



**US Army Corps
of Engineers**



Lower Missouri River Jefferson City L-142 Flood Risk Management Feasibility Study

Final Feasibility Report and Integrated Environmental Assessment

Appendix G Risk Assessment

July 2026



MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

TABLE OF CONTENTS

Table of Contents	i
List of Figures	i
List of Tables	i
1 General	1
1.1 Risk Assessment Team	1
1.2 Background.....	1
1.3 Existing Capital View Risk Assessment.....	1
2 Jefferson City L-142 Levee Features.....	6
3 2024 Risk Assessment	9
3.1 Inundation Scenarios	9
3.2 Methodology	10
3.3 Risk Assessment Results.....	14
3.4 Tolerable Risk Guidelines.....	15
3.5 IEPR	18

LIST OF FIGURES

Figure 1. Average Life Loss Plot from 2015 Capital View Screening Level Risk Assessment	5
Figure 2. Existing Capital View Drainage District Delineation	6
Figure 3. Proposed L-142 Alignment (Feasibility Study Alternative CA13).....	7
Figure 4. Proposed L-142 Alignment (pink) with assumed Breach Location (yellow)	10
Figure 5. Results of 2015 Capital View Screening Plotted on Life Safety Risk Matrix.....	11
Figure 6. Results of 2024 L-142 Jefferson City Feasibility Screening Plotted on Life Safety Risk Matrix	15
Figure 7. Life Risk Matrix with PFMs Plotted	16

LIST OF TABLES

Table 1. Risk Assessment PDT	1
Table 2. 2015 Screening Results for Prior to Overtopping	4
Table 3. 2015 Screening Results for Overtopping	5
Table 4. 2015 Screening Results for Overtopping and Prior to Overtopping Combined	5
Table 5. Proposed L-142 Loading Scenarios.....	9
Table 6. Breach Width and Development Times	9

1 GENERAL

1.1 Risk Assessment Team

The Risk Assessment team was comprised of a multi-disciplinary team of engineers, planners, geologists, and economists **Table 1**. The same PDT is currently working on the L-142 study.

Table 1. Risk Assessment PDT

Name	Office	Discipline
Reed Brown, PE	NWK-EDG-D	Facilitator
Ginger Niemann-Harper	NWK-PMP-C	Planner/PM
Jennifer Sciarra, PE	NWK-EDG-C	Civil Design
James Mehnert, PE	NWK-EDG-D	Geotechnical
Shelbi Swacker, PE	NWK-EDH-H	Hydrology and Hydraulics
Jennifer Wood, RG	NWK-PMP-C	Geologist
Noah Colby-George	NWK-PMP-C	Economist

1.2 Background

The study area for this project is within the leveed area of the existing Capital View levee. The Capital View levee system is a non-federally constructed levee that is active within the USACE Rehabilitation and Inspection Program (RIP). The Jefferson City L-142 Study has developed alternatives for a new federally constructed levee in this area.

The purpose of this risk assessment is to determine if an Independent External Peer Review (IEPR) will be required for this study per ER 1165-2-217 Civil Works Review Policy. A feasibility level risk assessment is also required in ER 1105-2-101, Risk Assessment for Flood Risk Management Projects, to evaluate the potential life-safety implications of the recommend plan and determine if it meets the USACE Tolerable Risk Guidelines.

1.3 Existing Capital View Risk Assessment

The Kansas City District completed a screening level risk assessment (SLRA) of the Capital View levee in 2015. This SLRA was reviewed and approved by headquarters USACE in 2017. A SLRA is a streamlined risk assessment that relies on existing data, historical performance, engineering judgment, and assumes pre-defined performance modes to quickly characterize the life-safety and economic risks associated with a given levee segment. A SLRA leverages the Levee Screening Tool (LST) and the team's engineering judgement to determine the annual probability of failure and potential life-loss and economic consequences associated with levee breach. Because Capital View is a non-federally constructed levee the available information regarding its design, construction, and past performance is limited. The 2015 screening was primarily based on damages and distresses documented in historical Project Information Reports (PIRs) from flood events in 1993 through 2016, simplified assumptions of non-federal levees, and engineering judgment. The simplified assumptions that were used on all non-federal levee screenings include that the levees have 1 on 3 vegetated side slopes, that the crown is 10

feet wide, that there was little to no compaction effort, that there is no zoning of materials, that materials are locally sourced soils pushed up or shaped into the shape of a levee, that they will always breach when overtopped, and that the levee toe is loaded when the closest MO River gage is at flood stage.

Hydraulic inputs for the Capital View levee screening included the Annual Exceedance Probabilities (AEPs) associated with toe loading and overtopping. At the time of the 2015 SLRA, the Upper Mississippi River System Flow Frequency Study (UMRSFFS) study was the most up to date hydraulic model of the Missouri River. Accordingly, it was used to develop stage-frequency relationships for the SLRA. Since the team did not have a rating curve for the Capital View levee, toe loading was set at the elevation of flood stage at the nearest river gage. Flood stage on the Jefferson City gage is 23 feet. This corresponded to an approximate AEP of 1/1.3 year for toe loading, and a representative AEP of 1-year was selected in the screening tool. The overtopping stage for Capital View levee is 30.5 feet at the Jefferson City gage. According to the NWS rating curve, a stage of 30.5 feet corresponds to a discharge of 332,000 cfs. Based on the frequency discharges found in the UMRSFFS at the Jefferson City gage, 332,000 cfs has a 14% AEP. A representative AEP of 10% was selected in the screening tool to represent the overtopping frequency.

The Capital View leveed area is approximately 3,300 acres of mixed commercial, residential, and agricultural land. The 2015 screening estimated the population at risk to be 600 during the day and 17 at night. The nighttime population of 17 was based on the residential population. The daytime population was driven by the ABB manufacturing plant. The LST estimated a total of 13 structures in the leveed area with a value of \$3.8 Million (FY 2006 dollars) based on the NLD Base Consequence data. The screening team updated the infrastructure value to \$4.8 Million in 2015 dollars. The SLRA identified the regional airport, but it is not clear if it was fully included in the infrastructure value.

The performance ratings were based largely on past performance. Based on Missouri River at Jefferson City gage height records, the levee has been loaded in excess of 75 percent of its height 14 times between 1983-2013. Two of those times, 1993 and 1995, the levee overtopped and subsequently breached. No issues with performance prior to overtopping have been documented. A Low Likelihood of failure rating was assigned to all three primary performance factors related to breach prior to overtopping: Seepage, Stability, and Erosion. The Capital View levee has no closures, so closures were not rated. Due to historical performance of the Capital View and similar non-federally constructed levees, the levee was rated as Highly Likely to breach once overtopped. There were no concerns with warning as the Missouri River is slow rising and forecasts are issued days to weeks in advance. There was no life loss when Capital View overtopped and breached in 1993 or 1995.

The SLRA resulted in a Levee Safety Action Classification (LSAC) of 4/Low. Results are shown in **Table 2**, **Table 3**, and **Table 4** and are plotted in **Figure 1**. Because the AEP of overtopping is relatively frequent, at 14 percent, overtopping was the primary risk driver. The prior to overtopping average life loss was estimated at 0.1 and the overtopping average life loss was estimated at 0.08, resulting in an incremental life loss less than 1.

