elwood and Wathena, Kansas and St. Joseph, Missouri in the form of economic development, reduced flooding potential, reduced insurance expense, and possible increase to population resulting in increased tax revenues and further economic development.	Substantial beneficial effects to Elwood and Wathena, Kansas and St. Joseph, Missouri in the form of economic development, reduced flooding potential, reduced insurance expense, and possible increase to population resulting in increased tax revenues and further economic development.	Substantial adverse effects to demographic distributions could result under Alternative 4. Similar adverse effects could occur as under the No Action Alternative due to the levee not receiving FEMA re-certification.
Development and Economy	Substantial adverse effects to development and economy of the local area could result under this Alternative. The development and economy of the local communities could be limited as these areas would fail to attract an influx of people and business.	Substantial beneficial effects to Elwood and Wathena, Kansas and St. Joseph, Missouri in the form of economic development, reduced flooding potential, reduced insurance expense, and possible increase to population resulting in increased tax revenues and further economic development.	Substantial beneficial effects to Elwood and Wathena, Kansas and St. Joseph, Missouri in the form of economic development, reduced flooding potential, reduced insurance expense, and possible increase to population resulting in increased tax revenues and further economic development.	Substantial beneficial effects to Elwood and Wathena, Kansas and St. Joseph, Missouri in the form of economic development, reduced flooding potential, reduced insurance expense, and possible increase to population resulting in increased tax revenues and further economic development.	Substantial adverse effects to development and economy of the local communities could result under Alternative 4. The development and economy of the local communities could be limited as these areas would fail to attract an additional people and businesses.

ALTERNATIVES ► FACTORS ▼	"No Action" Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Land Use	No adverse effects to land use would be expected under this alternative. This condition could change existing land use as present developed areas may close and could revert back to "natural" habitat over time. No future development would be expected.	Insignificant, local, and permanent adverse effects in the form of land conversion to permanent levee. Insignificant, local, and temporary adverse effects in the form of relocation of Herzog Sand and Gravel stockpiles. Increased development could occur within the area floodplain but would be subject to future floodplain management plans.	Insignificant, local, and permanent adverse effects in the form of land conversion to permanent levee. Insignificant, local, and temporary adverse effects in the form of relocation of Herzog Sand and Gravel stockpiles. Increased development could occur within the area floodplain but would be subject to future floodplain management plans.	Insignificant, local, and permanent adverse effects in the form of land conversion to permanent levee. Insignificant, local, and temporary adverse effects in the form of relocation of Herzog Sand and Gravel stockpiles. Increased development could occur within the area floodplain but would be subject to future floodplain management plans.	No adverse effects to land use would be expected under this alternative. This condition could change existing land use as present developed areas may close and could revert back to "natural" habitat over time. No future development would be expected.
Transportation	Substantial adverse effects to transportation could result under this alternative. Area roads could be flooded under the 100 year event impairing evacuation and rescue.	Insignificant, temporary, and construction related adverse effects in the form of increased traffic on area roads during construction. After project completion, area roads would be protected from flooding during the 100-year event. Thus, operation of the completed project will have a substantial beneficial effect to area transportation.	Insignificant, temporary, and construction related adverse effects in the form of increase traffic on area roads during construction. These impacts are expected to be slightly higher than Alternative 1 due to the increased size of the project and time to complete. After project completion, area roads would be protected from flooding during a 500-year event. Thus, operation of the completed project will have a substantial beneficial effect to area transportation.	Insignificant, temporary, and construction related adverse effects in the form of increase traffic on area roads during construction. These impacts are expected to be slightly higher than Alternative 2 due to the increased size of the project and time to complete. After project completion, area roads would be protected from flooding during a 500-year event. Thus, operation of the completed project will have a substantial beneficial effect to area transportation.	Substantial adverse effects to transportation could result under this alternative. Area roads could be flooded under a 100 year event impairing evacuation and rescue.
Utilities and Waste Water Supply	No effects to utilities/water supply would be expected under this alternative.	No effects to utilities/water supply would be expected under this alternative.	No effects to utilities/water supply would be expected under this alternative.	No effects to utilities/water supply would be expected under this alternative.	No effects to utilities/water supply would be expected under this alternative.
Flood Damage Reduction	Substantial adverse effects to flood damage reduction would result under this alternative. FEMA would likely not re-certify the levee. Flooding to Wathena, Elwood, and St. Joseph would be highly likely during a 100-year event. Economic development would be stymied.	Substantial beneficial effects in increased flood damage reduction to the St. Joseph metropolitan area during the 100-year flood event.	Substantial beneficial effects in increased flood damage reduction to the St. Joseph metropolitan area during the 500-year flood event.	Substantial beneficial effects in increased flood damage reduction to the St. Joseph metropolitan area during the 500-year flood event.	Substantial adverse effects to flood damage reduction would result under this alternative. FEMA would likely not re-certify the levee. Flooding to Wathena, Elwood, and St. Joseph would be highly likely during a 100-year event. Economic development would be stymied.

ALTERNATIVES ► FACTORS ▼	"No Action" Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Recreation	There would be no impacts to recreation under this alternative.	Insignificant, temporary, and construction related adverse affect to recreation in the form of impaired hiking and wildlife viewing. After construction, these recreational activities would revert to existing conditions.	Insignificant, temporary, and construction related adverse affect to recreation in the form of impaired hiking and wildlife viewing. These impacts are expected to be slightly longer in duration than Alternative 1 due to the increased size of the project and time to complete. After construction, recreational activities would revert to existing conditions.	Insignificant, temporary, and construction related adverse affect to recreation in the form of impaired hiking and wildlife viewing. These impacts are expected to be slightly longer in duration than Alternative 2 due to the increased size of the project and time to complete. After construction, recreational activities would revert to existing conditions.	Insignificant, temporary, and construction related adverse affect to recreation in the form of impaired hiking and wildlife viewing. After construction, these recreational activities would revert to existing conditions. No construction related impacts to recreation along L-455.
Archaeological and Historic Resources	There would be no impacts to archaeological and historic resources under this alternative.	There would be no impacts to archaeological and historic resources under this alternative.	There would be no impacts to archaeological and historic resources under this alternative.	There would be no impacts to archaeological and historic resources under this alternative.	There would be no impacts to archaeological and historic resources under this alternative.
Environmental Justice	Sensitive population indicators in the project area would experience no greater threat to flooding over that of the rest of the area population. Therefore, there would be no environmental justice issues as a result of this alternative.	This alternative will not exert a disproportionate impact on low income and/or minority populations. The beneficial and adverse impacts are equally shared across the racial and economic spectrums.	This alternative will not exert a disproportionate impact on low income and/or minority populations. The beneficial and adverse impacts are equally shared across the racial and economic spectrums.	This alternative will not exert a disproportionate impact on low income and/or minority populations. The beneficial and adverse impacts are equally shared across the racial and economic spectrums.	This alternative will not exert a disproportionate impact on low income and/or minority populations. The beneficial and adverse impacts are equally shared across the racial and economic spectrums.

Table 6
Compliance of Preferred Alternative with Environmental Protection Statutes and Other Environmental Requirements

Federal Polices	Compliance
Archeological Resources Protection Act, 16 U.S.C. 470, et seq.	Full Compliance
Clean Air Act, as amended, 42 U.S. C. 7401-7671g, et seq.	Full Compliance
Clean Water Act (Federal Water Pollution Control Act), 33 U.S.C. 1251, et seq.	Full Compliance
Endangered Species Act, 16 U.S.C. 1531, et seq.	Full Compliance
Farmland Protection Policy Act, 7 U.S.C. 4201, et. seq.	Full Compliance
Federal Water Project Recreation Act, 16 U.S.C. 4601-12, et seq.	Full Compliance
Fish and Wildlife Coordination Act, 16 U.S.C. 661, et seq.	Full Compliance
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	Full Compliance
National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470a, et seq.	Full Compliance
Rivers and Harbors Act, 33 U.S.C. 403, et seq.	Full Compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Full Compliance
Wild and Scenic River Act, 16 U.S.C. 1271, et seq.	Full Compliance
Protection & Enhancement of the Cultural Environment (Executive Order 11593)	Full Compliance
Floodplain Management (Executive Order 11988)	Full Compliance
Protection of Wetlands (Executive Order 11990)	Full Compliance
Environmental Justice (Executive Order 12898)	Full Compliance

NOTE: Full compliance. Having met all requirements of the statute for the current stage of planning (either preauthorization or post authorization).

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
Kansas and Missouri

Section 404(b)(1) Evaluation

Clean Water Act Section 404(b)(1) authorized the development of guidelines for specification of disposal sites for dredged or fill material by the U.S. Environmental Protection Agency (USEPA) in conjunction with the U.S. Army Corps of Engineers (Corps). The USEPA subsequently developed and adopted the Section 404(b)(1) guidelines in conjunction with the Corps (40 CFR Part 230). The purpose of these guidelines is to "restore and maintain the chemical, physical, and biological integrity of the waters of the United States through the control of discharges of dredged or fill material". This document reviews the compliance of the proposed flood damage reduction alternative for the Missouri River Levee System Units L-455 and R471-460 with these guidelines.

I. Description of the Flood Damage Reduction Project

Location

The Missouri River Levee System Units L-455 and R471-460 are located from Missouri River miles 445 to 452 adjacent to Doniphan County, Kansas and Andrew and Buchanan counties, Missouri.

General Description

The Corps, at the request and with the cooperation of the City of St. Joseph, the Elwood-Gladded Drainage District (Right Bank, Kansas), the St. Joseph Airport Drainage District (Right Bank, Missouri), and the South St. Joseph Levee District (Left Bank), the non-Federal sponsors, of the Levee Units L-455 and R471-460, has undertaken the Flood Damage Reduction Study, at Kansas and Missouri. This existing levee system protects areas in St. Joseph, Buchanan and Andrew Counties, Missouri and areas in Elwood and Wathena, Doniphan County, Kansas. The purpose of this study is to determine whether one or more plans for increasing the level of flood damage reduction is technically viable, economically feasible, and environmentally acceptable, or if no action is warranted. Failure of any part of the existing flood damage reduction system during a major flood would have substantial adverse impacts on the human environment, including property damage and potential loss of human life. Four alternatives were considered and include: Raise the Right Levee Section using earthen material to the one-hundred year level of flood damage reduction with 90 percent reliability, and a corresponding raise to the Left Levee Section in specific areas to accept the slight rise in water surface elevations resulting from the initial raise (PREFERRED); Raise the Right Levee Section to an Increased Level of Flood Damage Reduction (Alternative 2 - 500-year event plus 1.5 feet of freeboard), with a corresponding raise to the Left levee unit; Raise the Right Levee Section to a Further Increased Level of Flood Damage Reduction (Alternative 3 - 500-year event plus 3.0 feet of freeboard), with a corresponding raise to the Left levee unit, and the "No Action" Alternative.

Detailed descriptions of each alternative are provided in Chapter 2 of The Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Study EA.

Site construction activities that would be subject to regulation under Section 404 of the Clean Water Act include:

- obtaining borrow material from lands riverward of the existing levee, and

- placing fill material on the Flood Damage Reduction site in jurisdictional waters during construction of the increased levee and seepage berms.

Authority and Purpose

This study is being conducted under the authority provided by Section 216 of the 1970 Flood Control Act. This Act provides authority to reexamine completed civil works projects. Section 216 reads as follows:

> *The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects, the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to the significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying structures or their operation, and for improving the quality of the environment in the overall public interest.*

Section 216 of the 1970 Flood Control Act provided continuing authority to examine completed Federal projects to determine whether the projects are providing benefits as intended. The results of this examination indicate that raising the level of flood damage reduction provided by the St. Joseph levee unit system may be technically and economically feasible without unacceptable environmental or social impacts. Accordingly, a Federal interest exists in designing and constructing improvements because of the potential to benefit the National economy.

Purpose: The purpose of the Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Project in Kansas and Missouri is to restore the reliability of the units to reduce damages from potential flooding on the Missouri River in the vicinity of St. Joseph, Missouri, in order to provide for re-certification of the levees by the Federal Emergency Management Agency (FEMA).

Need: The need of the Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Project in Kansas and Missouri is restore the reliability of the units to reduce damages from potential flooding on the Missouri River in the vicinity of St. Joseph, Missouri because this level is lacking, and to allow FEMA to re-certify the levee. If the levee remains de-certified, the economic impact of a flood event will be borne entirely by the local communities.

General Description of Dredged or Fill Material

(1) The existing levee will require grading for the purpose of reshaping and preparing the initial levee slope. The existing levee is composed primarily of fill material that was borrowed from accreted lands adjacent to the project area when the levee was originally built. The existing material contains a mixture of sand, silts and clays with varying content of organic materials. The proposed levee raise and seepage berm extensions will be composed of similar materials. Fill will be obtained from adjacent accreted lands that, in some instances, may be the same borrow areas previously used.

(2) The approximate quantity of fill material proposed for construction of the flood damage reduction project includes approximately 1,882,445 bank cubic yards.

(3) The source of the fill material will be borrowed from accreted land riverward of the existing levees in both Kansas and Missouri. For Kansas, two borrow areas have been identified and are located at approximately river miles 454.9 to 451.9 and river miles 446.7 to 443.4. For Missouri, one borrow area has been identified and is located at approximately river miles 442.6 to 442.9.

Description of the Proposed Discharge Site

(1) Location. Borrow soils would be placed within the floodplain of the Missouri River on Levee Units R471-460 and L-455 between River Miles 437 and 457 to facilitate an earthen levee raise and the construction of underseepage control measures. Wetland determinations conducted

by Corps personnel revealed that approximately 4.9 acres of farmed wetlands would be filled as a result of the levee footprint expansion. See Appendix B of the EA for project location maps, borrow site areas, and accreted land surveys.

(2) Size. The proposed borrow areas include approximately 1,304 acres of land in Kansas: located riverward of the existing levee at river miles 454.9 to 451.9 and river miles 442.6 to 442.9. Additionally, a lesser area of approximately 30 acres of land in Missouri is located at river miles 442.6 to 442.9. These areas represent the total borrow areas and not the total amount of borrow to be obtained.

(3) Type of Site/Habitat. The proposed project site consists of an existing levee with strips of upland grassland and small amounts of deciduous trees. The borrow areas for the proposed project site consists of accreted lands containing secondary willow and cottonwood tree growth, shrubland vegetation, and farmed wetlands. During construction of the flood damage reduction project, some farmed wetlands will be eliminated due to fill. Obtaining borrow material will be conducted in a manner as to reduce impacts on the area. Such minimization measures will include, but not be limited to, shallow scrapes and reshaping along existing wetland areas to increase their functions, deeper diggings (eight to ten feet) in areas where trees and shrubs occur to reduce acreage impacted to these vegetation types, and ensuring a minimum of two feet of blanket material (capable of retaining water) is left in place to ensure the areas function as wetlands. Please see Section 4.4.3 of the EA for a complete description of the affects to wetland areas.

(4) Timing and Duration. Timing and duration of construction and borrow operations will be determined after final plans and specifications are made.

Description of Disposal Method

The disposal method will be as necessary for construction of each project element.

II. Factual Determinations

The 404(b)(1) guidelines (40 CFR Part 230, Subpart B, Section 230.11) require the determination in writing of the potential short-term and long-term affects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment. These factual determinations are presented below.

Physical Substrate Determinations

(1) Substrate Elevation and Slope. The bottom surface elevation of the borrow sites will be irregular to create greater diversity and habitat. The borrow excavation from area sites will result in depths which will be dependant on results from test pits dug to determine initial thickness of usable material. A minimum of approximately two feet of blanket material (soil capable of retaining water) will then be left in place to ensure wetland functions are obtained after the fill material has been excavated.

(2) Type of Fill Material. Fill material will consist of a mixture of sand, silts and clays with varying content of organic materials.

(3) Dredge/Fill Material Movement. The fill material will be stabilized on the levee and seepage berms and should not be subject to erosion.

(4) Physical Effects on Benthos. Benthic organisms may be displaced during construction activities.

Water Circulation, Fluctuation, and Salinity Determination

(1) Water Column Effects. Standing water and soils periodically inundated will be permanently and temporarily impacted during and following construction. Turbidity and erosion will be controlled during and following construction.

(2) Current Patterns and Circulation. Construction of the Flood Damage Reduction project will have minimal and temporary construction related impacts on the current hydrologic circulation patterns.

(3) Normal Water Level Fluctuation and Salinity Gradients. Surface and ground water levels will be minimally affected during construction. Salinity levels will not be affected by the proposed project.

Suspended Particulate/Turbidity Determinations

(1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site. There may be a temporary increase in turbidity levels in the project area during construction. Turbidity will be short-term and localized and no significant adverse impacts are expected. State standards for turbidity will not be exceeded.

(2) Effects on the Chemical and Physical Properties of the Water Column. There may be temporary impacts to the chemical and physical properties of nearby waters during construction activities. Borrow material will be dug and placed using traditional construction equipment (bull dozers, track-hoes, bobcats, etc). There are no acute or chronic chemical impacts anticipated as a result of construction. An environmental protection plan, prepared during detailed design, will address concerns regarding monitoring of equipment, maintenance and security of fuels, lubricants etc.

(a) Light Penetration. Some decrease in light penetration may occur in the immediate vicinity of the construction area. This effect will be temporary, limited to the immediate area of construction, and will have no adverse impact on the environment.

(b) Dissolved Oxygen. Dissolved oxygen levels will not be altered by this project.

(c) Toxic Metals, Organics, and Pathogens. No toxic metals, organics, or pathogens are expected to be released by the project.

(d) Aesthetics. The aesthetic quality of the water in the immediate area of the project may be temporarily affected by turbidity during construction. This will be a short-term and localized condition.

(3) Effects to Biota.

(a) Primary Productivity and Photosynthesis. Impacts on primary production within approximately 5.0 acres of impacted wetland areas will be minimized through on-site mitigation of similar habitat.

(b) Suspension/Filter Feeders. An increase in turbidity from construction related progress could adversely impact burrowing invertebrate filter feeders within and adjacent to the immediate construction area. It is not expected that a short-term, temporary increase in turbidity will have any long-term negative impact on these highly fecund organisms.

(c) Sight Feeders. No significant impacts on these organisms are expected as the majority of sight feeders are highly motile and can move outside the project area.

Contaminant Determinations

Material which will be obtained from the borrow sites will not introduce, relocate, or increase contaminants at the fill area.

Aquatic Ecosystem and Organism Determination

(1) Effects to Plankton. No adverse impacts on autotrophic or heterotrophic organisms are anticipated.

(2) Effects on Benthos. No adverse impacts to benthic organisms are anticipated.

(3) Effects on the Aquatic Food Web. No adverse impacts on aquatic organisms are anticipated. There is expected to be a relatively minor temporary effect on the aquatic food web due to construction activities. Wetlands impacted on the landside of the levee, and those filled on the river side of the levee, will be mitigated on-site in order to maintain wetland function and values.

(4) Effects on Special Aquatic Sites. A total of approximately 4.9 acres of wetlands will be permanently lost within the project area due to fill, reconstruction of levee slopes, and associated levee maintenance. However, minimization measures to reduce impacts have been incorporated into construction plans; thus, the impacts have been off-set.

(5) Endangered and Threatened Species. There will be no significant adverse impacts on any threatened or endangered species or on critical habitat of any threatened or endangered species. Some minor impacts to endangered and threatened species may occur during construction but will be reduced or avoided through timing restrictions. While some existing habitat will be lost as a result of obtaining borrow, re-establishment of this habitat will occur in the long-term. Refer to Section 4.4.4 of the EA for measures that will be implemented to protect endangered and threatened species.

(6) Other Wildlife. No adverse long-term impacts to small foraging mammals, reptiles, birds, or wildlife in general are expected.

(7) Actions to Minimize Impacts. All practical safeguards will be taken during construction to preserve and enhance environmental, aesthetic, recreational, and economic values in the project area. Specific precautions are discussed in the EA.

Proposed Disposal Site Determinations

(1) Determination of Compliance with Applicable Water Quality Standards. All State permits will be obtained prior to construction activities and coordination with Missouri Department of Natural Resources will ensure Section 401 – Water Quality Certification and Section 402 – National Pollution Discharge Elimination System Storm Water Discharge Permits have been obtained.

(2) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supplies. No municipal or private water supplies will be impacted by the implementation of the project.

(b) Recreational and Commercial Fisheries. Recreational and commercial fisheries would not be impacted by the implementation of the project.

(c) Water Related Recreation. Water related recreation in the immediate vicinity of construction will likely be impacted during construction activities. This will be a short-term impact.

(d) Aesthetics. The existing environmental setting may be impacted during construction. Construction activities cause a temporary increase in noise and air pollution from equipment as well as some temporary increase in turbidity. These impacts are not expected to adversely affect the aesthetic resources over the long term and once construction ends, conditions will return to pre-project levels. Trees removed landward of the levee will be replaced.

(e) Determination of Cumulative Effects on the Aquatic Ecosystem. There will be no cumulative impacts that result in a major impairment of water quality of the existing aquatic ecosystem as a result of the placement of fill at the project site.

(f) Determination of Secondary Effects on the Aquatic Ecosystem. There will be no secondary impacts on the aquatic ecosystem as a result of the construction.

III. Findings of Compliance or Non-compliance with the Restrictions on Discharge

The 404(b)(1) guidelines (40 CFR Part 230, Subpart B, Section 230.12) require written findings as to whether the proposed disposal site for the discharge of dredged or fill material:

- complies with the 404(b)(1) guidelines;
- complies with the 404(b)(1) guidelines with inclusion of appropriate and practical discharge conditions to minimize pollution or adverse effects to the affected aquatic ecosystems; or
- does not comply with the 404(b)(1) guideline requirement.

These findings are presented below.

Finding 1 – Adaptation of the 404(b)(1) Guidelines

No significant adaptations of the guidelines were made relative to this evaluation.

Finding 2 – Other Practicable Alternatives with Less Adverse Impact on Aquatic Ecosystems

No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States. Also, no practicable alternative exists that is significantly less damaging than the proposed alternative. Although Alternative 4 would impact less wetland area, the difference is not significant and would not result in a discernable difference in impacts on the aquatic ecosystem. Finally, although Alternative 4 is somewhat less damaging, it does not accomplish the overall project purpose, and therefore, is not a practicable alternative.

Finding 3 – Inclusion of Conditions to Minimize Pollution and/or Adverse Effects to the Affected Aquatic Ecosystems

As described in the EA, mitigation is proposed to minimize pollution, loss of wetland habitat, and adverse effect on the existing aquatic ecosystem in, and adjacent to, the Missouri River. On-site aquatic habitat will be lost, but will be replaced on-site. Mitigation measures relevant to reducing these effects are discussed in Chapter 4 of the EA.

Finding 4 – State Water Quality Standards

The discharge of fill materials will not cause or contribute to violations of any applicable State water quality standards. The discharge operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act. State water quality certifications (Kansas and Missouri) will be obtained before construction.

Finding 5 – Endangered and Threatened Species

The placement of fill materials for implementation of the proposed project will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended.

Finding 6 – Significant Degradation of U.S. Waters

The placement of fill material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

Finding 7 – Compliance Conclusion

Appropriate steps have been taken to minimize the adverse environmental impact of the proposed action. Turbidity will be monitored so that if levels exceed State water quality standards, the contractor will be required to cease work until conditions return to normal. On the basis of the guidelines, the proposed fill of wetlands are specified as complying with the requirements of these guidelines. The discharge of dredged or fill material complies with the Section 404(b)(1) Guidelines and is considered the least environmentally damaging practicable alternative.

Compliance Conclusion Signatures

Prepared by:

Mr. Matthew D. Vandenberg – Biologist DATE
Environmental Resources Section

Reviewed by:

Dr. Christopher M. White – Chief DATE
Environmental Resource Section

Reviewed by:

Mr. Matthew P. Jeppson – Acting Chief DATE
Regulatory Branch

I find that the discharge of dredged or fill material complies with the Section 404(b)(1) Guidelines and is considered the least environmentally damaging practicable alternative.

Michael A. Rossi DATE
Colonel, Corps of Engineers

APPENDIX A

Notice of Intent to Prepare a Draft EIS

Missouri River Levee System
Units L-455 and R-471-460
Flood Damage Reduction Study
Kansas and Missouri
Draft Environmental Impact Statement

5. James T. Blake, Deputy to the Commander, PEO STRI.

6. Paul Bogosian, Deputy Program Executive for Aviation, AAE.

7. T. Kevin Carroll, Program Executive Officer, Enterprise Information Structure, AAE.

8. Donald L. Damstetter, Jr., Deputy Assistant Secretary for Plans, Programs, and Resource, OASA (Acquisition, Logistics & Technology).

9. Edward G. Elgart, Director, CECOM Acquisition Center.

10. Kevin J. Flamm, Program Manager for Chemical Demiliterization Operations OASA (Acquisition, Logistics & Technology).

11. Craig D. Hunter, Deputy Assistant Secretary of the Army (Defense Exports and Cooperation), OASA (Acquisition, Logistics & Technology).

12. Joann H. Langston, Competition Advocate of the Army, Army Acquisition Executive Support Agency.

13. Russell W. Lenz, Director, Simulation and Training Technology Center, Research, Development and Engineering Command.

14. BG Michael R. Mazzucchi, Program Executive Officer, Command, Control, and Communications (Tactical).

15. Steven L. Messervy, Program Manager, Joint Simulation Systems, Army Acquisition Executive Support Agency.

16. Levator Norsworthy, Jr., Deputy General Counsel (Acquisition), Office of the General Counsel.

17. Michael A. Parker, Deputy to the Commander, U.S. Army Soldier & Biological Chemical Command.

18. John C. Perrapato, Deputy Program Executive Officer, Command and Control Systems, AAE.

19. Shelba J. Proffitt, Deputy Program Executive Officer, Air and Missile Defense, AAE.

20. Sandra O. Sieber, Director, Army Contracting Agency.

21. Albert P. Puzzuoli, Deputy Program Executive Officer, Armored Systems Modernization, AAE.

22. Wimpy D. Pybus, Deputy Assistant Secretary of the Army for Integrated Logistics Support, OASA (Acquisition, Logistics & Technology).

23. BG Stephen M. Seay, Program Executive Officer, PEO STRI.

24. BG Jeffrey A. Sorenson, Program Executive Officer, Tactical Missiles.

25. MG John M. Urias, Program Executive Officer, Air Missile Defense/Deputy Command General for Research, Development and Acquisition, U.S. Army Space and Missile Defense Command.

26. MG Joseph L. Yakovac, Program Executive Officer, Ground Combat Systems.

Luz D. Ortiz,

Army Federal Register Liaison Officer.

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DEPARTMENT OF DEFENSE

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Performance Review Board Membership for the U.S. Army Office of the Surgeon General

AGENCY: Department of the Army, DoD.

ACTION: Notice.

SUMMARY: Notice is given of the names of members of a Performance Review Board for the Department of the Army.

EFFECTIVE DATE: November 13, 2003.

FOR FURTHER INFORMATION CONTACT: Marilyn Ervin, U.S. Army Senior Executive Service Office, Assistant Secretary of the Army, Manpower & Reserve Affairs, 111 Army Pentagon, Washington, DC 20310–0111.

SUPPLEMENTARY INFORMATION: Section 4314(c)(1) through (5) of Title 5, U.S.C., requires each agency to establish, in accordance with regulations, one or more Senior Executive Service performance review boards. The boards shall review and evaluate the initial appraisal of senior executives' performance by supervisors and make recommendations to the appointing authority or rating official relative to the performance of these executives.

The members of the Performance Review Board for the U.S. Army Office of The Surgeon General are:

1. MG Kenneth L. Farmer, Chairperson, Deputy Surgeon General.

2. Mr. Mark R. Lewis, Director, Plans, Resources and Operations, Office of the Deputy Chief of Staff, G–1.

3. Ms. Zita M. Simutis, Director, Army Research Institute.

4. Mr. Jack E. Hobbs, Project Director, Army Workload and Performance System.

Luz D. Ortiz,

Army Federal Register Liaison Officer.

[FR Doc. 03–29009 Filed 11–19–03; 8:45 am]

BILLING CODE 3710–08–M

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Intent To Prepare a Draft Environmental Impact Statement for a Flood Damage Reduction Study, Missouri River Levees System Units L–455 and R 471–460, Buchanan County, MO and Doniphan County, KS

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of intent.

SUMMARY: The U.S. Army Corps of Engineers, Kansas City District (KCD), intends to prepare a Draft Environmental Impact Statement (DEIS) and Feasibility Study of flood damage reduction measures for property currently afforded flood protection by the Missouri River Levee System (MRLS) Units L–455 and R 471–460, in Buchanan County, Missouri and Doniphan County, Kansas. The purpose of this DEIS is to consider the economic, environmental, and social impacts that may occur as a result of various alternatives being considered in a flood damage reduction study, concerning flood protection provided by the existing MRLS Units L–455 and R 471–460. The study would determine the existing level of flood protection as well as possible flood damage reduction measures beyond what currently exists, under the authority of Section 216 of the 1970 Flood Control Act.

FOR FURTHER INFORMATION CONTACT: Ms. Maria Chastain-Brand, Formulation Section, Planning Branch, ATTN: CENWK–PM–PF, U.S. Army Engineer District, Kansas City, 601 East 12th Street, Kansas City, MO 64106–2896, Phone 816–983–3107 or *Maria.E.Chastain-Brand@usace.army.mil.*

SUPPLEMENTARY INFORMATION:

1. The U.S. Army Corps of Engineers, KCD, intends to prepare a DEIS and Feasibility Study of flood damage reduction measures for property currently afforded flood protection by the MRLS Units L–455 and R 471–460, in Buchanan County, Missouri and Doniphan County, Kansas. The purpose of this DEIS is to consider the economic, environmental, and social impacts that may occur as a result of various alternatives being considered in a flood damage reduction study. The Study would determine the existing level of flood protection as well as possible flood damage reduction measures beyond what currently exists, under the authority of Section 216 of the Flood Control Act.

2. The MRLS Units L–455 and R 471–460, are existing flood damage reduction projects which provide local flood protection for agricultural needs, the metropolitan area of St. Joseph, Missouri and the communities of Wathena and Elwood in Kansas. The two levees units are located on opposite sites of the Missouri River.

Levee unit L–455 is located on the left bank of the Missouri River in Buchanan County, Missouri, and connects to high ground in the southwestern part of St. Joseph, Missouri. The levee unit extends from Missouri River mile 447.3 downstream to mile 437.3 and then upstream along Contrary Creek. Levee unit L–455 is 15.6 miles long, averages 13 feet in height, and protects approximately 7,500 acres of urban and rural areas from flooding. Rural lands consist of about 6,500 acres. Urban lands include industrial, commercial, and residential areas of the city of St. Joseph, Missouri, including the residential and recreational development in the Lake Contrary area.

Levee unit R 471–460 is located on the right bank of the Missouri River between river mile 441.7 and 456.6 in eastern Doniphan County, Kansas, and a portion of western Buchanan County, Missouri. This levee unit is 13.8 miles long, averages 14.8 feet in height and protects approximately 13,500 acres of rural and urban areas from flooding. Rural lands consist of about 10,000 acres. Urban lands include the communities of Elwood and Wathena, Kansas. It also includes the area within an oxbow, which is a part of St. Joseph, Missouri and contains the Rosecrans Memorial Air National Guard Base.

3. KCD's study will evaluate the no action alternative as well as various structural and non-structural alternatives to determine:

a. Flood damage reduction costs and benefits;

b. Regional social and economic impacts; and

c. Environmental impacts and mitigation measures.

Reasonable alternatives KCD will examine include the feasibility of various structural and non-structural measures to reduce flood damage within areas protected by the existing MRLS Units L–455 and R 471–460. Structural alternatives may include reinforcing the existing structures, raising the existing levee with earth fill, floodwalls with a corresponding rise of appurtenances, or other change to the existing levee systems. Non-structural measures may include the development of contingency plans.

4. Scoping Process

a. A public workshop/scoping meeting will be held in the spring of 2004 in St. Joseph, MO area. The exact date, time, and location of the scoping meeting will be announced when the details are finalized. Additional workshops and meetings will be held as the study progresses to keep the public informed. Coordination meetings will be held as needed with the affected/concerned local, State, and Federal governmental entities, and tribes. These workshops and meetings, as well as any meetings which were previously held regarding this project, will serve as the collective scoping process for the preparation of the DEIS. Draft documents forthcoming from the study will be distributed to Federal, State, and local agencies, as well as interested members of the general public, for review and comment.

b. Potential issues to be analyzed in depth include evaluations of:

(1) Level of flood protection provided by the existing flood protection project and need for increased level of protection;

(2) Costs and benefits associated with alternatives that increase the flood protection level of the existing flood protection project;

(3) Fish and wildlife resources;

(4) Recreation;

(5) Cultural resources.

c. Environmental consultation and review will be conducted in accordance with the requirements of the National Environmental Policy Act of 1969, as per regulations of the Council of Environmental Quality (code of Federal Regulations Parts 40 CFR 1500–1508), and other applicable laws, regulations, and guidelines.

5. The anticipated date of availability of the DEIS for public review is late 2004.

Luz D. Ortiz,

Army Federal Register Liaison Officer.

[FR Doc. 03–29010 Filed 11–19–03; 8:45 am]

BILLING CODE 3710–KN–M

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Intent To Prepare a Draft Programmatic Environmental Impact Statement for Coastal Erosion Protection and Community Relocation, Shishmaref, AK

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of intent.

SUMMARY: The U.S. Army Engineer District, Alaska, intends to prepare a Draft Programmatic Environmental Impact Statement (DEIS) to evaluate the feasibility of constructing erosion protection alternatives and community relocation alternatives at Shishmaref, Alaska. Shishmaref, population 562, is on a barrier island on the Chukchi Sea on the northwestern coast of Alaska. The shoreline at the community is being rapidly eroded by storm waves possibly because the ice pack has been forming later in the autumn than in the past, allowing more of the force of late season storm energy to reach the shore. The programmatic DEIS will determine whether Federal action is warranted, and if so, and community relocation is selected, site alternatives will be addressed in more detail in a second tier of the EIS process.

FOR FURTHER INFORMATION CONTACT: Lizette Boyer (907) 753–2637, Alaska District, U.S. Army Corps of Engineers, Environmental Resources Section (CEPOA–EN–CW–ER), P.O. Box 6898, Elmendorf AFB, AK 99506–6898. E-mail: *Lizette.P.Boyer@poa02.usace.army.mil.*

SUPPLEMENTARY INFORMATION: This study is authorized under Section 203, 33 U.S.C. Tribal Partnership Program. The community of Shishmaref has existed on Sherichef Island for centuries. The four-mile-long island, formed by littoral drift, is steadily eroding along the Chucki Sea. As early as the 1950's the community began taking steps to fight the annual erosion problem. Strong wave and current action cause massive scouring and erosion of the fine sand embankment. Bank revetment structures (gabions filled with sand and concrete mattresses) were installed but failed to stop the erosion for long. Severe fall storms in 1989, 1990, and 1997 undermined the protective structures and caused buildings to be moved or abandoned. The late formation of the shorefast ice pack in recent years aggravates erosion damage during fall storms. Without shore protection structures and continued maintenance of them, all the community infrastructure is in jeopardy.

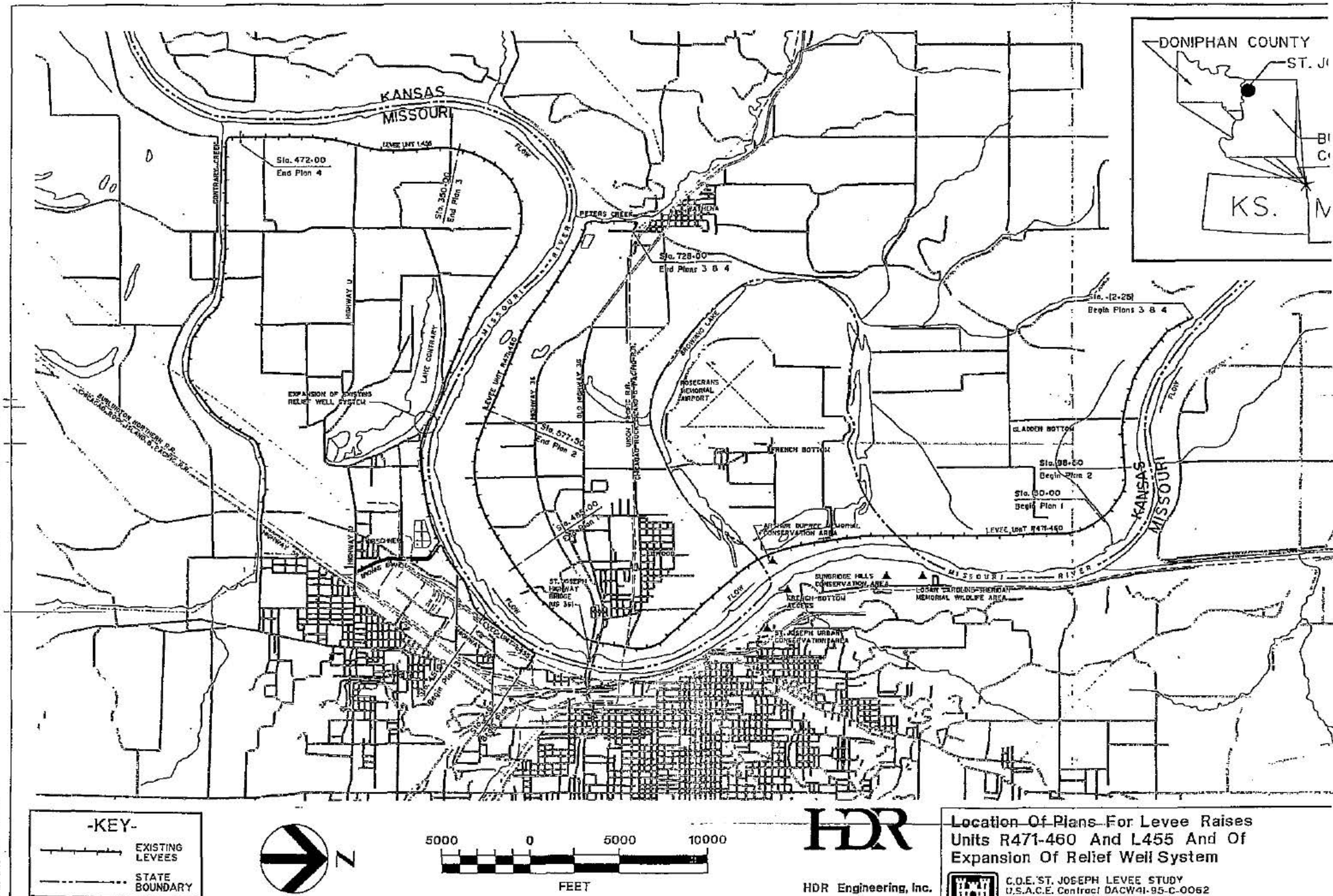
The programmatic DEIS will consider alternatives including the continuation of erosion protection structures to prevent land and property losses. The community has obtained funding for efforts to protect a stretch of the beach to the west of the school property where a Bureau of Indian Affairs road is at risk. The Corps of Engineers currently is conducting an emergency bank protection study to protect the school. Longer term protection for the

U.S. Army Corps of Engineers, Kansas City District

APPENDIX B

Maps of Project Site:
Location
Habitat Types and Borrow Areas
Shipwrecks

Missouri River Levee System
Units L-455 and R-471-460
Flood Damage Reduction Study
Kansas and Missouri
Draft Environmental Impact Statement



HDR

HDR Engineering, Inc.

Location Of Plans For Levee Raises Units R471-460 And L455 And Of Expansion Of Relief Well System

C.O.E. ST. JOSEPH LEVEE STUDY
U.S.A.C.E. Contract DACW41-95-C-0062
HDR Project 02285-008-133

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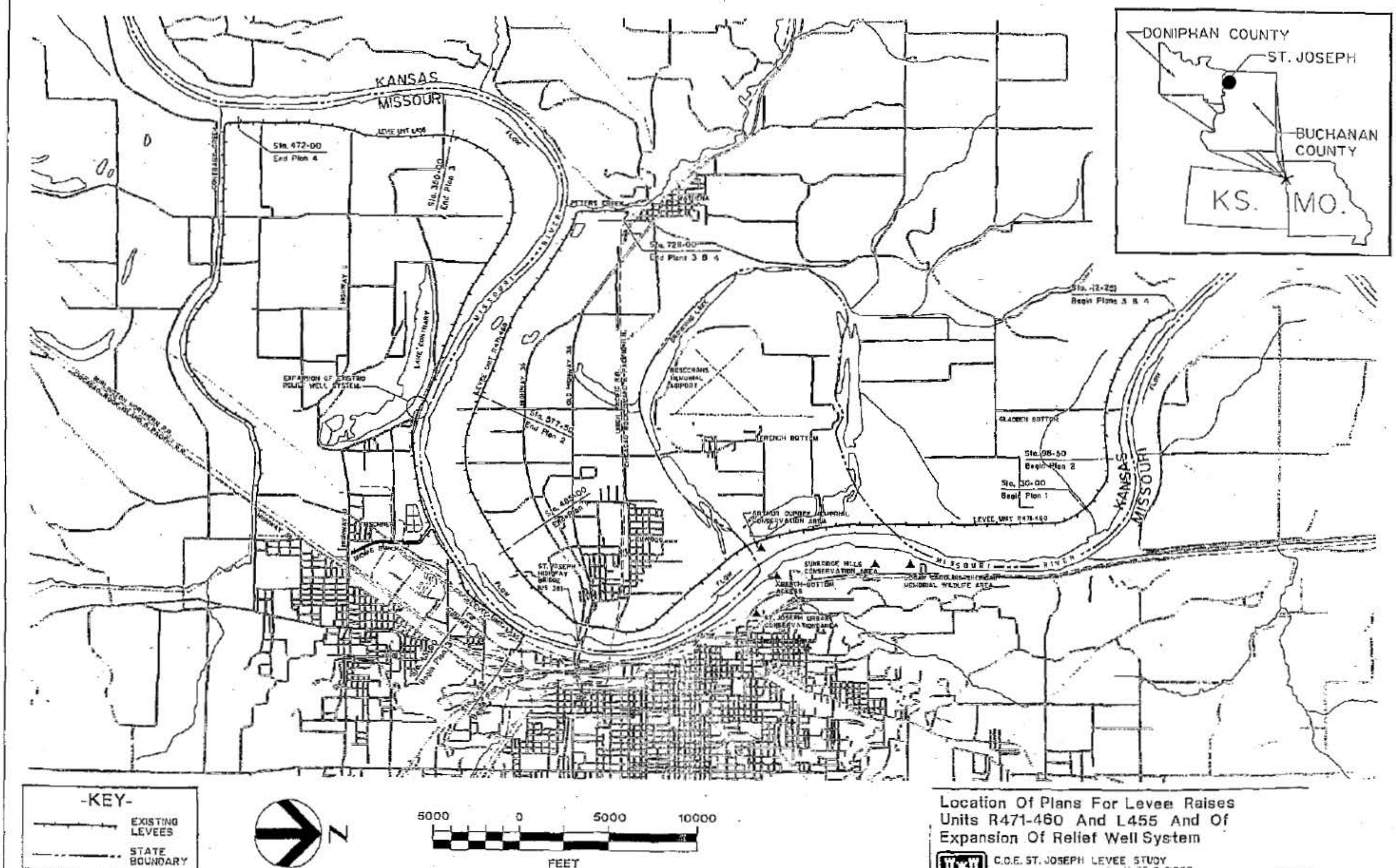
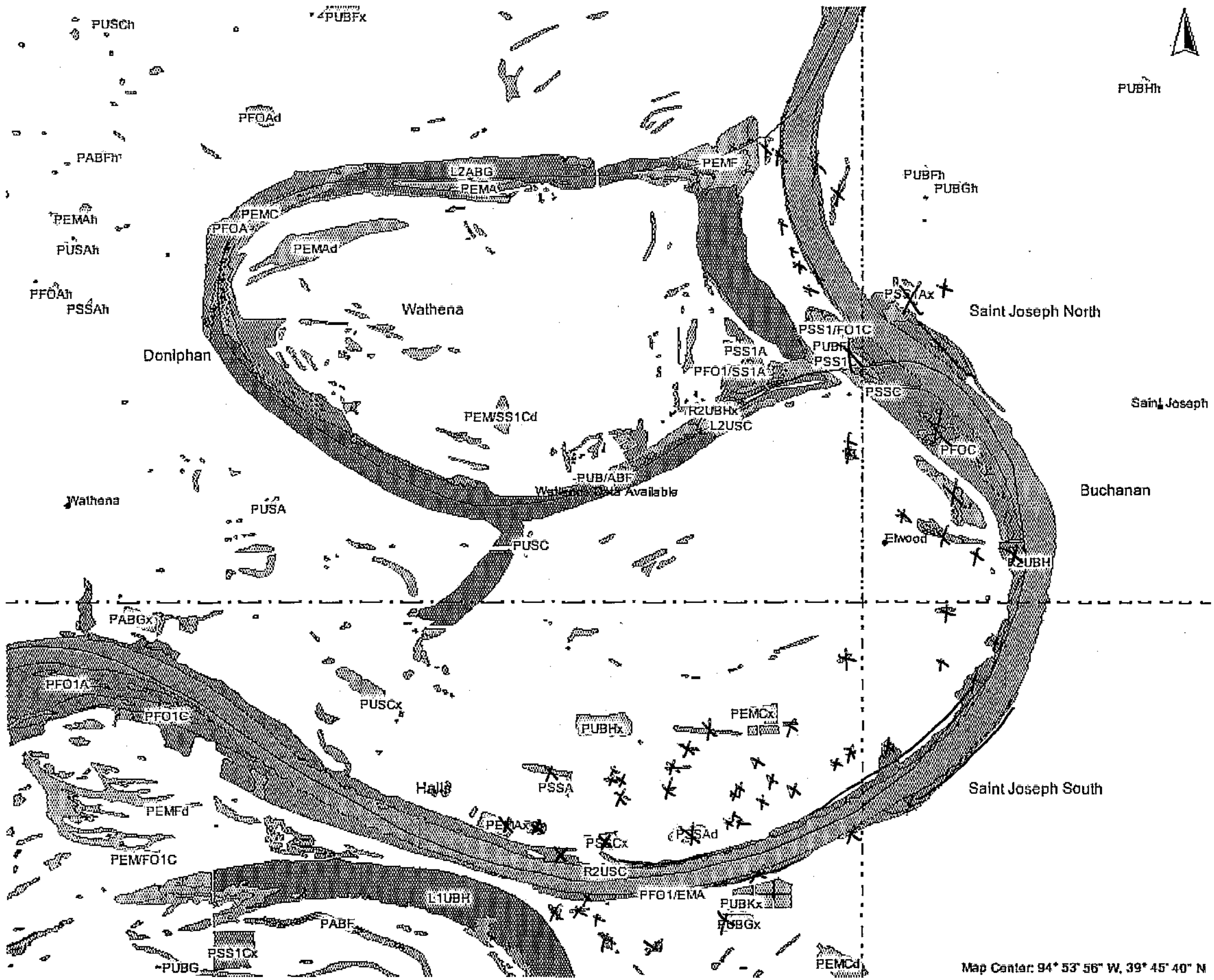


Location Of Plans For Levee Raises Units R471-460 And L455 And Of Expansion Of Relief Well System

C.O.E. ST. JOSEPH LEVEE STUDY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PUBFx
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PFOAd
PABFh
L2ABG
PEMF
PEMA
PUBFh
PUBGh
PEMAh
PEMC
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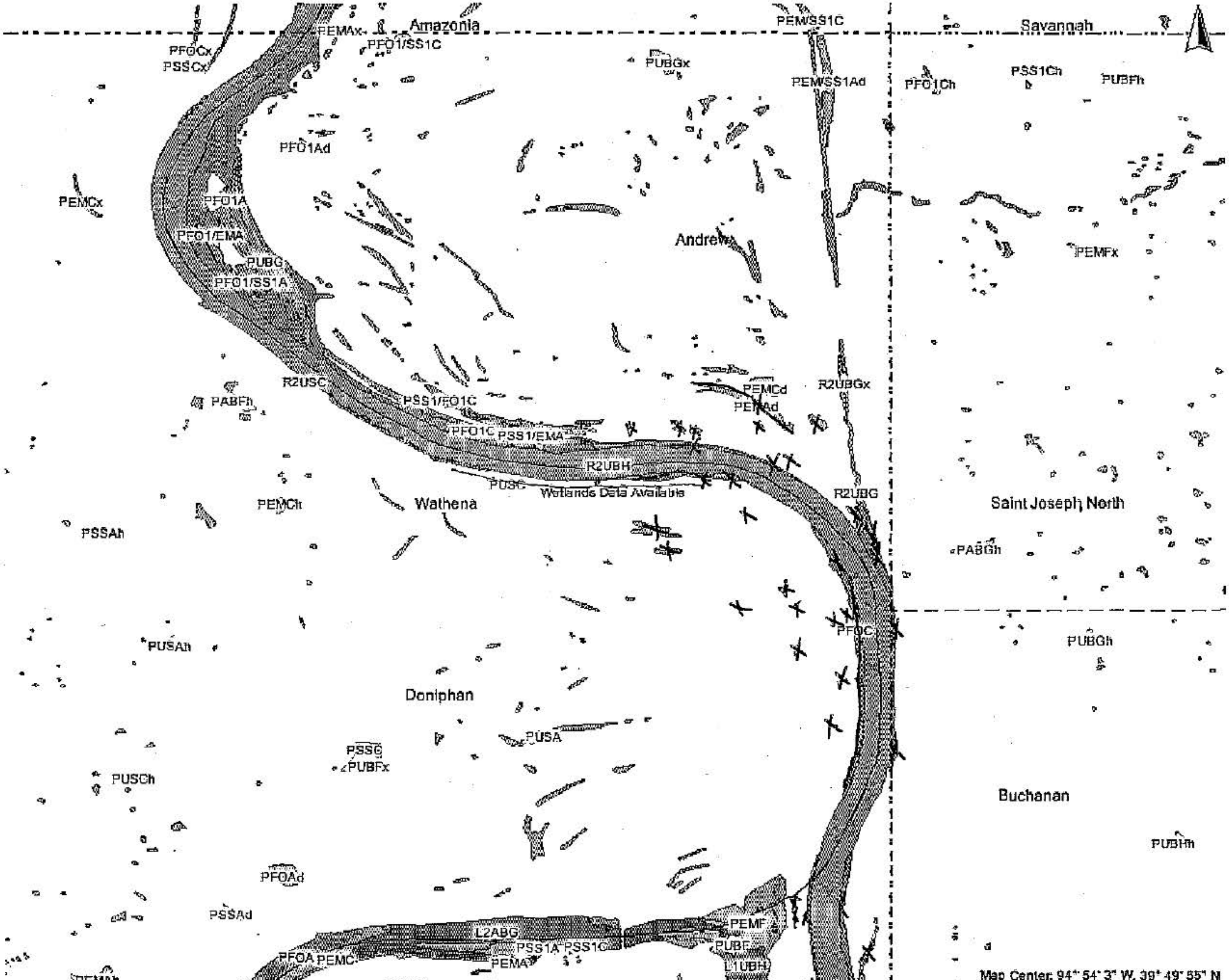
PUSAh
PEMAd
PFOAh
PSSAh
Wathena
PSS1Ax
Saint Joseph North
PSS1/FO1C
Doniphan
PUBF
PSS1A
PSS1
PFO1/SS1A
PSSC
Saint Joseph
PEM/SS1Cd
R2UBHx
L2USC
PFOC
PUB/ABF
Wathena
PUSA
Buchanan
Elwood
PUSC
R2UBH
PABGx
PFO1A
PUSCx
PFO1C
PEMCx
PUBHx
Halls
PSSA
Saint Joseph South
PEMFd
PEMAx
PSSAd
PSSCx
PEM/FO1C
R2USC
L1UBH
PFO1/EMA
PUBKx
PABF
PUBGx
PSS1Cx
PUBG
PEMCd
Map Center: 94° 53' 56" W, 39° 45' 40" N

1150,183



Amazonia
PEMAx
PFO1/SS1C
PFOCx
PSSCx
PEM/SS1C
Savannah
PUBGx
PEM/SS1Ad
PFO1Ch
PSS1Ch
PUBFh
PFO1Ad
PEMCx
PFO1A
PFO1/EMA
PUBG
PFO1/SS1A
Andrew
PEMFx
R2USC
PABFh
PSS1/FO1C
PEMCd
PEMAd
R2UBGx
PFO1C
PSS1/EMA
R2UBH
PUSC
Wetlands Data Available
R2UBG
PEMCh
Wathena
Saint Joseph North
PSSAh
PABGh
PFOC
PUBGh
PUSAh
Doniphan
PUSA
PSSC
PUBFx
PUSCh
Buchanan
PUBHh
PFOAd
PSSAd
PEMF
L2ABG
PSS1A
PSS1C
PUBF
PFOA
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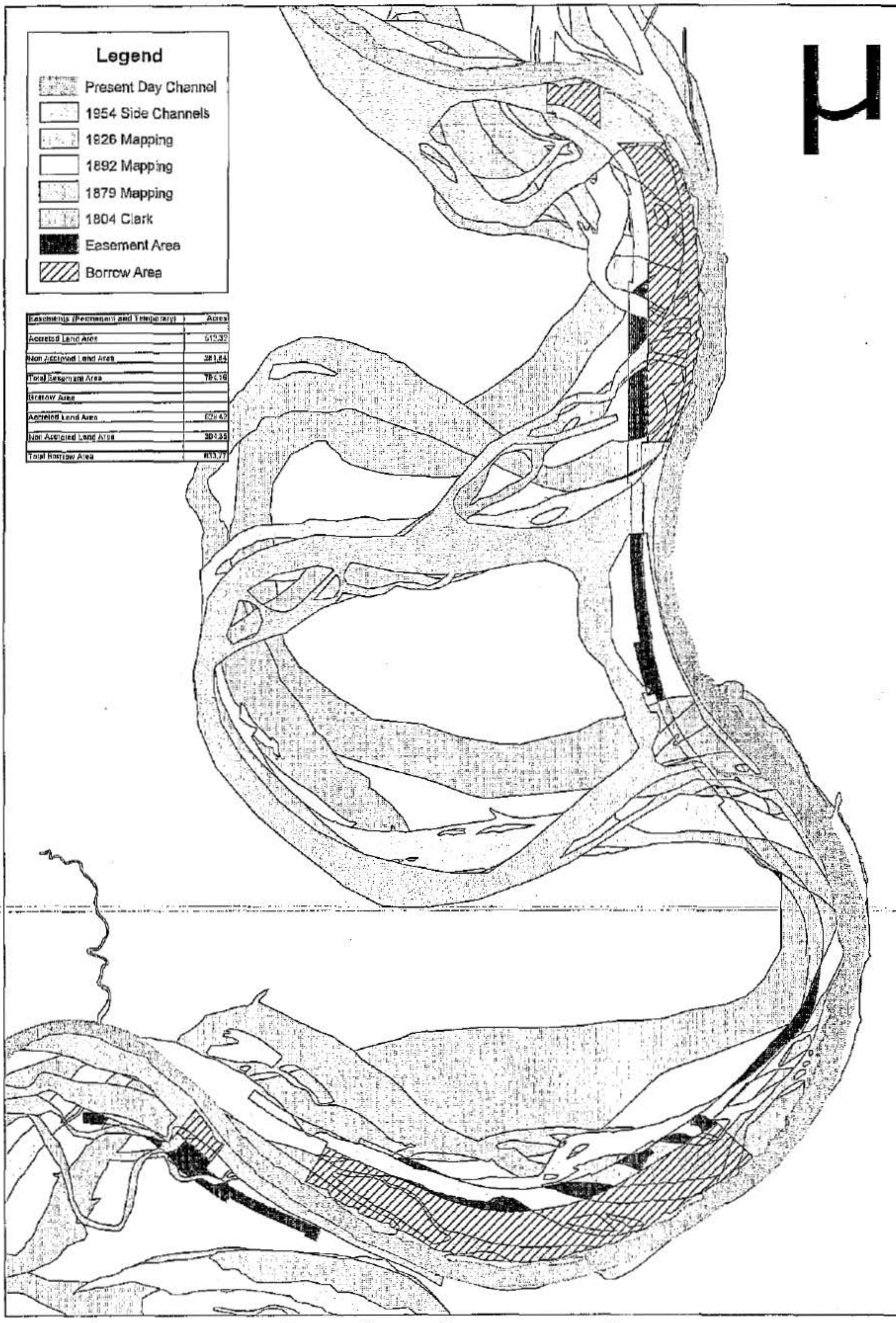
Map Center: 94° 54' 3" W, 39° 49' 55" N

St. Joe Levees - Easements with Accreted Lands



Easements (Permanent and Temporary)	Acres
Accreted Land Area	512.32
Non Accreted Land Area	281.84
Total Easement Area	794.16
Borrow Area	
Accreted Land Area	629.42
Non Accreted Land Area	304.35
Total Borrow Area	933.77

USERS SHOULD REFER CORRECTIONS, ADDITIONS, AND COMMENTS FOR IMPROVING THIS PRODUCT TO : GDS COORDINATOR, UNITED STATES ARMY CORPS OF ENGINEERS, KANSAS CITY DISTRICT OFFICE, 601 EAST 12TH, ROOM 812, KANSAS CITY, MISSOURI 64106

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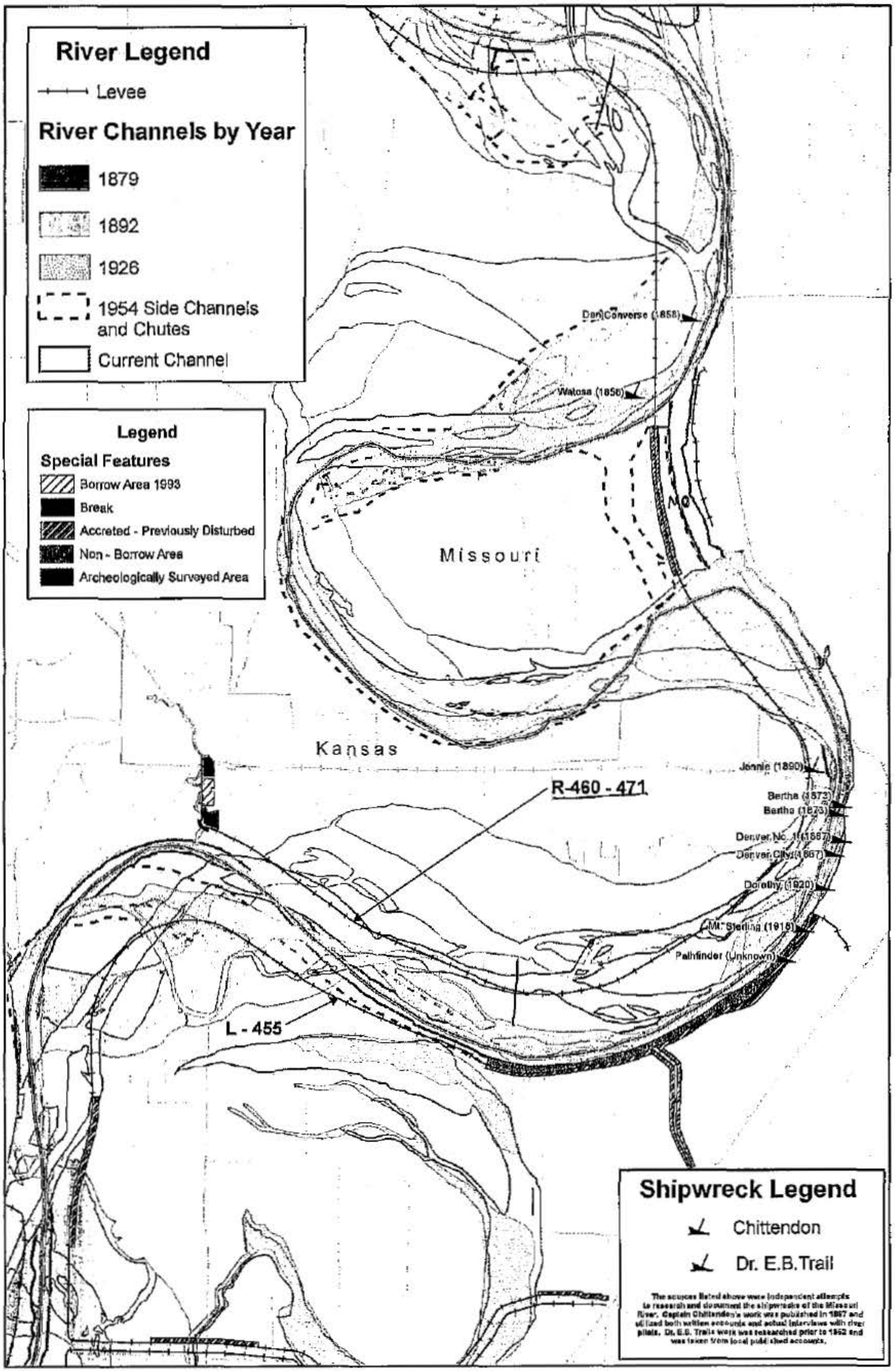
Kansas City District

L-455 R- 460-471



USERS SHOULD REFER CORRECTIONS, ADDITIONS, AND COMMENTS FOR IMPROVING THIS PRODUCT TO : GDS COORDINATOR, UNITED STATES ARMY CORPS OF ENGINEERS, KANSAS CITY DISTRICT OFFICE, 601 EAST 12TH, ROOM 812, KANSAS CITY, MISSOURI 64106

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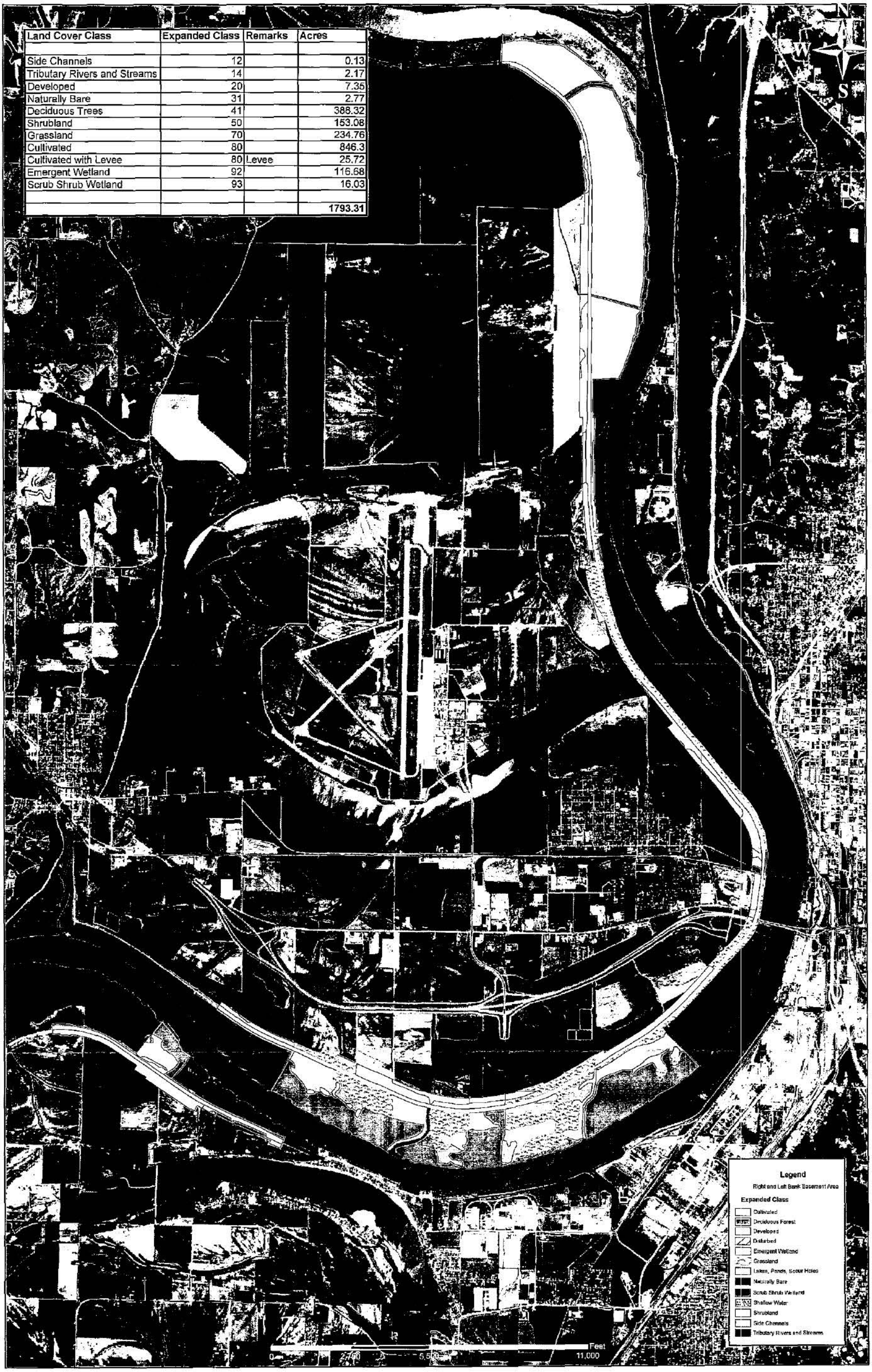
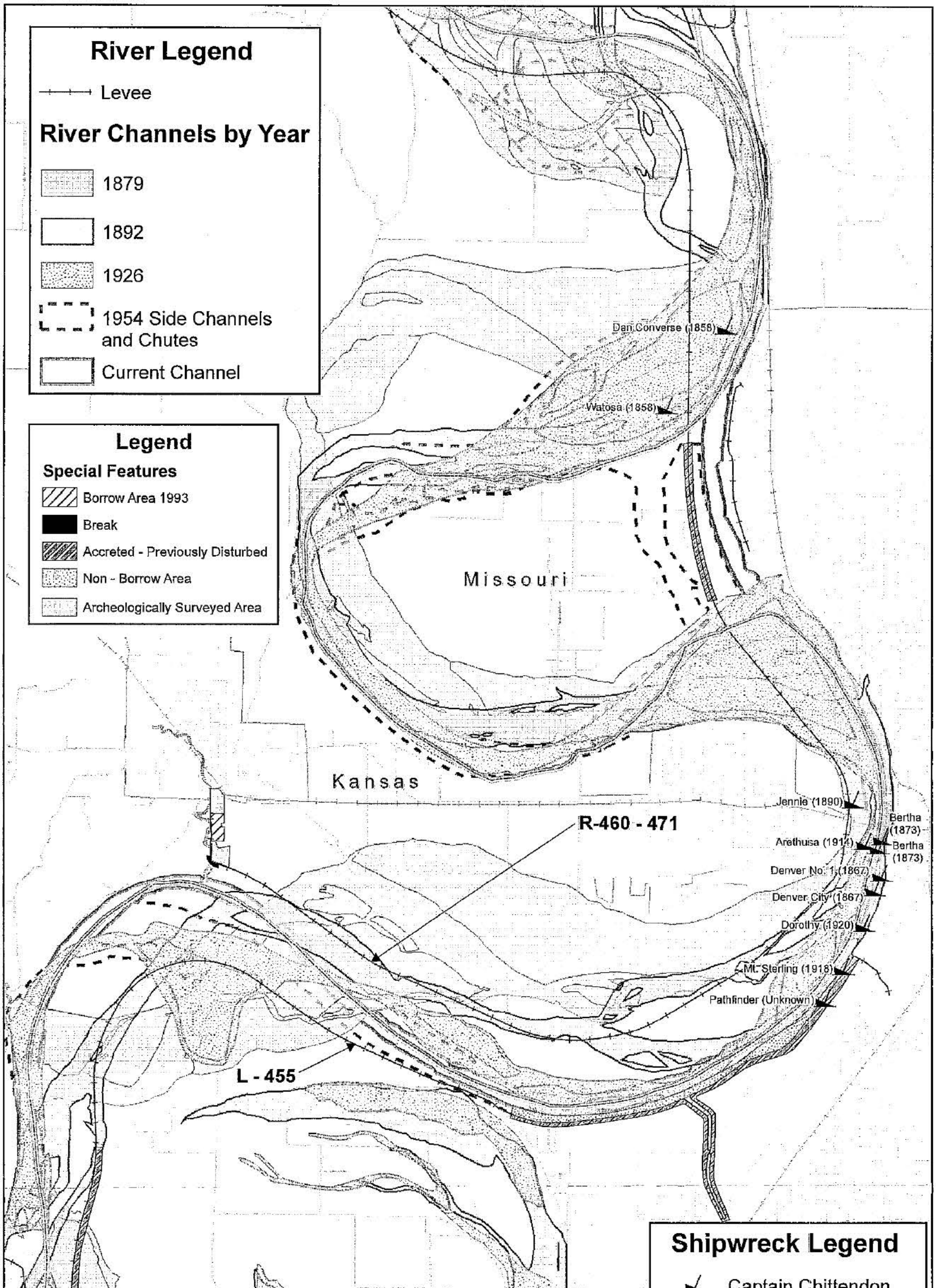
Land Cover Areas in Proposed St. Joe Levee Easement Area

Land Cover Class	Expanded Class	Remarks	Acres
Side Channels	12		0.13
Tributary Rivers and Streams	14		2.17
Developed	20		7.35
Naturally Bare	31		2.77
Deciduous Trees	41		388.32
Shrubland	50		153.08
Grassland	70		234.76
Cultivated	80		846.3
Cultivated with Levee	80	Levee	25.72
Emergent Wetland	92		116.68
Scrub Shrub Wetland	93		16.03
			1793.31



River Levees L455 and R460-471



USERS SHOULD REFER CORRECTIONS, ADDITIONS, AND COMMENTS FOR IMPROVING THIS PRODUCT TO : GDS COORDINATOR, UNITED STATES ARMY CORPS OF ENGINEERS, KANSAS CITY DISTRICT OFFICE, 601 EAST 12TH, ROOM 812, KANSAS CITY, MISSOURI 64106

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Kansas City District

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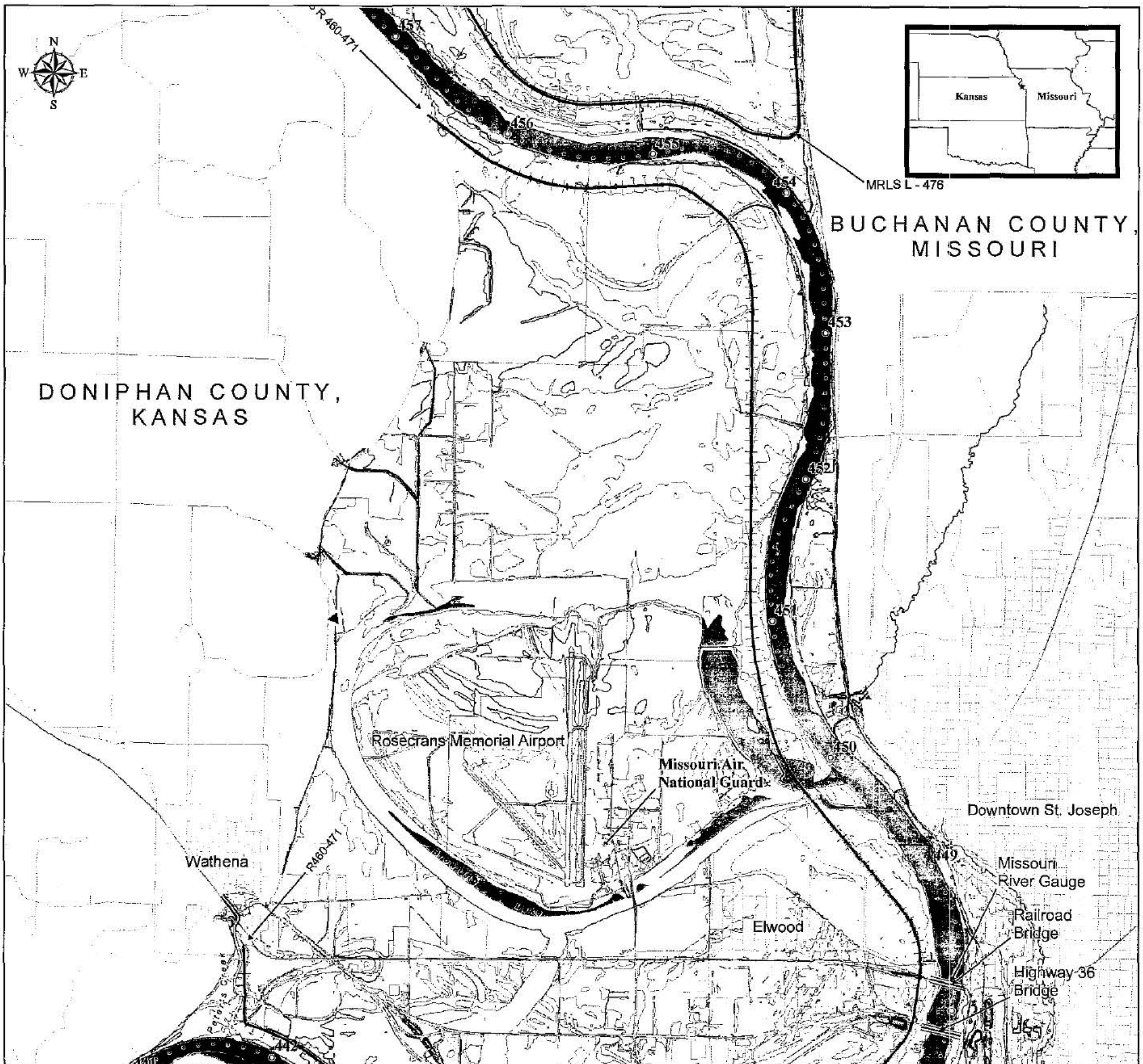
MRLS L-455 and R460-471
FEASIBILITY STUDY AREA



Edition 2, October 2004

U.S. Army Corps of Engineers, Kansas City District

APPENDIX C

Scoping Comments

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
Kansas and Missouri
Environmental Assessment

PUBLIC MEETINGS, SCOPING, AND WORKSHOPS

On March 19, 1996, a meeting in St. Joseph was held with the potential sponsors from the levee districts and representatives of the Cities of St. Joseph, Elwood, and Wathena to disseminate the results of the study and to solicit views concerning the study findings. As a result of this meeting, the local sponsors expressed an interest in proceeding to feasibility studies.

On October 29, 2002, the Corps and FEMA held a public meeting in Elwood, Kansas at the Elwood Community Center to explain to the residents the increased risk of flooding in the area. A similar meeting was held on October 30, 2002 in Wathena, Kansas.

The Corps initial scoping workshops were conducted during the fall of 1995 and included meetings with local, state and Federal agencies, organizations and the general public.

On September 13, 1995, the Corps held a public information workshop at the Holiday Inn in St. Joseph, Missouri to provide notification to the public that a Federal study had been initiated, and to solicit information and views about water resource problem and potential solutions in the study area. Comments were solicited from the public at this initial meeting in which approximately 50 people attended. No substantial opposition or controversial comments were received as a result of the public scoping meeting.

A draft EIS was prepared and provided to resource agencies for review as well as to Corps personal for Internal Technical Review. Based on comments received, a determination was made to revert back to preparation of an EA because impacts were not deemed significant and are readily being mitigated.

No significant comments have been received from any government agency, private organization or the public as a result of meetings, workshops, and public notices for this project

On August 1, 2006, a description of the proposed project was circulated to the public and resource agencies through Public Notice No. 200501489 issued jointly by the Kansas City District; the Missouri Department of Natural Resources, Water Pollution Control Program; and the Kansas Department of Health and Environment. The Public Notice included a thirty-day comment period that ended on August 31, 2006, and provided instructions for the public to provide comments on the proposed project. The public notice also included information on the Corps preliminary determination to prepare a Finding of No Significant Impact (FONSI) for the project and a draft Section 404(b)(1) Evaluation. The public notice was mailed to individuals, agencies, and businesses listed on the NWK-Regulatory Branch's general, state of Missouri and Buchanan County mailing lists, as well as the state of Kansas and Doniphan County mailing lists. A copy of the public notice is included in this appendix, along with a copy of the mailing lists.

The following comments were received during the Public Comment period:

1. The Missouri Department of Conservation (MDC), in an email dated August 3, 2006, requested additional information on levee raise elevations in the Arthur Dupree Conservation Area. **RESPONSE:** The MDC were provided with levee raise specifications for this areas as well as a map detailing the permanent and temporary right-of-way easements.

2. The Wyandotte Nation, in a facsimile dated August 3, 2006, stated that based on the topographic and hydrologic setting of the project, archaeological materials could be encountered, and should such be encountered, requested that the Nation be immediately contacted. **RESPONSE:** The Wyandotte Nation will be immediately contacted should any archaeological materials be encountered.

3. The Pawnee Nation of Oklahoma, in an email dated August 4, 2006, stated that they had no objection to the proposed project.

4. The Federal Aviation Administration, in a letter dated August 4, 2006, stated they had no comments regarding environmental matters.

5. The Kansas State Historical Society, in a letter dated August 4, 2006, stated that the proposed project should have no effect on properties listed on the National Register of Historic Places or otherwise identified in "their" files.

6. The Osage Tribe of Oklahoma, in a letter dated August 9, 2006, stated that the proposed project area could have religious or cultural significance to the Osage Tribe, and that should archeological materials such as bone, pottery, chipped stone, etc. become exposed that work cease and that they be contacted. **RESPONSE:** The Osage Tribe of Oklahoma will be immediately contacted should any archaeological materials be encountered.

7. The Omaha Tribe of Nebraska, in a letter dated August 15, 2006, stated that the proposed project area is within their historical lands; however, because the area has been

previously disturbed, they had no objections to the proposed project. The Tribe further stated that should archeological materials become exposed during construction, that work cease and that they be immediately contacted. **RESPONSE:** The Omaha Tribe of Nebraska will be immediately contacted should any archaeological materials be encountered.

8. The Save the Lake Committee, in a letter dated August 16, 2006, stated that dredged material from Lake Contrary should be used, in part, for the levee raise. **RESPONSE:** Beneficial reuse of dredged material is an excellent strategy that results in a "win-win" solution for compatible projects. However, the Study did not consider dredging Lake Contrary as a source of fill because there are concerns with the probable organic content at the bottom of the lake and the likelihood the dredged material would not be free draining material. The borings in the vicinity of the levee adjacent Lake Contrary indicate zones of silty sands as well as zones of silt and clay materials. Some borings indicate poorly graded sands which would work well with a dredging and fill operation for the underseepage berms; however, it would be difficult to separate the free draining sands from the zones that are not free draining. Organic material is not recommended as a levee structural fill or a fill other than topsoil, which has a limited thickness. Placement of saturated material that is not free draining precludes proper compaction and will introduce instability and long term consolidation (i.e., settlement).

9. The State of Missouri Emergency Management Agency (State), in a memorandum dated August 28, 2006, stated that any development associated with the project that is located within a special flood hazard area, as identified by the Federal Emergency Management Agency, must meet requirements of the State of Missouri Executive Order 98-03 and local floodplain management ordinances. To meet these requirements, a floodplain development permit must be obtained prior to the commencement of any construction/development activities. Further, the State stated that if the development is also located within a regulatory floodway a "No-Rise" Certificate and statement as to the effects of possible flooding, prepared by a licensed engineer and to current FEMA standards, also is required before the development can be permitted. **RESPONSE**: The comment is noted. The US Army Corps of Engineers will obtain any required permits concerning development within a special flood hazard area (SFHA) at the time of the finalized design and prior to any construction activity. The intention of the design at this time is that any raises and widening of the existing levee will occur on the landside of the levee. Thus, there should be no encroachments within the regulatory floodway other than removal of some riverward borrow material during the construction process

10. The Kansas Department of Wildlife and Parks, in a letter dated August 29, 2006, provided a formal response to previous emails and conversations between the Department and the Corps. The letter reiterated that no significant impacts to either state or federally listed threatened or endangered species would occur, and the impacts to area wetlands and vegetation has been minimized and avoided. The Department reminded the Corps that no Department of Wildlife and Parks permits or special authorizations are currently required and that any dredging to obtain borrow material is strongly discouraged. Additionally, the Department stated that should any design changes be made in project

plans, the project sponsor must contact the Department to verify continued applicability. **RESPONSE:** The formal response comments were noted and appreciated. No dredging is currently planned, and the Corps will notify the Department of any changes in project plans.

11. The U.S. Fish and Wildlife Service, in a facsimile dated August 30, 2006, provided the following comments:

a. The Service stated that a discrepancy in levee raise was noted in the Feasibility Study, where Alternative 1 would raise the levee 2 and 2/3 feet while elsewhere in the document a raise of 3.37 feet would be conducted. **RESPONSE:** The maximum height of levee raise necessary to achieve the design profile elevation for unit R471-460 is 3.37 feet. The reference to two and two-thirds feet is the specific height of raise at the economic index point. The purpose and determination of the economic index point is discussed in Section 3.1.3 of Appendix C of the Feasibility Report.

b. The Service stated that impacts to migratory songbirds were not addressed and stated that the Migratory Bird Treaty Act and Executive Order 13112 Section 2(3) (invasive species) should be included in the documentation. **RESPONSE**: The Corps will ensure that project construction minimizes impacts to migratory birds by avoiding breeding times and by minimizing the cutting of trees. Bare and farmed areas will be considered first when obtaining borrow. To ensure Executive Order 13112 Section 2(3) is complied with, the Corps will seek to detect and respond rapidly to and control populations of invasive species in the mitigation areas in a cost-effective and environmentally sound manner, will monitor invasive species populations accurately and reliably, and will restore native species and habitat conditions in the project area in areas where reed canary grass currently existing.

c. The Service stated that they would not recommend, support, or advocate wetland mitigation in areas protected, restored, or targeted for protection or restoration under Federal programs designed to increase the Nation's wetland base (i.e., Elwood Bottoms and the Missouri River Fish and Wildlife Mitigation Program). **RESPONSE:** Because the MRFWMP is seeking to restore the Elwood Bottoms (adjacent to L-455) area under the MRFWMP, the Corps will seek only those areas north of Highway 36 to off-set the impacts to farmed wetlands resulting from the levee expansion.

d. The Service recommended that disturbed areas (levees) be reseeded with appropriate native species indigenous to the local area. They further stated that rye, brome and fescue are not native and should not be use. **RESPONSE:** The Corps will use native grass species to the extent practicable. However, the Kansas City District requirements for seeding and mulching of levee embankments dictate the use of grass species (such as fescue, brome, and rye) that sprout quickly to limit erosion, that can be readily mowed in order to facilitate levee inspection to ensure levee stability, and that help prevent the burrowing of animals that could disrupt levee integrity.

e. The Service stated that the dates identified in the Environmental Assessment were not the actual dates of issuance and expiration of the Public Notice. **RESPONSE:** The Corps intended to publish the Public Notice earlier in the environmental process but had missed the date that was originally contained in the Environmental Assessment. The date has since been updated in the Environmental Assessment.

f. The Service stated that the Best Management Practices (BMP's) discussed in Alterative 1 should be described in more detail. **RESPONSE:** The Corps has expanded these BMP's.

g. The Service recommends that wetland mitigation for emergent wetlands be at a ratio of 1:1.5 and mitigation for forested wetlands be at a ratio of 2:1 and questioned why the Corps is proposing only a 1:1 mitigation ratio. **RESPONSE:** The Corps used the Fish and Wildlife Service wetland database and maps to identify wetlands which might be impacted by the proposed project. This information revealed that emergent and forested wetlands occurred on the landside of the levee at locations that would be filled as the levee toe expands. Upon on-site investigation (photo taken and available) the Corps noted that these areas were actually farmed wetlands. To provide a no net loss of wetland habitat, and to be consistent with the USFWS Coordination Act Report of farmed wetlands, the Corps will be off-setting impacts to these habitats at a 1:1 ratio. The Corps apologizes for the confusion.

h. The Service questioned where in the borrow areas will wetland mitigation actually take place. **RESPONSE:** Specific locations have yet to be identified at the Feasibility stage. The Corps understands the Service's stance on not off-setting impacts in the Elwood Bottoms area, and the Corps will not off-set its impacts in his area will. As construction approaches, more detailed information will be available to make these determinations. The Corps will continue to coordinate with the Service and resource agencies on this issue.

i. The Service stated that Section 3.2.2 Wildlife was not updated with information provided by the Service. **RESPONSE:** This section has since been updated and the Corps appreciates the Service's assistance.

j. The Service stated that Section 3.2.3 Aquatic Ecosystem was not updated with information provided by the Service. **RESPONSE:** This section has since been updated and the Corps appreciates the Service's assistance.

k. The Service provided information on the Indiana bat, stated that suitable habitat for the Indiana bat may exist in the project area, and recommended that the Corps identify the extent of suitable habitat in the project area in both Kansas and Missouri. If suitable roost trees are proposed to be removed, the Service recommends that a survey of the area be made to determine the presence or absence of bats. If bats would be impacted, the Service stated that further consultation under Section 7 of the Act would be required. **RESPONSE:** The Corps included the information from the Service on Indiana bat in the Environmental Assessment. The Corps had previously stated that suitable roost habitat may occur along the Missouri River. As construction approaches, the Corps will survey the area for bat habitat per the Service's recommendation and also invites the Service to participate in this activity. Coordination between the Corps and the Service will continue as this time line nears.

l. The Service was concerned about allowing borrow areas to naturally revegetate due to the reed canary grass, an exotic and aggressively invasive species. **RESPONSE:** The Corps has included adaptive management in the Monitoring Plan to identify and rectify situations deemed unfitting. The spread of reed canary grass will be included in this effort.

m. The Service stated that unavoidable impacts to wetlands at borrow sites have mitigation concurrent with or shortly after project completion and that restoration be in-kind to ensure that no habitat value is lost. **RESPONSE:** The Corps does not anticipate negative impacts to wetlands in the borrow areas, none the less, the comment is noted and will be followed should negative impacts occur.

FWS Response to Selected Corp's Comments on FWS Recommendations in the Draft Fish and Wildlife Coordination Act.

a. Comment on native plant species (Recommendation Number 4) used during re-seeding operations. **RESPONSE:** Comment previously noted and appreciated.

b. Comment on wetland mitigation (Recommendation Number 6) proposed sites. **RESPONSE:** Exact wetland mitigation sites within the borrow areas have not been made at this time. The scraping and reshaping of wetlands will be conducted on wetlands within the borrow areas not along the farmed wetlands at the toe of the levee. No off-set will be conducted in the Elwood Bottoms area per the Service's recommendation. A map will be provided to the Service as the project nears construction and these areas are more readily identifiable.

c. Comment on encouraging wetland development and hydrological reconnection to the river at existing borrow areas landward of the levee units (Recommendation Number 9). **RESPONSE:** Wetland development and hydrological reconnection to the river at existing borrow areas landward of the levee units will be encouraged where practicable.

d. Best Management Practices to prevent the transport of invasive species to or from the construction sites should be included as an integral component of the project (Recommendation Number 10). **RESPONSE:** The updated information from the Service on footwear, clothing, and other sampling equipment has been included in the list of BMP's.

FWS Recommendations from the Final Fish and Wildlife Coordination Act

a. Take of borrow material from riverward areas should be closely coordinated with the Missouri River Fish and Wildlife Mitigation Project. **RESPONSE:** Agreed. The Corps has already coordinated take of borrow material with Corps MRFWMP team members, and this coordination will continue as the project reaches the final design stage.

b. Riparian and wetland habitats should be avoided to the maximum extent practicable when selecting borrow sites for the proposed levee raises and compensatory mitigation should be undertaken for unavoidable impacts. The Corps should focus or bare or cropland areas for borrow. **RESPONSE:** Concur. The Corps will seek the recommended areas for borrow material.

c. Reconsideration of the Levee Setback alternative. **RESPONSE:** Comment Noted. This alternative has been analyzed and based on land ownership, land price, environmental benefits gained vs. total costs, this alternative was reconsidered and not selected.

d. Levees and levee easements should be seeded with native vegetation. **RESPONSE:** Concur. Coordination with the Service for an approved seed mix will be conducted.

e. Removal of mature cottonwoods and other native vegetation should be avoided where possible, and if removed, replaced with woody vegetation by establishing 2 acres for every one impacted. **RESPONSE:** Mature cottonwoods and other "high value" habitat trees will be avoided during the project. Should any be removed, it will be off-set at a 2:1 ratio.

f. Corps should create wetland mitigation habitat to compensate for the loss of wetland acreage from construction of the projects at a minimum of 1.5:1 for emergent wetlands, 2:1 for forested wetlands, and 1:1 for farmed wetlands. **RESPONSE:** Concur. The Corps will be off-setting its impacts to farmed wetlands at a 1:1 ratio.

g. Encourage wetland development and hydrological reconnection to the river at existing and proposed borrow areas. **RESPONSE:** Concur. Comment noted above.

h. Best Management Practices to prevent transport of invasive species to and from the construction sites should be included as an integral component of the project. **RESPONSE:** Concur. Comment noted above.

Opportunities to Provide Fish and Wildlife Enhancement through the Project

a. Establish native vegetation riverward of the levee segments where riparian woodlands are sparse or nonexistent or where the invasive species, reed canary grass, has become established. If possible, borrow from reed canary grass areas and replace with permanent water or seasonal inundation such as chutes, deeper water wetlands, backwaters, and floodplain pond that would eliminate reed canary grass. **RESPONSE:**

The Corps, in coordination with the Service, will seek to obtain borrow and/or plant native species in the areas identified to enhance the project area.

b. All disturbed areas should be immediately planted with native vegetation following construction. **RESPONSE:** The Corps will revegetate with native vegetation following construction and will coordinate with the Service to obtain a list of native seed and plants for this purpose.

Appendix E

The Service stated that Appendix E did not appear to be updated to include revised information. **RESPONSE:** This appendix has been updated per the Service's revised information.

Appendix J

General Comments

a. The Service recommends a plant list, containing both common and scientific names, which includes all plants proposed to be used for any component of the project be included in the mitigation plan. **RESPONSE:** The mitigation plan contains a list of trees and shrubs to be planted. A list of grass species is being developed and will be provided to the Service upon its completion.

b. The Mitigation Plan does not conform to the Multi-Agency Compensatory Mitigation Checklist and Supplement: Compensatory Mitigation Plan Checklist included as part of the Kansas City District's Notice of Implementation of the Multi-Agency Compensatory Mitigation Checklist and the National Research Council's Mitigation Guidelines (PN 200400295). **RESPONSE:** This Checklist was used to formulate the Mitigation Plan.

c. Mitigation Goals and Objectives. Mitigation in MRFWMP lands. **RESPONSE:** Comment previously addressed. Mitigation will not occur in these lands.

d. Mitigation Site Selection and Justification. The Service stated that a map would be helpful to identify mitigation sites. **RESPONSE:** As the project gets closer to the construction phase, exact mitigation sites will be determined, mapped, and a map will be provided to the Service. Existing seed banks containing reed canary grass should not be used to supplement new wetland areas. **RESPONSE:** Concur. Locating proposed wetland mitigation adjacent to existing wetlands may negatively impact the existing wetland. **RESPONSE:** Wetlands mitigation will be designed to ensure that they function as anticipated. Adapted management will be used to assess and make changes as necessary.

e. Monitoring Plan. Any monitoring conducted on MRFWMP lands should include MRFWMP team members. **RESPONSE:** Concur. MRFWMP team members will be informed of any monitoring conducted on these lands.

f. Performance Measures. The performance measures should include measurable outcomes and a contingency plan if the mitigation fails during the monitoring period. **RESPONSE:** Concur. This information has been added to the Mitigation Plan.

g. Site Protection and Maintenance. Mitigation sites should be protected in perpetuity and a maintenance plan should be developed to address invasive species management. **RESPONSE:** Concur. This information has been added to the Mitigation Plan.

Public Notice 200501489

The proposed work statement states that the anticipated raise varies along its entire length from zero to two and one half feet. **RESPONSE:** The proposed raise will be from zero to 3.37 feet.

Additional Comments

a. The Service recommends that the Corps give first consideration for borrow areas along the banks of the river as a way to increase shallow water habitat in coordination with the MRFWMP team. **RESPONSE:** The Corps has coordinated with the MRFWMP team concerning borrow areas. As the project approaches the construction phase, the Corps will continue this coordination to ensure compatible use and selection of borrow areas.

b. New information on the Indiana bat. The Service recommends that the Corps identify the extent of suitable bat habitat in the project area, and evaluate potential effects to the habitat. **RESPONSE:** The Corps will conduct a survey to identify the extent of suitable bat habitat in the project area prior to construction to determine if suitable roost trees are present, and invites the Service to attend.

12. The Department of Natural Resources, in a letter dated August 31, 2006, provided the following comments:

a. Water Resources. The Department was concerned with impacts to area wetlands and stated that standard Best Management Practices should employed to adhere to the Missouri Clean Water Law. **RESPONSE:** Concur. The Corps will seek to mitigate impacts to wetlands through avoidance, minimization, and mitigation. Any unavoidable impacts to wetlands will be off-set on-site to ensure a no net loss of wetland habitat. The Corps also will be implemented Best Management Practices to ensure adherence to the Clean Water Law.

b. Hazardous Wastes. The Department provided a list of up-dated superfund listed properties and recommended the Corps verify these locations to determine which site, if any, might impact the proposed project. **RESPONSE:**The list of superfund sites will be verified by the Corps prior to construction to ensure these sites do not impact the proposed project.

August 28, 2006 Public Meeting Comments

A public meeting to present background information and the recommendations contained in the Draft Feasibility Report and Environmental Assessment was held August 28, 2006, at the Elwood Community Center. Twenty-seven members of the public attended including representatives of the local sponsors, adjacent property owners, local elected officials, upstream and downstream levee districts, and state agencies. Five written comment forms were received during the public meeting. The names and contact information of those submitting comments, the comment, and the response of the Corps of Engineers, is detailed below.

Comment 1

Submitted by: James Rader
Mayor, City of Elwood
508 So. 8th Box 143
Elwood, Kansas 66024
913-365-2812
816-262-5154

Comment: I have lived in Elwood for 69 ½ years. I have been here through the flood of 1952 and also 1993. We have had extensive commercial development here since 1973. I feel this will stop without the recommended work done on the levees. Also the personal trauma of going through a flood and the cleaning and repairs afterward more than justify the cost of these extensions. Thank you for your work, Jim Rader.

Response: Comment noted and appreciated.

Comment 2

Submitted by: John Osborne
314 Center P.O. 27
Elwood, Kansas 66024
913-365-2804
jarvisandjack@msn.com

Comment: I was here in "93" and along with my friends & neighbors, listened to State & Federal official pacify Elwood residents. All I ask for myself and all Elwood resident is "Do what you say you'll do & don't say you will & then don't." Most people who have had any dealing with FEMA or the Corp, are very skeptical of everything the say & do.

We all want to live in a safe community, & I for one support your efforts. Thank you, John Osborne.

Response: Comment noted and appreciated.

Comment 3

Submitted by: Doug Shepherd
President, South St. Joseph Levee & Drainage District
4070 SW State Route U
St. Joseph, Missouri 64504
816-262-5297
shepherdfarm@aol.com

Comment: Why is there proposed work for levee between 205+00 to 295+00 when our trouble spot in 1993 was in the area of 107+70. Where we had to sandbag the levee to contain flood water. In the proposed work area we didn't have any problem.

Response: Appendix B of the Feasibility Study has identified the reach of the levee in the vicinity of station 107+70 as a reach requiring additional field surveys during Preconstruction, Engineering, and Design (PED). A little over 300-feet of levee in this area has been identified as suspect and may require a levee cap approximately a minimum of 0.6 of a foot thickness. Your comment of your first hand experience during the flood of 1993 and the additional field surveys during PED will most likely result in a short length the levee at this location receiving fill on its crown sufficient to remove the low spot.

Comment 4

Submitted by: Laipple Farms
1409 Treece Rd.
Wathena, Kansas 66090
785-989-4990

Comment: If the improvements to the existing levee system is carried out we are concerned where the borrow area or dirt will be obtained? We are not willing to give any borrow areas or dirt for these improvements. There have been several borrow areas given on this land through the years. We depend on this land for our living. There is no difference between this business and any other business. There is no drainage for the three (3) creeks that drain into the old river channel, that drain through Gladden Bottom. The channel is about filled up. It should be dredged out going East, to the tubes that are there. If the old channel would be cleaned out, this material could be used for the improvements on the existing levee.

Response: Potential borrow areas are currently designated as those areas adjacent to the levee on the river side. Generally, borrow locations are chosen nearest to the project site to offset additional haul distances and cost and/or processing cost, if any. Furthermore, areas of significant tree growth and wildlife habitat are avoided. This is in accordance with Corps guidance. However, final locations and quantities that will be taken from each site are not finalized. During the Pre-Construction Engineering and Design (PED) phase, alternative locations and the use of dredged material will be considered. . If you are aware of borrow sources capable of producing acceptable fill material in the quantities necessary for construction of the selected plan, those locations should be provided to this office for consideration during PED.

Comment 5

Submitted by: John Cox
Airport Levee member
1008 NW Rosecrans Rd.
St. Joseph, Missouri 64503
816-271-4886
johncox@ci.st-joseph.mo.us

Comment: Since the Mo Air National Guard 139th AW has the greatest investment protected by the R471-460 levee system. Why can't the DOD fund the O&M and/or levee system improvements?

Response: Cost-sharing requirements for Civil Works projects were established by Congress in the Water Resources Development Act of 1986. For a project of this type, a 65/35 split between the Federal government and local interests is required, without regard to the value or nature of investment within the existing system.

Public Meeting Comment 6 (received by mail 31 August 2006)

Submitted by: Gary Laipple
Farmer
1225 Tioga Rd.
Wathena, KS 66090
785-989-3482

Comment: Our family farm runs along the river from north of river mile 454 then south to river mile 452. We went through the construction of the levee with all the right of way and borrow area. We filled the borrow areas and deep plowed the haul roads. We have also been through various floods, including the "1993 flood" which was devastating to our family farm. So perhaps you can understand why our family is against any destruction of our farm, which includes the borrow areas and right of ways. Here are several alternatives for borrow areas. (1) Government Land along the river south of our farm which is river mile #451. (2) Dredge the old river channel. This would provide dirt plus drainage for the bottom. (3) Haul dirt from the bluff. (4) Dredge dirt out of the Missouri river. Please consider an alternative for the borrow areas other than our farm.

Also if berms are extended we should be allowed to farm them instead of taking the ground out of production.

Response: Same response as Public Meeting Comment 4 with the addition that extension of underseepage berms will be conducted using temporary easements and the ground will revert back to the property owner after completion of construction. Farming of underseepage berm areas is allowed.

Public Meeting Comment 7

Submitted by: Jan B. Laipple
1409 Treece Rd.
Wathena, Kansas 66090
785-989-4990

Comment: I am opposed to giving any dirt (borrow areas) or material of any kind, concerning stations 100+00 – 120+00 – 140+00 – 160+00 – 180+00 – 200+00 – 220+00. I am also against parting with any additional land. Create the borrow areas South of the above stations. (Stations – 240+00 – 260+00 – 280+00 – 300+00 – 320+00.) This land is not being farmed. Dredge the material out of the present river channel. Material could also be obtained out of the old river channel prior to 1952. A levee could be constructed East and West to the North of Rosecrans Airport. The obstructions and bottleneck at stations 400+00 – 420+00 – 440+00 could be corrected. This would help the flow of the river and help prevent flooding. The river should be maintained for navigation, not for preservation of wildlife. Dikes should be maintained to keep the river channel navigable. Moving products up and down the river is a much cheaper way of moving them. We have spent a lifetime building and paying for this farm. The land affected is priceless. This is how my families' livelihood is obtained. Thank you.

Response: See response to Public Meeting Comment 4 regarding borrow locations and evaluation of possible alternative sources. Levee realignment and setback is significantly more expensive than a raise in the existing location. The cost would outweigh the benefits of the project and cause a greater financial impact to the local levee districts. Federal laws and regulations require the Corps of Engineers to examine the environmental impacts of proposed actions and propose alternatives to minimize or mitigate those impacts. The management of the Missouri River for various purposes and the maintenance of the channel dikes is beyond the scope of this study.

Public Meeting Comment 8

Submitted by: Pat Higdon
11897 Hwy 36
Easton, MO 64443
816-473-3011

Comment: The public meeting in Elwood, KS, was informative and I understand the plan and necessity of improving the levee. I currently farm ground on both sides of the levee. It was not made clear how the construction of the levee will affect my acreage economically and what expected length of time. Where will the dirt (ground) come from for the project? Will I lose acreage? Will I be compensated for the loss of crop production effected during the project? Please respond – Pat Higdon

Response: Borrow (soil) material for the levee raise is currently proposed to come from the areas between the levee and the river. Specific locations and quantities from each location have not been fully developed. Construction of the entire project is estimated to take three years, however, impacts to specific location within the project should be less than that. Permanent loss of acreage may occur and will be compensated through the negotiation and purchase of a permanent right-of-way easement. Similarly, temporary impacts during construction will be compensated through the negotiation of temporary easements. Impacts to specific parcels will be refined during the Pre-Construction Engineering and Design (PED) phase and, when available, will be coordinated with each individual affected property owner.

Vandenberg, Matthew D NWK

From: Mike_LeValley@fws.gov
Sent: Tuesday, September 05, 2006 10:38 AM
To: White, Christopher M NWK
Cc: Vandenberg, Matthew D NWK; Susan_Blackford@fws.gov; Dan_Mulhern@fws.gov
Subject: Re: Proposed Answer to HQ Comment on EA for St. Joe Levees re EA

Chris: Your response accurately reflects our discussions regarding bald eagle habitat and the subject project. Let me know if (and when) you will need a formal letter from me regarding our concurrence. Thanks.

Michael J. LeValley
Kansas Ecological Services Field Office Supervisor U.S. Fish and Wildlife Service
2609 Anderson Avenue
Manhattan, KS 66502
785-539-3474, Ext. 105
785-539-8567, Fax

"White, Christopher M NWK" <Christopher.M.White@nwk02.usace.army.mil>
09/04/2006 07:30 AM

To: <Mike_LeValley@fws.gov>
cc: "Vandenberg, Matthew D NWK" <Matthew.D.Vandenberg@nwk02.usace.army.mil>
Subject: Proposed Answer to HQ Comment on EA for St. Joe Levees re EA

Mike,

Could you please look over the below statement and let me know if this accurately reflects our discussions and your understanding of the issues?

I really appreciate you help in this and the cooperation of the service.
Please note that the last sentence in our answer is only a draft, but I wanted to make sure that I phrased it correctly.

If possible could you let me know on Tuesday morning as we need to get this to HQ by noon Tues.

If you happen to read this on Monday and you have questions, I am at home: 816-347-2672.

Thanks,

Chris White

This is the HQ comment followed by our proposed answer:
a. Endangered Species Act. There is an apparent disagreement between

the Corps and the U.S. Fish and Wildlife Service concerning the affect of the project on the threatened bald eagle. The discussion in Section 4.4.4 of the EA states that the Corps has determined that the proposed action would have no adverse affect on Federal or State listed species. The USFWS, as noted on page 11 of the June 30, 2006 Fish and Wildlife Coordination Act draft report, has determined that the project may adversely impact the bald eagle, and page 17 of the FWCAR contains specific measures designed to minimize impacts to the eagle.

According to the USFWS/NOAA Endangered Species consultation handbook, where a Federal action agency makes a "no effect" determination with regard to a listed species, no consultation pursuant to Section 7 of the Endangered Species Act is required;, and, no further coordination is needed to comply with the Act. However, Section 7 consultation is required in the event of a "may affect" determination. As the Federal action agency, the Corps has the responsibility for the determination of "affect" for a listed species, and does not have to accept the determination of the agency with ESA jurisdiction (USFWS). However, in this case the District should contact the USFWS to clarify the affect determination for the bald eagle. The results of the discussion concerning the affect of the project on the bald eagle should be included in the final report and EA.

NWK Response: The draft and final USFWS Coordination Act Reports (page 11) explain when Federal Agencies are required to consult under Section 7 of the ESA. They state: "If a project may affect listed species, the Corps of Engineers should initiate formal Section 7 consultation." The third paragraph of page 11 of the Final CAR states: "This project may adversely impact the bald eagle by removing trees from the levee footprint and from the borrow areas." An email to the USFWS was sent to clarify that mature cottonwoods (24-inches dbh, over 50 feet tall, and within 100-feet of the water's edge) will be avoided by project construction activities, thus avoiding any affects to bald eagle. The other secondary cottonwoods along the levee footprint are much less dbh than 24-inches, are not over 50 feet tall, and are ¼ to ½ mile from the water's edge. These trees do not constitute eagle habitat. However, recognizing that trees are important to the environment, the Service has stated that an adverse impact may occur (removal of trees is bad for wildlife) but that an affect (an action that causes harm or harassment to listed species and, thus, triggers Section 7) is not likely. The Field Supervisor at the Fish and Wildlife Service is currently working with the Corps and is in agreement with this determination.

STATE OF MISSOURI
Matt Blunt, Governor • Doyle Childers, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

August 31, 2006

Kansas City District, Corps of Engineers
Christopher M. White, Ph.D.
St. Joseph Levees Project
601 E. 12th Street
Kansas City, Missouri 64106-2896

Re: Draft Environmental Assessment and Draft Feasibility Report for Flood Damage Reduction on Missouri River Units R471-460 and L-455

Dear Dr. White:

The Missouri Department of Natural Resources has reviewed the Draft Environmental Assessment and Draft Feasibility Report for Flood Damage Reduction on Missouri River Units R471-460 and L-455. The department's comments are provided below.

The department has no record of ever receiving a Draft Environmental Impact Statement on this project. Consequently, these comments constitute the first comments by the department on the proposed project.

Water Resources

One of the department's concerns in a setting adjacent to a major water body is the presence of wetlands. The document describes the present wetlands as small pockets in meander scars and within the riparian area. In the area of concern (+- 21,000 acres) there are only 741 acres of scattered wetland – just 3.5 percent of the area. These are made up of 545 acres of forested wetland, 65 acres of scrub/shrub wetlands, and 131 acres of emergent wetlands. While exact figures are not immediately available, it is safe to say that this is much reduced from the historic acreage. While permanent impacts to the remaining wetlands from the proposed project would be relatively small, temporary impacts will likely be incurred during construction. Even small impacts on these diminished resources should be avoided to the extent possible. The employment of standard Best Management Practices should ensure protection of water quality and adherence to Missouri Clean Water Law.

HAZARDOUS WASTE PROGRAM
Superfund Sections
SITE STATUS REPORT BY DISTRICT

As of Monday, August 28, 2006

Buchanan County

Region: Kansas City
Ombudsman: Kansas City

1 ABC Recyclers

2902 S. 11th Street
St. Joseph 64503

County: Buchanan
Region: Kansas City
Ombudsman: Kansas City

Size of Site: 1
Land Use(s):
Contaminants:
Contaminated Media:

Site Description History

The site is the former location of a meat packing plant, Dugdale Packing, of which a portion was leased to a recycling operation known as ABC Recyclers. Neither business is still operating. When the recycling company left, they left behind several 55-gallon drums of paint waste.

Recent Activities **Last Revised: 05/20/1998**

An Integrated PA/SI was completed on March 29, 1996 with a recommendation for a PRP lead removal action. There are at least 15 55-gallon drums of hazardous waste on-site. A current lessee of the property indicated an interest in removing the hazardous and non-hazardous drums from the site. Investigator Al Wallen is overseeing this action. Apparently, Mr. Butts, the lessee, and the owner, June Ide, colaborated to hire an environmental contractor from Kansas City to do remove the drums sometime in late March. SEU is currently waiting for a closure report from Al.

2 Brooner & Associates

802 S. 5th Street
St. Joseph 64501-3676

County: Buchanan
Region: Kansas City
Ombudsman: Kansas City

Size of Site:
Land Use(s):
Contaminants:
Contaminated Media:

Site Description History

This site was discovered during the investigation of St. Joseph FMGP #3.

Recent Activities **Last Revised: 05/20/1998**

During the SI sampling for the St. Joseph FMGP #3 site, on September 17-18, 1997, DNR staff observed 10-15 drums stored outside on the property. Some of the drums appeared to have leaked. A soil sample collected as part of the FMGP investigation revealed low levels of TCE (42 ppb). Since Brooner & Associates is a currently active business, and the TCE is not thought to be related to the FMGP site, this information was forwarded to the KCRO for their consideration. Additional work may be conducted under RCRA authority.

3 Byers Commercial Storage

18th and Penn Street			
St. Joseph	64507	County	Buchanan
		Region:	Kansas City
Size of Site:	less than 1	Ombudsman:	Kansas City
Land Use(s):	Drum/Container Storage, Warehouse		
Contaminants:	Dioxin, Pesticides		
Contaminated Media:			

Site Description History

This site is a warehouse, where a number of cancelled pesticides were stored in 55-gallon drums. The building became contaminated with dioxin and other pesticides through spillage and leakage of containers. EPA has completed a removal of the drummed wastes, which were shipped off-site for inceneration. The building interior has been cleaned, and wipe tests were submitted to EPA.

Recent Activities **Last Revised:** **05/20/1998**

The site has not been accepted as cleaned up as of this update, since the groundwater issue has not been completely addressed.

4 Farmland Industries

Fourth & Seneca Street			
St. Joseph	64504	County	Buchanan
		Region:	Kansas City
Size of Site:	1-2	Ombudsman:	Kansas City
Land Use(s):	Pesticide Manufacturing/Use		
Contaminants:	Metals, Pesticides		
Contaminated Media:	Soil		

Site Description History

The site is contaminated with high concentrations of pesticides. This contamination occurred between 1959 & 1980 from the formulation of organochlorine pesticides.

Recent Activities **Last Revised:** **01/01/2006**

BNSF submitted the annual report for the closed farmland site on 6/26/06.

The report detailed the monthly inspections and maintenance of the protective cap. During the entire course of monthly inspections, no erosion nor signs of trespass were observed. Regular maintenance (mowing) took place through out the year. No significant maintenance activities were performed during the last year, and none are expected in the next year. Judith McDonough submitted the report on behalf of BNSF.

5 McArthur Drive Landfill

McArthur Drive and Water Works Road			
St. Joseph	64505	County	Buchanan
		Region:	Kansas City
Size of Site:	14	Ombudsman:	Kansas City
Land Use(s):	Landfill/Industrial, Landfill/Municipal		
Contaminants:	Pesticides		
Contaminated Media:	Soil		

Site Description History

Recent Activities **Last Revised:** **06/14/2004**

On 6/14/2004 the department received a copy of the annual Groundwater, Surface Water, and Sediment Monitoring Report from EPA.

6 Nufarm

317 Florence Rd.
St. Joseph 64504-1071

County: Buchanan
Region: Kansas City
Ombudsman: Kansas City

Size of Site:	1+
Land Use(s):	Herbicide Manufacturing/use
Contaminants:	Dioxin, Herbicides
Contaminated Media:	Soil

Site Description History

Several companies have operated herbicide formulation facilities at the site since 1956. From 1956 - 1975, Amchem Products operated a herbicide formulation and metalworking facility on the original 7.84-acre parcel. From 1975 – 1986, Union Carbide operated the facility. In 1986, Rhone-Poulenc purchased the herbicide formulation facility. The company acquired only that portion (2.5 acres) of the property that contained the facility. Union Carbide retained the remaining 5.34 vacant acres. Finally, in December 1997, Rhone-Poulenc sold the 2.5-acre property and facility to Nufarm Inc.

Contamination at the property dates from the period between 1956 and 1975 when herbicides containing dioxin were formulated (2,4-D and 2,4,5-T). The 5.34-acre property retained by Union Carbide is the former location of a lagoon used for waste disposal. The 2.5-acre Nufarm Site contains the storage tank and rail area, where railroad cars transporting chemicals and herbicides were loaded and unloaded. Spillage during the loading process is the probable source of on-site contamination of soils. In 1985, samples taken by the U. S. Environmental Protection Agency as part of a PA/SI show dioxin levels above the commonly used residential health-based benchmark for dioxin (1 part per billion (ppb)) at 7.1 ppb in the rail area, and at 4.5 and 3.4 ppb at the surface in the storage tanks area. Soil samples collected in 1988 and 1995 by the site owner's consultant revealed the presence of 2,4-D, dioxin and 2,4,5-TP (Silvex). A composite sample analyzed for Silvex failed the Toxicity Characteristic Leaching Procedure (TCLP) at 4.6 ppm.

The Nufarm Site was listed on the Registry of Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri (Registry) on August 3, 1998. The Union Carbide Site is also listed on the Registry. The site is located in

Recent Activities **Last Revised: 06/27/2003**

25 acre area located next to Union Carbide Site. Area is clean. No water standing. Area locked when not in use. Signs are posted.

7 Pigeon Hill Landfill (Norris and Sons)

South of Hwy O, 10 miles south of St. Joseph
St. Joseph 64501

County: Buchanan
Region: Kansas City
Ombudsman: Kansas City

Size of Site:	40 acres
Land Use(s):	Landfill/Municipal
Contaminants:	Metals, Pesticides, Solvents
Contaminated Media:	Groundwater, Soil

Site Description History

The site is a closed former municipal sanitary landfill for the city of St. Joseph. Several tons of industrial waste have been disposed of at the site. The site has been capped and vegetated, but has had erosion and leachate

Recent Activities **Last Revised: 06/27/2003**

Area is fenced barbwire with signs. Gates are locked, good grass coverage. No signs of erosion.

11

8 Rosecrans Field Rifle Range

Riverview Drive
St. Joseph 64501

County: Buchanan
Region: Kansas City
Ombudsman: Kansas City

Size of Site: 0.5 acres
Land Use(s): Military Installation, Recreational use
Contaminants: Lead
Contaminated Media: Soil

Site Description History

Rosecrans Field Rifle Range, also known as Camp Petree, was used in conjunction with the Rosecrans Army Air field in the early 1940s. Camp Petree was used as an overflow camp and rifle range for the training of troops stationed at the Army Air Field. The range was declared surplus in 1945. Live ammunition, mostly consisting of 0.22 caliber bullets were fired at the range. Nothing larger than 50 caliber was used. More recently, the site was used by a local

Recent Activities **Last Revised:** **04/08/2003**

The Abbreviated Preliminary Assessment (APA) Report was completed on 4/4/03. The APA investigation included surface soil sampling at the former firing range. No lead contamination was detected. Based on the absence of a release of hazardous substances at the site, no further CERCLA assessment is recommended at this time. The site is recommended for archival from CERCLIS.

12

9 St. Joseph FMGP #1

S. 4th & Cedar
St. Joseph 64501

County: Buchanan
Region: Kansas City
Ombudsman: Kansas City

Size of Site:
Land Use(s): FMGP
Contaminants: Coal Tar
Contaminated Media:

Site Description History

Recent Activities **Last Revised:**

None.

10 St. Joseph FMGP #3

802 S. 5th St. (South 6th & Lafayette)
St. Joseph 64501-3676

County: Buchanan
Region: Kansas City
Ombudsman: Kansas City

Size of Site: 3
Land Use(s): FMGP
Contaminants: Coal Tar
Contaminated Media:

Site Description History

This site is a former manufactured gas plant (FMGP).

Recent Activities **Last Revised:** **01/08/1999**

The SI report was completed on December 15, 1998. We are currently negotiating a voluntary deed restriction option with the two property owners of the former FMGP to restrict subsurface excavation. If appropriate restrictions are placed on the property deeds, no further action will be necessary under Superfund authority.

13 Union Carbide

317 West Florence Road			
St. Joseph	64504	County	Buchanan
		Region:	Kansas City
Size of Site:	approx. 5.5	Ombudsman:	Kansas City
Land Use(s):	Herbicide Manufacturing/use, Pesticide Manufacturing/Use		
Contaminants:	Dioxin, Pesticides		
Contaminated Media:	Soil		

Site Description History

Several companies have operated herbicide formulation facilities at the site since 1956. From 1956 - 1975, Amchem Products operated a herbicide formulation and metalworking facility on the original 7.84-acre parcel. From 1975 – 1986, Union Carbide operated the facility. In 1986, Rhone-Poulenc purchased the herbicide formulation facility. The company acquired only that portion (2.5 acres) of the property that contained the facility. Union Carbide retained the remaining 5.34 vacant acres. Finally, in December 1997, Rhone-Poulenc sold the 2.5-acre property and facility to Nufarm Inc.

Contamination at the property dates from the period between 1956 and 1975 when herbicides containing dioxin were formulated (2,4-D and 2,4,5-T). The 5.34-acre property retained by Union Carbide is the former location of a lagoon used for waste disposal. The 2.5-acre Nufarm Site contains the storage tank and rail area, where railroad cars transporting chemicals and herbicides were loaded and unloaded. In 1985, samples taken by the U. S. Environmental Protection Agency as part of a PA/SI show dioxin levels above the commonly used residential health-based benchmark for dioxin (1 part per billion (ppb)).

The Union Carbide Site was listed on the Registry of Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri (Registry) on December 12, 1996. The Nufarm Site is also listed on the Registry.

Recent Activities **Last Revised:** **05/01/2003**

The area was fenced with chain link fence. Gate for entry use was locked and posted with two signs. Cap was in fair condition with grass a little sparse in some areas. No significant water erosion was noted.

14 Varco-Pruden Buildings

2250 Lower Lake Road			
St. Joseph	64504	County	Buchanan
		Region:	Kansas City
Size of Site:		Ombudsman:	Kansas City
Land Use(s):			
Contaminants:	Solvents		
Contaminated Media:			

Site Description History

The Varco-Pruden Buldings site is an active manufacturing facility of pre-fabricated metal buildings. From 1984 to 1990, xylene, which is used as a paint solvent was stored in an Underground Storage Tank (UST). Subsequent removal of the UST and charaterization of the area of the UST revealed soil and shallow groundwater contamination. The Superfund Section will provide oversight for the final phase of cleanup of the site.

Recent Activities **Last Revised:** **03/30/2005**

On March 30, 2005 a Pre-CERCLIS Site Screening Report was submitted to EPA Region 7. The Site Screeing Report concluded that the site was sucessfully cleaned up and that no further action under CERCLA was warranted and that CERLCIS enter was not recommended.

St Joseph Tank Sites

Facility Id	Remediation	Active	Facility Name	Address	Facility Zip
ST0020459	R006284	Yes	SHOP & HOP #5	308 MAIN ST	64485
ST0009197	R005321	No	GRAY AUTOMOTIVE PRODUCTS	1313 S 4TH	64501
ST0005402	R006435	No	WIRE ROPE CORPORATION OF	609 N 2ND ST	64501
ST0005418			WYETH COMPANY, INC	101 JULES	64501
ST0005419	R002585	No	MIDLAND BOTTLING CO, INC	1422 S 6TH ST	64501
ST0005470	R006410	No	ST JOSEPH CITY YARDS	2316 S 3RD ST	64501
ST0005496			ROWLANDS AMOCO	801 MITCHELL	64501
ST0009044			RIVERMART 66	320 EDMOND	64501
ST0009327	R006412	No	CENTRAL FIRE STATION	401 S 7TH ST	64501
ST0009332	R006501	No	AVIATION FACILITY	RT 7 (OLD MOTOR POOL)	64501
ST0009341	R005620	No	HILAND DAIRY DIVISION	221 S 5TH ST	64501
ST0018825			LAW ENFORCEMENT CENTER	501 FARAON ST	64501
ST0010857	R007684	Yes	MISSOURI GAS ENERGY	402 CEDAR	64501
ST0009505	R007688	Yes	SEAMAN & SCHUSKE METAL WORKS CO	1215 SOUTH 4TH ST	64501
ST0019161	R006761	Yes	IMPERIAL SUPER GAS INC	811 S 6TH ST	64501
ST5700050	R001245	No	CITY OF ST JOE - FARAON ST LAGOON	FARAON ST	64501
ST0002419			BROWN TRANSFER & STORAGE	MESSANIE ST BETWEEN 5TH &	64502
ST0007412			HILLYARD INDUSTRIES	302 N 4TH ST	64502
ST0005454	R003231	No	GARAGE	613 ATCHISON	64502
ST0010440	R003160	No	HOLMES FREIGHT LINES, INC	801 HICKORY	64503
ST5800670	R004589	No	FAA STJ LOC	ROSECRANS FIELD	64503
ST5800636	R004450	No	FAA-ST JOSEPH RCAG	ROSECRAN'S FIELD-MUNICIPAL	64503
ST5710013	R006887	No	R-F HOLDINGS INC	8TH & MONTEREY NW CORNER	64503
ST0008755	R004704	No	MCNEILL GRAVE MARKER CO	1401 SOUTH 9TH ST	64503
ST0005490	R003924	Yes	CRISWELL PETROLEUM PROD, CO	916 S 9TH	64503
ST0005396	R001363	Yes	BURLINGTON NORTHERN RAILROAD CO	500 LAKE BLVD	64504
ST0005491	R007135	Yes	ALBAUGH INC	4900 PACKERS AVE	64504
ST0008584	R004585	No	VARCO-PRUDEN BLDGS	2250 LOWER LAKE RD	64504
ST0013633			DELUXE TRUCK STOP LLC	4500 PACKERS AVE	64504
ST0005491	R003608	No	ALBAUGH INC	4900 PACKERS AVE	64504

KANSAS

DEPARTMENT OF WILDLIFE AND PARKS KATHLEEN SEBELIUS, GOVERNOR

8/29/2006

Track: 20060121
DP
Ref: D1.1101

Mr. Matt Vandenberg
USACOE, Env. Res. Section
Room 843, 601 E. 12th Street
Kansas City, MO 64106

Dear Mr. Vandenberg:

We have reviewed PN 200501489, an application by the USACOE, Kansas City District to raise existing levees along the Missouri River in Levee System Units L-455 and R-471-460 in order to meet requirements established by the Federal Emergency Management Agency. The project was reviewed for potential impacts on crucial wildlife habitats, current state-listed threatened and endangered wildlife species, and public recreation areas for which this agency has some administrative authority.

We have had previous correspondence on the project through review of the Draft EIS and the Feasibility Report and Environmental Assessment. Those reports concluded that no significant impacts to either state or federally listed threatened or endangered species would occur. The project has addressed mitigation of wetlands, and although a significant amount of acreage (1,300+) will be impacted by borrow areas and expansion of the levee footprint, impacts crucial wildlife habitats such as riparian timber will be minimized and avoided. We would like to remind the applicant that any dredging activity that may be proposed in the future with the project would need a permit from the Kansas Department of Wildlife and Parks and is strongly discouraged.

No Department of Wildlife and Parks permits or special authorizations are required. Because the Department's recreational land obligations, state threatened and endangered species list and critical habitat designations periodically change; if construction has not started within one year of the date of this review, or if design changes are made in the project plans, the project sponsor must contact this office to verify continued applicability of this review assessment. For our purposes, we consider construction started when advertisements for bids are distributed.

Thank you for the opportunity to provide these comments and recommendations.

Sincerely,

Nate Davis, Aquatic Ecologist
Environmental Services Section

xc: KDWP Reg FW Sup, Wolfe KDWP Dist Bio, Whiteaker KBS, Liechti
KDHE, Mueldener USFWS, LeValley USEPA, Mulder MDC, Miller

Pratt Operations Office
512 SE 25th Ave., Pratt, KS 67124-8174
Phone 620-672-5911 Fax 620-672-6020 www.kdwp.state.ks.us

Matt Blunt
Governor

STATE OF MISSOURI

Ronald M. Reynolds
Director

EMERGENCY MANAGEMENT AGENCY

DEPARTMENT OF PUBLIC SAFETY
OFFICE OF THE ADJUTANT GENERAL

PO Box 116, Jefferson City, Missouri 65102
Phone: 573/526-9100 Fax: 573/634-7966
E-mail: mosema@mail.state.mo.us

MEMORANDUM

TO: **US Army Corps of Engineers – Kansas City District**
Draft Environmental Assessment & Feasibility Report
On R460-471 & L-455 Flood Damage Reduction Projects

FROM: **Dale Schmutzler, Floodplain Management Officer**
Missouri State Emergency Management Agency

REF: **City of St. Joseph and Buchanan County, Missouri**

DATE: **August 28, 2006**

The City of St. Joseph and Buchanan County, Missouri are participants in the National Flood Insurance Program (NFIP). Any development associated with this project located within a special flood hazard area (SFHA), as identified by the Federal Emergency Management Agency (FEMA), must meet the requirements of the State of Missouri Executive Order 98-03 and local floodplain management ordinances. This would require obtaining a floodplain development permit for the proposed project. This permit must be obtained prior to the commencement of any construction/development activities.

If the proposed development is also located within a regulatory floodway, a "No-Rise" Certificate and statement as to the effects of possible flooding, is required before the development can be permitted. This analysis must be performed by a licensed engineer and to current FEMA standards.

If you have any questions concerning this memo or the requirements of Executive Order 98-03, please feel free to contact me a (573) 526-9135.

DS:psh

cc: Community Files – City of St. Joseph
Buchanan County

US Army Corps of Engineers ®
Kansas City District

Meeting Date: August 28, 2006

COMMENT FORM

PUBLIC MEETING

DRAFT ENVIRONMENTAL ASSESSMENT AND FEASIBILITY REPORT ON R460-471 AND L-455 FLOOD DAMAGE REDUCTION PROJECTS

Name: John Cox	Address: 1006 NW Rosecrans Rd.
Affiliation: Airport Levee member	[redacted]
[redacted]	P[redacted]

Please write your comments and turn in the form at the sign-in desk. Your comments may also be mailed to the address on the reverse side. Comments must be postmarked by August 31, 2006. Comments can also be e-mailed to matthew.d.vandenberg@usace.army.mil

Since the Mo Air National Guard 139th AW has the greatest investment protected by the R 471-460 levee system. Why can't the DOD fund the O&M and/or levee system improvements?

Continue on the other side

US Army Corps of Engineers ®
Kansas City District

Meeting Date: August 28, 2006

COMMENT FORM

PUBLIC MEETING

DRAFT ENVIRONMENTAL ASSESSMENT AND FEASIBILITY REPORT ON R460-471 AND L-455 FLOOD DAMAGE REDUCTION PROJECTS

Name: JOHN OSBORNE	Address: [redacted]
[redacted]	[redacted]
[redacted]	[redacted]

[redacted] write your comments and turn in the form at the sign-in desk. Your comments may also be mailed to the address on the reverse side. Comments must be postmarked by August 31, 2006. Comments can also be e-mailed to matthew.d.vandenberg@usace.army.mil

I WAS HERE IN "93" AND ALONG WITH MY FRIENDS, & NEIGHBORS, LISTENED TO STATE & FEDERAL OFFICIALS PACIFY ELWOOD RESIDENTS. ALL I ASK FOR MYSELF & ALL ELWOOD RESIDENTS IS "DO WHAT YOU SAY YOU'LL DO. & DON'T SAY YOU WILL, & THEN DON'T.

MOST PEOPLE WHO HAD ANY DEALING WITH FEMA OR THE CORP, ARE VERY SKEPTICAL OF EVERYTHING THEY SAY & DO.

WE ALL WANT TO LIVE IN A SAFE COMMUNITY, & I FOR ONE SUPPORT YOUR EFFORTS.

THANK YOU,
J. Osborne

Continue on the other side

US Army Corps of Engineers ®
Kansas City District

Meeting Date: August 28, 2006

COMMENT FORM

PUBLIC MEETING

DRAFT ENVIRONMENTAL ASSESSMENT AND FEASIBILITY REPORT ON R460-471 AND L-455 FLOOD DAMAGE REDUCTION PROJECTS

Name: JAMES RADER

[redacted]

Address: [redacted]

Please write your comments and turn in the form at the sign-in desk. Your comments may also be mailed to the address on the reverse side. Comments must be postmarked by August 31, 2006. Comments can also be e-mailed to matthew.d.vandenberg@usace.army.mil

I have lived in Elwood for 69½ years. I have been here through the flood of 1952 and also 1993. We have had extensive commercial development here since 1973. I feel this will stop without the recommended work done on the levees. Also the personal trauma of going through a flood and the cleanup and repairs afterwards more than justify the cost of these extensions.

Thank you for your work

Jim Rader

Continue on the other side

US Army Corps of Engineers ®
Kansas City District

Meeting Date: August 28, 2006

COMMENT FORM

PUBLIC MEETING

DRAFT ENVIRONMENTAL ASSESSMENT AND FEASIBILITY REPORT ON R460-471 AND L-455 FLOOD DAMAGE REDUCTION PROJECTS

Name: Doug Shepherd [redacted]	Address: [redacted]

Please write your comments and turn in the form at the sign-in desk. Your comments may also be mailed to the address on the reverse side. Comments must be postmarked by August 31, 2006. Comments can also be e-mailed to matthew.d.vandenberg@usace.army.mil

Why is there proposed work for levee between 205+00 to 295+00 When our trouble spot in 1993 Was in the area of 107+70. Where we had to sandbag the levee to contain flood water. In the proposed work area we didn't have any ~~[illegible]~~ problem

Continue on the other side

US Army Corps of Engineers ®
Kansas City District

Meeting Date: August 28, 2006

COMMENT FORM

PUBLIC MEETING

DRAFT ENVIRONMENTAL ASSESSMENT AND FEASIBILITY REPORT ON R460-471 AND L-455 FLOOD DAMAGE REDUCTION PROJECTS

[redacted] haipple Farms [redacted] [redacted]	[redacted]

Please write your comments and turn in the form at the sign-in desk. Your comments may also be mailed to the address on the reverse side. Comments must be postmarked by August 31, 2006. Comments can also be e-mailed to matthew.d.vandenberg@usace.army.mil

8-28-2006

If the improvements to the existing levee system is carried out we are concerned where the barrow areas or dirt will be obtained? We are not willing to give any barrow areas or dirt for these improvements. There have been several barrow areas given on this land through the years. We depend on this land for our living. There is no difference between this business and any other business.

There is no drainage for the three (3) Creeks that drain into the old river Channel, that drain through Gladden Bottom. The Channel is about filled up. It should be dredged out going East, to the tubes that are there. If the old Channel would be cleaned out, this material could be used for the improvements on the existing levee.

Continue on the other side

US Army Corps of Engineers ®
Kansas City District

Meeting Date: August 28, 2006

COMMENT FORM

PUBLIC MEETING

DRAFT ENVIRONMENTAL ASSESSMENT AND FEASIBILITY REPORT ON R460-471 AND L-455 FLOOD DAMAGE REDUCTION PROJECTS

Name: GARY LAIPPLE	Address: [redacted]
[redacted]	[redacted]

Please write your comments and turn in the form at the sign-in desk. Your comments may also be mailed to the address on the reverse side. Comments must be postmarked by August 31, 2006. Comments can also be e-mailed to matthew.d.vandenberg@usace.army.mil

Our family farm runs along the river from North of river mile 454 then South to river mile 452. We went through the construction of the levee with all the right of ways and borrow areas. We filled the borrow areas and deep plowed the haul roads. We have also been through various floods, including the "1993 flood" which was devastating to our family farm. So perhaps you can understand why our family is against any destruction of our farm which includes the borrow areas and right of ways. Here are several alternatives for borrow areas. (1) Government Land along the river south of our farm which is river mile #451. (2) dredge the old river channel. This would provide dirt plus drainage for the bottom. (3) Haul dirt from the bluff. (4) Dredge dirt out of the Missouri river. Please consider an alternative for the borrow areas other than our farm. Also if berms

Continue on the other side

Gary P. Laipple
[redacted]
66090

KANSAS CITY
PM
AUG

Dr. Christopher M. White
CENWK-PM-PR
Kansas City District, Corps of Engineers
601 East 12th Street
Kansas City, Missouri 64106-2896

US Army Corps
of Engineers ®
Kansas City District

are extended we should be allowed to farm them
instead of taking the ground out of production.

tape here

Received 8/31/06

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kansas Ecological Services Office
2609 Anderson Avenue
Manhattan, Kansas 66503-6172

August 28, 2006

Christopher White, Ph.D.
St Joseph Levees Project
Kansas City District, Corps of Engineers
601 East 12th Street
Kansas City, Missouri 64106-2896

Dear Dr. White:

We have reviewed the Draft Feasibility Report and Draft Environmental Assessment (DEA) which included the mitigation plan, received August 3, 2006, for the Missouri River Levees System R-471-460 and L-455. The following comments are provided by the U.S. Fish and Wildlife Service (Service) for your consideration. This letter also includes our comments to Public Notice 200501489 for the same project.

GENERAL COMMENTS

The Service appreciates the coordination between the Service and the U.S. Army Corps of Engineers (Corps) throughout the development of this project and values the efforts made to address our concerns. Five alternatives were carried forward for analysis in the EA. Alternative 1, the Locally Preferred Plan and NED preferred alternative, appears to meet the objectives of the project with the least amount of impacts to fish and wildlife habitat including wetlands. While Alternative 4 has fewer impacts it does not meet the project's objective of obtaining FEMA recertification for the right bank levee. Alternatives 2 and 3 meet the project's objectives but have increased impacts to fish and wildlife habitat. "No Action" is the fifth alternative.

Alternative 1 will increase the right bank levee from zero to 3.37 feet in height and the left bank levee from zero to less than one foot in height. This will also require an increase to the levee toe width and an extension to the seepage berms associated with the levee.

SPECIFIC COMMENTS

Feasibility Study

Section IX - G. Economic Analysis and Screening of Plans

Page 38 – The Corps stated that "Alternative 1 is a levee raise of about 2 and 2/3 feet for the R471-460 unit…" Elsewhere in the document the stated raise for the R471-460 unit is 3.37 feet.

Section X. Description of the Selected Plan – C. Environmental and Cultural Considerations

Page 49 – The statement is made that "impacts within the 1,139 acres (R471-460) and 30 acres (L-455) of secondary tree growth and shrubland at the borrow sites would be considered temporary in nature and is expected to be less than significant." This statement does not appear to take into consideration that borrowing within these areas may impact Federal trust resources, i.e. migratory songbirds. Impacts to migratory songbirds could occur due to changing one habitat type to another, e.g. changing forest or shrubland to deepwater. It is unlikely that forest or shrubland would re-establish in that area. This loss would likely permanently impact migratory songbirds. In addition, although the tree growth may be secondary and relatively young, they are closer to a mature and more valuable stage than newly established trees.

The Corps has not provided any discussion of the measures that will be taken to comply with the Migratory Bird Treaty Act.

Finding of No Significant Impact (FONSI)

Mitigation Measures

In the preceding Draft Feasibility Report (DFR) the statement was made that wetlands filled from the levee construction would be mitigated adjacent to the impacted wetland. However in the FONSI it appears that the Corps is planning to mitigate those wetland losses and habitat losses in the areas being purchased for the MRFWMP. This is against Service policy i.e. "Where habitats are protected restored, or targeted for protection or restoration under Federal programs designed to increase the Nation's wetlands base, the Service will not recommend, support, or advocate the use of such lands as compensatory mitigation for habitat losses authorized under the section 10/404 wetlands regulatory permit program."

The Corps has not provided any discussion of the measures that will be taken to comply with either the Migratory Bird Treaty Act or Executive Order 13112 Section 2 (3) which directs Federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere and to ensure that all feasible and prudent measures to minimize the risk of harm will be taken in conjunction with the actions.

We recommend that disturbed areas are reseeded with appropriate native plant species indigenous to the local area. The rye, brome and fescue that the Corps has stated will be used in grassland areas are not native. The Service is willing to assist the Corps in developing plant lists for each area.

Public Availability

The issuance and ending dates for Public Notice Number 200501489 are incorrect. The Public Notice was issued on August 1, 2006 and expires on August 31, 2006.

2.2.1 Alternative 1 (Preferred Alternative)

Line 495 - The Best Management Practices (BMP) listed should be described in detail. Commenting agencies and the public may know of alternative methods that would produce better results, be more cost effective, etc. or may have concerns about the methods proposed by the Corps.

Line 508 – The Corps is proposing 1:1 mitigation of wetland losses for both emergent and forested wetlands through the scraping and reshaping of lands adjacent to impacted areas. The Service strongly recommends that emergent wetlands be mitigated at a 1.5:1 ratio and forested wetlands be mitigated at a 2:1 ratio. These ratios are consistent with the Fish and Wildlife Service, Region 6 Wetland Mitigation Policy (provided in both the Draft and Final Coordination Act Reports) for concurrent creation or restoration for mitigation wetlands. These ratios are also what the Kansas City District Corps typically requires for other Section 404 permit applicants. Recommended ratios for enhancement are greater than those for concurrent creation or restoration. Replacement ratios of greater than 1:1 are recommended because of the uncertainty of wetland creation and the amount of time required to develop fully functioning wetlands from either an area that will be allowed to revegetate naturally or planted with seedlings of wetland species. It is doubtful areas in this part of the floodplain will hold water if they don't now so the amount of wetland created through this option may be greatly limited.

From the above statement in the EA it appears that the Corps is proposing to mitigate wetland losses adjacent to the wetland loss caused by fill from the levee footprint. However, statements in other parts of the DFR and FONSI could be interpreted that the Corps is proposing to mitigate in the MRFWMP lands. As discussed under the FONSI comments, mitigating wetland losses in the MRFWMP land would be against Service policy.

3.2 Biological Environment

3.2.2 Wildlife

This section has not been updated to include new information in the Service's Final Coordination Act Report (FCAR).

3.2.3 Aquatic Ecosystem

This section has not been updated to include new information in the Service's FCAR.

3.2.4 Threatened and Endangered Species

The piping plover, bald eagle, least tern, and pallid sturgeon are on the Federal threatened and endangered species list in both Kansas and Missouri.

Line 912 – Indiana bat. As the Corps has stated, the Indiana bat (*Myotis sodalist*), federally listed as endangered, has been found throughout much of northern Missouri and may occur in suitable habitat along the river during the summer. The Service believes that suitable habitat may exist in the project area and that no surveys for the Indiana bat have been performed in the project area. Therefore the Service recommends that the Corps identify the extent of suitable habitat in the project area, both on the Kansas and Missouri sides, and evaluate potential effects to that habitat. If suitable roost trees are proposed to be removed, the Service recommends a survey, to determine the presence or absence of Indiana bats, be conducted by a qualified biologist. Survey efforts should include using a combination of mist nets and bat detection devices [e.g. "Anabat" (© Titley Electronics, Ballina, New South Wales, Australia)]. If it is determined that a survey for Indiana bats is needed, please contact the Missouri Ecological Services Field Office to obtain specific information regarding survey protocol. If surveys indicate that Indiana bats are using trees proposed to be removed during their breeding season (April 1 to September 30) further consultation with the Service under section 7 of the ESA will be required.

The Service provides the following information on the Indiana bat:

From late fall through winter Indiana bats in Missouri hibernate in caves in the Ozarks and Ozark Border Natural Divisions. During the spring and summer, Indiana bats utilize living, injured (e.g. split trunks and broken limbs from lightening strikes or wind), dead or dying trees for roosting throughout the state. Indiana bat roost trees tend to be greater than 9 inches diameter at breast height (dbh) (optimally greater than 20 inches dbh) with loose or exfoliating bark. Most important are structural characteristics that provide adequate space for bat to roost.

Preferred roost sites are located in forest openings, at the forest edge, or where the overstory canopy allows some sunlight exposure to the roost tree, which is usually within 1 km (0.61 mile) of water. Indiana bats forage for flying insects (particularly moths) in and around the tree canopy of floodplain, riparian, and upland forests.

4. Environmental effects of the Proposed Alternatives

4.3.2 Water Quality – Preferred Alternative

Line 1589 - Because of the prevalence of canary reed grass, an exotic and aggressive invasive species, allowing the vegetation in these areas to reestablish naturally over time may cause these areas to become dominated by reed canary grass.

4.1 Vegetation - Preferred Alternative

Line 1991 – As previously discussed, the Service strongly recommends that emergent wetland be mitigated at a 1.5:1 ratio and that forested wetlands are mitigated at a 2:1 ratio.

Line 2020 – This section states that the completed levee side slopes would be seeded and mulched with a native warm-season seed mix following project completion. However, statements made in the FONSI state that rye, brome and fescue would be used on the levee, while Corps comments to Service Recommendations (Appendix D) lists several other non-native species that may be used. The Service recommends that the native, warm season seed mix is used on the levee side slopes. The Service is willing to work with the Corps to develop appropriate plant lists.

Alternative 2, Line 2064 and Alternative 3, Line 2123 – Unavoidable impacts to wetlands at borrow sites should have compensatory mitigation concurrent with or shortly after project completion to ensure that no habitat value is lost. In addition, wetlands impacted by borrow operations should be restored in-kind, e.g. from emergent wetland to emergent wetland with similar native plant communities re-established.

Appendix D

Corps of Engineers Comments to Recommendations on the U.S. Fish and Wildlife Services' Draft Fish and Wildlife Coordination Act Report (DCAR).

Please note that some of these recommendations have been revised in the Final Fish and Wildlife Coordination Act (FCAR). The Services' responses to the Corps comments to the Services' recommendations in the DCAR are followed immediately by the Services' recommendations from the FCAR.

FWS Responses to Selected Corps' Comments on FWS Recommendations in the Draft Fish and Wildlife Coordination Act

Fish and Wildlife Service Recommendation Number 4 - Levees and levee easements should be seeded with native, warm-season grasses such as switch grass.

Corps Comment – "Only native plant species will be used during re-seeding operations. The following species are generally used for levee reseeding: Switchgrass (Panicum Virgatum), Sand Lovegrass (Eragrostis Trichodes), Yellow Sweet Clover (Melilotus Officinalis), Creeping Foxtail (Alopecuus Arundinaceus), Tall Wheatgrass (Agropyron Elongatum), and Yellow sweet Clover (Melilotus Officinalis)"

Service Response - Creeping foxtail, tall wheatgrass, and yellow sweet clover are not native to Kansas or the North American Continent. In addition, the FONSI stated that the levees would be seeded to rye, brome and fescue which are also not native to Kansas. The Service is willing to assist the Corps in developing an appropriate native seed mix.

Fish and Wildlife Service Recommendation Number 6. – The Corps should create wetland mitigation habitat to compensate for the loss of wetland acreage from construction of the projects. If farmed wetland is directly impacted by borrow activities it should be mitigated at a 1.0 to1.0 ratio.

Corps Comment - "...With this in mind the Corps has selected "off-set" sites" where wetlands still exist and has chosen restoration over creation..."

Service Response - It is unclear from the Draft Feasibility Study, Draft Environmental Assessment and the Draft Mitigation Plan exactly where these off-set sites are located. In the above documents statements are made that the wetlands impacted from the footprint of the levee would be mitigated adjacent to the impacted wetland through scraping and shaping. This indicates creation of a wetland, not restoration as lands adjacent to the wetland impact may not currently be a wetland. In other parts of the document statements made could be interpreted that wetland impacts would be mitigated through the creation/expansion of wetlands in the borrow areas. As previously discussed, this is unacceptable if those borrow areas are located on the MRFWMP lands. A map showing proposed wetland mitigation areas would be extremely helpful.

Fish and Wildlife Service Recommendation Number 9. – Encourage wetland development and hydrological reconnection to the river at existing borrow areas landward of the levee units.

Corps Comment - "Only riverside areas have been identified for obtaining borrow material. Landside wetlands that are impacted as a result of levee widening will be off-set by using the minimization and mitigation measures identified in Section 4.4.1 Vegetation.

Service Response: We believe that the Corps has misunderstood our recommendation. Our intent was to encourage the development/enhancement of wetland areas in old borrow areas landside of the levee near the project area. These areas could be used to provide compensatory mitigation for the wetlands impacted from the levee footprint. Establishing a hydrological connection from these old borrow areas to the Missouri River would benefit the river and its wildlife.

Fish and Wildlife Service Recommendation Number 10. – Best Management Practices to prevent the transport of invasive species to or from the construction sites should be included as an integral component of the project.

Corps Comment - "...As such, this recommendation has been incorporated throughout the project where construction equipment will be used."

Service Response - Footwear and other clothing as well as sampling equipment used during monitoring are also effective vectors to transport invasive species and measures should be included to minimize the risk of transporting invasive species from infested areas to non-infested areas through these means. The Service is willing to assist the Corps in identifying BMPs to address this issue.

FWS Recommendations from the Final Fish and Wildlife Coordination Act

1. The take of borrow from areas riverward of the levees should be closely coordinated with the Missouri River Fish and Wildlife Mitigation Project (MRFWMP) team to creatively construct areas that will conform to the objectives of the MRFWMP. This is particularly important in the proposed borrow area south of the City of Elwood, known as Elwood Bend, as it has been identified for inclusion in the MRFWMP. The MRFWMP team should be closely consulted about the take of borrow from the area and about the construction plans for the final design of the borrow areas. The MRFWMP should also be given approval rights for the borrow design plans. If the Corps and the project sponsors are unable to work with the MRFWMP, the Elwood Bend area should be eliminated from the plan.

2. Riparian and wetland habitats should be avoided to the maximum extent practicable when selecting borrow sites for the proposed levee raises and compensatory mitigation should be undertaken for unavoidable impacts. Since channelization, levee construction and floodplain development have already resulted in dramatic loss of riparian and wetland habitats in the Missouri River basin, the Corps should focus on bare or cropland areas for borrow.

3. Reconsideration of the Levee Setback alternative. The Levee Setback alternative was eliminated from further consideration because total benefits from this alternative were far less than the cost of construction. However, the MRFWMP team is considering setting back levees to improve habitat. Coordination with the MRFWMP may make it feasible to set back some portions of levees as part of this project thereby reducing impacts from those portions of the levees that would still need to be raised.

4. Levees and levee easements should be seeded with native, warm-season grasses such as switch grass.

5. Removal of mature cottonwoods, and other native vegetation should be avoided where possible, and if they are removed, replace woody vegetation by establishing 2 acres of native vegetation for every acre impacted.

6. The Corps should create wetland mitigation habitat to compensate for the loss of wetland acreage from construction of the projects at a minimum of 1.5:1 ratio for emergent wetland and at a 2:1 ratio for forested wetland. If farmed wetland is directly impacted by borrow activities it should be mitigated at a 1.0 to1.0 ratio.

7. Encourage wetland development and hydrological reconnection to the river at existing and proposed borrow areas.

8. Best Management Practices to prevent the transport of invasive species to or from the construction sites should be included as an integral component of the project.

The following recommendations describe opportunities to provide fish and wildlife enhancement through the project.

9. Establish native vegetation riverward of levee segments where riparian woodlands are sparse or nonexistent or where the invasive species, reed canary grass (*Phalaris arundinacea*), has become established. If possible, borrow from reed canary grass areas and replace with permanent water or seasonal inundation such as chutes, deeper water wetlands, backwaters, and floodplain ponds that would eliminate reed canary grass.

10. All disturbed areas should be immediately planted with native vegetation following construction. Due to the presence of reed canary grass, an exotic and aggressively invasive species, these areas would likely become a monoculture of reed canary grass if allowed to revegetate naturally.

Appendix E

It does not appear that this section has been updated to include revised information in the Service's Final Fish and Wildlife Coordination Act Report.

Appendix J - Mitigation Plan

General Comments

The Service recommends that a plant list, containing both common and scientific names, which includes all plants proposed to be used for any component of the project be included in the mitigation plan.

The Mitigation Plan does not conform to the Multi-Agency Compensatory Mitigation Checklist and Supplement: Compensatory Mitigation Plan Checklist included as part of the Kansas City District's Notice of Implementation of the Multi-Agency Compensatory Mitigation Checklist and the National Research Council's Mitigation Guidelines (Public Notice 200400295).

1. Mitigation Goals and Objectives: It appears that the Corps is planning to mitigate wetland losses in the areas being purchased for the MRFWMP. As previously discussed this is against Service policy, i.e. "Where habitats are protected restored, or targeted for protection or restoration under Federal programs designed to increase the Nation's wetlands base, the Service will not recommend, support, or advocate the use of such lands as compensatory mitigation for habitat losses authorized under the section 10/404 wetlands regulatory permit program....". If that is the case, the Corps will need to look for other areas to mitigate wetland losses. One possibility to mitigate wetlands may be in old borrow areas landward of the levee as discussed in the DCAR Recommendation 9.

It is also not clear if wetlands were delineated in the proposed borrow areas. If not, any wetlands in these areas should be delineated prior to the start of construction to ensure that they are not impacted or changed in habitat type.

3. Mitigation Site Selection and Justification:

The Service's Kansas Field Office did not participate in the identification or selection of borrow sites or mitigation sites. A map of proposed mitigation sites would be extremely helpful.

If the existing seed bank contains invasive species, such as reed canary grass, it should not be used. Using soil and seed banks containing reed canary grass will likely produce a wetland dominated by this species which will have marginal value as wildlife habitat.

Locating a proposed mitigation site adjacent to a wetland does not ensure that the site will develop into a functioning wetland. It is doubtful that areas in this part of the floodplain will hold water if they do not currently do so. Therefore, we believe that this type of activity represents creation and not restoration. In addition, this type of activity has a potential, however slight, to negatively impact the existing wetland by accidental draining, creating more area than existing hydrology can support, or by changing one habitat type to another, e.g. emergent wetland to deepwater habitat or forested wetland to emergent wetland.

5. Monitoring Plan:

Any monitoring conducted on MRFWMP lands should include MRFWMP team members.

6. Performance Measures:

The performance measures are very subjective. Performance measures should include measurable outcomes, e.g. an 85% survival rate of planted material or 90% percentage of ground covered by vegetation after the first year. The mitigation plan should also include contingency plans if the mitigation fails during the monitoring period.

7. Site Protection and Maintenance:

Mitigation sites should be protected in perpetuity. A maintenance plan should be developed to address invasive species management.

Public Notice 200501489

The Proposed Work statement states that the anticipated raise varies along its length from zero to two and one half feet. The Draft Feasibility Study and Draft EA state that the raise will be from zero to 3.37 feet.

Additional Comments

1. The creation of shallow water habitat may be more compatible to the objectives of the MRFWMP team than the creation of wetland in the Elwood Bend area and it would help the Corps meet its shallow-habitat goals under the 2003 Amended Biological Opinion. In addition, borrow from the banks of the river may be superior for the use of fill as it would not contain roots and other vegetation that may be in fill obtained from the limited riparian/forest habitats which still occur on the Missouri River floodplain and are essentially limited to areas riverward of the levees. The Service strongly recommends that the Corps give first consideration for borrow areas along the banks of the river as a way to increase shallow water habitat. These areas should be chosen and designed in close coordination with the MRFWMP team. The Service will work with the states and the Corps to develop specific recommendations if suitable borrow can be found along the banks of the river.

2. Because the Service has provided new information and recommendations concerning the Indiana bat, we wish to repeat it in this section to ensure that it is not overlooked. The Indiana bat (*Myotis sodalist*), federally listed as endangered, has been found throughout much of northern Missouri and may occur in suitable habitat along the river during the summer. The Service believes that suitable habitat may exist in the project area and that no surveys for the Indiana bat have been performed in the project area. Therefore the Service recommends that the Corps identify the extent of suitable habitat in the project area, both on the Kansas and Missouri sides, and evaluate potential effects to that habitat. If suitable roost trees are proposed to be removed, the Service recommends a survey, to determine the presence or absence of Indiana bats, be conducted by a qualified biologist. Survey efforts should include using a combination of mist nets and bat detection devices [e.g. "Anabat" (© Titley Electronics, Ballina, New South Wales, Australia)]. If it is determined that a survey for Indiana bats is needed, please contact the Missouri Ecological Services Field Office to obtain specific information regarding survey protocol. If surveys indicate that Indiana bats are using trees proposed to be removed during their breeding season (April 1 to September 30) further consultation with the Service under section 7 of the ESA will be required.

The Service provides the following information on the Indiana bat:

From late fall through winter Indiana bats in Missouri hibernate in caves in the Ozarks and Ozark Border Natural Divisions. During the spring and summer, Indiana bats utilize living, injured (e.g. split trunks and broken limbs from lightening strikes or wind), dead or dying trees for roosting throughout the state. Indiana bat roost trees tend to be greater than 9 inches diameter at breast height (dbh) (optimally greater than 20 inches dbh) with loose or exfoliating bark. Most important are structural characteristics that provide adequate space for bat to roost.

Preferred roost sites are located in forest openings, at the forest edge, or where the overstory canopy allows some sunlight exposure to the roost tree, which is usually within 1 km (0.61 mile) of water. Indiana bats forage for flying insects (particularly moths) in and around the tree canopy of floodplain, riparian, and upland forests.

3. The Corps has not provided any discussion of the measures that will be taken to comply with the Migratory Bird Treaty Act.

Thank you for the opportunity to comment on this project. If you have any questions, please contact me or [redacted]

Sincerely,

Mike LeValley
Mike LeValley
Field Supervisor

cc: EPA, Kansas City, KS (Wetland Protection Section)
KDWP, Pratt, KS (Environmental Services)
KDHE, Topeka,KS (Bureau of Water)
FWS, Columbia, MO
FWS, Region 6, Regional Office, Denver, CO (Connie Young-Dubovsky)
Missouri Department of Conservation, Jefferson City, MO (Jane Epperson)

MJL/shb

Save The Lake Committee
5810 Lake Front Lane
St. Joseph, MO 64504
(816) 835-2757

August 16, 2006

Christopher M. White, Ph.D.
St. Joseph Levees Project
Kansas City District, Corps of Engineers
601 E. 12th Street
Kansas City, MO 64106-2896

Re: Army Corps of Engineers, Kansas City District Permit No. 200501489 Public Notice

Dear Dr. White:

I am the Chairman of the Save The Lake Committee (STLC) which is dedicated to the restoration of Lake Contrary, Buchanan County, Missouri. Lake Contrary is immediately adjacent to the proposed Missouri River flood damage reduction project. The proposed work includes raising the existing Missouri River levees to allow re-certification of the levee by FEMA.

The notice identifies a borrow area on the Missouri side consisting of approximately 30 acres of land along River Miles 442.6 to 442.9. STLC has no objection to the use of this borrow area. However, we believe a better borrow area would be dredge material from the bottom of Lake Contrary. STLC has been working with the Corps of Engineers and other interested parties for the last several years in an attempt to fund a restoration project that involves, in part, dredging material from the Lake. We have identified de-watering sites adjacent to the River in close proximity to where the 10-mile levee raising restoration work will take place. STLC would appreciate your reconsideration of the borrow area to include the dredge material from Lake Contrary.

STLC fully supports the levee improvement project.

Very truly yours,

James C. Bowers, Jr.
Chairman

cc: Joan Bennett
Ron Martin
Matthew D. Vandenberg
Ted Hartsig

{88888 / 00003; 153436.}

OMAHA TRIBE OF NEBRASKA

P. O. Box 368
Macy, Nebraska 68039

(402) 837-5391
FAX (402) 837-5308

EXECUTIVE OFFICER
Eleanor Baxter, Chairperson
Orville Cayou, Vice-Chairman
Crystal Appleton, Treasurer
Rodney Morris, Secretary

TRIBAL ADMINISTRATION

MEMBERS
Mitch Parker
Bert Walker
Barry D. Webster

August 15, 2006

Mr. Matthew Vandenberg
U.S. Army Corps of Engineers
Environmental Resources Section
601 East 12th Street, Room 843
Kansas City, MO 64106

RE: Permit #200501489

Dear Mr. Vandenberg;

I am writing this letter in regards to the comment letter received by the Omaha Tribe in regards to a response for comment according to the National Historic Preservation Act.

It is our intention to state yes, it is our historical lands. However, if there has been previous disturbance of soil then no response should be required. Also, that if there should or happen to be an inadvertent discovery, your process should immediately be to contact me at the address of this letter.

The contact person will be myself and if you have any other questions, please do not hesitate to contact us at your convenience. I can be reached at (402) 846-5166.

Thank you for your time and attention.

Tony Provost – Historical Preservation Officer

SEAL OF OSAGE NATION ®

TRIBAL HISTORIC PRESERVATION OFFICE

August 9, 2006

U.S. Army Corps of Engineers
Environmental Resources Section
Attn: Mr. Matthew Vandenberg
601 East 12th St.
Room 843
Kansas City, MS 64106

Re: Permit No. 200501489

To Whom It May Concern:

The Osage Tribe of Oklahoma has evaluated the above reference sites, and we have determined that the site could have religious or cultural significance to the Osage Tribe being our former reservation & homeland. However, if construction activities should expose Osage archeological materials, such as bone, pottery, chipped stone, etc., we ask that construction activities cease, and this office be contacted so that an evaluation can be made.

Should you have any questions, you can reach me at [redacted]

Thank you.

Sincerely,

Samantha R. Gillett
Acting Project Specialist

ONTHPO reference number: 80406008

627 Grandview, Pawhuska, OK 74056, (918) 287-5446, Fax (918) 287-5562

Vandenberg, Matthew D NWK

From: Vandenberg, Matthew D NWK
Sent: Tuesday, August 08, 2006 9:39 AM
To: 'Stuart Miller'
Cc: Harold Kerns; Mitch Miller; Lynn, Eric S NWK
Subject: RE: St. Joe Levee PN

Attachments: Exhibit B 2 of 6 Preferred_2.pdf; SHEET 3.pdf

Exhibit B 2 of 6 Preferred_2... SHEET 3.pdf (156 KB)

Gentlemen,
Attached are two PDF files which I hope will answer your question. SHEET 3 provides the levee raises at the locations in question. Exhibit B is a map showing the temporary easement (approximately 14 acres) and the permanent easement (approximately 10 acres) that will be required to implement the project. If additional information is required, please do not hesitate to contact me again. Thanks,

Matthew Vandenberg
-----Original Message-----
From: Stuart Mille[redacted]
Sent: Thursday, August 03, 2006 10:43 AM
To: Vandenberg, Matthew D NWK
Cc: Harold Kerns; Mitch Miller
Subject: St. Joe Levee PN

Hi Matthew, our regional staff has the following questions about the St. Joe Levee public notice. Please copy me on your response. Thanks

Harold and I (Mitch Miller) have spent some time this morning looking these over. It seems to me we need more detail at a finer scale to understand how this might impact the Arthur Dupree CA(roughly RM 449.7 to 451.5). We need to know what raises in elevation occur within this section, because greater than 1 foot will result in a change in the centerline of the levee. Also this section is where they are proposing the 20 pressure relief wells illustrated in sheet reference # 7. Portions of the Dupree area lie on both sides of the levee in this stretch, so bottom line, we need more information.

Stuart Miller
Policy Coordinator
Missouri Department of Conservation
PO Box 180
Jefferson City, MO 65102-0180
[redacted]
573-526-4495 (FAX)

U.S. Department
Of Transportation

**Federal Aviation
Administration**

Central Region
Iowa, Kansas
Missouri, Nebraska

901 Locust
Kansas City, Missouri 64106-2325

August 4, 2006

Mr. Christopher M. White, Ph.D.
St. Joseph Levees Project
Kansas City District, Corps of Engineers
601 E. 12th Street
Kansas City, MO 64106-2896

Dear Mr. White:

The Federal Aviation Administration (FAA) reviews other federal agency environmental from the perspective of the FAA's area of responsibility; that is, whether the proposal will have effects on aviation and other FAA responsibilities. We generally do not provide comments from an environmental standpoint. Therefore, we have reviewed the material furnished with the August 1, 2006, transmittal letter, concerning the St. Joseph, Missouri, Flood Damage Reduction Study, Missouri River, and have no comments regarding environmental matters.

However, we remind you that you will need to consider whether or not the project will require formal notice and review from an airspace standpoint. The requirements for this notice may be found in Federal Aviation Regulations (FAR) Part 77, Objects Affecting Navigable Airspace. This regulation is contained under Subchapter E, Airspace of Title 14 of the Code of Federal Regulations. We would like to remind you that if any part of the project exceeds notification criteria under FAR Part 77, notice should be filed at least 30 days prior to the proposed construction date. Questions concerning this matter should be directed to Ms. Brenda Mumper a[redacted]

Sincerely,

Todd M. Madison

Todd M. Madison, P.E.
Environmental Specialist

Vandenberg, Matthew D NWK

From: Repatriation Tribal Historic Preservation Office [redacted]
Sent: Friday, August 04, 2006 10:34 AM
To: Vandenberg, Matthew D NWK
Subject: Permit 200501489

Dear Sir; This is to advise you that the Pawnee Nation has no objection to this project .
Thank You.

Francis Morris
Repatriation Coordinator/THPO
Pawnee Nation of Oklahoma

KSR&C No. 01-10-172

KANSAS

Kansas State Historical Society
Jennie Chinn, *Executive Director*

KATHLEEN SEBELIUS, GOVERNOR

August 4, 2006

Matthew Vandenberg
Environmental Resources Section
U.S. Army Corps of Engineers
601 East 12th Street
Kansas City, Missouri 64106

RE: Levee Construction Along the Missouri River
Permit No. 200501489
Doniphan County

Dear Mr. Vandenberg:

Earlier this year, the above referenced project was reviewed by our office in accordance with 36 CFR 800. In a letter dated March 23, 2006 (attached) we concluded that the project as proposed should have no effect on properties listed on the National Register of Historic Places or otherwise identified in our files. This office continues to have no objection to implementation of the project.

Any changes to the project, which include additional ground disturbing activities, will need to be reviewed by this office prior to beginning construction. If construction work uncovers buried archeological materials, work should cease in the area of the discovery and this office should be notified immediately.

This information is provided at your request to assist you in identifying historic properties, as specified in 36 CFR 800 for Section 106 consultation procedures. If you have questions or need additional information regarding these comments, please contact Tim Weston at 785-272-8681 (ext. 214).

Sincerely,

Jennie Chinn, Executive Director and
State Historic Preservation Officer

Timothy Weston
for

Patrick Zollner
Deputy SHPO

[redacted]

[illegible]
Chief

P.O. Box 250
Wyandotte, OK 74370
Phone (918) 678-2297/98
Fax (918) 678-3087

WYANDOTTE NATION

Karlene Roskob
2nd Chief

825 North 7th Street
Kansas City, KS 66101
(913) 321-8107
(913) 321-8158 Fax

TRANSMITTAL LETTER

DATE: 8-3-06 **TIME:** 4:10 pm

FAX NUMBER: 816-389-2025

PLEASE DELIVER TO: Matthew Vandenberg

FROM: Wyandotte Nation

MESSAGE: PN# 200501489
Comments

PAGES FOLLOWING: 3 **(INCLUDING COVER SHEET)**

CONTACT PERSON: Kathleen Welch **918.678.2297 Ext.** 235

If pages are illegible or incomplete, please call (918.) 678.2297

WYANDOTTE NATION

Leaford Bearskin
Chief

P.O. Box 250
Wyandotte, OK 74370

Earlene Roskob
2nd Chief

[redacted]

Aug. 3, 2006

U.S. Army Corps of Engineers
Environmental Resources Section
ATTN: Matthew Vandenberg
601 E 12th St., Room 843
Kansas City, MO 64106

Dear Mr. Vandenberg,

We have received and reviewed the documentation submitted concerning the referenced project listed on your letter of August 1, 2006. The following projects are as:

PN # 200501489

Based on the topographic and hydrologic setting of your project, archaeological materials could be encountered. Documentation on any historic archaeological site discovered requires immediate notification to the Wyandotte Nation and a proper archaeological field inspection is necessitated, as stated under Section 106 Process of the National Historic Preservation Act. We do not need to be included in the consulting process at this time. On future sites, if you do not receive a response from the Wyandotte Nation within 30 days, then please know that our office has no interest in that site. However if as previously stated, should you find any archaeological artifacts or human remains, please contact the Wyandotte Nation immediately.

If you should have any questions or comments, please do not hesitate to contact our office. Thank you for your consideration and cooperation.

Sincerely yours,

Janice R. Wilson

Janice R. Wilson
Wyandotte Nation Environmental Technician

PUBLIC NOTICE

US Army Corps
of Engineers
Kansas City District

Permit No. 200501489
Issue Date: August 1, 2006
Expiration Date: August 31, 2006

30-Day Notice

JOINT PUBLIC NOTICE: This public notice is issued jointly with the Missouri Department of Natural Resources, Water Pollution Control Program and the Kansas Department of Health and Environment. The Department of Natural Resources and the Kansas Department of Health and Environment will use the comments to this notice in deciding whether to grant Section 401 water quality certification. Commenter's are requested to furnish a copy of their comments to the Missouri Department of Natural Resources, P.O. Box 176, Jefferson City, MO 65102 or the Kansas Department of Health and Environment, Bureau of Water – Watershed Management Section, 1000 SW Jackson Street, Suite 420, Topeka, Kansas 66612-1367.

APPLICANT: Kansas City District, Corps of Engineers
Room 834, PM-PR
601 E. 12th Street
Kansas City, Missouri 64106-2896

PROJECT LOCATION (As shown on the attached drawings): The proposed flood damage reduction project involves the Missouri River levee units L-455 and R471-460. These units collectively comprise the protective works that provide flood protection for areas in St. Joseph, Buchanan County, Missouri and Elwood and Wathena, Doniphan County, Kansas.

AUTHORITY: Section 404 of the Clean Water Act (33 USC 1344). This project is being conducted under the authority provided by Section 216 of the 1970 Flood Control Act. This Act provides authority to reexamine completed civil works projects to determine whether the projects are providing benefits as intended.

ACTIVITY: PROPOSED WORK: The U.S. Army Corps of Engineers (USACE) proposes to raise existing Missouri River levees units R471-460 and L-455 to improve the adequacy of the levee units to reduce damages from potential flooding on the Missouri River. This will be accomplished by raising the existing levees using earth fill. A substantial portion (approximately ten miles) of the levee unit R471-460 would be raised to a level sufficient to pass the one percent (100-year) flood with a 90 percent level of reliability, thereby allowing for re-certification of the levee by FEMA. The anticipated raise varies along its length from zero to two and one half feet.

KANSAS KSR&C No. 01-10-172

Kansas State Historical Society
Jennie Chinn, *Executive Director*

KATHLEEN SEBELIUS, GOVERNOR

March 23, 2006

Timothy Meade
Cultural Resource Manager
Kansas City District, Corps of Engineers
700 Federal Building
Kansas City, Missouri 64106-2896

RE: Levee Construction Along the Missouri River
Doniphan County

Dear Mr. Meade:

In accordance with 36 CFR 800, the Kansas State Historic Preservation Office has reviewed your letter describing plans to raise Missouri River Levee System Units L-455 and R-471 – 460 in Doniphan County, Kansas. In addition, we have reviewed previous correspondence related to the project (KSR&C #01-10-172). Given the factors outlined in your letter, we concur with the conclusion that the proposed project will have no effect on historic properties as defined in 36 CFR 800. This office has no objection to the project.

Any changes to the project, which include additional ground disturbing activities, will need to be reviewed by this office prior to beginning construction. If construction work uncovers buried archeological materials, work should cease in the area of the discovery and this office should be notified immediately.

This information is provided at your request to assist you in identifying historic properties, as specified in 36 CFR 800 for Section 106 consultation procedures. If you have questions or need additional information regarding these comments, please contact Tim Weston at [redacted]

Sincerely,

Jennie Chinn, Executive Director and
State Historic Preservation Officer

Timothy Weston for

Patrick Zollner
Deputy SHPO

Phone 785-272-86[redacted]S 66615-1099
jchinn@kshs.org • TTY 785-272-8683

U.S. Army Corps of Engineers, Kansas City District

APPENDIX D

U.S. Fish & Wildlife Service Coordination Act Report
(Draft and Final)
and
State Agency Coordination
Letters

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
Kansas and Missouri
Environmental Assessment

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kansas Ecological Services Office
2609 Anderson Avenue
Manhattan, Kansas 66503-6172

August 9, 2006

Dr. Christopher White
U.S. Army Corps of Engineers, Kansas City District
601 E 12th Street
Kansas City, MO 64106-2896

Dear Dr. White:

This Final Fish and Wildlife Coordination Act Report (FCAR) is provided pursuant to the Fiscal Year 2006 Scope-of-Work Agreement for the Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Study, Kansas and Missouri, between the U.S. Fish and Wildlife Service (Service) and the Kansas City District, Corps of Engineers This FCAR was prepared in accordance with provisions of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), and constitutes the report of the Secretary of the Interior on the project within the meaning of Section 2 (b) of this Act.

As requested on July 17, 2006 (Matthew Vandenberg pers. comm. and email on July 20, 2006) the FCAR incorporates an evaluation of impacts associated with the new alternative, Alternative 4 as well as an evaluation of impacts associated with the seepage and stability berms.

Please note that modifications from the DCAR have been made to the Terrestrial Resources (amphibian and reptile list), Aquatic Resources (Missouri River fish population list) and Recommendations sections in response to review comments. Other minor modifications have been made throughout the document.

Cooperation and information utilized in preparation of this report was obtained from the Kansas Department of Wildlife and Parks (KDWP), the Missouri Department of Conservation (MDC), and the Kansas City District, Corps of Engineers.

Comments from the KDWP, MDC, Fish and Wildlife Service Columbia, MO Field Office and the Fish and Wildlife Service, Region 6, Regional Office have been reflected in the Final Coordination Act Report.

We appreciate the opportunity to discuss impacts to fish and wildlife anticipated by implementation of this project.

If we can be of any assistance please call Ms. Susan Blackford, of my staff, a[redacted] ext. 102.

Sincerely,

Michael J. LeValley

Michael J. LeValley
Field Supervisor

FINAL
FISH AND WILDLIFE COORDINATION ACT REPORT FOR THE MISSOURI RIVER LEVEE SYSTEM UNITS L-455 AND R-471-460 FLOOD DAMAGE REDUCTION STUDY KANSAS AND MISSOURI

PREPARED FOR THE

The Kansas City District
U.S. Army Corps of Engineers
Kansas City, Missouri

Prepared by
U.S. Fish and Wildlife Service
Kansas Ecological Services Field Office
Manhattan, Kansas
August, 2006

TABLE OF CONTENTS

LIST OF FIGURES

EXECUTIVE SUMMARY

The Kansas City District, Army Corps of Engineers (Corps), is in the process of developing a feasibility study for flood damage reduction measures for the city of St. Joseph, in Buchanan and Andrew Counties, Missouri and the towns of Elwood and Wathena, in Doniphan County, Kansas. This Final Fish and Wildlife Coordination Act Report describes the study area, identifies important aquatic and terrestrial resources, evaluates impacts of flood damage reduction measures, and describes mitigation measures.

The project area is highly urbanized inside the existing levee system. The primary impact from a fish and wildlife perspective will be the loss of terrestrial habitat from levee construction, permanent loss of wetlands from levee construction, and temporary loss of terrestrial habitat due to construction activities and borrow construction. One borrow area, known as Elwood Bend, has been proposed for purchase for inclusion in the Missouri River Fish and Wildlife Mitigation Program (MRFWMP). Inappropriate use or pattern of borrow from this area could diminish its value to the MRFWMP. The Fish and Wildlife Service (Service) recommends the following:

RECOMMENDATIONS

1. The take of borrow from areas riverward of the levees should be closely coordinated with the Missouri River Fish and Wildlife Mitigation Project (MRFWMP) team to creatively construct areas that will conform to the objectives of the MRFWMP. This is particularly important in the proposed borrow area south of the City of Elwood, known as Elwood Bend, as it has been identified for inclusion in the MRFWMP. The MRFWMP team should be closely consulted about the take of borrow from the area and about the construction plans for the final design of the borrow areas. The MRFWMP should also be given approval rights for the borrow design plans. If the Corps and the project sponsors are unable to work with the MRFWMP, the Elwood Bend area should be eliminated from the plan.

2. Riparian and wetland habitats should be avoided to the maximum extent practicable when selecting borrow sites for the proposed levee raises and compensatory mitigation should be undertaken for unavoidable impacts. Since channelization, levee construction and floodplain development have already resulted in dramatic loss of riparian and wetland habitats in the Missouri River basin, the Corps should focus on bare or cropland areas for borrow.

3. Reconsideration of the Levee Setback alternative. The Levee Setback alternative was eliminated from further consideration because total benefits from this alternative were far less than the cost of construction. However, the MRFWMP team is considering setting back levees to improve habitat. Coordination with the MRFWMP may make it feasible to set back some portions of levees as part of this project thereby reducing impacts from those portions of the levees that would still need to be raised.

