

**GENERAL REEVALUATION REPORT
MISSOURI RIVER LEVEE SYSTEM
UNIT L142**

SYLLABUS

Flooding has frequently damaged development on the north bank of the Missouri River, in Jefferson City, Missouri. The proposed levee is an unconstructed unit of the Missouri River Levee System (MRLS) authorized by the 1941 (Public Law) and 1944 Flood Control Acts (Public Laws 228, 77th Congress, 1st Session and 534, 78th Congress, 2d Session). Based on an initial appraisal report completed in June 1991, the project was classified active and funds were allocated in November 1992 to prepare a General Reevaluation Report (GRR). Since the Missouri River Levee System is an ongoing construction project, the GRR is part of the Planning, Engineering and Design (PED) phase of project development.

In July 1993 the study area experienced an approximately 0.2-percent-chance-exceedance flood event. The severe flooding substantially damaged the area. Following the flood, Jefferson City, Missouri, coordinated with many different agencies to mitigate for the extensive flood damage. Jefferson City, Missouri, with Flood Hazard Mitigation funds from the Federal Emergency Management Agency (FEMA) and Community Developmental Block Grants (CDBG) from the State of Missouri, acquired many residences and businesses in the study area. These properties now have deed restrictions which prohibit structures, including levees. In October 1995, because of the new base condition, we essentially reinitiated the L142 GRR.

The project development team considered several different levee alignments and non-structural measures. The most favorable plan consisted of a levee having a 0.1-percent (1 in 1,000) chance of overtopping in any year. Projected Missouri River stage increases are likely to decrease the future performance level. Approximately 25 years from project implementation, the project would be expected to have a 0.2-percent-chance (1 in 500) of overtopping in any year.

The recommended plan would not significantly affect the environment and is the National Economic Development (NED) plan. The benefit cost ratio is 2.2 to 1, with net annual benefits of \$2,462,800. The non-Federal sponsor, Jefferson City, Missouri, prefers the recommended plan. The estimated total project cost is \$24,507,600 (October 2000 prices). The Federal share is \$18,380,700 and the non-Federal share is \$6,126,900.

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UNIT L142**

JEFFERSON CITY, MISSOURI

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**FINDING OF NO SIGNIFICANT IMPACT (FONSI)
ENVIRONMENTAL ASSESSMENT (EA)**

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JEFFERSON CITY, MISSOURI

April 2001

1.0. INTRODUCTION

In response to an April 27, 1989, request from the City of Jefferson, Callaway County, Missouri, that we initiate a reevaluation of flood damage reduction measures on the left bank of the Missouri River, we completed an Initial Appraisal of the authorized Missouri River Levee System (MRLS) Unit L142 in June 1991. The area contains major land transportation routes to the city and the primary airport serving the city as well as a significant industrial area providing jobs to the Jefferson City economy. The initial appraisal was favorable for continued study and identified levee alternatives to reduce recurring flood damages. We announced the beginning of this Reevaluation Study on June 1, 1993, and cosponsored a public workshop with City officials. After the Flood of 1993, flood hazard mitigation funds provided by the Federal Emergency Management Agency (FEMA) and the City removed many residences and other damageable property from the area known as Cedar City. The alternatives formulated in the initial appraisal continued to be useful guidelines, but several factors, primarily the 1993 flood experience and the removal of damageable development from the Cedar City floodplain, prompted a distinct set of alternatives for the post-1993 condition. While this report briefly examines the alternatives evaluated prior to the flood of 1993, its focus is the formulation, comparison and evaluation of the alternatives developed after the flood of 1993. Figure 1 is a location and vicinity map .

A. STUDY AUTHORITY

Unit L142 is an unconstructed unit of the MRLS authorized by the 1941 and 1944 Flood Control Acts (Public Law 228, 77th Congress, 1st Session, and Public Law 534, 78th Congress, 2d Session) on the left bank of the Missouri River at Jefferson City. In December 1973, Unit L142 was classified "inactive" because our 1960's restudy indicated it was not economically justified. Based on the initial appraisal report completed in June 1991, the project was classified active and funds were allocated on November 4, 1992, to prepare a General Reevaluation Report (GRR). Because the Missouri River Levee System is an ongoing construction project, the GRR is part of the Planning, Engineering and Design (PED) phase of project development.

Figure 1. Location and Vicinity Map

B. STUDY PURPOSE AND SCOPE

The current study explores opportunities to reduce flood damages to properties and businesses along the left bank of the Missouri River near River Mile 142. Each alternative is evaluated for effectiveness, efficiency, completeness and acceptability. This GRR identifies the preferred alternative for reducing recurring flood damages in the project area and the Federal interest in constructing that alternative. It also documents the formulation and selection process for the project recommended for construction as well as similar information for the final array of alternatives to the recommended plan.

The L142 study area is at the southern edge of Callaway County, Missouri, along the left bank of the Missouri River from Turkey Creek (river mile 144.5) on the west to the approximate area of Niemann's Creek (river mile 140.5) on the east. Much of the area has been incorporated into the city limits of Jefferson City and is known informally as North Jefferson City.

C. PERTINENT PRIOR STUDIES AND REPORTS

The L142 Levee Unit is a part of the comprehensive plan for the Missouri River Basin, authorized by the Flood Control Act of 1944 (Public Law 534, 78th Congress, 2d Session). The following specific reports apply:

- ? **Missouri River "308" report, February 5, 1934 (House Document No. 238, 73rd Congress, 2d Session)** -- a report on the Missouri River presented a plan for the protection of agricultural lands in the Missouri River Valley between St. Joseph and Boonville, Missouri, by a system of levee units. This report included a complete topographic survey of the entire floodplain from St. Joseph, Missouri, to the mouth of the river.
- ? **Missouri River Levees, Definite Project Report (1947)** -- The report presented a plan for the protection of 1-1/2 million acres of land between Sioux City, Iowa, and the mouth of the Missouri by a system of levees supplemented by reservoirs.
- ? **Missouri River; Reevaluation of Main Stem Flood Control Benefits** -- The Missouri River Division completed this report in June 1955, as a basis to reevaluate the levee system authorized in 1944. The study allocated flood damage reduction benefits between reservoir storage and levees.

- ? **Report of Advisory Board on Agricultural Flood Damages to Army Corps of Engineers (April, 1956)** -- This report resulted from an advisory board's review of the June 1955 reevaluation report to assure that flood damage reduction benefits were properly developed. The report correlated flood losses and land value.
- ? **Missouri River Analysis and Evaluation Procedures for Establishing Agricultural Flood Damages in Missouri Flood Plain Areas (March 1960)** -- Consultants to the Missouri River Division, Dodson, Kinney and Lindbloom, determined whether changes to conditions since the 1944 authorization warranted new levee design criteria. The report recommends that flood damages be estimated by the Flood Hydrograph-Damage Integration method in lieu of land value analysis.
- ? **Missouri River Agricultural Levee Restudy Program, Hydrology Report (March 1962)** -- The Kansas City District released this restudy of the levee system to evaluate the effects of changed conditions since the 1944 authorization on economic justification of the levee project.
- ? **Missouri River Agricultural Levee Restudy Program: Economic Report for Reach 2 (Revised September 1963)** -- This summary document recommends future levee designs based on analysis of individual units.
- ? **Memorandum Report on Selection of Missouri River Agricultural Levee Design Discharges and Preliminary Design Water Surface Profiles (1964)** -- This report served as the basis for revising design discharges for agricultural levees, water surface profiles, and corresponding benefit-cost data.
- ? **Missouri River Levee System Economic Study (August 1967)** -- This report analyzed the economic justification of those levee units that had a high planning and construction priority. Unit L142 was not among the high-priority units.

2.0. PROBLEM IDENTIFICATION

A. FLOOD HISTORY

Historical Flood Events

Flooding has been a recurring problem for many years within the study area. An agricultural levee, the Capital View Levee, was constructed prior to 1970 to alleviate the recurring flood damages. The Capital View Levee is on the left descending bank of the Missouri River and extends from the upstream tieback at Turkey Creek (approximately 1/2 mile upstream of the Highway 54/63 bridge) to the downstream tieback (approximately 4 miles downstream of the highway 54/63 bridge). This levee is located on or near the Missouri River bankline with its crest at elevation 550.6 ft., NGVD, at the Jefferson City gauge, river mile 143.9. This levee protects against approximately the 20-percent-chance flood event or 5-year flood. A geotechnical evaluation of this levee determined that the Capital View Levee has approximately a 50-percent chance of failure at elevation 549.1 ft, NGVD, based on the Jefferson City gauge historical data. Consultation with Jefferson City, Missouri also, verified this elevation. The city stated, *At a gauge reading of 29 (elevation = 549.1 ft., NGVD) the reliability of the existing Capital View Levee is questionable.* We chose the of 549.1 ft., NGVD, elevation as a reference point for review of the historical flood data at the Jefferson City gauge. Table 1 lists the events in which the Missouri River stage was within the critical failure zone (greater than 50-percent chance of failure of the Capital View Levee). Assuming the Capital View Levee at 1997 conditions, the stage was in the critical zone 11 times from 1947 through 1998. Also provided in this table is the approximate frequency of the each event, based on the 1977 Flood Insurance Study (FIS) stage-frequency relationship. We selected the FIS stage-frequency relationship as representative of the midpoint of the period.

Figure 2 provides a photograph of the May 18, 1990, flood with an elevation of 550.4 ft., NGVD (stage = 30.3 feet) at the Jefferson City gauge. Figures 3 through 6 provide photographs of the Missouri River flood on July 29 and 30, 1993.

Table 1. Historical Flood Events that Exceeded the 50-Percent-Chance Failure Point on the Existing Capital View Levee (1947-1998)

Date	Elevation at Jefferson City Gauge (river mile 143.9) (ft., NGVD)	Gauge Reading	Amount Exceeding 50% failure point (549.1 ft., NGVD)	Approximate Event Frequency see note
31-Jul-1993	558.7	38.6	9.6 feet	100-500
19-Jul-1951	553.7	33.6	4.6 feet	10-50
05-Oct-1986	552.8	32.7	3.7 feet	10-50
19-May-1995	552.8	32.7	3.7 feet	10-50
28-Jun-1947	552.3	32.2	3.2 feet	10-50
24-Apr-1973	551.3	31.2	2.2 feet	<10
18-May-1990	550.4	30.3	1.3 feet	<10
07-Apr-1983	550.0	29.9	0.9 feet	<10
25-Feb-1985	549.5	29.4	0.4 feet	<10
08-Oct-1998	549.4	29.3	0.3 feet	<10
31-May-1996	549.2	29.1	0.1 feet	<10

note: The event frequencies are based on the 1977 Flood Insurance Study (FIS) for the Missouri River, at river mile 144, 10-percent-chance = 552.2, 2-percent-chance = 555.6, 1-percent-chance = 556.9, and 0.2-percent chance = 559.1.

Figure 2. May 18, 1990 -- Jefferson City Gauge Reading 30.3 (550.4 ft., NGVD)

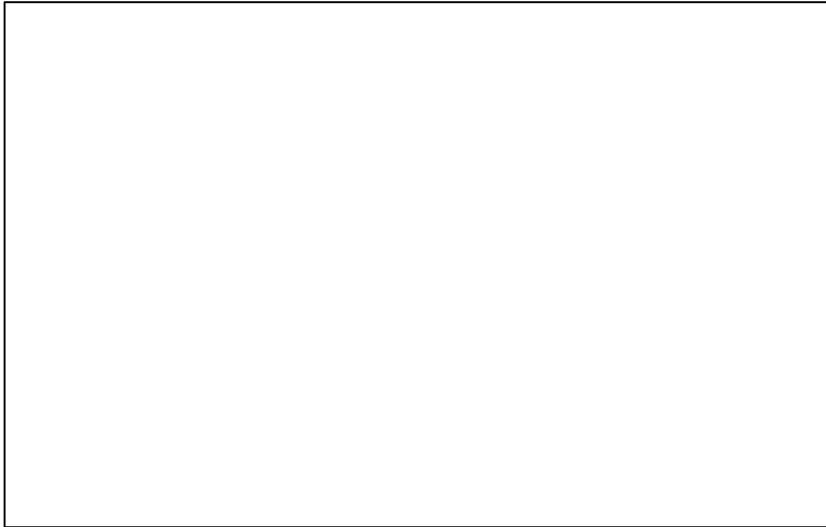


Figure 3. July 29, 1993 -- Jefferson City Gauge Reading 34.3 (554.4 ft., NGVD)

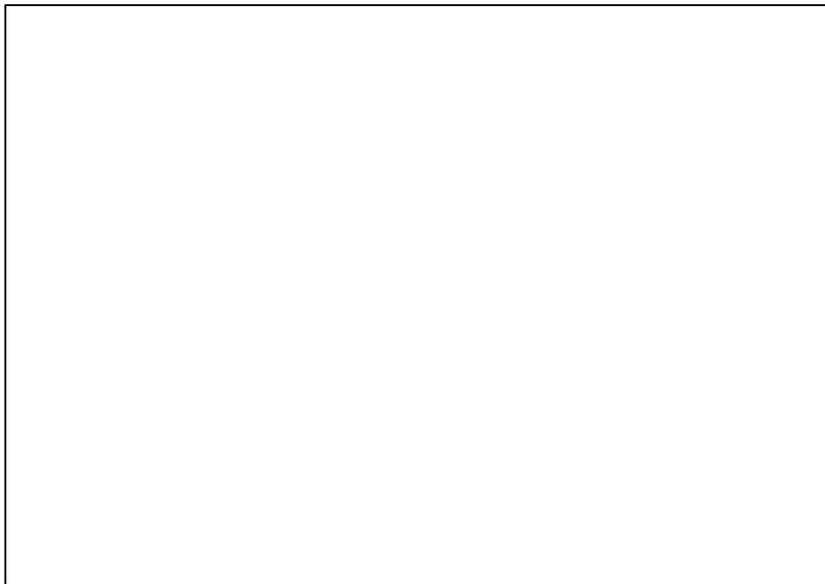


Figure 4. July 30, 1993 -- Jefferson City Gauge Reading 38.5 (558.6 ft., NGVD)

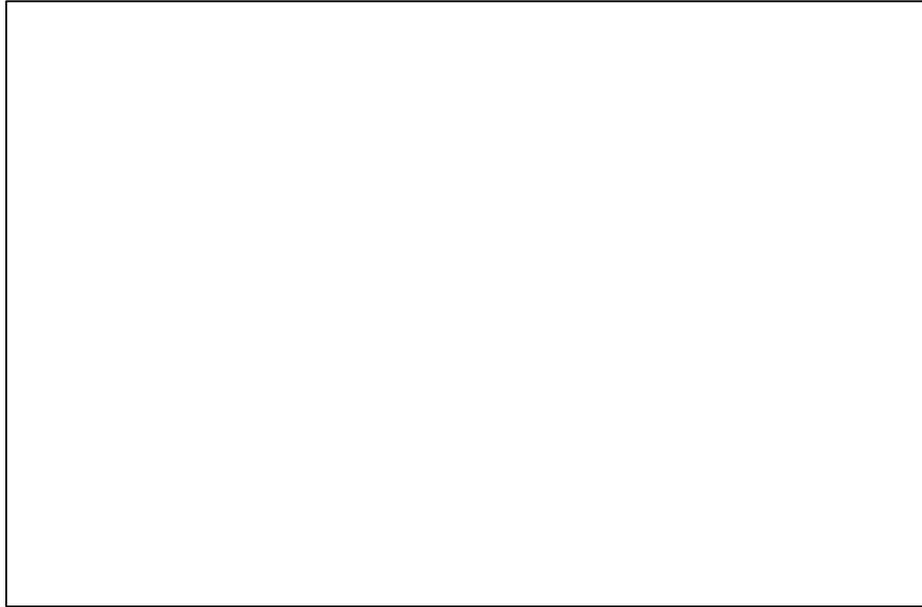


Figure 5. July 30, 1993 -- Jefferson City Gauge Reading 38.5 (558.6 ft., NGVD)

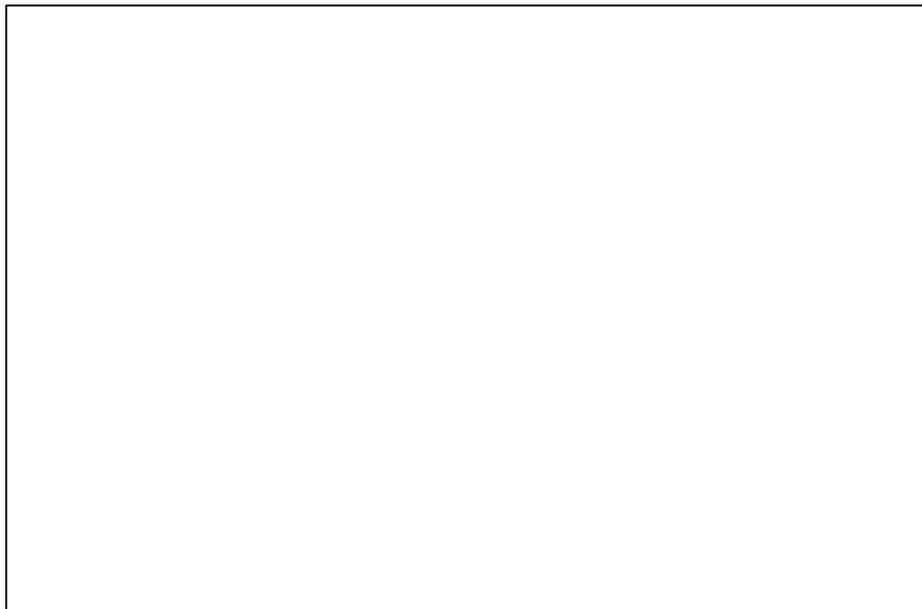


Figure 6. July 30, 1993 -- Jefferson City Gauge Reading 38.5 (558.6 ft., NGVD)

Historical Flood Damages

Kansas City District Corps of Engineers Water Control Section records show that the datum, or zero point, on the Missouri River gauge at Jefferson City is elevation 520.1 ft., NGVD. Flood stage on the Missouri River at Jefferson City is 23 feet above the datum, or elevation 543.1 ft., NGVD. The Capital View Levee, a non-Federal agricultural levee immediately adjacent to the river, currently protects most of the study area. When the Missouri River reaches flood stage, floodplain occupants typically have about 2 to 3 days to evacuate in a flood that eventually overtops the levee. This levee overtops at elevation 550.6 ft., NGVD, which is equivalent to about an 18-percent-chance event. Although the levee has a good record of integrity in recent experience, it could break before it overtops. Once the Capital View Levee overtops (or breaches), those in the immediate vicinity of the airport have only about 2 hours to safely complete any evacuations.