1.3.1 Performance modes

OVERTOPPING LEADING TO BREACH

The 2015 SLRA determined that life-safety risk within the leveed area was predominately a product of overtopping and breach of the levee embankments. At the time of the assessment Capital View levee had breached because of overtopping twice from 1993 to 2015. The 2015 SLRA estimated the APF of breach after overtopping was approximately $1\text{E-}01$. With the AEP of a top of levee loading as approximately 0.14, the representative AEP of 0.10 was selected in the screening tool, resulting in a system response of 1 for overtopping during the top of levee loading.

EMBANKMENT AND FOUNDATION SEEPAGE AND PIPING

The 2015 SLRA based its performance assessment mainly on historical performance of the existing levee embankments found in PIRs prepared for the Rehabilitation and Inspection Program (RIP). The levee has been loaded to 75% or more of their exposed height at least 14 times in the past 30 years. There is no available information of any seepage related distresses associated with these historical flood events. The APF estimated by the Levee Screening Tool was approximately $1.7\text{E-}04$. Given an AEP of 0.14 for top of levee loading and an AEP of 1.0 for levee toe loading, this results in a system response of approximately $7\text{E-}04$.

EMBANKMENT EROSION

The 2015 Capital View SLRA rated erosion as low likelihood of failure. Similarly, to the seepage assessment this determination was made based on historical performance of the levee during previous flood events. While there has been some scour documented in previous flood events, none of the scour damages have led to embankment instability or breach. The APR estimated by the Levee Screening Tool was approximately $1.2\text{E-}04$. Assuming an AEP of 0.14 for the top of levee loading and an AEP of 1.0 for levee toe loading, the system response would be approximately $7\text{E-}04$ for the erosion performance mode.

EMBANKMENT STABILITY

The 2015 Capital View SLRA rated stability as low likelihood of failure because the existing embankment has not experienced any slope failures or significant stability-related distresses. The embankments of the existing Capital View levee have similar, but small, geometry along the alignment. The levee's grass slopes are approximately 1V:3H, with a 10-foot-wide crest. This geometry is proven to be a stable embankment geometry throughout the Kansas City District. The Levee Screen Tool estimated the APF due to slope instability to be approximately $3\text{E-}05$. Given an AEP of 0.14 at top of levee loading and an AEP of 1.0 for levee toe loading, the SRP was estimated to be $2\text{E-}04$.

1.3.2 Life loss consequences

EVACUATION EFFECTIVENESS

The 2015 Capital View screening gave the following ratings for Evacuation Effectiveness:

- Evacuation Planning: U (.9)
Critical infrastructure within the leveed area includes the Jefferson City Memorial Airport. No evacuation plan exists, and no evacuation planning has been completed. Any evacuation efforts will be developed as they are needed during flood events.
- Community Awareness: A (.98)
The leveed area has been flooded multiple times in the last 30 years. This flooding, and general flooding events along the Missouri River over the past ten years, have resulted in a very flood-aware community. Community members understand that the leveed area is the Missouri River floodplain and engage in public meetings regarding the Missouri River and other flooding related issues.
- Flood Warning Effectiveness: M (.95)
Missouri River floods are slow rising with ample time for warning of imminent overtopping. River forecasts are routinely issued for up to five days in advance. The sponsor works with the local officials in providing flood warnings and evacuation notices.
- Transportation System Congestion Factor
Day: 1
Night: 1

ESTIMATED LIFE LOSS

The 2015 SLRA estimated the life loss associated with overtopping and breach, as well as that associated with breach prior to overtopping, to be approximately 0.1 lives/year. This was based on the Levee Screening Tool's methodology and the input information documented above.

Table 2. 2015 Screening Results for Prior to Overtopping

Prior To Overtopping	
Annual Probability of Inundation	1.87E-04
Average Life Loss	1.03E-01
Average Annual Life Loss	1.93E-05
Average Property Damages (in 1000s)	\$1,132.00
Average Annual Property Damages (in 1000s)	\$0.20

Table 3. 2015 Screening Results for Overtopping

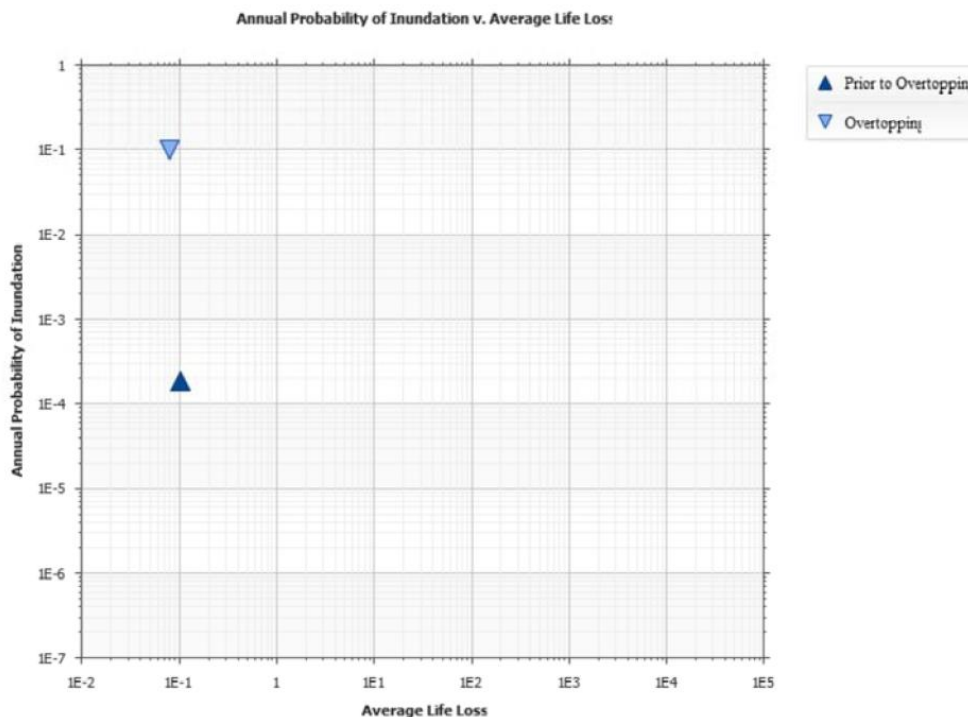
Overtopping	
Annual Probability of Inundation	1.00E-01
Average Life Loss	7.98E-02
Average Annual Life Loss	7.98E-03
Average Property Damages (in 1000s)	\$1,132.00
Average Annual Property Damages (in 1000s)	\$113.20

Table 4. 2015 Screening Results for Overtopping and Prior to Overtopping Combined

Combined	
Annual Probability of Inundation	1.00E-01
Average Life Loss	7.99E-02
Average Annual Life Loss	8.00E-03
Average Property Damages (in 1000s)	\$1,131.00
Average Annual Property Damages (in 1000s)	\$113.00

ANNUAL PROBABILITY OF INUNDATION V. AVERAGE ANNUAL LIFE LOSS

Quantitative View

**Figure 1. Average Life Loss Plot from 2015 Capital View Screening Level Risk Assessment**

2 JEFFERSON CITY L-142 LEVEE FEATURES

The Jefferson City L-142 levee will reduce flood risk to a portion of the Capital View leveed area. Along the Missouri River reach, the federal L-142 Levee will be set back 1,500 to 3,000 feet behind the current Capital View alignment as shown in **Figure 2**. The leveed area will be reduced from 3,300 acres to approximately 1,900 acres, delineated in **Figure 3**. Apart from two properties, all current residential structures landward of Capital View will remain landward of the L-142 levee. The new top of levee elevation will be selected to pass the 0.01 (1 in 100) AEP flood event on the Missouri River. The AEP for toe loading of the set-back levee will be approximately 0.294, or a 1 in 3.4-year occurrence.

