Floodway Modeling for Unsteady and 2D Models

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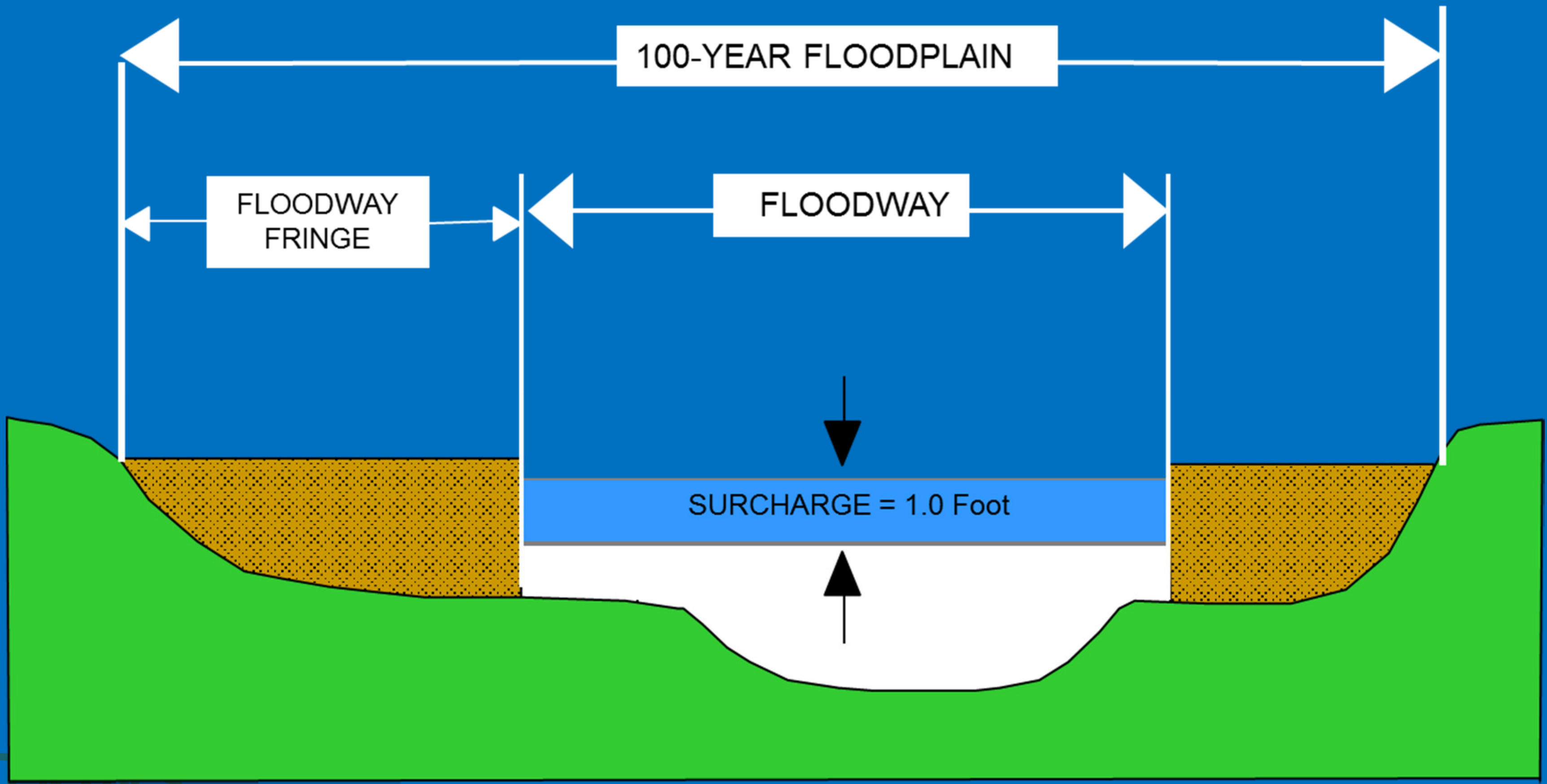
Plan Design Enable

Introduction

Floodway

The channel of a stream and the adjacent area that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height (44 CFR 59.1)

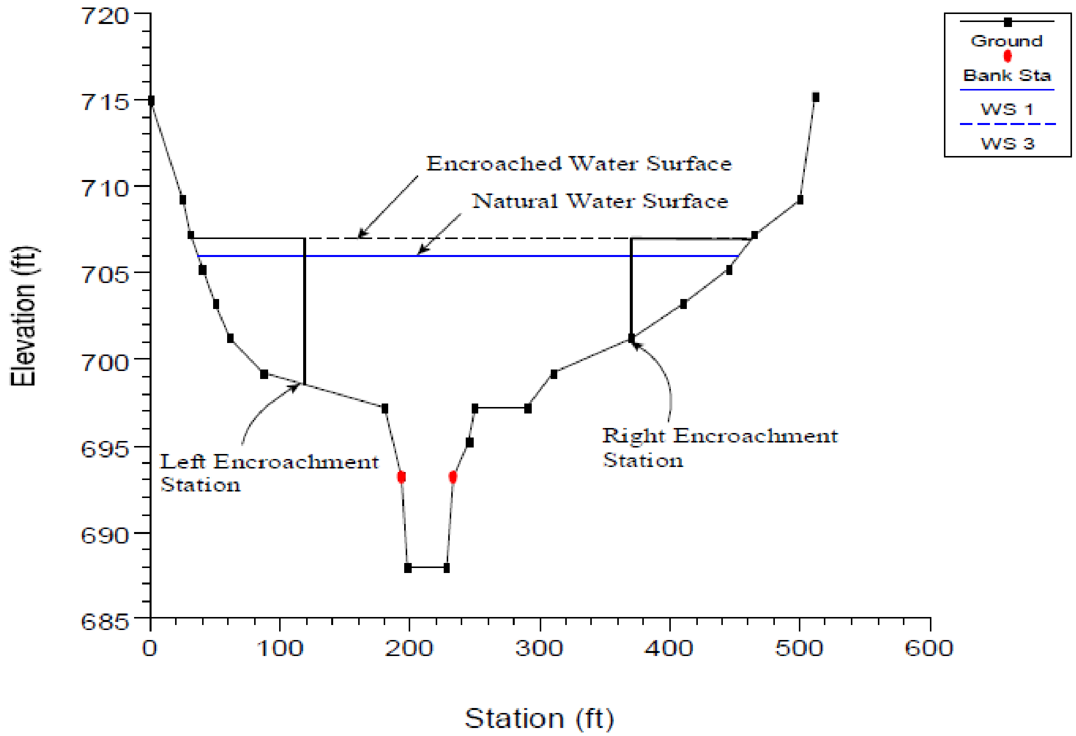


Purpose

Provides for development in the floodplain while preserving a conveyance zone for the flood flow

NOAA, 2016

Concept is well-suited for steady-state HEC-RAS



USACE, 2010

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How does this apply to unsteady and 2D modeling?

