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# **SYSTEMIC ANALYSIS OF THE MISSISSIPPI & ILLINOIS RIVERS UPPER MISSISSIPPI RIVER COMPREHENSIVE PLAN**

**2005 Tri-Service Infrastructure  
Systems Conference  
August 2005**

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# Authorization



WRDA 1999, Sec 459

## COMP PLAN

**“...shall develop a plan...in the interest of the systemic flood damage reduction...”**



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# **“systemic flood reduction”**



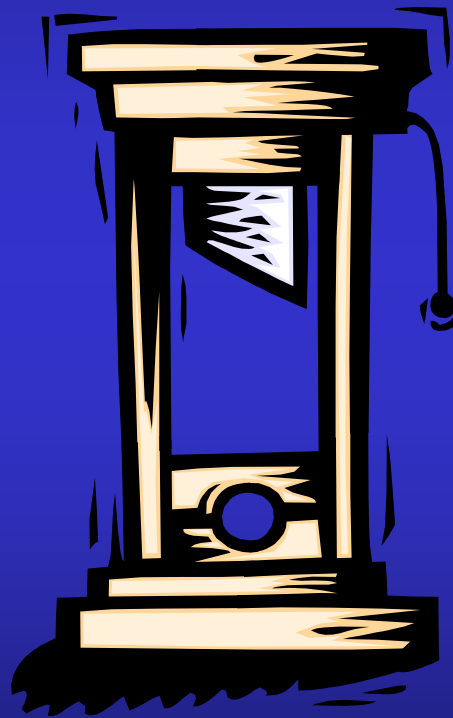
## **Major Challenges**

- **838 miles of the Mississippi River**
- **291 miles of the Illinois River**
- **Computed Frequency Analysis at all River Miles (Economics)**
- **Develop Alternatives**
- **Study completed in 3 years**
- **713,200 sq. miles**



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# Stick Your Neck out and be Creative



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# STOCHASTIC MODELING



- **Extend period of record from 2101 TO 3100**

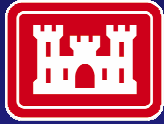
**Dr. Robert Barkau**

- **Goals of Reproduction at gages**

**1) Reproduce annual exceedence flow probability at gages**

**2) Reproduce primary event volume probability.**

**3) Approximately reproduce annual duration curve.**



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# **Three Tools Available**

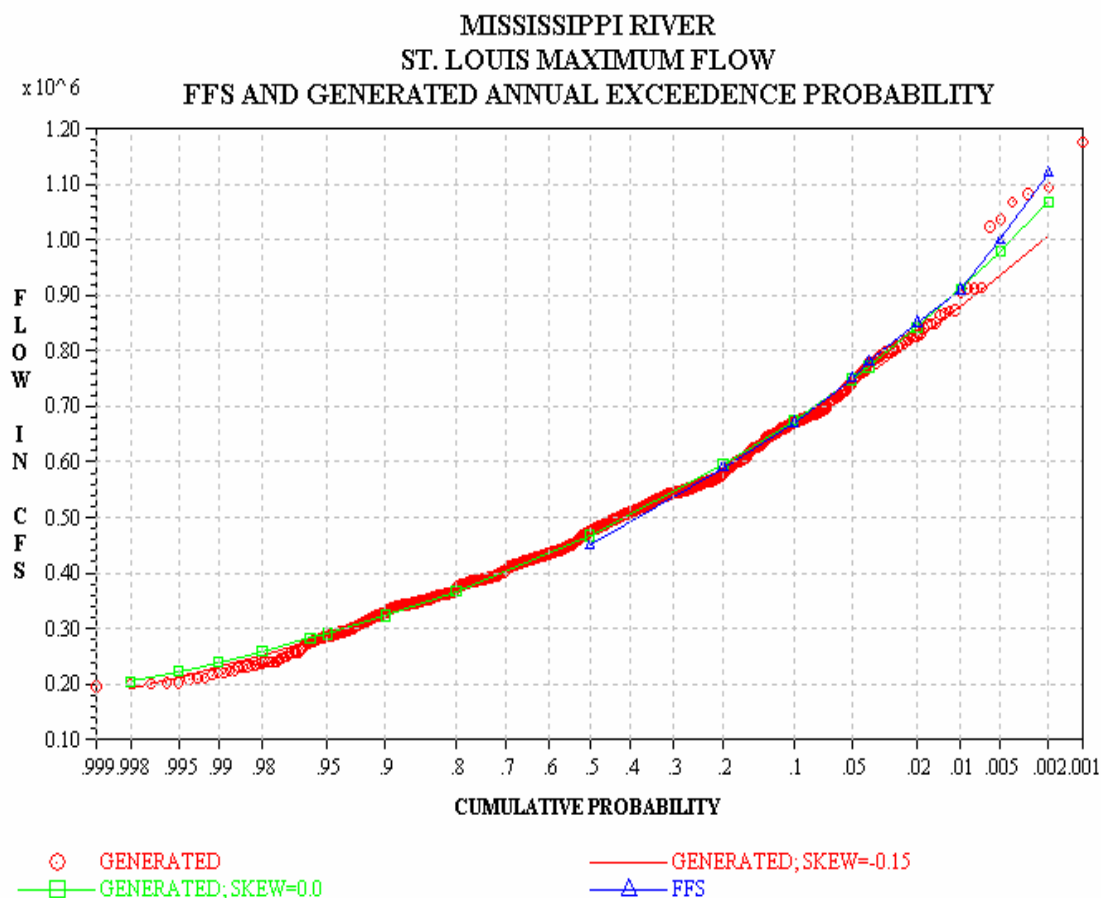


- 1) Statistical Frequency Curves at Gages from Flood Flow Frequency**
- 2) Existing UNET models from Flood Flow Frequency (Geometry)**
- 3) Computer Power**  
**1000 years at 3 hours intervals from Keokuk to Thebes takes 6 hours of computer time.**



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# Frequency Curve at St. Louis, MO