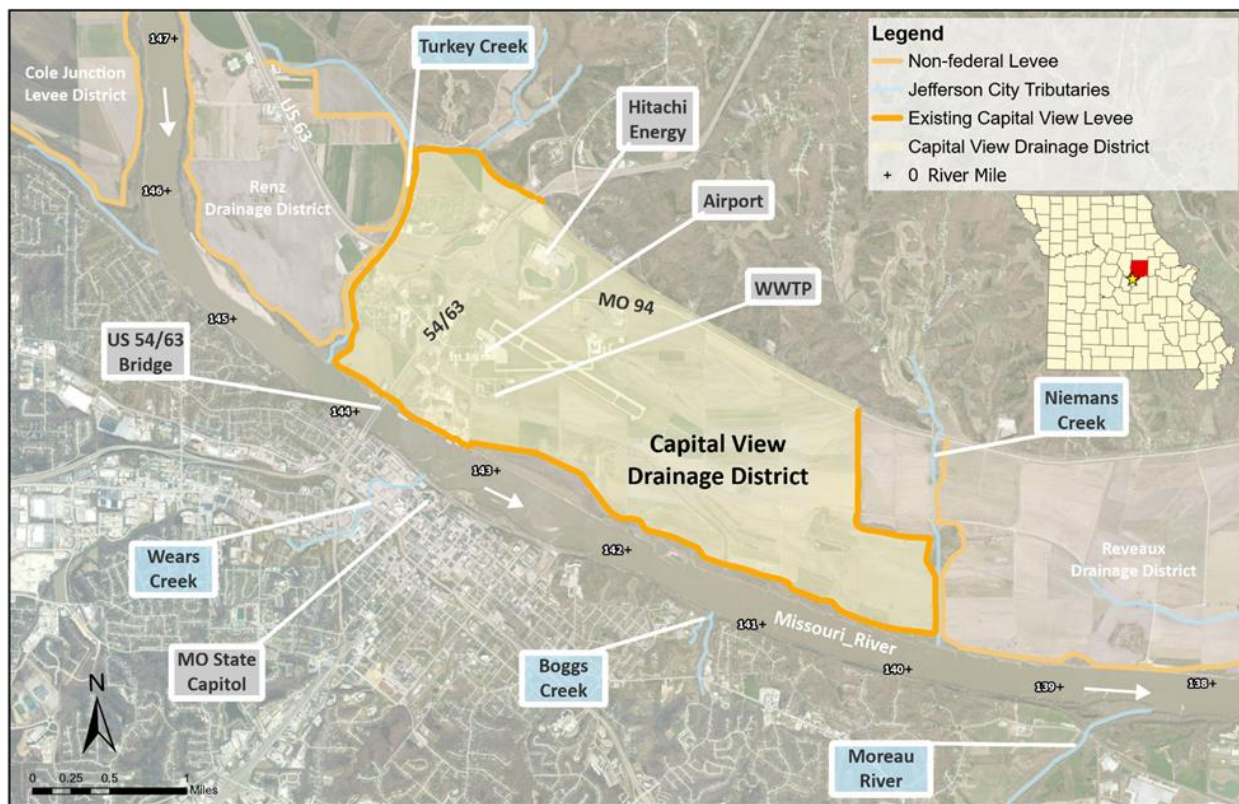


Figure 2. Existing Capital View Drainage District Delineation

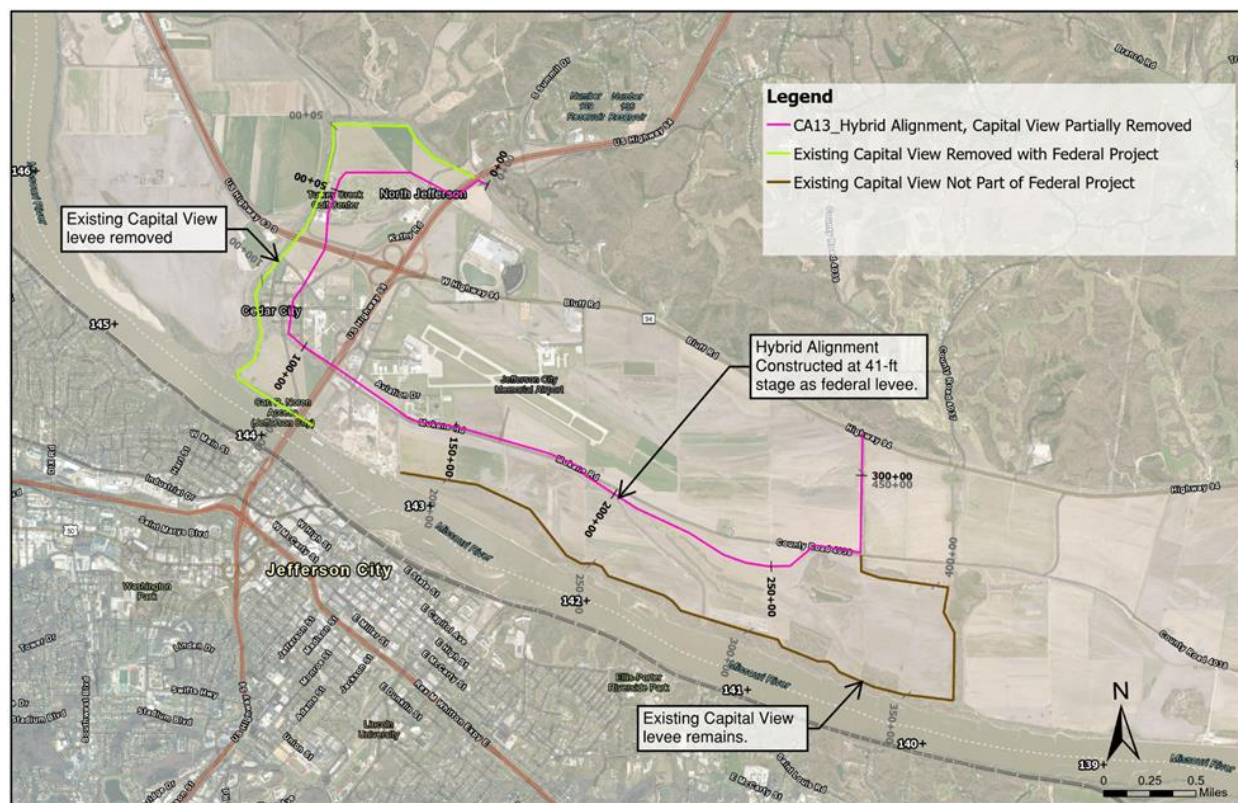


Figure 3. Proposed L-142 Alignment (Feasibility Study Alternative CA13)