Considerations:

- FEMA Policy and Guidance
- Existing effective FW
- Future updates
- Floodway extent

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FEMA Policy Standards

SID #	Standard
72	An equal conveyance reduction method must be used to establish the minimal regulatory floodway
73	To calculate floodways using methodologies other than steady-state, one-dimensional models, pre-approval must be received from the FEMA Project Officer and impacted communities and states with floodway authorities
99	Areas of shallow flooding shall not have modeled/computed floodways due to the inherent uncertainties associated with their flow patterns. However, communities can choose to have administrative floodways for such areas

Appendix C Guidance (superseded)

Unsteady model:

Equal conveyance reduction (dual model approach)

Equal storage reduction

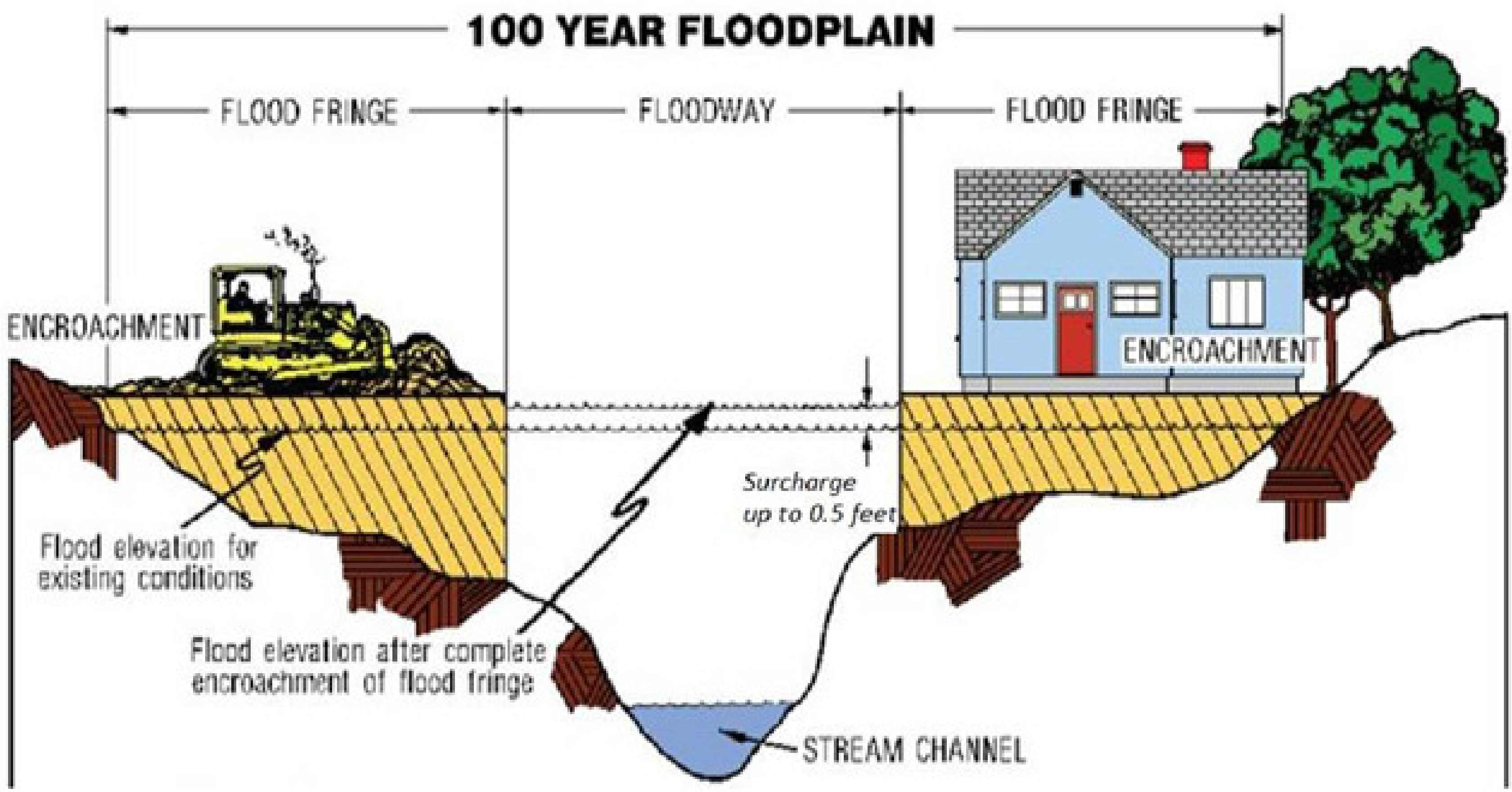
2D model:

Storage routing (fill up cell to surcharge before spilling into neighboring cells)

Floodway Revisions

- The base model for the allowable surcharge is the model used to determine the BFEs for the first time a floodway was adopted
- Subsequent floodway revisions are limited to the maximum allowable surcharge determined in the base model
- Updated hydraulic models should reflect encroachments in the floodway fringe
- Cumulative effects of existing and future encroachments is limited to the maximum allowable surcharge determined in the base model

