TAYLOR ENGINEERING, INC.

Combined Probability of Coastal and Riverine Flooding

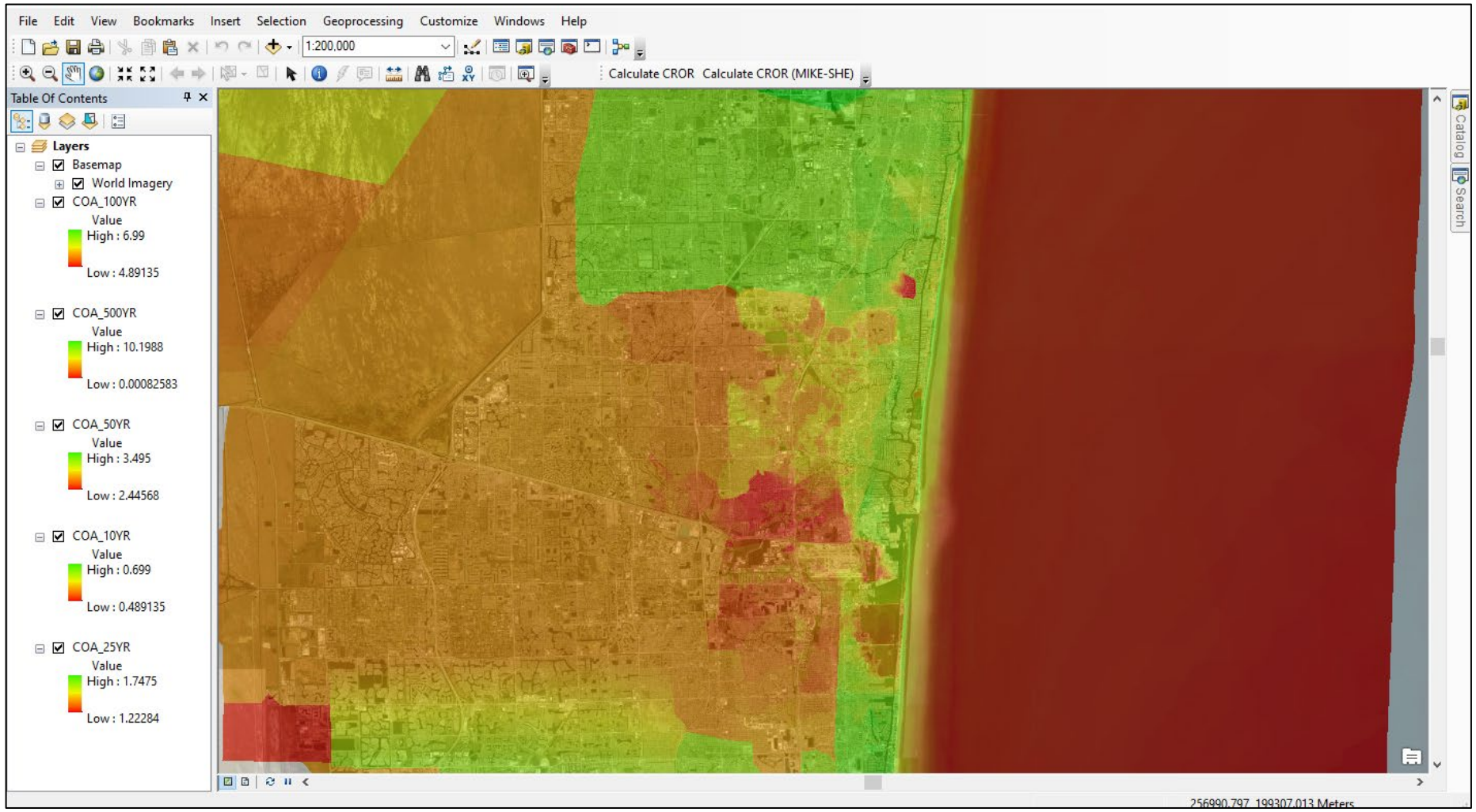
UF Water Institute

February 23, 2022

Angela Schedel, PhD, PE

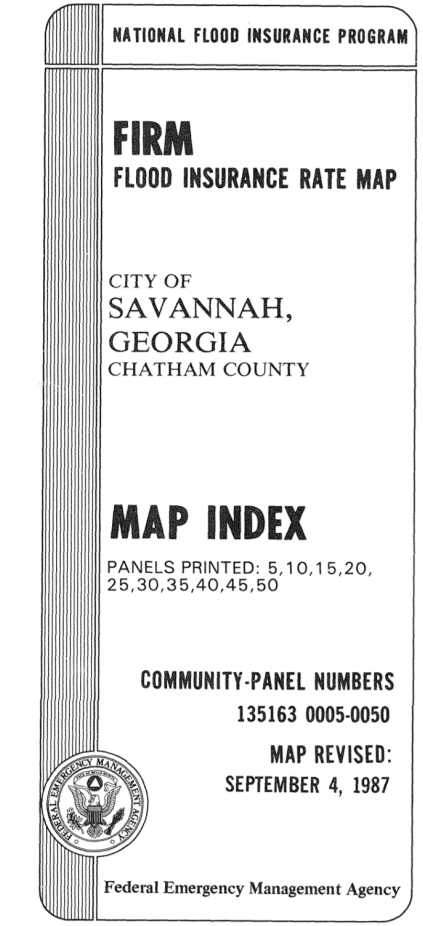
Overview

- History
- Method
- Assumptions
- Examples
- In Work



History

- FEMA Flood Insurance Studies (NFIP, previously FIA)
- Since 1970's


NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CITY OF
SAVANNAH,
GEORGIA
CHATHAM COUNTY