4. Levees and levee easements should be seeded with native, warm-season grasses such as switch grass.

5. Removal of mature cottonwoods, and other native vegetation should be avoided where possible, and if they are removed, replace woody vegetation by establishing 2 acres of native vegetation for every acre impacted.

6. The Corps should create wetland mitigation habitat to compensate for the loss of wetland acreage from construction of the projects at a minimum of 1.5:1 ratio for emergent wetland and at a 2:1 ratio for forested wetland. If farmed wetland is directly impacted by borrow activities it should be mitigated at a 1.0 to1.0 ratio.

7. Encourage wetland development and hydrological reconnection to the river at existing and proposed borrow areas.

8. Best Management Practices to prevent the transport of invasive species to or from the construction sites should be included as an integral component of the project.

The following recommendations describe opportunities to provide fish and wildlife enhancement through the project.

9. Establish native vegetation riverward of levee segments where riparian woodlands are sparse or nonexistent or where the invasive species, reed canary grass (*Phalaris arundinacea*), has become established. If possible, borrow from reed canary grass areas and replace with permanent water or seasonal inundation such as chutes, deeper water wetlands, backwaters, and floodplain ponds that would eliminate reed canary grass.

10. All disturbed areas should be immediately planted with native vegetation following construction. Due to the presence of reed canary grass, an exotic and aggressively invasive species, these areas would likely become a monoculture of reed canary grass if allowed to revegetate naturally.

INTRODUCTION

This Final Fish and Wildlife Coordination Act Report (FCAR) evaluates the effects on fish and wildlife resources of proposed alternatives identified for increasing the level of flood protection for areas in Kansas and Missouri near St. Joseph, Missouri and Elwood, Kansas. The considered alternatives consist primarily of earthen levee raises of two levee units, Levee Unit L-455 and Levee Unit R-471-460. These units collectively comprise the protective works that provide flood protection for areas in the city of St. Joseph, in, Buchanan and Andrew Counties, Missouri and the cities of Elwood and Wathena, in Doniphan County, Kansas (Figure 1).

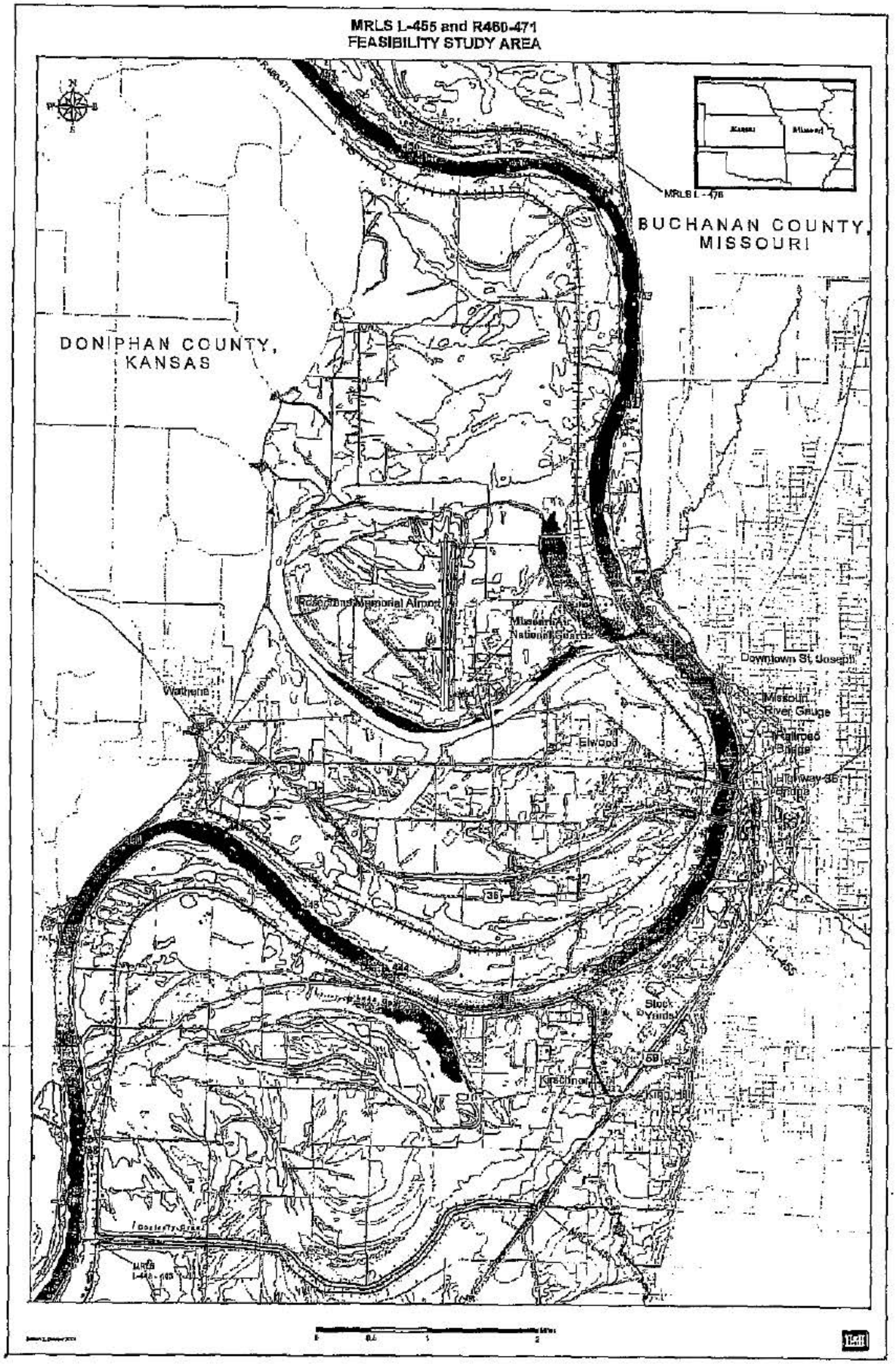
The south St. Joseph Levee Unit L-455 is located on the left bank of the Missouri River in Buchanan County, Missouri. It extends from the mouth of Whitehead Creek (Missouri River mile marker 447.3) ten miles downstream to Contrary Creek (Missouri River mile marker 437.3) and provides flood protection for a flood prone area within the southwest section of the City of St. Joseph. The Levee Unit R-471-460 is located on the right bank of the Missouri River between river miles 441.7 and 456.6 in eastern Doniphan County, Kansas, and northwestern Buchanan County, Missouri.

The right bank levee, R-471-460 was overtopped during the flood of 1993. The stated need for the Missouri River Levee System Units L-455 and R-471-460 Flood Damage Reduction Project in Kansas and Missouri is to allow passing of the one percent flood event with 90 percent reliability under both the existing and future conditions. This level is currently lacking and the Federal Emergency Management Agency (FEMA) is considering de-certification for the right bank levee. If the levee is decertified the economic impact of a flood event will be borne entirely by the local communities

Work on this project is based on agreements in the FY2006 Scope of Work to evaluate impacts to fish and wildlife resources from the NED-Preferred alternative, and Alternatives 2 and 3. On July 20, 2006, the Corps added Alternative 4 and requested that we evaluate it. This study was carried out under authority and in accordance with provisions of the U.S. Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661 et seq.).

The Fish and Wildlife Service has not provided any previous Planning Aid Letters or Planning Aid Reports on the Missouri River Levee System Units L-455 and R-471-460 Flood Damage Reduction Project in Kansas and Missouri. The Service provided a Draft Fish and Wildlife Coordination Act Report dated June 2006. We have reviewed the Corps' Pre-Draft Environmental Impact Statement (EIS), Draft Environmental Assessment (EA), and Draft Mitigation Plan.

The Kansas Department of Wildlife and Parks (KDWP) and the Missouri Department of Conservation (MDC) have cooperated in the preparation of this report and concur with its contents.



MRLS L-455 and R460-471
FEASIBILITY STUDY AREA
BUCHANAN COUNTY, MISSOURI
DONIPHAN COUNTY, KANSAS
Rosecrans Memorial Airport
Downtown St Joseph
Missouri River Gauge
Elwood
Wathena
Stock Yards

Figure 1.

DESCRIPTION OF THE PROJECT AREA

The site of St. Joseph was first noted in the journal of Lewis and Clark during their Journey of Discovery in 1804. Following the organization of the State of Missouri in 1821, Joseph Robidoux established the Blacksnake Hills trading post in 1826 at this site. In 1843 Robidoux platted the town of St. Joseph naming it after his patron saint. The town remained relatively small until the 1848 California Gold Rush when it became important as a departure point for the westward journey to the gold fields for hundreds of thousands of settlers and again in the 1850s during the Pike's Peak gold rush. In 1859 the railroad reached St. Joseph assuring its role as a supply and distribution point to the western half of the country. St. Joseph's proximity to the Missouri River and accessibility by way of river, rail, and land was to provide the impetus for phenomenal growth throughout the 19th century. The Pony Express operated in 1860 and 1861 with St. Joseph serving as its eastern terminus. In the 1870's St. Joseph became established as a leading wholesale center. A stockyard was opened in 1887 and several meat packing plants were established during the next forty years. The city currently has a population of approximately 74,000.

Elwood, Kansas was first established in 1856 under the name of Roseport. It also benefited from its association with the Missouri River serving as an important steamboat port with ferry service to St. Joseph. In the 1850s, thousands of emigrants outfitted in Elwood for their journey to Oregon and California. It was the first Kansas station on the Pony Express and the site of the first railroad construction west of the Missouri River. Much of the old town was washed away when the Missouri River undermined the banks. The current town has a population of approximately 1,176.

The Missouri River, one of the largest rivers in the United States, originates in southwestern Montana and flows about 2,315 miles to join the Mississippi River near St. Louis, Missouri. It drains approximately 424,300 square miles above Saint Joseph, Missouri. The River Mile (RM) references used in this report are measured upstream from the confluence of the Missouri River with the Mississippi River. The topography of the study area is generally represented by hills and uplands, which rise from 100 feet to 200 feet above the Missouri River floodplain. The Missouri River borders the eastern bluffs in the northern part of the city, and then crosses over to border the western bluffs opposite the southern part of the city. Its floodplain is three to five miles wide at Saint Joseph. Tributaries to the Missouri River in the St. Joseph study area in Missouri include Blacksnake Creek, Whitehead Creek, and Contrary Creek. On the Kansas side, Peters Creek joins the Missouri River south of the town of Wathena. Several unnamed tributaries to the Missouri River are also in the Kansas portion of the project area. An area called French Bottoms occupies the interior of an old oxbow of the Missouri River. Browning Lake is the remainder of the old channel. The Rosecrans Memorial Airport was built in the French Bottoms.

The project area is predominantly an alluvial flood plain underlain by bedrock of the Pennsylvanian System, Kansas City Group. Pennsylvania strata generally consist of inter-bedded sandstone, shale, limestone, clay, and coal. Limestone is the most abundant resource present and it is mined for materials primarily used for road and highway construction.

In addition to limestone, sand and gravel are locally important mineral resources. The historic production of these resources is from flood plain and in-channel deposits of major streams. Crushed limestone has replaced stream gravels as the predominant coarse aggregate in cement. Upland terrace and glacial deposits are important sources of sand and gravel in the southeastern and northwestern portions of Missouri.

Soils within the project area have primarily developed as a result of the wind-borne deposition of fine-grained material (loess) and the deposition of material on land by streams (alluvium). Loess deposits are visible on the exposed valley walls adjacent to the Missouri River. Missouri River floodplain soils belong to the Haynie-Urban Land-Leta association. Soils of the upland, loess hills are of the Knox-Judson-McPaul and the Marshall-Ladoga-Gara associations. The soil associations generally consist of deep, nearly level, well drained to somewhat poorly drained soils comprised of river-deposited sand, silt, and clay.

The flood plain or bottoms area is three to five miles wide in the St. Joseph study area and is characterized by low-lying, nearly level terrain. The uplands are composed of steep to moderately sloping hills composed of loess or loamy soils. Buchanan County and Doniphan County consist of several soils types, which are either hydric, prime farmland, or both.

Water quality of the Missouri River tributaries in St. Joseph has been severely impacted by urban development. Significant segments of five out of the seven tributaries in the study area have been placed underground in conduits and are used as a combined sanitary/storm water sewer system. The remaining two tributaries, Roy's Branch and Contrary Creek, drain relatively undeveloped areas.

The Missouri River near St. Joseph is classified as a permanent flow general warm water fishery resource. A general warm water resource provides protection to both game and non-game fish occurring in the area. The River provides a water source for irrigation, livestock/wildlife watering, aquatic life protection, boating, drinking water supply, and industrial withdrawal.

Terrestrial Resources

A review of historical conditions on the Missouri River can facilitate an understanding of how the river formerly functioned, and suggest the ecological functions and processes that were essential to development of such an abundant and rich array of fish and wildlife resources. However, clearly defining historical conditions is somewhat problematic, since most of the more detailed quantitative and qualitative descriptions of the Missouri River occurred during or after major episodes of human impact. Nevertheless, we can broadly surmise how the presettlement Missouri River appeared.

The Missouri River, presettlement, was free-flowing, without the restrictions of dams and diversions. The river water was extremely sediment laden and turbid, in comparison, current flow is fairly clear. Flows varied dramatically and fluctuated widely in response to rains. Sustained high flows occurred in the spring and early summer in response to snow melts.

The higher flow events resulted in over bank flooding, often over extensive reaches of the valley floor. Overflow areas were covered by dense forests of riparian vegetation. Some accounts place the riparian band as extending up to 14 -15 miles along each side of the river and encompassing at least one-half million acres. Extensive swamps, marshes, floodplain pools, and other diverse and expansive wetlands were also nourished by the regular flooding events.

Bank erosion and river meander, the basic forces for most riverine ecological processes and functions, were unimpeded. Erosion was most active on the outsides of the numerous meander bends, where the highest velocities impinged directly on the earthen substrates. As one bank was eroded, the opposite bank experienced sediment accretion. Some of the meanders became cut off from the river, forming oxbow lakes and other broad, highly diverse channel overflow areas. Erosion also resulted in the input into the river of large volumes of woody debris of a broad range of sizes, types, and complexities into the river. The fish, wildlife, and riparian vegetation of the river were in a dynamic equilibrium, adjusted to, and dependent upon the cycle of erosion, deposition, and changing channel pattern as the river slowly swung back and forth across its meander belt. The ecological health and productivity of the river at any point in time were dependent on periodic rejuvenation associated with these natural processes and changes.

Significant environmental changes and impacts have occurred in the past one-hundred and fifty years. Only fragments remain of the extensive riparian forests and wetlands which have been largely removed through urbanization and land clearing for agricultural purposes. The river is controlled by dozens of dams on the main stem and tributaries. The river is sediment starved. The lower river is channelized and largely confined by levees and bank stabilization, and overall, is a mere remnant of the ecologically dynamic and complex system of the past (USFWS 2005).

Remnants of the "oak-hickory-maple" upland forest vegetation type are present on the steep hillsides adjacent to the Missouri River floodplains. In addition to the species of sugar maple, white and black oak, and hickories for which this upland vegetation type is named, other hardwood species present include American sycamore, beech, black walnut, bur and chinkapin oak, hackberry, American and slippery elm, hawthorn, honeylocust, redbud, and dogwood. The understory consists of regeneration of the above species and the ground layer includes: violets, poison ivy, Virginia creeper, greenbrier, and honeysuckle and other species.

Most of the vegetation in the study area has been greatly impacted by urban development and agricultural land clearing. In general, the upper reaches of the tributaries draining the area are located in the more established, residential neighborhoods and the lower reaches are located in the intensively developed business district and croplands. The banks along Roy's Branch, Contrary Creek, and limited areas along the upper reaches of the other tributaries do contain tracts of riparian timber. A mix of sycamore, cottonwood, maple, oak, and hickory dominates these areas. Other areas along the upper reaches of the tributaries are in residential development, parkland, or various stages of successional recovery.

Three vegetation types generally dominated the project area: floodplain forest (*Populus-Salix*), oak-hickory-maple forest (*Quercus-Carya-Acer*), and openings of bluestem prairie (*Andropogon-Panicum-Sorghastrum*). Although the project area's floodplains have been largely cleared for development and agriculture, there are bands of riparian forest habitat located riverward of the levee units. Predominant tree species found in these riparian bands include eastern cottonwood, willows, box elder, green ash, silver maple, and American sycamore. The understory includes reproduction of these species, plus some redbud, dogwood, black cherry, and various shrubs. The ground layer in the riparian bands varies from sparse to dense vegetation and contains primarily poison ivy, Virginia creeper, honeysuckle, greenbrier, and gooseberry, and various other species. A monoculture of reed canary grass was observed in much of the area between the levee easement and the band of riparian forest at the water's edge on the Kansas side of the project area.

Mammals associated with the remaining wooded riparian habitat include the white-tailed deer, eastern cottontails, and red and gray squirrels. Aquatic and terrestrial furbearers are important parts of the ecosystem, and those present in the area include the beaver, mink, and muskrat (dependent on the aquatic habitat) and opossum, coyote, raccoon, and striped skunk (dependent on terrestrial habitat). However, small mammals, such as mice, voles, rats, and bats account for the majority of the species present. The white-tailed deer is the only naturally occurring large mammal still common in developed urban areas. Eastern wild turkeys are present in the open, less developed floodplain areas.

The avifauna of the study area includes permanent residents, summer residents, transients, and winter residents. The project area provides year-around habitat for approximately 31 bird species, with another 67 species using the project area for nesting and another 14 species as winter residents only. Over 110 species use the river corridor during the fall migration. Summer resident species associated with aquatic habitats include waterfowl, wading birds, and selected passerines. Summer waterfowl are dominated by wood ducks which nest in wooded bottomlands and rear their young in nearby aquatic habitats. Nesting by other waterfowl, primarily mallards, is minor. Wading birds, such as the great blue heron and green heron, utilize shallow areas as foraging habitat.

Waterfowl and shorebirds are dominant transient species associated with aquatic habitats. The most numerous and impressive migration is that of the snow goose, particularly in the spring. Other migrating species include the Canada goose, mallard, and pintail.

Amphibians found in the study area include the American toad, Rocky Mountain toad, Blanchard's cricket frog, Cope's gray treefrog, Great Plains toad, Woodhouse's toad, northern cricket frog, eastern gray treefrog, boreal chorus frog, western chorus frog, smallmouth salamander, plains spadefoot toad, plains leopard frog, bullfrog, Great Plains narrowmouth toad. Reptiles that may be found in the study area include the snapping turtle, painted turtle, false map turtle, ornate box turtle, slider, smooth softshell turtle, spiny softshell turtle, five-lined skink, Great Plains skink, northern prairie skink, six-lined racerunner, western worm snake, ringneck snake, eastern hognose snake, racer, rat snake, prairie kingsnake, red milksnake, gophersnake, northern water snake, brown snake, western ribbon snake, common garter snake, copperhead, and timber rattlesnake. The northern leopard frog and western fox snake may also be present in the study area (Collins 1993).

Wetlands

Wetlands exist within the project area as small pockets, old meander scars, and within the riparian strips. An old oxbow of the Missouri River (French Bottoms) was cut off when the river charged its course during the flood of 1952. Remnants of the oxbow remain as Browning Lake, an area protected by levee unit R471-460. Lake Contrary is in the area protected by levee L-455. It is currently being studied by the Corps for a restoration project.

National Wetland Inventory database (NWI) maps for the project area indicate that there are many wetlands in the project area. These wetlands are permanently flooded, seasonally flooded, temporarily flooded, or semi-permanently flooded and include forested, broad leaved deciduous, and scrub shrub vegetation. In addition, there are areas classified as palustrine unconsolidated bottom, intermittently exposed (PUBG) which are typically mud or sand flats. Some of the wetlands are natural and some are man-made.

Historically, wet mesic bottomland forest was the most extensive bottomland forest natural community in Missouri (Nelson 1987). This community has a diversity of tree species such as pin oak, cottonwood, river birch, green ash, and hackberry, cherry, sweetgum, hawthorn, dogwood, hickories, wildplum, persimmon, maples, elm, and sassafras. A well-developed understory is often present, containing poison ivy, elm, nettle, and honeysuckle. These communities provide habitat for a wide variety of resident and migratory wildlife. Forested wetlands have been found to support significantly higher abundance and diversity of bird species compared to upland forests (Brinson 1981).

A jurisdictional wetland determination will be necessary if levee alignments or borrow areas directly impact wetlands. The quantity and quality of existing wetlands will determine the amount of compensation necessary to offset project losses. A wetland mitigation plan would be developed in coordination with at least the Corps, Service, Environmental Protection Agency (EPA), Kansas Department of Wildlife and Parks (KDWP) and the Missouri Department of Conservation (MDC). This plan would include site locations, time frames, construction plans, a monitoring plan, progress reports, and standards of success. This plan would be a condition of any Section 404 permit issued for the project. The plan should be implemented regardless of the regulatory nature of the wetland. Minimum replacement ratios for compensatory wetland mitigation should be based on the following guidelines:

U.S. Fish and Wildlife Service, Region 6
Wetland Mitigation Policy Guidance (8/97)
Recommended Minimum Replacement Ratios

Mitigation Type	Ratio	Type of Wetland Being Mitigated
Advance Creation	1.5:1	forested, scrub-shrub
	1:1	emergent
Concurrent Creation	2:1	forested, scrub-shrub
	1.5:1	emergent
Advance Restoration	1.5:1	forested, scrub-shrub
	1:1	emergent
Concurrent Restoration	2:1	forested, scrub-shrub
	1.5:1	emergent
Advance Enhancement	3:1	forested, scrub-shrub
	2:1	emergent
Concurrent Enhancement	4:1	forested, scrub-shrub
	3:1	emergent

Aquatic Resources

The Missouri River has undergone considerable change since the Louisiana Purchase in 1803. The historical Missouri River provided a wide array of habitats within its wide, shallow bed. The braided channels were divided by sand islands and varied in depth and speed of current, from swift chutes to calm sloughs, backwaters, and oxbows. The River had constant flow, although the volume varied enormously. Its water was muddy except at low stages (Cross and Collins 1995). Modifications to the natural Missouri River floodplain ecosystem have been immense and ongoing for more than 150 years. Presently, 35 percent of the river's length is impounded, 32 percent is channelized or stabilized, and the remaining 33 percent is freeflowing (Schmulbach and others, 1992). Major civil works projects involved channelization, channel maintenance, and impoundment and reservoir operation. Agricultural, industrial, and urban development within the basin also significantly modified the Missouri River and its adjoining floodplain.

Presently all of the Missouri River from Sioux City, Iowa to its mouth at Saint Louis, Missouri is channelized. Even during flooding only about 10 percent of the original floodplain is inundated, as high agricultural and urban levees confine the river to a width of approximately 500 feet from Kansas City north (USFWS 1980). The impacts of channelization have been numerous and severe on the physical, chemical, and biological structure and function of the Missouri River and its floodplain. The most damaging of these alterations to aquatic communities has been the nearly complete isolation of the river from its floodplain, subsequent loss of floodplain habitat, drastic reduction in area and diversity of river channel habitats, and increased velocity of the main channel.

Missouri River fish populations have been significantly affected by channel alterations in the project area. Most indigenous fish species still remain, but have suffered serious population declines. Cross and Collins (1995) state that fishes characteristic of the Missouri River are typical of large turbid rivers and include sturgeon (pallid and shovelnose), paddlefish, goldeye, gizzard shad, smallmouth buffalo, bigmouth buffalo, blue sucker, channel, blue, and flathead catfish, burbot, sauger, and freshwater drum. The abundant minnow fauna consists of species adapted to muddy water which includes the flathead chub, sicklefin chub, sturgeon chub, speckled chub, plains minnow, western silvery minnow, silverband shiner, river shiner, and sand shiner (Cross and Collins 1995). Other fish species that may be present near the project site include river carpsucker, shortnose gar, longnose gar, gizzard shad, chestnut lamprey, goldeye, red shiner, brassy minnow, silver chub, quillbacks, black buffalo (Pflieger 1997, Cross and Collins 1995). Introduced species include common carp, bighead carp, and grass carp (Cross and Collins 1995).

Threatened and Endangered Species

Section 7(c) of the Endangered Species Act (87 Stat. 884, as amended), requires Federal Agencies to ask the Secretary of the Interior, acting through the Service, whether any listed or proposed endangered or threatened species may be present within an area proposed for construction. If the project may affect listed species, the Corps of Engineers should initiate formal Section 7 consultation with this office. If there will be no effect, or if the Fish and Wildlife Service concurs in writing there will be beneficial effects, further consultation is not necessary. An activity which harasses any listed species and disrupts its normal breeding, feeding, or sheltering activities to the extent that harm or injury results is a prohibited taking under the ESA.

As a result of habitat losses and flow regime changes, two species dependent on the river are federally-listed as endangered or threatened and are found in this section of the Missouri River.

The bald eagle (*Haliaeetus leucocephalus*), federally listed as threatened, may be expected to occur along any river or at any reservoir in Kansas or Missouri. Eagles utilize areas where live large trees and snags provide perch sites in proximity to open water, where they feed on fish and waterfowl. This project may adversely impact the bald eagle by removing trees from the levee footprint and from the borrow areas. In addition, if any project activity appears likely to harass or disturb any bald eagle observed at or near any construction site the Service should be notified prior to commencement of the activity, so that an assessment may be made of the potential for adverse impacts.

The pallid sturgeon (*Scaphirhynchus albus*), federally listed as endangered, occurs throughout the Missouri River reach. This species has been recently captured in the Missouri River in the project area. (Miller 2006 per. comm.). Information gained by recent capture and tagging research indicates that pallid sturgeons use nearly all the habitats found in the Missouri River during their life spans. Sturgeons have been found in tributary mouths, over sandbars, along main channel borders, and in deep holes elsewhere in the Missouri River. Small sturgeons have been captured in off-channel backwaters. Adults are often found in deep, swift flowing water, especially during winter months while young and larval pallids are found in areas of lower velocities out of the thalweg.

Because so little is known about the pallid sturgeon, much of the previous information available about the reproduction or spawning activities of the pallid sturgeon was, extrapolated from what is known about shovelnose sturgeons. Shovelnose sturgeon spawn over substrates of rock, rubble, or gravel in the main channel of the Missouri/Mississippi Rivers and major tributaries, or on wing dams in the main stem of larger rivers. Spawning was suspected to occur in the relatively swift water in or near the main channel. Initiation of shovelnose sturgeon spawning migrations have been associated with increased flows in May and June and water temperatures from 61° F to 70° F (USFWS 1993).

Destruction and alteration of habitats by human modification of the river system is believed to be the primary cause of declines of the pallid sturgeon. It is unlikely that successfully reproducing populations of pallid sturgeons can be recovered without restoring habitat elements of the Missouri and Mississippi Rivers necessary for the species continued survival. The construction of levees has contributed to the alteration of pallid sturgeon habitat by eliminating major natural floodways, which annually inundated and isolated many floodplain lakes, reduced the area of the floodplain, and changed erosion and accretion processes. In addition, bank stabilization, sediment trapping in reservoirs and channelization has led to bed degradation. The reduced amount of floodplain the river can access has diminished the availability of organic matter used by aquatic invertebrates which make up a large proportion of the of the pallid sturgeon's diet during early life stages. In addition, aquatic invertebrates are a primary food source for small fish which the pallid prefers as adults. Portions of the Missouri River 20 miles upstream and downstream of the mouths of the Kansas River and Platte Rivers are high priority reaches for recovery of the pallid sturgeon (USFWS 1993).

Kansas State Law (K.S.A. 32-504, 32-507: effective May 1, 1981) requires persons undertaking or sponsoring a publicly funded or State or Federally Assisted action which is likely to impact endangered or threatened wildlife habitats where they are likely to occur, to obtain a project action permit from the Secretary of the Kansas Department of Wildlife and Parks (KDWP) prior to initiation of such action. This list should be requested from the Environmental Services Section, Kansas Department of Wildlife and Parks, 512 SE 25th Ave., Pratt, KS 67124-8174.

KDWP maintains an internet site containing county lists and species information at http://www.kdwp.state.ks.us/news/other_services/threatened_and_endangered_species. State of Kansas listed threatened and endangered species for Doniphan County, Kansas listed on this site include sicklefin chub (*Macrhybopsis meeki*), flathead chub (*Platygobio gracilis*), western silvery minnow (*Hybognathus argyritis*), chestnut lamprey (*Ichthyomyzon castaneus*), eastern spotted skunk (*Spilogale putorius interrupta*), silverband shiner (*Notropis shumard*) peregrine falcon (*Falco peregrinus*), silver chub (*Machrhybopsis storeriana*), smooth earth snake (*Virginia valeriae*), and sturgeon chub (*Macrhybopsis gelida*). In addition, the following Federally listed threatened and endangered species are also listed by the State as occurring in Doniphan County, Kansas: American burying beetle (*Nicrophorus americanus*), Eskimo curlew (*Numenius borealis*), least tern (*Sterna antillarum*), and piping plover (*Charadrius melodus*).

The State of Kansas lists the following species as Species in Need of Conservation: black tern (*Chlidonias niger*), blue sucker (*Cycleptus elongates*), brassy minnow (*Hybognathus hankinsoni*), cerulean warbler (*Dendroica cerulea*), eastern hognose snake (*Heterodon platirhinos*), plains minnow (*Hybognathus placitus*), river shiner (*Notropis blennius*), short-eared owl (*Asio flammeus*), southern flying squirrel (*Glaucomys volans*), and timber rattlesnake (*Crotalus horridus*). As these lists are subject to change the Corps should contact the Kansas Department of Wildlife and Parks, Environmental Services directly.

According to the Missouri Department of Conservation's Natural History Data Base (1999) there are occurrences of state listed species or communities in the project area. Species and concerns should be requested from the Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102.

DESCRIPTION OF THE PROJECT ALTERNATIVES

The five alternatives considered for this Coordination Act Report are: 1) Raise the Right Levee Section using earthen material to the one-hundred year level of flood protection with 90 percent reliability, and a corresponding raise to the Left Levee Section in specific areas to accept the slight rise in water surface elevations resulting from the initial raise (PREFERRED); 2) Raise the Right Levee Section to an Increased Level of Protection (500-year event plus 1.5 feet of freeboard), with a corresponding raise to the Left levee unit; 3) Raise the Right Levee Section to a Further Increased Level of Protection (500-year event plus 3.0 feet of freeboard), with a corresponding raise to the Left levee unit, and 4) Raise the Right Levee Section only using earthen fill to the 100 year level of flood protection with 75 percent reliability and 5) the "No Action" Alternative The Corps of Engineers' Draft EA identifies Alternative 1 as the Preferred Alternative.

Alternative 1: Modifying Existing Levees to Design Level to provide a higher level of flood protection than that which currently exists. This is the current preferred alternative. This modification is accomplished by raising the existing levee using earth fill. A significant portion of the levee unit R-471-460 would be raised to a level sufficient to pass the one percent (100-year) flood with a 90 percent level of reliability, allowing for re-certification of the levee by FEMA. The anticipated right bank raise varies along its length from zero to 3.37 feet. Increases in levee height would result in corresponding increases in levee toe width and seepage berms. The overall width increase from the expanded levee and seepage berms would range from approximately 35 feet to 372.5 feet landward of the right bank levee unit and approximately 29 feet to 50 feet riverward of this same levee unit. Extension of the levee toe width and seepage berms would impact a total of approximately 285 acres of land landward of the levee and approximately 77 acres of land riverward of the existing levee.

Additionally, a raise to the right bank levee would require minor raises (less than one foot) at specific locations along the left bank levee to accept the increased rise in water surface elevation resulting from the initial work. These increased elevations to the left bank will also increase toe width and seepage berms by approximately 136.5 feet to 490 feet landward of the levee unit and approximately 41.5 feet riverward of the existing levee. Extension of the levee toe width and seepage berms will impact approximately 43 acres of land landward of the levee and approximately 54 acres of land riverward of the existing levee.

Expanding the levees would result in the permanent removal of approximately 1.6 acres of secondary tree growth and 4.7 acres of shrubland landward of the levees and 5.4 acres of secondary tree growth and 8.0 acres of shrublands riverward of the levee. The permanent impact to these habitats is expected to be substantial because it will be kept from growing on the levee areas through normal levee maintenance practices. The Corps is proposing to measures to mitigate the loss through the on-site planting of 7.0 acres of "in-kind" trees and 12.7 acres of shrubland vegetation.

Proposed borrow areas include riverward areas in both Kansas and Missouri (Figure 2). In Kansas, the borrow areas consist of approximately 1,139 acres of land located from River Miles 454.9 to 451.9 and from River Miles 446.7 to 443.4. For Missouri, the borrow area consists of approximately 30.4 acres of land along River Miles 442.6 to 442.9. Over the entire project area, including the impacts from borrow material excavation and riverward berm expansion, approximately 388 acres of secondary tree growth and approximately 136 acres of shrubland could be temporarily impacted. The Corps is proposing to allow these areas to naturally revegetate over time. Additional steps have been proposed to minimize effects to this habitat. Minimization measures include, but are not limited to, avoiding this habitat by first using bare and/or cropland areas, varying bottom depths of excavated borrow sites, creating islands within the borrow site through avoidance of specified areas, spacing borrow areas apart from one another by approximately 500 feet to provide areas of no disturbance, and avoiding any larger "old growth" trees.

Construction work to extend the seepage berms would result in temporary impacts to approximately 274 acres of primarily agricultural land with minor amounts of secondary tree growth and shrubland on the right bank levee and 44 acres of similar land use on the left-bank levee. The Corps is proposing to allow these areas to revert back to their existing conditions as no levee maintenance activities will be conducted over the top of seepage berm areas.

Modifying the two levees would permanently impact approximately 4.4 acres of emergent wetlands landward of the levees and approximately 0.5 acre of forested wetlands riverward of the two levees. The areas would be filled and sloped, thereby inhibiting the ponding of water. The Corps is proposing to mitigate a total of 4.4 acres of emergent wetlands and 0.5 acres of forested wetlands on site and adjacent to the impacted wetlands concurrently with construction activitites. Wetland impacts are proposed to be off set through the scraping and reshaping of the impacted areas to expand the existing wetland area equal to that which was lost.

Some of the wetlands along both levees may be enrolled in the Wetland Reserve Program. To the extent possible, these areas will be avoided and lands outside these protected areas will be used for borrow sites. Should WRP lands be impacted the Corps will utilize measures provided in the NRCS Engineering Field Handbook, May 1997, Chapter 13 "Wetland Restoration, Enhancement, or Creation" and the "Erodible Land and Wetland Conservation and Reserve Program" provisions of the Food Security Act of 1985, as amended, to avoid/reduce impacts and to provide for a more natural setting following construction. These minimization measures would be similar to those identified above.

Grassland strips occurring on and adjacent to the levee and the toe would be temporarily impacted during construction grading, sloping, and grubbing as the width of the levee and seepage berm expand. Impacts would be temporary but would cease to provide habitat to existing wildlife during project construction and for approximately two to three years after project completion or until the grassland vegetation is well established. The completed levee slopes would be seeded and mulched with a native warm-season mix following project completion.

Alternative 2: Modifying Existing Levees to an increased level (500-year event plus 1.5 feet of freeboard) of protection would raise the levees by an average of 2.5 feet along its entire length, an increase to the levee toe width, and extension to the seepage berms associated with the levee and the excavation of approximately 1,139 acres riverward of R471-460 and 30 acres riverward of L-455 of borrow material. Although impacts from this alternative exceed the project boundary set at no more than 500 feet from the center line of the existing levee, they were only reported to the boundary limit. Impacts would be greater than Alternative 1. Approximately 7.6 acres of secondary tree growth and 14.4 acres of shrubland would be impacted. A total of 6.2 acres of wetlands are anticipated to be filled as a result of this alternative. Mitigation ratios similar to Alternative 1 are proposed.

Alternative 3: Modifying Existing Levees to a further increased level (500-year event plus 3.0 feet of freeboard) of protection would result in raising the existing levee by approximately 3.5 feet along the entire levee, an increase to the levee toe width, an extension to the seepage berms associated with the levee, and the excavation of approximately 1,139 acres riverward or R471-460 and 30 acres riverward of L-455 of borrow material. Although impacts from this alternative exceed the project boundary set at no more than 500 feet from the center line of the existing levee, they were only reported to the boundary limit. Impacts from this alternative would be greater than either Alternative 1 or Alternative 2. Alternative 3 would result in the permanent impact of 2.7 acres of secondary tree growth and 8 acres of shrubland landward of the levees and 5.4 acres of secondary growth trees and 8 acres of shrubland riverward of the levees. Wetland impacts are calculated at approximately 7.3 acres from this alternative. Mitigation ratios similar to Alternative 1 are proposed.

Alternative 4: Modifying the existing right bank levee to provide a higher level of flood protection than currently exists using earthen fill (100-year plus 1.5 feet freeboard). This alternative would not allow for re-certification of the levee by FEMA. The right bank levee would be raised by zero to 1.2 feet, with an increase to the levee toe width, an extension to the seepage and stability berms associated with the levee, and borrow excavation within an area approximately 1,139 acres riverward of R471-460, and approximately 30 acres riverward of L-455. A raise to the left bank would not be required. Approximately 1.3 acres of secondary tree growth and approximately 4.0 acres of shrubland landward of the levees and approximately 4.5 acres of secondary growth trees and 6.2 acres of shrublands riverward of the levees would be lost. Wetland impacts are calculated at approximately 3.7 acres of emergent wetland landward of the levees and approximately 0.5 acres of forested wetlands riverward of the levees. Mitigation measures ratios to Alternative 1 are proposed.

"No Action" Alternative: The "No Action" alternative would involve no construction activity and no change in project operations. No borrow material would be obtained so no impacts to forested areas or shrub habitat would occur. The no action alternative would maintain these vegetation resources in the study area as status quo. Additionally, because the borrow areas would not be used, no reshaping of riverward areas to increase functions of existing wetland acreage and fishery habitat would occur.

OTHER PROJECT ALTERNATIVES

Several structural modifications were considered to reduce the frequency of damaging overflows including channel modifications, upstream reservoirs and levee setbacks. These modifications were eliminated from further consideration due to economic infeasibility, ineffectiveness in providing an adequate level of protection for the study area, the costs outweighed the benefits, or the environmental impacts that would result from a particular alternative were far greater than the preferred alternative.

Levee Setbacks would have removed a section of levee unit R471-460 from river mile 449 downstream to river mile 447.5 and reconstructed it landward. The objective of this alternative was to achieve a uniform 3,000 foot floodway within the study area consistent with the original Pick-Sloan Plan for flooding width above Kansas City, Missouri. This alternative was removed from further consideration because total benefits were less than the cost of construction. However, the cooperating agencies of the Missouri River Fish and Wildlife Mitigation Project (MRFWMP), which includes the Corps, are looking at levee setbacks as one component of the project. If levee setbacks were completed in cooperation with the MRFWMP, with the costs shared by both projects, the cost/benefit ratio might be more favorable and would help meet the objectives of both projects.

The Corps has also considered dredging the river for levee fill. This could have negative implications for the pallid sturgeon and other fish.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

The Missouri side of the project area is primarily urban consisting of industrial, commercial development with major roads and bridges, secondary roads, and housing developments on and above the floodplain. The Kansas side of the levee project contains similar development. Existing wildlife habitat is scarce, and of generally low quality due to habitat fragmentation and loss of habitat from the development that has been ongoing for more than a hundred and fifty years. Without the flood damage reduction project FEMA may de-certify the levee leaving the local communities to bear the economic impact of further flood events. This may result in the decrease of future development in the floodplain and flood prone areas of the Missouri River behind the levees and may even cause the abandonment of existing development. Cropland may also be abandoned, converted to other open space uses or enrolled in the Conservation Reserve Program (CRP) or the Wetland Reserve Program (WRP). All of these actions could actually increase the quantity and quality of wildlife habitat available in the area.

FISH AND WILDLIFE WITH THE PROJECT

The project would presumably keep the levees in compliance with FEMA and under their certification. With payments for flood damages more secure and many people believing that the likelihood of flooding is diminished, more floodplain and floodprone land landward of the levees would likely be developed. This would result in more wildlife habitat being converted and more habitat fragmentation.

The proposed borrow area known as Elwood Bend contains some of the highest quality wildlife habitat in the project area in a large unfragmented tract. Work in this area will displace wildlife that currently use the area due to disturbances from noise, dust, human activity, machinery and destruction of habitat. Depending on construction timing, this displacement could result in serious consequences to wildlife such as loss of reproduction and possible death of individual animals from accidents (crossing roads and unknown hazards in new areas), starvation, competition for other areas, etc. There is little refuge habitat in close proximity to the project area and available habitat is presumably at carrying capacity which further reduces the likelihood of wildlife surviving the displacement and intensifies the competition for the limited habitat available. Although the temporal displacement may be relatively short, the repercussions could be long-term. Impacts to migrating songbirds are of particular concern. Existing wildlife travel corridors linking the borrow areas and other areas of suitable floodplain upstream and downstream of the borrow area should be maintained during project construction. If the

Elwood Bend area is used as a borrow site, it would also be beneficial to allow early successional stages of woody and annual vegetation to grow landward of the levee to facilitate movement through the cropland outside of the growing season.

Large trees suitable for bald eagle habitat are present in the Elwood Bend borrow site and in other areas riverward of the levee. Trees 50 feet or greater in height and/or trees greater than 24 inches diameter at breast height (dbh) should be avoided. Many smaller trees are also present in the site. While these trees are young now, they are closer to a mature and more valuable stage than newly established trees and should be avoided if at all possible.

Habitat gains in quality could be realized if the Corps works closely with the MRFWMP team and constructively takes borrow to enhance habitat to meet the objectives of that program. However, there is an abundance of cropland and bare ground inside and outside the levee that could be used for borrow areas instead of the Elwood Bend area. Soils taken from these areas would be relatively free of the trash and debris (tree roots, vegetation, etc.) common to borrow taken from vegetation riparian areas. Borrow locations should be located in cropland or other bare ground as much as possible. Another option is to take borrow from areas infested with reed canary grass, an invasive species, and replace with permanent water or seasonal inundation such as chutes, deeper water wetlands, backwaters, and floodplain ponds that would eliminate this species.

The loss of levee brome grasses during heightening of the existing levee system will be a short-term loss. Re-seeding the levee to warm season grasses such as switch grass would reduce erosion, better insure the integrity of the levee system during floods and provide higher value wildlife habitat than brome.

Previous modifications within the Missouri River channel and floodplain has had an adverse effect on fish and wildlife habitat. The Missouri River surface area has declined more than 50 percent. The river channel is now deep, has swift currents, and decreased habitat diversity. River backwaters, chutes, sandbars, and oxbow lakes have been lost to floodplain development. Both proposed borrow areas are riverward of the levee. One is primarily cropland and should not cause significant impacts to wildlife. The other is the Elwood Bend area as previously discussed. Work in this area could cause significant short and long-term impacts to wildlife.

Construction activities would cause temporary, short-term impacts to fish and wildlife from noise, dust, and the presence of workers and machinery. Runoff from construction areas, access roads, staging areas and unprotected fills could degrade water quality inside the levee system. Accidental spills of fuels, lubricants, hydraulic fluids, and other petrochemicals would be harmful to aquatic life.

Removal of fill from the cropland area has the potential to cause the loss of farmed wetland. Farmed wetland should be delineated within the borrow site and should be avoided if possible. If an unavoidable loss is incurred, the quantity and quality of the farmed wetland will determine the amount of compensation necessary to offset project losses. The wetland mitigation plan for all wetland impacts should be developed in coordination with the Corps, Service, EPA, KDWP and MDC. This plan should include site locations, time frames, construction plans, a monitoring plan, progress reports, and standards of success. This plan should be a condition of any permit issued for the project. The proposed Mitigation Plan is lacking many of these components. The completed plan should be implemented regardless of whether impacted wetlands are classified as jurisdictional for purposes of the Clean Water Act.

Mitigation Discussion

The Service has established a mitigation policy used as guidance in determining resource categories and recommending mitigation measures (46 FR: 7644-7663).

We have determined that most of the wildlife habitat that would be affected by the raising of existing levees (levee footprints and easements) is in Resource Category No. 4 (habitats of medium to low value). For this category, loss of habitat value should be minimized.

Forested wetland and riparian woodland are consistent with Resource Category No. 2 that is, habitats are of high value that are relatively scarce or becoming scarce on a national or regional basis. Losses attributed to the project would require in-kind mitigation (replacement of habitat value lost with equal habitat values of the same kind of habitat as those eliminated). The cost of mitigating habitat losses should be included as a project cost.

Whenever possible, we recommend upland trees within the construction right-of-way remain undisturbed. While the trees may be young now, they are closer to a mature and more valuable stage than newly established tress.

Trees at least 50 feet tall and /or 24-inches dbh within 100 feet of the water's edge should be avoided. Removal of these trees may adversely affect the habitat of the bald eagle.

Under the Migratory Bird Treaty Act (MBTA), construction activities in prairies, wetlands, stream and woodland habitats, including the removal of upland borrow, and those that occur on bridges (e.g., which may affect swallow nests on bridge girders) that would otherwise result in the taking of migratory birds, eggs, young, and/or active nests should be avoided. To minimize impacts to birds protected under the MBTA, construction areas should be surveyed for the presence of nesting birds during the general migratory bird nesting season of March through August. Disturbance of nesting areas should be avoided until nesting is completed.

Vegetation clearing and construction related soil disturbances can cause sediment-laden runoff to enter waterways. To minimize impacts associated with erosion, contractors should employ silt curtains, coffer dams, dikes, straw bales or other suitable erosion control measures adjacent to floodplain water bodies or tributaries affected by the project.

Sediment control measures are not necessary adjacent to the Missouri River because it is sediment starved, although downstream water supply intakes are a concern. Construction related petrochemical spills can also negatively impact fish and wildlife resources. Therefore, measures should be implemented prior to construction to minimize the likelihood of petrochemical spills.

Invasive species have been identified as a major factor in the decline of native flora and fauna and their ecosystems and impact aquatic resources. Invasive species of particular concern in Kansas are the zebra mussel (*Dreissena polymorpha*), purple loosestrife (*Lythrum salicaria*), Johnson grass (*Sorghum halepense*), sericea lespedeza (*Lespedeza cuneata*), and reed canary grass (*Phalaris arundinacea*). Executive order 13112 Section 2 (3) directs Federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere and to ensure that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions. Proactive measures to prevent the inadvertent spread of exotic and invasive species would appear to satisfy this directive. Therefore we recommend the implementation of the following Best Management Practice (BMP).

> All equipment brought on site will be thoroughly washed to remove dirt, seeds, and plant parts. Any equipment that has been in any body of water within the past 30 days will be thoroughly cleaned with hot water (hotter than 40°C or 104°F) and dried for a minimum of five days before being used at this project site. In addition, before transporting equipment from the project site all visible mud, plants, and fish/animals will be removed, all water will be eliminated, and the equipment will be thoroughly cleaned. Anything that came in contact with the water will be cleaned and dried following the above procedure.

Section 2 of the Fish and Wildlife Coordination Act requires the Service to identify project related opportunities to enhance fish and wildlife. The enhancement recommendations discussed below refer to project related creation of wildlife habitat, over and above that required to mitigate losses attributable to project construction.

Native trees, grasses, and forbs, noted for their high wildlife value, could be established along the landward and stream side base of the existing levee system. This might help offset future losses due to increased encroachment along the river once flood protection is increased once again. Switch grass often takes longer to become fully established; however when established, stands of native vegetation provide excellent soil binding characteristics, valuable wildlife habitat and require fewer maintenance costs. The Service, Missouri Department of Conservation, the Kansas Department of Wildlife and Parks, and the Natural Resource Conservation Service offer assistance programs and could work with the cities of St. Joseph, Elwood and Wathena and the project sponsors to develop vegetation management plans.

RECOMMENDATIONS

1. The take of borrow from areas riverward of the levees should be closely coordinated with the Missouri River Fish and Wildlife Mitigation Project (MRFWMP) team to creatively construct areas that will conform to the objectives of the MRFWMP. This is particularly important in the proposed borrow area south of the City of Elwood, known as Elwood Bend, as it has been identified for inclusion in the MRFWMP. The MRFWMP team should be closely consulted about the take of borrow from the area and about the construction plans for the final design of the borrow areas. The MRFWMP should also be given approval rights for the borrow design plans. If the Corps and the project sponsors are unable to work with the MRFWMP, the Elwood Bend area should be eliminated from the plan.

2. Riparian and wetland habitats should be avoided to the maximum extent practicable when selecting borrow sites for the proposed levee raises and compensatory mitigation should be undertaken for unavoidable impacts. Since channelization, levee construction and floodplain development have already resulted in dramatic loss of riparian and wetland habitats in the Missouri River basin, the Corps should focus on bare or cropland areas for borrow.

3. Reconsideration of the Levee Setback alternative. The Levee Setback alternative was eliminated from further consideration because total benefits from this alternative were far less than the cost of construction. However, the MRFWMP team is considering setting back levees to improve habitat. Coordination with the MRFWMP may make it feasible to set back some portions of levees as part of this project thereby reducing impacts from those portions of the levees that would still need to be raised.

4. Levees and levee easements should be seeded with native, warm-season grasses such as switch grass.

5. Removal of mature cottonwoods, and other native vegetation should be avoided where possible, and if they are removed, replace woody vegetation by establishing 2 acres of native vegetation for every acre impacted.

6. The Corps should create wetland mitigation habitat to compensate for the loss of wetland acreage from construction of the projects at a minimum of 1.5:1 ratio for emergent wetland and at a 2:1 ratio for forested wetland. If farmed wetland is directly impacted by borrow activities it should be mitigated at a 1.0 to1.0 ratio.

7. Encourage wetland development and hydrological reconnection to the river at existing and proposed borrow areas.

8. Best Management Practices to prevent the transport of invasive species to or from the construction sites should be included as an integral component of the project.

The following recommendations describe opportunities to provide fish and wildlife enhancement through the project.

9. Establish native vegetation riverward of levee segments where riparian woodlands are sparse or nonexistent or where the invasive species, reed canary grass (*Phalaris arundinacea*), has become established. If possible, borrow from reed canary grass areas and replace with permanent water or seasonal inundation such as chutes, deeper water wetlands, backwaters, and floodplain ponds that would eliminate reed canary grass.

10. All disturbed areas should be immediately planted with native vegetation following construction. Due to the presence of reed canary grass, an exotic and aggressively invasive species, these areas would likely become a monoculture of reed canary grass if allowed to revegetate naturally.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kansas Ecological Services Office
2609 Anderson Avenue
Manhattan, Kansas 66503-6172

June 30, 2006

Colonel Michael Rossi
U.S. Army Corps of Engineers, Kansas City District
601 E 12th Street
Kansas City, MO 64106

Dear Colonel Rossi:

This Draft Fish and Wildlife Coordination Act Report (DCAR) is provided pursuant to the Fiscal Year 2006 Scope-of-Work Agreement for the Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Study, Kansas and Missouri, between the U.S. Fish and Wildlife Service (Service) and the Kansas City District, Corps of Engineers. Your agency has indicated that this kind of information would be useful in project planning and in avoiding environmentally sensitive areas during project development. This DCAR was prepared in accordance with provisions of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), and will in its' final form constitute the report of the Secretary of the Interior on the project within the meaning of Section 2 (b) of this Act.

Cooperation and information utilized in preparation of this report was obtained from the Kansas Department of Wildlife and Parks (KDWP), the Missouri Department of Conservation (MDC), and the Kansas City District. The Service is concurrently soliciting comments from the KDWP, MDC, and the Fish and Wildlife Service Columbia, MO Field Office. Their comments and recommendations will be reflected in the Final Coordination Act Report (FCAR). Their concurrence letters, if they are forthcoming, will be sent to you along with our final report.

We appreciate the opportunity to discuss impacts to fish and wildlife anticipated by implementation of this project and would appreciate any comments you or your staff have on the DCAR by July 21, 2006.

If we can be of any assistance please call Ms. Susan Blackford, of my staff, at [redacted] ext. 102.

Sincerely,

Michael J. LeValley
Field Supervisor

DRAFT
FISH AND WILDLIFE COORDINATION ACT REPORT FOR THE MISSOURI RIVER LEVEE SYSTEM UNITS L-455 AND R-471-460 FLOOD DAMAGE REDUCTION STUDY KANSAS AND MISSOURI

PREPARED FOR THE

The Kansas City District
U.S. Army Corps of Engineers
Kansas City, Missouri

Prepared by
U.S. Fish and Wildlife Service
Kansas Ecological Services Field Office
Manhattan, Kansas
June, 2006

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EXECUTIVE SUMMARY

The Kansas City District, Corps of Engineers, is in the process of developing a feasibility study for flood damage reduction measures for the city of St. Joseph, in Buchanan and Andrew Counties, Missouri and Elwood and Wathena, Doniphan County, Kansas. This Draft Fish and Wildlife Coordination Act Report describes the study area, identifies important aquatic and terrestrial resources, evaluates impacts of flood damage reduction measures, and describes mitigation measures.

The project area is highly urbanized inside the existing levee system. The primary impact from a fish and wildlife perspective will be the loss of terrestrial habitat from levee construction, permanent loss of wetlands from levee construction, temporary loss of terrestrial habitat due to construction activities and borrow construction. One borrow area, known as Elwood Bend, has been proposed for purchase for inclusion in the Missouri River Fish and Wildlife Mitigation Program (MRFWMP). Inappropriate use or pattern of borrow from this area could diminish its value to the MRFWMP. The Fish and Wildlife Service recommends the following:

RECOMMENDATIONS

1. The take of borrow from areas riverward of the levees should be closely coordinated with the Missouri River Fish and Wildlife Mitigation Project (MRFWMP) to creatively construct areas that will conform to the objectives of the MRFWMP. This is particularly important in the proposed borrow area south of the City of Elwood, known as Elwood Bend, as it has been identified for inclusion in the MRFWMP. The MRFWMP team should be closely consulted about the take of borrow from the area, the construction plans for the final design of the borrow areas and given approval rights for the borrow design plans. If the Corps and the project sponsors are unable to work with the MRFWMP, the Elwood Bend area should be eliminated from the plan.

2. Riparian and wetland habitats should be avoided to the maximum extent practicable when selecting borrow sites for the proposed levee raises and compensatory mitigation should be undertaken for unavoidable impacts. Since channelization, levee construction and floodplain development have already resulted in dramatic loss of riparian and wetland habitats in the Missouri River basin, the Corps should focus on bare or cropland areas for borrow.

3. Reconsideration of the Levee Setback alternative. The Levee Setback alternative was eliminated from further consideration because total benefits from this alternative were far less than the cost of construction. However, the MRFWMP team is considering setting back levees to improve habitat. Coordination with the MRFWMP may make it feasible to set back some portions of levees as part of this project thereby reducing impacts from those portions of the levees that would still need to be raised.

4. Levees and levee easements should be seeded with native, warm-season grasses such as switch grass.

5. Removal of mature cottonwoods, and other native vegetation should be avoided where possible, and if they are removed, replace woody vegetation by establishing 2 acres of native vegetation for every acre impacted.

6. The Corps should create wetland mitigation habitat to compensate for the loss of wetland acreage from construction of the projects. If farmed wetland is directly impacted by borrow activities it should be mitigated at a 1.0 to1.0 ratio.

7. Best Management Practices to prevent the transport of invasive species to or from the construction sites should be included as an integral component of the project.

The following recommendations describe opportunities to provide fish and wildlife enhancement through the project.

8. Establish native vegetation riverward of levee segments where riparian woodlands are sparse or nonexistent or where invasive species, i.e. reed canary grass, has become established. If it is possible, borrow from reed canary grass areas and replace with permanent water or seasonal inundation such as chutes, deeper water wetlands, backwaters, floodplain ponds that would eliminate this species.

9. Establish native vegetation riverward of levee segments where riparian woodlands are sparse or nonexistent or where invasive species, i.e. reed canary grass, has become established. If it is possible to borrow from reed canary grass areas and replace with permanent water or seasonal inundation such as chutes, deeper water wetlands, backwaters, floodplain ponds that would eliminate this species.

10. Encourage wetland development and hydrological reconnection to the river at existing borrow areas landward of the levee units.

INTRODUCTION

This Draft Fish and Wildlife Coordination Act Report (DCAR) evaluates the effects on fish and wildlife resources of proposed alternatives identified for increasing the level of flood protection for areas in Kansas and Missouri near St. Joseph, Missouri and Elwood, Kansas. The considered alternatives consist primarily of earthen levee raises of two levee units, Levee Unit L-455 and Levee Unit R-471-460. These units collectively comprise the protective works that provide flood protection for areas in St. Joseph, Buchanan and Andrew Counties, Missouri and Elwood and Wathena, Doniphan County, Kansas (Figure 1).

The south St. Joseph Levee Unit L-455 is located on the left bank of the Missouri River in Buchanan County, Missouri. It extends from the mouth of Whitehead Creek (Missouri River mile marker 447.3) ten miles downstream to Contrary Creek (Missouri River mile marker 437.3) and provides flood protection for a flood prone area within the southwest section of the City of St. Joseph. The Levee Unit R-471-460 is located on the right bank of the Missouri River between river miles 441.7 and 456.6 in eastern Doniphan County, Kansas, and northwestern Buchanan County, Missouri.

Both units were overtopped during the flood of 1993. The stated need for the Missouri River Levee System Units L-455 and R-471-460 Flood Damage Reduction Project in Kansas and Missouri is to allow passing of the one percent flood event with 90 percent reliability under both the existing and future conditions. This level is currently lacking and FEMA is considering de-certification for the levee. If the levee is decertified the economic impact of a flood event will be borne entirely by the local communities

Work on this project is based on agreements in the FY2006 Scope of Work to evaluate impacts to fish and wildlife resources from the NED-Preferred alternative, and Alternatives 2 and 3. This study was carried out under authority and in accordance with provisions of the U.S. Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661 et seq.).

The Fish and Wildlife Service has not provided any previous Planning Aid Letters or Planning Aid Reports on the Missouri River Levee System Units L-455 and R-471-460 Flood Damage Reduction Project in Kansas and Missouri. We have reviewed the Corps of Engineers draft, Pre-Draft EIS and Draft Mitigation Plan.

The Kansas Department of Wildlife and Parks (KDWP) and the Missouri Department of Conservation (MDC) have cooperated in the preparation of this report and concur with its contents as indicated in the attached letters dated XXX.

DESCRIPTION OF THE PROJECT AREA

The site of St. Joseph was first noted in the journal of Lewis and Clark during their Journey of Discovery in 1804. Following the organization of the State of Missouri in

Figure 1.

1821, Joseph Robicoux established the Blacksnake Hills trading post in 1826 at this site. In 1843 Robicoux platted the town of St. Joseph naming it after his patron saint. The town remained relatively small until the 1848 California Gold Rush when it became important as a departure point for the westward journey to the gold fields for hundreds of thousands of settlers and again in the 1850s during the Pike's Peak gold rush. In 1859 the railroad reached St. Joseph assuring its role as a supply and distribution point to the western half of the country. St. Joseph's proximity to the Missouri River and accessibility by way of river, rail, and land was to provide the impetus for phenomenal growth throughout the 19th century. The Pony Express operated in 1860 and 1861 with St. Joseph serving as its eastern terminus. In the 1870's St. Joseph became established as a leading wholesale center. A stockyard was opened in 1887 and several meat packing plants were established during the next forty years. The city currently has a population of approximately 74,000.

Elwood, Kansas was first established in 1856 under the name of Roseport. It also benefited from its association with the Missouri River serving as an important steamboat port with a ferry service to St. Joseph. In the 1850s, thousands of emigrants outfitted in Elwood for their journey to Oregon and California. It was the first Kansas station on the Pony Express and the site of the first railroad construction west of the Missouri River. Much of the old town was washed away when the Missouri River undermined the banks. The current town has a population of approximately 1,176.

The Missouri River, one of the largest rivers in the United States, originates in southwestern Montana and flows about 2,315 miles to join the Mississippi River near St. Louis, Missouri. It drains approximately 424,300 square miles above Saint Joseph, Missouri. The River Mile (RM) references used in this report are measured upstream from the confluence of the Missouri River with the Mississippi River. The topography of the study area is generally represented by hills and uplands, which rise from 100 feet to 200 feet above the Missouri River floodplain. The Missouri River borders the eastern bluffs in the northern part of the city, and then crosses over to border the western bluffs opposite the southern part of the city. Its floodplain is three to five miles wide at Saint Joseph. Tributaries to the Missouri River in the St. Joseph study area in Missouri include Blacksnake Creek, Whitehead Creek, and Contrary Creek. On the Kansas side, Peters Creek joins the Missouri River south of the town of Wathena. Several unnamed tributaries to the Missouri River are also in the Kansas portion of the project area. An area called French Bottoms occupies the interior of an old oxbow of the Missouri River. Browning Lake is the remainder of the old channel. The Rosecrans Memorial Airport was built in the French Bottoms.

The project area is predominantly an alluvial flood plain underlain by bedrock of the Pennsylvanian System, Kansas City Group. Pennsylvania strata generally consist of inter-bedded sandstone, shale, limestone, clay, and coal. Limestone is the most abundant resource present and it is mined for materials primarily used for road and highway construction.

In addition to limestone, sand and gravel are locally important mineral resources. The historic production of these resources is from flood plain and in-channel deposits of major streams. Crushed limestone has replaced stream gravels as the predominant coarse aggregate in cement. Upland terrace and glacial deposits are important sources of sand and gravel in the southeastern and northwestern portions of Missouri.

Soils within the project area have primarily developed as a result of the wind-borne deposition of fine-grained material (loess) and the deposition of material on land by streams (alluvium). Loess deposits are visible on the exposed valley walls adjacent to the Missouri River. Missouri River floodplain soils belong to the Haynie-Urban Land-Leta association. Soils of the upland, loess hills are of the Knox-Judson-McPaul and the Marshall-Ladoga-Gara associations. The soil associations generally consist of deep, nearly level, well drained to somewhat poorly drained soils comprised of river-deposited sand, silt, and clay.

The flood plain or bottoms area is three to five miles wide in the St. Joseph study area and is characterized by low-lying, nearly level terrain. The uplands are composed of steep to moderately sloping hills composed of loess or loamy soils. Buchanan County and Doniphan County consist of several soils types, which are either hydric, prime farmland, or both.

Water quality of the Missouri River tributaries in St. Joseph has been severely impacted by urban development. Significant segments of five out of the seven tributaries in the study area have been placed underground in conduits and are used as a combined sanitary/storm water sewer system. The remaining two tributaries, Roy's Branch and Contrary Creek, drain relatively undeveloped areas.

The Missouri River near St. Joseph is classified as a permanent flow general warm water fishery resource. A general warm water resource provides protection to both game and non-game fish occurring in the area. The River provides a water source for irrigation, livestock/wildlife watering, aquatic life protection, boating, drinking water supply, and industrial withdrawal.

Terrestrial Resources

A review of historical conditions on the Missouri River can facilitate an understanding of how the river formerly functioned, and suggest the ecological functions and processes that were essential to development of such an abundant and rich array of fish and wildlife resources. However, clearly defining historical conditions is somewhat problematic, since most of the more detailed quantitative and qualitative descriptions of the Missouri River occurred during or after major episodes of human impact. Nevertheless, we can broadly surmise how the presettlement Missouri River appeared.

The river at this time was free-flowing, without the restrictions of dams and diversions. The River water was extremely sediment laden and turbid, in comparison, current flow is fairly clear. Flows varied dramatically and fluctuated widely in response to rains. Sustained high flows occurred in the spring and early summer in response to snow melts.

The higher flow events resulted in over bank flooding, often over extensive reaches of the valley floor. Overflow areas were covered by dense forests of riparian vegetation. Some accounts place the riparian band as extending up to 14 -15 miles along each side of the river and encompassing at least one-half million acres. Extensive swamps, marshes, floodplain pools, and other diverse and expansive wetlands were also nourished by the regular flooding events.

Bank erosion and river meander, the basic forces for most riverine ecological processes and functions, were unimpeded. Erosion was most active on the outsides of the numerous meander bends, where the highest velocities impinged directly on the earthen substrates. As one bank was eroded, the opposite bank experienced sediment accretion. Some of the meanders became cut off from the river, forming oxbow lakes and other broad, highly diverse channel overflow areas. Erosion also resulted in the input of large volumes of woody debris of a broad range of sizes, types, and complexities into the river. The fish, wildlife, and riparian vegetation of the river were in a dynamic equilibrium, adjusted to, and dependent upon the cycle of erosion, deposition, and changing channel pattern as the river slowly swung back and forth across its meander belt. The ecological health and productivity of the river at any point in time were dependent on periodic rejuvenation associated with these natural processes and changes.

Significant environmental changes and impacts have occurred in the past one-hundred and fifty years. Only fragments remain of the extensive riparian forests and wetlands which have been largely removed through urbanization and land clearing for agricultural purposes. The river is controlled by dozens of dams on the main stem and tributaries. The river is sediment starved. The lower river is channelized and largely confined by levees and bank stabilization, and overall, is a mere remnant of the ecologically dynamic and complex system of the past (USFWS 2005).

Remnants of the "oak-hickory-maple" upland forest vegetation type are present on the steep hillsides adjacent to the Missouri River floodplains. In addition to the species of sugar maple, white and black oak, and hickories for which this upland vegetation type is named, other hardwood species present include American sycamore, beech, black walnut, bur and chinkapin oak, hackberry, American and slippery elm, hawthorn, honeylocust, redbud, and dogwood. The understory consists of regeneration of the above species and the ground layer includes: violets, poison ivy, Virginia creeper, greenbrier, and honeysuckle and other species.

Most of the vegetation in the study area has been greatly impacted by urban development and agricultural land clearing. In general, the upper reaches of the tributaries draining the area are located in the more established, residential neighborhoods and the lower reaches are located in the intensively developed business district and croplands. The banks along Roy's Branch, Contrary Creek, and limited areas along the upper reaches of the other tributaries do contain tracts of riparian timber. A mix of sycamore, cottonwood, maple, oak, and hickory dominates these areas. Other areas along the upper reaches of the tributaries are in residential development, parkland, or various stages of successional recovery.

Three vegetation types generally dominated the project area: floodplain forest (*Populus-Salix*), oak-hickory-maple forest (*Quercus-Carya-Acer*), and openings of bluestem prairie (*Andropogon-Panicum-Sorghastrum*). Although the project area's floodplains have been largely cleared for development and agriculture, there are bands of riparian forest habitat located riverward of the levee units. Predominant tree species found in these riparian bands include eastern cottonwood, willows, box elder, green ash, silver maple, and American sycamore. The understory includes reproduction of these species, plus some redbud, dogwood, black cherry, and various shrubs. The ground layer in the riparian bands varies from sparse to dense vegetation and contains primarily poison ivy, Virginia creeper, honeysuckle, greenbrier, and gooseberry, and various other species. A monoculture of reed canary grass was observed in much of the area between the levee easement and the band of riparian forest at the water's edge on the Kansas side of the project area.

Mammals associated with the remaining wooded riparian habitat include the white-tailed deer, eastern cottontails, and red and gray squirrels. Aquatic and terrestrial furbearers are important parts of the ecosystem, and those present in the area include the beaver, mink, and muskrat (dependent on the aquatic habitat) and opossum, coyote, raccoon, and striped skunk (dependent on terrestrial habitat). However, small mammals, such as mice, voles, rats, and bats account for the majority of the species present. The white-tailed deer is the only naturally occurring large mammal still common in developed urban areas. Eastern wild turkeys are present in the open, less developed floodplain areas.

The avifauna of the study area includes permanent residents, summer residents, transients, and winter residents. The project area provides year-around habitat for approximately 31 bird species, with another 67 species using the project area for nesting and another 14 species as winter residents only. Over 110 species use the river corridor during the fall migration. Summer resident species associated with aquatic habitats include waterfowl, wading birds, and selected passerines. Summer waterfowl are dominated by wood ducks which nest in wooded bottomlands and rear their young in nearby aquatic habitats. Nesting by other waterfowl, primarily mallards, is minor. Wading birds, such as the great blue heron and green heron, utilize shallow areas as foraging habitat.

Waterfowl and shorebirds are dominant transient species associated with aquatic habitats. The most numerous and impressive migration is that of the snow goose, particularly in the spring. Other migrating species include the Canada goose, mallard, and pintail.

Common amphibians found in the study area include the tiger salamander, bullfrog, leopard frog, plains toad, northern cricket frog, striped chorus frog, plains spadefoot toad, Rocky Mountain toad, western chorus frog, and plains leopard frog. Common reptiles that may be found in the study area include the snapping turtle, ornate box turtle, painted turtle, smooth and spiny soft-shelled turtles, the rough-scaled lizard, collared lizard, Texas horned lizard, prairie skink, Great Plains skink, six-lined racerunner, and glass-snake lizard. The prairie ringneck snake, eastern hognose snake, racer, bullsnake, prairie kingsnake, common watersnake, blotched kingsnake, plains blackhead snake, red-sided garter snake, copperhead, massasauga, and the timber rattlesnake may either be common or present in the study area.

Wetlands

Wetlands exist within the project area as small pockets, old meander scars, and within the riparian strips. An old oxbow of the Missouri River (French Bottoms) was cut off when the river charged its course during the flood of 1952. Remnants of the oxbow remain as Browning Lake, an area protected by levee unit R471-460. Lake Contrary is in the area protected by levee L-455.

National Wetland Inventory database (NWI) maps for the project area indicate that there are many wetlands in the project area. These wetlands are permanently flooded, seasonally flooded, temporarily flooded, or semi-permanently flooded and include forested, broad leaved deciduous, and scrub shrub vegetation. In addition, there are areas classified as palustrine unconsolidated bottom, intermittently exposed (PUBG) which are typically mud or sand flats. Some of the wetlands are natural and some are man-made.

Historically, wet mesic bottomland forest was the most extensive bottomland forest natural community in Missouri (Nelson 1987). This community has a diversity of tree species such as pin oak, cottonwood, river birch, green ash, and hackberry, cherry, sweetgum, hawthorn, dogwood, hickories, wildplum, persimmon, maples, elm, and sassafras. A well-developed understory is often present, containing poison ivy, elm, nettle, and honeysuckle. These communities provide habitat for a wide variety of resident and migratory wildlife. Forested wetlands have been found to support significantly higher abundance and diversity of bird species compared to upland forests (Brinton 1981).

A jurisdictional wetland determination will be necessary if levee alignments or borrow areas directly impact wetlands. The quantity and quality of existing wetlands will determine the amount of compensation necessary to offset project losses. A wetland mitigation plan would be developed in coordination with at least the Corps, Service, EPA, KDWP and the MDC. This plan would include site locations, time frames, construction plans, a monitoring plan, progress reports, and standards of success. This plan would be a condition of any Section 404 permit issued for the project. The plan should be implemented regardless of the regulatory nature of the wetland. Minimum replacement ratios for compensatory wetland mitigation should be based on the following guidelines:

U.S. Fish and Wildlife Service, Region 6
Wetland Mitigation Policy Guidance (8/97)
Recommended Minimum Replacement Ratios

Mitigation Type	Ratio	Type of Wetland Being Mitigated
Advance Creation	1.5:1	forested, scrub-shrub
	1:1	emergent
Concurrent Creation	2:1	forested, scrub-shrub
	1.5:1	emergent
Advance Restoration	1.5:1	forested, scrub-shrub
	1:1	emergent
Concurrent Restoration	2:1	forested, scrub-shrub
	1.5:1	emergent
Advance Enhancement	3:1	forested, scrub-shrub
	2:1	emergent
Concurrent Enhancement	4:1	forested, scrub-shrub
	3:1	emergent

Aquatic Resources

The Missouri River has undergone considerable change since the Louisiana Purchase in 1803. Modifications to the natural Missouri River floodplain ecosystem have been immense and ongoing for more than 150 years. Presently, 35 percent of the river's length is impounded, 32 percent is channelized or stabilized, and the remaining 33 percent is freeflowing (Schmulbach and others, 1992). Major civil works projects involved channelization, channel maintenance, and impoundment and reservoir operation. Agricultural, industrial, and urban development within the basin also significantly modified the Missouri River and its adjoining floodplain.

Presently all of the Missouri River from Sioux City, Iowa to its mouth at Saint Louis, Missouri is channelized. Even during flooding only about 10 percent of the original floodplain is inundated, as high agricultural and urban levees confine the river to a width of approximately 500 feet from Kansas City north (USFWS 1980). The impacts of channelization have been numerous and severe on the physical, chemical, and biological structure and function of the Missouri River and its floodplain. The most damaging of these alterations to aquatic communities has been the nearly complete isolation of the river from its floodplain, subsequent loss of floodplain habitat, drastic reduction in area and diversity of river channel habitats, and increased velocity of the main channel.

Missouri River fish populations have been significantly affected by channel alterations in the project area. Most indigenous fish species still remain, but have suffered serious population declines. The rivers' fishery is characterized by species typical of large, turbid rivers including the smallmouth buffalo, bigmouth buffalo, common carp, river carpsucker, shortnose gar, and channel catfish. Gizzard shad is the dominant forage species. Besides channel catfish other sport species present are the flathead and blue catfishes, white crappie, freshwater drum, green sunfish, and bluegill. Other forage and nongame species present include various minnows and shiners.

Threatened and Endangered Species

Section 7(c) of the Endangered Species Act (87 Stat. 884, as amended), requires Federal Agencies to ask the Secretary of the Interior, acting through the Service, whether any listed or proposed endangered or threatened species may be present within an area proposed for construction. If the project may affect listed species, the Corps of Engineers should initiate formal Section 7 consultation with this office. If there will be no effect, or if the Fish and Wildlife Service concurs in writing there will be beneficial effects, further consultation is not necessary. An activity which harasses any listed species and disrupts its normal breeding, feeding, or sheltering activities to the extent that harm or injury results is a prohibited taking under the ESA.

As a result of habitat losses and flow regime changes, two species dependent on the river are federally-listed as endangered or threatened and are found in this section of the Missouri River.

The bald eagle (*Haliaeetus leucocephalus*), federally listed as threatened, may be expected to occur along any river or at any reservoir in Kansas or Missouri. Eagles utilize areas where live large trees and snags provide perch sites in proximity to open water, where they feed on fish and waterfowl. This project may adversely impact the bald eagle by removing trees from the levee footprint and from the borrow areas. In addition, if any project activity appears likely to harass or disturb any bald eagle observed at or near any construction site the Service should be notified prior to commencement of the activity, so that an assessment may be made of the potential for adverse impacts.

The pallid sturgeon (*Scaphirhynchus albus*), federally listed as endangered, occurs throughout the Missouri River reach. This species has been recently captured in the project area. (Miller 2006 per. comm.). Information gained by recent capture and tagging research indicates that pallid sturgeons use nearly all the habitats found in the Missouri River during their life spans. Sturgeons have been found in tributary mouths, over sandbars, along main channel borders, and in deep holes elsewhere in the Missouri River. Small sturgeons have been captured in off-channel backwaters. Adults are often found in deep, swift flowing water, especially during winter months while young and larval pallids are found in areas of lower velocities out of the thalweg.

Because so little is known about the pallid sturgeon, much of the previous information available about the reproduction or spawning activities of the pallid sturgeon was, extrapolated from what is known about shovelnose sturgeons. Shovelnose sturgeon spawn over substrates of rock, rubble, or gravel in the main channel of the Missouri/Mississippi Rivers and major tributaries, or on wing dams in the main stem of larger rivers. Spawning was suspected to occur in the relatively swift water in or near the main channel. Initiation of shovelnose sturgeon spawning migrations have been associated with increased flows in May and June and water temperatures from 61° to 70° F (USFWS 1993).

Destruction and alteration of habitats by human modification of the river system is believed to be the primary cause of declines of the pallid sturgeon. It is unlikely that successfully reproducing populations of pallid sturgeons can be recovered without restoring habitat elements of the Missouri and Mississippi Rivers necessary for the species continued survival. The construction of levees has contributed to the alteration of pallid sturgeon habitat by eliminating major natural floodways, which annually inundated and isolated many floodplain lakes, reduced the area of the floodplain, and changed erosion and accretion processes. In addition, bank stabilization, sediment trapping in reservoirs and channelization has led to bed degradation. The reduced amount of floodplain the river can access has diminished the availability of organic matter used by aquatic invertebrates which make up a large proportion of the of the pallid sturgeon's diet during early life stages. In addition, aquatic invertebrates are a primary food source for small fish which the pallid prefers as adults. Portions of the Missouri River 20 miles upstream and downstream of the mouths of the Kansas River and Platte Rivers are high priority reaches for recovery of the pallid sturgeon (USFWS 1993).

Kansas State Law (K.S.A. 32-504, 32-507: effective May 1, 1981) requires person undertaking or sponsoring publicly funded or State or Federally Assisted action which is likely to impact endangered or threatened wildlife habitats where they are likely to occur, to obtain a project action permit from the Secretary of the Kansas Department of Wildlife and Parks (KDWP) prior to initiation of such action. This list should be requested from the Environmental Services Section, Kansas Department of Wildlife and Parks, 512 SE 25th Ave., Pratt, KS 67124-8174.

KDWP maintains an internet site containing county lists and species information at http://www.kdwp.state.ks.us/news/other_services/threatened_and_endangered_species. State of Kansas listed threatened and endangered species for Doniphan County, Kansas listed on this site include sicklefin chub (*Macrhybopsis meeki*), flathead chub (*Platygobio gracilis*), western silvery minnow (*Hybognathus argyritis*), chestnut lamprey (*Ichthyomyzon castaneus*), eastern spotted skunk (*Spilogale putorius interrupta*), silverband shiner (*Notropis shumard*) peregrine falcon (*Falco peregrinus*), silver chub (*Machrhybopsis storeriana*), smooth earth snake (*Virginia valeriae*), and sturgeon chub (*Macrhybopsis gelida*). In addition, the following Federally listed threatened and endangered species are also listed by the State as occurring in Doniphan County, Kansas: American burying beetle (*Nicrophorus americanus*), Eskimo curlew (*Numenius borealis*), least tern (*Sterna antillarum*), and piping plover (*Charadrius melodus*).

The State of Kansas lists the following species as Species in Need of Conservation: black tern (*Chlidonias niger*), blue sucker (*Cycleptus elongates*), brassy minnow (*Hybognathus hankinsoni*), cerulean warbler (*Dendroica cerulea*), eastern hognose snake (*Heterodon platirhinos*), plains minnow (*Hybognathus placitus*), river shiner (*Notropis blennius*), short-eared owl (*Asio flammeus*), southern flying squirrel (*Glaucomys volans*), and timber rattlesnake (*Crotalus horridus*). As these lists are subject to change the Corps should contact the Kansas Department of Wildlife and Parks, Environmental Services directly.

According to the Missouri Department of Conservation's Natural History Data Base (1999) there are occurrences of state listed species or communities in the project area. Species and concerns should be requested from the Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102.

DESCRIPTION OF THE PROJECT ALTERNATIVES

Several structural modifications were considered to reduce the frequency of damaging overflows including channel modifications, upstream reservoirs and levee setbacks. These modifications were eliminated from further consideration either because the costs outweighed the benefits or the environmental impacts that would result from a particular alternative were far greater than the preferred alternative.

The three alternatives considered for this Coordination Act Report are: 1. Raise the Right Levee Section using earthen material to the one-hundred year level of flood protection with 90 percent reliability, and a corresponding raise to the Left Levee Section in specific areas to accept the slight rise in water surface elevations resulting from the initial raise. (PREFERRED); 2. Raise the Right Levee Section to an Increased Level of Protection (500-year event plus 1.5 feet of freeboard), with a corresponding raise to the Left levee unit; and 3. Raise the Right Levee Section to a Further Increased Level of Protection (500-year event plus 3.0 feet of freeboard), with a corresponding raise to the Left levee unit." The Corps of Engineers' Pre-Draft EIS identifies Alternative 1 as the Preferred Alternative.

Alternative 1. Modifying Existing Levees to Design Level to provide a higher level of flood protection than that which currently exists. This is the current preferred alternative. This modification is accomplished by raising the existing levee using earth fill. A significant portion of the levee unit R-471-460 would be raised to a level sufficient to pass the one percent (100-year) flood with a 90 percent level of reliability, allowing for re-certification of the levee by FEMA. The anticipated right bank raise varies along its length from zero to two feet. Increases in levee height would result in corresponding increases in levee toe width (approximately 6-feet on each side for a 2-foot increase in levee height). Additionally, a raise to the right bank levee would require minor raises (approximately 6-inches) at specific locations along the left bank levee to accept the increased rise in water surface elevation resulting from the initial work.

Proposed borrow areas include riverward areas in both Kansas and Missouri. In Kansas, the borrow area consist of approximately 1,304 acres of land located from River Miles 454.9 to 451.9 and from River Miles 446.7 to 443.4. For Missouri, the borrow area consists of approximately 30.4 acres of land along River Miles 442.6 to 442.9.

Alternative 2. Modifying Existing Levees to an increased level (500-year event plus 1.5 feet of freeboard) of protection.. The Pre-Draft EIS did not identify any additional borrow areas for this alternative.

Alternative 3. Modifying Existing Levees to a further increased level (500-year event plus 3.0 feet of freeboard) of protection. The Pre-Draft EIS did not identify any additional borrow areas for this alternative.

OTHER PROJECT ALTERNATIVES

Several additional alternatives were considered during the scoping process but were not advanced for further study due to the economic infeasibility or ineffectiveness in providing an adequate level of protection for the study area. One alternative that was removed from further study was Levee Setbacks. This alternative would have removed a section of levee unit R471-460 from river mile 449 downstream to river mile 447.5 and reconstructed it landward. The objective of this alternative was to achieve a uniform 3,000 foot floodway within the study area consistent with the original Pick-Sloan Plan for flooding width above Kansas City, Missouri. This alternative was removed from further consideration because total benefits were less than the cost of construction. However, the cooperating agencies of the Missouri River Fish and Wildlife Mitigation Project (MRFWMP), which includes the Corps, are looking at levee setback as one component of the project. Working in cooperation with the MRFWMP may make this a more viable option for some sections of the levees and help to fulfill the objectives of both proposals.

The Corps has also considered dredging the river for levee fill. This could have negative implications for the pallid sturgeon and other fish.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

The Missouri side of the project area is primarily urban consisting of industrial, commercial development with major roads and bridges, secondary roads, and housing developments on and above the floodplain. The Kansas side of the levee project contains similar development. Existing wildlife habitat is scarce, and of generally low quality due to habitat fragmentation and loss of habitat from the development that has been ongoing for more than a hundred and fifty years. Without the flood damage reduction project FEMA may de-certify the levee leaving the local communities to bear the economic impact of further flood events. This may result in the decrease of future development in the floodplain and flood prone areas of the Missouri River behind the levees and may even cause the abandonment of existing development. Cropland may also be abandoned, converted to other open space uses or enrolled in CRP or WRP. All of these actions could actually increase the quantity and quality of wildlife habitat available in the area.

FISH AND WILDLIFE WITH THE PROJECT

The project would presumably keep the levees in compliance with FEMA and under their certification. With payments for flood damages more secure and many people believing that the likelihood of flooding is diminished, more floodplain and floodprone land landward of the levees would likely be developed. ~~This would result in more wildlife habitat being converted and more habitat fragmentation.~~

The proposed borrow area known as Elwood Bend contains the some of the highest quality wildlife habitat in the project area in a large unfragmented tract (Figure 2). Work in this area will displace wildlife that currently use the area due to disturbances from noise, dust, human activity, machinery and destruction of habitat. Depending on construction timing, this displacement could result in serious consequences to wildlife such as loss of reproduction and possible death of individual animals from accidents (crossing roads and unknown hazards in new areas), starvation, competition for other areas, etc. There is little refuge habitat in close proximity to the project area and is presumably at carrying capacity which further reduces the likelihood of wildlife surviving the displacement and intensifies the competition for the limited habitat available. Although the temporal displacement may be relatively short, the repercussions could be long-term. Impacts to migrating songbirds are of particular concern. Existing wildlife travel corridors linking the borrow areas and other areas of suitable floodplain upstream and downstream of the borrow area should be maintained during project construction. If the Elwood Bend area is used as a borrow site, it would also be beneficial to allow early successional stages of woody and annual vegetation to grow landward of the levee to facilitate movement through the cropland outside of the growing season.

Large trees suitable for bald eagle habitat are present in the Elwood Bend borrow site and in other areas riverward of the levee. Trees greater than 12 inches diameter at breast height (dbh) should be avoided. Many smaller trees are also present in the site. While these trees are young now, they are closer to a mature and more valuable stage than newly established trees and should be avoided if at all possible.

Habitat gains in quality could be realized if the Corps works closely with the MRFWMP team and constructively takes borrow to enhance habitat to meet the objectives of that program. However, there is an abundance of cropland and bare ground inside and outside the levee that could be used for borrow areas instead of the Elwood Bend area. Soils taken from these areas would be relatively free of the trash and debris (tree roots, vegetation, etc.) common to borrow taken from vegetation riparian areas. Borrow locations should be located in cropland or other bare ground as much as possible. Another option is to take borrow from areas infested with reed canary grass, an invasive species, and replace with permanent water or seasonal inundation such as chutes, deeper water wetlands, backwaters, floodplain ponds that would eliminate this species.

The loss of levee brome grasses during heightening of the existing levee system will be a short-term loss. Re-seeding the levee to warm season grasses such as switch grass would reduce erosion, better insure the integrity of the levee system during floods and provide higher wildlife habitat than brome.

Figure 2

Previous modifications within the Missouri River channel and floodplain has had an adverse effect on fish and wildlife habitat. The Missouri River surface area has declined more than 50 percent. The river channel is now deep, has swift currents, and decreased habitat diversity. River backwaters, chutes, sandbars, and oxbow lakes have been lost to floodplain development. Both proposed borrow areas are riverward of the levee. One is primarily cropland and should not cause significant impacts to wildlife. The other is the Elwood Bend area as previously discussed. Work in this area could cause significant short and long-term impacts to wildlife.

Construction activities would cause temporary, short-term impacts to fish and wildlife from noise, dust, and the presence of workers and machinery. Runoff from construction areas, access roads, staging areas and unprotected fills could degrade water quality inside the levee system. Accidental spills of fuels, lubricants, hydraulic fluids, and other petrochemicals would be harmful to aquatic life.

Removal of fill from the cropland area has the potential to cause the loss of farmed wetland. Farmed wetland should be delineated within the borrow site and should be avoided if possible. If an unavoidable loss is incurred, the quantity and quality of the farmed wetland will determine the amount of compensation necessary to offset project losses. The wetland mitigation plan would be developed in coordination with the Corps, EPA, KDWP and MDC. This plan should include site locations, time frames, construction plans, a monitoring plan, progress reports, and standards of success. This plan should be a condition of any permit issued for the project. The proposed Mitigation Plan is lacking many of these components. The completed plan should be implemented regardless of whether impacted wetlands are classified as jurisdictional for purposes of the Clean Water Act.

Although the floodway cross section will remain essentially unchanged, the heightened levees will increase flood stages downstream and upstream at very high flood stages. Flood crests may increase in height (the water has no place to go but up) and floodwaters will be impounded upstream. In 1993, the constricted Missouri River floodplain prevented the Kansas River from draining. This caused water to back up in the Kansas River, flooding far into the state of Kansas (White House Interagency Flood Plain Management Review Committee, 1994). The Corps is planning to increase the height of levees in the Kansas City area. With increased levee heights in the St. Joseph, Missouri and Kansas City, Kansas and Kansas City, Missouri areas other levee districts upstream and downstream may face the need to build their own levees even higher to avoid increased flood damages. Such cumulative effects should be addressed during the feasibility phase and NEPA documents.

Mitigation Discussion

The Service has established a mitigation policy used as guidance in determining resource categories and recommending mitigation (46 FR: 7644-7663).

We have determined that most of the wildlife habitat that would be affected by the raising of existing levees (levee footprints and easements) is in Resource Category No. 4 (habitats of medium to low value). For this category, loss of habitat value should be minimized.

Forested wetland and riparian woodland are consistent with Resource category No. 2 that is, habitats are of high value that are relatively scarce or becoming scarce on a national or regional basis. Losses attributed to the project would require in-kind mitigation (replacement of habitat value lost with equal habitat values of the same kind of habitat as those eliminated). The cost of mitigating habitat losses should be included as a project cost.

Whenever possible, we recommend upland trees within the construction right-of-way remain undisturbed. While the trees may be young now, they are closer to a mature and more valuable stage than newly established tress.

Trees at least 50 feet tall and /or 24-inches dbh within 100 feet of the water's edge should be avoided. Removal of these trees may adversely affect the habitat of the bald eagle.

Under the Migratory Bird Treaty Act (MBTA), construction activities in prairies, wetlands, stream and woodland habitats, including the removal of upland borrow, and those that occur on bridges (e.g., which may affect swallow nests on bridge girders) that would otherwise result in the taking of migratory birds, eggs, young, and/or active nests should be avoided. To minimize impacts to birds protected under the MBTA, construction areas should be surveyed for the presence of nesting birds during the general migratory bird nesting season of March through August. Disturbance of nesting areas should be avoided until nesting is completed.

Vegetation clearing and construction related soil disturbances can cause sediment-laden runoff to enter waterways. To minimize impacts associated with erosion, contractors should employ silt curtains, coffer dams, dikes, straw bales or other suitable erosion control measures adjacent to floodplain water bodies or tributaries affected by the project. Sediment control measures are not necessary adjacent to the Missouri River because it is sediment starved, although downstream water supply intakes are a concern. Construction related petrochemical spills can also negatively impact fish and wildlife resources. Therefore, measures should be implemented prior to construction to minimize the likelihood of petrochemical spills.

Invasive species have been identified as a major factor in the decline of native flora and fauna and their ecosystems and impact aquatic resources. Invasive species of particular concern in Kansas are the zebra mussel (*Dreissena polymorpha*), purple loosestrife (*Lythrum salicaria*), Johnson grass (*Sorghum halepense*), sericea lespedeza (*Lespedeza cuneata*), and reed canary grass (*Phalaris arundinacea*). Executive order 13112 Section 2 (3) directs Federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere and to ensure that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions. Proactive measures to prevent the inadvertent spread of exotic and invasive species would appear to satisfy this directive. Therefore we recommend the implementation of the following BMP.

> All equipment brought on site will be thoroughly washed to remove dirt, seeds, and plant parts. Any equipment that has been in any body of water within the past 30 days will be thoroughly cleaned with hot water (hotter than 40°C or 104°F) and dried for a *minimum* of five days before being used at this project site. In addition, before transporting equipment from the project site all visible mud, plants, and fish/animals will be removed, all water will be eliminated, and the equipment will be thoroughly cleaned. Anything that came in contact with the water will be cleaned and dried following the above procedure.

Section 2 of the Fish and Wildlife Coordination Act requires the Service to identify project related opportunities to enhance fish and wildlife. The enhancement recommendations discussed below refer to project related creation of wildlife habitat, over and above that required to mitigate losses attributable to project construction.

Native trees, grasses and forbs, noted for their high wildlife value, could be established along the landward and stream side base of the existing levee system. This might help offset future losses due to increased encroachment along the river once flood protection is increased once again. Switch grass often takes longer to become fully established; however when established, stands of native vegetation provide excellent soil binding characteristics, valuable wildlife habitat and require fewer maintenance costs. The Service, Missouri Department of Conservation, the Kansas Department of Wildlife and Parks, and the Natural Resource Conservation Service offer assistance programs and could work with the cities of St. Joseph, Elwood and Wathena and the project sponsors to develop vegetation management plans.

RECOMMENDATIONS

1. The take of borrow from areas riverward of the levees should be closely coordinated with the Missouri River Fish and Wildlife Mitigation Project (MRFWMP) to creatively construct areas that will conform to the objectives of the MRFWMP. This is particularly important in the proposed borrow area south of the City of Elwood, known as Elwood Bend, as it has been identified for inclusion in the MRFWMP. The MRFWMP team should be closely consulted about the take of borrow from the area, the construction plans for the final design of the borrow areas and given approval rights for the borrow design plans. If the Corps and the project sponsors are unable to work with the MRFWMP, the Elwood Bend area should be should be eliminated from the plan.

2. Riparian and wetland habitats should be avoided to the maximum extent practicable when selecting borrow sites for the proposed levee raises and compensatory mitigation should be undertaken for unavoidable impacts. Since channelization, levee construction and floodplain development have already resulted in dramatic loss of riparian and

wetland habitats in the Missouri River basin, the Corps should focus on bare or cropland areas for borrow.

3. Reconsideration of the Levee Setback alternative.. The Levee Setback alternative was eliminated from further consideration because total benefits from this alternative were far less than the cost of construction. However, the MRFWMP team is considering setting back levees to improve habitat. Coordination with the MRFWMP may make it feasible to set back some portions of levees as part of this project thereby reducing impacts from those portions of the levees that would still need to be raised.

4. Levees should be seeded with native warm season grasses such as switch grass.

5. Removal of mature cottonwoods, and other native vegetation should be avoided where possible, and if they are removed, replace woody vegetation by establishing 2 acres of native vegetation for every acre impacted.

6. The Corps should create wetland mitigation habitat to compensate for the loss of wetland acreage from construction of the projects. If farmed wetland is directly impacted by borrow activities it should be mitigated at a 1.0 to1.0 ratio.

The following recommendations describe opportunities to provide fish and wildlife enhancement through the project.

7. The Corps should coordinate with the MFWMP to enhance the diversity of aquatic and terrestrial wildlife habitat in the area. The MFWMP may provide the opportunity to set levees back, create shallow water, chutes, and backwater areas, and enhance and restore riparian areas.

8. Establish native vegetation riverward of levee segments where riparian woodlands are sparse or nonexistent or where invasive species, i.e. reed canary grass, has become established. If it is possible, borrow from reed canary grass areas and replace with permanent water or seasonal inundation such as chutes, deeper water wetlands, backwaters, floodplain ponds that would eliminate this species.

9. Encourage wetland development and hydrological reconnection to the river at existing borrow areas landward of the levee units.

10. Best Management Practices to prevent the transport of invasive species to or from the construction sites should be included as an integral component of the project.

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Corps of Engineers Response to Recommendations on the U.S. Fish and Wildlife Services' Draft Fish and Wildlife Coordination Act Report

Fish and Wildlife Service Recommendation Number 1. The take of borrow from areas riverward of the levees should be closely coordinated with the Missouri River Fish and Wildlife Mitigation Program (MRFWMP) to creatively construct areas that will conform to the objectives of the MRFWMP. This is particularly important in the proposed borrow area south of the City of Elwood, known as Elwood Bend, as it has been identified for inclusion in the MRFWMP. The MRFWMP team should be closely consulted about the take of borrow from the area, the construction plans for the final design of the borrow areas and given approval rights for the borrow design plans. If the Corps and the project sponsors are unable to work with the MRFWMP, the Elwood Bend area should be eliminated from the plan.

RESPONSE: Agree. The Corps has coordinated closely with Corps Mitigation Team Members to inform them of the work being proposed, particularly in the Elwood Bend area. Land in this area is of great interest to the Mitigation Team and Corps Mitigation Team Members ensured that they will coordinate with other agency members to obtain broad "buy-in" on project features. As the project moves closer to the construction phase, increased participation will likely ensue.

Fish and Wildlife Service Recommendation Number 2. Riparian and wetland habitats should be avoided to the maximum extent practicable when selecting borrow sites for the proposed levee raises and compensatory mitigation should be undertaken for unavoidable impacts. Since channelization, levee construction and floodplain development have already resulted in dramatic loss of riparian and wetland habitats in the Missouri River basin, the Corps should focus on bare or cropland areas for borrow.

RESPONSE: Agree. The Corps uses a step-down procedure to first avoid impacts to sensitive areas, then minimize impacts to the maximum extent, and finally mitigate for any unavoidable impacts. The Corps will use this step-down procedure while obtaining borrow for construction of the preferred alternative by first seeking use of bare ground and cropland. In cases where avoiding sensitive areas is not possible, the Corps will incorporate the minimization measures provided by the Natural Resource Conservation Service as outlined in Chapter 13 of the Wetland Restoration, Enhancement, or Creation Engineering Field Handbook as well as other minimization measures provided in the EA at Section 4.4.1 Vegetation. Unavoidable impacts to sensitive habitat areas will be mitigated as again outlined in Section 4.4.1 Vegetation.

Fish and Wildlife Service Recommendation Number 3. Reconsideration of the Levee Setback Alternative. The Levee Setback alternative was eliminated from further consideration because total benefits from this alternative were far less than the cost of construction. However, the MRFWMP team is considering setting back levees to improve habitat. Coordination with the MRFWMP may make it feasible to set back some portions of levees as part of this project thereby reducing impacts from those portions of the levees that would still need to be raised.

RESPONSE: The levee setback alternative was reconsidered following agency comments received from the US Fish and Wildlife Service, the Kansas Department of Wildlife and Parks, and the Missouri Department of Conservation and additional information was obtain. Based on this information, as provided below, the levee setback alternative was not carried forward for additional analysis.

Levee Setback/Realignment. Two options are available for possible realignment of Unit R471-460. At approximately river mile 448, the levee moves closer to the river, narrowing the floodway and creating a constriction, called by some a "pinch point", during high flow events. This constriction could be reduced by realignment of the levee in this location, or the unit could be realigned further upstream to provide a wider floodway upstream of the pinch point for increased floodplain storage during high flow events.

Levee Setback

The narrow point in the levee alignment at approximately river mile 448 coincides with the river bend immediately upstream of Unit L-455. Setting back Unit R471-460 at this location would provide for a wider floodway during high flow events. This location also coincides with the locations of an active Union Pacific railroad bridge and the double-span bridge carrying US Highway 36. There is significant business development, including a large construction company, located between the two bridges immediately inside the protected area. Both bridges would likely require extensive modification and the existing businesses would have to be relocated to achieve significant levee setback. The Corps estimates that a levee setback in this location could lower the general water surface profile in this vicinity up to half a foot; however, this is not enough to offset the overtopping concern for the remainder of the unit. Bridge modification, real estate acquisition, business demolition and relocation, and new levee construction would all contribute to a significantly higher cost for this alternative comparative to other proposed alternatives. Environmental benefits would be marginally enhanced by the creation of a short reach of new riverside floodplain habitat relative to the currently existing resources in the area. The economic benefits of the alternative would be negatively impacted by the loss of businesses in the area and the increased cost. It is clear from preliminary analysis that the marginal hydraulic and environmental benefits of a setback of the levee in the vicinity of river mile 448 would not offset the significant adverse economic, engineering, transportation, and social impacts that would be incurred to the project.

Levee Realignment in Upstream Portion of Unit R471-460

Upstream of the pinch point, consideration was given to methods to expand the floodway to provide storage during high flow events. In this area, the levee could be realigned toward the bluffs, and existing levee alignment removed, providing increased floodplain volume and connectivity to the river. Alternatively, the old levee alignment could remain, and could be allowed to overtop and fail during high flows, providing some increment of additional storage during large floods. In order to achieve certified protection for the communities and facilities in the study area, the new section of levee could be constructed north of Rosecrans Airport starting near river mile 452 to connect the existing levee with the bluff to the west. Requirements and anticipated impacts of this new levee are as follows:

- Formulating an alternative that allows for the overtopping and failure of an existing levee does not meet the stated Planning Objectives of this study.

- Nearly three miles of new levee would need to be constructed, requiring significant real estate acquisition, additional material borrow sites, new drainage structures, and possible a road closure structure at the tie-in to the bluff. This feature would involve a significant cost increase.

- There is no guarantee that real estate agreements would be easily reached with existing land owners and condemnation may be necessary. Such negotiations, and additional construction time, would likely cause a protracted time delay that would prolong the exposure of residents to impacts and risk from the currently decertified levee.

- Approximately six miles of the existing levee downstream of river mile 452 would still be subject to an overtopping concern that would need to be addressed to restore FEMA certification.

- The introduction of a new levee section into an existing levee system will increase the annual operation and maintenance costs.

- The new alignment would permanently remove some agricultural ground from production due to construction and would allow significant additional acreage of productive agricultural property to remain subject to impact from lesser floods. Some existing benefits of the existing project would be lost by removing this property from the certified protection area.

- The new alignment would cross the flight path in close proximity to the airport creating a right-of-way encroachment and safety issue that likely would not be acceptable to the Air Guard or the Federal Aviation Administration.

- The existing levee cannot be removed without specific authorization from Congress. Removal of the remaining existing levee section would likely be legally, politically, and socially unacceptable. The remaining existing levee section would likely still be maintained in operation by the local entities and if maintained in accordance with the program, would be eligible for flood disaster relief under the provision of Public Law 84-99. Future claims for Federal assistance for flood fighting and damage restoration would likely increase. With the existing levee section still in place, the incremental floodplain benefits associated with a realignment of the Federal project in the north would be marginal.

- No additional environmental benefits would be realized if the existing levee would stay in place and the existing agricultural land would remain in production. To realize any environmental benefits from realignment, the existing levee would have to be removed entirely and the land reverting to a natural riparian state, which may require the government to buy-out the existing agricultural property at considerable additional expense to the project.

- Significant political and public protest likely would be encountered by any proposal to remove property from the protected area or physically remove any existing section of levee.

It should be noted that in consultation with District counsel, it was determined that these actions may not be within the authority of the Modifications to Completed Works to remove a significant portion of the levee system, or construct a major new levee realignment.

A point-by-point consideration of the cost impacts to construct a new levee section, including all aspects discussed herein, indicated that realignment options would likely be greater than the cost of other alternatives proposed in the same area. Due to anticipated higher costs, a potential decrease in existing project benefits, and serious concerns over the social impacts of the proposal to the area communities, the levee realignment alternative was not carried forward for additional analysis.

<u>Fish and Wildlife Service Recommendation Number 4</u>. Levees should be seeded with native warm season grasses such as switchgrass.

RESPONSE: Agree. Only native plant species will be used during re-seeding operations. The following species are generally used for levee reseeding: Switchgrass (Panicum Virgatum), Sand Lovegrass (Eragrostis Trichodes), Yellow Sweet Clover (Melilotus Officinalis), Creeping Foxtail (Alopecuus Arundinaceus), Tall Wheatgrass (Agropyron Elongatum), and Yellow sweet Clover (Melilotus Officinalis).

<u>Fish and Wildlife Service Recommendation Number 5</u>. Removal of mature cottonwoods, and other native vegetation should be avoided where possible, and if they are removed, replace woody vegetation by establishing 2 acres of native vegetation for every acre impacted.

RESPONSE: The Corps will avoid mature trees with a DBH of 12 inches or greater to the extent possible. Should impacts occur that are unavoidable, the Corps will off-set these impacts at a 1:1 ratio based on US Army Corps of Engineer mitigation procedures.

Fish and Wildlife Service Recommendation Number 6. The Corps should create wetland mitigation habitat to compensate for the loss of wetland acreage from construction of the projects. If farmed wetland is directly impacted by borrow activities it should be mitigated at a 1:0 to 1:0 ratio.

RESPONSE: The Corps policy on wetlands is one of "no net loss". As such, the Corps will be off-setting all unavoidable impact to wetlands resulting from the proposed project. However, the U.S. Army Corps of Engineers and the Environmental Protection Agency Mitigation Memorandum of Agreement states that, "because the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, restoration should be the first option considered" (Fed. Regist. 60(Nov.28):58605). With this in mind, the Corps has selected "off-set" sites where wetlands still exist and has chosen restoration over creation realizing that these selected sites likely will contain the proper substrate, seed sources, and appropriate hydrological condition for wetland success.

Fish and Wildlife Service Recommendation Number 7. The Corps should coordinate with the MFWMP to enhance the diversity of aquatic and terrestrial wildlife habitat in the area. The MFWMP may provide the opportunity to set levees back, create shallow water, chutes, and backwater areas, and enhance and restore riparian areas.

RESPONSE: Agree. The Corps has already coordinated with MFWMP members to ensure that the maximum environmental opportunities can be gained from the proposed project.. Additional coordination will be taking place as the project moves closer to the construction phase to mesh needs of the preferred alternative with those of the Mitigation Project.

Fish and Wildlife Service Recommendation Number 8. Establish native vegetation riverward of levee segments where riparian woodlands are sparse on nonexistent or where invasive species, i.e. reed canary grass, has become established. If it is possible, borrow from reed canary grass areas and replace with permanent water or seasonal inundation such as chutes, deeper water wetlands, backwaters, floodplain ponds that would eliminate this species.

RESPONSE: Agree. Every opportunity will be made to first obtain borrow material from areas of lowest habitat quality, including areas of invasive species. Coordination meetings with MRFWMP team members have already begun to determine the best possible borrow material techniques to maximize benefits between the two projects.

Fish and Wildlife Service Recommendation Number 9. Encourage wetland development and hydrological reconnection to the river at existing borrow areas landward of the levee.

RESPONSE: Only riverside areas have been identified for obtaining borrow material. Landside wetlands that are impacted as a result of levee widening, will be off-set by using the minimization and mitigation measures identified in Section 4.4.1 Vegetation.

Fish and Wildlife Service Recommendation Number 10. Best Management Practices to prevent the transport of invasive species to or from the construction sites should be included as an integral component of the project.

RESPONSE: Agree. This is an excellent comment as the unintentional transport of invasive species often results in catastrophic reproductive events that in turn diminish the diversity of natural environments by producing areas of monotypic vegetation or introducing predatory species that forage unfettered. As such, this recommendation has been incorporated throughout the project where construction equipment will be used.

KANSAS

DEPARTMENT OF WILDLIFE AND PARKS KATHLEEN SEBELIUS, GOVERNOR

4/25/2006

Track: 20060121
DP
Ref: D1.1101

Mr. Eric Lynn
St. Joseph Levees Project Manager
Kansas City District, Corps of Engineers
Room 700, 601 E. 12th Street
Kansas City, MO 64106-2896

Dear Mr. Lynn:

We have reviewed the *Draft EIS* for the Flood Damage Reduction Study on the Missouri River Levee System Units L-455 and R-471-460 received by our office on March 6, 2006 via email from Mr. Matthew Vandenberg. The project was reviewed for potential impacts on crucial wildlife habitats, current state-listed threatened and endangered wildlife species, and public recreation areas for which this agency has some administrative authority.

The study was performed to determine what alternatives would be suitable for the levee system to meet the 1% flood protection with 90% reliability in order to accommodate FEMA requirements. The abstract identifies four alternatives analyzed for the study:

1. Raise levee to accommodate the 1% flood with 90% reliability (3' freeboard)
2. Raise levee to accommodate the 0.2% flood with 1.5' freeboard
3. Raise levee to accommodate 0.2% flood with 3' freeboard
4. Do nothing

The preferred alternative was #1, to raise the levee to meet compliance with FEMA. Information indicates that approximately 1300 acres of land in Kansas will be affected, either as borrow areas or by expansion of the footprint of the levee. The report indicated only 7.6 acres of secondary growth deciduous timber and 2.25 acres of wetlands would be impacted (4.4.1). It was concluded that no significant impacts to either state or federally listed threatened or endangered species would occur.

In reviewing the document, we did not come across any information as to why the levee is out of compliance (change in FEMA regs., breech of 1993, settling, inaccurate construction?).

Levee setbacks were not analyzed in the upstream portions of the levee system, only in the pinch area between Elwood, KS and St. Joseph, MO and no economic data was provided as to what made setbacks less feasible than levee raises. What factors limited moving the levee landward in these areas to allow for the River to access its floodplain? By raising the levee you are creating a situation that could lead to even more serious flooding in the event of a breech, such that occurred in 1993 in this R471-460.

Has the Corps considered any potential impacts on the proposed Missouri River Fish and Wildlife Mitigation Project, specifically in reference to the Shallow Water Habitats restoration at various public land sites in this reach of the River? Our office reviewed Public Notice 2004008885 issued by the

Kansas City District Corps office on March 10, 2004 for a project to restore shallow water habitat in the area (Lisa Peterson contact).
Would the levee raise prevent the overtopping and breeching of the levee like what occurred in 1993? It is our understanding that the flooding that occurred that year is the precursor for the study.

We recommend mitigation of any wetlands permanently filled by the expansion of levee footprints at a ratio of 3:1.

Any dredging activity is strongly discouraged with the project. In addition, this type of action would require a permit issued by the KDWP to the project sponsor and may include survey requirements of fish communities and mitigation.

Not all state-listed species were addressed in the no-significant impact determination (ie. Western Earth Snake)

In addition to the information in the Draft EIS, other information should include:

1. A map of the delineated land uses; along with borrow areas and the expanded footprint overlaid.
2. A map of the delineated wetlands according to wetland type
3. Proposed mitigation areas.

Thank you for the opportunity to provide these comments and recommendations.

Sincerely,

Nate Davis, Aquatic Ecologist
Environmental Services Section

xc: KDWP Reg FW Sup, Wolfe
KDWP Dist Bio, Whiteaker
KBS, Liechti
KDHE, Mueldener
USFWS, LeValley
USEPA, Mulder

KANSAS

DEPARTMENT OF WILDLIFE AND PARKS KATHLEEN SEBELIUS, GOVERNOR

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The preferred alternative was #1, to raise the levee to meet compliance with FEMA. Information indicates that approximately 1300 acres of land in Kansas will be affected, either as borrow areas or by expansion of the footprint of the levee. The report indicated only 7.6 acres of secondary growth deciduous timber and 2.25 acres of wetlands would be impacted (4.4.1). It was concluded that no significant impacts to either state or federally listed threatened or endangered species would occur.

Comment:
In reviewing the document we did not come across any information as to why the levee is out of compliance (change in FEMA regulations, breech of 1993, settling, inaccurate construction?).

Response:
This levee was constructed approximately 50 years ago after the 1952 flood. These were 100 year levees and were designed to contain a discharge of 324,000 cfs. The 1993 flood was a 500 year event and overtopped the levees. There were some small changes that occurred and the levees provided somewhat less than the 100 year flood protection it provided as constructed, and this is the reason for the levee reevaluation and reconstruction. The levee is still being reconstructed to provide 100 year protection as per the Sponsor and even when reconstructed would not contain another 500 year event. The levee would be construcated to meet FEMA certification for the 100 year or 1% event.

Comment:
Levee setbacks were not analyzed in the upstream portions of the levee system, only in the pinch area between Elwood, KS and St. Joseph, MO and no economic data was provided as to what made setbacks less feasible than levee raises. What factors limited moving the levee landward in these areas to allow for the River to access its floodplain? By raising the levee you are creating a situation hat could lead to even more serious flooding in the event of a breech, such that occurred in 1993 in this R471-460.

Response:
Levee Setback/Realignment. Two options are available for possible realignment of Unit R471-460. At approximately river mile 448, the levee moves closer to the river, narrowing the floodway and creating a constriction, called by some a "pinch point", during high flow events. This constriction could be reduced by realignment of the levee in this location, or the unit could be realigned further upstream to provide a wider floodway upstream of the pinch point for increased floodplain storage during high flow events.

Levee Setback

The narrow point in the levee alignment at approximately river mile 448 coincides with the river bend immediately upstream of Unit L-455. Setting back Unit R471-460 at this location would provide for a wider floodway during high flow events. This location also coincides with the locations of an active Union Pacific railroad bridge and the double-span bridge carrying US Highway 36. There is significant business development, including a large construction company, located between the two bridges immediately inside the protected area. Both bridges would likely require extensive modification and the existing businesses would have to be relocated to achieve significant levee setback. The Corps estimates that a levee setback in this location could lower the general water surface profile in this vicinity up to half a foot; however, this is not enough to offset the overtopping concern for the remainder of the unit. Bridge modification, real estate acquisition, business demolition and relocation, and new levee construction would all contribute to a significantly higher cost for this alternative comparative to other proposed alternatives. Environmental benefits would be marginally enhanced by the creation of a short reach of new riverside floodplain habitat relative to the currently existing resources in the area. The economic benefits of the alternative would be negatively impacted by the loss of businesses in the area and the increased cost. It is clear from preliminary analysis that the marginal hydraulic and environmental benefits of a setback of the levee in the vicinity of river mile 448 would not offset the significant adverse economic, engineering, transportation, and social impacts that would be incurred to the project.

Levee Realignment in Upstream Portion of Unit R471-460

Upstream of the pinch point, consideration was given to methods to expand the floodway to provide storage during high flow events. In this area, the levee could be realigned toward the bluffs, and existing levee alignment removed, providing increased floodplain volume and connectivity to the River. Alternatively, the old levee alignment could remain, and could be allowed to overtop and fail during high flows, providing some increment of additional storage during large floods. In order to achieve certified protection for the communities and facilities in the study area, the new section of levee could be constructed north of Rosecrans Airport starting near river mile 452 to connect the existing levee with the bluff to the west. Requirements and anticipated impacts of this new levee are as follows:

Formulating an alternative that allows for the overtopping and failure of an existing levee does not meet the stated Planning Objectives of this study.

Nearly three miles of new levee would need to be constructed, requiring significant real estate acquisition, additional material borrow sites, new drainage structures, and possible a road closure structure at the tie-in to the bluff. This feature would involve a significant cost increase.

There is no guarantee that real estate agreements would be easily reached with existing land owners and condemnation may be necessary. Such negotiations, and additional construction time, would likely cause a protracted time delay that would prolong the exposure of residents to impacts and risk from the currently decertified levee.

Approximately six miles of the existing levee downstream of river mile 452 would still be subject to an overtopping concern that would need to be addressed to restore FEMA certification.

The introduction of a new levee section into an existing levee system will increase the annual operation and maintenance costs.

The new alignment would permanently remove some agricultural ground from production due to construction and would allow significant additional acreage of productive agricultural property to remain subject to impact from lesser floods. Some existing benefits of the existing project would be lost by removing this property from the certified protection area.

The new alignment would cross the flight path in close proximity to the airport creating a right-of-way encroachment and safety issue that likely would not be acceptable to the Air Guard or the Federal Aviation Administration.

The existing levee cannot likely be removed without specific authorization from Congress. Removal of the remaining existing levee section would likely be legally, politically, and socially unacceptable. The remaining existing levee section would likely still be maintained in operation by the local entities and if maintained in accordance with the program, would be eligible for flood disaster relief under the provision of Public Law 84-99. Future claims for Federal assistance for flood fighting and damage restoration would likely increase. With the existing levee section still in place, the incremental floodplain benefits associated with a realignment of the Federal project in the north would be marginal.

No additional environmental benefits would be realized if the existing levee would stay in place and the existing agricultural land would remain in production. To realize any environmental benefits from realignment, the existing levee would have to be removed entirely and the land allowed to revert to a natural riparian state, which may require the government to buy-out the existing agricultural property at considerable additional expense to the project.

Significant political and public protest likely would be encountered by any proposal to remove property from the protected area or physically remove any existing section of levee.

It should be noted that in consultation with District counsel, it was determined that it may not be within the authority of the Modifications to Completed Works to remove a significant portion of the levee system, or construct a major new levee realignment.

A point-by-point consideration of the cost impacts to construct a new levee section, including all aspects discussed herein, indicated that realignment options would likely be greater than the cost of other alternatives proposed in the same area. Due to anticipated higher costs, a potential decrease in existing project benefits, and serious concerns over the social impacts of the proposal to the area communities, the levee realignment alternative was not carried forward for additional analysis.

Comment:
Has the Corps considered any potential impacts on the proposed Missouri River Fish and Wildlife Mitigation Project, specifically in reference to the Shallow Water Habitats restoration at various public land sites in this reach of the River? Our office reviewed Public Notice 2004008885 issued by the Kansas City District Corps office on March 10, 2004 for a project to restore shallow water habitat in the area (Lisa Peterson contact).

Response:
The Corps has considered potential impacts on the Missouri River Fish and Wildlife Mitigation project. As stated previously, the levee protection provided by the reconstructed levee will not change present Missouri River high water conditions. All borrow areas will however be constructed on the riverward side of the levee and would provide habitat. The Missouri river which once flowed around the Rosecrans Memorial Airport / Missouri National Guard flight facilities, was cut off by the flood of 1952, and now is surrounded on all sides by the old degraded cutoff oxbows of Browning Lake. These old Missouri River oxbow lakes are owned by KDWP and MDC and would provide good mitigation sites for certain types of habitat, if developed recognizing the needs of, and with the cooperation of the Rosecrans Memorial Airport to attract only wildlife that would be compatible with airport operations. Federal Aviation Agency regulations would determine the type of development of terrestrial, and aquatic mitigation within the flight zones to prevent flight accidents. The City of Elwood, the City of Wathena, highways, numerous roads, and all associated infrastructure would also inhibit much mitigation development. Even so, the Corps is looking at restoration opportunities along the entire Missouri River. The Corps is presently working to

acquire riparian floodplain lands along the R-471-460 levee Unit from willing sellers as part of the Missouri River Fish and Wildlife Mitigation Project. In this particular area, the Corps is specifically working on restoring approximately 1,000 acres of shallow water and terrestrial habitat on the Missouri River from the St. Joseph Bridge to Wathena and located on both sides of the R-471-460 levee. KDWP will manage this area through a cooperative agreement with the Corps. The Corps also is working on a Section 514 Missouri River Habitat Enhancement project at Contrary Lake on the Missouri side to restore aquatic wetland and terrestrial riparian habitat. Both the states of Kansas and Missouri are working with the Corps in the management of mitigation and restoration sites.

Comment:
Would the levee raise prevent the overtopping and breeching of the levee like what occurred in 1993? It is our understanding that the flooding that occurred that year is the precursor for the study.

Response: The information gathered from the 1993 flood did indeed cause impetus for a levee reevaluation. However, the flood of 1993 was a 500 year event. R-471-460 is a 100-year levee. The levee raise would insure the entire length provides the designed 100-year protection. If a 500-year flood should occur again, this levee would probably be overtopped.

Comment: We recommend mitigation of any wetlands permanently filled by the expansion of levee footprints at a ratio of 3:1.
Response: Corps of Engineers guidance has authorized the Kansas City District mitigate the wetland losses for the levee rehabilitation on a 1:1 basis. Mitigation of wetlands on a larger basis would require that the KDWP meet with the corps and discuss the specific needs that require additional mitigation measures should additional mitigation be necessary. Please recognize that the Corps is also embarking on purchasing, planning, and constructing a Missouri river Fish and Wildlife Mitigation site with forest, prairie, wetlands and shallow water habitat, to be restored on the Kansas side of the Missouri River. Contrary Lake, located on the east side of the Missouri River, would also be restored under the Section 514 Missouri River Enhancement program.

Comment:
Any dredging activity is strongly discouraged with the project. In addition, this type of action would require a permit, issued by the KDWP to the project sponsor and may include survey requirements of fish communities and mitigation.

Response:
Dredging is one alternative that could be used for obtaining borrow material. Dredging for a levee could occur from either a borrow pit or from the Missouri River. The National Environmental Policy Act (NEPA) requires that all alternatives must be evaluated in an environmental assessment. However, Missouri River dredging is not a Corps preferred alternative for obtaining borrow and therefore the Corps did not select Missouri River dredging as a preferred borrow method.

Comment:
Not all state-listed species were addressed in the no-significant impact determination (ie. Western Earth Snake)

Response:
The Western Earth Snake has been addressed in the EA. The levee reconstruction would not cause impact to the Western Earth Snake or to its critical habitat because the levee reconstruction would occur within the floodplain adjacent to the Missouri river and not near the uplands where the habitat of the Western Earth Snake occurs.

Comment:
In addition to the information in the Draft EIS, other information should include:
1. A map of the delineated land uses; along with borrow areas and the expanded footprint overlaid.
2. A map of the delineated wetlands according to wetland type
3. Proposed mitigation areas.

Response:
All of these three areas of interest are discussed in the Draft Environmental Assessment or the Draft Feasibility Report.

Thank you for the opportunity to provide these comments and recommendations.

Sincerely,

Nate Davis, Aquatic Ecologist
Environmental Services Section

xc: KDWP Reg FW Sup,
Wolfe KDWP Dist Bio,
Whiteaker KBS, Liechti
KDHE, Mueldener
USFWS, LeValley
USEPA, Mulder

MISSOURI DEPARTMENT OF CONSERVATION

Headquarters
2901 West Truman Boulevard, P.O. Box 180, Jefferson City, Missouri 65102-0180
Telephone: 573/751-4115 ▲ Missouri Relay Center: 1-800-735-2966 (TDD)

JOHN D. HOSKINS, Director

May 12, 2006

Eric S. Lynn
St. Joseph Levee Project Manager
U.S. Army Corps of Engineers
Kansas City District
Room 700
601 E. 12th Street
Kansas City, MO 64106-2896

Subject: MDC Comments, Draft EIS, St. Joseph Levee Project

Dear Mr. Lynn,

Thank you for the opportunity to comment on the draft environmental impact statement for the St. Joseph Levee Project, Units L-455, R-471 and R-460. The Missouri Department of Conservation's (MDC) mission is to protect and manage the fish, forest and wildlife resources in Missouri; to serve the public and facilitate their participation in resource management activities; and to provide opportunity for all citizens to use, enjoy and learn about fish, forest and wildlife resources. MDC participates in project review when projects might affect those resources. Comments, questions, and recommendations are for your consideration and are offered to reduce negative impacts to natural resources in the project area.

The U.S. Army Corps of Engineers has referred to the Missouri River floodplain in the vicinity of St. Joseph and Elwood as a "pinch point," possessing a narrow floodway (<3,000 feet). While the proposed levee raise may reduce flooding impacts in one area, it may exacerbate flooding in another. How does the proposed project address the "pinch point" concern in the St. Joseph area? Given the large scope and expense of this public project, a levee set back alternative should be considered.

Once the final EIS is out for public comment, MDC will make additional comments.

Thank you for your consideration of this comment.

Sincerely,

JANE EPPERSON
POLICY SUPERVISOR

c: Harold Kerns, Mitch Miller, Stuart Miller

MISSOURI DEPARTMENT OF CONSERVATION

Headquarters

2901 West Truman Boulevard, PO. Box 180, Jefferson City, Missouri 65102-0180

Telephone: 573/751-4115 Missouri Relay Center: 1-800-735-2966 (TDD)

JOHN D. HOSKINS, Director

May 12, 2006

Eric S. Lynn
St. Joseph Levee Project
Manager U.S. Army Corps of
Engineers Kansas City District
Room 700
601 E. 12th Street
Kansas City, MO 64106-2896

Subject: MDC Comments, Draft EIS, St. Joseph Levee Project

Dear Mr. Lynn,

Thank you for the opportunity to comment on the draft environmental impact statement for the St. Joseph Levee Project, Units L-455, R-471 and R-460. The Missouri Department of Conservation's (MDC) mission is to protect and manage the fish, forest, and wildlife resources in Missouri; to serve the public and facilitate their participation in resource management activities: and to provide opportunity for all citizens to use, enjoy and learn about fish, forest and wildlife resources. MDC participates in project review when projects might affect those resources. Comments, questions, and recommendations are for your consideration and are offered to reduce negative impacts to natural resources in the project area.

Comment:
The U.S. Army Corps of Engineers has referred to the Missouri River floodplain in the vicinity of St. Joseph and Elwood as a "pinch point," possessing a narrow floodway (<3,000 feet). While the proposed levee raise may reduce flooding impacts in one area, it may exacerbate flooding in another. How does the proposed project address the "pinch point" concern in the St. Joseph area? Given the large scope and expense of this public project, a levee set back alternative should be considered.

Response:
Levee Setback/Realignment. Two options are available for possible realignment of Unit R471-460. At approximately river mile 448, the levee moves closer to the river, narrowing the floodway and creating a constriction, called by some a "pinch point", during high flow events. This constriction could be reduced by realignment of the levee in this location, or the unit could be realigned further upstream to provide a wider floodway upstream of the pinch point for increased floodplain storage during high flow events.

Levee Setback

The narrow point in the levee alignment at approximately river mile 448 coincides with the river bend immediately upstream of Unit L-455. Setting back Unit R471-460 at this location would provide for a wider floodway during high flow events. This location also coincides with the locations of an active Union Pacific railroad bridge and the double-span bridge carrying US Highway 36. There is significant business development, including a large construction company, located between the two bridges immediately inside the protected area.

Both bridges would likely require extensive modification and the existing businesses would have to be relocated to achieve significant levee setback. The Corps estimates that a levee setback in this location could lower the general water surface profile in this vicinity up to half a foot; however, this is not enough to offset the overtopping concern for the remainder of the unit. Bridge modification, real estate acquisition, business demolition and relocation, and new levee construction would all contribute to a significantly higher cost for this alternative comparative to other proposed alternatives. Environmental benefits would be marginally enhanced by the creation of a short reach of new riverside floodplain habitat relative to the currently existing resources in the area. The economic benefits of the alternative would be negatively impacted by the loss of businesses in the area and the increased cost. It is clear from preliminary analysis that the marginal hydraulic and environmental benefits of a setback of the levee in the vicinity of river mile 448 would not offset the significant adverse economic, engineering, transportation, and social impacts that would be incurred to the project.

Levee Realignment in Upstream Portion of Unit R471-460

Upstream of the pinch point, consideration was given to methods to expand the floodway to provide storage during high flow events. In this area, the levee could be realigned toward the bluffs, and existing levee alignment removed, providing increased floodplain volume and connectivity to the River. Alternatively, the old levee alignment could remain, and could be allowed to overtop and fail during high flows, providing some increment of additional storage during large floods. In order to achieve certified protection for the communities and facilities in the study area, the new section of levee could be constructed north of Rosecrans Airport starting near river mile 452 to connect the existing levee with the bluff to the west. Requirements and anticipated impacts of this new levee are as follows:

Formulating an alternative that allows for the overtopping and failure of an existing levee does not meet the stated Planning Objectives of this study.

Nearly three miles of new levee would need to be constructed, requiring significant real estate acquisition, additional material borrow sites, new drainage structures, and possible a road closure structure at the tie-in to the bluff. This feature would involve a significant cost increase.

There is no guarantee that real estate agreements would be easily reached with existing land owners and condemnation may be necessary. Such negotiations, and additional construction time, would likely cause a protracted time delay that would prolong the exposure of residents to impacts and risk from the currently decertified levee.

Approximately six miles of the existing levee downstream of river mile 452 would still be subject to an overtopping concern that would need to be addressed to restore FEMA certification.

The introduction of a new levee section into an existing levee system will increase the annual operation and maintenance costs.

The new alignment would permanently remove some agricultural ground from production due to construction and would allow significant additional acreage of productive agricultural property to remain subject to impact from lesser floods. Some existing benefits of the existing project would be lost by removing this property from the certified protection area.

The new alignment would cross the flight path in close proximity to the airport creating a right-of-way encroachment and safety issue that likely would not be acceptable to the Air Guard or the Federal Aviation Administration.

The existing levee cannot likely be removed without specific authorization from Congress. Removal of the remaining existing levee section would likely be legally, politically, and socially unacceptable. The remaining existing levee section would likely still be maintained in operation by the local entities and if maintained in accordance with the program, would be eligible for flood disaster relief under the provision of Public Law 84-99. Future claims for Federal assistance for flood fighting and damage restoration would likely increase. With the existing levee section still in place, the incremental floodplain benefits associated with a realignment of the

Federal project in the north would be marginal.

No additional environmental benefits would be realized if the existing levee would stay in place and the existing agricultural land would remain in production. To realize any environmental benefits from realignment, the existing levee would have to be removed entirely and the land allowed to revert to a natural riparian state, which may require the government to buy-out the existing agricultural property at considerable additional expense to the project.

Significant political and public protest likely would be encountered by any proposal to remove property from the protected area or physically remove any existing section of levee.

It should be noted that in consultation with District counsel, it was determined that it may not be within the authority of the Modifications to Completed Works to remove a significant portion of the levee system, or construct a major new levee realignment.

A point-by-point consideration of the cost impacts to construct a new levee section, including all aspects discussed herein, indicated that realignment options would likely be greater than the cost of other alternatives proposed in the same area. Due to anticipated higher costs, a potential decrease in existing project benefits, and serious concerns over the social impacts of the proposal to the area communities, the levee realignment alternative was not carried forward for additional analysis.

Once the final EIS is out for public comment, MDC will make additional comments.

Thank you for your consideration of this comment.

Sincerely,

JANE EPPERSON
POLICY SUPERVISOR

c: Harold Kerns, Mitch Miller, Stuart Miller

6.13.06

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896

REPLY TO
ATTENTION OF:

Larry Sabata,
Resource Soil Scientist
USDA/NRCS
3231 SW VanBuren Street
Topeka, Kansas 66611

Subject: Farmland Conversion Impact Rating

Dear Mr. Sabata:

The purpose of this letter is to transmit 3 copies, with maps, of the Farmland Conversion Impact Rating form in order to comply with the Farmland Protection Policy Act (7 U.S.C. 4201, et. Seq).

The proposed project under consideration is the Missouri River Levee System Units L-455 and R-471-460 Flood Damage Reduction Study Doniphan County Kansas and Buchanan County Missouri. This preferred alternative for this project is to raise the above identified levee units thereby encroaching on agricultural land in the area. A total of approximately 37.5 acres will be permanently impacted along the entire project area in order to construct the levee raise and accompanying seepage berms (see enclosed maps).

Please review the enclosed forms to determine if the site of the proposed project contains prime, unique, statewide or local important farmland. If you have any questions or concerns regarding the enclosed forms, please do not hesitate to contact me at the letterhead address, by phone [redacted]ax [redacted] or by email at [redacted]hank you in advance for your cooperation.

Sincerely,

Matthew D. Vandenberg
Environmental Resource Specialist

Encls.

United States Department of Agriculture

USDA

NRCS Natural Resources Conservation Service

3915 Oakland Avenue, Suite 103, St. Joseph, MO. 64506

Kacerik

June 26, 2006

Mr. Matthew D. Vandenberg
Department of the Army
Kansas City District, Corps of Engineers
700 Federal Building
Kansas city, Missouri 64106

Dear Mr. Vandenberg,

Enclosed is the Farmland Conversion Rating (form AD-1006) for the Missouri River Levee Expansion project in Buchanan County Missouri. Sites A and B contain Prime Farmland. After you, or the funding agency, have completed parts VI and VII, please return one copy to my office.

If you have any questions, please call me at 816-232-6555 ext. 138.

Sincerely,

David K. Kacirek

David K. Kacirek
Area Resource Soil Scientist

enclosure:

cc: Rodney C. Saunders, District Conservationist, NRCS, St. Joseph, MO

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 6/13/06
Name Of Project Missouri River Flood Damage Reduction Project	Federal Agency Involved US Army Corps of Engineers
Proposed Land Use Levee Expansion	County And State Buchanan County, Missouri
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 6-16-06

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes [X] No [ ]	Acres Irrigated	Average Farm Size 234
Major Crop(s) Corn, Soybeans	Farmable Land In Govt. Jurisdiction Acres: 213230 % 80.4		Amount Of Farmland As Defined in FPPA Acres: 213230 % 80.4
Name Of Land Evaluation System Used LESA	Name Of Local Site Assessment System		Date Land Evaluation Returned By NRCS 6-26-06

PART III *(To be completed by Federal Agency)*	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	19.8	6.1		
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	19.8	6.1	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	19.8	6.1		
B. Total Acres Statewide And Local Important Farmland	—			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	.001	.001		
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	19%	9.4		
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	0 86	0 100	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	15			
2. Perimeter In Nonurban Use	10	10			
3. Percent Of Site Being Farmed	10	10			
4. Protection Provided By State And Local Government	0	0			
5. Distance From Urban Builtup Area	5	5			
6. Distance To Urban Support Services	10	10			
7. Size Of Present Farm Unit Compared To Average	0	0			
8. Creation Of Nonfarmable Farmland	0	0			
9. Availability Of Farm Support Services	0	0			
10. On-Farm Investments	1	1			
11. Effects Of Conversion On Farm Support Services	0	0			
12. Compatibility With Existing Agricultural Use	0	0			
TOTAL SITE ASSESSMENT POINTS	51 ~~160~~	~~0~~ 51	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	86 ~~100~~	~~0~~ 100	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	51 ~~160~~	~~0~~ 51	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	137 ~~260~~	0 151	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes [ ] No [X]

Reason For Selection:

(See Instructions on reverse side) Form AD-1006 (10-83)

This form was electronically produced by National Production Services Staff

United States Department of Agriculture

USDA

NRCS Natural Resources Conservation Service

3915 Oakland Avenue, Suite 103, St. Joseph, MO. 64506

May 8, 2006

Mr. Matthew D. Vandenberg
Dept. of the Army
Kansas City District, Corps of Engineers
700 Federal Building
Kansas City, MO 64106

Dear Mr. Vandenberg

I am responding to the Farmland Conversion Impact Rating (Form AD-1006) that you addressed to Patricia Hufford, of the Natural Resources Conservation Service, in St. Joseph, Missouri.

- The AD-1006 can not be completed; as you have combined acres from Kansas and Missouri. I do not have authority to complete this form for any acres in Kansas.

I suggest you pursue the following course of action:

- Resubmit the for AD-1006 to me, for **only the acres to be converted in Missouri**. send to:
- David Kacirek, Resource Soil Scientist, USDA/NRCS, 3915 Oakland Avenue,

  Suite 103, St. Joseph, MO 64506
- Attach a map that **clearly delineates the acres to be converted.** (topography map or aerial photo)
- For the **Kansas portion** of this project, send your Farmland Conversion Impact Rating request to: Larry Sabata, Resource Soil Scientist, USDA/NRCS, 3231 SW VanBuren St., Topeka, KS 66611.

Please call if you have any questions.
Sincerely,

David K. Kacirek

David K. Kacirek
Resource Soil Scientist, NRCS
816-232-6555 x138

NRCS
United States Department of Agriculture
Natural Resources Conservation Service
760 South Broadway
Salina, Kansas 67401-4604

"A Partner in Conservation Since 1935"

Phone: 785-823-4500
FAX: 785-823-4540
www.ks.nrcs.usda.gov

April 28, 2006

Mr. Eric S. Lynn
St. Joseph Levees Project Manager
U.S. Army Corps of Engineers
601 E. 12th Street, Room 700
Kansas City, Missouri 64106-2896

Dear Mr. Lynn:

The following comments are related to the St. Joseph Flood Damage Reduction Project. We realize the extensive work on this document by the U. S. Army Corps of Engineers and we appreciate the coordination with the Natural Resources Conservation Service (NRCS) and the opportunity to comment.

NRCS supports the proposal related to the issue of impacts associated with the excavation of borrow material for levee construction. The NRCS has provided technical coordination and it appears the plan includes increasing wetland acres with the project. Specifically, Chapter 4.4.1, Vegetation, Preferred Alternative, describes this process. The increase in wetlands will minimize the temporary effects of sedimentation caused by construction and this process will meet federal goals to increase wetland acres.

Sincerely,

HAROLD L. KLAEGE
State Conservationist

cc:
James J. Krueger, State Resource Conservationist, NRCS, Salina, Kansas
Kenneth A. Kuiper, State Biologist, NRCS, Salina, Kansas

NRCS

United States Department of Agriculture
Natural Resources Conservation Service
1125 Westport Drive
Manhattan, Kansas 66502-2860

"A Partner in Conservation Since 1935"

Phone: 785-776-5182
FAX: 785-539-7983
www.ks.nrcs.usda.gov

June 22, 2006

Matthew D. Vandenburg
Department of the Army
Kansas City District, Corps of Engineers
700 Federal Building
Kansas City, Missouri 64106-2896

Re: Missouri River Levee System Units L-455, R-471-460.

Dear Mr. Vandenburg:

Thank you for the opportunity to review the proposed Missouri River Levee System improvements in Doniphan County, Kansas.

Attached to this letter is the Farmland Conversion Impact Rating form (AD-1006) that you have requested to be filled out regarding the prime farmland and soils of state-wide importance that will be converted as part of the project. As for other negative environmental concerns regarding the project, I see none at this time.

I would also like to take this opportunity to inform you of a change in contact person in the event you should have future requests of this nature. Please send all environmental review requests to:

Harold L. Klaege
State Conservationist
Natural Resources Conservation Service
760 S. Broadway
Salina, Kansas 67401

Your cooperation in this matter would be deeply appreciated. Thank you.

If I can be of further assistance, please let me know.

Sincerely,

Alan R. Boerger
Resource Conservationist

Cc: Lynn Thurlow, Soil Conservationist, NRCS, Salina, Kansas.
Mechelle Foos, District Conservationist, NRCS, Troy, Kansas.
Ken Hoffman, ASTC(FO), NRCS, Manhattan, Kansas.

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 6/13/06
Name Of Project Missouri River Flood Damage Reduction Project	Federal Agency Involved US Army Corps of Engineers
Proposed Land Use Levee Expansion	County And State Doniphan County, Kansasi
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 6/21/06

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☑ No ☐	Acres Irrigated 1,500	Average Farm Size 396 ac.
Major Crop(s) Corn - Soybeans	Farmable Land In Govt. Jurisdiction Acres: 157,800 % 62		Amount Of Farmland As Defined in FPPA Acres: 39,800 % 16
Name Of Land Evaluation System Used	Name Of Local Site Assessment System		Date Land Evaluation Returned By NRCS 6/22/06

	Maximum Points	Site A	Site B	Site C	Site D
PART III *(To be completed by Federal Agency)*		Alternative Site Rating			
A. Total Acres To Be Converted Directly		37.5			
B. Total Acres To Be Converted Indirectly					
C. Total Acres In Site		37.5	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information					
A. Total Acres Prime And Unique Farmland		37.5			
B. Total Acres Statewide And Local Important Farmland		37.5			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted		<1			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value		98			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*		0 0	0	0	0
PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use					
2. Perimeter In Nonurban Use					
3. Percent Of Site Being Farmed					
4. Protection Provided By State And Local Government					
5. Distance From Urban Builtup Area					
6. Distance To Urban Support Services					
7. Size Of Present Farm Unit Compared To Average					
8. Creation Of Nonfarmable Farmland					
9. Availability Of Farm Support Services					
10. On-Farm Investments					
11. Effects Of Conversion On Farm Support Services					
12. Compatibility With Existing Agricultural Use					
TOTAL SITE ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	0	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	0	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	0	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

STATE OF KANSAS
DEPARTMENT OF WILDLIFE & PARKS
Operations Office
512 SE 25th Avenue
Pratt, KS 67124-8174
316/672-5911 FAX 316/672-6020

KANSAS WILDLIFE &PARKS

Ref: D1.0501
Doniphan
950580

LETTER OF TRANSMITTAL

This will transmit current localized list(s) of threatened and endangered species for your reference. The information provided is current as of the date shown on each list. As we gain additional natural history information about the listed species, county occurrences, and/or critical habitat, designations are subject to change.

The transmission of this information does not constitute in any way a formal review from our agency, nor does it grant clearance of any project.

To obtain a formal review, please send detailed project information including plans and information to fully describe the proposed action to the Environmental Services Section at the letterhead address. This information includes but is not limited to: engineering plans or sketch of proposed work, map showing how the action will alter the landscape, complete description and limits of any construction work to be accomplished including location and size of any excavation and fill areas, plus any other information pertinent to the proposed action. Also, attach an aerial photo/sketch map of areas to be affected by the proposed action showing existing land and vegetative cover characteristics. Details to be shown include woodland, rangeland, tame pasture, cropland, wetlands, stream, springs, water impoundments, plus any other appropriate landscape characteristics. Description of any stream within the affected area should include estimated width and depth.

Environmental Services Section

KANSAS WILDLIFE & PARKS

THREATENED AND ENDANGERED SPECIES KNOWN OR LIKELY TO OCCUR IN DONIPHAN COUNTY, KANSAS

American Burying Beetle (*Nicrophorus americanus*) - Endangered: Formerly occurred throughout temperate eastern North America including the eastern one-third of Kansas. Historic Kansas records exist for Doniphan county. Last recorded in Kansas in 1940. Endangered nationally.

Bald Eagle (*Haliaeetus leucocephalus*) - Endangered: Known to occur as a regular winter resident along the Missouri River. Prefers mature riparian woodland along the river. Critical habitat has been designated. Endangered nationally.

Chestnut Lamprey (*Ichthyomyzon castaneus*) - Threatened: Known to occur in the Missouri River main stem. Spawns over clean gravel in small tributary streams. Spawning has not been documented in Kansas. Critical habitat has been designated.

Eastern Spotted Skunk (*Spilogale putorius interrupta*) - Threatened: May occur in suitable habitat. Prefers brushy grasslands and woodland edges. May also use abandoned or little used farm buildings.

Eskimo Curlew (*Numenius borealis*) - Endangered: Formerly a regular spring transient using bare fields and heavily grazed or burned grasslands. Has not been recorded in Kansas since 1902. A few birds may still migrate through the state. Endangered nationally.

Flathead Chub (*Platygobio gracilis*) - Threatened: May occur in the Missouri River main stem. Prefers turbid streams with unstable sand bottoms. Critical habitat has been designated.

Least Tern (*Sterna antillarum*) - Endangered: Known to occur as an occasional seasonal transient or summer visitant at waters where forage fish are abundant. Endangered nationally.

Pallid Sturgeon (*Scaphirhynchus albus*) - Endangered: Known to occur in the Missouri River main stem. Prefers swift turbid rivers with firm sand substrate. Critical habitat has been designated. Endangered nationally.

Peregrine Falcon (*Falco peregrinus*) - Endangered: May occur as an uncommon seasonal transient or winter visitant at areas where waterfowl concentrate. Endangered nationally.

Piping Plover (*Charadrius melodus*) - Threatened: May occur as a rare seasonal transient at sparsely vegetated shores of streams, marshes, or impoundments. Threatened nationally.

MISSOURI DEPARTMENT OF CONSERVATION

Headquarters
2901 West Truman Boulevard, P.O. Box 180, Jefferson City, Missouri 65102-0180
Telephone: 314/751-4115 ◆ Missouri Relay Center: 1-800-735-2966 (TDD)

JERRY J. PRESLEY, Director

September 27, 1995

Mr. Howard Thelen, Project Manager
HDR Engineering, Inc.
8404 Indian Hills Drive
Omaha, Nebraska 68114-4049

Re: Flood Control Project

Dear Mr. Thelen:

Thank you for your letter of September 11, 1995 regarding threatened and endangered species within the proposed project area.

Department staff examined map and computer files for federal and state rare, threatened and endangered species and determined that sensitive species or communities are known to occur on the immediate site or surrounding area. Please refer to the enclosed Heritage Database report for details. It also includes "additional information for planning purposes." Incorporating these recommendations into project design will help assure adverse project impacts are minimal.

This report reflects information we currently have in our database. We provide this information for planning purposes only; it should not be regarded as a definitive statement as to the presence or absence of rare/endangered species or high-quality natural communities. We may need to conduct additional on-site inspections to verify the presence or absence of such species or communities.

Thank you for the opportunity to review and comment.

Sincerely,

Dan F. Dickneite

DAN F. DICKNEITE
PLANNING DIVISION CHIEF

Enclosure

ATTACHMENT G-5

HDR Engineering, Inc.
Flood Control Project
St. Joseph, MO - Buchanan County

No listed plants or animals are known to occur on the project site.

The following species and/or natural communities are known from the vicinity of the project site.

SCIENTIFIC NAME	COMMON NAME	FED STATUS	STATE STATUS	DATE	TOWN/RANGE	SEC	MANAGED AREA
PODILYMBUS PODICEPS	PIED-BILLED GREBE		R	1993	056N036W	15	
LYGODESMIA JUNCEA	SKELETON PLANT		WL	1900	057N035W	06	
LYGODESMIA JUNCEA	SKELETON PLANT		WL	1900	057N035W	29	

The following Managed Areas are located in the vicinity of the project site.

MANAGED AREA	OWNER	TOWN/RANGE SEC
ARTHUR DUPREE MEM CONSERVATION AREA	MDC	057N035W 07
FRENCH BOTTOM ACCESS	MDC	057N035W 06
LOGAN (CAROLINE SHERIDAN) MEM WA	MDC	058N035W 30 AND SEC 31
ROBIDOUX LANDING	ST. JOSEPH CITY	057N035W 06
ST. JOSEPH URBAN CONSERVATION AREA	MDC	057N035W 10
SUNBRIDGE HILLS CONSERVATION AREA	MDC	058N035W 30 AND SEC 31

Additional information for planning purposes.

Overwintering bald eagles may occur in the project area, as they are common winter residents in big river habitats and major lakes where they feed on fish.

Pallid sturgeons are big river fish that may range widely in the Mississippi River and Missouri River system. Because the preferred habitat and range of the species are unknown, any project that modifies big river habitat or impacts water quality should consider the possible impact to pallid sturgeon populations.

FEDERAL STATUS - The federal status is derived from the provisions of the federal Endangered Species Act, which is administered by the U.S. Fish and Wildlife Service. The Endangered Species Act provides federal protection for plants and animals listed as Endangered or Threatened. E = Endangered T = Threatened A,B,C = Candidate for Federal listing.

MISSOURI STATUS - The state status is determined by the Department of Conservation under Constitutional authority. Rule 3CSR10-4.111 of the Wildlife Code of Missouri and certain state statutes apply to state listed species. E = Endangered R = Rare SU = Status Undetermined WL = Watch List EXT = Extirpated XTN = Extinct.
Great blue heron rookeries, natural communities and geologic features may also occur on this printout. The status given these elements is provided for informational purposes only. C = Common, - = No status. These elements are not necessarily afforded protection through endangered species law or statute.

HDR Engineering, Inc.
Flood Control Project
St. Joseph, MO - Buchanan County

Additional information for planning purposes (cont).

Indiana bats roost and raise young under the bark of trees in riparian forests and upland forests near perennial streams in north Missouri. Favored roosts are large diameter (>9" dbh; best are ≥21" dbh) dead oaks and hickories, and living shagbark hickory. Other tree species such as elm, cottonwood, ash, and maple, if they have exfoliating bark, also may be used as roosts. Indiana bats especially need snags standing in openings, at edges, or where tree canopy is sparse. Projects should avoid or minimize the removal of potential roost trees from riparian zones or from woodlots within 0.6 mile of perennial streams or permanent water. If removal of potential roost trees is unavoidable, it should be done when Indiana bats are not likely to be present, i.e., between 15 September and 1 April. During the course of development, if possible, leave snags standing. Indiana bats feed upon terrestrial and aquatic insects; they preferentially forage in and around the canopy of riparian and floodplain forest, but also along forest/field edges and fencerows. Therefore, mature forest canopy should be enhanced and stream quality not degraded.

Streams in the area should be protected from soil erosion, water pollution and instream activities that modify or diminish aquatic habitats.

FEDERAL STATUS - The federal status is derived from the provisions of the federal Endangered Species Act, which is administered by the U.S. Fish and Wildlife Service. The Endangered Species Act provides federal protection for plants and animals listed as Endangered or Threatened. E = Endangered T = Threatened A,B,C = Candidate for Federal listing.

MISSOURI STATUS - The state status is determined by the Department of Conservation under Constitutional authority. Rule 3CSR10-4.111 of the Wildlife Code of Missouri and certain state statutes apply to state listed species. E = Endangered R = Rare SU = Status Undetermined WL = Watch List EXT = Extirpated XTN = Extinct.
Great blue heron rookeries, natural communities and geologic features may also occur on this printout. The status given these elements is provided for informational purposes only. C = Common, - = No status. These elements are not necessarily afforded protection through endangered species law or statute.

U.S. Army Corps of Engineers, Kansas City District

APPENDIX E

Common Mammals, Birds, Amphibians, Reptiles and Fish
of the Project Area

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
Kansas and Missouri
Environmental Assessment

Common Mammals, Birds, Amphibians, Reptiles and Fish of the Project Area

Common mammals that may be found in the study area include:

white-tailed deer (*Odocoileus virginianus*)
opossum (*Didelphis marsupialis*)
cottontail rabbit (*Sylvilagus floridanus*)
beaver (*Castor canadense*)
striped skunk (*Mephitis mephitus*)
plains pocket gopher (*Geomys bursarius*)
least shrew (*Cryptotis parva*)
eastern wood rat (*Neotoma floridana*)
coyote (*Canis latrans*)
raccoon (*Procyon lotor*)
muskrat (*Ondatra zibethica*)
badger (*Taxidea taxus*)
fox squirrel (*Sciurus niger*)
little brown bat (*Myotis lucifugus*)
hoary bat (*Lasiurus cinereus*)
eastern mole (*Scalopus aquaticus*)
big brown bat (*Eptesicus fuscus*)
meadow jumping mouse (*Zapus hudsonius*)
woodland white-footed mouse (*Peromyscus leucopus*)
plains harvest mouse (*Reithrodontomys montanus*)
western harvest mouse (*Reithrodontomys megalotis*)
prairie white-footed mouse (*Peromyscus maniculatus*)
thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*)

Common resident or migrant birds that may be found in the study area include:

great blue heron (*Ardea heordias*)
green heron (*Butorides virescens*)
blue-winged teal (*Anas discors*)
wood duck (*Aix sponsa*)
mallard (*Anas platyrhynchos*)
red-tailed hawk (*Buteo jamaicensis*)
black-eyed chickadee (*Parus atricapillus*)
tufted titmouse (*Parus bicolor*)
starling (*Sturnus vulgaris*)
American kestrel (*Falco sparverius*)
turkey vulture (*Cathartes aura*)
house sparrow (*Passer domesticus*)
robin (*Turdus migratorius*)
western meadowlark (*Sturnella neglecta*)
red-winged blackbird (*Agelaius phoeniceus*)
common grackle (*Quiscalus quiscula*)
Harris' sparrow (*Zonotrichia querula*)
tree sparrow (*Spizella arborea*)
chipping sparrow (*Spizella passerina*)
belted kingfisher (*Ceryle alcyon*)
whip-poor-will (*Caprimulgus vociferus*)
western kingbird (*Tyrannus verticalis*)
horned lark (*Cremophilia alpestris*)
blue jay (*Cyanocitta cristata*)
purple martin (*Progne subis*)
rock dove (*Columba livia*)
barred owl (*Strix varia*)
common crow (*Corvus brachyrhynchos*)
warbling vireo (*Vireo gilvus*)
yellow-breasted chat (*Decteria virens*)
bobwhite quail (*Colinus virginianus*)
morning dove (*Zenaida macroura*)
field sparrow (*Spizella pusilla*)
American coot (*Fulica americana*)
killdeer (*Charadrius vociferus*)
spotted sandpiper (*Actitis macularia*)
great horned owl (*Bubo virginianus*)

screech owl (*Otus asie*)
common night hawk (*Chordeiles minor*)
red-bellied woodpecker (*Centurus carolinus*)
red-headed woodpecker (*Melanerpes erythrocephalus*)
house wren (*Troglodytes aedon*)
eastern wild turkey (*Meleagris gallopovo*)
brown thrasher (*Toxostoma rufum*)

Common reptiles that may be found in the study area include:

snapping turtle (*Chelydra serpentine*)
painted turtle (*Chrysemys picta*)
false map turtle (*Graptemys pseudogeographica*)
ornate box turtle (*Terrapene ornata*)
slider (*Trachemys spp.*)
smooth soft-shelled turtle (*Apalone mutica*)
spiny soft-shelled turtle (*Apalone spinifera*)
common five lined skink (*Eumeces fasciatus*)
great plains skink (*Eumeces obsoletus*)
northern prairie skink (*Eumeces septentrionalis*)
six-lined racerunner (*Cnemidophorus sexlineatus*)
western worm snake (*Carphophis vermis*)
ringneck snake (*Diadophis spp.*)
Eastern hog-nosed snake (*Heterodon platyrhinos*)
Racer (*Coluber constrictor*)
black rat snake (*Pantherophis obsoleta*)
prairie king snake (*Diadophis punctatus arnyi*)
red milksnake (*Lampropeltis triangulum*)
gophersnake (*Pituophis melanoleucus*)
northern water snake (*Nerodia sipedon*)
brown snake (*Storeria dekayi*)
western ribbon snake (*Thamnophis proximus*)
common garter snake (*Thamnophis sirtalis*)
copperhead (*Agkistrodon contortrix*)
northern leopard frog (*Rana pipiens*)
western fox snake (*Elaphe vulpine*)

Common amphibians that may be found in the study area include:

American toad (*Bufo americanus*)
Rocky Mountain toad (*Bufo woodhousii*)
Cope's gray treefrog (*Hyla chrysoscelis*)
Great Plains toad (*Bufo cognatus*)
Northern cricket frog (*Acris crepitans*)
Eastern gray treefrog (*Hyla versicolor*)
Boreal chorus frog (*Pseudacris triseriata*)

Smallmouth salamander (*Ambystoma texanum*)
Great Plains narrowmouth toad (*Gastrophryne olivacea*)
Blanchard's cricket frog (*Acris crepitans*)
Woodhouse's toad (*Anaxyrus woodhousii*)
Western chorus frog (*Pseudacris triseriata*)
Plains spadefoot toad (*Sepa bombifrons*)
plains leopard frog (*Rana blairi*)
bullfrog (*Rana catesbeiana*)

Principal fish species of the Lower Kansas and Missouri Rivers at Kansas City:

channel catfish (*Ictalurus punctatus*)* blue catfish (*Ictalurus furcatus*)
gizzard shad (*Dorsoma cepadianum*)* flathead catfish (*Pylodictis olivaris*)
shortnose gar (*Lepisosteus platostomus*)* longnose gar (*Aplodinotus grunniens)*
carp (*Cyprinus carpio*)* bluegill (*Lepomis macrochirus*)
goldeye (*Hiodon alosoides*) fathead minnow (*Pimephales promelas*)
sand shiner (*Notropis ludibundus*) white crappie (*Pomoxis annularis*)
freshwater drum (*Aplodinotus grunniens*) quillback (*Carpiodes cyprinus*)
black bullhead (*Ameiurus melas*) river carpsucker (*Carpiodes carpio*)*
bigmouth buffalo (*Ictiobus cyprinellus*) walleye (*Stizostedion vitreum*) smallmouth buffalo (*Ictiobus bubalus*)* green sunfish (*Lepomis cyanellus*) shovelnose sturgeon (*Scaphirhynchus platorhynchus*)
shorthead redhorse (*Moxostoma macrolepidotum*)

*Dominant species

U.S. Army Corps of Engineers, Kansas City District

APPENDIX F

Common Trees, Shrubs and Grasses of the Study Area

Missouri River Levee System
Units L-455 and R-471-460
Flood Damage Reduction Study
Kansas and Missouri
Draft Environmental Impact Statement

Appendix F

Common Trees, Shrubs and Grasses of the Study Area

Predominant tree species found on the project lands include:

American elm (*Ulmus americana*)
sycamore (*Platanus occidentalis*)
black walnut (*Juglans nigra*)
bur oak (*Quercus macrocarpa*)
chinkapin oak (*Quercus muehlenbergii*)
eastern cottonwood (*Populus deltoides*)
hackberry (*Celtis occidentalis*)
hawthorn (*Crataegus sp.*)
honey locust (*Gliditsia triancanthos*)
osage-orange (*Maclura pomifera*)
redbud (*Cercis cancdensis*)
slippery elm (*Ulmus rubra*)
green ash (*Fraxinus pennsylvanica*)
mulberry (*Morus rubra*)
eastern red cedar (*Juniperous virginiana*)

Deciduous shrubs on the project lands include:

rough leaf dogwood (*Cornus drummondii*)
buckbrush (*Symphoricarpos orbiculatus*)
elderberry (*Sambucus canadensis*)
fragrant sumac (*Rhus aromatica*)
smooth sumac (*Rhus glabra*)
gooseberry (*Ribes missouriense*)
poison ivy (*Rhus radicans*)
prairie rose (*Rosa arkansana*)

Grass cover on the project lands include:

big bluestem (*Andropogon gerardii*)
little bluestem (*Schizaccharium scoparium*)
indiangrass (*Sorghastrum nutans*)
switchgrass (*Panicum virgatum*)
tumblegrass (*Schedonnardus paniculatus*)
Kentucky bluegrass (*Poa pratensis*)
vervain (*Verbena sp.*)
windmill grass (*Chloris verticillata*)
tall dropseed (*Sporobolus asper*)

U.S. Army Corps of Engineers, Kansas City District

APPENDIX G

Section 404 of the Clean Water Act
Compliance Review Documents
(Public Notice/Draft 404(b)(1) Evaluation)

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
Kansas and Missouri
Environmental Assessment

PUBLIC NOTICE

US Army Corps of Engineers Kansas City District

Permit No. 200501489
Issue Date: August 1, 2006
Expiration Date: August 31, 2006

30-Day Notice

JOINT PUBLIC NOTICE: This public notice is issued jointly with the Missouri Department of Natural Resources, Water Pollution Control Program and the Kansas Department of Health and Environment. The Department of Natural Resources and the Kansas Department of Health and Environment will use the comments to this notice in deciding whether to grant Section 401 water quality certification. Commenter's are requested to furnish a copy of their comments to the Missouri Department of Natural Resources, P.O. Box 176, Jefferson City, MO 65102 or the Kansas Department of Health and Environment, Bureau of Water – Watershed Management Section, 1000 SW Jackson Street, Suite 420, Topeka, Kansas 66612-1367.

APPLICANT: Kansas City District, Corps of Engineers
Room 834, PM-PR
601 E. 12th Street
Kansas City, Missouri 64106-2896

PROJECT LOCATION (As shown on the attached drawings): The proposed flood damage reduction project involves the Missouri River levee units L-455 and R471-460. These units collectively comprise the protective works that provide flood protection for areas in St. Joseph, Buchanan County, Missouri and Elwood and Wathena, Doniphan County, Kansas.

AUTHORITY: Section 404 of the Clean Water Act (33 USC 1344). This project is being conducted under the authority provided by Section 216 of the 1970 Flood Control Act. This Act provides authority to reexamine completed civil works projects to determine whether the projects are providing benefits as intended.

ACTIVITY: PROPOSED WORK: The U.S. Army Corps of Engineers (USACE) proposes to raise existing Missouri River levees units R471-460 and L-455 to improve the adequacy of the levee units to reduce damages from potential flooding on the Missouri River. This will be accomplished by raising the existing levees using earth fill. A substantial portion (approximately ten miles) of the levee unit R471-460 would be raised to a level sufficient to pass the one percent (100-year) flood with a 90 percent level of reliability, thereby allowing for re-certification of the levee by FEMA. The anticipated raise varies along its length from zero to two and one half feet.

Increases in levee height would result in corresponding increases in levee toe and seepage berm width. Additionally, minor raises (less than one foot) at specific locations along the left bank levee (L-455) to accept the minor increased rise in water surface elevation resulting from the initial work would also be required.

Borrow areas currently identified for the proposed levee raise include riverward areas in both Kansas and Missouri. For Kansas, the borrow areas consist of approximately 1,139 acres of land located from River Miles 454.9 to 451.9 and from River Miles 446.7 to 443.4. For Missouri, the borrow area consists of approximately 30 acres of land along River Miles 442.6 to 442.9. These sites consist of accreted lands with secondary tree growth, shrublands, and wetlands.

WETLANDS: A preliminary jurisdictional determination indicated that approximately 4.9 acres of emergent and shrub-scrub wetlands landward of the existing levees would be permanently impacted from expanding the levee width. During construction of the project, the Corps will off set the wetland lost through various minimization measures coordinated with the assistance of the Natural Resources Conservation Service and US Fish and Wildlife Service. These measures include, but are not limited to, scraping and reshaping of area wetlands to the existing size equal to, or greater than, that which was lost; varying bottom depths of excavated borrow sites to create diversity in newly created wetland areas; excavating deep in other borrow areas to minimize removal of trees; creating islands within some of the borrow sites through avoidance of specified areas; spacing borrow areas apart from one another by approximately 500 feet to provide areas of no disturbance; and, avoiding larger "old growth" trees (9 inch or larger DBH).

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) OF 1968, as amended: The Corps originally published a Notice of Intent to prepare an Environmental Impact Statement in the *Federal Register* on November 20, 2003 (Vol.68, No. 224, page 65450). However, after considerable review and re-evaluation of the project impacts, a determination was made that the project would not result in significant degradation of the human environment; and therefore, the proposed project would support a Finding of No Significant Impact (FONSI). The Corps will utilize comments received in response to this Public Notice to complete its evaluation of the project for compliance with the requirements of NEPA, and other Federal, state, and local regulations. The Corps has made a preliminary determination that the project as proposed would not be contrary to the public interest and is in compliance with the Section 404(b)(1) Guidelines.

DRAWINGS: The attached drawings provide location details of the proposed project.

PROPERTY ADJACENT TO PROJECT AREA: Property owners adjacent to the proposed project area will be notified directly to inform them of the project and to request their comments.

CULTURAL RESOURCES: The proposed project has been reviewed in compliance with the National Historic Preservation Act of 1966 (Public Law 89-665). Background research consisted of a review of the National Register of Historic Places (NRHP), a site records search, and a review of historic channel and shipwreck maps. No historic properties listed in the NRHP were identified in the project area. A search of records with the Kansas and Missouri State Historic Preservation Officers (SHPO's) identified no previously recorded archeological sites or historic structures in the immediate area. An accreted land study conducted by the Corps found that the entire project area consists of accreted land, with most of the accretion occurring since 1879. Because the project area consists of recently accreted land and no archeological sites, historic structures, or shipwrecks have been recorded in the project area, it is unlikely that the project would impact historic properties or sites that may be eligible for inclusion on the NRHP. Therefore, we have recommended no further investigations be conducted. The Kansas and Missouri State Historic Officers both concurred with this determination. However, the Corps will take into consideration any information from affiliated Native American tribes or the public on any sites or traditional cultural properties that may be of concern.

ENDANGERED SPECIES: In compliance with the Endangered Species Act, a preliminary determination has been made that the described work is not likely to adversely affect species designated as threatened or endangered or adversely modify or destroy critical habitat. In order to complete our evaluation of this activity, comments are being solicited from the U.S. Fish and Wildlife Service and other interested agencies and individuals.

FLOODPLAINS: This activity is being reviewed in accordance with Executive Order 11988, Floodplain Management, which discourages direct or indirect support of floodplain development whenever there is a practicable alternative. By this public notice, comments are requested from individuals and agencies that believe the described work will adversely impact the floodplain.

WATER QUALITY CERTIFICATION: Section 401 of the Clean Water Act (33 USC 1341) requires that all discharges of dredged or fill material must be certified by the appropriate state agency as complying with applicable effluent limitations and water quality standards. This public notice serves as an application to the state in which the discharge site is located for certification of the discharge. The discharge must be certified before Department of the Army authorization can be issued. Certification, if issued, expresses the state's opinion that the discharge will not violate applicable water quality standards.

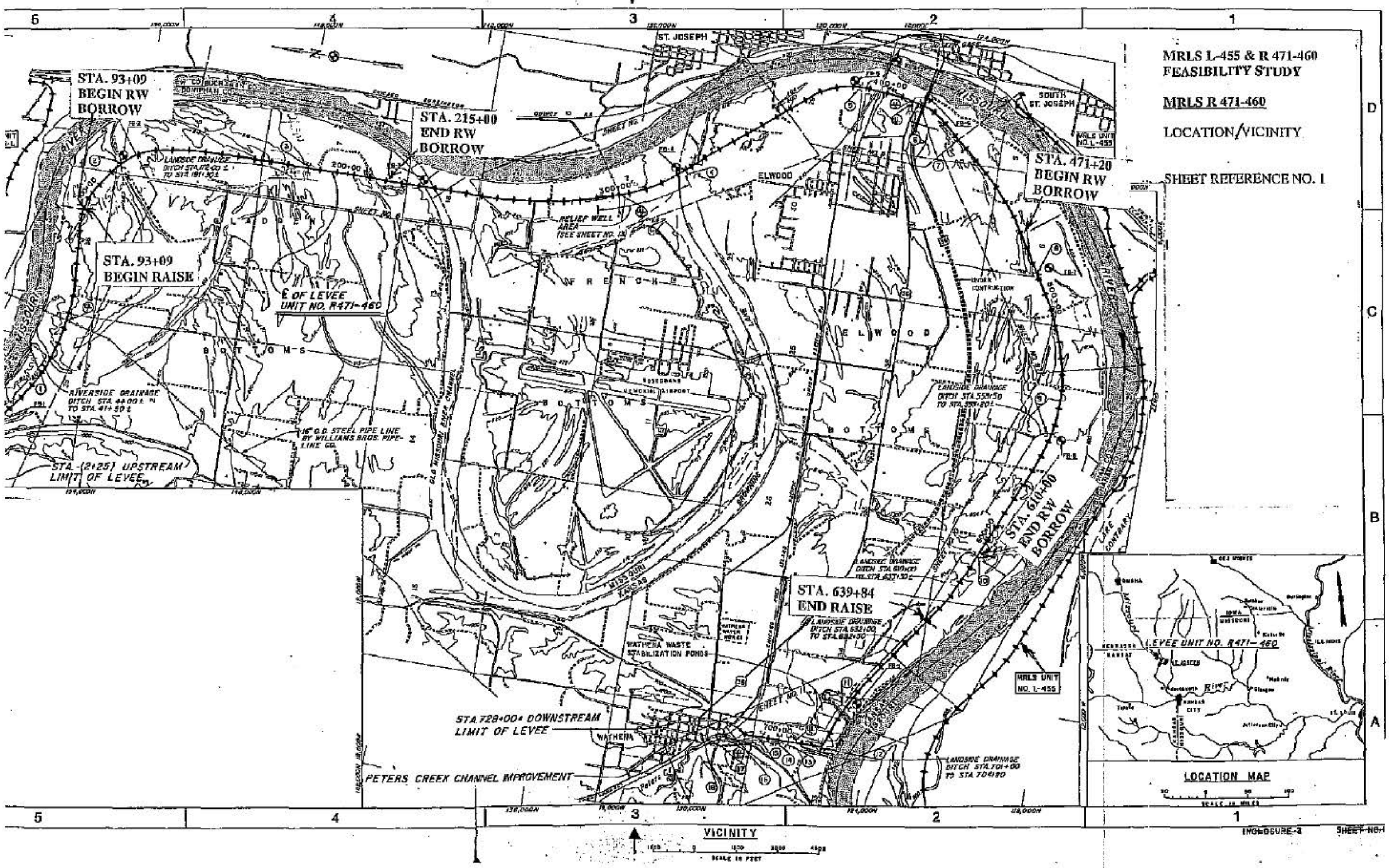
PUBLIC INTEREST REVIEW: The decision to issue authorization will be based on an evaluation of the probable impact including the cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefits which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including the cumulative effects thereof; among those are conservation, economics, esthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs and, in general, the needs and welfare of the people. The evaluation of the impact of the activity on the public interest will include application of the guidelines promulgated by the Administrator, Environmental Protection Agency under authority of Section 404(b) of the Clean Water Act (33 USC 1344). The Corps of Engineers is soliciting comments from the public; Federal, state, and local agencies and officials; Indian Tribes; and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition or deny an authorization for this proposal. To make this decision, comments are used to address impacts on endangered species, historic properties, water quality, general environmental effects, and other public interest factors listed above. Comments are used in preparation of an Environmental Assessment pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

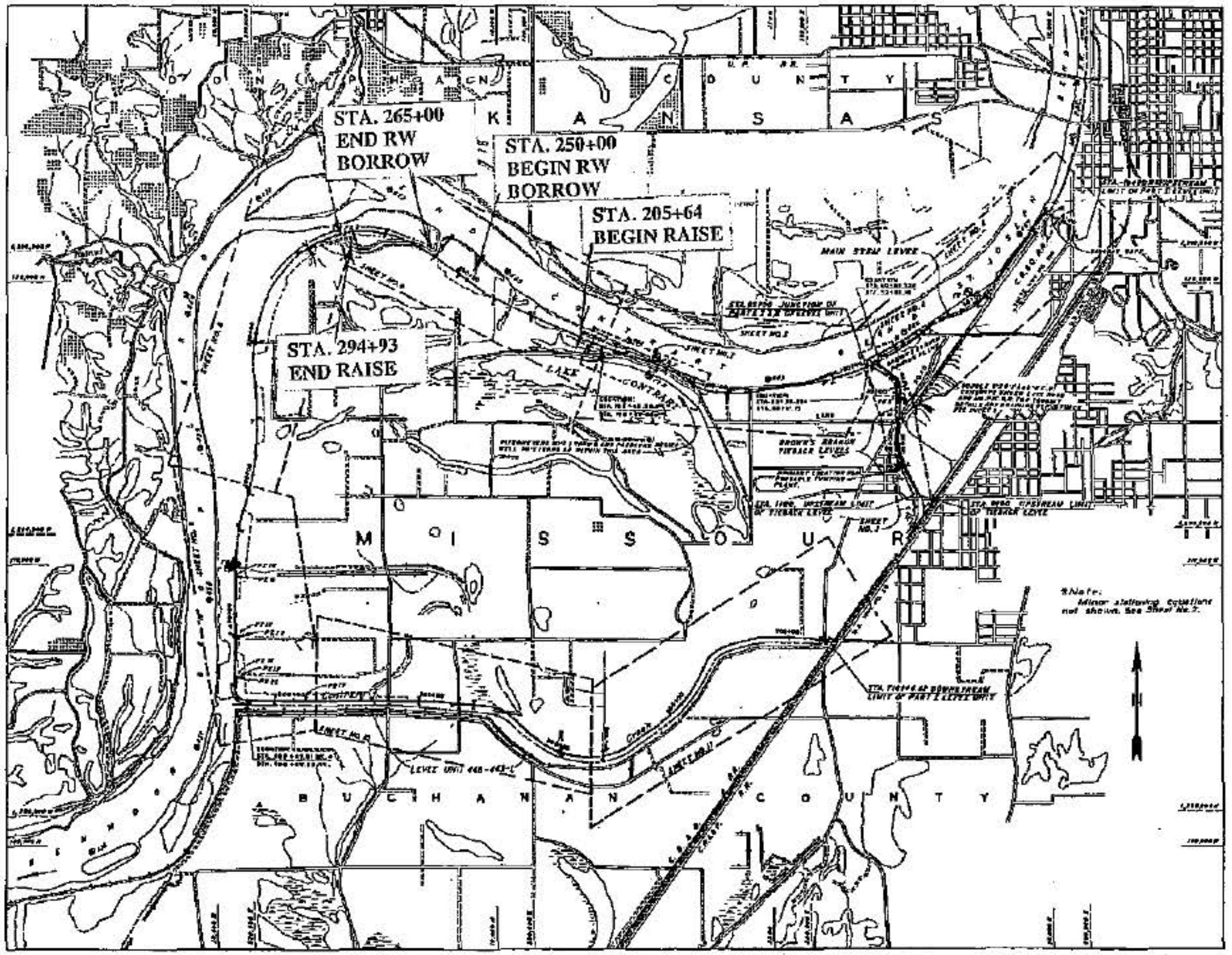
COMMENTS: This notice is provided to outline details of the above-described activity so this District may consider all pertinent comments prior to determining if issuance of an authorization would be in the public interest. Any interested party is invited to submit to this office written facts or objections relative to the activity on or before the public notice expiration date. Comments both favorable and unfavorable will be accepted and made a part of the record and will receive full consideration in determining whether it would be in the public interest to issue the Department of the Army authorization. Copies of all comments, including names and addresses of commenter's, may be provided to the applicant. Comments should be mailed to the address shown below.

PUBLIC HEARING: Any person may request, in writing, prior to the expiration date of this public notice, that a public hearing be held to consider this application. Such requests shall state, with particularity, the reasons for holding a public hearing.

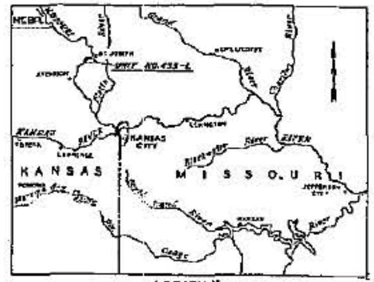
ADDITIONAL INFORMATION: Additional information may be obtained by contacting Mr. Matthew Vandenberg, U.S. Army Corps of Engineers, Environmental Resources Section, 601 East 12th Street, Room 843, Kansas City, Missouri 64106, at telephone 816-389-3146, (FAX 816-389-2025) or via e-mail at matthew.d.vandenberg@us.army.mil. All comments to this public notice should be directed to the above address.

NOTICE TO EDITORS: This notice is provided as background information for your use in formatting news stories. This notice is not a contract for classified display advertising.