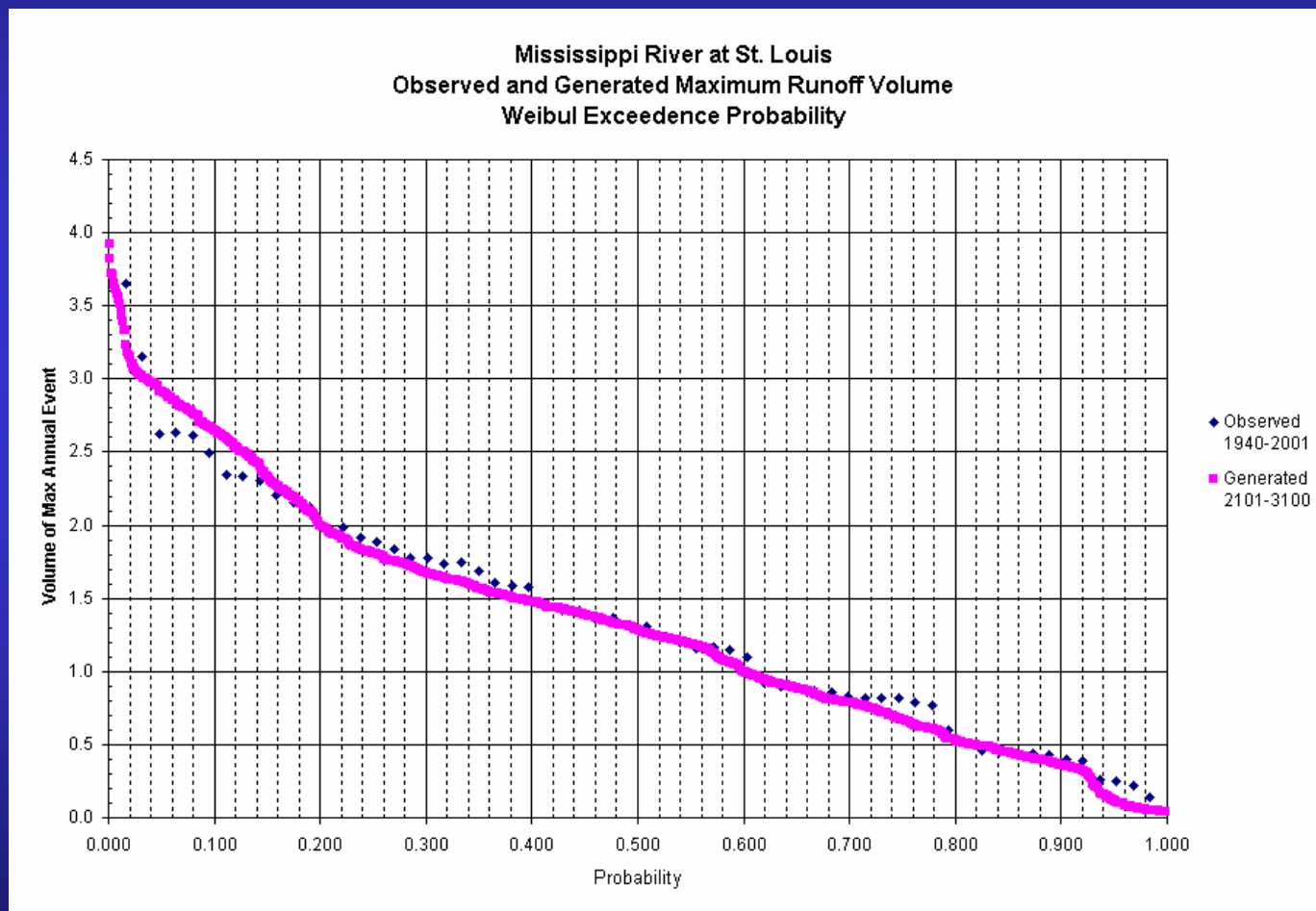


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# Event volume frequency at St. Louis, MO



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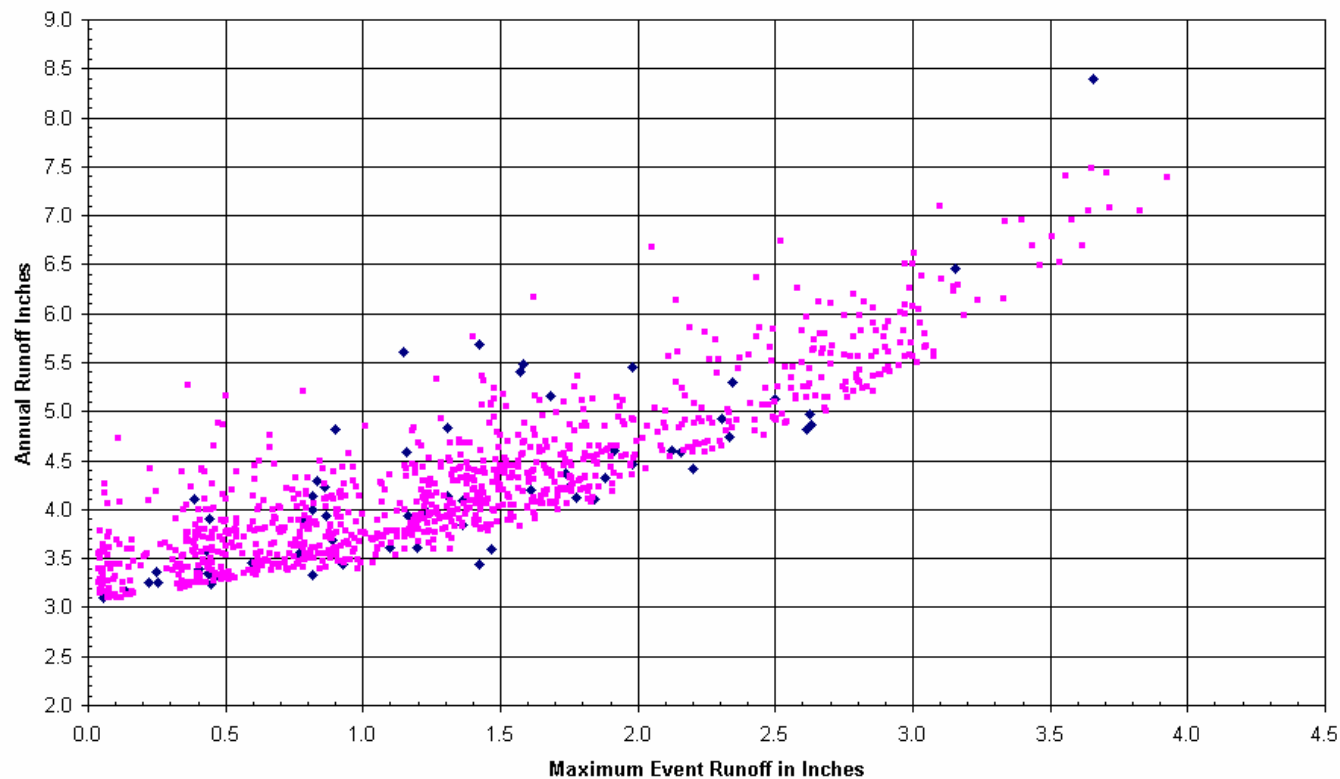


