

**Review of Completed Project,
Kansas City Levees, Kansas and Missouri**

**Interim Feasibility Report and
Environmental Impact Statement**

August 2006

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Interim Feasibility Report Document Organization

- **Feasibility Report**
- **Environmental Impact Statement (EIS) (*includes*)**
 - **Fish and Wildlife Coordination Documents**
 - **Section 404/401 Documentations**
 - **Public Involvement, Comments and Responses**
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 - **Hydrology and Hydraulics**
 - **Structural**
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 - **Other**

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Syllabus

The existing Kansas Citys, Missouri and Kansas, Local Flood Damage Reduction Project provides local flood damage reduction for the metropolitan areas of Kansas City, Missouri and Kansas City, Kansas. The Kansas Citys project is a unit of the Missouri River basin comprehensive plan authorized by the 1936, 1944, 1946, and 1951 Flood Control Acts. A modification to raise some of the levee units comprising the Kansas Citys Project was authorized in 1962.

The Kansas Citys project is authorized as seven levee units. This project extends over the lowest 10 miles of the Kansas River (at its confluence with the Missouri River) and a 20 mile reach on the Missouri River flanking the mouth of the Kansas River. These levees act in concert to protect an area of dense industrial and commercial development and minor areas of farmland all together covering about 32 square miles. Five of the seven units protect residential development. Communities within the study area include Kansas City, Missouri; North Kansas City, Missouri; Randolph, Missouri; Birmingham, Missouri; and Kansas City, Kansas.

Although the project is designed and functions as a coordinated system, its components are located on opposite banks of two major rivers involving two states and various political jurisdictions. Thus, the seven levee units are operated and maintained independently by five non-federal sponsors. Most of the Federally constructed works date to the 1940's and 1950's. Significant Federal modifications to several units were accomplished in the 1970's. While this metropolitan flood damage reduction system is designated as a Federal project, it has long been turned over to the sponsors for operation and maintenance. The Corps of Engineers continues to conduct regular inspections and technical review of significant modifications to the system.

The entire metropolitan system of seven levee units withstood the Missouri River Flood of 1993, but some components were nearly overtopped or experienced underseepage issues. As a result, there was a concern that the levees may provide less than the design level of protection. Section 216 of the 1970 Flood Control Act provides the authority to reexamine a completed civil works project.

This Interim Feasibility Report addresses recommended performance improvements in four of the levee units (the Argentine, North Kansas City, Fairfax-Jersey Creek, and East Bottoms units). These four units serve 11,700 residents and 68,750 local employees. Feasibility examination of the Birmingham levee unit has found the unit adequate. The remaining two levee units (Armourdale and Central Industrial District) will be addressed in the Final Feasibility Report scheduled for publishing in late 2008. The study included a continual and extensive independent technical review.

This report focuses on identifying, describing and offering solutions to flood performance weaknesses in four of the levee units by addressing the need for improved underseepage

control and reducing the risk of overtopping and structural failure. Generally these weaknesses impair the reliability of the individual unit where they are found. To address the study objective of ensuring reliability across the levee system consistent with the intent of the original authorizations, the study recommends the following improvements:

- The Argentine Unit must be raised 4 to 6 feet, along with major improvements to the existing line of protection and associated structures including three pump stations, floodwalls, stoplog gaps, drainage structures and related features.
- The East Bottoms, Fairfax-Jersey Creek, and North Kansas City Units can be strengthened at their present elevations to achieve an acceptable reliability. Strengthening will include specific structural and underseepage control measures as described in the Interim Feasibility Report. These measures include:
 - installing a new system of pressure relief wells at the East Bottoms Unit;
 - adding piles and buttresses to strengthen an existing floodwall and reconstructing a sheetpile wall at two locations within the Fairfax-Jersey Creek Unit, and
 - establishing a new pressure relief well system and pump plant, and a new buried seepage collector system at two locations within the North Kansas City Unit.

In addition the study recommends that upcoming efforts directed at a Final Feasibility Report will continue with analysis and recommendations for the Armourdale and Central Industrial District Units respective to a lower Kansas River system solution and other minor improvements in various units.

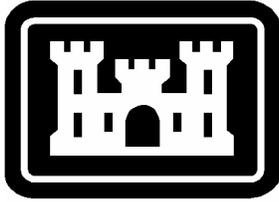
The Recommended Plan for the four units addressed in this Interim Report is the National Economic Development (NED) plan. The recommendations for the Final Feasibility Report, addressing the remaining units, will not impact the NED status of the Interim recommendations. Individually and collectively the recommendations are economically justified. Separable sites and features are incrementally justified. The report categorizes the various levee system problems and the related solutions as new work, reconstruction (a subcategory of new work), or design/construction deficiency remedies. Each category has its own authorization and budget implications. Remedies addressing deficiencies would be implemented under the existing project authorization. Measures to address new construction (associated with changed conditions) and reconstruction would require new authorization and would be identified differently in the budget process.

The Recommended Plan has few direct or cumulative environmental impacts largely because it sustains the existing project rather than encumbering additional resources for a “new” flood damage reduction project. Furthermore, because the authorized project footprint is essentially unchanged, there are relatively no other long-term adverse social effects. There are no takings of threatened or endangered species in the Recommended Plan. Very minor mitigation is required to compensate for the loss of less than 1 acre of wetland. Hazardous waste and CERCLA issues are addressed within the recommended solutions. The recommended levee raise for the Argentine Unit would result in minor induced damages during extremely rare events. However, there is no real estate taking.

The total implementation cost of these measures is \$75,550,000 shared with the four non-Federal levee sponsors. The total annual NED benefits are \$41,404,000; annual NED costs are \$5,176,000 and the net NED benefits are \$36,228,000. The resultant BCR is 8.0 to 1. The sponsors would receive credit for any necessary lands, easements, rights-of-way, relocations or disposal area (LERRD). The aggregate Federal share of the plan is \$49,107,000 or generally 65% (percent) of the total cost and the sponsor share is \$26,443,000 or generally 35%. The sponsors will take ownership of project improvements and assume all operation, maintenance, repair and replacement costs of the completed works.

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**Review of Completed Project,
Kansas City Levees, Missouri and Kansas**

**Interim Feasibility Report and
Environmental Impact Statement**

August 2006

**Kansas City District
Northwestern Division**

REVIEW OF COMPLETED PROJECT
KANSAS CITYS LEVEES, MISSOURI AND KANSAS
INTERIM FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT

Introduction and Discussion

Background

The existing Kansas Citys Flood Damage Reduction Project provides local flood damage reduction for the metropolitan areas of Kansas City, Missouri and Kansas City, Kansas.

The Kansas Citys project is authorized as seven levee units. This project extends along the Kansas and Missouri Rivers within the metropolitan area of Kansas City, Kansas and Kansas City, Missouri. These levees along with interior drainage pumps protect an area of dense industrial and commercial development and minor cropland altogether covering about 32 square miles. In addition, five of the seven units protect residential development.

While the project operates as a system, its components are located on opposite banks on two major rivers governed by five different geo-political jurisdictions. Thus, the seven levee units are, for the most part, operated and maintained independently by five non-federal sponsors. While the metropolitan flood damage reduction system is designated as a Federal project, it has been turned over to the sponsors for about 50 years. The Corps of Engineers continues to conduct regular inspections and technical review of significant modifications to the system.

Reason For Study

The entire metropolitan system of seven levee units withstood the Missouri River Flood of 1993, but the general performance of the system was severely tested during the flood. Not only were stages extreme, but durations were lengthy. Concerns arose about the level of protection against overtopping and underseepage. Further, there was a concern that the levees may provide less than the authorized level of protection.

The Kansas Citys metropolitan population and economy have grown significantly since the last levee system improvements were authorized in the 1962 modification. Much of the metropolitan economy is related to the areas protected by the levee system. Parts of the system are over 50 years old. Project failure would endanger lives and create massive physical flood damages. A total population of 19,818 persons reside and 94,036 people are employed within the protected areas. Value of protected physical structures and contents is estimated at \$16,295,000,000.

Both natural and man-induced geomorphological changes have occurred since the last project authorization. Reservoirs have reduced some of the river systems' sediment load, and navigation structures have contributed to the Missouri River's cross-sectional adjustments.

Study Authority

Section 216 of the 1970 Flood Control Act provides authority to reexamine completed civil works. 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.

Study Area

The study area includes all or portions of the communities of Kansas City, Missouri; North Kansas City, Missouri; Randolph, Missouri; Birmingham, Missouri; and Kansas City, Kansas. The overall feasibility study addresses the area protected by the existing seven levees of the Kansas Citys system and directly affected adjacent areas.

Purpose And Scope Of The Study

This Interim Feasibility Report addresses potential improvements to increase the project's current performance and reduce the flooding risk of four of the seven levee units within the Kansas Citys system: the Argentine Unit, the North Kansas City Unit, the East Bottoms Unit, and the Fairfax-Jersey Creek Unit. A fifth levee unit, the Birmingham Unit, was determined to meet the authorized level of protection assuming continued adequate operations and maintenance efforts. The Final Feasibility Report will address the two remaining levee units (Armourdale and the Central Industrial District (CID) Units).

The units addressed in this Interim report emerged from the initial investigation of all seven units based on the identification of specific remedies and improvements that could be most readily analyzed and evaluated within budget and schedule constraints. Proceeding with the Interim Feasibility Report enables the study of the overall system to progress in a more efficient and orderly manner within available funding, and will produce a series of (Phase 1) recommendations that can be implemented in a relatively short time span. Another series of (Phase 2) recommendations is expected to accompany the Final Feasibility Report. The Interim and Final Feasibility Report are a complementary effort that views the Kansas Citys project as one system.

Non-Federal Sponsors

The U.S. Army Corps of Engineers, Kansas City District, conducted the study in conjunction with four sponsors: Kansas City, Missouri (prime sponsor), the North Kansas City Levee District, the Fairfax Drainage District and the Kaw Valley Drainage District. These sponsors currently own and maintain the levee units within the Kansas Citys project.

Relevant Prior Studies And Reports

Flood Plain Information Report, Kansas River, Kansas, Junction City to the Mouth, Kansas City District, U.S. Army Corps of Engineers, April 1956. This report evaluated flood hazards along the Kansas River from Junction City downstream to the confluence with the Missouri River in Kansas City, Kansas. This document examines the hydrology and hydraulics of the Kansas River Valley.

Review Report on the Kansas River, Appendix IV, Hydrology, September 1960. This report resulted from a study authorized by Congress in 1953 in response to the 1951 flood. The report examines the hydrology on the Kansas River as part of an extensive review of flood damage reduction works on the Kansas River.

Senate Document No. 122, 87th Congress, 2nd Session, Kansas River and Tributaries, Kansas, Nebraska and Colorado, U.S. Army Corps of Engineers, August 1962. This is the final report submitted to Congress which reviews the Kansas River and tributaries, Kansas, Nebraska, and Colorado, which was requested by resolution of the Committee on Public Works, United States Senate, adopted on August 20, 1953 and June 16, 1954.

The Great Flood of 1993 Post-Flood Report, Lower Missouri River Basin, Kansas City District, U.S. Army Corps of Engineers, September 1994. Appendix E within this 1994 report covers floods which occurred within the boundaries of the Kansas City District from March through August of 1993. The report presents a picture of the Great Flood of 1993 to be used in the analysis of the flood damage reduction features on the lower Missouri River and Tributaries.

Annual Report of Reservoir Regulation Activities, Summary for 1997-1998, Kansas City District, U.S. Army Corps of Engineers, Water Control Section. This report summarizes the 1997-1998 regulation activities at storage projects operated for flood damage reduction under direction of the Corps of Engineers, within the boundaries of the Kansas City District.

Note: The Corps of Engineers projects covered herein have been authorized by specific legislation, as documented in the reports of Congress, and have been implemented through a series of definite project reports (DPR's), design memorandums (DM's), and operations and maintenance (O&M) manuals. These documents are too numerous to list.

Project History

The Kansas Citys project was created and modified by the Flood Control Acts authorized in 1936, 1944, 1946, and 1954. A modification to raise three of the levee units (Armourdale, Argentine, and Central Industrial District) along the Kansas River was authorized by Public Law 87-874 on October 23, 1962.

From authority in the 1936 Flood Control Act, construction of the first Federal levees began around 1940. Over the next decade, Federal construction on various units continued which included some Federal improvements to some existing local levees. Much of the levee system was nearing completion at the time of the 1951 Kansas River Flood. In this catastrophic flood,

the Argentine, Armourdale, CID, and Fairfax levees were overtopped and heavily damaged. Based on this experience, the Kansas River Basin system was reexamined and Congress later authorized the Kansas basin lakes system in the 1954 Flood Control Act.

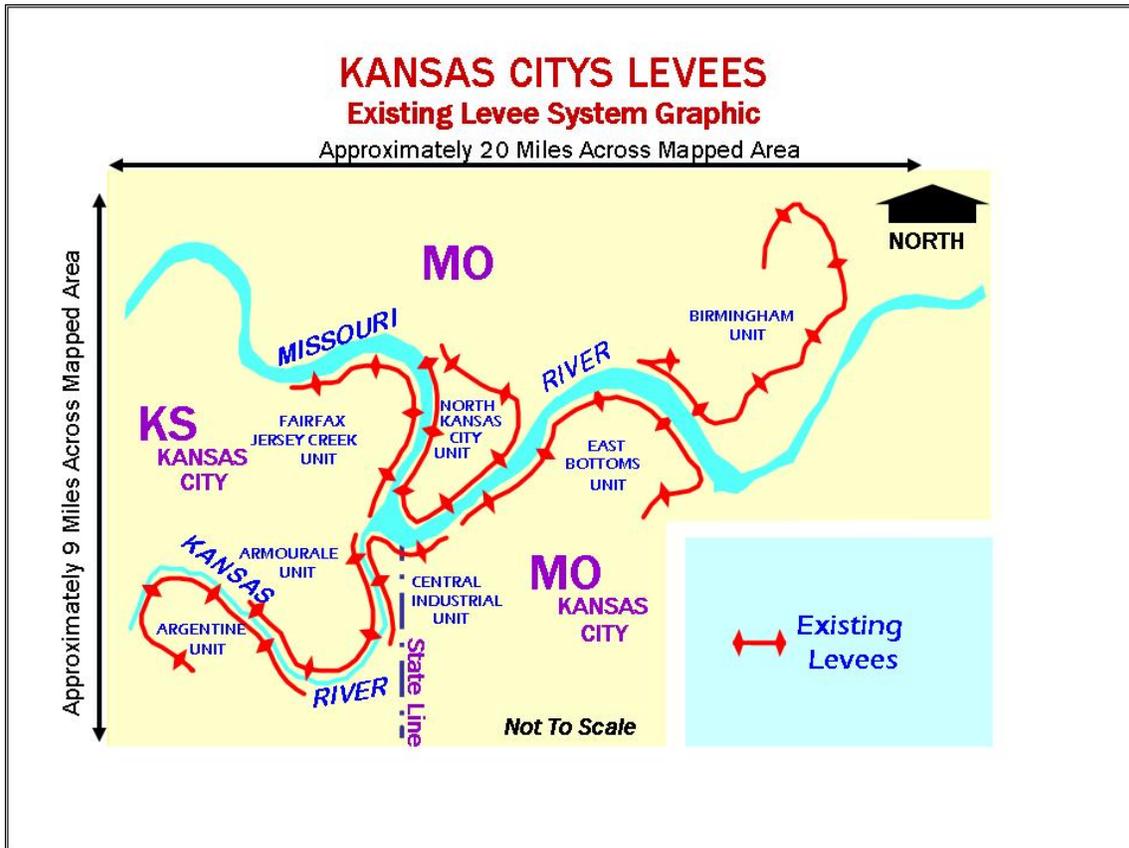
The Kansas Citys levees, especially along the Kansas River, were re-examined during the post-1951 period as Kansas River basin lakes were designed and constructed.

The post-1951 re-examination led to a major design modification (raise) of the three lower Kansas levee units (Armourdale, Argentine, and Central Industrial District) authorized under Public Law 87-874 on October 23, 1962 (also known as the “1962 modification”). In 1971 construction began on modifications to the Argentine, Armourdale and Central Industrial District levee units.

The design of the Kansas Citys project was predicated on operation of the Kansas River Basin system of lakes. Most of the lakes in that system are in place and operating, but three of the smaller lakes in the system (Woodbine, Grove and Onaga) were not built.

Figure 1 below provides a simplified graphic of the existing seven levee units in the Kansas Citys system.

Figure 1: Simplified Graphic of the Existing Seven Levee System.



Plan Formulation

Existing Project Conditions

The U.S. Army Corps of Engineers, Kansas City District designed and constructed the Kansas Citys levee system. The Kansas Citys project provides local flood damage reduction for the metropolitan areas of Kansas City, Missouri and Kansas City, Kansas.

The protective works consist principally of levees, floodwalls, bridge and approach alterations, and some limited channel improvement and alteration. The project extends over the lower 10 miles of the Kansas River and on the Missouri River from 6.5 miles upstream to 12.5 miles downstream of the mouth of the Kansas River. The 32-square-mile protected area covers the heavily industrialized floodplains of the two rivers. Complete effectiveness of the overall project is contingent on adequate reservoir control in the upper Missouri and Kansas River basins.

The existing seven levee units were designed and constructed as a system, but each is operationally independent. While the project operates as a system, its components are located on opposite banks on two major rivers governed by five different geo-political jurisdictions. While this metropolitan flood damage reduction system is designated as a Federal project, it has long been turned over to the sponsors for operation and maintenance. The Corps of Engineers continues to conduct regular inspections and technical review of significant modifications to the system.

The five owner-operators of the Kansas Citys Local Flood Damage Reduction Project are listed in the table below.

Table 1: Non-Federal Sponsors for the Kansas Citys Flood Damage Reduction System

LEEVE UNIT/SECTION	NON-FEDERAL SPONSOR
Central Industrial District (MO & KS)	City of Kansas City, Missouri (MO portions) Kaw Valley Drainage District (KS portions)
Armourdale	Kaw Valley Drainage District
Argentine	Kaw Valley Drainage District
Birmingham	Birmingham Drainage District (BDD) (for this study Kansas City, MO is acting for BDD as financial sponsor)
North Kansas City	North Kansas City Levee District City of Kansas City, Missouri (Airport area only)
Fairfax-Jersey Creek	Fairfax Drainage District (primary owner/operator) Kaw Valley Drainage District (extreme lower end)
East Bottoms	City of Kansas City, Missouri

Levee Unit Descriptions

A description of the major components of each of the seven authorized levee units is provided below. Exhibit #1: *Maps Showing the Six Areas of Interest (AOI) in the Interim Feasibility Report* provides an overall view of the system and the six specific areas with recommendations from the Interim Feasibility Report.

Each unit is designed and constructed to successfully pass a specified river discharge. Discharge and level of performance is a complex issue for this system due to the confluence of the Kansas River with the Missouri River occurring within the study area, and given that each river has an independent runoff basin. Additional details relating to design hydraulics are provided later in the report.

Argentine Levee Unit

The Argentine Unit is located in Wyandotte County, Kansas, on the right bank of the Kansas River between approximate Kansas River miles 10.1 and 4.7. Federal modification and strengthening of works originally constructed by the Kaw Valley Drainage District began in May 1951. Most of the Federal improvements, including repairs of Argentine Unit damage from the 1951 flood, were completed by 1955. More recent improvements, separately authorized under the 1962 Modification, were completed in 1978 (the 1978 improvements included raising the heights of floodwalls, earthen levees, and associated structures in the Argentine, Armourdale and CID-Kansas levee units). The primary components of the Argentine Unit are earthen levee, floodwalls, stoplog and sandbag gaps, pumping plants, and drainage structures. The overall Argentine Unit is approximately 5.5 miles long. The floodwalls, in two sections, total 1,338 feet long. Most of the floodwall is about 16 feet tall. The levee embankment consists of compacted earthen material placed in random and impervious zones. Underseepage and stability berms are located in reaches where the height of the levee, foundation strength, and hydraulic gradient require the use of such berms. The levees and floodwalls of the Argentine Unit are currently authorized to pass a maximum Kansas River flow of 390,000 cubic feet per second (cfs) coincident with a Missouri River flow of up to 220,000 cfs.

Armourdale Levee Unit

The Armourdale Unit is located in Wyandotte County Kansas, along the left bank of the Kansas River from mile 7 (Mattoon Creek) to mile 0.3, near the confluence of the Kansas and Missouri Rivers. The original levees and floodwalls were constructed under the jurisdiction of the Kaw Valley Drainage District and then modified and expanded in the initial and follow-on Federal projects. The primary components of the unit consist of earthen levee, floodwalls, riprap and toe protection on riverward slopes of levees, toe drains along the concrete floodwalls, sandbag gaps, stoplog gaps, drainage structures, relief wells and pumping plants. The floodwalls are roughly 22 feet high (varies) and are approximately 6,600 feet long. The levees in three sections total about 5.8 miles long with a sandbag gap between the two sections upstream of the floodwall. The uppermost levee section is a tieback from high ground west of Mattoon Creek which then heads downstream to the Union Pacific Railroad tracks. The second section extends from the Union Pacific Railroad embankment near the mouth of Mattoon Creek downstream along the left bank of the Kansas River to the floodwall. The floodwall begins north of the Chicago, Rock Island and Pacific Railroad Bridge and extends downstream to connect with the third levee

section. The third levee section ties back into high ground at the embankment of the Lewis and Clark Viaduct. Construction of the Federal project began in 1949 and was completed in 1951. More recent improvements, separately authorized under the 1962 Modification, were completed in 1976. The levees and floodwalls of the Armourdale Unit are currently authorized to pass a maximum Kansas River flow of 390,000 cfs coincident with a Missouri River flow of up to 220,000 cfs.

Birmingham Levee Unit

The Birmingham Unit is located in Clay County Missouri on the left bank of the Missouri River, approximately 12.4 miles downstream from the mouth of the Kansas River. The major flood damage reduction components include an 11 (eleven) mile levee, 430 feet of floodwalls, riprap slope protection, pumping plants, drainage structures, sandbag gaps, stoplog gaps, underseepage control and stability berms. The Birmingham Unit is designed to pass a Missouri River flow of 540,000 cfs. The original Birmingham Unit was developed by the Birmingham Drainage District. The Federal project in 1952 raised and strengthened the upstream section of the levee. The downstream section was strengthened and modified in 1954 and 1955.

Central Industrial District (CID) Levee Unit

Although the CID Unit is one levee unit, it is operated and managed as two separate and distinct sections: the CID-Kansas section, and the CID-Missouri section.

The CID-Kansas section (CID-KS), is located in Wyandotte County, Kansas, and extends along the right bank of the Kansas River from mile 3.4 to the mouth, then downstream along the right bank of the Missouri River to the Missouri and Kansas State Line. The unit consists of levee sections and floodwalls, riprap and levee toe protection and a surfaced levee crown and ramps, a stoplog gap, a sandbag gap, pumping plants, drainage structures, and relief wells. The levee sections total approximately 1.7 miles long. Three sections of floodwall total about 7,900 feet. This section was originally developed by the Kaw Valley Drainage District, and initial Federal improvements entered construction in 1948. Most of the Federal improvements including repairs to levee unit damage from the 1951 Flood were completed by 1955. The most recent improvements authorized under the 1962 Modification were completed in 1979. The CID-KS section is authorized to pass a Kansas River discharge of 390,000 cfs coincident with a Missouri River flow of 220,000 cfs.

The CID-Missouri section (CID-MO), is located in Kansas City, Jackson County, Missouri. This section extends along the right bank of the Missouri River (river mile 365.7) to the Kansas-Missouri state line (river mile 367.2). The CID-MO section consists of levee, floodwalls, a levee drainage system and pumping plants, sandbag and stoplog gaps, toe and bank protection, and slope protection on the riverward slope. The floodwalls total 1.5 miles long and the levee is about 430 feet long. The initial construction began in 1946. Significant improvements and repair of 1951 Flood damage followed the initial construction and were completed in 1955. The CID-MO section is designed to pass a Missouri River flow of 540,000 cfs.

East Bottoms Levee Unit

The East Bottoms Unit is located in Kansas City, Jackson County, Missouri. The unit extends downstream along the right bank of the Missouri River from river mile 365.6, to the mouth of the

Blue River, river mile 357.7, then upstream along the left bank of the Blue River to the Union Pacific Railroad embankment. The levee portion is 9.2 miles long. The floodwall portion is 2,190 feet long and either 12 or 14 feet tall. The unit includes drainage structures, stoplog gaps, pumping plants, and relief wells. The initial construction was completed in 1950. The most recent and major Federal work on the East Bottoms Unit was completed in 1974. It is designed to pass a Missouri River flow of 540,000 cfs and a 40,000 cfs Blue River flow along the southeastern Blue River tieback.

Fairfax-Jersey Creek Levee Unit

The Fairfax-Jersey Creek Unit is located on the left bank of the Kansas River (Kansas River mile 0.3) downstream to the mouth of the Kansas River and along the right bank of the Missouri River from Missouri River mile 367.5 to mile 373.9. The flood damage reduction features consist of about 5.3 miles of levees, 4,040 feet of floodwall, riprap and levee toe protection, a sandbag gap, stoplog gaps, drainage structures, relief wells, pumping plants and the Jersey Creek sewer pump station and shutter gate. The main floodwalls average 16 feet tall. The Fairfax Drainage District provides operation and maintenance from levee Sta. 31+50 (boundary line with Kaw Valley Drainage District) to Sta. 313+72 (bluff at upstream end of unit). The initial construction began in 1940. Numerous modifications and improvements were constructed in the late 1940s and early 1950s, the most recent significant Federal work was completed in 1955. Some limited work was completed post 1993 flood under the PL 84-99 program. The levees and floodwalls of the Fairfax-Jersey Creek Unit are designed to pass a Missouri River flow of 460,000 cfs.

North Kansas City Levee Unit

The North Kansas City Unit is operated and managed as two separate and distinct sections: the "Airport section" and the "lower section". Federal construction began in 1946. Several Federal improvements have been made since the initial construction. The most recent Federal work was completed post-1993 flood under the PL 84-99 program in the Airport section. The unit is designed to pass a Missouri River flow of 460,000 cfs upstream of the Kansas River confluence (Upper or Airport section) and 540,000 cfs downstream of the confluence (Lower Section).