The new L-142 levee will be constructed from station 0+00 to 318+73 with a length of 30,723 feet (5.82 miles) of new earthen embankment. The average height of the embankment is 14.0 feet above ground surface. The embankment is zoned with impervious and random fill materials. The embankment would be a minimum of 10 feet wide surfaced with aggregate to allow for operation and maintenance of the project. Seepage analysis was performed, requiring the project to include approximately 18,500 linear feet of landside underseepage berms extending 150 feet from the landside levee toe with an average height of 3 feet. Underseepage berms are comprised of random material. Stability analysis was performed and would require construction of approximately 11,600 linear feet of landside stability berms, which extend 20 feet from the landside toe of the levee and have a minimum height of 3 feet. Stability berms are comprised of random material and are constructed to the same level of compaction as the levee embankment. The embankment and stability berms would be capped with 4 inches of topsoil and vegetated. The underseepage berms, where farmed, would be capped with 12 inches of topsoil and temporarily vegetated. Riverside armoring with riprap slope protection is required where high velocities pose a risk to embankment erosion. The riprap and bedding would be constructed along approximately 3,120 linear feet on part of the western reach facing the Missouri River. The existing CV Levee embankment and drainage pipes would be removed between Station 0+00 and 160+00. Approximately 11 new drainage structures would be constructed to maintain proper drainage within the protected area. Eight gatewell structures will be constructed. It is estimated that three portable pumps are necessary for interior drainage. Drainage features would be evaluated and potentially combined to efficiently drain the interior.

Borrow material to construct the features would be hauled in from Church Farm levee upstream and from adjacent properties. Borrow sources are not finalized but identified sources will provide enough material.

Up and over ramps would be installed to maintain access to properties and businesses along the project. Five closure structures would be necessary at the Katy Trail, Cedar City Drive, Hibernia Road, Highway 94 and Katy Trail.

A substantial number of utilities would be required to be relocated with the Federal Interest Plan. The alignment would extend through well-developed areas and impact on a variety of utility services. Relocations would include waterlines, overhead electric lines and power poles, sanitary sewer force mains, sanitary sewer gravity mains, gas lines, telephone lines, fiber lines, storm drainage utilities, and communication lines. All project features will be designed to meet current deterministic design standards and applicable factor of safety for new levees. Internal drainage needs will be designed to the requirements of EM 1110-2-1413, "Hydrologic Analysis of Interior Areas".

3 2024 RISK ASSESSMENT

To understand the life-safety implications of potential levee raises or modifications, the PDT determined a risk assessment was the best method for comparing the existing Capital View levee and the proposed L-142 levee. The risk assessment would also help the PDT determine if an IEPR was necessary during the feasibility stage of the project.

3.1 Inundation Scenarios

Inundation was evaluated for proposed fully loaded top of levee (TOL) and 1-foot overtopping loadings for the proposed L-142 alignment, listed in **Table 5**. Proposed L-142 Loading Scenarios. The TOL condition is at the Jefferson City study location is equivalent to the 0.01 (1 in 100) AEP flood event on the Missouri River. The 1-foot overtopping condition at the Jefferson City study location is equivalent to the 0.002 (1 in 500) AEP flood event on the Missouri River. with a breach at the historic levee stress point.

Table 5. Proposed L-142 Loading Scenarios

Loading Scenario	Missouri River Peak Flow (cfs)	AEP
Fully Loaded to Top of Levee, No Breach	588,000	0.01
Fully Loaded to Top of Levee, Breach	588,000	0.01
1-foot Overtopping, Breach	748,000	0.002

The assumed, likely levee breach location for the proposed L-142 alignment is shown in **Figure 4**. This location was determined by analyzing historic breach locations along the existing Capital View levee. Hydraulic factors resulting from the hydraulic expansion downstream of the bridge suggest the approximate midpoint of the riverside levee is likely to continue to be stressed in flood scenarios. Therefore, this breach location was selected for this analysis. Other breach factor inputs utilized MMC modeling standards, with breach timing assumed to occur at the hydrograph peak at River Station 142.58. See **Table 6** for modeled breach assumptions.

Table 6. Breach Width and Development Times

Breach Scenario	Failure Mode	Breach Width (ft)	Development Time
L-142 Breach - All	Overtopping, at peak flow	500	12 hours

The hydraulic modeling for the risk analysis included a non-breach, fully loaded levee condition at a 0.01 AEP storm, breach condition at a 0.01 AEP storm and breach condition at a 0.002 AEP storm.

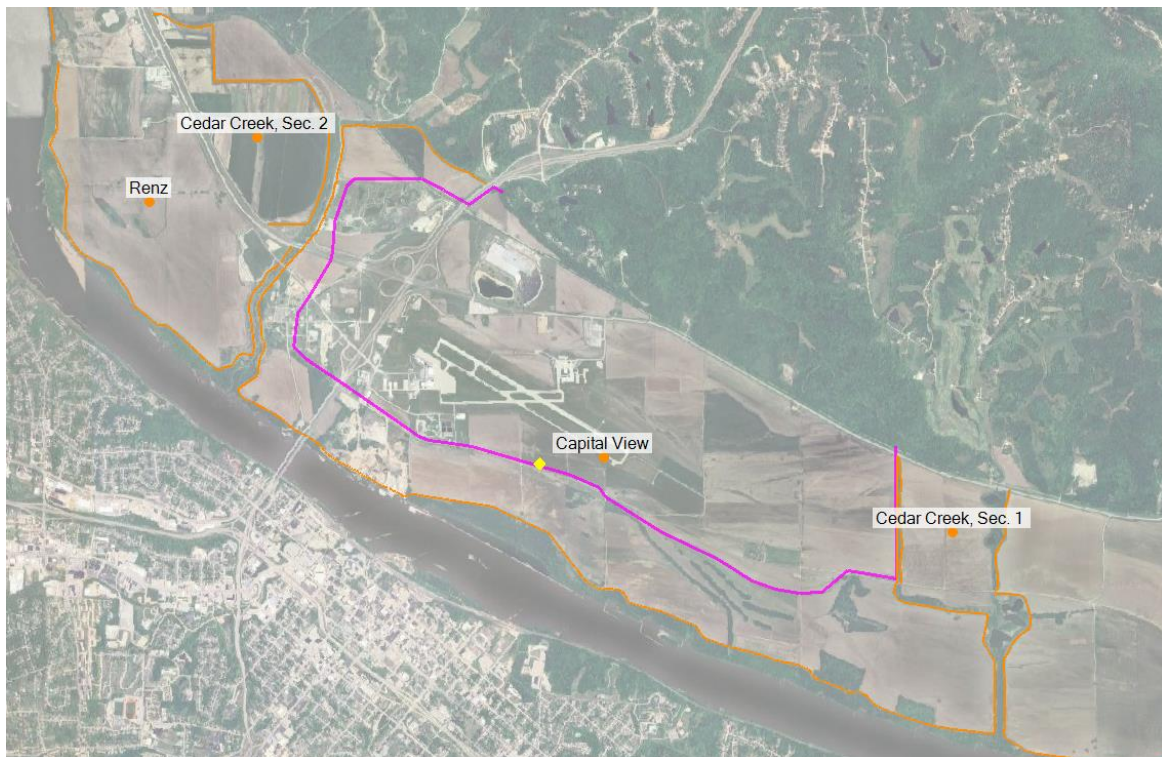


Figure 4. Proposed L-142 Alignment (pink) with assumed Breach Location (yellow)