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# Annual Volume at St. Louis, MO



Mississippi River at St. Louis  
Event Volume - Annual Volume Relationship

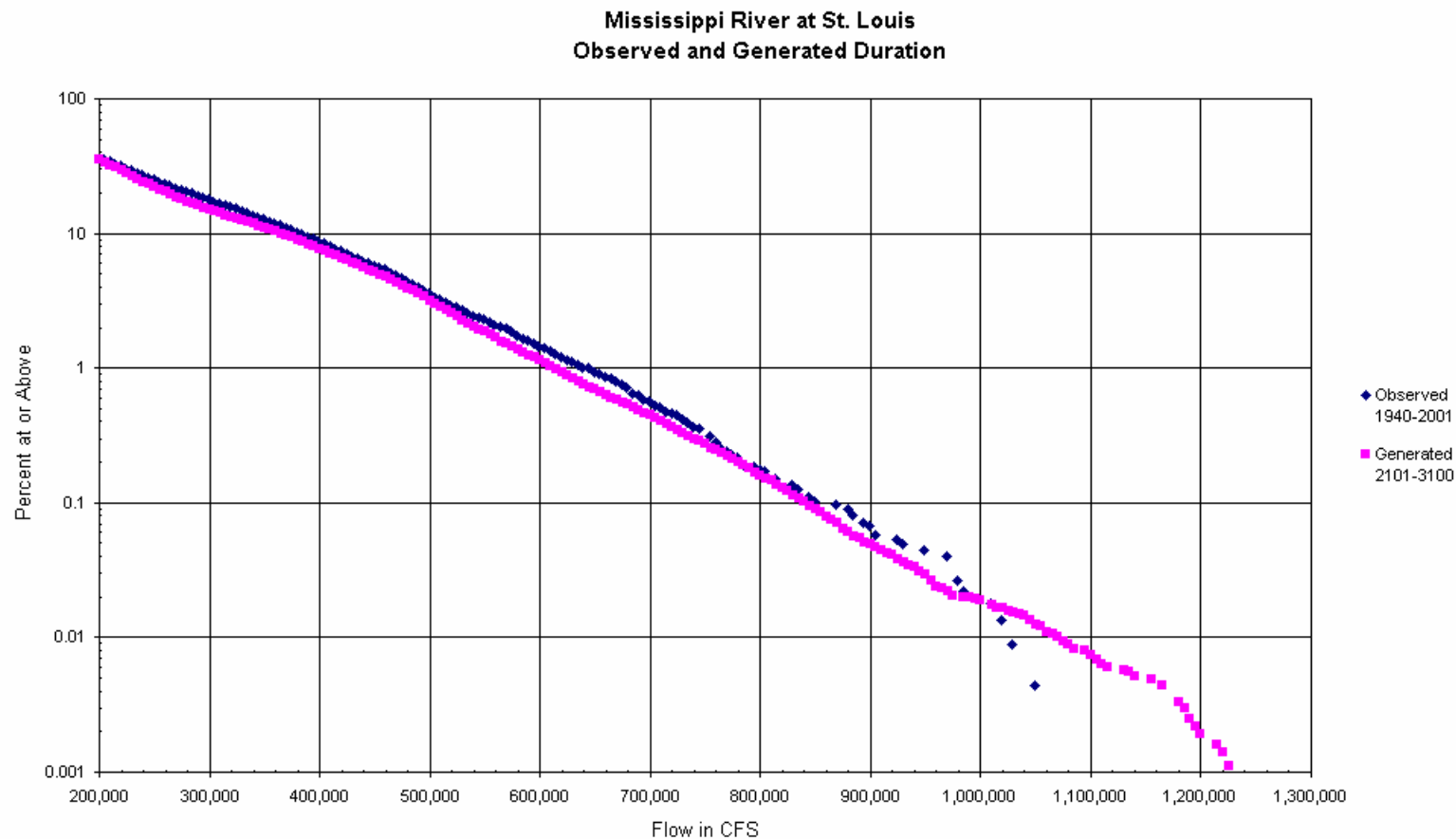


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# Annual Duration Curve at St. Louis, MO

