

Upper Turkey Creek Merriam, Kansas

Flood Risk Management Feasibility Study

Civil Works Review Board
19 May 2015

COL Andrew D. Sexton
Commander, Kansas City District



Project Briefing Outline

1. District Recommendation
2. Study Timeline & Update Summary
3. Purpose and Authority
4. Overview & Location
5. Existing Conditions – Problems & Opportunities
6. Planning Goals & Objectives
7. Plan Formulation
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9. Recommended Plan
10. Residual Risk & Climate Change
11. Cost Risk
12. NEPA
13. Policy Compliance Status
14. Implementation Schedule
15. Conclusion and Recommendation



District Recommendation

- Approve the Upper Turkey Creek Feasibility Report
- Release the Proposed Chief's Report for State and Agency Review.



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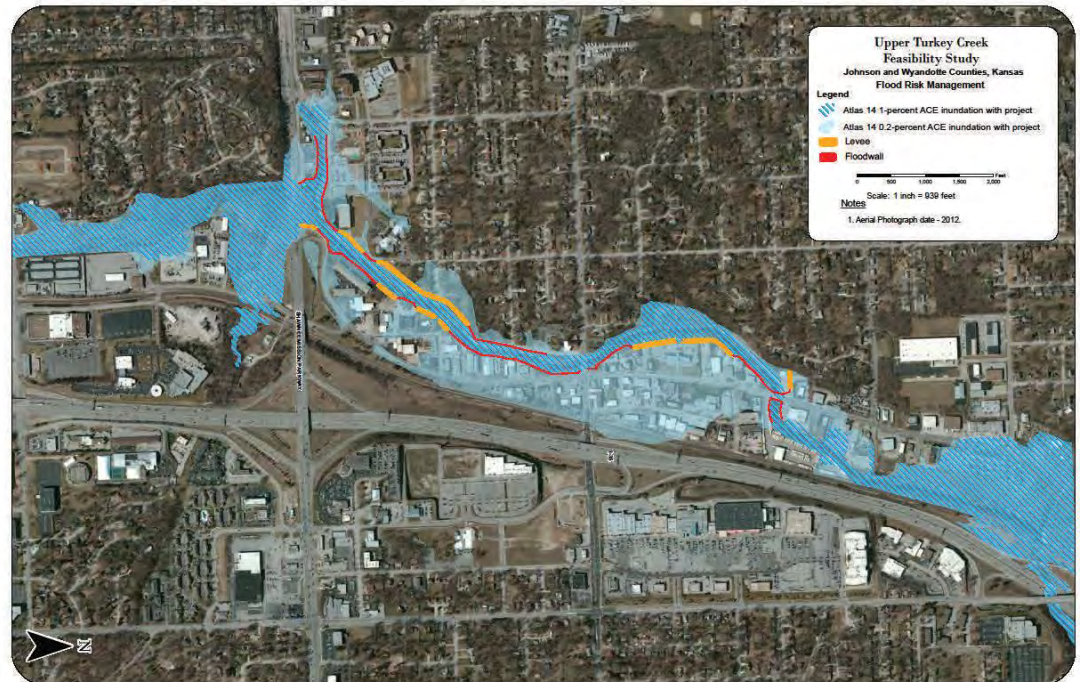
Recommended Plan

Recommended Plan 2d will reduce risk and flood damages in the City of Merriam:

- 10,650 ft. floodwall & levee from 3 to 6.5 ft. high
- Modifications to Merriam Drive & pedestrian bridges

Recommended Plan Results:

- 73% reduction in expected annual damages
- 83% probability of containing the 1-percent ACE event
- Net Annual Benefits: \$ 1.71M
- Benefit/Cost Ratio: 2.0 to 1



Feasibility Study Timeline



- Total study cost \$3,233,600
- Study funding average rate \$140k per year
- Atlas 14 & engineering updates added 17 months



Study Update

- In 2013 Plan 2d was the TSP after detailed screening
- 2013 IEPR Comment – update hydrology & hydraulics to current NOAA Atlas 14
- Oct 2013 to 2015 study hydrology & hydraulics (H&H) updated to incorporate NOAA Atlas 14 Rainfall
- Engineering Updates: concurrent with the H&H update, plans given a more detailed look - necessary engineering revisions to plans determined and applied:
 - Additional utilities relocations were determined necessary
 - Floodwall foundation revisions required



Purpose & Authority

Purpose - Flood Risk Management

Authority – Resolution of the Committee on Transportation & Infrastructure, U.S. House of Representatives, adopted February 16, 2000

*“Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Turkey Creek Basin, Kansas and Missouri, dated June 21, 1999, and other pertinent reports, to determine whether any modifications of the recommendations contained therein are advisable at the present time in the interest of **flood damage reduction** for areas of Turkey Creek Basin in Johnson and Wyandotte Counties, Kansas, upstream of the project for flood damage reduction authorized in section 101(a)(24) of Public Law 106-53, the Water Resources Development Act of 1999.”*