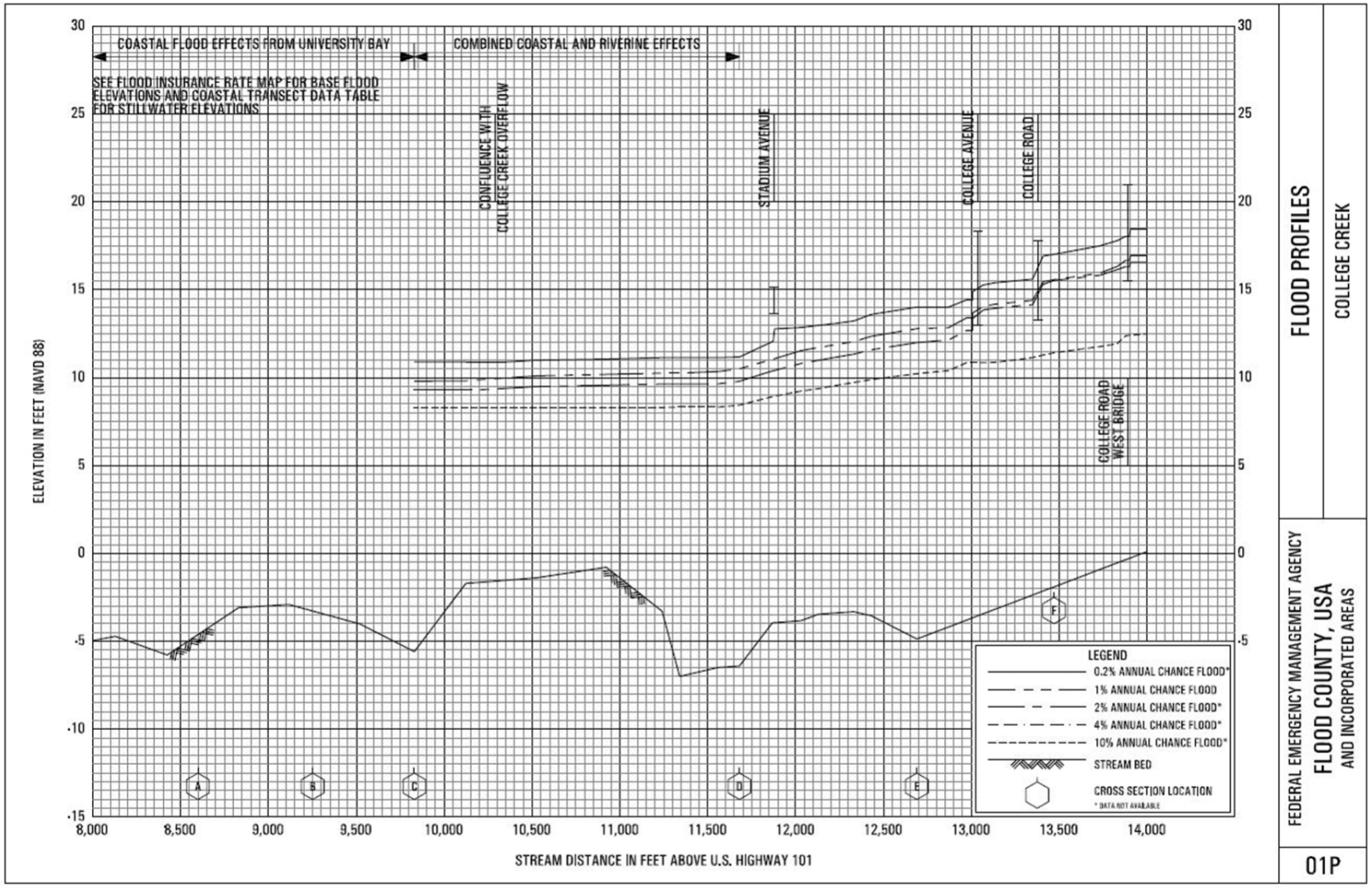
MAP INDEX

PANELS PRINTED: 5,10,15,20, 25,30,35,40,45,50

COMMUNITY-PANEL NUMBERS
135163 0005-0050

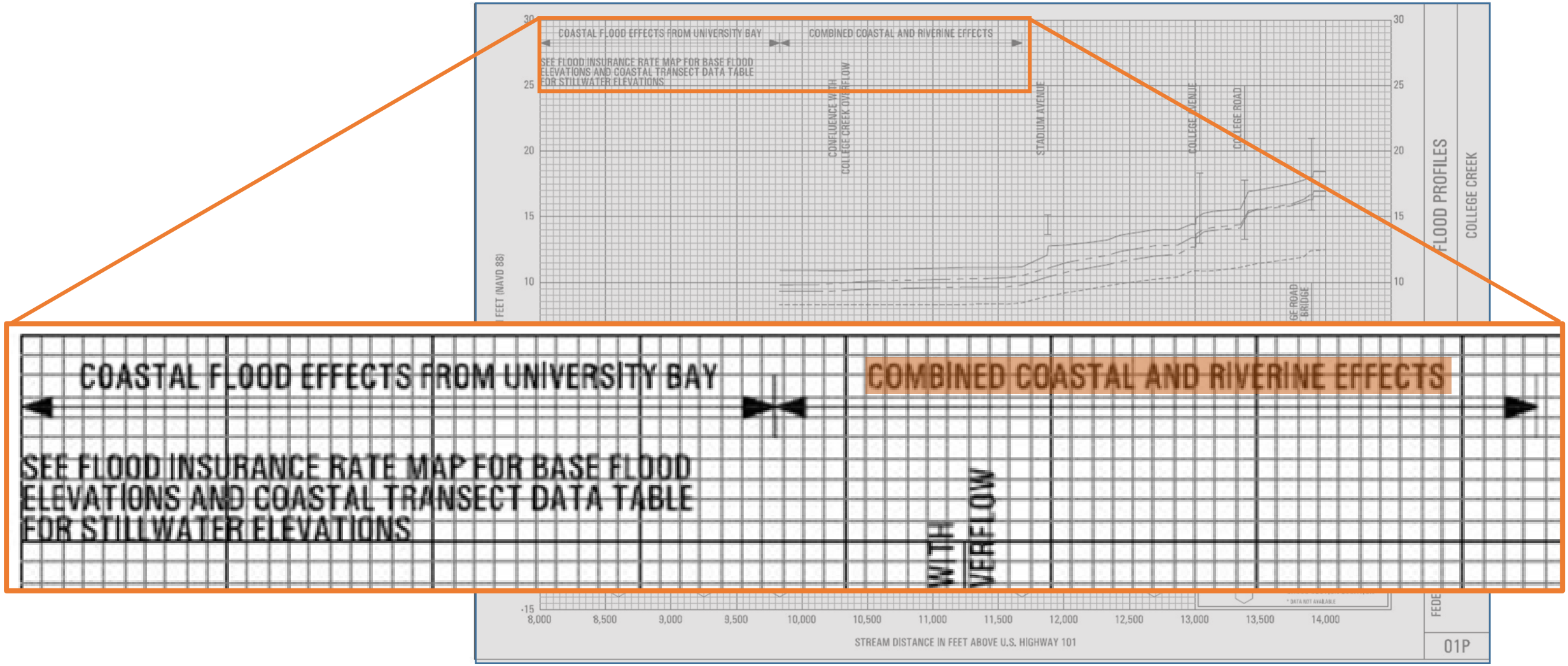
MAP REVISED:
SEPTEMBER 4, 1987

Federal Emergency Management Agency



History

- Is flooding controlled by riverine, coastal, or combined effects?