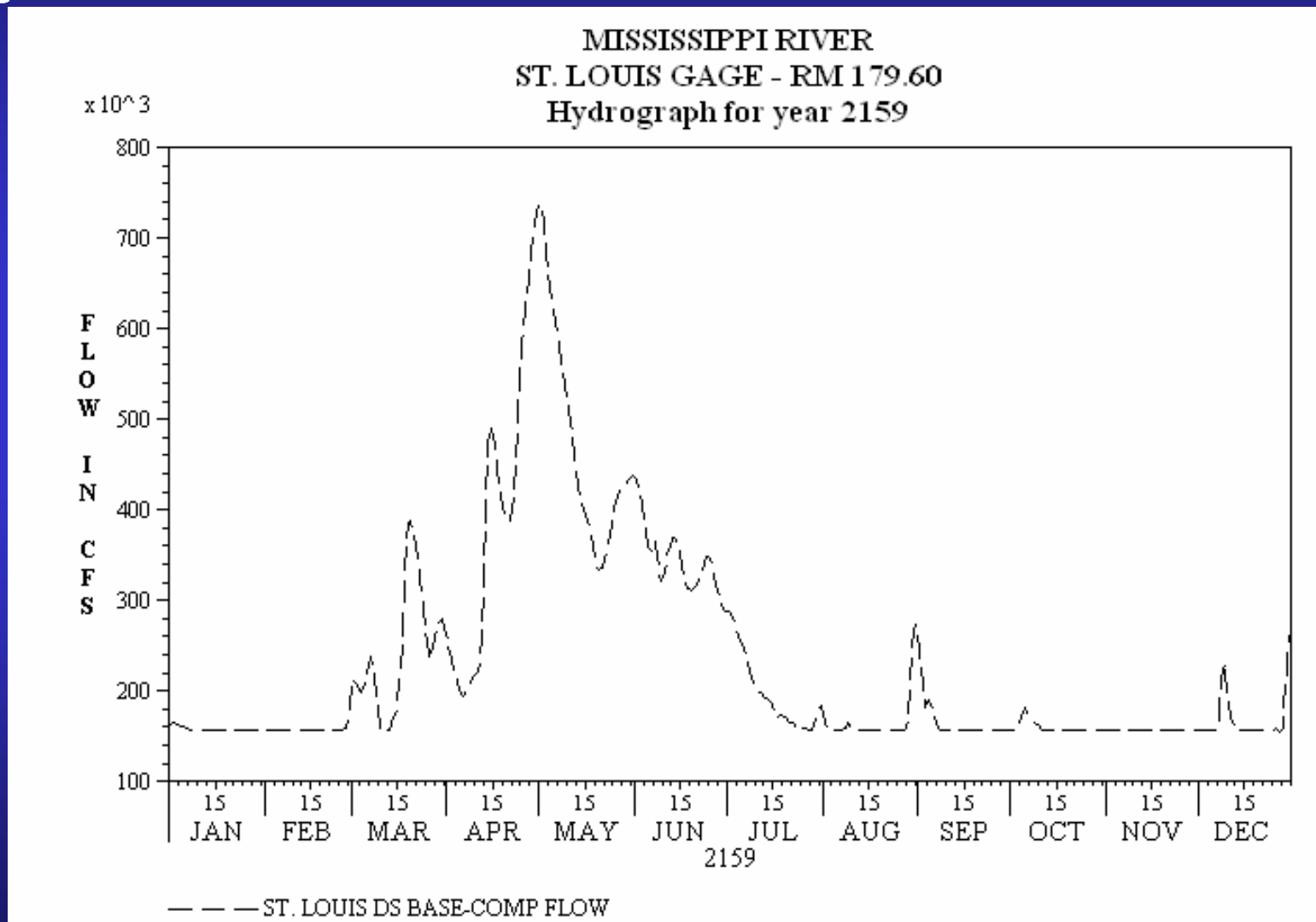


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# Year of 2159



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# Divided Basin into 4 hydraulic reaches



## Mississippi River

- 1) Anoka, MN (864.5) to Dubuque, IA(579.9)
- 2) Dubuque, IA (579.9) to Grafton, IL (218)
- 3) Keokuk, IA (364.2) to Thebes, IL (70.8)

## Illinois River

- 4) Lockport, IL (290.9) to Grafton, IL (0.0)



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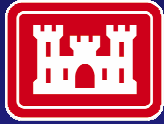
## Economic Reaches



- REACH 1  
St. Paul to Clinton (Pool 13)
- REACH 2  
Clinton to Keokuk (Pool 19)
- REACH 3  
Keokuk to Thebes (Open  
River RM 40)
- REACH 4  
Illinois River



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# Existing Levee Conditions Summary



<u>REACH</u>	<u>Urban</u>	<u>Unprot</u>	<u>Agri</u>	<u>OTHER</u>
1	17	21	0	8
2	12	20	12	0
3	14	18	54	24
4	10	10	31	6
Total	53	69	97	38

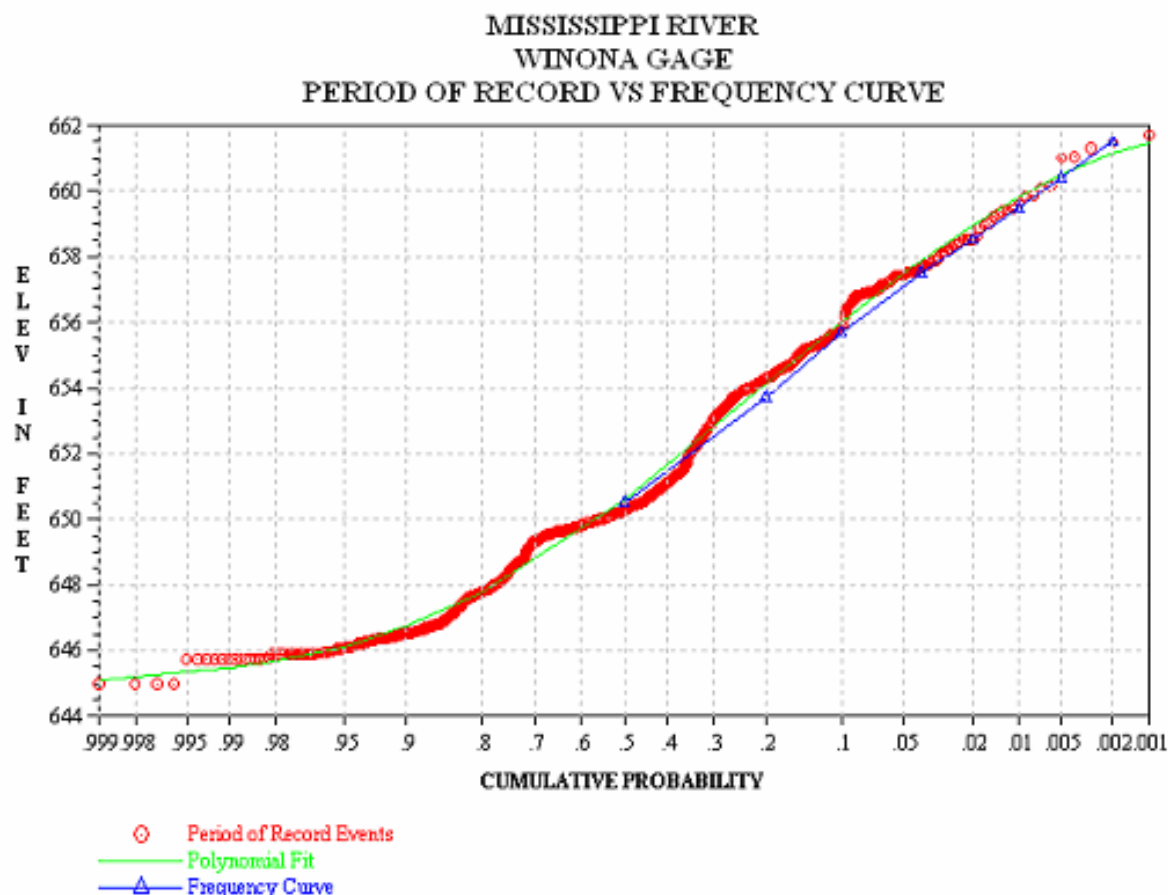
Number of Urban Systems, Unprotected Towns, Agricultural  
Levees and Refuge/Wildlife Areas (OTHER).