Under 1997 conditions, a 1-percent-chance flood (or 100-year flood) would reach an elevation at the gauge of 557.4 ft., NGVD, (37.4 feet on the gauge) while a 0.2-percent-chance (or 500-year) flood would reach an elevation of 560.1 ft., NGVD. The 1993 flood of record (slightly less than a 0.2-percent-chance event) reached an elevation of 558.7 ft., NGVD, (38.6 feet on the gauge). The July 1993 flood caused an estimated \$18,022,000 in damages in Jefferson City (2000 prices). This damage total includes southern Callaway County, and most of the damage occurred in the study area. The most recent flood event of May 1995 reached an elevation of 552.8 ft., NGVD, which was approximately a 10-percent-chance (or 10-year) flood. The 1995 flood resulted in estimated damages of \$602,000 in the study area (2000 prices).

Properties Subject to Damage

Five key properties in the study area floodplain are responsible for much of the area's damage potential. Figures 7 through 11 are photographs of these properties.

(1) The Jefferson City Airport primarily serves the State Capital and local industry. The ground elevation of the airport terminal is 547.0 ft., NGVD. Because of the slope of the water surface, an equivalent elevation at the gauge is about 547.7 ft., NGVD. (The Capital View Levee can provide protection up to about 3 feet above the airport's ground elevation, depending upon the performance of the levee, so actual flooding at the airport does not necessarily begin at a water surface elevation of 547.0 ft., NGVD.) About 60 aircraft are stationed at the airport. If the agricultural levee holds until it overtops, airport personnel usually have enough time to evacuate the aircraft, but when the levee breaches, prior to overtopping, the small staff may not have time to move all of the aircraft out of danger. Aircraft have been lost to floods on two occasions. The frequent flood events in the study area result in significant downtime for the airport. In October 1986, when the terminal had 4.25 feet of water inside, the airport was closed for 8 days. In 1993, it was closed for 49 days in July and August when water in the terminal

reached 9.75 feet, and an additional 19 days in September when a second flood peak put 2.67 feet of water inside. The 1995 event flooded the terminal to 4 feet and closed the airport for more than 3 weeks.

(2) The Asea Brown Boveri (ABB) plant, about 1/2 mile east of Highway 54, is the major industrial presence in the study area and in the city. This company manufactures underground and pad-mounted electrical distribution transformers. The first floor elevation at the ABB plant is 555.0 ft., NGVD, which is equivalent to about 555.8 ft., NGVD, water surface at the gauge. Built in 1971, the plant was above the estimated 1-percent-chance flood elevation at that time. Subsequent revision of the flood profiles indicates that flooding begins at about the 2-percent-chance flood elevation. The company has a sophisticated flood damage avoidance system which includes raising, evacuation, sandbagging and diversion of water flows. This avoidance system can limit damage if time is sufficient to implement the measures. However, sufficient response time depends on plugging a Highway 54 overpass to protect the plant from water flowing beneath the overpass. With the overpass plugged, the plant has a few days of preparation time before flooding from the south affects the plant. Without the plug, flood flows through the overpass can affect the plant in a few hours. The plant survived the 1993 event, despite a water level of 2.5 feet on the outside of the building, without catastrophic damage. However, during the 1993 flood peak, the Missouri Highway and Transportation Department (MHTD) took the position that the plugged Highway 54 overpass was endangering the highway above. MHTD has prohibited ABB from plugging the overpass since 1993. The potential for severe flood damage has increased dramatically as a result, and the plant's flood insurance deductible has increased substantially since the 1993 flood.

(3) The Missouri National Guard Army Aviation Support Facility, about 1 mile east of the highway, floods at an elevation of 556 ft., NGVD (equivalent to about 557.4 ft., NGVD, water surface at the gauge, which is the 1-percent-chance flood elevation). About 21 aircraft are generally stationed at this facility. The airstrip at the adjacent Jefferson City Airport is used for the Air Guard's Beechcraft Super King aircraft, while the helicopters at this facility have their own landing pads. Most damageable equipment can be evacuated by personnel stationed at this facility, but the building, lighting, fencing, and landing areas are susceptible to damage. Inventories of parts and tools may be subject to damage in some events as well. The facility had 1.5 feet of water inside during the 1993 event.

(4) The Jefferson City Water Pollution Control Plant, directly south of the airport, handles sewage treatment for all of Jefferson City as well as other small towns nearby. Damages in the basement of the plant begin at an elevation of 551 ft., NGVD (551.7 ft., NGVD water surface at the gauge), while the first floor elevation of most of the plant is 556.0 ft., NGVD (556.7 ft., NGVD water surface at the gauge). The plant was flooded with more than a foot of water in the 1993 event, closing the plant for 4 months. The 1995 event closed the plant for almost another month. During the plant's

downtime in 1993, an estimated 1 billion gallons of untreated sewage entered the Missouri River. Another 200 million gallons of raw waste emptied into the river in 1995 during the downtime. The Missouri Department of Natural Resources ranked Jefferson City as the State's worst violator of hazardous spill regulations in both years due to these incidents. Like other area properties, the treatment plant is forced to commence avoidance measures for possible imminent flooding very frequently, resulting in significant expenditures even in the absence of actual flooding.

(5) The Missouri Farmers Association (MFA) Agri Services plant, handling fertilizers and grains, is immediately west of the highway. The ground elevation is 548.0 ft., NGVD and floor elevations vary in different sections of the plant, but flooding affects most of the plant at an elevation of 550.0 ft., NGVD (549.8 ft., NGVD water surface at the gauge). The fertilizer and grain inventories are subject to total loss when significant flooding occurs.

In addition to these five key properties, U.S. Highway 54 is closed when the water surface reaches elevation of 557.9 ft., NGVD. More than 40,000 vehicles travel this route each day. The closure elevation is about 1/2 foot above the 1-percent-chance event water surface elevation. Floodwaters begin to flow under the highway overpass (Katy Trail) at an approximate elevation of 554.0 ft., NGVD. The flood waters back up behind (on the upstream side of) the highway and then flow through the underpass, which during the 1993 flood event resulted in a scour hole of 100 feet by 35 feet immediately below the downstream side of the highway overpass embankment. This severe scour damaged the concrete aprons of the overpass. The scour at the aprons or the large scour hole at the toe of the highway embankment might have undermined the highway overpass structure had floodwaters not receded. When Highway 54 is closed, drivers traveling between Jefferson City and the Columbia/I-70 intersection area are forced to make a 43-mile detour. Additionally, drivers traveling from the Holt/Summit area are forced to make an approximate 100-mile detour to Jefferson City when Highway 54 is closed.

Table 2 shows the relationship between various flood frequencies, water surface elevations, river stages, and discharges.

Table 2. General Flood Data (Water Surface Elevation and Discharge)

Event (percent-chance- exceedance)	Jefferson City Gauge Reading (river mile 143.9) Datum=520.1 ft. NGVD	Water Surface Elevation without project (ft., NGVD) (river mile 143.9) see note	Discharge (cfs)
Flood Stage		543.1	
50.0-percent (2-year)	23.4	543.5	198,000
20.0-percent (5-year)	28.9	549.0	285,000
Flood of 1998	29.3	549.4	
10.0-percent (10-year)	32.5	552.6	365,000
Flood of 1995	32.7	552.8	
2.0-percent (50-year)	35.7	555.8	485,000
1.0-percent (100-year)	37.3	557.4	550,000
Flood of 1993	38.6	558.7	
0.2-percent (500-year)	40.0	560.1	700,000

note: The water surface elevations provided are the 1997 conditions as defined in Appendix B -Engineering and Design Analysis

Picture of Airport to be placed in this Box

Figure 7. Damageable Property – Jefferson City Memorial Airport

Figure 8. Damageable Property – Asea Brown Boveri (ABB) Plant

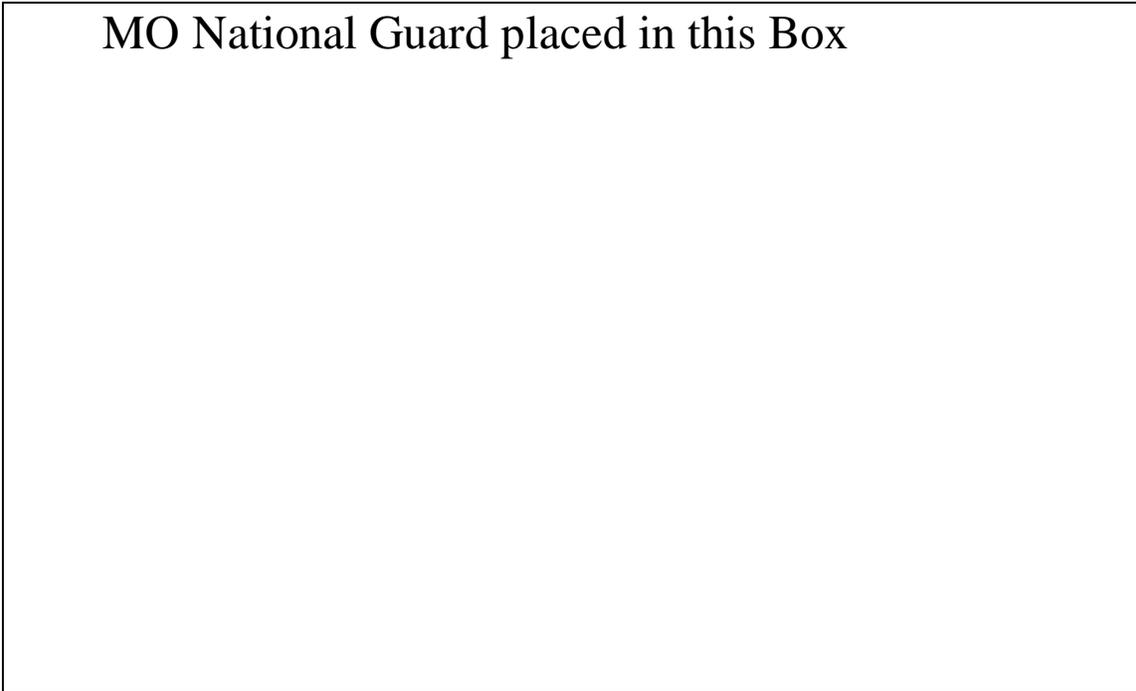


Figure 9. Damageable Property – Missouri National Guard Aviation Facility

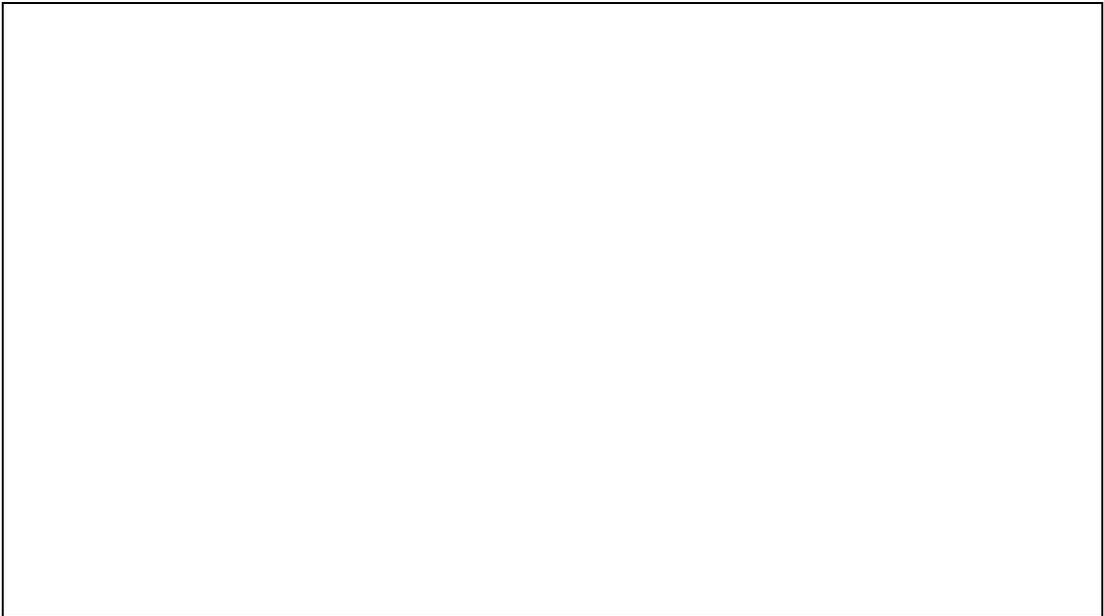


Figure 10. Damageable Property – Wastewater Treatment Plan

Picture of MFA to be placed in this Box

Figure 11. Damageable Property – Missouri Farmers Association

B. EXISTING CONDITIONS

Study Area and Land Use

The L142 study area is at the southern edge of Callaway County, Missouri, along the left bank of the Missouri River from Turkey Creek (river mile 144.5) on the west to the approximate area of Niemann's Creek (river mile 140.5) on the east. The area is known informally as North Jefferson City, and much of the area has been incorporated into the city limits of Jefferson City. Jefferson City, the State capital, had its origin on the opposite river bank, but recently annexed significant acreage in the project area. A January 10, 1998 aerial photograph of the approximate study area is shown on Figure 12.

The area of interest in this GRR is from just west of Highway 54 downstream to the east covering about 1,400 acres between the Missouri River channel and the high bluffs. About 1,100 people work at the 12 business and 4 public/non-profit enterprises within the study area. The Jefferson City Airport, a National Guard facility, a wastewater treatment plant, and a large manufacturer of electrical transformers share the area with about 1,100 acres in agricultural use concentrated in the eastern half of the area. Mokane Road is an east-west route across the entire area of interest. Mokane Road is landward of the Missouri River floodway boundary.

Flood Insurance Program

The City of Jefferson City, Missouri, has been in the Federal Emergency Management Agency (FEMA) Emergency National Flood Insurance Program (NFIP) since April 11, 1975. Upon approval of a Jefferson City Ordinance (#9404), dated March 19, 1980, which adopted special requirements for the construction of buildings when located in the designated flood hazard areas, the City was accepted into the regular NFIP on April 15, 1980. Callaway County, Missouri, has been in the program since January of 1985. The entire study area is in the FEMA Hazard Zone A9, which is defined as an area inundated by the 100-year flood with base flood elevations and flood hazard factors determined.