USACE DIVISION AND DISTRICT MAP



0 250 500 1,000 Miles

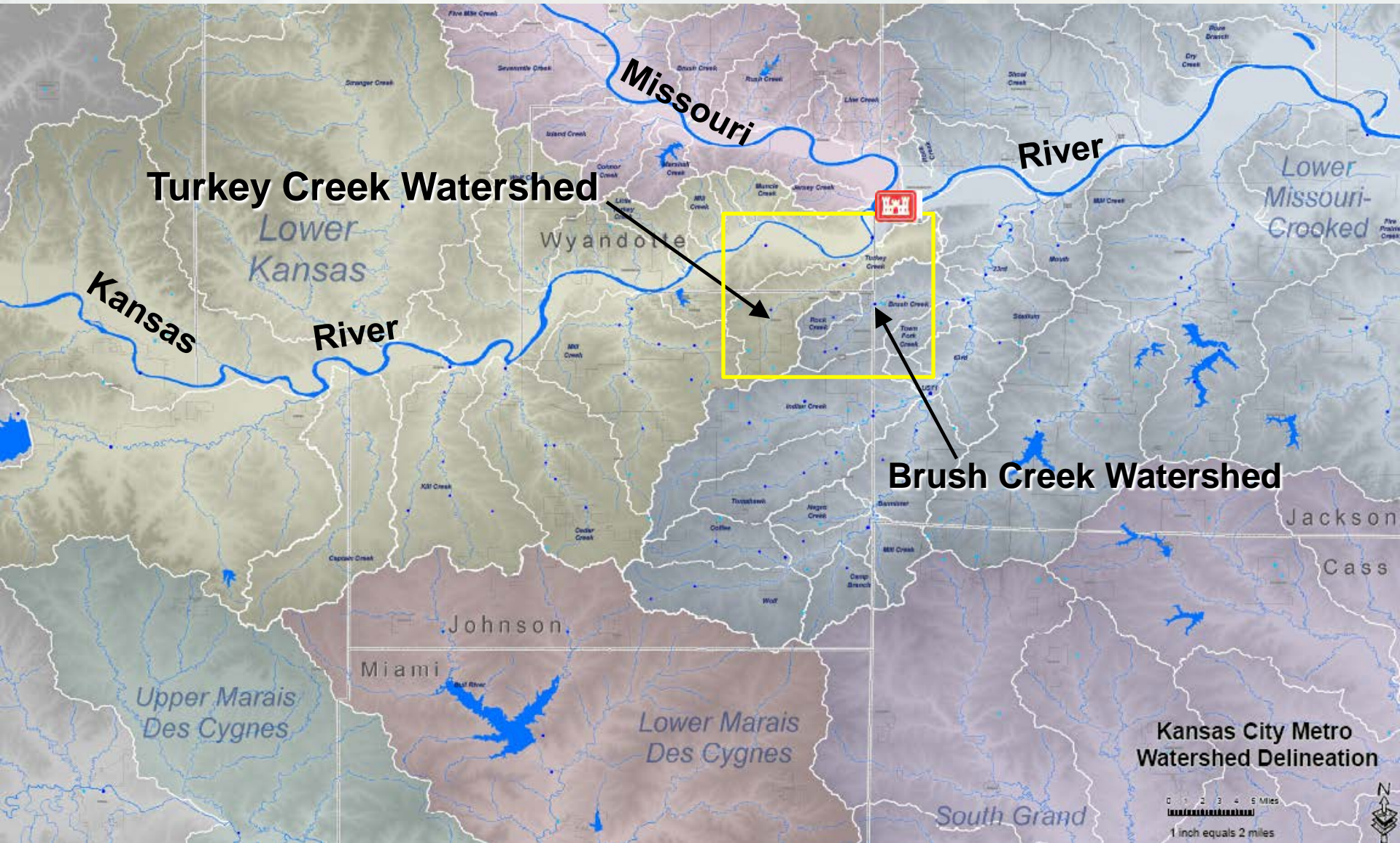


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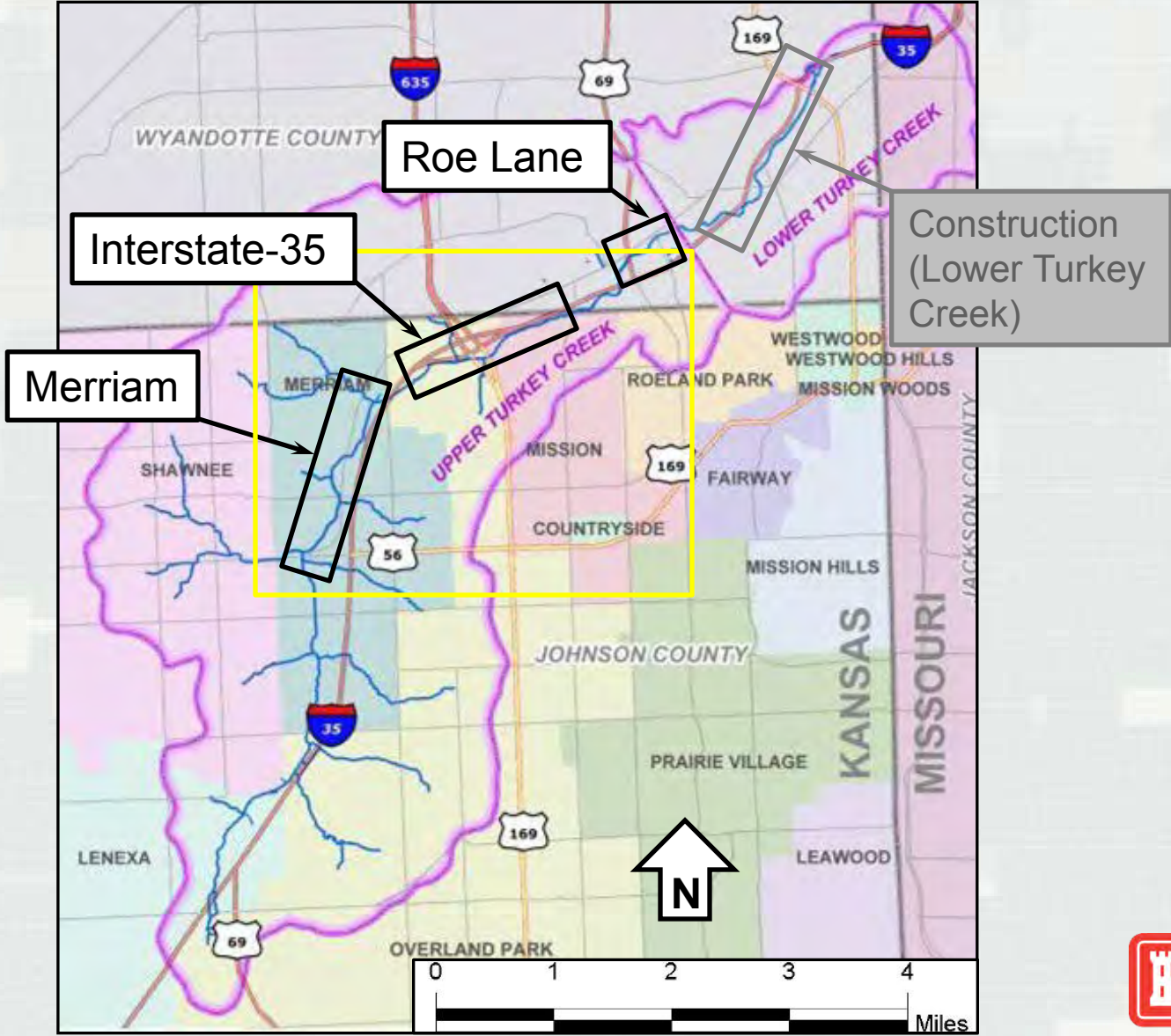
Flyover

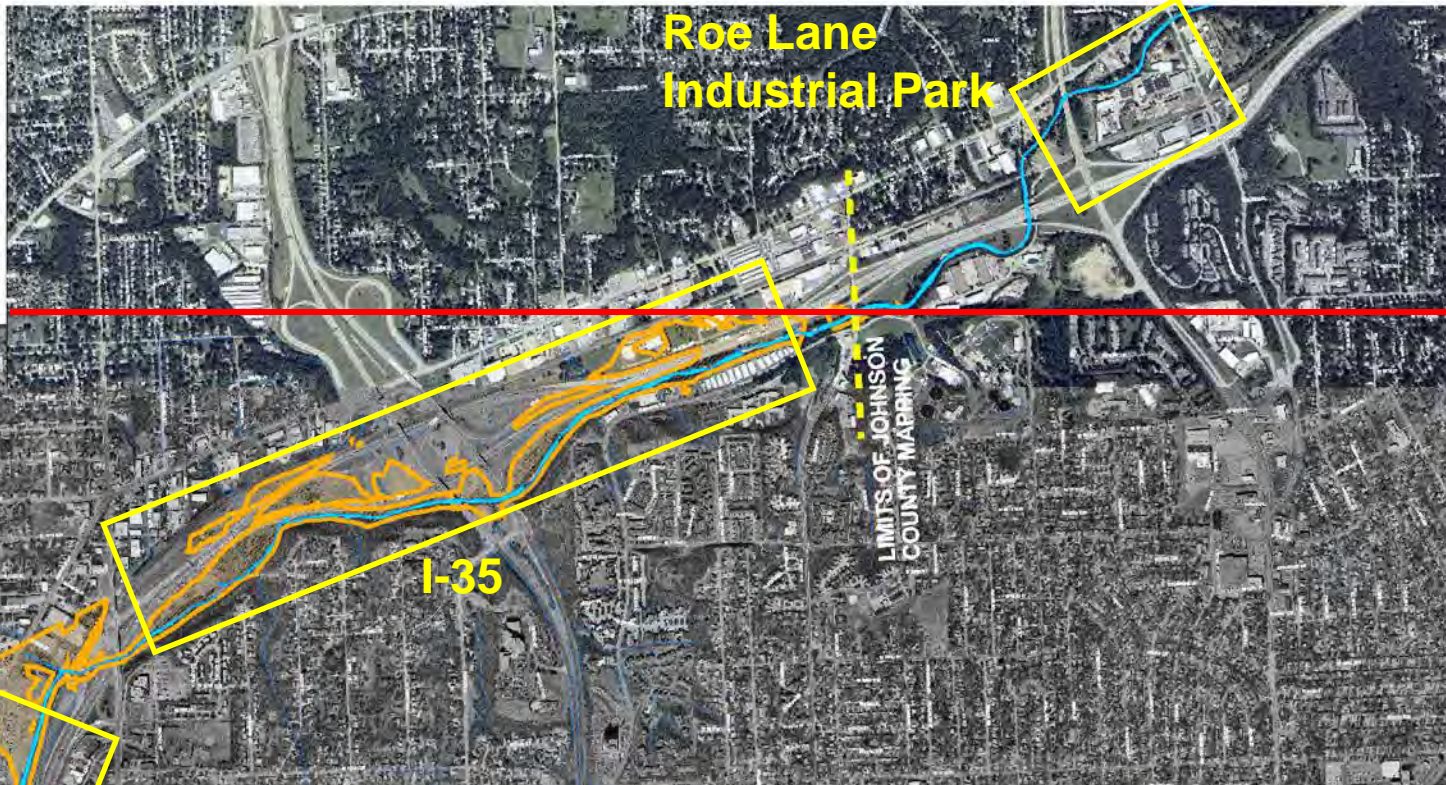


Kansas City Metro-Area Watersheds



Three Study Sites – Flood Risk Zones





Roe Lane Industrial Park

LIMITS OF JOHNSON COUNTY MAPPING

I-35

Downtown Merriam

LEGEND

- County line
- Base Flood
- Water Body
- Stream



Initial Study Areas of High Risk

Problems & Opportunities

Opportunities:

- Enhance community flood risk awareness
- Improve local, state and federal partnership