MRLS L-455 & R 471-460
FEASIBILITY STUDY
MRLS R 471-460
LOCATION/VICINITY
SHEET REFERENCE NO. 1
STA. 93+09
BEGIN RW
BORROW
STA. 215+00
END RW
BORROW
STA. 93+09
BEGIN RAISE
STA. 471+20
BEGIN RW
BORROW
STA. 610+00
END RW
BORROW
STA. 639+84
END RAISE
℄ OF LEVEE
UNIT NO. R471-460
ST. JOSEPH
SOUTH ST. JOSEPH
ELWOOD
WATHENA
RELIEF WELL AREA (SEE SHEET NO. 2)
RIVERSIDE DRAINAGE DITCH STA. 44+00 ± TO STA. 41+50 ±
LANDSIDE DRAINAGE DITCH STA. 553+50 TO STA. 558+20 ±
LANDSIDE DRAINAGE DITCH STA. 701+00 TO STA. 704+80
STA. -(2+25) UPSTREAM LIMIT OF LEVEE
STA. 728+00± DOWNSTREAM LIMIT OF LEVEE
PETERS CREEK CHANNEL IMPROVEMENT
WATHENA WASTE STABILIZATION PONDS
MRLS UNIT NO. L-455
MISSOURI
KANSAS
F R E N C H
E L W O O D
B O T T O M S
MEMORIAL AIRPORT
LEVEE UNIT NO. R471-460
LOCATION MAP
VICINITY
SCALE IN FEET
INCLOSURE-2
SHEET NO. 1



VICINITY



LOCATION

GENERAL NOTES

Planimetry from Corps of Engineers Aerial Survey of 1952.
Topography of plan sheets from U.S.C. of E. plane-table surveys of 1954, 1955 and 1958.
Elevations referred to mean sea level are based on the U.S.C. & G.S. 1929 general adjustment.
Alinements based on plane co-ordinate system with Missouri River Commission triangulation station "WESTON" as origin.
Weston grid system
Mercator (Missouri, west zone) grid system
Missouri River Mile based on 1960 Adjustment.

LEGEND

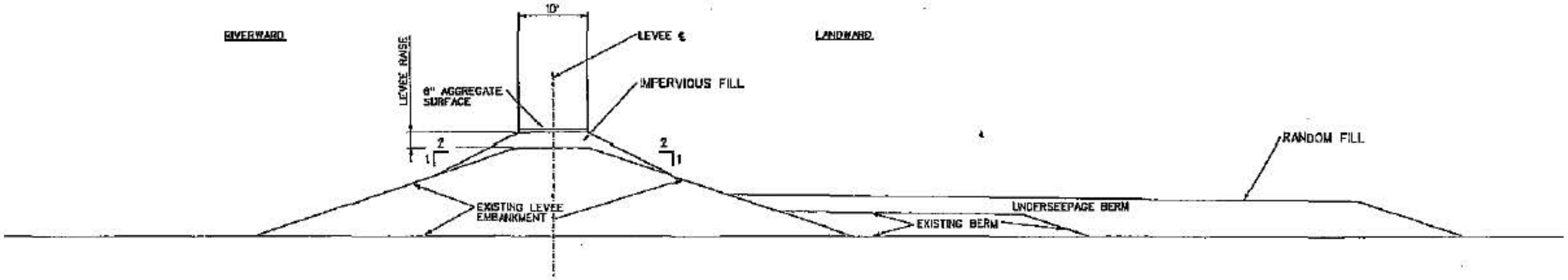
Levee Unit No. L 455
Other levees
New or improved channel
Drainage structure
Ramp
Riprap slope protection
Freeboard gage
Forecasting gage
Pumping plant
Piezometer
Pressure relief wells
Miles above mouth of Missouri River
Underseepage control berm

MRLS L-455 & R 471-460
FEASIBILITY STUDY

MRLS L 455

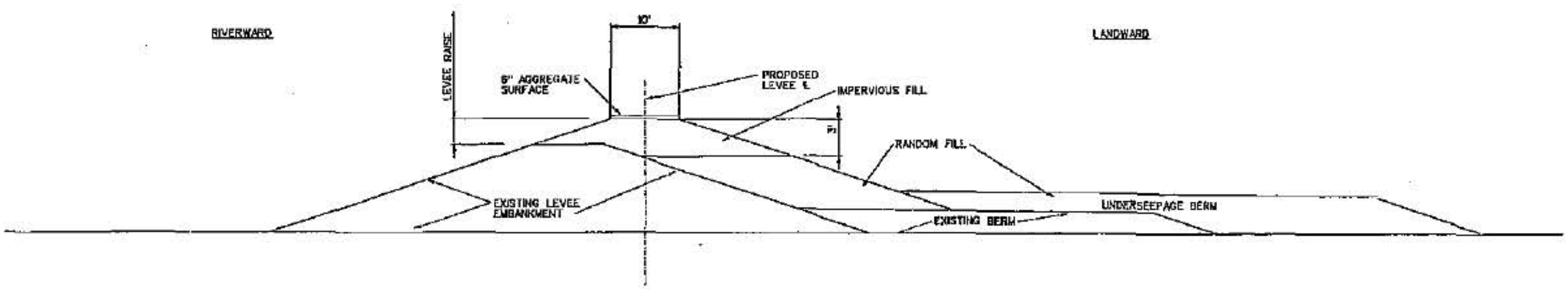
LOCATION/VICINITY

SHEET REFERENCE NO. 2



LEVEE RAISE UP TO 1-FOOT

SCALE: NOT TO SCALE



LEVEE RAISE GREATER THAN 1-FOOT AND LESS THAN 3-FEET

SCALE: NOT TO SCALE

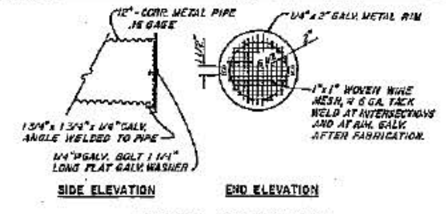
US Army Corps of Engineers
Kansas City District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

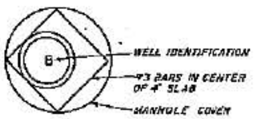
TYPICAL LEVEE SECTIONS
FILL ZONES
LEVEE RAISE LESS THAN 3 FEET

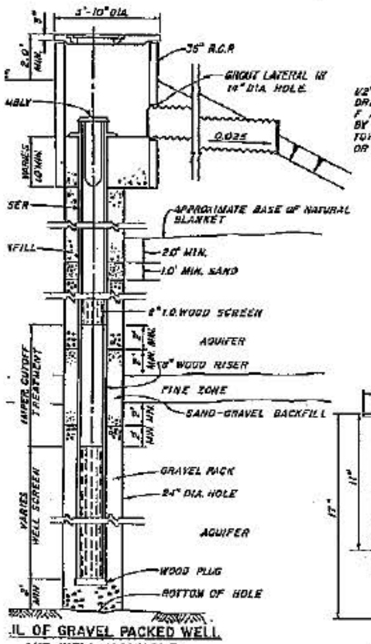
Sheet reference number:
5



LATERAL GUARD SCREEN

NOT TO SCALE





...IL OF GRAVEL PACKED WELL AND WELL MANHOLE

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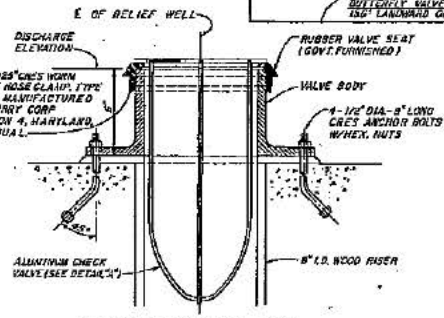

DISCHARGE ASSEMBLY DETAIL

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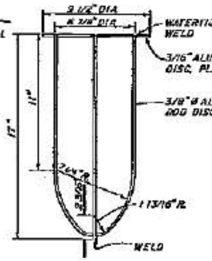

DETAIL "A"

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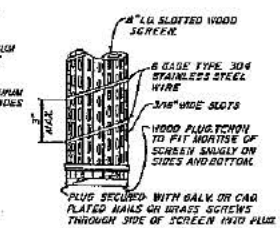

DETAIL OF WOOD SCREEN WITH BOTTOM PLUG

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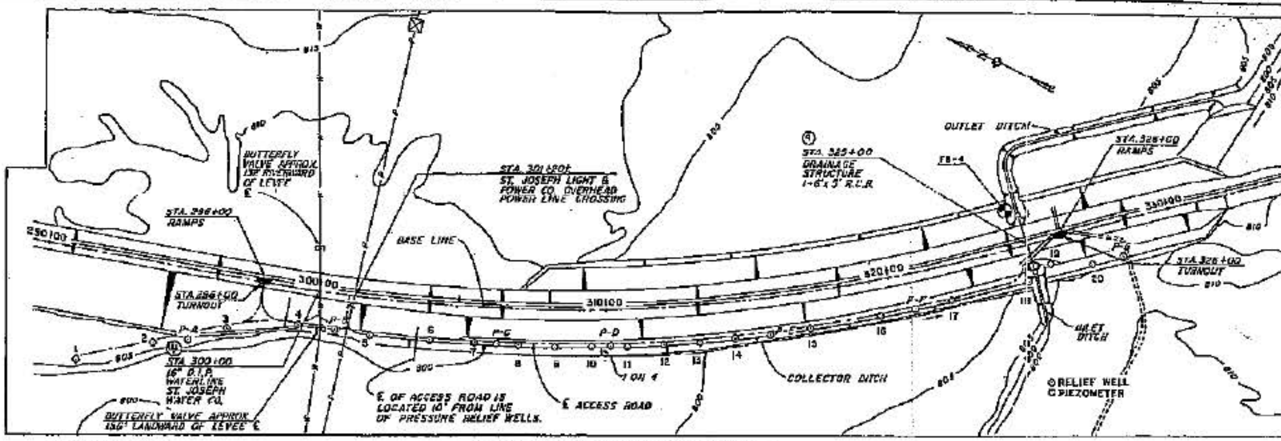

PLANS - PIEZOMETERS & RELIEF WELLS

SCALE IN FEET

NOTES:

1. Details show existing pressure relief wells. Existing pressure relief wells to be abandoned in-place.
2. Replacement pressure relief wells located the same distance out from the levee but offset 5-feet from the existing pressure relief well.
3. Replacement pressure relief wells will be 8-inch diameter stainless steel assemblies. Outfall will be similar to the existing details.

RELIEF WELL SCHEDULE

NO.	LOCATION STATION	LOCATION RANGE	DISCH. ELEV.	BOT. ELEV. HOLE	BOT. ELEV. WELL	SCREEN ELEVATIONS UPPER SEC. TOP	UPPER SEC. BOT.	LOWER SEC. TOP	LOWER SEC. BOT.	TOTALS (EST.) QUANTITY IN LINEAR FEET SCREEN	RISER	SAND-GRAVEL	GRAVEL PACK	CONC.	M.H.	LATERALS
1	292+00	305 R.	803	715.5	717.5	765.5	717.5			52	33	4	72.5	13.5	11	17.6
2	294+50	260 R.	803	713.0	716.0	770.0	764.0	744.0	716.0	44	42.5	7	68	15.5	11	17.6
3	297+00	190 R.	803	713.0	716.0	760.0	716.0			44	42.5	8	76	13.6	11	17.5
4	299+50	130 R.	804	714.0	716.0	768.0	764.5	752.0	718.0	40	47.5	8	67	13.5	11	13.0
5	302+00	130 R.	804	714.0	718.0	758.0	718.0			40	45.5	8	75	13.6	9	13.0
6	304+00	130 R.	804	714.0	718.0	772.0	760.0	748.0	718.0	44	41.5	9	67	13.5	9	13.0
7	305+50	130 R.	803	714.0	719.0	767.0	763.0	747.0	719.0	32	31.8	15	63	12.5	9	17.4
8	307+00	130 R.	802	714.0	718.0	774.0	762.0	749.0	718.0	40	43.5	13	61	12.5	11	21.5
9	308+25	130 R.	802	714.0	715.0	770.0	762.0	742.0	718.0	40	43.5	17	57.0	12.5	11	21.5
*10	309+50	130 R.	802	716.0	718.0	782.0	778.0	746.0	716.0	40	43.5	16.5	53.5	12.5	11	21.5
11	310+75	130 R.	802	719.0	720.0	784.0	750.0	752.0	720.0	36	45.5	24.5	50.5	12.5	11	21.5
12	312+00	130 R.	802	718.0	720.0	776.0	788.0	744.0	720.0	32	49.5	21.5	52.5	12.5	11	21.5
*13	313+25	130 R.	802	716.0	720.0	780.0	776.0	744.0	720.0	32	48.5	20.5	47.5	12.5	11	21.5
14	314+50	130 R.	804	719.0	721.0	781.0	777.0	745.0	721.0	28	54.5	24	44.0	12.5	9	13.0
15	317+00	130 R.	803	721.0	723.0	777.0	761.0	749.0	723.0	40	39.5	12.5	60.5	12.5	6	8.5
16	319+50	130 R.	805	721.4	724.0	780.0	764.0	752.0	724.0	44	36.5	10	60.6	12.5	6	8.5
17	322+00	130 R.	805	727.0	729.0	777.0	761.0	745.0	729.0	32	43.5	14	51.0	12.5	8	8.0
18	324+71	130 R.	802	728.0	731.5	770.0	763.5	755.5	731.5	36	34.0	6	55.0	12.5	11	13.5
19	325+29	90 R.	802	727.0	731.0	778.0	771.0	747.0	731.0	24	48.5	21	42.0	12.5	11	20.0
20	327+00	130 R.	805	728.0	750.5	766.5	738.5	748.5	750.5	24	50.0	81.5	52.0	12.5	9	8.5

* WELL NO. 10 HAS MIDDLE SECTION OF SCREEN EL. 762.0 TO EL. 754.0
WELL NO. 13 HAS MIDDLE SECTION OF SCREEN EL. 764.0 TO EL. 760.0

MRLS L-455 & R 471-460
FEASIBILITY STUDY

MRLS R 471-460

PRESSURE RELIEF WELLS

SHEET REFERENCE NO. 7

[redacted]

[redacted]

Laipple Farms, Inc.
Route 1
[redacted]

Rosecrans Memorial Airport
100B NW Rosecran Raod
[redacted]

COUNTY ENGINEER
COURTHOUSE
TROY, KS 66087

KANSAS CHIEF
P.O. BOX 369
TROY, KS 66087-0369

WATHENA TIMES
P.O. BOX 368
WATHENA, KS 66090

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Missouri River Levee System
Units L-455 and R-471-460
Flood Damage Reduction Study
Kansas and Missouri

Section 404(b)(1) Evaluation

Clean Water Act Section 404(b)(1) authorized the development of guidelines for specification of disposal sites for dredged or fill material by the U.S. Environmental Protection Agency (USEPA) in conjunction with the U.S. Army Corps of Engineers (Corps). The USEPA subsequently developed and adopted the Section 404(b)(1) guidelines in conjunction with the Corps (40 CFR Part 230). The purpose of these guidelines is to "restore and maintain the chemical, physical, and biological integrity of the waters of the United States through the control of discharges of dredged or fill material". This document reviews the compliance of the proposed flood damage reduction alternative for the Missouri River Levee System Units L-455 and R-471-460 with these guidelines.

I. Description of the Flood Damage Reduction Project

Location

The Missouri River Levee System Units L-455 and R-471-460 are located from Missouri River miles 445 to 452 adjacent to Doniphan County, Kansas and Andrew and Buchanan counties, Missouri.

General Description

The Corps, at the request and with the cooperation of the City of St. Joseph, the Elwood-Gladded Drainage District (Right Bank, Kansas), the St. Joseph Airport Drainage District (Right Bank, Missouri), and the South St. Joseph Levee District (Left Bank), the non-Federal sponsors, of the levee units L-455 and R-471-460, has undertaken the Flood Damage Reduction Study, at Kansas and Missouri. This existing levee system protects areas in St. Joseph, Buchanan and Andrew Counties, Missouri and areas in Elwood and Wathena, Doniphan County, Kansas. The purpose of this study is to determine whether one or more plans for increasing the level of flood protection is technically viable, economically feasible, and environmentally acceptable, or if no action is warranted. Failure of any part of the existing flood protection system during a major flood would have substantial adverse impacts on the human environment, including property damage and potential loss of human life. Four alternatives were considered and include: Raise the Right Levee Section using earthen material to the one-hundred year level of flood protection with 90 percent reliability, and a corresponding raise to the Left Levee Section in specific areas to accept the slight rise in water surface elevations resulting from the initial raise (PREFERRED); Raise the Right Levee Section to an Increased Level of Protection (Alternative 2 - 500-year event plus 1.5 feet of freeboard), with a corresponding raise to the Left levee unit; Raise the Right Levee Section to a Further Increased Level of Protection (Alternative 3 - 500-year event plus 3.0 feet of freeboard), with a corresponding raise to the Left levee unit, and the "No Action" Alternative.

Detailed descriptions of each alternative are provided in Chapter 2 of The Missouri River Levee System Units L-455 and R-471-460 Flood Damage Reduction Study EA.

Site construction activities that would be subject to regulation under Section 404 of the Clean Water Act include:

- obtaining borrow material from lands riverward of the existing levee, and
- placing fill material on the Flood Damage Reduction site in jurisdictional waters during construction of the increased levee and seepage berms.

Authority and Purpose

This study is being conducted under the authority provided by Section 216 of the 1970 Flood Control Act. This Act provides authority to reexamine completed civil works projects. Section 216 reads as follows:

The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects, the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to the significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying structures or their operation, and for improving the quality of the environment in the overall public interest.

Section 216 of the 1970 Flood Control Act provided continuing authority to examine completed Federal projects to determine whether the projects are providing benefits as intended. The results of this examination indicate that raising the level of protection provided by the St. Joseph levee unit system may be technically and economically feasible without unacceptable environmental or social impacts. Accordingly, a Federal interest exists in designing and constructing improvements because of the potential to benefit the National economy.

Purpose: The purpose of the Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Project in Kansas and Missouri is to restore the reliability of the units to reduce damages from potential flooding on the Missouri River in the vicinity of St. Joseph, Missouri, in order to provide for re-certification of the levees by the Federal Emergency Management Agency (FEMA).

Need: The need of the Missouri River Levee System Units L-455 and R471-460 Flood Damage Reduction Project in Kansas and Missouri is restore the reliability of the units to reduce damages from potential flooding on the Missouri River in the vicinity of St. Joseph, Missouri because this level is lacking, and to allow FEMA to re-certify the levee. If the levee remains de-certified, the economic impact of a flood event will be borne entirely by the local communities.

General Description of Dredged or Fill Material

(1) The existing levee will require grading for the purpose of reshaping and preparing the initial levee slope. The existing levee is composed primarily of fill material that was borrowed from accreted lands adjacent to the project area when the levee was originally built. The existing material contains a mixture of sand, silts and clays with varying content of organic materials. The proposed levee raise and seepage berm extensions will be composed of similar materials. Fill will be obtained from adjacent accreted lands that, in some instances, may be the same borrow areas previously used.

(2) The approximate quantity of fill material proposed for construction of the flood damage reduction project includes approximately 1,882,445 bank cubic yards.

(3) The source of the fill material will be borrowed from accreted land riverward of the existing levees in both Kansas and Missouri. For Kansas, two borrow areas have been identified and are located at approximately river miles 454.9 to 451.9 and river miles 446.7 to 443.4. For Missouri, one borrow area has been identified and is located at approximately river miles 442.6 to 442.9.

Description of the Proposed Discharge Site

(1) Location. Borrow soils would be placed within the floodplain of the Missouri River on levee units R-471-460 and L-455 between River Miles 437 and 457 to facilitate an earthen levee raise and the construction of underseepage control measures. Wetland determinations conducted by Corps personnel revealed that approximately 4.9 acres of forested and emergent wetlands would be filled as a result of the levee footprint expansion. See Appendix B of the EA for project location maps, borrow site areas, and accreted land surveys.

(2) Size. The proposed borrow areas include approximately 1,304 acres of land in Kansas: located riverward of the existing levee at river miles 454.9 to 451.9 and river miles 442.6 to 442.9. Additionally, a lesser area of approximately 30 acres of land in Missouri is located at river miles 442.6 to 442.9. These areas represent the total borrow areas and not the total amount of borrow to be obtained.

(3) Type of Site/Habitat. The proposed project site consists of an existing levee with strips of upland grassland and small amounts of deciduous trees. The borrow areas for the proposed project site consists of accreted lands containing secondary willow and cottonwood tree growth, shrubland vegetation, and manmade emergent wetlands. During construction of the flood damage reduction project, some emergent wetlands will be eliminated due to fill. Obtaining borrow material will be conducted in a manner as to reduce impacts on the area. Such minimization measures will include, but not be limited to, shallow scrapes and reshaping along existing wetland areas to increase their functions, deeper diggings (eight to ten feet) in areas where trees and shrubs occur to reduce acreage impacted to these vegetation types, and ensuring a minimum of two feet of blanket material (capable of retaining water) is left in place to ensure the areas function as

wetlands. Please see Section 4.4.3 of the EA for a complete description of the affects to wetland areas.

(4) Timing and Duration. Timing and duration of construction and borrow operations will be determined after final plans and specifications are made.

Description of Disposal Method

The disposal method will be as necessary for construction of each project element.

II. Factual Determinations

The 404(b)(1) guidelines (40 CFR Part 230, Subpart B, Section 230.11) require the determination in writing of the potential short-term and long-term affects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment. These factual determinations are presented below.

Physical Substrate Determinations

(1) Substrate Elevation and Slope. The bottom surface elevation of the borrow sites will be irregular to create greater diversity and habitat. The borrow excavation from area sites will result in depths which will be dependant on results from test pits dug to determine initial thickness of usable material. A minimum of approximately two feet of blanket material (soil capable of retaining water) will then be left in place to ensure wetland functions are obtained after the fill material has been excavated.

(2) Type of Fill Material. Fill material will consist of a mixture of sand, silts and clays with varying content of organic materials.

(3) Dredge/Fill Material Movement. The fill material will be stabilized on the levee and seepage berms and should not be subject to erosion.

(4) Physical Effects on Benthos. Benthic organisms may be displaced during construction activities.

Water Circulation, Fluctuation, and Salinity Determination

(1) Water Column Effects. Standing water and soils periodically inundated will be permanently and temporarily impacted during and following construction. Turbidity and erosion will be controlled during and following construction.

(2) Current Patterns and Circulation. Construction of the Flood Damage Reduction project will have minimal and temporary construction related impacts on the current hydrologic circulation patterns.

(3) Normal Water Level Fluctuation and Salinity Gradients. Surface and ground water levels will be minimally affected during construction. Salinity levels will not be affected by the proposed project.

Suspended Particulate/Turbidity Determinations

(1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site. There may be a temporary increase in turbidity levels in the project area during construction. Turbidity will be short-term and localized and no significant adverse impacts are expected. State standards for turbidity will not be exceeded.

(2) Effects on the Chemical and Physical Properties of the Water Column. There may be temporary impacts to the chemical and physical properties of nearby waters during construction activities. Borrow material will be dug and placed using traditional construction equipment (bull dozers, track-hoes, bobcats, etc). There are no acute or chronic chemical impacts anticipated as a result of construction. An environmental protection plan, prepared during detailed design, will address concerns regarding monitoring of equipment, maintenance and security of fuels, lubricants etc.

(a) Light Penetration. Some decrease in light penetration may occur in the immediate vicinity of the construction area. This effect will be temporary, limited to the immediate area of construction, and will have no adverse impact on the environment.

(b) Dissolved Oxygen. Dissolved oxygen levels will not be altered by this project.

(c) Toxic Metals, Organics, and Pathogens. No toxic metals, organics, or pathogens are expected to be released by the project.

(d) Aesthetics. The aesthetic quality of the water in the immediate area of the project may be temporarily affected by turbidity during construction. This will be a short-term and localized condition.

(3) Effects to Biota.

(a) Primary Productivity and Photosynthesis. Impacts on primary production within approximately 5.0 acres of impacted wetland areas will be minimized through on-site mitigation of similar habitat.

(b) Suspension/Filter Feeders. An increase in turbidity from construction related progress could adversely impact burrowing invertebrate filter feeders within and adjacent to the immediate construction area. It is not expected that a short-term, temporary increase in turbidity will have any long-term negative impact on these highly fecund organisms.

(c) Sight Feeders. No significant impacts on these organisms are expected as the majority of sight feeders are highly motile and can move outside the project area.

Contaminant Determinations

Material which will be obtained from the borrow sites will not introduce, relocate, or increase contaminants at the fill area.

Aquatic Ecosystem and Organism Determination

(1) Effects to Plankton. No adverse impacts on autotrophic or heterotrophic organisms are anticipated.

(2) Effects on Benthos. No adverse impacts to benthic organisms are anticipated.

(3) Effects on the Aquatic Food Web. No adverse impacts on aquatic organisms are anticipated. There is expected to be a relatively minor temporary effect on the aquatic food web due to construction activities. Wetlands impacted on the landside of the levee, and those filled on the river side of the levee, will be mitigated on-site and in-kind in order to maintain their functional values.

(4) Effects on Special Aquatic Sites. A total of approximately 4.9 acres of wetlands will be permanently lost within the project area due to fill, reconstruction of levee slopes, and associated levee maintenance. However, minimization measures to reduce impacts have been incorporated into construction plans; thus, the impacts have been off-set.

(5) Endangered and Threatened Species. There will be no significant adverse impacts on any threatened or endangered species or on critical habitat of any threatened or endangered species. Some minor impacts to endangered and threatened species may occur during construction but will be reduced or avoided through timing restrictions. While some existing habitat will be lost as a result of obtaining borrow, re-establishment of this habitat will occur in the long-term. Refer to Section 4.4.4 of the Draft EA for measures that will be implemented to protect endangered and threatened species.

(6) Other Wildlife. No adverse long-term impacts to small foraging mammals, reptiles, birds, or wildlife in general are expected.

(7) Actions to Minimize Impacts. All practical safeguards will be taken during construction to preserve and enhance environmental, aesthetic, recreational, and economic values in the project area. Specific precautions are discussed in the Draft EA.

Proposed Disposal Site Determinations

(1) Determination of Compliance with Applicable Water Quality Standards. All State permits will be obtained prior to construction activities and coordination with Missouri Department of Natural Resources will ensure Section 401 – Water Quality Certification and Section 402 – National Pollution Discharge Elimination System Storm Water Discharge Permits have been obtained.

(2) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supplies. No municipal or private water supplies will be impacted by the implementation of the project.

(b) Recreational and Commercial Fisheries. Recreational and commercial fisheries would not be impacted by the implementation of the project.

(c) Water Related Recreation. Water related recreation in the immediate vicinity of construction will likely be impacted during construction activities. This will be a short-term impact.

(d) Aesthetics. The existing environmental setting may be impacted during construction. Construction activities cause a temporary increase in noise and air pollution from equipment as well as some temporary increase in turbidity. These impacts are not expected to adversely affect the aesthetic resources over the long term and once construction ends, conditions will return to pre-project levels. Trees removed landward of the levee will be replaced.

(e) Determination of Cumulative Effects on the Aquatic Ecosystem. There will be no cumulative impacts that result in a major impairment of water quality of the existing aquatic ecosystem as a result of the placement of fill at the project site.

(f) Determination of Secondary Effects on the Aquatic Ecosystem. There will be no secondary impacts on the aquatic ecosystem as a result of the construction.

III. Findings of Compliance or Non-compliance with the Restrictions on Discharge

The 404(b)(1) guidelines (40 CFR Part 230, Subpart B, Section 230.12) require written findings as to whether the proposed disposal site for the discharge of dredged or fill material:

- complies with the 404(b)(1) guidelines;
- complies with the 404(b)(1) guidelines with inclusion of appropriate and practical discharge conditions to minimize pollution or adverse effects to the affected aquatic ecosystems; or
- does not comply with the 404(b)(1) guideline requirement.

These findings are presented below.

Finding 1 – Adaptation of the 404(b)(1) Guidelines

No significant adaptations of the guidelines were made relative to this evaluation.

Finding 2 – Other Practicable Alternatives with Less Adverse Impact on Aquatic Ecosystems

No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States.

Finding 3 – Inclusion of Conditions to Minimize Pollution and/or Adverse Effects to the Affected Aquatic Ecosystems

As described in the Draft EA, mitigation is proposed to minimize pollution, loss of wetland habitat, and adverse effect on the existing aquatic ecosystem in, and adjacent to, the Missouri River. On-site aquatic habitat will be lost, but will be replaced by in-kind habitat on-site. Mitigation measures relevant to reducing these effects are discussed in Chapter 4 of the Draft EA.

Finding 4 – State Water Quality Standards

The discharge of fill materials will not cause or contribute to violations of any applicable State water quality standards. The discharge operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

Finding 5 – Endangered and Threatened Species

The placement of fill materials for implementation of the proposed project will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended.

Finding 6 – Significant Degradation of U.S. Waters

The placement of fill material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

Finding 7 – Compliance Conclusion

Appropriate steps have been taken to minimize the adverse environmental impact of the proposed action. Turbidity will be monitored so that if levels exceed State water quality standards, the contractor will be required to cease work until conditions return to normal. On the basis of the guidelines, the proposed fill of wetlands are specified as complying with the requirements of these guidelines. The discharge of dredged or fill material complies with the Section 404(b)(1) Guidelines and is considered the least environmentally damaging practicable alternative.

US Army Corps of Engineers, Kansas City District

APPENDIX H

Cultural Resource

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
Kansas and Missouri
Draft Environmental Impact Statement

KANSAS

KSR&C No. 01-10-172

Kansas State Historical Society
Jennie Chinn, *Executive Director*

KATHLEEN SEBELIUS, GOVERNOR

March 23, 2006

Timothy Meade
Cultural Resource Manager
Kansas City District, Corps of Engineers
700 Federal Building
Kansas City, Missouri 64106-2896

RE: Levee Construction Along the Missouri River
Doniphan County

Dear Mr. Meade:

In accordance with 36 CFR 800, the Kansas State Historic Preservation Office has reviewed your letter describing plans to raise Missouri River Levee System Units L-455 and R-471 – 460 in Doniphan County, Kansas. In addition, we have reviewed previous correspondence related to the project (KSR&C #01-10-172). Given the factors outlined in your letter, we concur with the conclusion that the proposed project will have no effect on historic properties as defined in 36 CFR 800. This office has no objection to the project.

Any changes to the project, which include additional ground disturbing activities, will need to be reviewed by this office prior to beginning construction. If construction work uncovers buried archeological materials, work should cease in the area of the discovery and this office should be notified immediately.

This information is provided at your request to assist you in identifying historic properties, as specified in 36 CFR 800 for Section 106 consultation procedures. If you have questions or need additional information regarding these comments, please contact Tim Weston at 785-272-8681 (ext. 214).

Sincerely,

Jennie Chinn, Executive Director and
State Historic Preservation Officer

Timothy Weston for

Patrick Zollner
Deputy SHPO

6425 SW Sixth Avenue • Topeka, KS 66615-1099
Phone 785-272-8681 Ext. 205 • Fax 785-272-8682 • Email jchinn@kshs.org • TTY 785-272-8683
www.kshs.org

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT. CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY. MISSOURI 64106-2896
October 23, 2001

REPLY TO
ATTENTION OF:

Environmental Resources Section
Planning Branch

Dr. Ramon S. Powers
State Historic Preservation Officer
Attention: Mr. Will Banks
Kansas State Historical Society
6425 SW 6th Avenue
Topeka, Kansas 66615-1099

Dear Dr. Powers:

The U.S. Army Corps of Engineers, Kansas City District, is conducting a Feasibility Study of flood damage reduction measures for property currently afforded flood protection by the Missouri River Levee System (MRLS) Unit R 471-460. MRLS R 471-460 is in Doniphan County, Kansas and Buchanan County, Missouri.

The Feasibility Study will determine the existing level of flood protection as well as possible flood damage reduction measures beyond what currently exists. Flood damage reduction measures may include reinforcing the existing structures, raising the existing levee with earth fill or floodwalls with a corresponding rise of appurtenances, and/or development of contingency plans. Following the Feasibility Study, plans and specifications will be prepared for the measures recommended. Land alterations would depend on the selected alternative and these alterations could occur anywhere along the existing levee. Land disturbance could include the placement of fill material landward and/or riverward of the existing levee, construction of access roads, and excavation for borrow materials. Borrow activities could occur riverward or landward in the immediate vicinity of the levee, however, the locations of the borrow areas have not been determined at this time. Coordination with Federal, State, and local agencies as well as the public is required prior to a making a decision on implementation of any of the study alternatives.

In 1996, HDR Engineering Inc., under contract to the Corps of Engineers, conducted a literature/background investigation of prehistoric and historic sites for the document *Reconnaissance Report Missouri River Levee System Units L-455 and R-460-471*. This included consultation with your office. HDR Engineering Inc. found no sites within the same general locale designated for the Feasibility Study area. The limits of the present Feasibility Study area have not been specifically defined, but no disturbance is anticipated to be near any site locations listed in the 1996 report (enclosed). We are requesting an update from your office to advise if any additional sites have been recorded in the Feasibility Study area since the 1996 archeological investigation was completed.

The following maps and aerial mosaic were examined to determine the extent of accreted and disturbed lands in the Feasibility Study area:

a. Abandoned Shipwrecks on Missouri River and Channel Maps of 1879 and 1954, Sheet 11;

b. Missouri River Commission Map of 1893;

c. Missouri River, Kansas City to Sioux City, Revisions from Airplane, October 8 & 14, 1926; and

d. Aerial Photographic Mosaic of MRLS R 471-460 (flown in 2000).

These maps and mosaic demonstrate Missouri River Channel meanders and sand deposits, levee/other construction, and development that have covered most of the Feasibility Study area. Enclosed for your review are transparencies and hard copies of: the MRLS R 471-460 Levee Feasibility Study area (marked in red) in Kansas and the Missouri River channel maps (that can be overlain aligned on the bluffs) to show the levee alignment and former channels that are now accreted lands.

At this early stage of the Feasibility Study, we are planning to conduct an intensive archeological survey of non-accreted lands and any accreted lands with recorded cultural resources. However, archeological surveys are not proposed for: accreted lands formed by deposits of modern alluvium; a non-accreted area surveyed during the 1993 flood event (enclosed); heavily timbered mature stands that will not be land altered; and lands disturbed by past levee construction or other development.

Only two portions of the Feasibility Study area are non-accreted. There is only one small portion unaffected by the above conditions. Enclosures 3 and 4 are highlighted to show the areas that we propose to survey.

The 2000 aerial mosaic, sent under separate cover, indicates disturbance in the southernmost section of the proposed archeological survey area still evident from a levee break during the 1993 flood event. An archeological survey would confirm the degree of disturbance in this area. The mosaic also shows that the other non-accreted portion of the study area, between the Highway 36 and railroad bridges east of Elwood, Kansas, was severely disturbed by development and does not require survey.

The Abandoned Shipwrecks map indicates four possible locations of sunken vessels, the *Dan Converse*, *Watosa*, *Jennie* and *Arethusa*, in the vicinity of the Feasibility Study area. The exact locations of wrecks are unknown because they are deeply buried at least 15 or more feet below ground surface. Any proposed borrow activities would be limited in depth to avoid affecting buried shipwrecks.

In addition to asking for updated site information, the Kansas City District is requesting your concurrence that the area proposed for archeological survey is sufficient and that the remainder of the Feasibility Study area requires no field investigation.

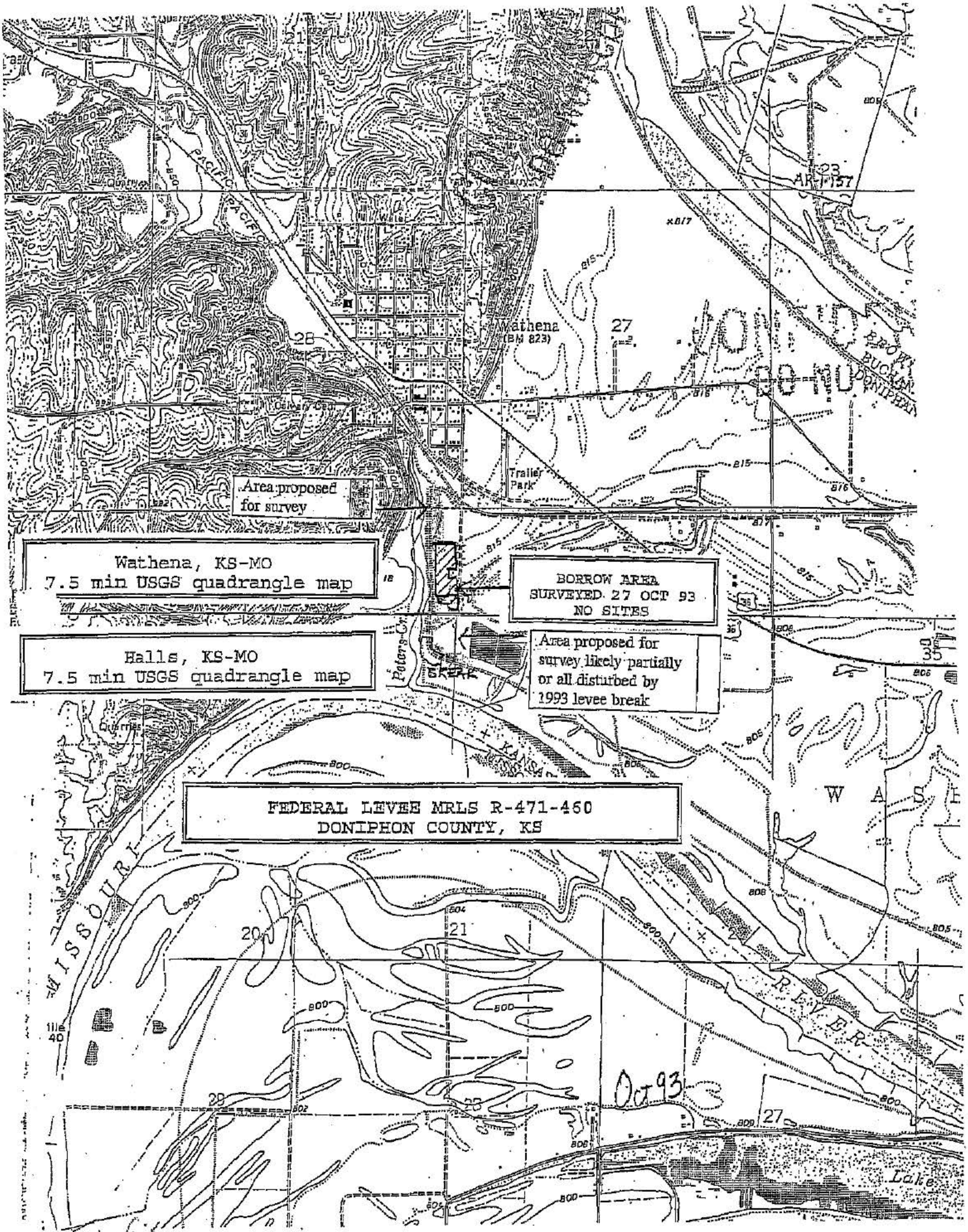
Your comments are requested by November 26, 2001. If you have any questions, please contact Ms. Mary Lucido, of my staff, a[redacted]

Sincerely,

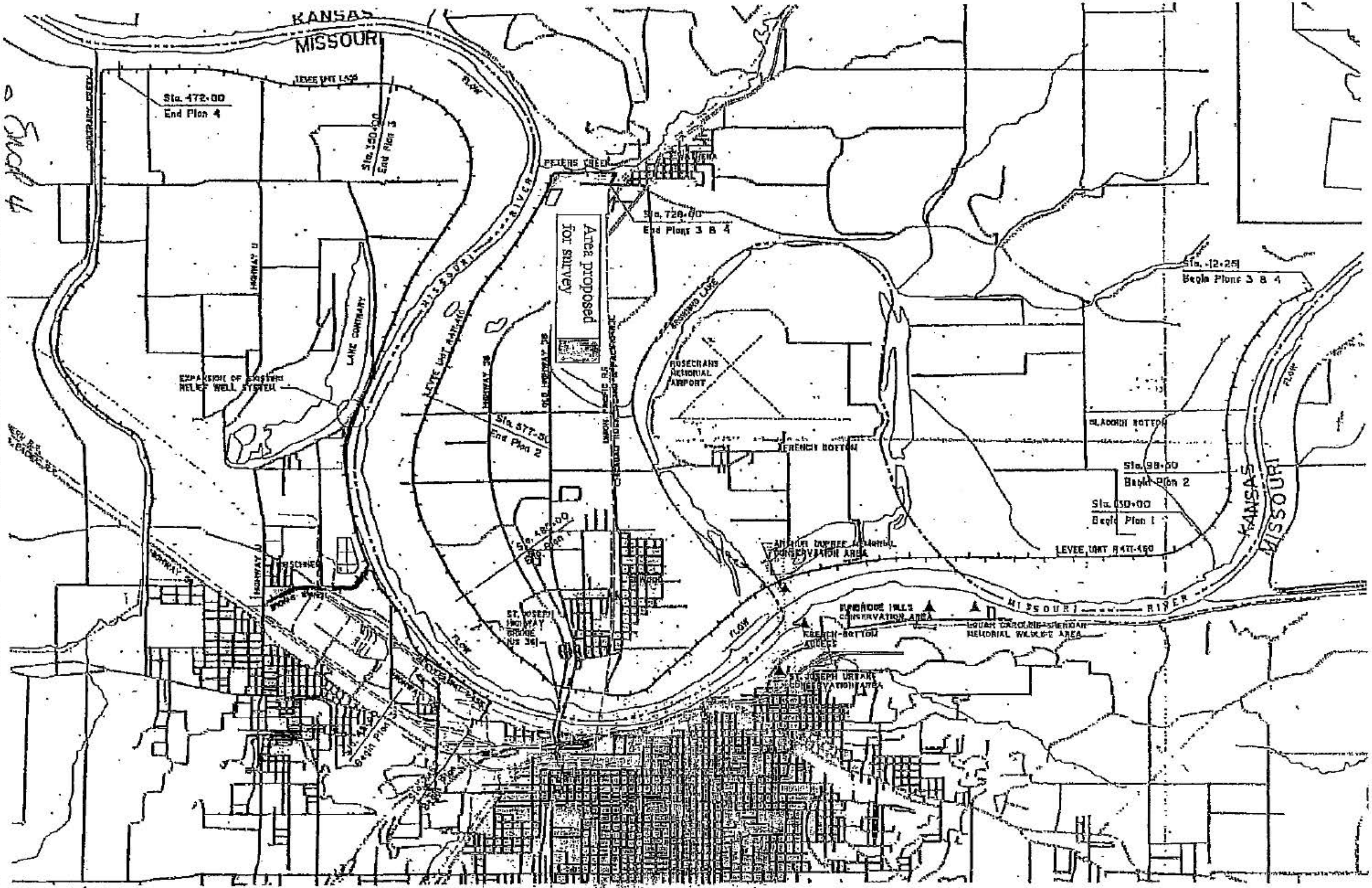
Michael J Bart

Michael J. Bart, P.E.
Chief, Planning Branch

Enclosures



Area proposed for survey
Wathena, KS-MO
7.5 min USGS quadrangle map
BORROW AREA
SURVEYED 27 OCT 93
NO SITES
Halls, KS-MO
7.5 min USGS quadrangle map
Area proposed for survey likely partially or all disturbed by 1993 levee break
FEDERAL LEVEE MRLS R-471-460
DONIPHON COUNTY, KS
Wathena
(BM 823)
Trailer Park
Calvary Cem
Quarries
BREAK
MISSOURI
RIVER
W A S
Lake
Oct 93



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HDR

HDR Engineering, Inc.

Location Of Plans For Levee Raise
Units R471-460 And L455 And O
Expansion Of Relief Well System.

C.O.E. ST. JOSEPH LEVEE STUDY
U.S.A.C.E. Contract DACW41-95-C-0062
HDR Project 02285-008-133

el.dgn

CULTURAL RESOURCE ASSESSMENT
Section 106 Review

CONTACT PERSON/ADDRESS	C:
Michael J. Bart, P.E. Chief, Planning Branch Corps of Engineers, Kansas City District 700 Federal Building Kansas City, Missouri 64106-2896	John Madras, DNR/WPSC Mary Lucido, COE/KC

PROJECT:
MRLS L-455 & R 471-460

FEDERAL AGENCY	COUNTY:
COE	BUCHANAN

The State Historic Preservation Office has reviewed the information submitted on the above referenced project. Based on this review, we have made the following determination:

- [X] After review of initial submission, the project area has a low potential for the occurrence of cultural resources. A cultural resource survey, therefore, is not warranted.
- [ ] Adequate documentation has been provided (36 CFR Section 800.11). There will be "no historic properties affected" by the current project.
- [ ] An adequate cultural resource survey of the project area has been previously conducted. It has been determined that for the proposed undertaking there will be "no historic properties affected".
- [ ] The proposed undertaking will have "no adverse effect" on properties listed on or determined eligible for listing in the National Register of Historic Places.

For the above checked reason, the State Historic Preservation Office has no objection to the initiation of project activities. PLEASE BE ADVISED THAT, IF THE CURRENT PROJECT AREA OR SCOPE OF WORK ARE CHANGED, A BORROW AREA IS INCLUDED IN THE PROJECT, OR CULTURAL MATERIALS ARE ENCOUNTERED DURING CONSTRUCTION, APPROPRIATE INFORMATION MUST BE PROVIDED TO THIS OFFICE FOR FURTHER REVIEW AND COMMENT. Please retain this documentation as evidence of compliance with Section 106 of the National Historic Preservation Act, as amended.

By: ______________________________ November 6, 2001
Claire F. Blackwell, Deputy State Historic Preservation Officer — Date

MISSOURI DEPARTMENT OF NATURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE
P.O. Box 176, Jefferson City, Missouri 65102
For additional information, please contact Judith Deel, (573) 751-7862. Please be sure to refer to the project number:
010-BN-02

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896
October 30, 2001

REPLY TO
ATTENTION OF:

Environmental Resources Section
Planning Branch

Ms. Claire Blackwell
Deputy State Historic Preservation Officer
Attention: Ms. Judith Deel
Department of Natural Resources
P. O. Box 176
Jefferson City, Missouri 65102-0176

Dear Ms. Blackwell:

The U.S. Army Corps of Engineers, Kansas City District is conducting a Feasibility Study of flood damage reduction measures for property currently afforded flood protection by the Missouri River Levee System (MRLS) Units L-455 and R 471-460. MRLS L-455 is in Buchanan County, Missouri and MRLS R 471-460 is in Buchanan County, Missouri and Doniphan County, Kansas. A relatively short reach of MRLS R 471-460 is located in Missouri and will be addressed in this correspondence. The remainder of MRLS R 471-460 is located in Kansas and will be addressed in correspondence to that State Historic Preservation Officer.

The Feasibility Study will determine the existing level of flood protection as well as possible flood damage reduction measures beyond what currently exists. Flood damage reduction measures may include reinforcing the existing structures, raising the existing levees with earth fill or floodwalls with a corresponding rise of appurtenances, and/or development of contingency plans. Following the Feasibility Study, plans and specifications will be prepared for the measures recommended. Land alterations would depend on the selected alternative and these alterations could occur anywhere along the existing levees. Land disturbance could include the placement of fill material landward and/or riverward of the existing levees, construction of access roads, and excavation for borrow materials. Borrow activities could occur riverward or landward in the immediate vicinity of the levees, however, the locations of the borrow areas have not been determined at this time. Coordination with Federal, State, and local agencies as well as the public is required prior to a making a decision on implementation of any of the study alternatives.

In 1996, HDR Engineering, Inc., under contract to the Corps of Engineers, conducted a literature/background investigation of prehistoric and historic sites for the document *Reconnaissance Report Missouri River Levee System Units L-455 and R-460-471*. This included consultation with your office. HDR Engineering, Inc. found no sites within the same general locale designated for the Feasibility Study area. The limits of the present Feasibility Study area have not been specifically defined, but no disturbance is anticipated to be near any site locations listed in the 1996 report (enclosed). An October 5, 2001 files search with the Archaeological

Survey of Missouri revealed no additional sites were recorded in the vicinity of the Feasibility Study area since the 1996 archeological investigation was completed.

The following maps and aerial mosaics were examined to determine the extent of accreted and disturbed lands in the Feasibility Study area:

a. Abandoned Shipwrecks on Missouri River and Channel Maps of 1879 and 1954, Sheet 11;

b. Missouri River Commission Map of 1893;

c. Missouri River, Kansas City to Sioux City, Revisions from Airplane, October 8 & 14, 1926; and

d. Aerial Photographic Mosaics of the entire MRLS L-455 levee and sections of non-accreted lands along L-455 (flown in 1997 [black and white] and in 2000 [color]) and R 471-460 (flown in 2000[color]).

These maps and mosaics demonstrate Missouri River Channel meanders and sand deposits, levee/other construction, and development that have covered most of the Feasibility Study area. Enclosed for your review are transparencies and hard copies of: the MRLS L-455 and R 471-460 Levees Feasibility Study areas (marked in red) in Missouri and the Missouri River channel maps (that can be overlain aligned on the bluffs and railroad tracks) to show the levee alignments and former channels that are now accreted lands.

At this early stage of the Feasibility Study, we are proposing to conduct an intensive archeological survey along specific sections of MRLS L-455, but no portion of MRLS R 471-460 in Missouri. The 1951 flood altered the river alignment by cutting a channel near the present location of MRLS R 471-460 in Missouri. Although this portion of the Feasibility Study area is comprised of non-accreted land, it was extensively disturbed by construction to stabilize the channel cut-off created in 1951 and build the adjacent levee to such an extent that additional disturbance would not impact any historic properties. It is proposed that cultural resources field investigation of MRLS R 471-460 in Missouri is not necessary.

Enclosed is a map highlighted with three undisturbed, non-accreted land areas that we propose to survey along MRLS L-455. The map also shows disturbed non-accreted lands in which no survey is proposed. Archeological survey is not proposed in: accreted lands formed by deposits of modern alluvium; heavily timbered mature stands that will not be land altered; and lands disturbed by past levee construction or other development. The 1997 and 2000 aerial mosaics, sent under separate cover, are keyed to the map and show the non-accreted lands and disturbances.

The Abandoned Shipwrecks map indicates two possible locations of sunken vessels, the *Mt. Sterling* and the *Pathfinder*, in the vicinity of the Feasibility Study area. The exact locations of wrecks are unknown because they are deeply buried at least 15 or more feet below ground surface. Any proposed borrow activities would be limited in depth to avoid affecting buried shipwrecks.

The Kansas City District is requesting your concurrence that the areas proposed for archeological survey are sufficient and that the remainder of the MRLS L-455 and R 471-460 located in the Missouri portion of the Feasibility Study area require no field investigation. Your comments are requested by December 3, 2001.

If you have any questions, please contact Ms. Mary Lucido, of my staff, at 816-983-3139.

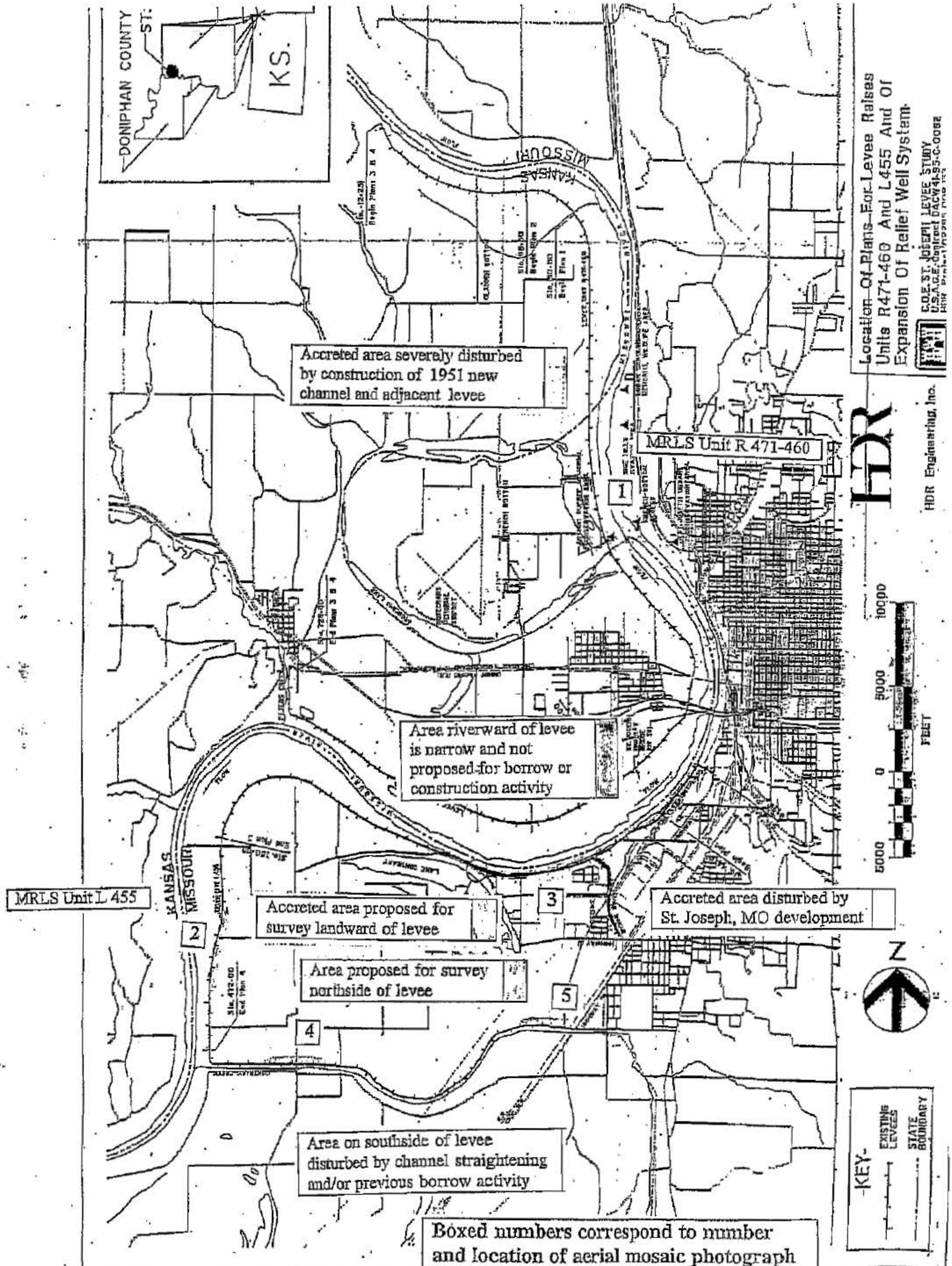
Sincerely,

Michael J. Bart

Michael J. Bart, P.E.
Chief, Planning Branch

Enclosures

CF:
PM-PF/Detrick (w/encl)


Accreted area severely disturbed by construction of 1951 new channel and adjacent levee
MRLS Unit R 471-460
1
Area riverward of levee is narrow and not proposed for borrow or construction activity
MRLS Unit L 455
KANSAS
MISSOURI
2
Accreted area proposed for survey landward of levee
3
Accreted area disturbed by St. Joseph, MO development
Area proposed for survey northside of levee
5
4
Area on southside of levee disturbed by channel straightening and/or previous borrow activity
Boxed numbers correspond to number and location of aerial mosaic photograph
DONIPHAN COUNTY
KS.
Location Of Plans For Levee Raises Units R471-460 And L455 And Of Expansion Of Relief Well System.
HDR Engineering, Inc.
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-KEY-
EXISTING LEVEES
STATE BOUNDARY

Encl 3

KANSAS

STATE

HISTORICAL

SOCIETY

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Cultural Resources Division

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6425 S.W. 6th Avenue
Topeka, Kansas
66615-1099
PHONE# (785) 272-8681
FAX# (785) 272-8682
TTY# (785) 272-8683

◆

KANSAS HISTORY CENTER

Administration
Center for Historical Research
Cultural Resources
Education / Outreach
Historic Sites
Kansas Museum of History
Library & Archives

November 8, 2001

Michael J Bart
Kansas City District, Corps of Engineers
700 Federal Building
Kansas City, Missouri 64106-2896

RE: Feasibility Study of Flood Damage Reduction Measures
Doniphan County, Kansas

Dear Mr. Bart:

Our office has received and reviewed your correspondence dated October 23, 2001, concerning the above referenced project. Our site files do not indicate that there have been any additional archeological sites recorded in the proposed project area. Our office concurs that the areas proposed for archeological survey are sufficient in scope, and that there are no other locations in the proposed study area that warrant additional field investigations.

If you have any questions or need additional information concerning these comments, please contact Will Banks at [redacted] ext. 214.

Sincerely,

Ramon Powers
State Historic Preservation Officer

Richard Pankratz, Director
Historic Preservation Office

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896

REPLY TO
ATTENTION OF:

June 21, 2002

Environmental Resources Section
Planning Branch

Dr. Ramon S. Powers
State Historic Preservation Officer
Kansas State Historical Society
6425 SW 6th Avenue
Topeka, Kansas 66615-1099

Dear Dr. Powers:

On October 23, 2001, the Kansas City District sent a letter to your office on the Feasibility Study of flood damage reduction measures for property currently afforded flood protection by the Missouri River Levee System (MRLS) Unit R 471-460. MRLS R 471-460 is in Doniphan County, Kansas, and Buchanan County, Missouri. That letter identified those portions of the Kansas side of the levee for which we proposed an archeological survey. Your letter response of November 8, 2001, (enclosed) concurred that these were the only areas within the Feasibility Study area in Kansas that required survey.

On May 15, 2002, an archeological survey was conducted in the agreed upon survey areas. No cultural materials were found. A report of findings on the field investigation, a map of the surveyed areas, and digital photographs of ground conditions are enclosed for your information. There are no historic properties that would be affected by the proposed undertaking. We feel no additional historic properties investigation is necessary for the Feasibility Study area.

Pursuant to Section 106 of the National Historic Preservation Act (16 USC 470f), we have made a determination of "No Historic Properties Affected" for the proposed undertaking. The Kansas City District is requesting your written concurrence of this determination. Also, please provide your concurrence that no additional historic properties investigation is necessary.

Please provide your response by July 24, 2002. If you have any questions, please contact Ms. Mary Lucido, of my staff, [redacted]

Sincerely,

Michael J. Bart

Michael J. Bart, P.E.
Chief, Planning Branch

Enclosures

Archeological Field Survey of Two Areas in Kansas of the Missouri River Levee System (MRLS) Unit R 471-460 in Doniphan County, Kansas

A field survey was conducted in two areas adjoining Federal Levee MRLS R-471-460 along Peters Creek south of Wathena, Kansas on 15 May 2002. The locale was divided into two sections. The northern survey section was approximately 9.438 acres. The southern survey section was about 9.138 acres and mostly scoured and refilled/leveled because of the 1993 flood. *(The middle section, in-between the survey areas, was examined during the 1993 flood for a possible borrow area, but no sites were found there. No borrow was taken from there, but it had been cleared for cultural resources.)*

Both the northern and southern areas consisted of agricultural fields recently planted to corn, which was no more than three inches in height. There was no standing stubble, and very little plant debris from last year's crop, making surface visibility 90% or better throughout both fields. There had recently been a soaking rain, but soil conditions were mostly dry, with slightly muddy areas in a very few small low-lying spots.

A walkover survey was performed with parallel courses about 5 meters apart. No shovel tests were necessary because of the excellent visibility. No artifacts or evidence of any sort of prehistoric occupation was found. In fact, the northern unit had no lithics of any sort, and the southern unit had only a scattering of river gravel and glacial erratics in one small spot, which stood out because the remainder of the field was bare soil. The river gravel and glacial erratics were located in the vicinity of a previous levee break and repair work associated with the 1993 flood event.

Digital photographs, taken during the survey, are enclosed. The photographs, labeled to show the North Field and South Field, illustrate the typical soil and ground conditions.

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KANSAS

STATE

HISTORICAL

SOCIETY

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Cultural Resources Division

Extension 240

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6425 S.W. 6th Avenue
Topeka, Kansas
66615-1099
PHONE# (785) 272-8681
FAX# (785) 272-8682
TTY# (785) 272-8683

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KANSAS HISTORY CENTER

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Center for Historical Research
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Education / Outreach
Historic Sites
Kansas Museum of History
Library & Archives

HISTORIC SITES

Adair Cabin
Constitution Hall
Cottonwood Ranch
First Territorial Capitol
Fort Hays
Goodnow House
Grinter Place
Hollenberg Station
Kaw Mission
Marais des Cygnes Massacre
Mine Creek Battlefield
Native American Heritage Museum
Pawnee Indian Village
Pawnee Rock
Shawnee Indian Mission

July 8, 2002

Michael J Bart
Kansas City District Corps of Engineers
700 Federal Building
Kansas City MO 64106-2896

RE: Feasibility Study of Flood Damage Reduction Measures - KSR&C # 01-10-172
Doniphan County

Dear Mr. Bart:

In accordance with 36 CFR 800, the Kansas State Historic Preservation Office has reviewed the report entitled *Archeological Field Survey of Two Areas in Kansas of the Missouri River Levee System (MRLS) Unit R 471-460 in Doniphan County, Kansas.* We concur with the conclusion that the proposed project will have no effect on historic properties as defined in 36 CFR 800. This office has no objection to implementation of the project.

Any changes to the project, which include additional ground disturbing activities, will need to be reviewed by this office prior to beginning construction. If construction work uncovers buried archeological materials, work should cease in the area of the discovery and this office should be notified immediately.

This information is provided at your request to assist you in identifying historic properties, as specified in 36 CFR 800 for Section 106 consultation procedures. If you have questions or need additional information regarding these comments, please contact Will Banks 785-272-8681 (ex. 214) or Jennifer Epperson (ex. 225). On all future correspondence regarding this project, please reference the KSR&C number listed above.

Sincerely,

Mary R. Allman
State Historic Preservation Officer

Richard Pankratz

Richard Pankratz, Director
Cultural Resources Division

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896

March 14, 2006

REPLY TO
ATTENTION OF

Environmental Resources Section
Planning Branch

Ms. Jennie A. Chinn
Executive Director, State Historic Preservation Officer
Kansas State Historical Society
6425 S. W. 6th Avenue
Topeka, Kansas 66615-1099

Dear Ms. Chinn:

The U.S. Army Corps of Engineers, Kansas City District, is planning to raise Missouri River Levee System Units L-455 and R-471-460 in Doniphan County, Kansas and Buchanan County, Missouri. The Kansas portion of the project was previously coordinated with your office in October 2001 and July 2002 (KSR&C#01-10-172). This letter continues Section 106 coordination for the proposed project.

The 2001 letter coordinated the proposed project area, the results of a cultural resources background reconnaissance conducted for the Corps, and the results of an accreted land study. Based on the results of the background and accreted land study the Corps recommended an archeological survey for a portion of the project area and no further work for the remainder of the area. On November 8, 2001, your office concurred with these recommendations. On June 21, 2002, the Corps coordinated the results of the completed survey of the agreed upon area. No cultural resource sites or materials were identified during the survey. In a letter dated June 21, 2002, the Corps recommended no further work in the proposed project area. SHPO concurred with this recommendation on July 8, 2002, with the stipulation that any additional ground disturbing activities be submitted for review prior to construction.

The Kansas City District has now identified potential borrow locations for the proposed project located in Doniphan County, Kansas, and Buchanan County, Missouri (Figure 1). The identified borrow areas are located riverward of the existing levee. The exact borrow locations and amounts needed have yet to be determined but would be taken from locations within the areas identified in Figures 1 and 2. Borrow material, or a portion of the borrow, may also be dredged from the current river channel. The amount of borrow needed would depend on the selected level of flood protection (i.e. protection for a 500 year flood event would require a higher levee then a 100 year protection raise and would therefore require more borrow material). The exact depth of impact for obtaining the borrow has not been determined. However, based on the existing conditions and the needs of past similar projects it's estimated that the depth of borrow would be less than 10 feet below the present ground surface. The total area for the proposed borrow areas is 933.7 acres. The area for the levee easement that was coordinated with your office in 2001 and 2002 is 794 acres.

A cultural resources reconnaissance report for the proposed project was completed for the Corps in May of 1996 and coordinated with the Kansas SHPO. No National Register of Historic Places (NRHP) sites or other archeological sites were identified within the project area. In November 2001, SHPO confirmed that no additional sites had been recorded within the study area. However, a number of shipwrecks have been recorded in the vicinity of the project including the Dan Converse (1858), the Watosa (1858), Jennie (1890), Bertha (1873), Denver No.1 (1867), Denver City (1867), Dorothy (1920), Mt. Sterling (1918), and Pathfinder (unknown) (Figure 3). All of the shipwrecks are located near the proposed borrow locations and/or the modern Missouri River channel. These areas will be avoided during borrowing activities or during river dredging if that option is selected.

The Kansas City District has updated the accreted lands study of the proposed project area including the proposed borrow locations (Figure 4). The study was undertaken by using GIS to overlay historic Corps of Engineer Missouri River channel maps from 1804, 1879, 1892, 1926, 1954, and present maps to show the various locations of the river channel. The former channel locations are then considered accreted land. The study found that the majority (629.42 acres) of the borrow areas have been determined to be accreted land from the historic channel maps. The remainder of the borrow areas, 304.35 acres, (shown in white in Figure 4) could not be positively identified as accreted by the historic maps from the specific years. However, based on the location of the undetermined areas it is likely that most or all of this area is accreted land as well.

In addition, it is likely that the proposed borrow areas have been previously disturbed by past borrowing activity. A review of construction schematics for the existing levee system from 1962 show that the borrow material obtained for this past levee construction was taken largely from the same areas as proposed for the present borrow (Figure 5a and b). Since the construction of the present levees these borrow areas have largely filled in with recent alluvial deposit.

In sum, no historic properties, archeological sites, or historic structures are recorded within the proposed project area. Shipwrecks located in the vicinity of the project will be avoided during construction, borrowing, and dredging activities. The proposed borrow easements are situated in areas that have been identified as accreted land or are likely accreted land. In addition, the majority of these areas were previously used as borrow locations as indicated on 1962 schematics.

Given the lack of previously recorded sites, the avoidance of the shipwreck locations, the accreted lands, and previous disturbances in the area; it is unlikely that the project will impact historic properties. Therefore, we recommend that no archeological survey be conducted for the proposed project.

At this time we are requesting your concurrence that the project will have no affect on historic properties and that the project be allowed to proceed with no further consultation with your office. If in the unlikely event that archeological materials are discovered during project construction, work in the area of discovery will cease and the discovery investigated by a qualified archeologist. The findings on the discovery would be coordinated with your office and appropriate federally recognized Native American tribes, if appropriate.

Thank you for your consideration in [redacted] have any questions or have need of further information please contact me at [redacted] or at Timothy.M.Meade@usace.army.mil.

Sincerely,

Timothy Meade
Cultural Resource Manager

Enclosure

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896

March 14, 2006

REPLY TO
ATTENTION OF

Environmental Resources Section
Planning Branch

Ms. Jennie A. Chinn
Executive Director, State Historic Preservation Officer
Kansas State Historical Society
6425 S. W. 6th Avenue
Topeka, Kansas 66615-1099

Dear Ms. Chinn:

The U.S. Army Corps of Engineers, Kansas City District, is planning to raise Missouri River Levee System Units L-455 and R-471-460 in Doniphan County, Kansas and Buchanan County, Missouri. The Kansas portion of the project was previously coordinated with your office in October 2001 and July 2002 (KSR&C#01-10-172). This letter continues Section 106 coordination for the proposed project.

The 2001 letter coordinated the proposed project area, the results of a cultural resources background reconnaissance conducted for the Corps, and the results of an accreted land study. Based on the results of the background and accreted land study the Corps recommended an archeological survey for a portion of the project area and no further work for the remainder of the area. On November 8, 2001, your office concurred with these recommendations. On June 21, 2002, the Corps coordinated the results of the completed survey of the agreed upon area. No cultural resource sites or materials were identified during the survey. In a letter dated June 21, 2002, the Corps recommended no further work in the proposed project area. SHPO concurred with this recommendation on July 8, 2002, with the stipulation that any additional ground disturbing activities be submitted for review prior to construction.

The Kansas City District has now identified potential borrow locations for the proposed project located in Doniphan County, Kansas, and Buchanan County, Missouri (Figure 1). The identified borrow areas are located riverward of the existing levee. The exact borrow locations and amounts needed have yet to be determined but would be taken from locations within the areas identified in Figures 1 and 2. Borrow material, or a portion of the borrow, may also be dredged from the current river channel. The amount of borrow needed would depend on the selected level of flood protection (i.e. protection for a 500 year flood event would require a higher levee then a 100 year protection raise and would therefore require more borrow material). The exact depth of impact for obtaining the borrow has not been determined. However, based on the existing conditions and the needs of past similar projects it's estimated that the depth of borrow would be less than 10 feet below the present ground surface. The total area for the proposed borrow areas is 933.7 acres. The area for the levee easement that was coordinated with your office in 2001 and 2002 is 794 acres.

A cultural resources reconnaissance report for the proposed project was completed for the Corps in May of 1996 and coordinated with the Kansas SHPO. No National Register of Historic Places (NRHP) sites or other archeological sites were identified within the project area. In November 2001, SHPO confirmed that no additional sites had been recorded within the study area. However, a number of shipwrecks have been recorded in the vicinity of the project including the Dan Converse (1858), the Watosa (1858), Jennie (1890), Bertha (1873), Denver No.1 (1867), Denver City (1867), Dorothy (1920), Mt. Sterling (1918), and Pathfinder (unknown) (Figure 3). All of the shipwrecks are located near the proposed borrow locations and/or the modern Missouri River channel. These areas will be avoided during borrowing activities or during river dredging if that option is selected.

The Kansas City District has updated the accreted lands study of the proposed project area including the proposed borrow locations (Figure 4). The study was undertaken by using GIS to overlay historic Corps of Engineer Missouri River channel maps from 1804, 1879, 1892, 1926, 1954, and present maps to show the various locations of the river channel. The former channel locations are then considered accreted land. The study found that the majority (629.42 acres) of the borrow areas have been determined to be accreted land from the historic channel maps. The remainder of the borrow areas, 304.35 acres, (shown in white in Figure 4) could not be positively identified as accreted by the historic maps from the specific years. However, based on the location of the undetermined areas it is likely that most or all of this area is accreted land as well.

In addition, it is likely that the proposed borrow areas have been previously disturbed by past borrowing activity. A review of construction schematics for the existing levee system from 1962 show that the borrow material obtained for this past levee construction was taken largely from the same areas as proposed for the present borrow (Figure 5a and b). Since the construction of the present levees these borrow areas have largely filled in with recent alluvial deposit.

In sum, no historic properties, archeological sites, or historic structures are recorded within the proposed project area. Shipwrecks located in the vicinity of the project will be avoided during construction, borrowing, and dredging activities. The proposed borrow easements are situated in areas that have been identified as accreted land or are likely accreted land. In addition, the majority of these areas were previously used as borrow locations as indicated on 1962 schematics.

Given the lack of previously recorded sites, the avoidance of the shipwreck locations, the accreted lands, and previous disturbances in the area; it is unlikely that the project will impact historic properties. Therefore, we recommend that no archeological survey be conducted for the proposed project.

At this time we are requesting your concurrence that the project will have no affect on historic properties and that the project be allowed to proceed with no further consultation with your office. If in the unlikely event that archeological materials are discovered during project construction, work in the area of discovery will cease and the discovery investigated by a qualified archeologist. The findings on the discovery would be coordinated with your office and appropriate federally recognized Native American tribes, if appropriate.

Thank you for your consideration in this matter. If you have any questions or have need of further information please contact me at [redacted] or at Timothy.M.Meade@usace.army.mil.

Sincerely,

Timothy Meade
Cultural Resource Manager

Enclosure

U.S. Army Corps of Engineers, Kansas City District

APPENDIX I

Corps of Engineers Regulatory Wetland Jurisdictional Determination

Missouri River Levee System
Units L-455 and R471-460
Flood Damage Reduction Study
Kansas and Missouri
Draft Environmental Impact Statement

CENK-OD-R (1145-b) 6 May 2005

MEMORANDUM FOR RECORD - FOR PM-PR

SUBJECT: Request for Review of Offsite Wetland Determination for Feasibility Study of MRLS L455 and R460-471 Increase Flood Protection Project.

1. At the request of PM-PR, OD-R has completed a review of the wetland delineation for the subject project. The project number for this request is 200501489. Please reference this number is all correspondence regarding the project.

2. OD-R concurs with the methods employed to complete the offsite determination and the field verification of the wetland areas. Therefore, OD-R concurs with the findings.

3. Any questions concerning the information furnished should be directed to me [redacted] (FAX 816-426-2321).

Douglas R. Berka
Regulatory Project Manager, OD-R

Encls.
JD Form
Memorandum thru OD-R
Attachments 1-7

JURISDICTIONAL DETERMINATION	Revised 8/13/04
U.S. Army Corps of Engineers

DISTRICT OFFICE: Kansas City District (CENWK)
FILE NUMBER: 200501489

PROJECT LOCATION INFORMATION:

State: Missouri and Kansas
County: Buchanan and Doniphan
Center coordinates of site (latitude/longitude):
Approximate size of area (parcel) reviewed, including uplands: Approx. 5000 acres.
Name of nearest waterway: Missouri River
Name of watershed: Missouri River

JURISDICTIONAL DETERMINATION

Completed: Desktop determination ☒ Date: May 6, 2005
Site visit(s) ☐ Date(s):

Jurisdictional Determination (JD):

☐ Preliminary JD - Based on available information, ☐ *there appear to be* (or) ☐ *there appear to be no* "waters of the United States" and/or "navigable waters of the United States" on the project site. A preliminary JD is not appealable (Reference 33 CFR part 331).

☒ Approved JD – An approved JD is an appealable action (Reference 33 CFR part 331).
Check all that apply:

☐ *There are* "navigable waters of the United States" (as defined by 33 CFR part 329 and associated guidance) within the reviewed area. Approximate size of jurisdictional area:

☒ *There are* "waters of the United States" (as defined by 33 CFR part 328 and associated guidance) within the reviewed area. Approximate size of jurisdictional area: acres.

☐ *There are "isolated, non-navigable, intra-state* waters or wetlands" within the reviewed area.
☐ Decision supported by SWANCC/Migratory Bird Rule Information Sheet for Determination of No Jurisdiction.

BASIS OF JURISDICTIONAL DETERMINATION:

A. **Waters defined under 33 CFR part 329 as "navigable waters of the United States":**
☐ The presence of waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.

B. **Waters defined under 33 CFR part 328.3(a) as "waters of the United States":**
☐ (1) The presence of waters, which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide.
☐ (2) The presence of interstate waters including interstate wetlands[1].
☐ (3) The presence of other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate commerce including any such waters (check all that apply):
☐ (i) which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ (ii) from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ (iii) which are or could be used for industrial purposes by industries in interstate commerce.
☐ (4) Impoundments of waters otherwise defined as waters of the US.
☐ (5) The presence of a tributary to a water identified in (1) – (4) above.
☐ (6) The presence of territorial seas.
☒ (7) The presence of wetlands adjacent[2] to other waters of the US, except for those wetlands adjacent to other wetlands.

Rationale for the Basis of Jurisdictional Determination (applies to any boxes checked above). *If the jurisdictional water or wetland is not itself a navigable water of the United States, describe connection(s) to the downstream navigable waters. If B(1) or B(3) is used as the Basis of Jurisdiction, document navigability and/or interstate commerce connection (i.e., discuss site conditions, including why the waterbody is navigable and/or how the destruction of the waterbody could affect interstate or foreign commerce). If B(2, 4, 5 or 6) is used as the Basis of Jurisdiction, document the rationale used to make the determination. If B(7) is used as the Basis of Jurisdiction, document the rationale used to make adjacency determination:* The identified wetland areas are on the floodplain of the Missouri River and therefore are considered adjacent to a navigable water of the United States.

Lateral Extent of Jurisdiction: (Reference: 33 CFR parts 328 and 329)

☒ Ordinary High Water Mark indicated by:
- ☐ clear, natural line impressed on the bank
- ☐ the presence of litter and debris
- ☐ changes in the character of soil
- ☐ destruction of terrestrial vegetation
- ☐ shelving
- ☒ other: Wetland Boundary

☐ High Tide Line indicated by:
- ☐ oil or scum line along shore objects
- ☐ fine shell or debris deposits (foreshore)
- ☐ physical markings/characteristics
- ☐ tidal gages
- ☐ other:

☐ Mean High Water Mark indicated by:
☐ survey to available datum; ☐ physical markings; ☐ vegetation lines/changes in vegetation types.

☒ Wetland boundaries, as shown on the attached wetland delineation map and/or in a delineation report prepared by: David Hibbs, Biologist, Kansas City District Corps of Engineers, PM-PR

Basis For Not Asserting Jurisdiction:

☐ The reviewed area consists entirely of uplands.
☐ Unable to confirm the presence of waters in 33 CFR part 328(a)(1, 2, or 4-7).
☐ Headquarters declined to approve jurisdiction on the basis of 33 CFR part 328.3(a)(3).
☐ The Corps has made a case-specific determination that the following waters present on the site are not Waters of the United States:
- ☐ Waste treatment systems, including treatment ponds or lagoons, pursuant to 33 CFR part 328.3.
- ☐ Artificially irrigated areas, which would revert to upland if the irrigation ceased.
- ☐ Artificial lakes and ponds created by excavating and/or diking dry land to collect and retain water and which are used exclusively for such purposes as stock watering, irrigation, settling basins, or rice growing.
- ☐ Artificial reflecting or swimming pools or other small ornamental bodies of water created by excavating and/or diking dry land to retain water for primarily aesthetic reasons.
- ☐ Water-filled depressions created in dry land incidental to construction activity and pits excavated in dry land for the purpose of obtaining fill, sand, or gravel unless and until the construction or excavation operation is abandoned and the resulting body of water meets the definition of waters of the United States found at 33 CFR 328.3(a).
- ☐ Isolated, intrastate wetland with no nexus to interstate commerce.
- ☐ Prior converted cropland, as determined by the Natural Resources Conservation Service. Explain rationale:
- ☐ Non-tidal drainage or irrigation ditches excavated on dry land. Explain rationale:
- ☐ Other (explain):

DATA REVIEWED FOR JURSIDICTIONAL DETERMINATION (mark all that apply):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant.
☐ Data sheets prepared/submitted by or on behalf of the applicant.
- ☐ This office concurs with the delineation report, dated , prepared by (company):
- ☐ This office does not concur with the delineation report, dated , prepared by (company):

☐ Data sheets prepared by the Corps.
☐ Corps' navigable waters' studies:
☐ U.S. Geological Survey Hydrologic Atlas:
☒ U.S. Geological Survey 7.5 Minute Topographic maps:
☐ U.S. Geological Survey 7.5 Minute Historic quadrangles:
☐ U.S. Geological Survey 15 Minute Historic quadrangles:
☒ USDA Natural Resources Conservation Service Soil Survey:
☒ National wetlands inventory maps:
☒ State/Local wetland inventory maps:
☐ FEMA/FIRM maps (Map Name & Date):
☐ 100-year Floodplain Elevation is: (NGVD)
☒ Aerial Photographs (Name & Date): February 2000
☒ Other photographs (Date):
☐ Advanced Identification Wetland maps:
☒ Site visit/determination conducted on: November 2002
☐ Applicable/supporting case law:
☒ Other information (please specify): USDA, Farm Service Agency compliance slides

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[1]Wetlands are identified and delineated using the methods and criteria established in the Corps Wetland Delineation Manual (87 Manual) (i.e., occurrence of hydrophytic vegetation, hydric soils and wetland hydrology).

[2]The term "adjacent" means bordering, contiguous, or neighboring. Wetlands separated from other waters of the U.S. by man-made dikes or barriers, natural river berms, beach dunes, and the like are also adjacent.

20050 1489

CENWK-PM-PR 16 December 2002

MEMORANDUM FOR RECORD, THRU OD-R

SUBJECT: MRLS L455 AND R460-471 Increased Flood Protection Feasibility Study, Wetland Jurisdictional Determination

1. The U.S. Army Corps of Engineers, Kansas City District, has begun a Feasibility Study and NEPA review of flood damage reduction measures for property currently afforded flood protection by the Missouri River Levee System (MRLS) Units L-455 and R 471-460, in Buchanan County, Missouri and Doniphan County, Kansas (Figure 1). The purpose of the study and NEPA review is to consider the economic, environmental, and social impacts that may occur as a result of various alternatives being considered in a flood damage reduction study, concerning flood protection provided by the existing MRLS Units L-455 and R 471-460. Structural alternatives may include reinforcing the existing structures, raising the existing levee with earth fill or floodwalls with a corresponding rise of appurtenances. The purpose of this memorandum is to outline and document the procedures used to make an off-site jurisdictional wetland determination for the potentially affected project area.

2. The MRLS Units L-455 and R 471-460, are existing flood damage reduction projects which provide local flood protection for agricultural areas, the metropolitan area of St. Joseph, Missouri and the communities of Wathena and Elwood in Kansas. The two levee units are located on opposite sides of the Missouri River.

Levee unit L-455 is located on the left bank of the Missouri River in Buchanan County, Missouri, and adjoins the southwestern part of St. Joseph, Missouri. The levee unit extends from Missouri River mile 447.3 downstream to mile 437.3 and then upstream along Contrary Creek. Levee unit L-455 is 15.6 miles long, averages 13 feet in height, and protects approximately 7,500 acres of urban and rural areas from flooding. Rural lands consist of about 6,500 acres. Urban lands include industrial, commercial, and residential areas of the city of St. Joseph, Missouri, including the residential and recreational development in the Lake Contrary area.

Levee unit R 471-460 is located on the right bank of the Missouri River between river mile 441.7 and 456.6 in eastern Doniphan County, Kansas, and a portion of western Buchanan County, Missouri. This levee unit is 13.8 miles long, averages 14.8 feet in height and protects approximately 13,500 acres of rural and urban areas from flooding. Rural lands consist of about 10,000 acres. Urban lands include the communities of Elwood and Wathena, Kansas. It also includes the area within the oxbow, which is a part of St. Joseph, Missouri and contains the Rosecrans Memorial Airport and the Missouri Air National Guard Base.

3. The procedures used to make this off-site jurisdictional wetland determination for the potentially affected project area followed the basic process outlined by the "Kansas Wetland Conventions, A Technical Document for Wetland Determinations/Delineations

in Kansas" (Attachment 1). The potentially affected project area (determination area) consisted of approximately 2,000 feet on each side of MRLS Units L-455 and R 471-460, a lineal strip 2,000 feet perpendicular from the centerline on each side of each levee. The wetland determination was conducted during the Fall of 2002, September through December. I, the undersigned, conducted the determination based on past professional experience. The determination utilized four primary sources of data for recording on a base map: Soil Survey Data, National Wetland Inventory Data, Farm Service Agency aerial slide data, and high-resolution aerial photography. Other sources of information that were considered and consulted with included the U.S.G.S. topographic maps, the Missouri River Wetland Hydrology Tool (attachment 2), and drainage ditches/structures through the existing levees.

4. The off-site wetland determination utilized high-resolution aerial photography from February 2000 for two purposes. First, the aerial photograph was used as the base map for recording the four primary sources of data for the determination. These base maps are included as Attachment 3, which includes the recording of all four primary sources of data, described below. Second, the high-resolution aerial photography was one tool used to record the location of likely wetland areas through photo interpretation. These areas are identified on the base map as yellow areas.

5. The off-site wetland determination included a review of Farm Service Agency aerial slide data. The review followed the procedures described in the Kansas Wetland Conventions concerning a representative sample of growing season slides; remote sensing wetland signatures such as shallow surface water, changes in tillage patterns, patches of greener vegetation and crop stress, to name a few; and methods for recording these signatures on preliminary and base maps. The Doniphan County, KS slides were reviewed in the county office on 30 September 2002. The aerial slides reviewed for each section were from March 1997, Sept. 1998, July 1999, Aug. 2000, and Aug. 2001. The Buchanan County, MO slides were reviewed in the county office on 7 October 2002. The aerial slides reviewed for each section were all from late July in '97, '98. '99, '00, and '01. The slides included equal numbers of "wet" and "dry" prior rainfall conditions. The exact sections, townships and ranges reviewed, along with the dates and colors used to review the aerial slides, are included in Attachment 4. The sheets (KS) and the clear overlays (MO) used to record the wetland signatures for each slide are included in Attachment 5. This data was then reviewed and evaluated for areas to include on the base map. Areas that were identified as having wetland signatures for at least 3 out of the 5 years reviewed were checked and included on the base map as green areas.

6. The off-site wetland determination included a review of NRCS Soil Survey Data. The review followed the procedures described in the Kansas Wetland Conventions for review of soil surveys and for positive indicators of hydric soils. Soil data evaluated for Doniphan Co, KS and Buchanan Co, MO is included in Attachment 6. This data and the soil surveys were then reviewed and evaluated for areas to include on the base map. Areas that were identified as having positive indicators of hydric soils and a potential for wetlands were included on the base map as orange areas.

7. The off-site wetland determination included a review of National Wetland Inventory (NWI) map data. The NWI maps were reviewed from arc-view data layers and double-checked against existing NWI hard copy maps. Areas that were identified as having wetland or water designations were included on the base map as pink areas.

8. After all four sources of data were included on the base map, the off-site wetland determination entered the final stage of the evaluation. The data was then reviewed and evaluated for areas to include on the final wetland determination map. Generally, areas that were identified as having potential for jurisdictional wetlands in at least 3 out of the 4 sources of data reviewed were checked and included on the final wetland determination map. However, occasionally areas with 2 out of the 4 sources of information were checked and included on the final wetland determination map for obvious areas where soil survey and NWI data were lacking. This final wetland determination map was then transferred on to the overall MRLS L455 and R460-471 Flood Protection Feasibility Study Map as a GIS layer for Wetlands. The final wetland jurisdictional determination map (Wetlands L455 and R471-460) is attached as Attachment 7.

9. The final wetland jurisdictional determination map was double checked in the field by performing a pedestrian survey. This was done by driving on the top of both levees for the entire length of the project and observing for areas of inconsistency in the field with areas on the final determination map. It was very evident that the wetland areas matched up well with the drainage patterns in the farm fields and the ditches and drainage structures under the levees. It appeared the final determination map was accurate. It is also worth noting that the determination relied heavily on the five years of Farm Service Agency aerial slide data. The types of wetlands included in the final wetland jurisdictional determination map are quite diverse and include, but are not limited to, farmed wetlands, oxbows, borrow pits, drainage ditches, scour holes, natural depressions, riverine wetlands and wetlands returning to natural conditions in NRCS CRP and WRP tracts. The types of wetlands are not categorized on the map, but are included here for information only.

10. Questions concerning the above-described off-site wetland determination should be directed to myself at x-3136.

David Hibbs
Biologist, PM-PR

Encl:
1 Fig.
7 Attach.

Mitigation Plan
for
Missouri River Levee System
Units L-455 and R-471-460
Flood Damage Reduction
Kansas and Missouri

1. **Mitigation Goals and Objectives**

- Wetlands provide numerous functions and values such as temporary storage of surface water, maintenance of subsurface hydrology, cycling of nutrients, removal of "hazardous" elements and compounds, detainment of particulates, export of organic carbon. Wetlands also contain varied plant communities, habitat for wildlife, unique areas of open space, and opportunity for research and pleasure. The wetlands at the project site likely provide combinations of these functions and; therefore, impacts to them need to be off-set.
- To off-set the loss of approximately 4.9 acres of farmed wetlands occurring along the toe of the existing levee units, similar amounts of wetlands will be re-established on-site in accordance with the USFWS recommendations from their August 9, 2006, Fish and Wildlife Coordination Act Report and the Corps of Engineers Regulatory Guidance Letter dated December 24, 2002. Re-establishment will require the manipulation of the physical, chemical, and biological characteristics of existing areas within the borrow sites. This will be accomplished through the reshaping and scraping of borrow area wetlands in order to expand their size equal to, or greater than, that which was lost. This will serve multiple purposes. First, borrow sites will be located in close proximity to where material is needed, thereby, reducing haul time and expense. Second, obtaining borrow in the manner previously described will off-set construction related impacts with in-kind habitat and reduce mitigation costs. Mitigation will not occur in MRFWMP lands (e.g., Elwood Bottoms).
- Riparian and associated upland woodlands provide year-round habitat for numerous terrestrial species. Mammals associated with these habitats include white-tailed deer, red and grey squirrels, eastern cottontail rabbits, raccoons, coyotes, gray and red fox, skunks, opossums, mink, beaver and muskrat. Small mammals such as mice, rats, voles, and bats account for the majority of species present, and in most cases provide the prey for higher-order predators. Moreover, approximately sixty-seven migratory species of birds nest in these habitats in addition to the resident species found in these areas. Riparian areas will be avoided and impacted woodlands will be off-set as described below.
- To off-set the loss of approximately 7.0 acres of secondary growth trees and 12.7 acres of shrubland habitat, similar acres of woodland habitat will be established on-site in areas of bare ground, or where reed canary grass or other exotic species have grown, if this land is available. The USFWS has recommended a 2:1 compensatory mitigation ratio for mature cottonwoods and "other" native vegetation. However, because the trees to be removed are secondary growth

trees, the Corps will be offsetting impacts with a 1:1 ratio. Additionally, because the Corps will be planting "higher-value" species (e.g., mast producing trees) than those removed, the offset will provide greater benefits to the area. The attached Tree, Shrub, and Groundcovers specification provides the basis for how this off-set will be accomplished.

- The overall goals and objectives for this activity is no net loss of any function or value of the affected wetland or terrestrial areas.

2. Baseline Information for Impact and Proposed Mitigation Sites

- Soils within the project area have primarily developed as a result of the wind-borne deposition of fine-grained material (loess) and the deposition of material on land by streams (alluvium). Missouri River floodplain soils belong to the Haynie-Urban Land-Leta association. These soils are considered to be partially hydric and not erodible by water or wind. The flood plain or bottoms area is three to five miles wide in the St. Joseph study area and is characterized by low-lying, nearly level terrain.
- Vegetation in the project area consists, in part, of floodplain forest (*Populus-Salix*). Although the project area's floodplains have been largely cleared for development, there are bands of riparian forest habitat located riverward of the levee units. Predominant tree species found in these riparian bands include eastern cottonwood, willows, box elder, green ash, silver maple, and American sycamore. The understory includes reproduction of these species, plus some redbud, dogwood, black cherry, and various shrubs. The ground layer in the riparian bands varies from sparse to dense vegetation and contains primarily poison ivy, Virginia creeper, honeysuckle, greenbrier, gooseberry, and various other species. Most of the vegetation in the study area has been greatly impacted by urban development. In general, the project area consists of established, residential neighborhoods and intensively developed business district and croplands, except riverward of the levees where more natural vegetation occurs.
- Hydrology landward of the levees occurs mainly from precipitation events where as hydrology riverward of the levee is predominately from precipitation and Missouri River overflow.
- The existing wetland vegetation in the area consists of cattails, sedges (*Carex*), smartweed (*Polygonum*), arrowhead (*Sagittaria*), and American lotus (*Nelumbo lutea*), willows (*Salix*), maples (*Acer spp.*), ash (*Fraxinus spp.*), and birch (*Betula spp.*) among others.

3. Mitigation Site Selection and Justification

- Mitigation sites will be identified and selected during borrow site selection and in coordination with Kansas and Missouri resource agencies. Consensus was reached that while obtaining borrow material for levee raises, innovative construction methods could be employed to scrape and reshape lands adjacent to existing wetlands riverward of the levees in order to expand their size equal to, or greater than, that which was lost.

- The mitigation method to be employed would restore and expand on-site wetlands and would use existing seed banks, which in turn, would provide similar vegetation replacement to that which is lost. The mitigation proposed reduces the cost of seeking off-site real estate to off-set wetland impacts and increases the likelihood of success by utilizing real estate adjacent to existing wetlands. Woodland replacement will involve the use of some similar species, obtained from local nurseries, plus "higher value" mast-producing species such as hickory, pecan, and oaks. Tree plantings would concentrate on areas of bare soil or areas where exotic species, such as reed canary grass, have become established.
- Preparation of the mitigation has been coordinated with the Missouri River Fish and Wildlife Mitigation Project team to ensure compatible goals in developing fish and wildlife habitat are met and objectives such as maximizing aquatic and terrestrial habitat, maximizing species diversity, and optimizing habitat conditions for this particular site are achieved. Mitigation will not occur in the Elwood Bottoms area.

4. **Mitigation Work Plan**

- The mitigated wetlands would be within the proposed borrow areas located in Kansas between River Miles 454.9 to 451.9 and between River Miles 446.7 to 443.4. In Missouri, mitigated wetlands would be located between River Miles 442.6 to 442.9.
- The construction plan would consist of, but not be limited to, re-establishing riverward wetlands concurrently with construction activities. During construction, shallow scraping, reshaping, and re-contouring of existing wetlands and scour features would be conducted as applicable. Side slopes would be varied, 1V:4H to 1V:1.5 H, bottom elevations would be irregular, and habitat islands left throughout borrow sites to allow greater diversity in natural revegetation and water depths. Off-setting impacted wetlands concurrently with levee construction activities will likely reduce overall mitigation costs.
- The hydrology required for success of these wetlands will stem solely from precipitation and Missouri River overflow. Vegetation will regenerate naturally from the existing seed bank. Borrow excavation sites will be spread out and contain "islands" to provide natural buffer areas and greater diversity.
- All equipment brought on site will be thoroughly washed to remove dirt, seeds, and plant parts. Any equipment that has been in any body of water within the past 30 days will be thoroughly cleaned with hot water (40 degrees C/104 degrees F) and dried for a minimum of five days before being used at the project site. In addition, before transporting equipment from the project site all visible mud, plants, and fish/wildlife will be removed, all water will be eliminated, and the equipment will be thoroughly cleaned. Anything that came in contact with the water will be cleaned and dried following the above procedure.

5. **Monitoring Plan**

- Site visits will be made by Corps personnel during construction, post construction during operations and maintenance inspections, after mitigation plantings are complete, and during years one, three, and five. Site assessments will be made, vegetation growth and types documented, hydrology noted, and photos taken and compared after each visit to help make determinations and future recommendations.

6. **Performance Standards**

- Success of the scraped and reshaped wetlands will be based on existing conditions and how well the re-established wetlands mimic these conditions. Establishment of similar vegetation, hydrology and function performance will be used as the performance standard. Vegetation surveys of both existing and restored wetlands will be conducted by Corps personnel. This will include photo documentation (at specific points to be determined) and a determination of plant species composition in order to provide a comparable format for future monitoring activities. Post construction monitoring in years 1, 3, and 5 will provide data to illustrate how well the restored wetlands are mimicking the existing wetland. In the event that the re-established wetlands do not function similar to the existing wetlands (including establishment of similar vegetation) within year 3, re-evaluation of the techniques used to re-establish the wetlands and a determination as to why the site is not functioning will be made. The results of this re-evaluation will be used to prepare a new monitoring plan to sufficiently off-set the original wetland loss, and will include an additional off-set to compensate for time lost.

7. **Site Protection and Maintenance**

- Current access to the proposed borrow areas is limited and hard to reach by the general public. Much of the area is in private ownership and enrolled in the Conservation Reserve Program. Thus, protection of these areas from the general public falls under private property laws and regulations.

- No maintenance plan has been developed at this time. The areas will be allowed to regenerate naturally and will make use of natural hydrology and existing seedbank. Based on the data obtained from the post construction monitoring, the use of adaptive management may be required in order to reach appropriate goals and objectives.

- Establishment of exotic and/or invasive species will be noted during on-site investigations and photo documented, if warranted. In the event of the establishment of large monotypic exotic and/or invasive species, a plan for eradication will be developed and implemented within year 3 to assure establishment of in-kind wetland and woody vegetation.

TREES, SHRUBS, AND GROUNDCOVERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

Datascape Nomenclature Guide availably from American Nurserymen Publishing Co., 77 W. Washington Street, Suite 2100, Chicago, IL 60602-2904.

American Association of Nurserymen, Inc. "American Standard for Nursery Stock", Z60.1-1973, or latest edition.

Available from: American Association of Nurserymen, Inc., 230 Souther Building, Washington, D.C. 20005.

1.2 DESCRIPTION OF WORK

The work covered by this Section consists of furnishing all plants and related materials, supervision, labor, equipment, appliances and services necessary for and incidental to completing all operations in connection with the planting of trees, shrubs, ground covers and other such materials in strict accordance with these Specifications and subject to the terms and conditions of the Contract. The work shall include, but not be limited to, the following within the Contract limits:

1.2.1 Excavating and backfill as required for all plant materials;

1.2.2 Furnishing and incorporating of fertilizer;

1.2.3 Furnishing and planting of trees, shrubs and other plant material as indicated;

1.2.4 Maintenance; and

1.2.5 Replacement of unsatisfactory plant material.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having no designation are for information only. The following shall be submitted in accordance with Section 01330: SUBMITTAL PROCEDURES.
SD-13 Certificates

Plant Material Inspection Certificates; GA-PR.

Fertilizer; GA. Ground Cloth; GA-RE. Mycorrhizal Inoculant; GA-RE.

Certified analysis by a recognized laboratory shall be submitted before delivery to the site.

1.4 CERTIFICATES OF INSPECTION

All necessary Inspection Certificates shall accompany the invoice for each shipment or order of stock, as may be required by law, for the necessary transportation, and such certificates shall be filed, prior to the acceptance of such material, with the Contracting Officer's Representative (COR).

1.5 ACCEPTANCE

1.5.1 Inspection

Inspection of the work to determine completion of the contract, exclusive of the possible replacement of plants, will be made by the COR upon written notice requesting such inspection submitted at least 10 days prior to the anticipated date.

1.5.2 Notification

After inspection of the work, the Contractor will be notified in writing by the COR of acceptance of all work exclusive of the possible replacement of plants subject to guaranty; or, if there are any deficiencies, of the requirement for completion of the work.

1.6 GUARANTEE

1.6.1 Guarantee Terms

All plant material shall be guaranteed by the Contractor for a period of six months from the date of acceptance to be in good, healthy, and flourishing condition. In addition, the Contractor shall guarantee a minimum of 95% of each species to be in good, healthy, and flourishing condition for a period of one year or one full growing season, whichever is longer, from the date of acceptance.

1.6.2 Replacement

The Contractor shall replace, without cost to the Government, and as soon as weather conditions permit, dead plants or plants not in a vigorous thriving condition, as determined by the COR and PM-PR (Mr. Vandenberg/816-389-3146) at the end of the six month and one year guarantee periods. Replacement plantings shall be of the same species as the species being replaced, unless otherwise directed/approved by PM-PR and the COR. The number of bare root stock replacement plantings at the one-year period shall be such that any planted areas which average less than 95% survival shall be replanted to the original number of trees/shrubs planted. The root pruned method (RPM) plantings also shall be replaced to the original number of RPM trees planted. Replacement plantings shall be subject to all requirements stated in these Specifications.

1.7 MAINTENANCE

Maintenance shall begin immediately after each plant is planted and shall continue throughout the length of the Contract and guarantee period, until final acceptance of the planting by PM-PR and the COR. All new plantings shall be maintained until final acceptance. Maintenance activities shall include insect and disease control, watering, removal of dead or damaged plants materials, resetting plants to proper grades and/or upright position, and other necessary operations.

1.8 CONTRACTOR'S RESPONSIBILITY

1.8.1 Examination of Drawings

The Contractor shall examine all drawings relating to the work required and visit the site to become fully informed as to all existing conditions and limitations as they apply to the work, and its relation to all construction work.

1.8.2. Agreement to Conditions

No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the extent and nature of the work to be done, it being understood that the tender of the proposal carries with it the agreement to all items and conditions specified, referred to herein, or indicated on the contract drawing.

1.8.3. Liability

The Contractor shall be liable for any damages to property caused by operations under this section and shall, without any additional costs to the Government, restore to their original condition all area disturbed or damaged by construction, including structures, lawns, pavement, curbs, etc.

1.8.4. Cooperation and Coordination

Cooperation and coordination of all planting and maintenance operations with the COR and PM-PR (Mr. Vandenberg/816-389-3146) is imperative for the successful completion/acceptance of the work.

1.9 PLANT SCHEDULE

1.9.1 Supply of Plants

The Contractor shall supply plants as shown in the Plant Schedule contained herein, and as specified subject to the conditions under the paragraph titled "Contractor's Responsibilities".

1.9.2 Height and Spread

Height is shown as an approximate dimension from the ground to the top of the previous year's growth. The top spread is shown as the approximate spread of the top at the principle width.

1.9.3 Ball Size

If plants are collected, the ball size shall be at least the size required by American Standards for Nursery Stock.

1.9.4 Schedule

The schedule of Plant Material to be furnished and planted is contained herein.

1.10 TESTS AND INSPECTIONS

1.10.1 Notification of Source Available

Within 30 days following acceptance of the bid, the Contractor shall notify the COR and PM-PR (Mr. Vandenberg/816-389-3146) of the plant material sources the Contractor proposes to use and required/desired to be inspected or tested.

1.10.2 Plant Material Inspection Certificates

The Contractor shall be responsible for all Certificates of Inspection of plant materials that may be required by Federal, State, or other authorities to accompany shipments of plants. The Contractor shall furnish the COR with copies of the Certifications that all plants conform to the standards of the American Association of Nurserymen.

1.10.3 Pre-Planting Inspection

All plant materials must be inspected and approved before they are planted. Inspection and approval of plants by the COR at the place of growth or upon delivery shall be for quality, size, and vitality only, and shall not in any way impair the right of rejection for failure to meet other requirements during progress of work.

1.10.4 Analyses and Tests

Analyses and tests of materials, if required, such as fertilizers, insecticides, etc., shall be made in accordance with the current method of the Association of Official Agricultural Chemists.

1.10.5 Certified Analyses

Certified analyses by a recognized laboratory of Fertilizer, etc., shall be submitted by the Contractor, at the Contractor's expense, for the COR's approval before delivery to the site. Packaged and sealed standard products accompanied by the manufacturer's or the vendor's analyses, complying with specification requirements, will be acceptable.

1.10.6 Approval of Materials

Approval of materials shall not be construed as final acceptance and the COR reserves the right to analyze, for comparison with Specification requirements, any or all materials delivered for use under this Section. The cost of such tests will be borne by the Government. Should these tests indicate noncompliance with Specification requirements, the COR will charge the entire costs of such tests to the Contractor. All rejected material shall be removed from the site and replaced with acceptable material.

1.11 DELETED

1.12 PLANT SCHEDULE

Botanical/Common Name	Plants/Acre	Total
Trees: Root Pruned Method (RPM) (3-gallon containers)	170/Acre (10' X 10' Spacing)	
Bare Root (BR) (Seedlings)		
Acer saccharinum/Silver Maple (BR)	25	175
Carya laciniosa/Shellbark Hickory (RPM)	6	42
Carya illinoensis/Pecan (BR)	30	210
Celtis occidentalis/Hackberry (BR)	25	175
Fraxinus pennsylvanica/Green Ash (BR)	20	140
Morus alba/White Mulberry (BR)	20	140
Nyssa sylvatica/Black Gum (BR)	30	210
Quercus bicolor/Swamp White Oak (RPM)	4	28
Quercus palustris/Pin Oak (RPM)	4	28
Quercus macrocarpa/Bur Oak (RPM)	6	42

Botanical/Common Name	Plants/Acre	Total
Shrubs	*60/Acre (6' within row X 8' between rows)	

* Shrub plantings should be placed in groups to allow openings between shrub lines and travel lanes between shrub plantings (e.g., spacing between groups of rows would be about 20-50 feet, depending on the particular site).

Cercis Canadensis/Eastern Redbud (BR)	15	195
Cornus racemosa/Gray Dogwood (BR)	15	195
Ilex decidua/Deciduous holly (BR)	15	195
Ilex verticillata/Winterberry (BR)	15	195

PART 2 PRODUCTS

2.1 COMMERCIAL FERTILIZERS

Commercial fertilizers shall conform to all applicable state fertilizer laws, and shall be delivered in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Fertilizer shall be controlled-released pellets, tablets, or packets (two-year duration), and be of the size, weight, quantity, and analysis recommended by the manufacturer for the type of plants specified. Root stimulator shall be used at the time of planting in accordance with the manufacturer's recommendations.

2.2 HEBICIDE

Herbicides shall be applied, according to label directions, over the top of dormant seedlings or root pruned potted specimens. Herbicides shall be applied in strips at least four feet wide or in circles with a radius of two feet with each seedling centered in the sprayed area. In order to assure that seedlings are dormant when sprayed, herbicide must be applied at the time of planting or within 48 hours of removal from cold storage.

2.3 MULCH/GROUND CLOTH

Mulch shall consist of horticultural grade shredded hardwood or cypress bark, free of sticks, stones, clay, or other foreign materials. Mulch shall be of such character as not to be easily displaced by wind. Ground cloth shall be a non-woven geotextile fabric no less than 36-inches square manufactured from polypropylene fibers. The fabric weight shall be no less than eight ounces per square yard, and shall possess a Minimum Average Roll Value (MARV) or 90 gallons per minute per square foot of material as tested in accordance with ASTM

D4491, and a puncture resistance of 130 pounds as tested in accordance with ASTM D4833.

2.4 WATER

Water, pumps, hoses, and other equipment required for the distribution of water shall be furnished by the Contractor.

2.5 PLANT MATERIAL

All bare-root planting stock shall be of conservation grade or better. The bare root seedlings shall be at least one-year old and at least 12-inches in height. A root to shoot ratio must be maintained at a range of 1:1 to 1:1.5. The taproot shall not be shortened to less than eight inches in length. Any variations in size must be approved by the COR and PM-PR (Mr. Vandenberg/816-389-3146).

All root pruned method potted stock shall consist of plant materials grown using the root pruning technique that develops a heavy, fibrous root system in a pot that is three-gallons in size. Minimum seedling height is three feet, minimum caliper of 5/8-inch at the tree base, measured at 6ix inches above the soil line. Seedlings shall be maintained in a dormant condition until planted.

2.5.1 Plant Schedule

The Plant schedule preceding this Section forms a part of these Specifications.

2.5.2 Nomenclature

The scientific and common names of plants herein specified conform to the approved names given in the Datascape Nomenclature Guide. Names of varieties not included therein conform generally with names accepted in the nursery trade.

2.5.3 Quantities

Quantities necessary to complete the planting are indicated in the Plant Schedule.

2.5.4 Substitutions

Substitutions will not be permitted. If proof is submitted that any plant specified is not reasonably obtainable, a proposal will be considered for use of the nearest equivalent size or variety with an equitable adjustment of contract price. Any proposed substitution must be approved by PM-PR (Mr. Vandenberg/816-389-3146). All efforts shall be made to avoid use of substitutions due to considerable earlier coordination/planning efforts.

2.5.5 Quantity and Size

Plants shall be sound, healthy, vigorous, and free from insect pests, plant diseases, injuries, and after-effects thereof. Plants shall be moist but free of mold and defects, and have well-developed root systems. Plant materials which do not conform to this description or condition will be discarded, removed from the project site, and shall be replaced by the Contractor.

All plants shall be equal to or exceed the minimum, acceptable sizes, measurements, and specifications specified in Sections herein. Planting stock shall be measured before pruning and/or planting, with branches in normal position.

All plants and all tree trunks shall be measured when the branches are in their normal position. Dimensions for height and spread as contained herein refer to the main body of the plant and not from branch tip to branch top. No pruning of branches to obtain the required height shall be done before the plants are delivered to the site, unless so approved by the COR.

Nursery-grown plants shall mean plants which are healthy vigorous plants, lined out in rows in a nursery, which are annually cultivated, sprayed, pruned and fertilized in accordance with good horticultural practices as required by the American Association of Nurserymen, Inc.

All plants shall be nursery-grown unless otherwise specified. All plants must be acclimated to area conditions. All plants shall be freshly dug; neither heeled-in plants nor plants from cold storage will be accepted. All nursery-grown plants shall have been transplanted or root-pruned at least once in the past three years.

No trees which have had their leaders cut or which have been so damaged that cutting is necessary will be accepted.

Planting stock specified to be furnished in a size range shall be interpreted to mean that no less than 50 percent of the tress shall be of the maximum size specified.

Plants larger in size than specified herein may be used if approved by the COR, but the use of larger plants shall not increase the contract price. If the use of larger plants is approved, the roots lengths and root mass balls of the planting stock must be of sufficient length to meet the root to shoot ration specified earlier in this Section. Plants grown in containers shall be fully rooted throughout the earth ball within the container, but not root bound. All container plants must be acclimated to area conditions.

2.6 MYCORRHIZAL INOCULANT

The container shall provide mycorrhizal inoculant for use with the planting of Root Pruned Method and Bare Root materials. The inoculant shall be GRO-Life Mycorrhizal Tablets or equal.

PART 3 EXECUTION

3.1 DIGGING, WRAPPING, and HANDLING

3.1.1 Protection

All plants shall be handled in such manner as to avoid unnecessary damage of any kind. No plants shall be bound with wire or rope at any time in order to prevent bark damage or breakage of branches. Plants shall not be handled or carried by the trunks or stems. Roots shall be especially protected at all times from drying. Plants which cannot be planted immediately upon delivery shall be protected from heat and prevented from drying wind and sun by healing-in any Bare Root stock and covering adjoining area and the root masses of all Root Pruned Method stock, or other protection if approved by the COR. The Contractor shall be responsible for replacement of all plants lost to improper protection and/or handling.

3.1.2 Labeling

Durable, legible labels stating in weather-resistant ink the correct botanical and common plant names and sizes, as specified in the Plant Schedule, shall be securely attached to all plants, bundles or packages of plants of a single species and size, or plant containers delivered to the plant site for the purpose of inspection and plant identification.

3.1.3 Shipment and Delivery

Bare Root seedlings shall be delivered to the site in a dormant state and shall be maintained in a dormant state by the Contractor until planted.

The Contractor shall promptly notify the COR in advance of the time and manner of delivery of plants, and shall furnish an itemized list in duplicate of the actual quantity of plant materials in each delivery, in order to ensure satisfactory coordination of delivery, and to expedite the required inspection at the point of delivery. The itemized duplicate list of the plant material for each delivery shall include the pertinent data as specified in the Plant Schedule and otherwise herein. These itemized lists and the necessary certificates to accompany each plant and/or shipment shall be delivered to the COR prior to acceptance and planting of the plant material.

FEASIBILITY REPORT
MISSOURI RIVER LEVEE SYSTEM UNITS R471-460 AND L-455
MISSOURI AND KANSAS

APPENDIX A

PUBLIC INVOVLEMENT

SEPTEMBER 2006

DEPARTMENT OF THE ARMY
Kansas City District, U.S. Army Corps of Engineers
Kansas City, Missouri

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APPENDIX A
MISSOURI RIVER LEVEE SYSTEM (MRLS)
UNITS R471-460 AND L-455
FEASIBILITY STUDY

Public meetings were held on October 29 and 30, 2002, in Elwood and Wathena, Kansas. These meetings were jointly presented by the Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers. The purpose of these meetings was to present to the public the increased risk of flooding in the area, decertification of the unit R471-460 by FEMA, the consequences of decertification, and the status of the feasibility study. Flyers used to advertise these meetings are included in this appendix.

A meeting was held on May 4, 2005, at Rosecrans Airport between representatives of the Missouri Air National Guard, the City of St. Joseph, the Corps, and Senator Christopher Bond. The purpose of the meeting was for the Guard to present to the Senator their plans for future expansion of the facilities at Rosecrans Airport that are being hindered by the decertification of the right bank levee. The Corps presented the current status of the feasibility study. The meeting was well documented in the St. Joseph News-Press newspaper the next day.

A public meeting was held August 28, 2006 in Elwood, Kansas to present the recommendations of the feasibility report and obtain public comment. Notice of the meeting was distributed to potentially interested parties and published in the newspapers of St. Joseph, MO and Doniphan County, KS. Copies of the notice letter, press release, affidavits of publication, and meeting agenda are included in this appendix. Twenty-six attendees were present at the meeting representing the local sponsors, land owners in the study area, local municipal and elected officials, levee districts upstream and downstream of the project area, and state agencies. Comments received, with responses by the Corps of Engineers, are included in this appendix.

FLOOD RISK ALERT

Residents living in the Elwood-Gladden and French Bottoms area of Doniphan County, Kansas and Buchanan County, Missouri are invited to attend a public meeting hosted by the Federal Emergency Management Agency (FEMA), the U.S. Army Corps of Engineers (USACE), and your community to explain the increased risk of flooding in the area.

Meeting Locations and Times

OCTOBER 29, 2002 at 7:00 p.m.
City of Elwood Community Center
803 Massachusetts Street
Elwood, Kansas

OCTOBER 30, 2002 at 7:00 p.m.
City of Wathena Community Center
303 East St. Joseph Street
Wathena, Kansas

For further information, contact your community floodplain official.

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For further information, contact your community floodplain official.

Flood Risk Alert

- If you are a resident living in the Elwood-Gladden and French Bottoms area of Doniphan County, Kansas and Buchanan County, Missouri you need to know you have an increased flood risk.
- The levee along the west side of the Missouri River no longer provides as much protection as it once did. As a result, much of the Elwood-Gladden and French Bottoms area will now be designated in the floodplain.
- Your community officials are working on a plan to restore the levee to its full protection level.
- What should you do?
  - ✓ Come to one of the public meetings (see other side) scheduled to explain your risk and options.
  - ✓ Contact your local community to determine whether your property is affected.
  - ✓ Contact your local insurance agent to see about adding or reviewing your flood insurance coverage.

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DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896
August 1, 2006

REPLY TO
ATTENTION OF:

Planning, Programs and Project Management Division
Planning Branch

Dear Interested Party:

In accordance with provisions of the National Environmental Policy Act of 1969, we are notifying you of the availability of the Draft Environmental Assessment and Draft Feasibility Report (DEA/DFR) for the MRLS Units R471-460 and L-455, Flood Damage Reduction Study, St. Joseph, Missouri. The document is available for review on the Kansas City District web page at: http://www.nwk.usace.army.mil/projects/R471-L455/. Also, in accordance with Section 404 of the Clean Water Act, a Public Notice (PN) of the proposed project is available for review and comment on our Regulatory Branch web page at:
www.nwk.usace.army.mil/regulatory/public_notices/200501489.pdf

This DEA is prepared pursuant to NEPA to assess the environmental and social impacts associated with improving the level of flood damage reduction for the two levee units in the Saint Joseph metropolitan area. The DEA examines impacts with and without the proposed alternatives. Written comments on the DEA/DFR or PN should be directed to the individual identified below no later than August 31, 2006.

Christopher M. White, Ph.D.
St. Joseph Levees Project
Kansas City District, Corps of Engineers
601 E. 12th Street
Kansas City, Missouri 64106-2896

The Corps of Engineers will respond to comments received as a result of issuance of the DEA/DFR and PN during final review and preparation of the Final Environmental Assessment and Feasibility Report.

Sincerely,

David L. Combs
Chief, Planning Branch

Enclosure

News Release

US Army Corps of Engineers
Kansas City District

601 E. 12th Street
Kansas City, Missouri 64106-2896

Contact: Tom O'Hara
Phone: (816) 389-3486

For immediate release

Date: August 10, 2006

U.S. Army Corps of Engineers sets Aug. 28 public meeting for St. Joseph levees study, environmental assessment

ELWOOD, Kan. – Officials from the Kansas City District, U.S. Army Corps of Engineers will meet with the public to discuss a Draft Environmental Assessment and Feasibility Study on the R460-471 & L455 Flood Damage Reduction Projects at 6:30 p.m. Aug. 28, 2006 in the Elwood Community Center, 803 Massachusetts Street, Elwood, Kan.

The Draft Environmental Assessment and Feasibility Study examines alternatives and recommends a proposed plan for improvements to the existing levee system aimed at reducing flood risk and improving levee reliability for the communities of St. Joseph, Elwood, and Wathena, as well as the Rosecrans Memorial Airport / Missouri Air National Guard Base. The levees provide flood protection to about 21,000 acres of rural agriculture and urban residential and commercial development.

Individuals, organizations, and agencies may participate by attending the public meeting or by emailing comments on the document before Aug. 31, 2006.

All comments must be postmarked or sent by August 31, 2006. Email: Matthew D. Vandenberg at matthew.d.vandenberg@nwk02.usace.army.mil; mail: Kansas City District, Corps of Engineers, 601 E. 12th Street - Room 843, Attn: Christopher M. White, Kansas City, Missouri 64106-2896; or phone 816-389-3158. The document may also be reviewed at local libraries or downloaded at http://www.nwk.usace.army.mil/regulatory/public_notices/200501489.pdf

-30-

Editor's Note: Public email comments on the Draft Environmental Assessment may be sent to matthew.d.vandenberg@nwk02.usace.army.mil. Media inquiries may be addressed to the Kansas City District Public Affairs Office at (816) 389-3486. Questions concerning the Draft Environmental Assessment should be addressed to Matthew D. Vandenberg at matthew.d.vandenberg@nwk02.usace.army.mil.

PUBLIC NOTICE

(Published in the Kansas Chief, Thursday, August 17, 2006)

LEGAL NOTICE

Notice of Public Meeting for U.S. Army Corps of Engineers Draft Environmental Assessment and Feasibility Study on the R460-471 & L455 Levee Flood Damage Reduction Projects on August 28th 2006, starting at 6:30 p.m. at the Elwood Community Center, 803 Massachusetts Street, Elwood, Kansas 66024

The Draft Environmental Assessment and Feasibility Study examines alternatives and recommends a proposed plan for improvements to the existing levee system aimed at reducing flood risk and improving levee reliability for the communities of St. Joseph, Elwood and Wathena, as well as the Rosecrans Memorial Airport / Missouri Air National Guard Base. These levee units provide flood protection to about 21,000 acres of rural agricultural and urban residential and commercial development.

Individuals, organizations, and agencies may participate by attending the public meeting or by emailing comments on the document prior to August 31, 2006. All comments must be postmarked or sent by August 31, 2006. Email: Mr. Matthew D. Vandenberg at matthew.d.vandenberg@nwk02.usace.army.mil; mail: Kansas City District, Corps of Engineers, 601 E. 12th Street – Rm 843, Attn: Dr. Christopher White, Kansas City, Missouri 64106-2896; or phone 816-389-3158. The document may also be reviewed at local libraries or downloaded at http://www.nwk.usace.army.mil/projects/r471-1455.

AFFIDAVIT OF PUBLICATION

STATE OF KANSAS, DONIPHAN COUNTY, SS:

Dana D. Foley, being first duly sworn, deposes and says: That he is publisher of *The Kansas Chief* a weekly newspaper printed in the State of Kansas, and published in and of general circulation in Doniphan County, Kansas, with a general paid circulation on a yearly basis in Doniphan County, Kansas, and that said newspaper is not a trade, religious or fraternal publication.

Said newspaper is weekly published at least weekly 50 times a year; has been so published continuously and uninterruptedly in said county and state for a period of more than five years prior to the first publication of said notice; and has been admitted at the post office of Wathena, Kansas, in said County as periodicals postage paid.

That the attached notice is a true copy thereof and was published in the regular and entire issue of said newspaper for One consecutive weeks, the first publication thereof being made as aforesaid on the 17 day of August, 2006, with subsequent publications being made on the following dates:

__________, 20___

__________, 20___

__________, 20___

[signature]
Publisher

Subscribed and sworn to before me this 17 day of August, 2006.

LORI VERTIN
NOTARY PUBLIC
STATE OF KANSAS

Lori Vertin
Notary Public

My commission expires 7-6-07

Printer's fee/ Affidavit fee $ 37.92

AFFIDAVIT OF PUBLICATION

St. Joseph News-Press, 825 Edmond St, St. Joseph, MO 64501

Reference: 163518
Ad ID: 5215773
P.O. :
DESC. :Levee Flood Damage Reduction Projects

MATTHEW VANDENBERG
ENVIRONMENTAL RESOURCES SPECIALIST
601 EAST 12TH STREET
KANSAS CITY, MO 64106

County of Buchanan
State of Missouri

I, Leona Gillenwater, being duly sworn according to law, state that I am the Legal Advertising Coordinator of the St. Joseph News-Press, a daily newspaper of general circulation in the county of Buchanan, where located; which has been admitted to the Post Office as second class matter in the city of St. Joseph, the city of publication; where newspaper has been published regularly and consecutively for a period of three years and has a list of bona fide subscribers voluntarily engaged to pay a stated price for a subscription for a definite period of time, and that such newspaper has complied with the provisions of Section 493.050 Revised Statutes of Missouri, 1949. The affixed notice appeared in said newspaper on the following date:

Run Dates:	08/17/06	to	08/17/06
Appearances:	1		
AD SPACE:	75		
TOTAL COST:	$135.00		
FILED ON	08/21/06		

(Signed) Leona Gillenwater

Subscribed and sworn before me this 25th day of August 2006
Heather Sturtz Notary Public

(Published in the St. Joseph News-Press Thurs., 08/17/06)

LEGAL NOTICE
Notice of Public Meeting for U.S. Army Corps of Engineers Draft Environmental Assessment and Feasibility Study on the R460-471 & L455 Levee Flood Damage Reduction Projects on August 28th 2006, starting at 6:30 p.m. at the Elwood Community Center, 803 Massachusetts Street, Elwood, Kansas 66024

The Draft Environmental Assessment and Feasibility Study examines alternatives and recommends a proposed plan for improvements to the existing levee system aimed at reducing flood risk and improving levee reliability for the communities of St. Joseph, Elwood and Wathena, as well as the Rosecrans Memorial Airport / Missouri Air National Guard Base. These levee units provide flood protection to about 21,000 acres of rural agricultural and urban residential and commercial development.

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Heather Sturtz
Notary Public Notary Seal
State of Missouri County of Buchanan
My Commission Expires 01/30/2010
Commission #06831729

US Army Corps of Engineers®

St. Joseph Levees Feasibility Study and Environmental Assessment

Public Meeting Agenda August 28, 2006

Meeting Location: Elwood, Kansas, Community Center
Meeting Time: 6:30pm

This meeting is presented by the Kansas City District Corps of Engineers in Cooperation with the Local Governing Boards for the St. Joseph Area Flood Protection System

LEVEE UNIT/SECTION	Non-Federal Owner/Operator
MRLS R471-460	St. Joseph Airport Levee District (MO portions) Elwood-Gladden Drainage District (KS portions)
MRLS L-455	South St. Joseph Levee District

Introductions and Meeting Overview -- ***Corps of Engineers***
(approx. 10 minutes)
- Levee owners/operators.
- Format and guidelines for tonight's session.
- Recording of formal comments (leave written comment forms at sign-up table).
- Informal question and answer period during the Information Table segment.

Brief Slide Presentation on Feasibility Study and the Environmental Assessment-- ***Corps of Engineers***
(approx. 20 minutes)
Background, levee descriptions, objectives of the feasibility study, recommended plan, and normal steps toward implementation of a Federal Civil Works project

Statements by the Levee Sponsors
(approx. 10 minutes)

Information Tables Segment
(approx. 1 hour)
- Information Tables and presentation boards are located around the meeting area.
- Attendees are welcome to ask informal questions to Corps & levee sponsors at the tables.

Meeting Adjournment

The Draft Feasibility Study and Environmental Assessment, along with the slides from this evening's presentation are available on the project website at:

http://www.nwk.usace.army.mil/projects/r471&l455

A summary of the written comments received at tonight's meeting will be posted to the website when available.

(8/25/06 ed.)

The following comments were received during, or in response to, the 28 August 2006 public meeting.

Public Meeting Comment 1

Submitted by: James Rader
Mayor, City of Elwood

Comment: I have lived in Elwood for 69 ½ years. I have been here through the flood of 1952 and also 1993. We have had extensive commercial development here since 1973. I feel this will stop without the recommended work done on the levees. Also the personal trauma of going through a flood and the cleaning and repairs afterward more than justify the cost of these extensions. Thank you for your work, Jim Rader.

Response: Comment noted and appreciated.

Public Meeting Comment 2

Submitted by: John Osborne

Comment: I was here in "93" and along with my friends & neighbors, listened to State & Federal official pacify Elwood residents. All I ask for myself and all Elwood resident is "Do what you say you'll do & don't say you will & then don't." Most people who have had any dealing with FEMA or the Corp, are very skeptical of everything the say & do. We all want to live in a safe community, & I for one support your efforts. Thank you, John Osborne.

Response: Comment noted and appreciated.

Public Meeting Comment 3

Submitted by: Doug Shepherd
President, South St. Joseph Levee & Drainage District

Comment: Why is there proposed work for levee between 205+00 to 295+00 when our trouble spot in 1993 was in the area of 107+70. Where we had to sandbag the levee to contain flood water. In the proposed work area we didn't have any problem.

Response: Appendix B of the Feasibility Study has identified the reach of the levee in the vicinity of station 107+70 as a reach requiring additional field surveys during Preconstruction, Engineering, and Design (PED). A little over 300-feet of levee in this area has been identified as suspect and may require a levee cap approximately a minimum of 0.6 of a foot thickness. Your comment of your first hand experience during the flood of 1993 and the additional field surveys during PED will most likely result in a short length the levee at this location receiving fill on its crown sufficient to remove the low spot.

Public Meeting Comment 4

Submitted by: Laipple Farms

Comment: If the improvements to the existing levee system is carried out we are concerned where the borrow area or dirt will be obtained? We are not willing to give any borrow areas or dirt for these improvements. There have been several borrow areas given on this land through the years. We depend on this land for our living. There is no difference between this business and any other business. There is no drainage for the three (3) creeks that drain into the old river channel, that drain through Gladden Bottom. The channel is about filled up. It should be dredged out going East, to the tubes that are there. If the old channel would be cleaned out, this material could be used for the improvements on the existing levee.

Response: Potential borrow areas are currently designated as those areas adjacent to the levee on the river side. Generally, borrow locations are chosen nearest to the project site to offset additional haul distances and cost and/or processing cost, if any. Furthermore, areas of significant tree growth and wildlife habitat are avoided. This is in accordance with Corps guidance. However, final locations and quantities that will be taken from each site are not finalized. During the Pre-Construction Engineering and Design (PED) phase, alternative locations and the use of dredged material will be considered. . If you are aware of borrow sources capable of producing acceptable fill material in the quantities necessary for construction of the selected plan, those locations should be provided to this office for consideration during PED.

Public Meeting Comment 5

Submitted by: John Cox
Airport Levee member

Comment: Since the Mo Air National Guard 139th AW has the greatest investment protected by the R471-460 levee system. Why can't the DOD fund the O&M and/or levee system improvements?

Response: Cost-sharing requirements for Civil Works projects were established by Congress in the Water Resources Development Act of 1986. For a project of this type, a 65/35 split between the Federal government and local interests is required, without regard to the value or nature of investment within the existing system.

Public Meeting Comment 6

Submitted by: Gary Laipple
Farmer

Comment: Our family farm runs along the river from north of river mile 454 then south to river mile 452. We went through the construction of the levee with all the right of way and borrow area. We filled the borrow areas and deep plowed the haul roads. We have also been through various floods, including the "1993 flood" which was devastating to our family farm. So perhaps you can understand why our family is against any destruction of our farm, which includes the borrow areas and right of ways. Here are several alternatives for borrow areas. (1) Government Land along the river south of our farm which is river mile #451. (2) Dredge the old river channel. This would provide dirt plus drainage for the bottom. (3) Haul dirt from the bluff. (4) Dredge dirt out of the Missouri river. Please consider an alternative for the borrow areas other than our farm. Also if berms are extended we should be allowed to farm them instead of taking the ground out of production.

Response: Same response as Public Meeting Comment 4 with the addition that extension of underseepage berms will be conducted using temporary easements and the ground will revert back to the property owner after completion of construction. Farming of underseepage berm areas is allowed.

Public Meeting Comment 7

Submitted by: Jan B. Laipple

Comment: I am opposed to giving any dirt (borrow areas) or material of any kind, concerning stations 100+00 – 120+00 – 140+00 – 160+00 – 180+00 – 200+00 – 220+00. I am also against parting with any additional land. Create the borrow areas South of the above stations. (Stations – 240+00 – 260+00 – 280+00 – 300+00 – 320+00.) This land is not being farmed. Dredge the material out of the present river channel. Material could also be obtained out of the old river channel prior to 1952. A levee could be constructed East and West to the North of Rosecrans Airport. The obstructions and bottleneck at stations 400+00 – 420+00 – 440+00 could be corrected. This would help the flow of the river and help prevent flooding. The river should be maintained for navigation, not for preservation of wildlife. Dikes should be maintained to keep the river channel navigable. Moving products up and down the river is a much cheaper way of moving them. We have spent a lifetime building and paying for this farm. The land affected is priceless. This is how my families' livelihood is obtained. Thank you.

Response: See response to Public Meeting Comment 4 regarding borrow locations and evaluation of possible alternative sources. Levee realignment and setback is significantly more expensive than a raise in the existing location. The cost would outweigh the benefits of the project and cause a greater financial impact to the local levee districts.

Federal laws and regulations require the Corps of Engineers to examine the environmental impacts of proposed actions and propose alternatives to minimize or mitigate those impacts. The management of the Missouri River for various purposes and the maintenance of the channel dikes is beyond the scope of this study.

Public Meeting Comment 8

Submitted by: Pat Higdon

Comment: The public meeting in Elwood, KS, was informative and I understand the plan and necessity of improving the levee. I currently farm ground on both sides of the levee. It was not made clear how the construction of the levee will affect my acreage economically and what expected length of time. Where will the dirt (ground) come from for the project? Will I lose acreage? Will I be compensated for the loss of crop production effected during the project? Please respond – Pat Higdon

Response: Borrow (soil) material for the levee raise is currently proposed to come from the areas between the levee and the river. Specific locations and quantities from each location have not been fully developed. Construction of the entire project is estimated to take three years, however, impacts to specific location within the project should be less than that. Permanent loss of acreage may occur and will be compensated through the negotiation and purchase of a permanent right-of-way easement. Similarly, temporary impacts during construction will be compensated through the negotiation of temporary easements. Impacts to specific parcels will be refined during the Pre-Construction Engineering and Design (PED) phase and, when available, will be coordinated with each individual affected property owner.

FEASIBILITY REPORT
MISSOURI RIVER LEVEE SYSTEM L-455 & R 471-460
MISSOURI AND KANSAS

APPENDIX B

ENGINEERING

SEPTEMBER 2006

DEPARTMENT OF THE ARMY
Kansas City District, U.S. Army Corps of Engineers
Kansas City, Missouri

FEASIBILITY REPORT
Missouri River Levee System L-455 & R 471-460
Missouri and Kansas

1.1 GENERAL

The purpose of the Engineering Appendix is to document engineering efforts completed during the Missouri River Levee Systems (MRLS) L-455 and R 471-460 Feasibility Study development.

1.2 PROJECT LOCATION AND LIMITS

MRLS R 471-460 (see drawing sheet number 1) is located on the right bank of the Missouri River in the vicinity of St. Joseph, Missouri and Elwood, Kansas. MRLS L-455 (see drawing sheet number 2) is located on the left bank of the Missouri River. The upstream levee limit along the Missouri River and the lower end tie-back levee upstream limit along Contrary Creek are located within the City of St. Joseph, Missouri. Sheet numbers 1 and 2 also include the limits of the respective top of levee raises for the selected plan.

1.3 ENGINEERING EFFORTS

1.3.1 Overview

This study utilized the following engineering disciplines: Hydrology and Hydraulics, Geotechnical, Civil, and Structural. Information presented in the Engineering Appendix focuses on establishing the existing condition and developing the selected plan as part of the study's plan formulation. Detailed documentation is included within the separately bound document, "Missouri River Levee Systems (MRLS) L-455 & R 471-460, Design Documentation Report (DDR)". The DDR is intended to span the processes from the reconnaissance study through engineering and design during construction (EDC). The DDR will be updated as data, analyses, and designs supersede previous efforts. The DDR will be dated according to the date each final product (i.e., reconnaissance study, feasibility study, pre-construction engineering and design, and EDC).

1.3.2 Existing Condition

The Hydrology and Hydraulics and Geotechnical disciplines provided input to the flood control works' existing condition. At the time the existing condition was being established it was decided since there were no floodwalls, the Structural discipline would not have a part in establishing the flood control works' existing condition.

1.3.3 Selected Plan

The selected plan is the National Economic Development Plan (NED) that maximizes the net benefits while providing a favorable benefit to cost ratio. The selected plan also provides for MRLS R 471-460 to obtain FEMA certification. The MRLS L-455 water surface profile and top of levee were set to eliminate impacts from work proposed on the right bank. The Hydrology and Hydraulics disciplines provided the water surface corresponding to the proposed top of levee. The Civil discipline provided the limits of the top of levee raise as well information on utility crossings within the limits of the top of levee raise. Although the Structural discipline did not establish an existing condition for either of the levee units, they did consider structures' existing condition in the sense of the respective structure meeting current design criteria with no top of levee raise. The Structural disciplines only considered gatewell structures and pipes when the structure or pipe fell within the limits of the top of levee raise. The impacts of the raise to the structures or pipes were also addressed. The Geotechnical discipline provided soil parameter support to other disciplines as well as developing the levee section necessary to accommodate the raise while at the same time ensuring levee stability.

1.3.4 Alternative Screening

The engineering disciplines provided input for alternative screening. Alternative screening primarily considered various top of levee raises. Alternative screening is addressed in more detail within the main body of the study. Realignment was also considered at a screening level of effort and is addressed in more detail within the main body of the study.

1.4 EXISTING CONDITION

The Hydrology and Hydraulic discipline as well as the Geotechnical discipline used risk and uncertainty to establish the existing condition for MRLS L-455 and MRLS R 471-460. The existing condition established the base condition for the Economics efforts as well as identifying potential problem areas with the levee to be addressed as part of the plan formulation process and the selected plan development.

1.5 SELECTED PLAN

The selected plan includes raising the top of the levee for selected reaches of MRLS L-455 and R 471-460. See Sheet numbers 1 and 2 for levee limits subject to a top of levee raise. As part of the top of levee raise the following features were addressed: add fill to the levee crest and landward slope and resurfacing the levee crown with aggregate; thickening and widening berms to ensure seepage control and stability; abandoning existing pressure relief wells that no longer can withstand the increased hydrostatic pressures; incorporating pressure relief wells where real estate will not accommodate underseepage berm widths; modifying utility crossings where the levee is subject to raise; modifying gatewell drainage structures to accommodate the additional levee fill; and replacing a gatewell drainage structure that no longer meets the minimum load safety factors.

2.1 INTRODUCTION

A hydraulic analysis was performed on the Missouri River by the U.S. Army Corps of Engineers (USACE), Kansas City District (KCD). The hydraulic computations are based on the USACE HEC-RAS step-backwater computer software program (HEC-RAS 3.1.3). Calibration was performed to produce water surface profiles for the Missouri River near St. Joseph, Missouri. The study area consists of approximately 56 river miles on the Missouri River, from RM 428 to RM 484. The HEC-RAS model was developed using the latest available floodplain mapping for the Missouri and the latest hydrographic survey data. The existing conditions model was calibrated to the Upper Mississippi River System Flow Frequency Study (UMRSFFS) flood profiles for the study reach.

This section of the Engineering Appendix documents development of water surface profiles through the existing St. Joseph reach and evaluates alternatives for improving the integrity of the existing flood control system. The HEC-RAS model developed in this study was used to model existing conditions, future conditions without project, and future conditions with project alternatives.

In addition to the hydraulic analysis performed on the Missouri River, results from other studies are presented that characterize the existing conditions. These additional studies include: an analysis of levee tiebacks; development of interior floodwater/exterior water surface elevation relationships; impacts due to any proposed improvements; and an evaluation of the adequacy of the original levee design.

2.2 STREAM AND VALLEY CHARACTERISTICS

The Missouri River natural valley floodplain is approximately 3½ to 4 miles wide, while the main channel averages about 700 to 1,000 feet wide throughout the project reach. Bank-full discharge is approximately 140,000 cubic feet per second (cfs) for this reach of the Missouri River. This discharge corresponds to a flood event between the 50% chance of exceedance (2-year) and the 20% chance of exceedance (5-year) event. The average bed slope through the project reach is approximately 1 foot per mile. The drainage area of the Missouri River at the St. Joseph Gage is 420,100 square miles.

There is one stream gage located on the Missouri River within the project reach. The St. Joseph Gage is on the Union Pacific Railroad Bridge, at RM 448.2. The datum of the gage is 788.19 feet above mean sea level (msl) (NGVD 1929). The flood stage for the Kansas City Gage is 17 feet, which corresponds to an elevation of 805.19 feet. The period of record for this gage extends from 1897 to present. Exhibit 2.1 shows the latest rating curve, USGS curve #9, at the St. Joseph Gage.

2.3 HYDROLOGY

The overall hydrology and flow frequencies on the Missouri River in the St. Joseph area have been estimated in three major studies. These are: the *Missouri River Levees, Sioux*

City, Iowa to the Mouth (1947); the *Missouri River Agriculture Levee Restudy Program* (1962); and the *Upper Mississippi River System Flow Frequency Study* (2003). A discussion of each of those study results is provided below.

2.3.1 Missouri River Levees, Sioux City, Iowa to the Mouth (1947)

The original design discharge for R460-471 and L455 was 325,000 cfs as reported in Appendix I, Hydrology of the 1947 report. There was no design frequency assigned to the 325,000 cfs design flow. However, the 1947 report did identify a reservoir controlled 100-yr discharge of 250,000 cfs. The design top of levee profile was based on a backwater profile developed for the 325,000 cfs through the St. Joseph reach with an additional two feet of freeboard added. An additional one foot of freeboard was added in certain locations due to flow dynamics along the studied reach.

2.3.2 Missouri River Agricultural Levee Restudy Program (1962)

Hydrology for the Missouri River in the Kansas City District was developed and published in a Hydrology Report dated March, 1962. The data presented in that report has been used by the Kansas City District to estimate flood flows for subsequent flood control studies, Federal Emergency Management Agency (FEMA) Flood Insurance Studies, and similar purposes since that time**.** Table 1 summarizes these flows at the St. Joseph Gage.

Table 1. Flow Frequency from March, 1962 Hydrology Report

Frequency in Percent Chance of Exceedance	Return Interval (years)	Missouri River Discharge at St. Joseph Gage (cfs)
0.2%	500	330,000
1%	100	270,000
2%	50	246,000
10%	10	185,000

2.3.3 Upper Mississippi River System Flow Frequency Study (2003)

Recently, a new discharge-frequency relationship on the Missouri River was produced. The Upper Mississippi River System Flow Frequency Study (UMRSFFS) (KCD 2003) is a large, complex evaluation of the regulated and unregulated flows on the Mississippi, lower Illinois, and Missouri River Basins. This study produced a detailed analysis of the effects of reservoir regulation on the main stem of the Missouri River. Table 2 summarizes the regulated flow frequency estimates published in UMRSFFS, as applicable to the St. Joseph Feasibility Study. These discharges have been used to establish the existing conditions flow frequency data used in this study.

Table 2. Flow Frequency Data as Developed in UMRSFFS (2001)

Frequency in Percent Chance of Exceedance	Missouri River at St. Joseph Gage (cfs)
0.2%	324,000
0.5%	287,000
1%	261,000
2%	233,000
5%	199,000
10%	174,000
20%	147,000
50%	109,000

Note: Expressing discharge probability in percent chance exceedance (occurrence) is currently used in lieu of a flood return interval expressed in years. Percent chance exceedance expresses the probability of the discharge occurring each year. A return interval is the period of time over which, on average, one flood event will equal or exceed that discharge. For example, a 1% chance exceedance flood event has a one-in-one-hundred chance of being equaled or exceeded in any given year. If a 1% chance exceedance flood event were to occur this year, the probability of occurring next year and the year after is still the same, 1%. On average, only one flood event would equal or exceed the 1% chance event during a 100-year time period, thus the term a 100-year flood event. For this document, discharge will be expressed as a percent chance of exceedance followed by the equivalent return interval. All profiles presented herein represent the "most probable" or "nominal" estimates of water surface elevations. It is possible that actual water surface elevations may be higher or lower than those shown.

2.3.4 Traditional Analysis vs. Risk Based Analysis

To account for uncertainties in discharge-frequency estimates, stage-discharge functions, and engineering parameters (geotechnical and structural), the traditional analysis allowed for freeboard (a factor-of-safety) to be added to the top-of-levee design. In other words, if 325,000 cfs were the design discharge, the levee would be designed to pass this flow with a certain degree of freeboard, typically 2 feet on agricultural levees. Therefore, when describing the project performance (or level of protection) one would assign it an average return period in years of the largest flood that can be accommodated by the project, with a high degree of assurance. This assurance came from the freeboard. Therefore, if the design discharge of 325,000 cfs had a frequency of 0.2% chance of exceedance, the levee could be characterized as a "500-year levee."

Currently, the Corps of Engineers uses Risk Based Analysis (RBA) for formulating flood damage reduction projects. This method considers all of the same engineering parameters as the traditional method, but accounts for the uncertainties in these parameters during the analysis in lieu of using freeboard. Project performance is measured in terms of how a given plan will function when exposed to a full range of floods that could occur. Under this new method, the project performance will be expressed as the chance in any year of a flow exceeding the largest flood that can be accommodated by the plan under study, with a conditional non-exceedance probability of 90%. The concept of freeboard in plan formulation is no longer used.

2.3.5 Hydrologic Uncertainty

The use of the new RBA methodology requires a characterization of the hydrologic uncertainty of the flow estimates used. This uncertainty is used in the Monte Carlo algorithms built into the Flood Damage Analysis (FDA) computer program as developed by the Hydrologic Engineering Center (HEC). The uncertainty bands used in this program are based on the effective record lengths used to develop the flow frequency estimates. For this study, the effective record length is governed by the gage histories of the main stem Missouri River gages. The effective record length used in the HEC-FDA for the discharge-frequency curve is 70 years. The graphical method was used by entering the range of discharges reported in the UMRSFFS.

2.4 HYDRAULICS

The basis for the hydraulic analysis was the development of an existing and future conditions HEC-RAS model. HEC-RAS, version 3.1.3, as developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, was used in the analysis. This model was used in an attempt to calibrate to the flood event of 1993 from measured high-water marks and corresponding instantaneous discharge estimates. Since, the St. Joseph reach was subject to a large levee failure on R471-460, the steady state HEC-RAS model could not be satisfactorily calibrated to the 1993 profile. However, the UMRFFS included the use of an unsteady hydraulic model, UNET, for generation of flood profiles calibrated to the 1993 high water marks. The unsteady UNET model is capable of modeling the significant flow lost through the R471-460 breach in 1993 to be able to reproduce the 1993 flood profile through the St. Joseph study reach. Therefore, the HEC-RAS model used for the current St. Joseph study was calibrated to the UNET profiles generated for UMRFFS. Once the model was calibrated, a series of steady flow water surface profiles was created based on the flood discharges in Table 2. The first step in the model development was to enter all applicable geometric data, including a schematic of the river system, cross-section data, bridge data, and other geometric data.

2.4.1 River System Schematic and Cross-Section Data

The Missouri River centerline was established by the Kansas City District and is based on the navigation sailing line and the 1960 adjusted river mileage. All of the mapping and cross section production work was part of the Mississippi Basin Modeling System (MBMS) project. The Missouri River mapping of the floodplain from bluff-to-bluff was accomplished under contracts with Horizons, Inc. The mapping is based on aerial photography from 1995 and 1998. Digital format for this mapping data is in the form of a digital terrain model, or DTM. Data files are in Universal Transverse Mercator (UTM)

Zone 15, North American Datum (NAD) 83, National Geodetic Vertical Datum (NGVD) 29, with units in feet. Mapping in the St. Joseph area is from the 1998 data.

Hydrographic survey of the Missouri River channel was accomplished via channel soundings performed by the Kansas City District in 1998. The channel soundings and the DTM data were merged into one continuous surface in DTM format to represent the Missouri River and its floodplain from bluff-to-bluff. Using the DTMs of the merged data, geo-referenced, bluff-to-bluff cross sections based were produced. On average, there are about three cross-sections per river mile with a higher density in the vicinity of the bridges.

The River System Schematic was imported into the HEC-RAS model using ArcView Geographic Information System (GIS) software. The Missouri River model begins near Atchison at RM 428.61 and extends upstream to RM 484.11. The downstream end of the model was extended far enough (RM 428.61) to account for uncertainties in starting water surface elevations. That is, any instability would be eliminated before the water surface profile reached the downstream end of the project reach. The upstream end was extended far enough (RM 484.11) to assess project impacts upstream from the study area. See Exhibit 2.2 for a plan view HEC-RAS schematic of the Missouri River model.

2.4.2 Bridge Data

Two bridges are located in the reach of the Missouri River used in the model. The U.S. Highway 36 Bridge is located at RM 447.84. The low chord elevation of this bridge (830 feet msl) is well above the water surface elevations during low frequency flood events. Therefore, only the piers of this bridge were included in the model. The Union Pacific Railroad Bridge is located at RM 448.16. This bridge is a rotating bridge and usually kept in the open position (the bridge structure in parallel with the current). It is closed only a few times a year and then only while a train crosses over it. Therefore, this bridge was modeled in the open position. The model used both the energy and momentum methods to calculate energy loss. The method that has the highest energy loss is used to determine the water surface elevations.

The data for the railroad bridge was taken from the As-built drawings of the bridge obtained from the Union Pacific Railroad. The drawings were dated 1917 and reference the Mean Gulf Tide at Biloxi, Mississippi as the vertical datum. This datum could not be correlated to the control used for the Missouri River Mapping. The As-built drawings for levee R471-460 indicated the low chord for the Union Pacific Railroad Bridge is 819.7 feet msl. This was verified by the U.S. Coast Guard. Therefore, a low chord elevation of 819.7 feet msl was used. All other elevations were taken from the Union Pacific As-built drawings and adjusted to correlate to the low chord elevation. As a test, the model was run with the low chord elevation of the bridge at lower elevations (up to three feet lower). This evaluation indicated that there was very little effect on the water surface elevations.

2.4.3 Other Geometric Data

Ineffective flow areas were entered into the HEC-RAS model to account for areas of quiescent water that do not contribute to the discharge calculations.

Contraction and expansion coefficients were entered into the model according to the guidance distributed by HEC (HEC-RAS 2001). These parameters account for losses associated with flows expanding and contracting across the flood plain. For areas with gradual transitions between cross sections, contraction and expansion coefficients were set at 0.1 and 0.3, respectively. In the vicinity of bridges of the Union Pacific Railroad Bridge the contraction and expansion coefficients were increased to 0.3 and 0.5, respectively.

Initial Manning's n-values were entered based on land cover from field investigation and aerial photography. These roughness coefficients were modified during the calibration, which will be discussed further in this chapter.

The existing top-of-levee elevations were surveyed for both levee units to more accurately define the levee profiles. The R471-460 data were collected by the Kansas City District Survey Section in 2003. The L455 data were collected by the Kansas City District Survey Section in 2002.

2.4.4 1993 Flow Data

Efforts were made to calibrate the HEC-RAS model to the 1993 high water mark data. However, this was not successful due to the unknowns in flow along the St. Joseph reach in the 1993 flood event and the unsteady nature of the 1993 flood in St. Joseph. Three flow rates were used in the RAS model calibration because two breaches occurred in the right bank levee:

RM 484.11	305,000 cfs
RM 452.80	228,050 cfs
RM 441.88	305,000 cfs

The upstream breach occurred at RM 452.80. The downstream breach occurred at RM 441.88. The USGS gauging station is located at RM 448.20. The peak stage of 32.69 feet was measured at this gauge at 0300 on 26 July 1993. At 1300 on 26 July 1993 the discharge at this gauge was measured to be 227,000 cfs by the USGS. At the time of this discharge measurement the stage was at 32.54 feet, 0.15 feet less than the peak. Based on the rating curve and these measurements, the peak discharge at the gauge was found to be 228,050 cfs.

It is difficult to determine the exact peak discharge of the Missouri River above the upstream breach and below the downstream breach. The upstream breach in the right bank levee occurred approximately 24 hours before the peak stage occurred. The downstream breach did not occur until after the peak stage occurred. The area behind the levee was filling with water at the time the peak stage was measured. The amount of water flowing through the upstream breach was unknown because the flow behind the levee was not in equilibrium.

2.4.5 Calibration

Due to the significant unsteady aspects of the 1993 flows through the St. Joseph reach, the calibration of the steady state HEC-RAS model to the 1993 high water mark data produced unsatisfactory results. The 1993 high water marks provided the best opportunity to calibrate for high flows as the existing geometry should be a fairly accurate representation of the geometry during the 1993 flood. The UMRFFS was occurring concurrently with the development of the HEC-RAS model for this study. The unsteady UNET model used in UMRFFS was calibrated to the 1993 flood hydrograph for the entire length of the Missouri River between Rulo, Nebraska, and St. Louis, Missouri. The UNET model was able to be calibrated as described in the following excerpt from the *Upper Mississippi River System Flow Frequency Study – Appendix E*:

> "Another aspect of the UNET calibration process that was extremely important in the Kansas City District was the simulation of the performance of the Missouri River levees. A unique routine, known as the Kansas City Levee Algorithm, has been built into UNET for this purpose. That algorithm allows the user to first specify the upstream and downstream limits of a particular levee, which allows UNET to compute the floodplain storage within that levee. Next it allows the modeler to specify the point of levee rupture and the water surface elevation causing that rupture. This allows UNET to divert a portion of the passing flood wave into floodplain storage. Finally, the modeler is allowed to specify the channel discharge that will mobilize overbank flow in the behind-the-levee area. Because levees line almost the entire bank of the Missouri River, and many of these levees fail during great floods, the model calibration process in the Kansas City District required careful modeling of levee performance as well as careful estimation of channel roughness elements.
>
> The year 1993 was chosen as the calibration standard for this study. The data is recent, multiple measurements by USGS were made close to the peak flow of that year, and high water marks from the July-August flood of that year are well documented. The initial calibration using the automated calibration techniques of UNET were not fully satisfactory because the computed profile did not reproduce the high water marks between the gages. A second calibration more closely reproduced those marks, but was not used because the model did not properly reproduce the rupture and measured back-of-levee flow in the L-471-460 levee (St. Joseph area), and could not trace the multiple high water marks in the Kansas City area. These automated calibration techniques were then abandoned. The model was calibrated by manually adjusting resistance coefficients and levee

> characteristics until the peak flow profile for 1993, and the observed flow and stage hydrographs at the gages, closely matched the observed data."

Once calibrated, the UNET model was then used to model the profiles as based on the frequency flows as defined in UMRFFS and documented in the Hydrology section of this report. The HEC-RAS model was then calibrated to reproduce the UNET model water surface profile for the 1% (100-year) chance event, as the profiles near this frequency are of primary concern in this study. Manning's n-values were adjusted in an attempt to match the resulting HEC-RAS water surface elevations with the UNET water surface elevations. The final Manning's n-values range from 0.025-0.030 for the channel and 0.030-0.100 in the overbank areas. Exhibit 2.3 displays the comparison of the water surface profiles for the 1% (100-year) chance event water surface profile as modeled by both the HEC-RAS model and the UNET model.

The model calibration has been verified with readings taken from USGS Gage 06818000 for field-measured discharges. The gage is located on the railroad bridge at River Mile 448.16 in the HEC-RAS model. The Exhibit 2.4 displays the model water surface profile along with gage readings from USGS field measured discharges. Only discharge measurements/gage readings since 1980 were used in this comparison to minimize the effects of any long-term stage trends in this reach. The data from 1980 to the present provides 856 discharge measurements/gage readings for this comparison. Exhibit 2.4 displays that the modeled water-surfaces are at the top edge of the data collected from the USGS gage. This result is expected, as HEC-RAS provides a complete backwater simulation, and the modeled water surfaces should lie along the top edge (the falling limb) of the hysteresis displayed in the gage data.

2.5 EXISTING CONDITIONS

2.5.1 Missouri River Water Surface Profiles

Once the model was calibrated, existing conditions water surface profiles were generated for the 50% (2-year), 20% (5-year), 10% (10-year), 5% (20-year), 2% (50-year), 1% (100-year), 0.5% (200-year), and 0.2% (500-year) chance of exceedance flood events. The starting water surface elevations for each of the profiles were calculated using the water surface elevation from the UMRFFS for RM 428.61.

For each of these flood events, an assumption was made about overbank flows. As levees begin to overtop, it was assumed in HEC-RAS that the protected areas would be considered ineffective flow areas. That is, the profiles will reflect a confined cross-sectional area from levee to levee and will not compute the protected areas as flowing. This was assumed to avoid trying to predict where a levee would fail. HEC-RAS is a one-dimensional steady state model. It is beyond the limitations for HEC-RAS to predict the overbank flow scenarios or to model multi-dimensional flow. The HEC-RAS results for the Missouri River are presented in Exhibit 2.5. The 0.2% and 0.5% chance event profiles are listed as 'confined' because the actual existing conditions profiles exceed the existing top of levee elevations but are confined by ineffective flow areas. Levee-Unit-specific water surface profiles showing the 2% (50-year), 1% (100-year), 0.5% (200-year), and 0.2% (500-year) chance of exceedance flood events in relation to the surveyed top-of-levee were created for the both R471-460 and L455 (Exhibits 2.6 and 2.7). The engineering performance of the levees in the existing condition can be found in Appendix C – Economic Appendix as this output comes from the economist's HEC-FDA analysis.

2.5.2 Hydraulic Uncertainty

Uncertainties in computed water surface elevations are a result of imperfect knowledge and lack of appropriate data. Uncertainties in water surface elevation result from a number of physical factors such as bed forms, debris and other obstructions, channel scour or deposition, sediment transport, and waves. In hydraulic modeling, other factors such as hydraulic roughness variation with season, inexact geometry and loss coefficients, and error in setting high-water marks result in errors in computed water surface elevations. Estimating these uncertainties in water surface elevation is based on sensitivity analyses, analytical studies of gage readings, and interpretation of the success of model adjustments following traditional procedures presented in USACE Engineering Manual (EM) No. 1110-2-1619 (EM 1996).

Stage uncertainty is expressed in the Risk Based Analysis as a standard deviation (in feet). To obtain a total standard deviation the formula below, taken from EM 1110-2-1619, was applied:

$$\text{Total Standard Deviation} = \text{SQRT}\,((S_{natural})^2 + (S_{model})^2)$$

where SQRT = square root mathematical function
$S_{natural}$ = standard deviation based on historical data and gage readings
S_{model} = standard deviation based on mapping detail and reliability of estimating Manning's n values

$S_{natural}$, is calculated by comparing observed data with the latest rating curve at the gage in the project reach. To avoid potential problems due to shifts in the rating curve over time, only observed data going back to 1978 were used. Only data for floods exceeding elevation 806 at the St. Joseph gage were analyzed. The following formula is used to calculate $S_{natural}$.

$$S_{natural} = \text{SQRT}((\Sigma(X-M)^2)/(N-1))$$

where SQRT = square root mathematical function
X = stage corresponding to measured Q
M = best fit curve estimate of stage corresponding to Q
N = number of stage-discharge observations in the range being analyzed

The standard deviation based on historical data and gage readings, $S_{natural}$, was computed as 1.24 feet.

The second component in quantifying standard deviation is S_{model}. S_{model} is obtained by estimating the confidence in the cross-section data from topographic mapping efforts and in estimating the reliability of the Manning's n-value. Table 5-2 in EM 1110-2-1619 quantifies an S_{model}, based on these two factors. A standard deviation of 0.3 foot was chosen from EM 1110-2-1619 Table 5-2 since the cross-sections were based on current aerial mapping and the Manning's n-values were assumed to be reliable.

Once $S_{natural}$ and S_{model} are known, a total standard deviation can be computed. Following traditional procedures presented in EM 1110-2-1619, a total standard deviation of 1.28 feet was computed for the entire discharge set.

2.6 LEVEE TIEBACK ANALYSIS

2.6.1 Introduction

At some locations, landward extensions of the main stem levee protect interior areas from backwater and/or tributary headwater flooding. These extensions are called levee tiebacks. Additional hydraulic analysis is required to characterize existing conditions relative to a levee tieback.

For this study, purposes for analyzing levee tiebacks include determining their impacts on interior floodwater and exterior water surface elevation relationships, and identifying the longitudinal extent of backwater-control on water surface elevations along a levee tieback.

Three levee tiebacks were analyzed for existing conditions hydraulics. Summarized in Table 4 are each levee tieback analyzed as part of the St. Joseph Feasibility Study.

Table 4. St. Joseph Study Levee Tiebacks

Missouri River Levee Unit	Levee Tieback Headwater Source Area	Missouri River HEC-RAS River Station
L455	Contrary Creek	437.30
L455	Browns Branch	445.73
R471-460	Peters Creek	441.73

2.6.3 Contrary Creek

Contrary Creek is the downstream tieback for levee L455. A HEC-RAS model of Contrary Creek was developed by HDR in 1999. This model provided the basis of the Contrary Creek model used in this study. The HDR model was modified to reflect survey elevations along the tieback levee collected as part of the L455 top of levee survey conducted in 2002. The Manning's n-values in the HEC-RAS model were also modified to reflect the tree growth along the channel banks. A channel n-value of 0.050 was used in the current model along with a n-value of 0.030 for the grassy overbank areas. A HEC-1 hydrologic model for the 26.2 sq. mi. Contrary Creek Watershed was used to determine the Contrary Creek design flows. The HEC-1 model was developed by HDR and documented in the report "Missouri River Levees L455 and R460-471: Interior Drainage Study, Task 3: Contrary Creek Watershed Model", (2001). Table 5 displays the results from the HEC-1 model.

Table 5. St. Joseph Study Levee Tiebacks Contrary Creek Flows

Frequency in Percent Chance of Occurrence	Contrary Creek Design Flow (cfs)
50%	4,070
20%	6,180
10%	7,830
4%	9,510
2%	11,200
1%	12,900
0.5%	14,900
0.2%	17,400

A headwater flood profile for each recurrence interval was calculated for Contrary Creek. This assumed that a flood event on Contrary Creek was completely independent of flooding on the Missouri River. This assumption is based on the relative size of the small Contrary Creek watershed to the Missouri River watershed at this location. The Contrary Creek watershed responds quickly to a storm event and the peak will pass quickly, whereas the Missouri River responds slowly to a prolonged weather pattern or snowmelt in the upstream tributary area. Therefore, downstream starting elevations were based on a normal depth within Contrary Creek.

The backwater elevations for each flood event on the Missouri River at the mouth of Contrary Creek was superimposed over the headwater flood profiles for the respective flood event on Contrary Creek. The final profile for Contrary Creek is the maximum of the headwater flood within Contrary Creek and the Missouri River backwater elevation for each flood event (Exhibit 2.8).

The possible effects due to a coincident event over the Contrary Creek watershed along with flood stages along the Missouri River were analyzed. This limited analysis provides a check as to whether further coincident analysis would be justified. The 1% chance Contrary Creek headwater event flood profile was calculated using a downstream starting elevation equal to the backwater from a 2% chance flood event on the Missouri River. This combination was viewed as a conservative scenario, providing an upper limit to coincident effects, as a coincident occurrence of two such low probability events would be rare. The coincident analysis showed despite the coincidence of occurrence between the Missouri River and Contrary Creek floods that the 1% chance Contrary Creek profile was not increased over that modeled using a normal depth starting elevation.

The Contrary Creek tieback levee is adequate to protect from overtopping by a 1% chance Missouri River flood event. However, the levee is not adequate to protect against Contrary Creek flooding events. The majority of the levee is inadequate to protect against the 1% chance Contrary Creek flood event and significant portions are adequate for only the 4% chance flood event. These areas can be addressed further at the request of the local sponsors, but are outside of the scope of the current feasibility study.

2.6.4 Browns Branch

Browns Branch is an internal tieback for levee L455. A HEC-RAS model of Browns Branch was developed by HDR in 1999. This model provided the basis of the Contrary Creek model used in this study. A HEC-1 model was developed by HDR and documented in the report "Tributary Hydraulics, Missouri River Levee System, Unit L-455 and Unit R-460-471", (2000). The hydrologic model assumed a freely discharging watershed to Browns Branch. Table 6 displays the results from the HEC-1 model.

Table 6. Browns Branch Flows

Frequency in Percent Chance of Occurrence	Browns Branch Design Flow (cfs)
50%	1,975
20%	2,850*
10%	3,500*
4%	4,500*
2%	5,350*
1%	6,150*
0.4%	7,500*
0.2%	8,600*

*Exceeds Capacity of 9'x9' RCB at beginning of Browns Branch

Browns Branch is protected from overland flow into the channel by the presence of L455 tieback levees on either side of the channel. The only discharge point into Browns Branch is a dual 9'x9' RCB at the extreme upstream end of the channel. This box culvert conveys surface runoff from the tributary watershed to Browns Branch. Therefore, the capacity of this box culvert limits the amount of runoff from the watershed that can be introduced to Browns Branch. The hydraulic capacity of this box culvert was analyzed. Information provided by the City of St. Joseph, indicated that the slope of the Dbl. 9'x9' RCB is 0.00179 ft/ft. The hydraulic capacity of the culvert was calculated to be 1,634 cfs. For this analysis, the culvert capacity was figured as 110% of the hydraulic capacity or 1,797 cfs. From the above table, the culvert capacity is less than the 2-Yr Flood Event from the contributing watershed. Therefore, the culvert capacity (1,797 cfs) is the design flow for each headwater flood profile within Browns Branch.

A headwater flood profile for the design flow was calculated for Browns Branch. This assumed that a flood event on Browns Branch was completely independent of flooding on the Missouri River. This assumption is based on the relative size of the small Browns Branch watershed to the Missouri River watershed at this location. The Browns Branch watershed responds quickly to a storm event and the peak will pass quickly, whereas the Missouri River responds slowly to a prolonged weather pattern or snowmelt in the upstream tributary area. Therefore, downstream starting elevations were based on a normal depth within Browns Branch. As stated previously, the headwater flood profile was the same for each Flood Event 2-yr through 500-yr.

The backwater elevations for each flood event on the Missouri River at the mouth of Browns Branch was superimposed over the headwater flood profiles for the respective flood event on Browns Branch. The final profile for Browns Branch is the maximum of the headwater flood within Browns Branch and the Missouri backwater elevation for each flood event (Exhibit 2.9).

The possible effects due to a coincident event over the Browns Branch watershed along with flood stages along the Missouri River were analyzed (Exhibit 2.9). Since the maximum flow within Browns Branch is achieved in a frequent event (>50% annual chance of occurrence), it is quite possible that this event could occur coincident with low frequency events on the Missouri River. The maximum Browns Branch headwater event flood profile was calculated using a downstream starting elevation equal to the backwater from a 1% chance flood event on the Missouri River. This combination was viewed as a conservative scenario, providing an upper limit to coincident effects.

The minimum difference between the lowest levee elevation and the 1% chance elevation from the Missouri River backwater exceeds 3 feet with the water surface elevation always lower. The Browns Branch coincident event headwater flood profile comes within 1.15 feet of the top of the tieback levee. Thus the most likely form of overtopping would be headwater flooding.

2.6.5 Peters Creek

Peters Creek is the downstream tieback for levee R471-460. A HEC-RAS model of Peters Creek was developed by HDR in 1999. This model provided the basis of the Contrary Creek model used in this study. A HEC-1 model was developed by HDR and documented in the report “Tributary Hydraulics, Missouri River Levee System, Unit L-455 and Unit R-460-471”, (2000). Table 7 displays the results from the HEC-1 model.

Table 7. Peters Creek Flows

Frequency in Percent Chance of Occurrence	Peters Creek Design Flow (cfs)
50%	1,950
20%	3,150
10%	4,375
4%	6,300
2%	8,000
1%	10,000
0.4%	13,000
0.2%	15,500

A headwater flood profile for each recurrence interval was calculated for Peters Creek. This assumed that a flood event on Peters Creek was completely independent of flooding on the Missouri River. This assumption is based on the relative size of the small Peters Creek watershed to the Missouri River watershed at this location. The Peters Creek watershed responds quickly to a storm event and the peak will pass quickly, whereas the Missouri River responds slowly to a prolonged weather pattern or snowmelt in the upstream tributary area. Therefore, downstream starting elevations were based on a normal depth within Peters Creek.

The starting water surface elevation for each headwater flood profile began at normal depth at the downstream end of Peters Creek. However, the lower 2000 feet of Peters Creek in the model has a flat invert at elevation 792.50. A slope of 0.0005 ft/ft was used as the downstream boundary condition since a zero slope can not be used in normal depth calculations. This assumption was tested by using various starting slopes ranging from 0.0002-0.002 and examining the resultant water surface profiles. The profiles for the various assumed downstream slopes were nearly identical at points more than 1700 feet upstream of the mouth of Peters Creek. These differences at the lower end of the tributary are insignificant as the flood profiles near the mouth of Peters Creek are controlled by Missouri River backwater and not headwater flooding in Peters Creek.

The backwater elevation for each flood event on the Missouri River at the mouth of Peters Creek was superimposed over the headwater flood profiles for the respective flood event on Peters Creek. The final profile for Peters Creek is the maximum of the headwater flood within Peters Creek and the Missouri backwater elevation for each flood event (Exhibit 2.10).

The possible effects due to a coincident event over the Peters Creek watershed along with flood stages along the Missouri River were analyzed. This limited analysis provides a check as to whether further coincident analysis would be justified. The 1% chance Peters Creek headwater event flood profile was calculated using a downstream starting elevation equal to the backwater from a 2% chance flood event on the Missouri River. This combination was viewed as a conservative scenario, providing an upper limit to coincident effects, as a coincident occurrence of two such low probability events would be rare.

The minimum difference between the lowest levee elevation and the 1% chance elevation from the Missouri River backwater exceeds 3 feet and has no effect on FEMA certification for this levee. Exhibit 2.10 also displays the results of the limited analysis of coincident events. The coincident event profile remained well below the top of levee along the length of the tieback for this worst-case scenario. Therefore, it was determined that a coincident event was not critical in the analysis of the Peters Creek tieback.

2.7 INTERIOR FLOODWATER/EXTERIOR WATER SURFACE ELEVATION RELATIONSHIPS

2.7.1 Introduction

For each levee unit, an analysis was performed for estimating a land-side (interior) floodwater elevation at a given river-side (exterior) water surface elevation. Interior flooding attributed to levee failure or levee overtopping was considered for developing interior/exterior water surface relationships. Results of this analysis will be used as input to the HEC-FDA model. To provide a means of economic analysis, damages to the protected area for a given flood event must be calculated. Interior flood profiles, assuming a breach of the studied levee, need to be analyzed for each flood event in the existing conditions model. These profiles must then be associated with the same probability flood in a confined channel exterior to the studied levee.

2.7.2 Approach

The proposed methodology used in the analysis of the interior flood profiles is based in part on the breach and subsequent flooding of R460-471 during the July 1993 flood. The reason for choosing this method is that past performance is the best predictor of future performance. In 1993 the levee breach occurred near the upstream end of the studied levee. The subsequent interior flood traveled from the breach location and ponded behind the lower end of the levee. This pond behind the downstream levee continued to rise until the downstream levee breached, returning the interior flood flow back to the river channel. The following timeline, summarizing the sequence of events occurring in July 1993, was assembled based upon information from Levee District eyewitness accounts as verified by Situation Report entries on file within the Kansas City District's Emergency Management Branch.

Date	Hour	Event
24 July 1993	1600	Overtopping begins near river mile 453
25 July	0200	Catastrophic failure near river mile 453
26 July	1400	Overtopping begins near river mile 442

27 July	2200	---
		Catastrophic failure takes place within this period near river mile 442
28 July	0200	----

The proposed methodology is based on a combination of past performance of the levee, combined with a logical modification of the FEMA delineation process. This approach was developed, in part, because of the delineation of an AR zone by FEMA utilized this same procedure. This same procedure was also applied to L455, even though that levee did not fail during the 1993 flood.

The Interior Floodwater Analysis assumes a complete breach of the upper limits of the levee system allowing uncontained flow through the protected area. This condition did occur with a breach in the upper portion of the levee during the 1993 flood event. The analyzed channel consists of the main channel geometry and the flooded protected area. Since the majority of the protected area behind the studied levee is row cropped agricultural land, n-values appropriate for such land use have been assigned to the flood plains landward of the levee. The Interior Floodwater Analysis model allows flow within the main channel and behind the studied levee, creating a family of interior flood profiles for the full valley. The most upstream section used in generating interior flood profiles for R471-460 was River Mile 453.44. The levee does extend to River Mile 456.24, but the portion from 453.44 to 456.24 flows from west to east. This results in the interior flood profile being distorted, showing an excessive rise in the profiles, by considering these cross-sections which flow perpendicular to the direction of interior flood flow. It is likely that the limited agricultural damage in the upper end of the protected area can be represented by the long North-South leg of the Missouri River. The same occurs at the downstream end of the levee, but it is inconsequential due to the interior flood profiles being overridden by the ponding elevation at the downstream end.

The levee low point is the minimum elevation of the interior floodwater prior to overtopping the levee and returning to the main channel. The levee low point elevation is 816.12 and 813.28 for R471-460 and L455, respectively. This creates a level pool at the lower portions of the interior floodwater profile. However, the level pool elevation cannot exceed the water surface elevation of the most upstream section of the confined channel flood profile adjacent to the studied levee, as there would not be adequate head to fill the protected area. Therefore, the minimum elevation of the interior flood profile will be the lesser of the levee low point or the confined channel water surface elevation for the most upstream section. It should also be noted that HEC-FDA, cannot accept flood profile data when the elevation of a more severe flood is not greater than that for a lesser flood. Therefore, the ponding elevation was incremented by 0.10 foot for each flood event. The final interior flood profile consists of a level pool behind the downstream portion of the levee extending to a point of intersection with the interior flood profile as discussed in the previous step.

The interior flood profile is assosciated with an exterior confined water surface profile to determine the interior/exterior relationship for each levee unit. The exterior confined profile is created by taking the accepted existing conditions model and not allowing any flow over the studied levee or within the protected area. This is achieved by setting ineffective flow limits on the studied levee to such a height that there are no areas of effective flow within the protected area, regardless of flood event probability. Thus there is an exterior profile and an associated interior profile for each flood frequency used in this study.

General discussions of the methods and results for all levee geotechnical and structural failure analyses can be found in the relevant Geotechnical and Structural chapters of this appendix. For each levee unit, exterior water surface and levee failure elevation data were translated to an index point along the top-of-levee.

The approach used for estimating interior floodwater elevations was dependent upon the cause of interior flooding (levee failure or levee overtopping) and the elevation of the lowest point along the top-of-levee. To identify the location and translate the elevation of initial levee overtopping to the index point, the existing conditions 1% chance of exceedance (100-year) flood event water surface profile was adjusted (equally raised or lowered) to intersect the top-of-levee at the initial point of overtopping. For levee failures below both the lowest top-of-levee and the elevation of initial levee overtopping, it was assumed that the interior floodwater would equilibrate to the elevation of the levee failure. When levee failure is above the lowest top-of-levee-elevation, but below the initial levee overtopping elevation, it was assumed that the interior floodwater elevation would equate to the lowest top-of-levee elevation. Once the levee is overtopped, it is assumed that the interior floodwater elevation would initially equate to lowest top-of-levee elevation. Once the exterior surface water exceeds the lowest top-of-levee elevation, it is assumed that the interior water surface elevation would then equal the exterior water surface elevation at that location.

2.7.3 Results

Results of categorizing interior floodwater and exterior water surface relationships and associated probabilities were tabulated and provided for input into the HEC-FDA analysis of the St. Joseph Levees. Figures showing the interior water surface profiles are provided for each levee unit (Exhibits 2.11 and 2.12). Figures showing the interior floodwater/exterior water surface relationship entered into HEC-FDA for each index point used in this study are provided (Exhibits 2.13 and 2.14).