Figure 12. January 10, 1998 -- Aerial Photograph of Study Area

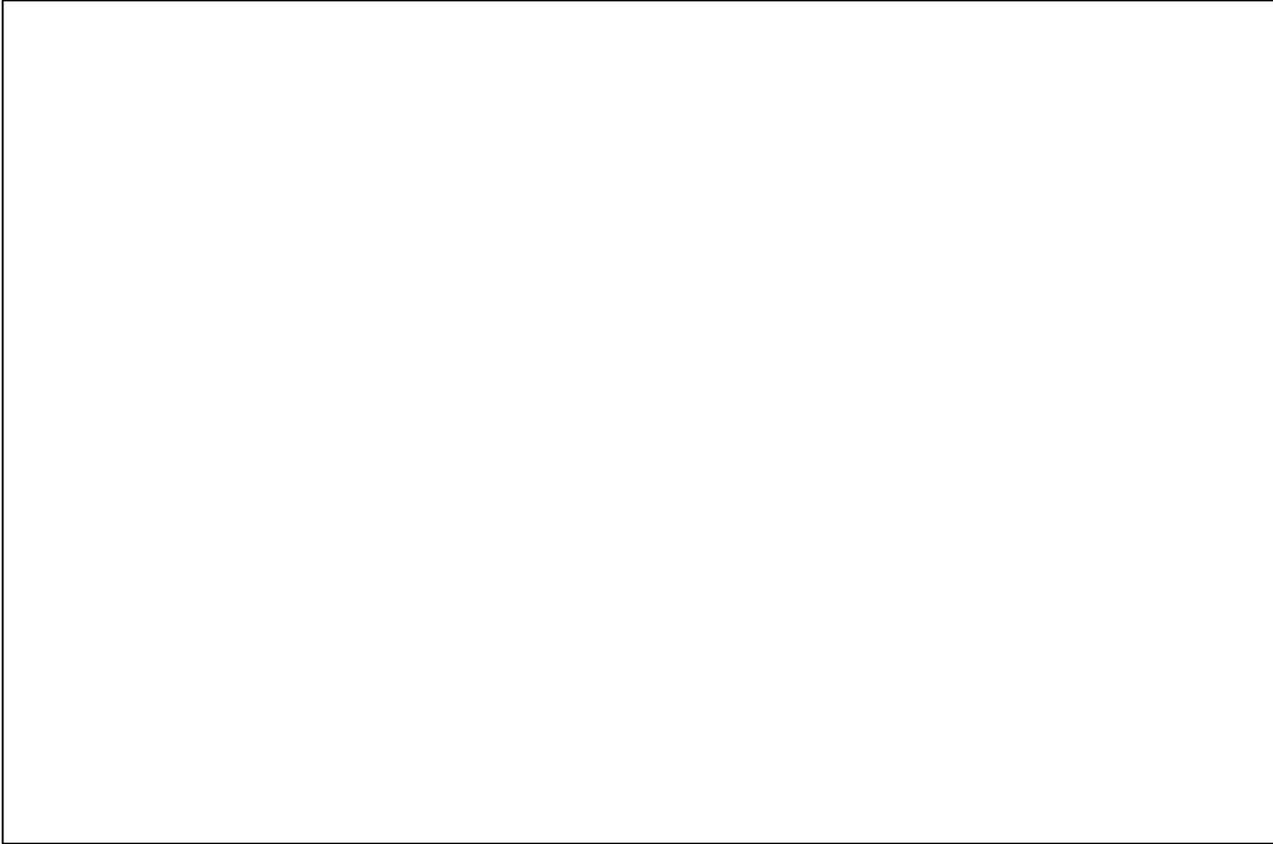


Figure 13. April 17, 1993 -- Former Cedar City

Social and Economic Setting

Jefferson City has a 1999 population of 35,406. Government and the legal industry dominates the local economy, but old, stable neighborhoods, a traditional downtown merchants area, and extensive new commercial strip developments add significantly to the mix of the area's economic base. With Columbia, Missouri, only 30 miles north, and home to the University of Missouri Columbia campus, the Jefferson City area anchors a healthy commercial, public and residential development area in central Missouri.

Across the river from the State Capitol, the North Jefferson City area features cropland and industrial development including the Jefferson City Airport. The airport was annexed by Jefferson City in 1968 and the previous town of Cedar City was consolidated into Jefferson City in 1989. Cedar City was a town of about 450 persons in 1980. After the Flood of 1993, nearly all the residences and businesses were acquired and removed from the floodplain as a flood hazard mitigation measure. Cedar City accounted for most of the area west of Highway 54 within the preliminary alignment for the L142 levee. With the removal of damageable development from the Cedar City area, the most advantageous upstream levee tieback alignment was closer to Highway 54. An April 17, 1993, aerial photograph of the Cedar City area is shown on Figure 13.

The North Jefferson City area has good highway access in all directions. The combined U.S. Highways 54/63, at the west edge of the study area, divides immediately north of the area with Highway 54 providing access northeast to the medium-sized towns of Fulton and Mexico and eventually to Illinois, and southwest to the Lake of the Ozarks and to Kansas. Highway 63 connects Jefferson City northward with Columbia, I-70, and eventually Iowa. To the south it continues though the university town of Rolla to Arkansas. State Highway 94, running through the north edge of the study area, provides access to Missouri River towns east of Jefferson City to St. Louis. Large Missouri River flood events inundate both Highway 54/63 and Highway 94.

The total investment in the protected area is estimated at about \$199.9 million. About 1,100 people work at the 16 businesses and public enterprises within the study area. (About 900 of these workers are employed at the ABB transformer plant.) Seven residences remain in the area, but none are expected to remain by the base year, 2006.

Geotechnical Aspects

The proposed site is located within the alluvial valley of the Missouri River. The site is relatively flat with the ground elevation varying between 535 and 570 ft., NGVD. The Missouri River Valley at the location of the proposed levee system is filled with alluvial deposits consisting of gravel, sand, silts and clays. Two broad strata are present: (1) a substratum of highly permeable sand and gravel, varying in thickness between 75 and 80 feet; and (2) a fine grained top stratum of clay, which is less permeable, ranging

between 5 and 15 feet thick based on new and previous subsurface investigation. The bottom of the blanket is at approximate elevation 530.0 ft, NGVD. The blanket thickness estimate is based on new and existing subsurface investigation information.

Missouri River Hydrology

The Missouri River hydrology for this study is based on the Definite Project Report (1946-1947) and the Missouri River Agricultural Levee Restudy Program: Hydrology Report (March 1962). This report documents the discharge-frequency relationship for eight separate discharge hydrograph conditions for the Missouri River from Sioux City, Iowa, to the mouth near St. Louis, Missouri. The conditions ranged from no control by reservoirs and levees to full project development through the year 2000.

The discharges used in this study, for the reach modeled, are listed in Table 3. The listed discharges account for specific contributions from major tributaries to the Missouri River. River mile 118.0 is the downstream limit of the modeled reach. River mile 130.3 is just downstream of the confluence with the Osage River. The Osage River contributes significant flows to the Missouri River; therefore, this is the location of a change in discharge. River mile 155.0 is the upstream limit of the modeled reach.

Table 3. Missouri River Discharges

River Miles for which Discharge Applies	Frequency in percent chance of Exceedance (Return Interval)						
	50-percent (2-year)	20-percent (5-year)	10-percent (10-year)	4-percent (25-year)	2-percent (50-year)	1-percent (100-year)	0.2-percent (500-year)
118.0 to 130.3	218,000	319,000	398,000	477,000	545,000	610,000	800,000
130.3 to 155.0	198,000	285,000	365,000	425,000	485,000	550,000	700,000

Missouri River Hydraulics

The Missouri River geometry data files used to perform the hydraulic analysis for this study were developed for the Missouri River Restudy completed in 1980. That restudy computed the 50-percent- through the 0.2-percent-chance exceedance flood event water surface profiles and floodway for the Missouri River from the mouth to Rulo, Nebraska. Although the 1980 channel and overbank geometry was used for this analysis, changes to the Missouri River channel and foreshore areas have occurred.

Possibly as a result of these foreshore changes and other factors, the stage-discharge records at the rated gauges along the Missouri River indicate an upward trend for the less frequent flood events. The report entitled "Missouri River Stage Trends - RCC Technical Report D-96," dated March 1997, published by the Missouri River Division, Reservoir Control Section, addresses the stage trend issue. This report states

for the Boonville gauge (river mile 197.1), *the data available for the 300,000 cfs (approximately a 20-percent-chance event) indicates an upward trend of 2 to 4 feet.* Additionally, this same document states for the Hermann gauge (river mile 97.9), *The data available for 400,000 cfs and 500,000 cfs indicate an upward shift of approximately 5 feet.* These statements are for the period of record, but the data presented indicate a continuing increasing stage for the gauges both upstream and downstream of the project site. This report states that the *deposition of sediments on berms, channel cut-offs, and construction of levees have contributed to changes in stages.* Based on this tendency for the stage to increase for a particular discharge, we developed a method to account for an increasing stage trend that is specific for, and limited to, the formulation and evaluation of plans for Unit L142. The method and its use is more fully discussed in Appendixes B and C.

Environmental Setting

The entire project area has been hydrologically altered either by the construction of levees and/or drainage ditches or the placing of tiles. Interior wetlands depend on surface runoff and rain for their hydrology. Wetlands located riverward of Mokane Road may also derive hydrology from the Missouri River. Therefore, ephemeral/farmed wetlands, which exist during the spring and early summer and then tend to dry up during mid to late summer, are the predominant wetland type present in the project area. These wetlands support fair to limited benefits to area wildlife.

Vegetation within the project area is predominantly agricultural cropland. Crops in the area consist of corn, soybeans, wheat, and several acres of pumpkins and watermelons. Most forest cover once found in the area has been cleared for agricultural use. Any remaining remnants are found in linear strips along interior drainages and adjacent to the Missouri River. Occasional large lone cottonwood and pecan trees are found scattered throughout the project area.

Wildlife in the project area is representative of animals found in an intensively cultivated agricultural community. These animals use various habitats within the project area. The adjacent bluffs, the edges of the cropped fields, and the drainages and wetlands adjacent to the Missouri River are the main habitat types in this area. Intensive farming methods and regulations related to airport activities limit the habitat available for wildlife on cropped lands and airport property for the majority of the area.

The primary fishery that exists in the project area is that of the Missouri River. Some small fish may be able to survive in the deeper scour hole areas, however, these areas are filling in and will eventually become shallow wetlands or completely terrestrial.

Federally Threatened or Endangered species that may exist within or adjacent to the project area include the bald eagle (*Haliaeetus leucocephalus*), Indiana bat (*Myotis sodalis*) and pallid sturgeon (*Scaphirhynchus albus*). Coordination with the USFWS

indicates that the project is not likely to adversely affect Federally rare, threatened or endangered species or their respective critical habitats.

A wildlife habitat appraisal model was used to evaluate the habitat values within the project area. Six scenarios were considered using existing conditions, future without project conditions, and future with project conditions. Each of these conditions was modeled using two different wetland matrices, cropland-wetland and nonforested wetland. Of all the evaluation species, only the king rail scored an Habitat Suitability Index (HSI) value of greater than 0.1 under existing conditions. The established species models used for this evaluation showed that effectively no habitat of value for any of the evaluation species currently exists in the project area.

Study Area Historical and Archeological Setting

A Phase I cultural resources survey of the project area in April and May 1996 consisted of: (1) a literature search of the cultural resources reports; (2) a file search of the records at Archaeological Survey of Missouri; (3) a review of historic Missouri River maps; and (4) a field survey of the project area. The literature and records search indicates a total of nine recorded cultural resources and two steamboat wreck sites within or near project boundaries, but none listed on the National Register of Historic Places (NRHP). No additional sites were recorded during the field survey.

Hazardous, Toxic, and Radioactive Waste Considerations

An initial hazardous, toxic, and radioactive waste (HTRW) assessment was performed for the project, in accordance with USACE Regulation ER 1165-2-132. The purpose of the assessment was to determine the potential for encountering contamination during project construction. The assessment consisted of reviewing existing regulatory documentation for the Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (MDNR), and historical aerial photographs. Additionally, interviews with local officials and site reconnaissance provided information regarding current and former land use activities.

Information collected during the assessment indicates that there are no active Comprehensive Environmental Response and Cleanup Liability Act (CERCLA) sites within 2 miles of the project area. Under the Resource Conservation and Recovery Act (RCRA) database, three hazardous waste generators were identified within the project area. ABB Power Transportation and Distribution Company is listed as a large quantity generator while Lauf Equipment Company and the Army Aviation Support Facility are listed as small quantity generators. Even though these hazardous waste generators represent potential sources of contamination, the RCRA listings do not imply non-compliance. A review of the public record and field reconnaissance did not yield any documentation of contamination associated with these facilities.

Information obtained from the Missouri Department of Natural Resources (MDNR) indicates that the State Hazardous Waste Registry lists no sites within 2 miles of the project area. Information from the Underground Storage Tank (UST) Program indicated that several leaking underground storage tanks (LUST) existed within the project study before 1995. To date, all the LUST sites identified in the assessment have been formally closed out following MDNR procedures and testing conducted by MDNR has shown that any remaining petroleum contamination is below regulatory action levels.

Based on the information presented, we do not anticipate any further HTRW investigations. However, a brief design change review and a visual site verification should be performed during detailed design activities to ensure that potential impacts and site conditions have not significantly changed since the information presented above was gathered.

C. FUTURE CONDITIONS WITHOUT PROJECT

Future Flooding

All hydraulic and hydrographic analyses were completed based on conditions that exist in the study area as of 1997. For the purposes of a flood damage reduction study on the Missouri River, these estimates are still valid as of the time of this writing. We anticipate that the project will be operational by 2006. All projections for future conditions were based on 25 years beyond the completion of construction, or the year 2031. Technical details and calculations of the trend extrapolation methods employed are found in Appendix B (Engineering and Design Analysis).

A significant issue is that some areas of the Missouri river floodplain are being transformed from agricultural ground to flood-prone wetland areas for environmental mitigation and enhancement. The long-term effect of these mitigation areas remains indefinite. One hypothesis is that the wetlands would produce additional storage in the floodplain reducing the peak stage of flood events. Another hypothesis is that the increase in vegetation from the wetland areas would cause additional sediment deposition in the overbanks continuing the process of losing floodplain storage and flow

capacity and resulting in increasing stages.

Socioeconomic Considerations

In the absence of flood damage reduction measures in the future, a number of detrimental social and economic effects would result:

- ? The city's airport would continue to be closed often and sometimes for long periods, eventually losing credibility as a regional airport.
- ? ?? Downtime at the Jefferson City Wastewater Treatment Plant would result in potentially large-scale spills into the river of untreated sewage, posing public health concerns for those communities downstream (including the St. Louis metropolitan area).
- ? ?? Large floods would close U.S. Highway 54, inconveniencing more than 40,000 vehicles each day and forcing most of them into 43-mile detours.
- ? ?? All businesses and public enterprises in the area would continue to suffer structural deterioration and loss of market value due to frequent flooding.
- ? ?? In addition to structural damage, businesses and public enterprises would continue to suffer significant losses of equipment and inventory. Aircraft could be lost to flooding at the airport.
- ? ?? Businesses would lose revenues during frequent closings, and the approximately 1,100 employees who work in the study area would be subject to frequent income losses during downtime.
- ? ?? Businesses and public enterprises would continue to undertake elaborate flood avoidance measures in advance of threatened flooding, resulting in diversion of personnel and significant expense. Clean-up operations in the wake of flooding would require substantial effort and expense.
- ? ?? Opportunities for desired expansion would be sharply limited for businesses in the study area such as ABB (the third-largest employer in the city), adversely affecting Jefferson City's prospects for economic growth.
- ? Farmers would continually suffer losses to crops in the flood plain.
- ? National defense readiness could be affected by prolonged flooding at the Army Aviation Support Facility due to unavailability of aircraft or landing facilities or personnel disruption.

- ?? Functioning of the nation's utilities could be affected at some level, since about 40 percent of ABB's transformer sales are sole-source sales to utilities. These sales might not be consummated during lengthy down times.
- ?? Extreme flood depths and velocities could threaten Human life.
- ??? Use of the Katy Trail, a major cross-state recreational trail following the old railroad right-of-way, would be limited periodically by closure and/or damage.

The effects of an upward stage trend would only worsen all of these impacts. Table 4 indicates the expected increase in flood elevations and primary (non-annualized) damages for each of several specific flood events from the existing conditions of 2000, to the base year of 2006, and finally to the future condition year 2031. The projected growth in water surface elevations for the 50 percent-chance event is 0.5 feet from 2000 to 2006, and an additional 2.1 feet over the 25-year period from 2006 to 2031, a total increase from 2000 to 2031 of 2.6 feet. For events less frequent than the 50 percent-chance event, the stage trends increase water surface elevations a total of 2.1 feet – 0.5 feet from 2000 to 2006, and 1.6 feet from 2006 to 2031. Accordingly, primary damages for a 10 percent-chance event, estimated to total \$5,287,100 under existing conditions of 2000, would increase to \$5,998,500 by 2006 and to \$19,760,100 by 2031. This growth represents an increase of 274 percent over the 31-year period. A 1 percent-chance event, which would be expected to cause \$48,760,900 in damages under existing conditions of 2000, would result in damages of \$66,059,300 by 2006 and \$91,189,300 by 2031. The 31-year growth here amounts to an 87 percent increase in primary damages.

Table 4. Stage-frequency-damage relationships

Price level: October 2000

In Thousands of Dollars

FREQUENCY (chance of occurrence)	WATER SURFACE ELEVATIONS			PRIMARY DAMAGES		
	2000	2006	2031	2000	2006	2031
50.00%	542.0	542.5	544.6	\$4.4	\$8.4	\$1,361.0
10.00%	551.3	551.8	553.4	\$5,287.1	\$5,998.5	\$19,760.1
2.00%	554.5	555.0	556.6	\$20,545.8	\$33,521.6	\$70,771.2
1.00%	555.8	556.3	557.9	\$48,760.9	\$66,059.3	\$91,189.3
0.20%	558.2	558.7	560.3	\$91,006.2	\$103,754.3	\$106,454.7
0.05%	563.3	563.8	565.4	\$99,692.6	\$112,361.8	\$112,802.0
0.02%	569.8	570.3	571.9	\$101,496.9	\$114,150.3	\$114,150.3 ¹

¹ Due to the infrequency of a 0.02-percent-chance event and the severity of flooding at year 2006, the primary damage for year 2031 is considered the same as year 2006.

D. PLANNING PROBLEMS AND OPPORTUNITIES

The problems of the study area are flood related. This is supported by correspondence, historical evidence, flood damage, and opinions expressed by local, State and Federal interests. The flood related problems are flood threats from the Missouri River and development problems resulting from zoning to conform with FEMA guidelines.