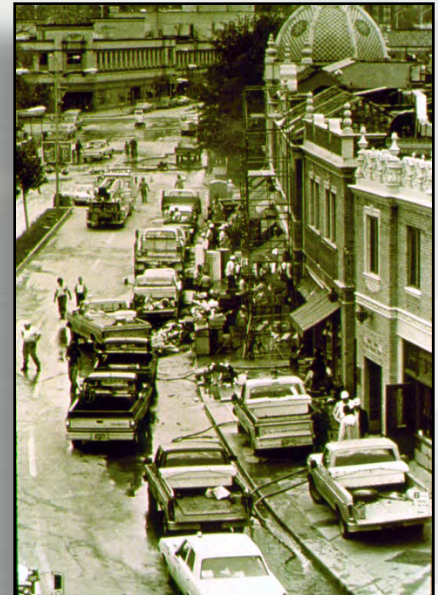
Problems:

- Severe flash flooding – low response time
- Heavily urbanized watershed
- Limited channel conveyance (10% ACE event or less)
- Property damages commercial/ industrial & infrastructure
- \$120 million in investment, \$3.5 million in estimated annual damages



Historic Damages from Flooding

- In 1977 damaging floods in Turkey Creek and Brush Creek basins, 25 fatalities and \$100 million in damages on Brush Creek
- In 1993 damaging flood hits Turkey Creek, 1 fatality
- In 1998 severe flooding on Turkey Creek and lower Brush Creek, 8 fatalities on Brush Creek
- Johnson County, Kansas - presidential disaster declarations in 1993 and 1998



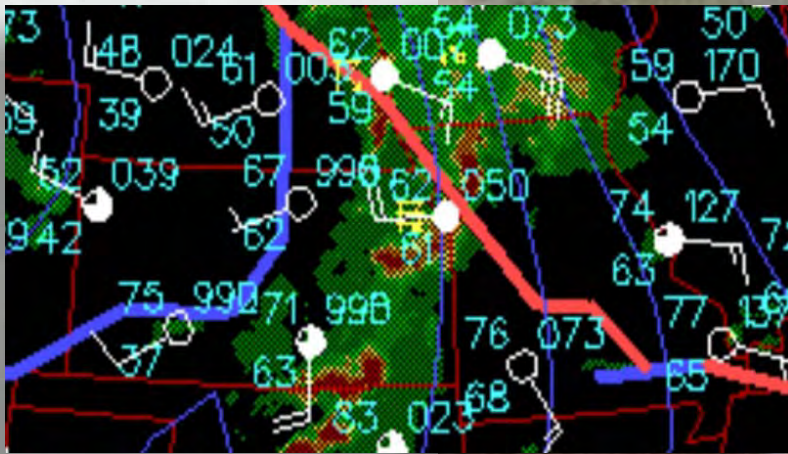
Summary of past Turkey Creek flood events:

Date	Peak Hour Rain	Total Rain
1977	1.6"	10.9"
1993	1.5"	6.0"
1998	3.5"	5.6"



Historic Damages from Flooding

- The flood of **September 1993** caused \$3.4 million in Merriam and \$20 million in the lower basin
- The **October 1998** event caused over \$12 million in damages to Merriam businesses and overtopped Interstate-35 in several locations.
- The 1998 storm event **approximates the 1-percent ACE event frequency for the 1-hour duration storm.**

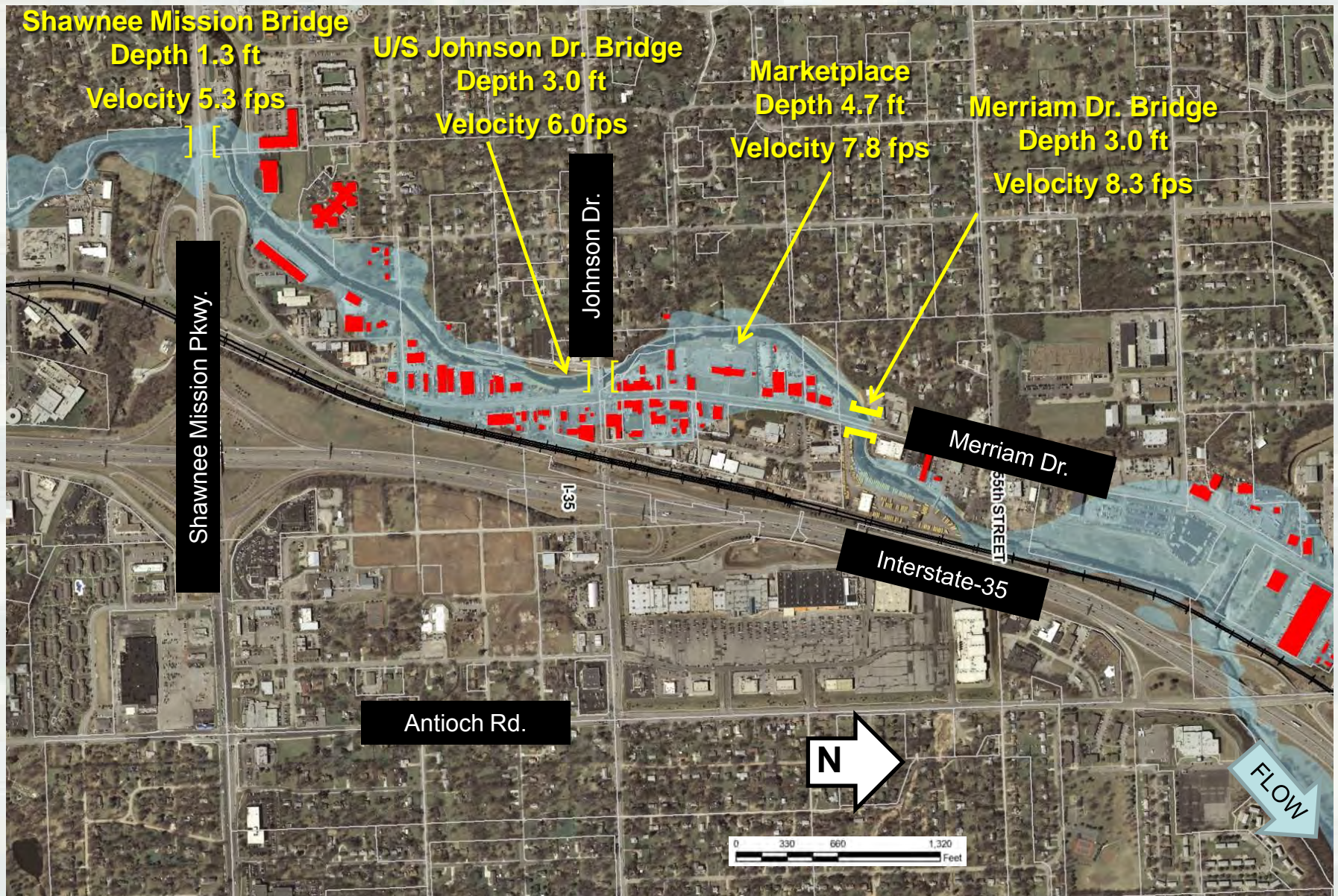


Flash Flood Risk

- Warning time
- Proximity of population risk
- Velocity
- Inundation depth
- Timeframe of occurrence



Risk Factors 1-percent ACE Event



Planning Goals & Objectives

- Reduce flash flooding risk
- Reduce potential for loss of life and property damage



Plan Formulation

Structural Measures Considered

Measure	Completeness	Effectiveness	Environmental Effects	Social Effects	Acceptability	Implementability	Cost	Risk	Separable Mitigation	Cost Effectiveness	Floodway Conveyance Considerations	Sustainability Considerations
STRUCTURAL												
Off-line Impoundment / Detention	●	◐	○	●	◐	●	○	◐	◑	○	●	◑
In-line Impoundment / Detention	◐	◐	◐	◐	◑	○	○	◐	○	○	●	◑
Levees	◑	●	◑	◑	◑	○	◑	◑	●	●	◑	◑
Floodwalls	◑	●	◑	◑	◑	◑	○	○	●	◑	◑	◑
Bridge Retrofit or Replacement (widening)	●	●	◑	●	◑	◑	◑	◑	●	◐	●	◑
Channel Modifications (widening)	◑	◑	◐	◐	◑	○	◐	◑	◐	◐	●	◑
Flow Diversion	○	◐	●	○	◑	●	●	○	◐	●	○	○

The symbol legend (Highly effective to Not effective and detracts from objectives): ● ◑ ○ ◐ ●