The North Kansas City Unit (Airport Section) is located around the perimeter of the downtown airport. The Airport section is owned and maintained by Kansas City, Missouri. The alignment passes along the left bank of the Missouri River starting from river mile 369.6 to the downstream floodwall at river mile 366.2. The unit is comprised of 2.5 miles of levee, 530 feet of floodwalls, and appurtenances including drainage structures, pumping plants, and pressure relief wells. The floodwalls range from 7 to 15 feet tall.

The North Kansas City Unit portions maintained by the North Kansas City Levee District are often called the "downstream section" or "lower section" and are located in both North Kansas City and in Kansas City, Missouri. These portions include a short upper section extending downstream along the left bank of the Missouri River from the bluff just north of the Kansas City, Missouri, Waterworks intake to where the Airport section (described above) begins. After the Airport section ends, the "downstream section" resumes at the Hannibal Bridge and continues in an easterly direction along the left bank of the Missouri River to a point where the North Kansas City hillside ditch exits to the Missouri River near the Missouri River Chouteau Bridge. At the hillside ditch outlet, a long hillside tieback turns back sharply to the Northwest and runs to a termination point just west of the North Cherry Street bridge. The unit consists of

6.2 miles of levee, 310 feet of floodwalls, riprap slope protection, Rock Creek channel relocation, underseepage berms, pumping plants, drainage structures, and stoplog gaps.

Construction History and Design Discharge

The table below provides a summary of the major periods of construction and the current design discharge conveyance targets for each of the seven levee units in the project.

Table 2: Summary of Levee Unit Construction History and Design Discharge

Levee Unit	Initial Federal Project Completed (year)	Modified, last major Federal (year)	River	Design Discharge Conveyance Capacity (when Constructed) (cfs)
Argentine	1955	1978	Kansas	390,000
Armourdale	1951	1976	Kansas	390,000
CID, Kansas	1948	1979	Kansas	390,000
CID, Missouri	1947	1955	Missouri	540,000
Fairfax-Jersey Creek	1941	1955	Missouri	460,000
East Bottoms	1950	1974	Missouri	540,000
North Kansas City, airport sec.	1947	1955	Missouri	460,000
North Kansas City, lower sec.	1948	1955	Missouri	540,000
Birmingham	Circa 1952	1955	Missouri	540,000

Inventory of Existing Levee (individual) Features

The levee features inventory developed during feasibility provides detailed levee feature information and appears within the General Chapter of the Engineering Appendix (Appendix A). As currently developed, the inventory includes a listing of all significant features and components that comprise the seven levee units. The inventory is updated and expanded as the feasibility study progresses.

Project Operations, Maintenance and Inspections

The various levee units in the Kansas Citys flood damage reduction project were turned over to the levee unit sponsors following each construction effort. Operation and maintenance of the levees is accomplished by the respective sponsors and inspected by the Kansas City District. The Operation and Maintenance Manual for each levee unit addresses sponsor responsibilities and contains the full text of Title 33 (see note below). The sponsors all have operating staff and these individuals are familiar with the details of effective maintenance practices. As one of their many maintenance activities, the sponsors arrange and perform pressure relief well testing and cleaning, along with well replacement when needed for adequate performance under flood conditions.

Each sponsor maintains their own office and legal records, and operation and maintenance records to the extent they determine useful. The Corps of Engineers does not normally inspect nor duplicate these records.

Note: Title 33 refers to the basic Federal law establishing primary responsibilities for sponsors of Federal flood damage reduction projects: Title 33 - Navigation and Navigable Waters, Chapter II - Corps of Engineers, Department of the Army, Part 208 - Flood Control Regulations, Maintenance and Operation of Flood Control Works. Also providing guidelines regarding operations and maintenance requirements is ER 1130-2-530 (Project Operation).

Major Maintenance & Repair History

Major (and minor) maintenance and repair is conducted by the sponsors on an as needed basis. Some examples are cited below:

- Periodic and ongoing relief well replacement and rehabilitation. A good example of sponsor relief well replacement is the Fairfax Drainage District replacement of 48 wells in the mid-1980s and 64 replacement wells in the mid-1990's.
- During 2000 to 2006, sponsors replaced stone-fill levee slope protection on many of the units (including Fairfax-Jersey Creek, North Kansas City, some of the Kaw Valley units).
- Late 1960's repair to a short segment of a sheet pile wall at the base of the Fairfax-Jersey Creek levee near the confluence with the Kansas River.
- Between 2000 and 2006, the Kaw Valley Drainage District oversaw a major repair of the Jersey Creek outlet structure along the Missouri River.
- Birmingham Drainage District recently oversaw a major repair of outlet structure and erosion along the upstream end of the Birmingham Unit
- Fairfax Drainage District has undertaken a major pump station modernization program from the 1990's up through the present. This work included automatic pump lubrication systems, remote computer monitoring system, new motor control centers, new gate operators, 20 pump overhauls, and various operational manual updates.
- North Kansas City Levee District has recently (2006) undertaken pump station outlet channel repairs near the toe of the levee at the Burlington and 26th Ave pump station outlets.
- Since 2000, the North Kansas City Levee District has also undertaken work on a stop log gap retaining wall in the Murray Yard area.
- The City of Kansas City, MO has undertaken sluice gate and pump rehabilitations, and pump station outfall repairs.

No major maintenance is needed at this time to bring the authorized levee system to a fully maintained condition.

Emergency Work and Modifications under Public Law (PL) 84-99

All the levee units have continuously met the requirements for eligibility for the Public Law 84-99 program since at least 1992. Corps of Engineers inspections have indicated that the levees have been maintained to a high standard. The levee sponsors have responded to maintenance requirements in a timely and adequate manner throughout the life of the Kansas Citys project. The Corps of Engineers has reviewed inspection reports since 1992 and concluded that only

occasionally does a defect linger from one year to the next and nearly every maintenance recommendation is addressed within 2 years.

Some of the more recent major PL 84-99 work accomplished on the Kansas Citys system:

- After the 1993 Flood, Public Law 84-99 activity resulted in replacement of a buried drainage line, relief well and gatewell restoration along the upper end of the Fairfax-Jersey Creek Unit, and replacement of a damaged pump station in the North Kansas City (airport segment) Unit, and repairs of damaged pump stations in the CID Unit.
- During/after late 1990's flooding (minor) along the Kansas River, erosive river flows undermined a riverside outlet slab for a drainage outfall in the lower end of the Argentine Unit. Emergency repairs were accomplished under Public Law 84-99. Emergency rock-fill and grouting of this eroded area prevented destabilization of an adjacent floodwall.

This PL 84-99 work produced little or no impact on overall unit maintenance (OMRR&R) costs.

Foundation & Underseepage Conditions

In other Civil Works projects, foundation conditions have been a factor in determining whether design or maintenance deficiencies existed for the underseepage control facilities. That question, in turn, was pertinent to determining whether proposed underseepage corrections were new work, reconstruction or deficiency corrections. In the other projects, the need for new relief wells was driven, at least partially, by the poor condition of the existing wells.

For the Kansas Citys study, an investigation was undertaken to determine whether any special foundation or other conditions exist that may create any extraordinary OMRR&R needs for the underseepage facilities. To help in that determination, the feasibility study undertook a review of the status of regular relief well testing and the maintenance efforts needed to maintain well capability. This review did not identify any special or unusual foundation conditions that would place design of wells or pumping facilities outside the scope of normal sound engineering practice. The well testing schedule and maintenance practices are variable among the levee units. The sponsors have adequately accomplished well maintenance and/or replacement as indicated by their associated test results. None of the remedies identified in this Interim Feasibility study address existing well systems; nor do the remedies provide substitute solutions for existing wells that might perform poorly.

The following table summarizes the relief well testing programs for the levee units that have relief wells (note that the Argentine and the North Kansas City Lower Section do not currently have relief wells).

Table 3: Pressure Relief Well Testing and Performance

Unit	General Description of Relief Well Systems	Tested	Last Tested	Overall Condition of Well Systems & Testing Schedule
East Bottoms Unit	28 pressure relief wells near coal fired power plant	Yes	1996	Adequate. Regularly test all wells every 10 years (next testing late in 2006)
North Kansas City Unit KCMO Airport	48 pressure relief wells at the toe of the levee located along KCMO Downtown Airport and BNSF RR yards	Yes	2003	Adequate. Regularly test all wells every 5 to 10 years.
Fairfax – Jersey Creek Unit	113 pressure relief wells at the toe of the levee spread along entire Missouri River line of protection especially in upstream end of the unit	Yes	2005	Adequate. Regularly test 28 wells every 4 years
Armourdale Unit	43 pressure relief wells at the toe of the levee -- various locations along line of protection	Yes	2005	Adequate. Regularly test 10 wells every 5 years
Central Industrial District Unit	10 pressure relief wells at the toe of the levee -- various locations along line of protection	Yes	2005	Adequate. Regularly test 10 wells every 5 years

Flood History

Kansas River Flood Events

Major floods on the Kansas River are usually caused by a series of short-duration, high intensity storms following a prolonged period of general widespread precipitation. Table 4 lists the five largest annual peaks at the United States Geological Survey (USGS) gage on the Kansas River at Topeka, Kansas. The period of record for this gage is from 1904 to the present, though intermittent and anecdotal information is available from 1869. The USGS gage (06889000) is located on the Sardou Bridge, river mile 83. 1, located 2.3 miles upstream of Soldier Creek.

Table 4: Kansas River Flood History

Year	Kansas River Discharge (cfs)
July 1951	469,000
May 1903	300,000 (est)
August 1908	200,000
July 1993	170,000
June 1935	154,000

Missouri River Flood Events

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. The table below lists the five largest annual peaks at the United States Geological Survey (USGS) gage on the Hannibal Bridge (gage is just downstream of Kansas/Missouri confluence). The period of record for stage data at this gage is from 1873 to the present. The period of record for flow data at this gage is from 1929 to present.

Table 5: Missouri River Flood History

Year	Missouri River Discharge (cfs)
1951	573,000
1903	543,000 (est)
1993	541,000
1908	402,000 (est)
1952	400,000

Historical Flood Events and Damages

Floods in the Missouri and Kansas River Basins are of comparatively low velocity and of several days duration. Flow data at the USGS gage on the Hannibal Bridge is available for the period 1929 to present. Before 1929 the major flood events in the Kansas Citys area occurred in 1844 (17.0 feet above flood stage), 1881 (6.8 feet above), 1903 (14.0 feet above), and 1908 (9.3 feet above). The 1844 event is considered the greatest known event in the lower Missouri Basin.

In the 1903 Flood, 19 lives were lost in the Kansas Citys area, and an estimated \$23,000,000 (1903 prices) in property damages were sustained. The flood of 1903 had an estimated Missouri River discharge of 543,000 cubic feet per second (cfs). The 1903 Flood gave rise to the first well-organized local efforts at major flood damage reduction works in the Kansas Citys area. These very old local works provided some initial line of protection layouts and features that were subsequently adapted, added to, strengthened and raised under the subsequent Federal project.

The 1951 Flood

The 1951 Flood exceeded all previous flood events except for the flood of 1844, with a discharge of 573,000 cfs on the Missouri River and 469,000 cfs on the Kansas River. A two-month period of above-normal precipitation followed by intense rains over a 72-hour period in early July caused the flooding. On Friday July 13, 1951, the Kansas River over-topped the levees in the Argentine District, Armourdale and CID. The flood filled the units with water depths of 15 to 30 feet. Exhibit #2 is a photograph of the 1951 Flood along the Kansas River in Kansas City.

During the 1951 Flood, a sequence of catastrophic overtopping events played out across several of the levee units existing at that time. Kansas River floodwaters first overtopped the Argentine Unit, then Armourdale and CID. Floodwaters eventually poured through the West Bottoms area and exited into the Missouri River by overtopping and breaching the CID-Missouri segment of

levee near the old Kansas City Missouri Municipal Wharf. Packing plants were flooded and railroad transportation was halted due to the flooding with severe damage to tracks, rail cars, and rail yards. After devastating the three Kansas River units, the floods then threatened the intact levees located opposite and upstream along the Kansas and Missouri River confluence area. Floodwaters eventually breached a section of levee near Jersey Creek and flowed into the Fairfax District the following morning.

At the peak of the flood, the Kansas River stretched from the Armourdale bluff to the Argentine bluff, with very few structures reaching above the floodwater. Of the five levee districts near the Kansas and Missouri Rivers confluence, only North Kansas City was completely saved. Altogether about 11 square miles were flooded in the metropolitan Kansas Citys area. At least 5 persons died, and about 15,000 people were evacuated. Many residents were left homeless. The flood caused a reported \$425 to \$870 million (1951 price level), or in 2004 terms between \$4 billion and \$9 billion in damages within the study area alone.

The 1993 Flood

The 1993 Flood event crested at 48.9 feet on July 27, 1993, with a Missouri River discharge of 543,000 cfs. Although this discharge was less than the 1951 flood (peak recorded 573,000 cfs), the 1993 crest of 48.9 feet exceeded the 1951 crest stage of 46.2 feet. All the levees in the Kansas Citys project held, although some units saw floodwaters near the top of levees, and underseepage problems were evident in several units. Several of the levees sustained some line-of-protection damage and were subsequently repaired.

An estimated \$4.57 billion (1993-1994 price level) in damages were prevented by the Kansas Citys flood damage reduction project (The Great Flood of 1993, Post-Flood Report, U.S. Army Corps of Engineers, Sept 1994). Even though all levees in the Kansas Citys project held, some flood associated damages were sustained within the protected area; likely due to indirect (seep water) or local tributary flooding. Damages to Kansas City, Kansas utilities reached several million dollars. Kansas City, Missouri reported more than \$15 million in damage to public infrastructure. Kemper Arena and the American Royal Building suffered about \$2.5 million in water damage to flooring and electrical circuits. The downtown airport sustained damages of nearly \$3 million, and pollution control and public works facilities sustained an estimated \$8 million in damage. Exhibit #3 shows the Missouri River hydrograph for the 1993 Flood.

Authorized Project Design Hydraulics

The original design discharges are contained in the October 31, 1936 report titled "Missouri & Kansas Rivers, Kansas Citys, Flood Control Project, Project Report." The report relates that the project should accommodate a probable maximum flow in the Kansas River of 370,000 cfs, and a combined flow of the Missouri and Kansas Rivers of 630,000 cfs. However, the plans for the levee units used 540,000 as the design discharge for units downstream of the confluence, 460,000 cfs for Missouri River units upstream of the confluence, and 390,000 for Kansas River units. The large design discharge of 630,000 cfs was never subsequently adopted into the downstream (of confluence) levee units' construction history.

The design discharges depended on assumptions about the center of storm events. The following excerpt was taken from House Document No. 342 (Congress 1943): “With an excessive storm centered principally over the Kansas River basin, the design-flood discharge at the Kansas Citys would be 170,000 cfs from the Kansas River and 330,000 cfs from the upper Missouri River, or a total of 500,000 cfs. Conversely, with an excessive storm centered principally over the Missouri River basin, the design flood discharges would be 80,000 cfs from the Kansas River and 460,000 cfs from the upper Missouri River, or a total of 540,000 cfs.”

After the catastrophic 1951 Flood, the Kansas River levee units were authorized to pass higher discharges. The table below shows the increased (authorized and) design discharges with coincident Missouri River discharges. However, the Missouri River levees were not improved as a result of the 1951 Flood event, even though the 1951 Flood discharge exceeded the design discharge of the units downstream of the Kansas River.

Table 6: Revised Design Discharges for the Kansas River Levees (“1962 Mod”)

Levee Unit	Kansas River Authorized Design Discharge (cfs)	Missouri River Coincident Discharge (cfs)	
		u/s of Kansas River	d/s of Kansas River
Armourdale	*390,000	220,000	610,000
CID (Kansas)	*390,000	220,000	610,000
Argentine	*390,000	220,000	610,000

Notes: u/s = upstream; d/s = downstream

In general, the “1962 Mod” discharges were used to develop higher design water surface profiles for levee raises in the affected units. The final elevation of the levee was determined by taking the design water surface profile and adding freeboard. The levee units were authorized to pass specified discharges on the Kansas and Missouri Rivers with either 2 or 3 feet of freeboard. The other units along the Missouri River have a design level of performance as authorized in 1944. Subsequently, the Liberty Bend Cutoff was constructed along the Missouri River in the 1950's and aided in overall conveyance of flood discharges through the Kansas Citys reach.

Effects of Kansas River Basin Reservoir System on the Kansas Citys Levees

Eighteen (18) Federal lakes/reservoirs exist in the Kansas River basin. This system of reservoirs was authorized in the Flood Control Act of 1944. Seven of these lakes are close enough to the Kansas City area, and are large enough, to have a major effect on flows passing through the Kansas City area.

This system was authorized, in part, to act in concert with the system of Federal levees in the Kansas City area to reduce flood damages in the areas protected by the levees (the levees in the Kansas City area had been previously authorized). Modifications to this original 1944 lakes authorization have appeared in subsequent Flood Control Acts, but the basic objective of providing a coordinated flood damage reduction system in the Kansas City area, as outlined in the 1944 Act, has been preserved. The Kansas City District operates these reservoirs in compliance with the original intent of that Act.

Effects of Missouri River Reservoir System on the Kansas Citys Levees

There are six major Federal lakes/reservoirs on the main stem of the Missouri River in the Dakotas and Montana. The reservoir furthest downstream is Gavins Point in southern South Dakota, which is about 440 river miles upstream of the Kansas City area. This system of reservoirs provides flood damage reduction benefits all along the Missouri River, but the system does not operate specifically for the Kansas City area. Any release at Gavins Point undergoes a five day travel lag before arrival of that water at Kansas City.

Recent Evaluations of Reservoir Effects

Following the flood of July 1993, the Corps of Engineers undertook a major reevaluation of the flow frequency of the upper Mississippi, Missouri and lower Illinois Rivers. The resulting Upper Mississippi River System Flow Frequency Study (UMRFFS) constituted an update of the previous flow frequency estimates then in use for these rivers. On the Missouri River, the old (previous) flow estimates were completed and published in 1962. The UMRFFS study provided revised flow frequency estimates and revised flood profiles. The results of the UMRFFS study were incorporated into the Kansas Citys feasibility study.

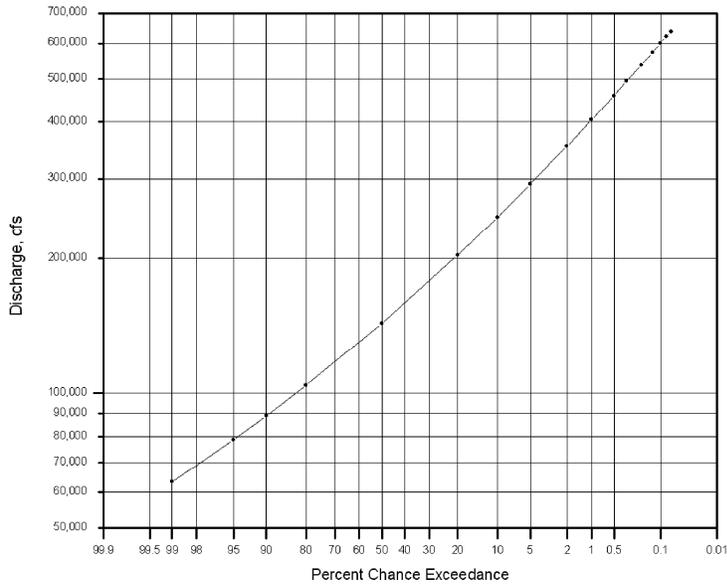
Because it was necessary to fully evaluate the operations of the Kansas River basin reservoir system as part of the UMRFFS study, updated flow information was generated for the Kansas River. This information was then incorporated into an update of the flow frequency estimates for the Kansas River from its mouth to Manhattan, Kansas. These revised flow frequency estimates have been incorporated into this Kansas Citys feasibility study. The table below summarizes the regulated flow frequency estimates as applicable to the Kansas Citys study.

Table 7: Study Area Flow Frequency Data (as Developed in Upper Mississippi River System Flow Frequency Study, 2001; and the Kansas River Hydrology Report, 2002)

Frequency in Percent Chance of Exceedance	Missouri River Downstream of Blue River (cfs)	Missouri River Downstream of Kansas River (cfs)	Missouri River Upstream of Kansas River (cfs)	Kansas River at Mouth (cfs)
0.2	537,000	530,000	358,000	341,000
0.5	459,000	454,000	316,000	283,000
1	405,000	401,000	287,000	241,000
2	354,000	351,000	257,000	202,000
5	292,000	289,000	220,000	150,000
10	247,000	245,000	192,000	121,000
20	203,000	201,000	162,000	90,700
50	143,000	142,000	120,000	51,200
80	104,000	103,000	89,500	26,400
90	89,100	88,300	77,200	18,700
95	78,800	78,100	68,500	14,000
99	63,400	62,900	55,100	8,200

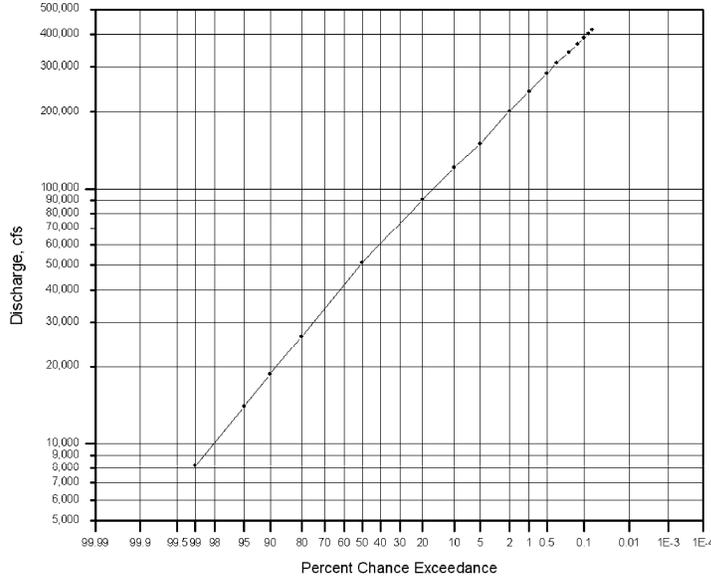
The table above is presented graphically in the following two figures.

Figure 2a: Discharge-Frequency Curve – Missouri River Just Downstream of Blue River



Missouri River Discharge Just Downstream of Blue River

Figure 2b: Discharge-Frequency Curve – Kansas River at Mouth



Kansas River Discharge at Mouth

Discharges developed from recent studies have been used to establish the existing conditions flow frequency data used in this study. Since flood events above the 0.2% chance of exceedance (500-year) event need to be considered in this study, the discharge-frequency curves were extended up to the 0.067% chance of exceedance (1,500-year) flood event. The table below summarizes all of the discharges developed for use in this study.

Table 8: Summary of Flood Discharges Used in this Study

Frequency in Percent Chance of Exceedance	Missouri River Downstream of Blue River (cfs)	Missouri River Downstream of Kansas River (cfs)	Missouri River Upstream of Kansas River (cfs)	Kansas River at Mouth (cfs)
0.067%	637,000	625,000	414,000	417,000
0.080%	621,000	610,000	403,000	403,000
0.100%	600,000	590,000	390,000	388,000
0.133%	573,000	565,000	377,000	367,000
0.200%	537,000	530,000	358,000	341,000
0.500%	459,000	454,000	316,000	283,000
1.000%	405,000	401,000	287,000	241,000
10.000%	247,000	245,000	192,000	121,200

Note: Expressing discharge probability in percent chance exceedance (occurrence) is currently used by the Corps of Engineers in lieu of a flood return interval expressed in years. Percent chance exceedance expresses the probability of the discharge occurring each year. Corps of Engineers risk and uncertainty (R&U) analytical tools and procedures were used in this feasibility analysis per ER 1105-2-101. The risk analysis and evaluations resulting from this type of analysis are not directly comparable to the discharge-plus-freeboard performance criteria used for the original authorized levee design.

The basis for the hydraulic analysis was the development of an existing conditions HECRAS model. This model was calibrated to the flood event of 1993 from measured high-water marks and corresponding instantaneous discharge estimates and included all applicable geometric data including cross-section data and bridge data. Once the model was calibrated, a series of steady flow water surface profiles was created based on flood discharges previously discussed.

Once the model was calibrated, existing conditions water surface profiles were generated for the 10% (10-year), 1% (100-year), 0.5% (200-year), 0.2% (500-year), 0.13% (750-year), 0.1% (1,000-year), 0.08% (1,250-year), and 0.067% (1,500-year) chance of exceedance flood events. Details of the modeling are found in the Hydrology and Hydraulics Chapter of the Engineering Appendix.

Economic Conditions & Inventory Overview

The economic analysis identifies the economic impact from flooding for the existing project, and on a comparable basis, evaluates the array of study alternatives for increasing the project performance. The economic analysis first developed a risk-based analysis of the flood problem under the existing condition (existing levees and floodwalls). Development of future without project condition followed the existing conditions. Finally, a similar risk-based evaluation was done for with-project alternatives in terms of benefits, costs, and performance. Refinements and some interactions of the existing conditions and the future without project conditions were

accomplished as new information surfaced. The analysis encompasses all flood-prone properties within the study area.

For purposes of the study, each levee unit protected area was designated as a separate study reach. The CID Unit, located near the confluence of the Missouri and Kansas Rivers, can be impacted by both Missouri River flooding and Kansas River flooding. The table below lists the study reaches, their river mile boundaries and the designated index point location for each reach. In accordance with standard Corps of Engineers practice, the reach index point is used as a common location to aggregate the stage damage relationships for the different categories of investment.

Table 9: Study Reaches Used in HECFDA Analysis

Damage Reach Name	Beginning Station (R.M.)	Ending Station (R.M.)	Bank	Index Location Station (R.M.)
Missouri River				
Fairfax-Jersey Creek	367.5	373.9	Right	367.7
North Kansas City	362.6	370.7	Left	365.8
East Bottoms	356.6	366.0	Right	357.6
Birmingham	353.2	360.4	Left	355.9
Kansas River				
Armourdale	0.6	7.7	Left	5.2
Argentine	4.6	10.0	Right	9.6
Missouri & Kansas Rivers				
CID-MO	Mo. R. 365.8	Mo. R. 367.4	Right	Mo. R. 367.1
CID-KS	Ks. R. 0.0	Ks. R. 3.0	Right	Ks. R. 1.4

Predominant Economic Characteristics of the Study Area

The overall existing project protects highly developed urban portions of the Kansas City metropolitan area. The protected areas encompass a major segment of the Kansas Citys' economy. Flood disruptions to this area would strongly impact the local, regional, and national economy.