Local landowners and Jefferson City, Missouri, have continuously identified a problem which exists because of repetitive flooding of critical facilities in the area including the Jefferson City wastewater treatment plant, Air National Guard facility and the Jefferson City Memorial Airport. Additionally, the second largest private employer in Jefferson City, ABB, is currently flooded by the 1.0-percent-chance exceedance event. Also, there are several small businesses and residences that are flood prone.

In addition, to providing flood damage reduction measures to the facilities in the study area, an opportunity exists to mitigate impacted wetlands as part of the proposed project. Using some strategically located borrow sites within the project, wetland mitigation can be developed with minimal cost and effort. This mitigation would increase the quality of the existing wetlands.

E. MOST PROBABLE FUTURE WITHOUT PROJECT

Without some type of flood damage reduction measure, the study area in Jefferson City, Missouri, will continue to suffer repeated flood damages. During flood events, the local community will continue to make attempts which will help a marginal amount to reduce damages, but large flood events will likely cause severe damages. An upward stage trend is part of the most probable future because we have recent evidence of the upward trend and no evidence indicating the trend is lessening. This most probable future without flood damage reduction measures is the basis for comparison of all alternatives.

3.0 PLAN FORMULATION

A. PLANNING CONSTRAINTS

The following planning constraints are applicable to this study:

1. The study shall be conducted in accordance with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, as approved by President Ronald Reagan, February 3, 1983 and accepted by the United States Water Resources Council on February 22, 1983. These guidelines are the contained in the U.S. Army Corps of Engineer Engineering Regulation (ER) 1105-2-100, *Policy and Planning, Guidance for Conducting Civil Works Planning Studies.*
2. Feasible projects will comply with the principles of the Executive Order 11988 which addresses floodplain management and Section 404 of the Clean Water Act concerning the protection of wetlands. Project planning must be accomplished to minimize project effects on floodplains in general, and wetlands and other environmental features. Mitigation must be considered where applicable.
3. Project formulation will adhere to the criteria of the FEMA, adopted by the State of Missouri, regarding the regulatory floodway. These guidelines require that construction in the base flood plain be accomplished in such a manner as to limit any resulting increase in the 1.0-percent-chance flood elevation to less than 1 foot.
4. Project design alternatives recognize the provisions of Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act and, more specifically, the Hazard Mitigation Grant Program Administered by FEMA and the Missouri State Emergency Management Agency (SEMA).
5. All other items of study will be in accordance with the standards of the U.S. Army Corps of Engineers.

B. PLANNING OBJECTIVES

Based on the flooding and related problems and opportunities identified in the study area, the planning team identified a number of planning objectives for the preparation and evaluation of specific plans. These objectives include:

1. To comply with the National objective of water and related land resources planning. This includes contributing to the National economic development consistent with protecting the Nation's environment. Contributions to National Economic Development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units.

2. To reduce the hazard to human life and human hardship and anguish resulting from flooding of the Missouri River within the study area.

3. To reduce the flood damage potential of the Missouri River within the study area.

4. To preserve, restore, and enhance the aesthetic and environmental qualities of the study area.

C. INITIAL SCREENING OF ALTERNATIVES

History of Plan Development

In a letter dated April 27, 1989, the project sponsor, Jefferson City, Missouri, requested the Kansas City District Corps of Engineers to determine whether a Federal project could be implemented to reduce the flood damage potential in the study area. On May 14, 1991, we requested that Unit L142 be classified from the inactive to the active category. On May 31, 1991, the U.S. Army Corps of Engineers Headquarters (CECW-PW) approved the request to classify MRLS Unit L142 from inactive to active. On July 1, 1991, the Kansas City District submitted an Initial Assessment Report, dated 20 June 1991 to the Missouri River Division. This Initial Assessment report indicated a high potential for developing a feasible flood damage reduction plan. This plan approximated the alignment of the levee unit authorized in 1944. The plan consisted of 6.4 miles of levee averaging 15.8 feet high and a minimal amount of stoplog closures. The 1944 plan would provide 100-year level protection with 3 feet of freeboard. The estimated cost for construction of the preliminary plan totaled \$13,919,000. This plan demonstrated the rationale for classifying the project from the inactive to active category. On August 6, 1991, the Missouri River Division approved the Initial Appraisal Report as a basis for preparation of a General Reevaluation Report.

In the time frame from the summer of 1991 through July of 1993, the planning team was involved in all aspects of completing a General Reevaluation Report, which included coordination with the local interests, plan formulation, analysis of the hydrology and hydraulics, and economic evaluation of the study area in addition to the many different studies required for a study of this magnitude. In July of 1993 the study area experienced approximately a 0.2-percent-chance exceedance event. The severe flooding substantially damaged the MRLS L142 study area. From July 1993 through October 1995, the MRLS L142 study was placed on hold. During this time following the flood, Jefferson City, Missouri, was coordinating with many different local, State and Federal agencies to mitigate for the extensive flood damage in the study area. As a result of the flooding, Jefferson City, Missouri, used funds from the FEMA and Community Developmental Block Grants from the State of Missouri to buy many flood-damaged residences and a few businesses in the study area.

In October 1995, we recognized a new base condition of the study area as we reactivated the L142 study. Changed conditions from the pre-1993-flood conditions to October 1995 included; (1) changed land use conditions, (2) fewer damageable properties in the study area, and (3) changed hydraulic conditions due to changes in the channel and overbank conditions. Essentially, effective in October of 1995 the project planning team reformed to reinitiate the General Reevaluation for L142 from the beginning.

Non-Federal Structural Alternatives

These alternatives could be implemented by the local sponsor or private individuals with or without involvement from the Federal Government, and include; levee construction by private individuals, State or local government.

Non-Structural Alternatives

General. The following are non-structural measures that could be implemented in lieu of a Federal levee system. Implementation of any non-structural flood proofing plan would be the responsibility of the State of Missouri, local government and private entities. The most common non-structural measures are listed as follows: flood insurance, flood warning systems with temporary evacuation plans, flood proofing, permanent evacuation, and floodplain regulations.

No Federal Action. The Federal Government would not implement any flood damage reduction measures. The state and/or local government action could be to construct a structural alternative to a level of protection the city determined desirable and affordable. Implementation of this alternative would mean that the State, city, and private individuals would decide whether they would build a structural alternative or implement non-structural measures to protect specific facilities.

Flood Insurance. The Federal flood insurance program administered by the FEMA compensates some property owners for some flood losses and draws attention to the flood hazard.

Flood Warning System with Temporary Evacuation Plan. This alternative would provide study area businesses and residences with warning of a predicted flood. Additionally, those having the capability to relocate would have the opportunity.

Flood Proofing. Flood proofing existing structures consists of raising them to place the first floor elevation above the level of threatened flooding or building flood walls or ring levees around individual structures or groups of structures. These measures would reduce flood damages and benefit only those properties treated.

Flood Proofing - Ring Levee at ABB Plant. The ring levee is a nonstructural alternative that would protect the ABB plant, a major beneficiary of flood protection. The ring levee would provide no protection to the airport, the wastewater treatment plant, the highway, the Missouri Farmers Association facility, or any other properties besides ABB. This plan consists of 8,450 feet of levee, two stoplog closures, and one drainage structure. This plan is shown on Plate 1. An array of elevations with associated costs was developed for this alternative. Screening level estimates are contained in Table 5 for the ABB ring levee. The estimates are contained in Exhibit B-10.1. of the Engineering and Design Analysis, Appendix B. This plan is evaluated in the economic analysis.

Table 5. ABB Screening Level Estimates

1997 percent-chance exceedance event	Recurrence Interval	Total Project Costs (October 1998 Prices, 7-1/8 percent Interest) (1,000's)
2.00%	50-year	\$4,866
1.00%	100-year	\$5,392
0.20%	500-year	\$6,596
0.05%	2000-year	\$7,897
0.02%	5000-year	\$10,886

Permanent Relocation/Evacuation/Floodplain Buy Out. The town of Cedar City west of the proposed project was essentially permanently evacuated. Following the flood of 1993 Jefferson City, Missouri, administered a buy out program for properties which could be justifiably purchased. The buy out opportunities were primarily offered to residents and a few smaller businesses in the study area. FEMA, Community Development Block Grants from the State of Missouri, and the City of Jefferson City, Missouri, contributed the funds for this program. Even with a substantial amount of properties acquired in the study area, damageable properties remain within the study area that are subject to frequent flooding. These damageable properties within the study area are subject to flooding more frequent than the 1.0-percent-chance exceedance event.

Floodplain Regulations. Adopting a set of floodplain regulations using Federal, State and/or local codes, ordinances, and/or other regulations related to the use of land and construction within the flood plain would reduce the flood damage incurred on any future development. However, damage to property already in place would not diminish and the continuing influence of the Missouri River stage trend would produce an escalation in average annual damages.

Non-Structural Alternatives Considered for Further Study

Two non-Structural alternatives were chosen for the final array of alternatives. These included the ? No Federal Action? plan and the ? Flood Proofing - Ring Levee at ABB Plant.? The No Federal Action plan will be recommended if no alternatives produce any positive net annual benefits. The Flood-Proofing - Ring Levee at ABB Plant will be examined further in the economic analysis.

The following non-structural alternatives were eliminated based on the rationale provided:

? ***Flood Insurance*** - The study area, Jefferson City, Missouri, and Callaway County, Missouri are currently participants in the National Flood Insurance Program

? ***Flood Warning System with Temporary Evacuation Plan*** - This alternative would result in the floodplain area being used only by those activities or businesses that could be effectively relocated during times of flooding or would not be significantly damaged during a flood event. This is the present situation and is not a satisfactory solution for those individuals and businesses that are not mobile or suffer significant flood damages.

? ***Flood Proofing*** - A comprehensive flood proofing plan was not evaluated in detail for this project with the exception of a ring levee around the ABB plant. When considering some of the damageable properties, particularly the Jefferson City Airport and the wastewater treatment plant, a flood proofing plan would not constitute a comprehensive plan to satisfy the planning objectives.

? ***Permanent Relocation/Evacuation/Floodplain Buy Out*** - Relocation of an entire airport with towers and runways, a large, technically advanced transformer plant, and a treatment plant with immobile equipment promise great expense, even in the unlikely event a suitable alternative site could be found. The relocation of a treatment plant would involve a very large capital outlay by Jefferson City, Missouri. The location of the wastewater treatment plant outside of the floodplain would be very challenging and likely add significantly to the expense. Essentially, these enterprises would have to be rebuilt, not simply moved.

? ***Floodplain Regulations*** - This option would reduce the potential for future flood damages if adopted, but would not prevent damage to existing developments.

Pre 1993 Flood - Structural Alternatives

Prior to the flood of 1993, the project planning team formulated several structural plans for the General Reevaluation Report. These plans consisted of alternatives 1 through 7. These plans ranged in length from 4.6 miles to 6.4 miles and

included various alignments, uses of flood walls, drainage structures, ramps and stoplog gaps. Subsequent to the flood of 1993, Jefferson City, Missouri, coordinated a buy out program for a majority of the residential area which mitigated many of the damageable properties which had been considered in the plan formulation process prior to the 1993 flood. This change in land use, in addition to changed hydraulic conditions of the study area as result of the flood warranted a complete reformulation. Alternatives 1 through 7 are no longer considered as part of this analysis.

Post 1993 Flood - Structural Alternatives

Following the flood of 1993, we formulated a new array of alternatives. These alternatives considered the change in land use, fewer damageable properties, and hydraulic conditions due to changes in the channel and overbank conditions. Table 6 contains general project details of each alternative formulated. Table 7 contains total project screening level cost estimates for the range of frequencies estimated. The following structural plans were considered in the post 1993 flood array of alternatives.

Alternatives 8 and 8a. Alternatives 8 and 8a provide flood damage reduction to the damageable properties downstream of Highway 54 for approximately 2.2 miles. The upstream alignment of Alternatives 8 and 8a remain as close as possible to the existing Highway 54 embankment. The concept of using this alignment is to use the existing highway embankment as random fill for the levee alternatives. Since development of this alternative, the Missouri Highway and Transportation Department expressed some safety concerns and design requirements for levees in the close proximity of highway embankments. The design guidance for levee alignments such as alternatives 8 and 8a parallel to an existing highway is provided in Appendix A (Coordination and Public Involvement) in a March 15, 1995 letter from the Missouri Highway and Transportation Department. Due to the requirements for safety and highway embankment stability, little benefit can be gained by using portions of the existing highway embankment as random levee fill.

The levee parallels the Missouri River on the landward side of Mokane Road. The landward side of Mokane Road was chosen because it is out of the FEMA regulated floodway. Additionally, the elevation landward of Mokane Road ranges from 3 to 8 feet higher than riverward which reduces the levee fill quantities, thereby reducing costs for the alternative.

The downstream end of Alternative 8 ties into the bluff upstream of a small watershed entering the Missouri River flood plain. The concept of this upstream tieback is that the amount of drainage entering the interior of the levee alternative would be minimized. Alternative 8a ties into the bluff approximately 4,800 feet downstream of alternative 8. The concept of the alignment allows for a greater ponding area for interior drainage and sufficient space for the airport approach facilities. Alternatives 8 and 8a are shown on Plate 2.

At one time, we considered the alternative which would be similar to alternatives 8 and 8a, with the exception that the alignment would be on the downstream side of the Highway 54/63 embankment. A cursory review of this alternative indicated that the costs associated with this alternative would be much higher than alternatives 8 and 8a, while not protecting Highway 54/63. Due to the fact that this alternative had comparable costs and fewer benefits than alternatives 8 and 8a, it was removed from further evaluation.

Alternatives 9 and 9a. Alternatives 9 and 9a provide flood damage reduction to the properties downstream of Highway 54 for approximately 2.2 miles and to a few smaller businesses upstream of Highway 54. We developed this upstream alignment concept based on the requirements that: (1) the levee would not cause a safety concern for Highway 54 as expressed by MHTD, (2) the real estate costs would be less as the project moves away from Highway 54, and (3) benefits would increase slightly with a minimal change in alignment. The levee alignment parallels the Missouri River, and the downstream tiebacks for Alternatives 9 and 9a are similar to Alternatives 8 and 8a, respectively, as previously discussed. Alternatives 9 and 9a are shown on Plate 3.

Alternatives 10 and 10a. Alternatives 10 and 10a provide flood damage reduction to the damageable properties downstream of Highway 54 for approximately 2.2 miles and to businesses ranging from 1000-2000 feet upstream. We developed this upstream alignment concept like Alternatives 9 and 9a based on the requirements that: (1) the levee would not cause a safety concern for Highway 54 as expressed by MHTD, (2) the real estate costs would be less as the project moves away from Highway 54, and (3) benefits would increase with a minimal change in alignment. The levee alignment parallels the Missouri River and the downstream tiebacks for Alternatives 10 and 10a are similar to Alternatives 8 and 8a, respectively, as previously discussed. Alternatives 10 and 10a are shown on Plate 4.

Alternative 10a was further refined following the FEMA/SEMA/City of Jefferson City acquisition of damageable properties using HMGP and other funds. Now included in this alternative is the local sponsor's commitment to provide 2 for 1 "compensatory mitigation" for land that was restricted from future structural use through deed restrictions required by the HMGP. The compensatory mitigation agreement applies to both land within the footprint of the proposed levee and any land within the area protected by the proposed levee.

Alternative 10 (Dredged Fill Material). We developed a Missouri River dredging alternative based on concerns expressed from different parties about the feasibility of using dredged material from the Missouri River for levee fill. As a result of this concern, we developed a screening level cost estimate for Alternative 10 to provide flood damage reduction for the 0.2-percent frequency event. This alternative with the associated frequency was selected for examination because of its potential to become the National Economic Development (NED) Plan. Table 7 shows the cost of this alternative.

Alternative 11. Alternative 11 is an alternative that was requested for examination by the likely non-Federal sponsor, Jefferson City, Missouri. This alternative is similar to Alternatives 10 and 10a for the upstream alignment and alignment parallel to the Missouri River. Alternative 11 extends downstream landward of Mokane Road to the right bank tributary of Niemann’s Creek. Alternative 11 is shown on Plate 5.