Plan Formulation

Nonstructural Measures Considered

Measure	Completeness	Effectiveness	Environmental Effects	Social Effects	Acceptability	Implementability	Cost	Risk	Separable Mitigation	Cost Effectiveness	Floodway Conveyance Considerations	Sustainability Considerations
NONSTRUCTURAL												
Flood Proofing												
Dry flood proofing	○	◐	○	○	◐	●	○	○	NA	○	●	●
Wet flood proofing	○	◐	○	○	◐	◐	○	◐	NA	○	●	●
Elevation	○	◐	◑	○	○	○	○	○	NA	○	●	●
Relocation	●	◑	◑	●	◐	◐	○	◑	◑	○	◑	○
Flood Warning Systems	○	◐	●	○	◐	○	○	◐	NA	●	NA	●
Floodplain Evacuation or "Buyout"	●	◑	◑	●	○	○	●	◑	◑	●	●	○

The symbol legend (Highly effective to Not effective and detracts from objectives): ● ◑ ○ ◐ ●

Plan Formulation – Measures Considered & Retained

- No Action
- Levee and floodwall
 - ▶ Works well with space constraints
 - ▶ Floodwalls have smaller footprint – lower environmental effects
- Channel widening
 - ▶ Efficient conveyance
 - ▶ Lower risk of non-performance
- Buyouts / relocations
 - ▶ Structures removed eliminating risk



Detailed Plan Formulation - Concepts Flood Risk Management in City of Merriam

- Alternative 1 Array: Channel Widening
- Alternative 2 Array: Levees and Flood Walls
- Alternative 3 Array: Combination of Channel Widening w/ Levees & Floodwalls
- Alternative 4 (Nonstructural): Floodplain Buyout



Plan Formulation – Screening Array of Alternatives

Alternative Array 1 Channel Widening:

	<u>Flow Capacity</u>	<u>Primary Features</u>
Alternative 1a:	10,500 cfs	Bottom width 40-46 ft, 3:1 side slope
Alternative 1b:	14,700 cfs	Bottom width 60 ft, 2:1 side slope
Alternative 1c:	14,700 cfs	Incl. bridge modifications, 60 ft bottom width, 2:1 slope
Alternative 1d:	15,300 cfs	Bottom width 100 ft, 2:1 slope
Alternative 1e:	15,300 cfs	Incl. bridge modifications, 100 ft bottom width, 2:1 slope

Alternative Array 2 Levees/Floodwalls:

	<u>Top Elevation</u>	<u>Primary Features</u>
Alternative 2a:	917.11 ft	8,500 ft of levee and floodwall up to 4 ft high
Alternative 2b:	920.05 ft	8,600 ft of levee and floodwall up to 5 ft high
Alternative 2c:	920.49 ft	8,600 ft of levee and floodwall up to 6 ft high
Alternative 2d:	920.99 ft	10,080 ft of levee and floodwall up to 6 ft high
Alternative 2e:	921.21 ft	11,700 ft of levee and floodwall up to 6 ft high
Alternative 2f:	922.78 ft	12,100 ft of levee and floodwall up to 8 ft high

Alternative 3 Array Combination Channel Widening w/ Levees & Floodwalls:

	<u>Top Elevation</u>	<u>Primary Features</u>
Alternative 3a:	916.36 ft	3,600 ft of levee and floodwall 3 ft high, 50 ft channel bottom
Alternative 3b:	917.80 ft	9,100 ft of levee and floodwall 5 ft high, 60 ft channel bottom
Alternative 3c:	916.86 ft	Incl. bridge mods, 8,100 ft levee & floodwall 5ft high, 60 ft channel
Alternative 3d:	916.64 ft	4,400 ft of levee and floodwall up to 5 ft high, 100 ft channel bottom
Alternative 3e:	915.93 ft	Incl. bridge mods, 1,700 ft levee & floodwall 3ft high, 100 ft channel

Alternative 4: Property Buy-outs

Buy out of properties in 1-percent chance floodplain

Detailed Screening Array Results

Reach Alternative	Total Annual Costs of Project	Annual Benefits	Residual Damages	Benefit/Cost Ratio	Net Benefits
Future Without Project	NA	NA	\$ 3,456.7	NA	NA
Alternative 1, Channel Widening					
Alternative 1a	\$ 612.9	\$ 916.2	\$ 2,540.5	1.5	\$ 303.3
Alternative 1b	\$ 807.5	\$ 953.3	\$ 2,503.4	1.2	\$ 145.8
Alternative 1c	\$ 1,202.5	\$ 1,678.5	\$ 1,778.2	1.4	\$ 476.0
Alternative 1d	\$ 1,028.7	\$ 2,031.3	\$ 1,425.4	2.0	\$ 1,002.6
Alternative 1e	\$ 1,511.9	\$ 2,500.8	\$ 955.9	1.7	\$ 988.9
Alternative 2, Levees and Floodwalls					
Alternative 2a	\$ 740.9	\$ 1,751.0	\$ 1,705.7	2.4	\$ 1,010.1
Alternative 2b	\$ 914.7	\$ 2,651.5	\$ 805.2	2.9	\$ 1,736.8
Alternative 2c	\$ 1,035.1	\$ 2,656.5	\$ 800.2	2.6	\$ 1,621.4
Alternative 2d	\$ 1,068.5	\$ 2,812.1	\$ 644.6	2.6	\$ 1,743.6
Alternative 2e	\$ 1,104.9	\$ 2,833.9	\$ 622.8	2.6	\$ 1,729.0
Alternative 2f	\$ 1,272.4	\$ 2,874.6	\$ 582.1	2.3	\$ 1,602.2
Alternative 3, Combination of Channel Widening and Levees/Floodwalls					
Alternative 3a	\$ 862.1	\$ 2,323.0	\$ 1,133.7	2.7	\$ 1,460.9
Alternative 3b	\$ 1,335.4	\$ 2,491.7	\$ 965.0	1.9	\$ 1,156.3
Alternative 3c	\$ 1,606.2	\$ 2,554.2	\$ 902.5	1.6	\$ 948.0
Alternative 3d	\$ 1,258.9	\$ 2,795.0	\$ 661.7	2.2	\$ 1,536.1
Alternative 3e	\$ 1,683.7	\$ 2,820.1	\$ 636.6	1.7	\$ 1,136.4
Alternative 4, Property Buy-Outs	\$ 2,710.7	\$ 3,397.0	\$ 59.7	1.3	\$ 686.3

In \$1,000s, 2012 price level, 4% rate, 50-yr period of analysis

Atlas 14 Update

- **In 2013 - Plan 2d** was TSP, also happened to meet USACE reliability criteria for NFIP certification under original H&H
- **2013 IEPR Comment** – Incorporate new **National Weather Service Atlas 14** into study
- Study hydrology & hydraulics were updated with new Atlas 14 rainfall intensities

Updated Evaluation Process:

- Developed new alternative **“Plan 2g”** –for comparison to Plan 2d and to meet USACE & FEMA criteria for NFIP certification, and as an upper bound benefit-cost comparison
- Concept Array 2 (Levees & Floodwalls) had highest net annual benefits
- So two of the closest competing plans in Concept Array 2, plans 2b and 2c were also evaluated under Atlas 14 for benefit-cost comparison to Plan 2d .

Engineering Revisions:

- Engineering revisions to these plans were necessary due to new findings regarding utility relocations and floodwall foundation stability - not related to Atlas 14
- Engineering revisions applied to all plans re-evaluated during the update



Engineering Revisions

- Foundation design requirements – due to condition of existing stacked rock wall, foundation for floodwalls revised to auger grout piles for stability
- Additional utility relocations were determined necessary in the more detailed evaluation
- Revisions were applied to all plans evaluated during the Atlas 14 Update
- Changes in engineering requirements affected competing plans proportionally
- **Cost increases** - 40% due to utilities, 30% due to floodwall foundation for auger-grout piles, 30% other misc cost increases