Floodway Revisions



City of Dublin, 2015

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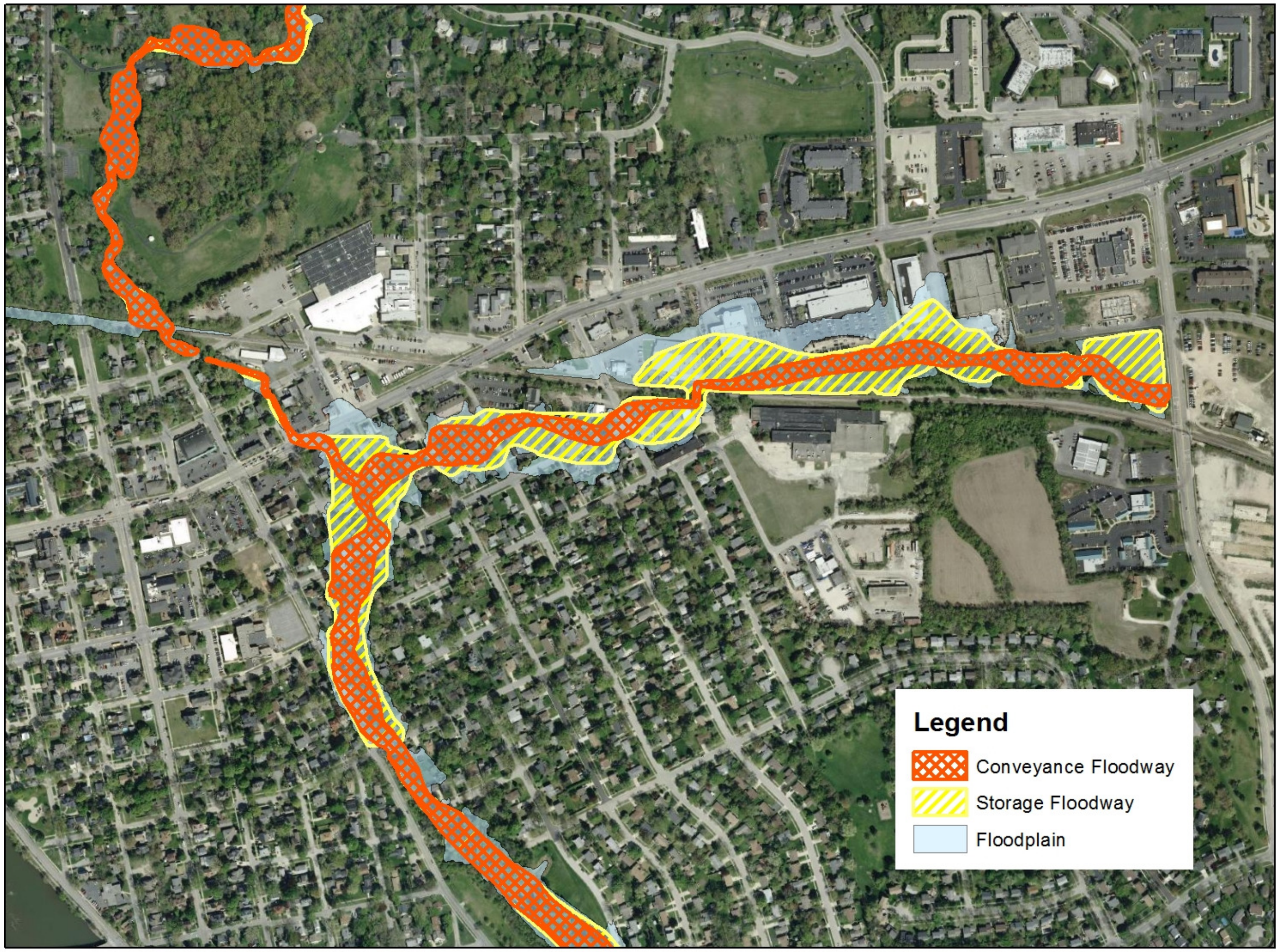
Floodway Revisions (cont.)

- If the base model is modified for reasons other than encroachments in the floodplain, e.g., revised hydrology, the revised model, excluding revisions attributable to loss of conveyance resulting from floodplain encroachment, becomes the base model for future floodway analyses

What about later updates?

- Cost (model)
- Modeling time
- Complexity (effects upstream and downstream depending on stability)

Relative size of floodplain



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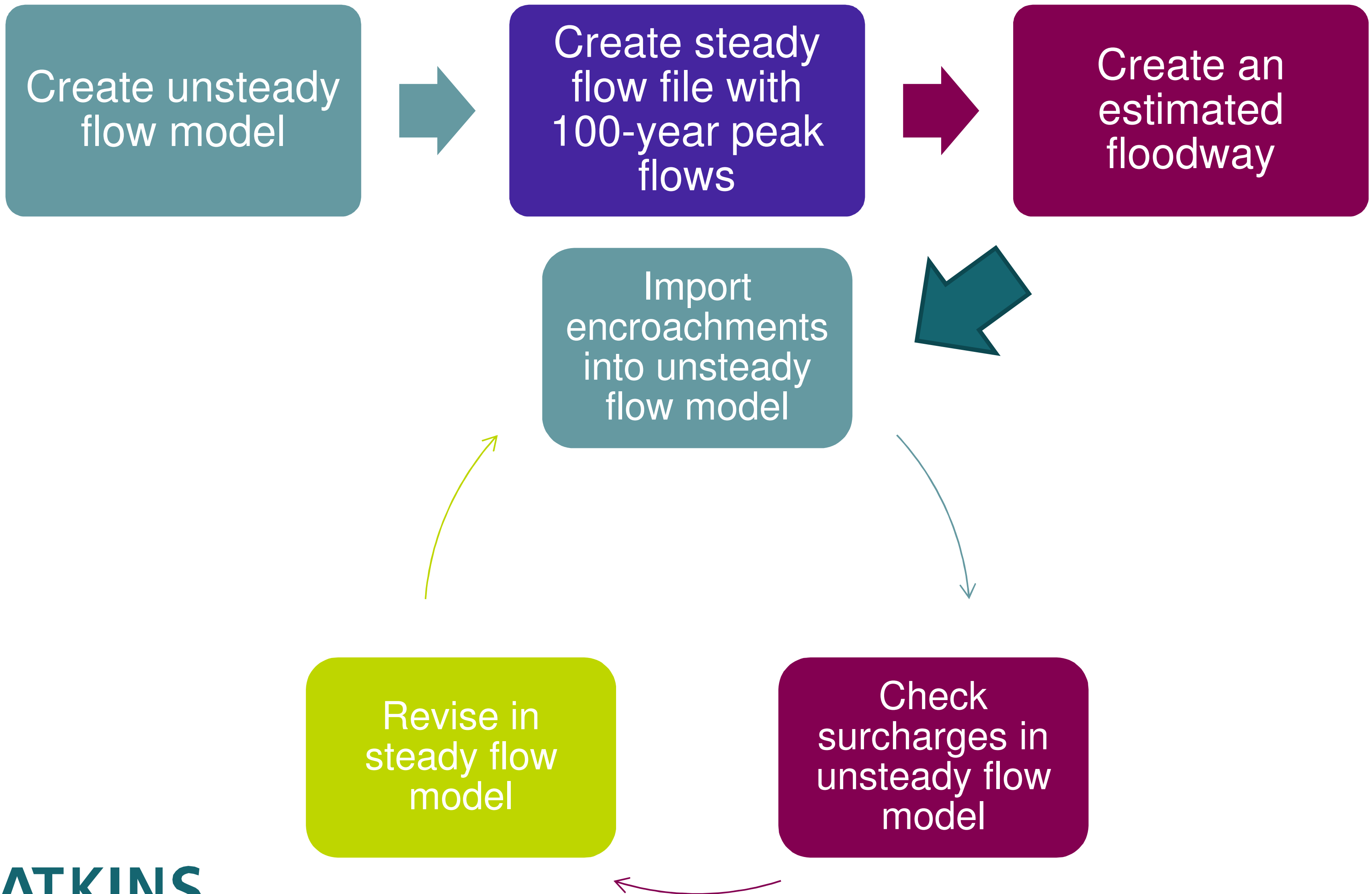
Approaches