Table 6. General Project Details for Structural Alternatives

Alternative Considered	Length (feet)	Length (miles)	Drainage Structures	Stoplog Gaps
Alternative 8	24,400	4.62	8	3
8a	24,900	4.72	8	3
Alternative 9	22,950	4.35	5	3
9a	23,450	4.45	5	3
Alternative 10	23,725	4.49	5	3
10a	24,225	4.59	5	3
Alternative 11	28,580	5.41	6	3

Table 7. Screening Level Estimates for Structural Alternatives

Alternative	1997 percent-chance exceedance event	Recurrence Interval	Total Project Costs (October 1998 Prices, 7-1/8 percent Interest) (1,000's)
Alternative 8	2.00%	50-year	\$10,190
	1.00%	100-year	\$11,162
	0.20%	500-year	\$14,312
	0.05%	2000-year	\$20,913
	0.02%	5000-year	\$32,487
Alternative 8a	2.00%	50-year	\$10,573
	1.00%	100-year	\$11,619
	0.20%	500-year	\$14,711
	0.05%	2000-year	\$21,409
	0.02%	5000-year	\$33,482
Alternative 9	2.00%	50-year	\$10,909
	1.00%	100-year	\$11,832
	0.20%	500-year	\$13,989
	0.05%	2000-year	\$20,274
	0.02%	5000-year	\$31,226
Alternative 9a	2.00%	50-year	\$11,108
	1.00%	100-year	\$12,231
	0.20%	500-year	\$14,546
	0.05%	2000-year	\$20,701
	0.02%	5000-year	\$32,297
Alternative 10	2.00%	50-year	\$10,440
	1.00%	100-year	\$11,131
	0.20%	500-year	\$13,202
	0.05%	2000-year	\$18,918
	0.02%	5000-year	\$29,817
Alternative 10 Dredge Option	0.20%	500-year	\$17,616
Alternative 10a	2.00%	50-year	\$10,808
	1.00%	100-year	\$11,562
	0.20%	500-year	\$13,544
	0.05%	2000-year	\$19,336
	0.02%	5000-year	\$30,742
Alternative 11	2.00%	50-year	\$11,410
	1.00%	100-year	\$12,398
	0.20%	500-year	\$14,642
	0.05%	2000-year	\$21,147
	0.02%	5000-year	\$34,486

Structural Alternatives Considered for Further Study

We chose five structural levee alignments for the final array of alternatives. These levee alignments are identified as Alternatives 9, 9a, 10, 10a, and 11. The alignments differ in how much property they protect immediately west of Highway 54 and in how far downstream they extend. Prior to detailed examination of the final array of alternatives, we dropped Alternatives 8 and 8a from further consideration. Compared with Alternatives 9 and 9a, the two dropped alternatives had lesser benefits and larger costs, suggesting that neither could be the NED plan. The Missouri River dredge material option was also dropped from final consideration. When comparing Alternative 10, estimated at the 0.2-percent event, the cost of the dredge material option provides the same benefits while being approximately 30-percent more expensive, suggesting that it could not be considered the NED plan. Finally, after considering public input and sponsor suggestions, we determined that Alternative 10a is the plan that provides the greatest net benefit.

D. CONCLUSIONS OF THE INITIAL SCREENING PROCESS

We selected seven alternatives to examine in-detail to determine the NED plan. The seven alternatives were: 9, 9a, 10, 10a, 11, and the ABB ring levee and no Federal action.

4.0 EVALUATION OF FINAL ARRAY OF ALTERNATIVES

A. ALTERNATIVES CONSIDERED

The project planning team examined seven alternatives in detail to determine the NED Plan. The seven alternatives are: 9, 9a, 10, 10a, 11, and the ABB ring levee and no Federal action.

B. HYDRAULIC AND HYDROLOGIC ASPECTS

Without Project Water Surface Profiles

We calibrated the 1997 conditions model to the Flood Insurance Study profiles and verified the model by comparison with surveyed high water marks from the September 1972, April and October 1973, and July 1993 floods as well as water surface profiles surveyed on 6 August 1975, 27 June 1995, and 11 February 1997. The replication of these events was good and, for the more recent flood events, excellent, although some variation between measured and calculated water surface elevations was observed. For the 1995 and 1997 water surface profiles, the calculated water surface elevations were within 1 foot of 95-percent of all high water marks. For the 1993 water surface profile, only four high water marks deviated more than 1 foot from the calibrated elevation. These marks were located upstream from the bridge. This variation could result from error in setting or surveying of the high water mark or from a localized variation in overbank roughness. The high water marks from earlier flood events are predominately below the calibrated water surface profiles for various discharges. We verified the model for the entire study reach. The flooded area for the without-project, 1.0-percent-chance-discharge event on the Missouri River is shown on Plate 6.

With Project Water Surface Profiles

We calibrated the 1997 conditions model, defined the uncertainty, and then modeled the various design conditions. We analyzed seven different levee alignments for possible impacts to the 1997 condition Missouri River water surface profiles. The alternatives are labeled 8, 8a, 9, 9a, 10, 10a, and 11. All alternatives have the same alignments along the river. The difference between the alternatives is the location and alignment of the tie off at the up- and downstream ends of the levee. We modeled all seven levee alignments with the Hydrologic Engineering Center-River Analysis System (HEC-RAS) software using the levee option.

For the 10-percent and 2-percent-chance-exceedance flood events, the impacts of all levee alternatives are negligible. For the 1-percent-chance-exceedance flood event, the water surface elevation through the project reach increases less than 0.2 foot. For the 0.2-percent-chance-exceedance flood event, the water surface elevations through the

project reach increase between 0.2 and 0.6 foot for alternatives 8 through 10a. For alternative 11, the increase in water surface elevation through the project reach ranges between 0.3 and 0.7 foot. For both the 1-percent- and 0.2-percent-chance-exceedance flood events, the increase in water surface elevation is less than the 1.0 foot allowed by the Federal Emergency Management Agency for fill in the flood plain outside of the floodway.

At the downstream end of the project, channel and overbank velocities are not increased until the 0.2-percent-chance-exceedance flood event. For Alternative 11, channel velocities are increased by 0.7 foot per second and overbank velocities by 0.5 foot per second for approximately 1 mile downstream. All of the other alignments have a negligible impact on velocities downstream of river mile 140.

Hydrologic Uncertainties

The hydrology developed in the 1962 Missouri River Agricultural Levee Restudy Program: Hydrology Report was based on a flow frequency methodology which adopted a log-normal continuous probability distribution. In defining the hydrologic uncertainties the equivalent years of record, skew, log₁₀ mean, and log₁₀ standard deviation are needed for use in the Monte Carlo Risk and Uncertainty analysis.

The hydrology discussed in the March 1962 report, and used for this study, was based on 63 years of record. A regulated curve, which includes the effect of dams, was derived based on the unregulated record listed in the 1962 study. We utilized the equivalent period of record for the hydrologic uncertainty analysis. The uncertainty guidance for derivation of the regulated curves suggests using between 50-percent and 90-percent of the unregulated period of record for the regulated period of record. The basis of this percentage is based on the confidence of the regulated curve's accuracy and engineering judgment. A shorter period for equivalent record length increases the uncertainty associated with the frequency curve. For this study, we selected a percentage of 70-percent based on the age of the hydrologic analysis and subsequent years of record not included in the analysis. The equivalent years of record would be 44 years for use in the risk and uncertainty analysis.

We derived the skew, log₁₀ mean, and log₁₀ standard deviations from the flow-frequency curve of the Boonville gauge, river mile 197.1. We developed the log₁₀ mean and log₁₀ standard deviation values using the log-normal distribution with application of the standard normal random value (Z- value). Table 8 summarizes the Missouri River hydrologic uncertainties to be used in all scenarios.

Table 8. Missouri River Hydrologic Uncertainties

Descriptive Variable	Value
Equivalent Years of Record	44
Skew	0
Log ₁₀ Mean	5.2967
Log ₁₀ Standard Deviation	0.190

Hydraulic Uncertainties

We selected the hydraulic uncertainty for the 1997 conditions, based on sensitivity models for roughness, comparison to historic high water marks, gauge data uncertainty, and minimum values described in EM 1110-2-1619, *Risk-Based Analysis for Flood Damage Reduction Studies*.

We estimated the uncertainty for future conditions using the sensitivity values for effects of private levees, overbank deposition, and stage trends. We added the 1997 conditions and stage trend standard deviations to obtain the future conditions uncertainty. We considered the 1997 conditions standard deviations to be for model uncertainty while the stage trends would be natural uncertainty. We computed the final hydraulic standard deviation, based on these two parameters, as recommended in EM 1110-2-1619, *Risk-Based Analysis for Flood Damage Reduction Studies*. Results are shown in Table 9. Appendix B contains a detailed discussion of both hydrologic and hydraulic uncertainties.

Table 9. Model, Natural, and Future Conditions Uncertainty

Range of Discharges	Project Implementation SD_M Model Uncertainty Standard Deviations	Stage Trends SD_F Natural Uncertainty Standard Deviation	Future (2031) SD Future Standard Deviation (see note)
0 to 170,000 cfs 3 (in channel flows)	0.9 feet	0.8 feet	1.2 feet
170,000 to 300,000 cfs (shallow overbank flows)	1.5 feet	1.2 feet	1.9 feet
300,000 to 800,000 cfs (flow in overbank)	1.4 feet	1.5 feet	2.0 feet
800,000 to 1.4 million cfs	1.4 feet	1.5 feet	2.0 feet

note: $SD = (SD_M^2 + SD_F^2)^{1/2}$

Evaluation of Levee Interior Drainage

We analyzed the interior drainage hydrology for possible alignments of L142 including Levee Alternatives 9, 9a, 10, 10a, and 11, and ABB Ring Levee. The area analyzed for rainfall runoff includes the protected area of the Missouri River floodplain and the adjoining bluff hillside watershed which presently drains into the area to be protected. Storm and flood events analyzed were for the 50.0-, 10.0-, 1.0-, and 0.2-percent-chance-exceedance events (2-, 10-, 100-, and 500-year frequencies).

The watershed that contributes runoff to the L142 protected area downstream of Highway 54 includes 2.23 square miles of floodplain to be protected and 0.64 square miles of hillside area. We analyzed the rainfall runoff hydrology of the interior watershed for Alternative 10a. We calculated rainfall runoff volumes for other proposed levee alignments as a percentage of Alternative 10a based on drainage area ratio. The protected areas for levee alternative alignments upstream and downstream of Highway 54 are hydrologically separate, thus inflow volumes were calculated separately for upstream and downstream levee alignments.

We assumed for the interior drainage analysis, that the interior storage capacity available for ponding is the natural, existing depression area within the interior of the levee alignments upstream and downstream from Highway 54. The low point for the upstream interior area is near where the proposed levee ties into the abutment of the Highway 54 bridge over the Missouri River. Drainage paths exist to convey all the inflow to this area via a drainage system of culverts, ditches, and overland flow. At approximately elevation 555 ft., NGVD, the upstream inflow volume will overflow into the levee's downstream protected area through the Highway 54 bridge opening over the

Katy Trail near the upstream tieback.

The low point for the downstream area is along the proposed downstream tieback. The ground along the tieback slopes toward the bluff line. Drainage paths exist to convey most of the inflow to this area via a drainage system of culverts, ditches, and overland flow. The interior area near the tieback is relatively flat and open. A storage pond could be excavated in this area taking into consideration the clearances required from the airport runways, the roads, and the toe of the proposed levee alignment.

We developed underseepage rates, based on the existing (1997) conditions Missouri River flood profiles, for both the upstream and downstream sections of each levee alternative. The volume of seepage is directly dependent on the duration of flood stages on the Missouri River. As the duration of flooding on the Missouri River increases, the interior flooding due to seepage increases.

We determined rainfall runoff volumes for 6-hour duration storms for the 50.0-, 10.0-, 1.0-, and 0.20-percent-chance-exceedance storm events. We determined seepage volumes using a period-of-record analysis. We then added these seepage volumes to the runoff volumes to determine total inflow volumes. We determined interior area inundation elevations from the capacity curves for each area.

Analysis of residual interior flooding allowed ponding over the entire interior area. We assumed the total volume of inflow from seepage plus rainfall runoff to be stored in the interior ponding area with no outflow through the levee from the interior. For each alternative, we determined inundation elevations corresponding to total inflow volumes. For upstream levee alternatives, the maximum interior flooding elevation is 555 ft., NGVD. Above this elevation, the inflow volume begins entering the downstream protected area by flowing under the Highway 54 bridge which spans the Katy Trail. For downstream levee alternatives, the maximum inundation elevations of the interior areas occurred for the 0.20-percent-exceedance (500-year) Missouri river flood event.

Considerable natural depression storage is available to be utilized for small events. Some capacity could be added by excavation. However, according to geotechnical analysis, excavation depths are limited to four feet below ground elevation. Interior relief could be provided by the use of interceptor ditches to drain the local detention areas to storage areas. The interior drainage plan final design will depend on the drainage plans of the local community to deliver the runoff to the levee.

We will design drainage structures which penetrate the proposed levee to evacuate interior rainfall runoff and underseepage once flood stages recede. The drainage structures will include sluice gates for positive control and flap gates to prevent backflow from the Missouri River. When storm events occur coincident with low river stages, interior waters would evacuate freely to the river side of the levee through

gravity outlets. Therefore, interior flooding exclusively due to rainfall runoff will be localized flooding dependent upon the local drainage patterns and the storm drainage system in place.

Depending on the magnitude and duration of flooding on the Missouri River, pumping may be necessary to alleviate interior flooding. The residual interior flooding due to levee underseepage may be substantially reduced by the use of portable pumps, which is an accepted practice in the region. The local, non-Federal Sponsor, Jefferson City, Missouri, is currently developing a plan for the interior drainage. The Local sponsor's interior drainage plan will be completed concurrently with the development of the plans and specifications for the NED Plan. A likely solution is to use the drainage ditches along the landside of the levee to intercept the underseepage flow and convey it to collection points or detention areas.

The locations of these detention areas will be determined following investigation and analysis of interior drainage paths with the levee in place. Portable pumps will be moved into place at the detention areas and used to pump the water out of the interior area and over the top of the levee. If the temporary pumping facilities were sized to handle only underseepage, the interior area would be subject to minor flooding due to the rainfall runoff during high flood stages. Of course, supplemental pumping capacity would reduce the extent and duration of interior flooding attributable to coincident rainfall.

C. ENVIRONMENTAL CONSIDERATIONS

When evaluating alternatives for L142, we considered the environmental aspects of the project area. No critical habitat for Federally listed species occurs within the project area; therefore, no constraints were placed on alternatives for construction of structures. The Federally endangered pallid sturgeon occurs in the Missouri River in the project area. When considering the option of obtaining borrow material from the river for construction of the levee, we recognized the possible impacts to the pallid sturgeon.

The habitat types most important to wildlife in the project area are wetlands, riparian corridors and large specimen trees. We attempted to avoid large specimen trees as we developed levee alignments. We minimized disturbance to the riparian corridor by choosing alignments that avoided these areas. We made adjustments to avoid or minimize disturbance to wetland areas when practical. Any wetlands not avoided would be mitigated.

We made an evaluation to assess whether any areas within the project boundary could be enhanced for wildlife benefits. We identified a large scour hole which was formed as a result of the 1993 flood as a potential enhancement area for riverine fisheries adjacent to the Missouri River. However, this area has filled with sediments quicker than anticipated and is not considered a viable option for enhancement. Minor adjustments

were made to the levee alignment to avoid 2 large specimen trees that meet the requirements of bald eagles for use as perching and roosting sites, as well as Indiana bat summer maternity/roost sites. This adjustment will also allow an important cultural resource site to be avoided.

D. NATIONAL ECONOMIC DEVELOPMENT (NED) ANALYSIS

We evaluate benefits and costs of a project based on their impacts on national wealth (not just on the wealth of the region directly affected by the project). After the benefits and costs are calculated, we identify for each alternative, the net benefits or the excess of benefits over costs. We consider the alternative with the highest net benefits (not necessarily the highest benefit-cost ratio) the NED plan.

We prepared preliminary screening-level cost estimates for the six alternatives taken into the risk analysis, with costs for five different levee heights for each alternative. The heights chosen covered a range from about a 2-percent-chance event to about 6 feet above the 0.2-percent-chance event. We computed interest during construction for each levee height and added this cost to the initial costs. We then annualized the total project costs using the FY 1999 Federal interest rate of 7-1/8 percent and a 50-year project life. We added the average annual operations and maintenance cost to each plan. The resulting total annual costs for the six alternatives went into the risk program, which computed a cost curve that was applied to each levee height tested.

The risk analysis program combined economic stage-damage results with hydrologic, hydraulic, and geotechnical uncertainties. We simulated both existing and future conditions for each proposed levee height of each alignment. The risk analysis produced estimated without-project average annual damages, residual (with-project) average annual damages, and resulting annual benefits for each condition (existing and future) and each height tested. We used the results from the risk analysis to calculate a total benefit encompassing both existing and future conditions for each height evaluated. We computed the total benefit by (1) finding the growth in benefits from the existing condition (base year 2006) to the future condition (base year 2031); (2) expressing the growth in discounted present-worth terms over the 25-year growth period; and (3) adding the discounted present-worth of the growth, which represents the future condition incremental benefit, to the existing condition benefits to produce a total benefit. We then compared the total annual benefit to the total annual cost produced by the risk program to generate a benefit-cost ratio and a total net benefit used to identify the NED plan.

We produced an array of possible levee heights for each alignment, and we optimized the array for each alignment to find the height with the greatest net benefits. Optimization involved finding the "peak" of the net benefits curve - i.e., the height at which net benefits decrease if one-tenth of a foot is either added to or subtracted from that height. Once we optimized each of the six alignments, we compared the optimal

heights for each alignment to find the alignment with the greatest net benefits, yielding the NED plan. Table 10. summarizes the rankings of the screening level analysis for the alternatives analyzed.