General Economy

The Kansas City metropolitan area has a diverse and varied economic base. As a centrally located market, it is a major warehouse and distribution center and a leading agribusiness center. It ranks first in the nation as a farm distribution center and as a market for hard wheat. In addition to its agribusiness activities, the metropolitan area has major industrial activities such as auto and truck assembly, steel and metal fabrication, and food processing. The metropolitan area also fosters a growing non-manufacturing sector. Wholesale and retail industries and service organizations are now chief employers in the area.

Transportation

The metropolitan area has a network of interstates and major highways that provides excellent access to each of the levee units.

- The CID Unit is accessed by means of I-70, I-35, and by I-670 which crosses over the middle of the protected area.
- The Argentine Unit is served by U.S. 69 and I-35, and I-635 crossing over the unit.
- The Armourdale Unit is served by U.S. 69, U.S. 169, and I-70.
- I-70 and the Fairfax Bridge/U.S. 69 provide highway access to the Fairfax-Jersey Creek Unit along with major truck-route arterials.
- Missouri Hwy 210, Burlington Ave (major north-south arterial), the Paseo Bridge (I-35/29) and Heart of America Bridge, and I-35 all provide access to the North Kansas City Unit.
- The East Bottoms Unit is served by I-35/29, I-435, Missouri Hwy 210, and truck-routes.
- The Birmingham Unit is accessed by means of Missouri Highway 210 and Interstate 435.
- Kansas City International Airport, less than 20 miles north of the study area, is easily accessible via the Interstate system. The Charles B. Wheeler (Downtown) Airport is located in the North Kansas City Unit. Major rail service is available to each of the units.

General Socioeconomic Characteristics

Census 2000 data for 17 census tracts were compiled to describe the socioeconomic characteristics of each levee unit area as well as for the overall study area. Census 2000 data were also compiled for counties in the study area and for the Kansas City (Missouri and Kansas) Metropolitan Statistical Area (KC MSA). Although census tracts cover areas that may typically be somewhat larger than the area protected by a levee unit, the census tract data is considered to be generally representative of the protected area.

Study Area Population, Household and Employment

The following table displays estimates of population, employment and housing in the year 2000 for the census tracts covering each levee unit and the study area as a whole.

Table 10: Year 2000 Estimates of Population, Employment and Housing

Unit	Population	Employment	Housing Units
Argentine Unit	3,481	10,700	1,380
Armourdale Unit	3,213	6,700	1,109
Birmingham Unit	4,029	11,112	1,528
CID (MO&KS) Unit	936	7,494	517
East Bottoms Unit	3,277	20,147	1,534
Fairfax-Jersey Creek Unit	0	11,180	0
North Kansas City Unit	4,882	26,703	2,933
Study Area Total	19,818	94,036	9,001

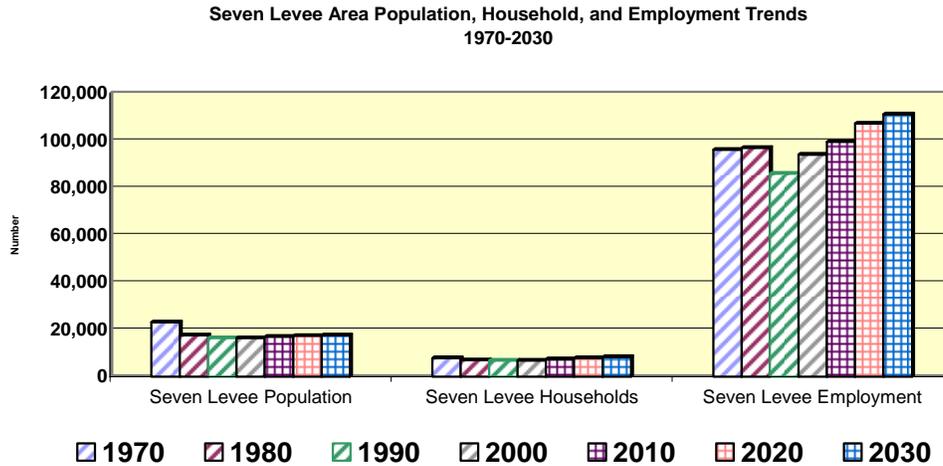
Source: Mid America Regional Council and Census 2000.

Census data, 1970 to 2000, and Mid-America Regional Council (MARC) forecasts, 2010 to 2030, for the census tracts in the study area were used to describe general trends in population,

households and employment. MARC is the metropolitan planning organization for the bi-state Kansas City region. In 1970 the study area levee units had total population of 23,124 persons and 7,952 households. Between 1970 and 1990, the total population and number of households in the study area declined. This trend in the study area was reflective of the national trend that occurred in the 1970's and 1980's when there were population shifts to areas outside of central city areas. After 1990 the population and number of households began to stabilize and by 2000 had increased to 19,818 persons and 8,180 households in the study area.

Fluctuations also occurred in study area employment, with an overall decline from a 1970 level of 96,069 to 85,949 by 1990 and then increasing by the year 2000 to a level of 94,035. Based on MARC forecast data for the period 2000 to 2030, total employment in the seven levee unit study area is expected to increase steadily. Population and number of households in the area are expected to experience steady but modest growth. The figure below displays the general trends in population, households and employment 1970 to 2030 for the entire study area.

Figure 3: Seven Levees Area Population, Households and Employment Trends



Study Area Investment

Total investment in the seven levee unit study area is estimated at **\$16.3 billion** dollars (Oct 2004 price levels) and includes investment in structures, contents and equipment for commercial, industrial, residential, transportation, and public categories of investment. More than 5,300 structures having significant value were identified in the study area. Depreciated replacement value for buildings and infrastructure in the study area is estimated at \$5.5 billion. The study area businesses and residences have roughly a \$10.7 billion investment in contents. Business contents include inventory, office equipment, computers, production equipment and machinery, and other miscellaneous contents. Total study area investment is shown in table on next page.

Table 11: Study Area Investment Summary (Oct '04 prices, rounded and shown without uncertainties)

Levee Units – Basis for Totals	Total Investment (\$)	Total Value of Structures Investment (\$)	Total Value of Contents Investment (\$)
Units Addressed by Interim Study (Argentine, E Bottoms, NKC, Birmingham, Fairfax-Jersey Creek)	\$13,350,000,000	\$4,523,000,000	\$8,827,000,000
Primary Units Addressed by Final Study (Armourdale and CID)	\$2,945,000,000	\$1,014,000,000	\$1,932,000,000
All Seven Levee Units	\$16,295,000,000	\$5,536,000,000	\$10,759,000,000

Argentine Unit

The Argentine Unit protects the Argentine industrial area within Kansas City, Kansas. Large industrial facilities, large and small commercial entities, public structures and many residential structures are protected by the Argentine Unit. Major companies protected include: Associated Grocers, Harcros Chemicals, Fairbanks Morse, Ankmar, Smurfit, and several major trucking centers. Burlington Northern Santa Fe (BNSF) railroad has a very large regional rail-intermodal facility in this unit. The Kansas City area has the second busiest rail yards in the nation.

Fairfax-Jersey Creek Unit

The Fairfax-Jersey Creek Unit protects the Fairfax Industrial District in Kansas City, Kansas. The Fairfax protected area includes large commercial facilities, industrial and manufacturing (e.g., General Motors assembly plant, Owens-Corning, Weyerhaeuser, Certaineed, Kellogg's and Union Pacific RR), and major public facilities. A large municipal power generation plant (BPU Quindaro plant) is located at the upper end of the protected area. No residential housing exists within this industrial district.

North Kansas City Unit

The North Kansas City Unit (Airport and downstream sections) protects the Charles B. Wheeler Downtown Airport, most of the City of North Kansas City, major Burlington Northern Santa Fe railroad yards, and Kansas City Power and Light Company facilities. The North Kansas City Unit protected area includes residential, retail, small commercial firms, extensive warehouse areas and some industrial sites. The main Kansas City Missouri water supply (Missouri River intakes, associated deep wells, and potable water treatment plant) facilities are located in the northern (upstream) end of the unit.

East Bottoms Unit

The unit protects a very large commercial and industrial area of Kansas City, Missouri and a smaller residential area. There is a wide range of business activity including manufacturing, extensive transportation facilities (trucking & warehousing facilities), and retail. Some companies have multiple sites in this area. Major companies in the area include a Sears distribution center, Cargill, a casino, FedEx, General Mills, and Bayer AG. A large KCPL power plant facility and a Kansas City Missouri wastewater treatment plant are located here.

Note: The Economic Investment Characteristics of the Birmingham Unit, Armourdale Unit, and Central Industrial District Units have been omitted from this narrative as no work is proposed in these units within the Interim Feasibility Report, but these units are listed in the following summary table.

Table 12: Study Area Investment (without uncertainties) for Structure and Content

Levee Unit	Number of Structures/Groups of Structures	Structure and Infrastructure Investment (\$M)	Contents Investment (\$M)	Levee Unit Total Investment (\$M)
Argentine	723	588	1,898	2,486
Armourdale	1,349	628	1,555	2,182
CID	287	386	377	763
Fairfax	348	657	2,303	2,960
North Kansas City	1,658	1,438	1,519	2,957
East Bottoms	751	1,580	2,981	4,561
Birmingham	209	260	126	386
Study Area Totals	5,325	5,536	10,759	16,295

*Notes: -- any discrepancies are due to rounding
-- October 2004 prices*

Overview of Existing Environmental and Cultural Resources

The study area is predominantly urban and highly industrialized in most units. Limited habitat, past disturbances, and dense development has limited the variety of fish and wildlife. However, many species commonly found within a Midwest U.S. urban setting are present. Wildlife populations are lowest in the central core of the study area and increase on the outer edge. Many common species of mammals, birds, reptiles, and amphibians use the habitat riverward of the existing levees. Cultural resources are limited due to deep depositional burial or natural transport processes arising from the rivers, as well as the past and present industrialized nature of the study area. Some of the more unique cultural and environmental features to this area are described below. Environmental considerations and impacts are discussed in the accompanying draft Environmental Impact Statement.

Note: The Interim Feasibility Report examines (and makes recommendations regarding) five of the seven levee units (Argentine, Fairfax-Jersey Creek, East Bottoms, North Kansas City, Birmingham). The Final Feasibility Report will address the remaining two units (Armourdale and CID). In accordance with 40 CFR 1500, the EIS addresses all seven levee units using projections of the tentatively preferred alternatives in the Armourdale and CID Units where firm detailed conclusions are not yet available. A supplement to the EIS will be developed to support the Final Feasibility Report.

Threatened or Endangered Species

Four Federally-listed threatened or endangered species are dependent on the Missouri and Kansas Rivers and their floodplains in the study area (Wyandotte County in Kansas, and Platte, Clay, and Jackson Counties in Missouri).

The bald eagle (*Haliaeetus leucocephalus*), Federally-listed as threatened but currently proposed for de-listing, migrates through and temporarily over-winters near large water bodies in or near the study area. The piping plover (*Charadrius melodus*), Federally-listed as threatened, is a seasonal spring and fall migrant through portions of Kansas and Missouri along the Kansas and Missouri Rivers, with nesting on the Kansas. Plovers are associated with unvegetated shorelines, sandbars, and mudflats. The Federally-endangered least tern (*Sterna antillarum*) utilizes similar unvegetated wetland habitat, as do the piping plovers in the same geographic regions of Kansas and Missouri. The pallid sturgeon (*Scaphirhynchus albus*) is a moderately large, bottom-dwelling, Federally-endangered fish species that may occur in low numbers in portions of the Missouri River and lower Kansas River. It is believed to require sandbars, chutes, and backwater areas for reproduction.

Wetlands

Few wetlands remain within the interior of most units. Along stretches of several units, some of the larger wetlands can be observed riverward of the existing protection. The Birmingham Unit interior has most of the significant high quality wetlands.

Wetland locations, classifications, and acreages were determined by overlaying study area maps with National Wetlands Inventory (NWI) maps. NWI maps are generally used as a reference for locating existing wetlands. Reconnaissance surveys and a field delineation were conducted to verify the presence or absence of NWI wetlands and any additional wetlands that might be observed. Impact determination and mitigation planning followed during plan formulation. Due to development within the project area, much wetland acreage has been converted into impervious surface since the 1980s NWI mapping in this region.

Feasibility evaluations found three small low quality wetlands (about 0.2 acres total) with the potential to affect plan formulation. Two of these wetlands are located within the Argentine levee unit and one wetland is located within the proposed borrow area.

Cumulative Effects

Although this study involves the evaluation of the existing Kansas Citys levee system, any Federal activity that affects the aquatic ecosystem of the Kansas and Missouri Rivers has typically been an area of concern for the resource agencies in this region. The Kansas and Missouri River systems and their adjacent floodplains were significantly altered by human activities in the past. These same types of activities continue now and are expected well into the future. As a result, resource agencies have expressed concerns about cumulative and secondary impacts on these river systems. Major impacts to the riverine environment on these rivers began with modification of the Missouri river channel and stabilization of the river bank to improve navigation. As industrial and residential development continued along the river, upstream reservoir and local levee systems were developed to provide flood damage reduction and allow continued economic development.

Modifications to the river systems and their floodplains have been through multiple Federal and private initiatives resulting in a changed environment within and along the river and specifically within urban areas bordering these rivers. The cumulative impact of these activities (navigation,

flood damage reduction, industrialization, and residential development) has resulted in a dense, heavily industrialized floodplain protected by levee systems within the Kansas City reach, and a channelized river system showing higher flood stages than the free flowing systems of over a century ago. Development is expected to continue within these urban areas into the foreseeable future as demands for products, services, and flood damage reduction continue. At the same time, restoration of the Missouri River, its former side channels and floodplain environment is on-going. These restoration actions will mitigate some of the past disturbance along the Missouri River up and downstream of the project area. Cumulative impacts of this project related to these past activities have been evaluated to determine the level of significance to the proposed project and to past and foreseeable activities on these riverine environments.

Cultural Resources

Historic buildings and properties are located within the general study area. No prior (to this study) archaeological surveys have been conducted in the study area as the Kansas City levee units predate the current requirements for cultural resources surveys. Cultural resources surveys were conducted during this study. Based on these surveys, appropriate avoidance and protective measures were planned and incorporated during the formulation process.

The cultural resources evaluation found no archaeological sites or historic structures listed on or eligible for listing on the National Register of Historic Places (NRHP) within the project area. The project area, heavily disturbed by past levee and urban related construction, was found unlikely to contain previously unidentified archaeological sites eligible for inclusion in the NRHP. Two sites of cultural concern lie near the study area, a site of two human burials near the proposed borrow area and two historic structures near the Fairfax/Jersey Creek Unit. These sites will be avoided during construction related activities. Cultural resource findings have been coordinated with both the Kansas and Missouri State Historic Preservation Officers who concurred with the Corps recommendations for no further investigations unless an inadvertent discovery is encountered during construction.

Hazardous, Toxic and Radioactive Waste (HTRW) Sites

An HTRW assessment of the study area adjacent to the levees and potential work areas was conducted in accordance with ER 1165-2-132. The assessment included an initial review of database search reports, followed by site visits, site testing, and analysis suitable for feasibility phase determinations. For the units addressed within this Interim Feasibility Report, hazardous waste and certain regulated non-CERCLA contamination is present at certain sites along the existing protective works.

Specifically, for the Argentine and the East Bottoms Units, it was necessary to carefully consider the type and extent of this contamination when developing feasibility alternatives. Details regarding the manner in which these sites affected planning appear in the Plan Formulation section. The HTRW Appendix contains detailed information on the sites.

Recreation Resources

Recreation in the project area primarily involves fishing, occurring on both the Kansas and Missouri Rivers, plus some hiking, canoeing (primarily on the Kansas River), and wildlife/bird

watching. Other recreational opportunities involving the Kansas or Missouri Rivers are oriented towards organized group activities. Further examination of recreational resources and opportunities appears in the EIS.

A 1980 proposal by the Heritage Conservation and Recreation Service (now part of the National Park Service) recommended that the lower Kansas River be designated as a "recreational river" and made a component of the National Wild and Scenic Rivers System. The plan identified proposed acquisition (fee and easement) acreages at the western end of the Argentine Unit between the Turner and 1-635 bridges to be used as the downstream takeout point for the recreational river. This proposal has not undergone further legislative action.

Recently, local initiatives have led to new park facilities within Wyandotte County, Kansas at the Kaw Point Park & Overlook (just north and west of the Kansas- Missouri river confluence), and within Kansas City, Missouri at the Berkley Downtown Riverfront Park along the south (right bank) foreshore area between the Heart of America and the Paseo Bridges.

Trail proponents are actively seeking the incorporation of trails along or near several levee units as part of a long-term implementation strategy for an interconnected metropolitan trail system. The Kansas City District Corps of Engineers has encouraged trail proponents to directly engage the levee unit sponsors/owners in dialog which might bring about a mutually agreeable long-term trail plan. The Kansas City District has and will continue to participate in general discussions regarding trails when consistent with the intent and purposes of the Federal project authorizations.

Initial Assessments of Missouri River Levee Units Integrity

The Corps of Engineers considers that the existing levees in the Kansas Citys flood damage reduction project are in an overall good to very good maintained condition. Since the 1951 Flood, many of the Kansas Citys units were upgraded in response to damage or problems experienced in 1951. After those upgrades, the largest flood event experienced by the Kansas City units was the 1993 Flood. In the existing conditions phase of this study, the 1993 Flood was used to evaluate the performance of the Missouri River levee units. During the 1993 Flood, the Missouri River units experienced several localized problems, although none of the problems resulted in complete failure of any levee unit.

Fairfax-Jersey Creek Unit

The Fairfax-Jersey Creek Unit experienced several localized problems due to seepage at gatewell structures and pipe connections. Problems also were encountered with collector systems at the base of floodwalls due to the removal of riser pipes. None of the problems encountered resulted in serious interior flooding. After the 1993 event, all problems within this system were repaired where necessary and deficiencies in the collector systems were upgraded. More recently, the Kaw Valley Drainage District provided an independent evaluation of the section of retaining sheet pile wall from Station 23+30 to 29+98. This evaluation identified the failure of the tieback connections and extensive rusting of the sheetpile retaining wall structure. The retaining wall provides stability of the foreshore bank for the existing levee and I-wall.

North Kansas City Unit

Underseepage problems were reported in the North Kansas City Lower Unit along the Harlem area located from approximately Station 210+00 to 240+00. The National Starch area, extending from Station 255+00 to 275+00, also exhibited underseepage problems. In 1993, the water on this particular levee section was at least four feet below the top. At that time, reports indicated that underseepage pressures were causing noticeable pumping of road pavements and the ground behind the levee. Although a levee failure did not occur in this area, it was evident from the field reports that if water levels had reached higher elevations even more serious underseepage problems could have developed.

East Bottoms

The East Bottoms Unit also had reports of underseepage problems in the reach approximately from Station 380+00 to 420+00. Reports from various sources indicate that during the 1993 Flood event, sand boils developed in this area concurrent with high water conditions. Around the peak of the flood, the river elevation here was about 3.5 feet from the top of levee. Although a levee failure did not occur in this area, it was evident from these field reports that if water levels had reached higher elevations even more serious underseepage problems could have developed. Additional feasibility analysis further refined the area of thin clay/silt blanket and identified the associated levee segment needing underseepage control improvements.

Review of Levee Elevations

During early portions of the existing conditions assessment, the O&M Manuals and Record Drawings were reviewed and were followed by field visits with sponsor representatives to compare available survey information with actual field conditions.

In 2001, a centerline survey of the top of levee was conducted for verification of the O&M Manual elevations and was used in conjunction with the hydrologic and hydraulic analyses. A review of the centerline survey indicated that some areas along the levee were slightly lower than shown in the O&M Manual. Based on this, a resurvey of portions of the centerline was conducted in late 2003. The results of the resurvey confirmed that some areas were slightly lower. This information led to discussions with sponsors and additional emphasis on preparations for emergency flood fighting (sandbagging) or local maintenance and repair of the low spots.

Final Assessments of Existing Levee Integrity

The study assessments provide insight into both the existing levee performance and the economic damages expected under existing conditions for an array of high water events. Risk and uncertainty analysis results and observations of levee performance during flood events forms the basis for the conclusions that the following six areas of interest (AOI) are opportunities for additional risk reduction measures. Quantification of the existing condition performance and damages for each unit are shown in Exhibits #4, #5, and #6.

Lower Kansas River Levee System (Argentine, Armourdale, and CID-KS maintained and operated by the Kaw Valley Drainage District)

This system is composed of three independent (but inter-related) units that act in concert to provide flood damage reduction on both sides of the lower Kansas River. These three units are composed of a number of subsystems and components of varying age. Findings for overtopping risk show that the units do not achieve the authorized 390,000 cfs conveyance target. This indicates the need for a general increase in the existing overtopping protection along the Argentine, Armourdale, and CID-KS Units. This Interim Feasibility Report provides conclusions regarding the Argentine Unit. The complete findings for Armourdale and the CID Unit are to be released in the Final Feasibility Report. In addition to the need for decreasing the overtopping risk in the Argentine Unit, the findings for geotechnical and structural risk indicate the need for some limited measures to improve underseepage control and a significant need for measures to reduce structural and uplift risk at three major pump stations. An inventory and detailed description of the Argentine Unit pump stations and levee drainage structures can be found in Exhibit #7.

Note: Flooding from a CID-KS segment failure will affect all of the protected area within the CID Unit (both MO and KS); and similarly a CID-MO segment failure will affect all of the protected area within the CID Unit (both MO and KS).

East Bottoms Levee Unit

This is a single very large unit composed of levee, floodwall, appurtenances all of mostly similar age. Analysis of the water surface elevations created by 0.2% probability flood event (nominal 500 year flooding) scenario and associated inundation analysis shows that the most of the East Bottoms Unit is subject to an average flood depth of between 9 and 10 feet if the unit were to suffer a catastrophic failure. Findings for overtopping reliability show the unit adequately complies with the original hydraulic design intent. Findings for geotechnical risk indicate the need for measures to improve underseepage control near the confluence of the Missouri and Blue Rivers along the Blue River tieback segment. The geotechnical R&U analysis is corroborated by observations during the 1993 Flood event.

Note: One minor local initiative was developed from the studies on the East Bottoms Unit. A local remedy is planned for one minor low spot (approximately one foot lower than surrounding tieback segments) on the Blue River tie-back levee near the I-435 overpass. This local initiative is planned for implementation by Kansas City, Missouri essentially using local O&M procedures.

North Kansas City Levee Unit

This is a single large unit composed of levee, floodwall, pump stations, and various drainage appurtenances, all of varying age. The operation of this unit is divided between two sponsors (City of Kansas City Missouri and the North Kansas City Levee District). Analysis of the water surface elevations created by 0.2% probability flood event (nominal 500 year flooding) scenario and associated inundation analysis shows that most of North Kansas City is within the original Missouri River floodplain (prior to levees) including the Downtown Airport and is subject to an average flood depth of 16 feet if the unit were to suffer a catastrophic failure. Findings for

overtopping reliability show the unit adequately complies with the original authorized hydraulics.

- Harlem Area of Interest: Findings for geotechnical risk indicate the need for measures to improve underseepage control along the Harlem area levee segment which lies along the left (north) bank of the Missouri River between the Broadway and the Heart of America Bridges, just east of the downtown airport. The geotechnical R&U analysis is corroborated by observations during the 1993 Flood event, and from documents associated with mid-1950's construction efforts which essentially state that additional underseepage control measures may be needed if verified by future flood performance observations.
- National Starch Area of Interest: Findings for geotechnical risk indicate the need for measures to improve underseepage control in the area lying along the left (north) bank of the Missouri River between the Heart of America Bridge and the Paseo Bridge, generally within or adjacent to National Starch Corporation properties. The geotechnical R&U analysis is corroborated by observations during the 1993 Flood event which indicated significant underseepage pressures well landward of the levee.

Fairfax-Jersey Creek Levee Unit

This is a single large unit composed of levee, floodwall, pump stations, and various drainage appurtenances, all of varying age. The operation of this unit is divided between two sponsors (Fairfax Drainage District and the Kaw Valley Drainage District for the Jersey Creek area). Analysis of the water surface elevations created by 0.2% probability flood event (nominal 500 year flooding) scenario and associated inundation analysis shows that most of the Fairfax-Jersey Creek Unit is subject to an average flood depth of 14 feet if the unit were to suffer a catastrophic failure. Findings for overtopping reliability show the unit adequately complies with the original authorized hydraulics.

- **Fairfax Unit Floodwall along the BPU Power Plant:** Findings for structural risk indicate the need for increased floodwall pile capacities to withstand flood loading to the top of the wall. Field tests were conducted to verify the pile length and diameter. The original construction drawings required a minimum pile length of 20'-0". Field tests showed that some piles are less than the 20' minimum and diameters were less than expected. Furthermore, even if constructed with the 20-foot minimum pile length, analysis shows this to be inadequate to support the floodwall under some rare flood loading conditions.
- **Fairfax-Jersey Creek Unit – Jersey Creek Sheetpile Wall Site:** Findings for geotechnical risk and overall sheetpile wall condition indicate the need for reconstruction of this wall located along the lower bank area from just upstream of the Jersey Creek outlet to near the confluence with the Kansas River. The poor condition of this entire wall is exacerbated by Missouri River channel degradation removing bank material riverward of the wall – this reduces the countervailing mass on the riverside and allows rapid failure of the wall during flood conditions. If the wall were to fail under flood conditions, landward and downward scour of the channel and bank-line can lead to a series of progressive failures: from the wall, to foreshore, to upper bank and eventually to the adjacent levee and floodwall atop the levee.

Note: Regarding the Kansas City Kansas municipal cargo wharf located on the Fairfax-Jersey Creek line of protection (Sta 17+70 to Sta 23+30). As part of the total work package for the Fairfax-Jersey Creek Unit, the Kaw Valley Drainage District (sponsor for the Jersey Creek area) and the Unified Government of Wyandotte County will undertake municipal wharf improvements germane to the line of protection. While this is not a part of the Federal project, the completion of these improvements is included as an associated cost (non-Federal) in the overall project analysis.