2.8 FUTURE CONDITIONS WITHOUT PROJECT (BASELINE)

The future conditions without project represents the probable stage-discharge relationship at a selected future date based on the best available current data, the incorporation of any definite projects planned to be completed within the study reach, and any long term natural river processes that may affect future stages. For the purposes of this study, the future conditions have been defined as conditions reasonably expected to be present in 2038. A critical assumption in the future conditions analysis is that hydrologic conditions along the Missouri River are relatively static and that flows used in the existing conditions study will be used in the future conditions analysis. The assumption was also implemented in the development of the recently released *Upper Mississippi River System Flow Frequency Study* (UMRFFS), 2003, which was based on the study of 100 years of gage records along the Missouri River. The UMRFFS superseded the previous Missouri River hydrology published in 1962 in the report titled *Missouri River Agricultural Levee Restudy Program*. It is therefore reasonable to assume that the newly published flows in the UMRFFS will still be applicable at the future conditions date.

2.8.1 Future Changes to Missouri River Model

The USACE Northwest Division-Missouri River Basin Reservoir Control Center in Omaha, Nebraska published *Missouri River Stage Trends, RCC Technical Report A-04* in April 2004. This report provided some long-term trend data for the St. Joseph gage on the Missouri River. The stage trends at the St. Joseph Gage for low frequency flows are shown in Exhibit 2.15. The 70,000 cfs and100,000 cfs data series reflects a significant rise in stages from 1928 to 2003.

A likely contributor to the flood flow stage changes along the Missouri River is accretion behind dikes placed for navigation channel confinement. Flows deposit sediment in the quiescent area downstream of the navigation dike structures. This sediment builds over time and encroaches further into the channel. As time passes, vegetation has grown on this newly accreted land. The vegetation stabilizes this accreted land from future erosion and allows the cycle to continue further into the channel. This cycle produces the tall stands of timber present in the accreted land behind the dikes along the riverward side of the levees. The accreted land tree growth then leads to higher stages for a given flow as conveyance area is decreased and overbank roughness is significantly increased.

Overgrowth of the foreshores can contribute to continued rising stages in the Missouri River along the studied reach. The right foreshore is primarily farmed north of the Missouri Department of Conservation Property. The Missouri Department of Conservation Property is composed of dense mature trees and extends north from the railroad bridge to approximately River Mile 452. Scattered portions of the left foreshore are being farmed currently, but much of the left foreshore has fully overgrown with mature trees. The area experiencing the most new growth is an area extending along the right foreshore from the Highway 36 Bridge to the downstream end of R460-471. This area is being allowed to experience natural tree growth as part of the Wetlands Conservation Program. This area will transition from grassland with small scrub trees to a mature stand of trees. This overgrowth will be considered as a condition affecting future Missouri River water surface profiles within the studied reach. For this study, land that is currently farmed will be assumed to continue to be farmed in the future and land overgrown with mature trees will be assumed to remain as mature tree growth.

Therefore, the only land use to change in the future conditions model is the land along the right foreshore in the Wetlands Conservation Program.

2.8.2 Future Conditions Water Surface Profiles

Future conditions water surface profiles were generated for the 50% (2-year), 20% (5-year), 10% (10-year), 5% (20-year), 2% (50-year), 1% (100-year), 0.5% (200-year), and 0.2% (500-year) chance of exceedance flood events (Exhibit 2.16). For each of these flood events, a similar assumption as used in the existing conditions model was made concerning overbank flows. As levees begin to overtop, the protected areas behind are considered ineffective flow areas. The profiles reflect flow in the area from levee to levee and do not consider the protected areas as conveying flow. Thus the 0.2% and 0.5% profiles are labeled "confined" to reflect this approximation. Levee unit-specific water surface profiles showing the 1% (100-year) chance of exceedance flood event in relation to the top-of-levee were created for both R471-460 (Exhibit 2.17) and L455 (Exhibit 2.18). The engineering performance of the levees in the future without project condition can be found in Appendix C – Economic Appendix as this output comes from the economist's HEC-FDA analysis.

2.8.3 Hydraulic Uncertainty

As discussed in the existing conditions section, stage uncertainty is expressed in Risk Based Analysis as a standard deviation (in feet). Per USACE Engineering Manual (EM) No. 1110-2-1619 (EM 1996), a total standard deviation was obtained by applying the formula below:

$$\text{Total Standard Deviation} = \text{SQRT}\left((S_{natural})^2 + (S_{model})^2\right)$$

where SQRT = square root mathematical function
$S_{natural}$ = standard deviation based on historical data and gage readings
S_{model} = standard deviation based on mapping detail and reliability of estimating Manning's n values

The $S_{natural}$ will remain unchanged, as that portion of the uncertainty is due to the agreement between historical gage readings and modeled water surface elevations. $S_{natural}$ is a function of calibration accuracy and does not change from existing conditions to future conditions. However, due to additional assumptions in the development of the future conditions model, S_{model} will increase. Due to the uncertainty of future channel morphology and vegetation growth, the reliability of the cross-section data and Manning's n-value was decreased. S_{model} is obtained by estimating the confidence in the cross-section data from topographic mapping efforts and in estimating the reliability of the Manning's n-value. Table 5-2 in EM 1110-2-1619 quantifies S_{model}, based on these two factors. A standard deviation of 0.7 feet was chosen since the cross-sections were based on current aerial mapping and the Manning's n-values were assumed to be less reliable than existing conditions.

Once $S_{natural}$ and S_{model} are known, a total standard deviation can be computed. Following traditional procedures presented in EM 1110-2-1619, a total standard deviation of 1.42 feet was estimated for the entire discharge set in the future conditions.

2.9 FUTURE CONDITIONS WITH PROJECT

2.9.1 Studied Alternative Raises

The future conditions with project represents the probable stage-discharge relationship at a selected future date (2038) reflecting any proposed alternatives from the current feasibility study. The basis of this hydraulic model is the future conditions without project model modified to reflect any proposed alternatives.

Four alternatives have been identified for the St. Joseph Levee Units levee raise. The alternatives include raising the levee to 1.5 feet above the nominal future conditions without project 1% (100-year) chance of exceedance flood profile (referred to as the n100+1.5 alternative), raising the levee to 3 feet above the nominal future conditions without project 1% (100-year) chance of exceedance flood profile (referred to as the n100+3 alternative), raising the levee to 1.5 feet above the future conditions without project "confined" 0.2% (500-year) chance of exceedance flood event (referred to as the 500+1.5 alternative), and raising the levee to 3 feet above the future conditions without project "confined" 0.2% (500-year) chance of exceedance flood event (referred to as the 500+3 alternative). Freeboard does not explicitly enter into this set of alternatives. A typical spread of four raises is examined for purposes of allowing economic optimization. This spread was chosen based on practical experience and expected costs. The n100+3 alternative analysis was conducted in detail with the other three alternatives receiving a cursory analysis as a means of developing a net benefits curve. Therefore, the with project analysis is focused on the n100+3 preferred alternative (Exhibit 2.19).

2.9.2 Performance of Alternatives

The preferred alternative, the n100+3 raise, increases the R471-460 conditional nonexceedance probability for the 1% (100-year) flood event profile from 41.8% in the future without project condition to 91.6% in the future with project condition. Please refer to Table 8 for a summary of HEC-FDA engineering performance results for the various alternatives. The detailed HEC-FDA results can be found in Appendix C – Economic Appendix. Appendix C contains the reliability data for all studied alternatives and for both the existing and future conditions.

Table 8. Engineering Performance Data from HEC-FDA 1% (100-yr) Conditional Nonexceedance Probability

ANALYSIS YEAR/ ALTERNATIVE	R471-460	L-455
2013 without-project	51.3%	93.6%
2013 overtopping only	67.8%	95.0%
2013 Alternative 4 (100+1.5)	84.3%	93.6%
2013 Alternative 1 (100+3)	95.8%	95.0%
2013 Alternative 2 (500+1.5)	99.8%	99.2%
2013 Alternative 3 (500+3)	100.0%	100.0%
2038 without-project	41.8%	92.8%
2038 overtopping only	56.6%	94.0%
2038 Alternative 4 (100+1.5)	75.7%	92.8%
2038 Alternative 1 (100+3)	91.6%	94.0%
2038 Alternative 2 (500+1.5)	99.3%	98.9%
2038 Alternative 3 (500+3)	99.9%	99.9%

Both existing levees currently pass the nominal 1% (100-year) chance of exceedance flood profile without overtopping. Therefore, there are no impacts to the profile for the 1% (100-year) chance of exceedance event for any raise alternative. This is an important designation as there are no impacts to the FEMA Base Flood Elevations along the Missouri River at any point as a result of any raise alternative. However, the preferred alternative would remove the FEMA AR Zone designation for the R471-460 protected area. The impacts due to the proposed alternatives impact only profiles for events larger than the 1% (100-year) chance of exceedance event.

2.9.3 Impacts to Others

As stated previously, the HEC-RAS model assumed a confined channel with no conveyance through the protected area in the event of overtopping. Therefore, the HEC-RAS model would not identify any impacts to the Missouri River profile as a result of levee raises. The largest impact to the profile is due to the delaying or preventing of the overtopping as seen in the 1993 flood event on R471-460. This unsteady flow problem called for the use of the UNET model to capture the impacts to the Missouri River profile as a result of the proposed n100+3 alternative. The impacts for this alternative were analyzed for the 1993 flood event as modeled in the UMRFFS UNET model.

The UMRFFS UNET model used for calibration in this study was modified to reflect the proposed R471-460 raise. The UNET “include file” contains the levee designations for all Federal Levees and significant private levees along the Missouri River in the studied reach. The ZBLV variable, the river elevation when the breach in the levee initiates, in the LV record for Levee R471-460 was edited to reflect the raised breach elevation. In the existing conditions, ZBLV = 825.50, an elevation one foot below the existing top of levee. The proposed improvements to the levee will set the crest elevation at the 1% chance flood event plus 3-feet. The modeled breach elevation will account for increased reliability at stages below the crest elevation, as well as the physical top of levee elevation increase (1.5 feet at the breach location), and therefore the proposed model will use ZBLV = 828.00. The modification of the ZBLV value for R471-460 was the only modification to the existing UNET data.

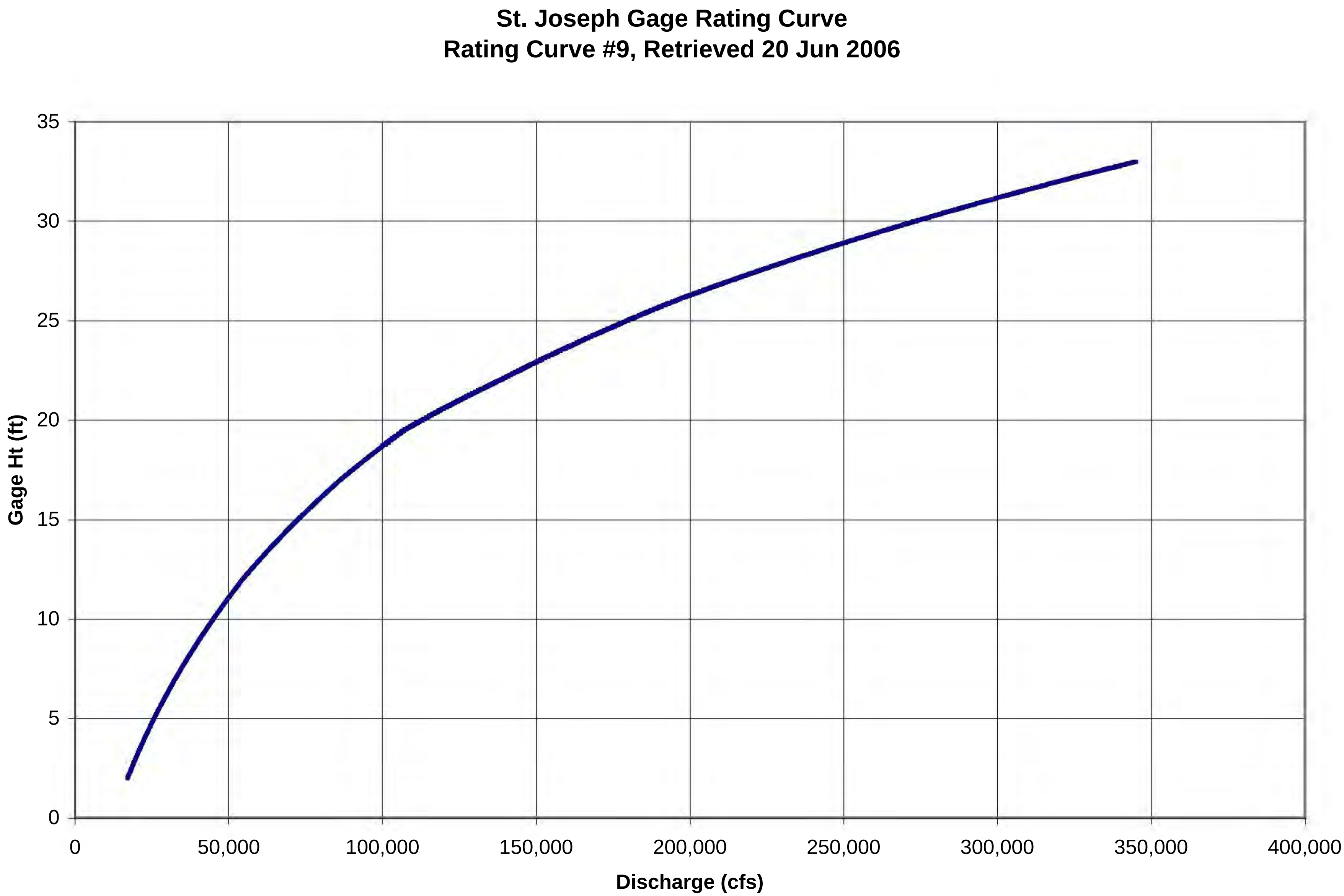
The proposed "with project" condition was run in UNET. The output provided a daily maximum water surface elevation profile along the river, which displays the impacts of the R471-460 improvements. It should be noted that while the top of levee elevation has been increased, the UNET model still shows that R471-460 fails due to the Flood of 1993. It should also be noted that this analysis assumes that the breach in an event similar to 1993 would occur in the same location at the upstream end of R471-460 as it occurred in 1993. The results of this analysis would vary if the initial levee overtopping and subsequent breach occurred at the downstream end of the R471-460 Levee Unit. The with and without project profiles for this analysis were plotted together to identify locations where the daily water surface was increased due to the improvements to R471-460.

Exhibits 2.20 and 2.21 tabulate and display the differences in the existing and proposed conditions maximum water surfaces along the studied reach. It is evident that the improvements to R471-460 have a significant effect to the maximum water surface profiles seen in the 1993 Flood event. By delaying the breaching of R471-460 in the 1993 Flood event and the subsequent flow loss to storage, greater peak flows are seen in the reaches adjacent to and downstream of R471-460. This increased peak flow causes increases in the maximum water surface seen adjacent to and downstream of R471-460. The maximum rise in the water surface profile, 0.82 feet, is seen at RM 433.44. Levees L448-443 and R440 are located near the location of the maximum rise. Each of these levees has significant freeboard (minimum freeboard approximately 3.5 feet) above the maximum water surface calculated in the UNET model for the Flood of 1993. The increase in maximum water surface elevations adjacent to L455 range from approximately 0.40-feet at the upstream end of the levee to approximately 0.60-feet at the downstream end of L455. All Federal levees should perform in a 1993 flood event similar to their respective performance in 1993. Levees that overtopped in the 1993 flood event would still overtop and those levees which were elevated above the maximum 1993 water surface elevation would continue to be above the 1993 maximum water surface with the proposed R471-460 and L455 raise.

2.10 EVALUATION OF THE ADEQUACY OF THE ORIGINAL DESIGN

Unit R471-460 was overtopped by a flow of approximately 268,000 cfs during the Flood of 1993. This overtopping flow was approximately 60,000 cfs less than the design flow, 325,000 cfs, for R471-460. The original levee design, completed in 1965, also accounted for two feet of freeboard above the design flow profile. The relatively low overtopping flow as compared to design has brought into question the adequacy of the original design and the subsequent top of levee profile. Upon review of the original design, the cause for the current recommended alternative and inadequacy of the existing levee unit has been deemed a design deficiency in the original design of R471-460. Please refer to the attached Memorandum for Record (Exhibit 2-22) for a detailed summary of the design deficiency analysis.

Exhibit 2.1



Designed by: EDS
Checked by: MMW
Date: 7/22/2006

Exhibit 2.2
HEC-RAS Schematic of Study Reach

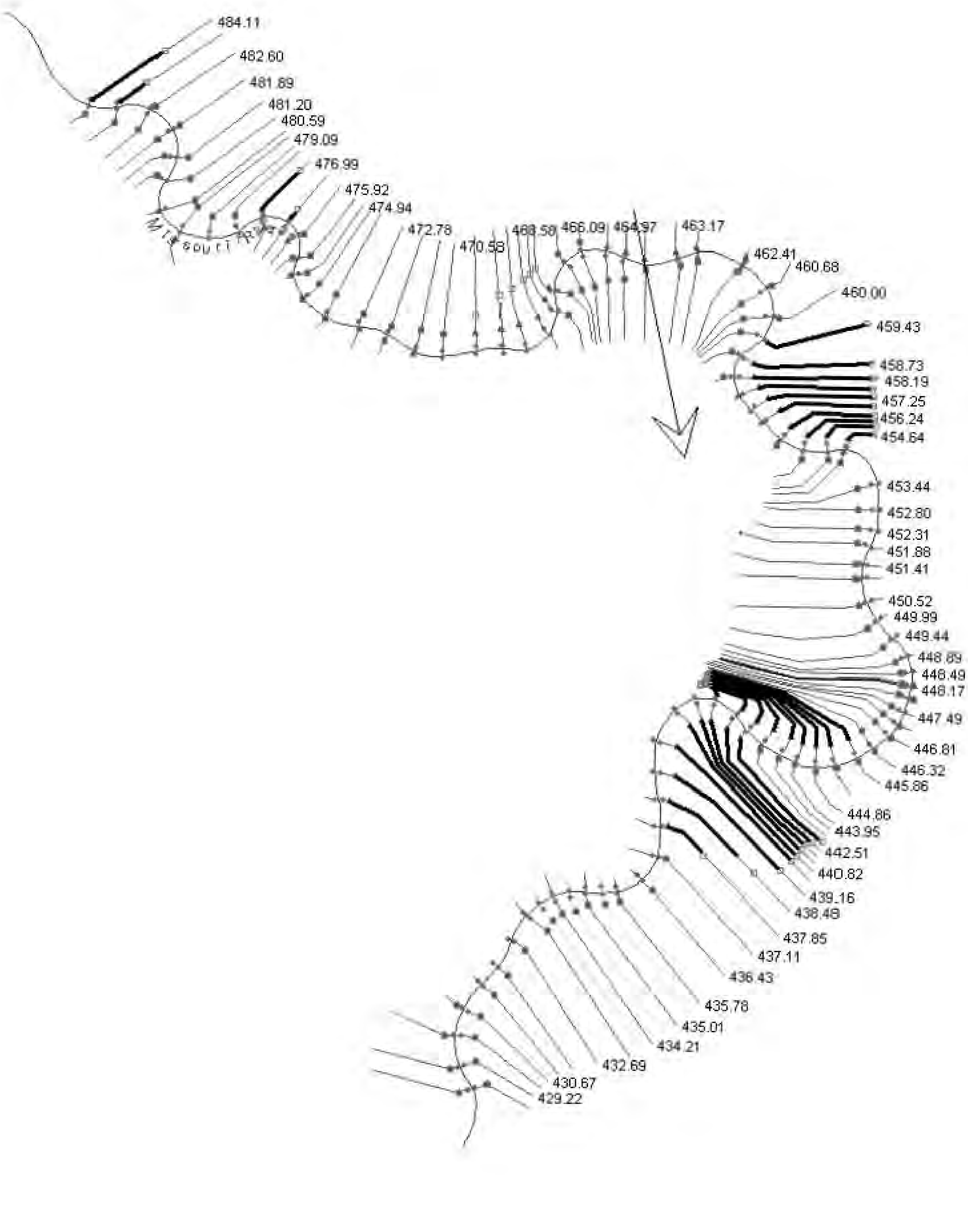
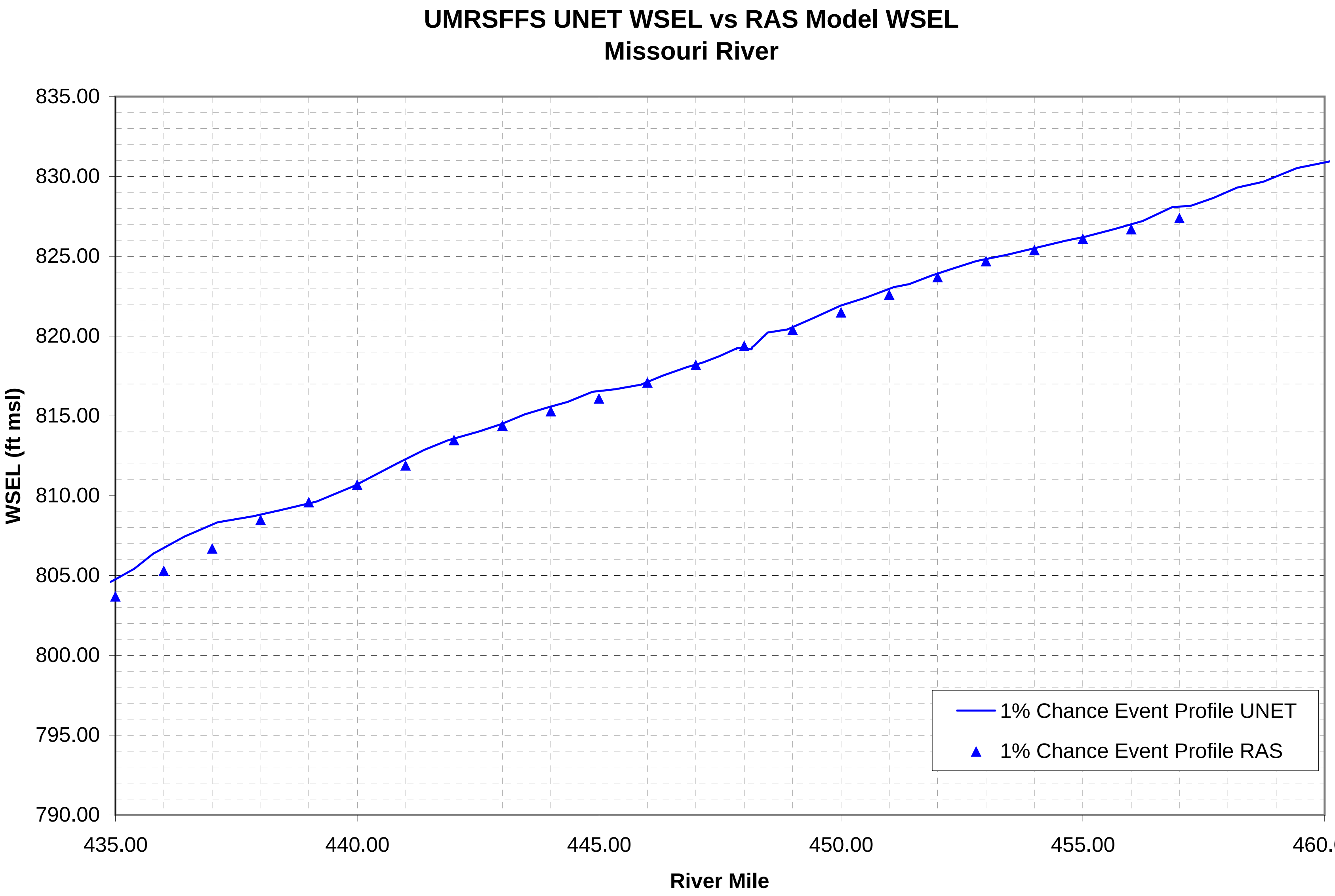
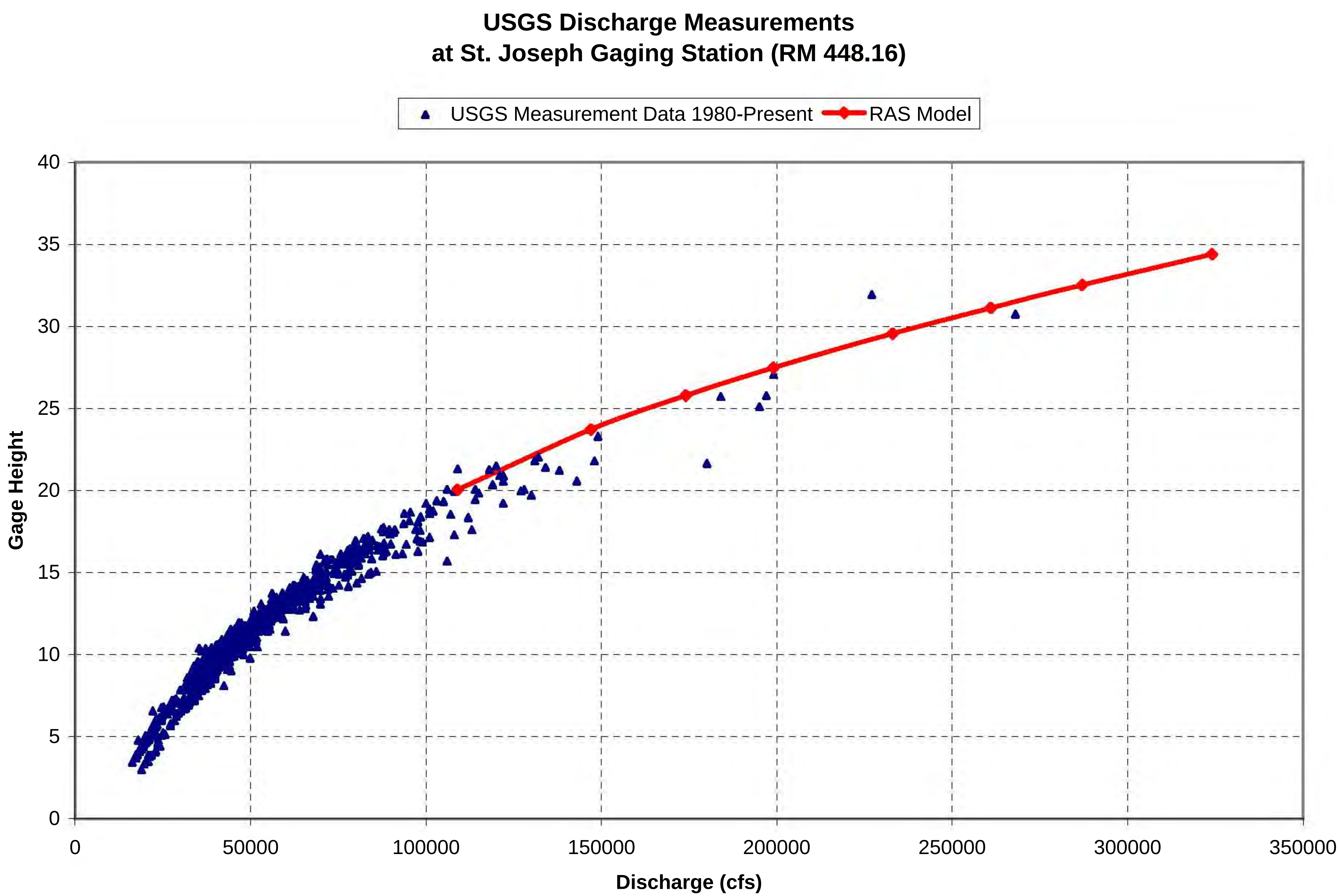


Exhibit 2.3



Designed by: EDS
Checked by: MMW
Date: 7/22/2006

Exhibit 2.4



Designed: EDS
Checked: MMW
Date: 7/22/2006

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
428.61	50%	2	109000	750.79	789.5	772.59	789.88	0.000106	4.98	0.18
428.61	20%	5	147000	750.79	791.2	774.41	791.78	0.000152	6.19	0.22
428.61	10%	10	174000	750.79	792.8	775.58	793.46	0.000166	6.69	0.23
428.61	5%	20	199000	750.79	793.9	776.6	794.64	0.000182	7.17	0.24
428.61	2%	50	233000	750.79	795.1	777.95	795.96	0.000207	7.82	0.26
428.61	1%	100	261000	750.79	796.2	778.99	797.13	0.000218	8.2	0.27
428.61	0.5% (Confined)	200	287000	750.79	797.1	779.94	798.09	0.000228	8.57	0.27
428.61	0.2% (Confined)	500	324000	750.79	798.3	781.21	799.38	0.000241	9.04	0.28
429.22	50%	2	109000	758.58	789.83	775.38	790.32	0.000154	5.64	0.21
429.22	20%	5	147000	758.58	791.68	777.31	792.38	0.000205	6.83	0.25
429.22	10%	10	174000	758.58	793.33	778.52	794.1	0.000215	7.26	0.26
429.22	5%	20	199000	758.58	794.49	779.57	795.32	0.000228	7.67	0.27
429.22	2%	50	233000	758.58	795.78	780.93	796.7	0.000245	8.21	0.28
429.22	1%	100	261000	758.58	796.92	781.99	797.88	0.000249	8.51	0.28
429.22	0.5% (Confined)	200	287000	758.58	797.86	782.91	798.86	0.000255	8.8	0.29
429.22	0.2% (Confined)	500	324000	758.58	799.15	784.22	800.19	0.000266	9.12	0.3
429.99	50%	2	109000	746.8	790.46	769.37	790.74	0.000067	4.27	0.15
429.99	20%	5	147000	746.8	792.53	771.23	792.94	0.000091	5.21	0.17
429.99	10%	10	174000	746.8	794.23	772.4	794.7	0.0001	5.65	0.18
429.99	5%	20	199000	746.8	795.44	773.51	795.97	0.00011	6.05	0.19
429.99	2%	50	233000	746.8	796.8	774.88	797.4	0.000123	6.59	0.2
429.99	1%	100	261000	746.8	797.97	775.98	798.62	0.000132	6.91	0.21
429.99	0.5% (Confined)	200	287000	746.8	798.96	776.95	799.64	0.000142	7.16	0.22
429.99	0.2% (Confined)	500	324000	746.8	800.29	778.32	801.01	0.000151	7.48	0.23
430.67	50%	2	109000	760.18	790.64	776.52	791.16	0.000161	5.8	0.22
430.67	20%	5	147000	760.18	792.77	778.32	793.51	0.000209	7	0.25
430.67	10%	10	174000	760.18	794.48	779.52	795.32	0.000226	7.55	0.27
430.67	5%	20	199000	760.18	795.71	780.56	796.65	0.000244	8.05	0.28
430.67	2%	50	233000	760.18	797.11	781.92	798.15	0.000264	8.6	0.29
430.67	1%	100	261000	760.18	798.3	782.98	799.39	0.000271	8.92	0.3
430.67	0.5% (Confined)	200	287000	760.18	799.32	783.94	800.45	0.000276	9.19	0.3
430.67	0.2% (Confined)	500	324000	760.18	800.67	785.25	801.85	0.00028	9.54	0.3
431.4	50%	2	109000	762.29	791.39	774.79	791.78	0.000153	5.05	0.18
431.4	20%	5	147000	762.29	793.75	776.56	794.32	0.000198	6.09	0.21
431.4	10%	10	174000	762.29	795.55	777.72	796.19	0.000211	6.54	0.22
431.4	5%	20	199000	762.29	796.88	778.73	797.57	0.000225	6.93	0.23
431.4	2%	50	233000	762.29	798.38	780.06	799.15	0.000244	7.39	0.26
431.4	1%	100	261000	762.29	799.62	781.09	800.41	0.00025	7.62	0.26
431.4	0.5% (Confined)	200	287000	762.29	800.67	782.01	801.49	0.000255	7.82	0.26
431.4	0.2% (Confined)	500	324000	762.29	802.05	783.31	802.9	0.000258	8.07	0.27
431.97	50%	2	109000	762.1	791.8	776.72	792.32	0.000188	5.81	0.22
431.97	20%	5	147000	762.1	794.29	778.66	795	0.000233	6.84	0.25
431.97	10%	10	174000	762.1	796.12	779.96	796.9	0.000242	7.27	0.25
431.97	5%	20	199000	762.1	797.5	781.08	798.33	0.00026	7.62	0.26
431.97	2%	50	233000	762.1	799.06	782.52	799.96	0.000277	8.07	0.28
431.97	1%	100	261000	762.1	800.31	783.66	801.25	0.000284	8.36	0.28
431.97	0.5% (Confined)	200	287000	762.1	801.36	784.65	802.34	0.000291	8.61	0.28
431.97	0.2% (Confined)	500	324000	762.1	802.74	786.05	803.78	0.000296	8.96	0.29
432.69	50%	2	109000	762.83	792.53	775.81	793.01	0.000171	5.61	0.21
432.69	20%	5	147000	762.83	795.2	777.8	795.87	0.000218	6.62	0.24
432.69	10%	10	174000	762.83	797.06	779.11	797.81	0.000229	7.07	0.25
432.69	5%	20	199000	762.83	798.47	780.25	799.29	0.000238	7.46	0.26
432.69	2%	50	233000	762.83	800.07	781.73	800.97	0.000251	7.97	0.27
432.69	1%	100	261000	762.83	801.34	782.93	802.29	0.000257	8.31	0.27
432.69	0.5% (Confined)	200	287000	762.83	802.41	783.94	803.41	0.000264	8.61	0.28
432.69	0.2% (Confined)	500	324000	762.83	803.8	785.4	804.88	0.000273	9.02	0.28

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
433.4	50%	2	109000	766.99	793.25	780.1	793.67	0.000175	5.25	0.21
433.4	20%	5	147000	766.99	796.17	781.76	796.61	0.00017	5.63	0.21
433.4	10%	10	174000	766.99	798.12	782.82	798.54	0.000156	5.67	0.2
433.4	5%	20	199000	766.99	799.61	783.77	800.03	0.000149	5.75	0.2
433.4	2%	50	233000	766.99	801.31	785.01	801.73	0.000144	5.89	0.2
433.4	1%	100	261000	766.99	802.64	785.96	803.04	0.000139	5.96	0.2
433.4	0.5% (Confined)	200	287000	766.99	803.77	786.83	804.17	0.000134	6.02	0.2
433.4	0.2% (Confined)	500	324000	766.99	805.24	788.03	805.64	0.00013	6.12	0.19
433.805*	50%	2	109000	762.08	793.8	780.33	794.23	0.000178	5.34	0.21
433.805*	20%	5	147000	762.08	796.68	782.04	797.19	0.000186	5.91	0.22
433.805*	10%	10	174000	762.08	798.58	783.14	799.07	0.000175	6.01	0.22
433.805*	5%	20	199000	762.08	800.05	784.12	800.53	0.000167	6.09	0.21
433.805*	2%	50	233000	762.08	801.74	785.47	802.21	0.000162	6.23	0.21
433.805*	1%	100	261000	762.08	803.05	786.45	803.51	0.000155	6.3	0.21
433.805*	0.5% (Confined)	200	287000	762.08	804.16	787.32	804.62	0.000151	6.38	0.21
433.805*	0.2% (Confined)	500	324000	762.08	805.62	788.49	806.08	0.000147	6.5	0.21
434.21	50%	2	109000	757.17	794.43	780.11	794.83	0.000196	5.14	0.2
434.21	20%	5	147000	757.17	797.37	781.8	797.8	0.000193	5.52	0.2
434.21	10%	10	174000	757.17	799.24	782.9	799.65	0.00018	5.57	0.2
434.21	5%	20	199000	757.17	800.69	783.87	801.08	0.000173	5.65	0.2
434.21	2%	50	233000	757.17	802.35	785.13	802.75	0.000169	5.8	0.19
434.21	1%	100	261000	757.17	803.63	786.09	804.03	0.000165	5.9	0.19
434.21	0.5% (Confined)	200	287000	757.17	804.73	787	805.13	0.000162	6	0.19
434.21	0.2% (Confined)	500	324000	757.17	806.17	788.2	806.58	0.00016	6.15	0.19
434.61*	50%	2	109000	761.57	795.08	781.13	795.62	0.000285	5.96	0.24
434.61*	20%	5	147000	761.57	797.98	783.61	798.6	0.000293	6.56	0.25
434.61*	10%	10	174000	761.57	799.8	785.49	800.41	0.000276	6.68	0.24
434.61*	5%	20	199000	761.57	801.23	786.77	801.81	0.000261	6.73	0.24
434.61*	2%	50	233000	761.57	802.88	788.06	803.44	0.000244	6.79	0.23
434.61*	1%	100	261000	761.57	804.15	789.11	804.69	0.00023	6.8	0.23
434.61*	0.5% (Confined)	200	287000	761.57	805.25	790.02	805.77	0.00022	6.83	0.22
434.61*	0.2% (Confined)	500	324000	761.57	806.68	791.27	807.19	0.00021	6.89	0.22
435.01	50%	2	109000	765.96	795.92	780.42	796.37	0.000199	5.49	0.21
435.01	20%	5	147000	765.96	798.84	782.34	799.4	0.000221	6.21	0.22
435.01	10%	10	174000	765.96	800.58	783.59	801.2	0.000231	6.62	0.23
435.01	5%	20	199000	765.96	801.95	784.69	802.61	0.000239	6.95	0.23
435.01	2%	50	233000	765.96	803.54	786.13	804.25	0.000246	7.33	0.24
435.01	1%	100	261000	765.96	804.77	787.25	805.49	0.000247	7.55	0.24
435.01	0.5% (Confined)	200	287000	765.96	805.83	788.24	806.56	0.000247	7.71	0.24
435.01	0.2% (Confined)	500	324000	765.96	807.23	789.64	807.98	0.000245	7.92	0.24
435.395*	50%	2	109000	765.51	796.51	780.98	796.99	0.000202	5.54	0.21
435.395*	20%	5	147000	765.51	799.48	782.91	800.12	0.000237	6.47	0.23
435.395*	10%	10	174000	765.51	801.24	784.18	801.96	0.000253	6.97	0.24
435.395*	5%	20	199000	765.51	802.63	785.31	803.41	0.000265	7.37	0.25
435.395*	2%	50	233000	765.51	804.22	786.69	805.11	0.000287	7.95	0.26
435.395*	1%	100	261000	765.51	805.43	787.78	806.38	0.000296	8.3	0.26
435.395*	0.5% (Confined)	200	287000	765.51	806.48	788.78	807.46	0.000303	8.58	0.27
435.395*	0.2% (Confined)	500	324000	765.51	807.86	790.1	808.9	0.000312	8.96	0.27
435.78	50%	2	109000	765.05	797.14	781.2	797.58	0.000187	5.38	0.2
435.78	20%	5	147000	765.05	800.24	783.34	800.8	0.000209	6.14	0.21
435.78	10%	10	174000	765.05	802.06	784.54	802.69	0.000222	6.6	0.22
435.78	5%	20	199000	765.05	803.48	785.6	804.18	0.000233	6.99	0.23
435.78	2%	50	233000	765.05	805.16	786.95	805.93	0.000248	7.49	0.24
435.78	1%	100	261000	765.05	806.37	788	807.23	0.000265	7.95	0.25
435.78	0.5% (Confined)	200	287000	765.05	807.43	788.96	808.34	0.000275	8.27	0.26
435.78	0.2% (Confined)	500	324000	765.05	808.82	790.27	809.81	0.000288	8.71	0.26

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
436.43	50%	2	109000	764.81	797.83	782.36	798.19	0.000163	4.87	0.18
436.43	20%	5	147000	764.81	801.03	784.01	801.47	0.000178	5.48	0.2
436.43	10%	10	174000	764.81	802.92	785.11	803.4	0.000182	5.81	0.2
436.43	5%	20	199000	764.81	804.39	786.05	804.91	0.000187	6.11	0.2
436.43	2%	50	233000	764.81	806.14	787.28	806.71	0.000196	6.51	0.21
436.43	1%	100	261000	764.81	807.44	788.26	808.05	0.000203	6.82	0.22
436.43	0.5% (Confined)	200	287000	764.81	808.54	789.11	809.19	0.00021	7.1	0.22
436.43	0.2% (Confined)	500	324000	764.81	810	790.32	810.7	0.00022	7.48	0.23
437.11	50%	2	109000	767.88	798.38	781.01	798.76	0.000152	5.12	0.18
437.11	20%	5	147000	767.88	801.73	783.04	802.05	0.000141	5.07	0.18
437.11	10%	10	174000	767.88	803.67	784.27	803.96	0.000127	5	0.17
437.11	5%	20	199000	767.88	805.19	785.4	805.46	0.000121	5	0.16
437.11	2%	50	233000	767.88	806.99	786.78	807.26	0.000115	5.06	0.16
437.11	1%	100	261000	767.88	808.34	787.92	808.61	0.000111	5.13	0.16
437.11	0.5% (Confined)	200	287000	767.88	809.48	788.96	809.76	0.000109	5.2	0.16
437.11	0.2% (Confined)	500	324000	767.88	810.99	790.34	811.28	0.000108	5.32	0.16
437.85	50%	2	109000	770.79	798.98	782.5	799.38	0.000164	5.14	0.19
437.85	20%	5	147000	770.79	802.24	784.28	802.67	0.000164	5.55	0.19
437.85	10%	10	174000	770.79	804.11	785.45	804.55	0.000159	5.7	0.19
437.85	5%	20	199000	770.79	805.6	786.5	806.04	0.000155	5.83	0.19
437.85	2%	50	233000	770.79	807.38	787.8	807.82	0.000153	6.01	0.19
437.85	1%	100	261000	770.79	808.71	788.89	809.16	0.000151	6.15	0.19
437.85	0.5% (Confined)	200	287000	770.79	809.84	789.83	810.3	0.000151	6.28	0.19
437.85	0.2% (Confined)	500	324000	770.79	811.34	791.11	811.82	0.000151	6.47	0.19
438.48	50%	2	109000	764.52	799.54	779.43	799.82	0.000101	4.31	0.15
438.48	20%	5	147000	764.52	802.77	781.23	803.15	0.00012	5.02	0.17
438.48	10%	10	174000	764.52	804.6	782.39	805.03	0.000132	5.44	0.17
438.48	5%	20	199000	764.52	806.07	783.44	806.54	0.00014	5.77	0.18
438.48	2%	50	233000	764.52	807.82	784.76	808.35	0.000149	6.19	0.19
438.48	1%	100	261000	764.52	809.14	785.81	809.71	0.000156	6.49	0.19
438.48	0.5% (Confined)	200	287000	764.52	810.26	786.71	810.87	0.000163	6.78	0.2
438.48	0.2% (Confined)	500	324000	764.52	811.75	788.02	812.41	0.000171	7.14	0.21
439.16	50%	2	109000	752.48	799.89	776.93	800.19	0.0001	4.36	0.15
439.16	20%	5	147000	752.48	803.19	778.91	803.59	0.000124	5.15	0.17
439.16	10%	10	174000	752.48	805.05	780.21	805.53	0.000139	5.65	0.18
439.16	5%	20	199000	752.48	806.54	781.37	807.09	0.000156	6.07	0.19
439.16	2%	50	233000	752.48	808.32	782.83	808.96	0.000173	6.62	0.2
439.16	1%	100	261000	752.48	809.64	784	810.36	0.000186	7.04	0.21
439.16	0.5% (Confined)	200	287000	752.48	810.77	785	811.56	0.000197	7.42	0.22
439.16	0.2% (Confined)	500	324000	752.48	812.27	786.44	813.16	0.000213	7.93	0.23
439.93	50%	2	109000	772.31	800.33	786.42	800.91	0.000284	6.25	0.24
439.93	20%	5	147000	772.31	803.76	788.51	804.37	0.000267	6.62	0.24
439.93	10%	10	174000	772.31	805.71	789.9	806.32	0.000257	6.81	0.24
439.93	5%	20	199000	772.31	807.29	791.02	807.9	0.00025	6.96	0.24
439.93	2%	50	233000	772.31	809.17	792.65	809.79	0.000243	7.16	0.24
439.93	1%	100	261000	772.31	810.6	793.86	811.22	0.000237	7.3	0.23
439.93	0.5% (Confined)	200	287000	772.31	811.82	794.95	812.45	0.000234	7.44	0.23
439.93	0.2% (Confined)	500	324000	772.31	813.44	797.2	814.08	0.00023	7.63	0.23
440.82	50%	2	109000	768.93	801.96	784.09	802.36	0.000152	5.1	0.18
440.82	20%	5	147000	768.93	805.33	786.08	805.86	0.000176	5.91	0.2
440.82	10%	10	174000	768.93	807.22	787.31	807.83	0.000191	6.42	0.21
440.82	5%	20	199000	768.93	808.77	788.41	809.46	0.000203	6.85	0.22
440.82	2%	50	233000	768.93	810.62	789.79	811.4	0.00022	7.42	0.23
440.82	1%	100	261000	768.93	812.01	790.9	812.88	0.000233	7.84	0.24
440.82	0.5% (Confined)	200	287000	768.93	813.21	791.91	814.14	0.000244	8.21	0.24
440.82	0.2% (Confined)	500	324000	768.93	814.79	793.25	815.83	0.000259	8.72	0.25

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
441.39	50%	2	109000	766.92	802.44	787.1	802.88	0.000195	5.4	0.2
441.39	20%	5	147000	766.92	805.92	788.99	806.43	0.000208	5.92	0.21
441.39	10%	10	174000	766.92	807.88	790.18	808.42	0.000207	6.22	0.21
441.39	5%	20	199000	766.92	809.49	791.19	810.06	0.000207	6.48	0.22
441.39	2%	50	233000	766.92	811.42	792.59	812.04	0.000211	6.84	0.22
441.39	1%	100	261000	766.92	812.88	793.62	813.53	0.000214	7.11	0.22
441.39	0.5% (Confined)	200	287000	766.92	814.14	794.61	814.82	0.000217	7.34	0.23
441.39	0.2% (Confined)	500	324000	766.92	815.81	795.9	816.54	0.000221	7.67	0.23
441.88	50%	2	109000	770.62	802.97	788.88	803.39	0.000201	5.28	0.2
441.88	20%	5	147000	770.62	806.48	790.59	806.94	0.000193	5.7	0.2
441.88	10%	10	174000	770.62	808.44	791.71	808.92	0.000191	5.96	0.21
441.88	5%	20	199000	770.62	810.05	792.67	810.56	0.00019	6.19	0.21
441.88	2%	50	233000	770.62	812	793.93	812.54	0.000191	6.5	0.21
441.88	1%	100	261000	770.62	813.47	794.93	814.03	0.000193	6.74	0.21
441.88	0.5% (Confined)	200	287000	770.62	814.73	795.84	815.32	0.000195	6.96	0.22
441.88	0.2% (Confined)	500	324000	770.62	816.42	797.05	817.04	0.000198	7.26	0.22
442.51	50%	2	109000	774.45	803.63	787.81	804.03	0.000182	5.14	0.2
442.51	20%	5	147000	774.45	807.11	789.64	807.59	0.000203	5.75	0.21
442.51	10%	10	174000	774.45	809.04	790.85	809.59	0.000209	6.15	0.22
442.51	5%	20	199000	774.45	810.64	791.88	811.24	0.000216	6.51	0.22
442.51	2%	50	233000	774.45	812.56	793.24	813.25	0.000226	6.98	0.23
442.51	1%	100	261000	774.45	814.02	794.31	814.77	0.000235	7.35	0.24
442.51	0.5% (Confined)	200	287000	774.45	815.27	795.25	816.08	0.000243	7.68	0.24
442.51	0.2% (Confined)	500	324000	774.45	816.94	796.55	817.83	0.000254	8.12	0.25
442.97	50%	2	109000	770.48	803.99	786.19	804.43	0.000143	5.31	0.19
442.97	20%	5	147000	770.48	807.5	788.54	808.03	0.000155	6	0.21
442.97	10%	10	174000	770.48	809.45	789.96	810.05	0.000162	6.44	0.21
442.97	5%	20	199000	770.48	811.06	791.23	811.71	0.000169	6.81	0.22
442.97	2%	50	233000	770.48	813.01	793.07	813.74	0.000178	7.3	0.23
442.97	1%	100	261000	770.48	814.48	794.27	815.28	0.000185	7.67	0.23
442.97	0.5% (Confined)	200	287000	770.48	815.75	795.25	816.61	0.000191	8	0.24
442.97	0.2% (Confined)	500	324000	770.48	817.45	796.6	818.38	0.0002	8.44	0.25
443.46	50%	2	109000	772.82	804.38	787.17	804.81	0.000146	5.3	0.2
443.46	20%	5	147000	772.82	807.95	789.46	808.43	0.000148	5.81	0.2
443.46	10%	10	174000	772.82	809.94	790.87	810.46	0.000151	6.16	0.21
443.46	5%	20	199000	772.82	811.58	792.16	812.14	0.000154	6.45	0.21
443.46	2%	50	233000	772.82	813.58	793.97	814.19	0.000159	6.84	0.22
443.46	1%	100	261000	772.82	815.09	795.08	815.74	0.000162	7.14	0.22
443.46	0.5% (Confined)	200	287000	772.82	816.4	796.08	817.09	0.000166	7.41	0.22
443.46	0.2% (Confined)	500	324000	772.82	818.13	797.44	818.88	0.000171	7.78	0.23
443.95	50%	2	109000	777.34	804.79	791.54	805.24	0.000187	5.51	0.22
443.95	20%	5	147000	777.34	808.36	793.37	808.85	0.000174	5.91	0.22
443.95	10%	10	174000	777.34	810.36	794.52	810.88	0.000173	6.22	0.22
443.95	5%	20	199000	777.34	812.01	795.54	812.56	0.000174	6.5	0.22
443.95	2%	50	233000	777.34	814.02	796.87	814.62	0.000177	6.87	0.22
443.95	1%	100	261000	777.34	815.54	797.92	816.18	0.000179	7.16	0.23
443.95	0.5% (Confined)	200	287000	777.34	816.85	798.86	817.53	0.000182	7.43	0.23
443.95	0.2% (Confined)	500	324000	777.34	818.6	801.28	819.34	0.000186	7.78	0.24
444.35	50%	2	109000	770.31	805.14	789.01	805.61	0.000166	5.56	0.21
444.35	20%	5	147000	770.31	808.69	791.84	809.2	0.000163	6.04	0.21
444.35	10%	10	174000	770.31	810.68	793.06	811.23	0.000165	6.38	0.21
444.35	5%	20	199000	770.31	812.33	794.17	812.91	0.000166	6.66	0.22
444.35	2%	50	233000	770.31	814.35	795.56	814.98	0.000169	7.02	0.22
444.35	1%	100	261000	770.31	815.87	796.69	816.54	0.000172	7.31	0.22
444.35	0.5% (Confined)	200	287000	770.31	817.19	797.67	817.9	0.000174	7.56	0.23
444.35	0.2% (Confined)	500	324000	770.31	818.95	799.04	819.7	0.000178	7.9	0.23

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
444.86	50%	2	109000	770.16	805.7	786.54	805.97	0.000103	4.29	0.15
444.86	20%	5	147000	770.16	809.25	788.35	809.56	0.000104	4.68	0.15
444.86	10%	10	174000	770.16	811.26	789.51	811.59	0.000106	4.94	0.16
444.86	5%	20	199000	770.16	812.93	790.54	813.28	0.000108	5.16	0.16
444.86	2%	50	233000	770.16	814.97	791.89	815.34	0.000111	5.45	0.16
444.86	1%	100	261000	770.16	816.51	792.91	816.91	0.000113	5.67	0.17
444.86	0.5% (Confined)	200	287000	770.16	817.85	793.87	818.27	0.000115	5.86	0.17
444.86	0.2% (Confined)	500	324000	770.16	819.64	795.15	820.09	0.000118	6.12	0.17
445.33	50%	2	109000	775.29	805.9	789.41	806.29	0.000128	5.01	0.18
445.33	20%	5	147000	775.29	809.44	791.38	809.88	0.000132	5.54	0.19
445.33	10%	10	174000	775.29	811.44	792.56	811.92	0.000135	5.87	0.19
445.33	5%	20	199000	775.29	813.1	793.57	813.62	0.000138	6.16	0.2
445.33	2%	50	233000	775.29	815.13	794.92	815.7	0.000142	6.53	0.2
445.33	1%	100	261000	775.29	816.67	795.99	817.27	0.000145	6.81	0.21
445.33	0.5% (Confined)	200	287000	775.29	818.01	796.91	818.64	0.000148	7.07	0.21
445.33	0.2% (Confined)	500	324000	775.29	819.79	798.2	820.47	0.000152	7.4	0.22
445.86	50%	2	109000	776.53	806.23	791.26	806.76	0.000183	5.84	0.22
445.86	20%	5	147000	776.53	809.75	793.21	810.38	0.000194	6.54	0.23
445.86	10%	10	174000	776.53	811.74	794.48	812.44	0.000202	6.98	0.24
445.86	5%	20	199000	776.53	813.39	795.59	814.15	0.000207	7.34	0.24
445.86	2%	50	233000	776.53	815.41	796.99	816.25	0.000213	7.78	0.25
445.86	1%	100	261000	776.53	816.95	798.14	817.84	0.000217	8.12	0.25
445.86	0.5% (Confined)	200	287000	776.53	818.28	799.15	819.22	0.000221	8.42	0.26
445.86	0.2% (Confined)	500	324000	776.53	820.06	800.49	821.07	0.000227	8.83	0.26
446.32	50%	2	109000	776.46	806.68	791.59	807.23	0.000206	6.07	0.23
446.32	20%	5	147000	776.46	810.23	794.19	810.87	0.000212	6.68	0.24
446.32	10%	10	174000	776.46	812.24	795.58	812.94	0.000214	7.05	0.24
446.32	5%	20	199000	776.46	813.92	796.72	814.66	0.000218	7.38	0.25
446.32	2%	50	233000	776.46	815.97	798.15	816.77	0.000225	7.78	0.25
446.32	1%	100	261000	776.46	817.52	799.32	818.37	0.000229	8.09	0.26
446.32	0.5% (Confined)	200	287000	776.46	818.87	800.34	819.76	0.000232	8.37	0.26
446.32	0.2% (Confined)	500	324000	776.46	820.66	801.75	821.61	0.000235	8.74	0.26
446.81	50%	2	109000	773.96	807.24	789.5	807.68	0.000141	5.38	0.19
446.81	20%	5	147000	773.96	810.78	791.61	811.35	0.000162	6.14	0.21
446.81	10%	10	174000	773.96	812.79	792.95	813.44	0.000175	6.61	0.22
446.81	5%	20	199000	773.96	814.46	794.11	815.17	0.000182	7.01	0.23
446.81	2%	50	233000	773.96	816.49	795.62	817.3	0.000192	7.53	0.24
446.81	1%	100	261000	773.96	818.04	796.82	818.92	0.000199	7.91	0.24
446.81	0.5% (Confined)	200	287000	773.96	819.38	797.86	820.33	0.000205	8.25	0.25
446.81	0.2% (Confined)	500	324000	773.96	821.17	799.3	822.2	0.000213	8.7	0.26
447.15	50%	2	109000	772.65	807.46	790.74	807.97	0.000161	5.7	0.21
447.15	20%	5	147000	772.65	811.04	792.79	811.67	0.000176	6.48	0.22
447.15	10%	10	174000	772.65	813.06	794.12	813.77	0.000185	6.96	0.23
447.15	5%	20	199000	772.65	814.74	795.33	815.52	0.000192	7.37	0.24
447.15	2%	50	233000	772.65	816.79	796.86	817.66	0.000201	7.87	0.24
447.15	1%	100	261000	772.65	818.35	798.05	819.29	0.000208	8.26	0.25
447.15	0.5% (Confined)	200	287000	772.65	819.7	799.1	820.71	0.000214	8.6	0.25
447.15	0.2% (Confined)	500	324000	772.65	821.51	800.57	822.6	0.000222	9.05	0.26
447.49	50%	2	109000	776.69	807.82	790	808.24	0.000134	5.23	0.19
447.49	20%	5	147000	776.69	811.41	791.99	811.97	0.000153	6.03	0.21
447.49	10%	10	174000	776.69	813.44	793.28	814.1	0.000164	6.57	0.22
447.49	5%	20	199000	776.69	815.12	794.38	815.85	0.000173	7.01	0.22
447.49	2%	50	233000	776.69	817.18	795.87	818.01	0.000184	7.54	0.23
447.49	1%	100	261000	776.69	818.75	797.03	819.65	0.00019	7.91	0.24
447.49	0.5% (Confined)	200	287000	776.69	820.12	798.03	821.08	0.000195	8.22	0.24
447.49	0.2% (Confined)	500	324000	776.69	821.95	799.46	822.98	0.000201	8.62	0.25

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
447.83	50%	2	109000	773	808.15	783.47	808.43	0.000061	4.21	0.13
447.83	20%	5	147000	773	811.8	785.47	812.19	0.000074	5.02	0.15
447.83	10%	10	174000	773	813.87	786.78	814.34	0.000085	5.56	0.16
447.83	5%	20	199000	773	815.56	787.92	816.11	0.000094	6.03	0.17
447.83	2%	50	233000	773	817.63	789.39	818.29	0.000106	6.64	0.18
447.83	1%	100	261000	773	819.2	790.56	819.94	0.000115	7.1	0.19
447.83	0.5% (Confined)	200	287000	773	820.55	791.62	821.38	0.000124	7.51	0.2
447.83	0.2% (Confined)	500	324000	773	822.36	793.03	823.3	0.000134	8.04	0.21
447.84	50%	2	109000	773	808.14	783.87	808.44	0.00008	4.39	0.14
447.84	20%	5	147000	773	811.79	785.95	812.21	0.000099	5.23	0.16
447.84	10%	10	174000	773	813.85	787.31	814.35	0.000114	5.79	0.17
447.84	5%	20	199000	773	815.54	788.49	816.13	0.000127	6.28	0.18
447.84	2%	50	233000	773	817.61	790.04	818.31	0.000145	6.9	0.19
447.84	1%	100	261000	773	819.17	791.21	819.97	0.000159	7.38	0.2
447.84	0.5% (Confined)	200	287000	773	820.52	792.3	821.41	0.000172	7.79	0.21
447.84	0.2% (Confined)	500	324000	773	822.32	793.77	823.33	0.000188	8.35	0.22
447.85	50%	2	109000	773	808.17	783.47	808.45	0.000061	4.21	0.13
447.85	20%	5	147000	773	811.83	785.47	812.22	0.000074	5.02	0.15
447.85	10%	10	174000	773	813.9	786.78	814.37	0.000084	5.55	0.16
447.85	5%	20	199000	773	815.6	787.92	816.14	0.000093	6.02	0.17
447.85	2%	50	233000	773	817.67	789.39	818.33	0.000105	6.63	0.18
447.85	1%	100	261000	773	819.24	790.56	819.99	0.000115	7.09	0.19
447.85	0.5% (Confined)	200	287000	773	820.6	791.62	821.43	0.000123	7.5	0.2
447.85	0.2% (Confined)	500	324000	773	822.41	793.03	823.35	0.000134	8.03	0.21
447.86	50%	2	109000	771.61	808.16	787.96	808.46	0.000081	4.34	0.15
447.86	20%	5	147000	771.61	811.82	789.73	812.22	0.000097	5.1	0.17
447.86	10%	10	174000	771.61	813.89	790.89	814.38	0.000107	5.61	0.18
447.86	5%	20	199000	771.61	815.59	791.9	816.15	0.000116	6.05	0.19
447.86	2%	50	233000	771.61	817.67	793.22	818.34	0.000128	6.62	0.2
447.86	1%	100	261000	771.61	819.25	794.23	820	0.000137	7.05	0.2
447.86	0.5% (Confined)	200	287000	771.61	820.61	795.16	821.44	0.000145	7.44	0.21
447.86	0.2% (Confined)	500	324000	771.61	822.42	796.44	823.36	0.000156	7.95	0.22
448.15	50%	2	109000	773.29	808.19	789.42	808.7	0.000152	5.73	0.2
448.15	20%	5	147000	773.29	811.83	791.73	812.52	0.000178	6.68	0.22
448.15	10%	10	174000	773.29	813.88	793.21	814.71	0.000195	7.32	0.24
448.15	5%	20	199000	773.29	815.57	794.51	816.52	0.00021	7.87	0.25
448.15	2%	50	233000	773.29	817.63	796.2	818.74	0.000229	8.58	0.26
448.15	1%	100	261000	773.29	819.18	797.51	820.44	0.000244	9.13	0.27
448.15	0.5% (Confined)	200	287000	773.29	820.52	798.65	821.91	0.000258	9.62	0.28
448.15	0.2% (Confined)	500	324000	773.29	822.3	800.27	823.88	0.000277	10.29	0.29
448.16			Bridge							
448.17	50%	2	109000	773.29	808.24	789.42	808.75	0.000151	5.71	0.2
448.17	20%	5	147000	773.29	811.91	791.73	812.59	0.000177	6.66	0.22
448.17	10%	10	174000	773.29	813.97	793.21	814.79	0.000193	7.29	0.23
448.17	5%	20	199000	773.29	815.67	794.51	816.61	0.000207	7.84	0.25
448.17	2%	50	233000	773.29	817.75	796.2	818.85	0.000226	8.55	0.26
448.17	1%	100	261000	773.29	819.31	797.51	820.55	0.000241	9.1	0.27
448.17	0.5% (Confined)	200	287000	773.29	820.71	798.65	822.08	0.000253	9.57	0.28
448.17	0.2% (Confined)	500	324000	773.29	822.58	800.27	824.12	0.00027	10.2	0.29
448.2	50%	2	109000	773.29	808.27	789.41	808.78	0.000151	5.71	0.2
448.2	20%	5	147000	773.29	811.94	791.73	812.62	0.000184	6.65	0.23
448.2	10%	10	174000	773.29	814.01	793.21	814.82	0.000202	7.26	0.24
448.2	5%	20	199000	773.29	815.72	794.5	816.64	0.000215	7.79	0.25
448.2	2%	50	233000	773.29	817.8	796.2	818.89	0.000233	8.47	0.26
448.2	1%	100	261000	773.29	819.38	797.51	820.6	0.000247	9	0.27
448.2	0.5% (Confined)	200	287000	773.29	820.79	798.67	822.13	0.000258	9.45	0.28

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
448.2	0.2% (Confined)	500	324000	773.29	822.66	800.27	824.17	0.000273	10.07	0.29
448.49	50%	2	109000	775.4	808.69	791.55	809.01	0.000107	4.61	0.17
448.49	20%	5	147000	775.4	812.47	793.19	812.9	0.000119	5.32	0.18
448.49	10%	10	174000	775.4	814.62	794.29	815.13	0.000129	5.8	0.19
448.49	5%	20	199000	775.4	816.39	795.24	816.98	0.000138	6.22	0.2
448.49	2%	50	233000	775.4	818.57	796.49	819.26	0.000149	6.75	0.21
448.49	1%	100	259000	775.4	820.23	797.4	820.99	0.000154	7.11	0.21
448.49	0.5% (Confined)	200	287000	775.4	821.69	798.33	822.54	0.000163	7.52	0.22
448.49	0.2% (Confined)	500	324000	775.4	823.66	799.52	824.61	0.000171	7.98	0.23
448.89	50%	2	109000	774.34	808.84	791.81	809.34	0.000161	5.71	0.21
448.89	20%	5	147000	774.34	812.63	793.96	813.27	0.000175	6.51	0.22
448.89	10%	10	174000	774.34	814.79	795.59	815.53	0.000186	7.04	0.23
448.89	5%	20	199000	774.34	816.57	796.74	817.4	0.000197	7.51	0.24
448.89	2%	50	233000	774.34	818.75	798.22	819.71	0.00021	8.11	0.25
448.89	1%	100	259000	774.34	820.41	799.33	821.46	0.00022	8.49	0.26
448.89	0.5% (Confined)	200	287000	774.34	821.9	800.46	823.04	0.000236	8.93	0.27
448.89	0.2% (Confined)	500	324000	774.34	823.88	801.88	825.13	0.000244	9.42	0.27
449.44	50%	2	109000	782.5	809.33	794.8	809.91	0.000227	6.14	0.24
449.44	20%	5	147000	782.5	813.16	796.95	813.85	0.000225	6.78	0.24
449.44	10%	10	174000	782.5	815.36	798.36	816.12	0.000226	7.18	0.25
449.44	5%	20	199000	782.5	817.18	799.57	818.01	0.000228	7.53	0.25
449.44	2%	50	233000	782.5	819.44	801.13	820.35	0.000232	7.98	0.26
449.44	1%	100	259000	782.5	821.15	802.25	822.11	0.000232	8.26	0.26
449.44	0.5% (Confined)	200	287000	782.5	822.7	803.4	823.72	0.000237	8.6	0.26
449.44	0.2% (Confined)	500	324000	782.5	824.73	804.86	825.84	0.000239	8.99	0.27
449.99	50%	2	109000	779.32	810.02	793.39	810.46	0.000147	5.35	0.2
449.99	20%	5	147000	779.32	813.87	795.6	814.42	0.000156	6.05	0.21
449.99	10%	10	174000	779.32	816.07	797	816.7	0.000164	6.5	0.21
449.99	5%	20	199000	779.32	817.91	798.09	818.6	0.000168	6.86	0.22
449.99	2%	50	233000	779.32	820.19	799.47	820.95	0.000174	7.31	0.23
449.99	1%	100	259000	779.32	821.9	800.47	822.72	0.000175	7.6	0.23
449.99	0.5% (Confined)	200	287000	779.32	823.47	801.51	824.35	0.00018	7.95	0.23
449.99	0.2% (Confined)	500	324000	779.32	825.52	802.84	826.47	0.000185	8.34	0.24
450.52	50%	2	109000	779.55	810.44	795.49	810.91	0.000171	5.5	0.21
450.52	20%	5	147000	779.55	814.3	797.31	814.9	0.000182	6.23	0.22
450.52	10%	10	174000	779.55	816.52	798.54	817.21	0.000191	6.7	0.23
450.52	5%	20	199000	779.55	818.37	799.61	819.12	0.000196	7.06	0.23
450.52	2%	50	233000	779.55	820.68	800.98	821.48	0.000201	7.4	0.24
450.52	1%	100	259000	779.55	822.42	801.96	823.23	0.000193	7.55	0.24
450.52	0.5% (Confined)	200	287000	779.55	824.03	803	824.87	0.00019	7.74	0.24
450.52	0.2% (Confined)	500	324000	779.55	826.14	804.3	826.99	0.000184	7.93	0.24
451.09	50%	2	109000	776.43	810.94	794.06	811.38	0.00014	5.32	0.19
451.09	20%	5	147000	776.43	814.83	795.94	815.41	0.000155	6.12	0.21
451.09	10%	10	174000	776.43	817.09	797.17	817.74	0.000162	6.54	0.21
451.09	5%	20	199000	776.43	818.99	798.24	819.66	0.000162	6.77	0.22
451.09	2%	50	233000	776.43	821.33	799.65	822.02	0.000157	7	0.21
451.09	1%	100	259000	776.43	823.06	800.65	823.75	0.000152	7.12	0.21
451.09	0.5% (Confined)	200	287000	776.43	824.68	801.74	825.37	0.00015	7.28	0.21
451.09	0.2% (Confined)	500	324000	776.43	826.78	803.1	827.48	0.000145	7.44	0.21
451.41	50%	2	109000	777.14	811.16	795.7	811.65	0.000166	5.62	0.21
451.41	20%	5	147000	777.14	815.08	797.55	815.7	0.000178	6.37	0.22
451.41	10%	10	174000	777.14	817.35	798.78	818.04	0.000182	6.78	0.23
451.41	5%	20	199000	777.14	819.24	799.83	819.97	0.000181	7.07	0.23
451.41	2%	50	233000	777.14	821.56	801.22	822.33	0.00018	7.39	0.23
451.41	1%	100	259000	777.14	823.26	802.25	824.05	0.000177	7.6	0.23
451.41	0.5% (Confined)	200	287000	777.14	824.86	803.32	825.68	0.000177	7.84	0.23
451.41	0.2% (Confined)	500	324000	777.14	826.94	804.65	827.79	0.000175	8.08	0.23

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
451.88	50%	2	109000	784.26	811.57	797.61	812.15	0.000218	6.15	0.24
451.88	20%	5	147000	784.26	815.54	799.58	816.19	0.000211	6.65	0.24
451.88	10%	10	174000	784.26	817.84	800.84	818.52	0.000204	6.88	0.24
451.88	5%	20	199000	784.26	819.74	801.96	820.45	0.000198	7.08	0.24
451.88	2%	50	233000	784.26	822.08	803.4	822.79	0.000189	7.29	0.23
451.88	1%	100	259000	784.26	823.8	804.43	824.51	0.000178	7.35	0.23
451.88	0.5% (Confined)	200	287000	784.26	825.42	805.51	826.13	0.000172	7.46	0.23
451.88	0.2% (Confined)	500	324000	784.26	827.52	806.89	828.23	0.000162	7.54	0.22
452.31	50%	2	109000	778.18	812.13	795.08	812.59	0.000167	5.46	0.21
452.31	20%	5	147000	778.18	816.04	797.06	816.64	0.000179	6.2	0.22
452.31	10%	10	174000	778.18	818.3	798.35	818.96	0.000184	6.58	0.22
452.31	5%	20	199000	778.18	820.19	799.43	820.87	0.000181	6.79	0.23
452.31	2%	50	233000	778.18	822.52	800.94	823.2	0.000175	6.97	0.22
452.31	1%	100	259000	778.18	824.22	801.97	824.9	0.000168	7.06	0.22
452.31	0.5% (Confined)	200	287000	778.18	825.82	803.09	826.51	0.000163	7.2	0.22
452.31	0.2% (Confined)	500	324000	778.18	827.88	804.47	828.58	0.000156	7.33	0.22
452.8	50%	2	109000	775.07	812.58	792.7	812.94	0.000105	4.85	0.17
452.8	20%	5	147000	775.07	816.54	794.66	817.02	0.000117	5.59	0.18
452.8	10%	10	174000	775.07	818.84	795.97	819.35	0.000119	5.89	0.19
452.8	5%	20	199000	775.07	820.73	797.11	821.26	0.000119	6.11	0.19
452.8	2%	50	233000	775.07	823.03	798.52	823.58	0.000119	6.35	0.19
452.8	1%	100	259000	775.07	824.7	799.63	825.27	0.000117	6.5	0.19
452.8	0.5% (Confined)	200	287000	775.07	826.29	800.74	826.87	0.000118	6.66	0.19
452.8	0.2% (Confined)	500	324000	775.07	828.34	802.12	828.93	0.000117	6.83	0.19
453.44	50%	2	109000	780.74	812.95	796.38	813.35	0.000134	5.11	0.19
453.44	20%	5	147000	780.74	816.95	798.22	817.47	0.000144	5.8	0.2
453.44	10%	10	174000	780.74	819.25	799.41	819.81	0.000145	6.1	0.2
453.44	5%	20	199000	780.74	821.14	800.46	821.71	0.000144	6.31	0.2
453.44	2%	50	233000	780.74	823.43	801.8	824.03	0.000142	6.56	0.2
453.44	1%	100	259000	780.74	825.09	802.8	825.71	0.000139	6.72	0.2
453.44	0.5% (Confined)	200	287000	780.74	826.68	803.83	827.31	0.000138	6.91	0.2
453.44	0.2% (Confined)	500	324000	780.74	828.72	805.14	829.37	0.000136	7.11	0.2
454.64	50%	2	109000	786.19	813.81	797.51	814.18	0.000126	4.87	0.18
454.64	20%	5	147000	786.19	817.88	799.25	818.34	0.00013	5.48	0.19
454.64	10%	10	174000	786.19	820.18	800.39	820.68	0.000131	5.77	0.19
454.64	5%	20	199000	786.19	822.05	801.37	822.56	0.000129	5.96	0.19
454.64	2%	50	233000	786.19	824.32	802.66	824.85	0.000126	6.19	0.19
454.64	1%	100	259000	786.19	825.97	803.6	826.51	0.000124	6.34	0.19
454.64	0.5% (Confined)	200	287000	786.19	827.54	804.56	828.1	0.000123	6.51	0.19
454.64	0.2% (Confined)	500	324000	786.19	829.57	805.76	830.14	0.000121	6.69	0.19
455.05	50%	2	109000	769.11	814.1	800.55	814.53	0.00018	5.28	0.21
455.05	20%	5	147000	769.11	818.17	802.25	818.68	0.000175	5.81	0.21
455.05	10%	10	174000	769.11	820.46	803.33	821.02	0.000172	6.1	0.21
455.05	5%	20	199000	769.11	822.32	804.3	822.9	0.000169	6.31	0.22
455.05	2%	50	233000	769.11	824.58	805.52	825.19	0.000164	6.56	0.21
455.05	1%	100	259000	769.11	826.22	806.44	826.83	0.000158	6.68	0.21
455.05	0.5% (Confined)	200	287000	769.11	827.79	807.38	828.42	0.000154	6.82	0.21
455.05	0.2% (Confined)	500	324000	769.11	829.81	808.56	830.45	0.000149	6.97	0.21
455.65	50%	2	109000	784.46	814.65	801.15	815.1	0.000181	5.43	0.21
455.65	20%	5	147000	784.46	818.7	802.88	819.24	0.000176	5.95	0.22
455.65	10%	10	174000	784.46	821	803.98	821.56	0.000171	6.22	0.22
455.65	5%	20	199000	784.46	822.84	804.97	823.43	0.000166	6.41	0.22
455.65	2%	50	233000	784.46	825.09	806.23	825.7	0.000161	6.66	0.22
455.65	1%	100	259000	784.46	826.7	807.13	827.33	0.000158	6.82	0.21
455.65	0.5% (Confined)	200	287000	784.46	828.26	808.1	828.91	0.000156	7.02	0.22
455.65	0.2% (Confined)	500	324000	784.46	830.26	809.32	830.93	0.000153	7.23	0.22

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
456.24	50%	2	109000	781.09	815.2	799.36	815.63	0.000154	5.23	0.2
456.24	20%	5	147000	781.09	819.25	801.38	819.76	0.000154	5.8	0.2
456.24	10%	10	174000	781.09	821.53	802.59	822.08	0.000158	6.1	0.21
456.24	5%	20	199000	781.09	823.37	803.62	823.93	0.000153	6.28	0.21
456.24	2%	50	233000	781.09	825.6	805	826.18	0.000148	6.5	0.21
456.24	1%	100	259000	781.09	827.21	805.96	827.8	0.000144	6.63	0.21
456.24	0.5% (Confined)	200	287000	781.09	828.78	806.99	829.38	0.000142	6.79	0.21
456.24	0.2% (Confined)	500	324000	781.09	830.77	808.3	831.39	0.000139	6.97	0.21
456.84	50%	2	109000	780.28	815.69	796.31	816.04	0.000111	4.74	0.17
456.84	20%	5	147000	780.28	819.74	798.45	820.19	0.00012	5.4	0.18
456.84	10%	10	174000	780.28	822.07	799.88	822.56	0.00012	5.71	0.18
456.84	5%	20	199000	780.28	823.99	800.99	824.49	0.000117	5.89	0.18
456.84	2%	50	233000	780.28	826.36	802.44	826.87	0.000114	6.09	0.18
456.84	1%	100	259000	780.28	828.06	803.51	828.57	0.000111	6.22	0.18
456.84	0.5% (Confined)	200	287000	780.28	829.7	804.63	830.23	0.000109	6.36	0.18
456.84	0.2% (Confined)	500	324000	780.28	831.8	805.98	832.34	0.000107	6.52	0.18
457.25	50%	2	109000	783.2	815.86	800.5	816.43	0.000207	6.11	0.23
457.25	20%	5	147000	783.2	819.92	802.8	820.6	0.000206	6.73	0.24
457.25	10%	10	174000	783.2	822.23	804.3	822.97	0.000207	7.1	0.24
457.25	5%	20	199000	783.2	824.14	805.56	824.91	0.000204	7.38	0.24
457.25	2%	50	233000	783.2	826.49	807.09	827.29	0.000199	7.67	0.24
457.25	1%	100	259000	783.2	828.18	808.22	828.99	0.000193	7.82	0.24
457.25	0.5% (Confined)	200	287000	783.2	829.84	809.38	830.66	0.000189	7.99	0.24
457.25	0.2% (Confined)	500	324000	783.2	831.93	810.85	832.77	0.000183	8.18	0.24
457.7	50%	2	109000	770.55	816.34	800.07	816.89	0.000181	5.99	0.22
457.7	20%	5	147000	770.55	820.38	802.13	821.07	0.000196	6.77	0.23
457.7	10%	10	174000	770.55	822.7	803.48	823.44	0.000196	7.13	0.23
457.7	5%	20	199000	770.55	824.6	804.67	825.37	0.000192	7.37	0.23
457.7	2%	50	233000	770.55	826.96	806.18	827.74	0.000185	7.59	0.23
457.7	1%	100	259000	770.55	828.65	807.31	829.43	0.000179	7.72	0.23
457.7	0.5% (Confined)	200	287000	770.55	830.3	808.47	831.08	0.000175	7.87	0.23
457.7	0.2% (Confined)	500	324000	770.55	832.39	809.93	833.18	0.00017	8.03	0.23
458.19	50%	2	109000	782.85	816.86	804.3	817.43	0.000237	6.1	0.24
458.19	20%	5	147000	782.85	820.95	806.28	821.62	0.000225	6.65	0.24
458.19	10%	10	174000	782.85	823.31	807.45	823.97	0.000208	6.77	0.24
458.19	5%	20	199000	782.85	825.25	808.47	825.88	0.000191	6.79	0.23
458.19	2%	50	233000	782.85	827.61	809.77	828.21	0.000171	6.8	0.22
458.19	1%	100	259000	782.85	829.3	810.76	829.87	0.000159	6.81	0.21
458.19	0.5% (Confined)	200	287000	782.85	830.95	811.76	831.51	0.00015	6.85	0.21
458.19	0.2% (Confined)	500	324000	782.85	833.03	813.03	833.58	0.00014	6.89	0.21
458.73	50%	2	109000	788.99	817.49	803.3	818.06	0.000202	6.05	0.23
458.73	20%	5	147000	788.99	821.55	805.16	822.23	0.000204	6.71	0.23
458.73	10%	10	174000	788.99	823.86	806.39	824.56	0.0002	6.97	0.23
458.73	5%	20	199000	788.99	825.73	807.47	826.44	0.000191	7.11	0.23
458.73	2%	50	233000	788.99	828.03	808.86	828.73	0.00018	7.27	0.23
458.73	1%	100	259000	788.99	829.67	809.88	830.37	0.000173	7.37	0.22
458.73	0.5% (Confined)	200	287000	788.99	831.29	810.94	831.99	0.000168	7.49	0.22
458.73	0.2% (Confined)	500	324000	788.99	833.34	812.29	834.04	0.000162	7.63	0.22
459.43	50%	2	109000	789.08	818.33	805.55	818.83	0.000216	5.67	0.23
459.43	20%	5	147000	789.08	822.45	807.3	822.96	0.000186	5.89	0.22
459.43	10%	10	174000	789.08	824.79	808.45	825.25	0.000171	5.83	0.21
459.43	5%	20	199000	789.08	826.65	809.48	827.08	0.000158	5.75	0.21
459.43	2%	50	233000	789.08	828.91	810.76	829.31	0.000139	5.72	0.2
459.43	1%	100	259000	789.08	830.52	811.71	830.91	0.000128	5.72	0.19
459.43	0.5% (Confined)	200	287000	789.08	832.12	812.71	832.51	0.00012	5.74	0.19
459.43	0.2% (Confined)	500	324000	789.08	834.14	813.94	834.53	0.000111	5.78	0.18

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
460	50%	2	109000	786.06	818.96	805.75	819.48	0.000209	5.78	0.23
460	20%	5	147000	786.06	822.98	807.79	823.54	0.000195	6.18	0.23
460	10%	10	174000	786.06	825.27	808.93	825.79	0.000192	6.16	0.22
460	5%	20	199000	786.06	827.08	809.92	827.56	0.000171	6.08	0.22
460	2%	50	233000	786.06	829.28	811.2	829.73	0.000154	5.99	0.21
460	1%	100	259000	786.06	830.87	812.1	831.28	0.000141	5.9	0.2
460	0.5% (Confined)	200	287000	786.06	832.45	813.05	832.84	0.000129	5.86	0.19
460	0.2% (Confined)	500	324000	786.06	834.45	814.36	834.83	0.000116	5.82	0.18
460.68	50%	2	109000	785.22	819.71	802.44	820.13	0.000145	5.21	0.19
460.68	20%	5	147000	785.22	823.7	804.4	824.18	0.000151	5.69	0.2
460.68	10%	10	174000	785.22	825.98	805.71	826.43	0.000163	5.67	0.21
460.68	5%	20	199000	785.22	827.69	806.85	828.12	0.00015	5.71	0.2
460.68	2%	50	233000	785.22	829.8	808.3	830.21	0.000137	5.75	0.19
460.68	1%	100	259000	785.22	831.32	809.38	831.73	0.000129	5.78	0.19
460.68	0.5% (Confined)	200	287000	785.22	832.85	810.47	833.25	0.000122	5.82	0.19
460.68	0.2% (Confined)	500	324000	785.22	834.81	811.89	835.2	0.000114	5.86	0.18
461.5	50%	2	109000	792.68	820.33	804.82	820.85	0.000172	5.77	0.21
461.5	20%	5	147000	792.68	824.29	806.73	824.97	0.000188	6.62	0.23
461.5	10%	10	174000	792.68	826.51	807.98	827.31	0.000203	7.19	0.24
461.5	5%	20	199000	792.68	828.12	809.06	829.03	0.000218	7.7	0.25
461.5	2%	50	233000	792.68	830.14	810.5	831.15	0.000239	8.25	0.26
461.5	1%	100	259000	792.68	831.58	811.56	832.67	0.000245	8.61	0.27
461.5	0.5% (Confined)	200	287000	792.68	833.03	812.65	834.2	0.00025	8.96	0.27
461.5	0.2% (Confined)	500	324000	792.68	834.9	814.03	836.15	0.000254	9.36	0.28
462.41	50%	2	109000	779.67	821.16	804.35	821.6	0.000142	5.34	0.19
462.41	20%	5	147000	779.67	825.22	806.23	825.79	0.000153	6.08	0.2
462.41	10%	10	174000	779.67	827.57	807.48	828.21	0.000169	6.52	0.22
462.41	5%	20	199000	779.67	829.35	808.56	830.06	0.000204	6.87	0.24
462.41	2%	50	233000	779.67	831.47	809.97	832.25	0.000214	7.29	0.24
462.41	1%	100	259000	779.67	832.95	811	833.79	0.000216	7.59	0.25
462.41	0.5% (Confined)	200	287000	779.67	834.44	812.04	835.33	0.000219	7.89	0.25
462.41	0.2% (Confined)	500	324000	779.67	836.34	813.4	837.3	0.000221	8.25	0.25
462.66	50%	2	109000	787.54	821.39	802.18	821.79	0.000125	5.06	0.18
462.66	20%	5	147000	787.54	825.47	804.24	825.99	0.000136	5.78	0.19
462.66	10%	10	174000	787.54	827.83	805.68	828.43	0.000144	6.24	0.2
462.66	5%	20	199000	787.54	829.64	806.89	830.31	0.00017	6.63	0.22
462.66	2%	50	233000	787.54	831.77	808.44	832.53	0.000195	7.11	0.23
462.66	1%	100	259000	787.54	833.24	809.57	834.07	0.000202	7.44	0.24
462.66	0.5% (Confined)	200	287000	787.54	834.72	810.86	835.62	0.000207	7.79	0.25
462.66	0.2% (Confined)	500	324000	787.54	836.6	812.36	837.59	0.000213	8.21	0.25
463.17	50%	2	104000	782.36	821.71	803.73	822.11	0.000121	5.08	0.18
463.17	20%	5	141000	782.36	825.83	805.64	826.35	0.000138	5.85	0.19
463.17	10%	10	167000	782.36	828.21	806.88	828.81	0.000147	6.29	0.2
463.17	5%	20	191000	782.36	830.07	807.94	830.74	0.000153	6.68	0.21
463.17	2%	50	225000	782.36	832.23	809.41	833.01	0.000165	7.23	0.22
463.17	1%	100	256000	782.36	833.7	810.66	834.59	0.000181	7.79	0.23
463.17	0.5% (Confined)	200	285000	782.36	835.18	811.79	836.17	0.000191	8.23	0.24
463.17	0.2% (Confined)	500	323000	782.36	837.07	813.24	838.17	0.000201	8.74	0.25
463.97	50%	2	104000	786.19	822.24	805.81	822.75	0.000167	5.77	0.21
463.97	20%	5	141000	786.19	826.39	807.85	827.08	0.000183	6.63	0.22
463.97	10%	10	167000	786.19	828.79	809.29	829.6	0.000196	7.21	0.23
463.97	5%	20	191000	786.19	830.65	810.52	831.57	0.000207	7.7	0.24
463.97	2%	50	225000	786.19	832.84	812.1	833.91	0.000224	8.38	0.26
463.97	1%	100	256000	786.19	834.35	813.4	835.59	0.000245	9.04	0.27
463.97	0.5% (Confined)	200	285000	786.19	835.86	814.59	837.23	0.000259	9.55	0.28
463.97	0.2% (Confined)	500	323000	786.19	837.77	816.08	839.3	0.000274	10.17	0.29

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
464.51	50%	2	104000	789.56	822.74	805.2	823.18	0.000136	5.35	0.19
464.51	20%	5	141000	789.56	827	807.17	827.53	0.00014	5.99	0.2
464.51	10%	10	167000	789.56	829.53	808.45	830.07	0.000135	6.15	0.2
464.51	5%	20	191000	789.56	831.52	809.56	832.05	0.000128	6.25	0.19
464.51	2%	50	225000	789.56	833.9	811.08	834.42	0.000122	6.37	0.19
464.51	1%	100	256000	789.56	835.59	812.4	836.13	0.000121	6.57	0.19
464.51	0.5% (Confined)	200	285000	789.56	837.25	813.57	837.78	0.000118	6.67	0.19
464.51	0.2% (Confined)	500	323000	789.56	839.34	815.05	839.87	0.000114	6.78	0.19
464.97	50%	2	104000	792.41	823.09	808.6	823.56	0.000175	5.48	0.21
464.97	20%	5	141000	792.41	827.41	810.43	827.9	0.000158	5.74	0.21
464.97	10%	10	167000	792.41	829.97	811.61	830.4	0.000133	5.63	0.19
464.97	5%	20	191000	792.41	831.97	812.64	832.35	0.000116	5.52	0.18
464.97	2%	50	225000	792.41	834.34	814.02	834.69	0.000103	5.47	0.17
464.97	1%	100	256000	792.41	836.04	815.23	836.4	0.000099	5.55	0.17
464.97	0.5% (Confined)	200	285000	792.41	837.7	816.3	838.04	0.000093	5.57	0.17
464.97	0.2% (Confined)	500	323000	792.41	839.78	817.66	840.12	0.000087	5.59	0.16
465.6	50%	2	104000	793.92	823.69	809.9	824.17	0.000189	5.58	0.22
465.6	20%	5	141000	793.92	827.94	811.7	828.42	0.000159	5.75	0.21
465.6	10%	10	167000	793.92	830.45	812.86	830.82	0.000124	5.41	0.18
465.6	5%	20	191000	793.92	832.39	813.85	832.7	0.000103	5.15	0.17
465.6	2%	50	225000	793.92	834.72	815.24	834.99	0.000086	4.96	0.16
465.6	1%	100	256000	793.92	836.42	816.41	836.67	0.000079	4.93	0.15
465.6	0.5% (Confined)	200	285000	793.92	838.06	817.49	838.29	0.000073	4.88	0.15
465.6	0.2% (Confined)	500	323000	793.92	840.13	818.83	840.35	0.000066	4.82	0.14
466.09	50%	2	104000	790.5	824.18	809.77	824.65	0.000187	5.49	0.22
466.09	20%	5	141000	790.5	828.39	812.18	828.81	0.00015	5.5	0.2
466.09	10%	10	167000	790.5	830.79	813.36	831.13	0.000133	5.21	0.19
466.09	5%	20	191000	790.5	832.67	814.36	832.96	0.000112	5.01	0.17
466.09	2%	50	225000	790.5	834.94	815.73	835.2	0.000095	4.89	0.16
466.09	1%	100	256000	790.5	836.61	816.91	836.87	0.000089	4.91	0.16
466.09	0.5% (Confined)	200	285000	790.5	838.23	817.97	838.47	0.000082	4.89	0.15
466.09	0.2% (Confined)	500	323000	790.5	840.28	819.3	840.51	0.000074	4.86	0.15
466.82	50%	2	104000	794.85	824.9	809.34	825.42	0.000193	5.78	0.22
466.82	20%	5	141000	794.85	828.92	811.45	829.52	0.0002	6.34	0.23
466.82	10%	10	167000	794.85	831.21	812.84	831.82	0.000204	6.51	0.23
466.82	5%	20	191000	794.85	832.97	814.04	833.58	0.000197	6.61	0.23
466.82	2%	50	225000	794.85	835.15	815.63	835.76	0.000191	6.76	0.23
466.82	1%	100	256000	794.85	836.78	817	837.41	0.000188	6.97	0.23
466.82	0.5% (Confined)	200	285000	794.85	838.35	818.22	838.99	0.000182	7.1	0.23
466.82	0.2% (Confined)	500	323000	794.85	840.34	819.75	840.99	0.000173	7.24	0.22
467.31	50%	2	104000	798.59	825.43	812.74	826.05	0.000283	6.32	0.26
467.31	20%	5	141000	798.59	829.44	814.85	830.14	0.000258	6.81	0.26
467.31	10%	10	167000	798.59	831.74	816.19	832.41	0.000249	6.84	0.26
467.31	5%	20	191000	798.59	833.49	817.37	834.13	0.000227	6.87	0.25
467.31	2%	50	225000	798.59	835.65	818.93	836.26	0.000204	6.89	0.24
467.31	1%	100	256000	798.59	837.28	820.26	837.88	0.000192	6.96	0.23
467.31	0.5% (Confined)	200	285000	798.59	838.86	821.44	839.44	0.000178	6.95	0.23
467.31	0.2% (Confined)	500	323000	798.59	840.86	822.87	841.42	0.000162	6.94	0.22
467.9	50%	2	104000	794.04	826.31	814.04	826.84	0.000245	5.87	0.24
467.9	20%	5	141000	794.04	830.22	815.96	830.87	0.000236	6.5	0.25
467.9	10%	10	167000	794.04	832.42	817.18	833.1	0.000227	6.76	0.25
467.9	5%	20	191000	794.04	834.08	818.36	834.78	0.00022	6.96	0.24
467.9	2%	50	225000	794.04	836.19	819.71	836.88	0.000228	7.09	0.25
467.9	1%	100	256000	794.04	837.78	820.83	838.48	0.000221	7.27	0.25
467.9	0.5% (Confined)	200	285000	794.04	839.31	821.88	839.99	0.000207	7.3	0.24
467.9	0.2% (Confined)	500	323000	794.04	841.27	823.19	841.92	0.000189	7.29	0.23

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
468.58	50%	2	104000	790.75	827.04	809.66	827.66	0.000196	6.34	0.23
468.58	20%	5	141000	790.75	830.91	812.03	831.77	0.000226	7.42	0.25
468.58	10%	10	167000	790.75	833.04	813.6	834.04	0.000246	8.08	0.26
468.58	5%	20	191000	790.75	834.66	814.92	835.74	0.000258	8.51	0.27
468.58	2%	50	225000	790.75	836.76	816.71	837.87	0.000274	8.88	0.28
468.58	1%	100	256000	790.75	838.32	818.26	839.45	0.00028	9.15	0.28
468.58	0.5% (Confined)	200	285000	790.75	839.81	819.66	840.92	0.000276	9.26	0.28
468.58	0.2% (Confined)	500	323000	790.75	841.71	821.4	842.77	0.000266	9.32	0.28
469.14	50%	2	104000	799.64	827.79	811.29	828.2	0.000154	5.14	0.2
469.14	20%	5	141000	799.64	831.84	813.19	832.36	0.00016	5.82	0.21
469.14	10%	10	167000	799.64	834.08	814.42	834.69	0.000172	6.27	0.22
469.14	5%	20	191000	799.64	835.73	815.49	836.41	0.000185	6.68	0.23
469.14	2%	50	225000	799.64	837.79	816.91	838.57	0.000195	7.2	0.24
469.14	1%	100	256000	799.64	839.29	818.18	840.16	0.000207	7.67	0.24
469.14	0.5% (Confined)	200	285000	799.64	840.67	819.29	841.62	0.000215	8.06	0.25
469.14	0.2% (Confined)	500	323000	799.64	842.41	820.73	843.46	0.000224	8.51	0.26
469.77	50%	2	104000	797.49	828.26	811.91	828.78	0.000178	5.77	0.21
469.77	20%	5	141000	797.49	832.37	813.95	833	0.000211	6.41	0.23
469.77	10%	10	167000	797.49	834.69	815.25	835.36	0.000226	6.72	0.24
469.77	5%	20	191000	797.49	836.38	816.36	837.11	0.000229	7.04	0.25
469.77	2%	50	225000	797.49	838.49	817.92	839.28	0.000233	7.45	0.25
469.77	1%	100	256000	797.49	840.05	819.27	840.91	0.000243	7.86	0.26
469.77	0.5% (Confined)	200	285000	797.49	841.47	820.46	842.4	0.000248	8.19	0.26
469.77	0.2% (Confined)	500	323000	797.49	843.26	822.1	844.26	0.000252	8.59	0.27
470.58	50%	2	104000	799.2	829.09	815.33	829.54	0.000178	5.41	0.21
470.58	20%	5	141000	799.2	833.29	817.06	833.82	0.000171	5.91	0.21
470.58	10%	10	167000	799.2	835.63	818.18	836.18	0.000164	6.15	0.21
470.58	5%	20	191000	799.2	837.36	819.09	837.94	0.000163	6.39	0.21
470.58	2%	50	225000	799.2	839.51	820.45	840.12	0.000162	6.7	0.21
470.58	1%	100	256000	799.2	841.13	821.61	841.78	0.000164	6.97	0.22
470.58	0.5% (Confined)	200	285000	799.2	842.6	822.63	843.27	0.000164	7.19	0.22
470.58	0.2% (Confined)	500	323000	799.2	844.45	823.92	845.15	0.000163	7.44	0.22
471.28	50%	2	104000	794.31	829.73	813.72	830.21	0.000177	5.6	0.21
471.28	20%	5	141000	794.31	833.89	816.38	834.47	0.000176	6.19	0.22
471.28	10%	10	167000	794.31	836.21	817.78	836.81	0.000169	6.4	0.22
471.28	5%	20	191000	794.31	837.94	818.97	838.55	0.000165	6.59	0.22
471.28	2%	50	225000	794.31	840.09	820.45	840.72	0.000163	6.86	0.22
471.28	1%	100	256000	794.31	841.71	821.73	842.37	0.000163	7.11	0.22
471.28	0.5% (Confined)	200	285000	794.31	843.19	822.85	843.86	0.000162	7.31	0.22
471.28	0.2% (Confined)	500	323000	794.31	845.03	824.3	845.72	0.000161	7.53	0.22
472.06	50%	2	104000	798.32	830.47	816.4	830.92	0.000171	5.38	0.21
472.06	20%	5	141000	798.32	834.66	818.1	835.22	0.000189	6	0.22
472.06	10%	10	167000	798.32	836.93	819.25	837.54	0.000191	6.34	0.23
472.06	5%	20	191000	798.32	838.62	820.23	839.29	0.000193	6.66	0.23
472.06	2%	50	225000	798.32	840.73	821.56	841.47	0.000197	7.1	0.24
472.06	1%	100	256000	798.32	842.34	822.7	843.15	0.000205	7.51	0.24
472.06	0.5% (Confined)	200	285000	798.32	843.78	823.74	844.66	0.00021	7.85	0.25
472.06	0.2% (Confined)	500	323000	798.32	845.59	825.03	846.55	0.000216	8.26	0.25
472.78	50%	2	104000	790.23	831.09	813.12	831.48	0.000125	5.01	0.18
472.78	20%	5	141000	790.23	835.33	815.08	835.82	0.000135	5.69	0.19
472.78	10%	10	167000	790.23	837.61	816.34	838.16	0.000141	6.08	0.2
472.78	5%	20	191000	790.23	839.32	817.41	839.92	0.000146	6.42	0.2
472.78	2%	50	225000	790.23	841.45	818.88	842.13	0.000153	6.86	0.21
472.78	1%	100	256000	790.23	843.1	820.18	843.84	0.000161	7.26	0.22
472.78	0.5% (Confined)	200	285000	790.23	844.57	821.33	845.38	0.000166	7.6	0.22
472.78	0.2% (Confined)	500	323000	790.23	846.41	822.77	847.29	0.000172	8	0.23

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
473.62	50%	2	104000	802.97	831.69	817.59	832.19	0.000187	5.69	0.22
473.62	20%	5	141000	802.97	835.95	819.42	836.57	0.000188	6.32	0.22
473.62	10%	10	167000	802.97	838.26	820.62	838.91	0.000186	6.62	0.23
473.62	5%	20	191000	802.97	840	821.66	840.65	0.000177	6.74	0.22
473.62	2%	50	225000	802.97	842.21	823.05	842.84	0.000166	6.86	0.22
473.62	1%	100	256000	802.97	843.94	824.26	844.57	0.000161	7	0.22
473.62	0.5% (Confined)	200	285000	802.97	845.48	825.34	846.11	0.000156	7.1	0.22
473.62	0.2% (Confined)	500	323000	802.97	847.39	826.7	848.02	0.000149	7.22	0.21
474.29	50%	2	104000	795.31	832.34	817.04	832.87	0.000185	5.87	0.22
474.29	20%	5	141000	795.31	836.61	819.06	837.23	0.000182	6.45	0.22
474.29	10%	10	167000	795.31	838.92	820.36	839.55	0.000173	6.64	0.22
474.29	5%	20	191000	795.31	840.61	821.5	841.26	0.000171	6.86	0.22
474.29	2%	50	225000	795.31	842.76	823.03	843.43	0.000169	7.15	0.22
474.29	1%	100	256000	795.31	844.45	824.32	845.15	0.00017	7.42	0.22
474.29	0.5% (Confined)	200	285000	795.31	845.95	825.52	846.68	0.00017	7.64	0.23
474.29	0.2% (Confined)	500	323000	795.31	847.83	827	848.59	0.00017	7.9	0.23
474.94	50%	2	104000	794.58	833	816.45	833.47	0.000163	5.53	0.21
474.94	20%	5	141000	794.58	837.27	818.59	837.81	0.00016	6.04	0.21
474.94	10%	10	167000	794.58	839.53	820.3	840.1	0.000159	6.31	0.21
474.94	5%	20	191000	794.58	841.19	821.41	841.8	0.000161	6.61	0.21
474.94	2%	50	225000	794.58	843.3	822.91	843.97	0.000165	7	0.22
474.94	1%	100	256000	794.58	844.97	824.18	845.7	0.00017	7.35	0.22
474.94	0.5% (Confined)	200	285000	794.58	846.46	825.34	847.24	0.000173	7.65	0.23
474.94	0.2% (Confined)	500	323000	794.58	848.32	826.87	849.15	0.000177	8	0.23
475.38	50%	2	104000	802.02	833.32	820.14	834.01	0.000264	6.65	0.26
475.38	20%	5	141000	802.02	837.58	822.2	838.34	0.000248	7.13	0.26
475.38	10%	10	167000	802.02	839.84	823.55	840.6	0.000242	7.32	0.26
475.38	5%	20	191000	802.02	841.51	824.72	842.3	0.000237	7.56	0.26
475.38	2%	50	225000	802.02	843.63	826.29	844.46	0.000233	7.88	0.26
475.38	1%	100	256000	802.02	845.31	827.64	846.19	0.000234	8.18	0.26
475.38	0.5% (Confined)	200	285000	802.02	846.82	828.86	847.73	0.000233	8.43	0.26
475.38	0.2% (Confined)	500	323000	802.02	848.68	830.37	849.65	0.000231	8.73	0.26
475.92	50%	2	104000	800.78	834.18	819.96	834.63	0.000175	5.39	0.21
475.92	20%	5	141000	800.78	838.38	821.71	838.94	0.000177	6.05	0.22
475.92	10%	10	167000	800.78	840.56	822.84	841.21	0.000183	6.5	0.22
475.92	5%	20	191000	800.78	842.17	823.82	842.91	0.000193	6.94	0.23
475.92	2%	50	225000	800.78	844.23	825.16	845.08	0.000205	7.5	0.24
475.92	1%	100	256000	800.78	846.07	826.33	846.74	0.000167	7.04	0.22
475.92	0.5% (Confined)	200	285000	800.78	847.58	827.35	848.28	0.000168	7.29	0.22
475.92	0.2% (Confined)	500	323000	800.78	849.44	828.67	850.19	0.000169	7.58	0.23
476.34	50%	2	104000	800.67	834.54	818.99	834.95	0.000146	5.16	0.19
476.34	20%	5	141000	800.67	838.75	820.78	839.27	0.000151	5.82	0.2
476.34	10%	10	167000	800.67	840.95	821.89	841.55	0.000158	6.28	0.21
476.34	5%	20	191000	800.67	842.59	822.92	843.27	0.000167	6.71	0.22
476.34	2%	50	225000	800.67	844.68	824.25	845.46	0.00018	7.27	0.23
476.34	1%	100	256000	800.67	846.38	825.43	847.06	0.000159	7.08	0.22
476.34	0.5% (Confined)	200	285000	800.67	847.88	826.49	848.61	0.000162	7.37	0.22
476.34	0.2% (Confined)	500	323000	800.67	849.74	827.82	850.52	0.000165	7.7	0.22
476.99	50%	2	104000	798.83	834.96	819.21	835.54	0.000193	6.11	0.22
476.99	20%	5	141000	798.83	839.15	821.32	839.9	0.000208	6.95	0.24
476.99	10%	10	167000	798.83	841.36	822.68	842.21	0.000217	7.48	0.25
476.99	5%	20	191000	798.83	843.02	823.89	843.97	0.000228	7.97	0.25
476.99	2%	50	225000	798.83	845.21	825.49	846.11	0.000211	8.03	0.25
476.99	1%	100	256000	798.83	846.75	826.93	847.72	0.00022	8.44	0.25
476.99	0.5% (Confined)	200	285000	798.83	848.26	828.24	849.27	0.000222	8.73	0.26
476.99	0.2% (Confined)	500	323000	798.83	850.12	829.79	851.19	0.000223	9.07	0.26

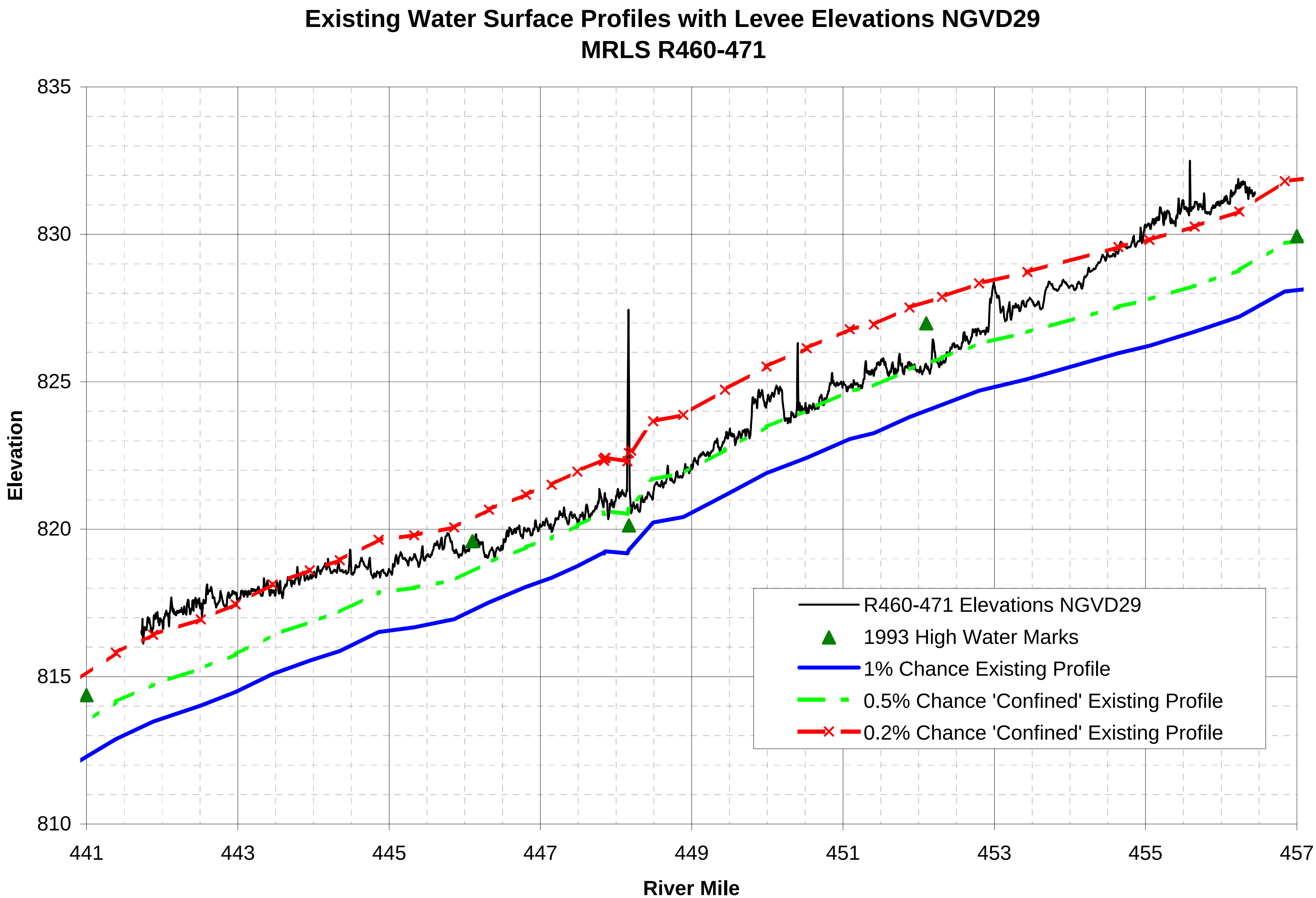
Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
477.64	50%	2	104000	800.29	835.78	820.48	836.16	0.000157	5.16	0.2
477.64	20%	5	141000	800.29	840.14	822.7	840.54	0.00015	5.41	0.2
477.64	10%	10	167000	800.29	842.43	823.98	842.84	0.000138	5.53	0.19
477.64	5%	20	191000	800.29	844.18	825.08	844.61	0.000134	5.7	0.19
477.64	2%	50	225000	800.29	846.25	826.49	846.71	0.000134	5.99	0.2
477.64	1%	100	256000	800.29	847.9	827.82	848.29	0.000115	5.76	0.18
477.64	0.5% (Confined)	200	285000	800.29	849.44	829.16	849.84	0.000112	5.88	0.18
477.64	0.2% (Confined)	500	323000	800.29	851.34	831.69	851.75	0.000109	6.02	0.18
478.4	50%	2	104000	806.35	836.36	821.67	836.81	0.000163	5.4	0.21
478.4	20%	5	141000	806.35	840.66	823.5	841.12	0.000146	5.68	0.2
478.4	10%	10	167000	806.35	842.9	824.72	843.37	0.000139	5.86	0.2
478.4	5%	20	191000	806.35	844.64	825.76	845.11	0.000135	6	0.2
478.4	2%	50	225000	806.35	846.71	827.18	847.2	0.000133	6.25	0.2
478.4	1%	100	256000	806.35	848.25	828.36	848.78	0.000136	6.52	0.2
478.4	0.5% (Confined)	200	285000	806.35	849.77	829.44	850.32	0.000135	6.7	0.2
478.4	0.2% (Confined)	500	323000	806.35	851.65	830.8	852.22	0.000134	6.9	0.2
479.09	50%	2	104000	810.08	837.01	824.25	837.44	0.000187	5.41	0.22
479.09	20%	5	141000	810.08	841.26	826.05	841.64	0.000146	5.37	0.2
479.09	10%	10	167000	810.08	843.51	827.22	843.84	0.000124	5.22	0.18
479.09	5%	20	191000	810.08	845.24	828.2	845.54	0.000109	5.12	0.17
479.09	2%	50	225000	810.08	847.32	829.54	847.6	0.000098	5.09	0.17
479.09	1%	100	256000	810.08	848.89	830.75	849.17	0.000093	5.15	0.16
479.09	0.5% (Confined)	200	285000	810.08	850.42	832.61	850.69	0.000088	5.16	0.16
479.09	0.2% (Confined)	500	323000	810.08	852.31	833.98	852.58	0.000082	5.19	0.16
479.81	50%	2	103000	800.46	837.74	823.01	838.18	0.000226	5.57	0.23
479.81	20%	5	140000	800.46	841.78	825.81	842.15	0.000164	5.41	0.21
479.81	10%	10	166000	800.46	843.92	828.05	844.25	0.000139	5.28	0.19
479.81	5%	20	190000	800.46	845.58	829.3	845.89	0.000127	5.27	0.18
479.81	2%	50	224000	800.46	847.61	830.73	847.91	0.000118	5.34	0.18
479.81	1%	100	255000	800.46	849.16	832.07	849.46	0.000116	5.47	0.18
479.81	0.5% (Confined)	200	284000	800.46	850.66	833.82	850.97	0.000111	5.55	0.18
479.81	0.2% (Confined)	500	322000	800.46	852.53	835.67	852.84	0.000106	5.65	0.18
480.59	50%	2	103000	809.61	838.58	823.55	839.06	0.000216	5.64	0.21
480.59	20%	5	140000	809.61	842.38	825.51	842.86	0.000193	5.84	0.21
480.59	10%	10	166000	809.61	844.42	826.78	844.88	0.000186	5.97	0.2
480.59	5%	20	190000	809.61	846.03	827.89	846.48	0.000179	6	0.2
480.59	2%	50	224000	809.61	848.02	829.38	848.45	0.000169	6.07	0.2
480.59	1%	100	255000	809.61	849.55	830.66	849.98	0.000166	6.2	0.2
480.59	0.5% (Confined)	200	284000	809.61	851.03	831.83	851.46	0.000159	6.26	0.19
480.59	0.2% (Confined)	500	322000	809.61	852.88	833.28	853.3	0.000151	6.34	0.19
481.2	50%	2	103000	809.33	839.31	825.88	839.76	0.000224	5.45	0.21
481.2	20%	5	140000	809.33	843	827.63	843.48	0.000207	5.8	0.21
481.2	10%	10	166000	809.33	844.99	828.78	845.48	0.0002	6.01	0.21
481.2	5%	20	190000	809.33	846.56	829.79	847.07	0.000198	6.22	0.21
481.2	2%	50	224000	809.33	848.5	831.12	849.04	0.000199	6.54	0.21
481.2	1%	100	255000	809.33	850	832.31	850.58	0.000204	6.85	0.22
481.2	0.5% (Confined)	200	284000	809.33	851.44	833.37	852.05	0.000204	7.07	0.22
481.2	0.2% (Confined)	500	322000	809.33	853.25	834.7	853.89	0.000204	7.32	0.22
481.89	50%	2	103000	810.32	840.11	826.31	840.59	0.000248	5.66	0.22
481.89	20%	5	140000	810.32	843.71	828.5	844.29	0.000252	6.3	0.23
481.89	10%	10	166000	810.32	845.66	829.83	846.29	0.000255	6.68	0.24
481.89	5%	20	190000	810.32	847.21	830.95	847.88	0.000258	6.99	0.24
481.89	2%	50	224000	810.32	849.13	832.98	849.85	0.000258	7.33	0.24
481.89	1%	100	255000	810.32	850.65	834.33	851.39	0.00026	7.62	0.25
481.89	0.5% (Confined)	200	284000	810.32	852.09	835.41	852.85	0.000256	7.8	0.25
481.89	0.2% (Confined)	500	322000	810.32	853.89	836.67	854.67	0.000251	8.01	0.25

Exhibit 2.5
Missouri River Existing Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
482.6	50%	2	103000	809.27	841.02	828.07	841.51	0.000265	5.69	0.23
482.6	20%	5	140000	809.27	844.62	829.92	845.19	0.000258	6.24	0.23
482.6	10%	10	166000	809.27	846.61	831.11	847.17	0.000242	6.35	0.23
482.6	5%	20	190000	809.27	848.18	832.16	848.73	0.000227	6.43	0.22
482.6	2%	50	224000	809.27	850.13	833.85	850.67	0.000215	6.56	0.22
482.6	1%	100	255000	809.27	851.66	834.99	852.2	0.000209	6.72	0.22
482.6	0.5% (Confined)	200	284000	809.27	853.09	836.01	853.64	0.000202	6.81	0.22
482.6	0.2% (Confined)	500	322000	809.27	854.88	837.37	855.43	0.000194	6.93	0.21
483.45	50%	2	103000	809.53	842.16	827.66	842.76	0.000297	6.22	0.25
483.45	20%	5	140000	809.53	845.76	830.32	846.55	0.000353	7.11	0.27
483.45	10%	10	166000	809.53	847.64	831.83	848.56	0.000384	7.7	0.29
483.45	5%	20	190000	809.53	849.1	833.16	850.13	0.000401	8.2	0.29
483.45	2%	50	224000	809.53	850.92	834.9	852.07	0.000416	8.77	0.3
483.45	1%	100	255000	809.53	852.39	836.18	853.61	0.000421	9.15	0.31
483.45	0.5% (Confined)	200	284000	809.53	853.76	837.25	855.01	0.000415	9.4	0.31
483.45	0.2% (Confined)	500	322000	809.53	855.48	838.72	856.76	0.000405	9.65	0.31
484.11	50%	2	103000	813.88	843.16	828.65	843.62	0.000209	5.44	0.21
484.11	20%	5	140000	813.88	846.93	830.48	847.5	0.000218	6.17	0.22
484.11	10%	10	166000	813.88	848.93	831.69	849.57	0.000224	6.59	0.22
484.11	5%	20	190000	813.88	850.48	832.73	851.19	0.000232	6.96	0.23
484.11	2%	50	224000	813.88	852.39	834.11	853.19	0.000245	7.48	0.24
484.11	1%	100	255000	813.88	853.88	835.33	854.76	0.000259	7.93	0.25
484.11	0.5% (Confined)	200	284000	813.88	855.22	836.39	856.17	0.000268	8.3	0.25
484.11	0.2% (Confined)	500	322000	813.88	856.89	837.75	857.93	0.000278	8.74	0.26

Exhibit 2.6



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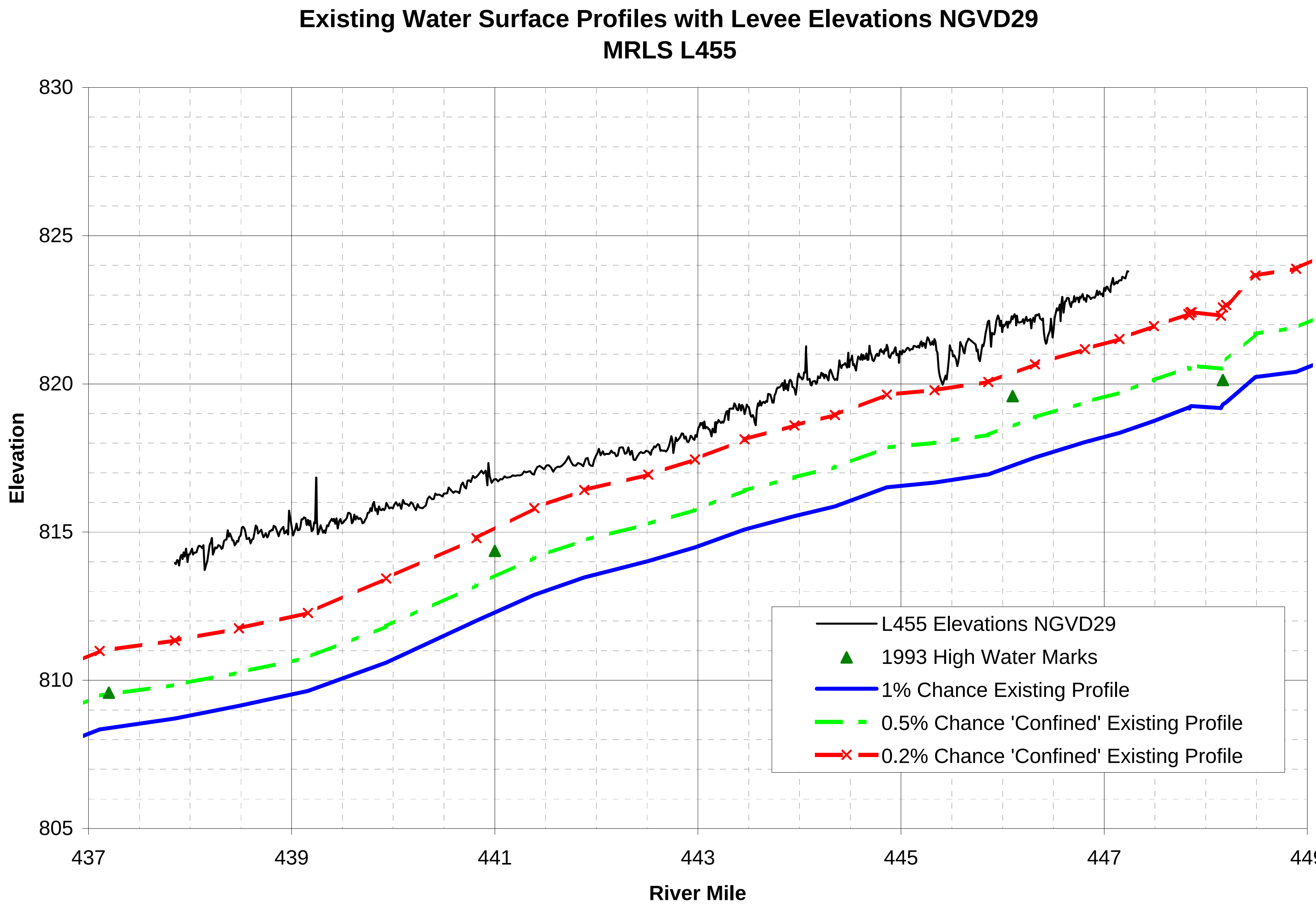
Checked By: MMW
Date: 7/22/2006

Exhibit 2.7



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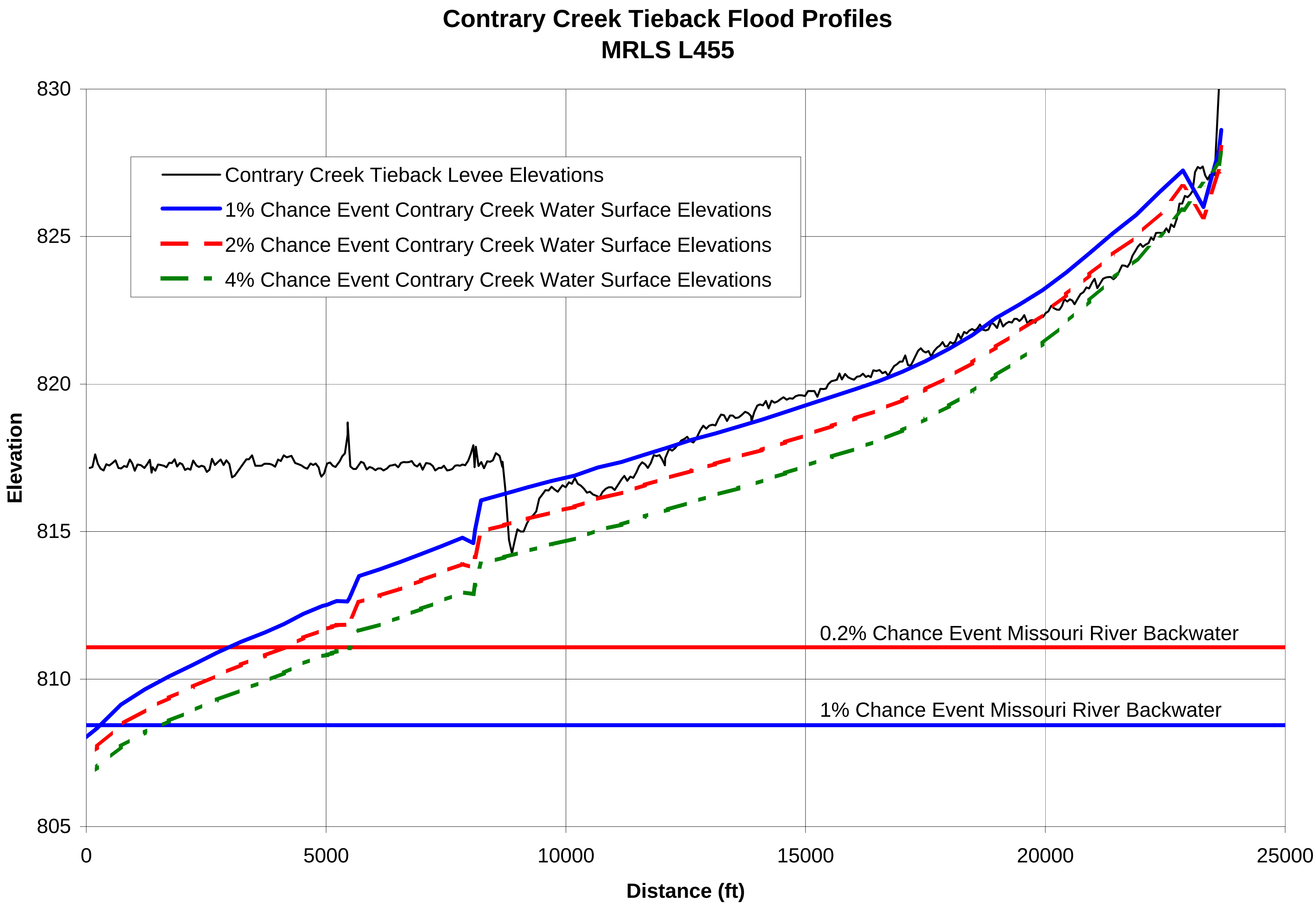
Date: 7/22/2006

Exhibit 2.8



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Date: 7/22/2006

Exhibit 2.9

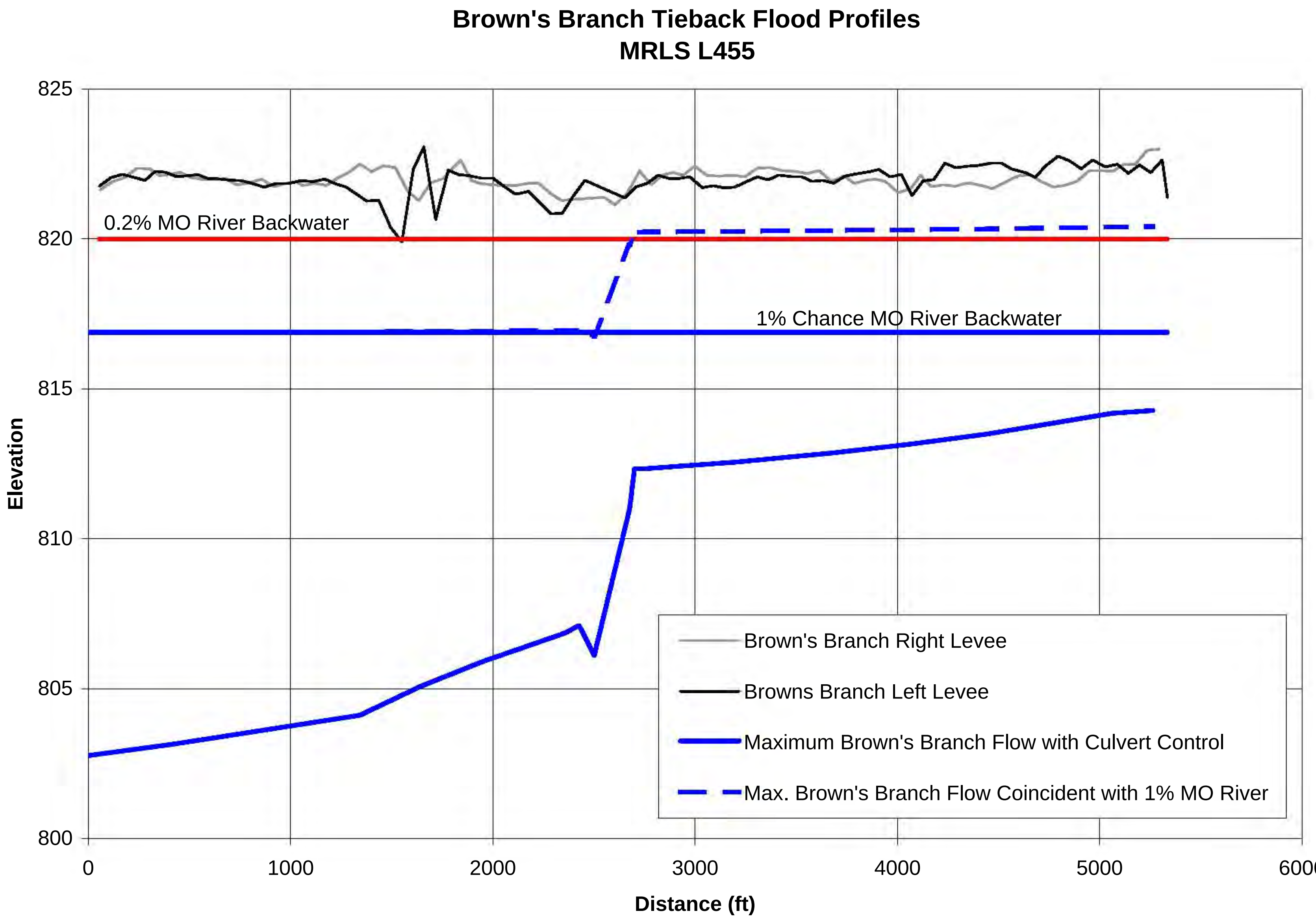

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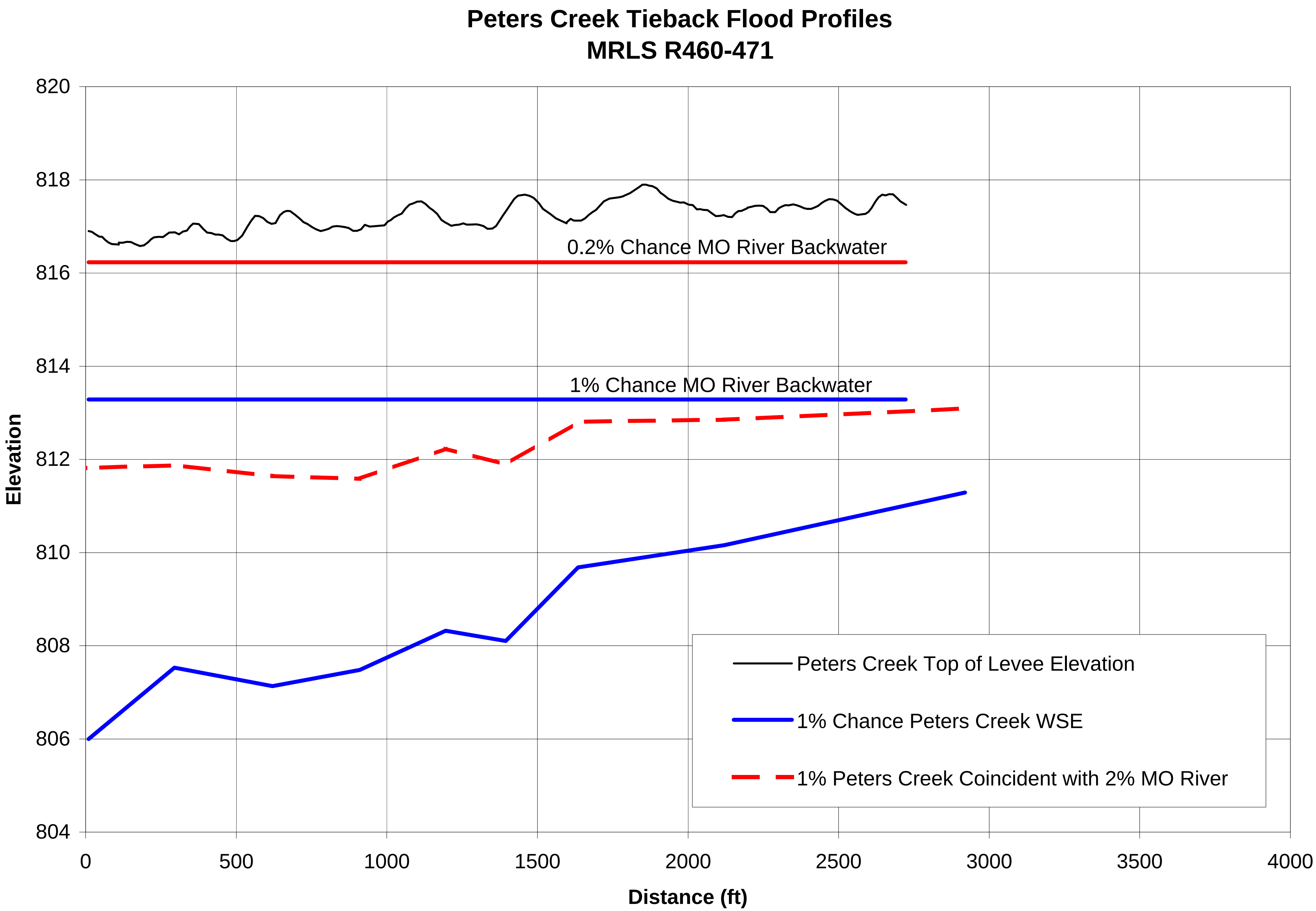
Exhibit 2.10



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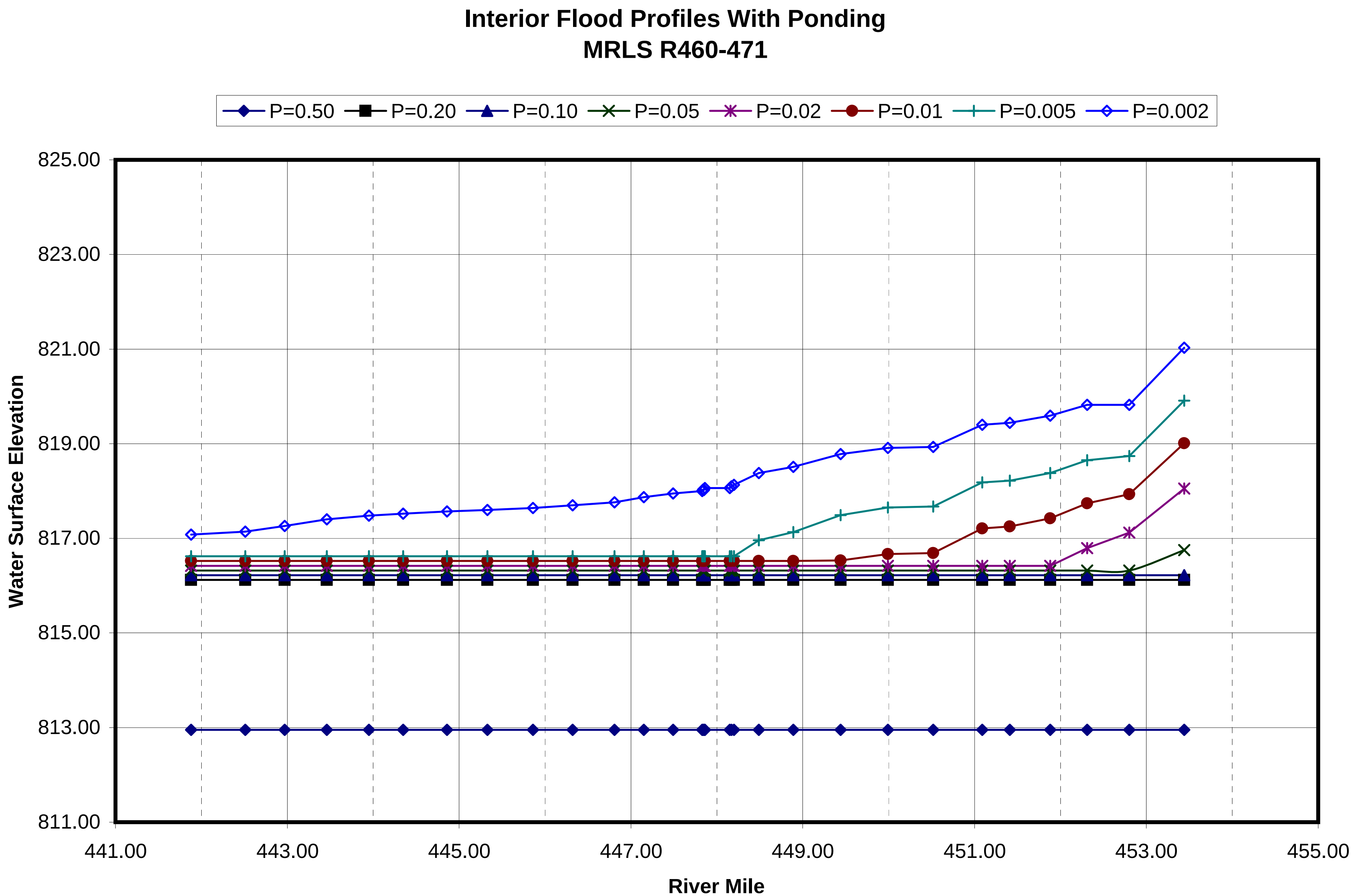
Date: 7/22/2006

Exhibit 2.11



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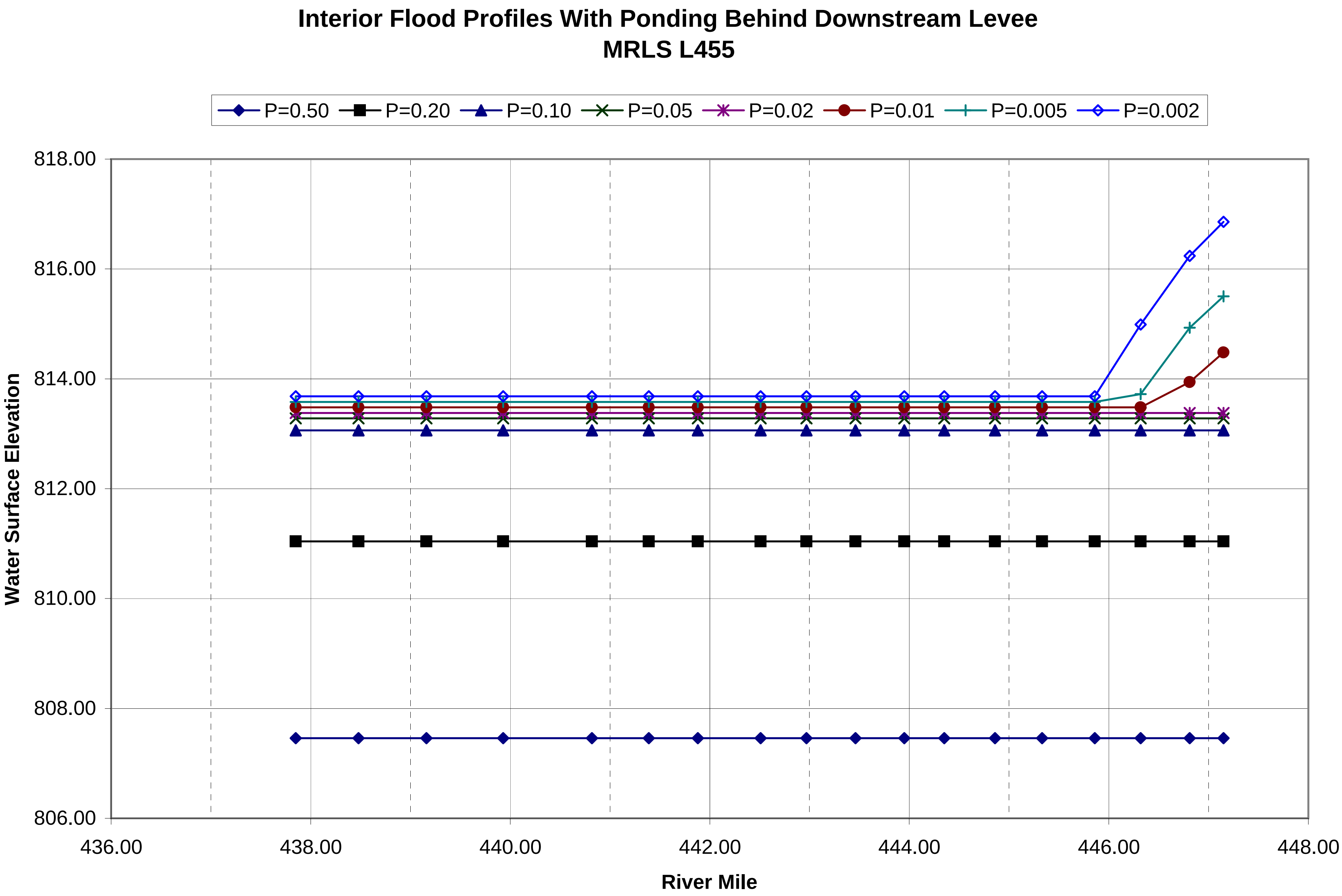
Date: 7/22/2006

Exhibit 2.12



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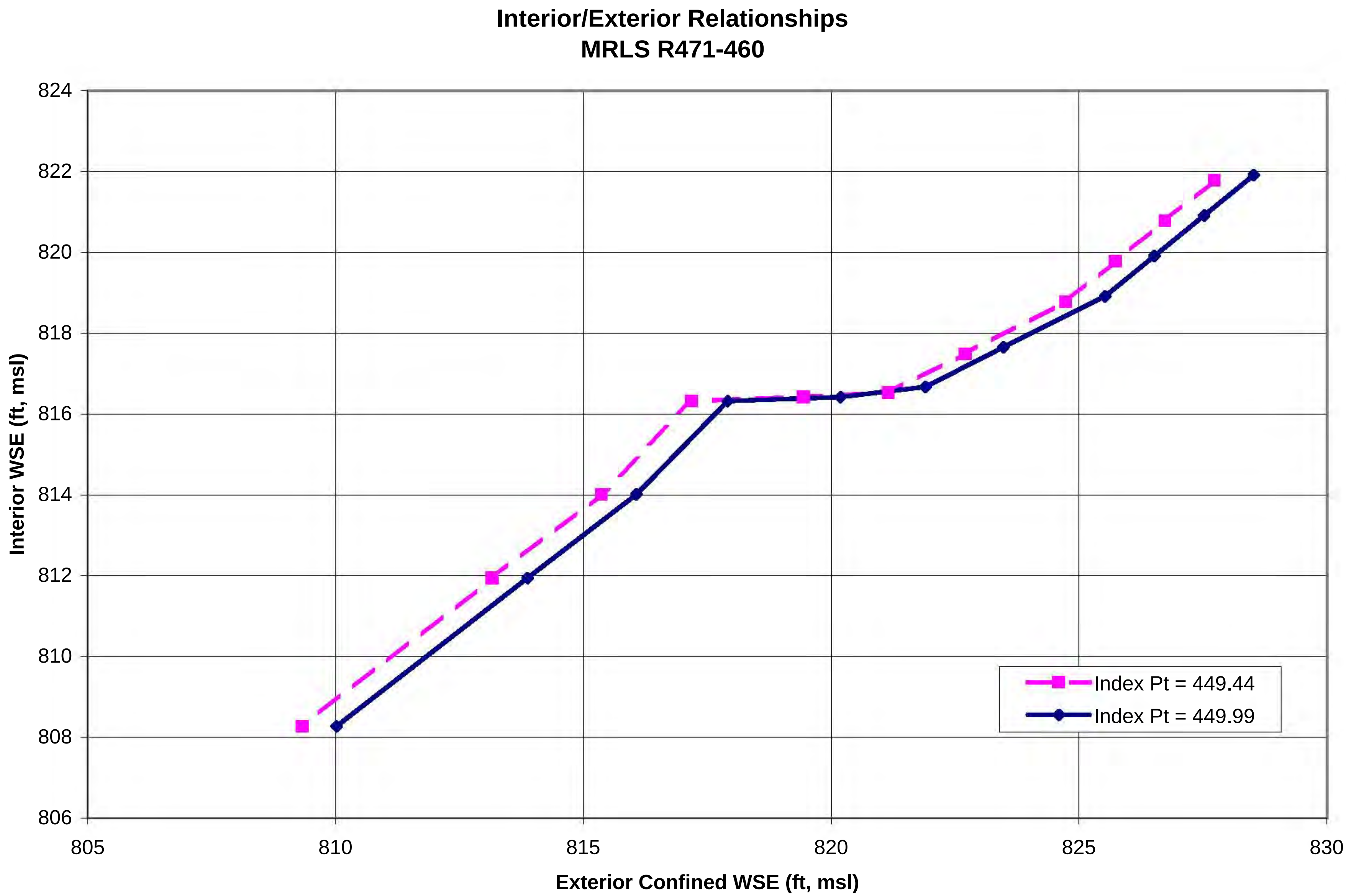
Date: 7/22/2006

Exhibit 2.13



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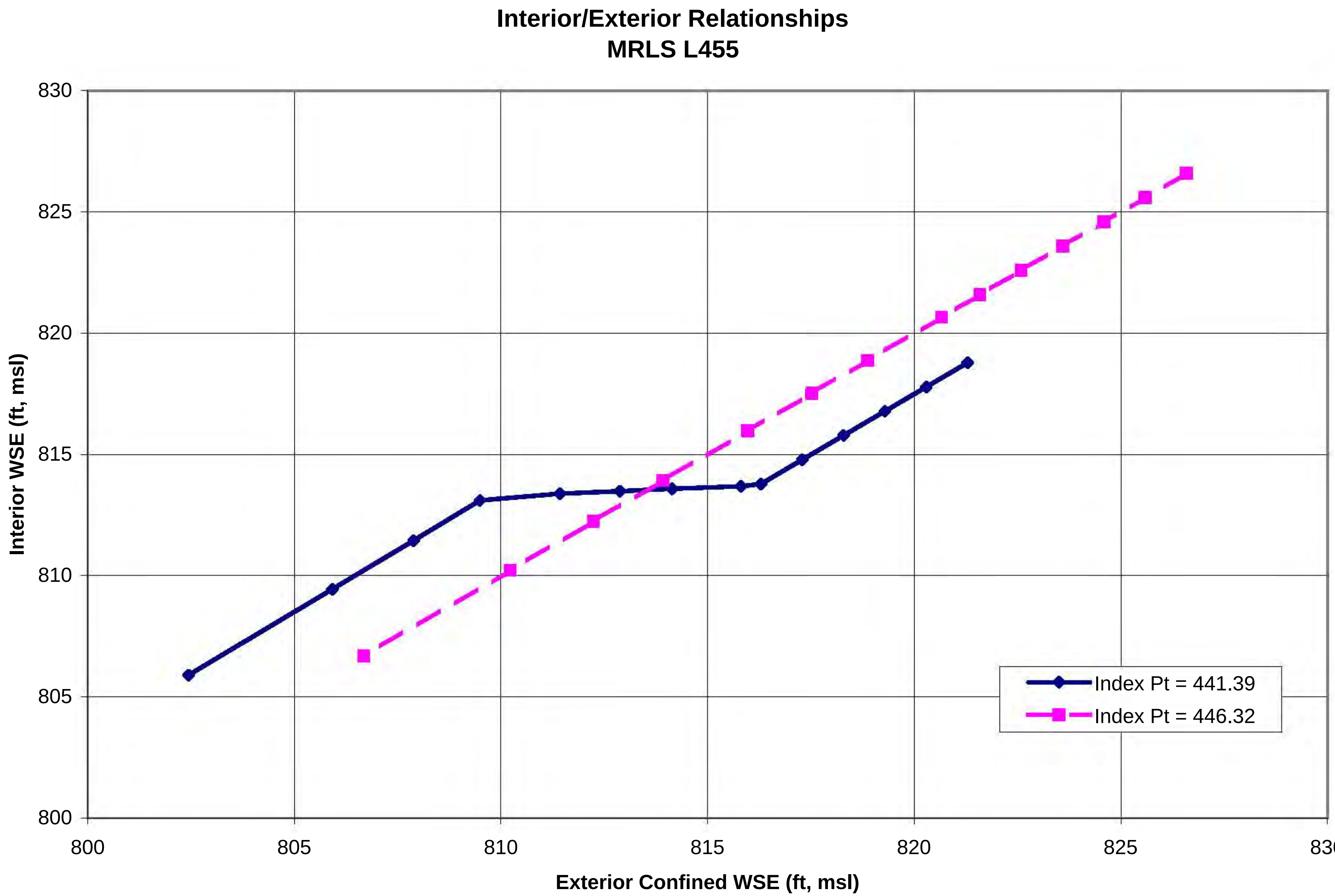
Date: 7/22/2006

Exhibit 2.14



Designed: EDS
Checked: MMW
Date: 7/22/2006

Exhibit 2.15
Taken From the *Missouri River Stage Trends, RCC Technical Report A-04*
By USACE Northwest Division-Missouri River Basin Reservoir Control Center in Omaha, Nebraska

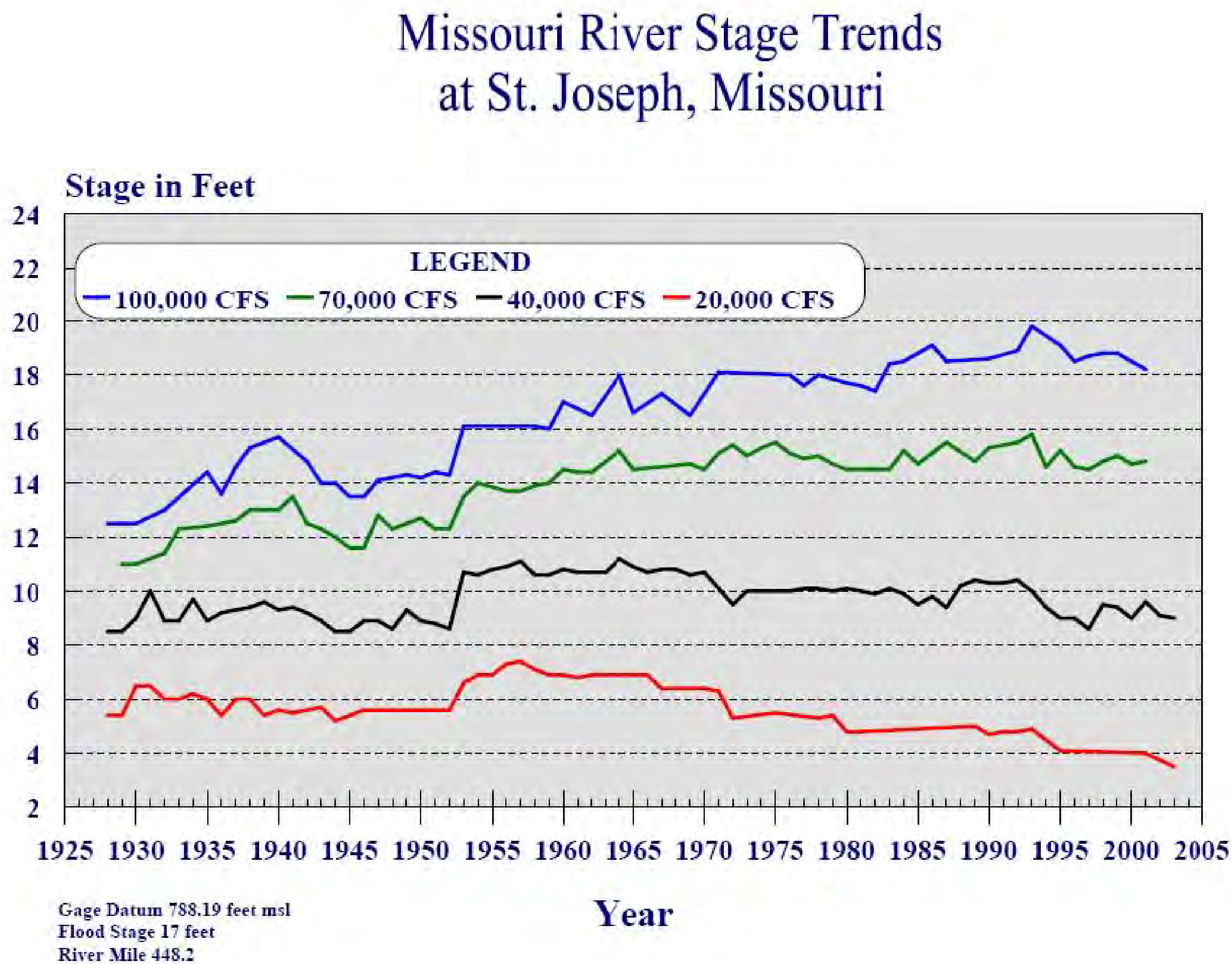


Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
428.61	50%	2	109000	750.79	789.5	772.59	789.88	0.000106	4.98	0.18
428.61	20%	5	147000	750.79	791.2	774.41	791.78	0.000152	6.19	0.22
428.61	10%	10	174000	750.79	792.3	775.58	793	0.000179	6.88	0.24
428.61	5%	20	199000	750.79	793.9	776.6	794.64	0.000182	7.17	0.24
428.61	2%	50	233000	750.79	795.1	777.95	795.96	0.000207	7.82	0.26
428.61	1%	100	261000	750.79	796.2	778.99	797.13	0.000218	8.2	0.27
428.61	0.5% (Confined)	200	287000	750.79	797.1	779.94	798.09	0.000228	8.57	0.27
428.61	0.2% (Confined)	500	324000	750.79	798.3	781.21	799.38	0.000241	9.04	0.28
429.22	50%	2	109000	758.58	789.83	775.38	790.32	0.000154	5.64	0.21
429.22	20%	5	147000	758.58	791.68	777.31	792.38	0.000205	6.83	0.25
429.22	10%	10	174000	758.58	792.87	778.52	793.69	0.000234	7.49	0.27
429.22	5%	20	199000	758.58	794.49	779.57	795.32	0.000228	7.67	0.27
429.22	2%	50	233000	758.58	795.78	780.93	796.7	0.000245	8.21	0.28
429.22	1%	100	261000	758.58	796.92	781.99	797.88	0.000249	8.51	0.28
429.22	0.5% (Confined)	200	287000	758.58	797.86	782.91	798.86	0.000255	8.8	0.29
429.22	0.2% (Confined)	500	324000	758.58	799.15	784.22	800.19	0.000266	9.12	0.3
429.99	50%	2	109000	746.8	790.46	769.37	790.74	0.000067	4.27	0.15
429.99	20%	5	147000	746.8	792.53	771.23	792.94	0.000091	5.21	0.17
429.99	10%	10	174000	746.8	793.85	772.4	794.34	0.000106	5.76	0.19
429.99	5%	20	199000	746.8	795.44	773.51	795.97	0.00011	6.05	0.19
429.99	2%	50	233000	746.8	796.8	774.88	797.4	0.000123	6.59	0.2
429.99	1%	100	261000	746.8	797.97	775.98	798.62	0.000132	6.91	0.21
429.99	0.5% (Confined)	200	287000	746.8	798.96	776.95	799.64	0.000142	7.16	0.22
429.99	0.2% (Confined)	500	324000	746.8	800.29	778.32	801.01	0.000151	7.48	0.23
430.67	50%	2	109000	760.18	790.64	776.52	791.16	0.000161	5.8	0.22
430.67	20%	5	147000	760.18	792.77	778.32	793.51	0.000209	7	0.25
430.67	10%	10	174000	760.18	794.11	779.52	795	0.000239	7.7	0.27
430.67	5%	20	199000	760.18	795.71	780.56	796.65	0.000244	8.05	0.28
430.67	2%	50	233000	760.18	797.11	781.92	798.15	0.000264	8.6	0.29
430.67	1%	100	261000	760.18	798.3	782.98	799.39	0.000271	8.92	0.3
430.67	0.5% (Confined)	200	287000	760.18	799.32	783.94	800.45	0.000276	9.19	0.3
430.67	0.2% (Confined)	500	324000	760.18	800.67	785.25	801.85	0.00028	9.54	0.3
431.4	50%	2	109000	762.29	791.39	774.79	791.78	0.000153	5.05	0.18
431.4	20%	5	147000	762.29	793.75	776.56	794.32	0.000198	6.09	0.21
431.4	10%	10	174000	762.29	795.25	777.72	795.91	0.000221	6.65	0.23
431.4	5%	20	199000	762.29	796.88	778.73	797.57	0.000225	6.93	0.23
431.4	2%	50	233000	762.29	798.38	780.06	799.15	0.000244	7.39	0.26
431.4	1%	100	261000	762.29	799.62	781.09	800.41	0.00025	7.62	0.26
431.4	0.5% (Confined)	200	287000	762.29	800.67	782.01	801.49	0.000255	7.82	0.26
431.4	0.2% (Confined)	500	324000	762.29	802.05	783.31	802.9	0.000258	8.07	0.27
431.97	50%	2	109000	762.1	791.8	776.72	792.32	0.000188	5.81	0.22
431.97	20%	5	147000	762.1	794.29	778.66	795	0.000233	6.84	0.25
431.97	10%	10	174000	762.1	795.85	779.96	796.66	0.000253	7.39	0.26
431.97	5%	20	199000	762.1	797.5	781.08	798.33	0.00026	7.62	0.26
431.97	2%	50	233000	762.1	799.06	782.52	799.96	0.000277	8.07	0.28
431.97	1%	100	261000	762.1	800.31	783.66	801.25	0.000284	8.36	0.28
431.97	0.5% (Confined)	200	287000	762.1	801.36	784.65	802.34	0.000291	8.61	0.28
431.97	0.2% (Confined)	500	324000	762.1	802.74	786.05	803.78	0.000296	8.96	0.29
432.69	50%	2	109000	762.83	792.53	775.81	793.01	0.000171	5.61	0.21
432.69	20%	5	147000	762.83	795.2	777.8	795.87	0.000218	6.62	0.24
432.69	10%	10	174000	762.83	796.83	779.11	797.6	0.000237	7.17	0.25
432.69	5%	20	199000	762.83	798.47	780.25	799.29	0.000238	7.46	0.26
432.69	2%	50	233000	762.83	800.07	781.73	800.97	0.000251	7.97	0.27
432.69	1%	100	261000	762.83	801.34	782.93	802.29	0.000257	8.31	0.27
432.69	0.5% (Confined)	200	287000	762.83	802.41	783.94	803.41	0.000264	8.61	0.28
432.69	0.2% (Confined)	500	324000	762.83	803.8	785.4	804.88	0.000273	9.02	0.28

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
433.4	50%	2	109000	766.99	793.25	780.1	793.67	0.000175	5.25	0.21
433.4	20%	5	147000	766.99	796.17	781.76	796.61	0.00017	5.63	0.21
433.4	10%	10	174000	766.99	797.93	782.82	798.36	0.000163	5.76	0.21
433.4	5%	20	199000	766.99	799.61	783.77	800.03	0.000149	5.75	0.2
433.4	2%	50	233000	766.99	801.31	785.01	801.73	0.000144	5.89	0.2
433.4	1%	100	261000	766.99	802.64	785.96	803.04	0.000139	5.96	0.2
433.4	0.5% (Confined)	200	287000	766.99	803.77	786.83	804.17	0.000134	6.02	0.2
433.4	0.2% (Confined)	500	324000	766.99	805.24	788.03	805.64	0.00013	6.12	0.19
433.805*	50%	2	109000	762.08	793.8	780.33	794.23	0.000178	5.34	0.21
433.805*	20%	5	147000	762.08	796.68	782.04	797.19	0.000186	5.91	0.22
433.805*	10%	10	174000	762.08	798.41	783.14	798.92	0.000182	6.1	0.22
433.805*	5%	20	199000	762.08	800.05	784.12	800.53	0.000167	6.09	0.21
433.805*	2%	50	233000	762.08	801.74	785.47	802.21	0.000162	6.23	0.21
433.805*	1%	100	261000	762.08	803.05	786.45	803.51	0.000155	6.3	0.21
433.805*	0.5% (Confined)	200	287000	762.08	804.16	787.32	804.62	0.000151	6.38	0.21
433.805*	0.2% (Confined)	500	324000	762.08	805.62	788.49	806.08	0.000147	6.5	0.21
434.21	50%	2	109000	757.17	794.43	780.11	794.83	0.000196	5.14	0.2
434.21	20%	5	147000	757.17	797.37	781.8	797.8	0.000193	5.52	0.2
434.21	10%	10	174000	757.17	799.09	782.9	799.51	0.000186	5.64	0.2
434.21	5%	20	199000	757.17	800.69	783.87	801.08	0.000173	5.65	0.2
434.21	2%	50	233000	757.17	802.35	785.13	802.75	0.000169	5.8	0.19
434.21	1%	100	261000	757.17	803.63	786.09	804.03	0.000165	5.9	0.19
434.21	0.5% (Confined)	200	287000	757.17	804.73	787	805.13	0.000162	6	0.19
434.21	0.2% (Confined)	500	324000	757.17	806.17	788.2	806.58	0.00016	6.15	0.19
434.61*	50%	2	109000	761.57	795.08	781.13	795.62	0.000285	5.96	0.24
434.61*	20%	5	147000	761.57	797.98	783.61	798.6	0.000293	6.56	0.25
434.61*	10%	10	174000	761.57	799.67	785.49	800.29	0.000285	6.76	0.25
434.61*	5%	20	199000	761.57	801.23	786.77	801.81	0.000261	6.73	0.24
434.61*	2%	50	233000	761.57	802.88	788.06	803.44	0.000244	6.79	0.23
434.61*	1%	100	261000	761.57	804.15	789.11	804.69	0.00023	6.8	0.23
434.61*	0.5% (Confined)	200	287000	761.57	805.25	790.02	805.77	0.00022	6.83	0.22
434.61*	0.2% (Confined)	500	324000	761.57	806.68	791.27	807.19	0.00021	6.89	0.22
435.01	50%	2	109000	765.96	795.92	780.42	796.37	0.000199	5.49	0.21
435.01	20%	5	147000	765.96	798.84	782.34	799.4	0.000221	6.21	0.22
435.01	10%	10	174000	765.96	800.48	783.59	801.1	0.000235	6.67	0.23
435.01	5%	20	199000	765.96	801.95	784.69	802.61	0.000239	6.95	0.23
435.01	2%	50	233000	765.96	803.54	786.13	804.25	0.000246	7.33	0.24
435.01	1%	100	261000	765.96	804.77	787.25	805.49	0.000247	7.55	0.24
435.01	0.5% (Confined)	200	287000	765.96	805.83	788.24	806.56	0.000247	7.71	0.24
435.01	0.2% (Confined)	500	324000	765.96	807.23	789.64	807.98	0.000245	7.92	0.24
435.395*	50%	2	109000	765.51	796.51	780.98	796.99	0.000202	5.54	0.21
435.395*	20%	5	147000	765.51	799.48	782.91	800.12	0.000237	6.47	0.23
435.395*	10%	10	174000	765.51	801.15	784.18	801.88	0.000257	7.01	0.24
435.395*	5%	20	199000	765.51	802.63	785.31	803.41	0.000265	7.37	0.25
435.395*	2%	50	233000	765.51	804.22	786.69	805.11	0.000287	7.95	0.26
435.395*	1%	100	261000	765.51	805.43	787.78	806.38	0.000296	8.3	0.26
435.395*	0.5% (Confined)	200	287000	765.51	806.48	788.78	807.46	0.000303	8.58	0.27
435.395*	0.2% (Confined)	500	324000	765.51	807.86	790.1	808.9	0.000312	8.96	0.27
435.78	50%	2	109000	765.05	797.14	781.2	797.58	0.000187	5.38	0.2
435.78	20%	5	147000	765.05	800.24	783.34	800.8	0.000209	6.14	0.21
435.78	10%	10	174000	765.05	801.98	784.54	802.61	0.000225	6.63	0.22
435.78	5%	20	199000	765.05	803.48	785.6	804.18	0.000233	6.99	0.23
435.78	2%	50	233000	765.05	805.16	786.95	805.93	0.000248	7.49	0.24
435.78	1%	100	261000	765.05	806.37	788	807.23	0.000265	7.95	0.25
435.78	0.5% (Confined)	200	287000	765.05	807.43	788.96	808.34	0.000275	8.27	0.26
435.78	0.2% (Confined)	500	324000	765.05	808.82	790.27	809.81	0.000288	8.71	0.26

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
436.43	50%	2	109000	764.81	797.83	782.36	798.19	0.000163	4.87	0.18
436.43	20%	5	147000	764.81	801.03	784.01	801.47	0.000178	5.48	0.2
436.43	10%	10	174000	764.81	802.84	785.11	803.33	0.000185	5.84	0.2
436.43	5%	20	199000	764.81	804.39	786.05	804.91	0.000187	6.11	0.2
436.43	2%	50	233000	764.81	806.14	787.28	806.71	0.000196	6.51	0.21
436.43	1%	100	261000	764.81	807.44	788.26	808.05	0.000203	6.82	0.22
436.43	0.5% (Confined)	200	287000	764.81	808.54	789.11	809.19	0.00021	7.1	0.22
436.43	0.2% (Confined)	500	324000	764.81	810	790.32	810.7	0.00022	7.48	0.23
437.11	50%	2	109000	767.88	798.38	781.01	798.76	0.000152	5.12	0.18
437.11	20%	5	147000	767.88	801.73	783.04	802.05	0.000141	5.07	0.18
437.11	10%	10	174000	767.88	803.6	784.27	803.9	0.000129	5.03	0.17
437.11	5%	20	199000	767.88	805.19	785.4	805.46	0.000121	5	0.16
437.11	2%	50	233000	767.88	806.99	786.78	807.26	0.000115	5.06	0.16
437.11	1%	100	261000	767.88	808.34	787.92	808.61	0.000111	5.13	0.16
437.11	0.5% (Confined)	200	287000	767.88	809.48	788.96	809.76	0.000109	5.2	0.16
437.11	0.2% (Confined)	500	324000	767.88	810.99	790.34	811.28	0.000108	5.32	0.16
437.85	50%	2	109000	770.79	798.98	782.5	799.38	0.000164	5.14	0.19
437.85	20%	5	147000	770.79	802.24	784.28	802.67	0.000164	5.55	0.19
437.85	10%	10	174000	770.79	804.05	785.45	804.49	0.00016	5.72	0.19
437.85	5%	20	199000	770.79	805.6	786.5	806.04	0.000155	5.83	0.19
437.85	2%	50	233000	770.79	807.38	787.8	807.82	0.000153	6.01	0.19
437.85	1%	100	261000	770.79	808.71	788.89	809.16	0.000151	6.15	0.19
437.85	0.5% (Confined)	200	287000	770.79	809.84	789.83	810.3	0.000151	6.28	0.19
437.85	0.2% (Confined)	500	324000	770.79	811.34	791.11	811.82	0.000151	6.47	0.19
438.48	50%	2	109000	764.52	799.54	779.43	799.82	0.000101	4.31	0.15
438.48	20%	5	147000	764.52	802.77	781.23	803.15	0.00012	5.02	0.17
438.48	10%	10	174000	764.52	804.55	782.39	804.98	0.000133	5.45	0.18
438.48	5%	20	199000	764.52	806.07	783.44	806.54	0.00014	5.77	0.18
438.48	2%	50	233000	764.52	807.82	784.76	808.35	0.000149	6.19	0.19
438.48	1%	100	261000	764.52	809.14	785.81	809.71	0.000156	6.49	0.19
438.48	0.5% (Confined)	200	287000	764.52	810.26	786.71	810.87	0.000163	6.78	0.2
438.48	0.2% (Confined)	500	324000	764.52	811.75	788.02	812.41	0.000171	7.14	0.21
439.16	50%	2	109000	752.48	799.89	776.93	800.19	0.0001	4.36	0.15
439.16	20%	5	147000	752.48	803.19	778.91	803.59	0.000124	5.15	0.17
439.16	10%	10	174000	752.48	805	780.21	805.48	0.00014	5.66	0.18
439.16	5%	20	199000	752.48	806.54	781.37	807.09	0.000156	6.07	0.19
439.16	2%	50	233000	752.48	808.32	782.83	808.96	0.000173	6.62	0.2
439.16	1%	100	261000	752.48	809.64	784	810.36	0.000186	7.04	0.21
439.16	0.5% (Confined)	200	287000	752.48	810.77	785	811.56	0.000197	7.42	0.22
439.16	0.2% (Confined)	500	324000	752.48	812.27	786.44	813.16	0.000213	7.93	0.23
439.93	50%	2	109000	772.31	800.33	786.42	800.91	0.000284	6.25	0.24
439.93	20%	5	147000	772.31	803.76	788.51	804.37	0.000267	6.62	0.24
439.93	10%	10	174000	772.31	805.67	789.9	806.28	0.00026	6.83	0.24
439.93	5%	20	199000	772.31	807.29	791.02	807.9	0.00025	6.96	0.24
439.93	2%	50	233000	772.31	809.17	792.65	809.79	0.000243	7.16	0.24
439.93	1%	100	261000	772.31	810.6	793.86	811.22	0.000237	7.3	0.23
439.93	0.5% (Confined)	200	287000	772.31	811.82	794.95	812.45	0.000234	7.44	0.23
439.93	0.2% (Confined)	500	324000	772.31	813.44	797.2	814.08	0.00023	7.63	0.23
440.82	50%	2	109000	768.93	801.96	784.09	802.36	0.000152	5.1	0.18
440.82	20%	5	147000	768.93	805.33	786.08	805.86	0.000176	5.91	0.2
440.82	10%	10	174000	768.93	807.19	787.31	807.8	0.000192	6.43	0.21
440.82	5%	20	199000	768.93	808.77	788.41	809.46	0.000203	6.85	0.22
440.82	2%	50	233000	768.93	810.62	789.79	811.4	0.00022	7.42	0.23
440.82	1%	100	261000	768.93	812.01	790.9	812.88	0.000233	7.84	0.24
440.82	0.5% (Confined)	200	287000	768.93	813.21	791.91	814.14	0.000244	8.21	0.24
440.82	0.2% (Confined)	500	324000	768.93	814.79	793.25	815.83	0.000259	8.72	0.25

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
441.39	50%	2	109000	766.92	802.44	787.1	802.88	0.000195	5.4	0.2
441.39	20%	5	147000	766.92	805.92	788.99	806.43	0.000208	5.92	0.21
441.39	10%	10	174000	766.92	807.85	790.18	808.39	0.000208	6.23	0.21
441.39	5%	20	199000	766.92	809.49	791.19	810.06	0.000207	6.48	0.22
441.39	2%	50	233000	766.92	811.42	792.59	812.04	0.000211	6.84	0.22
441.39	1%	100	261000	766.92	812.88	793.62	813.53	0.000214	7.11	0.22
441.39	0.5% (Confined)	200	287000	766.92	814.14	794.61	814.82	0.000217	7.34	0.23
441.39	0.2% (Confined)	500	324000	766.92	815.81	795.9	816.54	0.000221	7.67	0.23
441.88	50%	2	109000	770.62	802.97	788.88	803.4	0.000201	5.28	0.2
441.88	20%	5	147000	770.62	806.47	790.59	806.94	0.000195	5.72	0.21
441.88	10%	10	174000	770.62	808.4	791.71	808.9	0.000194	6	0.21
441.88	5%	20	199000	770.62	810.04	792.67	810.56	0.000193	6.24	0.21
441.88	2%	50	233000	770.62	811.98	793.93	812.54	0.000195	6.56	0.21
441.88	1%	100	261000	770.62	813.45	794.93	814.04	0.000197	6.82	0.22
441.88	0.5% (Confined)	200	287000	770.62	814.71	795.84	815.33	0.0002	7.05	0.22
441.88	0.2% (Confined)	500	324000	770.62	816.39	797.05	817.05	0.000204	7.36	0.22
442.51	50%	2	109000	774.45	803.63	787.81	804.03	0.000182	5.14	0.2
442.51	20%	5	147000	774.45	807.11	789.64	807.6	0.000204	5.77	0.21
442.51	10%	10	174000	774.45	809.02	790.85	809.57	0.000212	6.19	0.22
442.51	5%	20	199000	774.45	810.63	791.88	811.25	0.000218	6.55	0.22
442.51	2%	50	233000	774.45	812.56	793.24	813.26	0.00023	7.03	0.23
442.51	1%	100	261000	774.45	814.02	794.31	814.78	0.000239	7.41	0.24
442.51	0.5% (Confined)	200	287000	774.45	815.27	795.25	816.1	0.000247	7.74	0.24
442.51	0.2% (Confined)	500	324000	774.45	816.94	796.55	817.85	0.000258	8.2	0.25
442.97	50%	2	109000	770.48	803.99	786.19	804.43	0.000144	5.32	0.19
442.97	20%	5	147000	770.48	807.5	788.54	808.05	0.000157	6.04	0.21
442.97	10%	10	174000	770.48	809.42	789.96	810.04	0.000166	6.52	0.22
442.97	5%	20	199000	770.48	811.05	791.23	811.74	0.000173	6.91	0.22
442.97	2%	50	233000	770.48	813	793.07	813.78	0.000184	7.42	0.23
442.97	1%	100	261000	770.48	814.47	794.27	815.32	0.000192	7.82	0.24
442.97	0.5% (Confined)	200	287000	770.48	815.74	795.25	816.65	0.000199	8.17	0.25
442.97	0.2% (Confined)	500	324000	770.48	817.43	796.6	818.43	0.000209	8.64	0.25
443.46	50%	2	109000	772.82	804.37	787.17	804.82	0.000152	5.41	0.2
443.46	20%	5	147000	772.82	807.91	789.46	808.47	0.000166	6.14	0.21
443.46	10%	10	174000	772.82	809.85	790.87	810.5	0.000176	6.62	0.22
443.46	5%	20	199000	772.82	811.5	792.16	812.21	0.000183	7.03	0.23
443.46	2%	50	233000	772.82	813.47	793.97	814.28	0.000195	7.57	0.24
443.46	1%	100	261000	772.82	814.96	795.08	815.85	0.000204	7.98	0.25
443.46	0.5% (Confined)	200	287000	772.82	816.24	796.08	817.2	0.000212	8.35	0.25
443.46	0.2% (Confined)	500	324000	772.82	817.95	797.44	819.02	0.000223	8.84	0.26
443.95	50%	2	109000	777.34	804.79	791.54	805.28	0.000199	5.69	0.22
443.95	20%	5	147000	777.34	808.36	793.37	808.94	0.000196	6.28	0.23
443.95	10%	10	174000	777.34	810.34	794.52	810.98	0.000201	6.71	0.23
443.95	5%	20	199000	777.34	812.01	795.54	812.71	0.000206	7.07	0.24
443.95	2%	50	233000	777.34	814.02	796.87	814.8	0.000213	7.56	0.25
443.95	1%	100	261000	777.34	815.53	797.92	816.39	0.00022	7.93	0.25
443.95	0.5% (Confined)	200	287000	777.34	816.85	798.86	817.77	0.000226	8.27	0.26
443.95	0.2% (Confined)	500	324000	777.34	818.59	800.12	819.6	0.000234	8.73	0.27
444.35	50%	2	109000	770.31	805.18	789.01	805.66	0.000171	5.65	0.21
444.35	20%	5	147000	770.31	808.74	791.84	809.34	0.00018	6.36	0.22
444.35	10%	10	174000	770.31	810.72	793.06	811.39	0.000189	6.84	0.23
444.35	5%	20	199000	770.31	812.39	794.17	813.14	0.000196	7.25	0.24
444.35	2%	50	233000	770.31	814.41	795.56	815.25	0.000207	7.78	0.24
444.35	1%	100	261000	770.31	815.93	796.69	816.86	0.000215	8.18	0.25
444.35	0.5% (Confined)	200	287000	770.31	817.26	797.67	818.25	0.000222	8.54	0.26
444.35	0.2% (Confined)	500	324000	770.31	819.01	799.04	820.1	0.000232	9.03	0.27