Table 10. Rankings of the Screening Level Analysis (Price Level = 1 October 1998)

Rank	Alternative	Optimum Height @ river mile 142.8 note	Total First Cost	Annual Benefits	Annual Costs	Benefit / Cost Ratio	Net Annual Benefits
1	10a	562.0	\$18,009,000	\$3,910,500	\$1,730,500	2.3	\$2,180,000
2	10	561.5	\$17,427,000	\$3,837,300	\$1,676,100	2.3	\$2,161,200
3	11	561.5	\$18,757,000	\$3,877,800	\$1,807,600	2.1	\$2,070,200
4	9a	561.5	\$18,649,000	\$3,622,200	\$1,783,700	2.0	\$1,838,500
5	9	561.2	\$18,225,000	\$3,492,400	\$1,741,100	2.0	\$1,751,300
6	ABB Ring	563.3	\$7,989,000	\$2,029,000	\$750,900	2.7	\$1,278,100

note: River mile 142.8 was the index point used for the economic analysis

The risk analysis concluded that the NED plan is alignment 10a, which protects against a water surface elevation of 564.0 ft., NGVD, (gauge reading of 43.9 feet) at the Jefferson City gauge. This elevation is equivalent to 562.0 ft., NGVD, for the index point of river mile 142.8 in the aforementioned table. However, virtually all heights tested for all six alignments showed positive net benefits, suggesting strong economic feasibility for a project at L142. The optimal plan for alignment 10a had a margin of superiority of about \$18,800 in net annual benefits over its closest competitor, alignment 10. The margin of 10a over alignment 11 was \$109,800. Alignments 9a, 9, and the ring levee were respectively \$341,500, \$428,700, and \$901,900 less than 10a in net annual benefits.

E. PLAN SELECTION

Based on the discussion in the preceding sections, we determined the NED Plan to be alternative 10a. The likely non-Federal Sponsor, Jefferson City, Missouri, has reviewed this plan and accepts the NED Plan and has not proposed an alternative Locally Preferred Plan.

F. EFFECT OF STAGE TRENDS ON NATIONAL ECONOMIC DEVELOPMENT PLAN SELECTION

Uncertainties are inherent in forecasting future conditions in hydrology, hydraulics, and economics. The benefits in this analysis account for both existing and

future conditions, but it may be informative to briefly address benefit-cost relationships considering only existing conditions to identify the effect of stage trends. A few key points:

(1) Stage trends do not affect the ranking of alternatives. Table 10 presents the benefits and costs for each alternative in its optimized form, as in Table 11, but with benefits based on existing conditions only. Although benefits, benefit-cost ratios, and net benefits drop for all alternatives, comparison of Table 11 to Table 10 indicates no change in NED rankings. Alternative 10a continues to show the greatest net annual benefits of any alternative.

(2) If stage trends were not considered, alternative 10a would optimize at a point about 2 feet lower. The optimal height for 10a without stage trends would be about 560.0 ft., NGVD, instead of 562.0ft., NGVD. Therefore, protection against future stage increases accounts for about 2 feet of the levee in the NED plan.

(3) The incremental cost of the additional 2 feet of a levee built to a height of 562.0 ft., NGVD, based on the screening-level cost estimates employed in the NED analysis, is \$2,413,000 in first costs, or about 13.4 percent of the total first costs of \$18,009,000. In annualized terms, the additional 2 feet account for \$199,000 of the \$1,730,000 total annual cost. However, these cost totals are valid only if the additional 2 feet of levee are built at the same time as the rest of the levee. If the additional 2 feet are regarded as a separate project to be added later, the cost estimate would need to include such items as staging costs and would be much higher.

(4) The benefit-cost ratio for the NED plan (a levee built to an elevation of 562.0 ft., NGVD), if we only considered existing conditions, would drop from 2.3 to 1.7. Net annual benefits would drop from \$2,181,000 to \$1,246,000. Thus, the addition of future stage trends to this analysis results in an additional 2 feet for the levee height, but does not affect economic feasibility or NED rank.

Table 11. Rankings of the Screening Level Analysis - Existing Conditions Only
 (Price Level = 1 October 1998)

Rank	Alternative	Optimum Height @ river mile 142.8 note	Total First Cost	Annual Benefits	Annual Costs	Benefit / Cost Ratio	Net Annual Benefits
1	10a	560.0	\$15,595,000	\$2,837,700	\$1,531,300	1.9	\$1,306,400
2	10	560.0	\$15,563,000	\$2,818,700	\$1,522,500	1.9	\$1,296,100
3	11	560.0	\$16,766,000	\$2,852,000	\$1,655,600	1.7	\$1,196,400
4	9a	560.0	\$16,726,000	\$2,637,300	\$1,624,900	1.6	\$1,012,400
5	9	559.5	\$15,902,000	\$2,502,900	\$1,549,700	1.6	\$953,300
6	ABB Ring	563.3	\$7,989,000	\$1,463,400	\$750,900	1.9	\$712,600

note: River mile 142.8 was the index point used for the economic analysis

5.0. DESCRIPTION OF PREFERRED PLAN

A. IMPROVEMENTS TO THE NATIONAL ECONOMIC DEVELOPMENT PLAN

Upon completion of the evaluation of the array of alternatives, we determined the National Economic Development (NED) Plan as well as the Locally Preferred Plan (LPP) to be alternative 10a. During the development of a more detailed engineering analysis and coordination with the local non-Federal Sponsor and resource agencies, we made some minor changes to alternative 10a. The NED plan is shown on Plate 7. These changes include:

- (1) addition of a stoplog gap at station 49+05 (Oilwell Road),
- (2) addition of a stoplog gap at station 65+20 (Cedar City Drive),
- (3) addition of a stoplog gap at station 92+10 (actually 2 gaps for north and south bound lanes on Highway 54/63),
- (4) removal of a stoplog gap at station 130+00 (access to Wastewater Treatment Plant, new access will come in from the back),
- (5) addition of a drainage structure at station 48+00,
- (6) adjusting the levee for a better hydraulic transition and HMGP land use restrictions for the roadway alignments for stations 55+00 through 83+00 (Former Cedar City Area),
- (7) moving the levee closer to the Katy Trail from stations 12+00 through 17+00,
- (8) moving the levee along Mokane Road landward to account for environmental concerns,
- (9) detailed consideration of the utilities passing through the levee embankment,
- (10) moving the downstream tieback eastward approximately 500 feet to avoid sensitive archeological areas,
- (11) modification of drainage structure design requirements to account for a 48 inch minimum pipe diameter, and
- (12) real estate to account for minimum drainage facilities requirements through the preferred levee alignment.
- (13) detailed consideration of demolitions required to account for FEMA reductions along the revised proposed alignment
- (14) incorporation of public comments, where appropriate, following the distribution of the draft GRR and subsequent public meeting.

Any cost savings and/or increases added to the entire array of alternatives as a result of the aforementioned changes would have had no impact on the plan selection. All of the aforementioned changes are a result of additional analysis in defining the NED Plan, they do not constitute betterments to the NED plan, as identified in the original array of alternatives. These modifications would not have changed the rankings, optimized level of protection, or NED Plan selection in the evaluation of alternatives.

Therefore, we consider the preferred plan to be the NED Plan.

B. PLAN COMPONENTS

Plate 7 displays the preferred plan. This plan is for a levee system 24,800 feet or 4.7 miles long including six drainage structures and five stoplog structures. The height of the levee ranges from 15 to 23 feet. The typical levee section of this project will have a 10-foot levee crown and side slopes at 1 on 3. In some areas of the levee unit, we will utilize seepage and stability berms where necessary. The elevation of the levee at the Jefferson City gauge (river mile 143.9) is 568.6 ft., NGVD, which protects against a water surface elevation of 564.0 ft., NGVD (gauge reading 43.9). The difference between the height of the levee at the gauge and the level of protection provided is due to the hydraulic effects caused by the bridge constriction. Table 12 summarizes the preferred levee alignment components.

Table 12. Preferred Plan Levee Components

Length (feet)	Length (miles)	Drainage Structures Location	Stoplog Gaps	
			Location	Height
24,958	4.73	1. Sta 48+00	1. Sta 49+05 (Oilwell Road)	15.0'
		2. Sta 91+00	2. Sta 65+20 (Cedar City Drive)	15.0'
		3. Sta 114+20	3a. Sta 93+30 (Southbound Hwy 54)	6.6'
		4. Sta 131+70	3b. Sta 93+18 (Northbound Hwy 54)	6.0'
		5. Sta 186+70	4. Sta 100+10 (Hibernia Road)	15.0'
		6. Sta 245+20	5. Sta 246+25 (MO Hwy 94)	15.0'

The proposed levee and borrow areas would directly impact approximately 16.6 acres of emergent wetlands and 23 acres of farmed wetlands. Indirect impacts, associated with borrow and construction activities involve approximately 10 acres, of those, all but 0.6 acre are farmed wetlands. We will utilize an impervious borrow site in the northeast corner of the proposed project as a wetland mitigation area upon completion of borrow activities. This site would be approximately 42 acres in size, which would provide for approximately a 2:1 mitigation ratio for emergent wetland losses resulting from this levee alignment. Effects to farmed wetlands would be offset by providing gradual contouring and areas with deeper pockets within the impervious and random borrow areas. During dry periods these areas will most likely be farmed. At least 35 acres within the total borrow area acreage will be contoured this way to provide at least a 1:1 mitigation ratio for farmed wetland impacts. No habitat loss of farmed wetlands within the project area will occur with these provisions in place.

C. SUMMARY OF SOCIOECONOMIC AND ENVIRONMENTAL EFFECTS

National Economic Development and the Preferred Plan

The preferred plan protects the entire study area except for about 200 acres of farmland at the downstream end of the area. All of the businesses and public enterprises on both sides of Highway 54 are protected, including the ABB plant, the airport, the Army Aviation facility, the sewage treatment plant, and the MFA plant. About 900 acres of cropland, mostly interspersed with the airport's right-of-way, are also protected. Highway 54 also benefits from the plan. Total investment in the area amounts to about \$199.9 million.

The first cost of the preferred plan is about \$24,507,600 (October 2000 prices). The annualized cost, including interest during construction, is \$1,978,900 (October 2000 prices). The preferred / NED Plan has a benefit-cost ratio of 2.2 to 1, with annual benefits of \$4,441,700 and annual costs of \$1,978,900, based on a 50-year economic period of analysis. Net benefits total \$2,462,800. Residual average annual damages (those damages that would continue to occur in the with-project condition) would total \$168,000, meaning that the project would prevent 96.3 percent of total average annual damages in the study area.

Although portions of the levee on either side of Highway 54 could be considered separable, both portions are incrementally justified. This issue is discussed further in the socioeconomics appendix (Section V.E.). The socioeconomics appendix also discusses the possibility of damages induced by the project, which would appear to be minimal.

Future Condition with Project and Regional Economic Development (RED) Considerations

Implementation of the preferred plan would substantially alleviate structural deterioration of business and public structures in the flood plain. Continual losses of equipment and inventory to inundation would be averted. Ongoing expenditures for flood avoidance measures in advance of threatened flooding would be partially alleviated, although interior drainage limitations inside the levee, in the absence of locally-provided pumping plants, would allow for the continuation of frequent low-level flooding. Less time and money would be lost to clean-up after flooding. Companies would lose less revenue due to closings and employees would lose less income. Disruptions in public services - notably airport services and sewage treatment - would no longer be an issue except in the most extreme flood events. Hazardous waste spills due to downtime at the treatment plant would cease. Air traffic would not need to be diverted to other airports on such a frequent basis. Disruptions of traffic on Highway 54 between Jefferson City and Columbia and the attendant lengthy detours would be less likely. Threats to public safety from extreme river stages and velocities would be eliminated.

We expect the negative impacts from implementation of the project to be minimal. Few residences will remain in the area by the base year of 2006 and those still present will not suffer any adverse impacts from the project. We expect minimal to no relocation or disruption of businesses. Temporary traffic disruption along Highway 54 could occur. River stages will not increase downstream of the project. Across the river in Jefferson City, stage increases in the largest events would be minimal with very little practical effect. Upstream of the project for several miles, stages in only the largest, least frequent events would increase significantly, but the stages in these events are already extreme under existing without-project conditions. Once again there would be little practical impact. We discuss induced flooding and damage issues at greater length in the socioeconomics appendix (Section 5.5.5).

Natural Resource Effects

Replacement of wetlands adversely affected by the proposed project includes approximately 16.5 acres of emergent wetlands and 23.5 acres of farmed wetlands. Indirect impacts, associated with borrow and construction activities involve approximately 10 acres of wetlands, of those, all but 0.6 acre are farmed wetlands. Some trees scattered throughout the project area will be removed. We propose to replace both habitat types with proposed mitigation in the borrow area located in the northwest corner of the project. Replacement trees to be planted around the perimeter of the wetland would be native species typical of the area, at least some will be mast-producing. We will replace the emergent wetland acreage lost at approximately a 2:1 ratio. Farmed wetlands will be replaced on at least a 1:1 ratio. This would assure that the actual loss of habitat value is replaced and no net loss occurs.

Levee construction methods would entail borrowing fill materials from adjacent agricultural lands. The proposed borrow sites will be in irregular patterns with varying bottom contours. These areas would then accommodate varying water depths and encourage the propagation of a variety of aquatic, semi-aquatic and terrestrial plant species. Enhancement of wetland capabilities in natural drainages in the vicinity of the project area is also an option for mitigating wetland impacts in the area.

Using project borrow areas for a wetland site would entail minimal costs to the project as the site would be purchased by the sponsor for the purpose of obtaining fill material for levee construction. Operation and management of the constructed wetlands would be the responsibility of the project sponsor for the life of the project.

Prime agricultural lands will be adversely impacted by the levee structure. Since most land within the project area is classified as prime farmland it would be impossible to locate the levee on lands other than prime farmlands.

The NED Plan avoided two different specimen trees for the final levee alignment. The specimen trees are more than 150 years old and are significant to the floodplain

habitat and overall diversity of the study area. These trees contribute to the overall aesthetic value and are an important environmental component contributing to the natural resource benefits.

Cultural Resource Effects

Only one site within the limits of the study area has a possibility of being affected by project construction. A prehistoric archeological site, located during the field survey, consists of a moderate-to-high density surface scatter of artifacts on an old terrace remnant in the present-day Missouri River floodplain. Ceramics and projectile points suggest a Late Woodland cultural affiliation, with possibly an earlier Middle Woodland component present as well. This site is potentially eligible for listing on the National Register of Historic Places. We will avoid this site during all phases of levee construction.

Hazardous, Toxic, and Radioactive Wastes Considerations

A hazardous, toxic, and radioactive wastes (HTRW) assessment indicates that there are no know HTRW sites within the project area. Further HTRW investigations are not considered necessary. However, it is recommended that a brief design change review and a visual site verification be performed during detailed design activities to ensure that potential impacts and site conditions have not significantly changed since the original assessment was performed. If HTRW sites are discovered during design or construction, the project sponsor will be responsible for cleanup.

D. PROJECT RELIABILITY

One purpose of risk analysis, besides determining the benefit and cost data, is to estimate the reliability of the project over a long period of time by simulating a large number of flood events. The projected reliability of the preferred plan, as summarized in Table 13, suggests that, under existing conditions (base year 2006), the annual probability of overtopping or failure of the levee would be 0.10 percent. Over 10 years (under existing conditions), there would be about a 1 in 100 chance (0.10 percent) of failure or overtopping. Under future conditions (base year 2031), the annual probability of failure or overtopping would be 0.2percent, while the probability over 10 years would be about 1 in 50 (2 percent) and the probability over 50 years would be 1 in 10 (9.5 percent). In contrast, the existing Capital View agricultural levee has a 21.1- percent annual probability of failure or overtopping under 2006 conditions and a 29.2- percent probability under 2031 conditions.

Table 13. Preferred Plan - Project Reliability

	Chance of overtopping in any year	Chance of overtopping in a 10 year period	Chance of overtopping in a 20 year period	Chance of overtopping in a 50 year period
--	------------------------------------------	--------------------------------------------------	--------------------------------------------------	--------------------------------------------------

Project Implementation (2006)	0.1%	1%	2%	4.9%
Future Conditions (2031)	0.2%	2%	3.9%	9.5%

The proposed levee, while providing protection to the area from Missouri River floods, would have interior drainage concerns due to seepage flowing through the levee and accumulating behind the levee. An analysis of the interior drainage issue, discussed in more detail in the socioeconomics appendix, reached two conclusions: (1) An interior drainage problem already exists with the Capital View Levee, and, in net terms, the proposed project would worsen the existing problem only marginally; (2) Pumping plants or other measures might be desirable to address this problem. Benefits from a Federal perspective have not yet been fully developed. If information becomes available which substantiates a Federal interest in interior flood damage relief, an addendum with economics and formulation will be prepared which supports this General Reevaluation Report.

E. DESIGN AND CONSTRUCTION CONSIDERATIONS

The proposed construction has been coordinated with FEMA, SEMA, the Missouri Department of Transportation (MODOT), Missouri Department of Natural Resources, the Federal Aviation Administration, Jefferson City, Missouri, and local landowners.

The design of the preferred plan considered using a borrow location adjacent to the proposed levee alignment to minimize haul distance, access existing local haul routes and provide for a mitigation area adjacent to a local stream, Turkey Creek. Use of conventional scraper, front end loader, and backhoe excavation equipment with truck hauling equipment was the most economical choice when compared to dredged materials from the Missouri River. Local stockpiling of 1993 and 1995 flood carried sands provides readily available random fill materials on the foreshore of the proposed flood protection levee along the Missouri River.