HEC-RAS Unsteady



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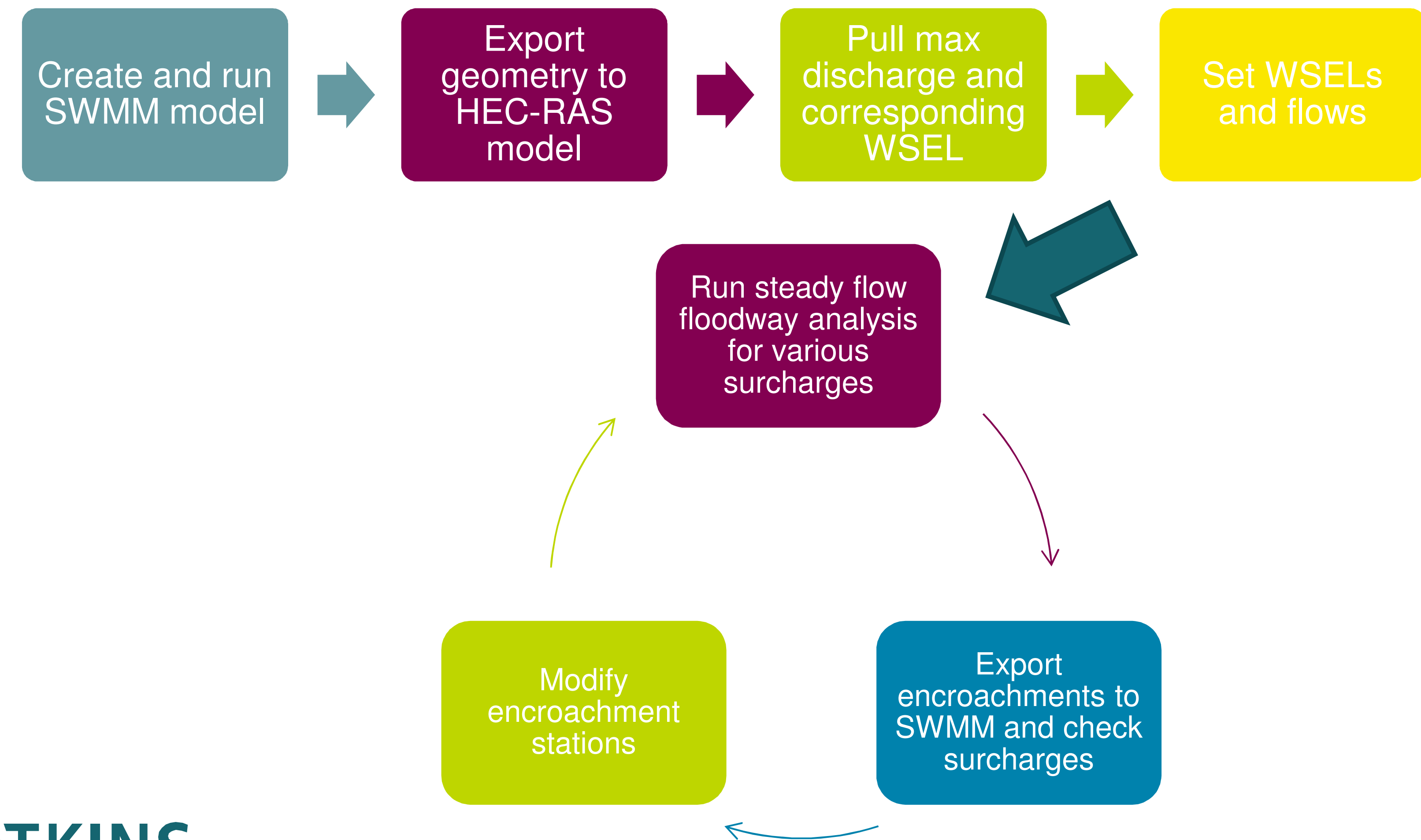
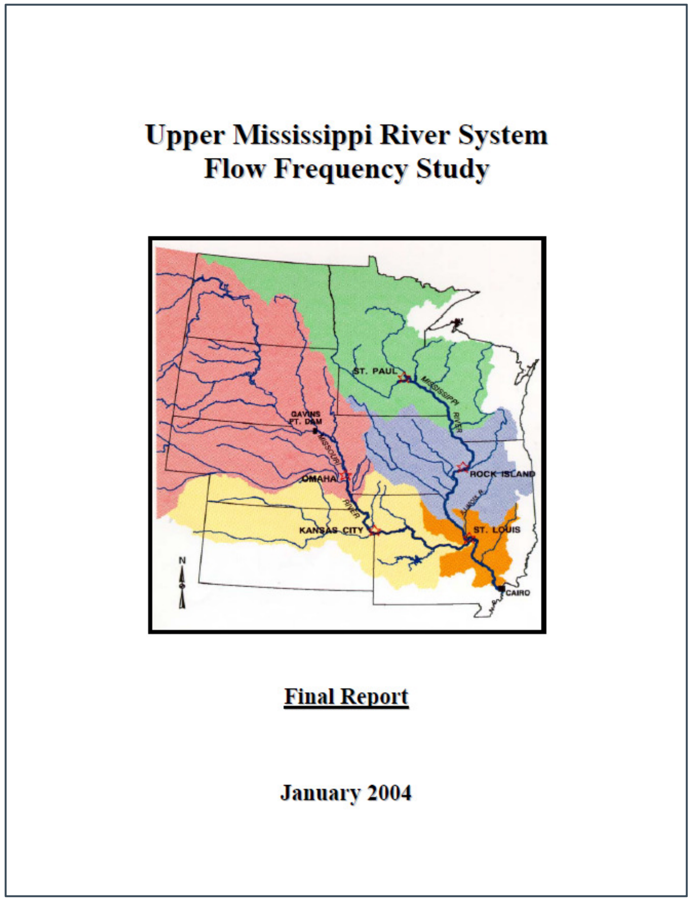
Dual Model Approach - Iterative procedure for SWMM Models