Atlas 14 Update

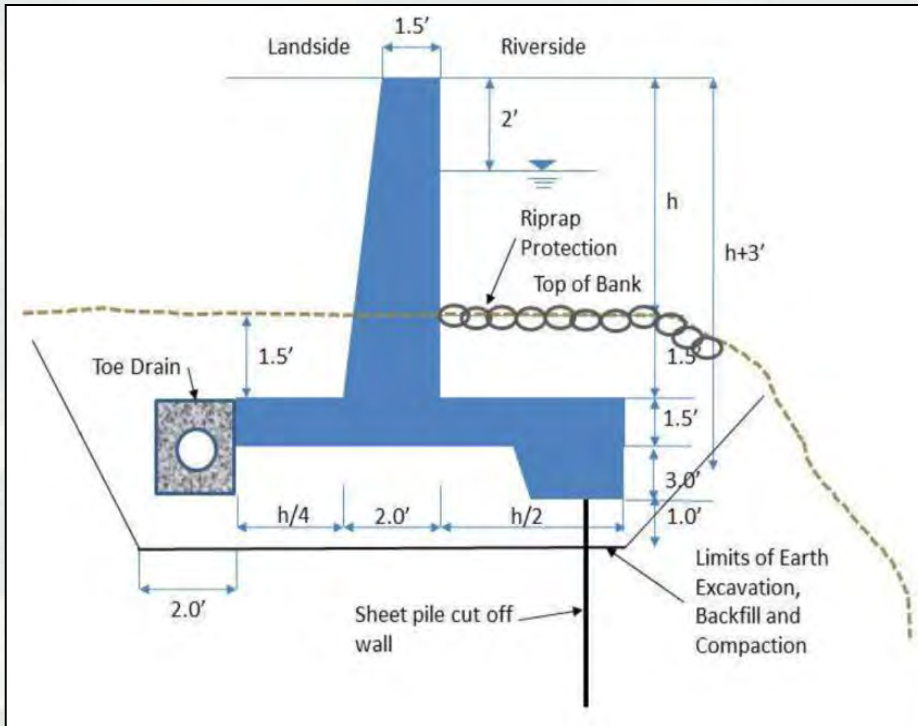
Comparisons of Atlas 14 vs. Original H&H 1-Percent ACE Flood Event

- Top row - change in nominal 1-percent ACE discharge at Merriam Marketplace
- Other rows compare 1-percent ACE water surface elevations (WSEL) at key locations

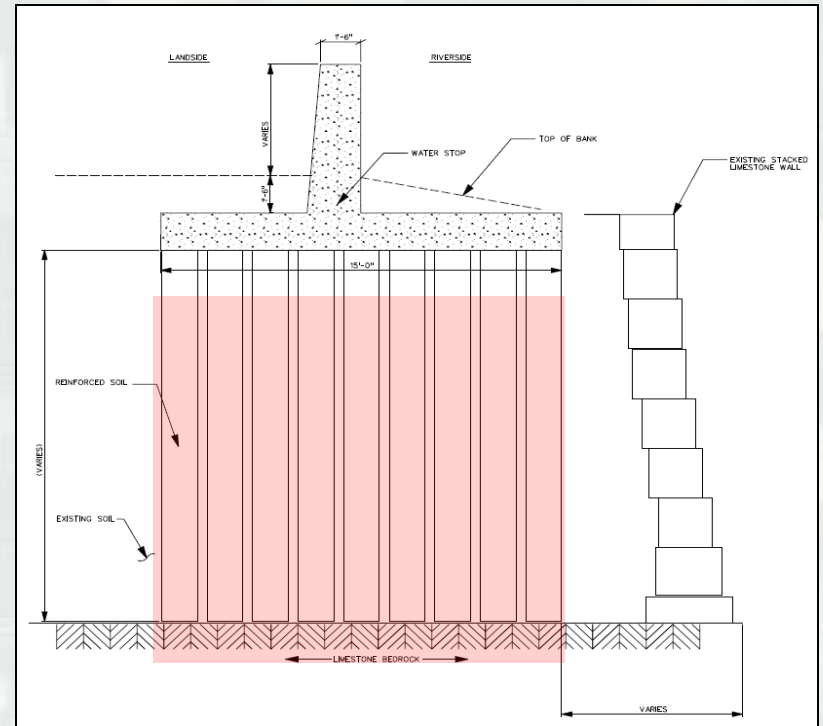
Location		Original H&H	Atlas 14 H&H	Change
Merriam Marketplace	Flow	15,700 cfs	17,700 cfs	+13%
Shawnee Mission Pkwy	WSEL	936.50 ft	937.10 ft	+0.6 ft
Johnson Drive	WSEL	912.30 ft	913.30 ft	+1.0 ft
Merriam Marketplace	WSEL	911.90 ft	912.80 ft	+0.9 ft
Merriam Drive	WSEL	906.50 ft	907.80 ft	+1.3 ft



Revised Floodwall Foundation



Original T-wall foundation



Auger-grout pile foundation



Plan Comparison – Post Atlas 14 Update

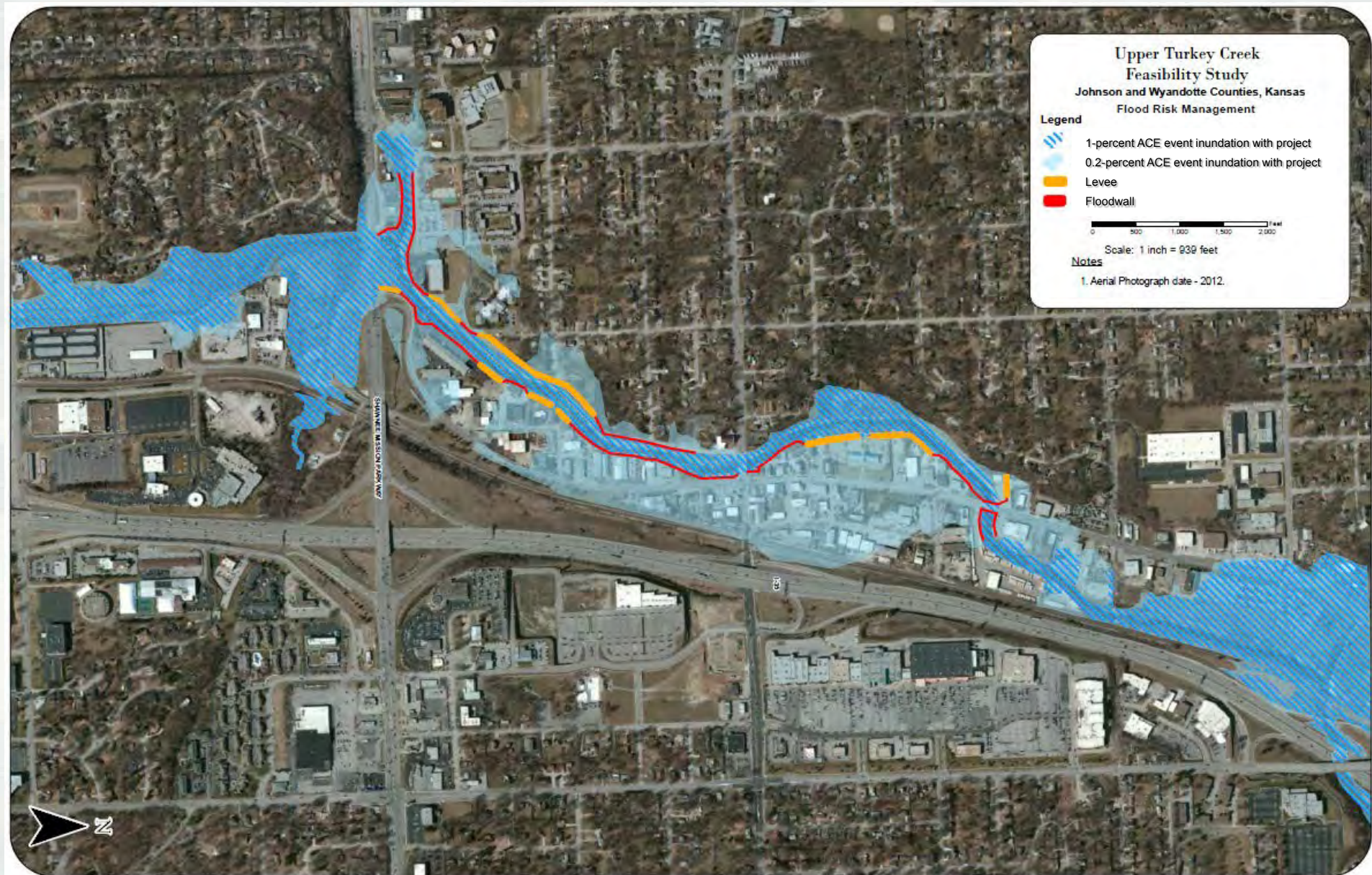
Alternative Plan	Plan 2b	Plan 2c	Plan 2d	Plan 2g
Total First Cost	\$36,732,000	\$37,146,000	\$37,579,000	\$43,026,000
Average Annual Costs	\$ 1,694,400	\$ 1,712,900	\$ 1,732,200	\$ 2,001,600
Average Annual Benefits	\$ 3,160,600	\$ 3,312,100	\$ 3,444,700	\$ 3,702,900
Net Annual Benefits	\$ 1,466,100	\$ 1,599,200	\$ 1,712,500	\$ 1,701,300
Residual Damages	\$1,589,000	\$1,437,500	\$1,304,900	\$1,046,700
B/C Ratio	1.9	1.9	2.0	1.8
Expected AEP <i>FWOP = 28.3%</i>	1.1%	0.8%	0.5%	0.01%
CNEP 1% Event <i>FWOP = 0.1%</i>	64.4%	74.0%	82.9%	99.5%
Plan Primary Features	9,700ft floodwall & levee 3 to 5.5 ft high	9,700ft floodwall & levee 3 to 6 ft high	10,205 ft floodwall & levee 3 to 6.5 ft high	7,965 ft floodwall & levee 6 to 8 ft high - 320 ft' triple box bypass at Merriam Dr.