We propose that the local Katy Trail be raised in order to match the existing elevation of a local levee providing protection for Turkey Creek. The Katy Trail raise allows for use of the existing levee along Turkey Creek as impervious borrow. Once the levee is removed water can flow into borrow excavations providing water into developed mitigation areas. We will contour the borrow area thus incorporating environmental areas into the project. We will modify the Katy Trail alignment, incorporating the Missouri Department of Natural Resources recommended 1 vertical to 12 horizontal longitudinal sloping of the ramp as it crosses the levee. The maximum side slope will be

1 vertical to 3 horizontal.

A zoned levee meeting urban design criteria uses impervious zoning along the riverside slopes and random zoning for landside fill and stability berms. We have adjusted the design of the levee alignment to consider both environmentally and archaeologically sensitive areas. The levee design has incorporated stoplog gaps at MODOT access routes meeting MODOT requirements. The levee design has incorporated stoplog gaps at local access routes meeting Jefferson City Public Works Department access requirements. Drainage structures are located at appropriate areas to allow for interior runoff to exit through the levee.

F. OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, & REHABILITATION (OMRR&R) CONSIDERATIONS

Sponsor Routine Annual OMRR&R Costs

The preferred plan will require routine maintenance and also repairs after flood events. The non-Federal Sponsor, Jefferson City, Missouri will be responsible for all operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) responsibilities after project completion. Routine maintenance would consist of periodic mowing and care of the vegetated surfaces such as the levee slopes, maintenance of the graveled levee crown, repair of damaged rock facing of the levee after flood events and removal of sediment and debris from drainage structures and ditches. Additionally, the stoplog structures and associated facilities will need to be properly maintained. As part of the requirements in the Emergency Levee Rehabilitation Program under PL84-99, the sponsor will also participate in an annual inspection by the Corps of Engineers. The estimate of the average annual sponsor OMRR&R responsibilities, based on actual costs of similar levees in the Kansas City District Corps of Engineers is \$30,000, at the October 1998 price level.

Federal Routine Annual OMRR&R Costs

Once the L142 project is complete, a detailed OMRR&R manual will be prepared in compliance with all applicable criteria and regulations. Upon implementation of the L142 project increased Federal responsibilities will include annual levee inspections and review of proposed development within a defined "buffer" zone of the levee. These evaluations are part of the Kansas City District's Inspection of Completed Works (ICW) program. This program assures that the local sponsor of the project is adhering to the requirements as defined in the approved operation and maintenance manual and assures that any development in the vicinity of the levee does not jeopardize the integrity of the levee structure. The L142 project would constitute a "typical" project within the Kansas City District, and therefore we estimate an average annual cost of \$11,000 for Federal operation and maintenance, based on the FY99 ICW program.

Turkey Creek Flood Event Considerations

Turkey Creek, located to the west of the preferred levee alignment, is a small creek with a contributing drainage area of 8.6 square miles. This creek will be a very "flashy" stream in local flood events. Based on experience in the study area and a hydrologic investigation of the basin characteristics, closing the stoplog gap at Oilwell Road (station 49+05) is extremely unlikely and will not be necessary when considering only Turkey Creek flooding.

Missouri River Flood Event Considerations

During flood events the local sponsor will be responsible for ensuring there is no flow of water through the drainage structures into the protected area, closing stoplog gaps, monitoring the levee, and addressing the interior drainage concerns. The stoplog gap on Highway 54 will affect the highest amount of traffic, approximately 40,000 vehicles each day. This stoplog gap would be closed for approximately a 0.2-percent-chance (500-year) event based on the 1997 conditions model. Examination of the 1993 flood event reveals that this stoplog gap would have been closed (not allowing traffic to pass) for 3 to 4 days.

Interior Drainage Considerations

Even with the NED Plan in place, which reduces the damages to the protected area by an estimated 96percent, water accumulating interior to the levee structure will continue to be significant. For the interior drainage analysis, we assumed the interior storage capacity available for ponding to be the natural depression area within the interior of the levee alignment upstream and downstream from Highway 54. We calculated seepage volumes with corresponding elevations for various frequencies of Missouri River flooding corresponding to different rainfall events over the study area. Table 14 displays seepage and rainfall volumes and corresponding inundation elevations.

When storm events occur coincident with low river stages, the gravity outlets through the levee will be operational and interior waters will evacuate freely to the riverside of the levee. Therefore, any interior flooding due to rainfall runoff would be only localized flooding dependent upon the local drainage patterns and the drainage system in place. Plate 8 shows the estimated interior flooding for the preferred / NED Plan for flood depths greater than 1 foot for the 1.0-percent-chance Missouri River flood event coincident with the 1.0-percent-chance rainfall event. These flooded areas do not incorporate any type of interior flood reduction project (e.g, drainage, detention basins, pumping plants).

Interior flooding due to levee underseepage may be substantially reduced by portable pumps, a practice accepted in the region. A plan for interior drainage is not definite at this time, but the outline of a plan based on temporary pumps follows. One possible solution would be to use the drainage ditches along the landside of the levee to

intercept the underseepage flow and direct it to collection points or detention areas. These detention areas might be sumps or detention ponds. We would determine the locations of these detention areas following investigation and analysis of interior drainage paths with the levee in place. Portable pumps would be placed into the detention areas to pump water over the top of the levee. Initial estimates indicate that five or six portable pumps in the 10 to 12-inch size range would be required. We expect the cost for this system to be reasonable.

Table 14. Preferred Alternative Plan Inflow Volume and Inundation Elevations
(Volumes in acre-feet and elevations in feet, NGVD)

10-YEAR (10%) FREQUENCY FLOOD	UPSTREAM OF HWY 54		DOWNSTREAM OF HWY 54	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
Seepage Volume	206	322	546	788
Seepage Inundation Elevation	549.6	550.8	544.3	544.8
100-year Runoff Volume	53	53	515	515
Total Inflow Volume	259	375	1061	1303
Total Inundation Elevation	550.3	551.2	545.3	545.6

100-YEAR (1%) FREQUENCY FLOOD	UPSTREAM OF HWY 54		DOWNSTREAM OF HWY 54	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
Seepage Volume	460	747	907	1387
Seepage Inundation Elevation	551.8	553.8	545.0	545.8
10-year Runoff Volume	32	32	304	304
Total Inflow Volume	492	779	1211	1691
Total Inundation Elevation	552.1	554.1	545.5	546.1

500-YEAR (0.2%) FREQUENCY FLOOD	UPSTREAM OF HWY 54		DOWNSTREAM OF HWY 54	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
Seepage Volume	710	900	1241	2095
Seepage Inundation Elevation	553.6	555.0	545.5	546.6
2-year Runoff Volume	17	17	160	160

Total Inflow Volume	727	900	1401	2272
Total Inundation Elevation	553.6	555.0	545.8	546.8

G. REAL ESTATE REQUIREMENTS

For project purposes, acquisition of real estate will include the following rights-of-way on private and publicly-owned land: permanent easements for an earthen levee of varying widths, including a maintenance right-of-way 10 feet either side of the levee toe, and temporary easements for staging and construction. Fee acquisition will be necessary for one residential and one business property, with relocation benefits probable. Approximately 19 ownerships would be affected in the right-of-way acquisition. This includes all borrow, temporary, and permanent easements. The non-Federal sponsor, Jefferson City, Missouri, currently owns 55 acres of the approximate 480 acres impacted by the proposed project. Jefferson City has sufficient staff and is capable of acquiring the required real estate rights. All acquired estates will conform to the requirements as described in applicable laws and regulations. A Preliminary Attorney's Opinion of Compensability has been prepared, and concludes that a Federal responsibility exists to assure that all relocations are properly completed by the local non-Federal Sponsor.

Approximately 10 acres in the vicinity of the old Cedar City area contain a deed restriction which prohibits placement of structures, on the necessary real estate for levee construction. The non-Federal sponsor, Jefferson City, Missouri, is aware of the requirement for deed-restricted land for the project right-of-way. Jefferson City, SEMA, and FEMA have agreed to a procedure that will result in relaxation of the deed restriction on the 10 acres coupled with the City's acquisition and deed-restriction of other land in the floodplain.

6.0. PLAN IMPLEMENTATION

A. INSTITUTIONAL REQUIREMENTS

Emergency Levee Rehabilitation Program (PL84-99) Assistance

Riverward of the proposed MRLS L142 project is an agricultural levee maintained by the Capital View Levee District. Lands within the Capital View Levee District will be purchased by Jefferson City prior to construction of the L142 system. Once in place, the L142 system and Jefferson City will be a participant in the Public Law (PL) 84-99 program. The PL 84-99 program assists levee districts with repair of flood damage to levees conditional upon their participation in the program. The major requirements for levee district participation are:

- (1) the district to be a recognized entity with taxing authority,
- (2) the district to take part in the PL84-99 inspection program, and
- (3) the levee unit to be considered the primary levee unit.

Executive Order 11988 on Flood Plain Management

Executive Order 11988 on Floodplain Management, dated 24 May 1977, requires Federal agencies to recognize the significant values of flood plains and to consider public benefits that would be realized from restoring and preserving flood plains. The goal is the "wise use, conservation, development and utilization of interrelated land and water resources to serve objectives of economic efficiency, environmental quality and social well-being as consonant with responsibilities assigned to respective levels of government by law." The policy seeks to avoid, wherever possible, long or short-term adverse impacts associated with the occupancy and modification of the base flood plain wherever there is a practicable alternative.

We discovered no significant issues in the EO11988 analysis. We believe the proposed Federal project generally avoids adverse impacts on the flood plain and successfully mitigates for those adverse impacts that are expected. The project does not protect large parcels of undeveloped land that would be subject to land speculation with protection. The undeveloped land that is protected is inherent to the integrity of the project. Land supply and demand for industrial sites in the Jefferson City area were examined, and we do not believe that the undeveloped areas to be protected would be in great demand, given the apparently adequate supply of land in already existing industrial parks. We also do not believe that the undeveloped land to be protected would be very marketable in the majority of cases due to the absence of many parcels of marketable size.

The potential for a small amount of future development in the area does exist, but we do not anticipate large-scale induced development during the project's life. No location benefits are claimed in the economic analysis and no additional development

over base year conditions is projected in the future with-project condition assumed in the analysis. The Federal project includes a mitigation plan that would compensate for any wetland acreage lost to the project and add aesthetic values valuable to the area's recreational base.

B. LOCAL SPONSORSHIP REQUIREMENTS

Project Cooperation Agreement

The requirements for non-Federal sponsorship of this project will be fully delineated in a Project Cooperation Agreement (PCA). The PCA will be finalized and executed prior to start of construction. Some of the major non-Federal requirements from the PCA follow:

1. Provide, during construction, a cash contribution equal to 5 percent of total project costs assigned to flood control.
2. Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas; and perform or ensure performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project.
3. Provide all improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the construction, operation, and maintenance of the project. Such improvements may include, but are not necessarily limited to, retaining dikes, wasteweirs, bulkheads, embankments, monitoring features, stilling basins, and dewatering pumps and pipes.
4. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, 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.
5. Grant the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor, now or hereafter, owns or controls for access to the project for the purposes of inspection, and, if necessary, after failure to perform by the non-Federal sponsor, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall operate to relieve the non-Federal sponsor of responsibility to meet the non-Federal sponsor's obligations or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance.
6. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project 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.
7. Perform, or cause to be performed, any investigations for hazardous substances as 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 (PL) 96-510, as amended, 42 USC 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the 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.

8. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor, for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the construction, operation, or maintenance of the project.
9. To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.
10. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (PL 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the construction, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected in connection with said Act.
11. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of Title VI of the Civil Rights Act of 1964, Public Law 88-352 (42 USC 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulations 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."
12. Provide that portion of total historic preservation mitigation and data recovery costs attributable to flood control that are in excess of one percent of the total amount authorized to be appropriated for flood control.
13. Participate in and comply with applicable Federal flood plain management and flood insurance programs.
14. Not less than once each year inform affected interests of the extent of protection afforded by the project.
15. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires that a Non-Federal interest prepare a floodplain management plan within one year from the date of the Project Cooperation Agreement. The plan shall be designed to reduce the impacts of future flood events in the project area, including, but not limited to, addressing those measures to be undertaken by Non-Federal interests to preserve the level of flood protection provided by the Project. The Non-Federal Sponsor shall provide an information copy of the plan to the Government upon its preparation. As required by Section 402, as amended, the Non-Federal sponsor shall implement such plan not later than one year after completion of construction of the Project.
16. Publicize flood plain information in the area concerned. Provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with the protection provided by the project.

Sponsor Acquisition of Real Estate

As a result of major flood events in the project area the likely non-Federal sponsor, Jefferson City, Missouri, has utilized FEMA grant funds to buyout businesses and residences in the flood prone area within the study boundaries. As a condition of the use of these funds, a deed restriction was placed on the property restricting future uses to those that are consistent with open space. FEMA has concluded previously that levees for flood control purposes do not conform to the open space requirement contained in the subject deeds. Approximately 10 acres in the vicinity of the old Cedar City area are thus restricted.

Engineer Circular (EC) 1105-2-118, Implementation Procedures, Memorandum of Agreement Between Federal Emergency Management Agency and Department of the Army, Hazard Mitigation Grant Program and Flood damage Reduction Projects, 1 October 2000, allows continued consideration of alternatives where HMGP lands would be impacted if a project was in the final stages of the planning process. Because the L142 project planning is in its final stage ending with recommendation of a specific plan for construction, the provisions of the memorandum apply. The levee itself would directly impact about 1.47 acres of HMGP deed restricted land. An additional 28.75 acres of HMGP deed restricted land would be protected by the proposed levee alignment and cut off from River flows.

The total HMGP land considered as adversely “impacted” by the levee project, per the interpretation of the Director, FEMA Region 7, was therefore 30.22 acres. The City of Jefferson City has reached agreement with FEMA that the deed restrictions on 1.47 acres directly affected by the levee footprint would be relaxed to allow construction of the levee. In exchange for this action, by the agreement between FEMA / SEMA and Jefferson City, the City would acquire and place deed restrictions on 60.44 acres of flood prone land to mitigate for the 30.22 acres of HMGP land affected. The 28.75 acres of HMGP land behind the levee shall remain deed restricted. In the implementation of this agreement, the acres to be deed restricted will include the 42-acre wetland mitigation site required for the project, and additional lands to be acquired by the City for borrow. Because the wetland mitigation site and the borrow areas are already included in the LERRD for the preferred plan, the agreement with FEMA does not increase the non-Federal cost or the total project cost.

Cost Sharing Requirements

Table 15 summarizes the cost sharing requirements of the total project cost estimate of \$24,508,000, at the October 2000 price level. The non-Federal Sponsor, Jefferson City, Missouri, will be responsible for an estimated \$1,420,500 in cash and \$4,706,300 in LERRD. The Federal government is responsible for \$18,381,000.

Table 15. Summary of Cost Sharing Requirements (Price Level: October 2000)

Item	Amount	
Planning, Engineering and Design	\$3,860,300	
Construction and Construction Management	\$15,941,900	
Lands, Easements, Relocations, Rights-of-Way, and Disposal Areas (LERRD)	\$4,706,300	
TOTAL PROJECT COSTS	\$24,507,600	
Non-Federal Share (Minimum 25.0%)	\$ 6,126,900	
Cash Contribution (Minimum 5.0%)	\$1,420,600	
LERRD	\$4,706,300	
TOTAL NON-FEDERAL SHARE (LERRD + 5.0% Cash Contribution)	\$6,126,900	
TOTAL FEDERAL SHARE	\$18,380,700	
Federal Percentage of Total Project Costs	75%	
Non-Federal Share of Total Project Costs	25%	

Flood Plain Management Plan

The Water Resources Development Act (WRDA) of 1996 (section 202 (c)) addresses the non-Federal responsibilities regarding Flood Plain Management Plans. Before the construction of any project for local flood damage reduction that involves assistance from the Secretary of the Army, the non-Federal interest must agree to participate in and comply with applicable flood plain management and flood insurance programs. It amends this provision to require non-Federal interests to prepare a flood plain management plan designed to reduce the impacts of future flood events in the project area within 1 year of signing a project cooperation agreement and to implement the plan not later than 1 year after completion of construction of the project.

Financing Plan Outline

Jefferson City would fund its responsibility, currently estimated at \$6,126,900, at the October 2000 price level, utilizing several different funding sources. These sources include utilizing a one-half-percent sales tax for capital improvements, which has been approved by Jefferson City voters in 1986, 1992 and 1996. This issue will again be presented to the electorate in 2001. Additionally, the City is exploring possibilities using non-city support. This support would come from the affected property owners who would contribute funds for the construction and maintenance of the project. The levy

will likely be based on property owners' asset values and acreages. A third alternative would be for the City to issue bonds, which would likely be backed by the City's sales tax. Jefferson City currently has a bond rating of AAA.

Use of Funds

The likely non-Federal sponsor, Jefferson City, Missouri currently owns a significant portion of the necessary lands and necessary rights-of-way. Other required lands are in private ownership and shall be acquired by the sponsor prior to initiation of construction. Land acquisition will begin after the project has been approved and the Project Cooperation Agreement has been executed. The cost estimate for the real estate requirements will be revised as necessary during the preparation of plans and specifications. The total cash contribution required from the non-Federal sponsor, Jefferson City, Missouri, is estimated to be \$ 1,420,600 (October 2000 price level). The total value of the Jefferson City, Missouri, responsibility is estimated at \$6,126,900 (October 2000 price level). The estimated average annual requirement, in October 2000 dollars, from the non-Federal sponsor for operation, maintenance, and rehabilitation is \$30,000.