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
444.86	50%	2	109000	770.16	805.75	786.54	806.05	0.00011	4.42	0.16
444.86	20%	5	147000	770.16	809.36	788.35	809.75	0.000122	5.07	0.17
444.86	10%	10	174000	770.16	811.39	789.51	811.83	0.000131	5.5	0.17
444.86	5%	20	199000	770.16	813.1	790.54	813.59	0.000138	5.86	0.18
444.86	2%	50	233000	770.16	815.17	791.89	815.74	0.000148	6.33	0.19
444.86	1%	100	261000	770.16	816.74	792.91	817.36	0.000156	6.68	0.2
444.86	0.5% (Confined)	200	287000	770.16	818.1	793.87	818.77	0.000163	7	0.2
444.86	0.2% (Confined)	500	324000	770.16	819.9	795.15	820.65	0.000172	7.43	0.21
445.33	50%	2	109000	775.29	805.98	789.41	806.37	0.00013	5.06	0.19
445.33	20%	5	147000	775.29	809.61	791.38	810.1	0.00014	5.73	0.2
445.33	10%	10	174000	775.29	811.65	792.56	812.21	0.000149	6.18	0.2
445.33	5%	20	199000	775.29	813.37	793.57	813.99	0.000155	6.56	0.21
445.33	2%	50	233000	775.29	815.45	794.92	816.16	0.000164	7.05	0.22
445.33	1%	100	261000	775.29	817.03	795.99	817.8	0.000171	7.43	0.23
445.33	0.5% (Confined)	200	287000	775.29	818.39	796.91	819.23	0.000177	7.77	0.23
445.33	0.2% (Confined)	500	324000	775.29	820.21	798.2	821.14	0.000185	8.22	0.24
445.86	50%	2	109000	776.53	806.31	791.26	806.84	0.000182	5.83	0.22
445.86	20%	5	147000	776.53	809.96	793.21	810.61	0.000194	6.59	0.23
445.86	10%	10	174000	776.53	812	794.48	812.75	0.000205	7.08	0.24
445.86	5%	20	199000	776.53	813.73	795.59	814.55	0.000213	7.5	0.25
445.86	2%	50	233000	776.53	815.83	796.99	816.75	0.000222	8.02	0.25
445.86	1%	100	261000	776.53	817.41	798.14	818.41	0.000229	8.42	0.26
445.86	0.5% (Confined)	200	287000	776.53	818.79	799.15	819.86	0.000235	8.78	0.27
445.86	0.2% (Confined)	500	324000	776.53	820.62	800.49	821.79	0.000244	9.26	0.27
446.32	50%	2	109000	776.46	806.75	791.59	807.32	0.000207	6.1	0.23
446.32	20%	5	147000	776.46	810.43	794.19	811.11	0.000215	6.78	0.24
446.32	10%	10	174000	776.46	812.51	795.58	813.26	0.000222	7.22	0.25
446.32	5%	20	199000	776.46	814.26	796.72	815.08	0.000228	7.6	0.25
446.32	2%	50	233000	776.46	816.4	798.15	817.3	0.000239	8.07	0.26
446.32	1%	100	261000	776.46	818.01	799.32	818.98	0.000244	8.44	0.27
446.32	0.5% (Confined)	200	287000	776.46	819.41	800.34	820.44	0.000249	8.77	0.27
446.32	0.2% (Confined)	500	324000	776.46	821.27	801.75	822.39	0.000254	9.2	0.28
446.81	50%	2	109000	773.96	807.33	789.5	807.77	0.00014	5.36	0.19
446.81	20%	5	147000	773.96	811.03	791.61	811.6	0.000161	6.11	0.21
446.81	10%	10	174000	773.96	813.12	792.95	813.77	0.000171	6.59	0.22
446.81	5%	20	199000	773.96	814.88	794.11	815.6	0.000178	7	0.23
446.81	2%	50	233000	773.96	817.02	795.62	817.84	0.000188	7.52	0.23
446.81	1%	100	261000	773.96	818.64	796.82	819.54	0.000195	7.92	0.24
446.81	0.5% (Confined)	200	287000	773.96	820.05	797.86	821.01	0.000201	8.27	0.25
446.81	0.2% (Confined)	500	324000	773.96	821.92	799.3	822.98	0.000209	8.73	0.25
447.15	50%	2	109000	772.65	807.55	790.74	808.05	0.00016	5.71	0.21
447.15	20%	5	147000	772.65	811.27	792.79	811.92	0.000177	6.54	0.22
447.15	10%	10	174000	772.65	813.36	794.12	814.12	0.000188	7.08	0.23
447.15	5%	20	199000	772.65	815.13	795.33	815.97	0.000197	7.52	0.24
447.15	2%	50	233000	772.65	817.28	796.86	818.23	0.000208	8.09	0.25
447.15	1%	100	261000	772.65	818.9	798.05	819.94	0.000217	8.53	0.26
447.15	0.5% (Confined)	200	287000	772.65	820.3	799.1	821.43	0.000225	8.92	0.26
447.15	0.2% (Confined)	500	324000	772.65	822.17	800.57	823.42	0.000235	9.43	0.27
447.49	50%	2	109000	776.69	807.91	790	808.33	0.000133	5.21	0.19
447.49	20%	5	147000	776.69	811.68	791.99	812.23	0.000149	6	0.2
447.49	10%	10	174000	776.69	813.8	793.28	814.45	0.00016	6.52	0.21
447.49	5%	20	199000	776.69	815.58	794.38	816.31	0.000167	6.95	0.22
447.49	2%	50	233000	776.69	817.77	795.87	818.59	0.000176	7.47	0.23
447.49	1%	100	261000	776.69	819.43	797.03	820.32	0.000182	7.83	0.23
447.49	0.5% (Confined)	200	287000	776.69	820.88	798.03	821.83	0.000186	8.14	0.24
447.49	0.2% (Confined)	500	324000	776.69	822.81	799.46	823.83	0.00019	8.53	0.24

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
447.83	50%	2	109000	773	808.24	783.47	808.51	0.00006	4.2	0.13
447.83	20%	5	147000	773	812.06	785.47	812.44	0.000072	4.98	0.15
447.83	10%	10	174000	773	814.22	786.78	814.68	0.000082	5.5	0.16
447.83	5%	20	199000	773	816.03	787.92	816.56	0.00009	5.94	0.17
447.83	2%	50	233000	773	818.23	789.39	818.86	0.0001	6.52	0.18
447.83	1%	100	261000	773	819.89	790.56	820.6	0.000108	6.96	0.19
447.83	0.5% (Confined)	200	287000	773	821.33	791.62	822.12	0.000115	7.34	0.19
447.83	0.2% (Confined)	500	324000	773	823.25	793.03	824.13	0.000124	7.83	0.2
447.84	50%	2	109000	773	808.22	783.87	808.52	0.000079	4.38	0.14
447.84	20%	5	147000	773	812.05	785.95	812.46	0.000097	5.19	0.15
447.84	10%	10	174000	773	814.2	787.31	814.7	0.00011	5.73	0.17
447.84	5%	20	199000	773	816.01	788.49	816.58	0.000122	6.19	0.18
447.84	2%	50	233000	773	818.21	790.04	818.89	0.000138	6.78	0.19
447.84	1%	100	261000	773	819.86	791.21	820.63	0.00015	7.23	0.19
447.84	0.5% (Confined)	200	287000	773	821.3	792.3	822.14	0.000161	7.62	0.2
447.84	0.2% (Confined)	500	324000	773	823.21	793.77	824.17	0.000175	8.14	0.21
447.85	50%	2	109000	773	808.26	783.47	808.53	0.00006	4.2	0.13
447.85	20%	5	147000	773	812.09	785.47	812.47	0.000072	4.97	0.15
447.85	10%	10	174000	773	814.25	786.78	814.71	0.000081	5.49	0.16
447.85	5%	20	199000	773	816.06	787.92	816.59	0.000089	5.94	0.17
447.85	2%	50	233000	773	818.27	789.39	818.9	0.0001	6.51	0.18
447.85	1%	100	261000	773	819.93	790.56	820.64	0.000108	6.95	0.19
447.85	0.5% (Confined)	200	287000	773	821.38	791.62	822.16	0.000115	7.33	0.19
447.85	0.2% (Confined)	500	324000	773	823.3	793.03	824.18	0.000124	7.82	0.2
447.86	50%	2	109000	771.61	808.25	787.96	808.54	0.00008	4.32	0.15
447.86	20%	5	147000	771.61	812.08	789.73	812.48	0.000094	5.05	0.16
447.86	10%	10	174000	771.61	814.25	790.89	814.72	0.000103	5.54	0.17
447.86	5%	20	199000	771.61	816.06	791.9	816.6	0.00011	5.96	0.18
447.86	2%	50	233000	771.61	818.27	793.22	818.91	0.00012	6.49	0.19
447.86	1%	100	261000	771.61	819.93	794.23	820.65	0.000128	6.91	0.2
447.86	0.5% (Confined)	200	287000	771.61	821.38	795.16	822.17	0.000135	7.27	0.21
447.86	0.2% (Confined)	500	324000	771.61	823.31	796.44	824.19	0.000143	7.73	0.21
448.15	50%	2	109000	773.29	808.27	789.42	808.78	0.000151	5.71	0.2
448.15	20%	5	147000	773.29	812.09	791.73	812.76	0.000173	6.62	0.22
448.15	10%	10	174000	773.29	814.24	793.21	815.04	0.000187	7.22	0.23
448.15	5%	20	199000	773.29	816.04	794.51	816.95	0.000199	7.74	0.24
448.15	2%	50	233000	773.29	818.22	796.2	819.29	0.000215	8.41	0.25
448.15	1%	100	261000	773.29	819.87	797.51	821.07	0.000228	8.93	0.26
448.15	0.5% (Confined)	200	287000	773.29	821.3	798.65	822.61	0.000239	9.4	0.27
448.15	0.2% (Confined)	500	324000	773.29	823.19	800.27	824.68	0.000255	10.02	0.28
448.16			Bridge							
448.17	50%	2	109000	773.29	808.33	789.42	808.83	0.00015	5.69	0.2
448.17	20%	5	147000	773.29	812.16	791.73	812.83	0.000171	6.6	0.22
448.17	10%	10	174000	773.29	814.32	793.21	815.12	0.000185	7.2	0.23
448.17	5%	20	199000	773.29	816.13	794.51	817.04	0.000197	7.72	0.24
448.17	2%	50	233000	773.29	818.33	796.2	819.39	0.000213	8.38	0.25
448.17	1%	100	261000	773.29	820.02	797.51	821.2	0.000224	8.89	0.26
448.17	0.5% (Confined)	200	287000	773.29	821.49	798.65	822.79	0.000235	9.34	0.27
448.17	0.2% (Confined)	500	324000	773.29	823.47	800.27	824.93	0.000248	9.94	0.28
448.2	50%	2	109000	773.29	808.35	789.41	808.85	0.000149	5.69	0.2
448.2	20%	5	147000	773.29	812.19	791.73	812.86	0.00018	6.58	0.22
448.2	10%	10	174000	773.29	814.36	793.21	815.15	0.000193	7.16	0.23
448.2	5%	20	199000	773.29	816.18	794.5	817.07	0.000204	7.66	0.24
448.2	2%	50	233000	773.29	818.39	796.2	819.43	0.000218	8.3	0.25
448.2	1%	100	261000	773.29	820.08	797.51	821.24	0.000229	8.79	0.26
448.2	0.5% (Confined)	200	287000	773.29	821.56	798.67	822.84	0.000239	9.23	0.27

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
448.2	0.2% (Confined)	500	324000	773.29	823.55	800.27	824.98	0.000251	9.81	0.28
448.49	50%	2	109000	775.4	808.76	791.55	809.09	0.000106	4.59	0.17
448.49	20%	5	147000	775.4	812.71	793.19	813.14	0.000116	5.27	0.18
448.49	10%	10	174000	775.4	814.95	794.29	815.45	0.000124	5.73	0.19
448.49	5%	20	199000	775.4	816.82	795.24	817.39	0.000131	6.12	0.19
448.49	2%	50	233000	775.4	819.11	796.49	819.78	0.00014	6.63	0.2
448.49	1%	100	259000	775.4	820.88	797.4	821.61	0.000144	6.96	0.21
448.49	0.5% (Confined)	200	287000	775.4	822.41	798.33	823.22	0.000152	7.35	0.21
448.49	0.2% (Confined)	500	324000	775.4	824.49	799.52	825.39	0.000158	7.79	0.22
448.89	50%	2	109000	774.34	808.92	791.81	809.42	0.000159	5.69	0.2
448.89	20%	5	147000	774.34	812.86	793.96	813.49	0.00017	6.45	0.22
448.89	10%	10	174000	774.34	815.11	795.59	815.83	0.000179	6.95	0.23
448.89	5%	20	199000	774.34	816.99	796.74	817.79	0.000187	7.39	0.23
448.89	2%	50	233000	774.34	819.28	798.22	820.2	0.000199	7.95	0.24
448.89	1%	100	259000	774.34	821.06	799.33	822.05	0.000209	8.3	0.25
448.89	0.5% (Confined)	200	287000	774.34	822.6	800.46	823.68	0.000219	8.71	0.26
448.89	0.2% (Confined)	500	324000	774.34	824.68	801.88	825.87	0.000225	9.17	0.26
449.44	50%	2	109000	782.5	809.4	794.8	809.98	0.000224	6.12	0.24
449.44	20%	5	147000	782.5	813.38	796.95	814.06	0.000218	6.7	0.24
449.44	10%	10	174000	782.5	815.66	798.36	816.4	0.000217	7.08	0.24
449.44	5%	20	199000	782.5	817.58	799.57	818.37	0.000216	7.4	0.25
449.44	2%	50	233000	782.5	819.94	801.13	820.8	0.000218	7.81	0.25
449.44	1%	100	259000	782.5	821.76	802.25	822.66	0.000216	8.06	0.25
449.44	0.5% (Confined)	200	287000	782.5	823.35	803.4	824.32	0.000219	8.39	0.26
449.44	0.2% (Confined)	500	324000	782.5	825.47	804.86	826.51	0.00022	8.76	0.26
449.99	50%	2	109000	779.32	810.08	793.39	810.52	0.000146	5.33	0.2
449.99	20%	5	147000	779.32	814.06	795.6	814.61	0.000153	6.01	0.2
449.99	10%	10	174000	779.32	816.34	797	816.95	0.000158	6.43	0.21
449.99	5%	20	199000	779.32	818.27	798.09	818.93	0.000161	6.76	0.21
449.99	2%	50	233000	779.32	820.64	799.47	821.37	0.000164	7.18	0.22
449.99	1%	100	259000	779.32	822.45	800.47	823.23	0.000165	7.45	0.22
449.99	0.5% (Confined)	200	287000	779.32	824.06	801.51	824.9	0.000169	7.78	0.23
449.99	0.2% (Confined)	500	324000	779.32	826.2	802.84	827.1	0.000173	8.16	0.23
450.52	50%	2	109000	779.55	810.5	795.49	810.97	0.00017	5.49	0.21
450.52	20%	5	147000	779.55	814.49	797.31	815.08	0.000177	6.18	0.22
450.52	10%	10	174000	779.55	816.77	798.54	817.45	0.000184	6.63	0.23
450.52	5%	20	199000	779.55	818.71	799.61	819.43	0.000187	6.95	0.23
450.52	2%	50	233000	779.55	821.11	800.98	821.87	0.000189	7.25	0.23
450.52	1%	100	259000	779.55	822.94	801.96	823.71	0.00018	7.36	0.23
450.52	0.5% (Confined)	200	287000	779.55	824.6	803	825.39	0.000177	7.55	0.23
450.52	0.2% (Confined)	500	324000	779.55	826.79	804.3	827.59	0.000169	7.7	0.23
451.09	50%	2	109000	776.43	811	794.06	811.43	0.000139	5.3	0.19
451.09	20%	5	147000	776.43	815	795.94	815.57	0.000152	6.07	0.2
451.09	10%	10	174000	776.43	817.33	797.17	817.96	0.000157	6.46	0.21
451.09	5%	20	199000	776.43	819.3	798.24	819.95	0.000155	6.67	0.21
451.09	2%	50	233000	776.43	821.72	799.65	822.38	0.000149	6.86	0.21
451.09	1%	100	259000	776.43	823.54	800.65	824.19	0.000142	6.95	0.21
451.09	0.5% (Confined)	200	287000	776.43	825.2	801.74	825.86	0.000139	7.1	0.21
451.09	0.2% (Confined)	500	324000	776.43	827.38	803.1	828.04	0.000134	7.24	0.2
451.41	50%	2	109000	777.14	811.21	795.7	811.7	0.000165	5.61	0.21
451.41	20%	5	147000	777.14	815.25	797.55	815.86	0.000174	6.33	0.22
451.41	10%	10	174000	777.14	817.58	798.78	818.25	0.000176	6.71	0.22
451.41	5%	20	199000	777.14	819.54	799.83	820.24	0.000174	6.96	0.22
451.41	2%	50	233000	777.14	821.93	801.22	822.67	0.000171	7.26	0.22
451.41	1%	100	259000	777.14	823.73	802.25	824.48	0.000167	7.44	0.22
451.41	0.5% (Confined)	200	287000	777.14	825.37	803.32	826.15	0.000166	7.66	0.22
451.41	0.2% (Confined)	500	324000	777.14	827.52	804.65	828.33	0.000163	7.89	0.22

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
451.88	50%	2	109000	784.26	811.62	797.61	812.2	0.000216	6.13	0.24
451.88	20%	5	147000	784.26	815.7	799.58	816.34	0.000205	6.58	0.24
451.88	10%	10	174000	784.26	818.06	800.84	818.72	0.000197	6.8	0.23
451.88	5%	20	199000	784.26	820.02	801.96	820.7	0.00019	6.98	0.23
451.88	2%	50	233000	784.26	822.43	803.4	823.11	0.000178	7.15	0.23
451.88	1%	100	259000	784.26	824.24	804.43	824.91	0.000167	7.18	0.22
451.88	0.5% (Confined)	200	287000	784.26	825.9	805.51	826.57	0.00016	7.27	0.22
451.88	0.2% (Confined)	500	324000	784.26	828.07	806.89	828.73	0.00015	7.33	0.21
452.31	50%	2	109000	778.18	812.18	795.08	812.64	0.000166	5.45	0.21
452.31	20%	5	147000	778.18	816.19	797.06	816.77	0.000175	6.16	0.22
452.31	10%	10	174000	778.18	818.5	798.35	819.14	0.000179	6.52	0.22
452.31	5%	20	199000	778.18	820.45	799.43	821.11	0.000174	6.69	0.22
452.31	2%	50	233000	778.18	822.85	800.94	823.5	0.000167	6.84	0.22
452.31	1%	100	259000	778.18	824.62	801.97	825.27	0.000158	6.91	0.21
452.31	0.5% (Confined)	200	287000	778.18	826.26	803.09	826.92	0.000153	7.04	0.21
452.31	0.2% (Confined)	500	324000	778.18	828.4	804.47	829.06	0.000146	7.14	0.21
452.8	50%	2	109000	775.07	812.62	792.7	812.99	0.000104	4.84	0.17
452.8	20%	5	147000	775.07	816.68	794.66	817.15	0.000115	5.55	0.18
452.8	10%	10	174000	775.07	819.02	795.97	819.53	0.000116	5.84	0.18
452.8	5%	20	199000	775.07	820.97	797.11	821.48	0.000115	6.03	0.18
452.8	2%	50	233000	775.07	823.33	798.52	823.87	0.000114	6.26	0.18
452.8	1%	100	259000	775.07	825.08	799.63	825.62	0.000112	6.38	0.18
452.8	0.5% (Confined)	200	287000	775.07	826.71	800.74	827.26	0.000112	6.53	0.19
452.8	0.2% (Confined)	500	324000	775.07	828.83	802.12	829.39	0.00011	6.68	0.19
453.44	50%	2	109000	780.74	812.99	796.38	813.39	0.000134	5.1	0.19
453.44	20%	5	147000	780.74	817.08	798.22	817.59	0.000142	5.76	0.2
453.44	10%	10	174000	780.74	819.43	799.41	819.97	0.000142	6.04	0.2
453.44	5%	20	199000	780.74	821.36	800.46	821.92	0.000139	6.24	0.2
453.44	2%	50	233000	780.74	823.71	801.8	824.29	0.000136	6.47	0.2
453.44	1%	100	259000	780.74	825.45	802.8	826.04	0.000132	6.6	0.2
453.44	0.5% (Confined)	200	287000	780.74	827.07	803.83	827.68	0.000131	6.78	0.2
453.44	0.2% (Confined)	500	324000	780.74	829.18	805.14	829.81	0.000128	6.97	0.2
454.64	50%	2	109000	786.19	813.85	797.51	814.22	0.000125	4.86	0.18
454.64	20%	5	147000	786.19	817.99	799.25	818.44	0.000128	5.45	0.19
454.64	10%	10	174000	786.19	820.33	800.39	820.82	0.000128	5.72	0.19
454.64	5%	20	199000	786.19	822.24	801.37	822.74	0.000125	5.9	0.19
454.64	2%	50	233000	786.19	824.57	802.66	825.09	0.000122	6.12	0.19
454.64	1%	100	259000	786.19	826.28	803.6	826.81	0.000118	6.24	0.19
454.64	0.5% (Confined)	200	287000	786.19	827.9	804.56	828.44	0.000117	6.4	0.19
454.64	0.2% (Confined)	500	324000	786.19	829.98	805.76	830.54	0.000114	6.57	0.19
455.05	50%	2	109000	769.11	814.13	800.55	814.56	0.000179	5.27	0.21
455.05	20%	5	147000	769.11	818.27	802.25	818.78	0.000172	5.77	0.21
455.05	10%	10	174000	769.11	820.6	803.33	821.16	0.000168	6.06	0.21
455.05	5%	20	199000	769.11	822.51	804.3	823.08	0.000164	6.25	0.21
455.05	2%	50	233000	769.11	824.82	805.52	825.41	0.000158	6.48	0.21
455.05	1%	100	259000	769.11	826.52	806.44	827.12	0.000151	6.57	0.21
455.05	0.5% (Confined)	200	287000	769.11	828.14	807.38	828.74	0.000147	6.71	0.21
455.05	0.2% (Confined)	500	324000	769.11	830.22	808.56	830.83	0.000141	6.84	0.2
455.65	50%	2	109000	784.46	814.68	801.15	815.13	0.00018	5.42	0.21
455.65	20%	5	147000	784.46	818.8	802.88	819.33	0.000174	5.92	0.22
455.65	10%	10	174000	784.46	821.13	803.98	821.68	0.000167	6.17	0.21
455.65	5%	20	199000	784.46	823.01	804.97	823.59	0.000162	6.35	0.21
455.65	2%	50	233000	784.46	825.31	806.23	825.9	0.000156	6.59	0.21
455.65	1%	100	259000	784.46	826.99	807.13	827.59	0.000152	6.73	0.21
455.65	0.5% (Confined)	200	287000	784.46	828.58	808.1	829.21	0.00015	6.91	0.21
455.65	0.2% (Confined)	500	324000	784.46	830.64	809.32	831.29	0.000146	7.11	0.21

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
456.24	50%	2	109000	781.09	815.23	799.36	815.66	0.000153	5.22	0.2
456.24	20%	5	147000	781.09	819.34	801.38	819.84	0.000152	5.77	0.2
456.24	10%	10	174000	781.09	821.65	802.59	822.19	0.000155	6.06	0.21
456.24	5%	20	199000	781.09	823.52	803.62	824.07	0.00015	6.23	0.21
456.24	2%	50	233000	781.09	825.81	805	826.37	0.000144	6.43	0.2
456.24	1%	100	259000	781.09	827.48	805.96	828.05	0.000139	6.54	0.2
456.24	0.5% (Confined)	200	287000	781.09	829.07	806.99	829.66	0.000137	6.7	0.2
456.24	0.2% (Confined)	500	324000	781.09	831.13	808.3	831.73	0.000133	6.86	0.2
456.84	50%	2	109000	780.28	815.72	796.31	816.07	0.000111	4.73	0.17
456.84	20%	5	147000	780.28	819.82	798.45	820.27	0.000118	5.38	0.18
456.84	10%	10	174000	780.28	822.18	799.88	822.66	0.000118	5.67	0.18
456.84	5%	20	199000	780.28	824.14	800.99	824.64	0.000115	5.85	0.18
456.84	2%	50	233000	780.28	826.55	802.44	827.05	0.000111	6.03	0.18
456.84	1%	100	259000	780.28	828.3	803.51	828.81	0.000107	6.14	0.18
456.84	0.5% (Confined)	200	287000	780.28	829.98	804.63	830.5	0.000105	6.28	0.18
456.84	0.2% (Confined)	500	324000	780.28	832.13	805.98	832.65	0.000103	6.42	0.18
457.25	50%	2	109000	783.2	815.88	800.5	816.46	0.000206	6.1	0.23
457.25	20%	5	147000	783.2	820	802.8	820.67	0.000203	6.7	0.24
457.25	10%	10	174000	783.2	822.34	804.3	823.07	0.000203	7.06	0.24
457.25	5%	20	199000	783.2	824.28	805.56	825.04	0.0002	7.32	0.24
457.25	2%	50	233000	783.2	826.68	807.09	827.46	0.000194	7.6	0.24
457.25	1%	100	259000	783.2	828.43	808.22	829.22	0.000186	7.72	0.24
457.25	0.5% (Confined)	200	287000	783.2	830.11	809.38	830.91	0.000182	7.88	0.23
457.25	0.2% (Confined)	500	324000	783.2	832.26	810.85	833.07	0.000176	8.06	0.23
457.7	50%	2	109000	770.55	816.36	800.07	816.91	0.00018	5.99	0.22
457.7	20%	5	147000	770.55	820.45	802.13	821.14	0.000194	6.75	0.23
457.7	10%	10	174000	770.55	822.8	803.48	823.54	0.000193	7.09	0.23
457.7	5%	20	199000	770.55	824.74	804.67	825.5	0.000188	7.31	0.23
457.7	2%	50	233000	770.55	827.14	806.18	827.9	0.00018	7.52	0.23
457.7	1%	100	259000	770.55	828.88	807.31	829.63	0.000174	7.63	0.23
457.7	0.5% (Confined)	200	287000	770.55	830.55	808.47	831.31	0.000169	7.77	0.22
457.7	0.2% (Confined)	500	324000	770.55	832.7	809.93	833.46	0.000163	7.92	0.22
458.19	50%	2	109000	782.85	816.88	804.3	817.45	0.000236	6.09	0.24
458.19	20%	5	147000	782.85	821.02	806.28	821.68	0.000223	6.63	0.24
458.19	10%	10	174000	782.85	823.41	807.45	824.06	0.000205	6.73	0.24
458.19	5%	20	199000	782.85	825.37	808.47	825.99	0.000187	6.74	0.23
458.19	2%	50	233000	782.85	827.78	809.77	828.36	0.000166	6.73	0.22
458.19	1%	100	259000	782.85	829.51	810.76	830.06	0.000154	6.72	0.21
458.19	0.5% (Confined)	200	287000	782.85	831.18	811.76	831.73	0.000145	6.76	0.21
458.19	0.2% (Confined)	500	324000	782.85	833.32	813.03	833.85	0.000135	6.79	0.2
458.73	50%	2	109000	788.99	817.51	803.3	818.08	0.000202	6.04	0.23
458.73	20%	5	147000	788.99	821.61	805.16	822.29	0.000202	6.68	0.23
458.73	10%	10	174000	788.99	823.94	806.39	824.64	0.000197	6.94	0.23
458.73	5%	20	199000	788.99	825.84	807.47	826.54	0.000187	7.07	0.23
458.73	2%	50	233000	788.99	828.18	808.86	828.86	0.000176	7.21	0.23
458.73	1%	100	259000	788.99	829.87	809.88	830.55	0.000168	7.29	0.22
458.73	0.5% (Confined)	200	287000	788.99	831.51	810.94	832.19	0.000163	7.41	0.22
458.73	0.2% (Confined)	500	324000	788.99	833.6	812.29	834.29	0.000156	7.53	0.22
459.43	50%	2	109000	789.08	818.35	805.55	818.85	0.000215	5.67	0.23
459.43	20%	5	147000	789.08	822.51	807.3	823.01	0.000184	5.86	0.22
459.43	10%	10	174000	789.08	824.86	808.45	825.32	0.000169	5.79	0.21
459.43	5%	20	199000	789.08	826.74	809.48	827.17	0.000155	5.71	0.2
459.43	2%	50	233000	789.08	829.03	810.76	829.43	0.000135	5.67	0.19
459.43	1%	100	259000	789.08	830.69	811.71	831.08	0.000124	5.65	0.19
459.43	0.5% (Confined)	200	287000	789.08	832.31	812.71	832.69	0.000116	5.68	0.18
459.43	0.2% (Confined)	500	324000	789.08	834.38	813.94	834.76	0.000107	5.71	0.18

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
460	50%	2	109000	786.06	818.98	805.75	819.5	0.000209	5.77	0.23
460	20%	5	147000	786.06	823.03	807.79	823.59	0.000195	6.16	0.23
460	10%	10	174000	786.06	825.33	808.93	825.85	0.000189	6.13	0.22
460	5%	20	199000	786.06	827.16	809.92	827.64	0.000168	6.03	0.21
460	2%	50	233000	786.06	829.4	811.2	829.84	0.00015	5.93	0.2
460	1%	100	259000	786.06	831.03	812.1	831.43	0.000137	5.83	0.2
460	0.5% (Confined)	200	287000	786.06	832.63	813.05	833.02	0.000125	5.79	0.19
460	0.2% (Confined)	500	324000	786.06	834.68	814.36	835.05	0.000112	5.74	0.18
460.68	50%	2	109000	785.22	819.73	802.44	820.15	0.000144	5.21	0.19
460.68	20%	5	147000	785.22	823.75	804.4	824.22	0.000152	5.67	0.2
460.68	10%	10	174000	785.22	826.03	805.71	826.48	0.000161	5.65	0.21
460.68	5%	20	199000	785.22	827.76	806.85	828.19	0.000148	5.68	0.2
460.68	2%	50	233000	785.22	829.9	808.3	830.31	0.000134	5.71	0.19
460.68	1%	100	259000	785.22	831.47	809.38	831.86	0.000125	5.72	0.19
460.68	0.5% (Confined)	200	287000	785.22	833.02	810.47	833.41	0.000118	5.76	0.18
460.68	0.2% (Confined)	500	324000	785.22	835.02	811.89	835.41	0.00011	5.79	0.18
461.5	50%	2	109000	792.68	820.34	804.82	820.86	0.000172	5.77	0.21
461.5	20%	5	147000	792.68	824.33	806.73	825.01	0.000187	6.61	0.23
461.5	10%	10	174000	792.68	826.56	807.98	827.36	0.000201	7.18	0.24
461.5	5%	20	199000	792.68	828.19	809.06	829.09	0.000216	7.68	0.25
461.5	2%	50	233000	792.68	830.23	810.5	831.24	0.000236	8.21	0.26
461.5	1%	100	259000	792.68	831.71	811.56	832.79	0.000241	8.56	0.26
461.5	0.5% (Confined)	200	287000	792.68	833.19	812.65	834.34	0.000245	8.9	0.27
461.5	0.2% (Confined)	500	324000	792.68	835.11	814.03	836.33	0.000248	9.28	0.27
462.41	50%	2	109000	779.67	821.17	804.35	821.61	0.000142	5.34	0.19
462.41	20%	5	147000	779.67	825.26	806.23	825.83	0.000152	6.07	0.2
462.41	10%	10	174000	779.67	827.61	807.48	828.25	0.000169	6.51	0.22
462.41	5%	20	199000	779.67	829.41	808.56	830.11	0.000204	6.85	0.24
462.41	2%	50	233000	779.67	831.55	809.97	832.33	0.000212	7.27	0.24
462.41	1%	100	259000	779.67	833.06	811	833.89	0.000213	7.55	0.25
462.41	0.5% (Confined)	200	287000	779.67	834.57	812.04	835.45	0.000215	7.85	0.25
462.41	0.2% (Confined)	500	324000	779.67	836.51	813.4	837.46	0.000217	8.2	0.25
462.66	50%	2	109000	787.54	821.4	802.18	821.8	0.000125	5.06	0.18
462.66	20%	5	147000	787.54	825.51	804.24	826.03	0.000135	5.77	0.19
462.66	10%	10	174000	787.54	827.87	805.68	828.46	0.000143	6.23	0.2
462.66	5%	20	199000	787.54	829.7	806.89	830.36	0.000169	6.62	0.22
462.66	2%	50	233000	787.54	831.85	808.44	832.6	0.000193	7.08	0.23
462.66	1%	100	259000	787.54	833.35	809.57	834.16	0.000199	7.41	0.24
462.66	0.5% (Confined)	200	287000	787.54	834.85	810.86	835.74	0.000204	7.76	0.24
462.66	0.2% (Confined)	500	324000	787.54	836.77	812.36	837.75	0.000209	8.17	0.25
463.17	50%	2	104000	782.36	821.73	803.73	822.12	0.000121	5.07	0.18
463.17	20%	5	141000	782.36	825.87	805.64	826.39	0.000138	5.84	0.19
463.17	10%	10	167000	782.36	828.25	806.88	828.85	0.000147	6.28	0.2
463.17	5%	20	191000	782.36	830.12	807.94	830.79	0.000152	6.66	0.21
463.17	2%	50	225000	782.36	832.3	809.41	833.07	0.000163	7.21	0.22
463.17	1%	100	256000	782.36	833.8	810.66	834.68	0.000179	7.77	0.23
463.17	0.5% (Confined)	200	285000	782.36	835.3	811.79	836.28	0.000188	8.2	0.24
463.17	0.2% (Confined)	500	323000	782.36	837.22	813.24	838.31	0.000198	8.7	0.25
463.97	50%	2	104000	786.19	822.25	805.81	822.76	0.000167	5.76	0.21
463.97	20%	5	141000	786.19	826.43	807.85	827.11	0.000182	6.63	0.22
463.97	10%	10	167000	786.19	828.83	809.29	829.63	0.000195	7.2	0.23
463.97	5%	20	191000	786.19	830.7	810.52	831.61	0.000206	7.69	0.24
463.97	2%	50	225000	786.19	832.91	812.1	833.97	0.000222	8.36	0.26
463.97	1%	100	256000	786.19	834.44	813.4	835.67	0.000243	9.01	0.27
463.97	0.5% (Confined)	200	285000	786.19	835.97	814.59	837.33	0.000256	9.52	0.28
463.97	0.2% (Confined)	500	323000	786.19	837.91	816.08	839.43	0.00027	10.12	0.29

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
464.51	50%	2	104000	789.56	822.74	805.2	823.19	0.000136	5.35	0.19
464.51	20%	5	141000	789.56	827.03	807.17	827.57	0.00014	5.97	0.2
464.51	10%	10	167000	789.56	829.57	808.45	830.1	0.000134	6.14	0.2
464.51	5%	20	191000	789.56	831.57	809.56	832.1	0.000127	6.23	0.19
464.51	2%	50	225000	789.56	833.96	811.08	834.47	0.00012	6.35	0.19
464.51	1%	100	256000	789.56	835.67	812.4	836.2	0.00012	6.54	0.19
464.51	0.5% (Confined)	200	285000	789.56	837.35	813.57	837.88	0.000116	6.64	0.19
464.51	0.2% (Confined)	500	323000	789.56	839.47	815.05	839.99	0.000112	6.74	0.19
464.97	50%	2	104000	792.41	823.1	808.6	823.56	0.000175	5.47	0.21
464.97	20%	5	141000	792.41	827.45	810.43	827.93	0.000157	5.73	0.21
464.97	10%	10	167000	792.41	830.01	811.61	830.43	0.000132	5.61	0.19
464.97	5%	20	191000	792.41	832.01	812.64	832.4	0.000115	5.5	0.18
464.97	2%	50	225000	792.41	834.39	814.02	834.75	0.000102	5.45	0.17
464.97	1%	100	256000	792.41	836.12	815.23	836.47	0.000097	5.52	0.17
464.97	0.5% (Confined)	200	285000	792.41	837.79	816.3	838.13	0.000092	5.54	0.17
464.97	0.2% (Confined)	500	323000	792.41	839.9	817.66	840.23	0.000085	5.55	0.16
465.6	50%	2	104000	793.92	823.7	809.9	824.18	0.000188	5.58	0.22
465.6	20%	5	141000	793.92	827.98	811.7	828.45	0.000158	5.74	0.21
465.6	10%	10	167000	793.92	830.48	812.86	830.85	0.000124	5.39	0.18
465.6	5%	20	191000	793.92	832.44	813.85	832.74	0.000102	5.13	0.17
465.6	2%	50	225000	793.92	834.78	815.24	835.04	0.000085	4.93	0.16
465.6	1%	100	256000	793.92	836.49	816.41	836.74	0.000078	4.91	0.15
465.6	0.5% (Confined)	200	285000	793.92	838.15	817.49	838.38	0.000071	4.85	0.15
465.6	0.2% (Confined)	500	323000	793.92	840.24	818.83	840.46	0.000064	4.79	0.14
466.09	50%	2	104000	790.5	824.19	809.77	824.66	0.000186	5.49	0.22
466.09	20%	5	141000	790.5	828.41	812.18	828.83	0.000149	5.49	0.2
466.09	10%	10	167000	790.5	830.82	813.36	831.16	0.000132	5.19	0.19
466.09	5%	20	191000	790.5	832.71	814.36	833	0.000111	5	0.17
466.09	2%	50	225000	790.5	834.99	815.73	835.25	0.000094	4.88	0.16
466.09	1%	100	256000	790.5	836.68	816.91	836.93	0.000088	4.88	0.16
466.09	0.5% (Confined)	200	285000	790.5	838.31	817.97	838.56	0.000081	4.86	0.15
466.09	0.2% (Confined)	500	323000	790.5	840.39	819.3	840.62	0.000073	4.83	0.15
466.82	50%	2	104000	794.85	824.9	809.34	825.42	0.000193	5.78	0.22
466.82	20%	5	141000	794.85	828.94	811.45	829.54	0.000199	6.33	0.23
466.82	10%	10	167000	794.85	831.23	812.84	831.84	0.000203	6.5	0.23
466.82	5%	20	191000	794.85	833.01	814.04	833.61	0.000196	6.6	0.23
466.82	2%	50	225000	794.85	835.2	815.63	835.8	0.00019	6.74	0.23
466.82	1%	100	256000	794.85	836.84	817	837.47	0.000186	6.95	0.23
466.82	0.5% (Confined)	200	285000	794.85	838.43	818.22	839.06	0.000179	7.07	0.23
466.82	0.2% (Confined)	500	323000	794.85	840.45	819.75	841.09	0.000171	7.2	0.22
467.31	50%	2	104000	798.59	825.44	812.74	826.06	0.000283	6.32	0.26
467.31	20%	5	141000	798.59	829.46	814.85	830.16	0.000257	6.8	0.26
467.31	10%	10	167000	798.59	831.76	816.19	832.43	0.000248	6.83	0.25
467.31	5%	20	191000	798.59	833.52	817.37	834.16	0.000225	6.85	0.25
467.31	2%	50	225000	798.59	835.69	818.93	836.3	0.000202	6.87	0.24
467.31	1%	100	256000	798.59	837.34	820.26	837.94	0.000189	6.93	0.23
467.31	0.5% (Confined)	200	285000	798.59	838.93	821.44	839.51	0.000176	6.92	0.22
467.31	0.2% (Confined)	500	323000	798.59	840.96	822.87	841.51	0.00016	6.9	0.22
467.9	50%	2	104000	794.04	826.31	814.04	826.85	0.000245	5.87	0.24
467.9	20%	5	141000	794.04	830.24	815.96	830.89	0.000235	6.5	0.25
467.9	10%	10	167000	794.04	832.44	817.18	833.12	0.000226	6.75	0.24
467.9	5%	20	191000	794.04	834.11	818.36	834.81	0.000219	6.94	0.24
467.9	2%	50	225000	794.04	836.23	819.71	836.92	0.000227	7.07	0.25
467.9	1%	100	256000	794.04	837.84	820.83	838.53	0.000219	7.24	0.25
467.9	0.5% (Confined)	200	285000	794.04	839.38	821.88	840.06	0.000204	7.27	0.24
467.9	0.2% (Confined)	500	323000	794.04	841.37	823.19	842.01	0.000186	7.24	0.23

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
468.58	50%	2	104000	790.75	827.04	809.66	827.66	0.000196	6.34	0.23
468.58	20%	5	141000	790.75	830.93	812.03	831.78	0.000226	7.42	0.25
468.58	10%	10	167000	790.75	833.06	813.6	834.06	0.000246	8.07	0.26
468.58	5%	20	191000	790.75	834.68	814.92	835.76	0.000257	8.5	0.27
468.58	2%	50	225000	790.75	836.79	816.71	837.9	0.000273	8.86	0.28
468.58	1%	100	256000	790.75	838.37	818.26	839.49	0.000278	9.12	0.28
468.58	0.5% (Confined)	200	285000	790.75	839.87	819.66	840.97	0.000273	9.22	0.28
468.58	0.2% (Confined)	500	323000	790.75	841.79	821.4	842.85	0.000262	9.27	0.27
469.14	50%	2	104000	799.64	827.79	811.29	828.2	0.000154	5.14	0.2
469.14	20%	5	141000	799.64	831.85	813.19	832.37	0.00016	5.81	0.21
469.14	10%	10	167000	799.64	834.09	814.42	834.7	0.000172	6.27	0.22
469.14	5%	20	191000	799.64	835.75	815.49	836.43	0.000185	6.68	0.23
469.14	2%	50	225000	799.64	837.82	816.91	838.59	0.000194	7.19	0.23
469.14	1%	100	256000	799.64	839.33	818.18	840.2	0.000206	7.66	0.24
469.14	0.5% (Confined)	200	285000	799.64	840.72	819.29	841.67	0.000214	8.04	0.25
469.14	0.2% (Confined)	500	323000	799.64	842.48	820.73	843.52	0.000222	8.49	0.26
469.77	50%	2	104000	797.49	828.26	811.91	828.78	0.000178	5.77	0.21
469.77	20%	5	141000	797.49	832.39	813.95	833.01	0.000211	6.41	0.23
469.77	10%	10	167000	797.49	834.7	815.25	835.37	0.000225	6.71	0.24
469.77	5%	20	191000	797.49	836.4	816.36	837.13	0.000228	7.04	0.25
469.77	2%	50	225000	797.49	838.52	817.92	839.3	0.000232	7.44	0.25
469.77	1%	100	256000	797.49	840.08	819.27	840.94	0.000241	7.85	0.26
469.77	0.5% (Confined)	200	285000	797.49	841.52	820.46	842.44	0.000247	8.17	0.26
469.77	0.2% (Confined)	500	323000	797.49	843.33	822.1	844.32	0.00025	8.56	0.27
470.58	50%	2	104000	799.2	829.09	815.33	829.55	0.000178	5.4	0.21
470.58	20%	5	141000	799.2	833.3	817.06	833.83	0.000171	5.9	0.21
470.58	10%	10	167000	799.2	835.64	818.18	836.2	0.000164	6.15	0.21
470.58	5%	20	191000	799.2	837.38	819.09	837.95	0.000162	6.38	0.21
470.58	2%	50	225000	799.2	839.53	820.45	840.14	0.000162	6.7	0.21
470.58	1%	100	256000	799.2	841.16	821.61	841.81	0.000163	6.96	0.22
470.58	0.5% (Confined)	200	285000	799.2	842.64	822.63	843.31	0.000163	7.17	0.22
470.58	0.2% (Confined)	500	323000	799.2	844.5	823.92	845.2	0.000162	7.42	0.22
471.28	50%	2	104000	794.31	829.73	813.72	830.22	0.000177	5.6	0.21
471.28	20%	5	141000	794.31	833.9	816.38	834.48	0.000175	6.18	0.22
471.28	10%	10	167000	794.31	836.22	817.78	836.82	0.000168	6.4	0.22
471.28	5%	20	191000	794.31	837.95	818.97	838.56	0.000165	6.59	0.22
471.28	2%	50	225000	794.31	840.11	820.45	840.73	0.000162	6.85	0.22
471.28	1%	100	256000	794.31	841.74	821.73	842.39	0.000162	7.1	0.22
471.28	0.5% (Confined)	200	285000	794.31	843.22	822.85	843.89	0.000161	7.29	0.22
471.28	0.2% (Confined)	500	323000	794.31	845.08	824.3	845.77	0.00016	7.51	0.22
472.06	50%	2	104000	798.32	830.48	816.4	830.93	0.000171	5.38	0.21
472.06	20%	5	141000	798.32	834.67	818.1	835.23	0.000189	6	0.22
472.06	10%	10	167000	798.32	836.94	819.25	837.55	0.00019	6.34	0.23
472.06	5%	20	191000	798.32	838.64	820.23	839.3	0.000192	6.66	0.23
472.06	2%	50	225000	798.32	840.75	821.56	841.48	0.000197	7.09	0.23
472.06	1%	100	256000	798.32	842.36	822.7	843.17	0.000204	7.5	0.24
472.06	0.5% (Confined)	200	285000	798.32	843.81	823.74	844.69	0.00021	7.84	0.25
472.06	0.2% (Confined)	500	323000	798.32	845.63	825.03	846.59	0.000215	8.25	0.25
472.78	50%	2	104000	790.23	831.09	813.12	831.48	0.000125	5.01	0.18
472.78	20%	5	141000	790.23	835.34	815.08	835.83	0.000135	5.69	0.19
472.78	10%	10	167000	790.23	837.62	816.34	838.17	0.000141	6.07	0.2
472.78	5%	20	191000	790.23	839.33	817.41	839.93	0.000146	6.41	0.2
472.78	2%	50	225000	790.23	841.47	818.88	842.14	0.000152	6.85	0.21
472.78	1%	100	256000	790.23	843.12	820.18	843.86	0.00016	7.26	0.22
472.78	0.5% (Confined)	200	285000	790.23	844.6	821.33	845.4	0.000166	7.59	0.22
472.78	0.2% (Confined)	500	323000	790.23	846.45	822.77	847.33	0.000172	7.99	0.23

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
473.62	50%	2	104000	802.97	831.69	817.59	832.19	0.000187	5.69	0.22
473.62	20%	5	141000	802.97	835.96	819.42	836.57	0.000188	6.32	0.22
473.62	10%	10	167000	802.97	838.27	820.62	838.92	0.000186	6.61	0.23
473.62	5%	20	191000	802.97	840.01	821.66	840.66	0.000177	6.73	0.22
473.62	2%	50	225000	802.97	842.23	823.05	842.85	0.000166	6.86	0.22
473.62	1%	100	256000	802.97	843.96	824.26	844.58	0.00016	6.99	0.22
473.62	0.5% (Confined)	200	285000	802.97	845.5	825.34	846.13	0.000155	7.09	0.21
473.62	0.2% (Confined)	500	323000	802.97	847.43	826.7	848.05	0.000149	7.2	0.21
474.29	50%	2	104000	795.31	832.34	817.04	832.87	0.000185	5.87	0.22
474.29	20%	5	141000	795.31	836.62	819.06	837.24	0.000182	6.45	0.22
474.29	10%	10	167000	795.31	838.92	820.36	839.55	0.000173	6.64	0.22
474.29	5%	20	191000	795.31	840.62	821.5	841.26	0.000171	6.86	0.22
474.29	2%	50	225000	795.31	842.77	823.03	843.44	0.000169	7.14	0.22
474.29	1%	100	256000	795.31	844.46	824.32	845.17	0.00017	7.41	0.22
474.29	0.5% (Confined)	200	285000	795.31	845.98	825.52	846.7	0.00017	7.63	0.23
474.29	0.2% (Confined)	500	323000	795.31	847.87	827	848.62	0.000169	7.89	0.23
474.94	50%	2	104000	794.58	833	816.45	833.47	0.000163	5.53	0.21
474.94	20%	5	141000	794.58	837.28	818.59	837.82	0.00016	6.03	0.21
474.94	10%	10	167000	794.58	839.53	820.3	840.1	0.000159	6.31	0.21
474.94	5%	20	191000	794.58	841.2	821.41	841.81	0.000161	6.61	0.21
474.94	2%	50	225000	794.58	843.31	822.91	843.98	0.000165	6.99	0.22
474.94	1%	100	256000	794.58	844.99	824.18	845.71	0.00017	7.34	0.22
474.94	0.5% (Confined)	200	285000	794.58	846.48	825.34	847.26	0.000173	7.64	0.23
474.94	0.2% (Confined)	500	323000	794.58	848.35	826.87	849.18	0.000177	7.99	0.23
475.38	50%	2	104000	802.02	833.33	820.14	834.01	0.000264	6.65	0.26
475.38	20%	5	141000	802.02	837.58	822.2	838.34	0.000247	7.13	0.26
475.38	10%	10	167000	802.02	839.85	823.55	840.61	0.000242	7.31	0.26
475.38	5%	20	191000	802.02	841.52	824.72	842.31	0.000237	7.56	0.26
475.38	2%	50	225000	802.02	843.64	826.29	844.47	0.000233	7.88	0.26
475.38	1%	100	256000	802.02	845.33	827.64	846.21	0.000233	8.18	0.26
475.38	0.5% (Confined)	200	285000	802.02	846.84	828.86	847.75	0.000232	8.42	0.26
475.38	0.2% (Confined)	500	323000	802.02	848.71	830.37	849.67	0.000231	8.72	0.26
475.92	50%	2	104000	800.78	834.18	819.96	834.64	0.000175	5.39	0.21
475.92	20%	5	141000	800.78	838.38	821.71	838.95	0.000177	6.04	0.22
475.92	10%	10	167000	800.78	840.56	822.84	841.21	0.000183	6.5	0.22
475.92	5%	20	191000	800.78	842.18	823.82	842.91	0.000192	6.93	0.23
475.92	2%	50	225000	800.78	844.24	825.16	845.09	0.000205	7.5	0.24
475.92	1%	100	256000	800.78	846.09	826.33	846.76	0.000166	7.04	0.22
475.92	0.5% (Confined)	200	285000	800.78	847.59	827.35	848.3	0.000167	7.28	0.22
475.92	0.2% (Confined)	500	323000	800.78	849.47	828.67	850.22	0.000168	7.57	0.22
476.34	50%	2	104000	800.67	834.54	818.99	834.95	0.000146	5.16	0.19
476.34	20%	5	141000	800.67	838.75	820.78	839.27	0.000151	5.82	0.2
476.34	10%	10	167000	800.67	840.95	821.89	841.55	0.000158	6.28	0.21
476.34	5%	20	191000	800.67	842.59	822.92	843.27	0.000167	6.71	0.22
476.34	2%	50	225000	800.67	844.68	824.25	845.47	0.000179	7.27	0.23
476.34	1%	100	256000	800.67	846.39	825.43	847.08	0.000159	7.08	0.22
476.34	0.5% (Confined)	200	285000	800.67	847.89	826.49	848.62	0.000162	7.36	0.22
476.34	0.2% (Confined)	500	323000	800.67	849.77	827.82	850.55	0.000165	7.69	0.22
476.99	50%	2	104000	798.83	834.96	819.21	835.54	0.000193	6.11	0.22
476.99	20%	5	141000	798.83	839.16	821.32	839.9	0.000208	6.95	0.24
476.99	10%	10	167000	798.83	841.37	822.68	842.22	0.000217	7.48	0.25
476.99	5%	20	191000	798.83	843.03	823.89	843.98	0.000228	7.96	0.25
476.99	2%	50	225000	798.83	845.22	825.49	846.12	0.000211	8.03	0.25
476.99	1%	100	256000	798.83	846.76	826.93	847.73	0.000219	8.44	0.25
476.99	0.5% (Confined)	200	285000	798.83	848.27	828.24	849.28	0.000221	8.73	0.26
476.99	0.2% (Confined)	500	323000	798.83	850.15	829.79	851.21	0.000223	9.06	0.26

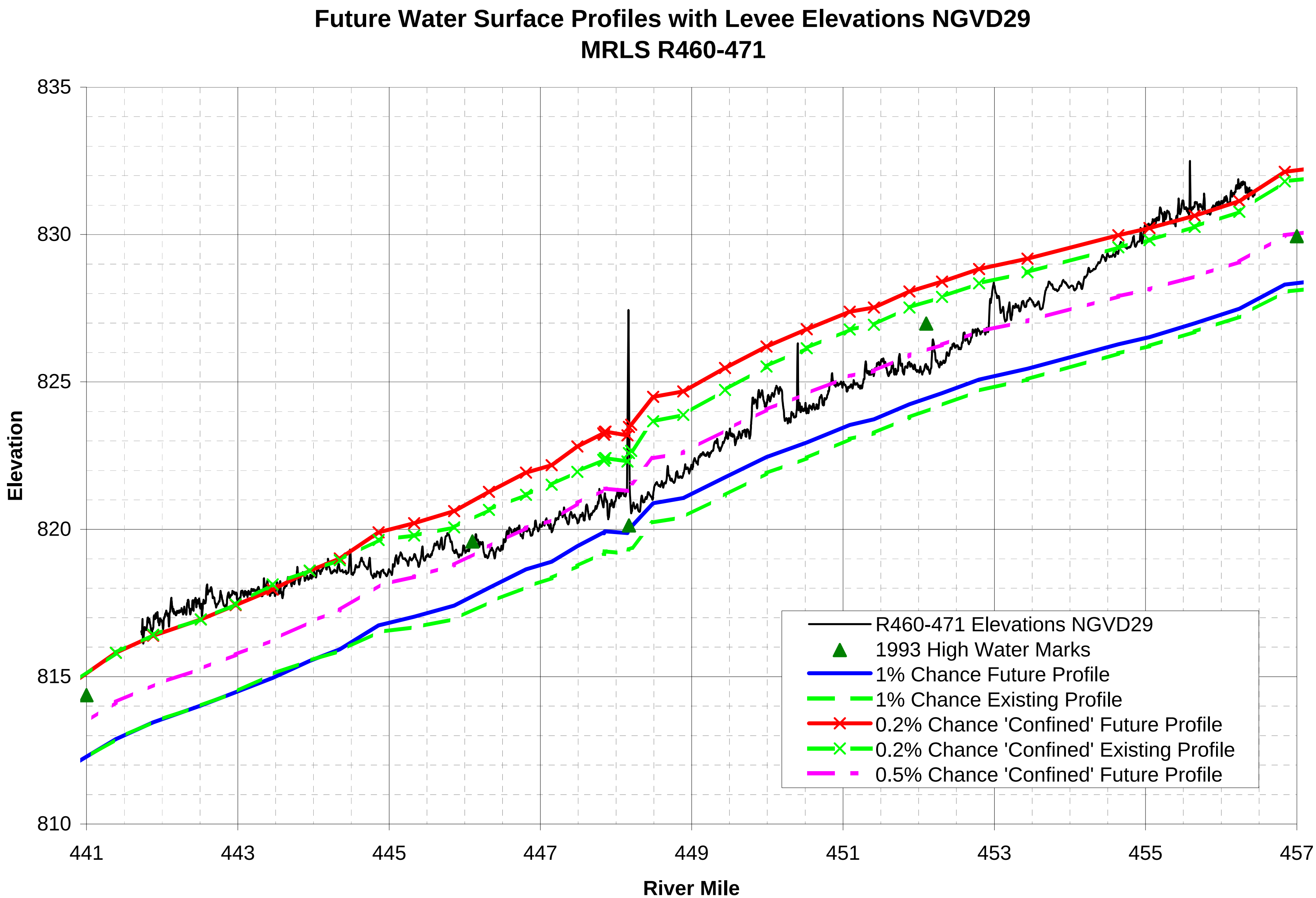
Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
477.64	50%	2	104000	800.29	835.78	820.48	836.17	0.000157	5.16	0.2
477.64	20%	5	141000	800.29	840.14	822.7	840.54	0.00015	5.4	0.2
477.64	10%	10	167000	800.29	842.43	823.98	842.84	0.000138	5.53	0.19
477.64	5%	20	191000	800.29	844.19	825.08	844.61	0.000134	5.7	0.19
477.64	2%	50	225000	800.29	846.26	826.49	846.72	0.000134	5.99	0.2
477.64	1%	100	256000	800.29	847.91	827.82	848.3	0.000115	5.76	0.18
477.64	0.5% (Confined)	200	285000	800.29	849.45	829.16	849.85	0.000112	5.87	0.18
477.64	0.2% (Confined)	500	323000	800.29	851.36	831.69	851.77	0.000109	6.01	0.18
478.4	50%	2	104000	806.35	836.36	821.67	836.81	0.000163	5.4	0.21
478.4	20%	5	141000	806.35	840.66	823.5	841.12	0.000145	5.68	0.2
478.4	10%	10	167000	806.35	842.91	824.72	843.38	0.000139	5.86	0.2
478.4	5%	20	191000	806.35	844.64	825.76	845.12	0.000135	6	0.2
478.4	2%	50	225000	806.35	846.71	827.18	847.21	0.000133	6.25	0.2
478.4	1%	100	256000	806.35	848.26	828.36	848.79	0.000136	6.52	0.2
478.4	0.5% (Confined)	200	285000	806.35	849.78	829.44	850.33	0.000135	6.69	0.2
478.4	0.2% (Confined)	500	323000	806.35	851.67	830.8	852.24	0.000133	6.9	0.2
479.09	50%	2	104000	810.08	837.01	824.25	837.44	0.000187	5.41	0.22
479.09	20%	5	141000	810.08	841.26	826.05	841.64	0.000146	5.37	0.2
479.09	10%	10	167000	810.08	843.51	827.22	843.84	0.000124	5.22	0.18
479.09	5%	20	191000	810.08	845.24	828.2	845.54	0.000109	5.12	0.17
479.09	2%	50	225000	810.08	847.33	829.54	847.61	0.000098	5.09	0.17
479.09	1%	100	256000	810.08	848.9	830.75	849.18	0.000093	5.15	0.16
479.09	0.5% (Confined)	200	285000	810.08	850.43	832.61	850.7	0.000088	5.16	0.16
479.09	0.2% (Confined)	500	323000	810.08	852.33	833.98	852.6	0.000082	5.18	0.16
479.81	50%	2	103000	800.46	837.74	823.01	838.18	0.000226	5.57	0.23
479.81	20%	5	140000	800.46	841.78	825.81	842.15	0.000164	5.41	0.2
479.81	10%	10	166000	800.46	843.93	828.05	844.25	0.000139	5.28	0.19
479.81	5%	20	190000	800.46	845.59	829.3	845.9	0.000127	5.27	0.18
479.81	2%	50	224000	800.46	847.62	830.73	847.92	0.000118	5.34	0.18
479.81	1%	100	255000	800.46	849.17	832.07	849.47	0.000115	5.47	0.18
479.81	0.5% (Confined)	200	284000	800.46	850.67	833.82	850.98	0.000111	5.54	0.18
479.81	0.2% (Confined)	500	322000	800.46	852.54	835.67	852.85	0.000106	5.64	0.18
480.59	50%	2	103000	809.61	838.58	823.55	839.07	0.000216	5.64	0.21
480.59	20%	5	140000	809.61	842.39	825.51	842.86	0.000193	5.84	0.21
480.59	10%	10	166000	809.61	844.42	826.78	844.88	0.000186	5.97	0.2
480.59	5%	20	190000	809.61	846.04	827.89	846.48	0.000179	5.99	0.2
480.59	2%	50	224000	809.61	848.02	829.38	848.45	0.000169	6.07	0.2
480.59	1%	100	255000	809.61	849.56	830.66	849.99	0.000165	6.2	0.2
480.59	0.5% (Confined)	200	284000	809.61	851.04	831.83	851.47	0.000158	6.26	0.19
480.59	0.2% (Confined)	500	322000	809.61	852.89	833.28	853.32	0.000151	6.33	0.19
481.2	50%	2	103000	809.33	839.31	825.88	839.76	0.000224	5.45	0.21
481.2	20%	5	140000	809.33	843.01	827.63	843.48	0.000207	5.79	0.21
481.2	10%	10	166000	809.33	845	828.78	845.48	0.0002	6.01	0.21
481.2	5%	20	190000	809.33	846.57	829.79	847.07	0.000198	6.22	0.21
481.2	2%	50	224000	809.33	848.5	831.12	849.04	0.000199	6.54	0.21
481.2	1%	100	255000	809.33	850.01	832.31	850.59	0.000204	6.84	0.22
481.2	0.5% (Confined)	200	284000	809.33	851.45	833.37	852.06	0.000204	7.06	0.22
481.2	0.2% (Confined)	500	322000	809.33	853.26	834.7	853.9	0.000204	7.32	0.22
481.89	50%	2	103000	810.32	840.11	826.31	840.59	0.000248	5.66	0.22
481.89	20%	5	140000	810.32	843.72	828.5	844.29	0.000252	6.3	0.23
481.89	10%	10	166000	810.32	845.66	829.83	846.29	0.000255	6.68	0.24
481.89	5%	20	190000	810.32	847.21	830.95	847.88	0.000258	6.99	0.24
481.89	2%	50	224000	810.32	849.14	832.98	849.85	0.000258	7.32	0.24
481.89	1%	100	255000	810.32	850.65	834.33	851.4	0.00026	7.61	0.25
481.89	0.5% (Confined)	200	284000	810.32	852.1	835.41	852.86	0.000256	7.8	0.25
481.89	0.2% (Confined)	500	322000	810.32	853.9	836.67	854.68	0.00025	8.01	0.25

Exhibit 2.16
Missouri River Future Conditions Water Surface Elevations

HEC-RAS River Mile	Profile Frequency Percent	Year	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Average Vel Chnl (ft/s)	Channel Froude #
482.6	50%	2	103000	809.27	841.02	828.07	841.52	0.000265	5.69	0.23
482.6	20%	5	140000	809.27	844.62	829.92	845.2	0.000258	6.24	0.23
482.6	10%	10	166000	809.27	846.61	831.11	847.17	0.000241	6.35	0.23
482.6	5%	20	190000	809.27	848.19	832.16	848.73	0.000227	6.42	0.22
482.6	2%	50	224000	809.27	850.13	833.85	850.67	0.000215	6.56	0.22
482.6	1%	100	255000	809.27	851.66	834.99	852.21	0.000209	6.71	0.22
482.6	0.5% (Confined)	200	284000	809.27	853.1	836.01	853.64	0.000202	6.81	0.22
482.6	0.2% (Confined)	500	322000	809.27	854.89	837.37	855.44	0.000193	6.92	0.21
483.45	50%	2	103000	809.53	842.16	827.66	842.76	0.000297	6.22	0.25
483.45	20%	5	140000	809.53	845.76	830.32	846.55	0.000353	7.11	0.27
483.45	10%	10	166000	809.53	847.64	831.83	848.56	0.000384	7.7	0.29
483.45	5%	20	190000	809.53	849.1	833.16	850.13	0.000401	8.2	0.29
483.45	2%	50	224000	809.53	850.92	834.9	852.08	0.000416	8.77	0.3
483.45	1%	100	255000	809.53	852.39	836.18	853.61	0.00042	9.15	0.31
483.45	0.5% (Confined)	200	284000	809.53	853.77	837.25	855.02	0.000415	9.39	0.31
483.45	0.2% (Confined)	500	322000	809.53	855.5	838.72	856.76	0.000404	9.64	0.31
484.11	50%	2	103000	813.88	843.16	828.65	843.62	0.000209	5.44	0.21
484.11	20%	5	140000	813.88	846.93	830.48	847.51	0.000218	6.17	0.22
484.11	10%	10	166000	813.88	848.93	831.69	849.57	0.000224	6.59	0.22
484.11	5%	20	190000	813.88	850.49	832.73	851.19	0.000232	6.96	0.23
484.11	2%	50	224000	813.88	852.39	834.11	853.19	0.000245	7.47	0.24
484.11	1%	100	255000	813.88	853.88	835.33	854.76	0.000259	7.93	0.25
484.11	0.5% (Confined)	200	284000	813.88	855.23	836.39	856.18	0.000268	8.3	0.25
484.11	0.2% (Confined)	500	322000	813.88	856.9	837.75	857.93	0.000278	8.73	0.26

Exhibit 2.17



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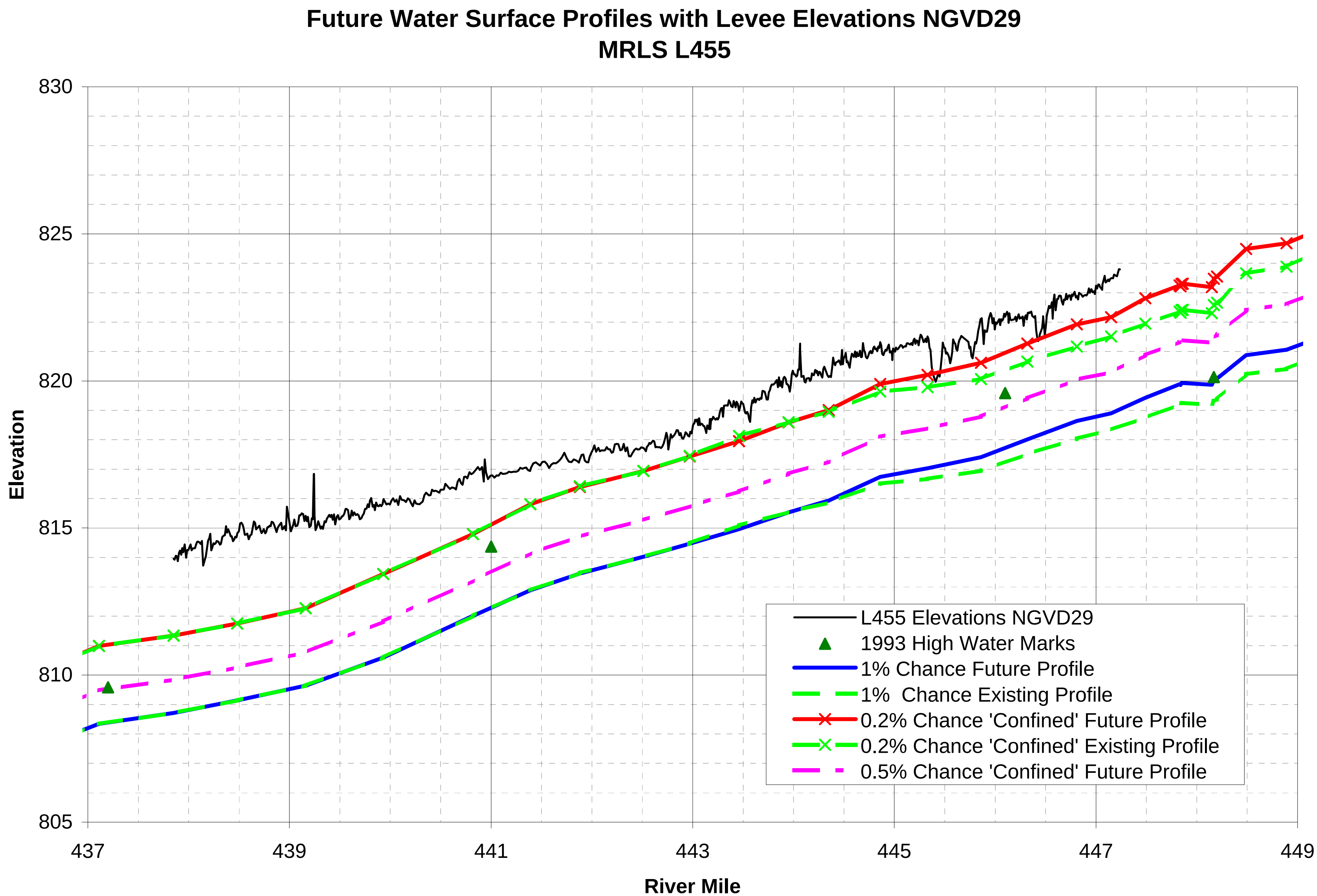
Date: 7/22/2006

Exhibit 2.18



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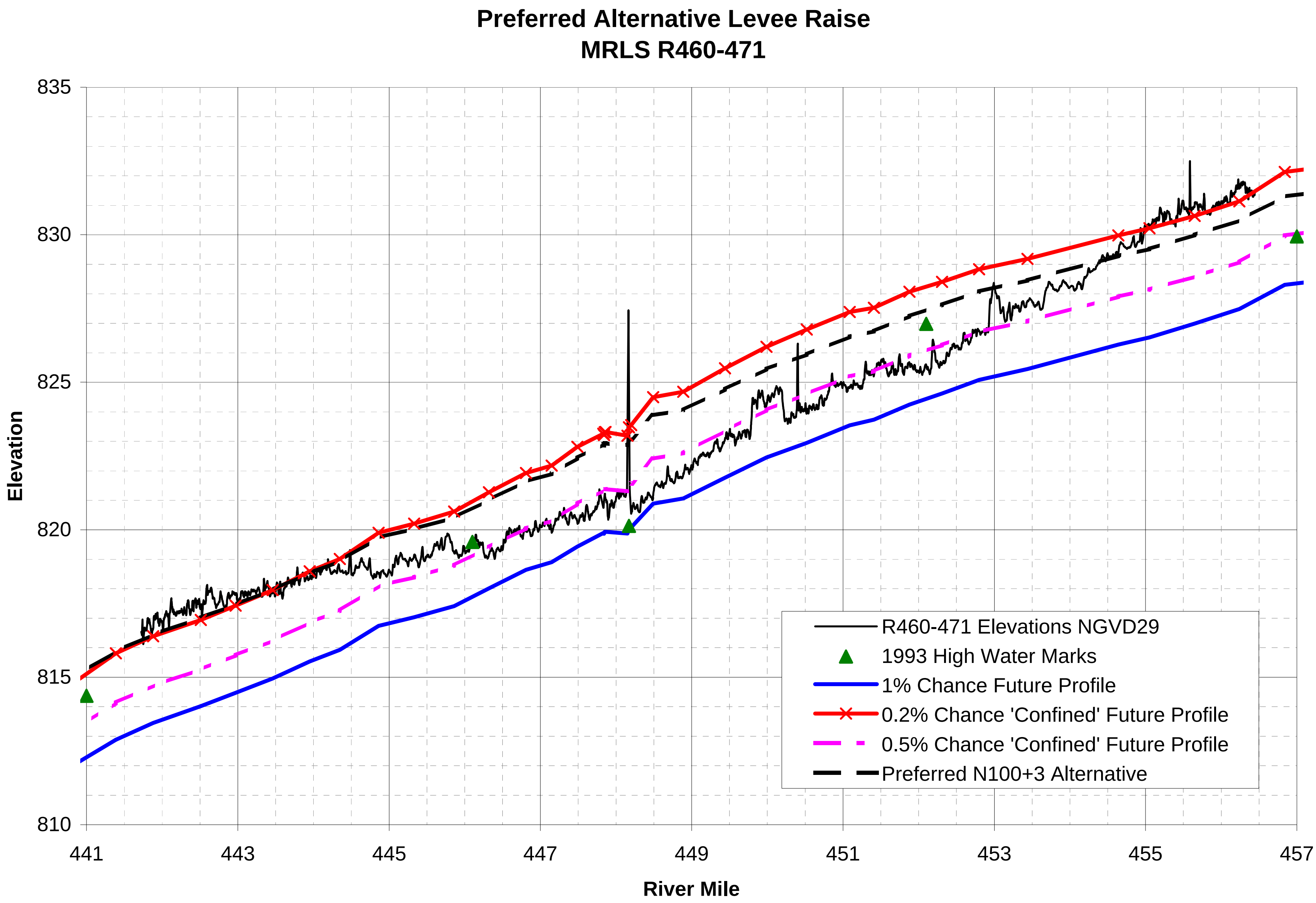
Date: 7/22/2006

Exhibit 2.19



Designed: EDS
Checked: MMW
Date: 7/22/2006

Exhibit 2.20
Future Conditions With Project Impacts to 1993 Flood Water Surface Elevations

River Mile	1993 Maximum WS Elev Without Project (Ft)	1993 Maximum WS Elev With Project (Ft)	Δ Max WS Elev (Ft)
481.89	853.28	853.34	0.06
481.20	852.71	852.77	0.06
480.59	852.03	852.10	0.07
480.00	851.84	851.90	0.06
479.81	851.78	851.85	0.07
479.09	851.52	851.59	0.07
478.40	850.67	850.75	0.08
477.64	850.18	850.27	0.09
476.99	849.58	849.68	0.10
476.70	849.55	849.65	0.10
476.34	849.43	849.54	0.11
475.92	849.12	849.23	0.11
475.38	848.57	848.70	0.13
475.34	848.55	848.69	0.14
474.94	848.08	848.21	0.13
474.29	847.48	847.62	0.14
473.62	846.91	847.06	0.15
472.78	846.24	846.41	0.17
472.06	845.51	845.70	0.19
471.28	844.43	844.65	0.22
470.58	843.72	843.97	0.25
469.77	843.03	843.27	0.24
469.14	842.44	842.65	0.21
468.58	840.94	841.00	0.06
468.40	841.03	841.11	0.08
467.90	840.71	840.76	0.05
467.31	840.47	840.50	0.03
466.82	839.92	839.91	-0.01
466.09	839.32	839.26	-0.06
465.60	838.82	838.74	-0.08
465.18	838.59	838.50	-0.09
464.97	838.48	838.39	-0.09
464.51	838.05	837.95	-0.10
463.97	837.64	837.52	-0.12
463.17	836.98	836.84	-0.14
462.66	836.23	836.08	-0.15
462.41	835.94	835.79	-0.15
462.02	835.55	835.41	-0.14
461.50	834.88	834.74	-0.14
461.00	834.61	834.48	-0.13
460.68	834.44	834.32	-0.12
459.97	833.82	833.70	-0.12
459.40	833.47	833.38	-0.09
458.72	832.50	832.44	-0.06
458.18	832.11	832.08	-0.03
458.00	831.84	831.82	-0.02
457.68	831.30	831.33	0.03
457.23	830.84	830.90	0.06

Exhibit 2.20

Future Conditions With Project Impacts to 1993 Flood Water Surface Elevations

River Mile	1993 Maximum WS Elev Without Project (Ft)	1993 Maximum WS Elev With Project (Ft)	Δ Max WS Elev (Ft)
456.82	830.89	830.95	0.06
456.50	830.65	830.73	0.08
456.22	830.41	830.52	0.11
455.64	829.95	830.08	0.13
455.05	829.38	829.56	0.18
454.63	829.16	829.35	0.19
454.00	828.69	828.92	0.23
453.44	828.19	828.46	0.27
452.80	827.82	828.10	0.28
452.31	827.31	827.63	0.32
451.88	826.62	826.99	0.37
451.41	826.18	826.56	0.38
451.09	825.78	826.18	0.40
450.52	825.04	825.45	0.41
450.00	824.59	825.00	0.41
449.44	823.59	823.98	0.39
448.89	822.76	823.22	0.46
448.49	822.62	822.95	0.33
448.30	822.12	822.61	0.49
448.26	822.07	822.56	0.49
448.21	822.03	822.51	0.48
448.21	822.02	822.51	0.49
448.21	822.02	822.51	0.49
447.79	821.89	822.29	0.40
447.78	822.12	822.44	0.32
447.71	821.85	822.22	0.37
447.60	821.90	822.22	0.32
447.51	821.64	822.00	0.36
447.16	821.13	821.55	0.42
446.83	820.63	821.10	0.47
446.33	820.08	820.53	0.45
445.88	819.64	820.06	0.42
445.60	819.42	819.84	0.42
445.33	819.24	819.66	0.42
444.86	819.04	819.45	0.41
444.36	818.82	819.23	0.41
443.98	818.60	819.02	0.42
443.49	818.25	818.66	0.41
442.99	817.89	818.30	0.41
442.53	817.54	817.95	0.41
441.92	816.76	817.17	0.41
441.80	816.61	817.02	0.41
441.42	815.93	816.36	0.43
440.85	815.02	815.47	0.45
439.96	812.28	812.83	0.55
439.19	812.01	812.56	0.55
438.53	811.26	811.82	0.56
437.88	810.27	810.90	0.63

Exhibit 2.20

Future Conditions With Project Impacts to 1993 Flood Water Surface Elevations

River Mile	1993 Maximum WS Elev Without Project (Ft)	1993 Maximum WS Elev With Project (Ft)	Δ Max WS Elev (Ft)
437.64	809.90	810.53	0.63
437.60	809.84	810.47	0.63
437.14	809.15	809.79	0.64
436.46	808.70	809.35	0.65
435.82	807.29	807.99	0.70
435.15	806.49	807.22	0.73
434.21	805.86	806.65	0.79
433.44	805.00	805.82	0.82
432.73	803.86	804.66	0.80
432.00	802.24	802.97	0.73
431.44	802.14	802.90	0.76
431.00	801.51	802.24	0.73
430.71	800.98	801.68	0.70
430.04	801.68	802.42	0.74
429.27	800.19	800.87	0.68
428.65	800.25	800.98	0.73
428.00	799.78	800.53	0.75
427.92	799.74	800.50	0.76
427.90	799.70	800.46	0.76
427.13	798.87	799.57	0.70
426.48	798.08	798.82	0.74
425.87	797.54	798.28	0.74
425.22	797.36	798.08	0.72
424.66	797.02	797.76	0.74
424.30	796.16	796.87	0.71
424.24	795.81	796.53	0.72
423.77	794.58	795.14	0.56
423.20	795.24	795.86	0.62
422.57	794.86	795.44	0.58
422.53	794.52	795.06	0.54
422.44	794.31	794.89	0.58
421.93	794.33	794.90	0.57
421.35	793.47	794.01	0.54
420.75	792.98	793.49	0.51
420.04	793.22	793.79	0.57
419.24	792.78	793.35	0.57
418.70	792.04	792.56	0.52
418.44	791.61	792.11	0.50
418.20	791.80	792.35	0.55
418.00	791.90	792.47	0.57
417.73	791.96	792.55	0.59
417.09	789.70	790.16	0.46
416.90	790.02	790.52	0.50
416.70	790.28	790.80	0.52
416.55	790.43	790.97	0.54
416.07	789.42	789.92	0.50
415.50	789.71	790.24	0.53
415.00	789.70	790.23	0.53

Exhibit 2.20
Future Conditions With Project Impacts to 1993 Flood Water Surface Elevations

River Mile	1993 Maximum WS Elev Without Project (Ft)	With Project (Ft)	Δ Max WS Elev (Ft)
414.90	789.70	790.23	0.53
414.20	789.32	789.84	0.52
413.47	788.03	788.48	0.45
412.80	787.62	788.09	0.47
412.00	787.69	788.13	0.44
411.50	787.02	787.45	0.43
411.39	786.85	787.27	0.42
410.68	785.49	785.89	0.40
410.01	785.41	785.86	0.45
409.49	785.15	785.62	0.47
408.79	783.53	784.09	0.56
408.26	784.07	784.54	0.47
407.74	784.02	784.48	0.46
407.19	783.15	783.57	0.42
406.75	783.11	783.52	0.41
406.50	783.21	783.66	0.45
406.25	783.44	783.90	0.46
405.60	782.39	782.83	0.44
405.01	782.24	782.70	0.46
404.36	782.09	782.55	0.46
403.81	781.87	782.35	0.48
403.50	781.83	782.30	0.47
403.14	781.77	782.24	0.47
403.00	781.71	782.19	0.48
402.47	781.41	781.88	0.47
401.86	781.12	781.60	0.48
401.41	780.91	781.41	0.50
401.30	780.82	781.32	0.50
400.76	780.32	780.81	0.49
400.15	779.70	780.16	0.46
399.53	779.12	779.56	0.44
399.30	778.80	779.24	0.44
398.86	778.04	778.46	0.42
398.31	778.40	778.84	0.44
397.60	776.93	777.35	0.42
397.57	777.23	777.65	0.42
397.48	777.56	777.99	0.43
396.71	776.25	776.66	0.41
396.04	775.69	776.09	0.40
395.50	775.45	775.87	0.42
394.54	775.23	775.64	0.41
394.00	774.70	775.13	0.43
393.74	774.36	774.80	0.44
393.18	773.74	774.17	0.43
392.59	773.08	773.50	0.42
391.93	772.84	773.26	0.42
391.50	772.69	773.15	0.46
391.29	772.58	773.01	0.43

Exhibit 2.20
Future Conditions With Project Impacts to 1993 Flood Water Surface Elevations

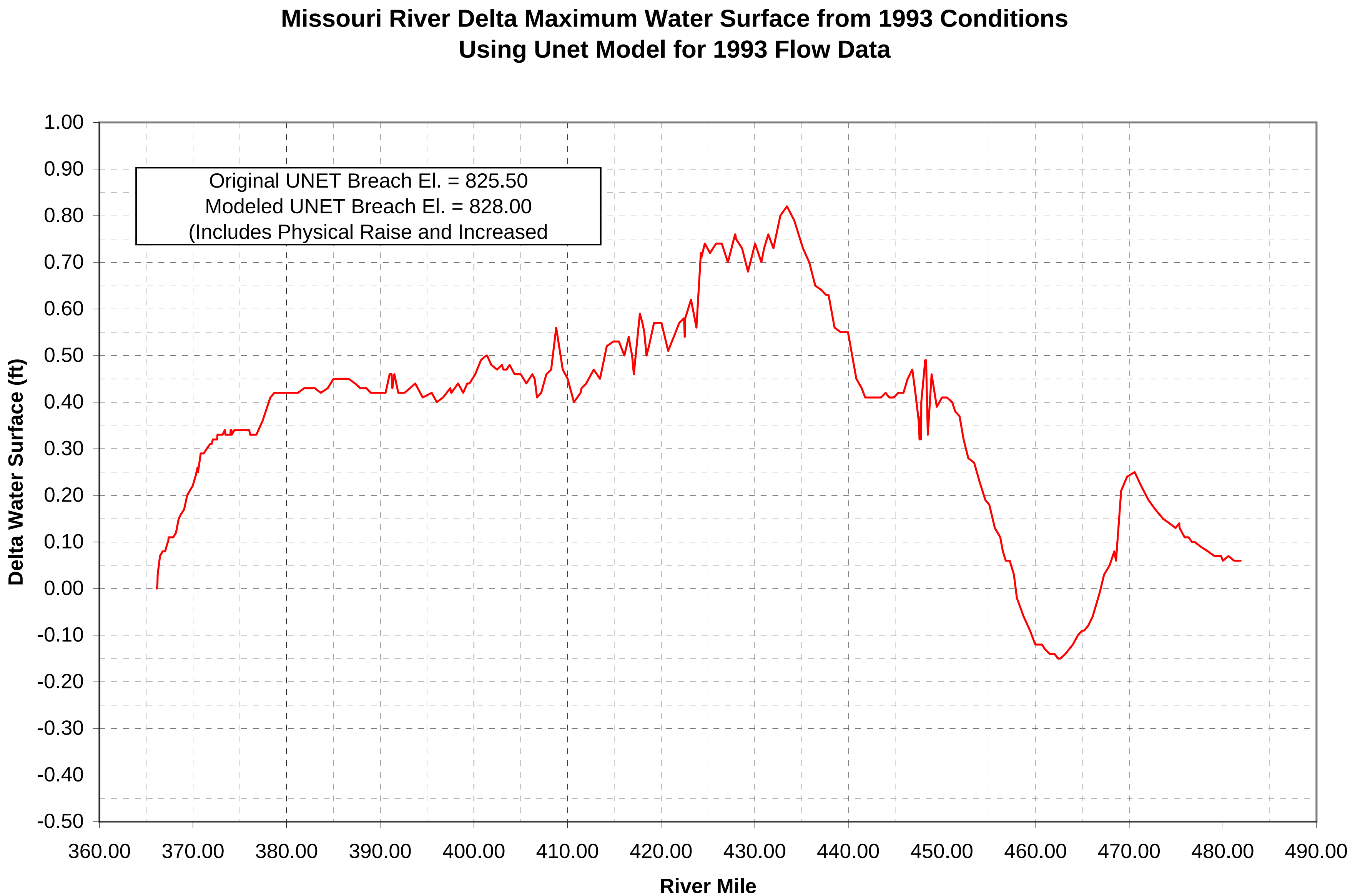
River Mile	1993 Maximum WS Elev Without Project (Ft)	With Project (Ft)	Δ Max WS Elev (Ft)
391.21	772.50	772.96	0.46
391.00	772.31	772.77	0.46
390.57	771.38	771.80	0.42
389.75	771.12	771.54	0.42
389.00	770.76	771.18	0.42
388.51	770.98	771.41	0.43
388.20	770.83	771.26	0.43
387.86	770.72	771.15	0.43
387.32	769.74	770.18	0.44
386.62	769.54	769.99	0.45
386.20	769.29	769.74	0.45
385.66	769.00	769.45	0.45
385.15	768.76	769.21	0.45
385.00	768.61	769.06	0.45
384.40	767.92	768.35	0.43
383.65	767.16	767.58	0.42
383.00	767.24	767.67	0.43
382.89	767.24	767.67	0.43
381.89	766.86	767.29	0.43
381.20	766.63	767.05	0.42
380.87	766.53	766.95	0.42
380.28	766.32	766.74	0.42
379.53	766.04	766.46	0.42
379.00	765.88	766.30	0.42
378.85	765.69	766.11	0.42
378.70	765.63	766.05	0.42
378.26	765.42	765.83	0.41
377.43	764.35	764.71	0.36
376.76	763.37	763.70	0.33
376.11	762.95	763.28	0.33
376.00	763.13	763.47	0.34
375.71	763.15	763.49	0.34
375.33	763.08	763.42	0.34
375.07	763.00	763.34	0.34
374.76	762.94	763.28	0.34
374.43	762.82	763.16	0.34
374.14	762.73	763.06	0.33
374.11	762.69	763.03	0.34
374.02	762.68	763.02	0.34
374.00	762.68	763.01	0.33
373.79	762.63	762.96	0.33
373.46	762.53	762.86	0.33
373.40	762.51	762.85	0.34
373.15	762.43	762.76	0.33
372.86	762.31	762.64	0.33
372.61	762.17	762.50	0.33
372.58	761.92	762.24	0.32
372.47	762.05	762.37	0.32

Exhibit 2.20

Future Conditions With Project Impacts to 1993 Flood Water Surface Elevations

River Mile	1993 Maximum WS Elev Without Project (Ft)	1993 Maximum WS Elev With Project (Ft)	Δ Max WS Elev (Ft)
372.13	761.89	762.21	0.32
372.00	761.79	762.10	0.31
371.83	761.57	761.88	0.31
371.47	761.40	761.70	0.30
371.14	761.10	761.39	0.29
370.83	760.86	761.15	0.29
370.54	760.33	760.58	0.25
370.50	760.27	760.53	0.26
370.26	759.91	760.15	0.24
369.96	759.46	759.68	0.22
369.66	759.29	759.50	0.21
369.38	758.95	759.15	0.20
369.05	758.56	758.73	0.17
368.73	758.41	758.57	0.16
368.48	758.09	758.24	0.15
368.19	757.59	757.71	0.12
367.89	757.33	757.44	0.11
367.57	757.39	757.50	0.11
367.50	757.34	757.45	0.11
367.40	757.30	757.41	0.11
367.36	757.28	757.38	0.10
367.30	757.25	757.35	0.10
367.03	756.76	756.84	0.08
366.75	756.72	756.80	0.08
366.48	756.60	756.67	0.07
366.23	755.63	755.66	0.03
366.20	755.44	755.45	0.01
366.15	755.20	755.20	0.00

Exhibit 2.21



Designed: EDS
Checked: MMW
Date: 7/22/2006

CENWK-EC-HH **6 Sep 2006**

MEMORANDUM FOR RECORD

SUBJECT: MRLS R471-460 Design Deficiency Investigation

1. Purpose of this MFR. The purpose of this MFR is to document the procedures that have led to a determination of design deficiency of the original MRLS R471-460 design.

2. Background. The St. Joseph Levees Feasibility Study is addressing the need for improved reliability for levees L455 and R471-460 of the Missouri River Levee System in the vicinity of St. Joseph, Missouri. The existing conditions investigation has identified that Unit R471-460 is currently performing at a reliability much lower than designed in 1965. The USACE Headquarters Policy Compliance Review Letter dated 31 August 2006 has brought into question the original design adequacy of the subject levee.

3. Problem. As stated in the 1947 *Missouri River Agricultural Levees Definite Project Report - Appendix I, Hydrology* the design discharge at St Joseph was 325,000 cfs. This was a design flow and was not associated with any frequency at that time. MRLS Unit R471-460 was overtopped in the 1993 Flood along the Missouri River. The exact flow that overtopped R460-471 in 1993 is unknown. However, from timelines kept by USACE liaisons and the local drainage district it is documented that overtopping began at 1600 on 7/24/1993. Catastrophic failure is estimated to have occurred at 0200 on 7/25/1993. The USGS recorded an actual stream measurement at the St Joseph Gage location as 268,000 cfs at 1445 on 7/24/1993. Thus a recorded flow of 268,000 cfs was recorded approximately 1 hour and 15 minutes prior to initial overtopping. This flow, much lower than the stated design flow, is a good estimate of the maximum flow that the levee could pass before overtopping and subsequent failure.

4. Design Flow History of MRLS R471-460. As stated in the 1947 *Missouri River Agricultural Levees Definite Project Report - Appendix I, Hydrology* the design discharge at St Joseph was 325,000 cfs. *Appendix I, Hydrology* was submitted to the Chief of Engineers for approval in August 1946 recommending a design flood discharge at St. Joseph of 293,000 cfs, with 2 ft of freeboard. In a letter to Missouri River Division (MRD) dated 17 Dec 1946, the Chief's office recommended a revised design flow of 355,000 cfs. On 19 March 1947, MRD responded by letter proposing a design flow of 325,000 cfs. The Chief's office approved this design discharge by letter dated 18 Apr 1947. This was a design flow and was not associated with any frequency at that time. However, Enclosure 2 of *Appendix I* in the 1947 DPR identified the natural 100-yr discharge as 255,000 cfs and the 100-yr discharge modified by Fort Peck as 250,000 cfs. No 500-year frequencies were reported in this enclosure to *Appendix I*. However, these numbers included within the hydrology appendix to the 1947 DPR indicate that the project was originally authorized for a discharge (325,000 cfs) that was well above the known 100-yr discharge at the time. The 1965 R471-460 General Design Memorandum (GDM) also included the design discharge of 325,000 cfs.

By the time the two St Joseph projects (R460-471 and L455) were constructed in 1962-1968, the *Missouri River Agricultural Levee Restudy Program – Hydrology Report* was published (March 1962). This report re-addressed flood frequencies on the Missouri River. The flood frequencies generated in the 1962 Restudy provided the basis for Flood Control Studies, Flood Insurance Studies, and FEMA maps for the next 40 years. The 1962 Restudy, taking into account the Missouri River Mainstem Reservoirs, reported that at the St. Joseph gage the 500-year discharge was 330,000 cfs and the 100-year discharge was 270,000 cfs. Thus before the projects were constructed the anticipated level of protection was nearly 500-year. The recent Upper Mississippi River System Flow Frequency Study (UMRSFFS, 2003) results indicate that flow frequencies in the St. Joseph area have not changed much from the 1962 study. The UMRFFS discharges are 324,000 cfs for the 0.2% chance (500-year) event and 260,000 cfs for the 1% chance (100-year) event. Thus with hydrology remaining fairly constant over the past 60 years, the focus of design deficiency analysis has been on hydraulic modeling.

5. Outline of Investigation Process. The R471-460 design profile assumptions were attempted to be re-created using available data and design information from the Levee Unit R471-460 General Design Memorandum (GDM) dated December 1965. Exhibit I of the GDM outlines the process used to develop the top of levee profile and alignment. The alignment was chosen such that the minimum floodway width adjacent the length of the levee should not be less than 3000 feet. The top of levee profile was computed by a backwater computation using Manning's n-values of 0.025 and 0.050 for channel and overbank areas, respectively. Cross-section and channel geometry data used in these computations were not located. However, detailed mapping of the Missouri River created in 1974 (six years following levee construction) was located. This 1974 mapping was used for the Missouri River Restudy completed in 1976, which resulted in FEMA mapping of the Missouri River.

Cross-sections from the 1976 Missouri River Restudy were entered into HEC-RAS for a reach extending from RM 425.44 – RM 465.59. The 1976 Missouri River Restudy cross-sections included dike geometry within the model. It was assumed that the design channel n-value, 0.025, used in the 1965 GDM was slightly high for the Missouri River channel and must have accounted for a composite n-value that included dikes as additional channel roughness. Therefore, the dike geometry was removed from the 1976 cross-section data in an attempt to reproduce 1965 design assumptions. The 1965 n-values were then applied to the HEC-RAS model to best re-create the design assumptions of 1965.

The design top of levee profile elevations taken from the 1965 GDM were compared to current surveyed elevations taken from a field survey conducted by the Kansas City District Survey Section in 2003 to ensure that the existing levee is built to design criteria. The surveyed top of levee elevations are slightly above the design top of levee elevations along the length of Unit R471-460. Therefore, the existing levee meets or exceeds the design top of levee profile.

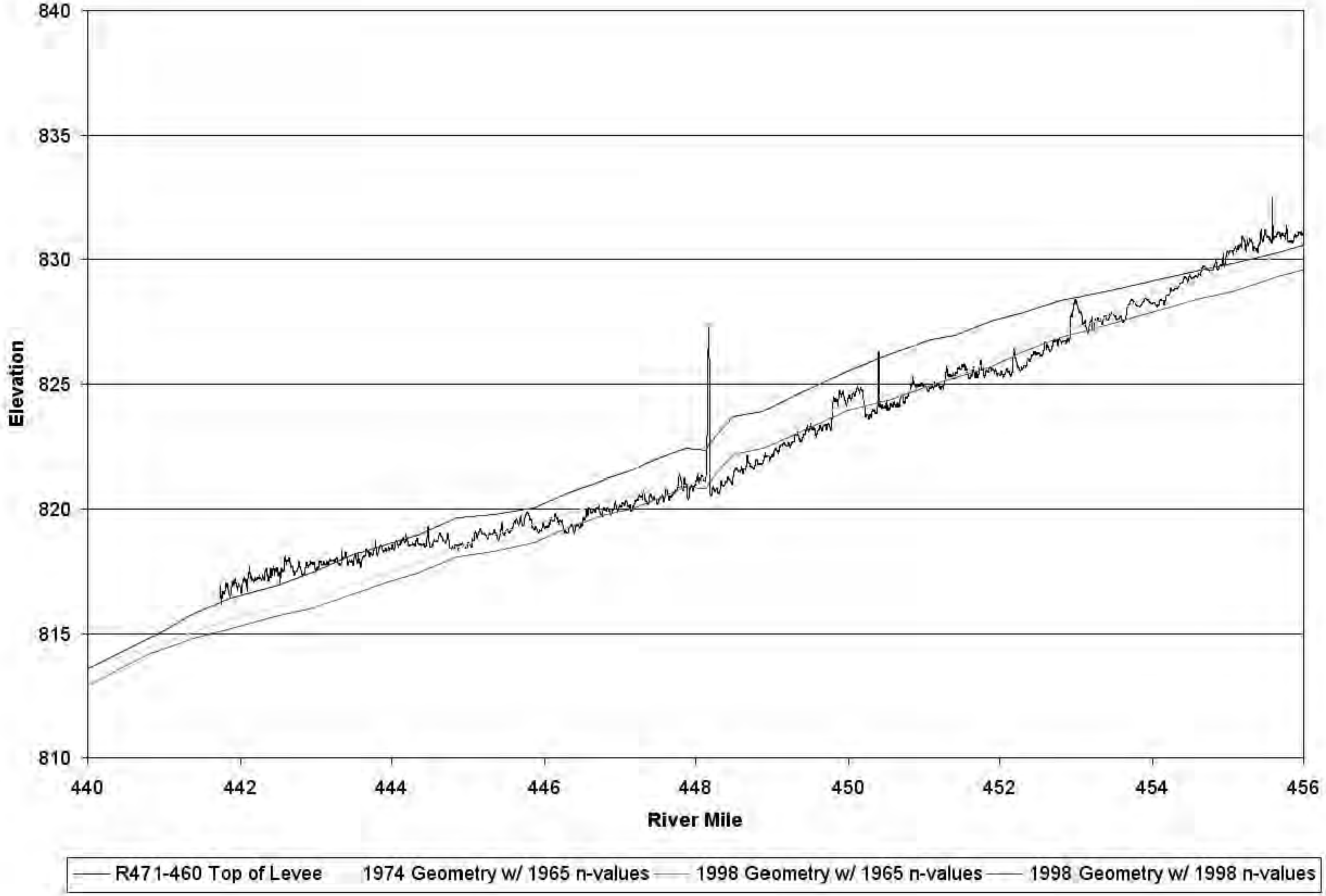
Plate 1 displays the HEC-RAS modeled design flow water surface profile using geometry from 1974 and design n-values from 1965. This profile, which lies above the top of levee, is the best attempt to model the assumptions used for design in 1965. The design flow was also modeled using the existing conditions geometry generated for the St. Joseph Feasibility Study using 1998 Missouri River Mapping with n-values from the 1965 GDM. The close agreement between the profiles for the 1974 geometry and the 1998 geometry with the 1965 n-values indicate that changed channel geometry has not been a significant contributor to the inadequacy of the existing levee. For comparison purposes, the design flow was run using the existing conditions geometry and n-values generated for the St. Joseph Feasibility Study. The 1998 existing conditions n-values were calibrated to the UMRSFFS UNET unsteady flow hydraulic model profiles which were calibrated to 1993 high water marks and gage data.

6. Results. A flow of approximately 268,000 cfs overtopped MRLS Unit R471-460 during the 1993 Flood. This flow was approximately 60,000 cfs less than the design flow of 325,000 cfs used in the 1965 design profile for Unit R471-460. The design top of levee was set at an elevation between two and three feet above the design water surface profile to allow for two feet of freeboard along the length of the levee and up to one foot of dynamic effects at certain locations along the levee. This low overtopping flow raises concerns as to the original design top of levee elevation. In an attempt to recreate the original design assumptions, historical cross section data (1974) gathered shortly after the time of levee construction (1968) was combined with n-value assumptions from the original design documentation. This modeling produced a water surface profile for the design flow that is above the top of the constructed levee without any consideration of freeboard. The modeled design flow profile coupled with the 1993 overtopping at a flow much lower than the design flow has led to the determination of design deficiency in the top of levee profile for MRLS Unit R471-460.

Eric Shumate, P.E.
Hydraulic Engineer
CENWK-EC-HH

Exhibit 2-22

Plate 1. MRLS R471-460 Historical Profile Comparisons Using Original Design Discharge = 325,000 cfs



3.1 INTRODUCTION

The Geotechnical support to the Missouri River Levee Systems (MRLS) L-455 and R 471-460 Feasibility Study focused on establishing the geotechnical existing condition and developing the selected plan. The selected plan provides flood protection against the 100-year plus 3-feet flood profile. Geotechnical input was also provided for alternative screening. Alternative screening is addressed in more detail within the main body of the study.

3.2 EXISTING FLOOD CONTROL WORKS DESCRIPTION

Both MRLS L-455 and R 471-460 levees are about 13 miles in length. MRLS L-455 protects a portion of St. Joseph. MRLS R 471-460 protects Elwood, KS and the Rosecrans Memorial Airport. Both flood control units protect large agricultural areas. The project features most relevant to geotechnical concerns are listed in Table 1. Both levees have a combination of stability berms (both riverside and landside) and landside seepage berms.

Table 1. Project Features

Item	L-455	R 471-460
Levee (linear feet)	71,644	72,800
Height (feet), Range	5 – 22	7 – 18 (17 – 26 at Relief Wells)
Height, Typical	13.5	14.2
Relief Wells	34	20
Typical side slopes	3H:1V	3H:1V
Top Width (feet)	10	10
Pumping Plant	2 cfs	-
Drainage Structures	27	12
Sand bag closures	4	0

3.3 PROJECT SITE CONDITIONS

The project site over most of the levee alignments consists of relatively level to slightly undulating agricultural fields situated in the Missouri River flood plain. Most of the foreshore areas, riverside of the levee, are wooded. Some of these foreshore areas were previously cultivated, but have recently been converted to natural floodplain woodlands, through the wetlands reserve program. The majority of the levee length is located in these agricultural fields with relatively typical heights.

There are numerous areas where previous channels have been filled in the levee foundation. The most significant is the MRLS R 471-460 crossing of the old oxbow that forms Browning Lake. This reach includes 20 relief wells. Locations where smaller tributary channels have been filled are shown on the drawings. Near Contrary Lake, the levee passes through a narrow section that subdivides the river from the lake. There are also two filled scour holes on MRLS R 471-460 from the breach that occurred during the 1993 flood. The upstream breach removed about 1100 feet of levee, scouring a hole about

1000 feet landward, and up to about 45 feet maximum depth. Tributary inlets include Contrary Creek and Browns Branch on MRLS L-455, and Peters Creek on MRLS R471-460.

3.4 PROJECT SITE GEOLOGY

St. Joseph, MO lies within the Dissected Till Plains of the Central Lowlands physiographic province of Missouri. The overlying soils in the upland areas consist of glacial till and loess of Pleistocene age. The Nebraskan and Kansan glacial advances (1.5 to 3 million years ago) leveled the topography of northern Missouri. The last two ice advances, the Illinoisan and Wisconsinian had no direct physical presence in northwestern Missouri, but added a thick layer of loess to the deposits of glacial till already present. The loess deposits are highly erodible soils that contribute sediment to low gradient and turbid prairie streams that are typical of the region.

MRLS L-455 and R 471-460 levees are founded on more recent alluvial sediments within meander belts of the Missouri River. Alluvial deposition and erosion that occurred during the changing course of the river has formed a complex system of soil conditions within the Missouri River floodplain at the project vicinity. Landform features in the project area are indicative of the active meander activity of the Missouri River, before revetments and channelization of the river stabilized it. Contrary Lake (on the L-455 levee) and Browning Lake (on the R 471-460 levee) were both formed by segments of abandoned channel. Past river meanders have left a system of buried channels, oxbow lakes, and sloughs. The meander activity also creates uncertainty in geologic interpretation of soil stratigraphy, since channel erosion and infilling creates discontinuities in the horizontal bedding of soils.

The predominant soil conditions on both levees consist of a typical alluvial plain that includes a thick deposit of pervious sand overlain by a surficial blanket of clay or plastic silt. Bedrock within the basin consists primarily of shale beds, limestone, and sandstone. The underlying bedrock forms a relatively impervious boundary influencing groundwater flow that affects levee underseepage. These predominant soil conditions are conducive to levee distress from underseepage during flood events; and also conform to the basic model for underseepage analysis. There are also some areas where weak cohesive soils directly underlay the foundation of the levee, requiring stability berms that were incorporated into the existing levee, and prompting concern regarding adequacy of slope stability.

3.5 LEVEE PERFORMANCE DURING PAST FLOOD EVENTS

There is a USGS gage (#06818000) located in St. Joseph, just upstream of the railroad bridge. The top 5 historical crests are listed in Table 2. Data was obtained during the flood of 1952 from the existing private levees at the time, and was used during design of the present levees. The 1993 flood is the most recent of the top 5 crests, and exceeded the 1973 and 1979 floods by over 6 feet. Performance of the levees during the Flood of 1993 provides a performance record with water essentially at or near the top of levee.

Table 2. Historical Crests for Missouri River at St. Joseph

Date	Stage
07/26/1993	32.07
04/29/1881	27.20
04/22/1952	26.82
03/03/1979	25.78
10/13/1973	25.63

3.5.1 MRLS R 471-460—Flood of 1993

Overtopping of MRLS R 471-460 levee occurred over a reach of about 5 miles, beginning at and extending upstream of the railroad crossing (at Station 404+30). The freeboard was not consistent, so the depth of overtopping varied from no overtopping to about ½ feet depth through this 5-mile reach. Air photographs show that much of the levee was completely submerged after the upstream breach flooded the interior areas landside of the levee.

The MRLS R 470-460 levee reportedly performed satisfactorily until it was overtopped. The St. Joseph Airport Levee District indicated there were no observations of sand-boils. In particular, the Levee District indicated there were no observations of piping or stability problems near the upstream breach area. The breach occurred during the night, and there were no witnesses that observed exactly how the levee unraveled. The evidence suggests that levee breach resulted entirely from erosion of the earth fill from water passing over it.

There was one area of heavy seepage where sheet-flow drained away from the levee, located on the north side of the levee access road at Station 270+00. A photograph of this area is shown on Figure 7. Gravel is present on the surface of the recently disked agricultural field in a zone from about Station 266+00 through station 270+00, and extending about 50 to 100 feet from the landside levee toe. There was about ¾ inch rainfall in the area the night prior to the inspection. The gravelly zone was lighter in color from less moisture, indicating a difference in soil texture and/or a thin topsoil stratum in this area. The GIS air photograph also shows a light colored area at this location over about a 900 feet reach.

There are no readings from the piezometers, observations of relief well discharges, or freeboard gage records from the 1993 flood.

Several photographs showed erosion of a channel (estimated at its maximum to be about 3 feet deep) along the levee centerline and leaving turf-covered slopes intact. Water was running in the erosion channel parallel to the levee and exiting down field access ramps. The field access ramps were also eroded, similar to the levee crown.

Figure 7. Heavy Seepage Area at R 471-460, Sta. 270+00.

3.5.2 MRLS L-455—Flood of 1993

MRLS L-455 levee had two areas of sand boil activity. The first area occurred in the Lake Contrary lakebed, and was not known until several years after the flood event. The local farmers observed circular depressions in the lakebed at the West end of Lake Contrary. The depressions were dish shaped, about 1-1/5 feet deep and 10 - 12 feet in diameter. These are thought to be remnants of significant sand boil activity. However, they occur about 1000 feet from the levee, and are not considered to provide a threat to the levee.

Some small sand boils were observed near the east end of Lake Contrary during the Flood of 1993. The boils first developed near a stage of 24, and the intensity did not seem to increase as the river level crested at stage 32.1. The boils were ringed with a single course of sand bags. It appears that the sand boils initially blew out some material from the blanket and then developed into concentrated seeps. The area of the sand boils is indicated in the two photographs (Figures 8 and 9), shot from the same approximate location. The levee is about 200 – 300 feet from the sandboils, and curves away from the lakeshore off the left side of the photographs.

The South St. Joseph Levee and Drainage District noted a soft wet area along the levee toe near the access ramp at Levee Station 137+43. An area about 200 –300 feet to the southwest was reported as very soft. It is likely that many other soft areas similar to this occurred, but were not observed in areas without traffic.

In 1993, two storm sewer outfalls on Brown's Branch had rubber valves. The rubber valve on a 30" RCP at Sta. 26+66 turned inside out during the flood. These were replaced with flap gates.

Figure 8. Ringed Sand-boils during Flood of 1993.

Figure 9. Vicinity of 1993 Sand-boils, as photographed in 2004.

The South St. Joseph Levee and Drainage District took freeboard readings daily during the Flood of 1993, but did not read piezometers or monitor relief well discharge. However, the relief wells discharge plenty of water to the point that it is a concern for interior drainage.

3.5.3 Contrary Creek Slide Failure

MRLS L-455 levee ends just below a railroad overpass on Contrary Creek at Station 716+44. A total of 12.62 inches of rainfall at St. Joseph was recorded on 7 - 10 June 1984, with over 7 inches on 8 June. High flows in Contrary Creek eroded the channel bank downstream of the railroad bridge. The toe scour initiated a deep-seated slide of the cohesive bank that encroached on the lower portion of the levee prism. The slide was repaired under PL 84-99 funding. The repair included riprap to prevent future scour, but the slope failed again following a 2.24 inch rainfall event on 17 May 1986. The second failure was likely due to rapid drawdown conditions in remolded soils in a weakened condition from the initial failure. The slope was again repaired with PL 84-99 funding. The second repair included 3 “baffle dikes” that consisted of rock filled trenches excavated into the slope (transverse to the levee alignment).

3.5.4 Peters Creek Scour Repairs

There have been at least 2 instances where scour has been a concern at Peters Creek, on Levee MRLS R 471-460. The bank was restored at Stations 7+65 to 8+50 under contract DACW41-85-Q-0191, issued 20 Feb 1985. This work placed 100 CY of fill and 780 TN of rockfill. Another concern regarding bank scour was documented in a request of PL 84-99 assistance from the Elwood-Gladden Drainage District on 19 August 1987. This concern was located at Sta. 708+00 to 711+00. The request was denied since the distress was documented in periodic inspection reports, and was considered to be operations and maintenance related.

3.6 POTENTIAL MODES OF FAILURE

The National Academy of Science[1] has noted that the Corps has many years of experience with levee performance (including levee failures), and that much of this experience is accessible. However, this experience is difficult to quantify. The Flood of 1993 provides an ideal case history potential because it met or exceeded the design flood of many levees, it covered a large region, and it is relatively recent. Yet, the post flood report provided no direct interpretation for the cause of levee failures. In most cases the cause of the breach was not listed. Non-federal levees, where most of the failures occurred, were summarized in lesser detail than the Federal levees. In many cases, perhaps most cases, the actual breach of the levees occurred at night and/or without observation. Post mortem speculation on the cause of breaches lead to controversy, and in some cases far-fetched scenarios. The only conclusion that can be drawn from the 1993 flood is that the case

[1] Risk Analysis and Uncertainty in Flood Damage Reduction Studies, National Academy Press (2000).

histories do not discredit long-standing engineering assumptions regarding levee performance.

In spite of shortcomings, there is some information available for the 1993 flood:

a. Within the St. Louis District, 39 federal levees were breached/overtopped out of a total of 229. Ten federal levees were severely damaged by floodwaters. Of these ten, “eight were overtopped and two were breached while the river was above the design flood flowline, but within the levee freeboard.” It is not clear how the levees could overtop if the water level was within the freeboard. About 80% of the private levees were overtopped or breached.[2]

b. Within the Rock Island District, boils were observed at nearly all of the sand levee projects. The boils were concentrated at berm toes inside curves, and at groves of trees. Sinkholes developed on berms typically at distances of 10 to 75 feet riverward of berm toe boils. Some sinkholes progressed up the levee slope. The report indicates, “Many levee districts experienced inundation as a result of overtopping or breaks in the levees.” It lists 15 federal levees and 10 non-federal levees, but does not resolve the cause of inundation.[3]

c. Within the Kansas City District, sandboils were observed landward of five levee units. “Six of the MRLS units were substantially overtopped resulting in four of them being completely breached by erosion of the levee embankment by overtopping scour”. Four levee units incurred sloughing, which was attributed to rapid drawdown conditions. Sinkholes, caused by pipe joint leakage and subsequent piping of the adjacent soils, were observed at six levee units.[4]

In spite of a large number of levees with observed sandboil activity, levees seldom fail from underseepage. The Kansas City and Omaha Districts recognized this in a meeting on underseepage in 1962[5]. During the Flood of 1993, there was only one breach on Federal levees definitely linked to seepage distress (Kaskaskia Island).[6, 7] Flood fight efforts are usually successful in identifying problems and stabilizing the distress. Minor sandboils sometimes occur if a landside blanket heaves and cracks; and these may heal over time. Also, levees are resilient since they tend to display signs of underseepage distress before they reach a collapse state.

It is clear that the predominant cause of inundation behind levees is overtopping. Nevertheless, premature levee failures due occur. In cases where geotechnical levee failure observations and/or data are available, post mortem failure analyses frequently link

[2] The Great Flood of 1993 Post-Flood Report, Appendix C, September 1994.
[3] The Great Flood of 1993 Post-Flood Report, Appendix B, September 1994.
[4] The Great Flood of 1993 Post-Flood Report, Appendix E, September 1994.
[5] Meeting at MRD on Underseepage Control on Agricultural Levees, CENWK files, 27 Nov. 1962, 11pp.
[6] The Great Flood of 1993 Post-Flood Report, USACE, Sept. 1994.
[7] Mansur, C. , G. Postol & J. Salley, Performance of Relief Well Systems Along Mississippi River Levees, J. of Geot. & Geoenv. Eng, ASCE, Aug. 2000.

failures to multiple causes. In many cases, the failure mode is complex and the predominant cause is speculative.

3.7 EXISTING CONDITIONS

3.7.1 General

The feasibility study will assess the economics of raising these levees. Potential projects will be considered by selection of an optimal NED (National Economic Development) plan, which seeks to optimize the benefit/cost ratio. The economics analysis will consider the baseline conditions by preparation of a river stage-flood damage analysis for the existing levees in their present condition. This analysis considers the potential for the levee to breach before it is overtopped.

In order to assess the potential for premature levee failure (other than by overtopping), a risk-based analysis of levee reliability has been made in conformance with ER 1105-2-101. The risk-based analysis is based on an engineering analysis with a probabilistic approach using likely failure modes, as described in ETL 1110-2-556. The reliability analysis has been based on failure modes of underseepage and slope stability. Most of the risk is associated with underseepage. Likewise, most of the emphasis of the analysis herein is placed on underseepage.

The results have been presented in a format of charting the probability of failure as a function of the remaining levee freeboard. These results are included in the Results section of the report. In general, the levees have a low probability of failure, as demonstrated by adequate performance during the flood of 1993.

ER 1105-2-101 states "the ultimate goal is a comprehensive approach in which the values of all key variables, parameters, and components of flood damage reduction studies are subject to probabilistic analysis." This report has used judgment to eliminate unlikely causes and focus on those failure modes considered most significant. For this reliability analysis, two predominant failure modes have been analyzed independently. These failure modes include underseepage and slope stability. Other common failure modes include through-seepage and settlement.

3.7.1.1 Underseepage

The presence of a deep pervious stratum and overlying blanket of fine, cohesive soils makes the levee susceptible to underseepage. Underseepage was a significant concern of the designers, and its relevance is apparent by identification of the typical site geology. Based on the analysis, the most likely geotechnical failure mode (other than by overtopping) of these levees would be initiated by a condition of severe piping.

3.7.1.2 Through Seepage

Through-seepage is categorized as seepage primarily passing through the levee as opposed to passing beneath it. Through-seepage distress is characteristic of sand levees. The L-455 and R 471-460 levees are constructed from clay soils, and are not prone to through-seepage problems. This is substantiated by observations during the 1993 flood. The only area where seepage was observed near the face or toe of the levee was near Station 270+00 on R 471-460. The landside blanket is known to be nearly absent in this area, leading to a prognosis of underseepage. Through seepage was not analyzed as part of the reliability analysis.

3.7.1.3 Slope Stability

Slide failures occurred during construction of the neighboring downstream levee unit L 448-443, just on the opposite side of Contrary Creek. These slide failures were attributed to presence of soft alluvial clays in the levee foundation and channel excavation combined with end-of-construction loading conditions. This area of soft foundation soils at L 448-443 extends across the Contrary Creek channel into the L-455 levee. The relief well fields on both projects are also situated in areas with soft foundation clays. Another slide failure occurred at Station 713+00 of L-455 that was initiated by erosion. Portions of the levee foundations are situated on soft alluvial clays that are a concern for stability of the levee.

The soft alluvial clays are most susceptible to slope failure during end-of-construction conditions due to rapid loading. The pore pressures dissipate over time, resulting in strength gain and increased stability of these levees. The end-of-construction condition is not a concern for the existing levees. However, it may be a concern that would require further analysis if the levees were raised a substantial amount.

Rapid drawdown increases loading conditions on the levee due to saturated soils in the embankment. The saturated soils increase the weight of the embankment and form seepage forces as it drains. Rapid drawdown is manifested by riverward slides. These forces are not activated until the river level recedes from its crest. The risk of inundation and property damage decreases as the river level recedes. Since the purpose of the levee reliability analysis is linked to economic damages, rapid drawdown was not considered as a failure mode.

Steady state seepage conditions peak as the river level crests. Steady state seepage is manifested by landward slides. Softening of the landward blanket caused by uplift and piping activity along the levee toe, may also contribute to sliding instability. The steady state seepage failure mode was investigated by reliability methods.

3.7.1.4 Settlement

The top of levee profile indicates that overtopping does not occur uniformly, and does not show superiority at the upstream end. The inconsistent levee profile is due to a number of sources. It may be related in part to settlement at select locations. Since the levees have been in place for over 40 years, and the foundation soils susceptible to consolidation are generally less than 20 feet in thickness, future settlement should be small in proportion to that which has already occurred. The existing levee profile is being addressed by overtopping analysis, and was not considered as a geotechnical failure mode.

3.7.1.5 Other Risks

Experience on the Upper Mississippi River – Illinois Waterway System Navigation Study has shown that many geotechnical failures, or unsatisfactory performance events that require repair or cause damages, result from unanticipated failure modes that were not analyzed in the design. There are other series of events (not captured in the probabilistic analysis) that could potentially result in levee failures. Some of these additional risks that compromise levee reliability are discussed.

a. Closures. There are gaps in the levees that require sandbag closures. There is risk associated with proper and timely placement of sandbag closures.

b. Outlet Gates. There are outlet structures in the levees for storm runoff and sanitary sewage. The outlets consist of reinforced concrete pipe with flap gates or sluice gates. There is risk that a flap gate may be lodged with debris and leak, or that a sluice gate may seize or not close securely. For the large ponding areas behind these levees, leaking gates would have minor consequences.

c. Piping at Outlets. Piping problems tend to be exacerbated at structures since the interface disrupts the soil fabric, the structure alters the stress state in the ground, the pipes allow roofing or formation of voids due to settlement or piping action, and compaction of soils is difficult around pipes and structures. Leaking pipe joints due to settlement or concrete degradation can result in loss of material around the pipe. There is no available performance function for assessing the potential for piping at the outlets, as the problem seems to have characteristics of random events. In most cases the outlets will be present with or without the levee project, so the consequences of failure would cancel out in the economic analysis.

d. Scour. Numerous areas were repaired subsequent to the 1993 flood where the grass vegetation had been eroded. Scour areas on the levee tended to occur near perturbations in the flow, such as near field access ramps or ditches/spoil piles. Several scour areas about 5 feet deep occurred in open fields. Changed conditions between the 1993 flood and the next flood event may result in changes of scour manifestation. The 1993 flood crested (Figure 1) in late July when the upper portions of the levee riverward slope had healthy turf cover. The turf cover during a spring flood may not be as resistant to erosion. New wooded areas in the foreshore that have been diverted into the wetlands reserve program could alter flow velocities or current patterns near the levee. Debris or ice jams could also cause localized scour by damaging the grass cover or redirecting the current. Pump outwash improperly spilled over the levee crest could initiate erosion of the levee. There is risk that a scour area below the water level could go undetected until it causes a slide, or collapse of the levee crown.

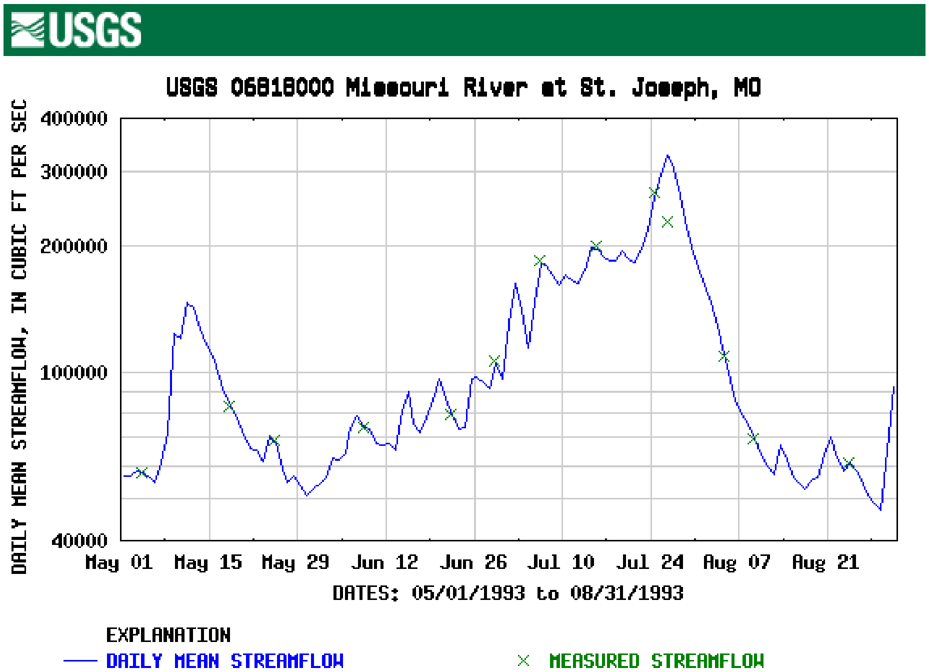


FIGURE 1. HYDROGRAPH AT ST. JOSEPH FOR 1993 FLOOD

e. Power Poles. Present design guidance strongly discourages power poles located within the levee prism, including berms. There are a series of large power poles for a high voltage line near the downstream end of the L-455 levee. The power poles may interfere with flood fight efforts, they tend to concentrate seepage and the formation of boils if located near the landside toe, and they are prone to instability during floods due to saturated ground and upward gradients. The enigma of power poles and trees in levees is that the only time they become unstable is when the river crests – the very time that their toppling failure poses a flood threat. There is risk that overturned power poles could lead to a levee breach.

3.7.2 Analysis Methodology

3.7.2.1 Reliability Analysis

The reliability analysis followed concepts described in ETL 1110-2-556. The reliability analysis proceeds by using a conventional engineering analysis. A failure mode is assumed; and the critical state of impending failure is expressed as a factor of safety, or ratio of capacity/demand. The reliability analyses conducted in this study used the first-order second-moment (FOSM). The FOSM method uses a first order Taylor's series expansion to calculate derivatives of the performance function, and only uses the first two moments of the normal distribution. The first moment is the mean, and the second moment is the variance (or standard deviation).

A probabilistic analysis must be based on a performance function. The performance function defines the failure criteria by either a factor of safety, or capacity-demand ratio. For slope stability, the limit state is taken at a factor of safety of 1. For underseepage, the capacity – demand ratio is used. The demand is defined by the calculated upward gradient. The capacity has been adjusted beyond the critical gradient to provide an estimation of failure that is more closely associated with conditions incipient to a levee breach.

The capacity for underseepage is based on a value linked to severe sand boil activity incipient to levee failure. If the capacity were based on the critical gradient, the performance function would predict the occurrence of (at a minimum) a low consequent event defined by initiation of sand boil activity. This would lead to an event tree, whereby some probability of events could be linked to high, medium or low consequences resulting from the occurrence of sandboil activity. An event tree could also be applied to estimate high or medium consequences resulting from severe sandboil activity incipient to levee failure, but it has been neglected from this analysis.

3.7.2.2 Underseepage Analysis

3.7.2.2.1 Factors of Safety

There are two factors of safety applicable to underseepage. These are the uplift factor of safety and the gradient factor of safety. These two factors of safety are defined here since they are both mentioned in subsequent discussions.

The uplift factor of safety (FS_g) is derived by analyzing forces acting on the base of the blanket layer,

$$FS_{up} = W/u, \qquad (1)$$

where W is the total weight of the overlying blanket layer, and u is the uplift pressure acting on the base of the blanket. The gradient factor of safety is derived as the ratio of the critical gradient (i_{cr}) to the calculated gradient (i),

$$FS_g = i_{cr}/i. \qquad (2)$$

If the piezometric level above the ground surface (H_g) and the blanket layer thickness (Z_{bl}) are known, as indicated in Figure 2, then the factors of safety are:

$$FS_g = \frac{\gamma_{sat} \cdot Z_{bl} - \gamma_w \cdot Z_{bl}}{\gamma_w \cdot H_g}, \qquad (3)$$

$$FS_{up} = \frac{\gamma_{sat} \cdot Z_{bl}}{\gamma_w \cdot H_g + \gamma_w \cdot Z_{bl}}, \qquad (4)$$

where γ_{sat} is the saturated unit weight of the blanket soil, and γ_w is the unit weight of water.

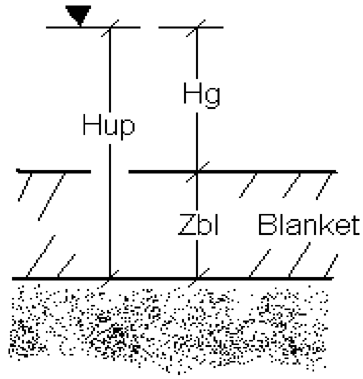


FIGURE 2. Uplift Pressure on Bottom of Blanket Layer

These two factors of safety have different characteristics:

a. For a uniform blanket layer at limit state conditions, $FS_{up} = FS_g = 1$. Since the factors of safety converge at the limit state, recent Corps practice has been to only address the gradient factor of safety if the blanket layer is relatively uniform.

b. The gradient factor of safety is more responsive, since as $H_g \rightarrow 0$, FSup $\rightarrow (\gamma_{sat}/\gamma_w) \cong 2$, but $FS_g \rightarrow$ infinity.

c. The factors of safety diverge if the layer thickness is transformed as appropriate for variable stratigraphy within the blanket layer.

3.7.2.2.2 Underseepage Calculation Procedure

Underseepage analysis was performed by the methods in EM 1110-2-1913, Appendix B. The equations were completely included within an Excel spreadsheet. The equations to calculate the head at the toe were modified based on an assumed impervious berm. The levee cross sections of the idealized seepage model is shown in Figure 3. The resulting equations are:

$$ho = \frac{X3}{X1 + L2 + X3}(H + H_{TOL} - h_{tw}) + h_{tw} \quad , \qquad i_o = \frac{h_o - h_{TW}}{Z_{bl}}, \quad (5)$$

$$h_1 = \frac{X3 + W_{SP} + W_{SB}}{X1 + (L2 - 3Z_{B1}) + W_{SB} + W_{SP} + X3}(H + H_{TOL} - h_{tw}) + h_{tw} \, , \qquad i_1 = \frac{h_1 - h_{TW}}{Z_{bl} + Z_{B1}}, \quad (6)$$

$$h_2 = \frac{X3 + W_{SP}}{X1 + (L2 - 3Z_{B1}) + W_{SB} + W_{SP} + X3}(H + H_{TOL} - h_{tw}) + h_{tw} \, , \qquad i_2 = \frac{h_2 - h_{TW}}{Z_{bl} + Z_{B2}}, \quad (7)$$

$$h_3 = \frac{X3}{X1 + (L2 - 3Z_{B1}) + W_{SB} + W_{SP} + X3}(H + H_{TOL} - h_{tw}) + h_{tw}\ , \qquad i_3 = \frac{h_3 - h_{TW}}{Z_{bl}}. \qquad (8)$$

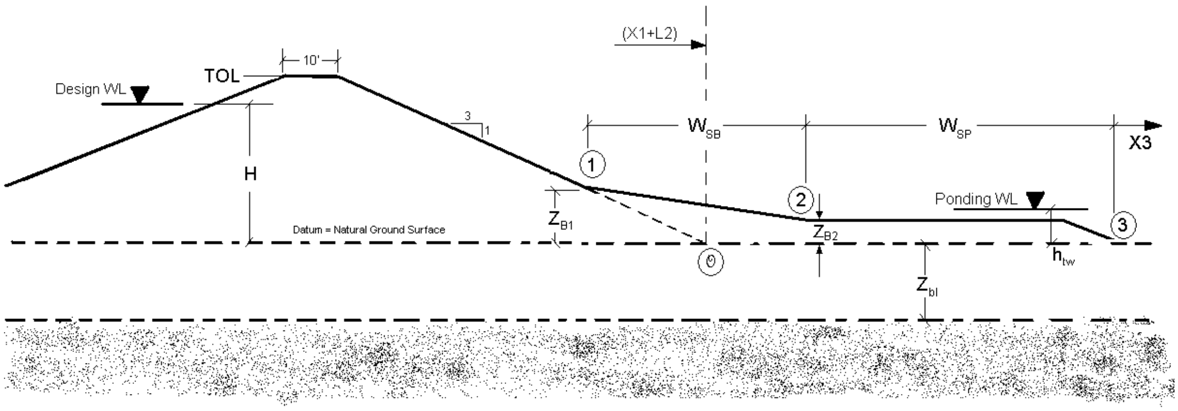


Figure 3. Model for Underseepage Analysis

Reliability was analyzed for all of the original seepage design sections where the data was reported. This was done for several reasons. The first is that the original design sections encompass the critical sections known to the designers, and thus should avoid overlooking critical reaches. The second is that the data was readily available and easily added to an automated spreadsheet. The third is that analysis of a comprehensive set of sections provides additional information on the overall performance of the levee system. Providing a comprehensive analysis of the levee system, rather than just focusing on the critical reaches, has been recommended by the National Academy of Science.[8]

3.7.2.2.3 Extrapolation of the Critical Gradient

The estimation of soil parameters for seepage analysis is complicated by the phenomenon that the effective permeability of the blanket layer over a large area tends to be orders of magnitude higher than the permeability of small samples of soil. Furthermore, the effective permeability of the landside blanket is not constant, but increases as uplift pressure may cause heave and cracking. Heavy seepage will flush out defects and preferential seepage paths in the blanket layer, either existing or introduced from blanket floatation response to uplift pressure.

Flotation factor of safety over a large area cannot be less than 1. If it did, the blanket layer would rise up as a membrane over a bed of water. This cannot occur to any appreciable amount without the blanket cracking and releasing water through concentrated seeps. As the river level raises further, the volumetric seepage quantities increase, and the sandboils are exacerbated by this increase in seepage flow. Increased sandboil activity could be correlated with increase in effective blanket permeability. However, the conventional mathematical model uses constant blanket permeability. Maintaining a constant blanket

[8] Risk Analysis and Uncertainty in Flood Damage Reduction Studies, National Academy Press (2000).

permeability leads to extrapolation of the gradient. This extrapolation is a hypothetical state, and is sometimes emphasized by referring to the "calculated gradient."

3.7.2.2.4 Design Values for Underseepage Analysis

The effective blanket permeability values are influenced primarily by spatial variation and geologic discontinuities that are obscured from direct observation. These are, for practicable purposes, impossible to detect and quantify. For this reason, design parameters have been based on back calculation of blanket permeability values correlated with piezometer readings. These correlations have evolved into design values in EM 1110-2-1913, and ETL 1110-2-555. Based on TM 3-424 Table 37 and 38, the amount of scatter in back calculated values varies widely, so it is difficult to question the original author's judgment in selecting design values. Collective consideration of various design value schemes and physical laws suggests that the following trends are generally applicable to underseepage analysis:

a. The effective permeability can be categorized by soil plasticity, where SM, ML, CL and CH soils have consecutively lower permeability.

b. The effective permeability is related to layer thickness. For moderate permeability soils (SM), the layer thickness affect is moderate. For low permeability soils (CL and CH), the layer thickness affect is more pronounced.

c. The variation (design value uncertainty) is higher for thin blankets, and becomes more consistent for thick layers.

The point at which piezometer readings are taken provides a baseline. The piezometer correlations were generally taken during sand boil activity, or at high river levels close to boil activity. Inconsistency in boil activity during piezometer readings may be responsible in part for the large amount of scatter.

3.7.2.2.5 Surcharge Factor

There are 5 sources that lead to an approximate surcharge factor to estimate a condition of severe sand boil activity incipient to levee failure. This surcharge factor is taken as the ratio (i_{cr}/i_f), where i_{cr} is the critical gradient and i_f is the gradient at "failure."

a. Many of the levees in Rock Island District (prior to 1962) were designed assuming a significant flood fight is justified.[9] The design anticipated that major boils, and hundreds of minor boils, would develop. This was confirmed by significant sandboil activity during the 1993 flood at the Rock Island District. The Rock Island criteria for berms was a calculated gradient factor of safety of 0.7 ($i_c/i = 0.7$). Assuming the factor of safety at failure is $i_f/i = 1$, leads to a surcharge factor of (i_{cr}/i_f) = 0.7.

[9] Rock Island District Levee Practices, MRKED-F Memorandum for Branch File, 25 October 1962.

b. Kansas District experience from the 1952 flood was that seepage was tolerable and near critical state indicated by distributed seepage and pin boils, for computed gradient factors of safety of 0.8. At computed gradient factors of safety of 0.55, the seepage conditions were objectionable, considered dangerous, and required a major flood fight. Adjusting the critical gradient to the field observations, the surcharge factor is $(i_{cr}/i_f) = 0.55/0.8 = 0.6875 \cong 0.7$.

c. St. Louis District back calculated a gradient of 1.35 for the Bois Brule and Kaskaskia Island levee failures that occurred during the Flood of 1993.[10] Both these failures were due to underseepage, and resulted in an actual breach of the levee. In a recent existing conditions report, St. Louis District used this calculated gradient to estimate the occurrence of a high consequence event (defined as a levee breach). Based on a critical gradient of 0.85, the surcharge factor is $(i_{cr}/i_f) = 0.85/1.35 = 0.63$.

d. Considering the TM 3-424 chart of observed seepage conditions (in Figure 9), the severity of seepage, described as light, medium, heavy, and sandboils, is shown to increase for calculated gradients. Extrapolating this chart to a higher level, the factor of $(i_{cr}/i_f) = 0.7$ seems reasonable.

e. Design of berms for MRLS projects in the time frame when L-455 and R 471-460 were designed and constructed using factor of safety criteria dependent on past observations.[11,12] Where major boil activity had occurred during past flood conditions, berms were proportioned to develop a gradient factor of safety of 1 at the berm toe and 1.5 at the levee toe. Although the logic is a little indirect, it can be inferred that the 1.5 factor of safety approximately shifts the boil activity from failure state back to critical state. Using this assumption, the surcharge factor is $(i_{cr}/i_f) = 1/1.5 = 0.6667 \cong 0.7$.

f. Using a value for the surcharge factor of 0.7 produces reasonable results when calibrating to the 1993 flood conditions at L-455 and R 471-460. Calibration to the 1993 flood is shown in Figures 4 and 5. The probabilities of failure at L-455 are less than 5%, so it is expected that no major seepage concerns were reported during 1993. At R 471-460, there were a few sections with higher probabilities of failure, but since the levee overtopped, there were not reliable observations of seepage conditions at design flood elevation.

[10] Private communication with Mr. Edward Demsky, CEMVS, 19 July 2004.
[11] Design Memorandum No. 1 - Underseepage Control – Levee Unit 400-L, including Appendices I and II, 20 November 1953.
[12] Design Memorandum No. 1 - Underseepage Control – Levee Unit 476-L, revised 24 March 1954.

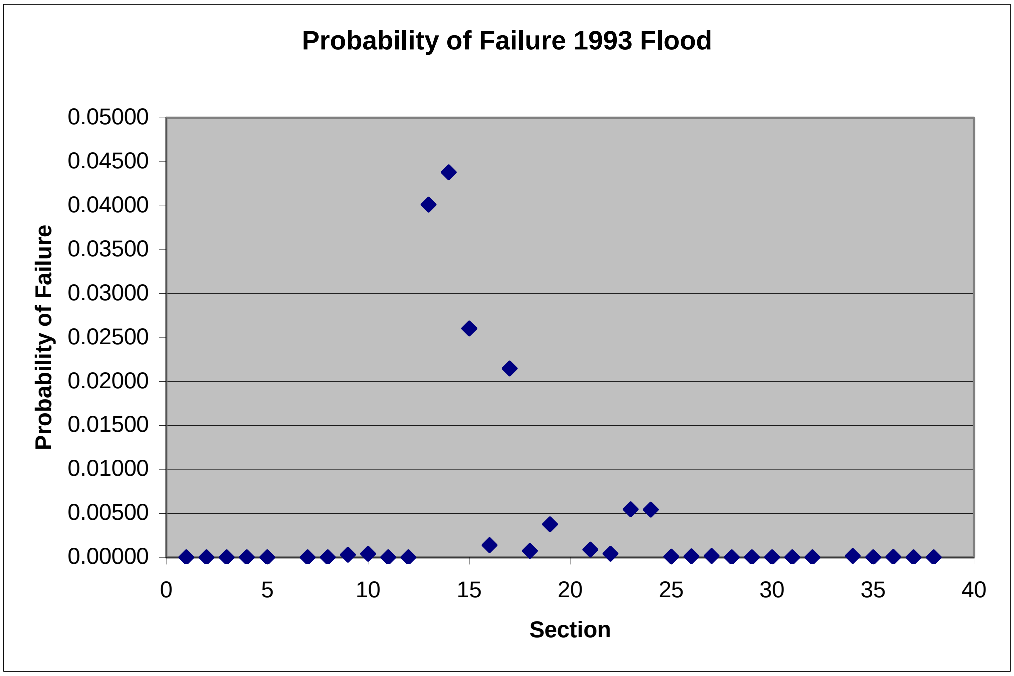


FIGURE 4. Probability of Failure Calculated for 1993 Flood at L455

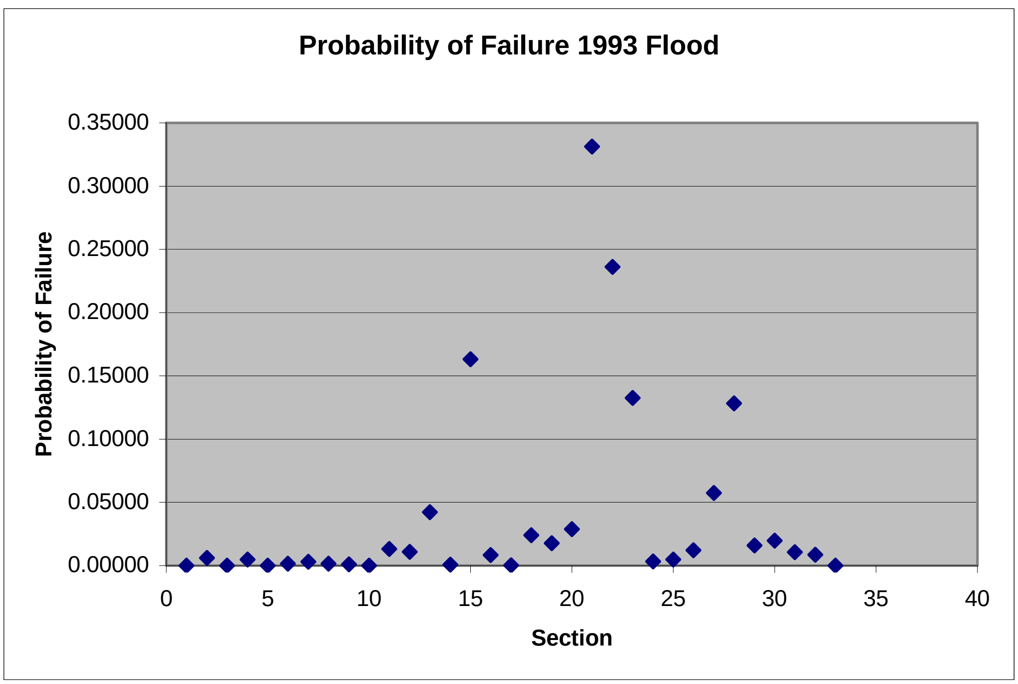


FIGURE 5. Probability of Failure Calculated for 1993 Flood at R471-460

3.7.2.3 Slope Stability Analysis

The slope stability analysis was performed with Utexas4. Factors of safety calculated from Utexas4 were inserted in the FOSM analysis to calculate the probability of failure. A typical section was used to determine if more detailed analysis is justified. Rather than proceeding with a number of detailed cross sections in various reaches, one typical section was analyzed with the FOSM method. Conservative assumptions were made, including a 20 feet levee height, a 15 feet foundation layer of soft clay, a fully developed phreatic surface extending from the riverside crest to the landside toe, and seepage entrance/exit length that maximizes the phreatic surface in the underlying sand without uplift at the berm toe.

3.7.3 Levee Dimension Information

Recent dimensions of the levee and surrounding topography are based on a 4-foot contour interval. This was not considered sufficient to construct levee cross sections; so seepage cross sections were based on the original tabulated design calculations. The original tabulated design calculations are in agreement with the as-built cross sections of the levees as indicated in typical design sections in the Operations and Maintenance manual.

Several sources were investigated for the purpose of verifying site conditions. Comparison of levee crest and toe elevations is shown in Figure 6. The recent top of levee profile survey shows elevations consistently above the as-built elevations in the O & M manual. The elevations of the berm are indicated as points 1 and 2. There are no recent surveys of the berms. To provide a consistent relation of the berm elevations to the top of levee, the O & M manual dimensions (including top of levee) were used in the reliability calculations.

The levee toe elevations were calculated from the O & M manual top of levee elevations, minus the levee heights in the design calculations.

On levee L-455, the design calculations were based on a design water surface 1 foot below top of levee. On levee R 471-460, the design calculations were based on a design water surface at the top of levee. Occasionally, levees are raised during flood events, such as by sand bags or flash boards. The 13-mile reach of levee for both projects makes it unlikely that the overall level of protection could be raised during flood fight operations. An exception may be pushing the landside slopes up to peak the crest; but this is not considered since it damages the levee and significantly increases seepage problems. The reliability calculations used a freeboard analysis referenced to the top of levee.

Interior ponding levels were assumed from a variety of abstract data. A booklet containing the original design calculations for L-455 included a note that assumed a ponding elevation of 799.5 at the reach at Sta. 445+00 to 465+00. However, this ponding level was not consistent in other reaches. The reliability analysis assumed a ponding elevation of 800.0-feet at the reach from Sta. 248+00 to 480+00. This generates ponding depths typically about 2 feet, which corresponds to the 1993 flood observations indicated by the local sponsor.

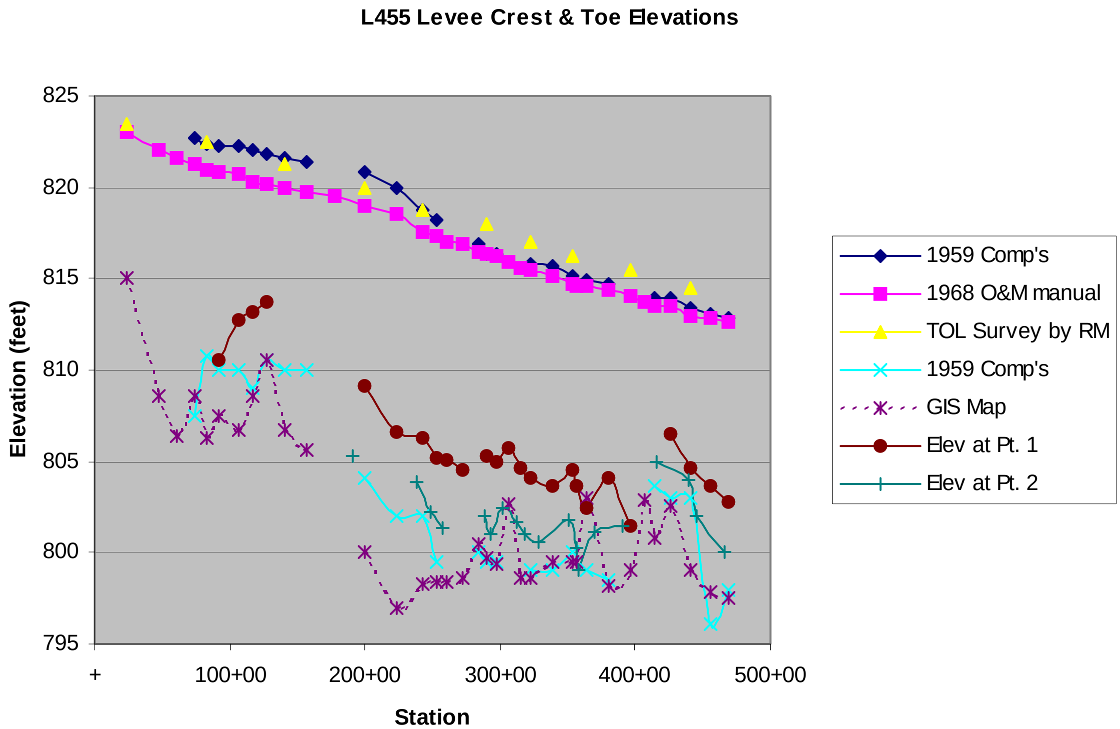


FIGURE 6. L-455 LEVEE CREST AND TOE ELEVATIONS

3.7.4 Soil Parameters for Reliability Analysis

3.7.4.1 Uncertainty in Soil Parameters

Measures of uncertainty of soil parameters are included in the reliability analysis. The uncertainty is expressed either as standard deviation, or coefficient of variation (COV). The standard deviation is used directly in the calculations. The COVs are relatively more consistent from project to project than the standard deviation, and are used for comparative purposes. Comparing COVs is a reality check. Some commonly accepted COVs for geotechnical parameters are:

Parameter	Coefficient of Variation	Source
Unit Weight	3 %	Harr[13] (After Hammitt)
Unit Weight (density)	5 - 10 %	Baecher & Christian[14] (After others)
Specific Gravity	2 %	Harr (After Padilla & Vanmarcke)
Porosity	10 %	Harr (After Schultz)
Friction Angle in Sand	12 %	Harr (After Schultz)
Friction Angle in Sand	2 - 5 %	Baecher & Christian (After others)
Cohesion	40 %	Harr (After Fredlund & Dahlman)
Cohesion	20 - 50 %	Baecher & Christian (After others)
Permeability, saturated	90 %	Harr (After Nielsen)

[13] Harr, Milton, Reliability-Based Design in Civil Engineering, McGraw-Hill, 1987.
[14] Baecher, Gregory and John Christian, Reliability and Statistics in Geotechnical Engineering, Wiley, 2003.

Although the original studies may have been specific as to how these COVs were derived, the tabulation of general values does not differentiate between different sources of error. Christian et al.[15] categorized four general categories for sources of error:

a. Spatial variation due to real changes in soil characteristics (aleatory)

b. Random testing errors (perceived as spatial error)

c. Statistical uncertainty arising from limited testing (epistemic)

d. Test Bias, such as sample disturbance (epistemic)

Spatial variation can be used to justify very high uncertainty. Averaging data from different geologic stratigraphy is not realistic for a probabilistic analysis, if it were detected and separated in conventional analysis. Similarly, statistical error from limited testing can be shown to be very high if based on an assumption of complete random sampling. However, there is intelligence in selection of boring locations, and selection of samples for testing. Combined with geologic interpretation, the subsurface information for confidence in soil parameters become subjective.

A subjective analysis (or expert opinion) method for determining parameter uncertainty can be approximated from the 4-Sigma or 6-Sigma rule. Inclusion of error should be based on representative values for analysis. The random testing errors (Category 2) should be subtracted out. Spatial variation and statistical uncertainty (Categories 1 and 3) can be estimated through engineering judgment by confidence in predicting test values if further testing were conducted.

Predicted test values should be thought of as weighted-average test values as they would affect the analysis. For example, when test values are obtained in a zone where spatial averaging affects the analysis, the standard error of the mean(σ_μ) is more appropriate in place of the standard deviation (σ), where N is the number of data values.

$$\sigma_\mu = \frac{\sigma}{\sqrt{N}}$$

3.7.4.2 Critical Gradient

The critical gradient is a measure of when the upward percolation of water begins to carry soil particles with it. The critical gradient is characterized by the soil and the water, not by other factors in the underseepage analysis. The critical gradient is calculated as

$$i_c = \gamma_b / \gamma_{h2o} \quad \text{, or} \qquad 1a$$

[15] Christian, J., C. Ladd & G. Baecher, "Reliability Applied to Slope Stability Analysis", J. of Geotech. Eng., ASCE, Dec. 1994.

$$i_c = (G_s - 1)/(1+e) \qquad 1b$$

Typical soil parameters for L-455 include a saturated unit weight for the top blanket soil of γ_{sat} = 114 pcf and a dry unit weight of γ_d = 80 pcf. Other soil properties calculated from these unit weights include: buoyant unit weight, γ_b = 51.5 pcf, saturated water content, w = 42.5 %, void ratio, e = 1.19, porosity, n = .54, and specific gravity of solids, G_s = 2.81. Based on these properties, the expected value for the typical critical gradient is calculated by either eqn. 1a or 1b as i_c = 0.84. Berm calculations for both levees listed critical gradients used in the original analyses. These ranged from 0.70 to 0.85, with a typical value of 0.80. Since the critical gradients reported in the original analyses are based on superior knowledge of soil conditions known at the time, they were used in the reliability analysis.

The uncertainty in the critical gradient was estimated from published field observations on the Lower Mississippi River, and correlation with typical uncertainty for the porosity. Figure 10 shows the field observations. The field observations were confirmed with piezometers, and not based on seepage calculations. Based on the reported gradients in the Sand Boils category, and deleting the two low values as outliers, the COV for the critical gradient is 15.8%. As a reality check, the COV is calculated from the porosity. Substituting e = n/(1-n) in Eqn. 1b,

$$i_c = (G_s - 1)(1-n) \qquad 1c$$

Based on a typical COV for the porosity of 10%, mean values of Gs=2.8 and n=0.54, the FOSM method and Eqn. 1c was used to determine a corresponding COV for the critical gradient of 11.7%. Wolff and Demsky[16] used a COV for the critical gradient of 9.5%, based on a point estimate analysis centered on assumed uncertainty in the unit weight of the blanket soil.

A COV for the critical gradient of 15% was used in the analyses. The uncertainty is primarily due to spatial variation of soil characteristics. The probability density function for the critical gradient (using a mean of 0.82 for L-455) is shown in Figure 11.

[16] Wolf, T., E. Demsky, J. Schauer & E. Perry, "Reliability Assessment of Dike and Levee Embankments for Water-Resources Planning", Uncertainty in the Geologic Environment: From Theory to Practice, ASCE Geotechnical Publication No. 58, Madison, WI, July 31 – Aug. 3, 1996.

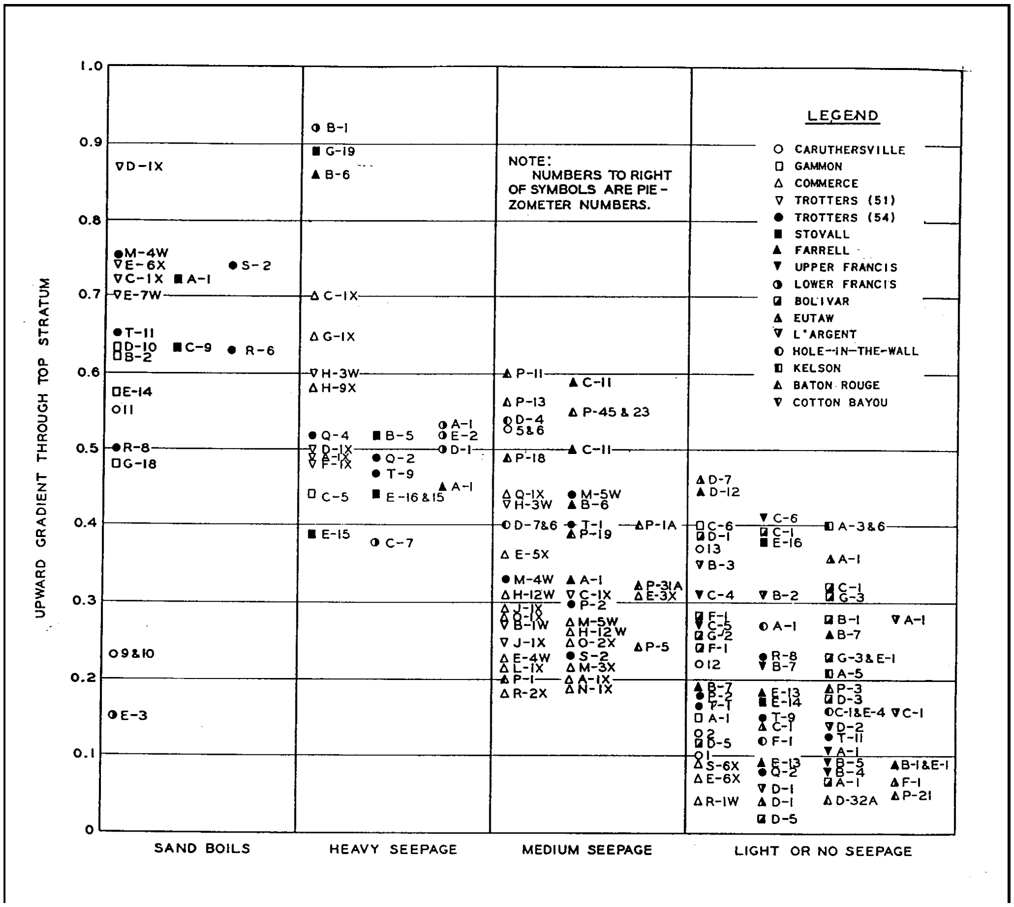


FIGURE 10. Seepage Observations on the Lower Mississippi River (From ETL 1110-2-555 Fig. 2-1, After WES Technical Memo 3-424 Fig 47 (1956))

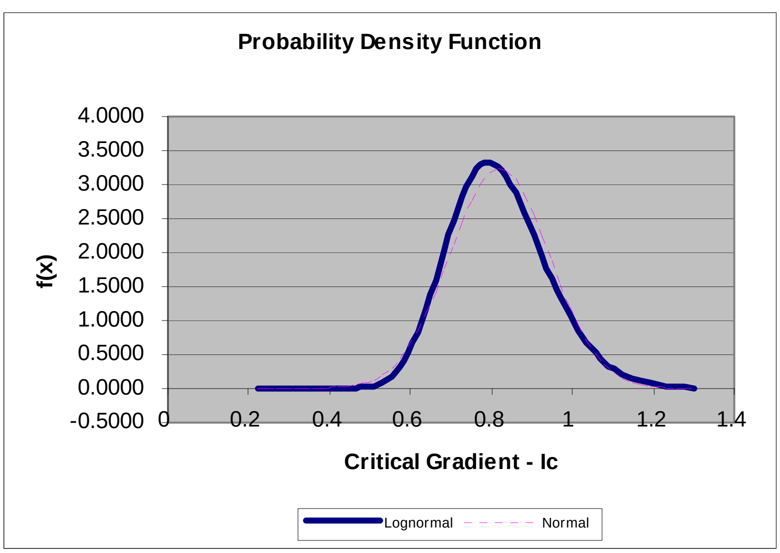


FIGURE 11. Critical Gradient, $E(i_c)$ Varies (0.82 shown for illustration), COV = 15%

3.7.4.3 Blanket Layer Thickness

Blanket layer thicknesses reported in the original analyses are based on superior knowledge of soil conditions known at the time, and these values were used in the reliability analysis. A COV of 10% used selected, based on subjective consideration of the 6-sigma rule. A typical distribution is shown in Figure 12.

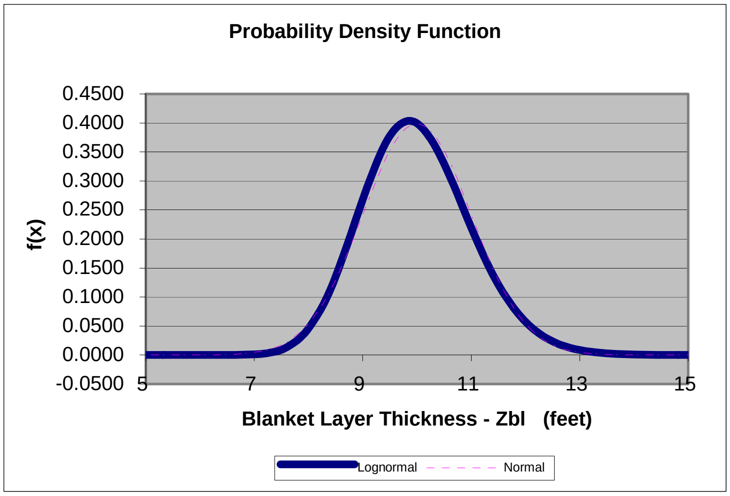


FIGURE 12. Blanket Layer Thickness, $E(Z_{bl})$ Varies (10' shown for illustration), COV = 10%

3.7.4.4 Permeability Ratio

The permeability ratios were recalculated based on soil type and layer thickness as shown in the calculations. A COV of 30% was used based on engineering judgment, and in consideration of inherent variation in design values (see charts shown in the calculations).

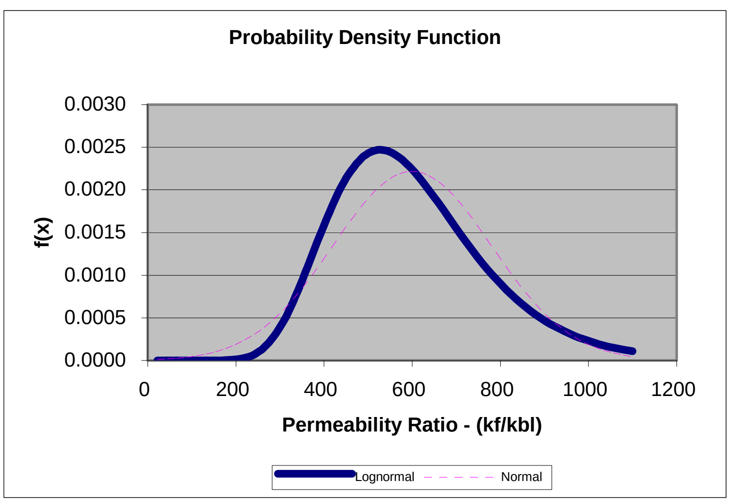


FIGURE 13. Permeability Ratio, $E(k_f/k_{bl})$ Varies (600 shown for illustration), COV = 30%

3.7.4.5 Aquifer Thickness

There were 7 borings that showed depth to rock on L-455. These included borings D-1, 2, 3, 4, 19, 55 and 142. The depth to rock was typically about 75 to 80 feet in the midsection of the project, ranging to about 70 feet near the upstream end and about 100 feet at the downstream end. The analysis was based on a mean depth of 80 feet with a 20% coefficient of variation. This uncertainty may somewhat include known variation through the project alignment, but the aquifer depth did not have a significant impact on the total variance for the factor of safety.

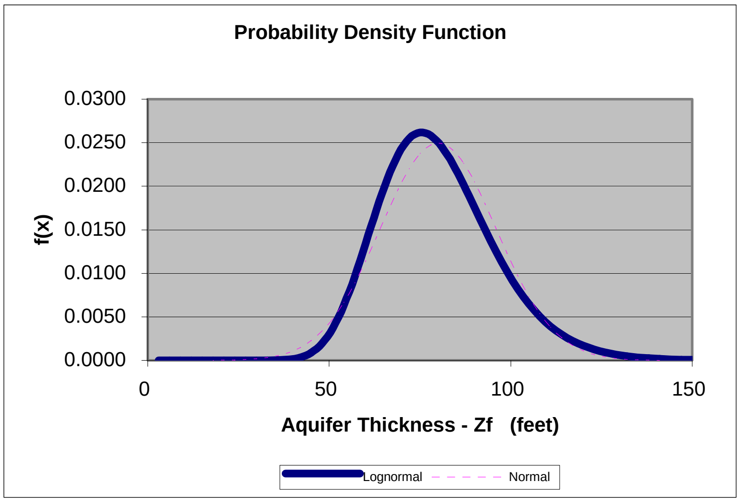


FIGURE 14. Aquifer Thickness, $E(Z_f)$ =80’, COV = 20%

3.7.4.6 Effective Seepage Entrance

The effective seepage entrance is variable, dependent on the soil type and the layer thickness. The values are dependent on layer thickness since defects and spatial variation have a more pronounced affect in thin layers. This results in the field permeability of the blanket layer being much higher than the laboratory permeability of a small sample. Design values for effective seepage entrance provided in EM 1110-2-1913, Table C-1 are shown in Figure 15. These values are the same as those published in TM 3-424, Table 37. The trends in Figure 15 show that there is a significant uncertainty in selecting values for X1.

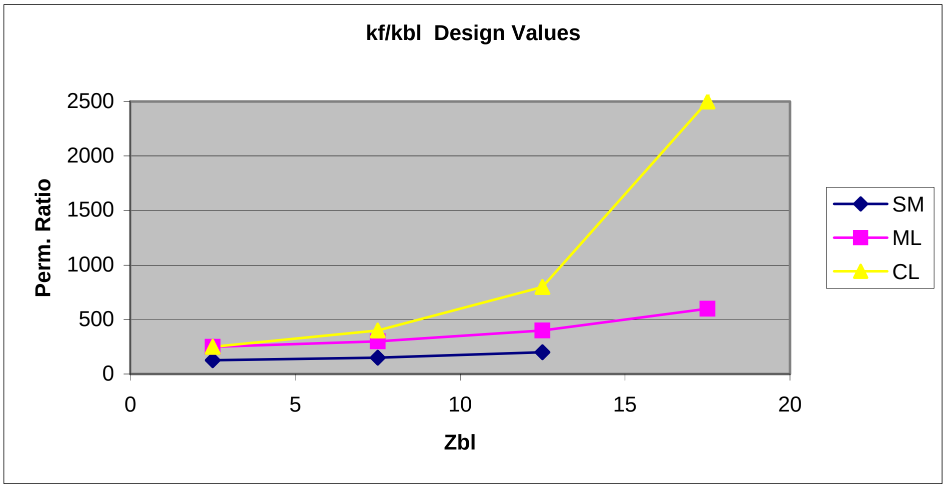


Figure 15. Design Values for Effective Seepage Entrance

The COV for the effective seepage entrance was analyzed by considering the COVs for the permeability ratio, thickness of the pervious stratum and the blanket layer, and the model correlation. The total variance was calculated based on typical values of $E(k_f/k_{bl})$ = 600, $E(Z_f)$ = 60, $E(Z_{br})$ = 10, $COV(k_f/k_{bl})$ = 30%, $COV(Z_f)$ = 20%, and $COV(Z_{br})$ = 10%. The parameter X3 in the table represents (1/c) = sqrt(Z_f * Z_{br} * k_f/k_{br}). The parameter L1/X3 represents model error in the design values, with a COV of 30%. Based on this analysis, the COV for effective seepage entrance is 25.3%. A value of COV(X1) = 25% was used in the analysis.

Table 3. Variance of Effective Seepage Entrance

VARIABLES				Computations		var(X1)	PERCENT OF TOTAL VARIATION
Kf/Kbl -	Zf (feet)	Zb (feet)	L1/X3 -	X3 (feet)	X1		
600	60	10	1	600	457.0		
420	60	10	1	502	382.3		
780	60	10	1	684	521.0	4808.96	35.9%
600	48	10	1	537	408.7		
600	72	10	1	657	500.6	2109.402	15.7%
600	60	9	1	569	433.5		
600	60	11	1	629	479.3	523.3347	3.9%
600	60	10	0.7	600	362.6		
600	60	10	1.3	600	517.0	5960.861	44.5%

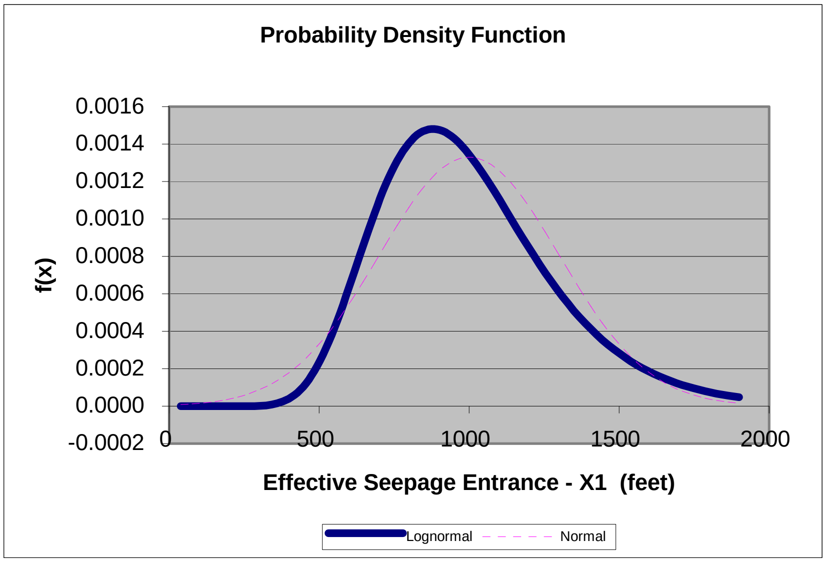


FIGURE 16. Effective Seepage Entrance Length, E(X1) = 1000', COV = 30%

Head loss at Relief Wells

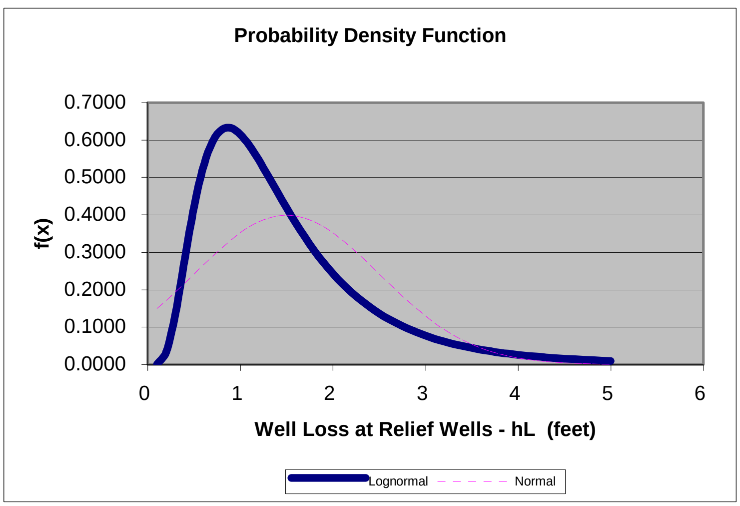


FIGURE 17. Head Loss at Relief Wells, $E(h_L)$ = 1.5', COV = 67%

3.7.4.7 Shear Strength

Figure 18 shows shear strength data obtained for R 471-460, correlated with the plasticity index. Strength correlations for lower and upper Mississippi River alluvial clays are also show. The strength correlation for the lower Mississippi is shown in EM 1110-2-1913 figure 3.2, and is taken from a WES report.[17] The strength correlation for the upper Mississippi is from 66 consolidated-undrained triaxial tests with pore pressure measurements (R-bar tests) from Mississippi River Locks and Dams 3 through 9. Borings

[17] Engineering Properties of Fine-Grained Mississippi Valley Alluvial Soils Meander Belt and Backwater Deposits, Technical Report No. 3-604, WES, June 1962.

were located to detect the worst soil conditions. The project samples from R 471-460 more closely match the correlation from the lower Mississippi. The softer clays found at the project sites likely exhibit shear strength near the lower range of the data shown. A mean shear strength of 19 degrees was used in the analysis, with a coefficient of variation of 10%.

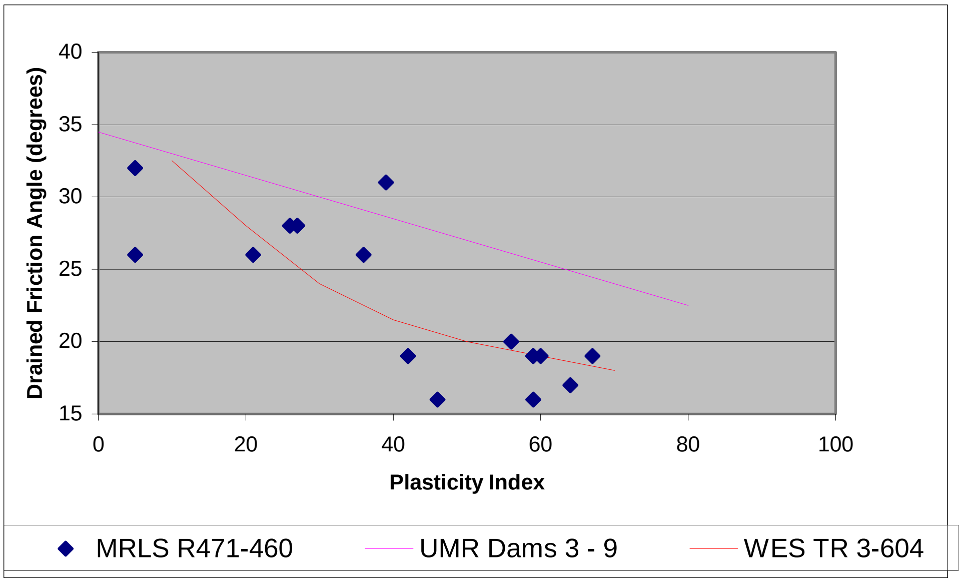


FIGURE 18. Shear Strength Data from R 471-460

3.7.5 Conclusions

a. Figures 19 and 20 shows probability of failure vs. freeboard traces for 38 sections on L-455 and 33 sections on R 471-460. Most traces are clustered near zero probability of failure. Significant probability of failure is limited to a few select sections. This means that the majority of the levee is expected to have good performance, and distress should be limited to isolated locations.

b. Combined underseepage and slope stability probability of failure vs. freeboard for the critical sections are shown in Figures 21 and 22.

c. The berms on the levees have a tendency to equalize the factors of safety along the levee alignment, which would be expected since they were designed to consistent standards.

d. Reduced interior ponding (such as by extensive interior drainage or a more rapid river stage rise time) could increase seepage related distress.

e. The paragraph on Underseepage Calculation Procedure includes equations for calculation of the exit gradient at four locations: (0) the theoretical levee toe, (1) the stability berm crest, (2) the stability berm toe, and (3) the seepage berm toe. (These locations are shown on Figure 3). The spreadsheets likewise calculate the probability of failure for these four locations. Only location (2) was used for the reported results. Reasons for selecting location (2) are that location (0) does not actually exist where berms are constructed, location (2) is consistently more critical than location (1), and design criteria for berm width dictates that location (3) is at a sufficient distance that boils beyond the seepage berm toe should not threaten the levee.

f. No attempts have been made to quantitatively separate out spatial (aleatory) uncertainty from systemic (epistemic) errors. However, the majority of the uncertainty is attributable to epistemic errors, which is related to the limits of what is known. These errors are incorporated in a systematic manner in the engineering analysis to provide an uncertain measure of levee stability. This means that the reported probabilities of failure are a measure of the chance for a levee breach to occur within the analyzed section given a flood event of the given magnitude. This is consistent with economic assumptions. The economic models may be based on a breach at any of the reported sections analyzed to search for the optimum breach location. However, to be consistent with the source of uncertainty assumptions, the economic damages must be based on only one breach location.