October 2014 Price Level, 3.375%, 50-yr period

Inundation Maps – Future Without Project



Inundation Maps – Future With Project



Plan 2d Cost & Cost Sharing

Cost Account	Oct 2014
Lands, Easements, Rights of Way, Relocation, Disposal Area (LERRD)	\$10,122,000
- Lands and Damages	\$ 4,854,000
- Relocations	\$ 5,268,000
Fish & Wildlife Facilities (Mitigation Costs)	\$ 15,000
Levee & Floodwalls	\$ 22,565,000
Planning, Engineering and Design	\$ 3,066,000
Construction Management	\$ 1,811,000
Project First Cost Total	\$ 37,579,000
Cost Apportionment	
Federal Share	\$ 24,426,000
Non-Federal Share (Total)	\$ 13,153,000
Non-Federal Cash	\$ 3,501,000
Non-Federal LERRD Credit	\$ 9,652,000



Plan 2d Future Performance

	Without	With
Annual Exceedance Probability		
Expected	28.3%	0.5%
Long-Term Risk		
10 years	96.4%	5.1%
30 years	99.98%	12.2%
50 years	100.0%	22.9%
Conditional Non-Exceedance Probability		
10%	9.0%	99.98%
2%	0.3%	94.3%
1%	0.1%	82.9%
0.20%	0.02%	53.0%

- Reduction of 93% of annual damages in project reach
- Annual chance of flooding is reduced to 1 in 200 in project reach
- No induced damages upstream or downstream
- Reduces loss of life risk due to flash flooding



Plan 2d Residual Risk & Climate Change

Residual Risk

- Recommended plan significantly reduces flooding risks and improves overall risk management.
- Residual annual damages estimated at \$1.3 million
- Exceedance probability of 5.1% in 10 years
- Exceedance probability of 23% over 50-yr period
- Sponsor maintains robust flood preparedness & response plans

Climate Change

- Evaluation conducted using ECB 2014-10 guidance
- NOAA future conditions model shows slightly wetter conditions
- Sensitivity analyses conducted to evaluate effects, no trend shown for storm durations used in study
- No changes to study plan formulation or the Recommended Plan

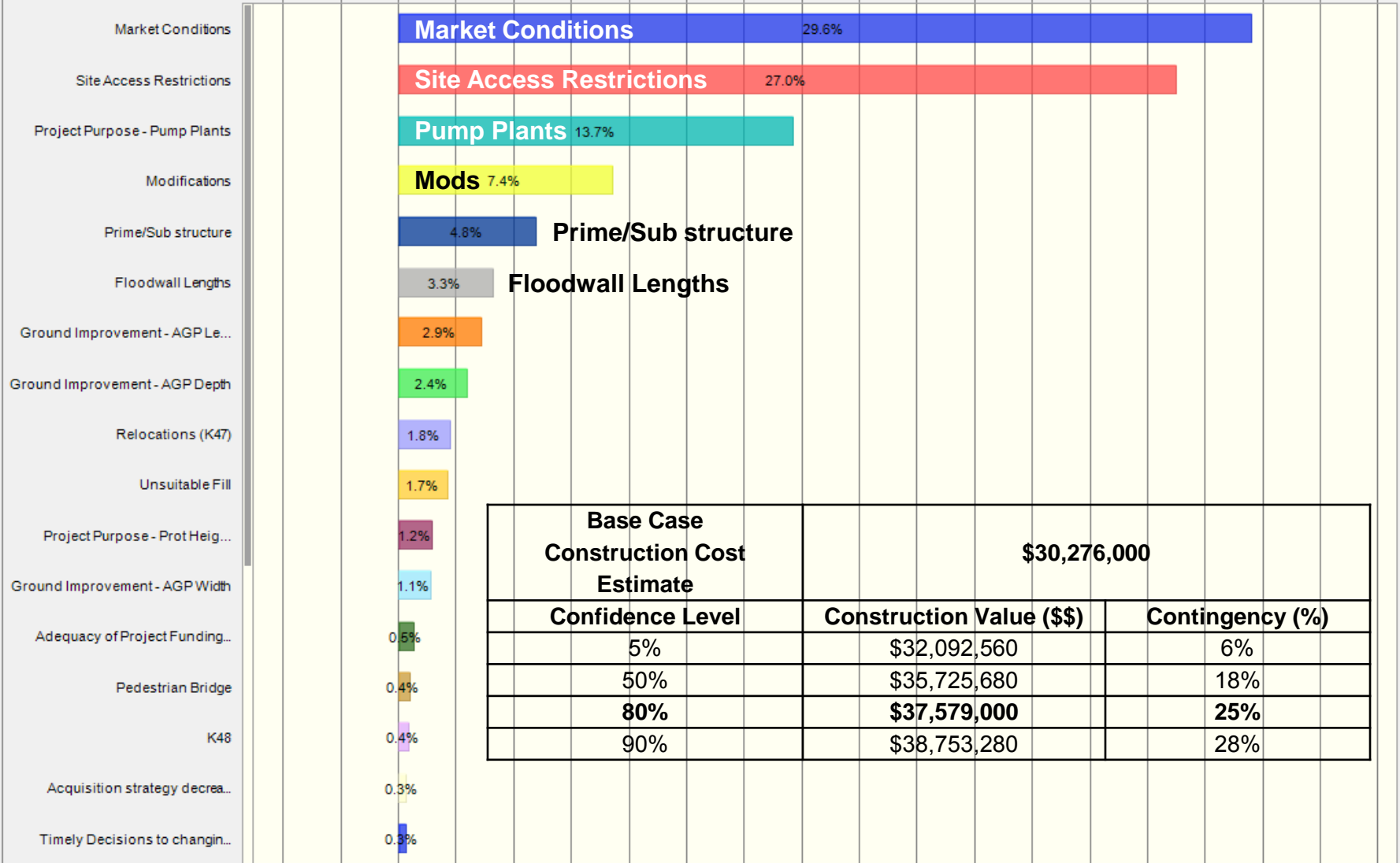
Cost Risk Analysis

10,000 Trials

Contribution to Variance View

Sensitivity: Project Contingency

-4.0% -2.0% 0.0% 2.0% 4.0% 6.0% 8.0% 10.0% 12.0% 14.0% 16.0% 18.0% 20.0% 22.0% 24.0% 26.0% 28.0% 30.0% 32.0% 34.0%



Base Case Construction Cost Estimate		\$30,276,000
Confidence Level	Construction Value (\$)	Contingency (%)
5%	\$32,092,560	6%
50%	\$35,725,680	18%
80%	\$37,579,000	25%
90%	\$38,753,280	28%

Environmental Status

- Compensatory mitigation analysis complete
- 7 acres of tree planting required
- NEPA integrated into Final Draft Feasibility Report
- Agency Coordination Complete – EPA, USFWS & Kansas Resource Agencies
- Low environmental concerns due to heavily impacted study area under without project condition
- Water quality certification has been provided



Policy Compliance Status

- ATR certified Mar 2015
- IEPR completed Oct 2013
- Cost Center - estimate certified Feb 2015
- PGM comments addressed
- VE Study completed Apr 2008
- Public Involvement – 9 meetings & workshops



Policy Compliance Status

Environmental Operating Principles and USACE Campaign Plan

Environmental Operating Principles

- Foster Sustainability
- Consider environmental consequences
- Create economic and environmentally sustainable solutions
- Consider the environment in a risk management and systems approach
- Leverage knowledge to understand the environmental context and effects

Campaign Plan Goals

- Transform Civil Works (2.a, 2.d)
- Reduce Disaster Risks (3.a)
- Prepare for Tomorrow (4.b)



Implementation Schedule

Milestone	Start Date	Finish Date
PED	October 2016	September 2018
LERRD Acquisition	October 2018	September 2019
Project Construction		
Contract 1	October 2019	April 2021
Contract 2	May 2021	October 2022
Contract 3	November 2022	April 2024



Conclusion and Recommendation

- The Recommended Plan is a feasible project meeting policy guidance and technical criteria. It will reduce flood damages and exposure to flash flooding in the City of Merriam.
- The plan is economically justified and supported by the Non-Federal Sponsor.
- Recommend the Civil Works Review Board approve the Upper Turkey Creek Final Feasibility Report and release the proposed Chief's Report for review.