C. VIEWS OF NON-FEDERAL SPONSORS

Throughout the entire study process we have coordinated the study efforts with Jefferson City, Missouri. The City has continually expressed its commitment and support of the project. By letter dated January 11, 1999, from the Mayor of Jefferson City, Missouri, and a City Council Resolution dated November 2, 1998, the City expressed a commitment to sponsor the project and indicated that it has reviewed this draft report and understands the requirements herein. More recently, in a resolution adopted February 5, 2001, the City Council approved the concept of acquiring agricultural land in the Capital View Drainage District contingent on approval and funding of the L142 levee project. We are confident that Jefferson City, Missouri, understands the legal and cost-sharing requirements prescribed in this General Reevaluation Report.

7.0 SUMMARY OF COORDINATION, PUBLIC VIEWS AND COMMENTS

A. COORDINATION

General

After the devastating flood of 1993, the City of Jefferson cooperated with Federal, State and Local Agencies to accomplish a flood hazard mitigation program which removed many of the properties in the Cedar City area were purchased and removed from potential future flood damage. This flood hazard mitigation action impacted the General Reevaluation of MRLS Unit L142 in two significant ways. First, it removed much of the population whose residences might have received flood protection from MRLS Unit L142. Consequently, the remainder of the study has focused on coordination with elected and appointed officials representing the public in general and the business interests that remain exposed to flood damages in the project area. The paragraphs that follow describe how the participation of officials, agencies, and businesses has influenced the development of the preferred plan. The second consequence of the flood hazard mitigation was to encumber land in the project area with restrictive easements prohibiting structures. Some coordination in the latter part of the General Reevaluation has focused directly on the interaction of these easements with the alignment of the preferred levee design and the potential sponsor's ability to meet the conditions of non-Federal sponsorship. Throughout the study process, we have worked cooperatively with the potential sponsor, Jefferson City, Missouri, in developing this General Reevaluation Report.

In a January 31, 1996, meeting with the potential sponsor and some business owners in the study area, we asked multiple questions to better understand the future of the area both for land use and economic investment. These responses assisted us in formulating alternative plans.

By a letter dated October 2, 1996, the Staff of the Historic Preservation Program, Missouri, Department of Natural Resources, confirmed that we had completed an adequate cultural resource survey and recommended that we minimize impacts as a result of a levee project. We altered the levee alignment to avoid the archeologically sensitive areas.

By letter dated April 7, 1998, we solicited participation of the U.S. Fish and Wildlife Service, Columbia, Missouri, Field Office, in a meeting held on May 5, 1998, to discuss the NED plan for Unit L142 and the remaining interagency coordination of the report and environmental assessment. We incorporated many of the ideas presented at this meeting into the preferred / NED Plan

By letter dated June 4, 1998, we requested that the Natural Resources Conservation Service prepare a wetlands inventory on agricultural lands. We made this request to facilitate our work in identifying affected wetlands and achieving compliance with Section 404 of the Clean Water Act. We utilized this information in finalizing the requirements for the proposed mitigation site of the preferred / NED Plan.

By letter dated June 11, 1998, we submitted to the Federal Aviation Administration (FAA) Form 7460-1, Notice of Proposed Construction or Alternation to the FAA Central Region. Because of the proximity of the operating Jefferson City Airport, FAA approval of construction plans is required. By letter of July 31, 1998, the FAA indicated the preferred levee design would not exceed FAA obstruction standards and would not be a hazard to air navigation.

By letter dated June 24, 1998, we requested formal comments regarding any significant resources that might be impacted by implementation of the preferred plan. We requested these comments from the U.S. Fish and Wildlife Service, Natural Resources Conservation Service, the Missouri Department of Conservation, the Missouri Department of Natural Resources, the U.S. Environmental Protection Agency, Region 7, the FAA, and the Missouri Department of Transportation - Aviation Department.

By letter dated June 24, 1998, the Missouri Department of Transportation Aviation Department cautioned that the levee construction must be planned to not interfere with operation of the Instrument Approach Landing System. The Aviation Department also suggested that the location of a mitigation wetland development could violate the FAA minimum distance of 10,000 feet from an airport serving jet aircraft. The Department recommended that we request an airspace case study from FAA. This issue was further clarified in letters from the FAA and the Missouri Department of Transportation Aviation Department dated July 31, 1998, and September 29, 1998, respectively.

In a letter of July 7, 1998, the Natural Resources Conservation Service, Fulton Field Office, commented that levee unit L142 would cause higher upstream flood levels and more scouring downstream, encourage more development in a flood prone area, narrow the floodway, and result in filling of a wetland south of Mokane Road resulting in changed drainage patterns over a large area and possible litigation from adjoining landowners. The Fulton Field Office recommended a non-structural alternative to the levee. We used this information in the examination of upstream and downstream impacts as a result of the levee and in the development of the mitigation plan.

Responding to our June 24, 1998, request, the Missouri Department of Natural Resources Division of State Parks commented in a July 10, 1998, letter that any modification to the Katy Trail State Park must assure that the trail remains accessible and open to the public. The Department requested information on the reason for passing the levee alignment under Highway 54 as compared to extending the levee to the northeast to tie to the west side of Highway 54. Due to the lack of geotechnical stability of Highway 54 to perform as a levee, tying into this highway embankment is not a viable option.

In a letter of July 24, 1998, the Missouri Department of Natural Resources Division of Environmental Quality commented that, if wetland areas cannot be avoided, they should be mitigated on at least an acre-for-acre basis. The Division of Environmental Quality recommended a levee scope reduced to the minimum necessary to protect existing structures coupled with acquiring as much of the project area as possible and allowing it to flood. The Division of Environmental Quality also recommended addressing cumulative impacts of Unit L142 and other activities on the Missouri River and maintaining a minimum 300-foot undisturbed corridor along the river. We considered these comments in the development of the wetland area to the extent possible.

In a letter of September 29, 1998, the Missouri Department of Transportation-Aviation Department recommended that wetland development be oriented to either emergent marsh or forested wetland and provided other guidelines to minimize the attractiveness of the wetland to waterfowl. The Aviation Department also requested further involvement in future wetland design activities. We incorporated these concerns in the wetland mitigation area.

In a letter of January 8, 1999, the City of Jefferson provided an outline of its financing plan for the non-Federal share of the project cost.

By letter of January 11, 1999, the Mayor of Jefferson City expressed the City's continuing support for the NED plan for Unit L142 and provided a copy of a resolution passed in November by the City Council authorizing the letter of support.

By a letter dated, February 2, 1999, we submitted to the Natural Resource Conservation Service (NRCS), Form AD-106, "Farmland Conversion Impact Rating," requesting a determination of prime and unique farmlands. By letter of February 19, 1999, the NRCS, provided us the evaluation of prime and unique farmlands.

Federal Agencies

Federal Emergency Management Agency (FEMA): FEMA Region VII (the Kansas City, Missouri, office) provided guidance regarding the floodplain management criteria. Additionally, we coordinated extensively with FEMA officials in identifying the properties purchased with FEMA funding after the 1993 Flood and alternatives to the use of HMGP lands for levee construction.

United States Department of Interior - Fish and Wildlife Service: With a letter dated January 21, 1999, FWS submitted a Draft Fish and Wildlife Coordination Act Report (CAR) for consideration. The report addressed likely effects to important fish and wildlife resources, including federally listed threatened and endangered species in the project area and included expected impacts to these resources from the preferred alternative. The CAR also recommended measures for resources mitigation and enhancement. The following discussion identifies each FWS recommendation as well our specific response.

1. **RECOMMENDATION:** Since channelization and levee construction have already resulted in the loss of riparian and wetland habitats in the Missouri River basin, these habitats should be avoided to the maximum extent practicable when selecting borrow sites for the proposed levee, and compensatory mitigation should be undertaken for unavoidable impacts.

RESPONSE: Considerations for wetland impacts was part of the alternatives development for the project. We avoided wetlands whenever practicable. Minor adjustments to the proposed levee alignment were made to avoid large, specimen trees and minimize wetland impacts. A mitigation plan has been developed for unavoidable wetland impacts.

2. **RECOMMENDATION:** The Corps should create wetland mitigation to compensate for the loss of wetland acreage due to the construction of the project. Final acreage will be determined when the final alignment and borrow areas are identified.

RESPONSE: The Corps has developed a wetland mitigation plan as proposed compensation for unavoidable wetland impacts (refer to Sect. 6.1.6 of the EA). Designs for the wetland mitigation area would be finalized as project designs are completed. Final acreage determinations would be made at that time as well.

3. **RECOMMENDATION:** The Corps should make a specific determination whether FAA/MODOT Bird Strike Zone Guidelines are applicable in selecting mitigation sites. The Service has determined that the impervious borrow areas might be suitable as possible mitigation sites depending on the interpretation of FAA guidelines. If the Corps should determine that mitigation must be located outside the FAA zone, then the service should be contacted to assist in selecting new site(s).

RESPONSE: The Corps has consulted FAA and MODOT on the compatibility of the proposed mitigation plan with airport regulations and safety restrictions (reference MFR on COE/FAA meeting dated 10 June 1998 and MODOT letter dated September 29, 1998 in Appendix A). The Corps has received a determination that MODOT does not have objections to the proposed mitigation plan provided requirements as outlined in the September 29, 1998 MODOT letter have been met. If regulations change, or it is determined that any conditions cannot be met, the Corps will consult with FWS on changes to the mitigation plan.

4. RECOMMENDATION: Borrow areas and wetland mitigation areas should be irregular in shape and have an irregular bottom providing both shallow and deep water habitat. The Corps should determine whether a reliable source of water is available for the wetland mitigation sites before implementing the plans.

RESPONSE: The mitigation plan will provide for an irregular shape and contouring of the wetland area to provide for varying depths. A reliable water source is available from Turkey Creek in addition to surface runoff which would meet the hydrologic requirements for wetland success.

5. RECOMMENDATION: Levees should be seeded with warm season grasses such as switch grass.

RESPONSE: The standard seed mix for levee vegetation includes such grasses as rye, brome and fescue. These grasses are used because they establish quickly, which reduces erosion on newly formed slopes. However, when possible, warm season grass mixes including switch grass and other native grasses and forbs would be utilized on flat areas on the landside of the levee such as the stability berms and the underseepage berms.

6. RECOMMENDATION: A buffer strip around the borrow areas should be planted with a mixture of warm season grasses, shrubs and trees that occur on the floodplain of the Missouri River.

RESPONSE: The mitigation plan includes a buffer strip of native grasses and forbs. This area would also be planted with native, bottomland hardwood trees and shrubs (refer to Sect. 6.1.6 of the EA).

7. RECOMMENDATION: Mitigation and borrow areas should be associated with the Missouri Department of Natural Resources? Katy Trail as much as possible.

RESPONSE: The 42 acre mitigation area would be located in the northwest corner of the project area. The Katy Trail runs adjacent to this site.

8. RECOMMENDATION: The Corps should consider the creation of an enhancement site to further increase fish and wildlife values in the vicinity of the project site.

RESPONSE: The authorized Missouri River Levee System Unit L142 is for purposes of flood damage reduction. Currently, no authorization exists for fish and wildlife enhancement purposes.

9. RECOMMENDATION: The Corps should mitigate for the losses of open space and floodplain values in the Cedar City area which was purchased under the Section 1362 Flooded Property Purchase Program.

RESPONSE: Currently, the local, non-Federal cost-share sponsor is working with local, state, federal and elected officials to resolve FEMA land restriction concerns.

10. RECOMMENDATION: If possible, the random borrow areas should be hydrologically connected to the Missouri River and provide water depths of eight feet or greater.

RESPONSE: This does not appear to be technically feasible, and is outside of project purposes and authorizations.

11. RECOMMENDATION: Brush shelters should be placed in the borrow areas to provide shelter for both fish and wildlife species.

RESPONSE: Concur. This recommendation will be implemented where feasible.

12. RECOMMENDATION: Islands should be created in the borrow areas to provide a safety barrier against predators.

RESPONSE: If the opportunity presents itself we would consider this recommendation during final designs. It appears that the only area this would be feasible is in the 42 acre proposed mitigation site in the northwest corner of the study area.

United States Environmental Protection Agency (U.S. EPA) Region VII: No official response was received from our June 1998 letter requesting comments. However, EPA Region VII subsequently provided a letter dated June 1, 1999, responding to our April 20, 1999 Public Notice of application for a Federal permit under Section 404 of the Clean Water Act.

Federal Aviation Agency: By letter of July 31, 1998, the FAA indicated the preferred levee design would not exceed FAA obstruction standards and would not be a hazard to aviation.

United States Department of Agriculture - Natural Resources Conservation Service (NRCS): Commented that levee unit L142 would cause higher upstream flood levels and more scouring downstream, encourage more development in a flood prone area, narrow the floodway, and result in filling of a wetland south of Mokane Road resulting in changed drainage patterns over a large area and possible litigation from adjoining landowners. The Fulton Field Office recommended a non-structural alternative to the levee.

State and Local Agencies

Missouri Department of Conservation (MDC): No official response was received from our June 1998 letter requesting comments.

Missouri Department of Natural Resources (MDNR): In a letter of July 24, 1998, the MDNR, Division of Environmental Quality made several recommendations that we considered in designing the wetland mitigation area as previously described.

Missouri Department of Transportation - Aviation Department: In a letter of September 29, 1998, the Missouri Department of Transportation - Aviation Department made recommendations that we considered in designing the wetland mitigation areas as previously described.

B. PUBLIC VIEWS AND COMMENTS

A public meeting on May 20, 1999, was held in conjunction with the project sponsors to present the NED/Preferred Plan. At that meeting and in correspondence received through May 31, 1999, we received comments on the NED/Preferred Plan. Appendix A, bound with this document, includes a tabular display of the comments and our responses to those comments including descriptions of changes made to the report or the project design in response to those comments. Non-Federal participation in the General Reevaluation Report was focused through public officials of the potential non-Federal sponsor, Jefferson City, Missouri, especially with regard to resolving issues directly related to the non-Federal obligation to provide the necessary LERRD. Jefferson City officials were successful in resolving the future of the Capital View levee after its eligibility for Public Law 84-99 assistance ends. In addition, Jefferson City requested a study to address flood damage reduction opportunities in the Wears Creek basin which can receive backwater flooding from the Missouri River. We also corrected inaccurate statements in the draft report relating to breaching of the Capital View levee and residual flooding of the MFA facility.

8.0. CONCLUSIONS

The feasibility analysis concludes that there is economic justification for a Federal flood damage reduction project at the study area in the vicinity of Missouri River mile 142. The NED Plan is a project with 0.1-percent chance of annual exceedance, or 1-in-1000 chance of overtopping in the base year of 2006. In the projection for year 2031, the annual exceedance probability is 0.2-percent, or a 1-in-500 chance of overtopping.

This plan would cost an estimated \$24,507,600 (October 2000 price level). Annual benefits of the plan total \$4,441,700, while annual costs are \$1,978,900. The plan has annual net benefits of \$2,462,800 and a benefit-cost ratio of 2.2 to 1.

This General Reevaluation Report for the Missouri River Levee System Unit L142, Jefferson City, Missouri, considered the public interest for all significant aspects of the potential project. Those aspects include environmental effects, compensation needs, social and economic effects, and engineering feasibility and effectiveness. We concluded that construction of a local flood damage reduction project on the left bank Missouri River at Jefferson City, Missouri, under the 1944 Flood Control Act (Public Law 534, 78th Congress, 2nd Session), is desirable and feasible.

9.0. RECOMMENDATION

I recommend that Unit L142, a system which includes a levee and closure structures to protect against a water surface elevation of 564.0 ft., NGVD (gauge reading 43.9, or about the 0.1-percent-chance flood event at time of project implementation), be approved for implementation as a Federal project under authority of the 1944 Flood Control Act, with such modifications as in the discretion of the Commander, HQUSACE, may be advisable.

George H. Hazel
Colonel, Corps of Engineers
District Engineer

Date

DISCLAIMER - *The recommendation contained herein reflects the information available at this time and current Departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a National Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for implementation funding. However, prior to transmittal to the Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any modification and will be afforded an opportunity to comment further.*

ENVIRONMENTAL ASSESSMENT

for the

**MISSOURI RIVER LEVEE SYSTEM
UNIT L142
JEFFERSON CITY, MISSOURI**

April 2001

**Prepared by the
Kansas City District
U.S. Army Corps of Engineers**

**GENERAL REEVALUATION REPORT
MISSOURI RIVER LEVEE SYSTEM
UNIT L142**

JEFFERSON CITY, MISSOURI

PLATES

- Plate 1. Asea Brown Boveri (ABB) Ring Levee
- Plate 2. Levee Alternatives 8 and 8a
- Plate 3. Levee Alternatives 9 and 9a
- Plate 4. Levee Alternatives 10 and 10a
- Plate 5. Levee Alternatives 11
- Plate 6. 1-Percent Missouri River Discharge Event Without Project
- Plate 7. National Economic Development / Preferred Plan
- Plate 8. Interior Flooding for the Preferred/NED Plan - 1.0% Chance
Missouri River Flood