Birmingham Unit

Findings for the Birmingham levee unit in regards to overtopping, geotechnical and structural reliability show the unit adequately complies with the original authorization intent. The Birmingham Unit performance is also deemed adequate in respect to the performance level of the other units within the overall system. Thus, the current Birmingham Unit performance is considered consistent with the planning objectives of this feasibility study, and no Federal improvements are recommended. Continued effective and prompt local operation, maintenance, and repair actions are necessary to maintain the reliability of the unit.

Future Without Project Conditions

Economic Considerations & Demographic Assumptions and Trends

Only gradual, minor changes in population, employment, and land use are expected within the study area. The population of the Kansas City metropolitan area has been relatively stable according to the 1980 through 2000 census. Based on historic trends, significant changes in population and land use in relation to existing conditions are not expected. However, several important planned commercial and residential developments have been identified in certain units during discussions with sponsors and occupants of the study area. These developments are expected to add to the overall economic activity.

Any development that occurs in the future may be under restrictions depending on where it occurs. Within the study area, significant acreage within the Birmingham and Fairfax-Jersey Creek Units could support future development. Most of this area would be within the base flood plain if not for the flood damage reduction project. Any development along the river outside the line of protection would be precluded by the regulatory floodway which covers the entire span between the left- and right-bank levees.

Hydrologic and Hydraulic Considerations and Assumptions

General

The future conditions without project HECRAS (Hydrologic Engineering Center River Analysis System) model represents the probable stage-discharge relationship at a selected future date based on the best available current data, the incorporation of any known projects planned to be completed within the study reach, and any long term natural river processes that may affect future stages.

Future Condition Changes to Missouri River HECRAS Model

A critical assumption in the future conditions analysis is that hydrologic conditions along the Missouri River and the Kansas River are relatively static and that flows used in the existing conditions study generally apply to the future conditions analysis. This assumption was also used 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*. We are using the newly published flows in the UMRFFS for both present and future conditions.

Missouri River Degradation

The Missouri River between miles 340 and 400 in the Kansas City reach has exhibited downcutting of the river bed. This phenomenon has been observed by evaluation of Missouri River gage data collected over a long period of time. This (Kansas Citys) feasibility study is directed towards the analysis of levee unit performance under flood conditions. Channel degradation has been considered where it has demonstrable effects on levee unit flood damage reduction performance. It was deemed unnecessary to project future degradation changes into the HECRAS model for the Kansas Citys study.

New Missouri River Levee System (MRLS) Unit L-385

The primary additional man-made feature included in the future conditions HECRAS model is a new Missouri River levee opposite and upstream of the Fairfax-Jersey Creek Unit (MRLS L385, and is commonly known as the “Riverside Levee” or “Quindaro Bend Levee”). The recently constructed L385 Unit extends from River Mile 371.4 to 376.5 on the left bank of the Missouri River. The L385 levee is situated at the extreme upstream end of the studied reach. The Corps of Engineers planning and design of L385 carefully evaluated the hydrologic and hydraulic effects on existing flood damage reduction projects, including the Kansas Citys local flood damage reduction system.

Downtown Airport Runway Extension

A proposal for extending certain runways in the Kansas City Missouri Downtown Airport has been offered by the Kansas City Missouri Aviation Department. If constructed, the extension will require some amount of fill within the floodway at Missouri River mile 369.2. The proposed fill lies between the cross-sections in the Corps of Engineers hydraulic (HECRAS) model used for the Kansas City’s study.

At this point in time, the proposal has not cleared Corps of Engineers review for hydraulic effects within the floodway. It should be noted that in this situation, the responsibility for addressing any floodway fill impacts to the existing flood damage reduction project lies with the runway extension proponent. Coordination with adjacent levee districts is also the responsibility of the runway extension proponent. The Corps of Engineers, through the long-established Inspection of Completed Works Program, provides technical review of the analysis and design of this type of proposed work. In general, such proposed projects are considered by the Corps of Engineers and may be approved if no adverse impacts to the existing flood damage reduction works are adequately demonstrated. The runway proponent is in the process of addressing

potential impacts. The final outcome of this proposal cannot be determined at this time. Thus, no runway extension is included in the Kansas Citys future conditions hydraulic model. The Final Feasibility Report will address any changes to the current conditions should the proposal move forward.

Missouri River Flood Stages

The Missouri River has been subject to many natural processes that have affected river stages for both low and high frequency flood events. These long-term changes in the stage-discharge relationship of the river are referred to as stage trends. 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.

For the Kansas City reach (as measured by the Hannibal Bridge gage):

- The data collected for flows ranging from 20,000 cfs to 100,000 cfs shows a clear trend for a general decline in stages. This is consistent with current Missouri River channel degradation problems as exhibited by dropping water levels at municipal and industrial water intakes. The subject of channel degradation is likely to be considered further as part of future Missouri River studies.
- The 200,000 cfs data series reflects a slight rise in stages from 1950 to 2000. This higher flow data series reflects limited data as collected in 1951 and 1952 flooding and from the flood of 1993. These floods are the only floods in recent history to produce flows greater than 200,000 cfs. The data indicate that stages recorded for similar flows in 1993 were higher than recorded in 1951 and 1952. However, two points in the highest flow series do not provide enough data to quantify a definite trend. The subject of stage trends is likely to be considered further as part of other future Missouri River studies.

Future Condition Changes to Kansas River HECRAS Model

Other than the work recommended by this feasibility study, the future conditions analysis does not anticipate the construction of any major Federal projects along the Kansas River that will have the capacity to affect the water surface elevations in the future conditions model. However, some of the natural processes occurring on the Kansas River are similar to processes occurring on the Missouri River.

Examination of aerial photography sequences show significant tree growth on certain lower Kansas River foreshore areas during the years from 1955 to the 1990's, especially on the left and right foreshores from the upper limits of the studied reach to approximately Kansas River mile 3.5, a distance of approximately 6.5 miles. Downstream of river mile 3.5, very little vegetation exists on the foreshore. Some accretion is noted along the studied reach, but not to the extent of the Missouri River. This difference may be due to the absence of navigation structures in the Kansas River.

The future conditions without project model assumes that because the upper reach is heavily vegetated for the existing conditions, the future conditions will not be worsened by further maturity of these growths. Based on a review of the vegetation patterns from 1955 to the

present, it is also assumed that the amount and extent of vegetation on the lower reach from river mile 3.5 to the mouth will remain relatively stable. Therefore, the future conditions without project model along the Kansas River does not change from the existing conditions model.

Period of Analysis and Related Assumptions

The future with and without project conditions are evaluated over a 50 year period of analysis to allow a consistent and appropriate comparison of alternatives. The period of analysis is the time horizon for which project benefits and project operation, maintenance, repair, rehabilitation and replacement (OMRR&R) costs are evaluated. The period of analysis begins with the base year condition (considering resources in the study area and economic and engineering factors) thought to exist in the first year a project alternative is expected to become operational. Engineering and economic data is also developed (projected) for a future year about 20 to 30 years out from the base year. The analysis years used in this interim feasibility study are 2012 for the base year and 2035 for the future year, with the total 50 year period of analysis ending in 2061.

In this study, certain assumptions related to the period of analysis were made:

- River stage uncertainty values were increased from 1.5 ft. to 1.8 ft. in the future year 2035; this allows the analysis to reflect the increased difficulty in predicting stages far in the future.
- No increase in economic development is projected for the 50 year period of analysis as much of the protected area is essentially built-out.
- Beyond the future condition year of 2035, the expected annual damage is assumed to be constant in the remaining years of the period of analysis.

Using these assumptions, the expected annual damage for each year in the period of analysis is then computed, discounted back to present value and annualized to determine the equivalent annual damage for any year during the analysis period. Exhibit #8 shows future without project annual damages.

Problems And Opportunities

The entire system of seven levee units withstood the Flood of 1993, but some elements of the system were seriously challenged as the flood crested. This flood experience raised a concern that the levees may provide less than the level of performance for which they were designed. Following the Flood of 1993, both Kansas sponsors and Kansas City, Missouri, wrote letters to the Kansas City District expressing concern for the adequacy of parts of the flood damage reduction system.

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. In response to these local concerns, a Reconnaissance Study was undertaken through Section 216 authority. The reconnaissance study produced recommendations supportive of further feasibility examination.

Accordingly, this feasibility study was undertaken to further investigate the Federal interest in planning, designing and constructing economically viable measures which might be able to address any changed conditions and levee performance issues. Furthermore, the magnitude of

human activity and dense development within the protected area makes a strong case that Federal and local officials should be involved in positive steps, where feasible, to maintain and improve the overall safety and performance of the levee system.

Planning Considerations And Constraints

Planning Objectives

The two primary objectives of the overall feasibility study are:

- 1) update and verify data on the reliability of the existing project (Kansas Citys, Missouri and Kansas, Local Flood Damage Reduction Project) performance under flood conditions, and
- 2) develop alternative plans (to include a review of the “no Federal action” alternative) for increasing the overall reliability of the existing system consistent with the original authorizations, and provide a final Recommended Plan for implementation. The Recommended Plan will be technically sound, economically feasible and environmentally acceptable.

Planning Criteria

Early problem definition efforts required that the study establish the existing performance condition and future without project condition for all seven units in the study area. The primary means of quantification of these baseline conditions was through the development of risk and reliability (for flood condition performance) metrics by using risk and uncertainty (R&U) principles and the Corps of Engineers HECFDA program. This is significant due to the numerous elements and features of the seven units which required the identification and quantification of performance weaknesses.

Much of the analysis used data and observations from recent high water events, especially those in 1993. This updated engineering analysis, along with the economic (HECFDA-based) existing conditions analysis, establishes a complete R&U approach to estimating existing conditions flood damages. The engineering and economic evaluations are taken together with a summary baseline environmental review and an HTRW review to develop the existing conditions.

Planning Constraints

Congressional Direction and Higher Headquarters Guidance

Reconnaissance efforts were undertaken with the following Congressional directions:

- 1) Per the report on the FY 1998 Energy and Water Appropriations Bill, the Senate Committee on Appropriations stated:

Kansas City, MO-KS- The Committee is aware that the Kansas City, MO, and Kansas City, KS, flood control study encompasses two States, two rivers, seven separable units, and five separate sponsors; and, therefore, believes that the study area and issues are too large and complex to be adequately addressed by the standard reconnaissance study simplified analysis of limited scope as set forth in current Corps policy. Accordingly, the Committee directs the Corps to use the additional \$300,000 provided to scope potential multifasibility studies, develop associated project study plans and negotiate feasibility cost sharing agreements related to the study.

2) In its report on the FY 1999 Energy and Water Appropriations Bill, the Senate Committee on Appropriations stated:

Kansas City, MO- The Committee has included \$545,000 for the Kansas City, MO, reconnaissance study which is comprised of seven separable levee units, encompasses two States and two major rivers, and has multiple sponsors. Due to the large study area, the complexities, and the large number of interest, the Committee directs that the study not be limited to the 1 year constraint for a reconnaissance study and that the study be scheduled for completion by the end of fiscal year 1999.

The reconnaissance report was certified by the Corps of Engineers and permission to proceed into feasibility studies was granted with the following stipulations:

1) The subject report (reconnaissance) and project study plans are approved as the basis for proceeding into the feasibility phase of planning. Based on the intense development behind the levees and the complex interaction between individual levee units we are supportive of limiting the alternatives to be investigated during the feasibility phase to those alternatives that provide a uniform level of protection.

*2) The project units of the flood protection plan for the Kansas Citys are so closely related and dependent upon each other for effectiveness that the project can only be analyzed by **considering the area as a whole**. Given the location of the seven levee units relative to the confluences of the two rivers, formulation based on reaches upstream and downstream of the confluence of the Kansas and Missouri rivers is not technically feasible. The levee units in this study are either at the confluence of the rivers, or within the zone of influence of the confluence. Therefore, all units are interrelated and function as a system in providing flood protection to the area. This is the same challenge that was faced by the Corps when designing the existing levee system. Furthermore, there are conditions under which failure or flooding of certain levee units may adversely affect adjacent levee units.*

and...

...the formulation of alternatives can proceed on the basis of providing a uniform level of protection, in lieu of doing an incremental analysis for the left and right bank levees.

Systems Approach to Formulation and Relationships between the Metropolitan Levee Units

For this feasibility study, the examinations of measures to increase the performance of the system are guided by an overarching principle that seeks to achieve a relatively consistent level of performance throughout the seven levee system. This essentially means that the study avoids recommending:

- any measures which would directly or indirectly exacerbate any performance weaknesses (or relative weaknesses) within the system, and
- any measures that would contribute to increasing the level of performance of strong components of the system without a commensurate strengthening of weaker components.

Financial and Schedule Constraints

Feasibility phase financial and schedule constraints played a significant role in the execution of this study. The large and intensely developed urban study area, and the numerous existing protective features within the seven levee units present broad possibilities for study and formulation. However, financial realities demanded that the feasibility scope, analysis, and planning efforts focus on those areas, measures and solutions which address pressing needs or significant performance weaknesses within the overall system (these provide the greatest relative opportunity for reliability improvements).

Plan Reformulation

The initial plan formulation concepts which guided early portions of the feasibility study were based on producing a plan and report products which addressed all units within the seven levee system. This approach had its genesis in the abbreviated studies conducted during the reconnaissance phase which indicated the possibility of system-wide levee raises. While no feasibility level plans were developed along these lines, it was the original guiding expectation.

The initial broad feasibility evaluations of existing conditions undertaken during the first two to three years of this study allowed subsequent formulation efforts more focus. The development of measures to increase reliability was narrowed to the candidate sites which offered the best opportunity for significant reliability improvements and potential economic return on investment. These candidates were also reviewed for compatibility with the basic planning objectives and constraints which emphasized the desirability of a relatively uniform level of protection across the system.

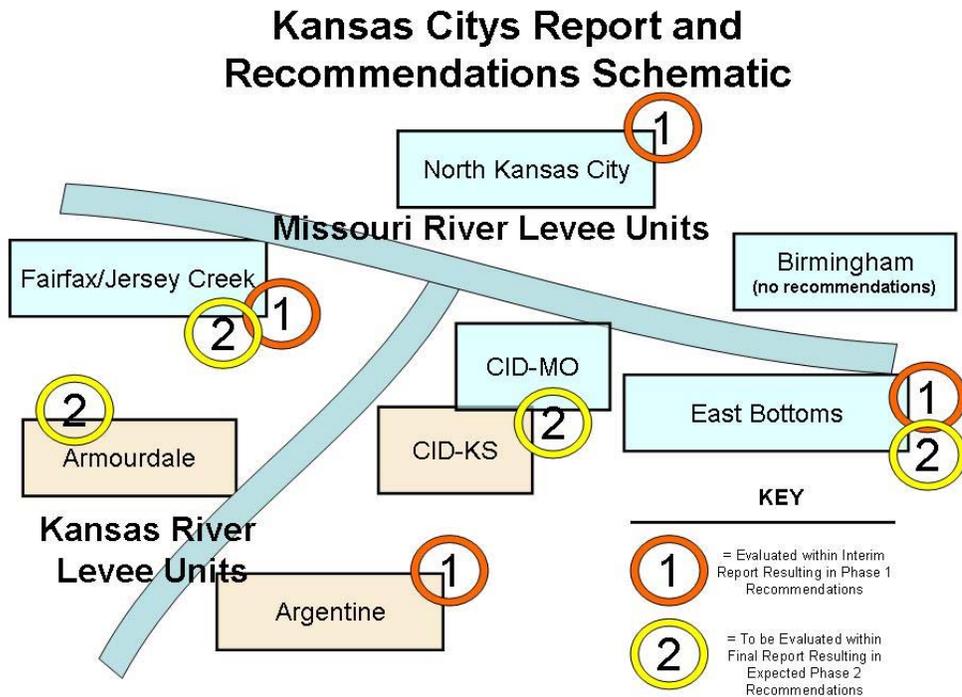
As feasibility progressed, the development of reliability improvements were thus focused on those areas of interest (AOI) with relatively low reliability; areas where low reliability significantly compromised the projects original intended level of performance. Engineered reliability remedies and improvements were developed considering both the improvements to individual unit performance and the performance of the whole system.

As the feasibility study moved towards formulation of alternative plans, it became apparent that schedule and funding constraints were best accommodated through an Interim Feasibility Report (this report) and a Final Feasibility Report (expected in/around late 2008). A two-step reporting process means the complete feasibility study will generate two sets of recommendations.

- The first set of recommendations from the Interim Feasibility Report are referred to herein as Phase 1 recommendations. The Phase 1 recommendations are intended for authorization and implementation as soon as appropriate approvals are gained. The second set of recommendations from the upcoming Final Feasibility Report is referred to herein as (upcoming) Phase 2 recommendations.
- The second set of (Phase 2) recommendations are intended for authorization and implementation under a separate authorization schedule following the release of the Final Feasibility Report.

This two-phased approach to authorization and implementation has several advantages, among which are the ability to better handle the large magnitude of the overall study area and the numerous features under study. It also better adapts the study and implementation schedule to a more manageable Federal (and nonfederal) funding stream. The Interim and Final Reporting process results in the phasing of the levee unit analysis and recommendation development as shown in Figure 4 below.

Figure 4: Kansas Citys Report and Recommendations Schematic



Development And Screening Of Alternatives

The results of the existing conditions analysis, and observations and effects from historic and recent flood events, were used to formulate potential engineered solutions aimed at lowering the risk of flooding for units under study. Often these alternatives needed to address problems with specific segments or locations within a unit (the problem areas are termed “areas of interest”, or AOI in the report).

An initial set of alternatives was screened and refined for each AOI. At times additional alternatives surfaced and were examined. Alternatives were examined and compared considering the Federal criteria of completeness, efficiency, effectiveness, and acceptability. Alternatives were closely examined for their potential to impact the environment. As the alternatives passed through this evaluation and screening process, the economic analysis of each alternative was used as a primary ranking factor in the final selection. Having passed review for engineering adequacy, environmental and public acceptability, and other evaluation criteria as described below, the remaining alternative with the highest net benefits to the national economy was identified as a component of the overall NED plan for the Interim Feasibility study.

The development and screening of alternatives involved the consideration of a number of evaluation factors or criteria. Primary among those factors were the following:

- Engineering adequacy of the proposed solutions (effectiveness)
- Contribution to planning objectives (related to completeness of solution)
- Consistency with planning constraints and authorities
- Environmental, cultural, and public acceptability
- Early cost indicators (early efficiency indicators for screening purposes)
- Floodway conveyance considerations
- Induced damages considerations (where applicable)
- Hazardous and regulated waste site constraints (where applicable)
- Constructability (are construction techniques and quality difficult to attain at reasonable price)
- Construction site constraints (given existing features and development)

Engineering Adequacy: The engineering adequacy of alternatives was analyzed and reviewed during the initial screening process. Any alternatives which could not meet the minimum technical criteria for the expected flood conditions were eliminated from further review. This is a key effectiveness criteria and normally must be met. The amount of engineering analysis necessary to perform the engineering review was generally considerable and is contained in the various Engineering Appendices.

Environmental Acceptability: Environmental acceptability of alternatives was reviewed in concert with appropriate resource agency guidance. Any alternative which had major disruptive effects on the environment was normally screened out. A typical formulation exercise would involve adjusting some of the alternative measures so as to minimize any environmental impacts when such impacts could not reasonably be avoided.

Cultural Acceptability: Any cultural resources present were considered as the areas likely to be affected by a solution were determined. Steps were taken during the alternatives screening and refinement process to generally avoid any impacts to culturally significant sites.

Early Cost Indicators (efficiency): Early approximate cost indicators related to the various alternatives were used to determine if an alternative was prudent for further examination. As the evaluation process continued, cost estimates and economics were refined. The detailed cost estimating and economic analysis normally focused only on those alternatives that remained viable solutions after early screening criteria were passed.

Floodway Conveyance Considerations: Very early in the plan formulation process, a general guiding rule was adopted: any measures which negatively impacted the establish floodway conveyance should be avoided. This was deemed essential as in most cases levees lie along both banks of the river reaches within the study area, and are often located either upstream or downstream of another unit. This principle is consistent with floodway “no rise” criteria as promulgated under FEMA regulations. This criteria was maintained during feasibility and the final alternatives are essentially benign in respect to any adverse floodway impact.

Induced Damages: While this consideration is similar in some respects to the floodway conveyance factor, the analysis actually goes one step further and addresses the possibility of

induced impacts during extremely rare events in which the order of overtopping may be altered by levee raise proposals.

No Federal Action Alternative

Note: As reported herein, the Birmingham Unit was examined and found adequate in its current condition in regards to the feasibility planning objectives. This may be correctly interpreted as recommending No Federal Action for the Birmingham Unit. The discussions within this section of the report actually address a broader perspective of the No Federal Action alternative as it relates to the other four units within the Interim Feasibility Report (Argentine, Fairfax-Jersey Creek, North Kansas City, and East Bottoms).

For each AOI, the No Federal Action alternative was considered. When examining the No Federal Action alternative, it is necessary to project what course of action local entities may take given the lack of Federal involvement. It is possible that some of the recommended measures may be undertaken by the local sponsors. These local initiatives are likely to be focused on the underseepage measures which are the least costly of the recommendations offered herein. However, the major requirements associated with the Argentine levee raise, Fairfax-BPU floodwall strengthening, and the Fairfax-Jersey Creek sheetpile wall reconstruction are just as likely not to be accomplished under a local initiative. This would mean significant long-term risk remaining for at least two of the units analyzed in this Interim report.

The No Federal Action alternative does nothing to alleviate risks to public health and safety. While some local emergency preparedness plans can be updated and general awareness of the risks can be increased, this could be considered an inappropriate small scale response to significant life and safety risks.

The economic implications of the No Federal Action alternative are broadly negative. The investment at risk within each unit is so large that No Federal Action will subject the study area to the possibility of an overall long-term adverse impact on the local economy, and dislocations of industry may even result. In the short term, with an absence of flooding, the current trends in place for the local economy, tax base, population, and employment may remain intact. However, if major flooding occurred and one or more of the levee units failed, the long term effects are likely to include: diminished economic stability, business interruptions that could jeopardize workers jobs and wages, potential losses in population and employment, and reductions in the tax base (given net movement out the protected areas) and generally diminished property values.

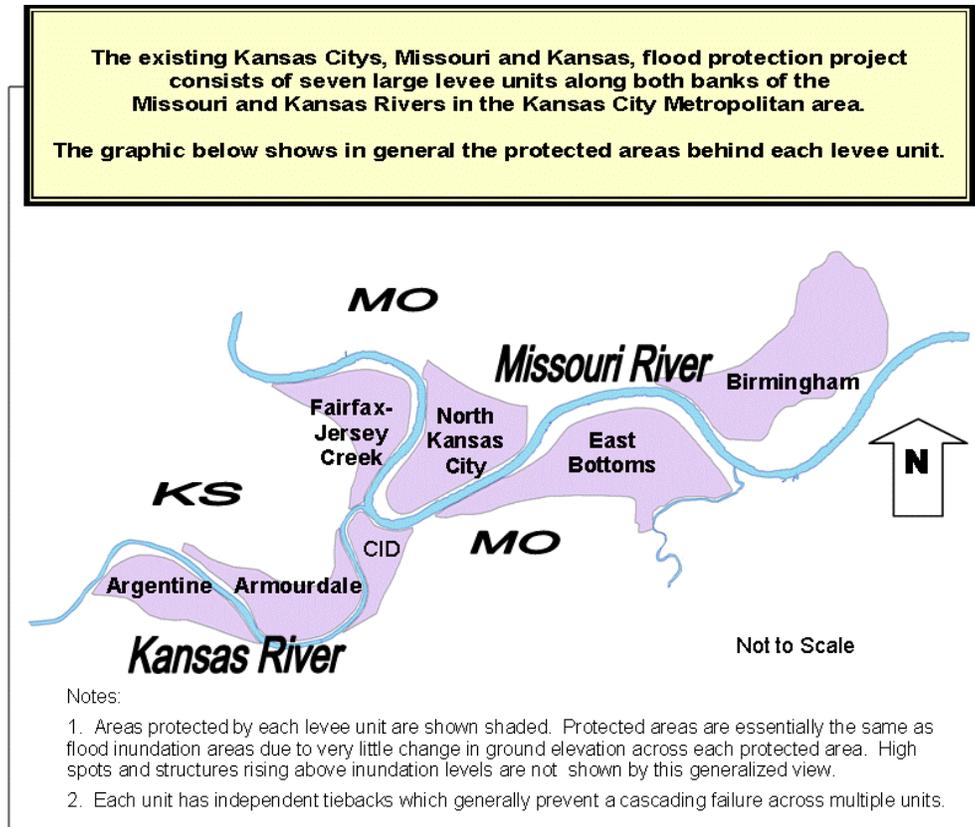
The No Federal Action alternative would leave several of the busiest rail yards in the nation at significant risk. Levee failure(s) would halt or at least significantly impede the nationwide movement of goods by rail, and major interstate highways could also shut down. During any such failure, it is also expected that production centers, wholesale distribution, and containerized shipping centers would close. Following the flood, subsequent restoration periods could be months or years depending on the damage involved.

The No Federal Action alternative also raises the possibility of permanent loss of local manufacturing employment through industrial relocation to developing countries. Certain industries may see moving outside the United States as a more viable option in lieu of industrial

re-investment and rebuilding after any widespread flood damage. Were this to occur, it could severely degrade the industrial base of the metropolitan area for decades.

The No Federal Action alternative results in no changes to the existing environment in and around the levee units unless catastrophic levee failure occurs. Levee failure at specific locations or across the system could result in direct and indirect impacts through inundation of habitat of terrestrial populations and through release of contaminants to the river systems or flood plain environment. Figure 5 shows the protected areas subject to inundation from failures of the respective levee units. Direct impacts during flood events would be the displacement of mobile organisms and the loss of organisms unable to escape inundated areas. Direct and indirect impacts could also result from the introduction of contaminants currently controlled or contained by businesses and industries interior of the levee systems. Levee failure and inundation of currently contaminated soils, stored chemicals, and the variety of chemicals released within the protected communities would allow introduction of these contaminants into the Kansas, Missouri, and/or Blue Rivers impacting water quality and contaminant loading of the rivers during these events. Potential impact to aquatic populations (fish and benthic communities) from the degradation of water quality and contaminant loading would result from chemical release during flood events. Subsidence of flood waters could also result in the introduction or redistribution of chemical contaminants across the foreshore floodplain and impact terrestrial communities (plants and animals) utilizing the foreshore habitat. Impacts from the No Federal Action alternative could range from no significant impact under non-flood events, to minor to significant impact depending on location of levee failure and the resulting duration of inundation.