Variant on the dual model approach: the Mississippi River


Upper Mississippi River System
Flow Frequency Study

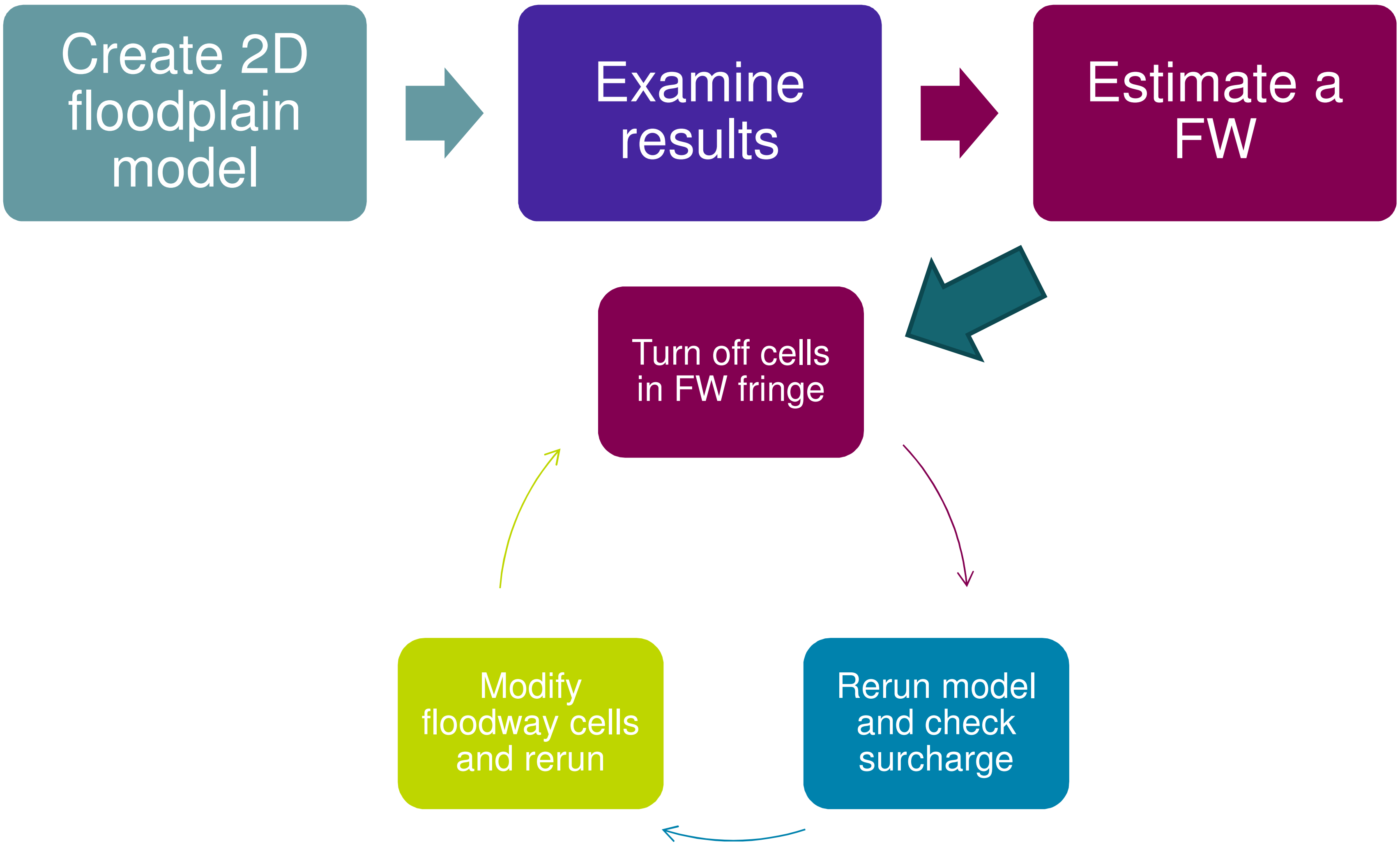
Final Report

January 2004

Variant on the dual model approach: the Mississippi River

- UNET Model
- 100-yr steady flow RAS model
- Calibrate to UNET 100-yr
- Run floodway analysis on steady model
- Final floodway