History

- Floodway Table

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	8,600	265	2,464	3.9	*	8.5[3]	8.9	0.4
B	9,250	320	3,014	2.9	*	8.9[3]	9.6	0.7
C	9,830	250	1,977	3.6	9.8[2]	9.2[3]	10.1	0.9
D	11,680	135	1,024	4.8	10.5[2]	10.4[3]	10.7	0.3
E	12,690	80	739	7.0	12.8	12.8	13.3	0.5
F	13,470	71	746	6.9	15.6	15.6	16.5	0.9
G	16,030	33	318	14.4	18.0	18.0	18.8	0.8
H	16,765	75	357	12.8	23.0	23.0	23.6	0.6
I	17,059	125	797	5.7	26.4	26.4	27.1	0.7
J	17,559	325	1,296	5.4	29.1	29.1	29.5	0.4
K	17,860	154	1,512	4.7	30.7	30.7	31.6	0.9
L	18,239	88	1,098	6.4	32.3	32.3	33.2	0.9
M	18,730	190	1,977	3.6	36.7	36.7	37.6	0.9

[1]Feet above U.S. Highway 101
[2]Combined coastal and riverine effects from University Bay and College Creek
[3]Elevation computed without consideration of backwater effects from University Bay
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD COUNTY, STATE

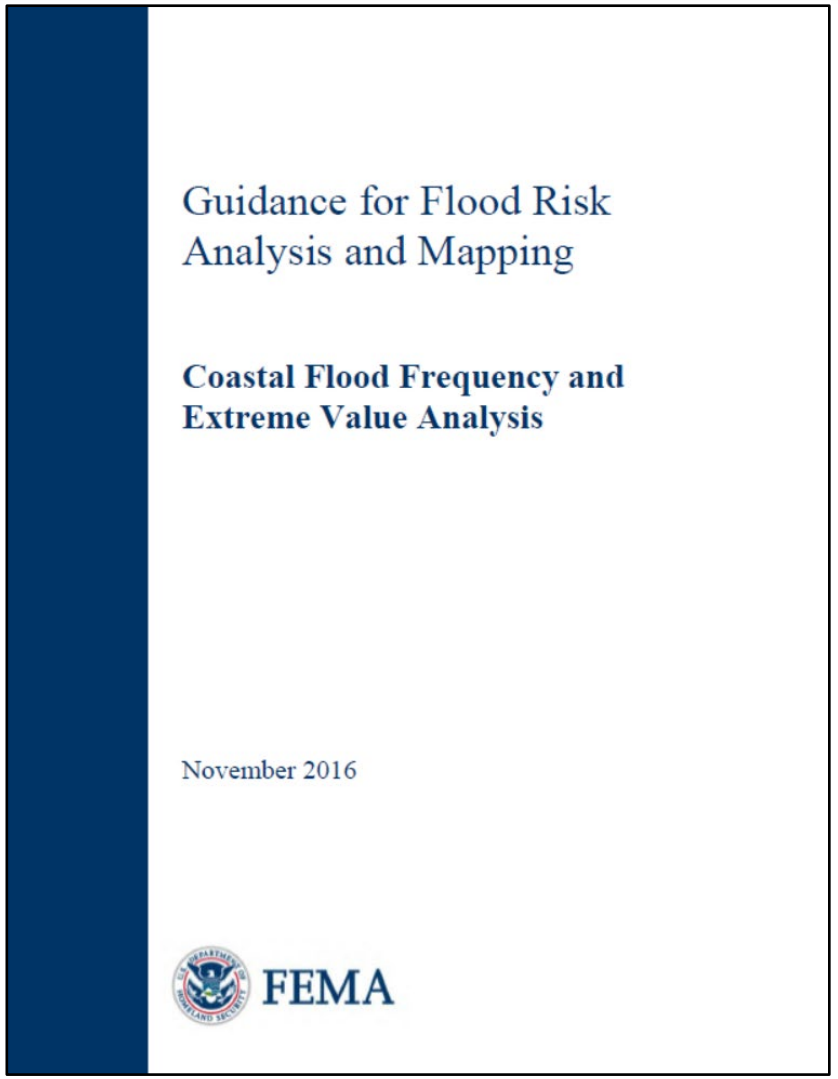
AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: COLLEGE CREEK