Figure 5: Kansas Citys Flood Damage Reduction Project – Protected Areas



Non-structural alternatives

Beginning with the Flood Control Act of 1936, the Federal government has led the nation's flood damage reduction efforts, and as a result, also led the nation's floodplain management activity. Historically, structural programs such as levees, floodwalls, channelization, and lake projects played the lead role in preventing flood damages. In more recent years, the Federal government has endeavored to support nonstructural approaches (such as flood warning systems, flood-proofing structures, floodplain management, etc.).

Nonstructural approaches have merit when the site characteristics and the flooding threat are compatible with the nonstructural capabilities. In the case of the existing Kansas Citys flood damage reduction system, use of nonstructural methods were eliminated early as potential solutions due to:

- Planning objectives for this study (which address existing structural flood damage reduction systems) cannot be met through the use of nonstructural measures.
- The need for large-scale risk reduction within the extensive protected areas is best accomplished through performance improvements to the existing Kansas Citys structural flood damage reduction system.
- The performance of the existing Kansas Citys flood damage reduction system far exceeds the normal performance parameters of nonstructural measures.

No opportunity for large-scale application of nonstructural measures is foreseen within this study other than continuing to effectively manage the floodplain using FEMA NFIP guidelines. It may be possible to find some limited use for nonstructural measures along the fringe of the protected area and for the prevention of damages due to localized interior flooding. These potential limited applications are outside the scope of this study.

Alternatives Studied

A variety of alternatives were examined. Some alternatives were soon found lacking sufficient validity and were screened-out. Exhibit #9 lists the early alternatives array for each AOI, shows the results of the general screening review, and indicates whether the alternative moved forward into a more detailed costing and analysis for final evaluation and comparison. Following is a series of descriptions for some of the more important alternatives examined.

All Units: Flood Fighting Alternative

The flood fight alternative normally requires a stockpile of sandbags to be stored near areas subject to high underseepage pressures or overtopping. Sandbags are then deployed to strategic locations and placed (or stacked) in accordance with proven flood fighting techniques. These stacks of sandbags serve to add mass or height in an attempt to temporarily reinforce the permanent features already in place. When working with major levee systems, flood fighting is generally best thought of as an aid to manage unpredictable and unforeseen problems during flood events.

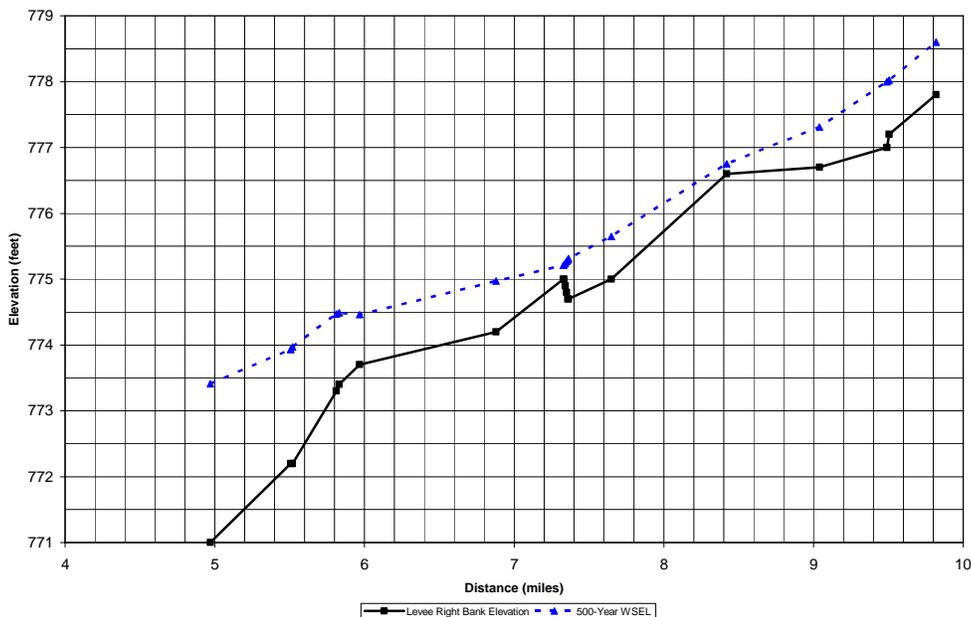
For large levee units where substantial investment is protected, some flood fighting can be planned and implemented for limited low-risk situations. But, in general, when exposed to massive flood events, flood fighting measures will often prove unreliable. For the levee units and problems under examination in this study, flood fighting is generally not an acceptable planning alternative when compared to engineered solutions. Flood fighting generally will not prevent underseepage failures when dealing with very high pressures, nor can flood fighting reliably prevent structural floodwall failures under extreme load conditions. Nor is flood fighting a reliable option for substantially raising the elevation of a large levee unit.

Argentine Unit Alternatives

A basic question posed when formulating the initial array of alternatives for Argentine Unit improvements was whether the alternative might be supportive of the “500 year” level of protection. While Corps of Engineers policy specifically adopts the use of risk characterization (level of performance) rather than a return frequency based characterization (level of protection), there is sometimes a need, when working with the public, to develop a conceptual framework for describing proposed alternatives in terms of the historical characterization of the existing protection. It is understood there is a general perception of the Argentine Unit as providing a “500 year” level of protection. The most recent FEMA floodplain mapping also indicates the area behind the Argentine Unit as Zone C which is typically defined as “areas of minimal flooding”.

The river stage profile charted below shows the 0.2 % (or “500 year”) chance exceedance water surface profile (within the Argentine reach) as defined by the median discharge value for the 0.2% event based on recent feasibility related studies of the Kansas River. The water surface profile is compared against the top of levee elevation. As can be seen in this chart, the Argentine levee does not currently provide the historical definition of “500 year” overtopping protection.

Figure 6: Argentine Levee Profile versus 0.2% Chance Exceedance Kansas River Event



Alternatives considered for increasing the hydraulic performance of the Argentine Unit are listed below.

Argentine Unit: Wide -Scale Tree Removal and Kansas River Channel Modification Alternative

Foreshore areas have developed along the left and right banks of the lower Kansas River within the study area. The feasibility examination of a potential channel modification alternative included consideration of river geomorphology and the expected conveyance gains. Essentially any channel modification would be aimed at attempting to establish a more efficient cross-sectional flow area contiguous along substantial lengths of the levee foreshore. Channel modification was modeled in HECRAS for both sides of the Kansas River adjacent to all three levee units (Argentine, Armourdale, and CID). The results indicated some additional conveyance capacity under modified conditions. However, the conveyance gains are very limited (not totally effective and complete) and do not fully serve to re-establish the original authorized discharge of 390,000 cfs.

Furthermore, based on review of historical aerials along the lower Kansas River, it is expected that any channel modification would have a limited life much less than the 50-year period of analysis. Following any significant channel modification effort, the Kansas River is likely to re-establish foreshore areas through a process of sediment transport and deposition, much as has happened in the recent past along the levees. This natural process of meandering and foreshore building would require repeated dredging cycles to maintain the expanded floodway. The overall prospect of massive environmental disruption, extensive maintenance dredging adjacent to the existing levees, the potential creation of new underseepage paths, and the general risk associated with effective timing of dredge cycles and potential floods make the channel-modification measure undesirable.

Mature trees have overgrown the left and right overbanks of the Kansas River along the reach extending upstream from Kansas River mile 3.5 to the upstream end of the Argentine Unit. This has reduced the current channel conveyance capacity as compared to the 1962 design parameters. An examination of tree removal throughout this stretch of the Kansas River included a hydraulic review of the potential for reduction in water surface profiles by restoring the Kansas River banks to a treeless condition similar to that seen in mid-1950's aerials.

HECRAS was used to model the effectiveness of tree removal. Modeling results indicated that a limited conveyance improvement is possible with the tree removal. However, the tree removal alternative would have major adverse impacts on riparian habitat along the lower Kansas River levee units. The habitat loss would require extensive and costly mitigation which would be nearly impossible given the urban and highly developed nature of the river channels within the study area. A "remove the trees and mitigate approach" would likely transfer the conveyance problem to another location on the river(s).

Even when combined channel modifications and wide-scale tree removal are examined together, it was shown that completeness and acceptability criteria were not met. These measures were thus essentially screened-out from further consideration. However, given that Federal criteria guided the evaluation process, there does exist the possibility of a local action along these lines if

No Federal action were taken. It should also be noted that the analysis of this alternative did identify incidental environmental benefits as derived from avoiding wide-scale habitat destruction (tree preservation) because the potential need for any local tree-clearing initiative is effectively eliminated. This recognizes that local actions are not subject to the same Federal criteria used in the feasibility study.

Argentine Unit: Landside Levee Raise Alternatives and Variations on Levee Components

As discussed above, there exists a need for a dual approach to communicating the nature of the Argentine levee raise alternatives array: alternative performance displays which include characterization from both a historical “level of protection” standpoint and from the current Corps of Engineers risk-based analysis standpoint. This dual approach to analysis and display of such results is in full compliance with ER 1105-2-101, but with the added benefit of identifying alternatives in terms associated with the local historical perspective. Some important characteristics of these levee raise alternatives are displayed in the following table.

Table 13: Argentine Unit Levee Raise Alternatives – Display of Various Naming Conventions

Argentine Unit Levee Raise Alternatives (Names)	Top of Levee at Index Point (elevation ft msl)	Median Discharge Capacity at Top of Levee (cfs)	Approx. Levee Height Above Grade at Index point (feet)	Approx. Change in Levee Height (raise amount at index point -- feet)
“Future w/o Project” or “No Federal Action”	776	317,000	13	0
“Nom500+0 ft”	778.2	341,000	15.2	2.2
“Nom500+3 ft”	781.2	372,000	18.2	5.2
“Nom500+5 ft”	783.2	392,000	20.2	7.2

Table Note: “Nom” is an abbreviated form of “Nominal”. The alternative name is “nominal” in the sense that the “500 year” designation is really an approximation of the best (median) singular value for a 0.2% percent chance exceedance flood event.

All levee raise alternatives include widening the levee footprint landward of the river for stability and underseepage berms as indicated by the geotechnical analysis. All major floodwalls are removed and replaced under each alternative. A cost comparison was developed for any new berms that would encroach upon existing buildings. The analysis showed relief wells to be more cost effective than relocation in most situations.

In a few cases, certain early levee raise variations included extension of the levee footprint and encroachment upon the railroad facilities. A cost analysis compared the relocation of the railroad with the installation of relief wells in combination with retaining walls. This showed that the combination of relief wells and retaining walls was the most cost effective alternative and railroad impacts were reduced for all alternatives. The remaining railroad impacts are essentially related to stop-log gap raises on the upper and lower ends of the unit which cannot be eliminated due to the need for effective high ground tieback.

All of the proposed levee raises (nom500+0 ft, nom500+3 ft, and nom500+5 ft) include the necessary overtopping reliability, structural stability and underseepage control improvements to

support the raise. The nom500+0 ft raise would result in less land disturbance than the other raise alternatives. The nom500+5 ft raise alternative would result in a high degree of land disturbance, substantial HTRW site impacts, and building and railroad track relocations.

East Bottoms Missouri and Blue Confluence Underseepage Control Alternatives

East Bottoms alternatives are aimed at improving underseepage control for an area prone to excessive underseepage risk along the East Bottoms Blue River tieback levee approximately Sta 403+00 to Sta 420+00.

East Bottoms: Underseepage Correction via Sheetpile Wall Alternative. The sheetpile wall alternative would consist of installing approximately 232,500 square feet of sheet piling down to bedrock (approximate 75 foot depth) along the riverside toe from Station 396+00 to 427+00 to control underseepage during flood events. This alternative would extend the seepage path of water that seeps through the soil to the toe of the levee, and construction could be completed within the existing right-of-way, outside of all existing Solid Waste Management Units (SWMUs). However, sheetpile installation is a relatively expensive alternative that is less effective for underseepage control than the installation of pressure relief wells. In addition to the high expense of materials and labor, variable bedrock depth could complicate the installation process and considerably increase the cost of effectively implementing this alternative.

East Bottoms: Slurry Cut-Off Wall Alternative. This alternative would consist of constructing a 3-foot wide slurry wall to bedrock depth (approximately 75 feet) along the riverside toe from Station 396+00 to 427+00 to control underseepage during flood events. The variables associated with slurry cut-off wall construction are similar to sheetpile wall construction. This alternative would extend the seepage path of water that seeps through the soil to the toe of the levee, and construction could be completed within the existing right-of-way, outside of all existing SWMUs. A slurry wall is a relatively expensive alternative, and the costs associated with construction could greatly increase due to variable bedrock depth. The performance of a slurry cut-off wall is wholly dependent upon construction quality which in some cases is very dependent on underground site conditions.

East Bottoms: Pressure Relief Wells Alternative. This alternative consists of installing a series of pressure relief wells located along Station 403+00 to Station 420+00. A header system will serve to transfer seep-water from the wells to the proximity of the Hawthorne pump plant. Relief wells are a highly effective apparatus used to control underseepage. However, pressure relief well performance is very dependent upon the quality of construction, and the long-term maintenance costs associated with this alternative are greater than installing a buried collector system. This type of well system has proven to be reliable under flood conditions that could be experienced at this site.

Fairfax-Jersey Creek Unit, Fairfax-Board of Public Utilities (Fairfax-BPU) Floodwall Alternatives

The pile foundation of the Fairfax-Jersey Creek BPU floodwall was analyzed and found deficient for load conditions with water near top of wall which can be experienced in rare flood events. The Fairfax-Jersey Creek BPU floodwall alternatives are aimed at strengthening or replacing the existing floodwall to reduce the risk of floodwall failure in extreme flood events.

Fairfax-Jersey Creek BPU Floodwall: New Floodwall Alternative. A new floodwall constructed landside of the existing floodwall would include a higher capacity pile system and stronger structural elements. Only a limited area is available for new floodwall construction, primarily due to the extensive utilities located in the area of Sta 290+00 to Sta 295+00. In addition to the limited space and numerous utilities relocations, a new floodwall is relatively costly with a large amount of preparatory excavation, raw materials transport (through the adjacent industrial site) and general construction activity that may be prone to disrupt operations of the adjacent power plant.

Fairfax-Jersey Creek BPU Floodwall: Modification of Existing Wall. This alternative would provide for strengthening modifications to the pile foundation and the main stem wall. This alternative would better adapt to the limited construction space as compared to the new wall alternative. It also has some advantage in less logistics and material transport as it uses less raw material (all materials require transport through/around the operating power plant facilities).

Fairfax-Jersey Creek BPU Floodwall: Foundation Soil Modification with Jet Grouting Alternative. Jet grouting or pressure grouting is used in a variety of construction applications to modify soil properties, but it is not considered a long-term, viable solution for floodwall strengthening. Within the Kansas City District, jet grouting was attempted on some levee features after the 1993 Flood with very limited success. Due to the limited shear capacity of the existing concrete piles, the entire floodwall foundation (4,039 feet) would require grout injection. In addition to the questionable effectiveness of jet grouting, controlling injection pressures to simultaneously achieve sufficient grouting without damaging existing adjacent utilities is problematic.

Fairfax-Jersey Creek BPU Floodwall: Temporary Earthen Fill Alternative. This alternative consists of placing earthen fill behind the floodwall as flood water rises and removing it when high water recedes. This is essentially a temporary flood fighting measure. Temporary earthen fill is not considered a viable alternative, because the weight of the fill needed to bolster the stem wall would excessively stress the structural components of the existing wall and foundation.

Fairfax-Jersey Creek BPU Floodwall: New Earthen Levee Next to Existing Floodwall Alternative. Permanently establishing an earthen levee adjacent to the existing floodwall is not considered a feasible alternative due to insufficient space available for levee construction. Several large power plant related facilities are in such close proximity as to make the necessary relocations prohibitively expensive.

Fairfax-Jersey Creek Unit Sheetpile Wall Alternatives

The Fairfax-Jersey Creek sheetpile wall (Sta 287+86 to Sta 302+32) alternatives are aimed at successfully reconstructing the sheetpile wall which is suffering from age-related deterioration.

Fairfax-Jersey Creek Sheetpile Wall: Landside Open or Closed Cell Sheet Pile Wall Alternatives. New sheetpile would be placed landside of the existing wall by a crane and existing sheetpile would be removed at wall intersections. The open and closed cell designs are practical solutions, with the main difference being cost. For certain applications, closed cell construction may be more reliable, but is more expensive than the open cell design due to the

additional lengths of sheetpile required to close the cells. The open cell solution provides the adequate reliability for this site.

Fairfax-Jersey Creek Sheetpile Wall: Auger Cast Pile Wall and Tiebacks Alternative. Piles would be placed landside of the existing sheetpile wall. A top cap comprised of concrete would be cast on top of the piles, and the tiebacks would be grouted into the soil. This alternative would incur construction costs much greater than the recommended open cell wall design due to the difficulty ensuring proper internal tensioning of the support structures.

North Kansas City Unit – Harlem Area Alternatives

North Kansas City Unit alternatives for the Harlem area are aimed at improving underseepage control for an area prone to excessive underseepage risk. This is located in the North Kansas City Lower Section (left bank of Missouri River) and is the responsibility of the North Kansas City Levee District.

North Kansas City Unit – Harlem: Landside Seepage Berm Alternative. Constructing seepage berm(s) of pervious fill to control underseepage during a flood event is considered an effective and relatively reliable alternative. Direct construction costs associated with this alternative are moderate. However, indirect costs such as extending the right-of-way, conducting subsurface investigations, structural demolition, and relocating utilities, residences and businesses greatly increase the total cost and logistics problems associated with this alternative. Constructing a landside seepage berm(s) would create significant local community disruption and is not considered a viable alternative due to economics and low public acceptability.

North Kansas City Unit – Harlem: Buried Collector System Alternative. A buried collector was considered for this site and was found to be technically adequate for control of the underseepage pressures. The buried collector is constructed using perforated pipe and placed within an excavated trench. Typically, buried collectors include a drainage pipe or ditch which collects and removes seep water.

North Kansas City Unit – Harlem: Pressure Relief Wells Alternative. This alternative consists of installing relief wells along the levee toe. Relief wells would collect the seepage and portable pumps would be used to pump seep water over the levee via access provided by six manholes. A permanent right-of-way is not required as this alternative can be implemented with a temporary construction easement. Relief wells are a highly effective apparatus used to control underseepage. However, pressure relief well performance is very dependent upon the quality of construction, and the long-term maintenance costs associated with this alternative are greater than installing a buried collector system.

North Kansas City Unit – National Starch Area Alternatives

North Kansas City Unit alternatives for the National Starch area are aimed at improving underseepage control for area prone to excessive underseepage risk. This area is located in the North Kansas City Lower Section (left bank of Missouri River) and is the responsibility of the North Kansas City Levee District.

North Kansas City Unit– National Starch Area: Landside Seepage Berm Alternative. Landside seepage berm construction is a costly alternative with other negative aspects. A landside seepage berm is not as effective as pressure relief wells in relieving foundation pressures and the costs of extending the right-of-way, modifying structures, and relocating structures are very high. Additional considerations include:

- Portions of the National Starch facilities would need relocation.
- National Starch plant operations could require a temporary shutdown, thereby potentially impacting the local community and economy.
- Land disturbance would total approximately 23 acres with associated undesirable environmental consequences.

North Kansas City Unit – National Starch Area: Buried Collector System Alternative. A buried collector was deemed technically inadequate for this site because of the magnitude of underseepage pressures at the site. These pressures extend beyond the typical zone of influence for a buried collector.

North Kansas City Unit – National Starch Area: Relief Wells and Pump Station Alternative. This alternative consists of installing a series of relief wells along the levee toe. Relief wells would collect the seepage and route it through a header system to a new pump station located nearby. The station is necessary to actively draw-down underseepage pressures at this site. A permanent right-of-way is required to maintain access for the installed wells and pump station. Relief wells are a highly effective apparatus used to control underseepage. However, pressure relief well performance is very dependent upon the quality of construction, and the long-term maintenance costs associated with this alternative are greater than installing a buried collector system. This type of well and pump system has proven to be reliable under flood conditions that could be experienced at this site.

Economic Evaluation of Alternatives

The economic analysis identifies the extent of the economic impact from flooding with the existing project and, on a comparable basis, evaluates the range of plans to increase project performance considered in the study. The analysis first requires a risk-based analysis of the flood problem under the existing condition (existing levees and floodwalls). The future without project condition is then determined, and finally a risk-based evaluation in terms of benefits, costs, and performance of the various alternatives under the with-project condition is completed. The analysis encompasses all flood-prone properties within the study area.

Screening cost estimates (Oct 2004 price level) and estimated construction periods for each of the alternatives were developed by the Kansas City District in accordance standard Corps of Engineers estimating practice. Interest during construction (IDC) for each alternative was calculated based on the total first cost for each alternative, the starting and completion dates for each phase, assumed equal monthly expenditures during each phase, and the FY05 Federal interest rate of 5.375 percent. During screening potential Federal funding constraints were not considered in the starting and completion dates of the implementation phases; appropriate funding was assumed available for each phase.

The total first cost for each alternative includes the estimated construction cost, cost for lands, easements and rights of way, preliminary engineering and design cost, supervision and administration cost, and contingencies. Interest during construction calculated for each alternative was then added to the total first cost to derive the economic cost of each alternative. The economic cost was then annualized for a 50-year period of analysis and a 5.375% interest rate. Other direct costs of project implementation (such as induced damages for the Argentine Unit) were determined and included in the total annual project implementation cost. Separable sites common to one unit (such as the Harlem and National Starch sites in the North Kansas City Unit) were examined and justified incrementally.

Costs for Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R)

OMRR&R were estimated in October 2004 prices for each alternative and are based on a life cycle cost analysis. The analyses include only the additional OMRR&R costs that the sponsors would be expected to incur based on the proposed unit modifications. The analyses considered and accounted for the additional OMRR&R in each year of occurrence, and then computed a present worth value of the future OMRR&R costs. The present worth value was then annualized using a Federal Interest Rate of 5.375% and a 50 year period of analysis. Following are the major assumptions used in determining the additional OMRR&R costs that the local sponsors would incur with each alternative.

- New Relief Wells: Each new well is assumed to be maintained every 4 years at an estimated cost of \$5,000 per well. New wells are assumed to be replaced after 40 years; the replacement cost includes 10% E&D and 7% S&A. The sponsor would continue to incur costs for any existing relief wells but these costs are ongoing for the existing project and are not included in the analysis of the proposed project.
- New Buried Collector System: It was assumed that a new buried collector pipe would be flushed every 25 years, and that this would require a 2 man crew and approximately 3 days, plus equipment cost.
- New Pump Plant: It was assumed that new pumps will be serviced every 10 years.
- The levee units in the Kansas Citys project are well-maintained and the sponsors comply with annual inspection requirements. It is assumed that the sponsor's current OMRR&R costs for the existing project will continue.

Evaluation and Comparison of Final Array of Alternatives

Exhibit #10 provides comparison of the various alternatives from an economic perspective.

Exhibit #11, *Principles and Guidelines (P&G) System of Accounts – Evaluation Table* addresses all four major planning evaluation accounts (NED, EQ, OSE, RED) and provides additional information regarding the evaluation process for the recommendations which require new authorization (note that certain recommendations do not require new authorization as described in the Work Categorization section of this report).

Other Economic Benefits Not Quantified

The Corps of Engineers benefit evaluation process involves analysis of the economic losses to the subject study area from flooding, and the potential gains to the study area from the successful

prevention of flooding. Some of the economic impacts that are likely to occur in the “without project” condition 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 should receive consideration in the overall decision-making process.

In the Kansas Citys study area, some major production facilities are either a sole producer of a specific product or are one of just a very few in the nation that produces that product. General Motors Corporation, National Starch, Proctor and Gamble are prime examples. Loss of production capability in these instances could be an economic loss to the nation unless consumers were able to find a similar product and made the choice to purchase the substitute product. However, these potential NED losses were not quantified for purposes of this study.

Selection of the Recommended Alternatives

When evaluating the Argentine alternative levee raises, incremental economic analysis strongly affects the optimization and selection process. Levee raise costs increase as the levee height increases. These cost increases arise from the various components of cost that increase along with levee height: additional material and construction requirements, additional real estate costs, and a longer construction period (Interest During Construction). Other life cycle costs (such as operation and maintenance costs over the period of analysis) are included in the analysis. The optimal raise is the one with the greatest net economic benefits (essentially damages reduced less project economic costs) as computed for an array of flood events. As the evaluation progressed, the nom500+3 raise eventually was shown to be an efficient raise with the highest net benefits, with limited land disturbance, limited relocations, limited environmental impacts, and limited HTRW material disturbance.

The remaining alternatives (after screening) for the other five Areas of Interest (AOI) were carried through into detailed economic analysis. These remaining alternatives were evaluated using NED principles. The NED alternative was selected as the recommended alternative in all cases.