3.2 Methodology

Since the proposed alignment is not in the National Levee Database (NLD), it cannot be re-screened with LST 2.0. Currently USACE is adding the capability to screen levee alignments not in the NLD with the LST. However, at the time of the risk assessment this feature was not available. Accordingly, the results from the 2015 Capital View Screening were plotted in a Life Safety Risk Matrix, shown in **Figure 5**. PFM 1 is Seepage and Piping (BEP), PFM 2 is Erosion, and PFM 3 is Stability. The risk assessment team used the annual probability of failure and AEP of top of levee loading to develop an estimate for the system response of the existing Capital View levee. This system response was assumed to be the baseline performance condition for the L-142 proposed alignment. The team developed the APF for the L-142 system by adjusting the AEP of a top of levee loading event based on the updated design water surface and hydraulic modeling, revising the system response as necessary based potential features and design requirements, and updating the life-loss consequences based on LifeSim consequence modeling.

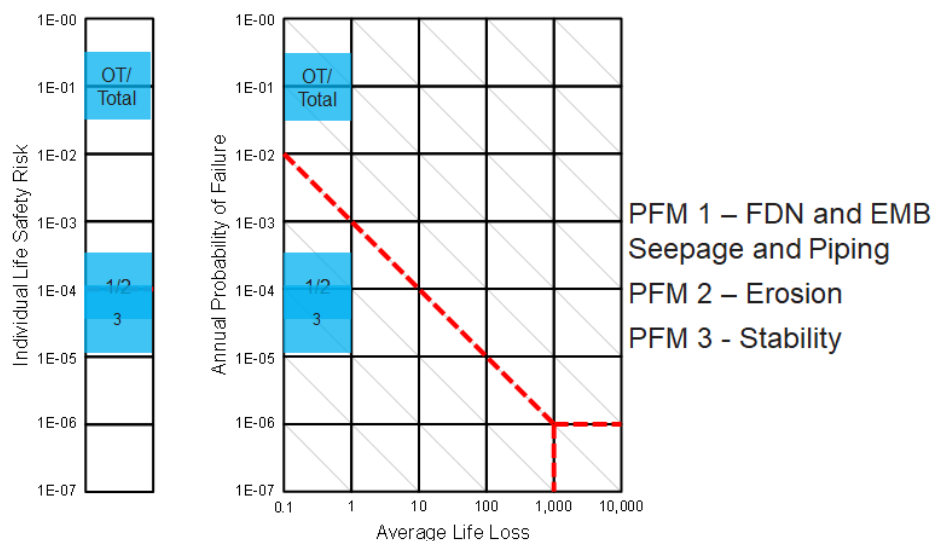


Figure 5. Results of 2015 Capital View Screening Plotted on Life Safety Risk Matrix

3.2.1 Overtopping

Annual Probability of Failure: Between 1E-03 and 1E-02

Rationale: The team estimated that the levee would likely breach when overtopped by more than 1 foot of sustained flows. The AEP of a top of levee event is 0.01, and the AEP of a 1-foot OT event is approximately 2E-03. The L-142 levee will be designed with a controlled overtopping location, but this is unlikely to significantly change the likelihood of breaching during a sustained 1-foot overtopping event. Ultimately, the PDT determined the APF to be between 1E-03 and 1E-02.

Consequences: Due to the increased levee height, broader leveed area, and slightly increased depths of inundation the life loss consequences were estimated to increase to between 0.3 and 3. The leveed area is not densely populated, and evacuation routes are short, less than two miles. The Missouri River is a slow rising system that would allow days to weeks of advanced notice before a large-scale flood loaded the system. Based on the updated LifeSim modeling, estimated the day life loss was 3 and the nighttime incremental life loss was 0. The team determined the average annual life loss would be between 0.3 and 3, with an average annual life loss of 1.

3.2.2 PFM 1: Foundation and Embankment Seepage and Piping

Annual Probability of Failure: Between 3E-06 and 3E-05

Rationale: The Capital View levee has a history of satisfactory performance with regards to seepage related distresses, in its current configuration. However, the proposed L-142 project will be built to a higher elevation. The excess head on the riverside of the levee will impact the performance with respects to seepage. However, the new alignment will be set back from the current alignment, lowering the annual probability of poor performance. Due to the alluvial deposition environment, the setback could have an impact on the seepage performance of the levee. However, the PED phase of the project will include sufficient subsurface investigations

and laboratory testing to characterize the site and develop the necessary seepage mitigation measures. Seepage berms, relief wells, or other underseepage mitigation measures will be designed and constructed where necessary, as determined by the PED site characterization efforts. Historically, the Kansas City District has constructed hundreds of seepage mitigation measures throughout the district's area of responsibility. These underseepage berms and relief wells have a long history of satisfactory performance through numerous flood events. The measures for the L-142 Levee will be designed to meet applicable factors of safety for flood loadings up to the top of levee elevation. The embankments will include an inspection trench too ensure shallow lenticular deposits of coarse-grained soils are removed, or cutoff, across the levee's foundation. Due to the inherent heterogeneity of alluvial depositions, the possibility of seepage distresses during flood events cannot be eliminated. However, USACE and local levee districts have a proven record of successfully flood fighting seepage-related distresses during large-scale flood events. Accordingly, the team determined that system response estimated in the 2015 SLRA was appropriate for the post-raise/modification levee. Assuming a system response of $1E-04$, and a top of levee AEP of 0.01, the APF for this PFM was estimated to be between $3E-06$ and $3E-05$.

Consequences: The increased levee height and increased depths of inundation could increase the life loss consequences, but the leveed area is not densely populated and evacuation routes are short, less than two miles. Most of the population is concentrated at Hitachi Energy where flood depths are shallow and evacuation is less than one mile. The Missouri River is a slow rising system that would allow days to weeks of advanced notice before a large-scale flood loaded the system. Based on the updated LifeSim modeling estimated the day life loss was 3 and the nighttime incremental life loss was 0. The team determined the average annual life loss would be between 0.3 and 3, with an average annual life loss of 1.