Sponsor Support

- City of Merriam



Comment & Discussion



Lessons Learned

- Current scientific & engineering data: More diligent & proactive in searching for changes & updates within communities of practice
- Risk based evaluation: take thorough risk review & inventory of existing site earlier in study process
- Utilities: Locate and assess full effects / requirements for utilities earlier in study process
- Policy comment tracking: User friendly tools similar to Air Force OC matrix or other off shelf could be utilized
- OWPR site visit earlier in study / utilize drone technology



BLUF:

NWD Recommendations

- Approve the Final Report
- Release the Proposed Chief's Report for State and Agency Review
- Complete the Chief's Report

Thank you to the team! – internal and external, horizontal and vertical



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Rationale for NWD Support

- Concur with the District Commander's findings and recommendations
- Consistent with Federal, State, and local laws and ordinances
- Strong Sponsor and stakeholder support
- \$1.71 million in net average annual FRM benefits
- 2.0 to 1 BCR
- Reduces expected annual damages by 73%



Certification of Legal and Policy Compliance

- District Counsel's legal certification of final report in March 2015
- IEPR completed in October 2013
- ATR certification in May 2015
- Cost certification completed in February 2015
- Vertical Team alignment; legal and policy reviews completed and all issues resolved
- Project is consistent with FRM mission and EOP



Quality Assurance Activities

- Vertical team coordination to ensure technical and policy compliance
- PCX coordination to ensure ATR and IEPR complete and compliant
- Reviewed DQC compliance and certification
- Reviewed ATR and IEPR comments and responses to ensure appropriate resolution and documentation
- Vertical team coordination to resolve all review comments/issues during various phases of study
- Review Plan for Feasibility Study approved by MSC on 13 December 2012
- Updated Review Plan for PED and Construction currently under final MSC Review



Upper Turkey Creek

Agency Technical Review

Marc Masnor

ATR Lead Upper Turkey Creek

Tulsa District

May 19, 2015



Agency Technical Review

- ✓ Subject Review: Upper Turkey Creek Final Report, March 2015, Kansas City District
- ✓ ATRs conducted at AFB, all Draft & Final phases
- ✓ ATR Completion Statement Date: March 2015
- ✓ Comment Status: All comments resolved and closed.
- ✓ Cost Center Certification: February 2015



Agency Technical Review Team

✓ ATR Team Members:

ATR Team Member	Title/Discipline	District
Marc L. Masnor	ATR Lead / Planner	Tulsa
Douglas E. Lilly	Plan Form & Policy	Tulsa
Brian Harper	Economics & Risk	IWR
David J. Williams	H&H Engineer	Tulsa
Cory H. Williams	Geotechnical Engineer	Memphis
Robert W. Newman	NEPA/Biologist	Fort Worth
James G. Neubauer	Cost Engineer	Cost Center
Zach Gerich	Structural Engineer	Fort Worth
Shane S. Callahan	Civil Engineer	Memphis
Leslie R. Williams	Real Estate	Louisville



Agency Technical Review Summary

- ✓ Model Summary: Models used were all USACE approved models including HEC-RAS, HEC-1/HMS and HEC-FDA
- ✓ Cost Engineering MCX Certification Date: NA
- ✓ ATR is complete for the Decision Document



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ATR Items of Significance

✓ Significant Issues Identified And Resolved.

- Cost: 46% cost increase to NED Plan since Oct 2013 - District explained that improved design with lower risks for foundation stability & better estimate of utilities modifications, increases would be proportional to other plans
- Civil: Quantities required better documentation, documentation added to report
- Economics: Description of residual risk and metric needed revision, revised in report
- H&H and Economics: Consider plan with performance between Plan 2d and 2g, i.e. plan w/ lower cost than 2g but better protection than 2d. Considered, plans above 2d in capacity have rising costs while net annual benefits are flat.

ATR Items of Significance

- ✓ Significant Issues Identified And Resolved (cont.)
 - Environmental/Plan Form: Better description of flood problem needed - threatened structures, investment and frequency of flooding. District added appropriate information to the report under FWOP sections.

- ✓ Items deferred to PED: None



Independent External Peer Review (IEPR) Upper Turkey Creek, Johnson and Wyandotte Counties, Kansas Flood Risk Management Project

Presented to the USACE CWRB
on May 19, 2015

Lynn McLeod, PMP
Project Manager



IEPR - Panel and Schedule

Upper Turkey Creek Panel Members	Panel Discipline
Roger Burke (Lead Panel Member)	Economics/Civil Works Planning
James Schall, P.E., Ph.D.	Hydrologic and Hydraulic Engineering
Kipkoech Chepkoiit, P.E., Ph.D.	Geotechnical Engineering
Peter Hegre, P.E., CCS, CCCA	Civil/Cost Engineering
Charles Newling, PWS, CWB	Biology/Ecology

Upper Turkey Creek IEPR was conducted from April – July, 2013

- Panel reviewed the April 2013 version of the documents along with several updated chapters and appendices provided to the Panel in May and June 2013

IEPR Bottom Line Up Front

The Panel agreed with the actions presented by the PDT to address the Final Panel Comments.

IEPR - Results

Final IEPR Report submitted on August 6, 2013

Results:

- 16 Final Panel Comments
 - 1 high significance
 - 7 medium
 - 8 low significance

Post-Final Panel Comments/Response results documented on October 18, 2013

Results:

- PDT Evaluator Responses to Final Panel Comments
 - 16 concurs, 0 non-concurs
- Panel BackCheck Responses to the PDT Responses
 - 16 concurs, 0 non-concurs

IEPR - Notable Findings

1. Rainfall values are based on an outdated publication; therefore, the hydrology and hydraulics (H&H) analysis underestimates the volume of runoff and flood elevations associated with the flood risk management project and could impact conclusions related to the National Economic Development (NED) alternative.
2. Significant pressure flow conditions may occur as a result of the proposed headwalls at roadway crossings increasing scour conditions and leading to potential failure of these crossings or adjacent levees and floodwalls.
3. A plan to communicate to the public the residual risks concerning possible loss of life associated with the design of the levee and floodwall system has not been presented.
4. The magnitude of the increase in the contingency from the alternative analysis to the National Economic Development (NED) plan Cost and Schedule Risk Analysis (CSRA) is not supported, and the connection between this increase and the lack of detailed site investigation or geotechnical investigation is not addressed.
5. It is not clear if the potential sources of uncertainty and the implications of the risk and uncertainty statistics provided with regard to Hydrologic Engineering Center-Flood Damage Reduction Analysis (HEC-FDA) modeling were considered.

Upper Turkey Creek Merriam, Kansas Flood Risk Management Feasibility Study

HQUSACE POLICY REVIEW CONCERNS

Scott Nicholson

Office of Water Project Review
Planning and Policy Division

May 19, 2015



US Army Corps of Engineers
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HQUSACE Team Reviews:

- Feasibility Scoping Meeting September 2004
- Alternative Formulation Briefing, January 2013
- Draft Report, October 2013
- Final Feasibility Report, March 2015

HQ OWPR Review Team:

Jeff Strahan - Economics

Deborah Scerno – Environmental

Chandra Pathak and Dave Margo - Engineering

Ted Nettles - Real Estate

Mayely Boyce - Counsel

Scott Murphy - Counsel



Policy Issues from Alternative Formulation Briefing, Draft Report and Final Report Reviews

- Economic Damages - Future Without Project**
- Environmental Assessment – Mitigation**
- H&H Modeling of the Stormwater System**
- Plan Formulation - Watershed Perspective**
- Plan Evaluation - Economic Benefit Comparison
- Plan Evaluation - Non-Structural
- Residual Risk Management**
- Plan Evaluation - Real Estate Constraints
- Floodplain Management Plan and Residual Risk
- Induced Flooding - Hydraulic Analysis.
- Headwalls Inducing Scour - Hydraulic Analysis
- Rainfalls Based on Outdated Publications
- Executive Order 11988.
- Real Estate Plan Requirements
- Application of Updated Rainfall Data**
- NED Plan Evaluation**
- Report Completeness - Plan Formulation**



Significant Areas of Policy Concern

- ❑ **Application of Updated Rainfall Data**
- ❑ **Plan Formulation - Report Completeness**
- ❑ **NED Plan Assessment**
- ❑ **Plan Formulation - Watershed Perspective**
- ❑ **Environmental Assessment**
- ❑ **Economic Damages – Future Without Project Assumption**
- ❑ **H&H Modeling of the Stormwater System**
- ❑ **Residual Risk Management - Flood Warning Systems**



Application of Updated Rainfall Data

- **CONCERN:** The National Weather Service's 2013 Atlas 14 new rainfall data publication initially indicated that there could be a 2 to 3 foot increase in the water surface elevation within portions of the study area.
- **REASON:** The study area has a significant number of bridge structures that regulate the severity of the water surface elevation change which could potentially affect the costs and benefits reported and change the plan selection from the Draft Report findings.
- **RESOLUTION:** A decision was made to refine the hydrology. The impacts to the feasibility decision were unknown at the time the decision was made. The risk of the impacts being significant were believed to be high enough to justify making the refinements during feasibility rather than deferring to PED. After doing the update, it turns out that there is no impact to the decision.
- **RESOLUTION IMPACT:** The concern is resolved.