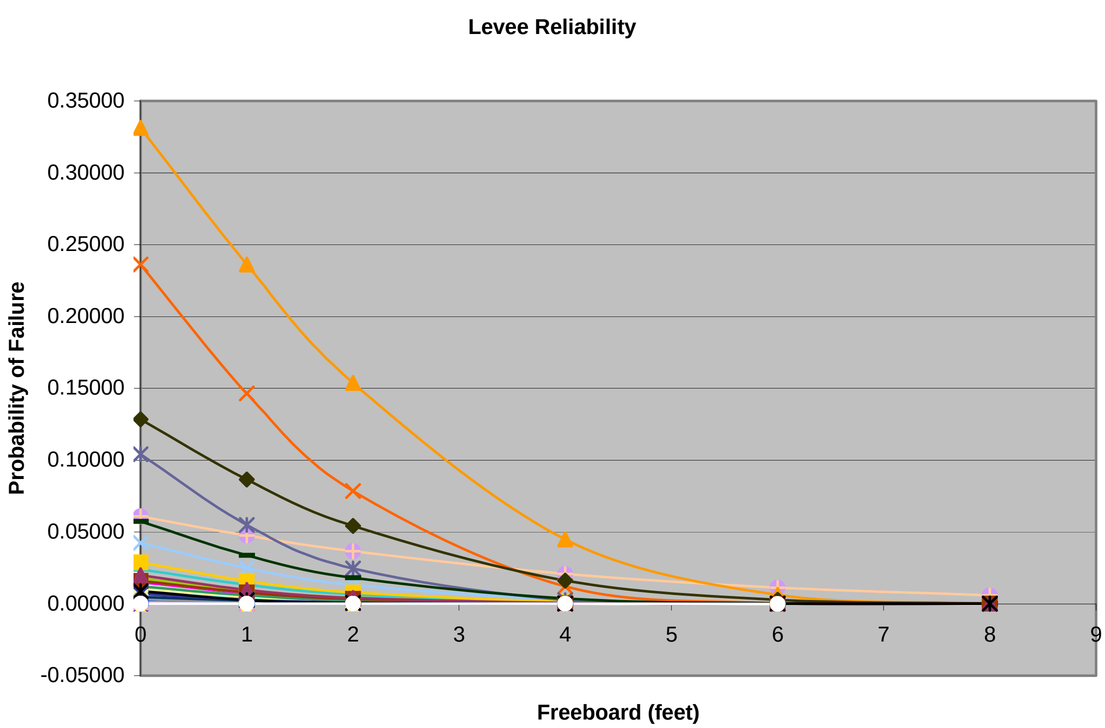


FIGURE 19. UNDERSEEPAGE RELIABILITY FOR R471-460

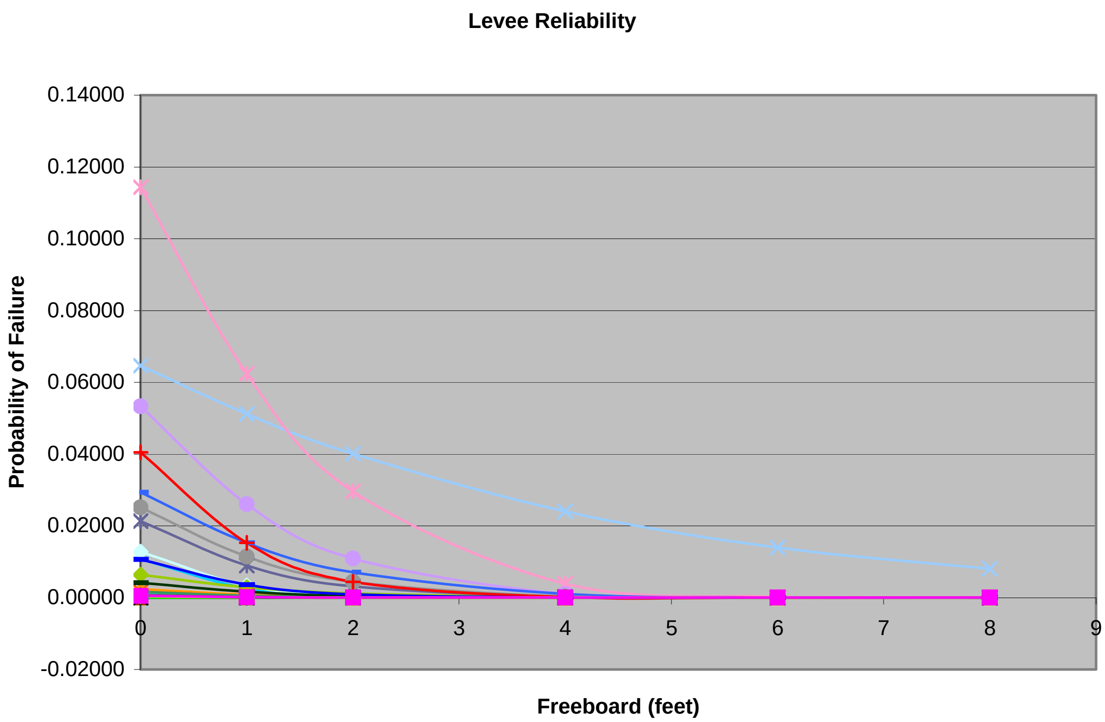


FIGURE 20. UNDERSEEPAGE RELIABILITY FOR L455

Critical Sections	Failure Mode	Levee Station:			Probability of Failure Freeboard 0 (feet)	Freeboard 1 (feet)	Freeboard 2 (feet)	Freeboard 4 (feet)	Freeboard 6 (feet)	Freeboard 8 (feet)
10	Underseepage	123+00	to	131+00	1.28%	0.34%	0.06%	0.00%	0.00%	0.00%
	Slope Stability				1.00%	0.75%	0.50%	0.00%	0.00%	0.00%
	Total				2.27%	1.08%	0.56%	0.00%	0.00%	0.00%
13	Underseepage	165+00	to	190+00	6.46%	5.12%	4.01%	2.40%	1.40%	0.81%
	Slope Stability				1.00%	0.75%	0.50%	0.00%	0.00%	0.00%
	Total				7.40%	5.83%	4.49%	2.40%	1.40%	0.81%
14	Underseepage	191+00	to	209+00	11.44%	6.24%	2.96%	0.39%	0.02%	0.00%
	Slope Stability				1.00%	0.75%	0.50%	0.00%	0.00%	0.00%
	Total				12.32%	6.94%	3.45%	0.39%	0.02%	0.00%
24	Underseepage	312+00	to	317+00	2.52%	1.14%	0.44%	0.04%	0.00%	0.00%
	Slope Stability				1.00%	0.75%	0.50%	0.00%	0.00%	0.00%
	Total				3.49%	1.88%	0.94%	0.04%	0.00%	0.00%

FIGURE 21. MRLS L-455 Critical Sections

Critical Sections	Failure Mode	Levee Station:			Probability of Failure: Freeboard 0 (feet)	Freeboard 1 (feet)	Freeboard 2 (feet)	Freeboard 4 (feet)	Freeboard 6 (feet)	Freeboard 8 (feet)
13	Underseepage	229+00	to	251+00	4.23%	2.48%	1.33%	0.28%	0.03%	0.00%
	Slope Stability				1.00%	0.75%	0.50%	0.00%	0.00%	0.00%
	Total				5.19%	3.21%	1.83%	0.28%	0.03%	0.00%
16	Underseepage	302+00	to	331+00	0.85%	0.66%	0.52%	0.31%	0.19%	0.11%
	Slope Stability				1.00%	0.75%	0.50%	0.00%	0.00%	0.00%
	Total				1.84%	1.41%	1.01%	0.31%	0.19%	0.11%
21	Underseepage	395+00	to	404+00	33.12%	23.62%	15.38%	4.50%	0.63%	0.02%
	Slope Stability				1.00%	0.75%	0.50%	0.00%	0.00%	0.00%
	Total				33.79%	24.19%	15.80%	4.50%	0.63%	0.02%
28	Underseepage	545+00	to	600+00	12.83%	8.66%	5.43%	1.61%	0.28%	0.02%
	Slope Stability				1.00%	0.75%	0.50%	0.00%	0.00%	0.00%
	Total				13.71%	9.35%	5.90%	1.61%	0.28%	0.02%

FIGURE 22. MRLS R 471-460 Critical Sections

3.8 SELECTED PLAN

3.8.1 General

The feasibility study selected plan provides flood protection against the 100-year plus 3-feet flood profile. Both urban and rural areas are protected by these two levee units and failure at any location of the levee will result in at least some urban areas being subjected to flooding.

The limits of the selected plan top of levee raise are addressed within Section 4, Civil and are also indicated within the drawings, Sheet 1 and 2. Within Section 4, Civil the magnitude of the raise represents the maximum value for the levee reach indicated. Since the top of levee raise is not parallel to the existing levee profile within the limits defined by Section 4, the Geotechnical effort refined the raise into representative levee reaches.

The Geotechnical effort is relying on available information and will not utilize a drill, sampling, and testing program as part of the study. A literature search was conducted of in-house files as well as the Records Holding facility. It is apparent the best information available is included within the respective levee unit's General Design Memorandum (GDM) documents, as-built drawings, and operation and maintenance manuals. These documents will serve as the sources for site characterization, establishing soil parameters, making engineering recommendations, considering original designs, and the basis for recommending efforts necessary during Preconstruction Engineering and Design (PED). For the most part, previous levee unit project summaries will be used for this study.

Both levee units were originally constructed with limited piezometric instrumentation. However, piezometric readings could not be located from a search of the project files. Discussions with the local non-Federal sponsors concluded readings were not obtained during the Great Flood of 1993.

Both units were subjected to a full and lengthy performance test from the Great Flood of 1993. As addressed earlier in this Section, all indications are both levees performed adequately with minimal, if any, signs of stress. Not only is this an acknowledgement the structural integrity of the levee under its current state is sound, but the procedures and designs used for the original project are sufficient and appropriate for the selected plan's minimal top of levee raise.

Where the levee is subject to a raise, criteria will follow current day Federal Levee criteria. The sources of criteria will be the Corps of Engineers' Engineering Manuals as well as the Kansas City District Website,
http://www.nwk.usace.army.mil/local_protection/levees.html A deterministic approach, with adopted safety factors, will be used for the plan formulation.

3.8.2 Levee Section

Drawing Sheet Number 4 shows the two typical levee sections used for this study. The top of levee raise builds off of the existing levee cross section maintaining previously designed levee slopes. For the most part levee slopes are 1 vertical on 3 horizontal except for a few instances where the levee slopes are 1 vertical on 4 horizontal. The flatter slopes are generally located where the levee crosses the Missouri River oxbow legs. The levee slopes are included within the table on Sheet Number 3. If the top of levee raise is 1-foot or less, then the raise is accounted for with a levee crown raise using 1 vertical on 2 horizontal slopes intercepting the existing slopes. If the top of levee raise is more than 1-foot, then the raise includes building off of the landward slope to support the raise. The landward slope is the same slope as currently exists. MRLS R 471-460 includes the maximum top of levee raise of 3.37-feet. The MRLS R 471-460 original GDM indicates embankment stability is not an issue except where the levee crosses the Missouri River oxbow legs. In addition, MRLS R 471-460 performance during the Great Flood of 1993 did not result in embankment slides or discoveries of embankment stress. The 3.37 feet maximum raise is not anticipated to induce instability. The landside is supported by additional fill at the levee toe since the minimum underseepage berm thickness at the levee toe is 5-feet. However, design and contingency did account for fill to construct limited stability berms, most likely riverward, if at all. Stability analysis will be completed during PED to verify berm locations. MRLS L-455 includes the maximum top of levee raise of 0.94 of a foot. MRLS L-455 did include stability berms as part of original design. The distance from the top of the levee to the berm-levee slope intercept was maintained. In addition, MRLS L-455 performance during the Great Flood of 1993 did not result in embankment slides or discoveries of embankment stress.

3.8.3 Underseepage Analysis

Underseepage analysis was performed for both units: L-455 and R 471-460. The analysis was completed using Excel spreadsheets and a hand check was included to verify the spreadsheets. An underseepage berm summary is presented within the drawings, Sheet Numbers 3 and 4. The analysis and support are included within the DDR documentation.

Both EM 1110-2-1913 and the Kansas City District Website, http://www.nwk.usace.army.mil/local_protection/pdf/underseepage.pdf were used in performing the analysis. The key considerations were as follows:

a. For this study, current Kansas City District criteria (regardless of original design) were applied to levee sections subject to a raise. The seepage criteria used for this study was coordinated with Kansas City District management. The Kansas City District agreed the criteria are appropriate for this study. However, it was acknowledged the criteria is evolving spurred by relatively recent major flood events and will be revisited during PED.

b. Floodwater at the top of the levee was considered when assessing if underseepage control is necessary. A 1.1 minimum gradient safety factor at the levee toe is necessary to warrant no underseepage control. (KCD Website)

c. Floodwater 3-feet below top of levee was considered when designing underseepage control. Design requires a 1.5 gradient safety factor at the levee/berm contact (levee toe) and a 1.1 gradient safety factor at the underseepage berm toe. (KCD Website)

d. If underseepage control is necessary and an underseepage berm is selected for the control, the minimum width of the berm is 150-feet, the minimum berm thickness at the levee is 5-feet, and the underseepage berm toe is 2-feet thick at the berm design width unless the landward natural blanket rises allowing the berm to terminate before achieving the design width. (EM 1110-2-1913)

e. The landward blanket is considered semi-pervious and infinite in extent unless features demonstrate otherwise.

Tables 4A, 4B, and 5 include summaries of underseepage analysis parameters and results.

Both levee units include a pressure relief well field. The R 471-460's pressure relief well field is included within the levee reach subject to a raise, therefore, only the R 471-460 pressure relief well field will be included as part of this study and is addressed within this Section and drawing, Sheet Number 7. The R 471-460 pressure relief wells are in a line approximately 100 feet landward of the levee toe. A berm was constructed between the levee and the relief wells and provides for both stability and underseepage control (supplementing the pressure relief wells especially at the levee toe). The underseepage analysis assumed a finite landward blanket ending at the pressure relief well line and Browning Lake. This reach does not require additional fill between the levee and the pressure relief well field.

During Preconstruction, Engineering, and Design (PED), additional field work will be conducted including mapping, surveys, and drilling/sampling to support a refined underseepage berm analysis and design as well as pressure relief field analysis and design.

3.8.4 MRLS R 471-460 Pressure Relief Wells

The twenty original pressure relief wells located between MRLS R 471-460 levee stations 292+00 and 327+00 form a line parallel to the levee about 100-feet out from the levee. Pressure relief wells are necessary at this location because there is insufficient area between the levee and Browning Lake for an underseepage berm.

During the Great Flood of 1993 this reach of levee was subjected to overtopping. The full hydrostatic head on the levee did not produce sand boils indicating the landward berm and the pressure relief wells are adequate to counter excessive underseepage activity.

The existing pressure relief wells are 8-inch diameter assembled wood stave screens and risers wrapped with stainless steel wire. Current day pressure relief well construction materials no longer include wood assemblies and have been replaced with the more reliable and durable steel riser and screen assemblies. Wood stave well assemblies cannot withstand aggressive pressure relief well testing, development, and treatments. The MRLS

R 471-460 pressure relief wells were installed in 1967 and all indications are that individual well efficiencies have decreased requiring development and treatment efforts the wood stave well assemblies may not be able to withstand. Throughout the pressure relief well field there will be a 1.5 to a 2.7 feet increase in differential hydrostatic head across the levee attributed to the top of levee raise. This will provide additional stress to the existing pressure relief well wooden assemblies of uncertain structural integrity. The recommendation included in the feasibility study is to abandon in-place the existing 20 pressure relief wells and replace as indicated through analysis and design. A thorough subsurface investigation, analysis, and design will be completed during Pre-construction, Engineering, and Design (PED).

For feasibility study estimating purposes, 22 pressure relief wells will be assumed necessary to replace the existing 20. The extra 2 will account for offsetting the replacement pressure relief wells, the additional hydrostatic head, and the uncertainty with the conditions landward within Browning Lake.

As part of the Federal project, the 20 pressure relief wells constructed with wood staves will be abandoned in-place by filling with aggregate materials to the base of the blanket and grouting throughout the thickness of the blanket. The abandonment will not occur until a replacement pressure relief well field has been constructed, pump tested, and developed. The pressure relief well field layout will be based upon subsurface investigation, seepage analysis and modeling, and design. The current pressure relief well layout follows the perimeter of Browning Lake where it approximately parallels the levee alignment. Additional pressure relief wells were located adjacent the drainage ditch discharging Browning Lake through the levee and into the Missouri River. Between the levee and the pressure relief well field, a berm was constructed as part of the original contract. It is anticipated a similar pressure relief well field layout as what currently exists will be necessary when laying out the replacement pressure relief wells. Within the drawings, Sheet Number 7 shows the existing pressure relief well field. During Preconstruction Engineering and Design (PED) the pressure relief well field analysis and design will be developed utilizing additional subsurface investigation and sampling and laboratory testing. Pilot borings' sampling as well as laboratory gradation testing of the subsurface formation at each pressure relief well location will be completed during PED to facilitate pressure relief well screen design. Pressure relief well assemblies will be stainless steel screen and risers. Each pressure relief well will include a discharge into Browning Lake consisting of a manhole, horizontal pipe with flap gate, and ditch, where necessary. A gravity plunger valve will be inserted into the top of each pressure relief well to provide necessary redundancy to preventing backflow into the pressure relief well should Browning Lake rise and the discharge pipe flap gate fail. Each pressure relief well manhole access will be secured with a lid and locking mechanism.

3.8.5 Stability

The selected plan's maximum top of levee raise is 3.37-feet over a 600-feet length of levee embankment. The magnitude of the top of levee raise decreases in both directions out from this 600-feet reach. Because of the limited magnitude of the top of levee raise, the favorable performance during the Great Flood of 1993, and the original levee design GDM indicating stability is not a problem for these units within the feasibility study limits, stability berms were addressed by maintaining the distance from the top of the levee to the berm and levee intercept where a berm currently exists. In addition, consideration was given to similar projects already constructed. Typically for a levee taller than the levees of this study and with similar foundation conditions, design provides for a distance of 17-feet from the top of the levee to the berm and levee intercept. The selected plan's landside underseepage berm includes a minimum 5-feet thickness at the levee. The maximum distance from the top of the levee to the berm and levee intercept is 15-feet. This is believed to be adequate. On the riverside of the levee, the distance from the top of the levee to the berm and levee intercept was maintained, if not decreased.

3.8.6 Settlement

The selected plan maximum top of levee raise is 3.37-feet over a 600-feet length of levee embankment. The magnitude of the top of levee raise decreases in both directions out from this 600-feet reach. Top of levee raises greater than 1-foot place fill on the levee crown and the levee landward slope. A 3.37 top of levee raise is results in slightly less than a 7-feet fill thickness on the landward slope. A 7-feet thickness is far less than the height of the original levee embankment. Settlement attributed to the additional fill is anticipated to be minimal or even insignificant and well within the range of fill finish grade allowances.

Search of the available project documentation determined consolidation testing had not been completed for this levee unit. Settlement analysis from the original design is not available and the soil investigation and testing completed at the time of original design is limited in value for computing settlement. It is apparent the designers for the original construction anticipated settlement as camber requirements were specified for each major pipe profile beneath the levee. The camber for the pipe profiles of this study ranged from 1.1 inches to 4.4 inches. However, this may have been nothing more than built in redundancy to eliminate any damage risk should there be settlement attributed to foundation conditions or questionable construction practices.

Review of the soils information within the levee limits subject to a top of levee raise indicates relatively thin zones of fine material that would be subject to the more typical consolidation processes. The thicker subsurface fine material zones where the risk of consolidation is relatively greater, are located outside the study reach. Zones beneath the upper fine materials tend to be fine to medium sand and settlement would tend to be instantaneously if any settlement at all for the magnitude of fill.

An empirical analysis using correlations is not recommended for the magnitude of the fill thickness for the selected plan. An empirical analysis will tend to deliver conservative results that are not realistic for the magnitude of fill to be placed as part of the selected plan.

Recent field surveys indicate there is no evidence of excessive settlement. However, the settlement magnitudes indicated may not be readily identifiable without a more detailed survey and uncertainty would remain since there is not 100 percent confidence in the as-built elevations at the time of original construction. Settlement in general should be revisited during the Preconstruction Engineering and Design (PED) Phase. The drainage structures' settlement investigation level of effort during PED should not be decided until the following has occurred and considered in the decision:

a. Investigate the pipe profile camber to determine if pipe settlement has occurred since original construction and if camber remains for additional settlement.

b. Inspect the pipe joints to determine if additional articulation is possible to accommodate additional settlement.

c. Complete precise field surveys documenting drainage structures key features' current elevations and compare these elevations to the available as-built details.

During PED it is recommended subsurface zones be identified, sampled, and performed consolidation testing. Consideration will be given to the magnitude of the additional loading, engineering assessment of ongoing consolidation (if any), and soil compressible tendencies (classification and thickness). Further settlement of the levee embankment is easily resolved with additional levee crown raise (overbuild). However, structural concerns should be coordinated, considered in design, and documented.

3.8.7 Rock Slope Protection

Within the limits of the levee raise, R 471-460 existing rock slope protection is limited to the railroad abutment (approximately Sta. 404+20) and beneath Highway 36 Bridge (over the levee and the Missouri River) (approximately Sta. 421+00). L-455 does have rock slope protection. Both of these units did not exhibit signs of levee slope erosion or river attack following the Flood of 1993 (flood of record). It is anticipated significant quantities of rock will not be required for the levee raise. Rock quantities provided to Cost Estimating allow for adding rock where rock currently exists to account for the levee subjected to a raise.

Modeling river attack and velocities for levee embankment erosion has improved since these levees were originally designed. During Preconstruction, Engineering, and Design (PED), analysis and modeling should be completed to determine if levee reaches currently rock faced could be replaced with sod cover. This would be a project cost savings and a future operations and maintenance savings. As part of the analysis and modeling process, a thorough coordinated review of the levees and possibly analysis should be completed to verify rock is not needed at locations currently sod covered.

3.8.8 Soil Quantity

The levee and underseepage berm quantity computations were completed with Excel spreadsheets and are maintained within the DDR and are to be used in conjunction with drawings, Sheet Numbers 8 and 9. The spreadsheets utilized a very simplistic approach breaking the section up into easily computed areas and assuming the cross section was applicable for length of levee.

During Preconstruction, Engineering, and Design (PED) accurate surveys and mapping will be necessary to refine quantity estimates.

3.8.9 Material Sources

3.8.9.1 General

Materials required for constructing the selected plan include concrete for the gatewell structures; pipe, conduit, valves, and manholes for utility relocations and pressure relief well construction; aggregate for levee surfacing; riprap to supplement the limited levee armoring disturbed by the construction; and earthen fill to construct the levee and berms. Manufactured items and materials, such as concrete, pipe, and valves, will be supplied by area vendors.

3.8.9.2 Aggregate and Riprap

Aggregate and riprap may be obtained from locally approved quarries. There is an approved quarry located north of St. Joseph in the area of Amazonia, Missouri. The relatively short haul distance and already identified as an approved source, is likely to result in the quarry used for this project.

3.8.9.3 Earthen Fill

3.8.9.3.1 Land Based Borrow Areas

EM 1110-2-1923, Design and Construction of Levees (30 April 2000), Chapter 4, Borrow Areas notes that generally the most economical borrow areas are those located parallel and adjacent the levee. Borrow area selection consideration not only much consider the most economical source of acceptable material, but other considerations must be addressed, such as cultural and environmental concerns. Two types of earthen fill necessary for constructing the selected plan are: impervious material and random material (pervious or impervious). Impervious material is needed for the levee cap, riverward fill, and to a limited extent the levee landward slope. Random fill is necessary for the levee landward slope and the wide underseepage berms. Top soil for covering the random will be obtained from stripping the borrow areas and the underseepage berms. The greatest percentage of the fill will be random material. Because the greater share of the fill requirements is random material, the concern is not as great in what material types will be discovered within the riverward borrow areas. Limited sorting during excavation will be practiced so as to preserve the impervious material for use in the applicable zone areas.

Riverward borrow bays between the river and the levee were identified as borrow sources for the selected plan. Sheet Numbers 1 and 2 include the borrow area levee station limits. MRLS L-455 borrow areas begin a minimum of 450-feet riverward of the levee and extend out to 100-feet of the Missouri River high bank. MRLS R 471-460 borrow areas begin a minimum of 300-feet riverward of the levee and extend out to 100-feet of the Missouri River high bank. Underseepage analysis accounted for the reduced riverward entrance for both units. Borrow areas for the selected plan are at the same locations as the borrow areas that were made available for original construction. Borrow area borings were not completed as part of this study. In addition, since documentation was not located indicating what areas have historically been borrowed, there is uncertainty as to what type of material exists within the borrow areas. However, as addressed above, the bulk of borrow will be used for landward underseepage berms and the landward face of the levee. Both of these fill zones allow random material. Random material is defined as sand, silt, clay, or combinations of sand, silt, or clay. Only the levee crown or fill placed riverward requires the use of impervious fill. The risk of unacceptable material from the borrow areas is minimal. However, during PED a drill and sampling program should be conducted for the borrow areas.

Based on the observation of the river stages, it appears excavations within the borrow areas riverward of the levee could be as deep as 10-feet towards the upstream borrow limits and 7-feet towards the downstream borrow limits before reaching the river stage. These depths will more than adequately allow for the estimated fill quantities.

There have been inquiries about dredging from Contrary Lake and Browning Lake. This study did not consider dredging Lake Contrary or Browning Lake as sources of fill because there are concerns with the probable organic content at the bottom of the lake and the likelihood the dredged material would not be free draining material. The borings in the vicinity of the levee adjacent Lake Contrary indicate zones of silty sands as well as zones of silt and clay materials. Some borings indicate poorly graded sands which would work well with a dredging and fill operation for the underseepage berms, however, it would be difficult to separate the free draining sands from the zones that are not free draining. Organic material is not recommended as a levee structural fill or a fill other than topsoil, which has a limited thickness. Placement of saturated material that is not free draining precludes proper compaction and will introduce instability and long term consolidation (settlement).

3.8.9.3.2 Dredge Operations

Since a considerable portion of the fill to construct the selected plan will be random material, dredging from the Missouri River would likely prove more economical than a land based borrow operation. Gradations from the Missouri River sediment indicate free draining fine to medium sands with less than 1% fine material (passing the #200 sieve). For this study, dredging from the Missouri River was not considered as a source of fill material as there are concerns that will require attention, such as cultural issues and issues with declining river sediment load. During PED it is recommended dredging be considered in greater depth. A river sedimentation study will most like be necessary to resolve some of the concerns.

3.8.10 Levee Gages and Instrumentation

Although some instrumentation and gages would be ideal as part of the selected plan construction, historically there has not been much success with local sponsors protecting, maintaining, and reading the instrumentation during a flood event. The lack of awareness and use may be attributed to the limited involvement from the Corps of Engineers, infrequent flood events, and the fact that generally there are different local board members from flood event to flood event. These levees have been tested and proven during the Great Flood of 1993. In addition, with the minimal raise, the benefits of additional instrumentation would not be significant.

The selected plan will include the following levee freeboard gages:

MRLS R 471-460:

FB-2……Station 115+60
FB-3……Station 230+00
FB-4……Station 325+00
FB-5……Station 398+00
FB-6……Station 420+35
FB-7……Station 497+60
FB-8……Station 558+50

MRLS L-455:

No additional freeboard gages or modifications to freeboard gages will be included as part of the selected plan.

4.1 INTRODUCTION

The Civil Design support to the Missouri River Levee Systems (MRLS) L-455 and R 471-460 Feasibility Study focused on the selected plan. The selected plan provides flood protection against the 100-year + 3-feet flood profile. The Civil Design efforts included managing and developing project area surveys and mapping, establishing the levee study project limits, developing alignment and levee stationing, addressing impacts to roads and railways, and addressing impacts to utilities. Civil Design efforts also provided input to the alternative screening process. Alternative screening is addressed in more detail within the main body of the study.

4.2 STUDY'S LEVEE LIMITS

4.2.1 General

The selected plan includes top of levee raises only and does not include levee realignments. Civil Design determined the limits of the top of levee raises for each unit of this study. Top of levee raises 1-foot or less will have earth fill placed on the levee crown with 1 vertical on 2 horizontal slopes intersecting both the existing riverward and landward levee slopes. In this case the levee centerline will remain at its current alignment. Top of levee raises greater than 1 foot will have earth fill placed on the levee crown and the landward levee slope. The landward levee fill slope will be the same as the existing landward slope. Top of levee raises greater than 1-foot will result in a landward shift of the levee centerline. The magnitude of the shift landward will depend on the top of levee raise value as well as the riverward and landward levee slopes. The limits and maximum raised considered as part of the study's selected plan are addressed within the paragraphs that follow. Additional information is located within the Surveys and Mapping paragraphs herein Section Four.

4.2.2 MRLS R 471-460

The study's selected plan for MRLS R 471-460 will include a top of levee raise from levee station 93+09 through levee station 639+84. The maximum top of levee raise will be 3.37-feet.

4.2.3 MRLS L-455

The study's selected plan for MRLS L-455 will include a top of levee raise from levee station 205+64 (Part 1) through levee station 294+93 (Part 1). The maximum top of levee raise will be 0.94-foot.

4.3 ROAD AND RAILWAY LEVEE CROSSINGS

4.3.1 MRLS R 471-460

4.3.1.1 Union Pacific Railway Crossing

The Union Pacific Railway levee crossing occurs at approximately MRLS R 471-460 levee station 402+60. Travel on the levee crown terminates at the railway levee crossing. Levee ramps are provided north and south of the railway embankment; however, each is located riverward of the levee centerline and will not be effective as a vehicle turn-a-round to reverse direction during a flood event. A turn-a-round or landward ramp would be beneficial both upstream and downstream of the railway embankment. Pre-construction, Engineering, and Design (PED) will revisit locations of ramps, turn-outs, and turn-a-rounds. The current top of levee is below the top of the railway embankment at the tie-in points. An impervious blanket lines the railway abutment face that projects riverward of the levee alignment. The levee's selected plan's proposed raise elevates the levee crown to about elevation 823.08. The top of the railway embankment is approximately elevation 827.2 or about 4-feet higher than the proposed top of levee at the levee tie-in points to the railway embankment. Additional impervious facing to account for the levee raise should be anticipated on the railway abutment projecting riverward of the levee alignment.

4.3.1.2 U.S. Highway 36 Crossing

U.S. Highway 36 spans both the levee and Missouri River approximately at MRLS R 471-460 levee station 421+00. Sufficient clearance lies between the top of levee raise and the U.S. Highway 36 low steel to allow for construction equipment and levee access equipment necessary for levee operation and maintenance.

4.3.2 MRLS L-455

The MRLS L-455 selected plan limits do not include existing road or railway crossings of the levee.

4.4 UTILITY RELOCATIONS

4.4.1 General

Utility relocations for the purpose of the Civil Design efforts do not include storm sewer drainage structures through the levee. Storm sewer drainage structures through the levee which are considered a feature of the flood control works are addressed within Section Five, Structural. Civil Design efforts included site visits to identify utilities crossing or in the vicinity of the levee unit and a literature search to supplement the site visit. During Pre-construction Engineering and Design (PED) contacts will be made with utility locator services as well as city and county agencies to verify a complete list of utilities crossing the levee or in the vicinity of the levee and to obtain additional information of each utility, such as vertical and horizontal alignment, size, utility material, utility use, and other utility features of concern with flood control.

4.4.2 MRLS R 471-460

4.4.2.1 General

A study of utilities crossing MRLS R 471-460 was conducted to estimate costs for relocation or removal of functioning or abandoned utilities. MRLS R 471-460 has six utilities crossing the levee. Of the six, three utilities are outside the limits of the raise. The three utilities within the limits of the raise will be relocated over the top of levee raise. During PED structural uplift will be addressed for the utility lengths landward of the levee. PED will also address the need for temporary flood control protection or not as part of each utility's relocation. The following paragraphs addresses disposition of the utilities crossing through the levee and specific items of interest for estimation of relocation cost.

4.4.2.2 Williams Brothers Pipeline

The Williams Brothers pipeline is identified as UL1 within the MRLS R 471-460 Operations and Maintenance Manual. The crossing occurs at levee station 53+38.3. The pipeline is a16-inch steel pipe (SP) and includes a gate valve. The line crosses the levee at about elevation 828.1. No action is required since this crossing is outside the limits of the top of levee raise.

4.4.2.3 St. Joseph Waterline

The St. Joseph Water Company maintains a 16-inch diameter ductile iron pipe (DIP) waterline that crosses MRLS R 471-460 at levee station 300+00. The waterline is identified as UL2 within the MRLS R 471-460 Operations and Maintenance Manual. The waterline crosses the levee at about elevation 821.6, and the line includes one butterfly valve 156-feet landward and one butterfly valve 132-feet riverward of the levee centerline. The waterline will be relocated over the top of levee raise with the new pipe invert elevation of 825.8 at the levee crossing. The crossing will include 3.5-feet of earthen overbuild. An air release valve and gate valve will be installed on the riverward edge of the levee crest. Information for cost estimating purposes is provided as follows:

a. Overbuild quantity: 3.5-feet of cover; 1,400 compacted cubic yards
b. Excavation: 714 cubic yards to expose the line and excavation of borrow for overbuild
c. Backfill: 17 compacted cubic yards of impervious fill to supplement the excavation quantity
d. Manhole: 4-feet diameter standard shallow pre-cast manhole placed on concrete base
e. Valves: one air/vacuum valve and one gate valve
f. Relocation Length: 300-feet. Existing butterfly valves to remain
g. Pipe Type: 16-inch diameter DIP standard water service pipe, class 50 rated at 350 pounds per square inch
h. Pipe Bends: four 22.5 degree bends and two 11.25 degree bends
i. Remove and dispose off site replaced existing pipe

4.4.2.4 Gas Line

The 8-inch diameter SP gas line crosses MRLS R 471-460 at levee station 417+65. The gas line is identified as UL3 within the MRLS R 471-460 Operations and Maintenance Manual. The existing line crosses the levee at about elevation 799.0. The gas line will be relocated over the top of levee raise. The top of levee raise elevation in this area is approximately 823.0. Information for cost estimating purposes is provided as follows:

a. Overbuild quantity: 2-feet of cover; 450 compacted cubic yards
b. Excavation: 3,760 cubic yards to expose the line and excavation of borrow for overbuild
c. Backfill: 1.5 compacted cubic yards of impervious fill to supplement the excavation quantity
d. Relocation Length: 288-feet
e. Pipe Type: 8-inch diameter schedule 40 welded SP, black pipe
f. Pipe Bends: six 90 degree bends and two 45 degree bends
g. Remove and dispose off site replaced existing pipe

4.4.2.5 Telephone Cable

The telephone cable line crosses MRLS R 471-460 at levee station 418+15. The cable line is identified as UL4 within the MRLS R 471-460 Operations and Maintenance Manual. The existing line crosses the levee at about elevation 816.5 buried approximately 3.5-feet deep. The cable line will be relocated over the top of levee raise. Information for cost estimating purposes is provided as follows:

a. Overbuild quantity: 2-feet of cover; 450 compacted cubic yards
b. Excavation: 295 cubic yards to expose the cable and excavation of borrow for overbuild
c. Backfill: 5 compacted cubic yards of impervious fill to supplement the excavation quantity
d. Relocation Length: 191-feet
e. Break Points: two splice points with splice box
f. Cable Type: 1200 pair cable
g. Remove and dispose off site replaced existing cable

4.4.2.6 Sanitary Sewer Line

The 12-inch diameter sanitary sewer line is identified as UL5 within the MRLS R 471-460 Operations and Maintenance Manual. The Peter's Creek and levee crossing occurs at levee station 709+40. The pipeline crosses the levee at about elevation 806.8 and is plugged and abandoned. No action is required during the feasibility phase since this crossing is outside the limits of the top of levee raise.

4.4.2.7 Sanitary Sewer Line

The 8-inch diameter sanitary sewer vitrified clay pipe (VCP) is identified as UL6 within the MRLS R 471-460 Operations and Maintenance Manual. The line crosses at Peter's Creek channel station 5+1.47. No action is required during the feasibility phase since this crossing is outside the limits f the top of levee raise.

4.4.2.8 Overhead Power Lines

Two power lines cross or are in the vicinity of MRLS R 471-460 within the limits of the top of levee raise. At approximately levee station 301+20 there is a major transmission line, however, the current lines are elevated well above the top of levee raise sufficiently to avoid clearance issues. At approximately levee station 300+00 there is a smaller single-phase power line adjacent to the landside levee toe. No modifications are necessary for the feasibility study. However, this area will be revisited during PED to ensure no interference with the selected plan's levee footprint.

4.4.3 MRLS L-455

The MRLS L-455 selected plan limits do not include utility crossings of the levee.

4.5 SURVEYS AND MAPPING

4.5.1 General

Sources of surveys and mapping include relative recent top of levee field surveys, the original topographic mapping available from the levee as-built drawings, and the 1998 Missouri River Mapping.

4.5.2 Mapping

4.5.2.1 General

Since the original levee topographic mapping pre-dates the mid 1960s and the contours are not complete, it is in question. This topography is used to supplement surveys and more recent mapping. The 1998 Missouri River Mapping is on 4-feet contour intervals and meets National Mapping Standards for accuracy. This mapping is primarily used to determine floodplain tendencies and obtain elevations where no other information is available.

4.5.2.2 Mapping Use and Limitations

The stationing for the levees should be considered approximate since stationing was applied to current topographic mapping by visual methods. Raster images from the levee as-built drawings were lined up with the 1998 Missouri River Mapping and the stationing was transposed from those raster images. The stationing is estimated to be accurate to within 50 feet based on professional judgment.

The cross section by H&H used river miles to determine predicted water elevation on the levee. This information was later converted to stationing and adjusted visually using professional judgment to account for difference between the curvature of the river and the curvature of the levee. Based on professional judgment, cross section stationing is estimated to be accurate to within 50 feet.

4.5.3 Surveys

4.5.3.1 General

The survey of MRLS L-455 was conducted in September 2002. The survey of MRLS R 471-460 was conducted in March 2003. Both surveys were done in State Plane coordinate System (SPS) zone Missouri West and US survey feet. The original required vertical accuracy for these surveys was ±0.1 feet and later changed to ±0.2 feet.

Two methods were used to conduct the survey: GPS and differential leveling. The GPS method used a base and receiver system. The base is put on a known control point and the coordinates for that point are programmed in. The control points for MRLS L-455 were BM-12 and BM-7; and the points for MRLS R 471-460 were BM T-216 and ROSE. The receiver is mounted on an All Terrain Vehicle (ATV), and then data is broadcasted from the receiver to base as the ATV moves on the line to be surveyed.

The second method was differential leveling. MRLS L-455 was measured in the fall of 2002 and a limited reach of MRLS R 471-460 was measured in December of 1996. This method is used for vertical surveys only.

The mapping standards on this project require 90% of spot elevations to meet standards, ±0.2 feet, which was met. "The certainty of accuracy for each station is not 100% dependable. Collecting GPS data continuously over extended time duration will inevitably produce outliers." (Greg Shamberger, Survey Memo, May 2003)

4.5.3.2 Limitations of the Survey; Vertical Accuracy

Quality control for the "surveyed top of levee" stated that 90% of the points were within the allowable limits of +/- 0.2-foot, which conceivably leaves up to 10% of the points with a lower level of accuracy. It is impossible to know how far off an outlier may be, as well as which specific points are outliers, however, relatively very small top of levee raises (i.e. less than 1-foot and some areas less than 0.2-foot) were calculated based upon the top of levee survey coupled with levee as-built information. Follow-up field checks and comparisons with structures and the levee centerline indicate the levee as-built elevations were generally accurate, though detailed field survey checks were not conducted. The information at hand gives a representation of the magnitude of the top of levee raises as well as the levee station limits. The top of levee raises will be further investigated during PED with detailed field surveys.

4.6 RAISE DETERMINATIONS

To determine top of levee raises the following method was used: if both the record drawings and the survey were above the predicted water level then there is clearly need for a raise. In other words, for a clearly needed levee raise, the design water surface elevation is higher than both the surveyed top of levee minus 0.5-foot (to account for aggregate surfacing) and the levee as-built drawings' top of levee elevation.

There are other areas, however, that are considered "inconclusive" that will require further screening during PED. There are areas where the surveyed top of levee minus 0.5-foot may be below the design water surface elevation, but by less than 0.2-foot (the stated accuracy of the survey), or the levee as-built information in the area indicates top of levee elevations above the design water surface elevation.

The table below indicates where a raise is required, how high, and whether the need for the raise is clear or inconclusive (requiring further investigation during PED). An additional column is also provided to indicate whether the UNET model (induced damages assuming raise to 1% + 3-feet on opposing bank) or the HEC-RAS model water surface elevations controls the identified need for a raise. Backwater elevations were considered for tiebacks on Browns Branch & Peters Creek.

MRLS R 471-460

Station Limits	Linear Feet	Raise (feet)	Clear or Inconclusive	Which Model Controls
064+53 - 064+78	25	0.003	Inconclusive	RAS
087+73 - 088+85	112	0.3	Inconclusive	RAS
089+35 - 092+62	327	0.3	Inconclusive	RAS
093+09 - 639+84	54,675	3.3	Clear (Inconclusive on ends)	RAS
639+84 - 717+00	7,716	0.5	Inconclusive	RAS & Backwater (Peters Creek)

MRLS L-455

Station Limits	Linear Feet	Raise (feet)	Clear of Inconclusive	Which Model Controls
047+81 - 048+44	63	0.2	Inconclusive	RAS
050+35 - 052+92	257	0.3	Inconclusive	RAS
084+38 - 084+56	18	0.1	Inconclusive	RAS
088+78 - 089+14	36	1.2	Inconclusive	RAS
089+46 - 089+55	9	0.5	Inconclusive	RAS
090+90 - 091+21	31	0.3	Inconclusive	RAS
104+83 - 110+02	519	0.6	Inconclusive	RAS
205+64 - 294+93	8,929	0.9	Clear	UNET

No raise required for Browns Branch tiebacks.

5.1 MRLS R 471-460 STRUCTURAL OVERVIEW AND SUMMARY

5.1.1 Introduction

The Structural support to the Missouri River Levee Systems (MRLS) L-455 and R 471-460 Feasibility Study focused on the selected plan. The selected plan provides flood protection against the 100-year plus 3-feet flood profile. Structural input was also provided for alternative screening. Alternative screening is addressed in more detail within the main body of the study. The documentation as follows provides a structural overview and summary for the MRLS R 471-460 selected plan.

5.1.2 Overview

The Kansas City District's Structural Section, EC-DS, performed the structural analysis. Technical reviews were completed by in-house staff and the St. Paul District. The 100-year plus 3-feet flood profile for the selected plan was established by the Hydrology/Hydraulics and Civil Design Project Development Team (PDT) disciplines. Only those structures within a levee reach subject to a raise were considered as part of the structural effort. The structural features within the MRLS R 471-460 top of levee raise limits included drainage pipes and a box culver as well as the drainage systems' gatewell structures. The documentation addresses the following:

a. Levee and structural analysis references
b. Feasibility study Scope of Work (SOW)
c. Documentation
d. Drainage systems identified for study
e. Utility lines identified for study
f. Stability analysis methodology
g. Stability analysis results
h. Strength analysis methodology
i. Strength analysis results
j. Recommendations

Detailed documentation is included within the separately bound document, "Missouri River Levee System (MRLS) L-455 & R 471-460, Design Documentation Report (DDR)" and is available for viewing upon request. The following project information can be found within the DDR:

a. Structural Overview and Summary (similar to this document)
b. Scope of Work
c. Conduit Analysis
d. Gatewell Analysis
e. EC-GD Hydraulic Grade Line and Settlement Estimates

5.1.3 Levee and Structural Analysis References

Levee reference material in Table 1 below provided information used to analyze the drainage structures, including specifications for construction of MRLS R 471-460. The structural criteria used to complete structural support to the feasibility study are listed in Table 2 below. Army Corps of Engineers (COE) and private industry criteria were used to conduct the structural analysis.

Table 1. References.

ID	Publication Title	Pub Date
R1*	Operation and Maintenance Manual, Appendix I (As-Builts)	10/13/69
R2	Plans for Construction of Unit No R471-460	04/66
R3*	MRLS R471 460 Photos	11/04
R4*	MRLS R471 L455 Photos	01/05
R5	Specifications for Construction of Unit No R471-460	1966
R6*	R471 L455 Binded Documents (Periodic Inspection Reports, Levee Repair, etc)	10/15/04
R7	Unit R-471-460 Operation and Maintenance Manual	12/86
R8	L455 & R471-460 Feasibility Study Drawings	04/05
R9	R471-460 Design Computations	1966

*Documents located within the DDR.

Table 2. Structural and Stability Criteria References

ID#	Publication Title	Pub Date
	Army Corps of Engineers (COE):	
S1	EM-1110-2-2104 Strength Design for Reinforced-Concrete Hydraulic Structures, Change 1	08/20/03
S2	EM 1110-2-2902 Conduits, Culverts, and Pipes, Change 1	03/31/98
S3	EC 1110-2-6058 Stability Analysis of Concrete Structures	11/30/03
S4	Kansas City District Local Protection Guidance. Web address: http://www.nwk.usace.army.mil/Local_Protection/guidance.html	Varies
S5	ETL 1110-2-307 Flotation Stability Criteria for Concrete Hydraulic Structures	08/20/87
	American Concrete Institute (ACI):	
S11	318-02 Building Code Requirements for Structural Concrete	2002
S12	340R-97 ACI Design Handbook	1997
S13	ACI 350-01 Code Requirements for Environmental Engineering Concrete Structures	2001
	American Concrete Pipe Association (ACPA):	
S21	Design Method for Reinforced Concrete Pipe and Concrete Sections, Prepared for Technical Committee for the American Concrete Pipe Association, Frank J. Heger	12/82
S22	Pipe Design Manual, (Revised to Include Standard Installations edition)	06/00
	Federal Emergency Management Agency	
S23	NEHRP Guidelines for the Seismic Rehabilitation of Buildings, FEMA 310	1997

5.1.4 Structures (EC-DS) Feasibility Study Scope of Work (SOW)

The MRLS L-455 and R 471-460 Feasibility Study Structural SOW is located within the Project Management Plan (PMP) located within PM-PF files and within the DDR. The SOW has undergone modifications and clarifications since its creation in September 2003. The following information represents modifications/clarification of the original SOW:

a. The feasibility study will address only those structures lying in areas requiring a top of levee raise.
b. The top of levee raise affects the drainage systems located from levee station 115+60 to levee station 610+00. The corresponding river miles are from 454.1 to 443.4 (plus or minus 0.2 miles).
c. Flap gates will not be used on the drainage systems.
d. This feasibility study utilized an alternatives' screening approach to determine the selected plan. The selected plan is the levee raise required to provide protection for the 100-year + 3-feet flood event. All references made to "Future Design" in this report refer to the design required to meet the 100-year +3 feet flood event level of protection.
e. The gatewells will not require electrical utilities.
f. The levee footprint change will require replacement of the drainage systems inlets listed in Table 3 below.

5.1.5 Project Management Plan and Quality Control Plan

The feasibility study Project Management Plan (PMP) and Quality Control Plan (QCP) are located within PM-PF files and within the DDR.

5.1.6 Drainage Systems Identified for Study

Only those drainage systems located in areas where a top of levee raise is necessary to fulfill the 100-year + 3-feet flood protection requirement were chosen for study. Through coordination with the Hydrology/Hydraulics and Civil Design disciplines, a total of 8 MRLS R 471-460 drainage systems were identified for this feasibility study. The 8 drainage systems are listed in Table 3 below. The drainage system identification number corresponds to the numbers given in the drawings of Reference R7 (Table 1 above). The top of gatewell elevation values obtained from Reference R1 (Table 1 above) was verified in the field by Civil Design in March 2005. Note that the existing top of levee elevation value is higher than the existing top of gatewell elevation value for all drainage systems. The higher elevation is due to aggregate added to the top of levee since initial construction. Except for drainage system 4, each drainage system is composed of an inlet, outlet, pipe, and gatewell each constructed of reinforced concrete. Drainage system 4 consists of an inlet, outlet, box culvert, and gatewell each constructed of reinforced concrete. None of these drainage systems have a flap gate.

Table 3. Drainage Systems Analyzed.

Drain Sys	Conduit Size, (in) / Type[A]	Levee STA[B]	River Mile[C]	100 year + 3 Feet Flood Elev., (ft)[D]	Existing Top of Gatewell Elev., (ft)[B] / Conduit Invert Elev., (ft)[E]	Proposed Top of Gatewell Elev. (ft)[F]	Proposed Gatewell Raise, (ft)[G]	Existing Top of Levee Elev., (ft)[H]	Proposed Top of Levee Elev., (ft)[J]	Proposed Levee Raise, (ft)[K]
2	48 / RCP	115+60	454.1	828.96	828.1 / 809.7	828.96	0.86	828.6	828.96	0.86
3	48 / RCP	186+00	452.5	827.73	825.7 / 807.7	827.73	2.03	826.2	827.73	2.03
4	72 x 60 / RCB	325+00	449.9	825.34	823.3 / 797.2	825.34	2.04	823.8	825.34	2.04
5	36 / RCP	398+00	448.4	823.47	821.2 / 801.2	823.47	2.27	821.7	823.47	2.27
7	24 / RCP	420+35	447.9	822.90	820.5 / 803.2	822.90	2.40	821.0	822.90	2.40
8	66 / RCP	497+60	446.1	820.68	819.3 / 797.2	820.68	1.38	819.8	820.68	1.38
9	48 / RCP	558+50	444.5	819.25	818.4 / 796.7	819.25	0.85	818.9	819.25	0.85
10	54 / RCP	610+00	443.4	817.88	817.7 / 795.2	817.88	0.18	818.2	817.88	0.18

[A] Precast Reinforced Concrete Pipe (RCP); Reinforced Concrete Box Culvert (RCB)
[B] Reference: R1
[C] Approximate, plus or minus 0.2 miles
[D] Reference: R8
[E] Reference: R1. Invert elevation at gatewell sluice gate thimble connection. The outlet invert elevation at the gatewell connection is 1 foot lower than the invert elevation at gatewell sluice gate thimble connection for each drainage system.
[F] Equal to the 100 year+3 feet flood elevation
[G] Proposed Top of Gatewell Elev. – Existing Top of Gatewell Elev.
[H] Does include the existing aggregate material placed on levee crown. The aggregate thickness is approximately 0.5 feet
[J] Levee crown elevation prior to placement of aggregate material. The aggregate thickness is assumed to be 0.5 feet
[K] Proposed Top of Levee Elev. – Existing Top of Levee Elev. + 0.5 feet

5.1.7 Utility Lines

The utility lines shown in Table 4 below are located where a top of levee raise is necessary to fulfill the 100-year + 3-feet flood protection requirement.

Table 4. Utility Lines.

Utility ID	Levee Station	River Mile	Utility
UL01	53+38.3	~455.7	Petroleum
UL02	300+00	~450.4	Water
Ulxx	3xx+xx	xxx.x	Electric, above ground, adjacent to protected side levee toe. Not on O&MM drawings
UL03	417+65	447.9	Natural Gas
UL04	418+15	447.9	Natural Gas

5.1.8 Stability Analysis Methodology

5.1.8.1 Flotation

The criterion posted in Chapter 3 of Reference S3 (Table 2 above) was used to determine if the structures studied met the required safety factors for uplift. Table 5 below lists the minimum flotation factors of safety for various types of events. For this feasibility study, an extreme event is considered the 100-year + 3-feet top of levee event, which has a minimum safety factor of 1.1. A 3-feet below top of levee event is considered an unusual event and has a minimum safety factor of 1.2.

Table 5. Required Factors of Safety for Flotation-All Structures.

Load Condition	Factor of Safety (FS)
Usual	1.3
Unusual	1.2
Extreme	1.1

5.1.8.1.1 Uplift

The uplift force (U) is an input variable used in calculating the FS for flotation value. Two methods were used to determine the U value. The weight of the water displaced by the structure represented the U value in the first method, referred herein as Method "A". The second method of analysis used the equation posted in Reference S4 (Table 2 above), titled *Uplift*. This method of analysis is referred herein as Method "B" and its associated equation is presented below:

$$U = p_3\,A = (H_1/H_2)*H_3\,G_w \qquad \text{EQN 1}$$

Where; U=uplift force acting on the structure

p_3=uplift pressure acting on the structure

A =area of the structure over which the uplift force acts

H_1=vertical distance from the impervious blanket base to the hydraulic grade line at the structure location (HGL)

H_2=impervious blanket thickness
H_3=vertical distance from the base of the structure to the top of the blanket
G_w=density of water

The value of U was calculated for Methods A and B. The largest value was carried forward in calculating the FS for flotation value.

5.1.8.1.2 Gatewells

Except for drainage system 4, each drainage system gatewell has an 8-inch base slab heel extension located on the inlet and outlet sides of the gatewell. Drainage system 4 does not have heel extensions. Instead, the drainage system 4 RCB structure is cast integrally with the gatewell walls. None of the drainage systems have flap gates. It was assumed that flap gates would not be required in the future design. Therefore, it is also assumed that the gatewell sluice gate will be closed and each of the gatewells will fill with water during a Missouri River flood event. The gatewell uplift was calculated in a rapid drawdown situation. In this situation the gatewells are assumed dry. The weight of water displaced by the gatewell adjusted by the weight of water in the soil located above the gatewell heels was calculated to determine the uplift force acting on the gatewell (Method A). This value of uplift force was compared to the uplift value calculated using the impervious blanket thickness value (Method B) and EQN 1. The largest value of uplift computed using the two above described methods was used to determine the resulting FS for flotation. The gatewell FS for flotation was calculated using Reference S5 (Table 2 above), equation 1.

5.1.8.1.3 Conduits

To determine the drainage system conduit factor of safety for flotation values, the hydraulic grade line (HGL) profiles and impervious blanket elevation values provided by the Geotechnical discipline were used. Conduit uplift was calculated at the levee/berm srpingline location (near the conduit inlet headwall) using the guidance provided in Reference S4 (Table 2 above) and the blanket/grade line parameter located in the DDR. By observation, it was determined that the governing conduit factor of safety for flotation would occur near the conduit inlet because of the minimum conduit earth cover and the conduit being dry during a flood event at this location.

5.1.8.2 Bearing Capacity and Settlement

An overview of the bearing and settlement analysis for the gatewells and conduits are located in the DDR.

5.1.9 Stability Analysis Results

5.1.9.1 Flotation

5.1.9.1.1 Gatewells

The gatewell flotation stability calculations are located in the DDR. The Method A calculated values of uplift force governed. All drainage system gatewells studied met the minimum safety factor against uplift for the future design (top of levee) and 3-feet below top of levee flood events. The evaluated gatewell factors of safety values (FS) are tabulated in Table 6 below.

Table 6. Gatewell Future Design Factors of Safety (FS) For Flotation.

Drainage System Gatewell	FS For An Unusual Event (3 Feet Below Top of Levee Flood Event)	Required FS Met For An Unusual Event? (Min SF=1.2)	FS For An Extreme Event (Top of Levee Flood Event)	Required FS Met For An Extreme Event? (Min SF=1.1)
2	1.7	YES	1.4	YES
3	1.7	YES	1.4	YES
4	1.2	YES	1.1	YES
5	1.8	YES	1.5	YES
7	1.9	YES	1.6	YES
8	1.5	YES	1.3	YES
9	1.6	YES	1.4	YES
10	1.5	YES	1.3	YES

5.1.9.1.2 Conduits

The conduit FS for flotation values are shown in Table 6A below and represent the FS for conduit flotation at the levee/berm springline during the design event. The values of uplift (U) calculated by Method B as described above governed the FS for flotation values. FS for flotation values that did not meet the minimum requirements are associated with drainage systems 3, 8 and 10.

Table 6A. Conduit Future Design Factors of Safety (FS) For Flotation.

Drainage System Conduit	Conduit Size, (in)	FS For An Unusual Event (3 Feet Below Top of Levee Flood Event)	Required FS Met For An Unusual Event? (Min SF=1.2)	FS For An Extreme Event (Top of Levee Flood Event)	Required FS Met For An ExtremeEvent? (Min SF=1.1)
2	48	1.4	YES	1.2	YES
3	48	1.0	NO	0.83	NO
4	72 x 60	>1.2	YES	>1.1	YES
5	36	1.7	YES	1.5	YES
7	24	2.2	YES	1.7	YES
8	66	1.3	YES	1.0	NO
9	48	1.3	YES	1.3	YES
10	54	1.3	YES	1.0	NO

5.1.9.2 Settlement

The gatewells' estimated settlement values determined by the Geotechnical discipline are shown in Table 7 below.

Table 7. Estimated Settlement Due to Additional Fill Required for the Future Design

Drainage System	Fill On Levee Crown, (ft)	Estimated Settlement, (in)
2	1.0	<0.5
3	2.0	<0.5
4	2.0	<0.5
5	3.5	<0.5
7	3.0	<0.5
8	2.0	<0.5
9	1.5	<0.5
10	0.5	<0.5

5.1.10 Strength Analysis Methodology

Strength analysis was conducted on the gatewells, reinforced concrete pipe (RCP) and reinforced concrete box (RCB) culvert. The RCB and gatewell center-to-center span length was used to compute the moment capacity and demand values. The shear demand values were taken at distance "d" equal to the reinforcement depth away from the support. The capacity (R) and demand (Q) values were calculated with both the load factor and strength reduction factor equal to 1. The resulting R/Q values were compared to the minimum acceptable safety factors shown in Table 8 below. Information on the concrete strength (f_c) and steel reinforcement strength (f_y) was not posted in the drawings or specifications. The Reference R9 (Table 1 above) design calculations used a concrete compression strength value of f_c equal to 1050 psi and an f_s value of 20 ksi. These values are based upon the working stress method of design whereby f_c=f'c(0.35) and f_s=20 ksi. This results in an f'_c value of 3 ksi. For the reinforcement, Reference R5 (Table 1 above) states *All bent bars and dowels #6 and larger shall be intermediate grade billet steel. Straight bars may be intermediate grade billet-steel, hard grade billet-steel or rail steel.* Table 6-2 of Reference S23 (Table 2 above) states that the yield strength of Intermediate Steel is 40 ksi, Hard steel 50 ksi and rail steel is 60 ksi. Based on the specification information posted in Reference R5 (Table 1 above), f_c=3ksi and f_y=40ksi values were used for the initial analysis of the gatewells and RCB. Additional analysis was conducted on the RCB, drainage system 4 and 8 gatewells using a concrete compressive strength equal to f'_c=3 x 1.25ksi=3.75 ksi.

Table 8. Minimum Acceptable Strength Safety Factors (SF) for Existing Structures.

Structure	Load Factor, LF	Strength Reduction Factor, SR	SF= LF/SR	Minimum Acceptable SF= 0.85*SF	Reference
RCP	Dependant upon the D-load strength value. Range: 1.5 to 1.25	0.9	1.67 to 1.39	Dependant upon the D-load strength value. Range: **1.28 to 1.06**	S21, S22
RCB & Gatewell Moment	1.7	0.9	1.89	**1.61**	S1, Single Load Factor Method

RCB & Gatewell Shear	1.7	0.85	2.0	**1.70**	S1, Single Load Factor Method

5.1.10.1 RCP

To determine the class of RCP present in the levee, the direct design equation 3.10 found in Reference S21 (Table 2 above) was used to calculate the $D_{0.01}$ capacity value. This equation was used because the class of RCP placed in the levee was not specified in the MRLS R 471-460 specifications or drawings. The capacity (R) value obtained from the Reference S21 (Table 2 above) equation 3.10 was compared to the demand (Q) value obtained from equation 3-2 found in Reference S22 (Table 2 above) to determine if the RCP met the minimum strength requirements. For RCP demand, the embankment condition was used. No live loads were placed on the RCP because the contribution of live loading on RCP is negligible when the pipe depth exceeds 10 feet (Figure 5-2 of Reference R5 (Table 1 above)). For strength analysis, it was assumed that the RCP would be full of water. A bedding factor (B_f) of 2.23 and a vertical arching factor (VAF) equal to 1.4 were used to determine the RCP loading. The VAF=1.4 was determined by using Illustration 4.3 located in Reference S22 (Table 2 above) for a "Type 3" pipe installation. The bedding factor value was determined by using equation 3-1 located in Reference S2 (Table 2 above) for a projection ratio of 0.7. This projection ratio was determined from information extrapolated from Reference R5 (Table 1 above). Section 8 of Reference R5 (Table 1) (levee specifications) stating *"The bed shall fit the contour of the pipe over a width of not less than 0.6 of the pipe diameter."* The calculated 2.23 bedding factor is comparable to the "Type 3" installation bedding factor value posted in Reference S22 (Table 2 above). The Type 3 installation is based upon the Standard Installation Direct Design (SIDD) procedure developed and recommended by the ACPA for the design of RCP. This method replaces the historical Marston/Spangler design procedure used in Reference S2 (Table 2 above).

5.1.10.2 RCB

The RCB was evaluated for the existing and future design load cases using the embankment condition, Case I and Case II as outlined in Reference S2 (Table 2 above). For Case I, the VAF=1.5 and the horizontal arching factor, HAF=0.5. For Case II, the VAF=1.0 and HAF=1.0. The coefficient of lateral at rest earth pressure used was K_o=0.7. The RCB was assumed dry (sluice gate closed) for all load cases and lateral load due to water pressure during a flood event would be present on the RCB sidewalls. Thrust loading was taken into account in determining the moment and shear capacity (R) values for all four RCB walls. The shear capacity (R) values were calculated using Reference S11 (Table 2 above), section 11.3.2 criteria. A section of the RCB located just landward of the sluice gate was chosen for analysis. The RCB at this location is referred to as the Type B RCB in Reference R1 (Table 1 above).

5.1.10.3 Gatewells

The gatewell wall sections chosen for analysis were determined by the locations where the reinforcement sizing changed and the conduit crown locations. These wall sections were analyzed for moment and shear capacity versus demand. For this feasibility study, the top of proposed levee (future design), 100-year + 3-feet flood event load case was analyzed. The at-rest coefficient of earth pressure, K_o=0.7 was used. Each gatewell was assumed to contain water at the same elevation as the flood event because none of the gatewells are expected to have flap gates installed. Therefore the net lateral loading on the gatewell walls due to water pressure would be zero. The moment capacity (R) values were calculated using Reference S1 (Table 2 above) equation D1, taking into account the benefit of lateral thrust acting on the gatewell wall sections. The shear capacity (R) values were calculated using Reference S11 (Table 2 above), section 11.3.2 criteria which also takes into account the benefit of lateral thrust acting on the wall sections. The moment demand (Q) values were computed using the moment distribution method. The moment distribution factors were obtained using the Deflection guidance provided in Reference S12 (Table 2 above) to obtain the wall section effective moment of inertia values.

5.1.10.4 Required Safety Factor (SF) Values

5.1.11.1 RCP

The hydraulic load factor of 1.3 that is based on environmental structure durability given in References S13 and S1 (Table 2 above) was not used in this feasibility study. This factor addresses durability and structure longevity versus strength. The American Concrete Pipe Association does not apply the hydraulic factor when determining the RCP demand. The strength reduction value R=0.9 is based on Reference S21 (Table 2 above) for the direct design of RCP. Reference S22 (Table 2 above) was used to determine the RCP D-load safety factors. The relationship between ultimate D-load and 0.01-inch crack D-load is 1.5 for 0.01-inch crack D-loads of 2,000 or less; 1.25 for 0.01 inch crack D loads of 3,000 or more; and a linear reduction from 1.5 to 1.25 for 0.01 inch crack D-loads between more than 2,000 and less than 3,000. For example, if the D-load 0.01 crack strength is calculated to be 2300, the resulting safety factor SF= 1.5 – (300/1000)(1.5-1.25)=1.425. The resulting safety factors were reduced by 15% to account for the fact that no reports of distress have been reported for the RCP included in this feasibility study. For the example given above, the minimum acceptable safety factor = 1.425(0.85)=1.21. The 15% reduction factor has been used on previous feasibility studies such as the Kansas City 7 Levees feasibility study.

5.1.11.2 RCB and Gatewells

The Single Load Factor Method (SLFM) and strength reduction factors from Reference S1 (Table 2 above) were used to determine the minimum SF. Note that the hydraulic factor = 1.3 required in Reference S1 (Table 2 above) for concrete hydraulic structures was not applied for reasons outlined in paragraph 9.4.1. For existing RCB and gatewell structures, it is recommended that the minimum SF = 1.61 be used for moment loads. The recommended minimum acceptable SF for shear loads is SF = 1.70. These SF values were determined by taking 85% of the load factor divided by strength reduction value. The resulting safety factors were reduced by 15% to account for the fact that no reports of distress have been reported for the RCB and gatewells in this feasibility study. The reduction is used only for the acceptance of existing structures that have no signs of distress. If modification is required, the structure will be required to adhere to the Corps criteria without reduction to applicable safety factors. Regardless of the calculated SF, all RCB and gatewell structures should be visually inspected prior to making a final decision on whether replacement is necessary.

5.1.11 Strength Analysis Results

5.1.11.1 RCB

Results of the RCB analysis are shown in Tables 9, 10 and 11 below. Analysis was conducted on the existing design for a top of levee flood event and for the future design top of levee flood event. For both load cases where VAF=1.5 and HAF=0.5, (Case I) the RCB negative sidewall moment controlled. For both load cases where VAF=HAF=1.0, the positive sidewall moment controlled (Case II). Additional analysis of the RCB was done in light of the R/Q values shown in Table 9 below. The RCB was analyzed using a concrete compressive strength, f'_c=3.75 ksi. The 3.75 ksi value was obtained by multiplying the 3 ksi by 1.25. This factor was obtained from Reference S23 (Table 2 above), and is an expected value (versus lower bound) for concrete compressive strength as the concrete continues to hydrate and strengthen with age. The minimum acceptable SF shown in Table 10 below was obtained in part from Reference S1 (Table 2 above). Reference S1 (Table 2 above) defines the Modified ACI 318 Method, where the SF =[(1.7)1.3(0.75)]/0.9 = 1.84. The resulting 1.84 value was then multiplied by 0.85 to get the 1.5 SF. Note that the 1.5 value is less conservative than the flexure SF=1.61 used in the initial analysis. The 0.85 coefficient stated above was incorporated because the structures analyzed for this feasibility study have not exhibited signs of distress, thus permitting a minimum acceptable SF equal to 1.5. Also, the maximum loads the structures may be exposed to are highly predictable relative to conventional building structures exposed to live loads. The herein described Modified ACI Method using a minimum acceptable SF of 1.5 was also used in the Kansas City District's Seven Levees and Topeka Feasibility Studies. Results of the analysis using the Modified ACI Method are posted in Table 10 below. The RCB still did not meet the minimum required SF for bending moment for f'_c=3.75 ksi.

5.1.11.2 Gatewells

Results of the gatewell strength analysis are shown in Tables 12, 13 and 14 below. Drainage system 4, 8 and 10 gatewells failed to meet the minimum SF for bending moment at the lower wall elevations. Additional analysis was performed using the same methodology outlined in Paragraph 5.1.11.1 Drainage system 4 and 8 gatewells failed to meet the minimum SF for bending moment at the lower wall elevations using a concrete compressive strength of 3.75 ksi.

Table 9. RCB Moment SF, Existing and Future Design Top of Levee Flood Events.

Load Case	Positive Moment R, (Kip*ft)	Positive Moment Q, (Kip*ft)	Positive Moment R/Q	Negative Moment R, (Kip*ft)	Negative Moment Q, (Kip*ft)	Negative Moment R/Q	Min. Acceptable SF	Meets Minimum Moment Capacity SF Requirement?
ET_I	11.3	4.7	2.40	14	10.4	1.35	1.61	NO
ET_II	10.3	7.8	1.32	13.0	10	1.30	1.61	NO
FT_I	11.9	5.2	2.29	14.6	12.2	1.20	1.61	NO
FT_II	10.8	8.6	1.26	13.5	10.8	1.25	1.61	NO

ET_I: Top of levee flood event, existing design, VAF=1.5 and HAF=0.5
ET_II: Top of levee flood event, existing design, VAF=1.0 and HAF=1.0
FT_I: Top of levee flood event, future design, VAF=1.0 and HAF=1.0
FT_II: Top of levee flood event, future design, VAF=1.0 and HAF=1.0

Table 10. RCB Moment SF, Future Design Top of Levee Flood Event, Concrete *f'_c=3.75 ksi*

Load Case	Positive Moment R, (Kip*ft)	Positive Moment Q, (Kip*ft)	Positive Moment R/Q	Negative Moment R, (Kip*ft)	Negative Moment Q, (Kip*ft)	Negative Moment R/Q	Min. Acceptable SF*	Meets Minimum Moment Capacity SF Requirement?
FT_I	12.0	4.9	2.45	14.8	11.1	1.33	1.5	NO
FT_II	10.9	8.6	1.27	13.7	10.9	1.26	1.5	NO

ET_I: Top of levee flood event, existing design, VAF=1.5 and HAF=0.5
ET_II: Top of levee flood event, existing design, VAF=1.0 and HAF=1.0
FT_I: Top of levee flood event, future design, VAF=1.0 and HAF=1.0
FT_II: Top of levee flood event, future design, VAF=1.0 and HAF=1.0
* Based on the Modified ACI Method, reduced by 15%

Table 11. RCB Shear SF, Future Design Top of Levee Flood Event.

Load Case	Shear R, (Kip)	Shear Q, (Kip)	Shear R/Q	Min. Acceptable SF	Meets Minimum Shear Capacity SF Requirement?
FT_I	15.5	7.4	2.09	1.70	YES
FT_II	11.5	5.3	2.17	1.70	YES

Table 12. Gatewell Wall Moment SF, Top of Levee Flood Event-Future Design. Moment values based upon a section width b = 1 foot unless noted otherwise.

DS	STA & Depth[A], (ft)	Positive Moment R, (Kip*ft)	Positive Moment Q, (Kip*ft)	Positive Moment R/Q	Negative Moment R, (Kip*ft)	Negative Moment Q, (Kip*ft)	Negative Moment R/Q	Min. Accept. SF	Meets Minimum Moment Capacity SF Requirement?
2	115+60 15.3	11.5	3.6	3.19	8.0	4.1	1.95	1.61	YES
2	115+60 14.5	7.9	3.4	2.32	7.9	3.8	2.08	1.61	YES
2	115+60 19.3	9.8	5.0	1.96	C	C		1.61	YES
3	186+00 16.0	8.0	3.8	2.11	8	4.3	1.86	1.61	YES
3	186+00 20.0	9.8	5.2	1.88	C	C		1.61	YES
4	325+00 12.0	7.7	4.9	1.57	7.7	5.1	1.51	1.61	NO
4	325+00 17.0	11.8	7.0	1.69	8.3	7.2	1.15	1.61	NO
4	325+00 21.0	16.2	7.6	2.13	8.5	8.3	1.02	1.61	NO
5	398+00 19.0	8.3	3.0	2.77	8.3	4.1	2.02	1.61	YES
7	420+35 17.7	8.2	1.5	5.47	8.2	3.1	2.65	1.61	YES
8	497+60 13.7	7.9	5	1.58	7.9	5.3	1.49	1.61	NO
8	497+60 16.1[B]	43.0	22.2	1.94	32.4	23.5	1.38	1.61	NO
8	497+60 25.0[B]	14.3	7.8	1.83	C	C		1.61	YES
9	558+50 18.5	8.3	4.4	1.89	8.3	5.0	1.66	1.61	YES
9	558+50 22.6	9.82	5.8	1.69	C	C		1.61	YES
10	610+00 16.0	8.2	4.3	1.91	8.2	5.0	1.64	1.61	YES
10	610+00 16.9	16.5	9.1	1.81	16.5	10.5	1.57	1.61	NO
10	610+00 22.0	14.3	6.9	2.07	C	C		1.61	YES

[A] Measured from top of levee, future design elevation, including the 0.5 ft aggregate material thickness.
[B] Section width b=3.8 ft.
[C] Gatewell wall section located orthogonal of the walls with pipe openings. Negative moment cannot be developed in these wall areas.

Table 13. Gatewell Wall Moment SF, Top of Levee Flood Event-Future Design. Moment values based upon a section width b = 1 foot and concrete *f'_c=3.75 ksi*

DS	STA & Depth[A], (ft)	Positive Moment R, (Kip*ft)	Positive Moment Q, (Kip*ft)	Positive Moment R/Q	Negative Moment R, (Kip*ft)	Negative Moment Q, (Kip*ft)	Negative Moment R/Q	Min. Accept. SF*	Meets Minimum Moment Capacity SF Requirement?
4	325+00 19.0	16.4	7.8	2.10	8.5	8.1	1.05	1.5	NO
8	497+60 13.7	8.0	5.0	1.60	8.0	5.3	1.51	1.5	YES
8	497+60 16.1[B]	43.2	22.2	1.95	32.5	23.5	1.38	1.5	NO

[A] Measured from top of levee, future design elevation, including the 0.5 ft aggregate material thickness.
[B] Section width b=3.8 ft.
* Based on the Modified ACI Method, reduced by 15%

Table 14. Gatewell Wall Shear SF, Top of Levee Flood Event-Future Design. Based on section width b= 1 foot unless noted otherwise.

DS	STA & Depth[A], (ft)	Shear R, (Kip)	Shear Q, (Kip)	Shear R/Q	Min. Acceptable SF	Meets Minimum Shear Capacity SF Requirement?
2	115+60 15.3	13.1	2.7	4.85	1.70	YES
3	186+00 16.0	12.9	2.9	4.45	1.70	YES
4	325+00 13.0	13.2	5.0	2.64	1.70	YES
5	398+00 19.0	12.9	2.6	4.96	1.70	YES
7	420+35 17.7	12.9	1.7	7.59	1.70	YES
8	497+60 24.0	13.0	5.8	2.24	1.70	YES
9	558+50 18.5	12.9	3.3	3.91	1.70	YES
10	610+00 16.9[B]	25.7	6.8	3.78	1.70	YES

[A] Measured from top of levee, future design elevation, including the 0.5 ft aggregate material thickness.
[B] Section width b=2 ft

5.1.11.3 RCP

The calculated RCP SF is shown in Table 15 below. All RCP studied met the minimum capacity requirements. All of the RCP analyzed meet the minimum capacity requirements.

Table 15. RCP Evaluated Safety Factors For Future Design Levee.

DS	Dia, (in)	Depth[A], (ft)	Capacity, R,(plf)	Demand, Q, (plf)	R/Q	Min. SF Allowed	Meets Minimum Capacity Requirement?
2	48	15.3	2236	1532	1.46	1.22	YES
3	48	16.1	2236	1602	1.4	1.22	YES
5	36	19.4	2395	1893	1.27	1.19	YES
7	24	17.9	2680	1761	1.52	1.13	YES
8	66	17.9	2934	1803	1.63	1.10	YES
9	48	18.6	2236	1832	1.22	1.22	YES
10	54	18.2	2262	1805	1.25	1.22	YES

[A] Measured from top of levee, future design elevation (including 0.5 ft of aggregate material on levee crown) to RCP crown.

5.1.12 Recommendations

5.1.12.1 Gatewells

Based on the strength analysis, it is recommended that testing be accomplished on the drainage systems 4 and 8 gatewell concrete and reinforcement steel per ACI guidance for the testing of existing structures. Based on the material properties obtained from testing, an analysis should be reaccomplished to determine if the structure meets the minimum strength requirements. Regardless of the calculated SF for any of the structures, the physical condition of the gatewells should undergo a through visual examination prior to making a final decision as to whether replacement or rehabilitation action is necessary. If flap gates are installed on drainage system 4, 8, 9 and 10 outlet pipes, the respective gatewells should be reanalyzed for strength. Drainage systems 2, 3, 5 and 7 gatewell walls have a bending moment R/Q value equal to or greater than the acceptable SF for the Future Design event and would not require replacement if flap gates were installed on the outlets.

5.1.12.2 Conduits

It is recommended that the drainage system 4 RCB be replaced. The drainage system 4 RCB sidewalls were not designed for the lateral loads incurred by water pressure during a flood event per the 1966 design calculations (Reference R9). This has resulted in a 38% increase in the lateral load on the RCB sidewalls for Case I. A 21% increase in the lateral load on the RCB sidewalls resulted for Case II. Please refer to the hand calculations in Section III of this document for details comparing the original RCB design load cases versus the RCB load cases used in this feasibility study. This has resulted in the RCB sidewalls not meeting the minimum moment strength requirements. The 1966 design calculations used a fill height of 18 feet whereas the existing fill height at the levee crown is 20 feet. The fill height for the Future Design event at the levee crown is approximately

22 feet. The minimum FS for flotation was not met for the drainage system 3, 8 and 10 conduits. It is recommended that the levee berm be raised approximately 1.25 feet at drainage system 3 and 1.0 feet at drainage systems 8 and 10 to provide the minimum FS for flotation during the design event.

5.1.12.3 Preliminary Design

Sheet S-01, “MRLS R 471-460, Drainage Structure No. 4, Sta. 325+00, Levee Removal and Temp. Flood Protection” of the Engineering Appendix includes details for removal of Drainage Structure No. 4 including temporary flood protection. The temporary flood protection is for a level currently provided by the existing levee system. Sheet S-02, “MRLS R 471-460, Drainage Structure No. 4, Sta. 325+00, Replacement Structure Profile and Details” of the Engineering Appendix includes preliminary designs for the replacement drainage structure. Sheet S-03, “MRLS R 471-460, Drainage Structure Details, Gatewell and Pipe Extensions” of the Engineering Appendix includes preliminary design for the gatewell top extensions, the inlet extensions, and the inlet treatments. Final detailed design will be completed during PED.

5.2 MRLS L-455 STRUCTURAL OVERVIEW AND SUMMARY

5.2.1 Introduction

The Structural support to the Missouri River Levee System (MRLS) L-455 and R 471-460 Feasibility Study focused on the selected plan. The selected plan provides flood protection against the 100 year plus 3-feet flood profile. Structural input was also provided for alternative screening. Alternative screening is addressed in more detail within the main body of the study. The documentation as follows provides a structural overview and summary for the MRLS L-455 selected plan.

5.2.2 Overview

The Kansas City District’s Structural Section, EC-DS, performed the structural analysis. Technical reviews were completed by in-house staff and the St. Paul District. The 100-year plus 3-feet flood profile for the selected plan was established by the Hydrology/Hydraulics and Civil Design Project Development Team (PDT) disciplines. Only those structures within a levee reach subject to a raise were considered as part of the structural effort. The structural features within the MRLS L-455 top of levee raise limits included drainage pipes as well as the drainage systems’ gatewell structures. The documentation addresses the following:

a. Levee and structural analysis references
b. Feasibility study Scope of Work (SOW)
c. Documentation
d. Drainage systems identified for study

e. Utility lines identified for study
f. Stability analysis methodology
g. Stability analysis results
h. Strength analysis methodology
i. Strength analysis results and recommendations

Detailed documentation is included within the separately bound document, "Missouri River Levee System (MRLS) L-455 & R 471-460, Design Documentation Report (DDR)" and is available for viewing upon request. The following project information can be found within the DDR:

a. Structural Overview and Summary (similar to this document)
b. Scope of Work
c. Corrugated Metal Pipe (CMP) Analysis
d. Gatewell Analysis

5.2.3 Levee and Structural Analysis References

Levee reference material in Table 1 below provided information used to analyze the drainage structures. The structural criteria used to complete structural support to the feasibility study are listed in Table 2 below. Army Corps of Engineers (COE) and private industry criteria were used to conduct the structural analysis.

Table 1. References.

ID	Publication Title	Pub Date
R1*	Operation and Maintenance Manual, Appendix I (As-Builts)	03/23/66
R4*	MRLS R471 L455 Photos	01/05
R5*	Unit L-455 Operation and Maintenance Manual, Appendix III, Periodic Inspection Report No. 1	02/74
R6*	R471 L455 Binded Documents (Periodic Inspection Reports, Levee Repair, etc)	10/15/04
R8	L455 & R471-460 Feasibility Study Drawings	04/05
R9	Specifications for Construction of Levee Unit 455-L, Part I	1962
R10	Specifications for Construction of Levee Unit 455-L, Part II	1963
R11	FEMA 356 Prestandard and Commentary for The Seismic Rehabilitation of Buildings	11/00

*Documents located within the DDR.

Table 2. Structural and Stability Criteria References

ID#	Publication Title	Pub Date
	Army Corps of Engineers (COE):	
S1	EM-1110-2-2104 Strength Design for Reinforced-Concrete Hydraulic Structures, Change 1	08/20/03
S2	EM 1110-2-2902 Conduits, Culverts, and Pipes, Change 1	03/31/98
S3	EC 1110-2-6058 Stability Analysis of Concrete Structures	11/30/03
S4	Kansas City District Local Protection Guidance. Web address: http://www.nwk.usace.army.mil/Local_Protection/guidance.html	Varies
S5	ETL 1110-2-307 Flotation Stability Criteria for Concrete Hydraulic Structures	08/20/87
	American Concrete Institute (ACI):	

S11	318-02 Building Code Requirements for Structural Concrete	2002
S12	340R-97 ACI Design Handbook	1997
S13	ACI 350-01 Code Requirements for Environmental Engineering Concrete Structures	2001
	ASTM	
S20	A796-04a Standard Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications	2004
	FHWA	
S30	Corrugated Metal Pipe, Structural Design Criteria and Recommended Installation Practice	04/1976

5.2.4 Structures (EC-DS) Feasibility Study Scope of Work (SOW)

The MRLS L-455 and R 471-460 Feasibility Study Structural SOW is located within the Project Management Plan (PMP) located within the PM-PF files and within the DDR. The SOW has undergone modifications and clarifications since its creation in September 2003. The following information represents modifications/clarification of the original SOW:

a. The feasibility study will address only those structures lying in areas requiring a levee raise.
b. The levee raise affects the drainage systems located at levee stations 232+00 and 312+36. The river mile locations are 443.2 and 440.9 respectively (plus or minus 0.2 miles).
c. Flap gates will not be used on the drainage systems.
d. This feasibility study utilized an alternatives' screening approach to determine the selected plan. The selected plan is the levee raise required to provide protection for the 100-year + 3-feet flood event.
e. The gatewells will not require electrical utilities.

5.2.5 Project Management Plan and Quality Control Plan

The feasibility study Project Management Plan (PMP) and Quality Control Plan (QCP) are located within PM-PF files and within the DDR.

5.2.6 Drainage Systems Identified for Study

Through coordination with the Hydrology/Hydraulics and Civil Design disciplines, a total of 2 MRLS L-455 drainage systems were identified for this feasibility study. The 2 drainage systems are listed in Table 3 below. Note that the reference documents in Table 1 above do not specify drainage system identification numbers. The top of gatewell elevation values obtained from reference R1 (Table 1 above) were verified in the field by Civil Design in March 2005. Both drainage systems are composed of an inlet, outlet, and gatewell constructed of reinforced concrete. Corrugated metal pipe (CMP) provide the drainage path at both drainage systems. The water surface elevations shown in Table 3 below indicate that a top of gatewell raise will not be necessary at levee stations 232+00

Table 3. Drainage Systems Analyzed.

Conduit Size, (in) / Type[A]	Levee STA[B]	River Mile[C]	100 year + 3 Feet Flood Elev., (ft)[D]	Existing Top of Gatewell Elev., (ft)[B] / Conduit Invert Elev., (ft)[E]	Proposed Top of Gatewell Elev. (ft)[F]	Proposed Gatewell Raise, (ft)[G]	Existing Top of Levee Elev., (ft)[H]	Proposed Top of Levee Elev., (ft)[J]	Proposed Levee Raise, (ft)[K]
24 / CMP	232+00	443.2	817.67	817.8 / 796.4	817.8	0	818.3	817.8	0
24 / CMP	312+36	440.9	815.19	815.7 / 794.0	815.7	0	816.2	815.7	0

[A] Precast Reinforced Concrete Pipe (RCP); Reinforced Concrete Box Culvert (RCB), Corrugated (Circular) Metal Pipe (CMP)
[B] Reference: R1
[C] Approximate, plus or minus 0.2 miles
[D] Reference: R8
[E] Reference: R1. Invert elevation at gatewell sluice gate thimble connection.
[F] Equal to the 100 year+3 feet flood elevation or existing top of gatewell elevation, whichever is greater
[G] Proposed Top of Gatewell Elev. – Existing Top of Gatewell Elev.
[H] Does include the existing aggregate material placed on levee crown. The aggregate thickness is approximately 0.5 feet
[J] Levee crown elevation prior to placement of aggregate material. The aggregate thickness is assumed to be 0.5 feet
[K] Proposed Top of Levee Elev. – Existing Top of Levee Elev. + 0.5 feet

and 312+36. Therefore, for this feasibility study, the drainage system analysis will be for existing conditions.

5.2.7 Utility Lines Identified for Study

No utility lines have been identified as impacted by this feasibility study.

5.2.8 Stability Analysis Methodology

5.2.8.1 Flotation

The criteria posted in Chapter 3 of reference S3 (Table 2 above) was used to determine if the structures met the required safety factors for uplift. Table 4 below lists the minimum flotation factors of safety for various types of events. For this feasibility study, an extreme event is considered the 100-year + 3-feet top of levee event, which has a minimum safety factor of 1.1. Three feet below top of levee event is considered an unusual event and has a minimum safety factor of 1.2.

Table 4. Required Factors of Safety for Flotation-All Structures.

Load Condition	Factor of Safety (FS)
Usual	1.3
Unusual	1.2
Extreme	1.1

5.2.8.1.1 Gatewells

The gatewells studied do not have a heel extension. None of the drainage systems have flap gates. It was assumed that flap gates would not be required in the future design. Therefore, it is also assumed that the gatewell sluice gate will be closed and each of the gatewells will fill with water during a Missouri River flood event. The gatewell uplift was calculated in a rapid drawdown situation. In this situation the gatewells are assumed dry. The uplift force acting on a gatewell was calculated to equal the weight of water displaced by the gatewell. It is not expected that the uplift force using the method posted in reference S4 (Table 2 above) will control the factor of safety against flotation.

5.2.8.1.2 Conduits

By observation, it was determined that the minimum factor of safety for flotation would occur at the conduit inlet because of the minimum conduit earth cover and the pipe being dry during a flood event at this location. Conduit flotation analysis was not completed for this study.

5.2.8.2 Bearing Capacity and Settlement

The gatewells' bearing analysis and settlement were not completed for this study.

5.2.9 Stability Analysis Results

5.2.9.1 Flotation

5.2.9.1.1 Gatewells

The gatewell flotation stability calculations are located in the DDR. All of the drainage system gatewells studied met the minimum safety factor against uplift for the existing top of levee and three feet below top of levee flood events. The evaluated gatewell factor of safety values (FS) is tabulated in Table 5 below.

Table 5. Gatewell Existing Design Factors of Safety For Flotation.

Factors of Safety, (FS)				
Levee Station	**FS For Event A: 3 Feet Below Top of Levee Flood Event**	**Required FS Met For Event A? Min FS=1.2**	**FS For Event B: Top of Levee Flood Event**	**Required FS Met For Event B? Min FS=1.1**
232+00	1.6	YES	1.4	YES
312+36	1.6	YES	1.4	YES

5.2.9.1.2 Conduits

The conduits flotation analysis was not completed for this study.

5.2.9.2 Bearing Capacity and Settlement

5.2.9.2.1 Gatewells

The gatewells' bearing capacity and settlement were not completed for this study.

5.2.9.2.2 Conduits

The conduit settlement was not completed for this study.

5.2.10 Strength Analysis Methodology

Strength analysis was conducted on the drainage system corrugated metal pipe (CMP) and gatewell structures. For the gatewells, the center-to-center span length was used to compute the moment capacity and demand values. The shear demand values were taken at distance "d" equal to the reinforcement depth away from the support. The capacity (R) and demand (Q) values were calculated with a load factor and strength reduction factor equal to one for the two gatewell structures. The resulting R/Q values were compared to the minimum acceptable safety factors shown in Table 7 below. The concrete reinforcement yield strength fy=40 ksi was obtained from References R9 and R11 (Table 1 above) (ASTM A615 Intermediate Billet Steel). Information pertaining to the concrete strength (f_c) could not be found. Based on the time period the structures were built (1960s) and Table 6-3 in Reference R11 (Table 1 above), f_c=3ksi was used in the gatewell analysis. The CMP strength was checked using the Load Resistance Factor Design (LRFD) method found in Reference S20 (Table 2 above).

Table 6. Minimum Acceptable Strength Factor of Safety (FS) Values for Existing Structures.

Structure	Load Factor, LF	Strength Reduction Factor, SR	FS= LF/SR	Minimum Acceptable FS= 0.85*FS	Reference
CMP	1.95 for Earth Loads 1.75 for Live and Impact Loads	1.0 for Wall Area and Buckling 0.67 for Seam Strength	1.95 for Wall Area and Buckling 2.61 for Seam Strength	No reduction allowed.	S20
RCB & Gatewell Moment	1.7	0.9	1.89	**1.61**	S1, Single Load Factor Method
RCB & Gatewell Shear	1.7	0.85	2.0	**1.70**	S1, Single Load Factor Method

5.2.10.1 CMP

The CMP was analyzed using the LRFD design provisions in Reference S20 (Table 2 above). The load factors (LF) and factor of safety (FS) values were incorporated in the design equations. An embankment loading condition was used. A soil stiffness factor k equal to 0.44 was used to determine the critical buckling stress. The k value was obtained from Reference S30 (Table 2 above). Reference S30 (Table 2 above) recommends a k=0.44 value when the quality of side fill material and compaction required for k=0.22 are not obtainable. The available pipe corrugation material property information is limited. Reference R1 (Table 1 above) stated only *14 gauge CMP*. 14 gauge steel corresponds to a thickness of 0.079 inches. Based on pictures taken during the January 2005 site visit, the CMP was assumed to have annular 2 $^{2}/_{3}$ x ½ corrugations. A single line of $^{5}/_{16}$-in diameter rivets was assumed to be present.

5.2.10.2 Gatewells

The gatewell wall sections were analyzed for moment and shear capacity versus demand. For this feasibility study, the top of proposed levee 100-year + 3-feet flood event load case was analyzed. Note that the proposed design does not dictate a raise in the gatewell or levee height. The at-rest coefficient of earth pressure, K_o=1.0 was used. The moment capacity (R) values were calculated using reference S1 (Table 2 above) equation D1, taking into account the benefit of lateral thrust acting on the gatewell wall sections. The shear capacity (R) values were calculated using reference S11 (Table 2 above), section 11.3.2 criteria which also takes into account the benefit of lateral thrust acting on the wall sections. The moment demand (Q) values were computed using the moment distribution method. The moment distribution factors were obtained using the Deflection guidance provided in reference S12 (Table 2 above) to obtain the wall section effective moment of inertia values. For the 95% Feasibility Study Report, the gatewell wall sections located at the pipe crown and lower elevations will be evaluated for moment strength capacity using plate analysis.

5.2.10.3 Required Factor of Safety (FS) Values

5.2.10.3.1 CMP

The CMP was required to meet the design standards of Reference S20 (Table 2 above) which include the LF and FS posted in Table 6 above. Reference S20 (Table 2 above) is referenced in Corps Reference S2 (Table 2 above) for the design of CMP.

5.2.10.3.2 Gatewells

The Single Load Factor Method (SLFM) and strength reduction factors from Reference S1 (Table 2 above) were used to determine the minimum FS. The hydraulic load factor of 1.3 that is based on environmental structure durability given in Reference S13 and S1 (Table 2 above) was not used in this feasibility study. This factor addresses durability and structure longevity versus strength. For existing RCB and gatewell structures, it is recommended that the minimum FS = 1.61 be used for moment loads. The recommended minimum acceptable FS for shear loads is FS = 1.70. These FS values were determined by taking 85% of the load factor divided by strength reduction value. The resulting factor of safety values were reduced by 15% to account for the fact that no reports of distress have been reported for the gatewells in this feasibility study.

5.2.11 Strength Analysis Results and Recommendations

5.2.11.1 Gatewells

Results of the gatewell strength analysis are shown in Tables 7 and 8 below. Based upon the moment strength analysis, the gatewells meet the minimum moment and shear safety factors for an existing structure. Regardless of the calculated FS, the physical condition of the gatewells should be examined prior to making a final decision as to whether replacement or modification is necessary.

Table 7. Gatewell Wall Moment FS, Top of Levee Flood Event-Existing Design.

	Positive Moment			Negative Moment				
STA & Depth[A], (ft)	R, (Kip*ft)	Q, (Kip*ft)	R/Q	R, (Kip*ft)	Q, (Kip*ft)	R/Q	Min. Accept. FS	Meets Minimum Moment Capacity FS Requirement?
232+00 19.9	9.3	2.5	3.72	9.3	5.0	1.86	1.61	YES
312+36 20.2	9.3	2.5	3.72	9.3	5.1	1.82	1.61	YES

[A] Measured from top of levee, future design elevation, including the 0.5 ft aggregate material thickness.

Table 8. Gatewell Wall Shear FS, Top of Levee Flood Event-Existing Design.
[A] Measured from top of levee, future design elevation, including the 0.5 ft aggregate material thickness.

	Shear				
STA & Depth[A], (ft)	R, (Kip*ft)	Q, (Kip*ft)	R/Q	Min. Acceptable FS	Meets Minimum Shear Capacity FS Requirement?
232+00 19.9	12.9	2.8	4.61	1.70	YES
312+36 20.2	12.9	2.8	4.61	1.70	YES

5.2.11.2 CMP

The factored demand and capacity values are posted in Table 9 below. The CMP met the Reference S20 (Table 2 above) strength requirements.

5.2.11.2.1 Corps Criteria for CMP Use

Reference S2 (Table 2 above) states that CMP cannot be used as an option in agricultural levees where the levee embankment is greater than 12 feet above the pipe invert. The CMP do not meet this criterion. As shown in Table 9 below, the pipe depth at both levee locations is in excess of 20 feet.

5.2.11.2.2 CMP Perforation Life

Figure 4-1 in Reference S2 (Table 2 above) was used to evaluate the CMP perforation life. Using a pH value of 7.0 (neutral) and a resistivity of 4000-ohm cm for a clay soil, the years to perforation value is approximately 40 years for galvanized CMP. A recent site visit revealed that the protective bituminous coating on the CMP located at Levee Station 312+36 is peeling off of the interior surfaces of the pipe. The pipe invert was filled with wooden debris and could not be inspected. The CMP at Levee Station 232+00 was completely silted in and could not be inspected as of January 2005. The South St. Joseph Levee and Drainage District has been advised of the operations and maintenance issues and the need to remove obstructions from the pipes.

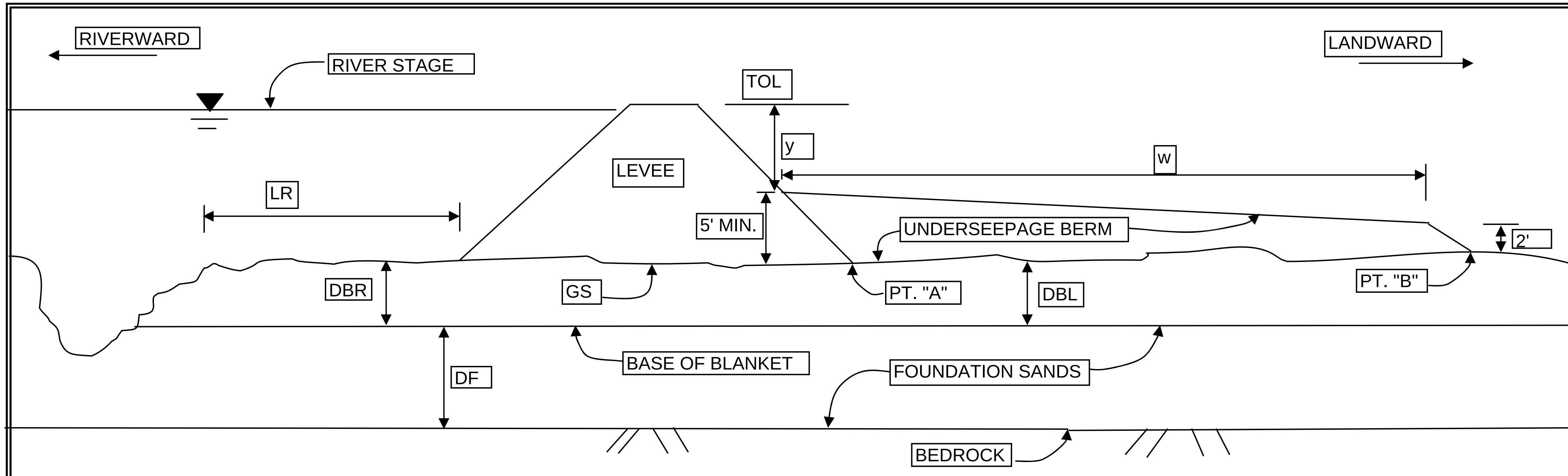
5.2.11.2.3 CMP Recommendations

The calculated life expectancy of the CMP has been exceeded. It is likely that the CMP at Levee Station 232+00 has significant corrosion given the silt buildup. If the pipe is perforated, piping of levee material will occur during flood events. This condition will jeopardize the levee's integrity during a significant Missouri river flood event. It is recommended that the silt be removed from the CMP located at Levee Station 232+00 and conduct a complete visual inspection of the CMP. Similarly, the wooded debris in the Levee Station 312+36 drainage system should be removed and conduct a visual inspection of the CMP. Based on the inspection results and a life cycle study, the CMP should be rehabilitated or replaced with reinforced concrete pipe. Possible rehabilitation alternatives include Cured In Place Pipe (CIPP) or a rigid HDPE pipe inlay.

Table 9. CMP Evaluated Safety Factors For Existing Design Levee.

STA Dia, (in)	Depth[A], (ft)	Factored Capacity, (plf)	Factored Demand, (plf)	Meets Minimum Capacity Requirement?
232+00 24	19.9	12194	4657	YES
312+36 24	20.2	12194	4727	YES

[A] Measured from top of levee, future design elevation (including 0.5 ft of aggregate material on levee crown) to CMP crown.



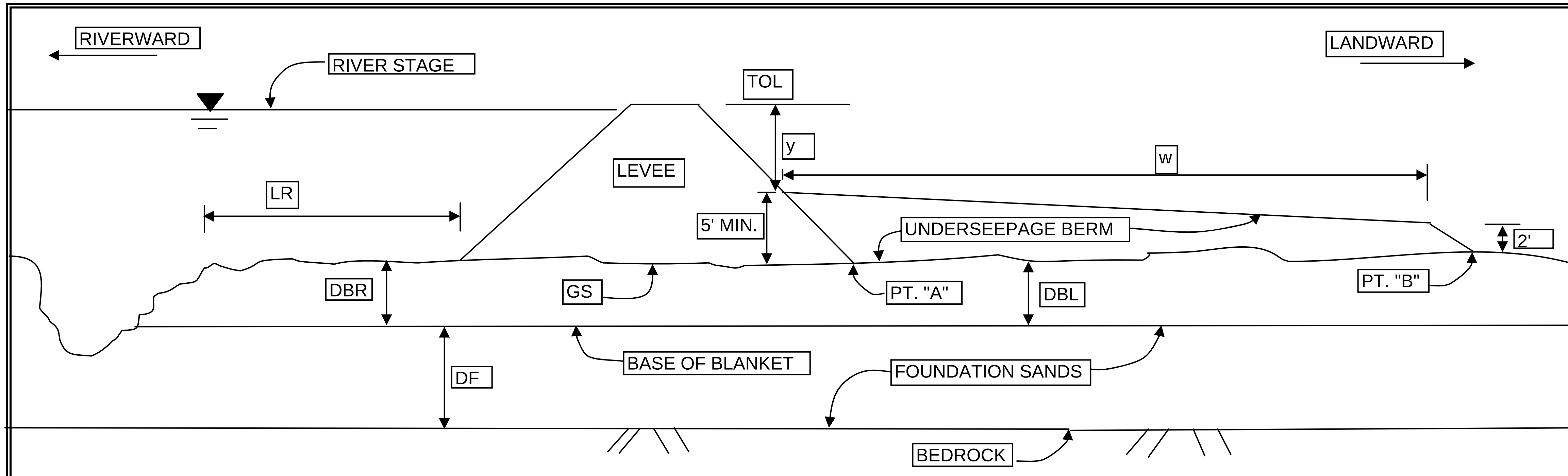
MRLS L-455 & R 471-460
FEASIBILITY STUDY

TABLE 4A

MRLS R 471-460
SEEPAGE SCHEDULE
September 7, 2006

NOTES: 1. L2 is the levee base width without an underseepage berm and is the levee base plus 1/2 the seepage berm width when there is a seepage berm.
2. Water surface elevation: check for seepage control use TOL - GS and a safety factor of 1.1 at PT. "A". Design seepage control use TOL - 3'- GS and safety factors of 1.5 at PT. "A" & 1.1 at PT. "B"

MRLS R 471-460 LEVEE REACH																UNDERSEEPAGE BERM			
STATION	STATION	GROUND SURFACE ELEVATION GS (FT)	TOP OF LEVEE ELEVATION TOL (FT)	RIVERWARD NATURAL BLANKET THICKNESS DBR (FT)	LANDWARD NATURAL BLANKET THICKNESS DBL (FT)	RIVERWARD BLANKET SOIL TYPE (USCS)	LANDWARD BLANKET SOIL TYPE (USCS)	RIVERWARD HYDRAULIC CONDUCTIVITY RATIO kf/kbr	LANDWARD HYDRAULIC CONDUCIVITY RATIO kf/kbl	RIVERWARD ENTRANCE LR (FT)	FOUNDATION SANDS THICKNESS DF (FT)	IMPERVIOUS BASE WIDTH NO SEEP. BERM L2 (FT)	IMPERVIOUS BASE WIDTH W/ SEEP. BERM L2 (FT)	NATURAL BLANKET CRITICAL VERTICAL GRADIENT	VERTICAL GRADIENT THRU BLANKET PT. "A"	DISTANCE "Y" (FT)	DISTANCE "w" (150' MIN.) (FT)	VERTICAL GRADIENT BLNKT/BERM PT. "A"	VERTICAL GRADIENT BLANKET PT. "B"
93+09	99+00	815.00	829.41	11	11	CL	CL	800	600	900	90	94	94	0.80	0.65	NO BERM REQUIRED			
100+00	114+00	814.50	828.97	11.5	11.5	CH	CH	1000	800	1000	90	91	91	0.75	0.65	NO BERM REQUIRED			
115+00	132+00	815.50	828.73	11	11	CH	CH	800	600	300	90	89	164	0.80	0.81	8.0	150	0.13	0.53
132+00	150+00	814.50	828.32	11	11	CH	CH	800	600	300	90	93	168	0.80	0.84	9.0	150	0.15	0.56
151+00	156+00	815.50	828.28	4	4	CL-ML	CL-ML	400	200	300	90	87	172	0.80	1.42	7.5	170	0.00	0.69
156+00	161+50	816.00	828.25	4	4	CL-ML	CL-ML	400	200	300	90	84	159	0.80	1.37	7.0	150	0.03	0.69
162+00	165+00	815.00	828.12	4	4	CL-ML	CL-ML	400	200	300	90	89	174	0.80	1.45	8.0	170	0.02	0.71
166+00	228+00	812.00	827.40	4.5	4.5	CL-CH	CL-CH	500	300	300	85	102	247	0.80	1.65	10.5	290	0.22	0.72
229+00	251+00	806.00	826.65	10.5	10.5	ML	ML	600	400	600	75	134	209	0.80	0.94	15.5	150	0.26	0.66
252+00	281+00	816.50	826.08	6	6	CL-ML	CL-ML	600	400	500	85	67	67	0.80	0.79	NO BERM REQUIRED			
282+00	295+50	807.00	825.97	4.5	4.5	CH	CH	600	400	700	75	124	309	0.80	1.72	14.0	370	0.33	0.72
296+50	299+00	808.00	825.79	4.5	4.5	CH	CH	600	400	700	75	117	282	0.80	1.62	12.5	330	0.26	0.73
300+00	307+00	800.00	825.74	6	6	CH	CH	900	700	1000	60	190	190	0.70		PRESSURE RELIEF WELLS			
308+00	313+00	800.00	825.60	6	6	CH	CH	900	700	1000	60	215	215	0.70		PRESSURE RELIEF WELLS			
314+00	331+00	802.00	825.48	6	6	CH	CH	900	700	1000	60	198	198	0.70		PRESSURE RELIEF WELLS			
332+00	341+00	810.00	825.22	9	9	ML	ML	500	300	1000	65	101	101	0.80	0.68	NO BERM REQUIRED			
342+00	351+00	804.00	824.07	5	5	ML	ML	500	300	1000	65	130	265	0.80	1.49	15.0	270	0.28	0.71
352+00	375+00	804.00	824.07	9	9	CH	CH	1000	800	1000	65	130	285	0.70	1.03	15.0	310	0.27	0.63
376+00	394+00	804.00	823.56	6	6	CH	CH	700	500	1000	65	127	292	0.75	1.35	14.5	330	0.29	0.68
395+00	397+00	804.00	823.56	6	6	OL	OL	700	500	500	65	127	302	0.80	1.50	14.5	350	0.37	0.72
398+00	404+00	805.00	823.52	6	6	OL	OL	700	500	500	65	121	276	0.80	1.43	13.5	310	0.31	0.73
405+00	419+00	808.00	823.01	4	4	ML	ML	400	200	500	75	100	185	0.80	1.40	10.0	170	0.04	0.70
420+00	439+00	806.00	822.49	8	8	CL	CL	700	500	400	65	109	184	0.80	1.08	11.5	150	0.20	0.71
440+00	466+00	805.00	821.72	6	6	CL	CL	700	500	1000	65	110	205	0.80	1.17	11.5	190	0.13	0.71



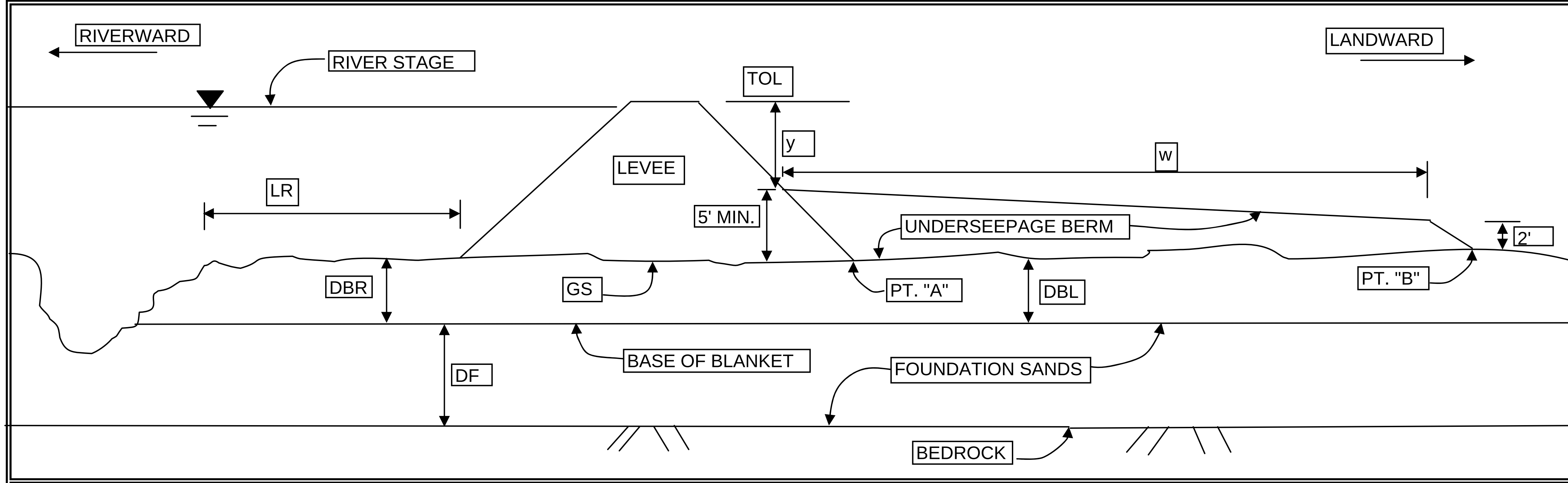
MRLS L-455 & R 471-460
FEASIBILITY STUDY

TABLE 4A

MRLS R 471-460
SEEPAGE SCHEDULE
September 7, 2006

NOTES: 1. L2 is the levee base width without an underseepage berm and is the levee base plus 1/2 the seepage berm width when there is a seepage berm.
2. Water surface elevation: check for seepage control use TOL - GS and a safety factor of 1.1 at PT. "A". Design seepage control use TOL - 3'-GS and safety factors of 1.5 at PT. "A" & 1.1 at PT. "B"

MRLS R 471-460 LEVEE REACH STATION	STATION	GROUND SURFACE ELEVATION GS (FT)	TOP OF LEVEE ELEVATION TOL (FT)	RIVERWARD NATURAL BLANKET THICKNESS DBR (FT)	LANDWARD NATURAL BLANKET THICKNESS DBL (FT)	RIVERWARD BLANKET SOIL TYPE (USCS)	LANDWARD BLANKET SOIL TYPE (USCS)	RIVERWARD HYDRAULIC CONDUCTIVITY RATIO kf/kbr	LANDWARD HYDRAULIC CONDUCIVITY RATIO kf/kbl	RIVERWARD ENTRANCE LR (FT)	FOUNDATION SANDS THICKNESS DF (FT)	IMPERVIOUS BASE WIDTH NO SEEP. BERM L2 (FT)	IMPERVIOUS BASE WIDTH W/ SEEP. BERM L2 (FT)	NATURAL BLANKET CRITICAL VERTICAL GRADIENT	VERTICAL GRADIENT THRU BLANKET PT. "A"	UNDERSEEPAGE BERM DISTANCE "Y" (FT)	UNDERSEEPAGE BERM DISTANCE "w" (150' MIN.) (FT)	UNDERSEEPAGE BERM VERTICAL GRADIENT BLNKT/BERM PT. "A"	UNDERSEEPAGE BERM VERTICAL GRADIENT BLANKET PT. "B"
467+00	492+00	806.00	821.12	7.5	7.5	ML	ML	700	500	300	65	101	176	0.80	1.14	10.0	150	0.18	0.72
493+00	506+50	803.50	820.65	5	5	ML	ML	500	300	300	70	113	258	0.80	1.60	12.0	290	0.29	0.70
506+50	516+00	804.00	820.48	5	5	ML	ML	500	300	300	70	109	244	0.80	1.55	11.5	270	0.25	0.70
517+00	544+00	801.00	819.87	4	4	CL	CL	500	300	300	70	123	308	0.80	2.07	14.0	370	0.43	0.72
545+00	550+50	802.00	819.75	3	3	CL-ML	CL-ML	500	300	300	70	117	312	0.80	2.46	12.5	390	0.40	0.71
550+50	564+00	802.00	819.19	3	3	CL-ML	CL-ML	500	300	300	70	113	298	0.80	2.40	12.0	370	0.36	0.72
564+00	600+00	802.00	818.17	3	3	CL-ML	CL-ML	500	300	300	70	107	282	0.80	2.28	11.0	350	0.29	0.71
601+00	622+00	803.00	818.02	8	8	CL-ML	CL-ML	600	400	800	65	95	170	0.80	0.82	10.0	150	0.05	0.52
623+00	628+00	802.00	817.56	9	9	ML	ML	600	400	600	60	100	175	0.80	0.80	10.5	150	0.09	0.51
629+00	639+84	801.00	817.33	9	9	ML	ML	600	400	600	60	130	205	0.80	0.81	11.0	150	0.10	0.53



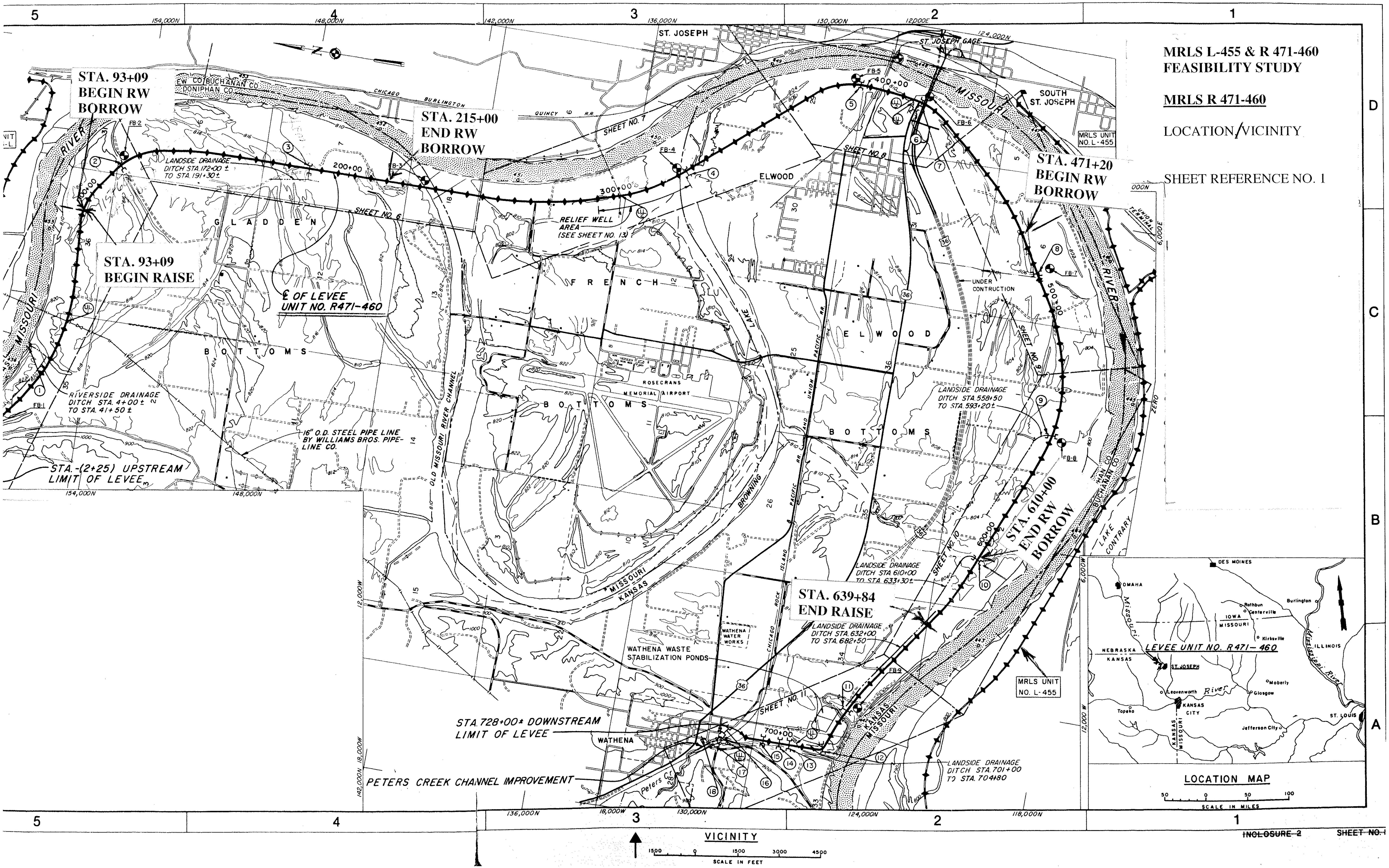
MRLS L-455 & R 471-460
FEASIBILITY STUDY

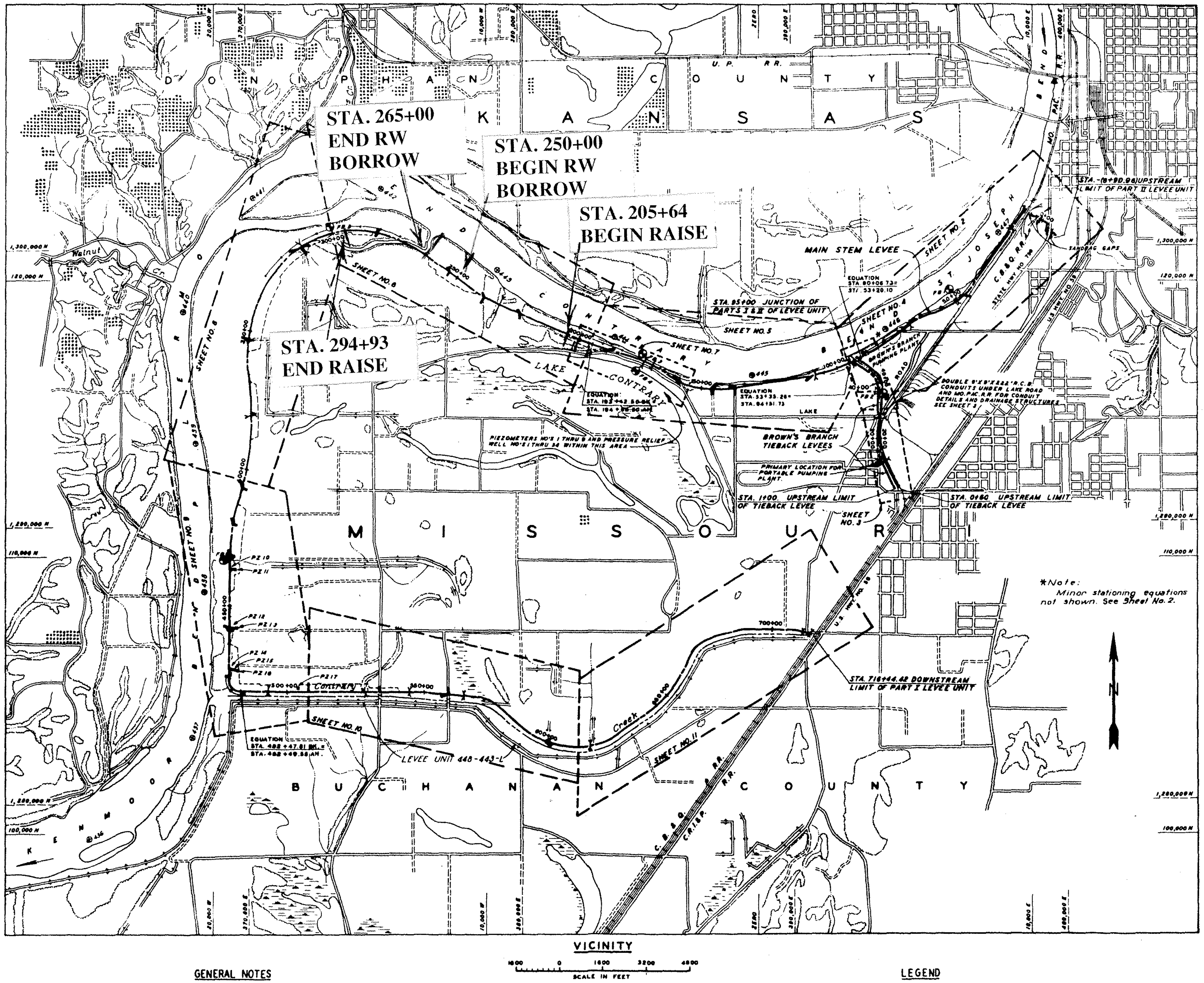
TABLE 5

MRLS L-455
SEEPAGE SCHEDULE
September 7, 2006

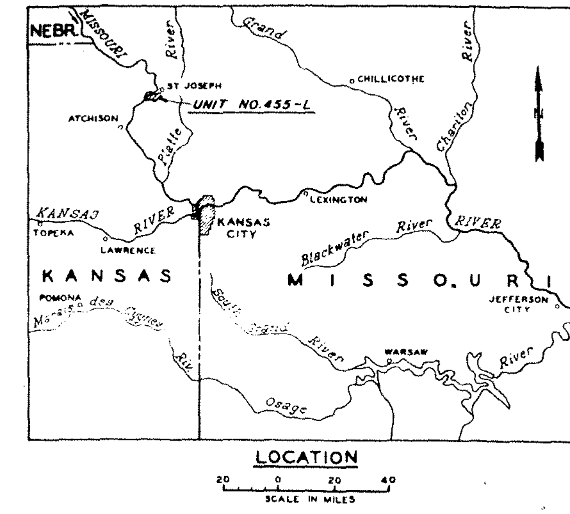
NOTES: 1. L2 is the levee base width without an underseepage berm and is the levee base plus 1/2 the seepage berm width when there is a seepage berm.
2. Water surface elevation: check for seepage control use TOL - GS and a safety factor of 1.1 at PT. "A". Design seepage control use TOL - 3'-GS and safety factors of 1.5 at PT. "A" & 1.1 at PT. "B"

MRLS L-455 LEVEE REACH STATION	MRLS L-455 LEVEE REACH STATION	GROUND SURFACE ELEVATION GS (FT)	TOP OF LEVEE ELEVATION TOL (FT)	RIVERWARD NATURAL BLANKET THICKNESS DBR (FT)	LANDWARD NATURAL BLANKET THICKNESS DBL (FT)	RIVERWARD BLANKET SOIL TYPE (USCS)	LANDWARD BLANKET SOIL TYPE (USCS)	RIVERWARD HYDRAULIC CONDUCTIVITY RATIO kf/kbr	LANDWARD HYDRAULIC CONDUCIVITY RATIO kf/kbl	RIVERWARD ENTRANCE LR (FT)	FOUNDATION SANDS THICKNESS DF (FT)	IMPERVIOUS BASE WIDTH NO SEEP. BERM L2 (FT)	IMPERVIOUS BASE WIDTH W/ SEEP. BERM L2 (FT)	NATURAL BLANKET CRITICAL VERTICAL GRADIENT	VERTICAL GRADIENT THRU BLANKET PT. "A"	UNDERSEEPAGE BERM DISTANCE "Y" (FT)	UNDERSEEPAGE BERM DISTANCE "w" (150' MIN.) (FT)	UNDERSEEPAGE BERM VERTICAL GRADIENT BLNKT/BERM PT. "A"	UNDERSEEPAGE BERM VERTICAL GRADIENT BLANKET PT. "B"
205+64	209+00	802.00	818.77	15	7.5	CL	ML	500	400	200	70	111	236	0.80	1.34	11.5	250	0.32	0.72
210+00	237+00	802.00	818.46	13	13	CL	OL	600	600	350	70	104	179	0.80	0.80	11.5	150	0.21	0.56
238+00	247+00	800.00	818.03	7.5	7.5	CH	CH	800	800	900	70	113	278	0.75	1.17	13.0	330	0.25	0.67
248+00	257+00	800.00	818.03	10	5	CH	CH	800	700	450	70	113	358	0.80	1.77	13.0	490	0.39	0.72
258+00	262+00	800.00	818.03	9	9	CH	CH	800	800	450	65	113	268	0.75	1.15	13.0	310	0.31	0.68
263+00	280+00	800.00	817.78	7	11	CL	CL	800	800	900	65	112	187	0.80	0.86	12.5	150	0.20	0.62
280+00	288+00	800.00	817.13	7.5	9.5	CH-CL	CH-CL	800	800	800	65	110	185	0.80	0.94	12.0	150	0.19	0.66
288+00	292+00	800.00	816.78	8	8	CH	CH	800	800	700	70	111	206	0.80	1.08	11.5	190	0.20	0.72
293+00	294+93	800.00	816.78	8	10	OL	ML	600	600	450	65	111	186	0.80	0.95	11.5	150	0.21	0.65


MRLS L-455 & R 471-460
FEASIBILITY STUDY
MRLS R 471-460
LOCATION/VICINITY
SHEET REFERENCE NO. 1
STA. 93+09
BEGIN RW
BORROW
STA. 215+00
END RW
BORROW
STA. 93+09
BEGIN RAISE
STA. 471+20
BEGIN RW
BORROW
STA. 610+00
END RW
BORROW
STA. 639+84
END RAISE
℄ OF LEVEE
UNIT NO. R471-460
ST. JOSEPH
ST. JOSEPH GAGE
SOUTH
ST. JOSEPH
MRLS UNIT
NO. L-455
ELWOOD
WATHENA
GLADDEN
FRENCH
BOTTOMS
ROSECRANS
MEMORIAL AIRPORT
MISSOURI RIVER
OLD MISSOURI RIVER CHANNEL
BROWNING LAKE
LAKE CONTRARY
RELIEF WELL
AREA
(SEE SHEET NO. 13)
LANDSIDE DRAINAGE
DITCH STA.172+00 ±
TO STA.191+30 ±
RIVERSIDE DRAINAGE
DITCH STA. 4+00 ±
TO STA. 41+50 ±
16" O.D. STEEL PIPE LINE
BY WILLIAMS BROS. PIPE-
LINE CO.
STA.-(2+25) UPSTREAM
LIMIT OF LEVEE
LANDSIDE DRAINAGE
DITCH STA.558+50
TO STA.593+20 ±
LANDSIDE DRAINAGE
DITCH STA 610+00
TO STA. 633+30 ±
LANDSIDE DRAINAGE
DITCH STA.632+00
TO STA.682+50
LANDSIDE DRAINAGE
DITCH STA.701+00
TO STA.704+80
WATHENA WASTE
STABILIZATION PONDS
WATHENA
WATER
WORKS
STA.728+00± DOWNSTREAM
LIMIT OF LEVEE
PETERS CREEK CHANNEL IMPROVEMENT
UNDER
CONTRUCTION
CHICAGO BURLINGTON QUINCY R.R.
UNION PACIFIC R.R.
CHICAGO ROCK ISLAND AND PACIFIC R.R.
BUCHANAN CO.
DONIPHAN CO.
LOCATION MAP
LEVEE UNIT NO. R471-460
DES MOINES
OMAHA
NEBRASKA
KANSAS
IOWA
MISSOURI
ILLINOIS
Burlington
Rathbun
Centerville
Kirksville
ST. JOSEPH
Leavenworth
KANSAS CITY
Topeka
Moberly
Glasgow
Jefferson City
ST. LOUIS
SCALE IN MILES
VICINITY
SCALE IN FEET
INCLOSURE 2
SHEET NO. 1



VICINITY



LOCATION

GENERAL NOTES

Planimetry from Corps of Engineers Aerial Survey of 1952.
Topography of plan sheets from U.S.C. of E. plane-table surveys of 1954, 1955 and 1958.
Elevations referred to mean sea level are based on the U.S.C. & G.S. 1929 general adjustment.
Alinements based on plane co-ordinate system with Missouri River Commission triangulation station "WESTON" as origin.
Weston grid system
Mercator (Missouri, west zone) grid system
Missouri River Mile based on 1960 Adjustment.

LEGEND

- Levee Unit No. L 455
- Other levees
- New or improved channel
- Drainage structure
- Ramp
- Riprap slope protection
- Freeboard gage
- Forecasting gage
- Pumping plant
- Piezometer
- Pressure relief wells
- Miles above mouth of Missouri River 456
- Underseepage control berm

MRLS L-455 & R 471-460
FEASIBILITY STUDY

MRLS L 455

LOCATION/VICINITY

SHEET REFERENCE NO. 2

NOTES:

1. SEE SHEET NO. 4 FOR TYPICAL LEVEE SECTIONS.
2. RAISE 1-FOOT OR LESS WILL HAVE 1 VERTICAL ON 2 HORIZONTAL LEVEE FILL SLOPE UNTIL IT INTERCEPTS EXISTING SLOPE.
3. WHERE THERE IS A GAP IN LEVEE STATIONS, PROVIDE A SMOOTH TRANSITION BETWEEN LEVEE SECTIONS. SMOOTH TRANSITION BETWEEN LEVEE SECTINS WITHOUT STATION GAP.
4. BERM SLOPES ARE APPROXIMATE.

LEVEE SECTION SCHEDULE

LEVEE STATION LIMITS		LEVEE	LEVEE	LANDWARD	PROPOSED LANDSIDE BERM		
		SECTION	RAISE	LEVEE SLOPE	SPRINGLINE y	WIDTH w	SLOPE
FROM	TO	A OR B	(FT)	(1 V ON 'x' H)	(FT)	(FT)	(1 V ON "s" H)
MRLS R 471-460							
93+09	99+00	A	0.33	N/A			
100+00	114+00	A	0.94	N/A			
115+00	132+00	B	1.14	3.0	8.0	150.0	50.0
132+00	150+00	B	1.71	3.0	9.0	150.0	50.0
151+00	156+00	B	1.71	3.0	7.5	170.0	55.0
156+00	161+50	B	1.39	3.0	7.0	150.0	50.0
162+00	165+00	B	2.00	3.0	8.0	170.0	55.0
166+00	228+00	B	2.66	3.0	10.5	290.0	100.0
229+00	251+00	B	2.36	3.0	15.5	150.0	50.0
252+00	281+00	B	2.47	3.0			
282+00	295+50	B	2.52	3.0	14.0	370.0	125.0
296+50	299+00	B	2.49	3.0	12.5	330.0	110.0
300+00	307+00	B	2.67	4.0			
308+00	313+00	B	1.50	4.0			
314+00	331+00	B	1.87	4.0			
332+00	341+00	B	2.60	3.0			
342+00	351+00	B	2.66	3.0	15.0	270.0	90.0
352+00	375+00	B	2.66	3.0	15.0	310.0	100.0
376+00	394+00	B	3.11	3.0	14.5	330.0	110.0
395+00	397+00	B	3.11	3.0	14.5	350.0	115.0
398+00	404+00	B	3.37	3.0	13.5	310.0	100.0
405+00	419+00	B	3.12	3.0	10.0	170.0	55.0
420+00	439+00	B	2.73	3.0	11.5	150.0	50.0

LEVEE STATION LIMITS		LEVEE	LEVEE	LANDWARD	PROPOSED LANDSIDE BERM		
		SECTION	RAISE	LEVEE SLOPE	SPRINGLINE y	WIDTH w	SLOPE
FROM	TO	A OR B	(FT)	(1 V ON "x" H)	(FT)	(FT)	(1 V ON "s" H)
MRLS R 471-460 (CON'T)							
440+00	466+00	B	2.43	3.0	11.5	190.0	60.0
467+00	492+00	B	2.56	3.0	10.0	150.0	50.0
493+00	506+50	B	2.00	3.0	12.0	290.0	95.0
506+50	516+00	B	1.75	3.0	11.5	270.0	90.0
517+00	544+00	B	1.95	3.0	14.0	370.0	120.0
545+00	550+50	B	1.88	3.0	12.5	390.0	130.0
550+50	564+00	B	1.15	3.0	12.0	370.0	120.0
564+00	600+00	B	1.02	3.0	11.0	350.0	115.0
601+00	622+00	A	0.78	N/A	10.0	150.0	50.0
623+00	628+00	A	0.56	N/A	10.5	150.0	50.0
629+00	639+84	A	0.49	N/A	11.0	150.0	50.0
MRLS L-455							
205+64	209+00	A	0.02	N/A	11.5	250.0	80.0
210+00	237+00	A	0.73	N/A	11.5	150.0	50.0
238+00	247+00	A	0.94	N/A	13.0	330.0	110.0
248+00	257+00	A	0.94	N/A	13.0	490.0	160.0
258+00	262+00	A	0.94	N/A	13.0	310.0	100.0
263+00	280+00	A	0.82	N/A	12.5	150.0	50.0
280+00	288+00	A	0.39	N/A	12.0	150.0	50.0
288+00	292+00	A	0.01	N/A	11.5	190.0	60.0
293+00	294+93	A	0.01	N/A	11.5	150.0	50.0

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DATE: 15-Feb-20 07:14

US Army Corps of Engineers
Kansas City District

Symbol | Description | Date | Appr.

Designed by: | Drawn by: | Checked by: | Submitted by:
Date: x | File no. | Plot scale: 100 : 1 | CADD File Name: XSECT03.DGN

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

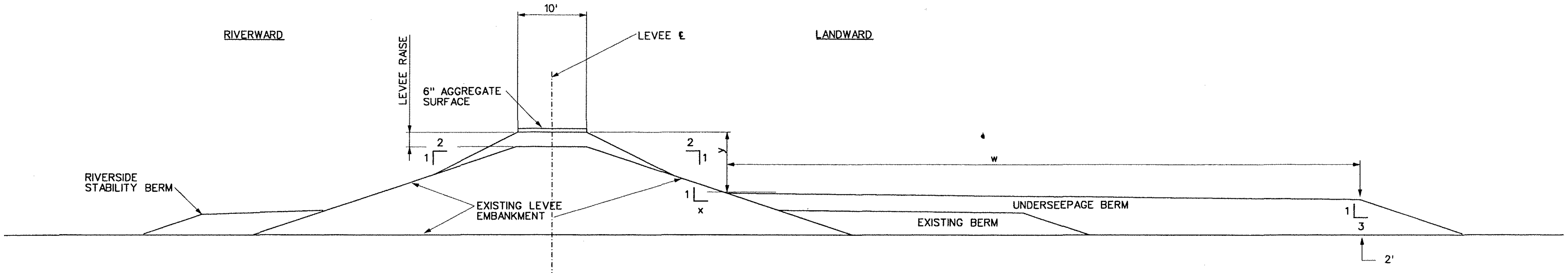
MRLS L-455 AND R 471-460
FEASIBILITY STUDY

LEVEE SECTION SCHEDULE

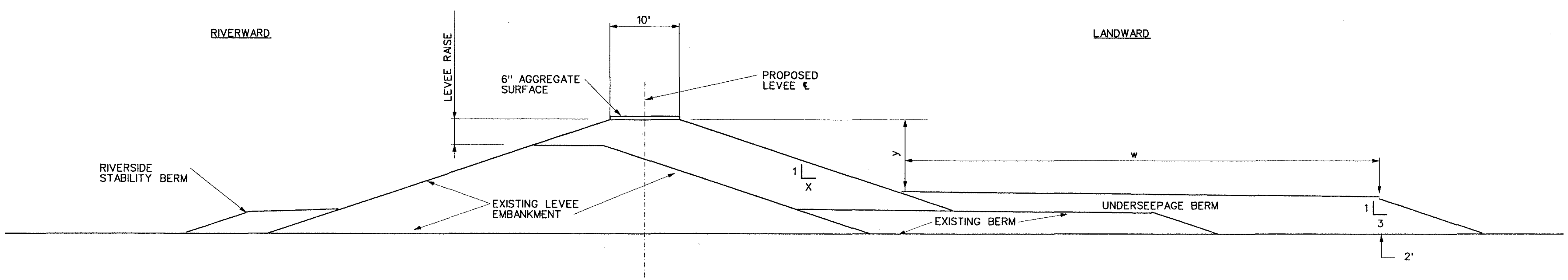
Sheet reference number:
3

NOTES:

1. TOP OF LEVEE REFERENCES ARE TO BELOW AGGREGATE SURFACE.
2. RIVERSIDE STABILITY BERM ONLY WHERE DESIGN REQUIRES.
3. SECTION A FOR RAISES 1' OR LESS. SECTION B FOR RAISES GREATER THAN 1'.
4. SEE SHEET NO. 3, "LEVEE SECTION SCHEDULE" FOR LANDWARD LEVEE SLOPE AND LANDWARD BERM DIMENSIONS.



A SECTION
X | X
SCALE: NOT TO SCALE



B SECTION
X | X
SCALE: NOT TO SCALE

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US Army Corps of Engineers
Kansas City District

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Drawn by:
Checked by:
Submitted by:
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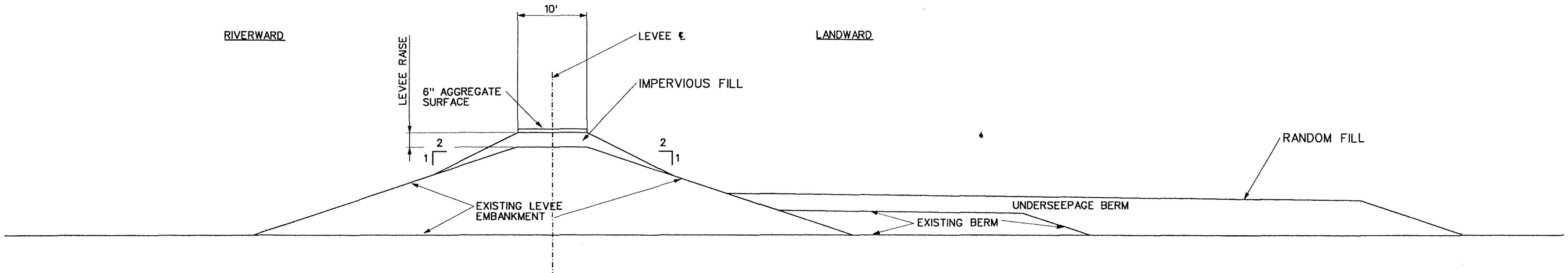
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

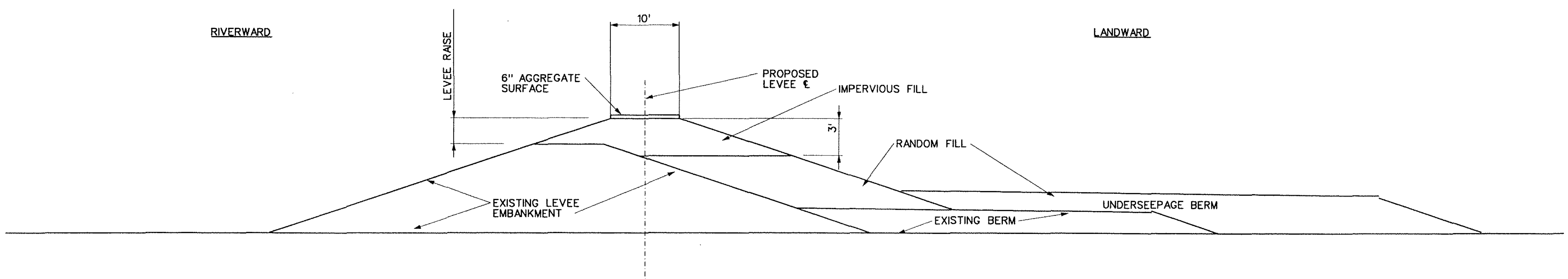
TYPICAL LEVEE SECTIONS

Sheet reference number:
4



LEVEE RAISE UP TO 1-FOOT

SCALE: NOT TO SCALE



LEVEE RAISE GREATER THAN 1-FOOT AND LESS THAN 3-FEET

SCALE: NOT TO SCALE

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US Army Corps of Engineers
Kansas City District

Symbol	Description	Date	Appr.

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CADD File Name: XSECT05.DGN

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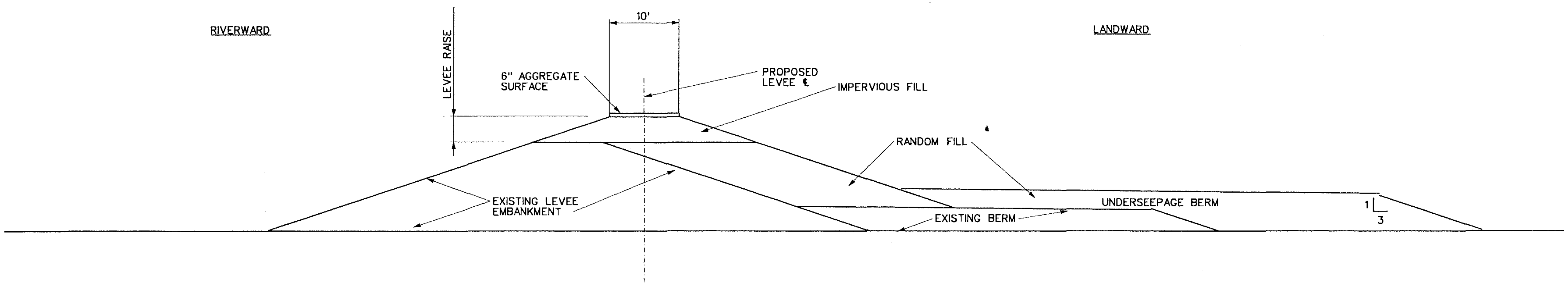
Drawn by:
Checked by:
Submitted by:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

TYPICAL LEVEE SECTIONS
FILL ZONES
LEVEE RAISE LESS THAN 3 FEET

Sheet reference number:
5



LEVEE RAISE 3'-FEET OR GREATER

SCALE: NOT TO SCALE

US Army Corps of Engineers
Kansas City District

Symbol	Description	Date	Appr.

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Drawn by:	File no.	
Checked by:	Plot scale: 100 : 1	
Submitted by:	CADD File Name: XSECT06.DGN	

U.S. ARMY ENGINEER DISTRICT
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KANSAS CITY, MISSOURI

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

TYPICAL LEVEE SECTION
FILL ZONES
LEVEE RAISE 3-FEET OR GREATER

Sheet reference number:

6

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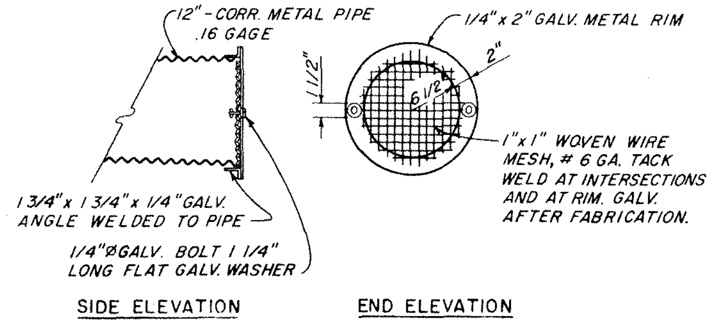
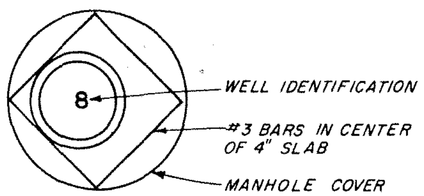
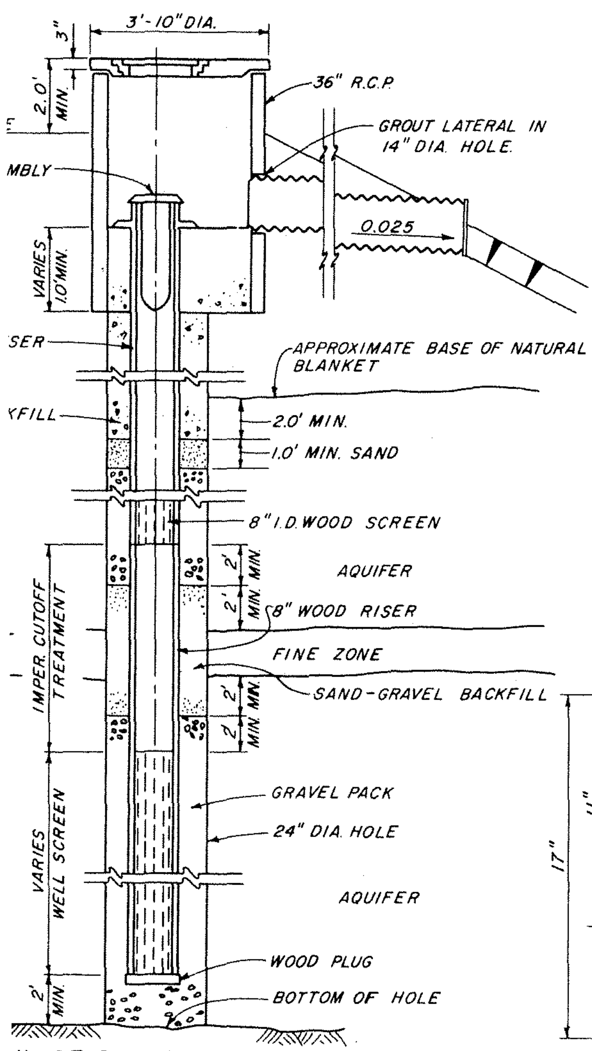
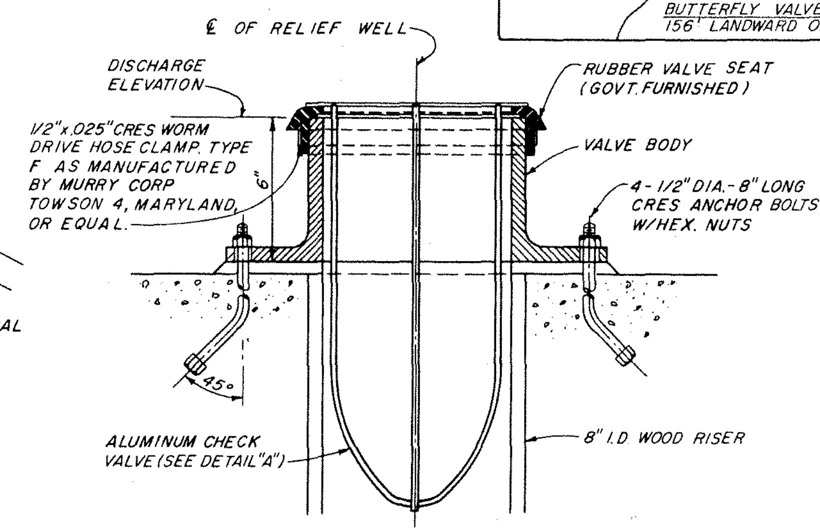


LATERAL GUARD SCREEN
NOT TO SCALE





IL OF GRAVEL PACKED WELL AND WELL MANHOLE
NOT TO SCALE



DISCHARGE ASSEMBLY DETAIL
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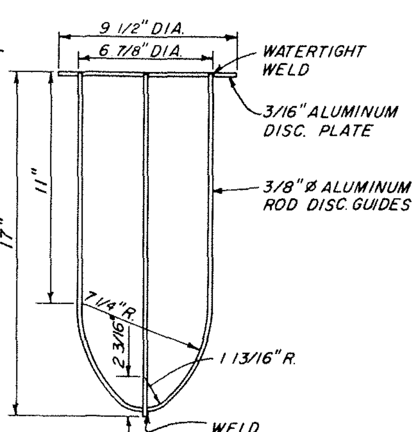
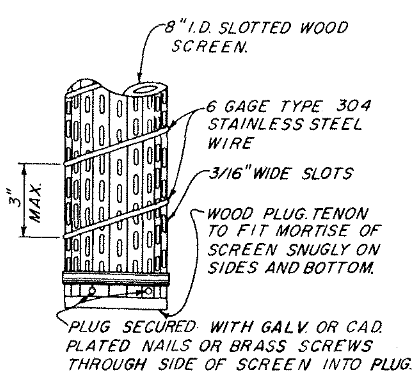
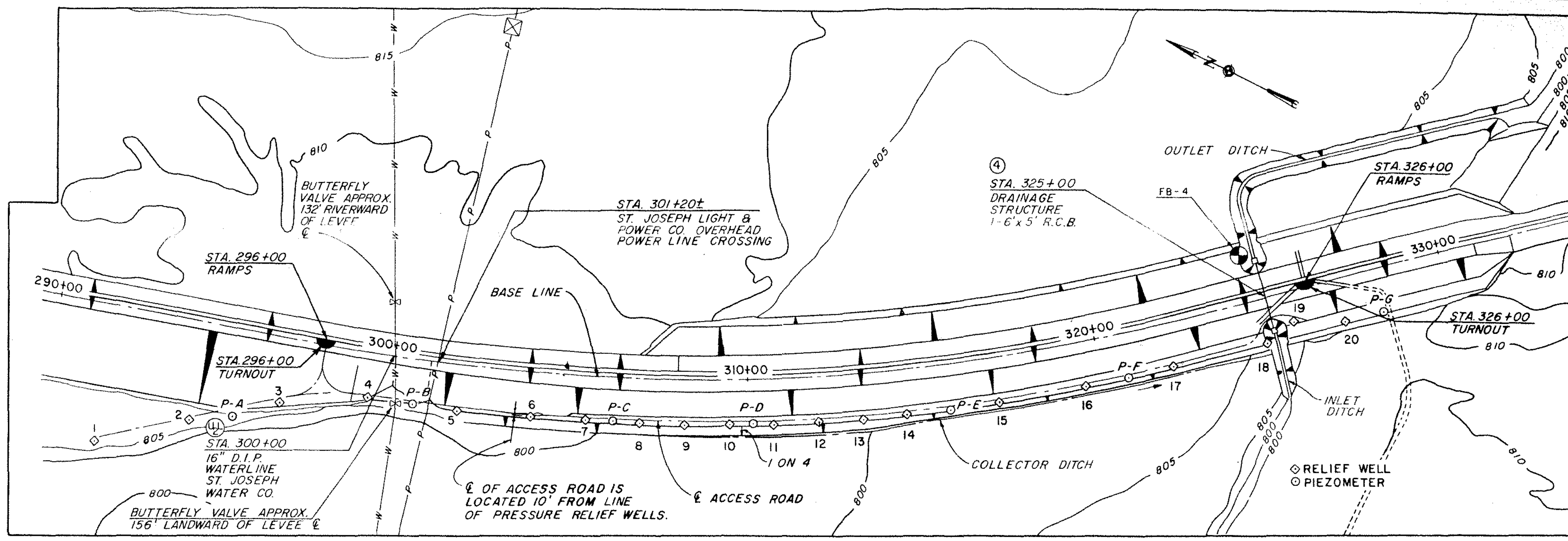


DETAIL "A"
NOT TO SCALE



DETAIL OF WOOD SCREEN WITH BOTTOM PLUG
NOT TO SCALE



PLANS - PIEZOMETERS & RELIEF WELLS
200 0 200 400
SCALE IN FEET

NOTES:

1. Details show existing pressure relief wells. Existing pressure relief wells to be abandoned in-place.

2. Replacement pressure relief wells located the same distance out from the levee but offset 5-feet from the existing pressure relief well.

3. Replacement pressure relief wells will be 8-inch diameter stainless steel assemblies. Outfall will be similar to the existing details.

RELIEF WELL SCHEDULE

NO.	LOCATION		DISCH.	BOT. ELEV.		SCREEN ELEVATIONS				TOTALS (EST.) QUANTITY IN LINEAR FEET						
						UPPER SEC.		LOWER SEC.								
	STATION	RANGE	ELEV.	HOLE	WELL	TOP	BOT.	TOP	BOT.	SCREEN	RISER	SAND-GRAVEL	GRAVEL PACK	CONC.	M.H.	LATERALS
1	292+00	385 R.	803	715.5	717.5	769.5	717.5			52	33	1	72.5	13.5	11	17.5
2	294+50	280 R.	803	713.0	716.0	770.0	754.0	744.0	716.0	44	42.5	7	65	13.5	11	17.5
3	297+00	190 R.	803	713.0	716.0	760.0	716.0			44	42.5	1	76	13.5	11	17.5
4	299+50	130 R.	804	714.0	716.0	768.0	764.5	752.0	716.0	40	47.5	9	67	13.5	11	13.0
5	302+00	130 R.	804	714.0	718.0	758.0	718.0			40	45.5	1	75	13.5	9	13.0
6	304+00	130 R.	804	714.0	716.0	772.0	760.0	748.0	716.0	44	41.5	9	67	13.5	9	13.0
7	305+50	130 R.	803	714.0	719.0	767.0	763.0	747.0	719.0	32	51.5	13	63	12.5	9	17.5
8	307+00	130 R.	802	714.0	718.0	774.0	762.0	746.0	718.0	40	43.5	13	61	12.5	11	21.5
9	308+25	130 R.	802	714.0	718.0	778.0	762.0	742.0	718.0	40	43.5	17	57.0	12.5	11	21.5
*10	309+50	130 R.	802	716.0	718.0	782.0	778.0	746.0	718.0	40	43.5	18.5	53.5	12.5	11	21.5
11	310+75	130 R.	802	715.0	720.0	784.0	780.0	752.0	720.0	36	45.5	24.5	50.5	12.5	11	21.5
12	312+00	130 R.	802	716.0	720.0	776.0	768.0	744.0	720.0	32	49.5	21.5	52.5	12.5	11	21.5
*13	313+25	130 R.	802	716.0	720.0	780.0	776.0	744.0	720.0	32	49.5	20.5	47.5	12.5	11	21.5
14	314+50	130 R.	804	718.0	721.0	781.0	777.0	745.0	721.0	28	54.5	29	44.0	12.5	9	13.0
15	317+00	130 R.	805	721.0	725.0	777.0	761.0	749.0	725.0	40	39.5	10.5	60.5	12.5	8	8.5
16	319+50	130 R.	805	721.4	724.0	780.0	764.0	752.0	724.0	44	36.5	10	60.6	12.5	8	8.5
17	322+00	130 R.	805	727.0	729.0	777.0	761.0	745.0	729.0	32	43.5	14	51.0	12.5	8	8.5
18	324+71	130 R.	802	728.0	731.5	775.5	763.5	755.5	731.5	36	34.0	6	55.0	12.5	11	13.5
19	325+29	90 R.	802	727.0	731.0	779.0	771.0	747.0	731.0	24	46.5	21	42.0	12.5	11	20.0
20	327+00	130 R.	805	729.0	730.5	766.5	758.5	746.5	730.5	24	50.0	91.5	52.0	13.5	9	8.5

* WELL NO. 10 HAS MIDDLE SECTION OF SCREEN EL. 762.0 TO EL. 754.0
WELL NO. 13 HAS MIDDLE SECTION OF SCREEN EL. 764.0 TO EL. 760.0

MRLS L-455 & R 471-460
FEASIBILITY STUDY

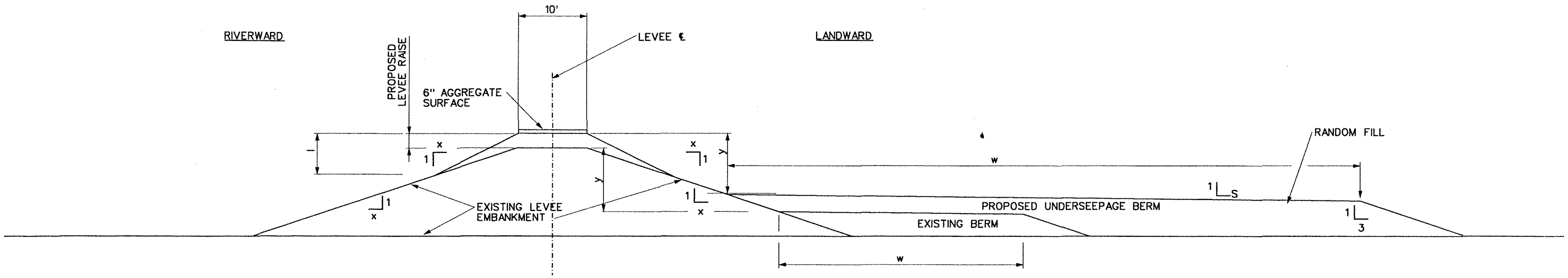
MRLS R 471-460

PRESSURE RELIEF WELLS

SHEET REFERENCE NO. 7

NOTES:

1. THIS SHEET TO BE USED WITH QUANTITY COMPUTATION SPREADSHEETS.
2. LETTER DUPLICATION ON SAME CROSS SECTION IS DIFFERENTIATED WITHIN QUANTITY COMPUTATION SPREADSHEETS WITH COLUMN DESIGNATIONS SUCH AS, RIVERWARD AND LANDWARD OR PROPOSED AND EXISTING.
3. LEVEE HEIGHT ADJUSTED WITHIN THE QUANTITY COMPUTATION SPREADSHEET REFERS TO TOP OF EXISTING BERM TO TOP OF PROPOSED LEVEE.



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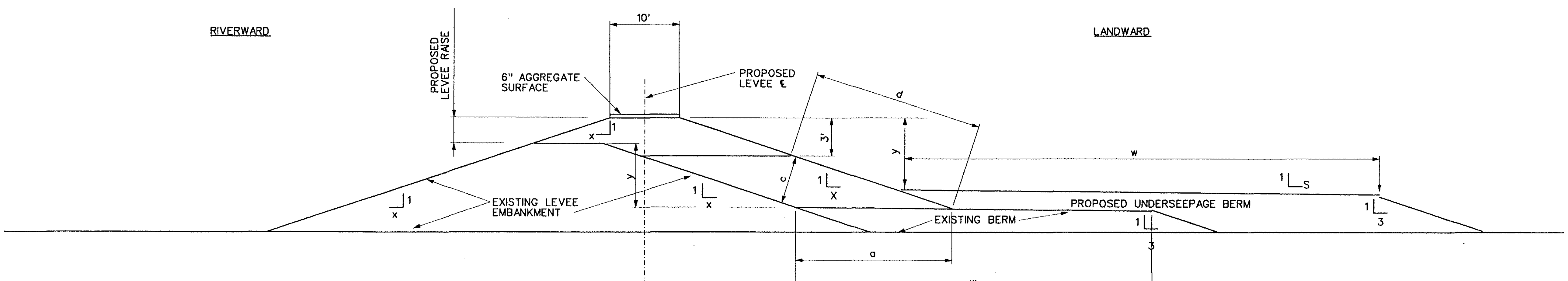

B SECTION
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US Army Corps of Engineers
Kansas City District

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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

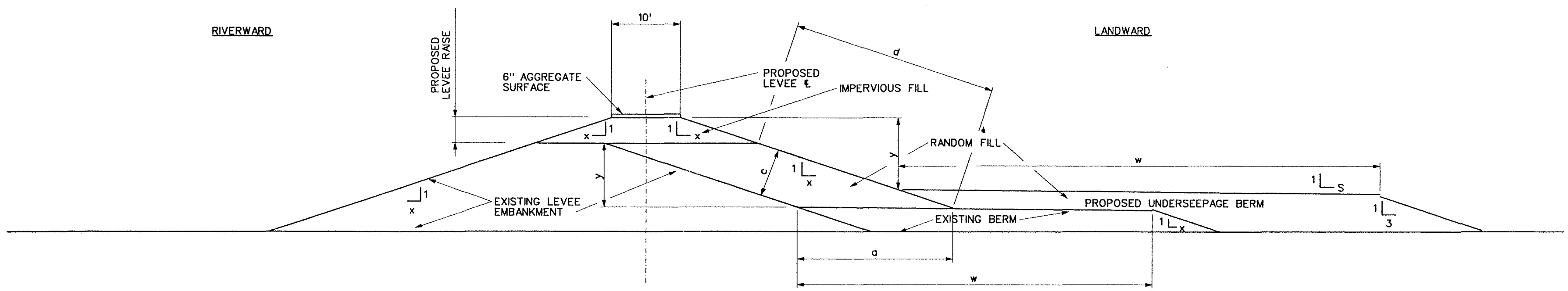
MRLS L-455 AND R 471-460
FEASIBILITY STUDY

TYPICAL LEVEE SECTIONS
QUANTITY COMPUTATIONS
LEVEE RAISE LESS THAN 3 FEET

Sheet reference number:
8

NOTES:

1. THIS SHEET TO BE USED WITH QUANTITY COMPUTATION SPREADSHEETS.
2. LETTER DUPLICATION ON SAME CROSS SECTION IS DIFFERENTIATED WITHIN QUANTITY COMPUTATION SPREADSHEETS WITH COLUMN DESIGNATIONS SUCH AS, RIVERWARD AND LANDWARD OR PROPOSED AND EXISTING.
3. LEVEE HEIGHT ADJUSTED WITHIN THE QUANTITY COMPUTATION SPREADSHEET REFERS TO TOP OF EXISTING BERM TO TOP OF PROPOSED LEVEE.



LEVEE RAISE 3'-FEET OR GREATER

SCALE: NOT TO SCALE

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US Army Corps of Engineers
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KANSAS CITY, MISSOURI

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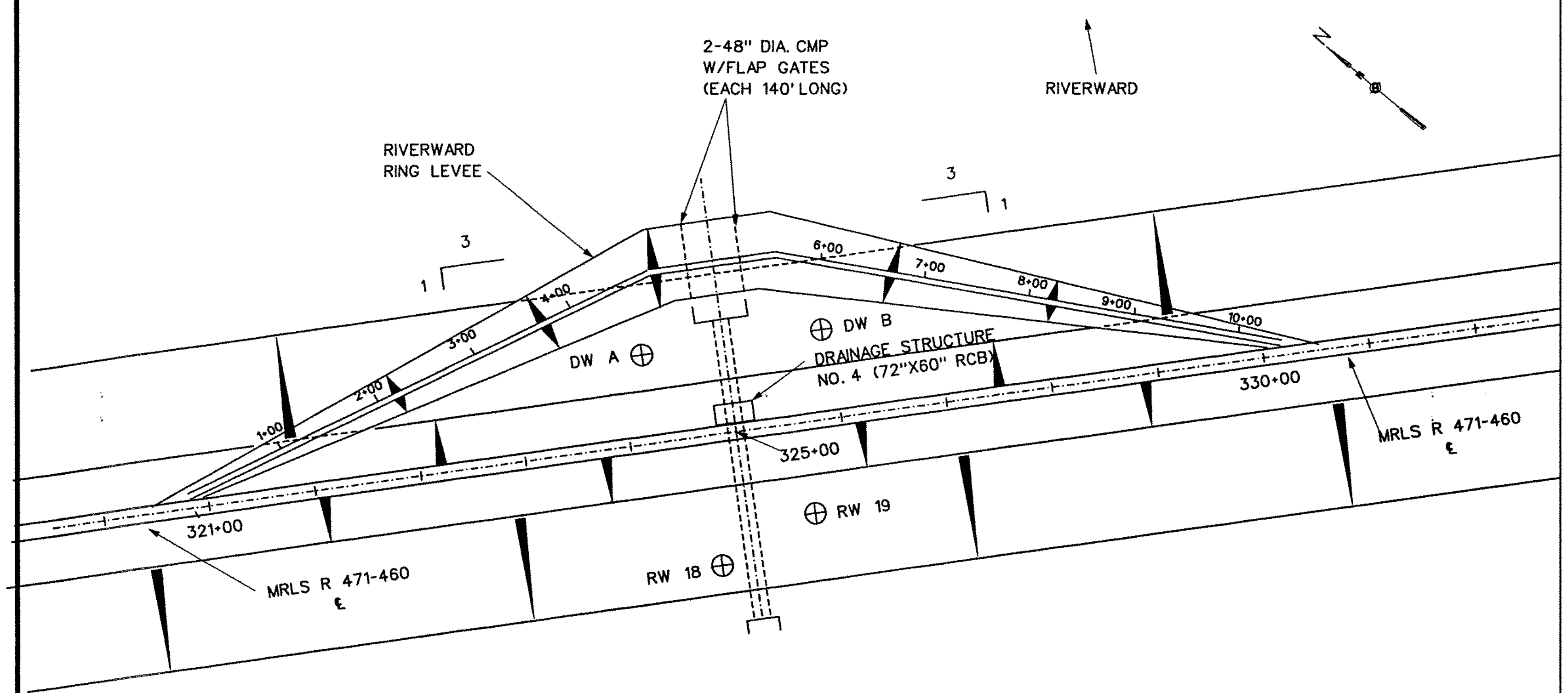
Submitted by: | CADD File Name: XSECT09.DGN

MRLS L-455 AND R 471-460
FEASIBILITY STUDY

TYPICAL LEVEE SECTION
QUANTITY COMPUTATIONS
LEVEE RAISE 3-FEET OR GREATER

Sheet reference number:
9

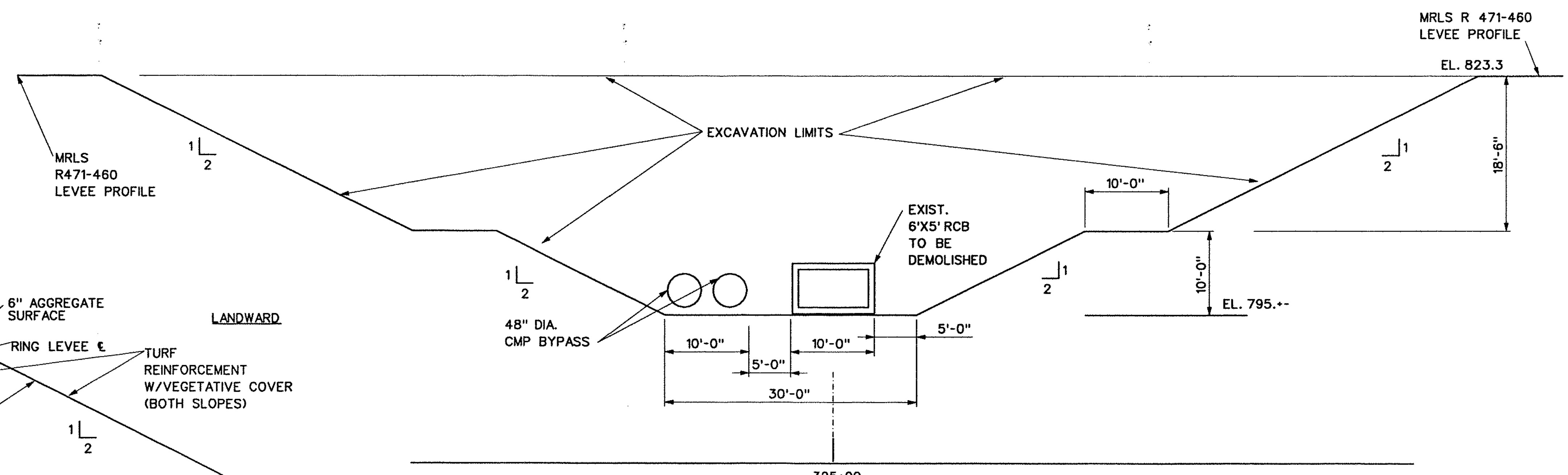


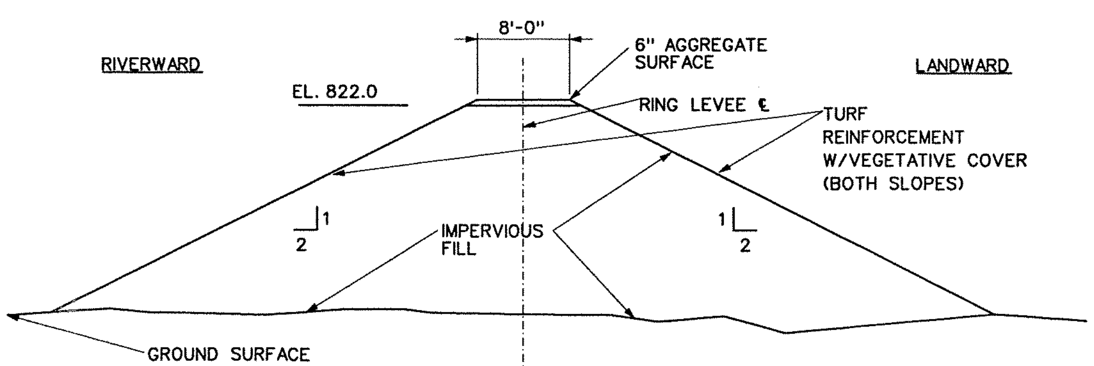
MRLS R 471-460--DRAINAGE STRUCTURE NO. 4
PLAN VIEW-- TEMPORARY FLOOD PROTECTION

SCALE: NOT TO SCALE

NOTES:

1. DRAWINGS REPRESENT THE 100-YR.+ 3-FT.
2. PRESSURE RELIEF WELLS, DEWATERING WELLS (DW), AND RIVERWARD RING LEVEE IN-PLACE AND OPERATIONAL PRIOR TO EXCAVATING MRLS R 471-460 LEVEE EMBANKMENT.
3. PRESSURE RELIEF WELLS (RW) 18 & 19 REPLACED AND USED AS DEWARTERING WELLS DURING CONSTRUCTION.
4. DW A & B SHALL BE REMOVED POST CONSTRUCTION.
5. RIVERWARD RING LEVEE SHALL BE REMOVED ONCE MRLS R 471-460 IS RECONSTRUCTED.
6. TWO 48" DIAMETER CMP SHALL BE CONTINUOUS FROM RING LEVEE TO LANDWARD OF MRLS R 471-460.





B RIVERWARD RING LEVEE

SCALE: NOT TO SCALE

B MRLS R 471-460 - PROFILE

SCALE: NOT TO SCALE

US Army Corps of Engineers
Kansas City District

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KANSAS CITY, MISSOURI

MRLS L455 AND R471-460
FEASIBILITY STUDY

MRLS R 471-460
DRAINAGE STRUCTURE NO. 4
STA. 325+00: LEVEE REMOVAL AND
TEMP. FLOOD PROTECTION

Sheet reference number:
S-01

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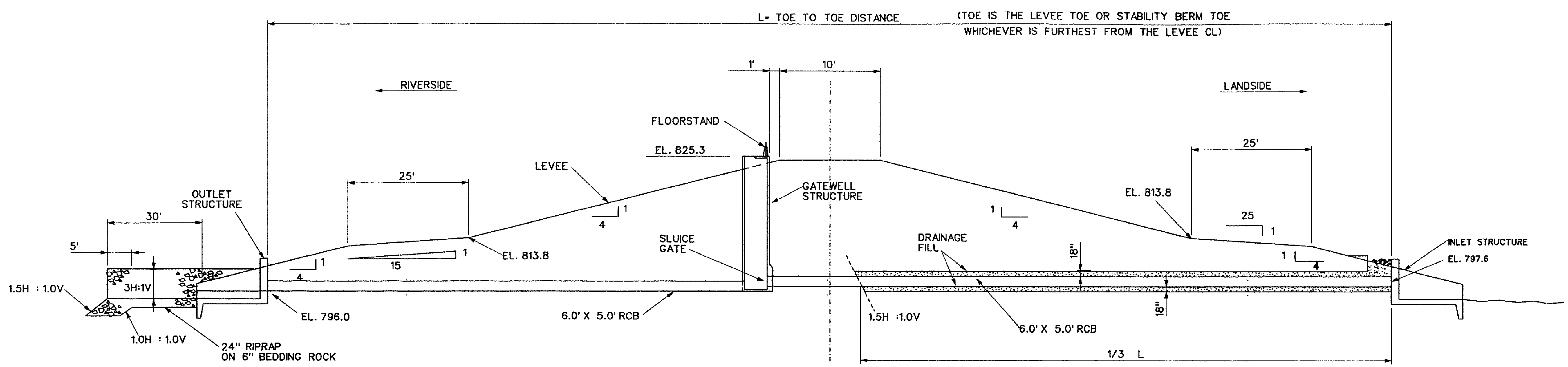

DRAINAGE STRUCTURE NO. 4 - PROFILE--STA.325+00

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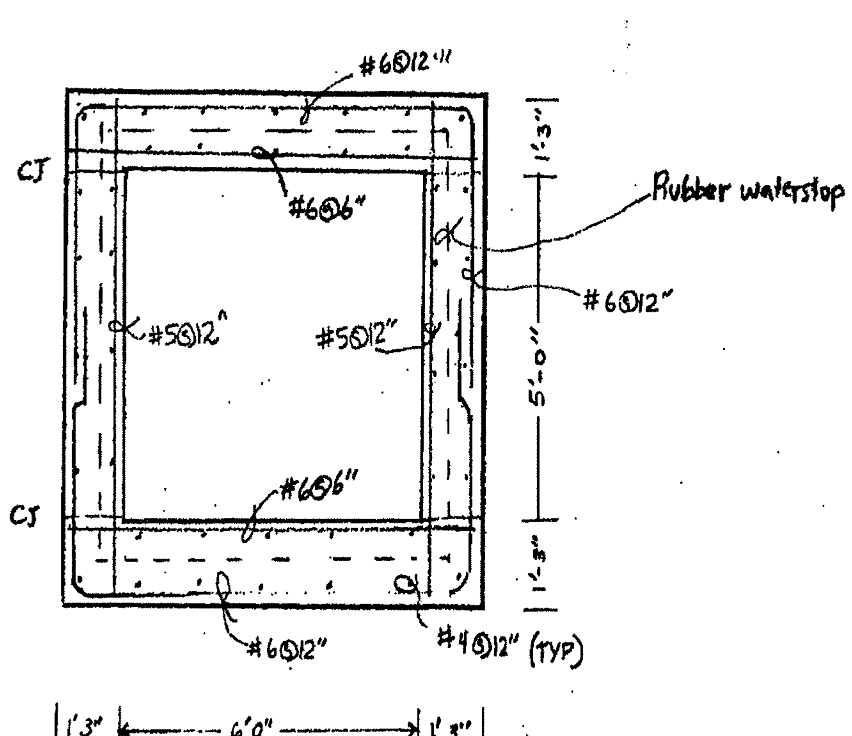

REINFORCED CONCRETE BOX

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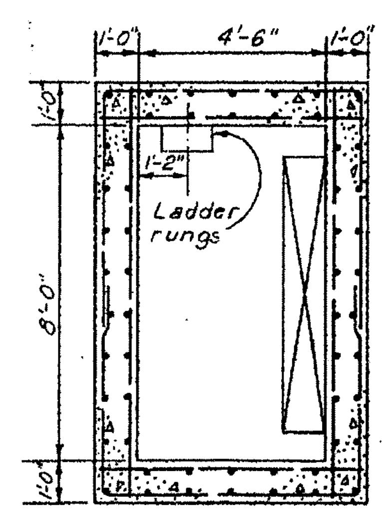

HORIZONTAL SECTION THRU GATEWELL

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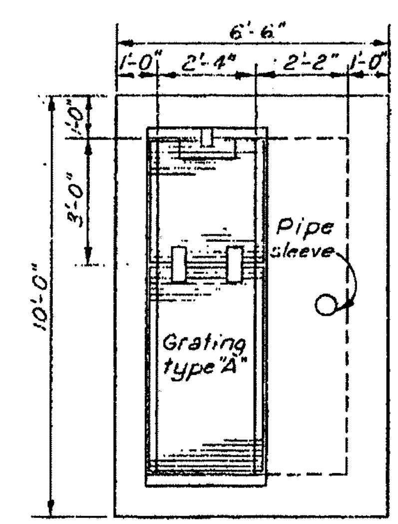

GATEWELL DECK- PLAN VIEW

SCALE: NOT TO SCALE

NOTES:

1. DRAWINGS REPRESENT THE 100-YR.+ 3-FT.
2. DETAILS INDICATED ARE SUBJECT TO DESIGN DURING PRE-CONSTRUCTION, ENGINEERING AND DESIGN (PED) FOLLOWING SITE INVESTIGATION AND STRUCTURAL TESTS. DETAILS ARE INDICATIVE OF THE INFORMATION AVAILABLE AT THE TIME OF THE STUDY.
3. SAND DRAIN IS A FINE TO MEDIUM POORLY GRADED SAND. UNIFIED SOIL CLASSIFICATION IS AN SP. THE SAND DRAIN OUTLET SHALL BE AT THE INLET HEADWALL. THE SAND OUTLET WILL BE PROTECTED WITH NON-WOVEN GEOTEXTILE FABRIC LAID OVER THE SAND SURFACE AT GRADE. EIGHTEEN INCH RIPRAP ON TOP OF 6-INCH BEDDING ROCK WILL BE PLACED ON THE GEOTEXTILE FABRIC. THE AREA WILL BE SHAPED SO DRAINAGE IS NOT INTO THE SAND DRAIN EXIT AREA.