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# Stage-Frequency Curve at Winona, MN Reach 1

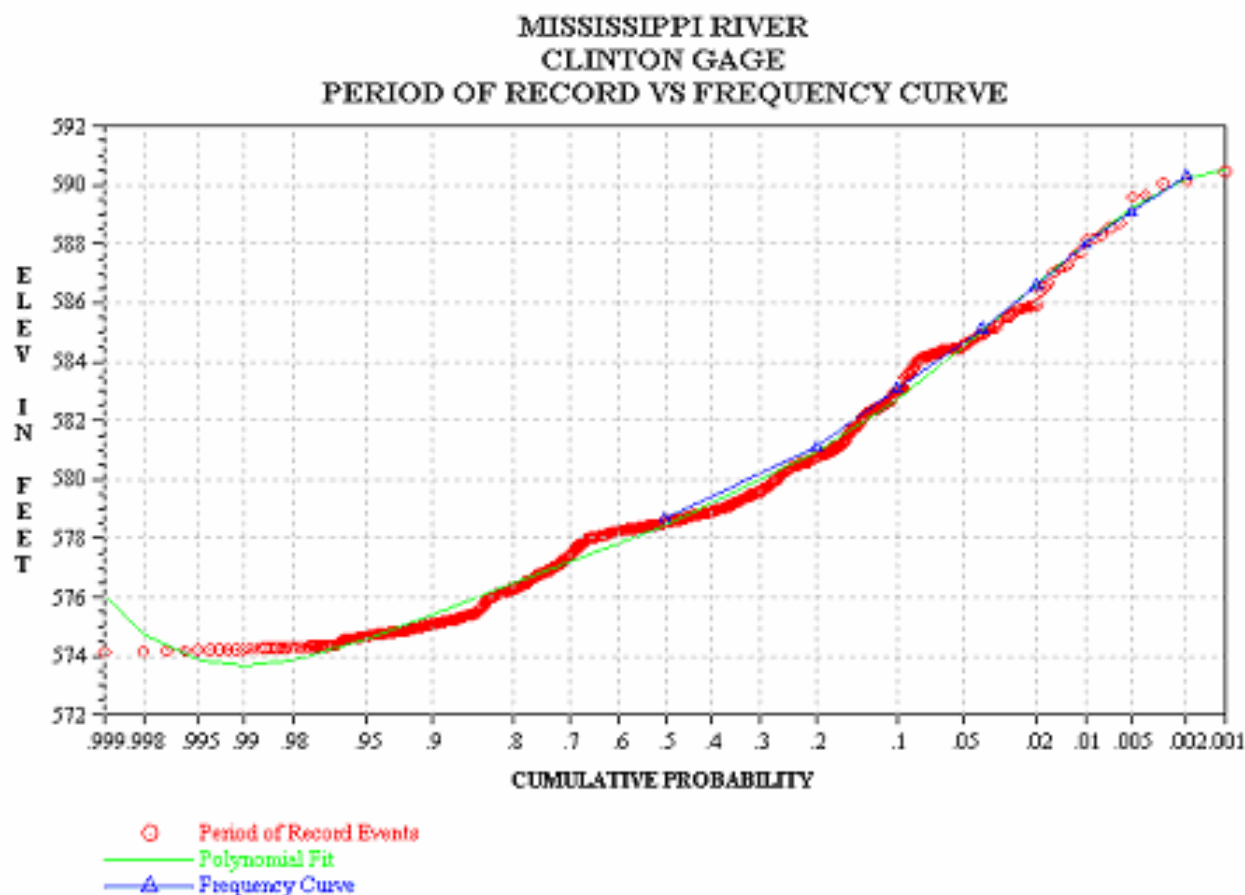


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# Stage-Frequency Curve at Clinton, IA Reach 2