Description Of The Recommended Plan

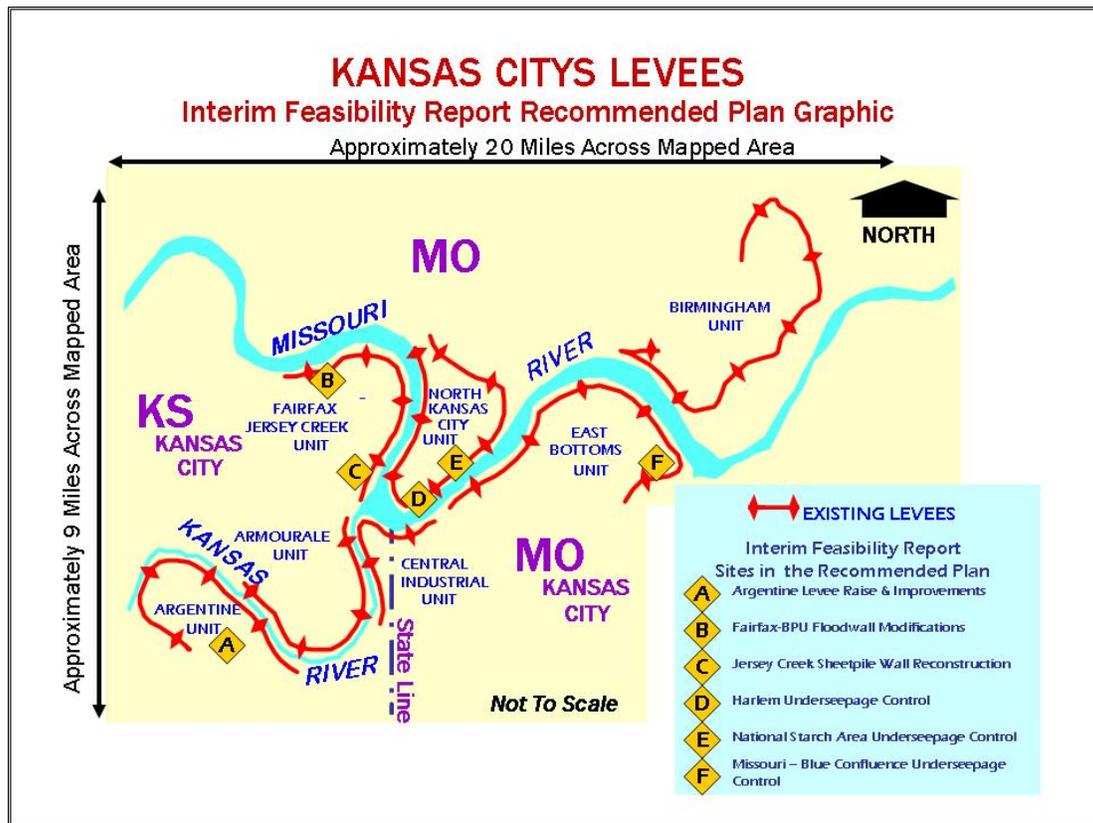
The “NED Plan” is the Recommended Plan

The NED Plan consists of a combination of remedial measures and improvements for six sites as summarized in the descriptions below. The NED plan essentially grows from an assembly of the recommended alternatives from each of the four levee units (six AOI or sites) addressed in the Interim Feasibility Report. If examined on a unit by unit basis, each unit's recommendations are also the NED measures for the unit. The NED Plan assembles these six individual recommendations into one complete set of recommendations (one plan). The economic analysis

of the NED plan shows that it is economically viable and furthers national economic development in manner consistent with Corps of Engineers economic regulations and Administration economic polices.

Figure 7 below provides a simplified graphic of the Kansas City levees system and the location of the sites within the Recommended Plan for this Interim Feasibility Report.

Figure 7: Location of Sites within the Interim Feasibility Report Recommended Plan



Recommended Plan Costs and Cost Apportionment

The Recommended Plan implementation costs are categorized and apportioned in the tables on the next page. Standard code of accounts and standard cost share amounts for Flood Damage Reduction apply.

Table 14: Cost Sharing Allocation – Overall Recommended Plan

Kansas Citys Levees Flood Damage Reduction – OVERALL RECOMMENDED PLAN COST SHARING TABLE (October 2005 Price Level)			
Item	Federal Cost	Non-Fed Cost	Total Cost
PED (Percent)	\$ 4,713,000 (65)	\$2,538,000 (35)	\$ 7,251,000
LERR&D	\$ 2,266,000	\$ 1,220,000	\$ 3,486,000
Flood Damage Reduction	<u>42,128,000</u>	<u>22,685,000</u>	<u>64,813,000</u>
Subtotal (Percent)	\$ 44,394,000 (65)	\$ 23,905,000 (35)	\$ 68,299,000
Total Recommended Plan (Percent)	<u>\$ 49,107,000</u> (65)	<u>\$ 26,443,000</u> (35)	<u>\$ 75,550,000</u>

Notes: 1) The totals in this table are rounded. Any discrepancies in totals are due to rounding.
2) The LERRD amounts shown are initially funded by sponsors and then are subject to the LERRD crediting process towards total project cost share requirement.

Table 15: Cost Summary By Levee Unit -- Recommended Plan

All cost shown in \$1,000s

Levee Unit & Site	Total By Unit	Federal (65%)	Sponsor (35%)	PED	LERRD	FDR Component
OCT 2005 PRICE LEVEL ESTIMATE						
Argentine (nom500+3) raise & pump sta	52,873	34,367	18,506	3,418	2,967	46,488
Fairfax/BPU floodwall modification	7,879	5,121	2,758	1,510	298	6,071
East Bottoms pressure relief wells	1,644	1,069	575	460	10	1,174
NKC-Harlem buried collector	1,549	1,007	542	359	86	1,104
NKC National Starch area wells & pump sta	6,621	4,304	2,317	1,008	125	5,488
Fairfax-Jersey Creek sheetpile wall reconstruct	4,984	3,240	1,744	496	-	4,488
Totals	75,550	49,107	26,443	7,251	3,486	64,813
FULLY FUNDED ESTIMATE						
Argentine (nom500+3) raise & pump sta	60,036	39,023	21,013	3,900	3,305	52,831
Fairfax/BPU floodwall modification	8,679	5,641	3,038	1,670	321	6,688
East Bottoms pressure relief wells	1,753	1,139	614	492	11	1,250
NKC-Harlem buried collector	1,667	1,084	583	384	92	1,191
NKC National Starch area wells & pump sta	7,228	4,698	2,530	1,080	132	6,016
Fairfax-Jersey Creek sheetpile wall reconstruct	5,346	3,475	1,871	532	-	4,814
Totals	84,709	55,060	29,649	8,058	3,861	72,790

Notes: Amounts include the estimated contingencies for each site
Totals in this table are rounded. Any discrepancies in totals are due to rounding.

Recommended Plan -- Work Components (Organized by AOI)

Major components of the Recommended Plan are discussed in the following paragraphs.

Argentine Levee Unit -- Recommendations

Measures addressing the reduction of geotechnical and structural risk are analyzed and packaged together with the levee raise measure so that the overtopping, geotechnical, and structural risks are addressed in a comprehensive manner.

Argentine Levee Raise -- Recommendations

The nom500+3 ft levee raise is recommended. This nom500+3 ft raise increases the height of the Argentine levee by roughly 5 feet on average. The exact amount of raise is determined through an analysis of the water surface profile and the construction requirements for particular sections along the existing line of protection. The levee unit raise is accomplished through a series of earthen levee and berm raises, reinforced-concrete floodwall raises, concrete and sheetpile I-wall raises, stoplog gap raises, and other necessary line of protection modifications as generally described below.

Refer to Plates 1 through 5 for concept drawings of the Argentine nom500 + 3 ft raise (Plates 11 through 15 address the Argentine nom500+0 ft alternative; and Plates 16 through 20 address the Argentine nom500+5 ft alternative).

Table 16: Argentine nom500+3 ft levee raise -- Line of Protection Modifications

Nominal 500 + 3 ft Approximate Levee Stations (feet)	Type of Features Used in Levee Raise
-2+00 to 28+30	Construct I-wall on levee
28+30 to 29+70	Remove & Replace Stoplog
29+70 to 61+00	Landside levee raise with berm
59+50 to 61+30	De-load RBC w/ Short Section of T-wall (Turner pump station)
61+00 to 118+00	Construct I-wall on Top of Levee
118+00 to 245+00	Landside levee raise with berm
245+00 to 251+65	Construct I-wall on Top of Levee
251+65 to 253+92	Replace floodwall w/ levee (after Argentine main pump station work)
257+46 to 259+26	De-load RBC w/ Short Section of T-wall (Santa Fe pump station)
253+92 to 276+70	Construct I-wall with rock-fill toe
272+51 to 274+31	De-load RBC w/ Short Section of T-wall (Strong Ave pump station)
276+70 to 289+09	Remove & Replace Floodwall
287+91 to 289+00	Remove and Replace Stoplog Gap
289+09 to 289+40	Construct I-wall on top of levee

Table Note: RBC = Reinforced Box Culvert (pump station outlet culvert)

Argentine Utilities Crossing the Levee -- Recommendations

Pressure pipelines currently passing under the Argentine Levee Unit are relocated over the raised levee. A total of fourteen utility crossings will be relocated over the levee. Two major drain lines that currently pass under the levee will remain in place due to the prohibitive relocation cost and due to the fact that each line has a sluice gate that can be closed in the event of a flood. One is a 30-inch sanitary sewer force main buried 35 feet below the top of levee which continues under the Kansas River, and the other line is a 30-inch sanitary sewer force main buried to a depth of 40 feet below the top of levee.

Argentine Pump Stations -- Recommendations:

All of the recommended pump station modifications derive from strength and flotation (uplift) issues which affect levee reliability or are related to the adaptation of the existing pump stations to a higher (raised) levee. None of the modifications are proposed for the purpose of curing any existing interior drainage deficiencies.

Analysis of the three major pump stations (Turner, Argentine main, and Strong Ave.) located along the line of protection resulted in reliability improvement recommendations for modification or replacement as part of the recommended Federal plan. These plants are owned and operated by the Kaw Valley Drainage District and the City of Kansas City, Kansas.

Analysis shows that when floodwater is high on the levee, the risk of flotation or strength failures are significant. Hydraulic uplift forces are significant at the Turner and Argentine main stations. This can quickly lead to cracks and failure of the foundation and walls. This will in turn trigger movement of soils from the levee embankment or allow general piping of materials in voids and the formation of sinkholes. This scenario of massive structural and soil movement cannot be predictably fought during extreme flooding and will likely result in the catastrophic failure of the adjacent levee or floodwall features. Strength evaluations also indicate that significant risks result from flood loading with water near the top of existing levee for the Strong Avenue pump station. The Argentine main station is also at risk for strength failure as it is built similar in some respects to the Strong Ave station. The Strong and Argentine main pump stations predate Federal involvement and are approaching 100 years old.

The analysis shows that as the levee is raised, some modifications are also required for two private pump stations with no formal easements (Con Agra station and Bulk Mail station). These modifications are needed for levee reliability due to the proximity of the pump stations and associated pipe crossings, and in order for the stations to effectively pump water over the raised levee. These modifications are the responsibility of the private pump station owners and are not part of the recommended Federal project.

Shown in the table on the next page is a summary of the recommended Argentine Unit pump station modifications. Detailed descriptions of the recommended modifications follow the table.

Table 17: Recommendations for the Argentine Unit Pump Stations

Station Name	Ownership	Major Required Modifications	Federal Project Categorization
Turner	Kaw Valley Drainage District	New Relief wells & Larger pumps	Federal Project Construction
Argentine Main	Kaw Valley Drainage District	Demo and Replace	Federal Project Construction
Strong Ave	Kansas City Kansas/UG	Major structural reinforcements	Federal Project Construction
Bulk Mail	Private (US Postal Service)	New Relief wells Larger discharge	Sta Owner responsible for modification
ConAgra	Private (ConAgra)	Larger discharge	Sta Owner responsible for modification
Santa Fe	Private (Railroad)	None	No work required

- Relief Wells and Minor Modifications for the Turner Pump Station:** The mechanical and structural evaluation indicates that Turner Pump Station does not meet flotation criteria. The use of relief wells to draw down the hydraulic grade line is the most effective alternative to allow the pump station to meet flotation criteria. Approximately seven new relief wells will be positioned around the perimeter of the pump station and will discharge (free flowing) into a collector pipe. The collector pipe will transfer the water to the pump station. This water will be evacuated from the pump station with the interior drainage. One existing pump will need to be replaced by a higher capacity pump to offset the increased river head associated with the raise, and the top of the discharge chamber will need to be raised to coincide with the top of the raised levee. Raising the discharge chamber will require replacement of the sluice gate stem, installation of a new motor actuated gate hoist, and installation of new stem guides. The Turner Pump Station was designed and constructed as part of the initial Federal involvement in the Argentine Unit (late 1940's to 1950's).
- Replacement of the Argentine (main) Pump Station and Associated Inlet and Outlet Structures:** This pump station does not meet general strength criteria and is suspect for flotation problems. The Argentine Main Pump Station was constructed well prior to the initial Federal involvement in the Argentine Unit. Record drawings are not available. The uncertainty associated with the structural details of this pump station, the results of the flotation analysis, and the age of the pump station circa 1910 resulted in the conclusion that this pump station and inlet and outlet culverts need replacement with a reliable structure. The existing maintenance building and existing pump station will undergo demolition. A floodwall protecting the Argentine main pump station is located from Sta 251+65 to Sta 253+92 (about 225 feet in length). This floodwall will be modified or replaced to allow construction of a section of raised levee across the current pump station location. The construction of the new pump station and inlets/outlets requires extensive excavation and shoring. New inlet and outlet pipes will be constructed and tied-in using construction sequencing that allows the station drainage function to remain operational. Remaining abandoned piping and substructures will be grouted full. The new pump station design will be fully detailed during PED. Existing pump(s) will need to be replaced by higher capacity

pump(s) to offset the increased river head associated with the levee raise. Probable new pump options include turbine type or totally enclosed fan-cooled type.

- **Strengthening Strong Avenue Pump Station:** The Strong Avenue Pump Station was constructed well prior to the initial Federal involvement in the project. The flotation and strength evaluation performed for the Strong Avenue Pump Station shows that the current pump station does not meet flotation and strength criteria under flood conditions. Drawings of the substructure were discovered and used in the strength analysis. The outlet culvert consists of an older portion (approximately 100 feet) and a newer portion (approximately 30 feet) and a new gatewell. The newer portion of the outlet culvert and the gatewell meet criteria for the existing conditions, while the older portion of the culvert does not meet strength criteria. A steel pilaster and braced strut design is proposed for strengthening the pump station foundation walls, along with a thickened reinforced slab to address floor strength and station uplift concerns. The most feasible alternative for strengthening of the older culvert is to line the culvert with a new stronger pipe. Existing pump(s) will need to be replaced by a higher capacity pump to offset the increased river head associated with the levee raise.

East Bottoms Levee Unit – Improve Underseepage Control at the Confluence of the Missouri and Blue Rivers -- Recommendations

The Recommended Plan provides for controlling underseepage and reducing uplift at the interior toe of the existing levee by installing a series of approximately seventeen stainless steel pressure relief wells located along thin blanket zones in the East Bottoms Unit from Station 403+00 to Station 420+00. A header system will serve to transfer seep-water from the wells to the proximity of the Hawthorne pump plant. The header system is constructed using approximately 2100 linear feet of 30-inch diameter Reinforced Concrete Pipe (RCP). The header system is tied into manholes which house the relief wells and collect well outflow.

The proposed underseepage control site is somewhat complicated by the RCRA classification of an adjacent industrial property. Soils and groundwater information were obtained and a more detailed site analysis was conducted in the latter stages of the study. This additional field information confirms that underseepage measures can be placed within the required area with no adverse effects on the contaminated areas, groundwater hydrology nor the contamination containment measures currently employed at the site. Refer to Plate 6 for concept drawing of the East Bottoms recommended alternative.

North Kansas City Levee Unit -- Recommendations

Harlem Area Underseepage Control Improvement Recommendations: The Recommended Plan provides for a new buried collector system to control underseepage and reduce uplift at the interior toe of the existing levee in the Harlem area from approximately sta 212+00 to 238+00. The buried collector is constructed using approximately 18 inch diameter perforated pipe placed within an excavated trench which then empties collected seep water into concrete vaults. The sponsors will provide temporary pumping arrangements during flood conditions. The sponsor will secure, set-up, and operate the temporary pumps when required by prevailing conditions during the flood. During flood conditions, the pump inlet hoses are placed in the concrete vaults

and the discharge hoses will cross the top of levee and discharge on the river side during flood conditions. Refer to Plate 7 for concept drawing of the Harlem area recommended alternative.

National Starch Area Underseepage Control Improvement Recommendations: The Recommended Plan provides for controlling underseepage and reducing uplift at the interior toe of the existing levee by installing a series of approximately twenty stainless steel pressure relief wells located along thin blanket zones in the North Kansas City Unit from approximately station 259+00 to station 271+00. Adequate pressure control at this site requires use of wells that discharge below existing grade and removal of seep-water by actively pumping and discharging below grade into header piping. This header piping then discharges into a cast-in-place concrete pump pit which collects the seep water and then allows other pumps to discharge the seep water to the river in a controlled manner. The pump pit is located at approximate levee station 260+00. The planned use of totally enclosed fan cooled (TEFC) motors and outdoor electrical panel eliminates the need for a pump station superstructure. A small gantry crane is provided for pump and motor maintenance. The header system is constructed using approximately 2,000 linear feet of 30-inch diameter Reinforced Concrete Pipe (RCP). The header system is tied into manholes which house the relief wells and collect well outflow. Refer to Plate 8 for concept drawing of the National Starch recommended alternative.

Fairfax Jersey Creek Levee Unit -- Recommendations

Fairfax-Jersey Creek BPU Floodwall Modification Recommendation The Recommended Plan for the Fairfax-BPU Floodwall (Sta 287+86 to Sta 302+32) provides for strengthening of the floodwall pile foundation and butressing the main stem wall. The proposed work includes extending the pile cap and adding an additional fourth row of auger-cast piles and reinforced concrete buttresses along the entire floodwall. The feasibility-level pile design uses approximately 50-ft deep, 24" diameter auger cast piles at seven foot on center. The PED phase will refine the exact dimensions and placement of the additional piles and buttresses. Refer to Plate 9 for concept drawing of the Fairfax-Jersey Creek BPU floodwall recommended alternative.

Fairfax-Jersey Creek Sheetpile Wall: Landside Open Cell Sheet Pile Wall Recommendation. This sheetpile retaining wall structure provides stability of the foreshore bank of the existing levee and I-wall. Reconstruction will use a driven open-cell sheetpile system constructed landside of the existing sheetpile wall using floating plant (barge with crane) positioned in the Missouri River. The sheetpile wall begins upstream of the Jersey Creek outlet at approximate Sta 29+98 and continues downstream to Sta 15+70 except that a section along the wharf area (sta 23+30 to sta 17+70) is not reconstructed under the Federal project (this wharf section is to be accomplished under a local initiative). Refer to Plate 10 for concept drawing of the Fairfax-Jersey Creek Sheetpile Wall recommended alternative.

Remaining Areas of Interest to be Addressed in the Final Report

Listed below are the remaining specific areas of interest within the overall study that are planned for further analysis and reporting under a Final Feasibility Report. Studies on these sites are in the initial stage. Sponsors strongly support completing studies on these areas. The draft Final Feasibility Report is planned for release for public and agency review around late 2008 subject to continued Federal funding.

- Armourdale (Kansas River) levee unit and CID (Kansas and Missouri River segments) levee unit: Early analysis on overtopping risk and geotechnical/structural risk indicate the need to pursue potential reliability improvements for these units. This early analysis suggests overtopping improvements similar to those recommended for the Argentine Unit. The detailed examination is likely to involve analysis of earthen levee raises, floodwall raises, pump station and drainage feature modifications, underseepage improvement measures, etc. This will require a substantial amount of feasibility level engineering analysis. These two units will comprise most of the efforts undertaken for the Final Feasibility Report.
- Fairfax/Jersey Creek Unit Downstream Tieback: This site is generally located under the Lewis & Clark (interstate) viaduct just upstream of the confluence area on the Kansas River. Sponsors have requested review of the possibility for constructing a permanent tieback improvement at the extreme lower end of the Fairfax-Jersey Creek Unit. Over past decades, road and railroad construction appear to have compromised the original project tieback measures. Sponsors now employ temporary embankments and sandbags (flood fight) measures to form a tieback during flood events. Potential tieback improvements may involve constructing a short segment of approximately 3 ft. high floodwall, permanent embankment(s) or other solutions for this area.
- Hawthorne Pump Plant Interior Analysis: The Hawthorne pump plant is sited along the Blue River tieback segment of the East Bottoms Unit. It serves to pump-out interior runoff and seep water during flood conditions. Adjacent industrial facilities are occasionally impacted by interior ponding when gravity gates are closed and the pump plant is operating. This may present an opportunity for an economically viable upgrade to the pump station pumping capacity through the prevention of localized interior flood damage.

Design and Construction Considerations

As this study deals with an existing levee system, the site constraints arising from adjacent infrastructure must be considered during design and construction. During alternatives development and refinement, the study examined design and construction considerations important to an efficient implementation of the Recommended Plan.

In particular, work alongside rivers must consider the somewhat unpredictable nature of flood hazards. Although unlikely, high water conditions may occur while construction is in progress. If the high water conditions were to occur while the line of protection is temporarily down or compromised by construction (such as when a floodwall is being removed), then serious inadvertent flooding could result. This situation is normally handled through the development of specific high-water contingency measures. Requirements for these contingency measures are included within the plans and specifications (construction contract) package. The construction package must address high-water contingencies for all sites in the Recommended Plan.

Such contingencies must aim to provide for at least “100-year level” of protection as the most basic requirement. Beyond this, an additional level of preparation should be planned to bring the protection back to the preconstruction (design) level if needed under severe flood conditions. Common site measures for water control include dewatering, construction of ring levees, and

emergency backfilling of open excavations. Sandbags and pumping can also be used to supplement the effort. It is preferable to schedule work within the levee critical zone for typically dry seasons. Excavation in the levee critical zone must be avoided during periods of ground saturation.

The project team will conduct specific utilities relocation coordination and design planning prior to levee raise construction contract award. In recent projects, this relocation work has proven very problematic if not thoroughly scheduled and coordinated. Even though sponsors (and utility owners) are responsible for most utilities relocations (for those utilities deemed without legal compensability), the Kansas City District must be consulted for approval of the relocation design and schedule. Detailed planning for utility relocations and assignment of responsibilities is fully developed by the latter stages of the PED phase. All parties (sponsor, utility owner, and Corps of Engineers) must prepare for a highly coordinated utility relocation effort as the levee raise begins.

For all sites, the project coordination team (composed primarily of sponsors, Corps of Engineers staff, and other stakeholders deemed appropriate to the work) will take the Recommended Plan and develop the design detail and contracting documents necessary for successful construction efforts. The project management plan (PMP) will address project scope, quality, schedule, communications, safety, and project team roles as the project develops. The requirements of ER 1110-2-1150 will guide the overall design effort. Highly coordinated efforts will continue as the project moves into the real estate acquisition and construction phases. The Project Cooperation Agreement (PCA) will contain specific requirements regarding responsibilities, funding and coordination of construction activities.

Additional descriptions of important site-specific design and construction requirements are listed in Exhibit #12: *Additional Design and Construction Considerations for the Recommended Plan*.

Cost Estimate Development

The cost estimate supporting the NED plan was prepared using the Corps of Engineers MCACES estimating program. The work breakdown structure (CWBS) was carried to at least the sub-feature level of detail. The unit costs for the construction features were computed by estimating the equipment, labor, material and production rates appropriate to the project. These estimates were developed with a specific price level date, were then escalated for inflation (fully funded) through project completion. In most cases, this was accomplished by escalation to the midpoint of construction.

The product development team included a highly experienced civil works cost engineer. The cost engineer developed the PED, Construction, and LERRD estimates through frequent and continuing team meetings and individual discussions with the appropriate specialists and engineers. The cost estimating procedures and methodology underwent a multi-year Independent Technical Review in accordance with Corps policies.

Quantities associated with the construction of each major feature were calculated or reviewed by the respective disciplines. Meetings and discussions were held by the team to determine and apply the appropriate amount of contingency to each line item in the cost estimate.

Contingencies were based on experience, judgment and cost estimating guidance. Specific line item contingencies are recorded and described in the MCACES estimate. The goal of project contingency development was to identify the uncertainty associated with an item of work, forecast the risk/cost relationship, and assign a contingency value that limits cost risk to an acceptable degree of confidence. Consideration was given to the amount of field information currently available in the feasibility phase. This consideration significantly affected the selected contingencies. Contingencies were added at the lowest MCACES level where the risks or uncertainties were identified. In the Recommended Plan, normal design variances are expected and normal feasibility contingency values were typically used except where otherwise described in the cost estimate narratives within the Cost Engineering chapter of the Engineering Appendix and as summarized below. During the PED and construction phases it is important that the following potential areas of cost uncertainty are recognized and monitored.

- The Argentine Unit Strong Avenue pump station strengthening measures are estimated with substantial contingency as the recommended strengthening and pipe jacking operations contain some inherent uncertainty.
- The Argentine Unit I-wall construction process was carefully considered but remains somewhat difficult to accomplish. The design phase should prevent any inadvertent complexities. It may prove beneficial to run a test section of I-wall construction in the field during early construction, and then adjust the process as needed for best efficiencies. Additional contingency was included.
- The Argentine Unit levee raise underseepage berm cost may be affected by Underground Storage Tank removal costs between levee Sta 165+00 to 168+00. The final number and size of the tanks are not completely known. Further testing and determinations are needed in PED. A higher contingency is provided for this item.
- The Argentine Unit utilities relocations are categorized as to the preliminary compensability determinations. Only one utility line has shown legal sufficiency for compensability at this time. Should this number increase in the future due to additional evidence of legal crossing rights, then project costs for utility relocation will increase accordingly.
- The Argentine Unit stoplog design and construction should include segmentation of the required work so that railroad operations may continue. This requirement could increase project costs but substantial contingencies for this item are included in the project estimate.
- Fairfax BPU floodwall pile design is subject to important site constraints. Given the nature of the utilities within the work area, the location and design of the proposed 36-inch diameter drilled piers supporting the foundation bridging (over utilities) must be monitored closely. Higher contingencies are included for this work area.

Cost reports for each site in the Recommended Plan are included in the Engineering Appendix Cost Engineering chapter. The MCACES reports include: title page, cost estimate narrative notes for each project site, contingency determinations, table of contents, and owner and indirect cost summary sheets (Oct 2005 Price Level). The cost estimate narrative notes provides a detailed review of the various features and categories of cost, assumptions, contingencies, and areas of cost sensitivity. Also provided in the Cost Engineering chapter are Total Project Cost Summary Sheets that provide a very useful summary of the fully funded cost estimate for each project site.