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DATE: 03-Jul-20 07:15

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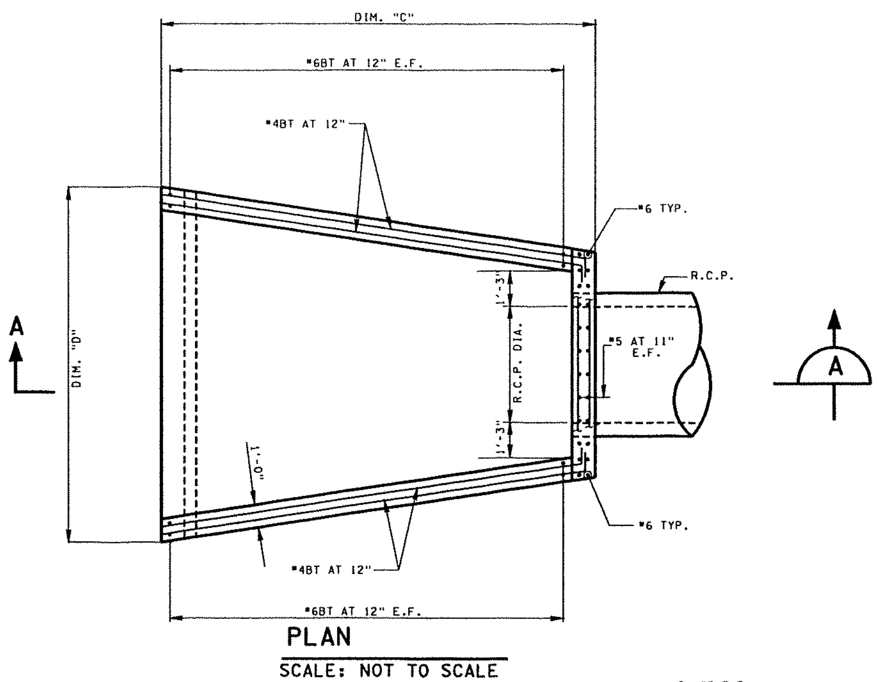
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

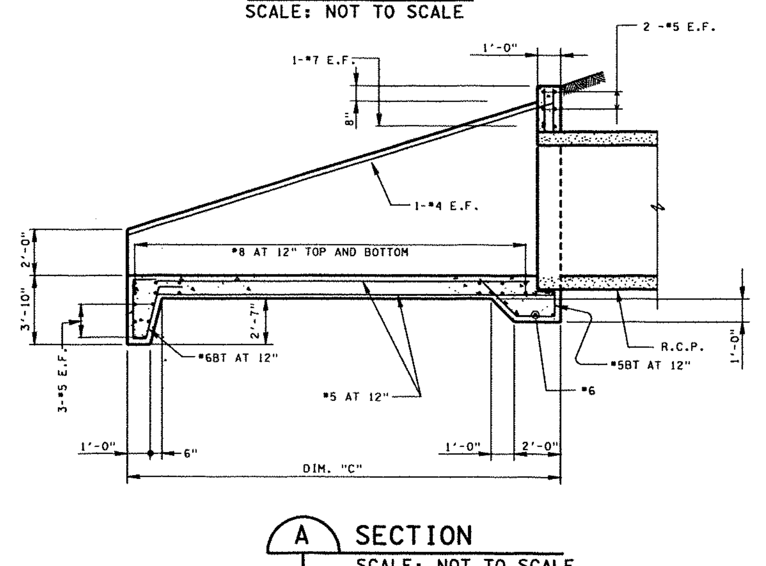
MRLS L455 AND R471- 460
FEASIBILITY STUDY

MRLS R 471- 460
DRAINAGE STRUCTURE NO. 4
STA. 325+00; REPLACEMENT
STRUCTURE PROFILE AND DETAILS

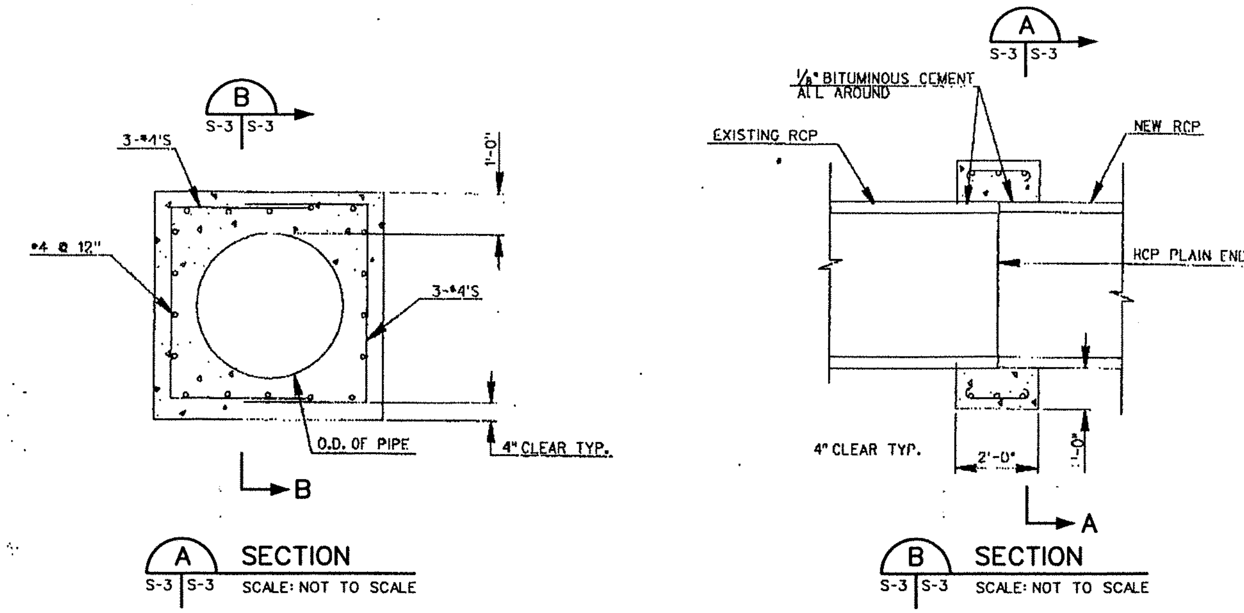
Sheet reference number:

S-02

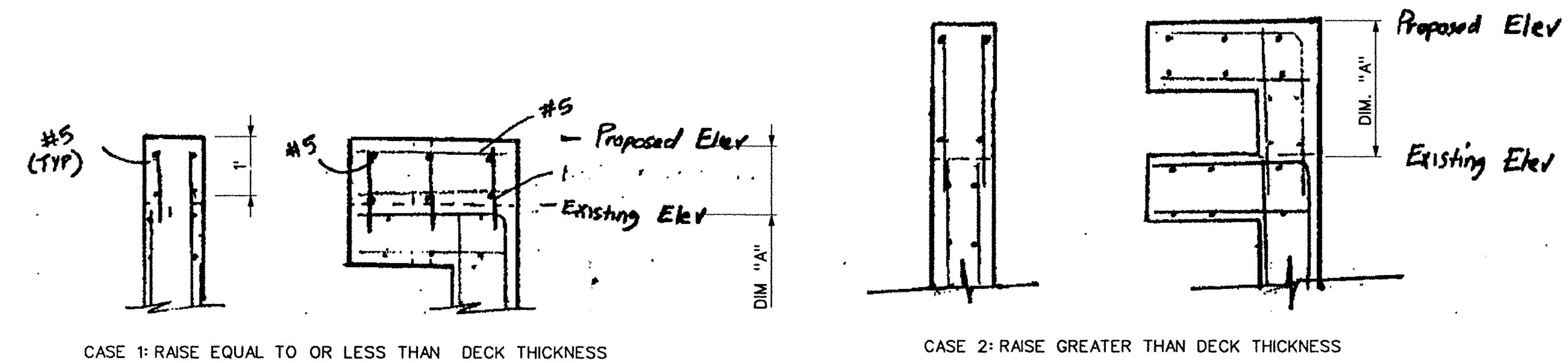




REPLACEMENT INLET FOR PIPE EXTENSIONS



CONCRETE COLLAR DETAILS



TOP OF GATEWELL RAISE

SCALE: NOT TO SCALE

NOTES:

1. DRAWINGS REPRESENT THE 100-YR.+ 3-FT.
2. DETAILS INDICATED ARE SUBJECT TO DESIGN DURING PRE-CONSTRUCTION, ENGINEERING, AND DESIGN (PED) FOLLOWING SITE INVESTIGATION AND STRUCTURAL TESTS. DETAILS ARE INDICATIVE OF THE INFORMATION AVAILABLE AT THE TIME OF THE STUDY.
3. REFER TO THE TABLE FOR DRAINAGE STRUCTURES SUBJECT TO AN INLET EXTENSION OR A GATEWELL TOP RAISE. INLETS SUBJECT TO AN EXTENSION ARE TO HAVE THE EXISTING INLET DEMOLISHED AND REMOVED FROM THE SITE. PIPE EXTENSION INSIDE DIAMETER SHALL BE EQUAL TO THE EXISTING PIPE INSIDE DIAMETER. THE SLOPE OF THE PIPE EXTENSION SHALL BE EQUAL TO THE EXISTING PIPE SLOPE.

MRLS R 471-460 DRAINAGE STRUCTURES
GATEWELL TOP RAISES AND INLET EXTENSIONS

DRAINAGE STRUCTURE (DS)	LEVEE STATION	PIPE DIAMETER (INCHES)	TOP OF GATEWELL RAISE DIM. A (FEET)	INLET PIPE EXTENSION (FEET)	INLET STRUCTURE DIM. C (FT-INCHES)	INLET STRUCTURE DIM. D (FT-INCHES)
DS NO. 2	115+60	48	1.00	8	14'-0"	15'-11"
DS NO. 3	186+00	48	2.00	16	14'-0"	15'-11"
DS NO. 5	398+00	36	2.25	24	11'-0"	12'-11"
DS NO. 7	420+35	24	2.33	16	8'-5"	10'-6"
DS NO. 8	497+60	66	1.33	16	17'-6"	18'-6"
DS NO. 9	558+50	48	1.00	8	14'-0"	15'-11"
DS NO. 10	610+00	54	0.00	0	N/A	N/A

US Army Corps of Engineers
Kansas City District

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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI

MRLS L455 AND R471 - 460 FEASIBILITY STUDY
MRLS R471 - 460
DRAINAGE STRUCTURE DETAILS
GATEWELL AND PIPE EXTENSIONS

Sheet reference number:
S-03

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MISSOURI RIVER LEVEE SYSTEM
UNITS R471-460 AND L455
ST. JOSEPH, MISSOURI / ELWOOD, KANSAS

FEASIBILITY REPORT
AND
ENVIRONMENTAL ASSESSMENT

APPENDIX C

Socioeconomics Analysis

September 2006

MISSOURI RIVER LEVEE SYSTEM
UNITS L-455 AND R471-460
ST. JOSEPH, MISSOURI / ELWOOD, KANSAS

FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

APPENDIX C
SOCIOECONOMICS ANALYSIS

September 2006

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MISSOURI RIVER LEVEE SYSTEM
UNITS L-455 AND R471-460
ST. JOSEPH, MISSOURI / ELWOOD, KANSAS

FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

APPENDIX C
SOCIOECONOMICS ANALYSIS

September 2006

1.0 INTRODUCTION

1.1 SCOPE OF ANALYSIS

This feasibility-level economic analysis will provide an accounting of all properties protected by the L-455 and R471-460 levee units: This inventory will serve as the database for a risk-based analysis that will produce several outputs:

- Description and quantification of economic flood damage impacts in the existing condition to properties within the study area;
- Statistical estimates of the projects' existing condition engineering performance (reliability) in the context of a range of possible flood events;
- Economic performance of alternatives formulated to improve project performance in terms of residual damages, damages prevented, annualized benefits and costs;
- Statistical estimates of enhanced project engineering performance provided by each alternative;
- Identification of the most economically efficient alternative;
- Characterization of the selected plan in terms of economic performance (annual benefits and costs, residual damages) and engineering performance.

1.2 GUIDANCE

The economic analysis is accomplished under standard Corps of Engineers guidance for economic analysis and other Federal guidance for water resources projects, including:

- Economic and Environmental Principles and Guidelines for Water and Related Resources Implementation Studies (P&G), dated March 1983;

- Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, dated 22 April 2000 with subsequent revisions;

- Engineer Manual (EM) 1110-2-1619, Risk-Based Analysis for Flood Damage Reduction Studies, dated 1 August 1996;

- ER 1105-2-101, Risk-Based Analysis for Evaluation of Hydrology/Hydraulics, Geotechnical Stability, and Economics in Flood Damage Reduction Studies, dated 13 January 2006;

- Engineering Technical Letter (ETL) 1110-2-556, Engineering and Design, Risk-Based Analysis in Geotechnical Engineering For Support of Planning Studies, dated 28 May 1999.

2.0 PROJECT AND STUDY AREA DESCRIPTION

2.1 FEDERAL PROJECT

Both the L-455 and R471-460 levee units were authorized as part of the comprehensive Missouri River Levee System in the 1944 Flood Control Act. Construction of both units began in 1962 and was completed in 1967-68.

2.1.1 L-455

The L-455 levee is located in Buchanan County, Missouri, along the left bank of the Missouri River. The levee extends approximately 15.6 miles from the mouth of Contrary Creek at Missouri River mile 437.4 to the mouth of Whitehead Creek at mile 447.3, about three-quarters of a mile south of downtown St. Joseph.

2.1.2 R471-460

The R471-460 levee is located along the right bank of the Missouri River, primarily in Doniphan County, Kansas, but also partly in Buchanan County, Missouri, a section of which is on the Kansas side of the river. The levee is across the river and slightly upstream from the L-455 unit, extending 13.8 miles from the mouth of Peters Creek at Missouri River mile 441.8 to the tieback at Treece Road at mile 456.5.

2.2 STUDY AREA DESCRIIPTION

The study area is located along the Missouri River in Buchanan County, Missouri, and Doniphan

County, Kansas. The entire study area is part of the St. Joseph MSA (Metropolitan Statistical Area). St. Joseph is about 50 miles north of Kansas City. Figure 1 displays a map of the study area.

2.2.1 L-455 Area

The area of 7,519 acres includes the southwestern portion of the city of St. Joseph (2000 pop. 73,990) as well as an unincorporated area. Within the protected area are several distinct areas.

- Stockyards – The Stockyards district is the old central industrial district of St. Joseph. It is home to a number of very large companies and public facilities and contains the lion's share of investment in the L-455 area. As an old stockyards hub area, it is naturally home to an active network of railroad lines. Although the old stockyards are long gone, the traditional identity has been revived recently by the opening of a massive new pork processing plant.

- King Hill – This neighborhood begins on the east edge of the protected area and is partially on high ground beyond the floodplain. It has a significant retail and commercial area along U.S. Highway 59/Lake Avenue as well as numerous small, older homes.

- Kirschner-Purtell – This older community with its own identity is southwest of the Stockyards area at the city limits. It is mainly residential with small, older homes and a small retail component along Highway 752.

- Lake Contrary – Lake Contrary is an unincorporated rural area west of Kirschner-Purtell. The lake is lined by dozens of residences. Land uses in the areas surrounding the lake are primarily agricultural. A small residential area with a few newer and relatively high quality homes also is located near Contrary Creek at the southern edge of the protected area.

2.2.2 R471-460 Area

This levee protects a total area of 13,424 acres and includes the following areas:

- Elwood, Kansas – Elwood (2000 pop. 1,145) is primarily residential, with nearly 500 homes. Many of the homes are newer manufactured homes purchased with flood insurance reimbursement to replace homes destroyed in the devastating 1993 flood. Several retail, industrial and public facilities are located along or near U.S. Highway 36 at the south edge of town.

- Rosecrans Airport – This area, known traditionally as the French Bottoms, is located within the Browning Lake oxbow and is part of St. Joseph, Missouri, despite being on the Kansas side of the river. The area originally was on the opposite bank of the river with the rest of St. Joseph, but was cut off when the river changed course during the 1952 flood. In addition to Rosecrans Airport, the 139th Airlift Wing of the Missouri Air National Guard also is located here. These two facilities, and especially the huge Air Guard base, dominate the overall river economic picture in the R471-460 area. This area was heavily damaged in both the 1993 and 1952 floods. A number of residences also are located to the north and east of the airport and base areas, particularly along Browning Lake.

- Wathena, Kansas (2000 pop. 1,348) – This town is at the far western edge of the protected area. It is mostly beyond the river bottoms and only the southeast corner of the town is in the floodplain. This section of the town mostly contains businesses and homes along and near Highway 36.

- Gladden Bottoms - This is a large unincorporated area north of Rosecrans Airport that is almost entirely farmed and planted in crops.

2.3 STUDY AREA ECONOMY

2.3.1 Economic Development and Land Use

Perhaps the main focus of economic development in the contemporary study area is a cluster of life science manufacturing concerns located in the St. Joseph Stockyards and extending across the river into the Elwood area. This cluster of firms ties into other such firms elsewhere in St. Joseph and in Kansas City to the south. Major life science companies in the study area include Triumph Foods, the huge new pork processing facility in St. Joseph's Stockyards, as well as AGP (soybean processing), Boehringer Ingelheim Vetmedica (veterinary drug manufacturing), Albaugh and Omnium (herbicide manufacturers), Biozyme and Friskies-Nestle Purina (animal food and supplements manufacturers), and Prime Tanning (leather manufacturing), among others.

Other major companies and facilities located in the L-455 area include Silgan and Cryovac (food container and packaging manufacturers), Johnson Controls (battery manufacturing), and VP Buildings (steel building frame manufacturers). Major utilities include the St. Joseph Water Pollution Control facility and Aquila (electric power utility), both located in the St. Joseph Stockyards.

In the R471-460 area, Rosecrans Airport and the Missouri Air Guard base are key economic components. Major companies in the right bank area include Affiliated Foods (grocery wholesaler), BMS Management (warehousing and storage), Porters Building Center (home supply retail), Snorkel (boom manufacturing), Herzog Construction, and Sellyer Industries (truck chassis and components manufacturing).

Agriculture is a major land use in the study area. Farmed crop acreage accounts for about 5,100 of 7,219 total acres in the L-455 area (71% of the total) and about 7,200 of 13,424 total acres in the R471-460 area (54%). Agricultural land uses are found primarily in the western portion of L-455 and the northern portion of R471-460.

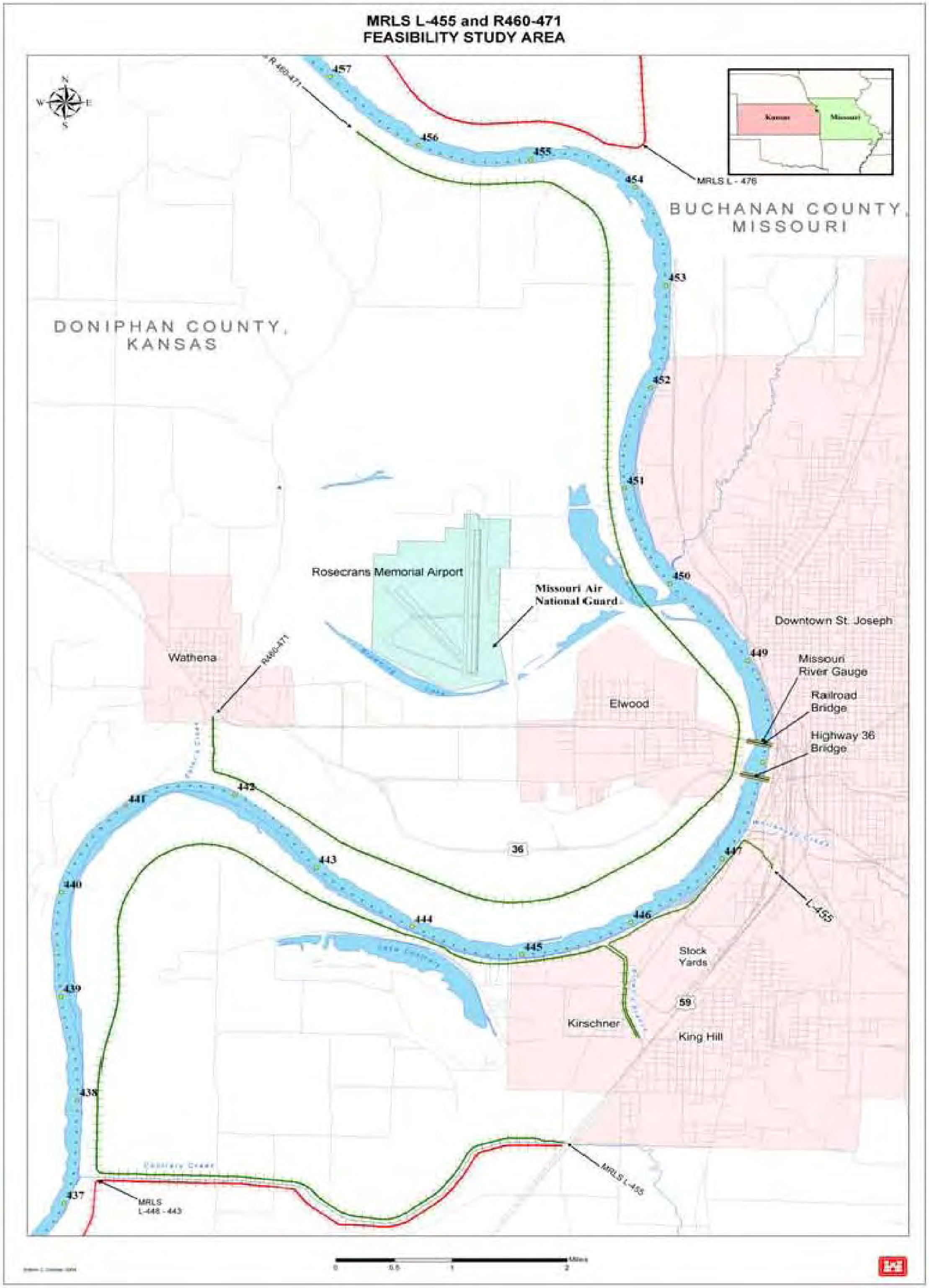

FIGURE 1
L-455 & R471-460 STUDY AREA

2.3.2 Access

Primary north-south road access in the study area is provided by Interstate Highway 229. I-229 links to I-29, providing a fast connection with Kansas City International Airport as well as with Omaha and points north and south from Canada to Mexico. State Highway 759, also known as the Stockyards Expressway; and U.S. Highway 59, also known as Lake Avenue, provide north-south routes in the L-455 area. These routes also serve the R471-460 area, which contains no major north-south routes. East-west access through the study area is provided by U.S. Highway 36, connecting St. Joseph, Elwood, and Wathena with other towns to the east and west. Highway 36 runs through the R471-460 area and is accessed by L-455 area commuters about a half-mile north of the upstream end of the levee.

Air transportation needs are served locally by Rosecrans Airport, located in the R471-460 area, and by Kansas City International Airport, which is located about 35 miles south of the study area. Rail service is provided in the L-455 area, primarily in the Stockyards area, by Union Pacific and Burlington Northern-Santa Fe Railroads. The Port of St. Joseph is situated at Missouri River mile 448 on the left bank, less than a mile from the upstream end of L-455, allowing easy access to river barge transportation.

2.4 FLOOD HISTORY

2.4.1 Early St. Joseph Floods

Major Missouri River flood events occurred in 1844 and 1881. Peak discharges were an estimated 350,000 cfs in 1844, the second largest in history, and 370,000 in 1881, the third largest. No damage estimates are available for these floods, but the impact presumably would have been sharply limited because development along the river was minimal at those early stages of St. Joseph history.

2.4.2 The 1952 Flood

One of the two largest flood events in modern history at St. Joseph was the flood of April 1952. The peak discharge of 397,000 cfs on April 23 was the greatest ever recorded at the St. Joseph gage, previously or subsequently. The flood crest reached an estimated stage of 26.8, nearly 10 feet above flood stage. The study area was still unprotected by Federal levees at that time, although the two study area levee units had been authorized as part of the comprehensive Missouri River Levee System in 1944. More than $2 million in damage was recorded in St. Joseph and another $450,000 in the Elwood and Wathena areas. In today’s prices, the approximately $2.5 million in 1952 damages would have amounted to about $23 million. This is believed to be a very incomplete accounting of damages from the flood, however. Corps county damage estimates at the time showed almost $15 million of damage in Buchanan and Doniphan Counties ($140 million in FY 2006 prices), most of which would have been in the St. Joseph area.

In any event, damages incurred were limited by the location of the damage center at Rosecrans Airport, which at that time consisted mostly of low-quality temporary World War II-era buildings, as well as by the successful flood fight in some districts of the city. All men in the city were drafted into an emergency flood-fighting effort. Temporary levees were constructed at Rosecrans Airport and other sites. Many portions of the city were spared flood damage due to these efforts, but the temporary levee at Rosecrans Airport failed and the airport area was inundated by 10 feet of flooding. Lake Contrary, at that time the site of a resort area with an amusement park, race track and summer homes, was also inundated to depths of 5 feet. In Wathena, backwater from the Missouri River caused Peters Creek to overflow, damaging a few blocks at the southeast corner of the town including a mobile home park. The Stockyards area was affected by sewer backflows, high water table and shallow flooding, as was the nearby Kirschner-Purtell community. About 800 residents were evacuated from Elwood, which was severely damaged.

Prior to the flood, the French Bottoms area of St. Joseph that is home to Rosecrans Airport was encompassed in a horseshoe bend of the river. But the 1952 flood scoured a new channel that bypassed the horseshoe bend, leaving Rosecrans Airport on the Kansas side of the river. (The Missouri River serves as the Missouri-Kansas state line in this region.) In the aftermath of the flood, the Corps constructed a new bypass channel parallel to the one scoured by the river, confirming the shift in geography. For this reason, the R471-460 levee protects areas in both Kansas and Missouri. The old channel was made into Browning Lake.

The main legacy of the 1952 flood was a heightened sense of urgency supporting construction of the L-455 and R471-460 units. Construction finally began in 1962 and was completed in 1967-68. Rosecrans Airport was also rebuilt and greatly modernized in the years succeeding the flood.

2.4.3 The 1993 Flood

The great Missouri and upper Mississippi River flood event of mid-1993 produced the flood of record in the study area in terms of peak stage. Although the peak discharge of 335,000 cfs was not as high as the 1952, 1881, or 1844 floods, the peak stage of 32.1 on July 26 was a new record for the St. Joseph gage. The R471-460 levee overtopped on July 26, one of the few Federal levees in the entire Midwest that failed during the 1993 flood. Most of the protected right bank area was subsequently inundated for several weeks. The nearly 1,300 residents of Elwood were evacuated in advance of flooding that reached 9 feet in the town and the adjacent Rosecrans Airport area, including the Missouri Air National Guard base. Interior overflows from Browning Lake already were threatening the same area even before the levee breach. More than 400 homes and several dozen businesses in Elwood were damaged, and about a third of the homes were ruined. The Air Guard base and Rosecrans Airport also were inundated by up to 9 feet of water. Sophisticated new avionics technology and training equipment at the Air Guard base were particularly hard hit, and a number of aircraft at the base and the airport were lost. Sherwood Medical, a medical supplies manufacturer with more than 700 local employees, was flooded to almost 4.5 feet. Damages at Sherwood reportedly topped $30 million. Snorkel, a work platforms manufacturer and large local employer, sustained severe damage from about 7 feet of flooding. Payless Cashways, now the site of Porter Building Center, was flooded by two feet of water.

Across the river, the L-455 levee threatened to overtop but ultimately held, probably because the right bank breach reduced pressure on it. Had floodwaters overtopped or breached the L-455 unit, catastrophic damages would have occurred in an industrial area estimated to contain assets of over $1 billion and an annual payroll in excess of $50 million. Nevertheless, significant damage was sustained even as the levee held. The water pump system on the Missouri River water intake was flooded, eliminating the water source to the city's water treatment plant (upstream of the protected area) for nearly a week and impacting about 80,000 customers, including many large corporate customers in the L-455 area. Early in the flood event, the city's sewage treatment plant, located within the L-455 area, was forced to shut down and begin discharging raw sewage into the Missouri River. Many L-455 area businesses closed for an extended period because of concern for the safety of the levee, resulting in lost wages, productivity, and sales. Many Stockyards businesses, as well as a number of homes and small businesses in the Kirschner-Purtell and Lake Contrary areas, were damaged by sewer backup, high water table and surface flows. A number of large businesses lost inventories in the hundreds of thousands of dollars due to business and water supply interruptions.

A systematic and comprehensive post-flood damage survey was not undertaken, partly because of the large scale of the damage. But available information on quantified damages indicated at least $115 million in damage in the R471-460 area and $4 million in the L-455 area. This total reflects October 1993 prices; at current price levels, it would be about $190 million. Please note that this total is not a complete accounting of damages in the Elwood area and the actual total would have been significantly larger in the context of complete information.

In the flood's aftermath, Sherwood Medical Corporation closed its local operation permanently, laying off more than 700 employees. Corporate management reportedly was skeptical that the building ever again could be sterilized well enough to meet Federal standards .

The R471-460 levee subsequently was decertified by FEMA in 1999, and the recent flood history has created difficulties for local economic development staff attempting to interest businesses in locating in the area. Nevertheless, the Elwood area has rebounded fairly well since 1993 and remains a viable community, the population level having almost returned to the pre-flood total.

2.5 DEMOGRAPHICS

2.5.1 Census Data Areas

The entire study area is contained in the St. Joseph Metropolitan Statistical Area (MSA). The following data on population and households, housing, income, age, and education were drawn from 2000 Census data. The specific block groups and blocks comprising the study area were identified for analysis of social characteristics. The study area contains portions of seven Census tracts and all or part of 11 block groups. The relevant tracts and block groups are summarized in Table 1. Table 2 summarizes selected socioeconomic indicators.

2.5.2 Population and Households

Key population and households data from the 2000 Census are summarized below for each relevant area from the county level down to the study area.

- Buchanan County, Missouri – 2000 population was 85,998, an increase of 3.5% over the 1990 population of 83,083. There were 33,557 households in 2000.

- Doniphan County, Kansas – 2000 population was 8,249, an increase of 1.4% over the 1990 total of 8,134. There were 3,173 households in 2000.

- St. Joseph Metropolitan Statistical Area (MSA) – 2000 population was 102,490. The MSA contains the entire study area. As of 2004, the metro area was ranked 296th in the U.S. and is approximately the same size as Harrisburg, Virginia; Dover, Delaware; or Bend, Oregon. There were 39,830 households in 2000.

- St. Joseph, Missouri (city) - 2000 population was 73,990, an increase of 3.0% over the 1990 population of 71,852. There were 29,026 households in 2000.

- Elwood, Kansas – 2000 population was 1,145, an increase of 6.1% over the 1990 population of 1,079. There were 446 households in 2000.

- Wathena, Kansas – 2000 population was 1,348, an increase of 16.2% over the 1990 population of 1,160. There were 524 households in 2000.

- Study area – 2000 population was 5,469. There were 2,301 households in 2000.

- L-455 protected area – 2000 population of 3,838. There were 1,573 households in 2000.

- R471-460 protected area – 2000 population of 1,631. There were 728 households in 2000.

2.5.3 Age

The median age for Buchanan County in 2000 was 36.1 years, which is identical to the Missouri state median age. The Doniphan County median age was 36.8, somewhat older than the Kansas state median of 35.2. The St. Joseph MSA showed a median age of 36.4. The median was 35.6 for St. Joseph city, 32.3 for Elwood, and 36.4 for Wathena.

TABLE 1
STUDY AREA CENSUS TRACTS & BLOCK GROUPS (2000 CENSUS)

L-455 PROTECTED AREA

COUNTY	*TRACT*	*BLOCK GROUP*	*BLOCKS*	*AREAS WITHIN STUDY AREA INCLUDED*	*BOUNDARIES*
BUCHANAN (MO)	20	1	1111-1119, 1130-1138	St. Joseph - Stockyards, Kirschner-Purtell neighborhood	Alabama (S) to downtown, Missouri River (W) to RR tracks (E)
BUCHANAN (MO)	21	3	3001-3007	St. Joseph - King Hill neighborhood northern edge	Russell (N) to Cherokee/Blake (S), RR tracks (W) to 3rd (E)
BUCHANAN (MO)	24	1	1001-1007, 1010-1018, 1022-1031, 1033-1035	St. Joseph - King Hill neighborhood	Cherokee (N) to Alabama (S), RR tracks (W) to King Hill (E)
BUCHANAN (MO)	25	1	1003-1016	St. Joseph - King Hill neighborhood	Alabama (N) to Cliff/Brown/Valley (S), Lake (W) to King Hill (E)
BUCHANAN (MO)	25	2	ALL	St. Joseph - King Hill neighborhood southern edge	Cliff/Brown/Valley (N) to Joseph/Washington /Elizabeth (S) , Lake (W) to King Hill (E)
BUCHANAN (MO)	29	1	ALL	Unincorporated Lake Contrary & surrounding ag area	Missouri River (N) to Janston (S), Missouri River (W) to Diagonal (E)
BUCHANAN (MO)	29	2	2001-2005	Unincorporated Contrary Creek area	Janston (N) to Contrary Creek (S), Missouri River (W) to Diagonal (E)

R471-460 PROTECTED AREA

COUNTY	*TRACT*	*BLOCK GROUP*	*BLOCKS*	*AREAS WITHIN STUDY AREA INCLUDED*	*BOUNDARIES*
BUCHANAN (MO)	3	6	ALL	Missouri portion of right bank area - Rosecrans Airport & Air Guard base	Missouri River (E) & Browning Lake (N, S, & W)
DONIPHAN (KS)	203	1	1045-1049, 1052	Ag area above Wathena and Browning Lake	Missouri River (N) to 210th Rd/ Runnymede Rd/ 200th Rd/ Saratoga Rd/ 190th Rd/ Hwy 36/ Joseph St (S), Peck Rd (W) to Missouri River/ creek/ Treece Rd (E)
DONIPHAN (KS)	203	3	ALL	Elwood northern half and lower Browning Lake	Unnamed creek/ Browning Lake (N) to St. Joseph St/ 175th St/ 170th St/ Vermont/ Old Hwy 238/ Hwy 36 (S), Treece Rd (W) to Missouri River (E)
DONIPHAN (KS)	203	4	ALL	Elwood southern half; SE portion of Wathena	175th Rd/ 170th Rd/ Vermont/ Old Hwy 238/ Hwy 36 (N) to Missouri River (S), Peters Creek (W) to Missouri River (E)

TABLE 2 STUDY AREA SOCIOECONOMIC CHARACTERISTICS									
From 2000 Census data All dollars in $1,000s									
Place	**Buchanan County**	**Doniphan County**	**St. Joseph MSA**	**St. Joseph**	**Elwood**	**Wathena**	**State of Missouri**	**State of Kansas**	**U.S.**
Population	85,998	8,249	102,490	73,990	1,145	1,348	5,595,211	2,688,418	281,421,906
Households	33,557	3,173	39,830	29,026	446	524	2,194,594	1,037,891	105,480,101
Housing Units	36,574	3,489	43,236	31,752	494	566	2,442,017	1,131,200	115,904,641
Median Value of Owner Units	72.7	54.7	75.4	69.6	45.5	65.5	89.9	83.5	119.6
Median Household Income	$34.7	$32.5	$35.7	$32.7	$29.0	$34.0	$37.9	$40.6	$42.0
Per-Capita Income	$17.9	$14.8	$18.1	$17.4	$12.6	$15.4	$19.9	$20.5	$21.6
Individuals Below Poverty Level	12.2%	11.9%	11.6%	13.0%	17.0%	9.8%	11.7%	9.9%	12.4%
% Adults (25+) with High School Diploma	81.5%	80.2%	82.0%	80.9%	72.3%	78.2%	81.3%	86.0%	80.4%
% Adults (25+) with Bachelors Degree	16.9%	14.8%	17.2%	17.1%	50.0%	18.4%	21.6%	25.8%	24.4%
% of People Over 65	15.0%	16.2%	14.9%	15.4%	11.2%	15.2%	13.5%	13.3%	12.4%
% of People Under 18	24.3%	25.3%	24.6%	24.1%	30.9%	27.3%	25.5%	26.5%	25.7%

Median age for the study area block groups ranged from 30.3 in the block group containing Wathena to 38.3 in the Contrary Creek area southwest of St. Joseph.

Approximately 14.9% of the population of the St. Joseph MSA was 65 years of age or older in 2000. The comparable rates at the county level were 15.0% for Buchanan and 16.2% for Doniphan. All of these rates exceed the state averages of 13.5% for Missouri and 13.3% for Kansas. About 24.6% of the 2000 population of the St. Joseph MSA was below 18 years of age. It was 24.3% for Buchanan County and 25.3% for Doniphan County. These figures are slightly lower than the statewide averages of 25.5 for Missouri and 26.5 for Kansas.

2.5.4 Education

Buchanan County's 2000 Census results showed 81.5% of the adult population (over 25) with at least a high school diploma and 16.9% with at least a bachelor's degree. The high school diploma total is slightly better than the Missouri state average of 81.3%, but the bachelor's degree total is below the statewide average of 21.6%. For Doniphan County, 80.2% of the population had high school diplomas, significantly less than the Kansas state average of 86%.

14.8% had bachelor's degrees, again well below the Kansas state average of 25.8. For the St. Joseph MSA, 82.0% had high school diplomas and 17.2% had bachelor's degrees or higher..

2.5.5 Income and Poverty

In general, the study area population is characterized by lower incomes and greater poverty than the state and national averages. In 2000, Buchanan County's median household income was $34,704, well below the Missouri state average of $37,934. Doniphan County's median household income was $32,537, again well below the Kansas state average of $40,624. The St. Joseph MSA had a median household income of $35,675 in 2000. The figures for the cities in the study area were $32,663 for St. Joseph, $28,950 for Elwood, and $34,046 for Wathena. Among study area block groups, median household income ranged from $25,000 for the Stockyards and Kirschner-Purtell areas of St. Joseph to $36,509 for the nearby Contrary Creek area. The national median household income was $41,994, considerably above all portions of the study area.

In terms of per capita income, the St. Joseph MSA figure was $18,123 in 2000. The Buchanan County total of $17,882 was well below the Missouri state average of $19,936. The Doniphan County figure was $14,849, well below the Kansas state average of $20,506. The per capita income in 2000 was $17,445 for St. Joseph, $12,601 for Elwood, and $15,440 for Wathena. The study area block groups range from $11,491 for the northern portion of the King Hill neighborhood in St. Joseph and $11,755 for the northern portion of Elwood to $21,181 in the Contrary Creek area. The latter figure is an outlier representing a block group with a very small population which skews the overall range. The next highest figure is $17,509 in the southern portion of the King Hill neighborhood. All of the study area is well below the national 2000 per capita income of $21,587.

The 2000 poverty level was 11.6% for the St. Joseph MSA. It was 12.2% for Buchanan County, somewhat more than the Missouri state level of 11.7%. Doniphan County's poverty rate was 11.9%, well above the Kansas state average of level of 9.9%. The national rate was 12.4%. The poverty rate was 13% for St. Joseph, 17.0% for Elwood, and 9.8% for Wathena. The highest poverty rate among study area block groups was 25.9% in the northern portion of the King Hill neighborhood. The Lake Contrary area and the Rosecrans Airport area also were at or above 25%. The lowest rates were 6.2% in the Contrary Creek area and 8.9% in the rural area north of Rosecrans Airport.

2.5.6 Employment

Approximately 5.5% of the St. Joseph MSA labor force was unemployed in 2000. The unemployment rate of 5.9% in Buchanan County was above the Missouri state rate of 5.3%. The Doniphan County rate of 7.0% was well above the Kansas state unemployment rate of 4.2%. The national rate was 5.8%. The rate was 6.4% for St. Joseph, 5.2 % for Elwood, and 4.1% for Wathena. Among study area block groups, the unemployment rate ranged from zero in one King Hill neighborhood area and in the Rosecrans Airport area to 16.6% in the Stockyards and Kirschner-Purtell areas of St. Joseph.

The largest portions of the St. Joseph MSA labor force, with a total of 47,184 workers in 2000, are employed in education, health and social services (21.1%), manufacturing (17.0%), and retail (11.5%). Labor force percentages for other industries include recreation and hospitality (7.7%), construction (7.1%), financial, insurance and real estate (6.9%), transportation, warehousing and utilities (6.3%), professional and scientific (6.2%), public administration (5.1%), other services (4.3%), wholesale trade (3.2%), information (1.9%), and agriculture, forestry and mining (1.7%).

2.5.7 Housing

The 2000 Census showed a total of 36,574 housing units in Buchanan County and 3,489 in Doniphan County. The St. Joseph MSA had 43,236 units. There were 31,752 units in the city of St. Joseph, 494 units in Elwood, and 566 units in Wathena in 2000. Missouri block groups in the study area had 2,610 units, while the Kansas block groups had 728 units for a total of 3,338 total housing units in the study area in 2000.

The 2000 median value of owner-occupied housing was $72,700 for Buchanan County, well below the Missouri state median value of $89,900. The Doniphan County total of $54,700 similarly was well below the Kansas state median of $83,500. For the St. Joseph MSA, the median value was $75,400. For the cities in the study area, the 2000 median value was $69,600 in St. Joseph, $45,500 in Elwood, and $65,500 in Wathena. In terms of block groups contained in the study area, the 2000 median value ranged from $29,700 in northern sections of the King Hill neighborhood in St. Joseph and in Elwood to $137,500 in the Missouri portion of the R471-460 area adjacent to Elwood. The latter value is again an outlier since there are only 27 homes in the area and a few very expensive newer homes appear to have skewed the total. The next highest block group median value is $86,700 for the Lake Contrary area.

Buchanan County's 2000 vacancy rate of 8.2% is below the Missouri state rate of 10.1%. The Doniphan County rate of 9.1% was higher than the Kansas state vacancy rate of 8.2%. The St. Joseph MSA vacancy rate was 7.9%. The rate was 8.6% in St. Joseph city, 9.7% in Elwood, and 7.4% in Wathena. Within the study area block groups, the highest vacancy rate, 22.2%, was found in the Rosecrans Airport area.

3.0 DAMAGE ANALYSIS MODEL CONSTRUCTION

3.1 STUDY CONFIGURATION

3.1.1 Analysis Years

The analysis evaluates without and with project conditions based on a 50-year period of analysis, the standard assumption for a Federal levee. In addition to the existing conditions analysis which represents conditions as of 2006, the analysis also assumes a base year of 2013, the approximate year any project would become operational, and a future condition year of 2038, which is the midpoint of the 50-year period beginning in 2013. The analysis years represent static time periods or years relative to which the engineering and economic data are developed.

No additional, separate analysis was prepared for the base condition. There are no known differences between 2006 existing and 2013 base year conditions in terms of either economic development or hydrologic/hydraulic conditions. Therefore, the analysis for 2006 existing conditions should adequately portray base year conditions as well.

3.1.2 Interest Rate and Price Level

The price level for this analysis is October 2005. The current Federal interest rate of 5.125 percent is used in annualizing costs and benefits over the 50-year period of analysis.

3.1.3 Study Reaches

As summarized in Table 3, the study area was divided into four reaches for the economic analysis, including two on each bank. The purpose of the divisions is to facilitate the reporting of economic damages and benefits for distinct subareas of the study area, as well as to ensure accurate computation of damages by heading off problems that could occur in translating property or water surface elevations at remote locations to common index points. The reach selection was made on the basis of distinct land uses, political subdivisions, hydrologic features such as Browning Lake and Brown's Branch, and hydraulic data. The reach delineations were not intended to affect, and do not affect, plan formulation or selection in this study.

3.1.3.1 L-455 Reaches The L-455 protected area extends from the downstream end at Contrary Creek at Missouri RM (River Mile) 437.35 to the upstream end at Whitehead Creek at RM 447.3. This area is divided into two reaches by the tiebacks along Brown's Branch at RM 445.7. The upstream reach is a densely developed urban area which includes the central industrial district in the old Stockyards as well as part of the King Hill neighborhood. This reach is almost completely within the city limits of St. Joseph. The more rural downstream reach is dominated by Lake Contrary and includes an extension of the central industrial district along Lower Lake Road, the Kirschner-Purtell neighborhood, the homes surrounding Lake Contrary, some scattered homes near Contrary Creek, and farmed land to the west and south of Lake Contrary. Most of the downstream area is to the southwest of the St. Joseph city limits and is unincorporated.

The two L-455 reaches are not hydraulically independent, inasmuch as flooding in the upstream reach could enter the downstream reach. However, flooding that begins downstream cannot back up into the upstream reach, and the overtopping point and critical geotechnical section for L-455 both are on the downstream segment of the levee.

3.1.3.2 R471-460 Reaches On the right bank, the protected area extends from Peters Creek at RM 441.8 to the upstream tieback near Treece Road at RM 456.5. Like the L-455 area, this area is divided into two reaches. The dividing point is at RM 449.5, just downstream of the upstream entrance to Browning Lake and near levee station 250+00. This point was chosen to highlight differences in the water surface profiles affecting the upstream and downstream portions of the levied area as well as differing land uses and political subdivisions. The downstream right bank area features mainly small town urban land uses including the town of Elwood, Kansas, a portion of the town of Wathena, Kansas, and the commercial and industrial area along U.S. Highway 36 connecting the two towns. The upstream reach, in contrast, is mainly industrial and agricultural. It includes the Rosecrans Airport area, the Missouri Air National Guard base, a large farming region north of the airport, and a number of rural residences. The airport and Air Guard base are in the Missouri portion of the reach, while the farmed areas are primarily in the Kansas portions. If a breakout of damage or benefit totals for the Missouri portion of R471-460 is needed, the totals for the upstream reach can be regarded as rough estimates for Missouri since the farmed Kansas portions of the reach are overwhelmed in value by the large public facilities in the Missouri portion.

TABLE 3
ECONOMIC ANALYSIS REACHES

All stations are Missouri River miles

Reach	Levee unit	Downstream end station	Upstream end station	Econ index station	Areas included
LB-US	L-455	445.70	447.30	446.32	Urban SW portion of St. Joseph, including Stockyards & King Hill neighborhood
LB-DS	L-455	437.35	445.70	441.39	Unincorporated Lake Contrary & surrounding ag areas; Kirschner-Purtell neighborhood
RB-US	R471-460	449.50	456.50	449.99	Rosecrans Airport; Air Guard base; ag area
RB-DS	R471-460	441.80	449.50	449.44	Town of Elwood; town of Wathena (portion); Hwy. 36

3.1.4 Economic Categories

The economic structure inventory in this study utilizes four categories of basic land uses: residential, non-residential (including businesses, non-profit institutions such as churches and schools, public facilities and utilities), roads and streets, and agriculture (crops – farm sets are categorized in residential). Physical inundation damage and benefit estimates produced by the risk analysis are reported in terms of totals for these four categories.

3.2 DATA COLLECTION METHODOLOGY

3.2.1 Tax Records

Initial data collection for the economic analysis included obtaining 2003 county tax records from Buchanan County, Missouri, and Doniphan County, Kansas. The then-current state of the counties' databases allowed only minimal outputs, but information obtained for each structure included address, owner name, appraised value, land use, and parcel numbers.

3.2.2 Mapping

1998 GIS mapping was obtained from the city of St. Joseph and the Corps Missouri River floodplain mapping. The available maps were contoured at intervals of 4 feet and also contained many spot elevations. In addition, areas for each building in square feet were estimated by Corps GIS staff from the footprint of each building in the protected areas.

3.2.3 Field Survey

The somewhat rudimentary outputs available from county tax records in the study area were complemented and, eventually, largely replaced by a structure-by-structure field survey carried out in May-August 2004. Each structure in the protected areas within the 0.2% floodplain (and slightly beyond, in some areas) was surveyed, accounting for approximately 2,400 structures. Information noted for each structure included address; identification of business/facility and industry at non-residential properties; type of home (single, duplex, multiple, mobile home); construction type and quality; with or without basement; number of stories; first floor elevations relative to ground elevations; condition; and estimated age. Significant outbuildings and outdoor inventory or equipment also were noted.

The field survey was updated periodically during preparation of the analysis. The economic database used in this analysis reflects 2006 conditions.

3.2.4 Corporate Interviews

The other major data collection task involved extensive, on-site interviews with major companies and facilities in the study area for the purpose of collecting detailed values and depth-damage data. It was not realistic within the study budget and schedule to interview all or most businesses in the study area. Therefore, we emphasized those businesses and facilities with the largest investments in the protected areas. In this study area, a large percentage of total property value is accounted for by a few very large facilities. These facilities were identified with the help of values from the 1997 reconnaissance study and discussions with St. Joseph Chamber of Commerce staff. Ultimately, 20 extensive interviews were carried out, including 14 in the L-455 area and 6 in the R471-460 area, accounting for the majority of non-residential investment in both areas.

Interviews with representatives of these facilities resulted in site-specific data broken out by each individual building within the plant or facility. For each building, we noted the following information: functions of building (office, manufacturing, warehouse, etc.); first floor elevation; any uses of basement or second floors; estimated replacement values of assets, including ranges of values whenever possible; estimated remaining life and condition of assets; key depth-damage elevations for each major contents item; and any known flood history. Values of buildings and major equipment were estimated in terms of depreciated replacement value, while inventory and smaller equipment estimates were based on replacement values.

3.3 DATA DEVELOPMENT

3.3.1 Ground Elevations

All structures surveyed were assigned a ground elevation from the topographic mapping and a station positioning them relative to the river. Foundation heights observed during the field survey were applied to the ground elevations to obtain first floor elevations. Roads and street lengths were assigned elevations on a block-by-block basis using the topographic mapping. Crop acreage was divided into small areas and each area was broken down into a range of elevations.

To account for uncertainty, a standard deviation of 0.5 feet was assigned to each ground elevation based on the topographic mapping with 4-foot contours. Table 6-5 of EM 1110-2-1619, which gives standard deviations for various methods of determining stages, was consulted to determine the correct standard deviation.

3.3.2 Residential Values and Damage Susceptibility

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3.3.2.1 Residential Structures Valuation - Corps of Engineers guidance requires property to be valued in terms of depreciated replacement value. Also called current cash value, depreciated replacement value is the cost today to replace an asset (a building, a piece of equipment, etc.) with another object of the same type, function, and condition.

Appraised residential values from county tax records initially were considered, but these values were not ultimately used in the final feasibility study computations, primarily because of difficulties in matching up the tax records with available field survey mapping. Instead, a modified Marshall and Swift methodology based on costs per square foot was used to value all homes using data collected during the field survey. No information was available for some of the factors used in Marshall and Swift valuation, particularly interior characteristics such as walls, heating and cooling, floor type and other attributes requiring internal inspections of each home. A valuation process was developed to adapt the detailed Marshall and Swift process to the more limited data available for this study. The valuation method enumerated below was used to determine depreciated replacement values for all residential structures.

1. Determine type of home - site-built or manufactured, single family or multiple (apartments).

2. Determine quality of construction – low, fair, average, good, very good, or excellent. These standard Marshall and Swift categories were applied to each structure during the field survey using sample photographs of each type provided in the Marshall and Swift reference guides.

3. Determine size of home in square feet, using the footprint measurements provided by GIS staff and also referring to the number of stories.

4. Identify exterior walls type. We noted whether the walls were wood or masonry. Although these basic wall composition types are in turn divided into multiple categories in the Marshall and Swift data, with each category characterized by a separated set of values per square foot, we noted only the basic material.

5. Determine basic replacement cost per square foot based on type, construction quality, size, and exterior wall type. Since it was not possible to identify exterior wall types in optimal detail in the field survey, we instead computed an average of the square foot values for all categories listed within each construction type, quality type, and size.

6. Calculate a basic total replacement cost by multiplying the square foot cost by the area in square feet.

7. For homes with basements, add a value to account for the basement. Basement sizes for individual structures were not available, so it was assumed that basement size was equal to 75% of the structure footprint area. Values for unfinished basements were used in an effort to be conservative in assigning values.

8. Add garage value based on map measurement of outbuildings by GIS staff.

9. Calculate total replacement value using the basic cost per square foot plus the additions for basement and garage.

10. Determine typical physical life for each type of home by using Marshall and Swift tables.

11. Determine effective age. The field survey evaluated the relative condition of each home using a rating of 1 to 5 (low to very good). These ratings were converted to an average aging factor for each level, from 10% of physical life used for homes in very good condition to 80% of physical life used for homes in poor condition. These age factors based on observed conditions were applied to the typical physical life to obtain an effective age.

12. Select depreciation factor using the effective age and typical physical life. These percentages are available in Marshall and Swift tables.

13. Calculate depreciated replacement value for the structure by applying the depreciation

factor to the total replacement value.

14. Calculate adjusted depreciated replacement value for structure by applying Marshall and Swift multipliers to reflect current cost and locality adjustments.

Uncertainty factors for residential structure values were developed by assuming that the true rating of construction quality for any given home could be one category higher or lower than our estimate. For example, if we rated a home's construction quality as fair in the field survey, for the uncertainty calculations we assumed that the true rating could instead be low (one category below fair) if we were too optimistic, or average (one category above fair) if we were too pessimistic. Basic square foot values were identified for each condition for 1 and 2 story homes with either wood or masonry walls. Three typical home sizes were evaluated: 1600, 2400, and 3000 square feet. Within each home type and typical size, the percentage change in square foot value from one construction quality rating to the next was calculated. We then accounted for uncertainty by finding the maximum incremental change between quality ratings in any category or size. The maximum incremental change was approximately 38%. The 38% maximum change was divided by 2 to obtain an estimated standard deviation of 19%. This standard deviation was applied to each residential occupancy type used in the damage analysis.

3.3.2.2 Residential Contents Valuation - Because residential depth-damage functions developed by the Institute for Water Resources were used in the analysis, the contents-to-structure-value ratio for homes was set to 1.0 in the HEC-FDA risk analysis model (see section 3.5 below) in accordance with guidance for the use of these functions. In estimating investment, it was assumed that residential contents value is equal to 50% of the structure value. This assumption is purely for estimating investment and does not influence the estimates of damages and benefits. Mobile homes are not covered by the IWR functions. A content-to-structure value ratio of 63.6% was assumed for mobile homes based on FEMA flood insurance claims data referred to in Table 6-4 of EM 1110-2-1619.

The standard deviation used for mobile home contents is 37.8%, again from Table 6-4 of EM 11102-1619. For other residential occupancy types covered by IWR depth-damage functions, no uncertainty factor is included for contents value in HEC-FDA based on IWR guidance.

In addition to contents, an "other" category was added to all residential properties to account for both vehicles and landscaping. Most families today own more than one vehicle, and with imminent threat of flooding, it is likely that they would load belongings into one vehicle and evacuate the area. Therefore, vehicles subject to flood damage were limited to one per home. At the same time, warning times associated with levee failure (as opposed to overtopping) are not generally sufficient to allow comprehensive evacuations, so it is assumed that each home would have one vehicle that would not be evacuated. Most homes in the protected areas have typical shrub plantings, lawns, and gardens that would also be damaged by flooding. The "other" value accounting for the sum of vehicle and landscaping value was assumed to be equivalent to 20% of residential structure value with a standard deviation of 5%. Since the "other" category amounts to about 16.7% of total residential value (20% / (100% + 20%) = 16.7%) and residential value accounts for about 9% of total investment (see Table 4 below), vehicles and landscaping can be seen to account for about 1.5% of total property value in the analysis.

3.3.2.3 Residential Depth-Damage Relationships - The depth-damage functions applied to homes in this analysis were developed by the Institute for Water Resources (IWR) based on post-flood data from thousands of flood insurance claims. The functions are for 1 story with or without basement, 2 story with or without basement, and split level with or without basement. Structure and contents functions are provided for each structure type. The split level functions were not used in this analysis since there are few such homes in the study area, but a pair of unofficial functions for 1.5 story with or without basement were produced by averaging the 1 and 2 story functions. The 1 story functions also were used to evaluate both single family homes and apartments. The only other depth-damage functions not included in the IWR data were the mobile home and vehicle functions, which came from New Orleans District data (see section 3.3.3.2 below).

One consideration in the preparation of depth-damage functions is the likelihood and extent of effective avoidance measures. Avoidance measures could include raising of contents, evacuation, flood proofing and other measures that would lessen property damages in a flood event. No specific data were available concerning residential avoidance measures in this analysis. However, the standard IWR residential depth-damage functions used in this study purportedly were based on flood insurance claims emanating from actual flood events, and these depth-damage relationships are assumed to at least indirectly reflect avoidance measures.

All IWR depth-damage functions are equipped with standard deviations per foot of flooding in addition to the most likely values. The New Orleans functions are accompanied by minimum and maximum percentages for each foot of flooding for use as a triangular uncertainty distribution.

3.3.3 Non-Residential Values and Damage Susceptibility

3.3.3.1 Non-Residential Structure Valuation - As with residential valuation, the appraised county tax values for businesses were considered but not ultimately used to determine depreciated replacement values since matching tax records with field survey mapping could not be accomplished in a reliable manner. An additional shortcoming was that most public facilities did not have values in the tax records.

For interviewed firms and facilities, depreciated replacement value was estimated for the relevant structures during the interviews. In all other cases, an adapted Marshall and Swift methodology for commercial valuation was employed based on costs per square foot. These computations relied on attributes gathered during the field survey. The process, similar to the one used for residential structure values, is summarized below.

1. Determine occupancy type, such as garage, church, office building, retail store, motel, etc.

2. Determine construction class. The classes are A, B, C, D, or S as defined in the Marshall and Swift Valuation Service.

3. Determine construction quality – low, fair, average, good, very good, or excellent.

4. Identify replacement value per square foot based on occupancy type, construction class and quality.

5. Compute total replacement value by multiplying area in square feet by the square foot replacement value selected.

6. Determine typical physical life for the relevant structure type by using Marshall and Swift tables.

7. Determine effective age. As with residences, the field survey evaluated the condition of each business or facility using a relative rating of 1 to 5 (low to very good). These ratings were converted to an average aging factor for each level, from 10% of physical life used for structures in very good condition to 80% of physical life for structures in poor condition. These age factors based on observed conditions were applied to the typical physical life to obtain an effective age.

8. Select depreciation factor from the Marshall and Swift tables using the effective age and typical physical life.

9. Calculate depreciated replacement value for the structure by applying the depreciation factor to the total replacement value.

10. Calculate adjusted depreciated replacement value for the structure by applying Marshall and Swift multipliers to account for necessary current cost and locality adjustments.

3.3.3.2 Non-Residential Contents Valuation

For interviewed firms and facilities, content values were estimated directly from interview data and then converted to content-to-structure value ratios. Interview subjects were asked about the value of each major type of contents in each area or building. These line items were aggregated into a single contents value for use in the HEC-FDA risk analysis model. Major equipment items were characterized in terms of replacement cost and estimated remaining useful life, which facilitated computation of depreciated replacement values. Inventories were valued in terms of replacement value. In addition to a most likely value, maximum and minimum values for each line item were developed which served as the basis for a triangular uncertainty distribution for contents value.

Relative to the final structure inventory database that went into the damage analysis, about 57% of non-residential investment in the study area and about 47% of total investment value is accounted for by the 20 interviewed firms and facilities, indicating that the bulk of the value assumed within the economic structure inventory is backed by primary sources and detailed analysis.

For other firms and facilities that were not interviewed, content-to-structure value ratios published by the New Orleans and Baltimore Districts of the Corps of Engineers were used in most cases. The New Orleans District working in conjunction with Gulf Engineers and Consultants (G.E.C.) of Baton Rouge, Louisiana has developed a great deal of analysis over several studies concerning valuation and depth-damage relationships of flood-prone properties under various conditions, and three reports have been published documenting their methods and results. These reports collectively are one of the few sources of published information on commercial contents valuation and depth-damage functions. The content-to-structure value ratios as published also are accompanied by standard deviations to account for uncertainty. The three reports use slightly different methodologies that produce slightly different datasets. The one used here is the set developed from post-flood owner-operator interviews for the May 1997 report "Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVR) In Support of the Lower Atchafalaya Reevaluation and Morganza to the Gulf, Louisiana Feasibility Studies." This dataset was based on a mid-1990s canal flooding event in the Baton Rouge area. The context of inland, freshwater, long duration flooding, as well as similarity of construction and occupancy types, suggested the data could be appropriately transferred to the problem area in the present study.

A few ratios also were obtained from an IWR report (originally Baltimore District data) on the Wyoming Valley of the Susquehanna River basin in Pennsylvania. Like the New Orleans data, the Wyoming Valley data also were based on long duration, main stem, inland, freshwater flooding and additionally involved a context of existing levees, all of which strengthens the relevance of the data to the present study. In some cases where little information was available about a business property or industry, a content-to-structure value ratio of 1.0 was assumed.

3.3.3.3 Non-Residential Depth-Damage Relationships

Non-residential depth-damage functions were largely taken from the New Orleans District and Baltimore District data referenced above. All non-residential structures, including interviewed companies, were evaluated using New Orleans functions for commercial wood, masonry and metal buildings. The functions include median, minimum and maximum values, allowing expression of damage uncertainty as a triangular distribution.

Non-residential contents damage functions for interviewed firms or facilities were developed in each case based on data obtained from the interview concerning elevations, values, and damage potential. Depth-damage functions, values, and elevations were assigned for each major line item of property, including uncertainty factors. A total depth-damage function for contents was then developed by computing a weighted average of depth-damage curves for all contents items, with each item weighted by its value as a percentage of total contents value for the company. For example, if office equipment was valued at $10,000 for a given facility, and total equipment and inventory for the facility was valued at $200,000, the depth-damage curve for office equipment would get 5% of the weight in determining the total depth-damage curve for contents.

Flood avoidance measures were factored into the depth-damage relationships where appropriate. The economic interviews, which covered key facilities accounting for approximately 57% of total non-residential investment value in the study area, included discussion of evacuation, raising, and other avoidance measures that could be employed in a typical Missouri River flood event. Most of the large plants or warehouses evaluated in this study would be unable to relocate very much of their massive inventories in the warning time provided, and most of the facilities would be unable to move or raise their equipment regardless of warning time. One exception would be the aircraft at Rosecrans Airport and the adjacent Missouri Air National Guard base, where we assumed evacuation of nearly all aircraft, although it was assumed that a few aircraft could be damaged in the largest flood events.

For non-residential contents damage estimates at other businesses and facilities that were not interviewed, most of the depth-damage functions used are from the New Orleans data. These functions include median, minimum and maximum values to support a triangular uncertainty distribution. A few contents functions for specific occupancy types not covered by the New Orleans data came from the Wyoming Valley data. The Wyoming Valley functions as published were not accompanied by uncertainty factors. In these cases, uncertainty was developed as a triangular distribution with minimum and maximum percentages assigned as appropriate for each increment of flooding based on professional judgment. In cases where no generalized depth-damage curve was available based on similar businesses or not enough information existed concerning the nature of the business, one of three generalized depth-damage curves was used based on high, medium or low damage potential. Vacant businesses were evaluated using a depth-damage curve that assigned damage to the structure but only minimal damage to contents. (Contents value for vacant buildings, while minimal, is not completely zeroed out since a 50-year period of analysis is assumed and it is likely that a currently vacant building would be occupied for at least a portion of that period.)

3.3.4 Roads and Streets

Roads, streets, highways and railroads were valued in terms of typical construction costs per mile. These costs were obtained by averaging typical costs from a variety of sources, including consulting private sector engineers who have worked on road projects, previous Corps projects, and state Departments of Transportation. The new (replacement) construction costs per mile were converted to depreciated replacement values by assuming a depreciation factor of 35%. Depreciated replacement values per miles used in this analysis include railroads, $1,122,000; highways (4-lane rural), $3,487,000; major arterials, $4,190,000; connector streets, $2,287,000; neighborhood streets, $1,715,000; and county roads, $1,143,000.

Depth-damage functions used for roads in this analysis were formulated by obtaining typical costs per mile for minor maintenance such as regrading and resurfacing as well as for more major reconstruction to compare against the costs of new construction. In general, it is assumed that lower levels of inundation will result in relatively minor damage requiring repairs amounting to regrading and/or resurfacing, while more severe inundation levels will require much more expensive repairs that would be comparable to reconstruction. The resurfacing and reconstruction costs per mile obtained were divided by the new construction costs per mile to produce the depth-damage percentages.

3.3.5 Agriculture – Crop Damage

Crop damages in the analysis are expressed as a value per representative acre. A value per acre was prepared for each county in the study area, Buchanan and Doniphan, using a weighted average that accounts for a number of factors. Initially, a typical crop pattern or distribution is established for river bottoms in the relevant area. Standard, widely available county and district crop data are not useful for this purpose since they reflect all farms, not just those in river bottom areas, and crop patterns and yields in river bottom areas usually differ significantly from other farms. Instead, Farm Service Agency county staff and Natural Resource Conservation Service state staff are consulted for their estimates of local crop patterns and yields in floodplain areas. Virtually all river bottom farming in the study area involves corn and soybeans, with a very small amount of wheat and bean double-cropping in Kansas counties. Crop budgets available from state university extension offices are used to determine annual production costs per acre for each crop, including planting costs per input and harvest costs. Crop calendars for each crop are used to determine the typical monthly schedule for planting, growing and harvesting. Yields per acre for each crop are obtained from the FSA and NRCS sources. For prices per bushel, Corps economic analyses are required to use normalized prices updated each year by the U.S. Department of Agriculture for all basic crops.

These data inputs are integrated to determine on a monthly basis the extent to which each crop is in the ground, mature, and harvested. These calculations in turn determine the value per acre that can be lost to flooding at any given time during the year. Potential monthly losses for each crop are then integrated with monthly flooding probabilities to determine actual losses. Finally, the losses for each crop are combined with crop distribution data to determine the overall crop value lost per acre in a flood. The damage per acre values used in this analysis are $140 for Buchanan County, Missouri, and $162 for Doniphan County, Kansas.

To determine an uncertainty factor for these values, the FSA staff consulted on local crop distribution and yields were asked to estimate yields per acre in an average year, a very good year, and a poor year. The value per acre computations that had been done using the yields per average year were repeated using the very good and poor year values. These computations established a maximum and minimum value. The maximum was 14 to 16% greater than the average, while the minimum was 19 to 22% less than the average. The value uncertainty for crops is therefore expressed using a triangular distribution, with a minimum of 78% and a maximum of 116%.

The depth-damage function used for crop damages assumes that one foot of water ruins a crop.

3.3.6 Base vs. Future Year Adjustments

Separate modules were developed for base and future year conditions to be used in the risk analysis. Each module is a complete economic property inventory reflecting a particular set of conditions. The base and future modules in this analysis include the same data with one exception. The Missouri Air National Guard base on the right bank, which was heavily damaged in the 1993 flood, plans to relocate to higher ground within the protected area. The new site for the base at the north end of Rosecrans Airport would be about nine feet higher than the present site, which would not entirely remove the base from the floodplain but would greatly reduce the damage potential. (The 1993 flood depth at the base was 9 feet.) The elevation of the new facilities is expected to be 11 feet higher than at the current site. Although the move originally was planned to be completed by 2010, the current timeline is unclear because of wartime Federal funding exigencies and because the decertification of the levee unit reportedly has caused enough uncertainty in the military's planning horizon to delay most funding for the project. The relocation by the base year of the analysis would barely be completed before the base year even if the projected funding schedule proves valid, and any funding delays probably would push forward the date of completion to well past the base year. The economic analysis assumes that the base will have been relocated for the future (2038) without-project condition but not for the base year (2013) condition.

The relocation of the Air Guard base is the only change in the economic database between the base year and future year conditions. No other economic changes are assumed in going from the 2013 to the 2038 condition. However, all properties in the future module are affected by increased Missouri River water surface profiles summarized later in this appendix in Table 11.

3.4 STUDY AREA INVESTMENT TOTALS

The economic structure inventory for this analysis, as defined in the field survey and developed and refined subsequently, resulted in a database that is summarized in Table 4. This database was used in the subsequent risk analysis simulations for computation of damages and benefits. Highlights of the investment data include the following:

- Total investment in homes, businesses and facilities, roads, and crop acreage in the study area is just under $2 billion ($1,997,175,000).

- There are 1,968 homes and 290 businesses and facilities in the study area, as well as almost 80 miles of roads and streets and 12,300 crop acres.

- The L-455 area accounts for 71% of total investment, or about $1.43 billion.

- The L-455 area contains 1,301 homes, two-thirds of the study area total; 165 businesses and facilities), 5,100 crop acres, and almost 53 miles of roads and streets.

- 57% of study area non-residential properties are in the L-455 area, but L-455 accounts for 73% of total non-residential investment.

- R471-460 area investment is an estimated $572 million, accounting for 29% of the study area total.

- The R471-460 area contains 667 homes and 125 non-residential properties, as well as 27 miles of roads and 7,200 crop acres (58.5% of the study area total).

The residential category, about 9% of total study area investment, includes homes and their contents as well as vehicles and landscaping. The non-residential category includes business, non-profit and public facility structures along with their equipment, inventory and furnishings. Non-residential investment comprises 82.2% of total study area investment. The roads category, which includes streets, county roads, highways and railroads, accounts for 7.9% of total investment. Crops account for the remaining 0.9% of total investment.

TABLE 4
STUDY AREA INVESTMENT TOTALS

In $1,000s

	L-455		R471-460		TOTAL	
RESIDENTIAL						
# Homes	**1,301**	66.1%	**667**	33.9%	**1,968**	
Structure Value	$68,066.5		$37,905.3		$105,971.8	
Contents Value	$47,646.5		$26,533.7		$74,180.2	
Total Value	$115,713.0	64.2%	$64,439.0	35.8%	$180,152.0	9.0%
NON-RESIDENTIAL						
# Businesses / Facilities	**166**	57.2%	**124**	42.8%	**290**	
Structure Value	$322,262.8		$196,012.3		$518,275.1	
Contents Value	$877,551.2		$245,813.5		$1,123,364.7	
Total Value	$1,199,814.0	73.1%	$441,825.8	26.9%	$1,641,639.0	82.2%
ROADS						
Miles	52.9	66.4%	26.8	33.6%	79.7	
Total Value	$102,698.9	65.4%	$54,235.1	34.6%	$156,934.0	7.9%
CROPS						
Acres	5,100	41.5%	7,200	58.5%	12,300	
Total Value	$7,650.0	41.5%	$10,800.0	58.5%	$18,450.0	0.9%
GRAND TOTAL	**$1,427,888.0**	71.4%	**$571,299.9**	28.6%	**$1,997,175.8**	100.0%

3.5 RISK ANALYSIS MODEL

3.5.1 HEC-FDA Software

The ultimate goal of the data collection, development and refinement phase is the compilation of economic data files for import into the HEC-FDA program. HEC-FDA is the Hydrologic Engineering Center’s Flood Damage Reduction Analysis program, a risk analysis software product that is the Corps standard for flood damage reduction analyses. HEC-FDA integrates economic data with hydraulic/hydrologic and geotechnical/ structural engineering data, including uncertainty factors for each type of data, to produce estimates of project economic and engineering performance under existing without-project conditions and alternatives. The current HEC-FDA version 1.2 is used in this analysis.

3.5.2 Economic Data Inputs

The economic input files for HEC-FDA include a structure inventory file compiling data for all damageable property in the study area, including structure values, ground elevations and foundation heights (which are added to the ground elevations to produce first-floor elevations), and stream stationing. The structure inventory file is accompanied by an occupancies file that compiles information for each major occupancy type (1-story homes, retail businesses, government offices, etc.) such as content-to-structure value ratios, depth-damage functions, and uncertainty factors for all economic variables. Together, these data files contain the three main factors critical to estimating flood damages at each location: elevation, value, and damage susceptibility.

Damages in this analysis consist of physical inundation damages to commercial, industrial, residential and public/non-profit structures and their contents, as well as damages to roads and crops.

3.5.3 Engineering Data Inputs

Engineering inputs for the model include water surface profiles with stages and discharges for a range of eight selected flood events: 50%, 20%, 10%, 5%, 2%, 1%, 0.5%, and 0.2%-chance events, plus invert stages. Sets of profiles were prepared for both the 2013 and 2038 analysis years. The exceedance probability relationships for each reach and each analysis year were evaluated using the graphical method, which involves specifying a discharge-probability relationship (including a discharge for the 0.999 probability event) for each index point along with the equivalent record length (70 years) for the Missouri River. A stage-discharge relationship also was entered for each of the four index points and two analysis years, with the addition of a standard deviation of 1.28 feet for 2013 conditions and 1.42 feet for 2038 conditions.

Top of levee stages based on critical levee low points were identified and translated to each index point, as were exterior-interior stage relationships. The exterior/interior relationships tell the HEC-FDA program the depth of flooding that affects property inside the levee when a given stage is reached on the river side of the levee. The exterior and interior stages can be identical, as they are for the upstream reach of L-455. In other cases, the interior stages can be slightly less (about 2 feet less for the downstream L-455 reach) or significantly less (about 5 feet for the R471-460 reaches).

Geotechnical probability of failure curves were developed for one critical section on each levee and then adjusted to the appropriate index points. Geotechnical concerns are more significant relative to the R471-460 levee, where probability of failure reaches 34% before overtopping. For the L-455 levee, probability of failure reaches only 7% before overtopping in the downstream reach, and the upstream reach has no probability of failure function. No probable failure points (PFP) were prepared for the analysis since none of the probability of failure curves reach 85% significantly below top of levee.

More information on the methodologies used in developing the geotechnical probability of failure functions and the hydrologic and hydraulic data can be found in the sections corresponding to these disciplines in Appendix B to this report.

3.5.4 Risk Analysis

Upon completion of the economic and engineering data entry, the first phase of the risk analysis produces an economic stage-damage function. The program performs numerous iterations, each combining various possible values for each economic input (elevation, value, and depth-damage) by sampling the uncertainty distributions provided for those variables. Flood damages for each foot of flooding are computed based on the level of investment subject to flooding, the beginning damage elevation, and the estimated damage to that investment with various depths of flooding. The HEC-FDA program references each structure's first floor elevation or beginning damage elevation to the corresponding frequency event elevation at the reach index point. Individual stage-damage relationships at each structure for each investment category are then computed with risk and aggregated to the reach index location specified for integration with the engineering data.

The second and final phase of the risk analysis integrates the economic stage-damage function with the engineering data. A Monte Carlo process is used to simulate up to a half-million individual flood events in each analysis. Each event samples the engineering and economic variables within their specified ranges of uncertainty to determine whether flood damage occurs and if so, how much. Computations are made for expected annual damages under each condition, existing (or base, since both condition are equivalent in this analysis) and future. Expected annual damage is assumed constant in those years of the period of analysis beyond the most likely future condition. An equivalent annual damage also is computed, representing essentially a summation of base and future year conditions (see Tables 7 and 10 below), with the future year damages expressed as a discounted present worth value which is added to the base year damages.

Results of the risk analysis are described in the following section.

4.0 DAMAGE ANALYSIS – WITHOUT-PROJECT CONDITION

4.1 EXISTING AND BASE YEAR CONDITIONS

Results in this study for existing (2006) and base year conditions (2013) are identical, as there are no differences in property inventories, water surface profiles or other data.

4.1.1 Beginning Damage Frequencies and Key Flood Events

This section summarizes results of the economic analysis as they pertain to beginning damage points and selected flood events. Table 5 summarizes the damages and impacts that would be expected in each of three selected flood events. Like many areas protected by main stem levees, both the L-455 and the R471-460 protected areas essentially form "bowls" behind the levees, so there is almost no difference in the number of homes and businesses flooded in the three events that are enumerated here. The main difference is in depth of flooding. Table 6 compiles many of the key elevations in this study, including top of levee elevations, water surface profiles for selected flood events for 2013 and 2038 conditions, historical flood peaks, and important properties. Hydraulic data prepared for this study includes a set of water surface profiles for the existing and base year conditions and a second set of profiles for future conditions that reflects stage increases. Both sets of data are summarized in Table 6.

It should be emphasized that the damages summarized in this section are risk-based, and the results obtained in the risk analysis can seem at odds with data that do not reflect the uncertainties involved. As an example, it is stated elsewhere in this report that the R471-460 levee unit can, under existing conditions, contain a 1% flood. This is true inasmuch as the current top of levee elevation for R471-460 exceeds the nominal or most likely 1% flood elevation. However, that does not mean that the 1%-chance flood would cause no damage to R471-460 in the context of a Monte Carlo-based risk analysis simulation. (Witness the existing decertification of the right bank levee for failing to meet certain standards of protection against the 1%-chance flood.) Within the risk analysis, the standard-deviation of 1.28 feet for the stage-frequency relationship under existing conditions means that the elevation reached by a 1%-chance flood could be over 2.5 feet above or below the nominal elevation at two standard deviations from the mean. The 1%-chance flood elevation, in other words, could assume a value anywhere within a range of about 5.1 feet. (The range increases to 5.7 feet under 2038 future conditions.) If a top of levee elevation contains a nominal flood elevation by a margin of 0.9 feet, while the uncertainty factors assumed would allow the risk-based elevation for the same flood to exceed the nominal elevation by 2.6 feet, it is clear that the risk-based flood event could actually exceed top of levee by as much as 1.7 feet.

An additional factor that distinguishes damage potential in the risk context from data based on nominal top of levee and flood event elevations is that the risk model assumes that a flood can occur from geotechnical or structural failure as well as by overtopping.

4.1.1.1 Beginning Damage Frequencies - Results of the risk analysis indicate that, under existing conditions of 2006 or base year conditions of 2013, the R471-460 area could suffer flood damage in an event smaller than the 1% flood – specifically, in a 1.5% (67 year) event. The frequencies involved are approximate since the risk analysis outputs are relative to only a few selected events. Therefore, it would perhaps be more accurate to characterize the beginning damage frequency for R471-460 as being in the range of 2%-chance (50-year) to 1.33%-chance (75-year).

Damage to the L-455 area would require a flood of a 0.2% chance magnitude under existing or base year conditions.

4.1.1.2 The 1% Chance Flood - A 1%-chance (100-year) flood under existing conditions would be associated with a discharge of 261,000 cubic feet per second (cfs). A flood of this magnitude would result in damages of $304.3 million, all in the R471-460 area. L-455 would not be flooded. All but 4 of the 667 homes in the R471-460 area and all but 4 of the 125 businesses and facilities would be affected. Depths in the flooded areas would average 6.7 feet and would reach as much as 17.7 feet.

4.1.1.3 The 0.5% Chance Flood - A 0.5%-chance or 200-year flood under existing conditions would be associated with a discharge of 287,000 cfs. The L-455 area would not be flooded, but the R471-460 area would suffer damages of $343.4 million. All but one of the 125 businesses and facilities and all but 1 of the 667 homes in the right bank area would be affected by depths averaging 8.1 feet and reaching as much as 19 feet.

4.1.1.4 The 0.2% Chance Flood - A 0.2% or 500-year flood, under existing conditions, would be characterized by a discharge of 324,000 cfs. Damages in the R471-460 area would total $369.5 million, or 54% of total damage in the study area. An estimated 666 homes and 124 businesses and facilities in the right bank area would be damaged by depths of up to 20.8 feet and averaging about 10 feet. The L-455 area's downstream reach would experience similar depths, resulting in damage of $316 million, or 46% of the total study area damage. An estimated 23 businesses and facilities and 590 homes would be affected, all in the downstream left bank area. The upstream reach of L-455 would not flood. Damage in the study area overall would total $685.5 million.

TABLE 5
SINGLE EVENT DAMAGES FOR SELECTED FLOODS

Based on existing conditions (2006)

	L-455	**R471-460**	**Total**
1% (100-Year) Event			
Total Damage	$0.0	$304,332.8	$304,332.8
Homes Affected	0	663	663
Businesses Affected	0	121	121
Average Depths	0.0	6.7	
Maximum Depths	0.0	17.7	
0.5% (200-Year) Event			
Total Damage	$0.0	$343,429.5	$343,429.5
Homes Affected	0	666	666
Businesses Affected	0	124	124
Average Depths	0.0	8.1	
Maximum Depths	0.0	19.0	
0.2% (500-Year) Event			
Total Damage	$316,015.1	$369,501.6	$685,516.7
Homes Affected	590	666	1,256
Businesses Affected	23	124	147
Average Depths	9.8	10	
Maximum Depths	20.8	20.8	

TABLE 6 - KEY ELEVATIONS

***** Index point - St. Joseph USGS Missouri River gage - RM 448.16**
Datum = 788.19

	ELEVATION	STAGE	
	824.0	35.8	
823.3 = 0.2% (500-year) flood, future	823.0		822.9 = R471-460 NEW OVERTOPPING STAGE WITH PROJECT
822.4 = 0.2% (500-year) flood, existing			822.4 = L-455 OVERTOPPING STAGE
	822.0	33.8	
821.4 = 0.5% (200-year) flood, future	821.0	32.8	
820.6 = 0.5% (200-year) flood, existing			820.3 = 1993 flood peak (July 26) - 335,000 cfs (highest stage on record)
			820.2 = R471-460 OVERTOPPING STAGE, EXISTING
820.0 = 1% (100-YEAR) FLOOD, FUTURE			
819.3 = 1% (100-YEAR) FLOOD, EXISTING	819.0	30.8	819.2 = Missouri Air Guard base (relocated site)
818.3 = 2% (50-year) flood. future	818.0	29.8	818.5 = Triumph Foods
817.7 = 2% (50-year) flood, existing			817.9 = Livestock Exchange building
	817.0	28.8	
	816.0	27.8	
			815.4 = 1881 flood peak (Apr 29) - 370,000 cfs (2nd highest stage and discharge on record)
	815.0		815.0 = 1952 flood peak (Apr 23) - 397,000 cfs (highest discharge & 3rd highest stage on record)
			814.3 = Aquila; AGP
	814.0		813.8 = 1984 flood peak (Jun 16) - 198,000 cfs
			813.8 = 1973 flood peak (Oct 13) - 200,000 cfs
	813.0	24.8	
			812.7 = 1844 flood peak (June) - 350,000 cfs (est.; 3rd highest discharge)
	812.0		812.0 = 1995 flood peak (May 14)- 164,000 cfs
			812.0 = 1987 flood peak (May 27) - 207,000 cfs
	811.0	22.8	
			810.8 = 1967 flood peak (Jun 13) - 162,000 cfs
	810.0	21.8	810.2 = Rosecrans Airport
	809.0	20.8	
			808.7 - 1903 flood peak (Jun 2) - 252,000 cfs (5th highest discharge on record)
			808.2 = Missouri Air Guard base (current location)
	808.0	19.8	
805.2 = flood stage			
	805.0		

4.1.2 Expected Annual Damages for Existing and Base Years

Expected annual damages (EAD) under existing and base year conditions are summarized in Table 7. For the total study area, EAD is an estimated $7.84 million. About 77% of this total, or $6.07 million, is associated with the R471-460 area. The L-455 area accounts for the remaining EAD of $1.77 million.

Although the L-455 area contains a large and valuable property base, EAD potential is limited by the absence of serious geotechnical or hydraulic issues affecting the levee. The decertified R471-460 unit has much more significant concerns in both areas, resulting in greater EAD than the L-455 area despite a much smaller property base.

Total study area EAD is 85.1% non-residential, 11% residential, 3.6% roads, and 0.3% crops.

TABLE 7
EXPECTED ANNUAL DAMAGES BY CATEGORY
EXISTING / BASE YEAR CONDITIONS - WITHOUT PROJECT

Damage in $1,000's

	Residential	Non-Residential	Roads	Crops	Total	
L-455						
Downstream	$101.5	$1,078.8	$40.5	$2.3	$1,223.1	
Upstream	$2.3	$542.5	$5.9	$0.0	$550.7	
L-455 Total	$103.8	$1,621.3	$46.4	$2.3	$1,773.8	22.6%
	5.8%	91.4%	2.6%	0.1%	100.0%	
R471-460 Total						
Downstream	$738.4	$2,726.0	$232.8	$5.1	$3,702.3	
Upstream	$20.5	$2,319.3	$4.3	$18.2	$2,362.4	
R471-460 Total	$758.9	$5,045.3	$237.2	$23.3	$6,064.7	77.4%
	12.5%	83.2%	3.9%	0.4%	100.0%	
Study Area Total	$862.7	$6,666.6	$283.6	$25.6	$7,838.5	
	11.0%	85.1%	3.6%	0.3%	100.0%	

4.1.3 Nonexceedance Probability Ratings for Existing Conditions

In addition to estimating economic performance of the levees, the HEC-FDA risk analysis also characterizes their engineering performance in terms of computed nonexceedance probabilities. Some key results for the existing and base year conditions are summarized below and in Table 8.

4.1.3.1 R471-460 Performance - The main results of the risk analysis pertaining to the right bank levee in existing or base year conditions are as follows:

- The R471-460 unit has only a 51.3% chance of containing a 1%-chance flood event, compared to the 90% or better chance required for certification. This nonexceedance probability accounts for damage due to either overtopping or levee failure.
- R471-460 has a margin above the nominal 1% chance flood elevation of less than one foot (0.9 feet), compared to the margin of three feet that is a standard criterion for levee certification.
- If overtopping alone is considered without geotechnical or structural considerations, the R471-460 unit has a 67.8% chance of containing the 1% flood, still well below the 90% standard even without adding geotechnical risk factors.
- In the levee's current condition, a 0.2%-chance flood would exceed the top of levee by 2.7 feet.
- Over 10 years, the chance of overtopping or failure would be 16%; over 25 years, 36%; over 50 years, 58%.

4.1.3.2 L-455 Performance – Results of the risk analysis pertaining to the left bank unit in the context of existing or base year conditions are as follows:

- The L-455 levee would have a 93.6% chance of containing a 1% chance flood event under existing conditions, considering risk of both overtopping and failure.
- If geotechnical considerations are left aside, L-455 would have a 95% chance of containing a 1% chance overtopping event.
- The levee has a margin of 3.1 feet over the nominal 1% chance flood elevation.
- The top of levee exceeds the nominal 0.2% chance flood elevation, although only by 0.2 feet.
- Long term risk of overtopping or failure is about 2.5% over 10 years; 6% over 25 years; and 12% over 50 years.

4.1.4 Benefits of Existing Project

One additional result of the risk analysis is an estimated annual benefit for each levee. Benefits of the existing levees were determined by deleting the top of levee elevations, geotechnical probability of failure relationships, and interior-exterior stage relationships

TABLE 8 LEVEE ENGINEERING PERFORMANCE RATINGS EXISTING / BASE WITHOUT-PROJECT CONDITION						
	R471-460			L-455		
	overall	Downstream	Upstream	Overall	downstream	Upstream
Top of levee elevations						
Reference river mile		449.4	450.0		441.4	446.3
Existing (without-project) TOL		822.1	822.8		816.0	821.2
Annual Exceedance Probability						
Median (as %)	1.4%	1.4%	1.4%	0.1%	0.1%	0.1%
Expected (as %)	1.7%	1.7%	1.7%	0.1%	0.3%	0.1%
Long-Term Risk (years)						
10 years						
Exceedance probability	16.1%	16.2%	16.1%	2.5%	2.5%	1.2%
Exceedance chance over period	1 in 6.2	1 in 6.2	1 in 6.2	1 in 39.8	1 in 39.8	1 in 83.3
25 years						
Exceedance probability	35.6%	35.6%	35.6%	6.2%	6.2%	3.0%
Exceedance chance over period	1 in 2.8	1 in 2.8	1 in 2.8	1 in 16	1 in 16	1 in 38.5
50 years						
Exceedance probability	58.5%	58.6%	58.5%	12.1%	12.0%	5.9%
Exceedance chance over period	1 in 1.7	1 in 1.7	1 in 1.7	1 in 8.4	1 in 8.4	1 in 17.1
1%-chance flood event context						
Levee height superiority (feet)						
Reference flood elevation		821.2	821.9		812.9	817.5
Levee height superiority	0.9	0.9	0.9	3.1	3.1	3.7
Nonexceedance probability (as %)						
Without-project	51.3%	51.4%	51.3%	93.6%	93.6%	97.3%
Overtopping only	67.8%	67.9%	67.8%	95.0%	95.0%	97.3%
0.2%-chance flood event context						
Reference flood elevation Levee height superiority (ft.)		824.7	825.5		815.8	820.7

TABLE 9 BENEFITS OF EXISTING LEVEES			
	L-455	R471-460	Total
Annual damages without existing levee	$90,114.5	$60,404.3	$150,518.8
Annual damages with existing levee	$2,074.5	$6,378.3	$8,452.8
Benefits of existing levee	$88,040.0	$54,026.0	$142,066.1

for each levee in the HEC-FDA model and then re-running the analysis. The resulting damage total represents the amount of annual damages that would occur if no levees or other structural flood damage reduction measures existed. Taken together with the EAD from Table 6, which are essentially residual damages that continue to occur even with the levees in place, the difference is the annual benefit of each levee in its existing conditions, as summarized in Table 9.

The analysis indicated that the L-455 area would suffer equivalent annual damages of about $90.1 million if there were no levee in place. Computed EAD for L-455, from Table 7, amounts to $2.1 million, which is essentially a residual damage that continues to occur even with the existing levee in place. Therefore, the existing L-455 unit can be said to have an annual benefit of $88 million. For the R471-460 levee, equivalent annual damages of $60.4 million would occur in the absence of a levee, and EAD with the levee in place totals $6.4 million, so the annual benefit of the existing R471-460 levee is an estimated $54 million.

4.2 FUTURE WITHOUT-PROJECT CONDITION

The primary distinction between existing/base and future conditions in this study involves increases in Missouri River stages. Water surface profiles prepared for the future condition in this study reflect stage increases over existing/base year conditions for all events analyzed. Table 10 summarizes the increases for each event elevation in each study reach (except for the downstream L-455 reach, where no stage increases are slated to occur). Stages increase by up to 0.7 feet in the largest events. The stage increases, based on published historical analysis of Missouri River stages over time, are believed to be caused by the effects of sedimentation. More information on the hydraulic data and its assumptions can be found in section B-2.8 of Appendix B to this report.

A secondary distinction between base and future conditions concerns the relocation of the Missouri Air National Guard base, which is discussed in section 4.2.2.1 below.

4.2.1 Beginning Damage Frequencies and Key Flood Events

Under 2038 conditions, the beginning damage frequency for L-455 remains the 0.2%-chance event. This is because there is no stage increase from existing/base year conditions to the future year in the L-455 downstream reach. The downstream reach would overtop in a slightly smaller event than the upstream reach, so the downstream reach is the benchmark for the L-455 unit as a whole. For R471-460, the beginning frequency becomes a 2%-chance (50-year) event.

These frequencies take into account both overtopping and failure, and again, these frequencies are very approximate due to the limited number of risk analysis event outputs.

In a 1% chance flood event, 2038 damages would be expected to total $267.9 million. This is a 13.6% decrease from 2006 and 2013 conditions due to the relocation of the Air Guard base, discussed below in section 4.2.2.1. No left bank flooding would occur.

In a 0.5% chance event, 2038 damages would total $305.2 million, a decrease of about 12.5% from existing and base year conditions. Again, all of this damage would occur in the R471-460 area as there would be no flooding at L-455.

In a 0.2% chance event under 2038 conditions, flooding would occur in both units. Damages would top $1 billion, almost two-thirds of which would be sustained in the L-455 area.

TABLE 10 WATER SURFACE ELEVATIONS, EXISTING & FUTURE						
	River Mile	Frequency	Discharge	Water Surface Elevations		
				2006 & 2013	2038	Increase
L-455	441.39	50.0%	109000	802.4	802.4	0.0
downstream	441.39	20.0%	147000	805.9	805.9	0.0
	441.39	10.0%	174000	807.9	807.9	0.0
	441.39	5.0%	199000	809.5	809.5	0.0
	441.39	2.0%	233000	811.4	811.4	0.0
	441.39	1.0%	261000	812.9	812.9	0.0
	441.39	0.5%	287000	814.1	814.1	0.0
	441.39	0.2%	324000	815.8	815.8	0.0
L-455	446.32	50.0%	109000	806.7	806.8	0.1
upstream	446.32	20.0%	147000	810.2	810.4	0.2
	446.32	10.0%	174000	812.2	812.5	0.3
	446.32	5.0%	199000	813.9	814.3	0.3
	446.32	2.0%	233000	816.0	816.4	0.4
	446.32	1.0%	261000	817.5	818.0	0.5
	446.32	0.5%	287000	818.9	819.4	0.5
	446.32	0.2%	324000	820.7	821.3	0.6
R471-460	449.44	50.0%	109000	809.3	809.4	0.1
downstream	449.44	20.0%	147000	813.2	813.4	0.2
	449.44	10.0%	174000	815.4	815.7	0.3
	449.44	5.0%	199000	817.2	817.6	0.4
	449.44	2.0%	233000	819.4	819.9	0.5
	449.44	1.0%	259000	821.2	821.8	0.6
	449.44	0.5%	287000	822.7	823.4	0.6
	449.44	0.2%	324000	824.7	825.5	0.7
R471-460	449.99	50.0%	109000	810.0	810.1	0.1
upstream	449.99	20.0%	147000	813.9	814.1	0.2
	449.99	10.0%	174000	816.1	816.4	0.3
	449.99	5.0%	199000	817.9	818.3	0.4
	449.99	2.0%	233000	820.2	820.6	0.4
	449.99	1.0%	259000	821.9	822.5	0.6
	449.99	0.5%	287000	823.5	824.1	0.6
	449.99	0.2%	324000	825.5	826.2	0.7

4.2.2 Expected Annual Damages

As shown in Table 11, EAD for the total study area increases from $7.84 million in the existing and base conditions to $9.03 million in the future conditions of 2038. This is an increase of 15% which is driven by the growth in river stages from the base to the future condition.

The increase in EAD is disproportionately due to L-455, where EAD increases almost 33%. The increase in the R471-460 area is only about 10%, which is discussed in the next section. The significant increase in the L-455 area is due to the stage increases. In existing and base year conditions, the upstream L-455 does not flood in even the largest events evaluated, but by the future year, the upstream reach would flood in a 0.2%-chance event. Since this reach contains a heavy concentration of large companies and facilities with nearly $1 billion in total investment, any flooding, even in rare events, results in quickly accumulating EAD.

4.2.2.1 Effect of Air Guard Base Relocation

The difference in base and future condition EAD in the R471-460 area is the result of assumptions made for the analysis concerning the Missouri Air Guard base and their relocation schedule as well as increases in river stages. The key assumption concerning the future condition is that the Air Guard base will have been relocated to higher ground by 2038, which in itself would substantially reduce EAD for the future condition in the R471-460 upstream reach. Damages for the 1% chance event at the Air Guard base drop from $78.8 million in existing and base year conditions at the current base location to $17.2 million in the future condition following the relocation. Yet expected annual damages still show an increase. This anomaly is due to the increased stages and increased stage-discharge uncertainty factors in the future condition. The stage increases of 0.6 to 0.7 feet in the largest events in the upstream R471-460 reach prop up the annual damages even when the property inventory for the future condition is significantly reduced (i.e., by raising the Air Guard base elevation by 11 feet).

Another important assumption regarding the Air Guard base relocation and the base vs. future conditions is that the relocation to high ground will not have been completed by the base year of 2013. Since the base has such a central role in the right bank area's economy, that assumption is potentially important. We tested the assumption by alternately assuming that the relocation would be completed by the base year of 2013. Thus, both the base and future year conditions would have the Air Guard base at a site 11 feet higher than its present location. An additional run of the HEC-FDA model was executed based on this assumption, and the results showed that the assumption is considerably less critical to the analysis than expected. EAD for the R471-460 area were reduced only by about 5.8% despite the large drop in primary or single event damages due to the base relocation.

TABLE 11 EXPECTED ANNUAL DAMAGES FUTURE WITHOUT-PROJECT CONDITION				
Damage in $1,000's; Oct. 2005 prices				
	2013	**2038**	**% Change**	**Equiv Ann Dmg**
L-455				
Downstream				
Residential	$101.5	$109.3	7.7%	$105.5
Non-Residential	$1,078.8	$1,159.5	7.5%	$1,120.6
Roads	$40.5	$44.7	10.4%	$42.7
Crops	$2.3	$2.4	6.1%	$2.4
Total	$1,223.1	$1,315.9	7.6%	$1,271.1
Upstream				
Residential	$2.3	$5.1	120.3%	$3.8
Non-Residential	$542.5	$1,022.9	88.6%	$790.9
Roads	$5.9	$11.5	94.2%	$8.8
Crops	$0.0	$0.0	0.0%	$0.0
Total	$550.7	$1,039.4	88.7%	$803.4
L-455 TOTAL	**$1,773.8**	**$2,355.3**	**32.8%**	**$2,074.5**
R471-460				
Downstream				
Residential	$738.4	$919.1	24.5%	$831.9
Non-Residential	$2,726.0	$3,415.8	25.3%	$3,082.7
Roads	$232.8	$294.2	26.3%	$264.5
Crops	$5.1	$6.0	19.6%	$5.6
Total	$3,702.3	$4,635.1	25.2%	$4,184.6
Upstream				
Residential	$20.5	$34.6	68.2%	$27.8
Non-Residential	$2,319.3	$1,964.1	-15.3%	$2,135.6
Roads	$4.3	$7.4	71.0%	$5.9
Crops	$18.2	$30.0	64.4%	$24.3
Total	$2,362.4	$2,036.0	-13.8%	$2,193.6
R471-460 TOTAL	**$6,064.7**	**$6,671.1**	**10.0%**	**$6,378.3**
STUDY AREA TOTAL	**$7,838.5**	**$9,026.5**	**15.2%**	**$8,452.8**

4.2.3 Nonexceedance Probabilities for Future Condition

The engineering performance of both levees is reduced in the future condition because of the increased stages in the 2038 condition (see Table 10). Under 2038 conditions, the R471-460 unit's chance of containing a 1% flood event drops from 51.3% to 41.8%, and the levee has a mere 0.3 feet of margin above the 1% event. If only overtopping events are considered, the nonexceedance probability would be 56.6%. The L-455 levee has a nonexceedance probability of 92.8%, down from the 2013 estimate of 93.6%. Engineering performance statistics for both levees in the future without-project condition are summarized in Table 12.

4.2.4 Other Impacts

It is considered likely that the Missouri Air Guard base would be relocated from the St. Joseph area if the flood threat and subsequent levee decertification becomes protracted. This loss would significantly harm the St. Joseph area in general and would be a severe impact in the Elwood area. St. Joseph could be forced to relocate their main airport if another major flood occurred. The right bank area in general would be faced with difficulties in attracting new businesses and maintaining their existing economic base.

TABLE 12
LEVEE ENGINEERING PERFORMANCE RATINGS
FUTURE WITHOUT-PROJECT CONDITION (2038)

	R471-460			L-455		
	overall	downstream	Upstream	overall	downstream	upstream
Top of levee elevations						
Reference river mile		449.4	450.0		441.4	446.3
Existing (without-project) TOL		822.1	822.8		816.0	821.2
Annual Exceedance Probability						
Median (%)	1.70%	1.70%	1.70%	0.10%	0.10%	0.20%
Expected (%)	2.10%	2.10%	2.10%	0.30%	0.30%	0.30%
Long-Term Risk (years)						
10 years	19.38%	19.38%	19.03%	2.68%	2.68%	2.51%
25 years	41.64%	41.64%	41.01%	6.56%	6.56%	6.15%
50 years	65.94%	65.94%	65.20%	12.69%	12.69%	11.92%
1%-chance flood event context						
Levee height superiority (feet)						
Reference flood elevation		821.8	822.5		812.9	818.0
Without-project	0.3	0.3	0.4	3.1	3.1	3.7
Nonexceedance probability (as %)						
Without-project	41.8%	41.8%	42.9%	92.8%	92.8%	94.0%
Overtopping only	56.6%	56.6%	57.6%	94.0%	94.1%	94.0%
0.2%-chance flood event context						
Levee height superiority (feet)						
Reference flood elevation		825.5	826.2		815.8	821.3
Without-project	-3.4	-3.4	-3.4	0.2	0.2	0.6

5.0 ALTERNATIVES SCREENING ANALYSIS

5.1 ALTERNATIVES EVALUATED

This study presents a relatively narrow range within which it is possible to formulate alternatives that are potentially feasible in terms of economics and engineering. The two levee units on the ground right now, in their existing conditions, represent a floor or minimum for the formulation of any range of alternatives. Even in the less than satisfactory conditions characterizing the R471-460 levee currently, these levees still offer considerable existing protection which serves to truncate most of the lower range in which alternatives normally could be formulated. This lower range is truncated even more by the fact that some smaller raises apparently would not even be technically feasible and would present extremely high costs while yielding small benefit totals.

On the other hand, formulation of larger-scaled alternatives also is limited by the prospects of sharp cost increases as well as induced stage increases and damages. Hydraulic data developed for this study indicated that new construction would begin to produce a significant increase in induced stages at almost 4 feet above the nominal 1%-chance flood elevation, while another flex point would be reached at 5 feet. In formulating the larger alternatives, we were mindful of these considerations as well as the expressed views of our non-Federal sponsors, who are mainly interested in regaining levee certification for R471-460 as well as heading off any comparable potential concerns for the L-455 levee. The local sponsors indicated their interest in a plan no larger in scale than needed to regain or maintain certification, and they also indicated that even if a larger plan emerged as the NED plan, they would exercise their right to choose the smaller plan that met their objectives.

A number of theoretical alternatives were proposed but screened out prior to economic analysis; see the main report for more details. Four alternatives ultimately were evaluated in the economic screening analysis. All are different scales of levee raises focused on the decertified R471-460 unit, and the alternatives include any L-455 raises necessary to avoid induced damages on the left bank. All differ only in scale and protect essentially the same land and properties as most of the floodplain in the study area is clearly delineated by marked increases in elevation.

The raises required for each alternative are described below in terms of the raise required at the economic index points. The exact amount of the raise will vary along different sections of the levee.

- Alternative 1 is a levee raise of about 2 and 2/3 feet for the R471-460 unit, bringing it up to a level 3 feet above the nominal 1%-chance flood elevation. (This elevation is essentially identical to the 0.2%-chance flood elevation, negating any need to formulate an additional alternative accounting for that scale.) No raise would be required at the economic index point for the L-455 unit in this alternative, although minor raises of less than one foot would be implemented at certain levee stations in order to offset small anticipated increases in water surface profiles for extreme events due to the R471-460 work

- Alternative 2 is a levee raise bringing R471-460 up to an elevation 1.5 feet above the nominal 0.2%-chance flood, requiring a raise of almost 5 feet. L-455 would be raised approximately 1.5 feet.

- Alternative 3, the largest in scale of the alternatives, raises R471-460 about 6.5 feet, with a 3 foot raise for L-455. The raise would bring the top of levee elevations to about 3 feet above the nominal 0.2%-chance flood.

- Alternative 4, the smallest alternative, raises R471-460 to a level 1.5 feet above the nominal 1%-chance flood elevation. A raise of about 1.1 feet is required. L-455 would not be modified in any way under this alternative.

5.2 ECONOMIC SCREENING PROCESS

5.2.1 Screening Costs

Screening-level costs were obtained for the four alternatives. Interest during construction (IDC) was computed for these costs assuming a design and construction period ending in mid-2012. Costs including IDC were then annualized over a 50-year period of analysis. The current FY 06 Federal interest rage of 5.125% is used in the computations, which are summarized in Table 13.

First costs range from $18.9 million for the smallest alternative (Alternative 4), to $30.8 million for Alternative 1, to $94.1 million and $124.0 million for Alternatives 2 and 3. These are broken down in Table 13 by preconstruction engineering and design (PED) costs, real estate costs, and construction and construction management (S & A) costs. IDC also is shown.

OMRR&R costs are not included in this analysis due to a determination by geotechnical and operations staff that no additional such costs over and above present levels would be incurred for any of the alternatives under consideration; i.e., OMRR&R costs associated with any of the alternatives would continue at the current levels. Even if new OMRR&R costs did exist, they would be on far too small a scale to affect economic justification and would not differ enough among alternatives to affect the rankings from this analysis.

5.2.2 Optimization of Alternatives

Each alternative was entered into the HEC-FDA risk analysis model. The Monte Carlo analysis in HEC-FDA was then employed to determine residual damages – i.e., damages that would continue to occur in the with-project condition even with implementation of that alternative – and damages prevented for each alternative.

NED (National Economic Development) analysis involves computation of benefits and costs and subsequent identification of the most economically efficient plan. Economic efficiency is defined in terms of net annual benefits (annual benefits minus annual costs) added to the national economy by the project. The NED optimization process for the four alternatives emphasizes a "systems" approach that focuses primarily on the combined benefits and costs for the two levee units rather than their individual outputs. The NED plan in the systems approach would be the

TABLE 13 NED SCREENING COSTS FOR ALTERNATIVES								
October 2005 prices; 5.125% interest rate In $1,000s Note: no annual O&M costs are added since none of the alternatives would produce additional O&M costs beyond existing without-project levels.								
ALTERNATIVE	**FIRST COSTS**	**FIRST COSTS BREAKDOWN**				**ANNUAL COSTS BREAKDOWN**		
		PED	**LERRD**	**Constr.**	**S & A**	**IDC**	**Economic Costs**	**Annual Costs (subtotal)**
ALTERNATIVE 4 – R471 RAISE TO 1% EVENT + 1.5 FT.								
L455	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
R471	$18,917.6	$1,395.8	$3,012.1	$13,603.8	$905.9	$1,982.9	$20,900.5	$1,167.0
Total	**$18,917.6**					$1,982.9	$20,900.5	$1,167.0
ALTERNATIVE 1 – R471 RAISE TO 1% EVENT + 3 FT.								
L455	$3,051.9	$244.2	$207.5	$2,441.7	$158.5	$300.1	$3,352.0	$187.2
R471	$27,793.7	$2,151.6	$3,083.8	$21,161.9	$1,396.4	$2,819.4	$30,613.1	$1,709.4
Total	**$30,845.6**					$3,119.5	$33,965.1	$1,896.6
ALTERNATIVE 2 – R471 RAISE TO 0.2% EVENT + 1.5 FT.								
L455	$44,389.9	$3,663.7	$2,093.5	$36,254.9	$2,377.8	$4,307.5	$48,697.4	$2,719.2
R471	$49,742.9	$4,002.3	$3,677.9	$39,465.2	$2,597.5	$4,919.5	$54,662.4	$3,052.2
Total	**$94,132.8**					$9,227.0	$103,359.8	$5,771.4
ALTERNATIVE 3 – R471 RAISE TO 0.2% EVENT + 3 T.								
L455	$58,929.0	$4,886.8	$2,385.4	$48,485.3	$3,171.5	$5,689.7	$64,618.7	$3,608.2
R471	$65,075.0	$5,315.5	$3,712.2	$52,597.5	$3,449.8	$5,798.0	$70,873.0	$3,957.4
Total	**$124,004.0**					$11,487.7	$135,491.7	$7,565.6

alternative with the highest combined net benefits for the two levee units. However, the benefit-cost analysis also is presented for each unit individually within each alternative, and the eventual NED plan would be expected to show economic feasibility (i.e., a benefit-cost ratio of at least 1) for each unit as well as the highest net benefits for the two units combined.

Benefits estimated in the screening process do not account for any damages induced by the alternatives. Hydraulic impacts of the alternatives were quantified, but economic impacts were not since it was clear that the stage increases involved would have had no significant effect on the NED plan selection or economic justification. Increased stages across the river at L-455 that would be induced by the R471-460 raises are accommodated by corresponding improvements to the L-455 levee in each alternative (except Alternative 4). Stage increases downstream of the project area would primarily affect agricultural land uses and would occur only in the largest flood events. These factors combined would necessarily result in annualized induced damages that would be more than zero but could only be extremely minimal if quantified. Moreover, the alternatives that would cause the most significant downstream impacts would be the two largest alternatives. These alternatives are the third and fourth ranking alternatives in the NED analysis, and if induced damages were quantified and subtracted from their benefits, it would serve only to make these alternatives even less economically efficient and thereby reinforce the existing ranking of alternatives.

Screening benefits are based on physical inundation reduction and do not include other benefits such as reduced emergency costs, emergency assistance, or flood insurance administration savings. These categories were not estimated for the screening analysis because we judged that they would not impact the net benefit rankings, but they will be added to the NED plan for the final project benefit-cost ratio. Thus, the benefits for the NED plan in this section will not match those for the NED plan in section 6.

5.3 SCREENING RESULTS

Residual damages for each alternative are detailed by category and study reach in Table 14. The residual damages that would continue to occur in the with-project condition are expressed as equivalent annual damages that account for both the base year condition and the discounted present-worth of the future year condition. The difference between the without-condition EAD and the residual EAD for each alternative represents the benefits for the alternative.

The resulting benefits and benefit-cost results for the screening are summarized in Table 15, while Table 16 summarizes engineering performance data for without and with-project conditions. Four main results emerged from the risk-based screening analysis:

- The NED plan - the plan with the greatest net benefits - is Alternative 1, which consists of a raise of the R471-460 unit to 3 feet above the 1%-chance flood elevation. This plan has estimated net benefits of $4.11 million and a benefit-cost ratio of 3.2.

- The NED plan has a margin of superiority of 15% in net benefits over the second-ranking alternative, Alternative 4. Alternative 4, the smallest alternative, has net benefits of $3.58 million. The NED plan has an 89% margin of superiority over Alternative 2 and a 391% margin over Alternative 3. These are the two largest alternatives. Therefore, Alternative 1, as the NED plan, is bracketed by both smaller and larger-scaled alternatives over which the NED plan has clear superiority in economic efficiency. See Figure 2 for a graphical summary of the net benefits by alternative.

- All alternatives are economically justified. Benefit-cost ratios are strong for Alternatives 1 (3.2) and 4 (4.1), while the justification for Alternatives 2 and 3 would be more marginal with benefit-cost ratios of 1.4 and 1.1 respectively.

- Benefit-cost ratios for R471-460 by itself would be at least fairly strong in all four alternatives. In contrast, Alternative 1 is the only alternative that produces positive net benefits for the L-455 unit by itself.

TABLE 14 EQUIVALENT ANNUAL DAMAGES BY ALTERNATIVE					
Damages shown for alternatives are residual damages that continue to occur with the alternative in place. Damage in $1,000's; Oct. 2005 prices					
	WITHOUT CONDITION	**ALT 4 RESIDUAL**	**ALT 1 RESIDUAL**	**ALT 2 RESIDUAL**	**ALT 3 RESIDUAL**
L-455 Downstream					
Residential	$105.5	$105.5	$71.0	$17.8	$1.7
Non-Residential	$1,120.6	$1,120.6	$749.8	$183.0	$16.8
Roads	$42.7	$42.7	$29.4	$8.1	$0.8
Crops	$2.4	$2.4	$1.6	$0.4	$0.0
Total	$1,271.1	$1,271.1	$851.7	$209.3	$19.4
L-455 Upstream					
Residential	$3.8	$3.8	$3.8	$1.6	$0.3
Non-Residential	$790.9	$790.9	$790.9	$181.8	$19.1
Roads	$8.8	$8.8	$8.8	$2.3	$0.3
Crops	$0.0	$0.0	$0.0	$0.0	$0.0
Total	$803.4	$803.4	$803.4	$185.6	$19.7
L-455 TOTAL	**$2,074.5**	**$1,655.1**	**$1,655.1**	**$394.9**	**$39.0**
R471-460 Downstream					
Downstream					
Residential	$831.9	$202.3	$99.4	$14.2	$1.4
Non-Residential	$3,082.7	$764.7	$385.9	$56.5	$5.7
Roads	$264.5	$67.6	$34.6	$5.6	$0.6
Crops	$5.6	$1.1	$0.5	$0.1	$0.0
Total	$4,184.6	$1,035.6	$520.3	$76.3	$7.8
R471-460 Upstream					
Residential	$27.8	$8.3	$4.2	$0.6	$0.1
Non-Residential	$2,135.6	$577.3	$260.0	$31.2	$3.3
Roads	$5.9	$2.0	$1.0	$0.2	$0.0
Crops	$24.3	$6.2	$2.8	$0.3	$0.0
Total	$2,193.6	$593.8	$268.1	$32.3	$3.4
R471-460 TOTAL	**$6,378.3**	**$1,629.3**	**$788.5**	**$108.6**	**$11.1**
STUDY AREA TOTAL	**$8,452.8**	**$3,284.4**	**$2,443.6**	**$503.4**	**$50.2**

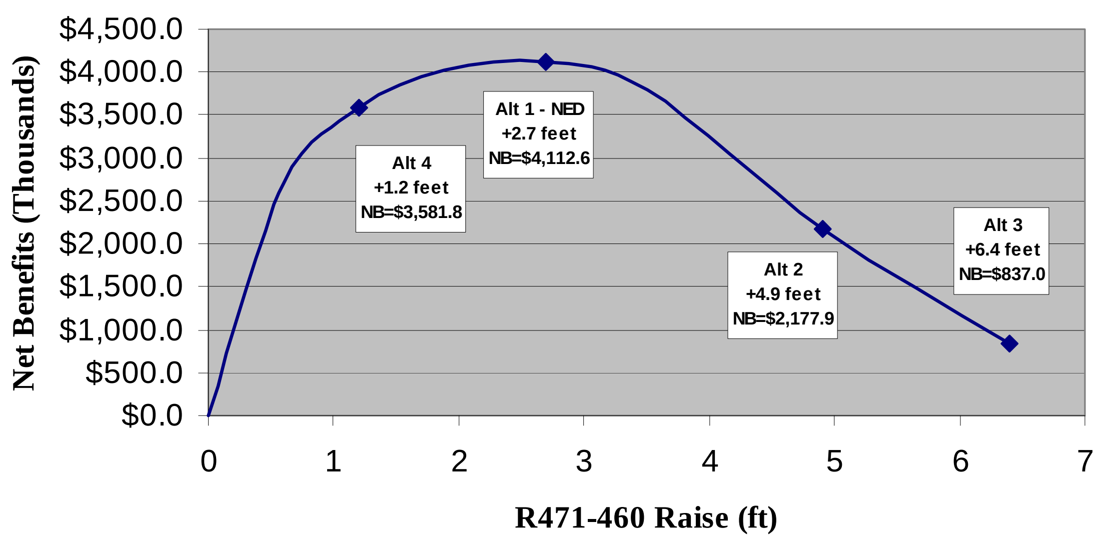
TABLE 15 NED SCREENING BENEFIT-COST DATA FOR ALTERNATIVES								
October 2005 prices; 5.125% interest rate In thousands of dollars								
Alternative	**First cost**	**Total annual costs**	**Total annual damages**	**Residual annual damage**	**Total benefits**	**BCR**	**Net benefits**	**Superiority of NED plan**
ALTERNATIVE 4 – R471 RAISE TO 1% EVENT + 1.5 FT.								
L455								
Reach 1			$1,271.1	$1,271.1				
Reach 2			$803.4	$803.4				
Total L455	$0.0	$0.0	$2,074.5	$2,074.5	$0.0	0.0	$0.0	
R471								
Reach 1			$4,184.6	$1,035.6				
Reach 2			$2,193.6	$593.8				
Total R471	$18,917.6	$1,167.0	$6,378.3	$1,629.4	$4,748.9	4.1	$3,581.9	
Total	**$18,917.6**	**$1,167.0**	**$8,452.8**	**$3,703.9**	**$4,748.8**	**4.1**	**$3,581.8**	14.8%
ALTERNATIVE 1 – R471 RAISE TO 1% EVENT + 3 FT.								
L455								
Reach 1			$1,271.1	$851.7				
Reach 2			$803.4	$803.4				
Total L455	$3,051.9	$187.2	$2,074.5	$1,655.1	$419.4	2.2	$232.2	
R471								
Reach 1			$4,184.6	$520.3				
Reach 2			$2,193.6	$268.1				
Total R471	$27,793.7	$1,709.4	$6,378.3	$788.4	$5,589.8	3.3	$3,880.4	
Total	**$30,845.6**	**$1,896.6**	**$8,452.8**	**$2,443.5**	**$6,009.2**	**3.2**	**$4,112.6**	*NED*
ALTERNATIVE 2 – R471 RAISE TO 0.2% EVENT + 1.5 FT.								
L455								
Reach 1			$1,271.1	$209.3				
Reach 2			$803.4	$185.6				
Total L455	$44,389.9	$2,719.2	$2,074.5	$394.8	$1,679.6	0.6	$1,039.6	
R471								
Reach 1			$4,184.6	$76.3				
Reach 2			$2,193.6	$32.2				
Total R471	$49,742.9	$3,052.2	$6,378.3	$108.6	$6,269.7	2.1	$3,217.5	
Total	**$94,132.8**	**$5,771.4**	**$8,452.8**	**$503.4**	**$7,949.3**	**1.4**	**$2,177.9**	88.8%
ALTERNATIVE 3 – R471 RAISE TO 0.2% EVENT + 3 FT.								
L455								
Reach 1			$1,271.1	$19.4				
Reach 2			$803.4	$19.7				
Total L455	$58,929.0	$3,608.2	$2,074.5	$39.0	$2,035.5	0.6	$1,572.7	
R471								
Reach 1			$4,184.6	$7.8				
Reach 2			$2,193.6	$3.4				
Total R471	$65,075.0	$3,957.4	$6,378.3	$11.1	$6,367.1	1.6	$2,409.7	391.3%
Total	**$124,004.0**	**$7,565.6**	**$8,452.8**	**$50.1**	**$8,402.6**	**1.1**	**$837.0**	

TABLE 16 LEVEE ENGINEERING PERFORMANCE - WITHOUT PROJECT AND ALTERNATIVES						
	R471-460			L-455		
	OVERALL	downstream	upstream	OVERALL	downstream	upstream
Top of levee elevations						
ref. river mile		449.4	450.0		441.4	446.3
Existing (without-project) TOL		822.1	822.8		816.0	821.2
Alternative 4 TOL (1% + 1.5 ft.)		823.3	824.0		816.0	821.2
Raise required (feet)		1.2	1.1		0.0	0.0
Alternative 1 TOL (1%t + 3 ft.)		824.8	825.5		816.0	821.2
Raise required (feet)		2.7	2.6		0.0	0.0
Alternative 2 TOL (0.2% + 1.5 ft.)		827.0	827.7		817.3	822.8
Raise required (feet)		4.9	4.9		1.3	1.5
Alternative 3 TOL (0.2% + 3 ft.)		828.5	829.2		818.8	824.3
Raise required (feet)		6.4	6.4		2.8	3.0
1%-chance flood context						
Levee height superiority (feet)						
2013 ref. flood elevation		821.2	821.9		812.9	817.5
2013 without-project	0.9	0.9	0.9	3.1	3.1	3.7
2013 Alternative 4	1.1	1.2	1.1	0.0	0.0	0.0
2013 Alternative 1	3.6	3.6	3.6	3.1	3.1	3.7
2013 Alternative 2	5.8	5.8	5.8	4.4	4.4	5.3
2013 Alternative 3	7.3	7.3	7.3	5.9	5.9	6.8
2038 ref. flood elevation		821.8	822.5		812.9	818.0
2038 without-project	0.3	0.3	0.4	3.1	3.1	3.2
2038 Alternative 4	1.5	1.5	1.5	3.1	3.1	3.2
2038 Alternative 1	3.0	3.0	3.0	3.1	3.1	3.2
2038 Alternative 2	5.2	5.2	5.3	4.4	4.4	4.8
2038 Alternative 3	6.7	6.7	6.8	5.9	5.9	6.3
Nonexceedance probability						
2013 without-project	51.3%	51.4%	51.3%	93.6%	93.6%	97.3%
2013 overtopping only	67.8%	67.9%	67.8%	95.0%	95.0%	97.3%
2013 Alternative 4	84.3%	85.1%	84.3%	93.6%	93.6%	97.3%
2013 Alternative 1	95.8%	96.2%	95.8%	95.0%	95.0%	97.3%
2013 Alternative 2	99.8%	99.9%	99.8%	99.2%	99.2%	99.7%
2013 Alternative 3	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2038 without-project	41.8%	41.8%	42.9%	92.8%	92.8%	94.0%
2038 overtopping only	56.6%	56.6%	57.6%	94.0%	94.1%	94.0%
2038 Alternative 4	75.7%	75.9%	75.7%	92.8%	92.8%	94.0%
2038 Alternative 1	91.6%	91.7%	91.6%	94.0%	94.1%	94.0%
2038 Alternative 2	99.3%	99.3%	99.3%	98.9%	98.9%	99.0%
2038 Alternative 3	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%

(Table continued on next page)

TABLE 16 (continued) LEVEE ENGINEERING PERFORMANCE - WITHOUT PROJECT AND ALTERNATIVES						
	R471-460			L-455		
0.2%-chance flood context	OVERALL	downstream	upstream	OVERALL	downstream	upstream
Levee height superiority (feet)						
2013 ref. flood elevation		824.7	825.5		815.8	820.7
2013 without-project	-2.7	-2.7	-2.7	0.2	0.2	0.6
2013 Alternative 4	-1.6	-1.5	-1.6	0.2	0.2	0.6
2013 Alternative 1	-0.1	0.0	-0.1	0.2	0.2	0.6
2013 Alternative 2	2.2	2.2	2.2	1.5	1.5	2.1
2013 Alternative 3	3.7	3.7	3.7	3.0	3.0	3.6
2038 ref. flood elevation		825.5	826.2		815.8	821.3
2038 without-project	-3.4	-3.4	-3.4	0.0	0.2	0.0
2038 Alternative 4	-2.6	-2.5	-2.6	-3.6	-3.0	-3.6
2038 Alternative 1	-0.8	-0.7	-0.8	0.0	0.2	0.0
2038 Alternative 2	1.5	1.5	1.5	1.5	1.5	1.5
2038 Alternative 3	3.0	3.0	3.0	3.0	3.0	3.0

FIGURE 2
NET BENEFITS FOR ALTERNATIVES



6.0 NED PLAN

6.1 PLAN DESCRIPTION

The NED plan emerging from the economic screening is Alternative 1. The plan raises the R471-460 levee to an elevation 3 feet above the nominal 1% chance flood elevation. A raise of about 2.6 feet would be required at the economic index point, and the raise required at other points along the levee would be up to 3.4 feet. Seven structures would be modified or replaced. Modifications also would be made to the L-455 levee at certain stations in order to offset small increases in water surface profiles for the most extreme events resulting from the R471-460 construction. The first cost of the NED plan is $32,685,700 in October 2005 prices.

6.2 DAMAGE REDUCTION

By far the largest portion of NED annual benefits is based on prevention of flood damages to homes, businesses and facilities, roads, and crops. The HEC-FDA model credits the NED plan with $6,009,300 in annual benefits based on damage reduction. This total includes $5,589,900 in damages reduced by the R471-460 unit, or 93% of the damage reduction by the total project, and an additional $419,400 in damages reduced by the L-455 unit.

A more probabilistic assessment of damage reduction by the NED plan is shown in Table 17. The most likely value of damages reduced as produced by the risk analysis is $6,009,300. There is a 75% probability that the true benefits exceed $2,470,000, a 50% probability that they exceed $4,550,000, and a 25% probability that they exceed $7,576,000.

TABLE 17
DAMAGE REDUCED BY NED PLAN

Damage in $1,000's

Unit / Damage Reach	Total Without Project	Total With Project	Damage Reduced	Probability Damage Reduced Exceeds Indicated Values		
				0.75	0.50	0.25
L-455						
Left Bank - Downstream	$1,271.1	$851.7	$419.4	$57.6	$70.4	$251.1
Left Bank - Upstream	$803.4	$803.4	$0.0	$0.0	$0.0	$0.0
L-455 Total	$2,074.5	$1,655.1	**$419.4**	$57.6	$70.4	$251.1
R471-460						
Right Bank - Downstream	$4,184.6	$520.3	$3,664.3	$1,572.5	$2,932.3	$4,811.5
Right Bank - Upstream	$2,193.6	$268.1	$1,925.5	$840.0	$1,547.4	$2,513.6
R471-460 Total	$6,378.3	$788.4	**$5,589.8**	$2,412.4	$4,479.7	$7,325.1
Total	$8,452.8	$2,443.5	**$6,009.2**	$2,470.1	$4,550.1	$7,576.2

6.3 OTHER BENEFIT CATEGORIES

Although reduction of physical inundation damages is the main source of benefits for the alternatives analyzed, a number of much smaller benefit categories also exist. These categories of benefits were not large enough to influence plan selection, so they were computed only for the NED plan. The computations were done outside the risk program and are not risk-based as are the damage reduction benefits.

The additional benefit categories considered significant enough to quantify in the context of this study include emergency costs reduced, relocation and reoccupation costs reduced, and flood insurance administrative cost savings. Advance replacement benefits for structures that would be replaced for the project were considered but were not included because there are very few such structures in this analysis.

6.3.1 Emergency Cost Savings

Emergency cost savings can encompass savings related to a wide range of flooding impacts, including emergency personnel costs, floodfighting costs (sandbagging, for example), avoidance costs (raising or evacuation of property), temporary food and housing, debris cleanup, and damage to infrastructure items not otherwise included in the damage analysis such as sewer lines. The cities of St. Joseph, Elwood, and Wathena were contacted to obtain available historical data on emergency costs incurred during the 1993 flood. This is the only flood event that has occurred recently enough to provide useful information since the last previous flood was in 1952. Although the cities provided some anecdotal information on their 1993 costs, we were unable to obtain enough reliable data to estimate this category of impacts based on direct or first-hand data. Yet emergency floodfighting costs are a recognized and significant category of economic impacts from flooding, and accuracy is not served by their absence from the economic analysis.

As an alternative, we consulted several reports published by the Corps pertaining to the 1993 flood in order to estimate typical emergency costs for a large flood (the 1993 event was approximately a 0.2%-chance event) in an urban setting. These reports included the 1993 Interagency Floodplain Management Review Committee Report (Galloway Report); Impacts of the Great Flood of 1993 (CELMV, May 1996); and the Flood Plain Management Assessment of the Upper Mississippi River and Lower Missouri Rivers and Tributaries (USACE, June 1995). We compared 1993 flood damage estimates for damage centers detailed in these reports with 1993 agency emergency costs as reported in these documents. Based on these data, emergency costs as a percentage of total physical flood damages ranged from a low of 12.4% to a high of 15%, with an average of 13.4% for all states impacted by the 1993 flood. In addition, we also consulted an informal analysis by a former HQUSACE reviewer who surveyed planning reports submitted to HQUSACE by Corps districts across the nation in recent years. This analysis found that emergency costs claimed in approved Corps reports averaged about 9% of total EAD reduced.

Based on the information contained in these sources, we assume that emergency costs are equivalent to 9% of flood damage reduction benefits for the NED plan. This is a somewhat more conservative assumption than the 13.4% gleaned from the 1993 post-flood reports. Based on EAD reduced in the two protected areas, annual emergency cost savings due to the NED plan are estimated to total $503,100 for R471-460 and $37,700 for L-455.

6.3.2 Relocation and Reoccupation Cost Savings

The Kansas City District obtained data from the Region VII FEMA office regarding typical costs for disaster housing assistance and grant assistance to individuals and families following recent Missouri floods, including the great 1993 Missouri River flood. The data indicated that these types of emergency assistance average about $7,500 per home. We used the estimated number of homes affected in the 1%, 0.5%, and 0.2-chance events (see Table 6) to calculate costs associated with each of these events and then annualize the results. Relocation and reoccupation cost savings total $61,300 for R471-460 and $16,700 for L-455.

6.3.3 Flood Insurance Administrative Cost Savings

When a levee provides sufficient protection against a 1%-chance flood event to be certified by FEMA, that action removes vulnerable structures from the putative “100-year” floodplain and allows occupants holding flood insurance policies to give them up. The estimated savings per policy in administrative costs when a policy is not renewed is $192 per policy in current Corps guidance. Approximately 40 occupants of the floodplain in the R471-460 area hold current flood insurance policies and would have the option of discontinuing them, which would result in an annual benefit of $7,700 for the NED plan. This benefit is applied to the R471-460 portion of the NED plan.

6.4 BENEFITS AND COSTS

As summarized in Table 18, the NED plan shows strong economic justification with a benefit-cost ratio of 3.3 and net benefits of $4,626,900. The annualized cost of the plan is $2,008,900, based on the first cost of $32,685,700. Annual benefits total $6,635,800, of which about 90.6% are based on physical flood damage reduction. (Note that these totals will not match the benefit and cost totals for the NED plan as computed in the screening process and displayed in Table 15. The screening estimate of benefits did not include benefits discussed above in section 6.3, and the estimated first costs of the project were revised for the final benefit-cost estimates.)

Table 18 also shows that, if the project is evaluated as two elements (i.e., R471-460 vs. L-455), both portions are economically justified. For R471-460, the first cost of the selected plan is $29,633,400 and the annual cost is $1,821,700. Benefits total $6,162,000. The resulting benefit-cost ratio is 3.4 and net benefits total $4,343,300. For the L-455 project, first costs of $3,052,300 result in annual costs of $187,200, which, when set against the annual benefits of $473,800, result in a benefit-cost ratio of 2.5 and net benefits of $286,600. It can be seen from these breakouts that there is strong economic justification for each portion of the project as well as for the total project.

TABLE 18 BENEFIT-COST RATIO FOR NED PLAN			
In $1,000s; Oct. 2005 prices Equivalent annual damages			
	PROJECT	**R471-460**	**L-455**
BENEFITS			
EAD without-project	$8,452.8	$6,378.3	$2,074.5
EAD with project (residual)	$2,443.5	$788.4	$1,655.1
EAD reduced	$6,009.3	$5,589.9	$419.4
Emergency cost savings	$540.8	$503.1	$37.7
Relocation and reoccupation cost savings	$78.0	$61.3	$16.7
Flood insurance administrative cost savings	$7.7	$7.7	$0.0
TOTAL ANNUAL BENEFITS	**$6,635.8**	**$6,162.0**	**$473.8**
% by unit		92.9%	7.1%
COSTS			
First cost	$32,685.7	$29,633.4	$3,052.3
IDC	$3,291.9	$2,991.8	$300.1
Economic cost	$35,977.6	$32,625.2	$3,352.4
Interest & amortization factor	0.05584	0.05584	0.05584
Annual cost	$2,008.9	$1,821.7	$187.2
Annual O & M costs	$0.0	$0.0	$0.0
TOTAL ANNUAL COSTS	**$2,008.9**	**$1,821.7**	**$187.2**
% by unit		90.1%	9.9%
BENEFIT-COST RATIO	**3.3**	**3.4**	**2.5**
NET BENEFITS	**$4,626.9**	**$4,340.3**	**$286.6**
% by unit		94.0%	6.0%

6.5 ENGINEERING PERFORMANCE

The NED plan would restore a margin of at least 3 feet above the nominal 1% chance flood elevation for both levee units. Under future conditions of 2038, the nonexceedance probability for R471-460 would rise to 91.6% compared to its nonexceedance probability of 51.3% under existing condition without project. The R471-460 unit would have a 1 in 30.1 chance of overtopping or failing over a 10-year period, and a 1 in 6.4 chance over a 50-year period. The L-455 unit would have a 1 in 39.8 chance of overtopping or failing over a 10-year period and a 1 in 8.4 chance over 50 years. See Table 19 for statistics describing various aspects of the engineering performance of the NED plan.

6.6 INDUCED DAMAGES

Hydraulic investigations for this study concluded that the project is not expected to have any significant impact in terms of raising water surface profiles. The water surface profile for the

1%-chance event is not affected by the project. The profiles for events larger than the 1%-chance event would be somewhat increased downstream of the project area as well as across the river at the L-455 area. The purpose of the L-455 portion of the project is to offset the increases at that location. However, as discussed above, the L-455 portion of the project is economically justified on its own independent terms - i.e., it is justified by the damages it would prevent within the L-455 area under without-project conditions, even without additional consideration of its efficacy in alleviating incremental damage potential contributed by the project. Downstream economic damages were not quantified for this analysis but would necessarily be minimal since the increased stages occur only in the most infrequent events and affect downstream areas with primarily agricultural impacts. Although minimal, the induced damages, if quantified, would be greater than zero and would serve to slightly reduce the estimated annual benefits for the project. Economic justification would not be affected.

6.7 REGIONAL ECONOMIC DEVELOPMENT (RED) IMPACTS

The benefit evaluation process involves analysis of the economic losses to the subject study area from flooding as well as the potential gains to the study area from the successful prevention of flooding. Some impacts with and without a flood control project may be of major significance to a metropolitan area or community, but may not have any net impact on the national economy. For example, if a flood interrupts production at a given business in one community, that community suffers a loss. However, if the lost production is replaced by production at another plant elsewhere in the country, the loss to the local community does not represent a net loss to the national economy. These regional (RED) impacts are not included in determining the NED benefits and costs, but do receive consideration in the decision-making process.

Construction of the selected plan would contribute to the long-term stability of both the R471-460 and L-455 areas. Plans considered do not require acquisition or relocation of residents or businesses. There would be no impacts to the local tax bases due to demolition or removal of structures. With increased levee unit reliability and performance, existing businesses would be expected to continue their existing occupancy and new businesses and investment would be more easily attracted to the study area in the future if vacancies occur, resulting in a stronger tax base. With continued industrial and commercial stability enhanced by the increased reliability against flooding, existing neighborhoods and populations would also be expected to remain relatively stable, barring impacts from other sources. Temporary increases in employment would be expected during construction. The temporary presence of construction workers for the project could bring a temporary increase in demand for some services in the local area, but also a temporary increase in business volume, profits and sales tax receipts at the local retail and service establishments.

During the later stages of this study, a massive new pork processing facility was constructed and opened in the St. Joseph stockyards area. There has not been an opportunity to assess the likely consequences of prolonged business interruption regarding this very new business, but it will be one of the largest such plants in the U.S. and at least some business losses during flood events could be NED losses. These losses could be significant in relation to the overall benefits of the project.

6.8 RESIDUAL RISK

Although floodplain users and occupants may desire total protection from flooding, this is an unachievable goal. No flood damage reduction project can guarantee total elimination of flooding. The selected plan has substantial economic benefits and reduces equivalent annual damages in the study area by about 71% over without project conditions. But this means that there remains a significant residual equivalent annual damage in excess of $2.4 million. There still would be a 10% to 16% chance of exceedance over a 50-year period under 2038 conditions (see Table 19).

With any flood damage reduction project, it is important for floodplain users and occupants to be aware of the level of flood risk that remains even after implementation of a recommended project (see Table 19). The probability and occurrence of flooding will be much less frequent with the implementation of the recommended plan in the study area However, during major flood events, residents and other floodplain occupants may still be ordered to evacuate and move to higher ground. And in rare large events, the Federal levees could be overwhelmed, resulting in flood depths inside the levied areas could reach 20 feet. Because the areas within the levee units are relatively flat, most of the study area could be affected. It has been said that a flood damage reduction project designed relative to a 1%-chance flood event (the event that is critical to certification criteria) is an especially dangerous project, in that an event of historical magnitude is not necessarily required to overwhelm the project and cause catastrophic damage, yet many floodplain tenants will feel that they have near-total protection against flooding and give up their flood insurance policies. They might find it advantageous to keep their policies, which usually are fairly inexpensive in areas with certified levees. Meanwhile, local leadership and emergency operations staff will need to design plans for these flood events which may be infrequent, but would hold the potential for catastrophe if they occurred. Effective emergency planning in advance is the best way to protect communities and minimize the damage from these rare flood events.

TABLE 19 ENGINEERING PERFORMANCE RATINGS FOR NED PLAN						
For future conditions (2038)						
	R471-460			L-455		
	OVERALL	downstream	upstream	OVERALL	downstream	upstream
Top of levee elevations						
Reference river mile		449.4	450.0		441.4	446.3
New TOL		824.8	825.5		816.0	821.2
Annual Exceedance Probability						
Median (as %)	0.30%	0.30%	0.30%	0.10%	0.10%	0.20%
Expected (as %)	0.30%	0.30%	0.30%	0.20%	0.20%	0.30%
Long-Term Risk (years)						
10 years						
Exceedance probability	3.32%	3.14%	3.32%	2.51%	2.26%	2.51%
Exceedance chance over period	1 in 30.1	1 in 31.9	1 in 30.1	1 in 39.8	1 in 44.3	1 in 39.8
25 years						
Exceedance probability	8.09%	7.67%	8.09%	6.15%	5.55%	6.15%
Exceedance chance over period	1 in 12.4	1 in 13.0	1 in 12.4	1 in 16.2	1 in 18.0	1 in 16.2
50 years						
Exceedance probability	15.53%	14.75%	15.53%	11.92%	10.80%	11.92%
Exceedance chance over period	1 in 6.4	1 in 6.8	1 in 6.4	1 in 8.4	1 in 9.3	1 in 8.4
1% Event Context						
Levee height margin						
Reference flood elevation		821.8	822.5		812.9	818.0
Margin (ft.)	3.0	3.0	3.0	3.1	3.1	3.2
Nonexceedance probability (as %)	91.6%	91.7%	91.6%	94.0%	94.1%	94.0%
0.2% Event Context						
Levee height margin						
Reference flood elevation		825.5	826.2		815.8	821.3
Margin (ft.)	-0.7	-0.7	-0.7	-0.1	0.2	-0.1

FEASIBILITY REPORT

MISSOURI RIVER LEVEE SYTEM UNITS R471-460 AND L-455
SAINT JOSEPH, MISSOURI / ELWOOD, KANSAS

APPENDIX D

REAL ESTATE PLAN

September 2006

DEPARTMENT OF THE ARMY
Kansas City District, U.S. Army Corps of Engineers
Kansas City, Missouri

REAL ESTATE PLAN
For
MISSOURI RIVER LEVEE SYSTEM (MRLS)
L-455 AND R471-460
FLOOD DAMAGE REDUCTION PROJECT

BUCHANAN COUNTY, MISSOURI &
DONIPHAN COUNTY, KANSAS

This Real Estate Plan (REP) information is developed in support of the Feasibility Study for the subject project. The authority for this feasibility study is the continuing authority of Section 216 of the 1970 Flood Control Act. The Reconnaissance Report published in May 1996 identifies a potential Federal interest in flood damage reduction measures. The non-Federal sponsors (NFS) for the Feasibility Study are the South St. Joseph Levee District, the Elwood-Gladden Drainage District, and the Airport Levee District. The purpose of this plan is to include information on any real estate activities that may be involved for the identified project. The project is located on the Missouri River in Buchanan County, Missouri and Doniphan County, Kansas. The project is currently estimated to involve approximately 92 acres, six (6) landowners and eleven (11) parcels on the left bank (South St. Joseph Levee District, L-455), approximately 1285 acres, twenty-one (17) landowners and thirty five (35) parcels on the Kansas right bank portion (Elwood-Gladden Drainage District) and approximately 45 acres, five (5) landowners and eight (8) parcels on the Missouri right bank portion (St. Joseph Airport Levee District). See Page 3, Tables 2.1- 2.3.

1. **PROJECT PURPOSE:** To raise the level of protection to provide greater protection against rare flood events as identified in the Reconnaissance Study and in support of the Feasibility Study. No other REP has been developed for this project. The alternatives provide protection against flood events of the 1-percent and 0.2-percent chance of occurrence. To the extent that accepted techniques permit, the analysis of protection will account for the rising stage trend of the Missouri River to assure that an alternative will be designed to accomplish the stated protection under future conditions up to 25 years after the project is constructed.

2. **DESCRIPTION OF LANDS, EASEMENT, RIGHTS-OF-WAY, RELOCATION, DISPOSAL (LERRD):** Project purposes require acquisition at a minimum of permanent and temporary easements that will include borrow area sites and temporary access easements.

Estates to be acquired by the NFS(s) are explained below and further detailed in Table 2.1 -2.3:

a. <u>Fee Simple</u>: No Fee Simple acquisition is required for levee right-of-way (r-o-w) on this project. Plus, a disposal site is not required as the project plan is for all aggregates to be used as fill, all trees and branches to be burned on site and all top soils to be used on the new surfaces.

b. <u>Flood Protection Levee Easements:</u>

A perpetual and assignable right and easement in (the lands to be described) to construct, maintain, repair, operate, patrol and replace a flood protection levee, including all appurtenances thereto; reserving, however, to the owners, their heirs and assigns, all such rights and privileges in the land as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

c. Temporary Work Area Construction Easement:

A temporary easement and right-of-way in, on, over and across (the land to be described) for a period not to exceed three (3) years, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a construction area, borrow area and work area, including the right to borrow, move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Missouri River Levee System, L-455 and R471-460, Flood Damage Reduction Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

NOTE: Temporary Work Area Easements are proposed for the under seepage berms to be constructed along the levee system. This proposed temporary easement does not prove to be a risk to the project stability as the under seepage berms fall outside of the critical zone of the main levee protection. All stability berms which fall within the critical zone will require permanent flood control easements. At a range of 1' on 50'-100' slope, there will be a gradual change in the grade of the fields that is beneficial to the drainage and allows owners to return to farming the areas at no risk to the project. Our levee inspection program is very active and monitors activity on and near the levees on a regular basis.

b. Temporary Work Area Access Easement:

A temporary easement and right-of-way in, on, over and across (the land to be described) for a period not to exceed three (3) years, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a temporary ingress and egress route, thereon, move, store, and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Missouri River Levee System, L-455 and R471-460, Flood Damage Reduction Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Below is a summary of estate to be acquired, estimated acres and estimated land values for each of the Non-Federal sponsors.

Table 2.1: South St. Joseph Levee District (Missouri Left Bank)		
ESTATE/Project Feature	**ESTIMATED ACRES**	**ESTIMATED LAND VALUE**
Permanent Levee Easements $1900.00 per acre	6.0	$11,000.00
Temporary Work Area Sites (3- year period) 10% FMV inflated for 3 years	44.0	$25,000.00
Temporary Work Area Sites Borrow (3- year period) *100% FMV $1900 per acre	42.0	$80,000.00
Estimated TOTAL	11 parcels 92.0	$116,000.00

Table 2.2: Elwood-Gladden Drainage District, Kansas (Kansas Right Bank Portion)		
ESTATE/Project Feature	**ESTIMATED ACRES**	**ESTIMATED LAND VALUE**
Permanent Levee Easements $2000.00 per acre	41.0	$ 82,000.00
Temporary Work Area Sites (3- year period) 10% FMV inflated for 3 years	244.0	$ 160,000.00
Temporary Work Area Sites Borrow (3- year period) *100% FMV $2000 per acre	1000.0	$2,000,000.00
Estimated TOTAL	35 parcels 1285.0	$2,242,000.00

Table 2.3: St. Joseph Airport Levee District, Missouri (Missouri Right Bank Portion)		
ESTATE/Project Feature	**ESTIMATED ACRES**	**ESTIMATED LAND VALUE**
Permanent Levee Easements $2000.00 per acre	16.0	$ 33,000.00
Temporary Work Area Sites (3- year period) 10% FMV inflated for 3 years	29.0	$ 4,000.00
Temporary Work Area Sites Borrow (3- year period) *100% FMV $2000 per acre	0.0	0.00
Estimated TOTAL	5 parcels 45.0	$ 37,000.00

***Note**: Borrow is 100% FMV due to the extent of top soil removal, up to 6 feet in some locations which will leave the land unusable for its current agricultural purposes. Only a few areas are suitable for borrow and preliminary meetings with the landowners have indicated that there is opposition to this borrow area. At the start of the project if there is still opposition, the land may need to be condemned or bought in fee. A safe assumption for planning purposes is to expect paying nearly 100% of FMV for this property. Final locations and quantities that will be taken from each site have not been finalized. During the Pre-Construction Engineering and Design (PED) phase, alternative locations and the use of dredged material will be considered to lower borrow area costs. Given these circumstances it would be irrelevant to estimate a residual value of the lands after the borrow has been removed without the assistance of a timely appraisal.

3. **NON-FEDERAL OWNED LANDS:** There are three State Chartered Levee/Drainage Districts whom own lands or hold easements along the MRLS L-455 & R471-460 Levee System. In addition to the three levee Districts (also NFS), there are two state agencies that own or manage land along the levee, Kansas Department of Wildlife and Parks (KDWP) and Missouri Department of Conservation (MDC). The Missouri Air National Guard and the City of St. Joseph, Missouri own approximately 1950 acres near the area (Rosecrans Memorial Airport) but this area will not be affected by the levee project. For Kansas Department of Wildlife and Parks, approximately 1.2 acres of permanent easement will be required to extend the berm. For MDC, approximately 10 acres of permanent easement and 14 acres of temporary easement will be required for berm extension and under seepage berm placement.

South St. Joseph Levee District: Holds a permanent flood control easement over the South St. Joseph Levee Unit project area, Stations 00+00 to 717+44, and the lands are sufficient and available for the project. L-455 is a federal levee and it is assumed that the sponsor has previously provided these lands as an item of local cooperation. Further research of the original project O&M Manuals during PED will help to identify any existing lands the sponsor may have provided outside the existing easement indicated on the RE Mapping.

Elwood-Gladden Drainage District: Holds a permanent flood control easement over the Elwood/Gladden Levee Unit project area, Levee Stations 12+25 to 240+00 and Stations 321+00 to 728+00 and the lands are sufficient and available for the project. R471-460 is a federal levee so the sponsor has previously provided these lands as an item of local cooperation. Further research of the original project O&M Manuals during PED will help to identify any existing lands the sponsor may have provided outside the existing easement indicated on the RE Mapping.

St. Joseph Airport Levee District: Holds a permanent flood control easement over the Airport Levee Unit project area, Levee Stations approximately 240+00 to 320+00, and the lands are sufficient and available for the project. R471-460 is a federal levee so the sponsor has previously provided these lands as an item of local cooperation. Further research of the original project O&M Manuals during PED will help to identify any existing lands the sponsor may have provided outside the existing easement indicated on the RE Mapping.

4. **NON-STANDARD ESTATES**: There will be no non-standard estates required for this project.

5. **EXISTING FEDERAL PROJECT IN AREA**: The current Missouri River Levee System (MRLS) Units R471-460 and L-455 (Figure 1) are existing Federal projects and are located on opposite sides of the Missouri River and provide local flood protection for the metropolitan area of St. Joseph, Missouri, and surrounding communities. The MRLS was authorized by the Flood Control Act of 1944 (P.L. 534, 72nd Congress). These Units were designed by the Corps of Engineers, Kansas City District, and constructed between 1962 and 1968. The LERRD that

supports the current project was previously provided as an item of local cooperation during the original levee construction project. The levee is now being raised to a new level of protection and the sponsors will only receive credit of the newly provided lands.

Since the levee has been in place for many years, there is established access for required O&M needs. The raise of the system will not affect the established access nor will it add a need for more access. The current routes will be used for hauling materials and access to the levee construction areas. All routes have been noted on the real estate plates.

6. **FEDERALLY OWNED LAND IN PROJECT AREA**: Recently, the Corps has purchased agricultural property along the Elwood/Gladden Levee. It was purchased under the authority of the Missouri River Fish and Wildlife Mitigation Program, which is a federally funded “willing seller” program that returns property along the Missouri River to the flood plain for fish and wildlife mitigation. The lands purchased do encompass parts of the proposed St. Joseph Levee Project and any use for this land for the project will be coordinated with the Missouri River Mitigation Project Manager to make sure it does not interfere with the intended mitigation project purposes. At this time we feel the areas will be a benefit to the levee raise project.

7. **NAVIGATIONAL SERVITUDE**: Navigational Servitude does not apply on this project.

8. **REAL ESTATE MAPPING**: Maps of the proposed project areas are attached as EXHIBIT “A” and EXHIBIT “B”, Pages 1 – 6. Mapping is consistent with the preferred alternative footprint. Mapping contains a vicinity map with sectioning, ingress and egress routes, ownership, utilities to be relocated, and a note describing the difficulty if establishing Sections, Township and Range due to vicinity to a major river.

9. **FLOODING INDUCED BY PROJECT**: The feasibility study requires the analysis of any induced damages due to raises in the water surface profile caused by raises of the studied levee unit. The H & H analysis conducted shows no induced damages to the 1% (100-yr) flood event. Induced damages do not begin until we reach a flood event that is greater than the 1% (100-year) flood event. A Preliminary Takings Analysis has not been performed at this point due to the determination of "no induced damages" up to the 100 year event. Implementation of any right bank raise alternative will cause some limited amount of increased damages to Unit L-455, located just across the river and slightly downstream. The Baseline Event (100+3) alternative includes a minimal raise to the left bank to mitigate these damages. Even though a similar situation on the Kansas City Levees Feasibility established a “no taking opinion” it was decided that during PED, as further defining of the Hydrology and Hydraulics occurs, a preliminary taking analysis or Attorneys Opinion of no taking will need to be accomplished.

Water surface profiles will be affected upstream of St. Joseph and possibly as far downstream as Kansas City. An H & H analysis was conducted to determine potential impacts to other levee units in those areas. It was determined that the 100+3 alternative raise does not significantly affect these other units.

10. **BASELINE COST ESTIMATE FOR REAL ESTATE**: Below are summary tables of the Real Estate Baseline Cost Estimate for LERRD, NFS incidental costs, In-House Labor costs and Contingencies by Sponsor. A rollup of all costs is included as Table 10.4. LERRD values are based on tract appraisals obtained in 2006 for the Missouri River Mitigation Program. A Cost

Estimate covering the area was created by St. Louis District Review Appraiser, Tim Nelson. The MRLS L-455 and L471-460 Levee System Project fall directing in the appraised area.

TABLE 10.1: SOUTH ST. JOSEPH LEVEE DISTRICT (LEFT BANK L-455)	
LERRD Costs:	
Perm. Easement - Stability berm	$ 11,000.00
Temp. Easement - Underseepage berm	$ 25,000.00
Temp. Easement - Borrow Area	$ 80,000.00
Contingencies (15%)	$ 17,000.00
	$133,000.00
Non Federal Sponsor Incidental Costs:	$ 44,000.00
Contingencies (15%)	$ 7,000.00
	$ 51,000.00
In-house Government Costs:	$ 20,000.00
Contingencies (15%)	$ 3,000.00
	$ 23,000.00
Total	$207,000.00

TABLE 10.2: ELWOOD/ GLADDEN DRAINAGE DISTRICT (RIGHT BANK R470-460)	
LERRD Costs:	
Perm. Easement - Stability berm	$ 82,000.00
Temp. Easement - Underseepage berm	$ 160,000.00
Temp. Easement - Borrow Area	$2,000,000.00
Contingencies (15%)	$ 336,000.00
	$2,578,000.00
Non Federal Sponsor Incidental Costs:	$ 61,000.00
Contingencies (15%)	$ 9,000.00
	$ 70,000.00
In-house Government (Federal)Costs:	$ 21,000.00
Contingencies (15%)	$ 3,000.00
	$ 24,000.00
Total	$2,672,000.00

TABLE 10.3 ST. JOSEPH AIRPORT LEVEE DISTRICT (RIGHT BANK R471-460)	
LERRD Costs:	
Perm. Easement - Stability berm	$ 33,000.00
Temp. Easement - Underseepage berm	$ 4,000.00
Temp. Easement - Borrow Area	$ 0.00
Contingencies (15%)	$ 6,000.00
	$ 43,000.00
Non Federal Sponsor Incidental Costs:	$ 4,000.00
Contingencies	$ 1,000.00
	$ 5,000.00
In-house Government Costs:	$ 9,000.00
Contingencies	$ 1,000.00
	$ 10,000.00
Estimated Total	$ 58,000.00

Table 10.4 : Rollup of Estimated Total Land Costs for Total Project	
Land Values w/contingency	$2,754,000.00
Non Federal Sponsor Cost w/contingency	$ 125,000.00
In House Federal Costs w/contingency	$ 57,000.00
Total Estimated Project RE Costs	$2,936,000.00

Note: Utility LERRD Values will be determined in PED due to lack of information on compensable rights of the utility owners. See Section 16, paragraph 1.

11. **RELOCATION ASSISTANCE (P.L. 91-646)**: The non-federal sponsors have been advised of the Uniform Relocation Assistance and Real Property Acquisitions Policies Act of 1948, as amended (Public Law 91-646). There are no families or businesses that will temporarily or permanently require displacement as a result of this project, so there is no resettlement or relocation activity anticipated.

12. **MINERAL ACTIVITY IMPACTED PRESENT/FUTURE**: At this time the COE is not aware of any outstanding mineral interests that need to be acquired or subordinated in the project area.

13. **ASSESSMENT OF NON-FED SPONSOR(S) LEGAL/PROFESSIONAL CAPABILITY**: The non-Federal sponsors had land acquisition capabilities either through contract or in-house personnel and are fully capable of acquiring any lands necessary for the project. See Exhibit “C” for the Assessment of Non-Federal Sponsor’s RE Acquisition Capabilities Checklist. Financial capability is addressed in the main report.

14. **ZONING ORDINANCES CONSIDERED IN LIEU OR/SUPPORT OF LERRD REQUIREMENTS**: There are no zoning ordinances proposed in connection with the project.

15. **REASONABLE, DETAILED, & COORDINATED TIMELINE FOR LERRD ACQUISITION**: The following are proposed milestones for project implementation:

Activity	Project TimeLine
Feasibility Complete	*July 2006*
Div. & HQ Review and Approval	*September 2006*
WRDA 2006	*Unknown*
PED (2 years)	*August 2006 – 2008*
Acquisition Plan to Sponsor	*August 2008*
Acquisition (18 months)	*September 2008 – March 2010*
LERRD Certification	*2010*
Construction (2 years)	*2010 - 2012*

16. **FACILITY/UTILITY RELOCATION**: A study of utilities crossing the St Joseph Levee Units R471-460 and L455 were conducted to estimate costs for relocation or removal of functioning or abandoned utilities. For Unit R471-460, six (6) utilities cross the levee. Of the six, three (3) utilities are outside the limits of the raise and three utilities within the limits of the raise will be relocated up and over the levee (modified in place). Documents for the three public utilities are being sought at this time; however sufficient information is not available for a Preliminary Attorney's Opinion of Compensability for the three public utilities.

Attorney's Opinion's of Compensability Interest, as required by paragraph 12-22 of Engineering Regulation 405-1-12 for the three utility relocations will be completed in the next project phase. Based on preliminary information utility relocation costs are estimated at approx. $350,000.00. A small percent of the total project costs. Therefore, delaying completion of the Opinions of Compensable Interest to the next project phase when more specific information will be available poses a negligible risk due to the comparatively small cost for the relocation work in relation to TPC.

Further, any conclusion or categorization contained in this report that an item is a utility or facility relocation to be performed is at the cost of the non-federal sponsor as part of LERRD responsibilities and is preliminary only. The federal Government will make a final determination of the relocations necessary for the construction, operation or maintenances of the project after further analysis and completion and approval of Final Attorney's Opinions of Compensability for each of the impacted utilities and facilities.

17. **IMPACT OF HTRW**: The land in the project is not known or suspected to contain hazardous and/or toxic wastes. The Kansas City District of the US Army Corps of Engineers did complete the Feasibility Study (FS) Hazardous, Toxic, and Radiological Waste (HTRW) assessment of levee units L-455 and R-460-471 in St. Joseph, Missouri and Elwood, Kansas, in September 1999. Based on site visits and data search information, the known or suspected contaminant areas located in, on, under, or adjacent to the land required for the construction, operation and maintenance of the project where concluded as no further action or consideration required.

18. **OPPOSITION/SUPPORT OF PROJECT BY LOCAL LANDOWNERS**: The Corps of Engineers is not aware of any public opposition to this project at this time. Many public meeting have been held and the consensus of the input is “fix the levee and fix it now”. A public meeting was held on August 28, 2006 to take comments on the Feasibility Plan. One area of opposition is the borrow areas. Landowners affected by the proposed areas are greatly concerned at the number of acres to be acquired for borrow sites and the extent of the soil removal. See attached RE Mapping for areas of concern.

19. **NOTIFICATION TO NON-FEDERAL SPONSOR OF EARLY ACQUISITION OF LERRD**: During PED the construction limit will be clearly defined and an acquisition schedule set. The non federal sponsors will be issued risk letters explaining the risk of acquiring lands prior to execution of the PCA.

20. **OTHER RE ISSUES:**

The land areas identified in the project footprint have been reviewed by environmental staff to identify Wetland Reserve Program (WRP) and Conservation Reserve program (CRP) lands within its reaches.

Lands purchase by the Corps of Engineers Missouri River Mitigation sites along the Elwood/ Gladden Levee Unit could be suitable for borrow and access to the project. This could create a saving on cost of proposed permanent easement for borrow.

Missouri River Levee System, L-455 Real Estate Site Plan

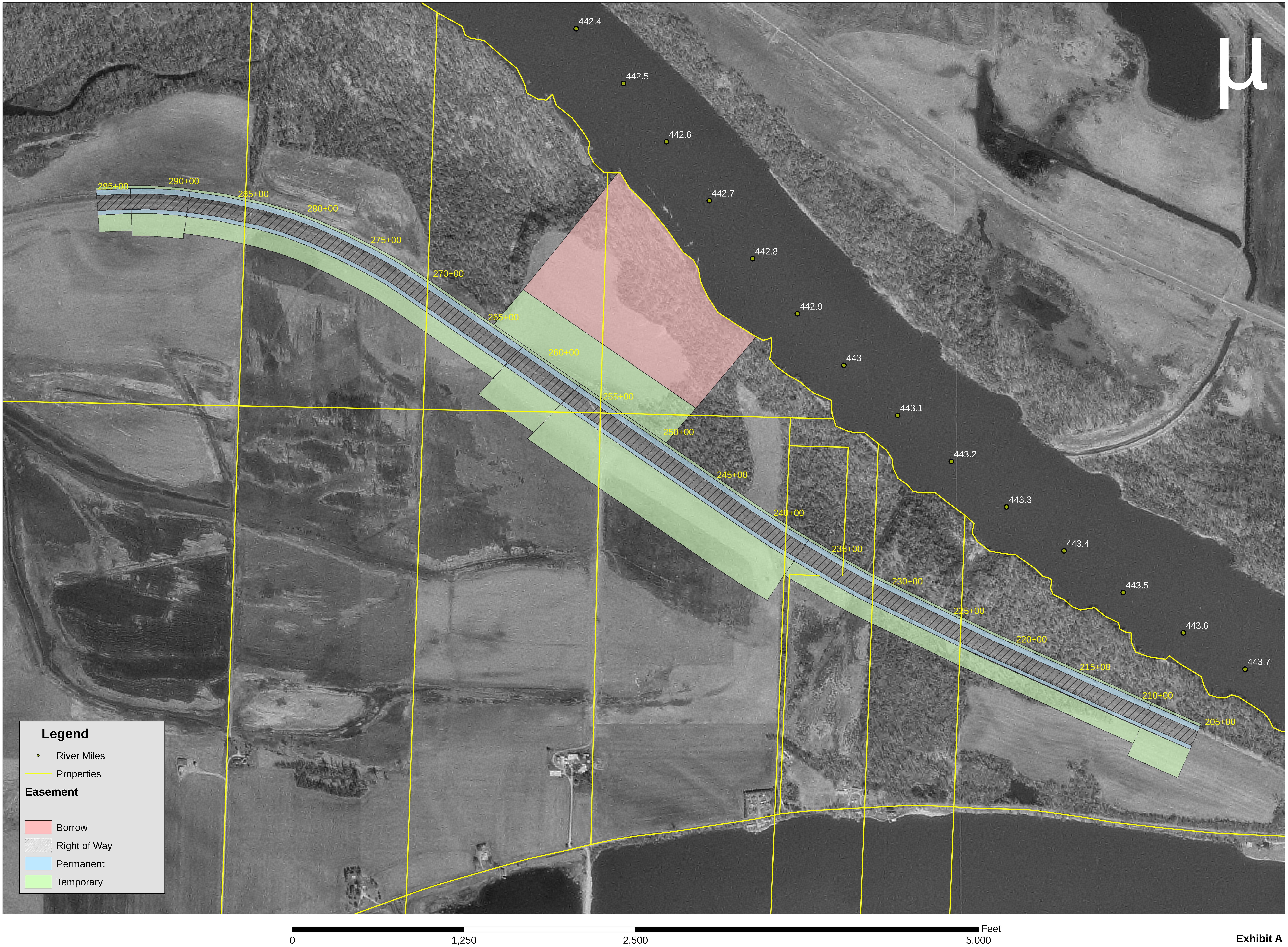


Exhibit A

Missouri River Levee System, R-471-460 Real Estate Site Plan

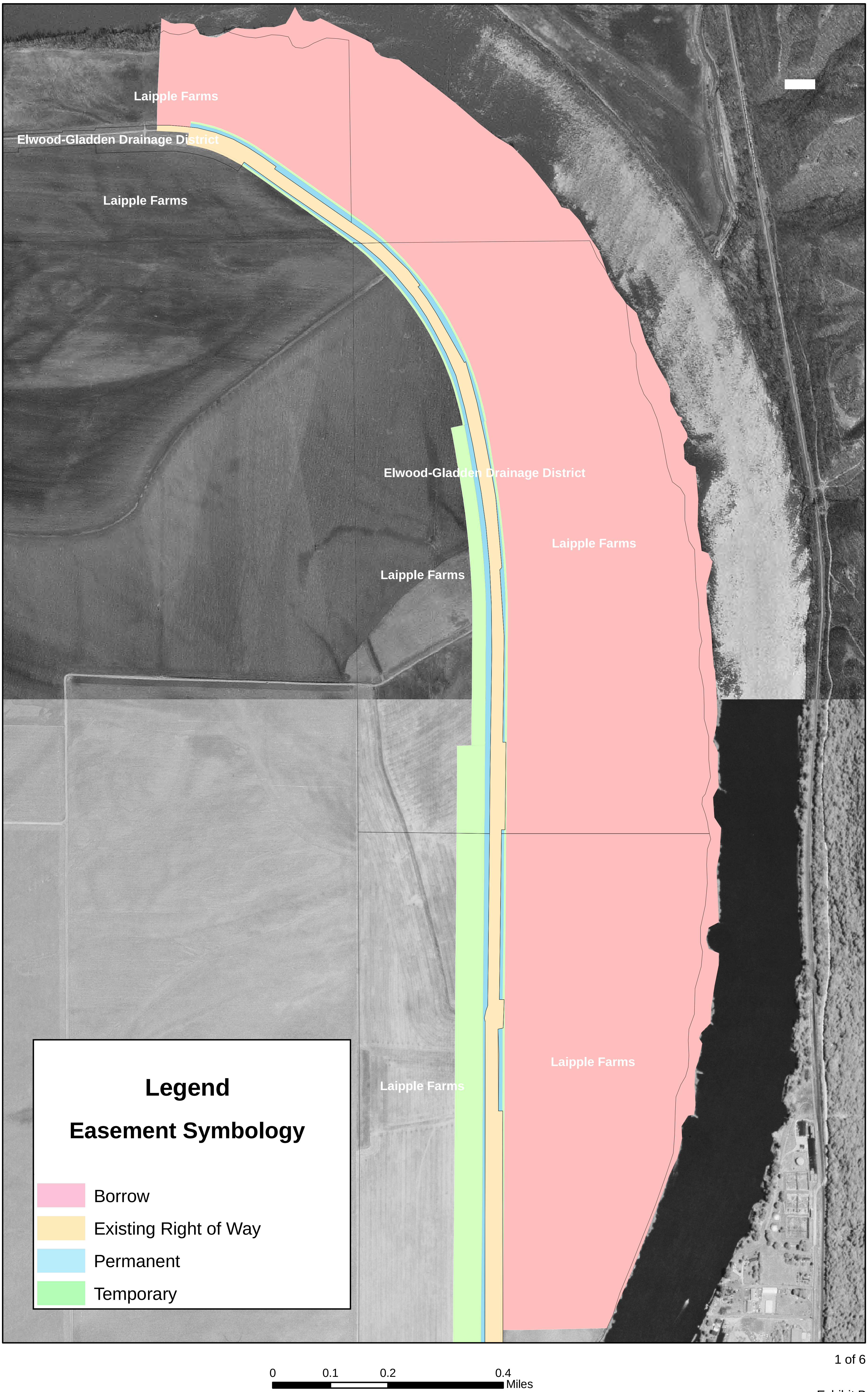


Exhibit B

Missouri River Levee System, R-471-460 Real Estate Site Plan

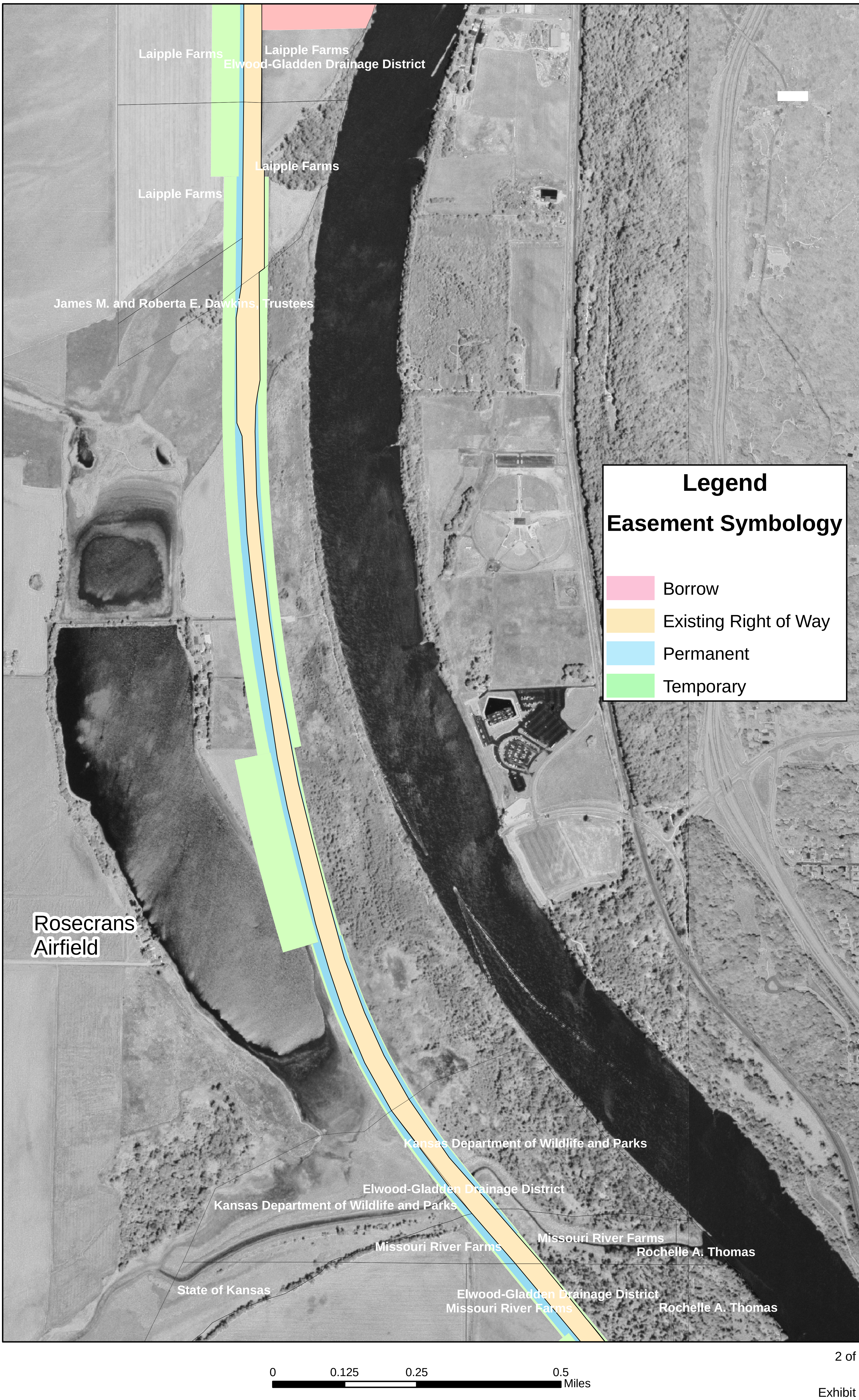
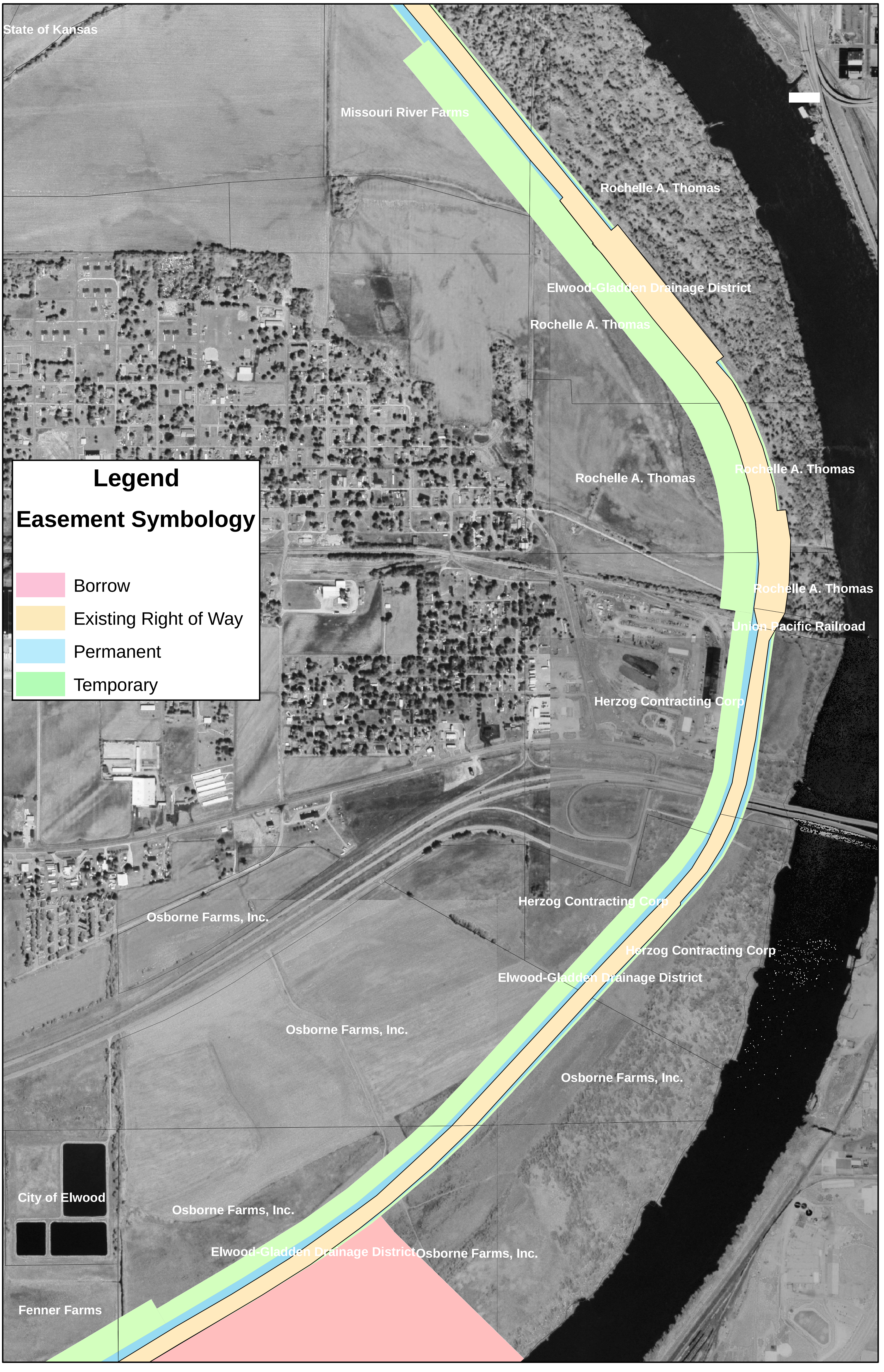


Exhibit B

Missouri River Levee System, R-471-460 Real Estate Site Plan



0 0.125 0.25 0.5 Miles

Exhibit B

Missouri River Levee System, R-471-460 Real Estate Site Plan

Exhibit B

Missouri River Levee System, R-471-460 Real Estate Site Plan

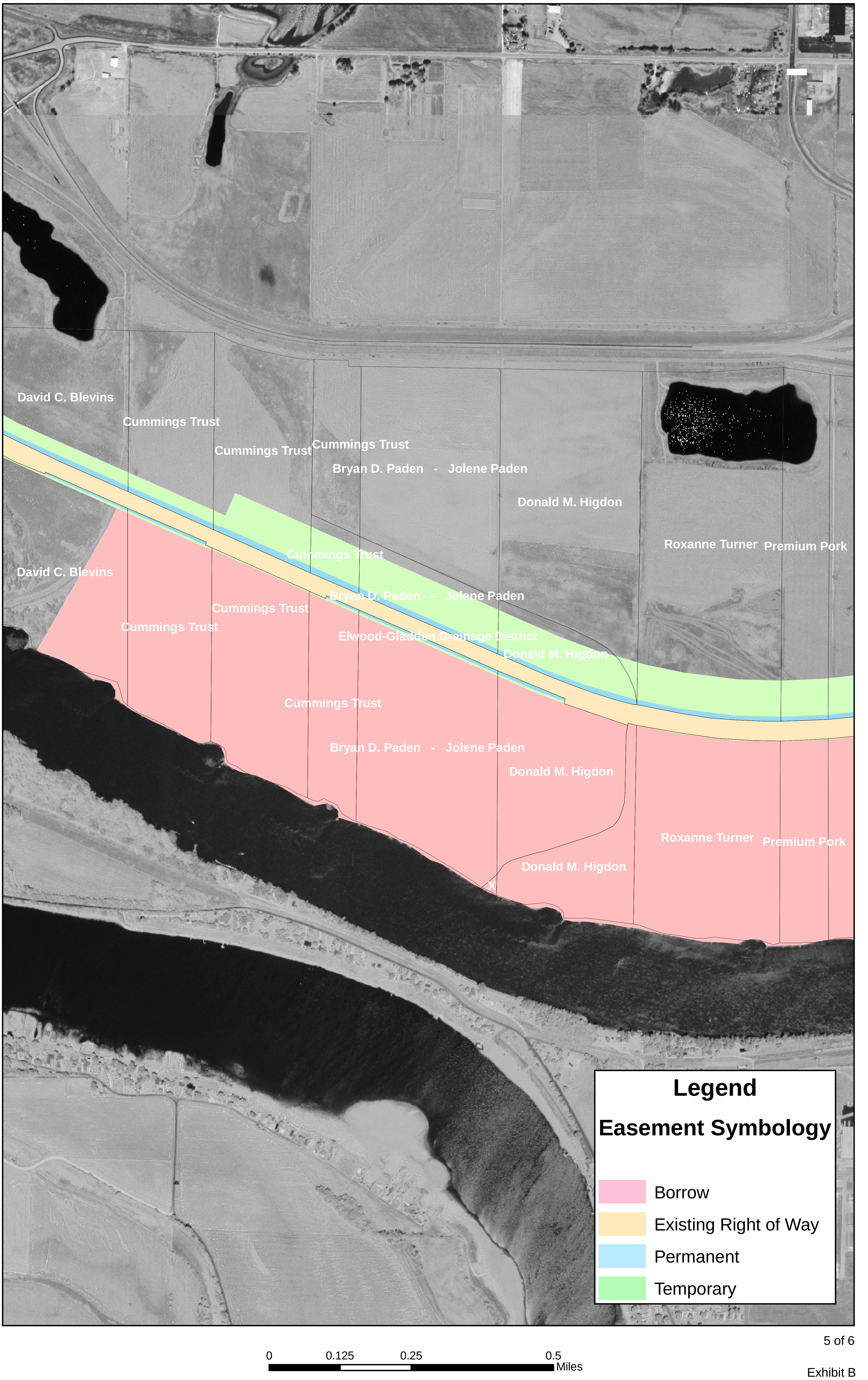


Exhibit B

Missouri River Levee System, R-471-460 Real Estate Site Plan

0 0.125 0.25 0.5
Miles

Exhibit B

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

South Saint Joseph Drainage and Levee District, MRLS R471-460
Elwood-Gladden Drainage District, MRLS L-455

I. Legal Authority:

a. Does the sponsor have the legal authority to acquire and hold title to real property for project purposes? **Yes**

b. Does the sponsor have the power of eminent domain for this project? **Yes**

c. Does the sponsor have "quick take" authority for this project? **No**

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? **No**

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **No**

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirement of Federal projects including P.L. 91-646, as amended? **No, Coordination meetings where held with sponsors to explain process and requirements.**

b. If the answer to II.a. is "yes", has a reasonable plan been developed to provide such training? **N/A**

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **Yes**

D. Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule? **Yes**

e. Can the sponsor obtain contractor support, if required, in a timely fashion? **Yes**

f. Will the sponsor likely request USACE assistance in acquiring real estate? **No**

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? **Yes**

b. Has the sponsor approved the project/real estate schedule/milestones? Review of Milestones and acquisition schedule will come during PED.