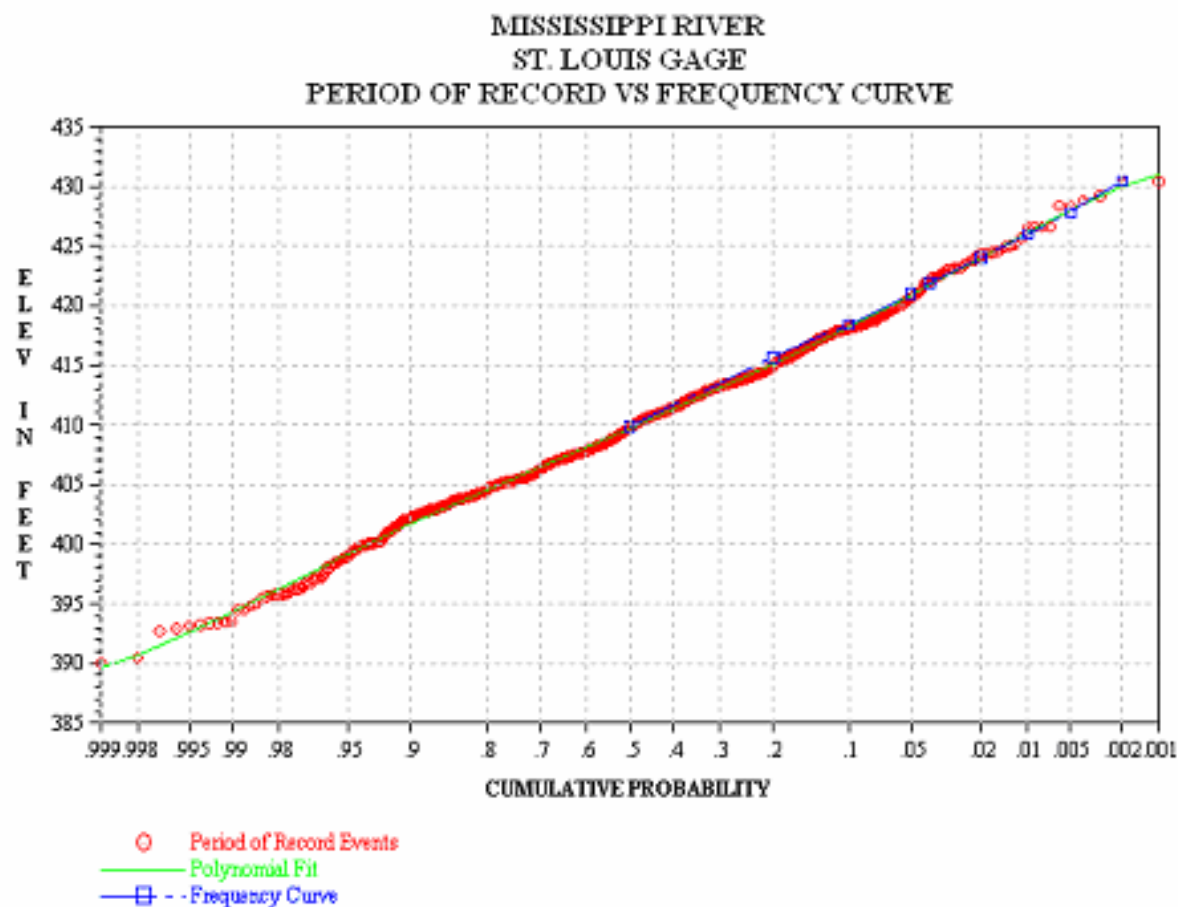
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# Stage-Frequency Curve at St. Louis, MO Reach 3

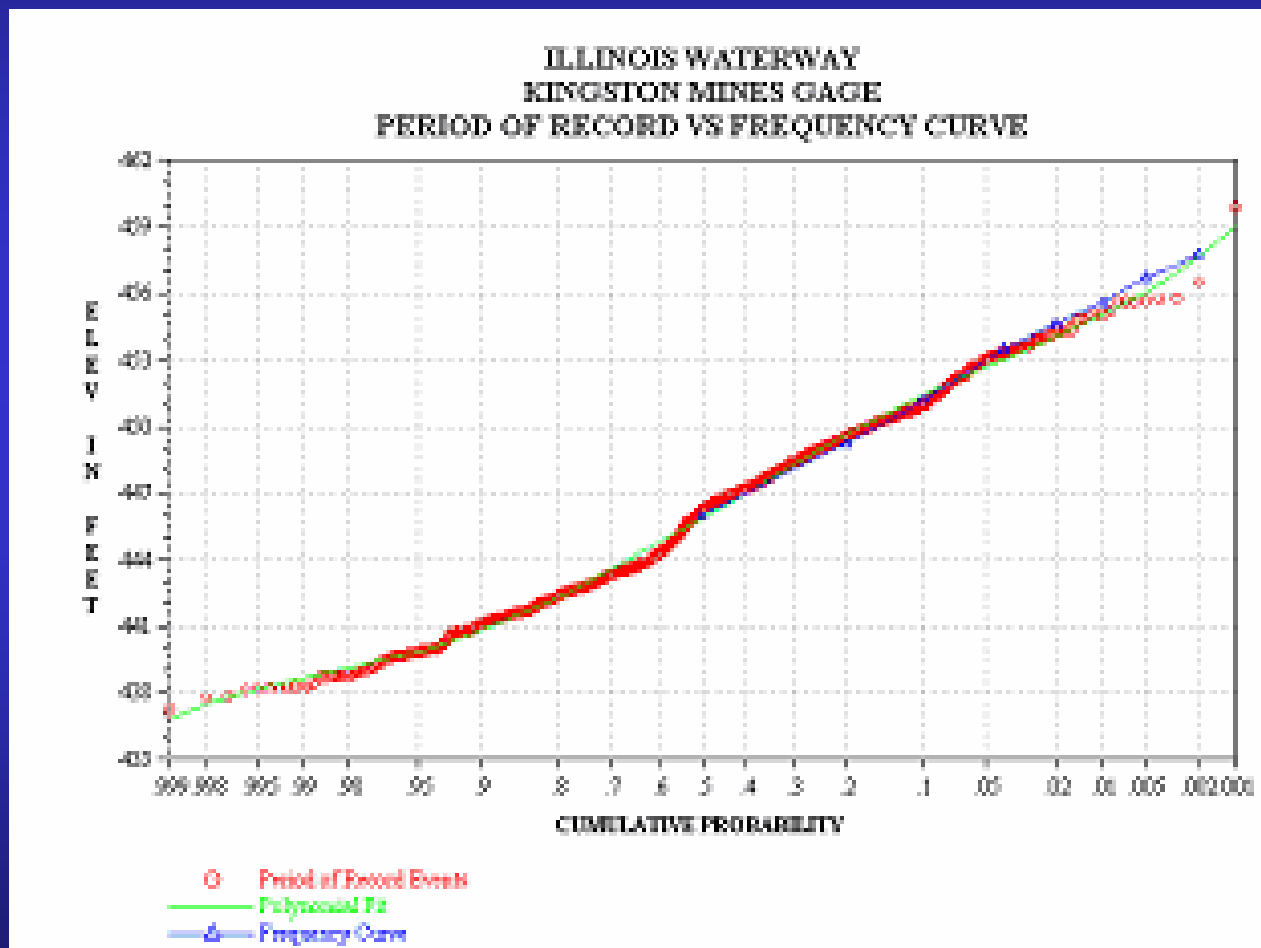


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# Stage-Frequency at Kingston Mines, IL Reach 4



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# Alternative Criteria



- 1) 1 foot allowable increase for the 100-year**
- 2) Impact to existing MR&T levee system**
- 3) Dollar damage per acre for levee district**