Cost Estimate Code of Accounts Information

The major cost estimating categories for the Recommended Plan are summarized by Corps code of accounts in the paragraphs below:

01- Lands & Damages: For all units in the Recommended Plan, this LERRD category includes the costs for Non-Federal sponsor acquisition of lands in fee title, permanent right-of-way, temporary right-of-way; and associated and incidental costs for legal work, title work, tract appraisals, and land surveys; these acquisition costs recognize PL 91-646 assistance to business owners with six out-buildings impacted by the Argentine Unit levee raise. For the Argentine Unit, this category also includes the fair market value of the sponsor maintenance facility requiring demolition per the Recommended Plan.

02 - Relocations: For all units in the Recommended Plan, this category includes utility relocations. No other types of public facility relocations were identified. Utility relocations for the Argentine Unit includes relocations of utility crossings and relocations of utilities within the critical levee zone affected by increased uplift. This category is further divided into: a) public utility relocation costs which are deemed compensable and are included within project LERRD, and b) those utility relocations without proven real estate rights that are the responsibility of the utility owners (relocation of non-compensable utilities are an associated cost for economic analysis but not a cost-shared project cost).

06 - Fish & Wildlife Facilities: An allowance was included within the Argentine Unit construction costs for mitigation of anticipated impacts to the environment from borrow area development, overall project construction (both identified and anticipated), and associated mitigation contingencies. A conceptual mitigation plan is included in the EIS which addresses currently identified mitigation requirements.

11 - Levees & Floodwalls: This cost category consists of many major construction components across all units in the Recommended Plan. These components typically include: relief wells (underseepage control), borrow site, levee raise (including levee cut and raise, stability and underseepage berms), drainage system modifications, floodwalls, I-walls, and stoplog gaps (closure structures).

Relief wells are used in a number of sites (Argentine, North Kansas City, and East Bottoms Units). Costs are typically based on 10-inch diameter stainless steel wells. The estimated costs reflect local experience and standard cost factors.

A borrow site is designated for the Argentine levee raise. Argentine is the only site in the Recommended Plan that requires borrow material. Borrow area costs include the preparation of the borrow site (including clearing & grubbing) and the final grading of the borrow site when completed. The borrow area covers roughly the same area for all levee raise alternatives, but is dug deeper for higher raise alternatives. The borrow area is located upstream of the Argentine Unit, between Holiday drive and the Kansas River.

Quantities for the levee surface preparation were based on the removal of the existing aggregate surfacing on top of the levee, and the stripping of grass and topsoil from landside slope of the existing levee (all significant work is scheduled for the top of levee or the landward slope).

Quantities for the earthen levee raise were calculated using In-Roads CAD software and then manually adjusted where necessary for special conditions. Haul distances were calculated based on the borrow site location and the quantities required. The borrow material is excavated, loaded, and hauled using on-highway dump trucks over the existing roadways as identified in the haul route plan. Cost includes an amount for road repair and street sweeping as the borrow operations proceed. A cost is also included for new top of levee (access path) aggregate surfacing, and the final seeding and mulching operations.

Drainage system modifications include costs for box culvert modifications and associated work on the line of protection, constructing new gatewell structures, abandoning pipes, and the raising of height of existing gatewells to adjust for raised levee elevations and other minor drainage work.

Floodwall costs include excavation and demolition of an existing floodwall, backfilling to the new floodwall foundation elevation, the provision and installation of pipe piles, provision and installation of sheetpile cutoff wall, and the construction of new reinforced concrete floodwalls. The floodwall item also includes the necessary reinforcing/strengthening modifications of the Fairfax-BPU floodwall. Floodwall heights vary by site.

I-walls are used in constricted stretches along the Argentine Unit raise. Construction cost includes driving a line of sheetpile along the riverside crest of the levee and placing the concrete cap over the exposed sheetpile and any associated work. These I-walls are limited to an exposed height of not more than 5 ½ ft above grade in the Recommended Plan.

Stoplog gap costs include the excavation and demolition of the existing stoplog gaps. After demolition of the existing structure, the site is backfilled to the new base elevation. H-piles are driven for load support. A sheetpile cutoff wall is constructed. New abutment walls are built along with a new sill. The concrete sill/foundation/walls are constructed in phases to accommodate railroad traffic. Standard stop-logs are used. Remaining backfill is placed and the railroad lines replaced.

13 - Pump station requirements vary widely by individual site and are described in detail in the Recommended Plan for the Argentine levee raise and the North Kansas City – National Starch site.

30 - A Preconstruction Engineering and Design (PED) phase cost estimate was prepared addressing labor costs for design and any necessary testing costs. The design phase requirements were developed through a team analysis of the Recommended Plan and the supporting design elements. About a 2 to 3 year design period is expected. Design phase duration varies by site depending on the difficulties and complexities of each individual design requirement. Design labor rates are based on local Corps district rates adjusted for inflation.

31 - A construction management cost estimate was developed for the Federal construction portion of the Recommended Plan based on local experience in recent and ongoing levee projects and related Corps guidance for the construction management function.

Other Cost Estimate Information

- Being a Federal project no state sales tax was included in the estimated construction costs.
- The source for the labor rates used in the estimate is the September 2004 Department of Labor Wage rates for Wyandotte County, Kansas or Jackson/Clay County, Missouri as applicable. A minor cost adjustment factor is added to bring the labor rates to the appropriate price level date.
- Corps-approved 2004 equipment rates were used. An adjustment factor is added to bring the rates to the appropriate price level date.
- Escalation factors used were derived from the Civil Works Construction Cost Index System (CWCCIS) EM1110-2-1304.

Summary Cost Estimate Table

Summary Cost estimate table for the Recommended Plan appears below.

**Table 18: Total Project Costs By Category – Overall Recommended Plan
October 2005 price level (\$1,000s)**

Category of Cost	Argentine (nom500+3 raise & pump stations)	Fairfax/BPU floodwall modification	East Bottoms pressure relief wells	NKC- Harlem buried collector	NKC- National Starch area wells & pump sta	Fairfax-Jersey Creek Sheetpile Wall Reconstruction	All Sites in Plan
Lands & Damages	1,654	244	9	75	105	0	2,087
Relocations	836	0	0	0	0	0	836
Fish & Wildlife Mitigation	500	0	0	0	0	0	500
Levees & Floodwalls	24,932	4,374	894	841	1,204	3,418	35,663
Pumping Plants	9,783	0	0	0	2,973	0	12,756
PED	2,789	1,186	377	294	825	404	5,875
Construction Management	2,579	326	63	59	296	239	3,562
Contingencies	9,800 (23%)	1,748 (29%)	301 (22%)	280 (22%)	1,218 (23%)	922 (23%)	14,269 (23%)
Total Cost	52,873	7,879	1,644	1,549	6,621	4,984	75,550

Note: Values in this table are rounded. Any discrepancies are due to rounding.

Environmental and Cultural Aspects of the Recommended Plan

Cultural Resources

The cultural resource evaluation found no archaeological sites or historic structures listed on or eligible for listing on the National Register of Historic Places (NRHP) within the project area. The project area, heavily disturbed by past levee and urban related construction, was found unlikely to contain previously unidentified archaeological sites eligible for inclusion in the NRHP. Two sites of cultural concern lie near the study area, a site of two human burials near the proposed borrow area and two historic structures near the Fairfax/Jersey Creek Unit. Construction will avoid these sites. Cultural resource findings were coordinated with both the Kansas and Missouri State Historic Preservation Officers who concurred with Corps of Engineers recommendations for no further investigations unless an unanticipated discovery is encountered during construction.

Secondary and Cumulative Impacts

Potential cumulative impacts relating to past, present, and projects within the foreseeable future were evaluated along with the preferred plan to determine the level, if any, of impacts upon the physical and natural environment along the Kansas and Missouri Rivers. The Recommended Plan involves a combination of levee raises, sheetpile wall reconstruction, and the installation of buried collectors, relief wells, pump station, and appurtenances that lies primarily within the footprint of the existing levee system. As a result of project implementation, impacts to the existing river systems are relatively minor and not considered significant. Compared to past activities and current operations within these reaches of the rivers, the additional minor impacts created by the increased levels of protection do not create significant additional or cumulative impacts to the environment.

Induced Damages

Minor induced damages from the Argentine levee unit raise can occur under certain rare and somewhat extraordinary conditions. If one of these rare flood events occurs, then minor induced damages could possibly occur in the following areas:

- areas downstream of the Argentine Unit (areas within the existing Armourdale and CID Units),
- in a small unprotected area opposite the Armourdale Unit and located below the bluff line,
- and unprotected areas upstream of the Argentine Unit situated downstream (east of) the I-435 river crossing.

The flood events for which these induced damages can be calculated to possibly occur are more rare than the 250 year (or 0.4%) event and approaching the 300 year (0.33%) event. In these situations the induced flooding is very small (about 6 inches deep in most cases). The estimated annual induced damages are \$207,000 per year. Given this, the induced damages amount on each structure is essentially inconsequential compared to the existing damages from normal river flooding. The predominant threat of flooding in these areas remains essentially the same as the without-raise conditions. While the events that may trigger these induced damages are rare, in accordance with economic policy the costs associated with induced damages are recognized in the study economics. Exhibit #13 provides details of the technical derivation of potential induced flooding.

Environmental Justice

The Executive Order on Environmental Justice (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 culture and dietary differences are taken into consideration to ensure that adequate risk is evaluated (USEPA, 2003). 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. The focus of Executive Order 12898 provides for the protection of both minority and low-income groups.

The results of the Environmental Justice evaluation show that a significant minority population (>25%) is present within the Argentine, Armourdale, and CID levee units. A significant number of persons living at below the national poverty level also reside within the Argentine, Armourdale, and East Bottoms Units. There exists a minor potential for the Recommended Plan to have limited impacts on the Armourdale and CID populations and community cohesion. Under some very rare flood events, the Argentine levee raise may induce some Kansas River flood damages in the Armourdale and CID Units. No impacts were identified for populations within the Argentine and East Bottoms Units.

Implementation of the Recommended Plan results in a levee raise of the Argentine Unit prior to any raise in the Armourdale and CID Units. This phased approach where Argentine is approved and implemented prior to any work in the Armourdale and CID Units may induce flood damages on the Armourdale and CID under extremely rare flood events until such time as equal levels of protection are attained at all three levee units. These potential induced damages are considered temporary and would only occur in the event of a major flood (more rare than the nominal "250 year" event). Impacts to the Armourdale and CID populations are limited by the rarity of coincident circumstances which must occur in order to produce the induced damages. Because significant populations of low income families and cultural and racial minorities reside and work within all the Kansas River Units, there would be no significant difference between implementation of the one unit prior to another. The project would meet the intent of protection of minority and low income populations under Executive Order 12898.

Wetlands

Wetlands within the proposed project are limited in number, size, and quality. The assessment of the project area identified three small emergent wetlands (approximately 0.2 acres total area) that are potentially impacted by construction of the Recommended Plan. Other wetlands were identified near or within the protected area; however, these are not impacted by implementation of the Recommended Plan. Of the three impacted wetlands, two lie within the construction footprint of the recommended Argentine levee raise and one wetland lies within the proposed borrow area for the Argentine levee raise. These three wetlands are eliminated through construction of the proposed project. Although of concern by the USFWS, these wetlands are small linear wetlands associated with fence line depressions or drainage depressions at the toe of the existing levee units. The wetlands within the Argentine Unit (0.027 acres combined) are of poor quality, dominated by cattails, curly dock and reed canary grass with no open water community. The wetland within the borrow area is a 0.17 acre farmed wetland of similar quality providing limited wildlife habitat.

Mitigation

After considering the environmental features of the project area, adverse impacts were identified on the three wetlands. Although these wetlands are of poor quality and limited wildlife potential, their loss through construction activities would be a net loss of wetlands to the nation and as such, are proposed for mitigation. In addition to the known impacts to wetlands, there is a potential for impacts to a limited number of trees from project area construction activities. Should unavoidable impacts occur as the result of construction activities, mature trees will be mitigated.

Mitigation is proposed by creation of wetlands with a similar location, hydrology, form, depth and function as those provided by the impacted wetlands. Creation of these mitigated wetlands will provide improvement to the quality and function of the existing wetlands within the Argentine Unit. It is proposed to mitigate emergent wetland impacts at a 1.5:1 ratio and farmed wetlands at a 1.0:1 ratio, the mitigation ratios suggested through the USFWS coordination process. Although mitigation lands are limited within the project area, mitigation will be accomplished by establishing approximately 0.21 acres of emergent wetland just landward of the Argentine levee toe where adequate water source is provided by runoff from the adjacent levee slope. Should individual mature trees be impacted during construction activities, trees will be mitigated within the project area by replacement of like species at a 2:1 ratio. Adequate mitigation funding is included within the Recommended Plan estimated costs to mitigate for the wetland loss and ancillary impacts to other resources should they occur.

Application of Environmental Operating Principles

During the feasibility study, various candidate environmental measures were reviewed in recognition of the Environmental Operating Principles. In addition, flood damage reduction engineering measures were developed in a manner which sought to preserve, improve and sustain the environment. After review of the options and consideration of the conditions in this project area, it was generally determined that the best way to comply with the EOPs for this project, would be preservation of the continuity and value of habitat along and adjacent to the Missouri River and Kansas River bankline areas within the metropolitan area. The Recommended Plan has minimal impacts on existing habitat and wetlands and serves to protect the environmental and community fabric that has developed behind the existing levee system.

It is important to note the other Corps of Engineers projects underway in the general area that have substantial environmental benefits. The Missouri River Fish and Wildlife Mitigation Program provides for a long-term major restoration of areas along the Missouri River. The Riverfront Ecosystem Restoration Section 1135 project in the Kansas City reach of the Missouri River (near river mile 365.7) provides numerous environmental benefits along levee and floodwall areas and is a part of a larger effort to restore habitat and increase recreational opportunities along the Kansas City Missouri riverfront area. The Blue River project in the eastern sections of Kansas City and Jackson County also provides for a number of important environmental benefits in an urban setting. The benefits from all these other projects include: a) improvement of aquatic habitat by measures to improve water quality, bottom diversity, aquatic species spawning and rearing habitat; b) wetland restoration and natural vegetation development to improve habitat function and diversity; and c) improving the hydraulic connection and habitat continuity between riverine habitat areas, tributaries, and the Missouri River.

Environmental Conclusions

Based on determinations within the Environmental Impact Statement, environmental impacts of the Recommended Plan are limited to three minor wetlands within the project area. However, mitigation of these impacted wetlands would adequately replace the existing wetland community and result in no significant impacts. Other environmental impacts to the project area are considered minor or not significant with many impacts temporary in nature during construction activities. Cultural resource assessment of the project area showed no significant archaeological sites or historic structures impacted by the Recommended Plan; thereby resulting in no significant impacts. However, if significant archaeological or cultural materials are discovered as the project progresses, then appropriated measures for coordination, documentation, and preservation, if needed, would be undertaken. No significant long term socio-economic impacts were identified for the populations within the project areas. Temporary impacts associated with construction activities would occur but are considered not significant. Based on the environmental analysis, implementation of the Recommended Plan would result in no significant impacts to the environment and as such, a Record of Decision should be prepared on the project.

Measures Taken within the Recommended Plan for Contaminated Areas

Given the industrial and commercial nature of the study area, the presence of contamination was anticipated, investigated, and addressed throughout the planning process. The discussion below explains the manner in which contaminated areas are addressed within the Recommended Plan. The Recommended Plan comprehensively addresses known contamination in two of the levee units (Argentine and East Bottoms). There is no evidence of contamination on any of the properties adjacent to recommended work sites for the two other units (Fairfax/Jersey Creek and North Kansas City).

Some additional investigations are planned during PED phase for relatively minor Argentine Unit properties with the potential for contamination. Testing access to some of these minor sites was not made available by the land owners, and additional real estate access negotiations may be needed during PED. If tests on these sites indicate the presence of regulated CERCLA material, then the sponsor is aware that if the site cannot be avoided, then both clean-up and the costs for any clean-up is the sponsor's responsibility.

Argentine Levee Raise – Contaminated Areas Considerations

The HTRW Appendix contains detailed information on the Argentine sites listed below. It should be noted that the HTRW Appendix addresses potential contamination impacts from the perspective of the alternative(s) with the highest probability of impact to identified contaminated sites (i.e. the most extreme case). The selection of the recommended levee raise eliminated many potential impacts to the contaminated areas, as the footprint of the Recommended Plan in most instances is smaller than the most extreme case.

- **Approximately Sta 91+00 to Sta 118+00:** RCRA contamination and remediation areas along the landward toe of the levee in and around Sta 100+00 was the focus of avoidance measure planning as the Argentine alternatives were refined. In the Recommended Plan, an I-wall is used to raise the existing levee section adjacent to the contaminated area. The I-wall is

located on top of the levee with sheetpile supports driven inside the levee. This approach avoids the area of contamination. Construction activities will be planned to prevent disturbance of the contamination. Access roads and work zones are planned for non-contaminated areas.

- **Approximately Sta 80+00 to Sta 105+00 foreshore area:** The foreshore area just north of the levee (opposite Sta 100+00 area) was originally considered as a potential borrow area, because of its close proximity. During the site evaluation process, it was determined that area should be avoided and other borrow sources be investigated. The reasons for this recommendation are 1) extensive soil testing would be required because the foreshore property is associated with a RCRA permitted facility currently undergoing soil and groundwater remediation 2) there are two SWMUs which have been identified in this area and 3) there is the potential for borrow area activities to have an adverse impact on the ongoing groundwater cleanup.
- **Approximately Sta 200+00 to Sta 225+00:** Property along Sta 200+00 to 225+00 has a history of groundwater contamination. The area is located outside the footprint of the recommended alternative. However, the presence of the groundwater contamination resulted in the elimination of a buried collector system in favor of a earthen filter blanket. The filter blanket is a surface feature which and will not affect contaminant plumes.
- **Approximately Sta 252+00 to Sta 255+00:** The main Argentine pump station/box culvert construction near Sta 253+00 was planned in recognition of the POL contamination present in/around this area. The contaminated material in this area is considered non-CERCLA. The contaminated material will be removed and replaced (with clean fill material) during construction of the replacement pump station. An appropriate landfill will be used for disposal of the contaminated excavated material. The cost estimate contains contingency and work area factors to cover this plan.
- **Approximately Sta 220+00 to Sta 245+00:** The Recommended Plan was adjusted during final refinement to avoid one area of potential organic and metals contamination (not tested) associated with auto salvage yards along Sta 220+00 to Sta 245+00.
- **Approximately Sta 260+00 to Sta 275+00:** During early alternative planning, the area between Sta 260+00 to 275+00 was considered for buried collector or relief well installation to improve levee raise stability. As the development of alternatives proceeded, it was recommended that measures which introduce the possibility of migration of POL contamination in this area be avoided where possible. Refinements to the Recommended Plan included a rock toe for levee stability in lieu of relief wells or buried collector.
- **Various Stations:** Other relatively minor areas of either verified or potential contamination such as leaking USTs (usually associated with transportation and trucking facilities) are anticipated at various locations along the length of the levee. These sites are identified within the HTRW Appendix. These UST sites are expected to have typical POL non-CERCLA type contamination. Established Corps of Engineers construction procedures have the capability to effectively address such sites. Under the Recommended Plan, the USTs are planned for

removal, the area backfilled with clean fill, and disposal action taken for contaminated material within a suitable approved landfill. The cost estimates include cost for removal and replacement of five USTs along with appropriate contingencies.

East Bottoms Missouri Blue Confluence Site -- Contaminated Areas Considerations

During planning of the recommended relief well system (approximately Sta 405+00 to Sta 420+00 along the Blue River Tieback), contamination within an adjacent industrial property was carefully considered. The Recommended Plan satisfies underseepage concerns and avoids impacts to ongoing contamination remediation measures and any future corrective actions. The location of the proposed relief wells is a considerable distance west of known contaminant plumes. The wells are located up and side gradient from those plumes. Therefore, the proposed relief wells should have no impact on the existing groundwater plumes under transient or flowing conditions. Testing and analysis of this site was undertaken during feasibility and the results support the Recommended Plan.

Real Estate and LERRD Considerations of the Recommended Plan

Important real estate aspects of the Recommended Plan are highlighted below. See the Real Estate Appendix for additional detailed information.

Lands and Damages Costs

For all units in the Recommended Plan, this LERRD category includes the costs for Non-Federal sponsor acquisition of lands in fee title, permanent right-of-way, temporary right-of-way; and associated and incidental costs for legal work, title work, tract appraisals, and land surveys; these acquisition costs also recognize PL 91-646 assistance to business owners with six small out-buildings displaced by the Argentine Unit levee raise. This category also includes the fair market value of certain Argentine Unit sponsor real estate, the footprint of which includes a maintenance facility that undergoes demolition in the Recommended Plan in order to complete the Argentine levee raise. The main Kaw Valley Drainage District field maintenance facility is adjacent to and above the Argentine main pump plant. This maintenance facility requires demolition in conjunction with the pump plant replacement. The maintenance facility is owned by Kaw Valley Drainage District. The estimated demolition cost is categorized as a cost-shared construction cost. The preliminary feasibility estimate of fair market value of the existing maintenance facility is categorized as a LERRD (creditable) item as this is required real estate that the sponsor must provide for the proposed project.

Land acquisition anticipated for the Recommended Plan primarily consists of limited permanent and temporary easements on private and public lands. Fee acquisition is not expressly required for levee rights-of-way (r-o-w) on any of the six units. Estates to be acquired by the sponsors include permanent levee and floodwall easements necessary for the levee raise (berm placement) and floodwall work. Of the six project areas within the Recommended Plan, the Argentine levee unit, the North Kansas City Harlem and National Starch areas and the Fairfax BPU floodwall area require some minimum permanent and temporary easements. The East Bottoms and the Fairfax-Jersey Creek sheet pile wall sites require no easements as they fall within the existing sponsor r-o-w.

Temporary easements will be used for borrow, equipment storage, construction vehicles and staging areas. Temporary access road easements will vary in width along the different work areas but are generally 15 to 30 feet wide. Duration of the temporary easements will also vary for each of the individual work areas, generally running from 1 year to 2.5 years. The Recommended Plan does not require acquisition of an off-site disposal area.

PL 91-646 assistance for the Recommended Plan specifically applies to the removal and relocation costs for six private business structures (less than 10,000 sf total) that are currently located in the footprint of the raised Argentine levee or construction area. Sponsors were provided information on PL 91-646 and are aware of obligation to ensure compliance. PL 91-646 assistance is not required for the East Bottoms, the Fairfax-Jersey Creek (BPU floodwall and sheetpile wall), nor the North Kansas City (Harlem and National Starch area) sites within the Recommended Plan. No residential housing is affected in any unit.

Relocation Costs

Some public utility relocations are deemed necessary in the Recommended Plan. No other types of public facility relocations were identified. Utility relocations for the Argentine Unit includes relocations of utility crossings (crossing the raised levee) and relocations of utilities within the critical levee zone affected by increased uplift pressures. This category is further divided into: a) public utility relocation costs which are deemed compensable and are included within project LERRD, and b) those utility relocations which were deemed not compensable and are the responsibility of the utility owners (relocation of non-compensable utilities are considered an associated cost but not a project cost).

- **Relocation of Utilities Crossing the Levee.** These are active utilities needing to be removed from their current location and then relocated up and over the raised Argentine levee. This usually involves excavation within and adjacent to the levee. These costs are not included in the Recommended Plan unless the utility owner can provide evidence of a legally sufficient real estate right for crossing the levee (i.e. compensable rights). All utility lines crossing the levee were identified for relocation requirements and were considered for appropriate incorporation within the project LERRD costs or categorized as utility owner's responsibility. One line was determined through preliminary opinions of compensability to have compensable rights and is subject to LERRD credit. A final attorney's opinion during PED phase will identify any further utility owners that may have a compensable interest.
- **Relocations of Utilities Impacted by High Uplift Forces.** Certain areas along the raised Argentine levee are subject to high uplift (underseepage pressures). Utilities within these high uplift areas may need modification or deeper burial so as to effectively resist the uplift forces and remain operational. These costs are included in the estimated LERRD cost for the Recommended Plan since these areas of high uplift normally occur on private lands (outside the levee right of way). An allowance and contingencies to address the need for utility relocations within areas of high uplift is included within the estimated cost for the Recommended Plan. The detailed design treatment of these utility relocations will occur in PED phase.

The other five work areas within the Recommended Plan have minimal or no utility relocations identified. The Fairfax-BPU floodwall site requires relocation of one buried electrical line. The North Kansas City National Starch area requires relocation of five waterlines. No other utility relocation requirements are known.

Transportation Facilities Impacts Under the Recommended Plan

No active railroad tracks nor railroad facilities require permanent relocation. Temporary adjustments to trackage or schedules are likely needed during some periods of construction especially in the case of stoplog gap replacement in the Argentine Unit levee raise.

No public roads nor bridge crossings require modification. The Kansas River bridges in the Argentine Unit are wide-span and located well above the raised levee profile. In the case of the Turner bridge, the raised levee embankment may need some slight adjusting to adapt to the existing bridge embankment.

Operation and Maintenance Associated with the Recommended Plan

Operation, maintenance, repair, replacement and rehabilitation of the project will remain the responsibility of the non-Federal sponsors. Operation and Maintenance (O&M) manuals will be prepared (or updated as appropriate) by the Corps of Engineers and provided to the sponsors. Implementation of the Recommended Plan will produce little overall change in sponsor O&M costs as shown by the table below:

Table 19: Annual Operation & Maintenance Cost for Levee Units in Recommended Plan

Levee Sponsor	Average Annual O&M Costs for Levee Units	Incremental Annual O&M Cost for Recommended Plan (2005 basis)
Kaw Valley Drainage District <i>(four levee units or segments)</i>	\$1,700,000	+\$16,000
North Kansas City Levee District <i>(one levee unit; some support by City of NKC outside cost shown)</i>	\$500,000	+\$35,000
Fairfax Drainage District <i>(one levee unit)</i>	\$2,300,000	+\$3,000
Kansas City Missouri <i>(three levee units or segments)</i>	\$875,000	+\$26,000

Regional Economic Development Considerations of the Recommended Plan

The primary benefits of the Recommended Plan are the reductions in the potential for flood damage. Because much of the protected area is already industrial, implementation of the Recommended Plan will provide continuity to the current employment base of the area. In the long-term, business volume, personal income, employment and taxes are not expected to change

significantly as a result of implementing the Recommended Plan. However, with improved flood damage reduction, new business and investment would be more easily attracted to the protected area if vacancies were to occur.