Encroachments in the 2D Model



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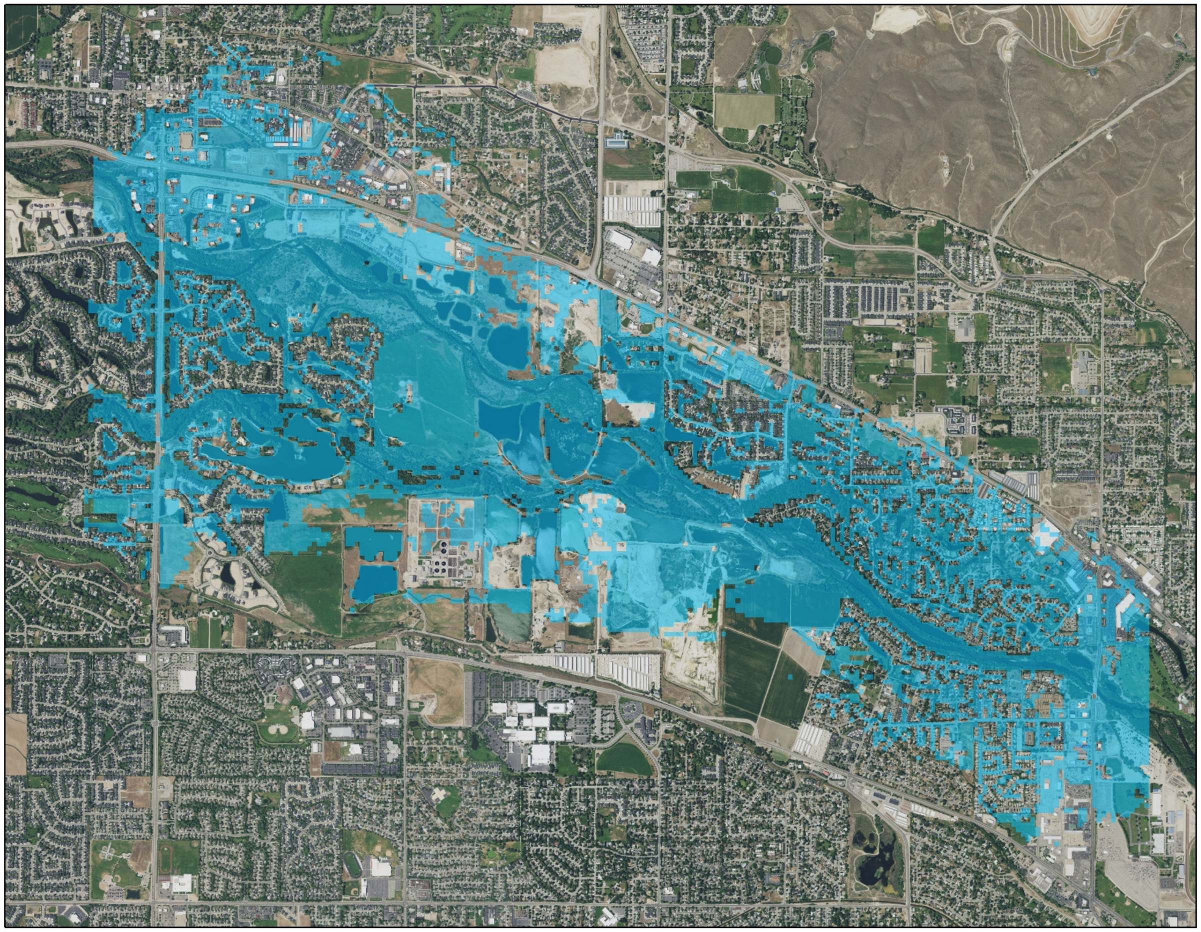
2D Floodplain



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2D Floodplain – Velocity Map

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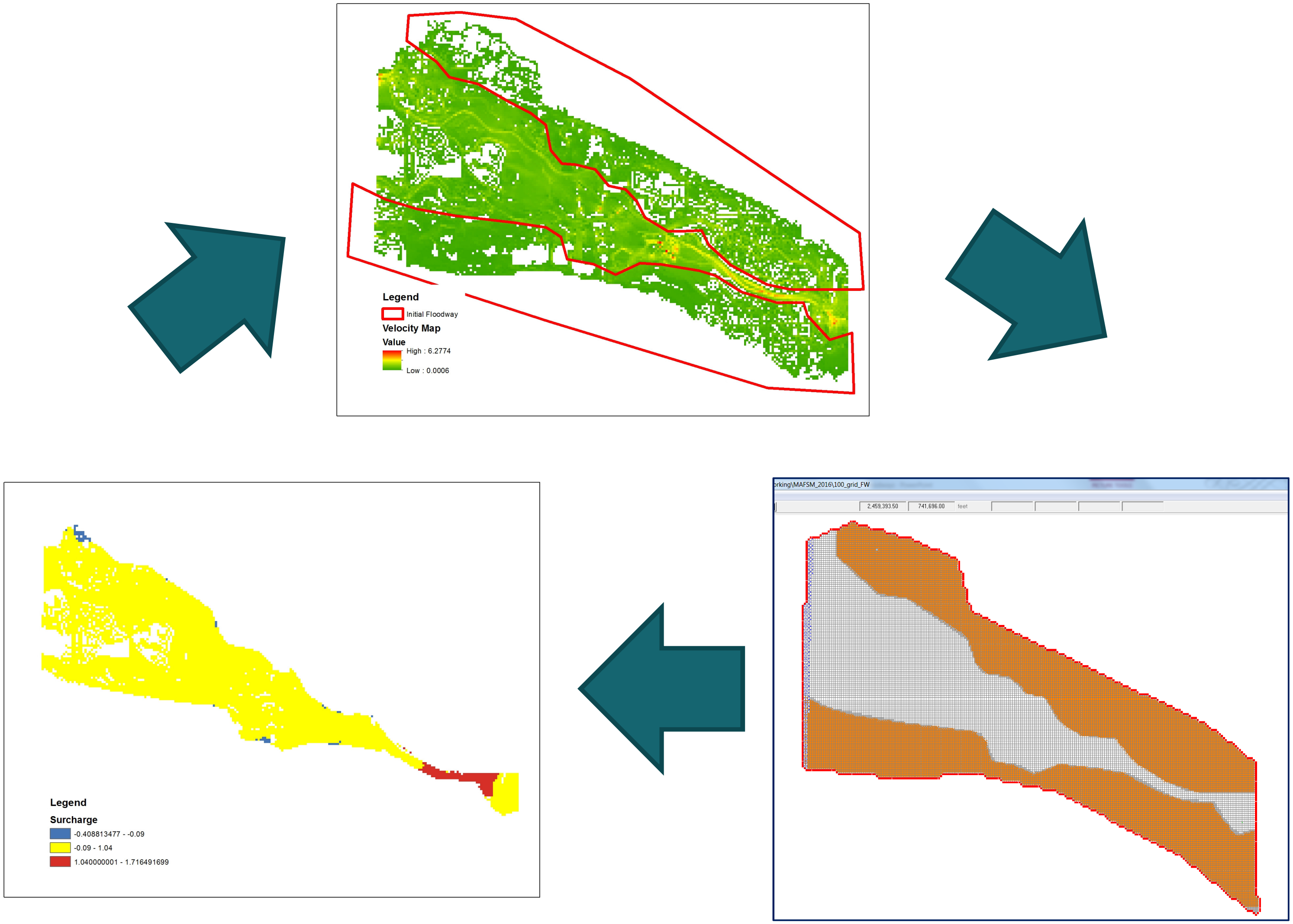
2D Floodplain - Iteration