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# Levee Measures Considered



- **Levee Setback**
- **Levee Removal**
- **Levee Elevation altered (raised or lowered)**
- **New Levee**



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# Alternative Plans - FDR



- **500-yr confined**
- **UNCONFINED (Must meet Criteria)**
  - 500-yr Urban/Agri/Unprotected
  - 500-yr Urban + 200-yr Agri (no longer Ag)
  - 500-yr Urban + -100-yr Agri (not cert 100-yr)
  - 500-yr Urban + 50-yr Agri (only raise levees not 50-yr)
- **Removing all Agri Levees (Agricultural & Natural Growth)**
- **Non-structural**

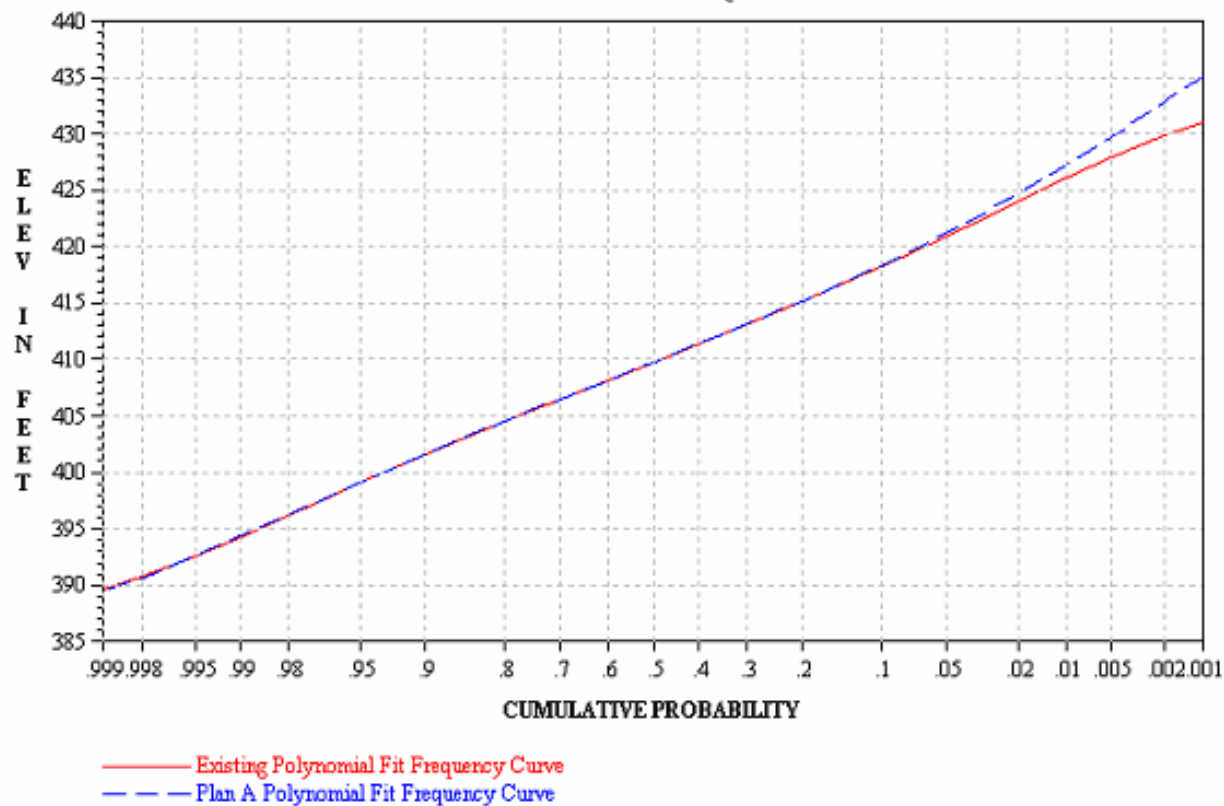


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## FREQUENCY CURVE FOR 500-YEAR CONFINED ALTERNATIVE



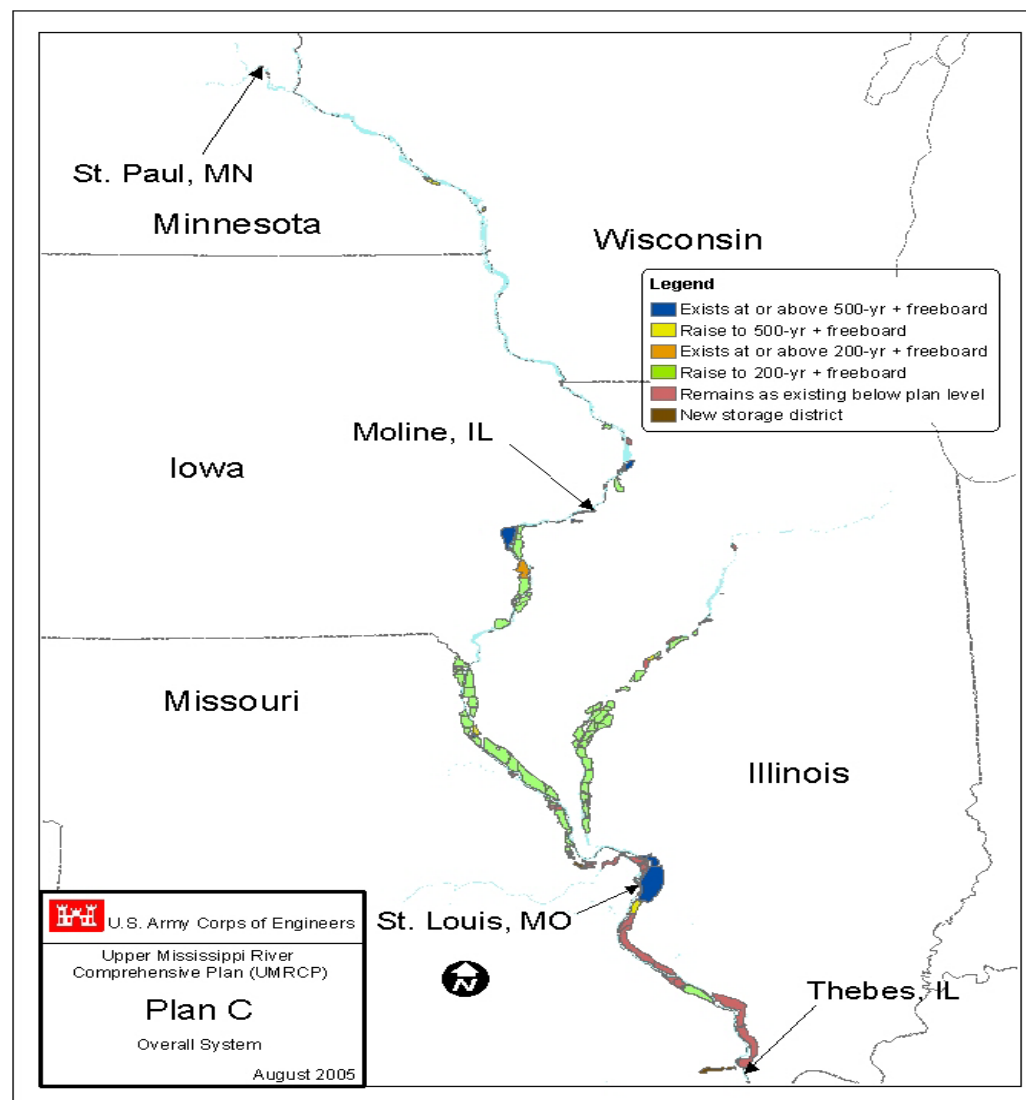
MISSISSIPPI RIVER  
ST. LOUIS GAGE  
EXISTING VS PLAN A FREQUENCY CURVES



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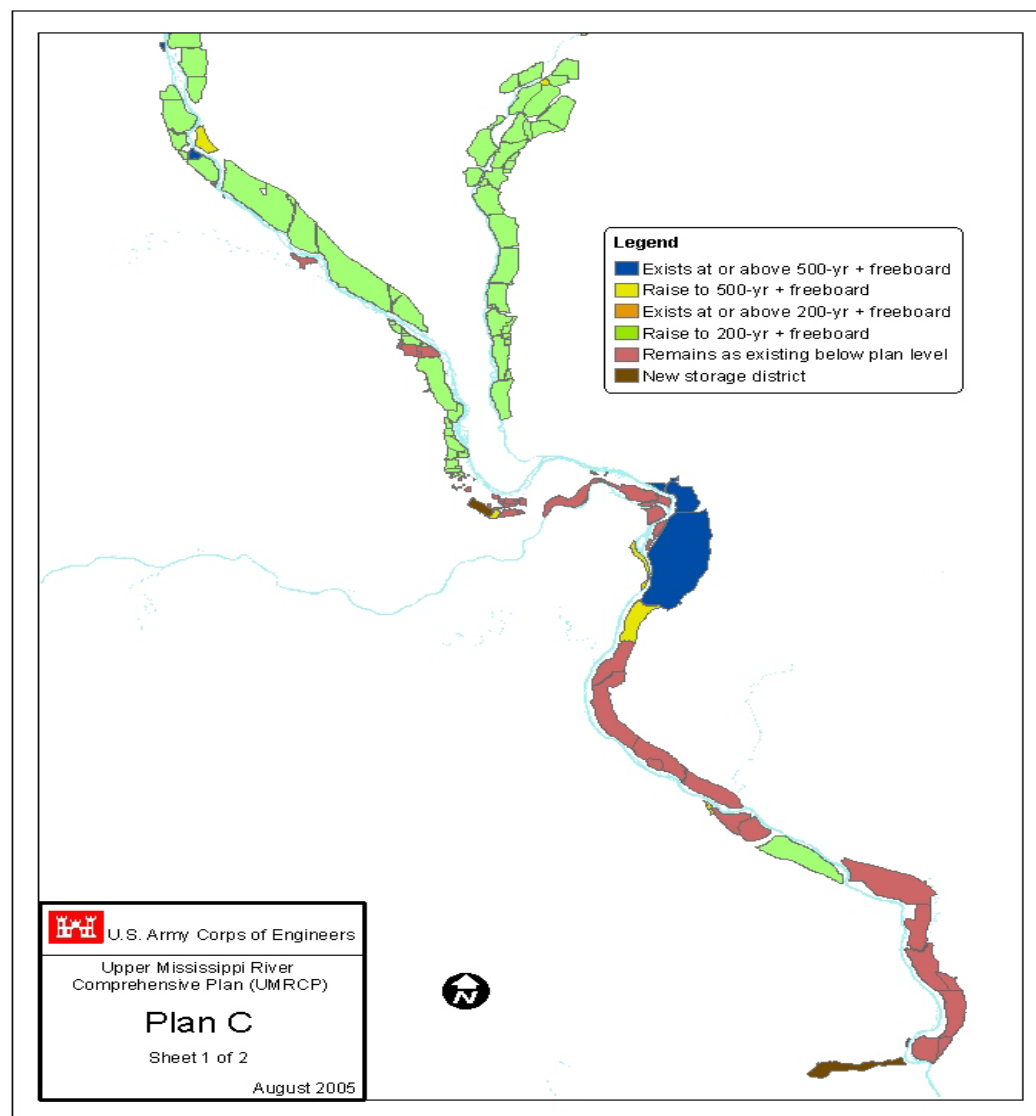
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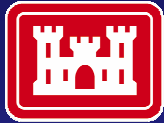


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## **ALTERNATIVE INCREASE OF THE 100-YEAR ELEVATION REACH 3**



GAGE SITE	STATE	RIVER MILE	500-yr confined	500-yr Urban/Agri/ Unprotected*	500-yr Urban + 200-yr Agri*
KEOKUK	IA	364.2	0.1	0.1	0.1
HANNIBAL	MO	309	0.9	0.6	0.4
GRAFTON	IL	218	1.2	0.7	0.8
ST. LOUIS	MO	179.6	1.4	0.5	0.7
CHESTER	IL	109.9	2.7	0.4	0.6
THEBES	IL	43.7	2.2	0.2	0.2

**\*Must meet criteria**

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# Accomplishments



- This is the first time the basin has been analyzed systemically on a statistical frequency basic
- This has resulted in significant understanding of the relationship and impact of the major rivers on one another
- The systemic impacts of both large-and small-scale changes to the existing flood protection system are better understood



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# Any Questions???

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