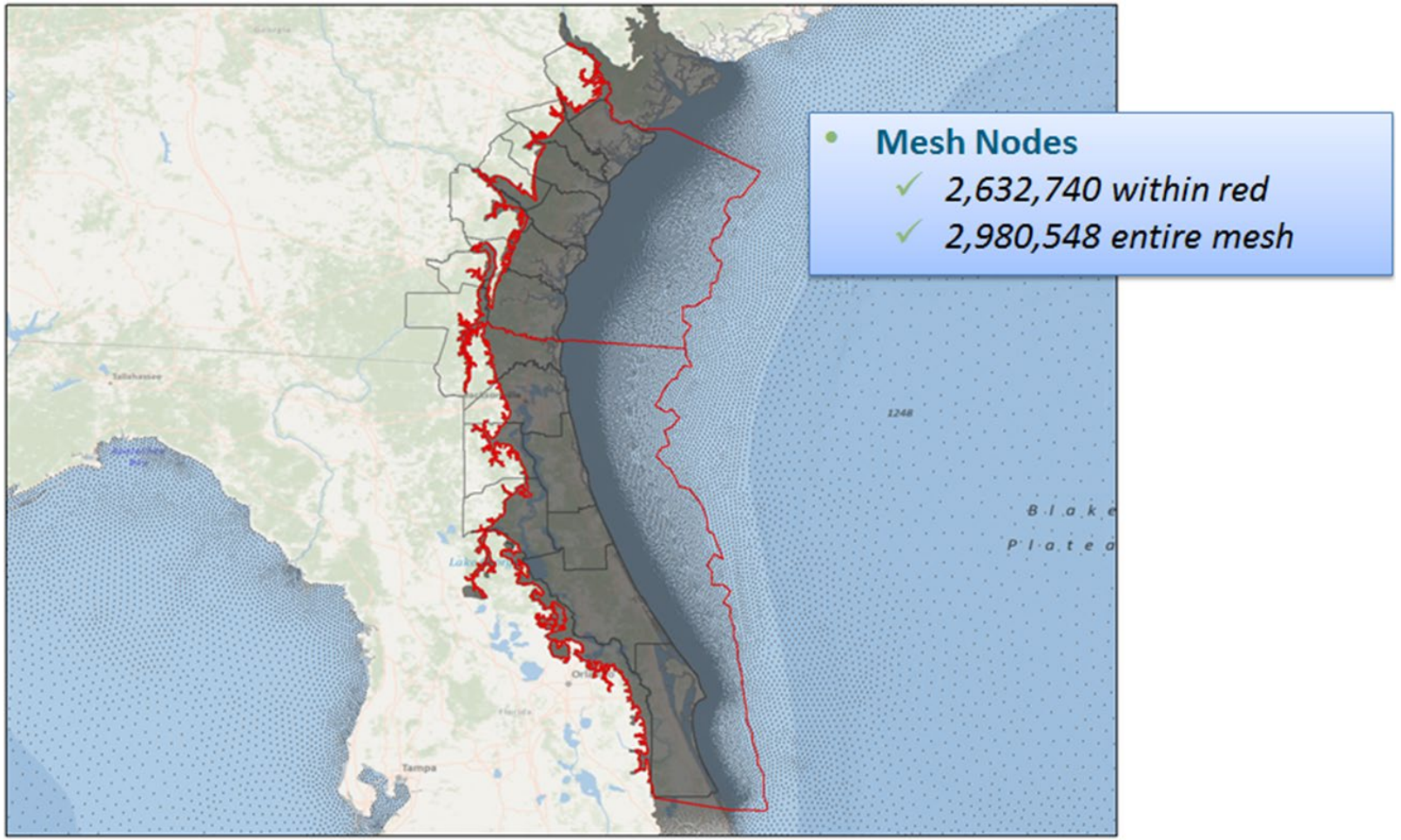
Methods – Prescribed by FEMA

- Combined Probability Analysis
- Riverine & Coastal Surge
- Assumptions
  - Extreme levels in riverine and coastal processes are physically independent
  - And are not concurrent
  - Or at least widely separated in time



Inputs for Combined Probability Analysis

- Coastal Stillwater Elevations (Surge SWEL)
  - ADCIRC – Advanced CIRCulation storm surge model
- Riverine WSELs
  - HEC-RAS
  - SWMM
  - MIKE-SHE