3.2.3 PFM 2: EROSION

Annual Probability of Failure: Between $3E-06$ and $3E-05$

The new L-142 levee embankment will be protected against erosion by a stand of turf grasses or riprap, depending on the anticipated velocities along the riverward face. During PED various hydraulic models will be used to determine the appropriate armoring/erosion protection for each design reach of the embankment. Levees throughout the Kansas City District have performed well with regards to erosion. The district has recently designed several levee modifications which included slope protection, increasing the likelihood that erosion protection measures will be designed in accordance with appropriate guidance. Additionally, the new L-142 levee will be set back 1,500 to 3,000 feet from the current alignment. This increase in the foreshore riverward of the levee will reduce the velocities of flow along the embankment, ultimately reducing the likelihood of scour leading to breach. However, the new L-142 levee will be constructed to a higher elevation than the current Capital View levee; potentially increasing the peak velocity of flow developing during top of levee river stages. Accordingly, the team determined that system response assumed for the 2015 SLRA was appropriate for the post-modification levee. Given an AEP or 0.01 for top of levee loading for the L-142 Levee and an SRP of $7E-04$, the APF for the raised L-142 levee would be between $3E-06$ and $3E-05$.

Consequences: The increased levee height and increased depths of inundation could increase the life loss consequences, but the leveed area is not densely populated and evacuation routes are short, less than two miles. Most of the population is concentrated at Hitachi Energy where

flood depths are shallow and evacuation is less than one mile. The Missouri River is a slow rising system that would allow days to weeks of advanced notice before a large-scale flood loaded the system. Based on the updated LifeSim modeling estimated the day life loss was 3 and the nighttime incremental life loss was 0. The team determined the average annual life loss would be between 0.3 and 3, with an average annual life loss of 1.

3.2.4 PFM 3: Stability

Annual Probability of Failure: Between 1E-6 and 1E-05

The new L-142 levee will be designed to meet requirements in EM 1110-2-1913, including steady-state seepage conditions assuming both drained and undrained shear strength parameters. The PED phase will include sufficing subsurface investigations and laboratory testing programs to adequately characterize the levee's foundation and potential sources of embankment materials required for construction. The through-seepage models will be calibrated to blanket theory underseepage analysis to ensure consistency. The embankments will include internal sand drains or stability berms as necessary to ensure adequate factors of safety. The Kansas City District has a long history of designing and constructing stable earthen embankments, with satisfactory performance across the full range of loading. The embankment construction will include a continuous inspection trench to ensure that in-situ foundation materials are similar to those used in the design of the embankments. The new L-142 levee would be expected to perform as designed under all loading conditions. Given an AEP of 0.01 for L-142 top of levee loading and an SRP of 2E-04, the APF was assumed to be between 1E-06 and 1E-05.

Consequences: The increased levee height and increased depths of inundation could increase the life loss consequences, but the leveed area is not densely populated and evacuation routes are short, less than two miles. Most of the population is concentrated at Hitachi Energy where flood depths are shallow and evacuation is less than one mile. The Missouri River is a slow rising system that would allow days to weeks of advanced notice before a large-scale flood loaded the system. Based on the updated LifeSim modeling estimated the day life loss was 3 and the nighttime incremental life loss was 0. The team determined the average annual life loss would be between 0.3 and 3, with an average annual life loss of 1.

3.2.5 Closure Structures

Annual Probability of Failure: Less than 1E-07

Rationale: Closure structures were not evaluated in the 2015 SLRA because there are no closure structures on the Capital View levee. The current design for the L-142 levee includes four closure structures at the Katy Trail, Cedar City Drive, Hibernia Road, and Highway 94/Katy Trail. The closure structures will be designed to meet requirements in EM 1110-2-1913. The Missouri River is slow rising, resulting in several days of advance notice during large-scale flood events. This would provide sufficient time to initiate setting the closures, reducing the likelihood of failing to install the closures. Due to the limited size of the closures, the potential for differing site conditions in the foundations or other anomalies leading to poor flood performance are lower than the other PFMS discussed above. The closures will be designed to meet the requirements of EM 1110-2-1913, EM 1110-2-2502, and EM 1110-2-2107. Additionally, the sills of the closure structure will be designed to mitigate internal erosion beneath the closure. The Kansas City District has designed and constructed numerous closure structures across the 5-

state area of responsibility. These structures have a long history of satisfactory performance across the district. Accordingly, the team estimated the APF of the closure structures was less than 1E-07. Accordingly, it did not plot on the Life-Safety Risk Matrix.

Consequences: The leveed area is not densely populated and evacuation routes are short, less than two miles. There is only a small residential population. Most of the population is concentrated at Hitachi Energy where flood depths are shallow and evacuation is less than one mile. The Missouri River is a slow rising system that would allow days to weeks of advanced notice before a large-scale flood loaded the system. The greatest risk to performance prior to overtopping would be from underseepage. Underseepage failures are not sudden. They progress slowly giving adequate warning time.

This area is very aware of their flood risk. Levees upstream and downstream would be overtopped prior to water reaching the top of the new L-142. Even with construction of a new federal levee, they would still be aware of the potential for breach. Levee breaches on the Missouri River are not uncommon. There is no local interest in accrediting this levee, so there is not expected to be an increase in development after construction. The area will remain mapped as Zone A on the FEMA flood insurance rate maps (FIRMs). Based on the updated LifeSim modeling estimated the day life loss was 3 and the nighttime incremental life loss was 0. The team determined the average annual life loss would be between 0.3 and 3, with an average annual life loss of 1. Capital View has overtopped and breached three times since 1993 with no life loss.

3.3 Risk Assessment Results

The results of the 2024 Feasibility Risk Assessment are shown below, in **Figure 6**. The annual probability of failure for overtopping was lowered by 1.5 orders of magnitude. The new levee will have an overtopping AEP of 0.01. The AEP for one foot overtopping is approximately 0.002. The total Life-Safety Risk is driven primarily by breach after overtopping, with all breach prior to overtopping PFMs plotting at least 1.5 orders of magnitude lower than the overtopping PFM.

The life loss consequences in the 2015 SLRA were shifted to be lower in this risk assessment based on the LifeSim model for CA13 that shows a life loss prior to over topping of 0.1 and an overtopping average life loss of 0.08. Although there will be an increase in the depth of inundation, the population at risk is highly aware of the flood risk and the warning will be long. There has been zero life loss attributed to the three past overtopping's of the Capital View levee.

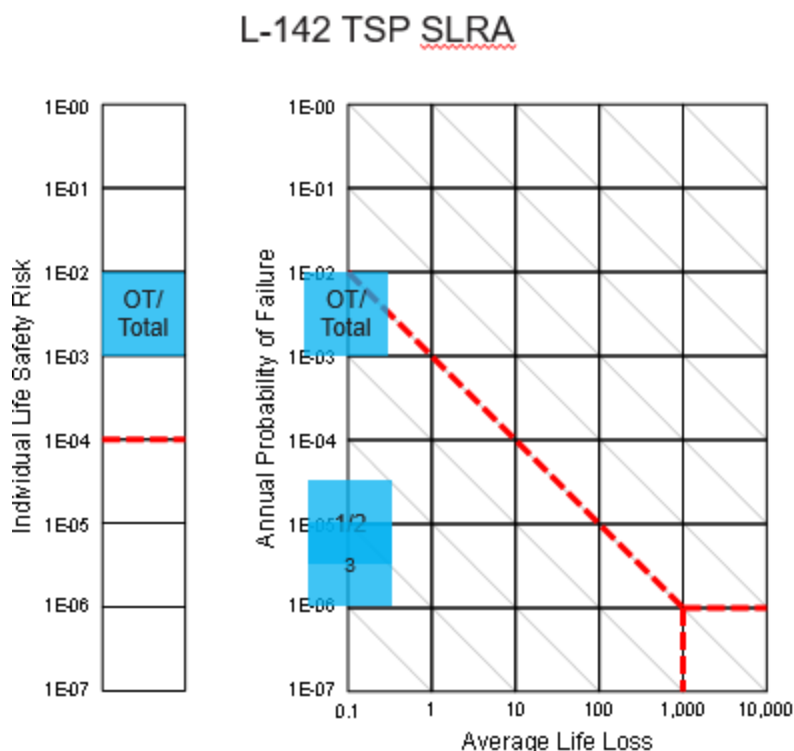


Figure 6. Results of 2024 L-142 Jefferson City Feasibility Screening Plotted on Life Safety Risk Matrix