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? **Yes**

b. With regard to this project, the sponsor is anticipated to be **fully capable**.

V. Coordination:

a. Has this assessment been coordinated with the sponsor? Yes

b. Does the sponsor concur with this assessment? Yes

Prepared by:

Lora E. Vacca
Real Estate Specialist

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

St. Joseph Airport Drainage District
Missouri River Levee System (MRLS) L455, R471-460

I. Legal Authority:

a. Does the sponsor have the legal authority to acquire and hold title to real property for project purposes? **Yes**

b. Does the sponsor have the power of eminent domain for this project? **Yes**

c. Does the sponsor have "quick take" authority for this project? **No**

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? **No**

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **No**

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirement of Federal projects including P.L. 91-646, as amended? **No, Coordination meetings where held with sponsors to explain process and requirements.**

b. If the answer to II.a. is "yes", has a reasonable plan been developed to provide such training? **N/A**

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **Yes**

D. Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule? **Yes**

e. Can the sponsor obtain contractor support, if required, in a timely fashion? **Yes**

f. Will the sponsor likely request USACE assistance in acquiring real estate? **No**

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? **Yes**

b. Has the sponsor approved the project/real estate schedule/milestones? **Not at this time but once a final alternative is selected, all will re-look at schedules.**

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? **Yes**

b. With regard to this project, the sponsor is anticipated to be **fully capable**.

V. Coordination:

a. Has this assessment been coordinated with the sponsor? Not at this time.

b. Does the sponsor concur with this assessment? N/A

Prepared by:

Lora E. Vacca
Real Estate Specialist

FEASIBILITY REPORT
MISSOURI RIVER LEVEE SYSTEM UNITS R471-460 AND L-455
SAINT JOSEPH, MISSOURI / ELWOOD, KANSAS

APPENDIX E

HAZARDOUS AND TOXIC WASTE

SEPTEMBER 2006

DEPARTMENT OF THE ARMY
Kansas City District, U.S. Army Corps of Engineers

Kansas City, Missouri

FEASIBILITY STUDY HTRW ASSESSMENT
ST. JOSPEH, MISSOURI AND ELWOOD, KANSAS
MISSOURI RIVER LEVEE SYSTEM UNITS L-455 AND R-460-471

22 September 1999

1 INTRODUCTION

The Kansas City District of the US Army Corps of Engineers has completed the Feasibility Study (FS) Hazardous, Toxic, and Radiological Waste (HTRW) assessment of levee units L-455 and R-460-471 in St. Joseph, Missouri and Elwood, Kansas, respectively. This assessment includes:

1. Review of database search report covering the St. Joseph and Elwood corridors, and

2. Documentation of the site visit.

This document includes a summary of the database search report and the site visit. The database search results can be found in Attachment 1 at the end of this document.

Before the FS phase of this project, a complete Reconnaissance Report that included HTRW evaluation was performed by HDR Engineering, Inc. for the US Army Corps of Engineers in May 1996. This FS phase HTRW Assessment was performed to re-examine the levee areas and further investigate the following areas outlined in the Feasibility Study Scope of Work:

1. Union Carbide Ag. Products – former lagoon with dioxin
2. Farmland/BN Railroad – former insecticide plant
3. FMGP/KCPBL – manufacturing gas plant
4. Gilmore Chemical- agricultural chemicals
5. Former St. Joseph Landfill
6. Elwood dri, drum found after the 1993 flood.

2 STUDY AREA

The study area comprises of two levee units: L-455 in Missouri and R-460-471 in Kansas and Missouri. The corridor encompassing these areas is defined as 500 feet either side of levee centerline and can be seen in Attachment 1.

3 ENVIRONMENTAL DATABASE SEARCH

The Corps of Engineers Kansas City District commissioned VISTA Information Solutions, Inc. to conduct the environmental database search. CENWK-EC-ED reviewed the VISTA report for indications of environmental concern in the vicinity of the subject area.

Listed in table 1 below are the databases that were searched. The table includes the acronym of the database, the database name, date of last data release, and number of "hits" (the number of sites within the corridor that registered during a search of that particular database).

Table 1. Databases Searched

Database Acronym	Database Description	Last Data Release Date	No. of Hits
NPL	National Priorities List	July 1999	0
SPL	Superfund Section of Department of Natural Resources (DNR) Missouri Priorities List	October 1998	0
CERCLIS	Sites proposed or on the NPL	May 1999	0
NFRAP	Sites originally considered for NPL, but where action is complete, or it was decided no action was necessary because contamination was not found, quickly removed, or not serious	May 1999	3
SCL	Kansas identified disposal sites list confirmed abandoned or uncontrolled	July 1999	0
CORRACTS	RCRA facilities undergoing "Corrective Action"	May 1999	1
ERNS	Emergency Response Notification System reported releases of oil and hazardous substances	December 1998	3[A]
RCRA-TSD	Resource Conservation and Recovery Act (RCRA) Transport, Storage, and Disposal Facilities	May 1999	1
RCRA-LgGen	RCRA Facilities generating at least 1000 kg/month of non-acutely hazardous waste or 1 kg/month of acutely hazardous waste	May 1999	1
RCRA-SmGen	RCRA Facilities generating less than 1000 kg/month of non-acutely hazardous waste	May 1999	2
SWLF	Solid Waste Landfills, Incinerators, and Transfer Stations Provided by the Missouri DNR	July 1995	0
LUST	Registered Leaking Underground Storage Tanks provided by KDHE	July 1999	0
LUST	Registered Leaking Underground Storage Tanks provided by the Waste Mgmt. Div. of Missouri DNR	March 1999	0
UST	Registered Underground Storage Tanks provided by Missouri DNR	June 1999	1
UST	Registered Underground Storage Tanks provided by the Kansas Bureau of Environmental Remediation	July 1999	0
SWLF	Solid waste landfills, incinerators and transfer stations provided by USGS	July 1995	
SPILL	Equivalent to ERNS database for Kansas	June 1999	0
AST	Registered Above Ground Storage Tanks provided by the Kansas Bureau of Environmental Remediation	July 1999	0

[A] - All three hits were for the same event

Database survey results are classified into two types of sites: mapped sites and unmapped sites. Mapped sites were located on a map in the database search report. Unmapped sites are listed as possibly in the search corridor since VISTA mapping was apparently unable to accurately map the addresses supplied. Table 2 below summarizes the seven sites, five mapped and two unmapped, registered from the database search:

Table 2. Sites Registered in Database Searches

Property	Database Hits	Summary of Events
Mapped Sites Omnium LLC 1417A Lower Lake Road St. Joseph, MO 64504	CORRACTS RCRA-LgGen RCRA-TSD	Completed RCRA Facility Assessment with no RCRA Facility Investigation imposed
Farmland Industries, Inc. 1417 Lower Lake Road St. Joseph, MO 64504	UST-MO	Removed 2, 20,000 gal tanks; 2, 1000 gal tanks; and 2, 5000 gal tanks
St. Joseph Light and Power Lake Road Plant 1413 Lower Lake Road St. Joseph, MO 64504	RCRA-SmGen	Small generator of waste
Lake Road Warehouse Company 1400 Lower Lake Road St. Joseph, MO 64504	RCRA-SmGen NFRAP	Not on NPL, incident type unknown
Larry Helfry 1613 Vernon St. Joseph, MO 64504	ERNS (3 hits from same address)	Spilled 30 gallons of diesel fuel 26 July 1992 into soil and storm sewers
Unmapped Sites Old Fanning Dump Sec 13 T56N R36W St. Joseph, MO 64504	NFRAP	Described as a 7.3 acre site used as an open dump containing many open and rusty 55 gallon drums, preliminary assessment 2 January 1988
St. Joseph Light Power Company NW ¼ NE ¼ SEC 36 T57N R36W St. Joseph, MO 64504	NFRAP	Described as a 2 to 3 acre fly ash landfill in wet land area, preliminary assessment 2 January 1988

4 SITE VISIT

The 12 August 1999 site visit is documented in Attachment 2. During the visit, a local member of the levee board was questioned about some of the sites mentioned in the FS Scope of Work. He had no knowledge of the dioxin pits and the St. Joseph Landfill sites mentioned in the FS Scope of Work.

On levee R-460-471, the only potential HTRW concern is at the Herzog Hot Mix Plant north of Highway 36. Stockpiles of what appears to be recycled asphalt are in contact with the landside toe of the levee.

On levee L-455, three potential HTRW concerns exist. One is the proximity of underground gas pipelines near station 55+00 to station 85+00. The second concern is industrial sewage pipes crossing the west side of the levee along Brown's Branch Creek. The third concern is sediment ponds near station 110+00. Although the ponds are within 500 feet of the levee centerline, they are at least 100 feet from the toe of the levee. This distance makes it unlikely they would be disturbed for a levee raise of 5 feet or less, but the existence of the ponds should be considered.

5 CONCLUSIONS

Potential sites of concern can be separated into three categories: sites from the FS Scope of Work, sites from the 12 August 1999 field visit, and sites highlighted in the database search.

All sites mentioned in the FS Scope of Work (listed in part 1) were eliminated as items of concern. No additional information was obtained despite an interview with a levee board member, a site visit, and a thorough database search. Below is a summary of how each potential site outlined in the FS Scope of Work was addressed for this report:

Table 3. FS Scope of Work Sites Summary and Conclusions

FS Scope of Work Potential Site	Findings	Conclusion/ Recommended Action
Union Carbide Ag. Products – former lagoon with dioxin	• No database search hits • No information from levee board member • Nothing noticed during site visit	No further consideration
Farmland/BN Railroad – former insecticide plant	• No markings noticed during site visit • No database search hits	No further consideration
FMGP/KCPBL – manufacturing gas plant	• Manufacturing plants noticed during site visit, but none adjacent to the levee	No further consideration
Gilmore Chemical- agricultural chemicals	• Manufacturing plants noticed during site visit, but none adjacent to the levee	No further consideration
Former St. Joseph Landfill	• No database search hits • No information from levee board member	No further consideration
Elwood dri, drum found after the 1993 flood	• No database search hits • Assumed anomaly from 1993	No further consideration

flood

Four items were highlighted as potential concerns during the 12 August site visit. Table 4 below summarizes the findings and recommendations for each:

Table 4. Field Site Visit Sites Summary and Conclusions

Field Visit Site of Potential Concern	Findings	Conclusion/ Recommended Action
Levee R-460-471 Herzog Hot Mix Plant at Highway 36 and Levee	• Recycled asphalt material stockpiled against levee toe	Remove pile from toe now and move pile farther from toe during construction
LeveeL-455 Williams Gas Pipelines	• Running along toe from station 55+00 to 85+00	Maintain utility awareness all along the levees and do not disturb
Industrial Sewage Pipes crossing levee	• at Brown's Branch Creek portion of levee	Maintain awareness and do not disturb
Sediment ponds	• near station 110+00	Do not disturb

No follow-up action is necessary for any of the database search sites. Potential concerns from the database search are summarized in Table 5 below:

Table 5. Database Search Sites Summary and Conclusions

Database Search Sites of Potential Concern	Database Findings	Conclusion/ Recommended Action
Omnium LLC	• CORRACTS • RCRA-LgGen • RCRA-TSD	No RCRA investigation necessary, no action necessary
Farmland Industries, Inc.	• UST-MO	Removal action complete, no action necessary
St. Joseph Light and Power Lake Road Plant	• RCRA-SmGen • Registered UST	no action necessary
Lake Road Warehouse	• RCRA-SmGen • NFRAP	No information provided for contamination , no action necessary
Larry Helfry	• ERNS	30 gal. diesel fuel spill over 7 years ago, no action necessary
Old Fanning Dump	• NFRAP	Site estimated to be greater than 2.5 miles from nearest levee, no action necessary[B]
St. Joseph Light and Power Co.	• NFRAP	Fly ash landfill found to be approximately 0.5 miles from Brown's Branch Levee, no action necessary[B]

[B]- See attachment 3 for maps

FEASIBILITY REPORT
MISSOURI RIVER LEVEE SYSTEM UNITS R471-460 AND L-455
SAINT JOSEPH, MISSOURI / ELWOOD, KANSAS

APPENDIX F

COST ESTIMATING

SEPTEMBER 2006

DEPARTMENT OF THE ARMY
Kansas City District, U.S. Army Corps of Engineers
Kansas City, Missouri

* * * * TOTAL CONTRACT COST SUMMARY * * * *

TOTAL - ALL CONTRACTS

Date: 18 July 2006

PROJECT: MRLS L-455 & R-471-460 Feasibility Study
DISTRICT: Kansas City District Corps of Engineers

LOCATION: St. Joseph, Missouri
P.O.C.: Patrick J. Miramontez, Cost Engineering Section

ACCOUNT NUMBER	FEATURE DESCRIPTION	CURRENT MCACES ESTIMATE PREPARED: JUL 2006; EFFECTIVE PRICING LEVEL: 1 OCT 05 — COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZ./BUDGET YEAR: EFFECT. PRICING LEVEL: 1 OCT 05 — COST ($K)	CNTG ($K)	TOTAL ($K)	* * * FULLY FUNDED ESTIMATE * * * COST ($K)	CNTG ($K)	FULL ($K)
06 - - -	FISH & WILDLIFE FACILITIES										
0603- -	WILDLIFE FACILITIES & SANCTUARIES	500	0	0%	500	500	0	500	549	0	549
11- - -	LEVEES & FLOODWALLS										
1101- -	LEVEES	18,509	4,595	25%	23,104	18,508	4,595	23,103	20,336	5,048	25,384
1102- -	FLOODWALLS	0	0	0%	0	0	0	0	0	0	0
13- - -	PUMPING PLANTS										
1300- -	PUMPING PLANTS	0	0	0%	0	0	0	0	0	0	0
	TOTAL CONSTRUCTION COSTS ===>	19,009	4,595	24%	23,604	19,008	4,595	23,603	20,885	5,048	25,933
01 - - -	LANDS AND DAMAGES										
0101- -	LAND VALUES	2395.1	359.27	15%	2,754	2,395	359	2,754	2,539	380	2,919
0102- -	LABOR	158.58	23.787	15%	182	159	24	182	170	25	195
02 - - -	RELOCATIONS	295.41	59.082	20%	354	295	59	354	325	65	390
30 - - -	PLANNING, ENGINEERING & DESIGN	1,930	465.48	24%	2,396	1,930	465	2,396	2,067	499	2,566
31 - - -	CONSTRUCTION MANAGEMENT	1253	302.1	24%	1,555	1,253	302	1,555	1,430	345	1,775
	TOTAL PROJECT COSTS ========>	25,041	5,805	23%	30,846	25,041	5,804	30,845	27,416	6,362	33,778

TOTAL FEDERAL COSTS (65%)====> $ 21,956 K

TOTAL NON-FEDERAL COSTS (35%)====> $ 11,822 K

TOTAL FULLY FUNDED ESTIMATE =======> $ 33,778 K

APPROVED:

* * * * TOTAL CONTRACT COST SUMMARY * * * *

CONTRACT A - R471-460 (100 year + 3ft)

Date: 18 July 2006

PROJECT: MRLS L-455 & R-471-460 Feasibility Study | DISTRICT: Kansas City District Corps of Engineers

LOCATION: St. Joseph, Missouri | P.O.C.: Patrick J. Miramontez, Cost Engineering Section

	CURRENT MCACES ESTIMATE PREPARED: JUL 2006 / EFFECTIVE PRICING LEVEL: 1 OCT 05					AUTHORIZ./BUDGET YEAR: / EFFECT. PRICING LEVEL: 1 OCT 05				* * * FULLY FUNDED ESTIMATE * * *				
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
06 - - -	FISH & WILDLIFE FACILITIES													
0603- -	WILDLIFE FACILITIES & SANCTUARIES	500	0	0%	500	0.0%	500	0	500	Jun-2010	9.88%	549	0	549
11- - -	LEVEES & FLOODWALLS													
1101- -	LEVEES	16,606	4,056	24%	20,662	0.0%	16,606	4,056	20,662	Jun-2010	9.88%	18,246	4,456	22,702
1102- -	FLOODWALLS	0	0	0%	0	0.0%	0	0	0		0.00%	0	0	0
13- - -	PUMPING PLANTS													
1300- -	PUMPING PLANTS	0	0	0%	0	0.0%	0	0	0		0.00%	0	0	0
	TOTAL CONSTRUCTION COSTS ===>	17,106	4,056	24%	21,162		17,106	4,056	21,162			18,795	4,456	23,251
01 - - -	LANDS AND DAMAGES													
0101- -	LAND VALUES	2278.8	341.8	15%	2,621	0.0%	2,279	342	2,621	Jun-2008	6.00%	2,416	362	2,778
0102- -	LABOR	94	14	15%	109	0.0%	94	14	109	Jun-2008	7.10%	101	15	116
02 - - -	RELOCATIONS	295	59	20%	354	0.0%	295	59	354	Jun-2010	9.88%	325	65	390
30 - - -	PLANNING, ENGINEERING & DESIGN	1740	411	24%	2,152	0.0%	1,740	411	2,152	Oct-2007	7.10%	1,864	441	2,305
31 - - -	CONSTRUCTION MANAGEMENT	1129	267	24%	1,396	0.0%	1,129	267	1,396	Jun-2010	14.10%	1,289	305	1,594
	TOTAL PROJECT COSTS ========>	22,644	5,149	23%	27,794		22,644	5,149	27,794			24,790	5,644	30,434

**** TOTAL CONTRACT COST SUMMARY ****

CONTRACT B - L455 (100 Year + 3ft)

Date: 18 July 2006

PROJECT: MRLS L-455 & R-471-460 Feasibility Study

DISTRICT: Kansas City District Corps of Engineers

LOCATION: St. Joseph, Missouri

P.O.C.: Patrick J. Miramontez, Cost Engineering Section

	CURRENT MCACES ESTIMATE PREPARED: JUL 2006					AUTHORIZ./BUDGET YEAR:								
	EFFECTIVE PRICING LEVEL: 1 OCT 05					EFFECT. PRICING LEVEL: 1 OCT 05				*** FULLY FUNDED ESTIMATE ***				
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
06 - - -	FISH & WILDLIFE FACILITIES													
0603- -	WILDLIFE FACILITIES & SANCTUARIES	0	0	0%	0	0.0%	0	0	0	Jun-2010	9.88%	0	0	0
11- - -	LEVEES & FLOODWALLS													
1101- -	LEVEES	1,902	539	28%	2,442	0.0%	1,902	539	2,441	Jun-2010	9.88%	2,090	592	2,682
1102- -	FLOODWALLS	0	0	0%	0	0.0%	0	0	0		0.00%	0	0	0
13- - -	PUMPING PLANTS													
1300- -	PUMPING PLANTS	0	0	0%	0	0.0%	0	0	0		0.00%	0	0	0
	TOTAL CONSTRUCTION COSTS ===>	1,902	539	28%	2,442		1,902	539	2,441			2,090	592	2,682
01 - - -	LANDS AND DAMAGES													
0101- -	LAND VALUES	116.29	17.44	15%	134	0.0%	116	17	134	Jun-2008	6.00%	123	18	141
0102- -	LABOR	64.12	9.618	15%	74	0.0%	64	10	74	Jun-2008	7.10%	69	10	79
02 - - -	RELOCATIONS	0	0	0%	0	0.0%	0	0	0	Jun-2010	9.88%	0	0	0
30 - - -	PLANNING, ENGINEERING & DESIGN	190	54	28%	244	0.0%	190	54	244	Oct-2007	7.10%	203	58	261
31 - - -	CONSTRUCTION MANAGEMENT	124	35.05	28%	159	0.0%	124	35	159	Jun-2010	14.10%	141	40	181
	TOTAL PROJECT COSTS ========>	2,397	655	27%	3,052		2,396	655	3,052			2,626	718	3,344

Feasibility Study Estimate For:
St. Joseph Feasibility Study -
L455
Nominal 100 Yr + 3ft Levee Raise
dated 18 Jul 2006

Designed By: CENWK
Estimated By: CENWK-EC-DC

Prepared By: Patrick Miramontez 816-983-3322
LATEST ESTIMATE AS OF 18 Jul 06

Preparation Date: 01/10/06
Effective Date of Pricing: 10/01/05

Sales Tax: 0.00%

This report is not copyrighted, but the information
contained herein is For Official Use Only.

01- Lands & Damages - The costs include the acquisition of Permanent Right-of-Way, Temporary Right-of-Way, and borrow areas. Also included, where necessary, is the relocation cost of businesses that infringe on the footprint of the raised levee. These costs include Non Federal Sponsors cost to perform the Legal work, Title Work, Tract appraisals, and land surveys, as well as Federal labor costs.

02 - Relocations - This item currently includes only utility relocations. There are two types of utility relocations: 1) Utilities crossing the levee - These are utilities identified as having to be removed from their current location and placed up and over the new levee raise. This will require a fill zone that will be evident above the levee projected lines. All abandoned pipes crossing the levee will be removed. No Utilities have been identified for this reach. 2) Utilities impacted by Uplift - None identified.

06 - Fish & Wildlife Facilities - NOT USED.

11 - Levees
This item consists of 4 different components. These components include: 1) Relief Wells, 2) Borrow Site, 3) Levee Raise (including Levee Cut, Levee Raise, Stability (Riverside Berms) and Underseepage berms), and 4) Drainage System Modifications.

- Relief Wells - NOT USED.

- Borrow Site - It is currently assumed one borrow site will be utilized. It is assumed 100% of the material will come from the borrow sites located a maximum of .66 miles from the levee centroid. The costs include the preparation of the borrow site, and the final grading of the borrow site when completed.

- Levee Cut - Quantities for the levee cut were based on the removal of the aggregate surfacing on top of the levee, and the stripping of topsoil from the landside of the existing levee. It was assumed this material will be dozed off and windrowed next to the levee.

- Levee Raise (including Stability/Underseepage Berms) - Quantities for the levee raise was calculated by using In-Roads CAD software and then hand manipulated. Haul distances were hand calculated based on the borrow site locations and the quantities required. Haul distances vary from 0.51 miles to .66 miles. The material is to be excavated, loaded, and hauled using off-highway dump trucks over the existing ramps and new ramps and low water crossings where needed. A cost is also included for new aggregate surfacing and seeding and mulching.

- Drainage System Modifications - NOT USED.

-Estimated Engineering and Design Costs = 10% of project implementation (less lands & damages) cost. To be refined.

-Estimated Construction Supervision & Administration = 6.5% of project implementation (less lands & damages) cost. To be refined.

Areas of Cost Sensitivity
- Estimate does not include any costs for sampling/testing for HTRW.
- Estimate does not include any costs for the hauling and disposal of HTRW.
- Estimate does not include O&M costs. Only project implementation (construction, real-estate and associated) costs.
- Estimate based on borrow source located at Approx Left Bank Levee Station 250+00 to 265+00. If this borrow is not available for use additional costs will have to be considered.

General Cost Information
- The quantities have been calculated by EC-GD, EC-DC, and EC-DS. A contingency determination meeting will be held with all of the designers to apply the appropriate amount of contingency to each line item.
- No tax has been included for the state of Missouri.
- The source for the labor rates used in the estimate is the Dec 2005 Department of Labor Wage rates for Buchanon County, Missouri.
- The national 2001 Unit Price Book is used to price minor items. Quotes were received for major cost items. An adjustment factor is added to bring the rates to the appropriate price level date.
- 2005 equipment rates were used.
- Once all of the databases are normalized to the appropriate price level date an escalation factor will be added to the owner level to bring the estimate to the appropriate price level date. The escalation factors used were derived from the Civil Works Construction Cost Index System (CWCCIS) EM1110-2-1304.

SUMMARY REPORTS SUMMARY PAGE

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

** PROJECT OWNER SUMMARY - Feature **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
01 Lands and Damages	1.00	EA	180,410	27,061	0	0	0	207,471	207470.93
11 Levees and Floodwalls	1.00	EA	1,902,490	539,252	0	244,174	158,469	2,844,385	2844385
TOTAL Feasibility Study Estimate For:	1.00	EA	2,082,899	566,313	0	244,174	158,469	3,051,856	3051856

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
01 Lands and Damages									
01.23 Land Values									
01.23.01 Land Values									
01.23.01.01 Land Values									
01.23.01.01.01 Borrow Area-Sta 250+00 to 265+00	42.00	ACR	79,800	11,970	0	0	0	91,770	2185.00
01.23.01.01.02 Sta 205+50 to 209+50	2.65	ACR	2,043	306	0	0	0	2,349	886.37
01.23.01.01.03 Sta 209+50 to 237+50	10.75	ACR	7,790	1,169	0	0	0	8,959	833.35
01.23.01.01.04 Sta 237+50 to 257+50	19.00	ACR	12,825	1,924	0	0	0	14,749	776.25
01.23.01.01.05 Sta 257+50 to 262+50	3.85	ACR	2,660	399	0	0	0	3,059	794.55
01.23.01.01.06 Sta 262+50 to 288+50	10.60	ACR	8,702	1,305	0	0	0	10,007	944.08
01.23.01.01.07 Sta 288+50 to 292+50	2.05	ACR	1,634	245	0	0	0	1,879	916.63
01.23.01.01.08 Sta 292+50 to 295+00	1.00	ACR	836	125	0	0	0	961	961.40
TOTAL Land Values	1.00	EA	116,290	17,443	0	0	0	133,733	133732.93
01.23.01.02 Non Federal Sponsors Costs									
01.23.01.02.09 NFS Costs	1.00	EA	44,400	6,660	0	0	0	51,060	51060.00
TOTAL Non Federal Sponsors Costs	1.00	EA	44,400	6,660	0	0	0	51,060	51060.00
01.23.01.03 Federal Costs									
01.23.01.03.10 Federal Costs	1.00	EA	19,720	2,958	0	0	0	22,678	22678.00
TOTAL Federal Costs	1.00	EA	19,720	2,958	0	0	0	22,678	22678.00
TOTAL Land Values	1.00	EA	180,410	27,061	0	0	0	207,471	207470.93
TOTAL Land Values	1.00	EA	180,410	27,061	0	0	0	207,471	207470.93
TOTAL Lands and Damages	1.00	EA	180,410	27,061	0	0	0	207,471	207470.93
02 Relocations									
02.01 Utility Relocations									
02.01.03 Cemetery, Utilities, & Structure									
02.01.03.18 Utilities Crossing Levee									
02.01.03.18.11 Utilities Crossing Levee - NONE									
02.01.03.20 Utilities Affected by Uplift									

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
02.01.03.20.12 Util affected by uplift - NONE									
06 Fish & Wildlife Facilities									
11 Levees and Floodwalls									
11.01 Levees									
11.01.01 Relief Wells									
11.01.02 Borrow Sites & Site Prep									
11.01.02.01 Site Prep Sta 250+00 to 265+00									
11.01.02.01.13 Stripping/Windrow Material	13889.00	CY	20,148	4,030	0	2,418	1,569	28,165	2.03
TOTAL Site Prep Sta 250+00 to 265+00	13889.00	CY	20,148	4,030	0	2,418	1,569	28,165	2.03
11.01.02.02 Low Water Crossing - Sta 232+00									
11.01.02.02.14 Low Water Crossing - Sta 232+00									
11.01.02.02.14.01 Low Water Crossing - Sta 232+00	1.00	EA	6,233	1,247	0	748	485	8,713	8713.08
TOTAL Low Water Crossing - Sta 232+00	1.00	EA	6,233	1,247	0	748	485	8,713	8713.08
TOTAL Low Water Crossing - Sta 232+00	1.00	EA	6,233	1,247	0	748	485	8,713	8713.08
11.01.02.10 Final Grade Site									
11.01.02.10.15 Final Grade Sta 250+00 to 265+00	13889.00	CY	20,115	4,023	0	2,414	1,567	28,118	2.02
TOTAL Final Grade Site	1.00	EA	20,115	4,023	0	2,414	1,567	28,118	28118.26
TOTAL Borrow Sites & Site Prep	1.00	EA	46,496	9,299	0	5,580	3,621	64,996	64995.88
11.01.03 Stripping Levee									
11.01.03.05 Remove Aggr Sta 205+64 to 294+93									
11.01.03.05.16 Excavate Aggregate from Levee	1654.00	BCY	1,140	228	0	137	89	1,594	0.96
TOTAL Remove Aggr Sta 205+64 to 294+93	1654.00	BCY	1,140	228	0	137	89	1,594	0.96
11.01.03.06 Strip Levee-Less than 1' Raise									

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.03.06.17 Strip Topsoil from Levee	3065.35 BCY	2,776	555	0	333	216	3,880	1.27
11.01.03.06.18 Windrow Material	3065.35 BCY	1,409	282	0	169	110	1,970	0.64
TOTAL Strip Levee-Less than 1' Raise	3.80 ACR	4,185	837	0	502	326	5,850	1539.39
11.01.03.09 Strip Berm-Less than 1' Raise								
11.01.03.09.19 Strip Topsoil from Levee	38800.83 BCY	66,177	13,235	0	7,941	5,154	92,508	2.38
11.01.03.09.20 Windrow Material	38800.83 BCY	18,658	3,732	0	2,239	1,453	26,082	0.67
TOTAL Strip Berm-Less than 1' Raise	48.10 ACR	84,836	16,967	0	10,180	6,607	118,590	2465.50
TOTAL Stripping Levee	43519.00 BCY	90,161	18,032	0	10,819	7,022	126,034	2.90
11.01.04 Levee Raise (Impervious)								
11.01.04.01 Exc/Haul Matl-Sta 205+64-257+50								
11.01.04.01.21 Exc/Haul	3001.25 BCY	13,341	2,668	0	1,601	1,039	18,649	6.21
TOTAL Exc/Haul Matl-Sta 205+64-257+50	3001.25 BCY	13,341	2,668	0	1,601	1,039	18,649	6.21
11.01.04.02 Exc/Haul Matl-Sta 257+50-294+93								
11.01.04.02.22 Exc/Haul	2486.25 BCY	11,052	2,210	0	1,326	861	15,449	6.21
TOTAL Exc/Haul Matl-Sta 257+50-294+93	2486.25 BCY	11,052	2,210	0	1,326	861	15,449	6.21
11.01.04.03 Place Material								
11.01.04.03.23 Scarify Existing Surface	133935.00 SF	426	85	0	51	33	596	0.00
11.01.04.03.24 Place	5487.50 BCY	8,863	1,773	0	1,064	690	12,390	2.26
TOTAL Place Material	5487.50 BCY	9,289	1,858	0	1,115	723	12,986	2.37
TOTAL Levee Raise (Impervious)	4390.00 CCY	33,682	6,736	0	4,042	2,623	47,084	10.73
11.01.07 Underseepage Berm (Random)								
11.01.07.02 Exc/Haul Matl-Sta 205+64- 257+00								
11.01.07.02.25 Exc/Haul	162793.75 BCY	723,641	217,092	0	94,073	61,054	1,095,861	6.73
TOTAL Exc/Haul Matl-Sta 205+64- 257+00	162793.75 BCY	723,641	217,092	0	94,073	61,054	1,095,861	6.73

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.07.03 Exc/Haul Matl-Sta 257+00- 294+93									
11.01.07.03.26 Exc/Haul	83327.50	BCY	370,403	111,121	0	48,152	31,251	560,927	6.73
TOTAL Exc/Haul Matl-Sta 257+00- 294+93	83327.50	BCY	370,403	111,121	0	48,152	31,251	560,927	6.73
11.01.07.53 Place Material									
11.01.07.53.27 Scarify Existing Surface	1785800	SF	5,685	1,137	0	682	443	7,947	0.00
11.01.07.53.28 Place	244467.25	BCY	367,550	110,265	0	47,782	31,010	556,607	2.28
11.01.07.53.29 Spread Aggregate Surfacing Matl	1654.00	BCY	978	196	0	117	76	1,366	0.83
TOTAL Place Material	246121.25	BCY	374,213	111,598	0	48,581	31,529	565,920	2.30
TOTAL Underseepage Berm (Random)	196897.00	CCY	1,468,257	439,811	0	190,807	123,834	2,222,708	11.29
11.01.27 Seeding & Mulching									
11.01.27.01 Seeding & Mulching									
11.01.27.01.30 Seeding & Mulching									
11.01.27.01.30.01 Seeding & Mulching	14.70	ACR	27,488	5,498	0	3,299	2,141	38,425	2613.92
TOTAL Seeding & Mulching	14.70	ACR	27,488	5,498	0	3,299	2,141	38,425	2613.92
TOTAL Seeding & Mulching	14.70	ACR	27,488	5,498	0	3,299	2,141	38,425	2613.92
TOTAL Seeding & Mulching	14.70	ACR	27,488	5,498	0	3,299	2,141	38,425	2613.92
11.01.28 Replace Aggregate Surfacing									
11.01.28.27 Replace Aggregate Surfacing									
11.01.28.27.31 Replace Aggregate Surfacing									
11.01.28.27.31.01 Replace Aggregate Surfacing	3143.00	TON	64,734	12,947	0	7,768	5,041	90,491	28.79
TOTAL Replace Aggregate Surfacing	3143.00	TON	64,734	12,947	0	7,768	5,041	90,491	28.79
TOTAL Replace Aggregate Surfacing	3143.00	TON	64,734	12,947	0	7,768	5,041	90,491	28.79
TOTAL Replace Aggregate Surfacing	1654.00	CCY	64,734	12,947	0	7,768	5,041	90,491	54.71
11.01.29 Replace Stripped Material									
11.01.29.06 Repl Lev w/ less than 1' Raise									

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.29.06.32 Push Topsoil to Levee	3065.35	BCY	2,776	555	0	333	216	3,880	1.27
11.01.29.06.33 Finish Grade Lev for TS Placemnt	3.80	ACR	4,701	940	0	564	366	6,571	1729.22
TOTAL Repl Lev w/ less than 1' Raise	3.80	ACR	7,476	1,495	0	897	582	10,451	2750.28
11.01.29.09 Repl Berm-Less than 1' Raise									
11.01.29.09.34 Push Topsoil to Berm	36542.15	BCY	66,177	13,235	0	7,941	5,154	92,508	2.53
11.01.29.09.35 Finish Grade Lev for TS Placemnt	45.30	ACR	56,038	11,208	0	6,725	4,364	78,334	1729.22
TOTAL Repl Berm-Less than 1' Raise	45.30	ACR	122,215	24,443	0	14,666	9,518	170,842	3771.35
TOTAL Replace Stripped Material	41865.00	CY	129,691	25,938	0	15,563	10,100	181,293	4.33
11.01.30 Slope Protection									
11.01.30.27 Place Bedding Material									
11.01.30.27.36 Place Bedding Material									
11.01.30.27.36.01 Place Bedding Material	350.00	TON	9,603	4,801	0	1,440	935	16,780	47.94
TOTAL Place Bedding Material	350.00	TON	9,603	4,801	0	1,440	935	16,780	47.94
TOTAL Place Bedding Material	350.00	TON	9,603	4,801	0	1,440	935	16,780	47.94
11.01.30.28 Place Riprap Protection									
11.01.30.28.37 Place Riprap Protection									
11.01.30.28.37.01 Place Riprap Protection	1000.00	TON	32,378	16,189	0	4,857	3,152	56,576	56.58
TOTAL Place Riprap Protection	1000.00	TON	32,378	16,189	0	4,857	3,152	56,576	56.58
TOTAL Place Riprap Protection	1000.00	TON	32,378	16,189	0	4,857	3,152	56,576	56.58
TOTAL Slope Protection	1.00	EA	41,981	20,990	0	6,297	4,087	73,355	73355.18
11.01.31 Drainage Systems									
TOTAL Levees	1.00	EA	1,902,490	539,252	0	244,174	158,469	2,844,385	2844385
11.02 Floodwalls - NONE									
TOTAL Levees and Floodwalls	1.00	EA	1,902,490	539,252	0	244,174	158,469	2,844,385	2844385
TOTAL Feasibility Study Estimate For:	1.00	EA	2,082,899	566,313	0	244,174	158,469	3,051,856	3051856

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
01 Lands and Damages	1.00	EA	180,410	0	0	0	0	180,410	180409.50
11 Levees and Floodwalls	1.00	EA	1,526,127	0	183,135	170,926	22,302	1,902,490	1902490
TOTAL Feasibility Study Estimate For:	1.00	EA	1,706,536	0	183,135	170,926	22,302	2,082,899	2082899
Contingency								566,313	
SUBTOTAL								2,649,212	
Engineering & Design								244,174	
SUBTOTAL								2,893,387	
Supervision & Administration								158,469	
TOTAL INCL OWNER COSTS								3,051,856	

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
01 Lands and Damages									
01.23 Land Values									
01.23.01 Land Values									
01.23.01.01 Land Values									
01.23.01.01.01 Borrow Area-Sta 250+00 to 265+00	42.00	ACR	79,800	0	0	0	0	79,800	1900.00
01.23.01.01.02 Sta 205+50 to 209+50	2.65	ACR	2,043	0	0	0	0	2,043	770.75
01.23.01.01.03 Sta 209+50 to 237+50	10.75	ACR	7,790	0	0	0	0	7,790	724.65
01.23.01.01.04 Sta 237+50 to 257+50	19.00	ACR	12,825	0	0	0	0	12,825	675.00
01.23.01.01.05 Sta 257+50 to 262+50	3.85	ACR	2,660	0	0	0	0	2,660	690.91
01.23.01.01.06 Sta 262+50 to 288+50	10.60	ACR	8,702	0	0	0	0	8,702	820.94
01.23.01.01.07 Sta 288+50 to 292+50	2.05	ACR	1,634	0	0	0	0	1,634	797.07
01.23.01.01.08 Sta 292+50 to 295+00	1.00	ACR	836	0	0	0	0	836	836.00
TOTAL Land Values	1.00	EA	116,290	0	0	0	0	116,290	116289.50
01.23.01.02 Non Federal Sponsors Costs									
01.23.01.02.09 NFS Costs	1.00	EA	44,400	0	0	0	0	44,400	44400.00
TOTAL Non Federal Sponsors Costs	1.00	EA	44,400	0	0	0	0	44,400	44400.00
01.23.01.03 Federal Costs									
01.23.01.03.10 Federal Costs	1.00	EA	19,720	0	0	0	0	19,720	19720.00
TOTAL Federal Costs	1.00	EA	19,720	0	0	0	0	19,720	19720.00
TOTAL Land Values	1.00	EA	180,410	0	0	0	0	180,410	180409.50
TOTAL Land Values	1.00	EA	180,410	0	0	0	0	180,410	180409.50
TOTAL Lands and Damages	1.00	EA	180,410	0	0	0	0	180,410	180409.50
02 Relocations									
02.01 Utility Relocations									
02.01.03 Cemetery, Utilities, & Structure									
02.01.03.18 Utilities Crossing Levee									
02.01.03.18.11 Utilities Crossing Levee - NONE									
02.01.03.20 Utilities Affected by Uplift									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
02.01.03.20.12 Util affected by uplift - NONE									
06 Fish & Wildlife Facilities									
11 Levees and Floodwalls									
11.01 Levees									
11.01.01 Relief Wells									
11.01.02 Borrow Sites & Site Prep									
11.01.02.01 Site Prep Sta 250+00 to 265+00									
11.01.02.01.13 Stripping/Windrow Material	13889.00	CY	16,162	0	1,939	1,810	236	20,148	1.45
TOTAL Site Prep Sta 250+00 to 265+00	13889.00	CY	16,162	0	1,939	1,810	236	20,148	1.45
11.01.02.02 Low Water Crossing - Sta 232+00									
11.01.02.02.14 Low Water Crossing - Sta 232+00									
11.01.02.02.14.01 Low Water Crossing - Sta 232+00	1.00	EA	5,000	0	600	560	73	6,233	6233.07
TOTAL Low Water Crossing - Sta 232+00	1.00	EA	5,000	0	600	560	73	6,233	6233.07
TOTAL Low Water Crossing - Sta 232+00	1.00	EA	5,000	0	600	560	73	6,233	6233.07
11.01.02.10 Final Grade Site									
11.01.02.10.15 Final Grade Sta 250+00 to 265+00	13889.00	CY	16,136	0	1,936	1,807	236	20,115	1.45
TOTAL Final Grade Site	1.00	EA	16,136	0	1,936	1,807	236	20,115	20114.93
TOTAL Borrow Sites & Site Prep	1.00	EA	37,298	0	4,476	4,177	545	46,496	46496.04
11.01.03 Stripping Levee									
11.01.03.05 Remove Aggr Sta 205+64 to 294+93									
11.01.03.05.16 Excavate Aggregate from Levee	1654.00	BCY	915	0	110	102	13	1,140	0.69
TOTAL Remove Aggr Sta 205+64 to 294+93	1654.00	BCY	915	0	110	102	13	1,140	0.69
11.01.03.06 Strip Levee-Less than 1' Raise									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.03.06.17 Strip Topsoil from Levee	3065.35	BCY	2,227	0	267	249	33	2,776	0.91
11.01.03.06.18 Windrow Material	3065.35	BCY	1,130	0	136	127	17	1,409	0.46
TOTAL Strip Levee-Less than 1' Raise	3.80	ACR	3,357	0	403	376	49	4,185	1101.23
11.01.03.09 Strip Berm-Less than 1' Raise									
11.01.03.09.19 Strip Topsoil from Levee	38800.83	BCY	53,086	0	6,370	5,946	776	66,177	1.71
11.01.03.09.20 Windrow Material	38800.83	BCY	14,967	0	1,796	1,676	219	18,658	0.48
TOTAL Strip Berm-Less than 1' Raise	48.10	ACR	68,053	0	8,166	7,622	994	84,836	1763.74
TOTAL Stripping Levee	43519.00	BCY	72,324	0	8,679	8,100	1,057	90,161	2.07
11.01.04 Levee Raise (Impervious)									
11.01.04.01 Exc/Haul Matl-Sta 205+64-257+50									
11.01.04.01.21 Exc/Haul	3001.25	BCY	10,702	0	1,284	1,199	156	13,341	4.45
TOTAL Exc/Haul Matl-Sta 205+64-257+50	3001.25	BCY	10,702	0	1,284	1,199	156	13,341	4.45
11.01.04.02 Exc/Haul Matl-Sta 257+50-294+93									
11.01.04.02.22 Exc/Haul	2486.25	BCY	8,865	0	1,064	993	130	11,052	4.45
TOTAL Exc/Haul Matl-Sta 257+50-294+93	2486.25	BCY	8,865	0	1,064	993	130	11,052	4.45
11.01.04.03 Place Material									
11.01.04.03.23 Scarify Existing Surface	133935.00	SF	342	0	41	38	5	426	0.00
11.01.04.03.24 Place	5487.50	BCY	7,110	0	853	796	104	8,863	1.62
TOTAL Place Material	5487.50	BCY	7,452	0	894	835	109	9,289	1.69
TOTAL Levee Raise (Impervious)	4390.00	CCY	27,019	0	3,242	3,026	395	33,682	7.67
11.01.07 Underseepage Berm (Random)									
11.01.07.02 Exc/Haul Matl-Sta 205+64- 257+00									
11.01.07.02.25 Exc/Haul	162793.75	BCY	580,486	0	69,658	65,014	8,483	723,641	4.45
TOTAL Exc/Haul Matl-Sta 205+64- 257+00	162793.75	BCY	580,486	0	69,658	65,014	8,483	723,641	4.45

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.07.03 Exc/Haul Matl-Sta 257+00- 294+93									
11.01.07.03.26 Exc/Haul	83327.50	BCY	297,127	0	35,655	33,278	4,342	370,403	4.45
TOTAL Exc/Haul Matl-Sta 257+00- 294+93	83327.50	BCY	297,127	0	35,655	33,278	4,342	370,403	4.45
11.01.07.53 Place Material									
11.01.07.53.27 Scarify Existing Surface	1785800	SF	4,560	0	547	511	67	5,685	0.00
11.01.07.53.28 Place	244467.25	BCY	294,839	0	35,381	33,022	4,309	367,550	1.50
11.01.07.53.29 Spread Aggregate Surfacing Matl	1654.00	BCY	784	0	94	88	11	978	0.59
TOTAL Place Material	246121.25	BCY	300,183	0	36,022	33,621	4,387	374,213	1.52
TOTAL Underseepage Berm (Random)	196897.00	CCY	1,177,796	0	141,336	131,913	17,212	1,468,257	7.46
11.01.27 Seeding & Mulching									
11.01.27.01 Seeding & Mulching									
11.01.27.01.30 Seeding & Mulching									
11.01.27.01.30.01 Seeding & Mulching	14.70	ACR	22,050	0	2,646	2,470	322	27,488	1869.92
TOTAL Seeding & Mulching	14.70	ACR	22,050	0	2,646	2,470	322	27,488	1869.92
TOTAL Seeding & Mulching	14.70	ACR	22,050	0	2,646	2,470	322	27,488	1869.92
TOTAL Seeding & Mulching	14.70	ACR	22,050	0	2,646	2,470	322	27,488	1869.92
11.01.28 Replace Aggregate Surfacing									
11.01.28.27 Replace Aggregate Surfacing									
11.01.28.27.31 Replace Aggregate Surfacing									
11.01.28.27.31.01 Replace Aggregate Surfacing	3143.00	TON	51,928	0	6,231	5,816	759	64,734	20.60
TOTAL Replace Aggregate Surfacing	3143.00	TON	51,928	0	6,231	5,816	759	64,734	20.60
TOTAL Replace Aggregate Surfacing	3143.00	TON	51,928	0	6,231	5,816	759	64,734	20.60
TOTAL Replace Aggregate Surfacing	1654.00	CCY	51,928	0	6,231	5,816	759	64,734	39.14
11.01.29 Replace Stripped Material									
11.01.29.06 Repl Lev w/ less than 1' Raise									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.29.06.32 Push Topsoil to Levee	3065.35	BCY	2,227	0	267	249	33	2,776	0.91
11.01.29.06.33 Finish Grade Lev for TS Placemnt	3.80	ACR	3,771	0	452	422	55	4,701	1237.03
TOTAL Repl Lev w/ less than 1' Raise	3.80	ACR	5,997	0	720	672	88	7,476	1967.47
11.01.29.09 Repl Berm-Less than 1' Raise									
11.01.29.09.34 Push Topsoil to Berm	36542.15	BCY	53,086	0	6,370	5,946	776	66,177	1.81
11.01.29.09.35 Finish Grade Lev for TS Placemnt	45.30	ACR	44,952	0	5,394	5,035	657	56,038	1237.03
TOTAL Repl Berm-Less than 1' Raise	45.30	ACR	98,038	0	11,765	10,980	1,433	122,215	2697.90
TOTAL Replace Stripped Material	41865.00	CY	104,035	0	12,484	11,652	1,520	129,691	3.10
11.01.30 Slope Protection									
11.01.30.27 Place Bedding Material									
11.01.30.27.36 Place Bedding Material									
11.01.30.27.36.01 Place Bedding Material	350.00	TON	7,703	0	924	863	113	9,603	27.44
TOTAL Place Bedding Material	350.00	TON	7,703	0	924	863	113	9,603	27.44
TOTAL Place Bedding Material	350.00	TON	7,703	0	924	863	113	9,603	27.44
11.01.30.28 Place Riprap Protection									
11.01.30.28.37 Place Riprap Protection									
11.01.30.28.37.01 Place Riprap Protection	1000.00	TON	25,973	0	3,117	2,909	380	32,378	32.38
TOTAL Place Riprap Protection	1000.00	TON	25,973	0	3,117	2,909	380	32,378	32.38
TOTAL Place Riprap Protection	1000.00	TON	25,973	0	3,117	2,909	380	32,378	32.38
TOTAL Slope Protection	1.00	EA	33,676	0	4,041	3,772	492	41,981	41980.82
11.01.31 Drainage Systems									
TOTAL Levees	1.00	EA	1,526,127	0	183,135	170,926	22,302	1,902,490	1902490
11.02 Floodwalls - NONE									
TOTAL Levees and Floodwalls	1.00	EA	1,526,127	0	183,135	170,926	22,302	1,902,490	1902490
TOTAL Feasibility Study Estimate For:	1.00	EA	1,706,536	0	183,135	170,926	22,302	2,082,899	2082899

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
Contingency							566,313	
SUBTOTAL							2,649,212	
Engineering & Design							244,174	
SUBTOTAL							2,893,387	
Supervision & Administration							158,469	
TOTAL INCL OWNER COSTS							3,051,856	

No errors detected...

* * * END OF ERROR REPORT * * *

Feasibility Study Estimate for:
R470-461
St. Joseph, Missouri
Nominal 100 Yr +3ft Levee Raise
dated 18 Jul 2006

Designed By: CENWK
Estimated By: CENWK-EC-DC

Prepared By: Patrick Miramontez 816-983-3322
LATEST ESTIMATE AS OF 18 Jul 06

Preparation Date: 01/10/06
Effective Date of Pricing: 10/01/05

Sales Tax: 0.00%

01- Lands & Damages - The costs include the acquisition of Permanent Right-of-Way, Temporary Right-of-Way, and borrow areas. Also included, where necessary, is the relocation cost of businesses that infringe on the footprint of the raised levee. These costs include Non Federal Sponsors cost to perform the Legal work, Title Work, Tract appraisals, and land surveys, as well as Federal labor costs.

02 - Relocations - This item currently includes only utility relocations. There are two types of utility relocations:

1) Utilities crossing the levee - These are utilities identified as having to be removed from their current location and placed up and over the new levee raise. This will require a fill zone that will be evident above the levee projected lines. All abandoned pipes crossing the levee will be removed.

2) Fences, Gates, and Power Poles - These structures/utilities are currently in or near the levee. They will be impacted in the levee raise, and therefore will need to be relocated.

06 - Fish & Wildlife Facilities - An allowance of $500,000 was included to allow for mitigation of the borrow areas. Specifics of the plan are currently not known.

11 - Levees & Floodwalls- The levees cost consists of 4 different components. These components include: 1) Relief Wells, 2) Borrow Site, 3) Levee Raise (including Levee Cut, Levee Raise, Stability (Riverside Berms) and Underseepage berms), and 4) Drainage System Modifications.

- Relief Wells - Relief Wells are placed in areas of tight congestion to avoid the costly displacement of businesses. The costs are based on 10" stainless steel wells. It is assumed 22 new wells will be required at varying depths based on current analysis. To be refined in final plan.

- Borrow Site - It is currently assumed two borrow sites will be utilized. It is assumed 100% of the material will come from the borrow sites located a maximum of 4.2 miles from the levee centroid. The costs include the preparation of the borrow site, and the final grading of the borrow site when completed. Also included is additional clearing of trees in the levee ROW.

- Levee Cut - Quantities for the levee cut were based on the removal of the aggregate surfacing on top of the levee, and the stripping of topsoil from the landside of the existing levee. It was assumed this material will be dozed off and windrowed next to the levee.

- Levee Raise (including Stability/Underseepage Berms) - Quantities for the levee raise was calculated by using In-Roads CAD software and then hand manipulated. Haul distances were hand calculated based on the borrow site locations and the quantities required. Haul distances vary from 0.55 miles to 4.22 miles. The material is to be excavated, loaded, and hauled using off-highway dump trucks over the existing ramps and new ramps and low water crossings where needed. A cost is also included for new aggregate surfacing and seeding and mulching.

- Drainage System Modifications - This item includes costs to raise existing platforms on gatewells due to levee raises and the complete replacement of one gatewell.

- Floodwalls - None in this contract.

30 - Estimated Engineering & Design Cost = 10% of project implementation (less lands & damages) cost. To be refined.

31 - Estimated Construction Supervision & Administration = 6.5% of project implementation (less lands & damages) cost. To be refined.

Areas of Cost Sensitivity

- Estimate does not include any costs for sampling/testing for HTRW.
- Estimate does not include any costs for the hauling and disposal of HTRW.
- Estimate does not include O&M costs. Only project implementation (construction, real-estate and associated) costs.
- Estimate based on borrow source located at Approx Right Bank Levee Stations 93+09 to 215+00, and Sta 471+20 to 610+00. If this borrow is not available for use additional costs will have to be considered.

General Cost Information

- The quantities have been calculated by EC-GD, EC-DC, and EC-DS. A contingency determination meeting will be held with all of the designers to apply the appropriate amount of contingency to each line item.
- No tax has been included for the state of Missouri.
- The source for the labor rates used in the estimate is the Dec 2005 Department of Labor Wage rates for Buchanon County, Missouri.
- The national 2001 Unit Price Book is used to price minor items. Quotes were received for major cost items. An adjustment factor is added to bring the rates to the appropriate price level date.
- 2005 equipment rates were used.
- Once all of the databases are normalized to the appropriate price level date an escalation factor will be added to the owner level to bring the estimate to the appropriate price level date. The escalation factors used were derived from the Civil Works Construction Cost Index System (CWCCIS) EM1110-2-1304.

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

** PROJECT OWNER SUMMARY - Feature **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
01 Lands and Damages	1.00	EA	2,373,298	355,995	0	0	0	2,729,293	2729293
02 Relocations	1.00	EA	295,409	59,082	0	35,449	23,006	412,947	412946.67
06 Fish & Wildlife Facilities	1.00	EA	500,000	0	0	50,000	32,450	582,450	582450.00
11 Levees and Floodwalls	1.00	EA	16,606,176	4,055,680	0	2,066,186	1,340,954	24,068,996	24068996
TOTAL Feasibility Study Estimate for:	1.00	EA	19,774,883	4,470,756	0	2,151,635	1,396,411	27,793,685	27793685

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
01 Lands and Damages									
01.23 Land Values									
01.23.01 Land Values									
01.23.01.01 Land Values									
01.23.01.01.01 Borrow Area	1000.00	ACR	2,000,000	300,000	0	0	0	2,300,000	2300.00
01.23.01.01.02 Sta 93+00 to 132+00	9.13	ACR	13,262	1,989	0	0	0	15,251	1670.46
01.23.01.01.03 Sta 132+00 to 161+50	14.47	ACR	15,164	2,275	0	0	0	17,439	1205.16
01.23.01.01.04 Sta 161+50 to 228+50	48.84	ACR	38,460	5,769	0	0	0	44,229	905.59
01.23.01.01.05 Sta 228+50 to 281+50	26.46	ACR	19,768	2,965	0	0	0	22,733	859.15
01.23.01.01.06 Sta 281+50 to 299+50	14.72	ACR	8,832	1,325	0	0	0	10,157	690.00
01.23.01.01.07 Sta 299+50 to 331+50	9.43	ACR	10,684	1,603	0	0	0	12,287	1302.93
01.23.01.01.08 Sta 331+50 to 341+50	2.67	ACR	4,052	608	0	0	0	4,660	1745.24
01.23.01.01.09 Sta 341+50 to 404+50	46.35	ACR	31,086	4,663	0	0	0	35,749	771.28
01.23.01.01.10 Sta 404+50 to 492+50	45.15	ACR	41,706	6,256	0	0	0	47,962	1062.28
01.23.01.01.11 Sta 492+50 to 516+50	19.07	ACR	17,042	2,556	0	0	0	19,598	1027.70
01.23.01.01.12 Sta 516+50 to 600+50	77.09	ACR	60,618	9,093	0	0	0	69,711	904.28
01.23.01.01.13 Sta 600+50 to 639+84	17.58	ACR	18,164	2,725	0	0	0	20,889	1188.20
TOTAL Land Values	1.00	EA	2,278,838	341,826	0	0	0	2,620,664	2620664
01.23.01.02 Non Federal Sponsors Costs									
01.23.01.02.14 NFS Costs	1.00	EA	64,900	9,735	0	0	0	74,635	74635.00
TOTAL Non Federal Sponsors Costs	1.00	EA	64,900	9,735	0	0	0	74,635	74635.00
01.23.01.03 Federal Costs									
01.23.01.03.15 Federal Costs	1.00	EA	29,560	4,434	0	0	0	33,994	33994.00
TOTAL Federal Costs	1.00	EA	29,560	4,434	0	0	0	33,994	33994.00
TOTAL Land Values	1.00	EA	2,373,298	355,995	0	0	0	2,729,293	2729293
TOTAL Land Values	1.00	EA	2,373,298	355,995	0	0	0	2,729,293	2729293
TOTAL Lands and Damages	1.00	EA	2,373,298	355,995	0	0	0	2,729,293	2729293
02 Relocations									
02.01 Utility Relocations									
02.01.03 Cemetery, Utilities, & Structure									

** PROJECT OWNER SUMMARY - Assembly **

		QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
02.01.03.18	Utilities Crossing Levee									
02.01.03.18.16	UL1- Sta 53+38 - 16" SP - No Act									
02.01.03.18.17	UL2- Sta 300+00-16" DIP waterlin									
02.01.03.18.17.01	Excavation for Bypass	355.00	CY	8,475	1,695	0	1,017	660	11,848	33.37
02.01.03.18.17.02	16" Ductile Iron Pipe	300.00	LF	36,272	7,254	0	4,353	2,825	50,704	169.01
02.01.03.18.17.03	16" Ductile Iron Fittings	6.00	EA	16,808	3,362	0	2,017	1,309	23,496	3915.99
02.01.03.18.17.04	Air Release Valve/Chamber	1.00	EA	6,578	1,316	0	789	512	9,195	9195.24
02.01.03.18.17.05	Final Cutover Connection	6.00	HR	3,679	736	0	441	286	5,142	857.04
02.01.03.18.17.24	Excavation for Demolition	714.00	CY	8,475	1,695	0	1,017	660	11,848	16.59
02.01.03.18.17.25	Removal of Existing Waterline	284.00	LF	4,506	901	0	541	351	6,298	22.18
02.01.03.18.17.26	Excavate & Haul BF Material	2022.00	BCY	17,201	3,440	0	2,064	1,340	24,045	11.89
02.01.03.18.17.27	Backfill/Compaction	3108.00	CY	12,996	2,599	0	1,560	1,012	18,167	5.85
	TOTAL UL2- Sta 300+00-16" DIP waterlin	1.00	EA	114,990	22,998	0	13,799	8,955	160,742	160742.40
02.01.03.18.18	UL3- Sta 417+65 - 8" Gas Pipe									
02.01.03.18.18.01	Excavation for Bypass	804.00	CY	8,475	1,695	0	1,017	660	11,848	14.74
02.01.03.18.18.02	8" Dia Gas Line	300.00	LF	20,126	4,025	0	2,415	1,567	28,134	93.78
02.01.03.18.18.03	8" Gas Line Fittings	6.00	EA	5,628	1,126	0	675	438	7,868	1311.28
02.01.03.18.18.04	Final Cutover Connection	4.00	HR	2,466	493	0	296	192	3,447	861.82
02.01.03.18.18.05	Excavation for Demolition	3760.00	BCY	21,189	4,238	0	2,543	1,650	29,619	7.88
02.01.03.18.18.06	Removal of Existing Gas Line	120.00	LF	1,408	282	0	169	110	1,968	16.40
02.01.03.18.18.07	Excavate & Haul BF Material	600.00	BCY	6,450	1,290	0	774	502	9,017	15.03
02.01.03.18.18.08	Backfill/Compaction	5264.00	BCY	28,505	5,701	0	3,421	2,220	39,846	7.57
02.01.03.18.18.09	Contingency plan	1.00	EA	25,000	5,000	0	3,000	1,947	34,947	34947.00
	TOTAL UL3- Sta 417+65 - 8" Gas Pipe	1.00	EA	119,247	23,849	0	14,310	9,287	166,693	166693.12
02.01.03.18.19	UL4- Sta 418+15 - Telephone Cbl									
02.01.03.18.19.02	New Telephone Cable incl Exc	200.00	LF	12,469	2,494	0	1,496	971	17,431	87.15
02.01.03.18.19.05	Splice Connection & Testing	1.00	EA	4,094	819	0	491	319	5,723	5722.69
02.01.03.18.19.24	Excavation for Demolition	295.00	CY	3,798	760	0	456	296	5,309	18.00
02.01.03.18.19.27	Backfill/Compaction	300.00	CY	2,661	532	0	319	207	3,720	12.40
	TOTAL UL4- Sta 418+15 - Telephone Cbl	1.00	EA	23,022	4,604	0	2,763	1,793	32,183	32182.53
02.01.03.18.21	UL6- Sta 5+1.47 - 8" VCP-No Act									
	TOTAL Utilities Crossing Levee	1.00	EA	257,260	51,452	0	30,871	20,035	359,618	359618.05
02.01.03.20	Fencing, Gates, & Power Poles									

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
02.01.03.20.22 Fencing, Gates, and Power Poles									
02.01.03.20.22.01 Sta 269+12-Rem/Repl Wood Post/Gt	2.00	EA	1,918	384	0	230	149	2,681	1340.46
02.01.03.20.22.02 Sta 269+12-Rem/Repl Barbed Wire	1000.00	LF	4,315	863	0	518	336	6,032	6.03
02.01.03.20.22.03 Sta 269+12-Relocate Power Poles	6.00	EA	12,000	2,400	0	1,440	935	16,775	2795.76
02.01.03.20.22.04 Sta 269+12-Clearing for Poles	1.00	EA	1,226	245	0	147	96	1,714	1714.35
02.01.03.20.22.05 Sta 404+00 - Clearing	1.00	EA	1,745	349	0	209	136	2,439	2438.91
02.01.03.20.22.06 Sta 404+00-Rem CLF/gate	140.00	LF	718	144	0	86	56	1,004	7.17
02.01.03.20.22.07 Sta 404+00-New CLF/gate	1.00	EA	2,718	544	0	326	212	3,800	3799.89
02.01.03.20.22.08 Sta 418+00-Rem gate	1.00	EA	359	72	0	43	28	502	501.96
02.01.03.20.22.09 Sta 418+00-New gate	1.00	EA	589	118	0	71	46	823	823.32
02.01.03.20.22.10 Sta 418+00-Rem/Repl Barbed Wire	130.00	LF	561	112	0	67	44	784	6.03
02.01.03.20.22.11 Remove/Replace Additional Gates	6.00	EA	12,000	2,400	0	1,440	935	16,775	2795.76
TOTAL Fencing, Gates, and Power Poles	1.00	EA	38,150	7,630	0	4,578	2,971	53,329	53328.62
TOTAL Fencing, Gates, & Power Poles	1.00	EA	38,150	7,630	0	4,578	2,971	53,329	53328.62
TOTAL Cemetery, Utilities, & Structure			295,409	59,082	0	35,449	23,006	412,947	
TOTAL Utility Relocations	1.00	EA	295,409	59,082	0	35,449	23,006	412,947	412946.67
TOTAL Relocations	1.00	EA	295,409	59,082	0	35,449	23,006	412,947	412946.67
06 Fish & Wildlife Facilities									
06.03 Fish & Wildlife Fac/Sanc									
06.03.99 Associated General Items									
06.03.99.01 Environmental Enhancement									
06.03.99.01.23 Environmental Enhancement	1.00	EA	500,000	0	0	50,000	32,450	582,450	582450.00
TOTAL Environmental Enhancement	1.00	EA	500,000	0	0	50,000	32,450	582,450	582450.00
TOTAL Associated General Items	1.00	EA	500,000	0	0	50,000	32,450	582,450	582450.00
TOTAL Fish & Wildlife Fac/Sanc	1.00	EA	500,000	0	0	50,000	32,450	582,450	582450.00
TOTAL Fish & Wildlife Facilities	1.00	EA	500,000	0	0	50,000	32,450	582,450	582450.00
11 Levees and Floodwalls									
11.01 Levees									
11.01.01 Relief Wells									
11.01.01.01 Sta 292+00 to 327+00									

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.01.01.24 New Relief Wells									
11.01.01.01.24.01 RW Sta 292+00 to 327+00	22.00	EA	899,755	179,951	0	107,971	70,073	1,257,750	57170.46
TOTAL New Relief Wells	22.00	EA	899,755	179,951	0	107,971	70,073	1,257,750	57170.46
11.01.01.01.25 Abandon Existing Relief Wells									
11.01.01.01.25.01 RW Sta 292+00 to 327+00	20.00	EA	19,149	3,830	0	2,298	1,491	26,768	1338.38
TOTAL Abandon Existing Relief Wells	20.00	EA	19,149	3,830	0	2,298	1,491	26,768	1338.38
TOTAL Sta 292+00 to 327+00	22.00	EA	918,904	183,781	0	110,268	71,564	1,284,518	58387.16
TOTAL Relief Wells	1.00	EA	918,904	183,781	0	110,268	71,564	1,284,518	1284518
11.01.02 Borrow Sites & Site Prep									
11.01.02.01 Site Prep Sta 93+09 to 215+00									
11.01.02.01.26 Stripping/Windrow Material	112880.00	CY	147,269	29,454	0	17,672	11,469	205,864	1.82
TOTAL Site Prep Sta 93+09 to 215+00	112880.00	CY	147,269	29,454	0	17,672	11,469	205,864	1.82
11.01.02.05 Site Prep Sta 471+20 to 610+00									
11.01.02.05.27 Site Prep New Borrow Site	159.00	ACR	16,403	3,281	0	1,968	1,277	22,930	144.21
11.01.02.05.28 Clearing and Grub Site	159.00	ACR	388,146	97,037	0	48,518	31,488	565,189	3554.65
11.01.02.05.29 Push Cleared Material to Piles	106.00	PIL	27,771	5,554	0	3,332	2,163	38,820	366.23
11.01.02.05.30 Maintain Burning Piles	106.00	PIL	19,648	3,930	0	2,358	1,530	27,466	259.11
TOTAL Site Prep Sta 471+20 to 610+00	159.00	ACR	451,968	109,801	0	56,177	36,459	654,405	4115.75
11.01.02.06 Additional Clearing & Grubbing									
11.01.02.06.2A Sta 496+00 to Sta 558+50	50.70	ACR	52,282	13,071	0	6,535	4,241	76,129	1501.56
11.01.02.06.2B Sta 558+50 to 610+00 (landward)	23.70	ACR	127,852	31,963	0	15,981	10,372	186,168	7855.19
11.01.02.06.2C Sta 610+00 to 639+84 (landward)	11.10	ACR	59,880	14,970	0	7,485	4,858	87,193	7855.19
11.01.02.06.2D Push Cleared Material to Piles	57.00	PIL	14,933	3,733	0	1,867	1,211	21,745	381.49
11.01.02.06.2E Maintain Burning Piles	57.00	PIL	10,566	2,641	0	1,321	857	15,385	269.91
TOTAL Additional Clearing & Grubbing	85.50	ACR	265,512	66,378	0	33,189	21,540	386,619	4521.86
11.01.02.10 Final Grade Both Sites									
11.01.02.10.31 Final Grade Sta 93+09 to 215+00	112880.00	CY	162,771	32,554	0	19,532	12,677	227,534	2.02

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.02.10.32 Final Grade Sta 471+20 to 610+00	159.00	ACR	137,565	27,513	0	16,508	10,714	192,299	1209.43
TOTAL Final Grade Both Sites	2.00	EA	300,335	60,067	0	36,040	23,390	419,833	209916.47
11.01.02.15 Ramps for Levee Crossings									
11.01.02.15.33 Ramps for Levee Crossings	4200.00	CY	28,055	5,611	0	3,367	2,185	39,218	9.34
TOTAL Ramps for Levee Crossings	7.00	EA	28,055	5,611	0	3,367	2,185	39,218	5602.55
11.01.02.20 Remove Ramps at Project End									
11.01.02.20.34 Remove Ramps at Project End	4200.00	CY	23,976	4,795	0	2,877	1,867	33,516	7.98
TOTAL Remove Ramps at Project End	7.00	EA	23,976	4,795	0	2,877	1,867	33,516	4788.03
11.01.02.25 Low Water Crossings									
11.01.02.25.35 Low Water Crossings									
11.01.02.25.35.01 Low Water Crossings	13.00	EA	80,678	16,136	0	9,681	6,283	112,779	8675.27
TOTAL Low Water Crossings	13.00	EA	80,678	16,136	0	9,681	6,283	112,779	8675.27
TOTAL Low Water Crossings	13.00	EA	80,678	16,136	0	9,681	6,283	112,779	8675.27
TOTAL Borrow Sites & Site Prep	1.00	EA	1,297,795	292,242	0	159,004	103,193	1,852,234	1852234
11.01.03 Stripping Levee									
11.01.03.05 Remove Aggr Sta 93+09 to 639+84									
11.01.03.05.36 Excavate Aggregate from Levee	10125.00	BCY	6,951	1,390	0	834	541	9,716	0.96
TOTAL Remove Aggr Sta 93+09 to 639+84	10125.00	BCY	6,951	1,390	0	834	541	9,716	0.96
11.01.03.06 Strip Levee-Less than 1' Raise									
11.01.03.06.37 Strip Topsoil from Levee	2178.01	BCY	1,768	354	0	212	138	2,471	1.13
11.01.03.06.38 Windrow Material	2178.01	BCY	997	199	0	120	78	1,393	0.64
TOTAL Strip Levee-Less than 1' Raise	2.70	ACR	2,765	553	0	332	215	3,865	1431.30
11.01.03.07 Strip Levee - > than 1' < 3' Rse									

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.03.07.39 Strip Topsoil from Levee	37590.82	BCY	30,510	6,102	0	3,661	2,376	42,649	1.13
11.01.03.07.40 Windrow Material	37590.82	BCY	17,204	3,441	0	2,064	1,340	24,049	0.64
TOTAL Strip Levee - > than 1' < 3' Rse	46.60	ACR	47,714	9,543	0	5,726	3,716	66,698	1431.29
11.01.03.08 Strip Levee - > than </= 3' Rse									
11.01.03.08.41 Strip Topsoil from Levee	3226.68	BCY	2,619	524	0	314	204	3,661	1.13
11.01.03.08.42 Windrow Material	3226.68	BCY	1,477	295	0	177	115	2,064	0.64
TOTAL Strip Levee - > than </= 3' Rse	4.00	ACR	4,096	819	0	491	319	5,725	1431.29
11.01.03.09 Strip Berm-Less than 1' Raise									
11.01.03.09.43 Strip Topsoil from Levee	12100.05	BCY	19,641	4,910	0	2,455	1,593	28,600	2.36
11.01.03.09.44 Windrow Material	12100.05	BCY	5,538	1,384	0	692	449	8,064	0.67
TOTAL Strip Berm-Less than 1' Raise	15.00	ACR	25,179	6,295	0	3,147	2,043	36,664	2444.28
11.01.03.10 Strip Berm- > than 1' > 3' Raise									
11.01.03.10.45 Strip Topsoil from Levee	182710.76	BCY	296,586	74,147	0	37,073	24,061	431,867	2.36
11.01.03.10.46 Windrow Material	182710.76	BCY	83,621	20,905	0	10,453	6,784	121,762	0.67
TOTAL Strip Berm- > than 1' > 3' Raise	226.50	ACR	380,207	95,052	0	47,526	30,844	553,629	2444.28
11.01.03.11 Strip Berm- >/= 3' Raise									
11.01.03.11.47 Strip Topsoil from Levee	23312.76	BCY	37,843	9,461	0	4,730	3,070	55,104	2.36
11.01.03.11.48 Windrow Material	23312.76	BCY	10,670	2,667	0	1,334	866	15,536	0.67
TOTAL Strip Berm- >/= 3' Raise	28.90	ACR	48,512	12,128	0	6,064	3,936	70,640	2444.28
TOTAL Stripping Levee	271244.00	BCY	515,423	125,780	0	64,120	41,614	746,937	2.75
11.01.04 Levee Raise (Impervious)									
11.01.04.01 Exc/Haul Matl-Sta 93+09 - 114+00									
11.01.04.01.49 Exc/Haul	1166.25	BCY	5,162	1,032	0	619	402	7,215	6.19
TOTAL Exc/Haul Matl-Sta 93+09 - 114+00	1166.25	BCY	5,162	1,032	0	619	402	7,215	6.19
11.01.04.02 Exc/Haul Matl-Sta 600+00- 639+84									

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.04.02.50 Exc/Haul	2061.25	BCY	9,123	1,825	0	1,095	710	12,753	6.19
TOTAL Exc/Haul Matl-Sta 600+00- 639+84	2061.25	BCY	9,123	1,825	0	1,095	710	12,753	6.19
11.01.04.03 Exc/Haul Matl-Sta 114+00- 228+00									
11.01.04.03.51 Exc/Haul	23696.25	BCY	104,876	20,975	0	12,585	8,168	146,604	6.19
TOTAL Exc/Haul Matl-Sta 114+00- 228+00	23696.25	BCY	104,876	20,975	0	12,585	8,168	146,604	6.19
11.01.04.04 Exc/Haul Matl-Sta 228+00- 375+00									
11.01.04.04.52 Exc/Haul	34861.25	BCY	219,156	43,831	0	26,299	17,068	306,354	8.79
TOTAL Exc/Haul Matl-Sta 228+00- 375+00	34861.25	BCY	219,156	43,831	0	26,299	17,068	306,354	8.79
11.01.04.05 Exc/Haul Matl-Sta 419+00- 467+00									
11.01.04.05.53 Exc/Haul	11558.75	BCY	51,157	10,231	0	6,139	3,984	71,512	6.19
TOTAL Exc/Haul Matl-Sta 419+00- 467+00	11558.75	BCY	51,157	10,231	0	6,139	3,984	71,512	6.19
11.01.04.06 Exc/Haul Matl-Sta 467+00- 600+00									
11.01.04.06.54 Exc/Haul	23607.50	BCY	104,483	20,897	0	12,538	8,137	146,055	6.19
TOTAL Exc/Haul Matl-Sta 467+00- 600+00	23607.50	BCY	104,483	20,897	0	12,538	8,137	146,055	6.19
11.01.04.07 Exc/Haul Matl-Sta 375+00- 398+00									
11.01.04.07.55 Exc/Haul	6402.50	BCY	48,192	9,638	0	5,783	3,753	67,366	10.52
TOTAL Exc/Haul Matl-Sta 375+00- 398+00	6402.50	BCY	48,192	9,638	0	5,783	3,753	67,366	10.52
11.01.04.08 Exc/Haul Matl-Sta 398+00- 419+00									
11.01.04.08.56 Exc/Haul	6093.75	BCY	38,308	7,662	0	4,597	2,983	53,551	8.79
TOTAL Exc/Haul Matl-Sta 398+00- 419+00	6093.75	BCY	38,308	7,662	0	4,597	2,983	53,551	8.79
11.01.04.52 Place Material									
11.01.04.52.57 Scarify Existing Surface	2187000	SF	6,932	1,386	0	832	540	9,690	0.00

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.04.52.58 Place	109447.50	BCY	176,006	35,201	0	21,121	13,707	246,035	2.25
TOTAL Place Material	109447.50	BCY	182,938	36,588	0	21,953	14,247	255,726	2.34
TOTAL Levee Raise (Impervious)	87558.00	CCY	763,396	152,679	0	91,608	59,453	1,067,136	12.19
11.01.05 Levee Raise (Random)									
11.01.05.03 Exc/Haul Matl-Sta 114+00- 228+00									
11.01.05.03.59 Exc/Haul	54895.00	BCY	242,957	48,591	0	29,155	18,922	339,625	6.19
TOTAL Exc/Haul Matl-Sta 114+00- 228+00	54895.00	BCY	242,957	48,591	0	29,155	18,922	339,625	6.19
11.01.05.04 Exc/Haul Matl-Sta 228+00- 375+00									
11.01.05.04.60 Exc/Haul	124602.50	BCY	783,318	156,664	0	93,998	61,005	1,094,984	8.79
TOTAL Exc/Haul Matl-Sta 228+00- 375+00	124602.50	BCY	783,318	156,664	0	93,998	61,005	1,094,984	8.79
11.01.05.05 Exc/Haul Matl-Sta 419+00- 467+00									
11.01.05.05.61 Exc/Haul	29440.00	BCY	130,297	26,059	0	15,636	10,148	182,140	6.19
TOTAL Exc/Haul Matl-Sta 419+00- 467+00	29440.00	BCY	130,297	26,059	0	15,636	10,148	182,140	6.19
11.01.05.06 Exc/Haul Matl-Sta 467+00- 600+00									
11.01.05.06.62 Exc/Haul	64110.00	BCY	283,741	56,748	0	34,049	22,098	396,637	6.19
TOTAL Exc/Haul Matl-Sta 467+00- 600+00	64110.00	BCY	283,741	56,748	0	34,049	22,098	396,637	6.19
11.01.05.07 Exc/Haul Matl-Sta 375+00- 398+00									
11.01.05.07.63 Exc/Haul	20798.75	BCY	156,552	31,310	0	18,786	12,192	218,841	10.52
TOTAL Exc/Haul Matl-Sta 375+00- 398+00	20798.75	BCY	156,552	31,310	0	18,786	12,192	218,841	10.52
11.01.05.08 Exc/Haul Matl-Sta 398+00- 419+00									
11.01.05.08.64 Exc/Haul	15510.00	BCY	97,504	19,501	0	11,700	7,594	136,299	8.79
TOTAL Exc/Haul Matl-Sta 398+00- 419+00	15510.00	BCY	97,504	19,501	0	11,700	7,594	136,299	8.79

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.05.52 Place Material									
11.01.05.52.65 Scarify Existing Surface	2187000	SF	6,932	1,386	0	832	540	9,690	0.00
11.01.05.52.66 Place	309356.25	BCY	497,486	99,497	0	59,698	38,744	695,425	2.25
TOTAL Place Material	309356.25	BCY	504,418	100,884	0	60,530	39,284	705,116	2.28
TOTAL Levee Raise (Random)	247485.00	CCY	2,198,787	439,757	0	263,854	171,242	3,073,641	12.42
11.01.06 Riverward Berm									
11.01.06.01 Exc/Haul Matl-Sta 166+00- 398+00									
11.01.06.01.67 Exc/Haul	161111.25	BCY	1,012,831	253,208	0	126,604	82,166	1,474,809	9.15
TOTAL Exc/Haul Matl-Sta 166+00- 398+00	161111.25	BCY	1,012,831	253,208	0	126,604	82,166	1,474,809	9.15
11.01.06.02 Exc/Haul Matl-Sta 398+00- 550+00									
11.01.06.02.68 Exc/Haul	105555.00	BCY	532,639	133,160	0	66,580	43,210	775,589	7.35
TOTAL Exc/Haul Matl-Sta 398+00- 550+00	105555.00	BCY	532,639	133,160	0	66,580	43,210	775,589	7.35
11.01.06.56 Place Material									
11.01.06.56.69 Scarify Existing Surface	1344000	SF	4,260	852	0	511	332	5,955	0.00
11.01.06.56.70 Place	266666.25	BCY	428,835	107,209	0	53,604	34,789	624,437	2.34
TOTAL Place Material	266666.25	BCY	433,095	108,061	0	54,116	35,121	630,392	2.36
TOTAL Riverward Berm	213333.00	CCY	1,978,565	494,428	0	247,299	160,497	2,880,789	13.50
11.01.07 Underseepage Berm (Random)									
11.01.07.02 Exc/Haul Matl-Sta 600+00- 639+84									
11.01.07.02.71 Exc/Haul	80203.75	BCY	354,970	106,491	0	46,146	29,949	537,556	6.70
TOTAL Exc/Haul Matl-Sta 600+00- 639+84	80203.75	BCY	354,970	106,491	0	46,146	29,949	537,556	6.70
11.01.07.03 Exc/Haul Matl-Sta 114+00- 228+00									
11.01.07.03.72 Exc/Haul	275548.75	BCY	1,219,538	365,862	0	158,540	102,892	1,846,832	6.70
TOTAL Exc/Haul Matl-Sta 114+00- 228+00	275548.75	BCY	1,219,538	365,862	0	158,540	102,892	1,846,832	6.70

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.07.04 Exc/Haul Matl-Sta 228+00- 375+00									
11.01.07.04.73 Exc/Haul	97012.50	BCY	609,872	182,962	0	79,283	51,455	923,572	9.52
TOTAL Exc/Haul Matl-Sta 228+00- 375+00	97012.50	BCY	609,872	182,962	0	79,283	51,455	923,572	9.52
11.01.07.05 Exc/Haul Matl-Sta 419+00- 467+00									
11.01.07.05.74 Exc/Haul	64632.50	BCY	286,054	85,816	0	37,187	24,134	433,192	6.70
TOTAL Exc/Haul Matl-Sta 419+00- 467+00	64632.50	BCY	286,054	85,816	0	37,187	24,134	433,192	6.70
11.01.07.06 Exc/Haul Matl-Sta 467+00- 600+00									
11.01.07.06.75 Exc/Haul	317035.00	BCY	1,403,151	420,945	0	182,410	118,384	2,124,889	6.70
TOTAL Exc/Haul Matl-Sta 467+00- 600+00	317035.00	BCY	1,403,151	420,945	0	182,410	118,384	2,124,889	6.70
11.01.07.07 Exc/Haul Matl-Sta 375+00- 398+00									
11.01.07.07.76 Exc/Haul	58356.25	BCY	439,247	131,774	0	57,102	37,059	665,182	11.40
TOTAL Exc/Haul Matl-Sta 375+00- 398+00	58356.25	BCY	439,247	131,774	0	57,102	37,059	665,182	11.40
11.01.07.08 Exc/Haul Matl-Sta 398+00- 419+00									
11.01.07.08.77 Exc/Haul	52578.75	BCY	330,538	99,161	0	42,970	27,887	500,557	9.52
TOTAL Exc/Haul Matl-Sta 398+00- 419+00	52578.75	BCY	330,538	99,161	0	42,970	27,887	500,557	9.52
11.01.07.53 Place Material									
11.01.07.53.78 Scarify Existing Surface	10935000	SF	34,660	6,932	0	4,159	2,699	48,451	0.00
11.01.07.53.79 Place	935242.50	BCY	1,400,011	420,003	0	182,001	118,119	2,120,134	2.27
11.01.07.53.80 Spread Aggregate Surfacing Matl	10125.00	BCY	5,958	1,192	0	715	464	8,328	0.82
TOTAL Place Material	945367.50	BCY	1,440,629	428,127	0	186,876	121,282	2,176,914	2.30
TOTAL Underseepage Berm (Random)	756295.00	CCY	6,083,999	1,821,138	0	790,514	513,043	9,208,694	12.18
11.01.08 Seeding & Mulching									
11.01.08.01 Seeding & Mulching									
11.01.08.01.81 Seeding & Mulching									

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.08.01.81.01 Seeding & Mulching	120.00 ACR	223,417	44,683	0	26,810	17,400	312,310	2602.58
TOTAL Seeding & Mulching	120.00 ACR	223,417	44,683	0	26,810	17,400	312,310	2602.58
TOTAL Seeding & Mulching	120.00 ACR	223,417	44,683	0	26,810	17,400	312,310	2602.58
TOTAL Seeding & Mulching	120.00 ACR	223,417	44,683	0	26,810	17,400	312,310	2602.58
11.01.09 Replace Aggregate Surfacing								
11.01.09.27 Replace Aggregate Surfacing								
11.01.09.27.82 Replace Aggregate Surfacing								
11.01.09.27.82.01 Replace Aggregate Surfacing	19238.00 TON	403,272	80,654	0	48,393	31,407	563,726	29.30
TOTAL Replace Aggregate Surfacing	19238.00 TON	403,272	80,654	0	48,393	31,407	563,726	29.30
TOTAL Replace Aggregate Surfacing	19238.00 TON	403,272	80,654	0	48,393	31,407	563,726	29.30
TOTAL Replace Aggregate Surfacing	10125.00 CCY	403,272	80,654	0	48,393	31,407	563,726	55.68
11.01.10 Replace Stripped Material								
11.01.10.06 Repl Lev w/ less than 1' Raise								
11.01.10.06.84 Push Topsoil to Levee	2178.01 BCY	1,964	393	0	236	153	2,745	1.26
11.01.10.06.85 Finish Grade Lev for TS Placemnt	2.70 ACR	3,325	665	0	399	259	4,649	1721.72
TOTAL Repl Lev w/ less than 1' Raise	2.70 ACR	5,289	1,058	0	635	412	7,394	2738.35
11.01.10.07 Repl Lev w/ > than 1' < 3' Rse								
11.01.10.07.86 Push Topsoil to Levee	37590.82 BCY	33,891	6,778	0	4,067	2,639	47,375	1.26
11.01.10.07.87 Finish Grade Lev for TS Placemnt	46.60 ACR	57,396	11,479	0	6,887	4,470	80,232	1721.72
TOTAL Repl Lev w/ > than 1' < 3' Rse	46.60 ACR	91,286	18,257	0	10,954	7,109	127,607	2738.35
11.01.10.08 Repl Lev w/ > than </= 3' Rse								
11.01.10.08.88 Push Topsoil to Levee	3226.68 BCY	2,909	582	0	349	227	4,067	1.26
11.01.10.08.89 Finish Grade Lev for TS Placemnt	4.00 ACR	4,927	985	0	591	384	6,887	1721.72
TOTAL Repl Lev w/ > than </= 3' Rse	4.00 ACR	7,836	1,567	0	940	610	10,953	2738.35
11.01.10.09 Repl Berm-Less than 1' Raise								

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.10.09.90 Push Topsoil to Berm	12100.05	ACR	21,818	4,364	0	2,618	1,699	30,499	2.52
11.01.10.09.91 Finish Grade Lev for TS Placemnt	15.00	ACR	18,475	3,695	0	2,217	1,439	25,826	1721.72
TOTAL Repl Berm-Less than 1' Raise	15.00	ACR	40,293	8,059	0	4,835	3,138	56,325	3754.98
11.01.10.10 Repl Berm- > than 1' > 3' Raise									
11.01.10.10.92 Push Topsoil to Berm	182710.76	BCY	329,451	65,890	0	39,534	25,658	460,534	2.52
11.01.10.10.93 Finish Grade Lev for TS Placemnt	226.50	ACR	278,972	55,794	0	33,477	21,726	389,970	1721.72
TOTAL Repl Berm- > than 1' > 3' Raise	226.50	ACR	608,424	121,685	0	73,011	47,384	850,503	3754.98
11.01.10.11 Repl Berm- >/= 3' Raise									
11.01.10.11.94 Push Topsoil to Berm	23312.76	BCY	42,036	8,407	0	5,044	3,274	58,761	2.52
11.01.10.11.95 Finish Grade Lev for TS Placemnt	28.90	ACR	35,595	7,119	0	4,271	2,772	49,758	1721.72
TOTAL Repl Berm- >/= 3' Raise	28.90	ACR	77,631	15,526	0	9,316	6,046	108,519	3754.98
TOTAL Replace Stripped Material	261119.00	CY	830,759	166,152	0	99,691	64,699	1,161,301	4.45
11.01.11 Slope Protection									
11.01.11.27 Place Bedding Material									
11.01.11.27.96 Place Bedding Material									
11.01.11.27.96.01 Place Bedding Material	40.00	TON	1,500	750	0	225	146	2,621	65.53
TOTAL Place Bedding Material	40.00	TON	1,500	750	0	225	146	2,621	65.53
TOTAL Place Bedding Material	40.00	TON	1,500	750	0	225	146	2,621	65.53
11.01.11.28 Place Riprap Protection									
11.01.11.28.97 Place Riprap Protection									
11.01.11.28.97.01 Place Riprap Protection	120.00	TON	5,429	2,715	0	814	529	9,487	79.06
TOTAL Place Riprap Protection	120.00	TON	5,429	2,715	0	814	529	9,487	79.06
TOTAL Place Riprap Protection	120.00	TON	5,429	2,715	0	814	529	9,487	79.06
TOTAL Slope Protection	1.00	EA	6,929	3,465	0	1,039	675	12,108	12107.91
11.01.12 Freeboard Gages									

** PROJECT OWNER SUMMARY - Assembly **

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.12.01 Freeboard Gages									
11.01.12.01.98 Freeboard Gages									
11.01.12.01.98.01 Freeboard Gages	7.00	EA	173,769	8,688	0	18,246	11,841	212,544	30363.45
TOTAL Freeboard Gages	7.00	EA	173,769	8,688	0	18,246	11,841	212,544	30363.45
TOTAL Freeboard Gages	7.00	EA	173,769	8,688	0	18,246	11,841	212,544	30363.45
TOTAL Freeboard Gages	7.00	EA	173,769	8,688	0	18,246	11,841	212,544	30363.45
11.01.13 Drainage Systems									
11.01.13.16 Drainage System 2 - Sta 115+60									
11.01.13.16.99 Platform Raise - 1 foot									
11.01.13.16.99. 1 Sand Blasting	28.00	SF	97	19	0	12	8	136	4.87
11.01.13.16.99.10 Vertcl Drilg Holes -1.5"X 6"Deep	60.00	EA	1,376	275	0	165	107	1,924	32.06
11.01.13.16.99.15 Grouting of vertical holes	60.00	EA	829	166	0	99	65	1,159	19.31
11.01.13.16.99.30 Hole Layout	3.00	HR	311	62	0	37	24	435	144.95
11.01.13.16.99.45 Concrete -Slab	1.14	CY	750	150	0	90	58	1,048	919.15
11.01.13.16.99.50 Forms for Slab	98.00	SF	706	141	0	85	55	987	10.07
11.01.13.16.99.55 Reinforcing Steel for Slab	201.00	LB	349	70	0	42	27	488	2.43
11.01.13.16.99.60 Replace Stem	1.00	EA	3,275	655	0	393	255	4,578	4578.44
TOTAL Platform Raise - 1 foot	1.00	EA	7,693	1,539	0	923	599	10,754	10754.45
11.01.13.16.A0 Drainage Structure Extension									
11.01.13.16.A0.01 Excavate and Remove Existing End	1.00	EA	1,152	230	0	138	90	1,610	1610.01
11.01.13.16.A0.02 Place RCP Extension	1.00	EA	1,869	374	0	224	146	2,612	2612.05
11.01.13.16.A0.03 Replace Flared End Section	1.00	EA	2,278	456	0	273	177	3,184	3184.27
11.01.13.16.A0.04 Place Concrete Collars	1.00	EA	2,431	486	0	292	189	3,398	3398.23
11.01.13.16.A0.05 Additional Compaction Labor	1.00	EA	352	70	0	42	27	492	491.53
11.01.13.16.A0.06 Riprap Removal and Replacement	1.00	EA	3,199	640	0	384	249	4,472	4472.43
TOTAL Drainage Structure Extension	1.00	EA	11,280	2,256	0	1,354	879	15,769	15768.52
TOTAL Drainage System 2 - Sta 115+60	1.00	EA	18,974	3,795	0	2,277	1,478	26,523	26522.97
11.01.13.17 Drainage System 3 - Sta 186+00									
11.01.13.17.A1 Platform Raise - 2 foot									
11.01.13.17.A1. 1 Sand Blasting	28.00	SF	97	19	0	12	8	136	4.87
11.01.13.17.A1.10 Vertcl Drilg Holes -1.5"X 6"Deep	48.00	EA	1,101	220	0	132	86	1,539	32.06

** PROJECT OWNER SUMMARY - Assembly **

		QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.13.17.A1.15	Grouting of vertical holes	48.00	EA	666	133	0	80	52	932	19.41
11.01.13.17.A1.30	Hole Layout	3.00	HR	311	62	0	37	24	435	144.95
11.01.13.17.A1.45	Concrete -Slab	2.28	CY	962	192	0	115	75	1,345	589.70
11.01.13.17.A1.50	Forms for Slab	123.00	SF	865	173	0	104	67	1,209	9.83
11.01.13.17.A1.55	Reinforcing Steel for Slab	186.00	LB	350	70	0	42	27	489	2.63
11.01.13.17.A1.60	Replace Stem	1.00	EA	3,351	670	0	402	261	4,684	4684.10
	TOTAL Platform Raise - 2 foot	1.00	EA	7,703	1,541	0	924	600	10,768	10768.20
11.01.13.17.A2	Drainage Structure Extension									
11.01.13.17.A2.01	Excavate and Remove Existing End	1.00	EA	1,152	230	0	138	90	1,610	1610.01
11.01.13.17.A2.02	Place RCP Extension	1.00	EA	2,684	537	0	322	209	3,752	3752.33
11.01.13.17.A2.03	Replace Flared End Section	1.00	EA	2,278	456	0	273	177	3,184	3184.27
11.01.13.17.A2.04	Place Concrete Collars	1.00	EA	2,431	486	0	292	189	3,398	3398.23
11.01.13.17.A2.05	Additional Compaction Labor	1.00	EA	352	70	0	42	27	492	491.53
11.01.13.17.A2.06	Riprap Removal and Replacement	1.00	EA	3,199	640	0	384	249	4,472	4472.43
	TOTAL Drainage Structure Extension	1.00	EA	12,096	2,419	0	1,452	942	16,909	16908.80
	TOTAL Drainage System 3 - Sta 186+00	1.00	EA	19,799	3,960	0	2,376	1,542	27,677	27676.99
11.01.13.18	Drainage System 4 - Sta 325+00									
11.01.13.18.A3	Dewatering									
11.01.13.18.A3.01	Drill Well & Set Casing	2.00	EA	73,659	14,732	0	8,839	5,737	102,967	51483.31
11.01.13.18.A3.02	Pilot Hole	1.00	EA	11,449	2,290	0	1,374	892	16,004	16003.64
11.01.13.18.A3.03	Dewatering Labor	30.00	DAY	12,053	2,411	0	1,446	939	16,848	561.62
11.01.13.18.A3.04	Abandon Wells	2.00	EA	9,930	1,986	0	1,192	773	13,880	6940.22
	TOTAL Dewatering	1.00	EA	107,090	21,418	0	12,851	8,340	149,699	149699.15
11.01.13.18.A4	Exc/Haul Imp Fill for Ring Levee	21717.50	BCY	149,998	30,000	0	18,000	11,682	209,679	9.65
11.01.13.18.A5	Place Imp Fill for Ring Levee	21717.50	BCY	34,925	6,985	0	4,191	2,720	48,820	2.25
11.01.13.18.A6	48" Dia CMP for Ring Lev/Bypass									
11.01.13.18.A6.01	48" Dia CMP for Ring Levee	280.00	LF	37,809	7,562	0	4,537	2,945	52,852	188.76
11.01.13.18.A6.02	48" Dia CMP for Bypass	700.00	LF	48,390	9,678	0	5,807	3,769	67,643	96.63
	TOTAL 48" Dia CMP for Ring Lev/Bypass	980.00	LF	86,198	17,240	0	10,344	6,713	120,495	122.95
11.01.13.18.A7	Seeding/Mulching for Ring Levee									
11.01.13.18.A7.01	Seeding and Mulching	1.30	ACR	1,129	226	0	136	88	1,579	1214.54
	TOTAL Seeding/Mulching for Ring Levee	1.30	ACR	1,129	226	0	136	88	1,579	1214.54

** PROJECT OWNER SUMMARY - Assembly **

		QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.13.18.A8	Turf Reinforcement Mat									
11.01.13.18.A8.01	Delivery of Reinforcement Mat	55215.00	SF	124	25	0	15	10	174	0.00
11.01.13.18.A8.02	Reinforcement Mat	63000.00	SF	27,019	5,404	0	3,242	2,104	37,769	0.60
11.01.13.18.A8.03	Trenching	19.26	CY	2,467	493	0	296	192	3,449	179.05
11.01.13.18.A8.04	Placement of Reinforcement Mat	6135.00	SY	6,208	1,242	0	745	483	8,677	1.41
11.01.13.18.A8.05	Backfill Trench & Reseed	19.26	CY	2,715	543	0	326	211	3,796	197.07
	TOTAL Turf Reinforcement Mat	55215.00	SF	38,533	7,707	0	4,624	3,001	53,864	0.98
11.01.13.18.B0	Exc/Stockpile Exist Levee	16250.00	BCY	47,736	9,547	0	5,728	3,718	66,729	4.11
11.01.13.18.B1	Gatewell Structure									
11.01.13.18.B1.01	Demo Exist Gatewell Str/RCB	1.00	EA	30,014	6,003	0	3,602	2,337	41,956	41955.77
11.01.13.18.B1.02	Structural Excavation	1.00	EA	3,201	640	0	384	249	4,474	4474.03
11.01.13.18.B1.03	Base Slab	2.81	CY	5,073	1,015	0	609	395	7,091	2523.53
11.01.13.18.B1.04	1st Lift	17.22	CY	22,405	4,481	0	2,689	1,745	31,319	1818.76
11.01.13.18.B1.05	2nd Lift	17.22	CY	23,274	4,655	0	2,793	1,813	32,535	1889.35
11.01.13.18.B1.06	3rd Lift	9.98	CY	17,772	3,554	0	2,133	1,384	24,843	2489.23
11.01.13.18.B1.07	Elevated Slab	2.96	CY	5,268	1,054	0	632	410	7,364	2487.99
11.01.13.18.B1.08	Concrete Collars (allowance)	2.00	EA	2,482	496	0	298	193	3,470	1735.05
11.01.13.18.B1.15	Metals - Ladders	1.00	EA	3,681	736	0	442	287	5,145	5145.43
11.01.13.18.B1.16	Metals - Landings	1.00	EA	4,065	813	0	488	317	5,682	5682.39
11.01.13.18.B1.17	Metals - Labor	1.00	EA	8,351	1,670	0	1,002	650	11,674	11674.13
11.01.13.18.B1.30	Metals - Hydraulic Structures	1.00	EA	70,574	14,115	0	8,469	5,496	98,654	98653.66
	TOTAL Gatewell Structure	1.00	EA	196,159	39,232	0	23,539	15,277	274,207	274207.37
11.01.13.18.B2	Inlet Structure For 6'x5' RCB									
11.01.13.18.B2.01	Toe	0.54	CY	220	44	0	26	17	307	569.25
11.01.13.18.B2.03	Slab	4.15	CY	4,315	863	0	518	336	6,032	1453.59
11.01.13.18.B2.04	Wingwall	4.01	CY	11,139	2,228	0	1,337	868	15,572	3883.18
11.01.13.18.B2.05	Headwall	1.88	CY	6,135	1,227	0	736	478	8,576	4561.61
11.01.13.18.B2.06	Concrete Collars (allowance)	1.00	EA	1,241	248	0	149	97	1,735	1735.05
11.01.13.18.B2.07	Free Draining Material Behind HW	1.30	CY	973	195	0	117	76	1,361	1046.55
	TOTAL Inlet Structure For 6'x5' RCB	1.00	EA	24,024	4,805	0	2,883	1,871	33,583	33582.75
11.01.13.18.B3	Outlet Structure for 6'x5' RCB									
11.01.13.18.B3.01	Toe	1.70	CY	456	91	0	55	36	637	374.83
11.01.13.18.B3.03	Slab	6.30	CY	2,745	549	0	329	214	3,837	608.97
11.01.13.18.B3.04	Wingwall	5.53	CY	11,252	2,250	0	1,350	876	15,729	2844.38
11.01.13.18.B3.05	Headwall	3.09	CY	5,102	1,020	0	612	397	7,132	2307.98
11.01.13.18.B3.07	Concrete Collars	1.30	CY	1,529	306	0	183	119	2,138	1644.30
	TOTAL Outlet Structure for 6'x5' RCB	1.00	EA	21,084	4,217	0	2,530	1,642	29,472	29472.41

	QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.13.18.B4 6'x5' RCB									
11.01.13.18.B4.33 Earthwork for 5'x6' RCB	190.00	LF	1,975	395	0	237	154	2,760	14.53
11.01.13.18.B4.34 Base Slab for 6'x5' RCB	74.77	CY	57,489	11,498	0	6,899	4,477	80,363	1074.80
11.01.13.18.B4.35 Walls for 6'x5' RCB	87.96	CY	124,188	24,838	0	14,903	9,672	173,600	1973.62
11.01.13.18.B4.36 Elevated Slab for 6'x5' RCB	74.77	CY	61,049	12,210	0	7,326	4,755	85,340	1141.37
TOTAL 6'x5' RCB	190.00	LF	244,701	48,940	0	29,364	19,057	342,062	1800.33
11.01.13.18.B6 Replace Exist Levee/Compact	16250.00	BCY	115,532	23,106	0	13,864	8,998	161,501	9.94
11.01.13.18.B7 Seeding/Mulching for RS of Levee									
11.01.13.18.B7.01 Seeding and Mulching	2.30	ACR	1,998	400	0	240	156	2,793	1214.54
TOTAL Seeding/Mulching for RS of Levee	2.30	ACR	1,998	400	0	240	156	2,793	1214.54
TOTAL Drainage System 4 - Sta 325+00	1.00	EA	1,069,108	213,822	0	128,293	83,262	1,494,485	1494485
11.01.13.19 Drainage System 5 - Sta 398+00									
11.01.13.19.B9 Platform Raise - 2.25 foot									
11.01.13.19.B9. 1 Sand Blasting	26.00	SF	90	18	0	11	7	127	4.87
11.01.13.19.B9.10 Vertcl Drilg Holes -1.5"X 6"Deep	44.00	EA	1,009	202	0	121	79	1,411	32.06
11.01.13.19.B9.15 Grouting of vertical holes	44.00	EA	601	120	0	72	47	840	19.09
11.01.13.19.B9.30 Hole Layout	3.00	HR	311	62	0	37	24	435	144.95
11.01.13.19.B9.45 Concrete -Slab	2.65	CY	1,081	216	0	130	84	1,511	570.17
11.01.13.19.B9.50 Forms for Slab	117.00	SF	827	165	0	99	64	1,155	9.88
11.01.13.19.B9.55 Reinforcing Steel for Slab	182.00	LB	345	69	0	41	27	483	2.65
11.01.13.19.B9.60 Replace Stem	1.00	EA	3,786	757	0	454	295	5,293	5292.58
TOTAL Platform Raise - 2.25 foot	1.00	EA	8,051	1,610	0	966	627	11,254	11254.12
11.01.13.19.C0 Drainage Structure Extension									
11.01.13.19.C0.01 Excavate and Remove Existing End	1.00	EA	1,152	230	0	138	90	1,610	1610.01
11.01.13.19.C0.02 Place RCP Extension	1.00	EA	2,461	492	0	295	192	3,441	3440.57
11.01.13.19.C0.03 Replace Flared End Section	1.00	EA	1,930	386	0	232	150	2,698	2698.46
11.01.13.19.C0.04 Place Concrete Collars	1.00	EA	2,291	458	0	275	178	3,203	3202.86
11.01.13.19.C0.05 Additional Compaction Labor	1.00	EA	352	70	0	42	27	492	491.53
11.01.13.19.C0.06 Riprap Removal and Replacement	1.00	EA	3,199	640	0	384	249	4,472	4472.43
TOTAL Drainage Structure Extension	1.00	EA	11,386	2,277	0	1,366	887	15,916	15915.86
TOTAL Drainage System 5 - Sta 398+00	1.00	EA	19,437	3,887	0	2,332	1,514	27,170	27169.98
11.01.13.20 Drainage System 7 - Sta 420+35									

** PROJECT OWNER SUMMARY - Assembly **

		QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.13.20.C1	Platform Raise - 2.5 foot									
11.01.13.20.C1. 1	Sand Blasting	24.00	SF	84	17	0	10	7	117	4.87
11.01.13.20.C1.10	Vertcl Drilg Holes -1.5"X 6"Deep	40.00	EA	917	183	0	110	71	1,283	32.06
11.01.13.20.C1.15	Grouting of vertical holes	40.00	EA	561	112	0	67	44	784	19.61
11.01.13.20.C1.30	Hole Layout	3.00	HR	311	62	0	37	24	435	144.95
11.01.13.20.C1.45	Concrete -Slab	2.22	CY	992	198	0	119	77	1,387	624.84
11.01.13.20.C1.50	Forms for Slab	116.00	SF	809	162	0	97	63	1,130	9.74
11.01.13.20.C1.55	Reinforcing Steel for Slab	198.00	LB	362	72	0	43	28	506	2.56
11.01.13.20.C1.60	Replace Stem	1.00	EA	3,612	722	0	433	281	5,048	5048.46
	TOTAL Platform Raise - 2.5 foot	1.00	EA	7,648	1,530	0	918	596	10,691	10690.55
11.01.13.20.C2	Drainage Structure Extension									
11.01.13.20.C2.01	Excavate and Remove Existing End	1.00	EA	1,152	230	0	138	90	1,610	1610.01
11.01.13.20.C2.02	Place RCP Extension	1.00	EA	1,482	296	0	178	115	2,072	2071.96
11.01.13.20.C2.03	Replace Flared End Section	1.00	EA	1,610	322	0	193	125	2,251	2250.81
11.01.13.20.C2.04	Place Concrete Collars	1.00	EA	2,338	468	0	281	182	3,268	3267.75
11.01.13.20.C2.05	Additional Compaction Labor	1.00	EA	352	70	0	42	27	492	491.53
11.01.13.20.C2.06	Riprap Removal and Replacement	1.00	EA	3,199	640	0	384	249	4,472	4472.43
	TOTAL Drainage Structure Extension	1.00	EA	10,133	2,027	0	1,216	789	14,164	14164.50
	TOTAL Drainage System 7 - Sta 420+35	1.00	EA	17,781	3,556	0	2,134	1,385	24,855	24855.05
11.01.13.21	Drainage System 8 - Sta 497+60									
11.01.13.21.C3	Platform Raise - 1 foot 5 inches									
11.01.13.21.C3. 1	Sand Blasting	32.00	SF	111	22	0	13	9	156	4.87
11.01.13.21.C3.10	Vertcl Drilg Holes -1.5"X 6"Deep	80.00	EA	2,018	404	0	242	157	2,822	35.27
11.01.13.21.C3.15	Grouting of vertical holes	80.00	EA	1,227	245	0	147	96	1,715	21.44
11.01.13.21.C3.30	Hole Layout	3.00	HR	311	62	0	37	24	435	144.95
11.01.13.21.C3.45	Concrete -Slab	2.46	CY	1,042	208	0	125	81	1,456	591.91
11.01.13.21.C3.50	Forms for Slab	147.00	SF	918	184	0	110	72	1,284	8.73
11.01.13.21.C3.55	Reinforcing Steel for Slab	293.00	LB	445	89	0	53	35	621	2.12
11.01.13.21.C3.60	Replace Stem	1.00	EA	3,606	721	0	433	281	5,041	5041.17
	TOTAL Platform Raise - 1 foot 5 inches	1.00	EA	9,679	1,936	0	1,161	754	13,530	13529.83
11.01.13.21.C4	Drainage Structure Extension									
11.01.13.21.C4.01	Excavate and Remove Existing End	1.00	EA	2,914	583	0	350	227	4,073	4073.28
11.01.13.21.C4.02	Place RCP Extension	1.00	EA	4,057	811	0	487	316	5,671	5670.88
11.01.13.21.C4.03	Place Conc Collars for RCP Ext	1.00	EA	2,431	486	0	292	189	3,398	3398.23
11.01.13.21.C4.04	Toe	0.54	CY	220	44	0	26	17	307	569.25
11.01.13.21.C4.05	Slab	4.15	CY	4,315	863	0	518	336	6,032	1453.59

** PROJECT OWNER SUMMARY - Assembly **

		QUANTITY	UOM	CONTRACT	CONTING	ESCALATN	E&D	S&A	TOTAL COST	UNIT COST
11.01.13.21.C4.06	Wingwall	4.01	CY	11,139	2,228	0	1,337	868	15,572	3883.18
11.01.13.21.C4.07	Headwall	1.88	CY	6,135	1,227	0	736	478	8,576	4561.61
11.01.13.21.C4.08	Concrete Collars (allowance)	1.00	EA	1,241	248	0	149	97	1,735	1735.05
11.01.13.21.C4.09	Free Draining Material Behind HW	1.30	CY	973	195	0	117	76	1,361	1046.55
11.01.13.21.C4.10	Additional Compaction Labor	1.00	EA	352	70	0	42	27	492	491.53
11.01.13.21.C4.11	Riprap Removal and Replacement	1.00	EA	3,199	640	0	384	249	4,472	4472.43
	TOTAL Drainage Structure Extension	1.00	EA	36,977	7,395	0	4,437	2,880	51,689	51689.10
	TOTAL Drainage System 8 - Sta 497+60	1.00	EA	46,656	9,331	0	5,599	3,634	65,219	65218.92
11.01.13.22	Drainage System 9 - Sta 558+50									
11.01.13.22.C5	Platform Raise - 1 foot									
11.01.13.22.C5. 1	Sand Blasting	28.00	SF	97	19	0	12	8	136	4.87
11.01.13.22.C5.10	Vertcl Drilg Holes -1.5"X 6"Deep	60.00	EA	1,376	275	0	165	107	1,924	32.06
11.01.13.22.C5.15	Grouting of vertical holes	60.00	EA	829	166	0	99	65	1,159	19.31
11.01.13.22.C5.30	Hole Layout	3.00	HR	311	62	0	37	24	435	144.95
11.01.13.22.C5.45	Concrete -Slab	1.14	CY	750	150	0	90	58	1,048	919.15
11.01.13.22.C5.50	Forms for Slab	98.00	SF	706	141	0	85	55	987	10.07
11.01.13.22.C5.55	Reinforcing Steel for Slab	201.00	LB	349	70	0	42	27	488	2.43
11.01.13.22.C5.60	Replace Stem	1.00	EA	3,709	742	0	445	289	5,185	5185.10
	TOTAL Platform Raise - 1 foot	1.00	EA	8,127	1,625	0	975	633	11,361	11361.11
11.01.13.22.C6	Drainage Structure Extension									
11.01.13.22.C6.01	Excavate and Remove Existing End	1.00	EA	1,152	230	0	138	90	1,610	1610.01
11.01.13.22.C6.02	Place RCP Extension	1.00	EA	1,869	374	0	224	146	2,612	2612.05
11.01.13.22.C6.03	Replace Flared End Section	1.00	EA	2,278	456	0	273	177	3,184	3184.27
11.01.13.22.C6.04	Place Concrete Collars	1.00	EA	2,431	486	0	292	189	3,398	3398.23
11.01.13.22.C6.05	Additional Compaction Labor	1.00	EA	352	70	0	42	27	492	491.53
11.01.13.22.C6.06	Riprap Removal and Replacement	1.00	EA	3,199	640	0	384	249	4,472	4472.43
	TOTAL Drainage Structure Extension	1.00	EA	11,280	2,256	0	1,354	879	15,769	15768.52
	TOTAL Drainage System 9 - Sta 558+50	1.00	EA	19,408	3,882	0	2,329	1,511	27,130	27129.63
	TOTAL Drainage Systems	1.00	EA	1,211,161	242,232	0	145,339	94,325	1,693,058	1693058
	TOTAL Levees	1.00	EA	16,606,176	4,055,680	0	2,066,186	1,340,954	24,068,996	24068996
11.02	Floodwalls - NONE									
	TOTAL Levees and Floodwalls	1.00	EA	16,606,176	4,055,680	0	2,066,186	1,340,954	24,068,996	24068996
	TOTAL Feasibility Study Estimate for:	1.00	EA	19,774,883	4,470,756	0	2,151,635	1,396,411	27,793,685	27793685

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
01 Lands and Damages	1.00	EA	2,373,298	0	0	0	0	2,373,298	2373298
02 Relocations	1.00	EA	295,409	0	0	0	0	295,409	295409.24
06 Fish & Wildlife Facilities	1.00	EA	500,000	0	0	0	0	500,000	500000.00
11 Levees and Floodwalls	1.00	EA	13,379,088	0	1,605,491	1,498,458	123,140	16,606,176	16606176
TOTAL Feasibility Study Estimate for:	1.00	EA	16,547,795	0	1,605,491	1,498,458	123,140	19,774,883	19774883
Contingency								4,470,756	
SUBTOTAL								24,245,640	
Engineering & Design								2,151,635	
SUBTOTAL								26,397,274	
Supervision & Administration								1,396,411	
TOTAL INCL OWNER COSTS								27,793,685	

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
01 Lands and Damages									
01.23 Land Values									
01.23.01 Land Values									
01.23.01.01 Land Values									
01.23.01.01.01 Borrow Area	1000.00	ACR	2,000,000	0	0	0	0	2,000,000	2000.00
01.23.01.01.02 Sta 93+00 to 132+00	9.13	ACR	13,262	0	0	0	0	13,262	1452.57
01.23.01.01.03 Sta 132+00 to 161+50	14.47	ACR	15,164	0	0	0	0	15,164	1047.96
01.23.01.01.04 Sta 161+50 to 228+50	48.84	ACR	38,460	0	0	0	0	38,460	787.47
01.23.01.01.05 Sta 228+50 to 281+50	26.46	ACR	19,768	0	0	0	0	19,768	747.09
01.23.01.01.06 Sta 281+50 to 299+50	14.72	ACR	8,832	0	0	0	0	8,832	600.00
01.23.01.01.07 Sta 299+50 to 331+50	9.43	ACR	10,684	0	0	0	0	10,684	1132.98
01.23.01.01.08 Sta 331+50 to 341+50	2.67	ACR	4,052	0	0	0	0	4,052	1517.60
01.23.01.01.09 Sta 341+50 to 404+50	46.35	ACR	31,086	0	0	0	0	31,086	670.68
01.23.01.01.10 Sta 404+50 to 492+50	45.15	ACR	41,706	0	0	0	0	41,706	923.72
01.23.01.01.11 Sta 492+50 to 516+50	19.07	ACR	17,042	0	0	0	0	17,042	893.65
01.23.01.01.12 Sta 516+50 to 600+50	77.09	ACR	60,618	0	0	0	0	60,618	786.33
01.23.01.01.13 Sta 600+50 to 639+84	17.58	ACR	18,164	0	0	0	0	18,164	1033.22
TOTAL Land Values	1.00	EA	2,278,838	0	0	0	0	2,278,838	2278838
01.23.01.02 Non Federal Sponsors Costs									
01.23.01.02.14 NFS Costs	1.00	EA	64,900	0	0	0	0	64,900	64900.00
TOTAL Non Federal Sponsors Costs	1.00	EA	64,900	0	0	0	0	64,900	64900.00
01.23.01.03 Federal Costs									
01.23.01.03.15 Federal Costs	1.00	EA	29,560	0	0	0	0	29,560	29560.00
TOTAL Federal Costs	1.00	EA	29,560	0	0	0	0	29,560	29560.00
TOTAL Land Values	1.00	EA	2,373,298	0	0	0	0	2,373,298	2373298
TOTAL Land Values	1.00	EA	2,373,298	0	0	0	0	2,373,298	2373298
TOTAL Lands and Damages	1.00	EA	2,373,298	0	0	0	0	2,373,298	2373298
02 Relocations									
02.01 Utility Relocations									
02.01.03 Cemetery, Utilities, & Structure									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
02.01.03.18 Utilities Crossing Levee									
02.01.03.18.16 UL1- Sta 53+38 - 16" SP - No Act									
02.01.03.18.17 UL2- Sta 300+00-16" DIP waterlin									
02.01.03.18.17.01 Excavation for Bypass	355.00	CY	8,475	0	0	0	0	8,475	23.87
02.01.03.18.17.02 16" Ductile Iron Pipe	300.00	LF	36,272	0	0	0	0	36,272	120.91
02.01.03.18.17.03 16" Ductile Iron Fittings	6.00	EA	16,808	0	0	0	0	16,808	2801.38
02.01.03.18.17.04 Air Release Valve/Chamber	1.00	EA	6,578	0	0	0	0	6,578	6577.99
02.01.03.18.17.05 Final Cutover Connection	6.00	HR	3,679	0	0	0	0	3,679	613.10
02.01.03.18.17.24 Excavation for Demolition	714.00	CY	8,475	0	0	0	0	8,475	11.87
02.01.03.18.17.25 Removal of Existing Waterline	284.00	LF	4,506	0	0	0	0	4,506	15.86
02.01.03.18.17.26 Excavate & Haul BF Material	2022.00	BCY	17,201	0	0	0	0	17,201	8.51
02.01.03.18.17.27 Backfill/Compaction	3108.00	CY	12,996	0	0	0	0	12,996	4.18
TOTAL UL2- Sta 300+00-16" DIP waterlin	1.00	EA	114,990	0	0	0	0	114,990	114990.13
02.01.03.18.18 UL3- Sta 417+65 - 8" Gas Pipe									
02.01.03.18.18.01 Excavation for Bypass	804.00	CY	8,475	0	0	0	0	8,475	10.54
02.01.03.18.18.02 8" Dia Gas Line	300.00	LF	20,126	0	0	0	0	20,126	67.09
02.01.03.18.18.03 8" Gas Line Fittings	6.00	EA	5,628	0	0	0	0	5,628	938.05
02.01.03.18.18.04 Final Cutover Connection	4.00	HR	2,466	0	0	0	0	2,466	616.52
02.01.03.18.18.05 Excavation for Demolition	3760.00	BCY	21,189	0	0	0	0	21,189	5.64
02.01.03.18.18.06 Removal of Existing Gas Line	120.00	LF	1,408	0	0	0	0	1,408	11.73
02.01.03.18.18.07 Excavate & Haul BF Material	600.00	BCY	6,450	0	0	0	0	6,450	10.75
02.01.03.18.18.08 Backfill/Compaction	5264.00	BCY	28,505	0	0	0	0	28,505	5.42
02.01.03.18.18.09 Contingency plan	1.00	EA	25,000	0	0	0	0	25,000	25000.00
TOTAL UL3- Sta 417+65 - 8" Gas Pipe	1.00	EA	119,247	0	0	0	0	119,247	119247.09
02.01.03.18.19 UL4- Sta 418+15 - Telephone Cbl									
02.01.03.18.19.02 New Telephone Cable incl Exc	200.00	LF	12,469	0	0	0	0	12,469	62.35
02.01.03.18.19.05 Splice Connection & Testing	1.00	EA	4,094	0	0	0	0	4,094	4093.83
02.01.03.18.19.24 Excavation for Demolition	295.00	CY	3,798	0	0	0	0	3,798	12.87
02.01.03.18.19.27 Backfill/Compaction	300.00	CY	2,661	0	0	0	0	2,661	8.87
TOTAL UL4- Sta 418+15 - Telephone Cbl	1.00	EA	23,022	0	0	0	0	23,022	23022.39
02.01.03.18.21 UL6- Sta 5+1.47 - 8" VCP-No Act									
TOTAL Utilities Crossing Levee	1.00	EA	257,260	0	0	0	0	257,260	257259.60
02.01.03.20 Fencing, Gates, & Power Poles									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
02.01.03.20.22 Fencing, Gates, and Power Poles									
02.01.03.20.22.01 Sta 269+12-Rem/Repl Wood Post/Gt	2.00	EA	1,918	0	0	0	0	1,918	958.93
02.01.03.20.22.02 Sta 269+12-Rem/Repl Barbed Wire	1000.00	LF	4,315	0	0	0	0	4,315	4.32
02.01.03.20.22.03 Sta 269+12-Relocate Power Poles	6.00	EA	12,000	0	0	0	0	12,000	2000.00
02.01.03.20.22.04 Sta 269+12-Clearing for Poles	1.00	EA	1,226	0	0	0	0	1,226	1226.40
02.01.03.20.22.05 Sta 404+00 - Clearing	1.00	EA	1,745	0	0	0	0	1,745	1744.72
02.01.03.20.22.06 Sta 404+00-Rem CLF/gate	140.00	LF	718	0	0	0	0	718	5.13
02.01.03.20.22.07 Sta 404+00-New CLF/gate	1.00	EA	2,718	0	0	0	0	2,718	2718.32
02.01.03.20.22.08 Sta 418+00-Rem gate	1.00	EA	359	0	0	0	0	359	359.09
02.01.03.20.22.09 Sta 418+00-New gate	1.00	EA	589	0	0	0	0	589	588.98
02.01.03.20.22.10 Sta 418+00-Rem/Repl Barbed Wire	130.00	LF	561	0	0	0	0	561	4.32
02.01.03.20.22.11 Remove/Replace Additional Gates	6.00	EA	12,000	0	0	0	0	12,000	2000.00
TOTAL Fencing, Gates, and Power Poles	1.00	EA	38,150	0	0	0	0	38,150	38149.64
TOTAL Fencing, Gates, & Power Poles	1.00	EA	38,150	0	0	0	0	38,150	38149.64
TOTAL Cemetery, Utilities, & Structure			295,409	0	0	0	0	295,409	
TOTAL Utility Relocations	1.00	EA	295,409	0	0	0	0	295,409	295409.24
TOTAL Relocations	1.00	EA	295,409	0	0	0	0	295,409	295409.24
06 Fish & Wildlife Facilities									
06.03 Fish & Wildlife Fac/Sanc									
06.03.99 Associated General Items									
06.03.99.01 Environmental Enhancement									
06.03.99.01.23 Environmental Enhancement	1.00	EA	500,000	0	0	0	0	500,000	500000.00
TOTAL Environmental Enhancement	1.00	EA	500,000	0	0	0	0	500,000	500000.00
TOTAL Associated General Items	1.00	EA	500,000	0	0	0	0	500,000	500000.00
TOTAL Fish & Wildlife Fac/Sanc	1.00	EA	500,000	0	0	0	0	500,000	500000.00
TOTAL Fish & Wildlife Facilities	1.00	EA	500,000	0	0	0	0	500,000	500000.00
11 Levees and Floodwalls									
11.01 Levees									
11.01.01 Relief Wells									
11.01.01.01 Sta 292+00 to 327+00									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.01.01.24 New Relief Wells									
11.01.01.01.24.01 RW Sta 292+00 to 327+00	22.00	EA	724,905	0	86,989	81,189	6,672	899,755	40897.97
TOTAL New Relief Wells	22.00	EA	724,905	0	86,989	81,189	6,672	899,755	40897.97
11.01.01.01.25 Abandon Existing Relief Wells									
11.01.01.01.25.01 RW Sta 292+00 to 327+00	20.00	EA	15,428	0	1,851	1,728	142	19,149	957.43
TOTAL Abandon Existing Relief Wells	20.00	EA	15,428	0	1,851	1,728	142	19,149	957.43
TOTAL Sta 292+00 to 327+00	22.00	EA	740,333	0	88,840	82,917	6,814	918,904	41768.37
TOTAL Relief Wells	1.00	EA	740,333	0	88,840	82,917	6,814	918,904	918904.06
11.01.02 Borrow Sites & Site Prep									
11.01.02.01 Site Prep Sta 93+09 to 215+00									
11.01.02.01.26 Stripping/Windrow Material	112880.00	CY	118,650	0	14,238	13,289	1,092	147,269	1.30
TOTAL Site Prep Sta 93+09 to 215+00	112880.00	CY	118,650	0	14,238	13,289	1,092	147,269	1.30
11.01.02.05 Site Prep Sta 471+20 to 610+00									
11.01.02.05.27 Site Prep New Borrow Site	159.00	ACR	13,215	0	1,586	1,480	122	16,403	103.16
11.01.02.05.28 Clearing and Grub Site	159.00	ACR	312,717	0	37,526	35,024	2,878	388,146	2441.17
11.01.02.05.29 Push Cleared Material to Piles	106.00	PIL	22,374	0	2,685	2,506	206	27,771	261.99
11.01.02.05.30 Maintain Burning Piles	106.00	PIL	15,830	0	1,900	1,773	146	19,648	185.36
TOTAL Site Prep Sta 471+20 to 610+00	159.00	ACR	364,137	0	43,696	40,783	3,351	451,968	2842.57
11.01.02.06 Additional Clearing & Grubbing									
11.01.02.06.2A Sta 496+00 to Sta 558+50	50.70	ACR	42,122	0	5,055	4,718	388	52,282	1031.21
11.01.02.06.2B Sta 558+50 to 610+00 (landward)	23.70	ACR	103,006	0	12,361	11,537	948	127,852	5394.58
11.01.02.06.2C Sta 610+00 to 639+84 (landward)	11.10	ACR	48,243	0	5,789	5,403	444	59,880	5394.58
11.01.02.06.2D Push Cleared Material to Piles	57.00	PIL	12,031	0	1,444	1,348	111	14,933	261.99
11.01.02.06.2E Maintain Burning Piles	57.00	PIL	8,512	0	1,021	953	78	10,566	185.36
TOTAL Additional Clearing & Grubbing	85.50	ACR	213,915	0	25,670	23,959	1,969	265,512	3105.41
11.01.02.10 Final Grade Both Sites									
11.01.02.10.31 Final Grade Sta 93+09 to 215+00	112880.00	CY	131,139	0	15,737	14,688	1,207	162,771	1.44

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.02.10.32 Final Grade Sta 471+20 to 610+00	159.00	ACR	110,832	0	13,300	12,413	1,020	137,565	865.19
TOTAL Final Grade Both Sites	2.00	EA	241,971	0	29,037	27,101	2,227	300,335	150167.73
11.01.02.15 Ramps for Levee Crossings									
11.01.02.15.33 Ramps for Levee Crossings	4200.00	CY	22,603	0	2,712	2,532	208	28,055	6.68
TOTAL Ramps for Levee Crossings	7.00	EA	22,603	0	2,712	2,532	208	28,055	4007.89
11.01.02.20 Remove Ramps at Project End									
11.01.02.20.34 Remove Ramps at Project End	4200.00	CY	19,317	0	2,318	2,164	178	23,976	5.71
TOTAL Remove Ramps at Project End	7.00	EA	19,317	0	2,318	2,164	178	23,976	3425.21
11.01.02.25 Low Water Crossings									
11.01.02.25.35 Low Water Crossings									
11.01.02.25.35.01 Low Water Crossings	13.00	EA	65,000	0	7,800	7,280	598	80,678	6206.02
TOTAL Low Water Crossings	13.00	EA	65,000	0	7,800	7,280	598	80,678	6206.02
TOTAL Low Water Crossings	13.00	EA	65,000	0	7,800	7,280	598	80,678	6206.02
TOTAL Borrow Sites & Site Prep	1.00	EA	1,045,594	0	125,471	117,106	9,624	1,297,795	1297795
11.01.03 Stripping Levee									
11.01.03.05 Remove Aggr Sta 93+09 to 639+84									
11.01.03.05.36 Excavate Aggregate from Levee	10125.00	BCY	5,600	0	672	627	52	6,951	0.69
TOTAL Remove Aggr Sta 93+09 to 639+84	10125.00	BCY	5,600	0	672	627	52	6,951	0.69
11.01.03.06 Strip Levee-Less than 1' Raise									
11.01.03.06.37 Strip Topsoil from Levee	2178.01	BCY	1,424	0	171	160	13	1,768	0.81
11.01.03.06.38 Windrow Material	2178.01	BCY	803	0	96	90	7	997	0.46
TOTAL Strip Levee-Less than 1' Raise	2.70	ACR	2,227	0	267	249	20	2,765	1023.91
11.01.03.07 Strip Levee - > than 1' < 3' Rse									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.03.07.39 Strip Topsoil from Levee	37590.82	BCY	24,581	0	2,950	2,753	226	30,510	0.81
11.01.03.07.40 Windrow Material	37590.82	BCY	13,861	0	1,663	1,552	128	17,204	0.46
TOTAL Strip Levee - > than 1' < 3' Rse	46.60	ACR	38,442	0	4,613	4,305	354	47,714	1023.90
11.01.03.08 Strip Levee - > than </= 3' Rse									
11.01.03.08.41 Strip Topsoil from Levee	3226.68	BCY	2,110	0	253	236	19	2,619	0.81
11.01.03.08.42 Windrow Material	3226.68	BCY	1,190	0	143	133	11	1,477	0.46
TOTAL Strip Levee - > than </= 3' Rse	4.00	ACR	3,300	0	396	370	30	4,096	1023.90
11.01.03.09 Strip Berm-Less than 1' Raise									
11.01.03.09.43 Strip Topsoil from Levee	12100.05	BCY	15,825	0	1,899	1,772	146	19,641	1.62
11.01.03.09.44 Windrow Material	12100.05	BCY	4,462	0	535	500	41	5,538	0.46
TOTAL Strip Berm-Less than 1' Raise	15.00	ACR	20,286	0	2,434	2,272	187	25,179	1678.62
11.01.03.10 Strip Berm- > than 1' > 3' Raise									
11.01.03.10.45 Strip Topsoil from Levee	182710.76	BCY	238,950	0	28,674	26,762	2,199	296,586	1.62
11.01.03.10.46 Windrow Material	182710.76	BCY	67,371	0	8,084	7,546	620	83,621	0.46
TOTAL Strip Berm- > than 1' > 3' Raise	226.50	ACR	306,321	0	36,759	34,308	2,819	380,207	1678.62
11.01.03.11 Strip Berm- >/= 3' Raise									
11.01.03.11.47 Strip Topsoil from Levee	23312.76	BCY	30,489	0	3,659	3,415	281	37,843	1.62
11.01.03.11.48 Windrow Material	23312.76	BCY	8,596	0	1,032	963	79	10,670	0.46
TOTAL Strip Berm- >/= 3' Raise	28.90	ACR	39,085	0	4,690	4,377	360	48,512	1678.62
TOTAL Stripping Levee	271244.00	BCY	415,261	0	49,831	46,509	3,822	515,423	1.90
11.01.04 Levee Raise (Impervious)									
11.01.04.01 Exc/Haul Matl-Sta 93+09 - 114+00									
11.01.04.01.49 Exc/Haul	1166.25	BCY	4,159	0	499	466	38	5,162	4.43
TOTAL Exc/Haul Matl-Sta 93+09 - 114+00	1166.25	BCY	4,159	0	499	466	38	5,162	4.43
11.01.04.02 Exc/Haul Matl-Sta 600+00- 639+84									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.04.02.50 Exc/Haul	2061.25	BCY	7,350	0	882	823	68	9,123	4.43
TOTAL Exc/Haul Matl-Sta 600+00- 639+84	2061.25	BCY	7,350	0	882	823	68	9,123	4.43
11.01.04.03 Exc/Haul Matl-Sta 114+00- 228+00									
11.01.04.03.51 Exc/Haul	23696.25	BCY	84,496	0	10,139	9,463	778	104,876	4.43
TOTAL Exc/Haul Matl-Sta 114+00- 228+00	23696.25	BCY	84,496	0	10,139	9,463	778	104,876	4.43
11.01.04.04 Exc/Haul Matl-Sta 228+00- 375+00									
11.01.04.04.52 Exc/Haul	34861.25	BCY	176,568	0	21,188	19,776	1,625	219,156	6.29
TOTAL Exc/Haul Matl-Sta 228+00- 375+00	34861.25	BCY	176,568	0	21,188	19,776	1,625	219,156	6.29
11.01.04.05 Exc/Haul Matl-Sta 419+00- 467+00									
11.01.04.05.53 Exc/Haul	11558.75	BCY	41,216	0	4,946	4,616	379	51,157	4.43
TOTAL Exc/Haul Matl-Sta 419+00- 467+00	11558.75	BCY	41,216	0	4,946	4,616	379	51,157	4.43
11.01.04.06 Exc/Haul Matl-Sta 467+00- 600+00									
11.01.04.06.54 Exc/Haul	23607.50	BCY	84,179	0	10,101	9,428	775	104,483	4.43
TOTAL Exc/Haul Matl-Sta 467+00- 600+00	23607.50	BCY	84,179	0	10,101	9,428	775	104,483	4.43
11.01.04.07 Exc/Haul Matl-Sta 375+00- 398+00									
11.01.04.07.55 Exc/Haul	6402.50	BCY	38,826	0	4,659	4,349	357	48,192	7.53
TOTAL Exc/Haul Matl-Sta 375+00- 398+00	6402.50	BCY	38,826	0	4,659	4,349	357	48,192	7.53
11.01.04.08 Exc/Haul Matl-Sta 398+00- 419+00									
11.01.04.08.56 Exc/Haul	6093.75	BCY	30,864	0	3,704	3,457	284	38,308	6.29
TOTAL Exc/Haul Matl-Sta 398+00- 419+00	6093.75	BCY	30,864	0	3,704	3,457	284	38,308	6.29
11.01.04.52 Place Material									
11.01.04.52.57 Scarify Existing Surface	2187000	SF	5,585	0	670	626	51	6,932	0.00

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.04.52.58 Place	109447.50	BCY	141,803	0	17,016	15,882	1,305	176,006	1.61
TOTAL Place Material	109447.50	BCY	147,388	0	17,687	16,507	1,357	182,938	1.67
TOTAL Levee Raise (Impervious)	87558.00	CCY	615,045	0	73,805	68,885	5,661	763,396	8.72
11.01.05 Levee Raise (Random)									
11.01.05.03 Exc/Haul Matl-Sta 114+00- 228+00									
11.01.05.03.59 Exc/Haul	54895.00	BCY	195,743	0	23,489	21,923	1,802	242,957	4.43
TOTAL Exc/Haul Matl-Sta 114+00- 228+00	54895.00	BCY	195,743	0	23,489	21,923	1,802	242,957	4.43
11.01.05.04 Exc/Haul Matl-Sta 228+00- 375+00									
11.01.05.04.60 Exc/Haul	124602.50	BCY	631,095	0	75,731	70,683	5,809	783,318	6.29
TOTAL Exc/Haul Matl-Sta 228+00- 375+00	124602.50	BCY	631,095	0	75,731	70,683	5,809	783,318	6.29
11.01.05.05 Exc/Haul Matl-Sta 419+00- 467+00									
11.01.05.05.61 Exc/Haul	29440.00	BCY	104,976	0	12,597	11,757	966	130,297	4.43
TOTAL Exc/Haul Matl-Sta 419+00- 467+00	29440.00	BCY	104,976	0	12,597	11,757	966	130,297	4.43
11.01.05.06 Exc/Haul Matl-Sta 467+00- 600+00									
11.01.05.06.62 Exc/Haul	64110.00	BCY	228,602	0	27,432	25,603	2,104	283,741	4.43
TOTAL Exc/Haul Matl-Sta 467+00- 600+00	64110.00	BCY	228,602	0	27,432	25,603	2,104	283,741	4.43
11.01.05.07 Exc/Haul Matl-Sta 375+00- 398+00									
11.01.05.07.63 Exc/Haul	20798.75	BCY	126,129	0	15,135	14,126	1,161	156,552	7.53
TOTAL Exc/Haul Matl-Sta 375+00- 398+00	20798.75	BCY	126,129	0	15,135	14,126	1,161	156,552	7.53
11.01.05.08 Exc/Haul Matl-Sta 398+00- 419+00									
11.01.05.08.64 Exc/Haul	15510.00	BCY	78,556	0	9,427	8,798	723	97,504	6.29
TOTAL Exc/Haul Matl-Sta 398+00- 419+00	15510.00	BCY	78,556	0	9,427	8,798	723	97,504	6.29

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.05.52 Place Material								
11.01.05.52.65 Scarify Existing Surface	2187000 SF	5,585	0	670	626	51	6,932	0.00
11.01.05.52.66 Place	309356.25 BCY	400,809	0	48,097	44,891	3,689	497,486	1.61
TOTAL Place Material	309356.25 BCY	406,394	0	48,767	45,516	3,740	504,418	1.63
TOTAL Levee Raise (Random)	247485.00 CCY	1,771,496	0	212,579	198,408	16,305	2,198,787	8.88
11.01.06 Riverward Berm								
11.01.06.01 Exc/Haul Matl-Sta 166+00- 398+00								
11.01.06.01.67 Exc/Haul	161111.25 BCY	816,007	0	97,921	91,393	7,510	1,012,831	6.29
TOTAL Exc/Haul Matl-Sta 166+00- 398+00	161111.25 BCY	816,007	0	97,921	91,393	7,510	1,012,831	6.29
11.01.06.02 Exc/Haul Matl-Sta 398+00- 550+00								
11.01.06.02.68 Exc/Haul	105555.00 BCY	429,131	0	51,496	48,063	3,950	532,639	5.05
TOTAL Exc/Haul Matl-Sta 398+00- 550+00	105555.00 BCY	429,131	0	51,496	48,063	3,950	532,639	5.05
11.01.06.56 Place Material								
11.01.06.56.69 Scarify Existing Surface	1344000 SF	3,432	0	412	384	32	4,260	0.00
11.01.06.56.70 Place	266666.25 BCY	345,499	0	41,460	38,696	3,180	428,835	1.61
TOTAL Place Material	266666.25 BCY	348,931	0	41,872	39,080	3,212	433,095	1.62
TOTAL Riverward Berm	213333.00 CCY	1,594,069	0	191,288	178,536	14,672	1,978,565	9.27
11.01.07 Underseepage Berm (Random)								
11.01.07.02 Exc/Haul Matl-Sta 600+00- 639+84								
11.01.07.02.71 Exc/Haul	80203.75 BCY	285,989	0	34,319	32,031	2,632	354,970	4.43
TOTAL Exc/Haul Matl-Sta 600+00- 639+84	80203.75 BCY	285,989	0	34,319	32,031	2,632	354,970	4.43
11.01.07.03 Exc/Haul Matl-Sta 114+00- 228+00								
11.01.07.03.72 Exc/Haul	275548.75 BCY	982,545	0	117,905	110,045	9,043	1,219,538	4.43
TOTAL Exc/Haul Matl-Sta 114+00- 228+00	275548.75 BCY	982,545	0	117,905	110,045	9,043	1,219,538	4.43

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.07.04 Exc/Haul Matl-Sta 228+00- 375+00									
11.01.07.04.73 Exc/Haul	97012.50	BCY	491,355	0	58,963	55,032	4,522	609,872	6.29
TOTAL Exc/Haul Matl-Sta 228+00- 375+00	97012.50	BCY	491,355	0	58,963	55,032	4,522	609,872	6.29
11.01.07.05 Exc/Haul Matl-Sta 419+00- 467+00									
11.01.07.05.74 Exc/Haul	64632.50	BCY	230,465	0	27,656	25,812	2,121	286,054	4.43
TOTAL Exc/Haul Matl-Sta 419+00- 467+00	64632.50	BCY	230,465	0	27,656	25,812	2,121	286,054	4.43
11.01.07.06 Exc/Haul Matl-Sta 467+00- 600+00									
11.01.07.06.75 Exc/Haul	317035.00	BCY	1,130,475	0	135,657	126,613	10,405	1,403,151	4.43
TOTAL Exc/Haul Matl-Sta 467+00- 600+00	317035.00	BCY	1,130,475	0	135,657	126,613	10,405	1,403,151	4.43
11.01.07.07 Exc/Haul Matl-Sta 375+00- 398+00									
11.01.07.07.76 Exc/Haul	58356.25	BCY	353,888	0	42,467	39,635	3,257	439,247	7.53
TOTAL Exc/Haul Matl-Sta 375+00- 398+00	58356.25	BCY	353,888	0	42,467	39,635	3,257	439,247	7.53
11.01.07.08 Exc/Haul Matl-Sta 398+00- 419+00									
11.01.07.08.77 Exc/Haul	52578.75	BCY	266,304	0	31,957	29,826	2,451	330,538	6.29
TOTAL Exc/Haul Matl-Sta 398+00- 419+00	52578.75	BCY	266,304	0	31,957	29,826	2,451	330,538	6.29
11.01.07.53 Place Material									
11.01.07.53.78 Scarify Existing Surface	10935000	SF	27,925	0	3,351	3,128	257	34,660	0.00
11.01.07.53.79 Place	935242.50	BCY	1,127,946	0	135,354	126,330	10,381	1,400,011	1.50
11.01.07.53.80 Spread Aggregate Surfacing Matl	10125.00	BCY	4,800	0	576	538	44	5,958	0.59
TOTAL Place Material	945367.50	BCY	1,160,671	0	139,280	129,995	10,683	1,440,629	1.52
TOTAL Underseepage Berm (Random)	756295.00	CCY	4,901,692	0	588,203	548,989	45,115	6,083,999	8.04
11.01.08 Seeding & Mulching									
11.01.08.01 Seeding & Mulching									
11.01.08.01.81 Seeding & Mulching									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.08.01.81.01 Seeding & Mulching	120.00	ACR	180,000	0	21,600	20,160	1,657	223,417	1861.81
TOTAL Seeding & Mulching	120.00	ACR	180,000	0	21,600	20,160	1,657	223,417	1861.81
TOTAL Seeding & Mulching	120.00	ACR	180,000	0	21,600	20,160	1,657	223,417	1861.81
TOTAL Seeding & Mulching	120.00	ACR	180,000	0	21,600	20,160	1,657	223,417	1861.81
11.01.09 Replace Aggregate Surfacing									
11.01.09.27 Replace Aggregate Surfacing									
11.01.09.27.82 Replace Aggregate Surfacing									
11.01.09.27.82.01 Replace Aggregate Surfacing	19238.00	TON	324,904	0	38,988	36,389	2,990	403,272	20.96
TOTAL Replace Aggregate Surfacing	19238.00	TON	324,904	0	38,988	36,389	2,990	403,272	20.96
TOTAL Replace Aggregate Surfacing	19238.00	TON	324,904	0	38,988	36,389	2,990	403,272	20.96
TOTAL Replace Aggregate Surfacing	10125.00	CCY	324,904	0	38,988	36,389	2,990	403,272	39.83
11.01.10 Replace Stripped Material									
11.01.10.06 Repl Lev w/ less than 1' Raise									
11.01.10.06.84 Push Topsoil to Levee	2178.01	BCY	1,582	0	190	177	15	1,964	0.90
11.01.10.06.85 Finish Grade Lev for TS Placemnt	2.70	ACR	2,679	0	322	300	25	3,325	1231.66
TOTAL Repl Lev w/ less than 1' Raise	2.70	ACR	4,261	0	511	477	39	5,289	1958.93
11.01.10.07 Repl Lev w/ > than 1' < 3' Rse									
11.01.10.07.86 Push Topsoil to Levee	37590.82	BCY	27,305	0	3,277	3,058	251	33,891	0.90
11.01.10.07.87 Finish Grade Lev for TS Placemnt	46.60	ACR	46,242	0	5,549	5,179	426	57,396	1231.67
TOTAL Repl Lev w/ > than 1' < 3' Rse	46.60	ACR	73,547	0	8,826	8,237	677	91,286	1958.93
11.01.10.08 Repl Lev w/ > than </= 3' Rse									
11.01.10.08.88 Push Topsoil to Levee	3226.68	BCY	2,344	0	281	262	22	2,909	0.90
11.01.10.08.89 Finish Grade Lev for TS Placemnt	4.00	ACR	3,969	0	476	445	37	4,927	1231.66
TOTAL Repl Lev w/ > than </= 3' Rse	4.00	ACR	6,313	0	758	707	58	7,836	1958.93
11.01.10.09 Repl Berm-Less than 1' Raise									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.10.09.90 Push Topsoil to Berm	12100.05	ACR	17,578	0	2,109	1,969	162	21,818	1.80
11.01.10.09.91 Finish Grade Lev for TS Placemnt	15.00	ACR	14,885	0	1,786	1,667	137	18,475	1231.67
TOTAL Repl Berm-Less than 1' Raise	15.00	ACR	32,463	0	3,896	3,636	299	40,293	2686.20
11.01.10.10 Repl Berm- > than 1' > 3' Raise									
11.01.10.10.92 Push Topsoil to Berm	182710.76	BCY	265,429	0	31,851	29,728	2,443	329,451	1.80
11.01.10.10.93 Finish Grade Lev for TS Placemnt	226.50	ACR	224,759	0	26,971	25,173	2,069	278,972	1231.67
TOTAL Repl Berm- > than 1' > 3' Raise	226.50	ACR	490,188	0	58,823	54,901	4,512	608,424	2686.20
11.01.10.11 Repl Berm- >/= 3' Raise									
11.01.10.11.94 Push Topsoil to Berm	23312.76	BCY	33,867	0	4,064	3,793	312	42,036	1.80
11.01.10.11.95 Finish Grade Lev for TS Placemnt	28.90	ACR	28,678	0	3,441	3,212	264	35,595	1231.67
TOTAL Repl Berm- >/= 3' Raise	28.90	ACR	62,545	0	7,505	7,005	576	77,631	2686.20
TOTAL Replace Stripped Material	261119.00	CY	669,317	0	80,318	74,964	6,160	830,759	3.18
11.01.11 Slope Protection									
11.01.11.27 Place Bedding Material									
11.01.11.27.96 Place Bedding Material									
11.01.11.27.96.01 Place Bedding Material	40.00	TON	1,209	0	145	135	11	1,500	37.50
TOTAL Place Bedding Material	40.00	TON	1,209	0	145	135	11	1,500	37.50
TOTAL Place Bedding Material	40.00	TON	1,209	0	145	135	11	1,500	37.50
11.01.11.28 Place Riprap Protection									
11.01.11.28.97 Place Riprap Protection									
11.01.11.28.97.01 Place Riprap Protection	120.00	TON	4,374	0	525	490	40	5,429	45.24
TOTAL Place Riprap Protection	120.00	TON	4,374	0	525	490	40	5,429	45.24
TOTAL Place Riprap Protection	120.00	TON	4,374	0	525	490	40	5,429	45.24
TOTAL Slope Protection	1.00	EA	5,583	0	670	625	51	6,929	6929.30
11.01.12 Freeboard Gages									

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.12.01 Freeboard Gages									
11.01.12.01.98 Freeboard Gages									
11.01.12.01.98.01 Freeboard Gages	7.00	EA	140,000	0	16,800	15,680	1,289	173,769	24824.08
TOTAL Freeboard Gages	7.00	EA	140,000	0	16,800	15,680	1,289	173,769	24824.08
TOTAL Freeboard Gages	7.00	EA	140,000	0	16,800	15,680	1,289	173,769	24824.08
TOTAL Freeboard Gages	7.00	EA	140,000	0	16,800	15,680	1,289	173,769	24824.08
11.01.13 Drainage Systems									
11.01.13.16 Drainage System 2 - Sta 115+60									
11.01.13.16.99 Platform Raise - 1 foot									
11.01.13.16.99. 1 Sand Blasting	28.00	SF	79	0	9	9	1	97	3.48
11.01.13.16.99.10 Vertcl Drilg Holes -1.5"X 6"Deep	60.00	EA	1,109	0	133	124	10	1,376	22.94
11.01.13.16.99.15 Grouting of vertical holes	60.00	EA	668	0	80	75	6	829	13.81
11.01.13.16.99.30 Hole Layout	3.00	HR	251	0	30	28	2	311	103.70
11.01.13.16.99.45 Concrete -Slab	1.14	CY	604	0	72	68	6	750	657.53
11.01.13.16.99.50 Forms for Slab	98.00	SF	569	0	68	64	5	706	7.20
11.01.13.16.99.55 Reinforcing Steel for Slab	201.00	LB	281	0	34	31	3	349	1.74
11.01.13.16.99.60 Replace Stem	1.00	EA	2,639	0	317	296	24	3,275	3275.27
TOTAL Platform Raise - 1 foot	1.00	EA	6,198	0	744	694	57	7,693	7693.40
11.01.13.16.A0 Drainage Structure Extension									
11.01.13.16.A0.01 Excavate and Remove Existing End	1.00	EA	928	0	111	104	9	1,152	1151.75
11.01.13.16.A0.02 Place RCP Extension	1.00	EA	1,505	0	181	169	14	1,869	1868.58
11.01.13.16.A0.03 Replace Flared End Section	1.00	EA	1,835	0	220	206	17	2,278	2277.93
11.01.13.16.A0.04 Place Concrete Collars	1.00	EA	1,959	0	235	219	18	2,431	2430.99
11.01.13.16.A0.05 Additional Compaction Labor	1.00	EA	283	0	34	32	3	352	351.62
11.01.13.16.A0.06 Riprap Removal and Replacement	1.00	EA	2,578	0	309	289	24	3,199	3199.44
TOTAL Drainage Structure Extension	1.00	EA	9,088	0	1,091	1,018	84	11,280	11280.31
TOTAL Drainage System 2 - Sta 115+60	1.00	EA	15,287	0	1,834	1,712	141	18,974	18973.71
11.01.13.17 Drainage System 3 - Sta 186+00									
11.01.13.17.A1 Platform Raise - 2 foot									
11.01.13.17.A1. 1 Sand Blasting	28.00	SF	79	0	9	9	1	97	3.48
11.01.13.17.A1.10 Vertcl Drilg Holes -1.5"X 6"Deep	48.00	EA	887	0	106	99	8	1,101	22.94

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.13.17.A1.15 Grouting of vertical holes	48.00	EA	537	0	64	60	5	666	13.88
11.01.13.17.A1.30 Hole Layout	3.00	HR	251	0	30	28	2	311	103.70
11.01.13.17.A1.45 Concrete -Slab	2.28	CY	775	0	93	87	7	962	421.86
11.01.13.17.A1.50 Forms for Slab	123.00	SF	697	0	84	78	6	865	7.03
11.01.13.17.A1.55 Reinforcing Steel for Slab	186.00	LB	282	0	34	32	3	350	1.88
11.01.13.17.A1.60 Replace Stem	1.00	EA	2,700	0	324	302	25	3,351	3350.86
TOTAL Platform Raise - 2 foot	1.00	EA	6,206	0	745	695	57	7,703	7703.23
11.01.13.17.A2 Drainage Structure Extension									
11.01.13.17.A2.01 Excavate and Remove Existing End	1.00	EA	928	0	111	104	9	1,152	1151.75
11.01.13.17.A2.02 Place RCP Extension	1.00	EA	2,163	0	260	242	20	2,684	2684.30
11.01.13.17.A2.03 Replace Flared End Section	1.00	EA	1,835	0	220	206	17	2,278	2277.93
11.01.13.17.A2.04 Place Concrete Collars	1.00	EA	1,959	0	235	219	18	2,431	2430.99
11.01.13.17.A2.05 Additional Compaction Labor	1.00	EA	283	0	34	32	3	352	351.62
11.01.13.17.A2.06 Riprap Removal and Replacement	1.00	EA	2,578	0	309	289	24	3,199	3199.44
TOTAL Drainage Structure Extension	1.00	EA	9,745	0	1,169	1,091	90	12,096	12096.03
TOTAL Drainage System 3 - Sta 186+00	1.00	EA	15,952	0	1,914	1,787	147	19,799	19799.26
11.01.13.18 Drainage System 4 - Sta 325+00									
11.01.13.18.A3 Dewatering									
11.01.13.18.A3.01 Drill Well & Set Casing	2.00	EA	59,345	0	7,121	6,647	546	73,659	36829.56
11.01.13.18.A3.02 Pilot Hole	1.00	EA	9,224	0	1,107	1,033	85	11,449	11448.51
11.01.13.18.A3.03 Dewatering Labor	30.00	DAY	9,711	0	1,165	1,088	89	12,053	401.76
11.01.13.18.A3.04 Abandon Wells	2.00	EA	8,000	0	960	896	74	9,930	4964.82
TOTAL Dewatering	1.00	EA	86,279	0	10,354	9,663	794	107,090	107090.13
11.01.13.18.A4 Exc/Haul Imp Fill for Ring Levee	21717.50	BCY	120,848	0	14,502	13,535	1,112	149,998	6.91
11.01.13.18.A5 Place Imp Fill for Ring Levee	21717.50	BCY	28,138	0	3,377	3,151	259	34,925	1.61
11.01.13.18.A6 48" Dia CMP for Ring Lev/Bypass									
11.01.13.18.A6.01 48" Dia CMP for Ring Levee	280.00	LF	30,461	0	3,655	3,412	280	37,809	135.03
11.01.13.18.A6.02 48" Dia CMP for Bypass	700.00	LF	38,986	0	4,678	4,366	359	48,390	69.13
TOTAL 48" Dia CMP for Ring Lev/Bypass	980.00	LF	69,447	0	8,334	7,778	639	86,198	87.96
11.01.13.18.A7 Seeding/Mulching for Ring Levee									
11.01.13.18.A7.01 Seeding and Mulching	1.30	ACR	910	0	109	102	8	1,129	868.84
TOTAL Seeding/Mulching for Ring Levee	1.30	ACR	910	0	109	102	8	1,129	868.84

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.13.18.A8 Turf Reinforcement Mat									
11.01.13.18.A8.01 Delivery of Reinforcement Mat	55215.00	SF	100	0	12	11	1	124	0.00
11.01.13.18.A8.02 Reinforcement Mat	63000.00	SF	21,768	0	2,612	2,438	200	27,019	0.43
11.01.13.18.A8.03 Trenching	19.26	CY	1,988	0	239	223	18	2,467	128.09
11.01.13.18.A8.04 Placement of Reinforcement Mat	6135.00	SY	5,001	0	600	560	46	6,208	1.01
11.01.13.18.A8.05 Backfill Trench & Reseed	19.26	CY	2,188	0	263	245	20	2,715	140.98
TOTAL Turf Reinforcement Mat	55215.00	SF	31,045	0	3,725	3,477	286	38,533	0.70
11.01.13.18.B0 Exc/Stockpile Exist Levee	16250.00	BCY	38,460	0	4,615	4,307	354	47,736	2.94
11.01.13.18.B1 Gatewell Structure									
11.01.13.18.B1.01 Demo Exist Gatewell Str/RCB	1.00	EA	24,181	0	2,902	2,708	223	30,014	30013.85
11.01.13.18.B1.02 Structural Excavation	1.00	EA	2,579	0	309	289	24	3,201	3200.59
11.01.13.18.B1.03 Base Slab	2.81	CY	4,087	0	490	458	38	5,073	1805.26
11.01.13.18.B1.04 1st Lift	17.22	CY	18,051	0	2,166	2,022	166	22,405	1301.08
11.01.13.18.B1.05 2nd Lift	17.22	CY	18,751	0	2,250	2,100	173	23,274	1351.59
11.01.13.18.B1.06 3rd Lift	9.98	CY	14,318	0	1,718	1,604	132	17,772	1780.72
11.01.13.18.B1.07 Elevated Slab	2.96	CY	4,245	0	509	475	39	5,268	1779.83
11.01.13.18.B1.08 Concrete Collars (allowance)	2.00	EA	2,000	0	240	224	18	2,482	1241.20
11.01.13.18.B1.15 Metals - Ladders	1.00	EA	2,966	0	356	332	27	3,681	3680.88
11.01.13.18.B1.16 Metals - Landings	1.00	EA	3,275	0	393	367	30	4,065	4065.00
11.01.13.18.B1.17 Metals - Labor	1.00	EA	6,728	0	807	754	62	8,351	8351.31
11.01.13.18.B1.30 Metals - Hydraulic Structures	1.00	EA	56,859	0	6,823	6,368	523	70,574	70573.77
TOTAL Gatewell Structure	1.00	EA	158,040	0	18,965	17,700	1,455	196,159	196159.45
11.01.13.18.B2 Inlet Structure For 6'x5' RCB									
11.01.13.18.B2.01 Toe	0.54	CY	177	0	21	20	2	220	407.22
11.01.13.18.B2.03 Slab	4.15	CY	3,477	0	417	389	32	4,315	1039.85
11.01.13.18.B2.04 Wingwall	4.01	CY	8,975	0	1,077	1,005	83	11,139	2777.91
11.01.13.18.B2.05 Headwall	1.88	CY	4,943	0	593	554	45	6,135	3263.23
11.01.13.18.B2.06 Concrete Collars (allowance)	1.00	EA	1,000	0	120	112	9	1,241	1241.20
11.01.13.18.B2.07 Free Draining Material Behind HW	1.30	CY	784	0	94	88	7	973	748.67
TOTAL Inlet Structure For 6'x5' RCB	1.00	EA	19,355	0	2,323	2,168	178	24,024	24024.05
11.01.13.18.B3 Outlet Structure for 6'x5' RCB									
11.01.13.18.B3.01 Toe	1.70	CY	367	0	44	41	3	456	268.14
11.01.13.18.B3.03 Slab	6.30	CY	2,211	0	265	248	20	2,745	435.64
11.01.13.18.B3.04 Wingwall	5.53	CY	9,066	0	1,088	1,015	83	11,252	2034.78
11.01.13.18.B3.05 Headwall	3.09	CY	4,110	0	493	460	38	5,102	1651.06
11.01.13.18.B3.07 Concrete Collars	1.30	CY	1,232	0	148	138	11	1,529	1176.28
TOTAL Outlet Structure for 6'x5' RCB	1.00	EA	16,986	0	2,038	1,902	156	21,084	21083.65

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.13.18.B4 6'x5' RCB									
11.01.13.18.B4.33 Earthwork for 5'x6' RCB	190.00	LF	1,591	0	191	178	15	1,975	10.39
11.01.13.18.B4.34 Base Slab for 6'x5' RCB	74.77	CY	46,317	0	5,558	5,188	426	57,489	768.88
11.01.13.18.B4.35 Walls for 6'x5' RCB	87.96	CY	100,054	0	12,007	11,206	921	124,188	1411.87
11.01.13.18.B4.36 Elevated Slab for 6'x5' RCB	74.77	CY	49,186	0	5,902	5,509	453	61,049	816.50
TOTAL 6'x5' RCB	190.00	LF	197,148	0	23,658	22,081	1,815	244,701	1287.90
11.01.13.18.B6 Replace Exist Levee/Compact	16250.00	BCY	93,081	0	11,170	10,425	857	115,532	7.11
11.01.13.18.B7 Seeding/Mulching for RS of Levee									
11.01.13.18.B7.01 Seeding and Mulching	2.30	ACR	1,610	0	193	180	15	1,998	868.84
TOTAL Seeding/Mulching for RS of Levee	2.30	ACR	1,610	0	193	180	15	1,998	868.84
TOTAL Drainage System 4 - Sta 325+00	1.00	EA	861,348	0	103,362	96,471	7,928	1,069,108	1069108
11.01.13.19 Drainage System 5 - Sta 398+00									
11.01.13.19.B9 Platform Raise - 2.25 foot									
11.01.13.19.B9. 1 Sand Blasting	26.00	SF	73	0	9	8	1	90	3.48
11.01.13.19.B9.10 Vertcl Drilg Holes -1.5"X 6"Deep	44.00	EA	813	0	98	91	7	1,009	22.94
11.01.13.19.B9.15 Grouting of vertical holes	44.00	EA	484	0	58	54	4	601	13.66
11.01.13.19.B9.30 Hole Layout	3.00	HR	251	0	30	28	2	311	103.70
11.01.13.19.B9.45 Concrete -Slab	2.65	CY	871	0	105	98	8	1,081	407.88
11.01.13.19.B9.50 Forms for Slab	117.00	SF	666	0	80	75	6	827	7.06
11.01.13.19.B9.55 Reinforcing Steel for Slab	182.00	LB	278	0	33	31	3	345	1.90
11.01.13.19.B9.60 Replace Stem	1.00	EA	3,050	0	366	342	28	3,786	3786.15
TOTAL Platform Raise - 2.25 foot	1.00	EA	6,486	0	778	726	60	8,051	8050.85
11.01.13.19.C0 Drainage Structure Extension									
11.01.13.19.C0.01 Excavate and Remove Existing End	1.00	EA	928	0	111	104	9	1,152	1151.75
11.01.13.19.C0.02 Place RCP Extension	1.00	EA	1,983	0	238	222	18	2,461	2461.28
11.01.13.19.C0.03 Replace Flared End Section	1.00	EA	1,555	0	187	174	14	1,930	1930.39
11.01.13.19.C0.04 Place Concrete Collars	1.00	EA	1,846	0	222	207	17	2,291	2291.23
11.01.13.19.C0.05 Additional Compaction Labor	1.00	EA	283	0	34	32	3	352	351.62
11.01.13.19.C0.06 Riprap Removal and Replacement	1.00	EA	2,578	0	309	289	24	3,199	3199.44
TOTAL Drainage Structure Extension	1.00	EA	9,173	0	1,101	1,027	84	11,386	11385.71
TOTAL Drainage System 5 - Sta 398+00	1.00	EA	15,659	0	1,879	1,754	144	19,437	19436.56
11.01.13.20 Drainage System 7 - Sta 420+35									

** PROJECT INDIRECT SUMMARY - Assembly **

		QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.13.20.C1	Platform Raise - 2.5 foot									
11.01.13.20.C1. 1	Sand Blasting	24.00	SF	67	0	8	8	1	84	3.48
11.01.13.20.C1.10	Vertcl Drilg Holes -1.5"X 6"Deep	40.00	EA	739	0	89	83	7	917	22.94
11.01.13.20.C1.15	Grouting of vertical holes	40.00	EA	452	0	54	51	4	561	14.03
11.01.13.20.C1.30	Hole Layout	3.00	HR	251	0	30	28	2	311	103.70
11.01.13.20.C1.45	Concrete -Slab	2.22	CY	799	0	96	90	7	992	446.99
11.01.13.20.C1.50	Forms for Slab	116.00	SF	651	0	78	73	6	809	6.97
11.01.13.20.C1.55	Reinforcing Steel for Slab	198.00	LB	292	0	35	33	3	362	1.83
11.01.13.20.C1.60	Replace Stem	1.00	EA	2,910	0	349	326	27	3,612	3611.51
	TOTAL Platform Raise - 2.5 foot	1.00	EA	6,162	0	739	690	57	7,648	7647.69
11.01.13.20.C2	Drainage Structure Extension									
11.01.13.20.C2.01	Excavate and Remove Existing End	1.00	EA	928	0	111	104	9	1,152	1151.75
11.01.13.20.C2.02	Place RCP Extension	1.00	EA	1,194	0	143	134	11	1,482	1482.22
11.01.13.20.C2.03	Replace Flared End Section	1.00	EA	1,297	0	156	145	12	1,610	1610.16
11.01.13.20.C2.04	Place Concrete Collars	1.00	EA	1,883	0	226	211	17	2,338	2337.65
11.01.13.20.C2.05	Additional Compaction Labor	1.00	EA	283	0	34	32	3	352	351.62
11.01.13.20.C2.06	Riprap Removal and Replacement	1.00	EA	2,578	0	309	289	24	3,199	3199.44
	TOTAL Drainage Structure Extension	1.00	EA	8,164	0	980	914	75	10,133	10132.84
	TOTAL Drainage System 7 - Sta 420+35	1.00	EA	14,325	0	1,719	1,604	132	17,781	17780.53
11.01.13.21	Drainage System 8 - Sta 497+60									
11.01.13.21.C3	Platform Raise - 1 foot 5 inches									
11.01.13.21.C3. 1	Sand Blasting	32.00	SF	90	0	11	10	1	111	3.48
11.01.13.21.C3.10	Vertcl Drilg Holes -1.5"X 6"Deep	80.00	EA	1,626	0	195	182	15	2,018	25.23
11.01.13.21.C3.15	Grouting of vertical holes	80.00	EA	989	0	119	111	9	1,227	15.34
11.01.13.21.C3.30	Hole Layout	3.00	HR	251	0	30	28	2	311	103.70
11.01.13.21.C3.45	Concrete -Slab	2.46	CY	839	0	101	94	8	1,042	423.43
11.01.13.21.C3.50	Forms for Slab	147.00	SF	740	0	89	83	7	918	6.25
11.01.13.21.C3.55	Reinforcing Steel for Slab	293.00	LB	358	0	43	40	3	445	1.52
11.01.13.21.C3.60	Replace Stem	1.00	EA	2,905	0	349	325	27	3,606	3606.30
	TOTAL Platform Raise - 1 foot 5 inches	1.00	EA	7,798	0	936	873	72	9,679	9678.82
11.01.13.21.C4	Drainage Structure Extension									
11.01.13.21.C4.01	Excavate and Remove Existing End	1.00	EA	2,348	0	282	263	22	2,914	2913.90
11.01.13.21.C4.02	Place RCP Extension	1.00	EA	3,268	0	392	366	30	4,057	4056.77
11.01.13.21.C4.03	Place Conc Collars for RCP Ext	1.00	EA	1,959	0	235	219	18	2,431	2430.99
11.01.13.21.C4.04	Toe	0.54	CY	177	0	21	20	2	220	407.22
11.01.13.21.C4.05	Slab	4.15	CY	3,477	0	417	389	32	4,315	1039.85

** PROJECT INDIRECT SUMMARY - Assembly **

		QUANTITY	UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
11.01.13.21.C4.06	Wingwall	4.01	CY	8,975	0	1,077	1,005	83	11,139	2777.91
11.01.13.21.C4.07	Headwall	1.88	CY	4,943	0	593	554	45	6,135	3263.23
11.01.13.21.C4.08	Concrete Collars (allowance)	1.00	EA	1,000	0	120	112	9	1,241	1241.20
11.01.13.21.C4.09	Free Draining Material Behind HW	1.30	CY	784	0	94	88	7	973	748.67
11.01.13.21.C4.10	Additional Compaction Labor	1.00	EA	283	0	34	32	3	352	351.62
11.01.13.21.C4.11	Riprap Removal and Replacement	1.00	EA	2,578	0	309	289	24	3,199	3199.44
	TOTAL Drainage Structure Extension	1.00	EA	29,791	0	3,575	3,337	274	36,977	36976.78
	TOTAL Drainage System 8 - Sta 497+60	1.00	EA	37,589	0	4,511	4,210	346	46,656	46655.59
11.01.13.22	Drainage System 9 - Sta 558+50									
11.01.13.22.C5	Platform Raise - 1 foot									
11.01.13.22.C5. 1	Sand Blasting	28.00	SF	79	0	9	9	1	97	3.48
11.01.13.22.C5.10	Vertcl Drilg Holes -1.5"X 6"Deep	60.00	EA	1,109	0	133	124	10	1,376	22.94
11.01.13.22.C5.15	Grouting of vertical holes	60.00	EA	668	0	80	75	6	829	13.81
11.01.13.22.C5.30	Hole Layout	3.00	HR	251	0	30	28	2	311	103.70
11.01.13.22.C5.45	Concrete -Slab	1.14	CY	604	0	72	68	6	750	657.53
11.01.13.22.C5.50	Forms for Slab	98.00	SF	569	0	68	64	5	706	7.20
11.01.13.22.C5.55	Reinforcing Steel for Slab	201.00	LB	281	0	34	31	3	349	1.74
11.01.13.22.C5.60	Replace Stem	1.00	EA	2,988	0	359	335	28	3,709	3709.26
	TOTAL Platform Raise - 1 foot	1.00	EA	6,548	0	786	733	60	8,127	8127.38
11.01.13.22.C6	Drainage Structure Extension									
11.01.13.22.C6.01	Excavate and Remove Existing End	1.00	EA	928	0	111	104	9	1,152	1151.75
11.01.13.22.C6.02	Place RCP Extension	1.00	EA	1,505	0	181	169	14	1,869	1868.58
11.01.13.22.C6.03	Replace Flared End Section	1.00	EA	1,835	0	220	206	17	2,278	2277.93
11.01.13.22.C6.04	Place Concrete Collars	1.00	EA	1,959	0	235	219	18	2,431	2430.99
11.01.13.22.C6.05	Additional Compaction Labor	1.00	EA	283	0	34	32	3	352	351.62
11.01.13.22.C6.06	Riprap Removal and Replacement	1.00	EA	2,578	0	309	289	24	3,199	3199.44
	TOTAL Drainage Structure Extension	1.00	EA	9,088	0	1,091	1,018	84	11,280	11280.31
	TOTAL Drainage System 9 - Sta 558+50	1.00	EA	15,636	0	1,876	1,751	144	19,408	19407.69
	TOTAL Drainage Systems	1.00	EA	975,796	0	117,095	109,289	8,981	1,211,161	1211161
	TOTAL Levees	1.00	EA	13,379,088	0	1,605,491	1,498,458	123,140	16,606,176	16606176
11.02	Floodwalls - NONE									
	TOTAL Levees and Floodwalls	1.00	EA	13,379,088	0	1,605,491	1,498,458	123,140	16,606,176	16606176
	TOTAL Feasibility Study Estimate for:	1.00	EA	16,547,795	0	1,605,491	1,498,458	123,140	19,774,883	19774883

** PROJECT INDIRECT SUMMARY - Assembly **

	QUANTITY UOM	DIRECT	OVERHEAD	% OVRHD	PROFIT	BOND	TOTAL COST	UNIT COST
Contingency							4,470,756	
SUBTOTAL							24,245,640	
Engineering & Design							2,151,635	
SUBTOTAL							26,397,274	
Supervision & Administration							1,396,411	
TOTAL INCL OWNER COSTS							27,793,685	

No errors detected...

* * * END OF ERROR REPORT * * *