During the short-term, construction of the Recommended Plan can be expected to temporarily increase employment. The temporary presence of construction workers is likely to bring a temporary increase in the demand for local area goods and services. Taken together, this is likely to result in a temporary increase in retail business and associated profits, and increased sales tax receipts at the local level.

Recommended Plan – Accomplishments

The without and with-project (residual) flood risks and flood damages are shown in Exhibits: #14, #15 and #16. The residual risk results address all three major aspects of the levee performance analysis: overtopping (hydraulic), geotechnical, and structural. The with-project performance provides a very significant decrease in the flood risk for each of the respective units. The economic characteristics of the Recommended Plan and components are shown in Table 20.

Under the Recommended Plan, the Argentine levee unit will comply with FEMA base flood (100 year) levee certification requirements. Furthermore, although no standard exists for a “500 year” certification, the Argentine levee unit will have 3 feet of margin against the median 0.2% chance exceedance flood profile. This can reasonably be interpreted as “500 year” level of protection when classifying performance characteristics. Other performance aspects of the with-project condition are described in some detail within the Exhibit #17: *Perspectives and Discussion of Levee Performance Analysis*.

The tax bases within most of the levee units are relatively stable as most protected areas are essentially built-out. This limitation on tax base essentially places an upper limit on the potential for totally local initiatives. The Recommended Plan leverages local funding through the Federal cost share process. It is likely that several of the major recommendations herein would remain un-built if not for the Federal cost sharing opportunity provided by the Recommended Plan. The Recommended Plan also provides many lower income residents with additional flood damage reduction which might not otherwise be available through local processes.

Table 20: Economic Characteristics of the Recommended Plan and Components
October 2005 Price Level, 5.125% Discount Rate, 50 Year Period of Analysis

	OVERALL RECOMMENDED PLAN	Argentine	Fairfax-Jersey Creek	North Kansas City	East Bottoms
INVESTMENT COSTS:					
Total Project Construction Costs	\$75,550,000	\$52,873,000	\$12,863,000 (BPU Floodwall: \$7,879,000; JC Sheetpile Wall: \$4,984,000)	\$8,170,000 (Harlem: \$1,549,000 Nat'l Starch: \$6,621,000)	\$1,644,000
Interest During Construction	\$6,569,000	\$5,212,000	\$850,000 (BPU Floodwall: \$612,000; JC Sheetpile Wall: \$238,000)	\$434,000 (Harlem: \$70,000; Nat'l Starch: \$364,000)	\$72,000
Total Investment Cost	\$82,119,000	\$58,085,000	\$13,713,000 (BPU Floodwall: \$8,491,000; JC Sheetpile Wall: \$5,222,000)	\$8,604,000 (Harlem: \$1,619,000; Nat'l Starch: \$6,985,000)	\$1,716,000
AVERAGE ANNUAL COSTS:					
Interest and Amortization of Initial Investment	\$4,585,000	\$3,243,000	\$766,000 (BPU Floodwall: \$474,000; JC Sheetpile Wall: \$292,000)	\$480,000 Harlem: \$90,000; Nat'l Starch: \$390,000)	\$96,000
Other Annual Direct/Associated Costs*	\$512,000	\$313,000	\$199,000 (BPU Floodwall: \$0; JC Sheetpile Wall: \$199,000)	\$0	\$0
OMRR&R (Incremental Increment.)	\$79,000	\$13,000	\$6,000 (BPU Floodwall: \$3,000; JC Sheetpile Wall: \$3,000)	\$35,000 (Harlem: \$2,000; Nat'l Starch: \$33,000)	\$25,000
Total Average Annual Costs	\$5,176,000	\$3,569,000	\$970,000 (BPU Floodwall: \$477,000; JC Sheetpile Wall: \$493,000)	\$516,000 (Harlem: \$93,000; Nat'l Starch: \$423,000)	\$121,000
AVERAGE ANNUAL BENEFITS AND RESIDUAL DAMAGES					
Residual Damages With Project	\$16,610,000	\$4,160,000	\$4,549,000	\$4,915,000	\$2,986,000
Residual Damages as a % of Future Without Proj Damages	28.8%	18.6%	27.5%	41.7%	40.7%
Average Annual Flood Damage Reduction Benefits	\$41,404,000	\$18,165,000	\$12,014,000	\$6,866,000	\$4,358,000
Other Beneficial Effects	Preserve 185 riparian acres	Preserve 185 riparian acres			
Net Annual Benefits	\$36,228,000	\$14,596,000	\$11,044,000	\$6,350,000	\$4,237,000
BC Ratio at 5.125%	8.0	5.1	12.4	13.3	35.9
BC Ratio at 7.0% (EO 12893)	6.0	3.8	9.4	10.3	28.9

Notes: * Other Annual Direct/Associated Costs of Project Implementation include induced damages (\$207,000), Non-Creditable Relocations, and Wharf area costs in the Fairfax Jersey Creek Unit

**Values in this table are rounded. Any discrepancies are due to rounding

Plan Implementation

Work Categorization

For the purposes of developing an appropriate implementation plan, the NED Plan recommendations were examined under established Corps of Engineers criteria for categorization as design deficiencies, improvements (new work), or reconstruction (a subcategory of new work). The categorization of work described in this section was approved by the Corps of Engineers on May 03, 2006.

Corps of Engineers Guidance on Design Deficiency Correction

According to Engineer Regulation ER 1165-2-119, a design or construction deficiency is a flaw in the Federal design or construction of a project that significantly interferes with the project's authorized purposes or full usefulness as intended by Congress at the time of original project development. Corrective action, therefore, falls within the purview of the original project authorization. Design deficiencies will be cost shared with the non-Federal sponsor on a 65% Federal and 35% non-Federal basis. Work to correct a design or construction deficiency may be recommended for accomplishment under existing project authority without further Congressional authorization if the proposed corrective action meets all the following conditions (reference above citation, paragraph 7a):

- It is required to make the project function as initially intended by the designer in a safe, viable and reliable manner; e.g., pass the original design flow without failure. This does not mean the project must meet present-day design standards. However, if current engineering analysis or actual physical distress indicates the project will fail, corrections may be considered a design or construction deficiency if the other criteria are met.
- It is not required because of changed conditions.
- It is generally limited to the existing project features. Remedial measures that require land acquisitions or new project features must not change the scope or function of the authorized project.
- It is justified by safety or economic considerations.
- It is not required because of inadequate local maintenance.

Recommendations Categorized Under Design Deficiency Correction (Remedies)

The following items are categorized as design deficiencies. These items would be cost shared with the non-Federal sponsor on a 65% Federal and 35% non-Federal basis. Following amounts are Oct 2005 cost basis.

- **North Kansas City Unit National Starch Site: New Relief Wells and Pump Plant.** The Recommended Plan provides for underseepage control remedies which include a new relief well system composed of approximately twenty relief wells and a new pumping plant all located approximately between stations 259+00 to 271+00. This work is appropriately categorized as a design deficiency correction.
- **Estimated Implementation Cost = \$6,621,000.**

- **North Kansas City Unit Harlem Site: New Buried Collector System.** The Recommended Plan provides for underseepage control remedies which include a new buried collector along the landward levee toe and associated pump pits (precast manholes) for sponsor temporary pumping operations during major flood events. This work is appropriately categorized as a design deficiency correction.
- **Estimated Implementation Cost** = \$1,549,000.
- **Fairfax BPU Floodwall Strengthening.** The Recommended Plan provides for strengthening of the floodwall (buttresses, additional row of piles, pile cap modification, etc.) in order to meet the original design intent for reliability during rare flood events. This work is appropriately categorized as a design deficiency correction.
- **Estimated Implementation Cost** = \$7,879,000.

Recommendations Categorized Under Reconstruction

The following item is categorized as reconstruction. This item would be cost shared with the non-Federal sponsor on a 65% Federal and 35% non-Federal basis but could be undertaken only with additional authority. Amount shown is Oct 2005 cost basis.

- **Fairfax-Jersey Creek Sheetpile Wall Reconstruction.** The reconstruction will use a new open-cell sheetpile wall configuration driven all along the existing sheetpile wall except for the wharf area.
- **Estimated Implementation Cost** = \$4,984,000

Recommendations Categorized Under New Work

The following items are categorized as new work. These items would be cost shared with the non-Federal sponsor on a 65% Federal and 35% non-Federal basis but could be undertaken only with additional authority. Following amounts are Oct 2005 cost basis.

- **Argentine Levee Raise and Pump Station Improvements.** Numerous components make up this recommendation and are described fully within this report. The Argentine Unit levee raise primarily consists of an approximate 5-foot raise all along the unit with associated reliability improvements at the pump stations.
- **Estimated Implementation Cost:** \$52,873,000
- **East Bottoms New Relief Wells:** The Recommended Plan for maintaining a high reliability against underseepage failure includes a new relief well system and header piping approximately between Sta 405+00 to 420+00 along the Blue River tieback.
- **Estimated Implementation Cost** = \$1,644,000

Sponsorship and Product Development During Implementation

In order to maintain the necessary flexibility and control in the acquisition process, and in order to manage the Federal and sponsor funding cycles effectively, it is anticipated that for the most part, the Corps of Engineers will develop and award separate contract packages for each sponsor. This approach will lead to individual PED design agreements and individual Project Cooperation

(PCA) agreements for each sponsor. Sponsors are aware of this and concur with this approach to implementation.

Design Deficiencies Implementation Approach

The Corps of Engineers will sign PED design agreements with the respective local sponsors for the sites in the Recommended Plan addressing design deficiency correction. Development of the plans and specifications will begin as soon as funding is made available. The Corps of Engineers will prepare a Design Documentation (or Design Deficiency) Report (DDR). The design and construction activities for these design deficiency remedies require no additional project authorization. Potential failures associated with the identified design deficiencies tend to be sudden and occur during flood conditions, with significant potential for catastrophic failure. For this reason, the design deficiency correction work (starting with PED) will be undertaken under the existing authority while the report is provided to Congress for approval of the new work and reconstruction portions of the Recommended Plan.

Following essential completion of the PED phase (and normally prior to the acquisition of any required project lands), the Corps of Engineers and the respective sponsors will execute a Project Cooperation Agreement (PCA). The DDR prepared during PED will guide development of the PCA. Work under this PCA can begin in levee reaches requiring no additional lands. For sites requiring lands, the sponsor will acquire easements, rights-of-way and necessary disposal areas prior to advertisement and award of the first construction contract. The construction contracts are then awarded for the respective sites following real estate acquisition.

New Work and Reconstruction Implementation Approach

The Interim Feasibility Report is offered to Congress for authorization of the new work and reconstruction portions of the Recommended Plan. Following authorization, the Corps of Engineers will sign PED design agreements with the respective local sponsors for the sites in the Recommended Plan addressing new work and reconstruction. Development of the plans and specifications will begin as soon as funding is made available. The Corps of Engineers will prepare a Design Documentation Report.

Following essential completion of the PED phase (and normally prior to the acquisition of any required project lands), the Corps of Engineers and the respective sponsors will execute a Project Cooperation Agreement (PCA). The Design Documentation Report prepared during PED will guide development of the PCA. Work under this PCA can begin in levee reaches requiring no additional lands. For sites requiring lands, the sponsor will acquire easements, rights-of-way and necessary disposal areas prior to advertisement and award of the first construction contract. The construction contracts are then awarded for the respective sites following real estate acquisition.

Project Management

The Corps of Engineers will manage the project in accordance with applicable laws, regulations, and policies. The principles of project management within the Corps of Engineers is contained in Engineering Regulation 5-1-11. A project coordination team composed of key Corps and sponsor personnel is formed under the auspices of the PCA and will guide the construction phase.

Implementation Schedule

An overall project schedule used for the six areas of interest in the Interim Feasibility Report analysis is presented at Exhibit #18 and was developed based upon the assumption that a positive Chief of Engineers' Report will be forwarded to the Assistant Secretary of the Army for Civil Works during late calendar year 2006. Funding is assumed available at the earliest practical opportunity for new PED starts. Lack of initial PED funding for any of the six sites will shift the schedule out accordingly until such time as the funding is made available. Additional refinements to the project schedule will be made as authorization and program guidance is received.

The project schedule provides for almost immediate start of design for the design deficiency remedies beginning in FY2007, and followed by award of construction contracts for the remedies in late FY2008 or FY2009.

Following authorization, the new work and reconstruction components are shown with design beginning (late) FY2007, followed by award of construction contracts for the various sites in FY2008 through FY2010. Work is sequenced to allow construction contracts for different features to be undertaken simultaneously in order to ensure efficiency. This schedule also assumes construction funding is available in the years required and that real estate actions are completed on schedule.

The project schedule reflects the information currently available and the current departmental policies governing execution of projects. It does not reflect program and budgeting priorities inherent in either the formulation of a national civil works construction program or the perspective of higher review levels within the Executive Branch. Consequently, the proposed schedule may be modified before it is transmitted to higher authority for authorization and/or implementation funding.

Institutional Requirements

In addition to the cost sharing responsibilities discussed below, the following sections outline additional Federal responsibilities and local cooperation requirements associated with the development of general flood damage reduction projects, as mandated by the Water Resources Development Act of 1986, Public Law 99-662, and other pertinent laws and policy guidance.

Division of Plan Responsibilities

Implementation responsibilities refer to actions and financial arrangements of Federal and non-Federal interests directed toward implementation of the Recommended Plan.

Federal

In meeting the area's needs for flood damage reduction, the Federal Government will be responsible for providing the Federal share of project costs and for implementing the Recommended Plan. The Kansas City District will develop the Project Management Plan sections needed for guiding the PED (design) and construction of the project.

Non-Federal

The non-Federal sponsors will comply with all non-Federal sponsor responsibilities as described within the Recommendation section of this report.

Financial Capability Analysis

All construction and design costs referred to in this section are fully funded, accounting for all costs through construction completion. The total fully funded project cost, including all six individual project components, is estimated at \$84,709,000. The following individual non-Federal sponsor amounts are based on the fully funded project cost.

Of the four non-Federal sponsors, the Kaw Valley Drainage District (KVDD) of Wyandotte County, Kansas, is responsible for the largest non-Federal share. KVDD will fund the non-Federal share of work on the Argentine Unit and the Fairfax-Jersey Creek Unit sheetpile wall. Costs for these two project components are expected to total \$65,382,000. Kaw Valley will assume responsibility for the 35 percent non-Federal share of \$22,884,000. KVDD will continue to be responsible for combined annual operation and maintenance costs currently estimated at \$1.7 million for all or portions of four units: Armourdale, Argentine, Fairfax (Jersey Creek portion only), and Central Industrial District (Kansas portion only). This amount would include the approximately \$16,000 in annual costs that would be added by this project (KVDD portions of the Recommended Plan). In a letter to the Kansas City District Corps of Engineers dated April 12, 2006, the KVDD has asserted the intent to fund non-Federal costs for design, construction, operation and maintenance functions related to these two project components. KVDD plans to issue general obligation bonds to fund project commitments under authority granted to them under state statutes. Expansion of their statutory authority will be necessary, as will identification of local funding partners.

The North Kansas City Levee District (NKCLD) of Clay County, Missouri, is responsible for non-Federal cost sharing of the recommended underseepage control work on the North Kansas City Unit. The total cost of the two project components (Harlem area and National Starch area) involved for this unit is estimated at \$8,895,000, with \$3,113,000 to be funded by non-Federal sources. The NKCLD will continue to provide annual budgets for operations and maintenance at approximately \$500,000 per year, including the \$35,000 in incremental annual costs added by this project (NKCLD portions of the Recommended Plan). The NKCLD expressed its intent to fund the non-Federal share in a letter to the Kansas City District Corps of Engineers dated April 28, 2006. NKCLD would meet its obligations by issuing general obligation bonds under existing state authority. Approval by voters served by the levee district is necessary.

The Fairfax Drainage District (FDD) of Wyandotte County, Kansas, is responsible for non-Federal cost sharing of the recommended Fairfax-BPU floodwall modification. The total cost of this project component is estimated at \$8,679,000, with \$3,038,000 funded by non-Federal sources. The FDD will continue to provide annual budgets for operations and maintenance at approximately \$2.3 million per year, including \$3,000 in incremental annual costs added by this project (FDD portions of the Recommended Plan). The FDD expressed its intent to provide the required non-Federal funding for this project component in a letter to the Kansas City District

dated April 11, 2006. FDD intends to finance their share of costs from their general operating budget along with additional contributions by industrial and utility concerns within the district.

Kansas City, Missouri is responsible for non-Federal cost sharing of the recommended underseepage relief well system on the East Bottoms Unit, with an estimated total cost of \$1,753,000. The non-Federal cost share responsibility would be \$614,000. The City will continue to provide annual budgets for levee operations and maintenance at approximately \$875,000 per year (for three levee units or segments thereof), including the estimated \$25,000 in annual operations and maintenance costs added by this project (for Kansas City portions of the Recommended Plan). The City expressed its intent to provide the required non-Federal share in a letter to the Kansas City District dated June 16, 2006. The City anticipates providing the non-Federal share from the City Public Improvements Advisory Committee (IPAC) funds.

The Kansas City District is of the opinion, based on the current financial standing and past performance of these four sponsors, that their financing plans are reasonable and that they will be capable of meeting their financial obligations if the Recommended Plan is implemented.

Views of the Local Sponsors

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 obligations associated with the Recommended Plan.

Views of Other Agencies

Extensive coordination with several State and Federal agencies took place during development and evaluation of the Recommended Plan and the Environmental Impact Statement. In addition, the US Environmental Protection Agency became a cooperating agency for this study, providing both content for the EIS and review of the EIS. The following agencies were coordinated with and in some cases have provided comments or participated in the review of this project:

- Kansas Department of Health and Environment
- Kansas Department of Wildlife and Parks
- Kansas State Historic Preservation Office
- Missouri Department of Conservation
- Missouri State Historic Preservation Office
- US Environmental Protection Agency
- US Fish and Wildlife Service
- US National Parks Service

Agency views or concerns expressed during the scoping process or through ongoing study coordination, focused on:

- potential or actual contamination within the industrialized areas of the levee units,
- environmental justice for local communities during the formulation of alternatives,
- potential channelization of the Kansas and Missouri Rivers
- quality of the foreshore riparian habitat along the rivers,

- wetlands within the project area,
- threatened and endangered species,
- and cultural resources or historic properties that may be encountered.

Agencies have provided concerns or comments through the public scoping process, through a Planning Aid Letter, through coordination and submittal of the draft Fish and Wildlife Coordination Act Report, through coordination letters to the State Historic Preservation Officer, and through day to day contact with appropriate agencies as the formulation process and EIS developed. As a cooperating agency, the EPA has provided specific input and review on contaminant issues, air quality information, and an Environmental Justice evaluation pursuant to Executive Order 12898.

Summary of Coordination, Public Review, and Comments

The Environmental Impact Statement supporting this feasibility study was conducted in accordance with the National Environmental Policy Act (NEPA), and the Corps of Engineers process relating to preparation of an Environmental Impact Statement. The NEPA and EIS processes require full disclosure of present, future and cumulative, economic, environmental and social impacts that might occur as a result of implementing the preferred plan examined within this study. Following is a general description of the public involvement process applicable to the interim feasibility study.

- Public involvement provides for general public and Agency input and review within the overall NEPA process. The Corps actively solicited input from numerous Federal, State and local agencies, businesses, and organizations. In addition, individuals have opportunities for input, especially during the Public Information/Scoping Meeting, during the 45-day comment period and public meeting on the draft Interim Feasibility Report and Draft Environmental Impact Statement, and during the 30-day comment period on the final Interim Feasibility Report and Final Environmental Impact Statement.
- Concurrent to the public release of the draft Interim Feasibility Report and Draft Environmental Impact Statement, a Notice of Availability appears in the Federal Register. The Corps also mails notices to individuals and organizations on the project mailing list. A press release is made and the project website is updated to include the release information. Draft reports are made available for public review on the website, at area public libraries and at the Kansas City District Corps of Engineers office. The comment period on the draft documents runs for 45 days after the Notice of Availability appears in the Federal Register. The Corps of Engineers holds a public meeting during the 45-day comment period to present information on the draft Interim Feasibility Report and Draft Environmental Impact Statement and to receive comments from the public. All substantive comments received during this period are included and addressed in the Final Environmental Impact Statement.
- A similar notification process takes place for the release of the final Interim Feasibility Report and final Environmental Impact Statement. A Notice of Availability appears in the Federal Register. The Corps also mails notices to individuals and organizations on the appropriate mailing list. A press release is made and the project website is updated to include the release information. Final reports are made available for public review on the website, at area public

libraries and at the Kansas City District Corps of Engineers office. The comment period on the final documents runs for 30 days after the Notice of Availability appears in the Federal Register. All substantive comments received during this period are included and addressed in the Record of Decision.

- After the close of the 30-day comment period on the final Interim Feasibility Report and Final Environmental Impact Statement the Corps of Engineers prepares a Record of Decision. The Record of Decision states the alternatives, factors considered, and the decision. When the Record of Decision is approved, it is made available for viewing on the project website. The Corps of Engineers also mails notices to individuals on the project mailing list, circulates a press release and announces the approval of the Record of Decision on the project website.

Public Scoping Meetings

Scoping meetings for the feasibility study and Environmental Impact Statement were held for agencies on 7 August 2003 and for the general public on 20 August 2003. Invitations and announcements for the scoping meetings were sent to the study sponsors, elected officials, tribal governments, Federal agencies, state, county, city and local governments, environmental groups, businesses, individuals, news media, libraries, and neighborhood groups. Approximately 80 individuals attended these meetings.

Issues and concerns identified by Agencies regarded potential impacts to downstream areas resulting from implementing any flood damage reduction measures, economic development of the riverfront area, transportation impacts on bridges, highways, barge traffic, channelization of the Kansas and Missouri Rivers, the potential loss of natural resources, impacts on historic trails and sites, and opportunities for Missouri River recreation and levee trails related to the Metro Green Trail System.

The public recognized the need for flood damage reduction, however they also recognized other needs. The priority needs voiced by the public were related to Missouri River recreational opportunities. Many public comments related to incorporating walking and bicycling trails into the Kansas Citys levees system. Comments also related to the interest and need for parks along the rivers and/or levees. The public also voiced concern over the lack of public access to the Missouri River and Kansas Rivers due to the continuous linear nature of the levees. There were some questions concerning peak flows, scouring, and the water resource models that would be used when addressing urban flood damage reduction issues.

Public Meeting and Comment on the Draft Interim Feasibility Report and Draft EIS

A public meeting was held on the evening of 13 July 2006 in Kansas City, Kansas for presentation and discussion of the draft Interim Feasibility Report and Draft EIS. These documents were released to the public on 2 June 2006, and the forty-five day public comment period ran until 17 July 2006. Invitations and announcements for the public meeting were sent to the study sponsors, elected officials, tribal governments, Federal agencies, state, county, city and local governments, environmental groups, businesses, individuals, news media, libraries, and neighborhood groups. This meeting had 49 persons in attendance.

The comments provided by the public at this meeting, and during the associated 45-day comment period, primarily addressed concerns over lack of river recreational access and the desire for trails on levees. Some of the public comment recognized the need for reliable flood damage reduction and endorsed the Recommended Plan. The EIS contains a detailed consideration of the levee trails and recreation access comments.

Corps of Engineers Review Process

The Alternative Formulation Briefing was conducted in January 2006. The Policy Guidance Memorandum (PGM) was issued on February 2, 2006. The District has complied with all PGM directives.

The study process and products have undergone a continuing independent technical review (ITR). All issues have been satisfactorily resolved in accordance with the ITR process.

Interim Report Conclusions

The Recommended Plan (NED Plan) reduces the risk of flooding through project improvements and remedies planned for six sites within the five levee units examined in this Interim Feasibility Report. In general, the Recommended Plan would raise the top-of-levee elevation of the Argentine Unit and would strengthen the East Bottoms, Fairfax-Jersey Creek and North Kansas City Units. This plan helps to restore a relatively uniform level of protection for the project. Design considerations include avoidance of environmental resources, cultural resources, and HTRW where possible.

There are no significant long-term social or environmental impacts. In fact, 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 60 years. Approximately 0.2 acres of wetlands are lost and mitigation is planned accordingly.

Raising the Argentine Unit has the potential for creating relatively small in magnitude induced damages during certain extremely rare events, and a legal review has concluded that there is no taking. Raising the Argentine Unit will allow preservation of 185 acres of established riverine habitat on the foreshore of the Kansas River as compared to the removal of habitat for a limited conveyance increase. This preservation is considered important to the environment within the project area and well serves the objectives of the Corps of Engineers Environmental Operating Principles.

Some of the recommendations carry a small associated increase in OMRR&R. The sponsors have sufficiency to provide all real estate requirements.

RECOMMENDATION

Upon considering the economic, environmental, social, and engineering aspects of making improvements to the existing Kansas Citys, Missouri and Kansas, Local Flood Damage Reduction Project, it has been determined that a project to reduce the risk of flooding and to 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.

Implementation of the Recommended Plan will use existing authority to implement the design deficiencies remedies (underseepage for two sites in the North Kansas City unit, and strengthening of the Fairfax-Jersey Creek unit BPU floodwall site), at a cost of \$16,049,000 (\$10,432,000 Federal and \$5,617,000 Non-Federal). Implementation of the Recommended Plan will require new authorization for construction of the Argentine levee raise, the associated Argentine unit reliability improvements, and the East Bottoms unit underseepage control measures. The Recommended Plan will also require new authorization for reconstruction of the Fairfax-Jersey Creek sheetpile wall. All of these new authorization work items are necessary to continue providing the flood damage reduction benefits as intended by Congress. The cost for these new authorization work items totals \$59,501,000, of which \$38,676,000 is Federal and \$20,825,000 is Non-Federal.

The estimated implementation cost of the entire Recommended Plan is \$49,107,000 Federal and \$26,443,000 Non-Federal for a total estimated cost of \$75,550,000 at October 2005 price levels. The average annual flood damage reduction benefits of the Recommended Plan exceed the average annual cost by a ratio of 8.0 to 1. 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 therefor, 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 this 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 recommendations 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
Colonel, Corps of Engineers
District Engineer

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