3.4 Tolerable Risk Guidelines

One of the main goals of planning studies that include proposed levee systems and dams is to achieve all four Tolerable Risk Guidelines (TRG). Where TRGs are not currently met, measures and alternatives can be formulated to reduce risk and achieve all four TRGs. USACE considers risk to life safety related to the TRGs from two perspectives, societal life risk and individual life risk. The Societal Life Risk Line and the Individual Risk Line are shown on **Figure 7**.

1. Societal life risk is the risk of widespread or large-scale catastrophes from the inundation of a leveed or dammed area that would result in a negative societal response. In general, society is more averse to risk if multiple fatalities were to occur from a single event. In contrast, society tends to be less averse to risks that result from many events resulting in only one or two fatalities, even if the total losses from the small events are larger than that from the single large event.
2. Individual life risk is represented by the probability of life loss for the identifiable person or group by location that is most at risk of loss of life due to a levee or dam breach. Individual life risk is influenced by location, exposure, and vulnerability within a leveed or dammed area.

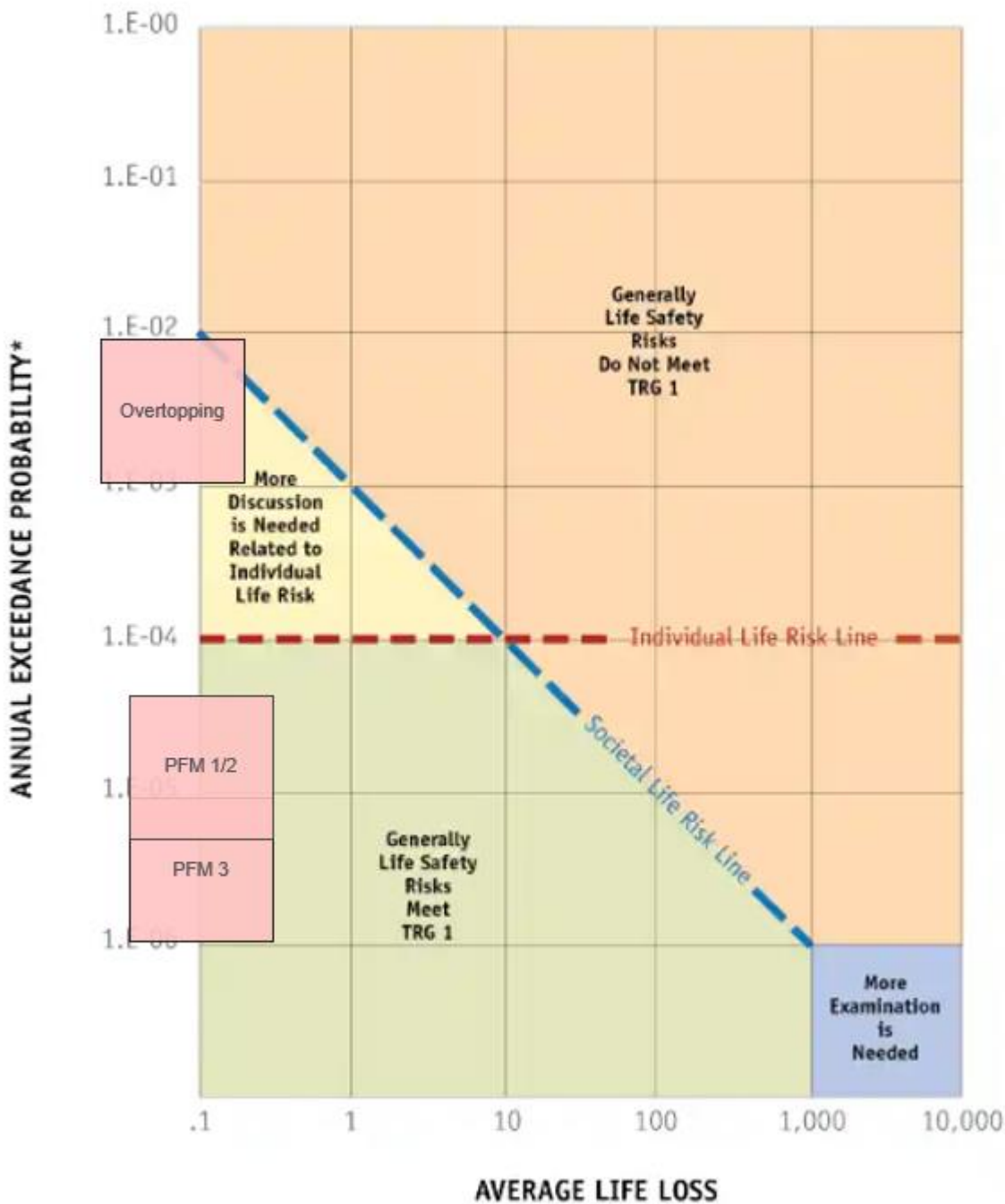


Figure 7. Life Risk Matrix with PFMs Plotted

The Federal Interest Plan of CA13 adequately addresses TRGs 1 and 4 to the extent practicable. Once the project is complete, the sponsor, along with USACE, will continue to meet TRGs 2 and 3 through regular operations and maintenance and risk communication activities. Below is a discussion of all four TRGs and how they are being met by the Federal Interest Plan.

TRG 1: Understanding the Risk

The first tolerable risk guideline involves considering whether society is willing to live with the risk associated with the levee system to secure the benefits of living and working in the leveed area. In other words, it answers a basic question: are the risks commensurate with the benefits?

The life risk matrix is used to evaluate compliance with TRG 1. Risks that plot above the societal life risk line are considered unacceptable except in exceptional circumstances. With an average life loss for overtopping of 0.08, the overtopping PFM on CA13 plots just below the societal life risk line. Overtopping does plot above the individual risk line, which is common for levee projects. Building a taller levee would reduce the probability of overtopping but would likely result in increased life loss if the sponsor decides to accredit the levee through FEMA. With the Federal Interest Plan, the population of the leveed area is not expected to increase as the area will still be mapped as a special flood hazard area. The Federal Interest Plan meets TRG1 as the life risk is reduced as much as practical. Once the project moves into design, additional resiliency measures will be looked at to further reduce the likelihood of breaching due to overtopping as well as the damages caused from an overtopping breach.