Plan Formulation - Report Completeness

- **CONCERN:** Updates to the Final Report were required to take into account the most recent H&H data from the 2013 publication of the National Weather Service's NOAA Atlas 14 report resulted in numerous changes to the feasibility analysis.
- **REASON:** Engineering Manual (EM 1110-2-1417: Flood Runoff Analysis) states that the most current rainfall data should be used for decision making. The revised without and with project hydrologic and hydraulic analysis with up to a 13 percent increase in discharges and a maximum of 2 foot increase in hydraulic profiles at certain locations affected numerous plan formulation inputs and evaluation.
- **RESOLUTION:** An evaluation of the updated H&H determined that these revised results did not significantly alter the plan formulation or economic analyses used to identify the recommended plan as the NED Plan. The process resulted in updated engineering and economic analyses and expanded narratives throughout the Final Report to support the decision-making for the recommended plan. The IEPR, ATR and HQUSACE review concur with the evaluation.
- **RESOLUTION IMPACT:** The concern is resolved.



NED Plan Evaluation

- **CONCERN:** Draft report documentation identified the NED Plan as the Tentatively Selected Plan. After release for public comment, the future without and with project condition changed due to the new precipitation data (NOAA Atlas 14) affecting the study's H&H results and the NED plans performance.
- **REASON:** ER 1105-2-100, 2-3 provides that the future without-project condition provides the basis from which alternative plans are formulated and impacts are assessed and that the alternative that reasonably maximizes net economic benefits consistent with protecting the Nation's environment, the NED plan be selected.
- **RESOLUTION:** The changed future without project and with project condition were used in the updated economic evaluation to include the Atlas 14 H&H data. It was found that the revised NED plan's assurance level no longer met NFIP criteria. A new alternative (2g) was created to meet the NFS planning objectives for NFIP compliance and to bracket the NED plan. The plan evaluation found the recommended NED plan did not change, however the NED plan assurance no longer meets their NFIP compliance requirements. The sponsor decided not to endorse (2g) as a locally preferred plan.
- **RESOLUTION IMPACT:** The concern is resolved.



Plan Formulation - Watershed Perspective

- **CONCERN:** Turkey Creek is listed on 305(b) list (for metals, turbidity and nutrients), has hardened channel banks already, has buildings in its flood plain and has an ecologically degraded riparian zone (more suburban, than natural). The plan formulation needs to consider the watershed perspective.
- **REASON:** ER 1105-2-100, Section 2-6 states: *“We also should take into account: the interconnectedness of water and land resources (a systems approach); the dynamic nature of the economy and the environment; and the variability of social interests over time. Specifically, civil works planning should consider the sustainability of future watershed resources, specifically taking into account environmental quality, economic development and social well-being.”*
- **RESOLUTION:** Given the constricted and impacted nature of the channel and floodplain in the study area, there is little opportunity to make significant water quality or environmental improvements in conjunction with the flood risk management project. The study has documented opportunities and benefits for environmental enhancements in the watershed that could be implemented as a separable project, but none of them sufficiently mitigated flood risk.
- **RESOLUTION IMPACT:** The concern is resolved.



Environmental Assessment

- **CONCERN:** How the conclusions for the environmental justice and cumulative impacts sections were determined was not clear in the report. The status of the water quality certification was not clear. The reason for some calculations not being completed was not clear.
- **REASON:** The logic behind the environmental analysis and the result of the coordination with the agencies should be apparent in the report.
- **Discussion:** The report did a good job of presenting the projects completed or on-going in the project area as well as the socio-economic status of the project area. Clarity was needed in the report on cumulative effects and how the conclusion of insignificant impacts was reached given the information presented. Although the water quality certification had been received, it was still listed as needed in the report. These clarifications were made in the report.
- **RESOLUTION IMPACT:** The concerns are resolved.



Economic Damages – FWOP Assumptions

- **CONCERN:** The future without project condition damages have a high number of car sales and vehicle repair shops where inventory gets damaged. The analysis assumes these vehicles will be in place and the report did not discuss the damage functions used for the vehicles
- **REASON:** ER 1105-2-100 states, “Base measurement and projection of flood damages on the establishment of actual, observed relationships between damages, flood characteristics, and those indicators used for measurement and projection.”
- **RESOLUTION:** Evacuating the inventory could create congestion along the evacuation routes. Businesses have shown that they evacuate their employees due to the short lead time rather than inventory. EGM 09-04 was used to estimate damages to vehicles. Clarifications were made in the report.
- **RESOLUTION IMPACT:** The concern is resolved.



Stormwater System Modeling Assumptions

- **CONCERN:** The H&H modeling did not include the stormwater management system. Generally, characteristics that would potentially impact the inputs or outputs of the system or impact the conveyance of water through the system would be included in the modeling.
- **REASON:** There are concerns as to whether the storm water system could change the timing and location of discharges compared to the model impacting the plan requirements for pump stations. The existing stormwater system plans were requested from the City of Merriam but we were informed that these plans are not available.
- **RESOLUTION:** It is expected that the timing and magnitude of the flows downstream of the City of Merriam will be controlled by Turkey Creek and that the impact of the interior watersheds would be too small to significantly alter the timing or peak magnitudes to downstream communities. However, cost risk analysis has included a contingency to cover the potential need for a pump station due to the uncertainty.
- **RESOLUTION IMPACT:** The concern is resolved.



Residual Risk Management - Flood Warning Systems

- **CONCERN:** Flash flooding and the potential Loss of life from previous storms indicated that a non-structural measure to improve flood warning times may be practicable.
- **REASON:** Historic loss of life in the Turkey Creek watershed and adjacent Brush Creek has been significant during the 1977, 1993 and 1998 flood events.
- **RESOLUTION:** The recommended plan does not rely on operational elements needing to be closed as the PDT knew during flash floods there would be minimal time for operations. In addition during the feasibility phase, the NFS funded a new STORM WATCH System that includes first a flash flood warning to alert staff; then watching the radar for rain intensity and storms heading their way; and lastly watching gages for precipitation and water level information falling in their area before starting evacuation plans.
- **RESOLUTION IMPACT:** Documentation of the STORM Watch system was added to the Report and the concern is resolved.



HQUSACE POLICY COMPLIANCE REVIEW TEAM RECOMMENDATION

Approval to release the proposed Chief's Report, Final Feasibility Report and Environmental Assessment dated May 2015 (revised) for S&A Review



NWK Lessons Learned

- Current scientific & engineering data: More diligent & proactive in searching for changes & updates within communities of practice
- Risk based evaluation: take thorough risk review & inventory of existing site earlier in study process
- Utilities: Locate and assess full effects / requirements for utilities earlier in study process
- Policy comment tracking: User friendly tools similar to Air Force OC matrix or other off shelf could be utilized
- OWPR site visit earlier in study / utilize drone technology



NWD Lessons Learned

- The vertical team decision to update the hydrology and hydraulics (H&H) analysis with new rainfall values in response to an IEPR comment improved the overall quality and integrity of the project recommendations.
- We need to continue to actively consider and communicate potential impacts of critical changes (data sets, models, policies and regulations) across stovepipes and throughout the vertical team.
- There is great value in vertical team members viewing project sites to develop a better understanding of their features and issues. Emerging technology has the potential to provide a superior alternative to written descriptions and photographs.