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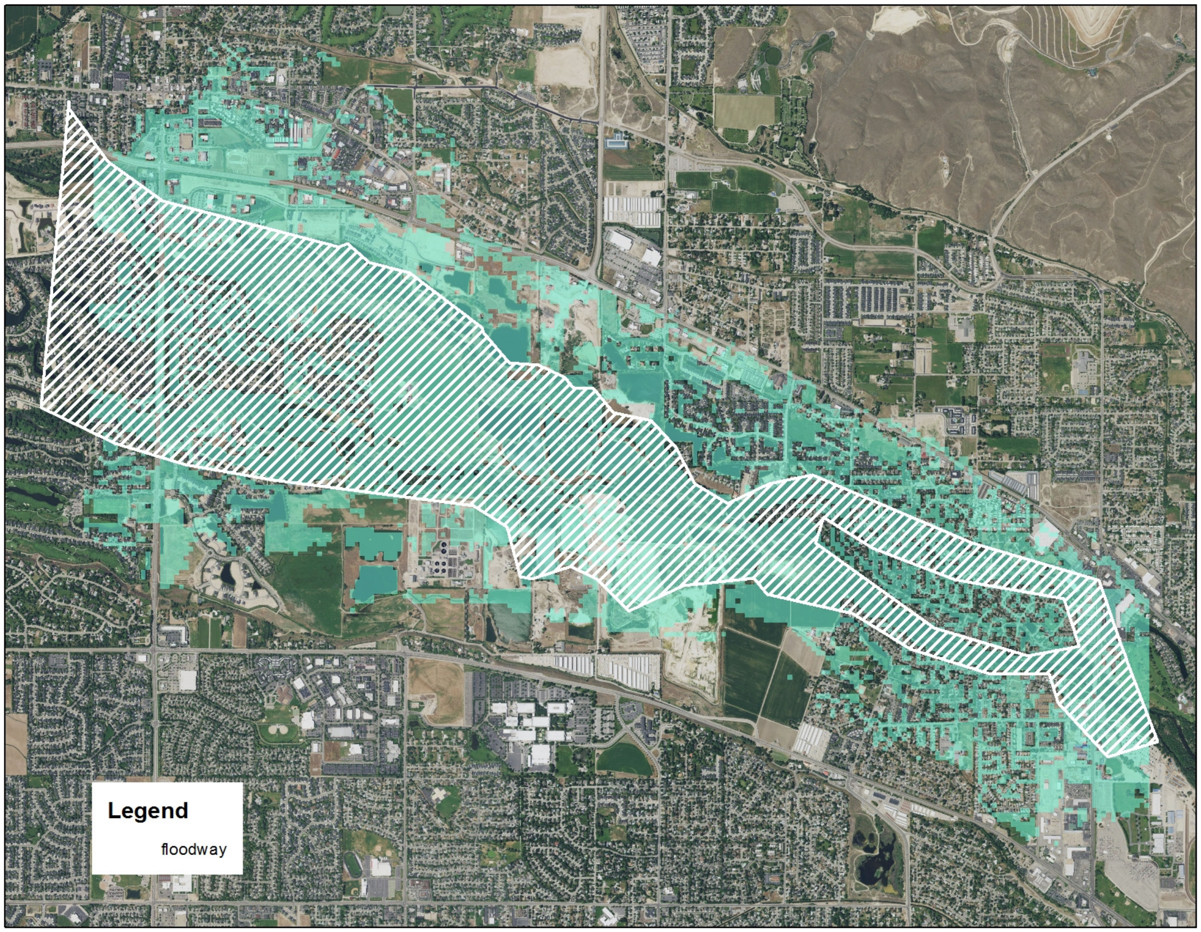
Estimated floodway



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Other solutions – administrative FW

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
NODE	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
MINNEHAHA CREEK								
A	2,495	*	*	*	715.2	714.0[2]	*	*
B	2,525	*	*	*	715.2	714.2[2]	*	*
C	4,140	*	*	*	743.5	743.5	*	*
D	4,153	*	*	*	744.4	744.4	*	*
E	4,864	*	*	*	807.9	807.9	*	*
F	4,894	*	*	*	807.8	807.8	*	*
G	8,854	*	*	*	813.2	813.2	*	*
H	9,495	*	*	*	813.3	813.3	*	*
I	10,449	*	*	*	814.2	814.2	*	*
J	10,808	*	*	*	814.5	814.5	*	*
K	15,320	*	*	*	818.0	818.0	*	*
L	15,479	*	*	*	818.0	818.0	*	*
M	17,005	*	*	*	820.7	820.7	*	*
N	17,505	*	*	*	820.8	820.8	*	*
O	18,599	*	*	*	822.7	822.7	*	*
P	19,546	*	*	*	823.6	823.6	*	*
Q	21,074	*	*	*	824.4	824.4	*	*
R	21,424	*	*	*	824.7	824.7	*	*
S	21,974	*	*	*	825.3	825.3	*	*
T	22,188	*	*	*	825.5	825.5	*	*