TRG 2: Building Risk Awareness

The second tolerable risk guideline involves determining that there is a continuation of recognition and communication of the levee and/or dam risk, because the risk associated with levee systems and/or dams are not broadly acceptable and cannot be ignored. The rationale for addressing TRG 2 will be determined qualitatively and may be met through USACE levee and dam safety program activities and/or the levee or dam sponsor's activities, which includes risk communication. If the non-federal sponsor is very active in building risk awareness, then the levee system or dam project addresses TRG2.

Being built in the floodplain of the Missouri River, this community is highly aware of their flood risk. Capital View levee has overtopped and breached three times in the past 35 years. The project area is currently mapped on FEMA FIRMs as a Zona AE, Special Flood Hazard Area Subject to Inundation by the 1% Annual Chance Flood. Construction of Federal Interest Plan will not affect that classification. Currently TRG 2 is met. Once the project is constructed the sponsor, along with USACE, will continue to build risk awareness in the leveed area through routine and non-routine activities.

TRG 3: Fulfilling Daily Responsibilities

The third tolerable risk guideline involves determining that the risks associated with the levee system and/or dam are being properly monitored and managed by those responsible for managing the risk. The rationale for addressing TRG 3 will be determined qualitatively and may be met through USACE levee and dam safety program activities and/or levee or dam sponsor activities. TRG 3 can be met through demonstrated monitoring and risk management activities. This would include an active operation and maintenance program, visual monitoring (documented regular inspections), updated and tested emergency plan, instrumentation program, and interim risk reduction measures plan.

As shown through this risk assessment, construction of a new federal levee reduces risk to the leveed area. Proper operation and maintenance and regular inspections and monitoring are an essential part of reducing risk. Once the project is constructed, Jefferson City will be the non-federal sponsor. The city has been made aware of the requirements for operation, maintenance,

repair, rehabilitation and replacement (OMRR&R) of the project and the associated costs. They have a sufficient tax funding to implement a successful OMRR&R program. USACE will assess the sponsor's operation and maintenance program as well as their emergency planning activities and flood fight preparedness through Levee Safety program activities.

TRG 4: Actions to Reduce Risk

The fourth guideline is determining if there are cost effective, socially acceptable, or environmentally acceptable ways to reduce risks from an individual or societal risk perspective. If it is determined that there are no cost effective or acceptable ways to further reduce risks, USACE may consider this an exceptional circumstance and therefore might consider the levee and/or dam risk to be tolerable even if the life safety risk exceeds the associated tolerability guideline under TRG 1.

Although CA13 does plot above the individual life risk line, this risk is considered reduced as much as practically possible. The community has a high awareness of their flood risk, there is a long warning time prior to the levee being overtopped and there is a history of successful evacuation of the area during previous flood events. The only structural option to further reduce risk would be to build the levee higher, which is cost prohibitive and not desirable by USACE or the sponsor. A taller levee would have a higher likelihood of the community acquiring FEMA accreditation. FEMA accreditation would lead to increased population in the leveed area by removing the requirement of mandatory flood insurance. This would increase the annual life loss estimate and possibly increase life risk. The risk for the Federal Interest Plan CA13 is considered to be reduced as much as practically possible.

3.5 IEPR

An IEPR is the most independent level of review. This review is applied in cases where the uncertainties, risk, and magnitude of the proposed project are such that a critical examination by a qualified team outside of USACE is warranted. ER 1165-2-217 Civil Works Review Policy Guidance identifies IEPR risk-informed decision triggers. The L-142 Review Plan documents potential for a mandatory trigger requiring an IEPR as it relates to cost being greater than \$200 million. Exclusion conditions listed below believe to provide the justification for not conducting an IEPR:

Mandatory IEPR Triggers

- Has the Chief of Engineers determined the project is controversial? No, however, the initial design of L-142 drew controversy to the point that the designed levee was never constructed.
- Has the Governor of an affected state requested an IEPR? No, the Governor of Missouri has not requested an IEPR to date.
- Is the cost of the project more than \$200 million? Yes, the project cost is above \$200M.

Discretionary IEPR

- Has the head of another Federal agency requested an IEPR? No, the District has not received notification to request an IEPR from any Federal agency.

Potential IEPR Exclusion

- Is the project cost greater than \$200 million? Yes.
- Does the project have an Environmental Impact Statement (EIS)? No, the PDT is preparing an environmental assessment.

IEPR Exclusion Condition A

Does the study include an EIS? No. Prior project determination that the EA was not sufficient was a result of not modeling the impacts far enough upstream. Based on the updated extents for the HEC-RAS model as well as tying the alternatives into the overall Missouri River System Plan, the team feels they can adequately address the impacts far enough upstream and downstream and an EA will be sufficient.

Is the project controversial? Yes. The Missouri River possesses numerous stakeholders with sometimes conflicting interests. As a result, the potential for controversy on water resources development projects along the Missouri River is always present. It is not without reason that there may be controversy over any tentatively selected plan, especially based on prior experience in the area. However, any anticipated controversy is not expected to change the project outcomes.

Does the project have more than negligible adverse impacts on scarce or unique tribal, cultural, or historic resources? No. The Osage Nation has requested Cooperating Agency status and NHPA Section 106 compliance is being achieved via development of a Programmatic Agreement.

Does the project have substantial adverse impacts on fish and wildlife species and their habitat prior to the implementation of mitigation measures; None anticipated. Preliminary findings based on existing data do not show substantial adverse impacts within the project area. Due to the project location near an airport, the team will also need to consider no increase in bird habitat to increase bird strikes.

Does the project, before implementation of mitigation measures, have more than a negligible adverse impact on a species listed as endangered or threatened species under the Endangered Species Act of 1973 (16 U.S.C. § 1531 et seq.) or the critical habitat of such species designated under such Act? None anticipated. Preliminary findings based on existing data do not show the possibility of greater than negligible adverse impacts to the species within the project area, (two bat species, pallid sturgeon, monarch butterfly).

Additionally, a discretionary IEPR could be performed if the project meets any of the triggers listed below:

- Significant life safety concerns
- Novel methods
- Complex challenges
- Precedent Setting methods or models
- Likely to change prevailing practices

This risk assessment determined that the response to the above are all no, as documented below.

Significant Life Safety Concerns: The total risk to the population in the leveed area is actually reduced by approximately 1.5 orders of magnitude. Additionally, the potential incremental life loss is relatively low at 0.3 to 3.

Novel Methods: As documented above, the design will be based on current methodology and design requirements listed in Engineering Manuals and on common practices used for decades in the Kansas City District.

Complex Challenges: As documented above, USACE and the Kansas City District have designed and constructed earthen levees throughout the Missouri River Basin. These levees have performed well during several large-scale flood events with few distresses.

Precedent Setting Methods or Models: As documented above, the designs will be based on current Engineering Manuals and methodologies which have been used for decades across the Kansas City District.

Likely to Change Prevailing Practice: Since the design will use USACE guiding documents and criteria, it is very unlikely that any of the methods of analysis or construction will require any special methods to change the Prevailing Practices associated with levee design.

Ultimately, the PDT determined that a discretionary IEPR was not warranted at this point in the study.