[1]Feet above confluence with Mississippi River
[2]Elevation computed without consideration of backwater effects from Mississippi River
*Data not available – Administrative Floodway

TABLE 9

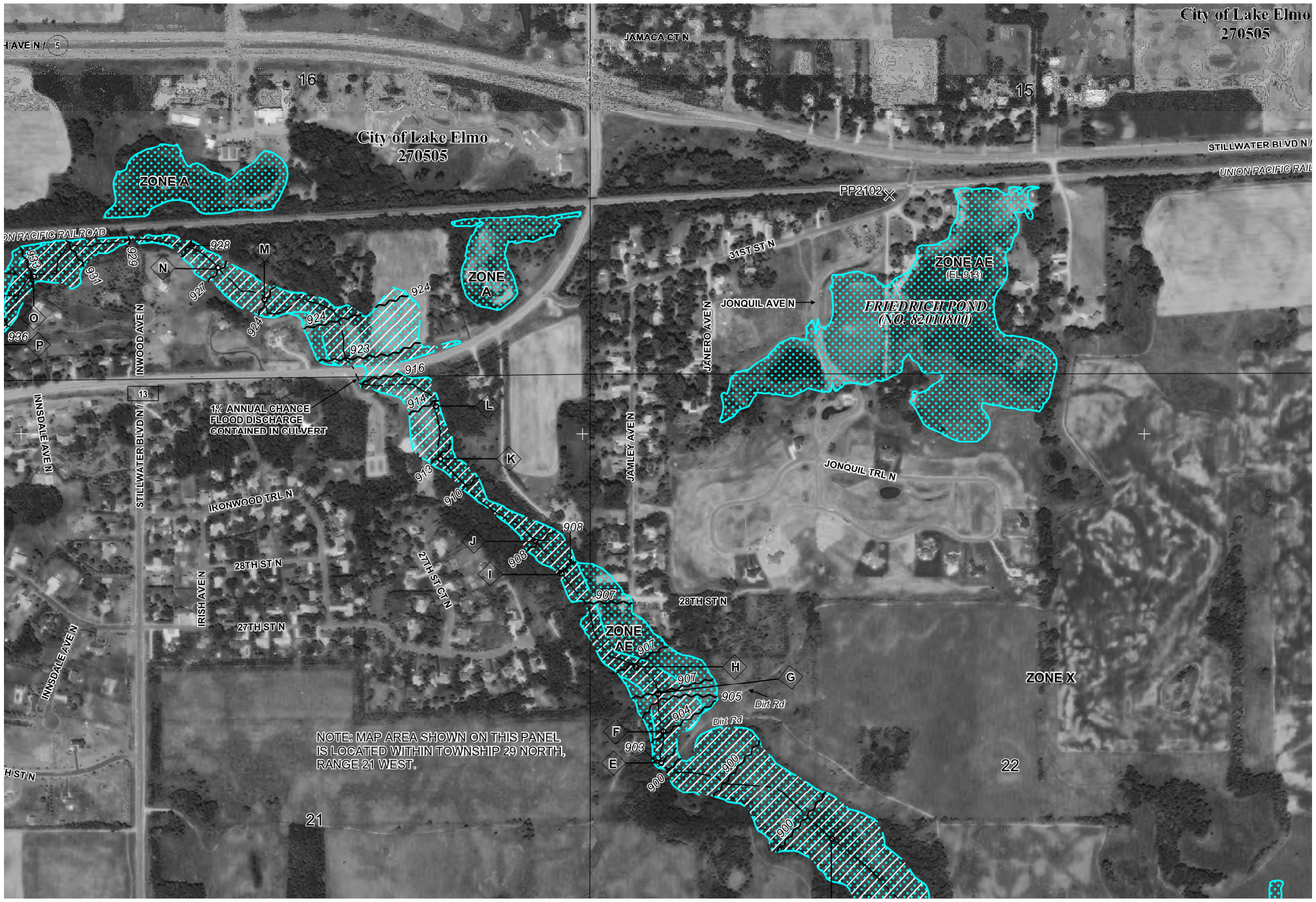
FEDERAL EMERGENCY MANAGEMENT AGENCY

HENNEPIN COUNTY, MN
(ALL JURISDICTIONS)

FLOODWAY DATA

MINNEHAHA CREEK

Other solutions – Floodplain as floodway



FEMA, 2010

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Other solutions – Floodplain as floodway

FLOODING SOURCE			FLOODWAY[1]			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
NODES	LINKS	DISTANCE[2]	WIDTH (FEET)	PEAK FLOW (CFS)	VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
RALEIGH CREEK									
A		2,559				899.3	899.3	899.3	0.0
	A-B		209	210	0.3				
B		2,805				899.3	899.3	899.3	0.0
C		7,225				899.5	899.5	899.5	0.0
	C-D		369	374	0.2				
D		8,416				899.5	899.5	899.5	0.0
E		9,574				902.5	902.5	902.5	0.0
	E-F		289	768	2.5				
F		9,758				904.2	904.2	904.2	0.0
G		9,972				906.7	906.7	906.7	0.0
	G-H		492	770	1.4				
H		10,199				907.0	907.0	907.0	0.0
I		10,907				907.6	907.6	907.6	0.0
	I-J		194	772	2.4				
J		11,165				908.2	908.2	908.2	0.0
K		11,929				912.9	912.9	912.9	0.0
	K-L		226	609	1.1				
L		12,229				913.7	913.7	913.7	0.0
M		13,844				924.1	924.1	924.1	0.0
	M-N		138	685	4.3				
N		14,202				927.4	927.4	927.4	0.0

[1]Values represent maximum along link
[2]Feet above confluence with Lake Elmo

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, MN
AND INCORPORATED AREAS

FLOODWAY DATA

RALEIGH CREEK

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FEMA, 2010

Summary

Questions?

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References

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