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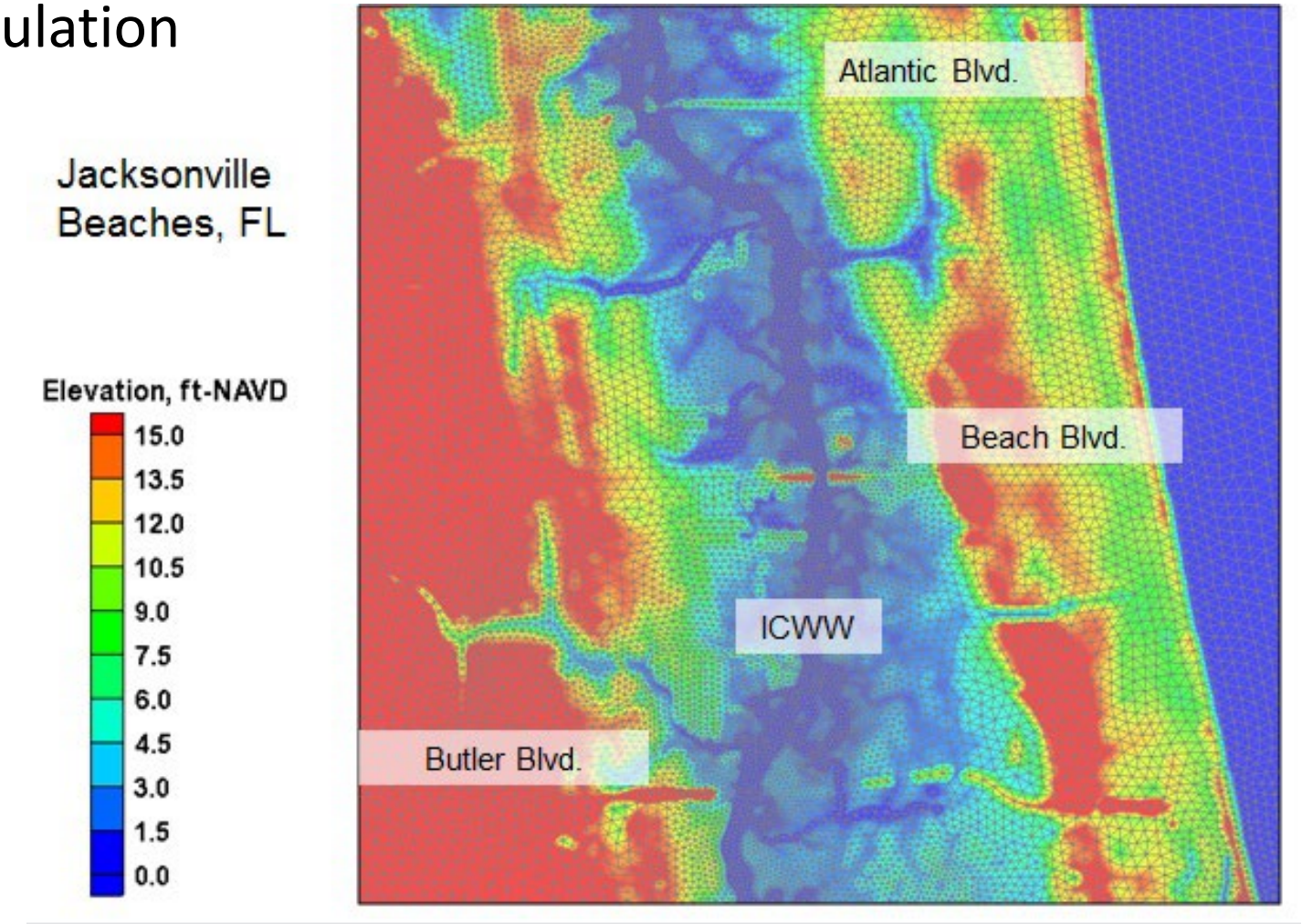

Combined Probability Analysis

$$R_{P,T}(Z) = R_{P,R}(Z) + R_{P,S}(Z)$$

where:

$R_{P,T}(Z)$ = Total Rate of occurrence at each point of interest, P, and elevation, Z
$R_{P,R}(Z)$ = Riverine Rate of occurrence at each point of interest, P, and elevation, Z
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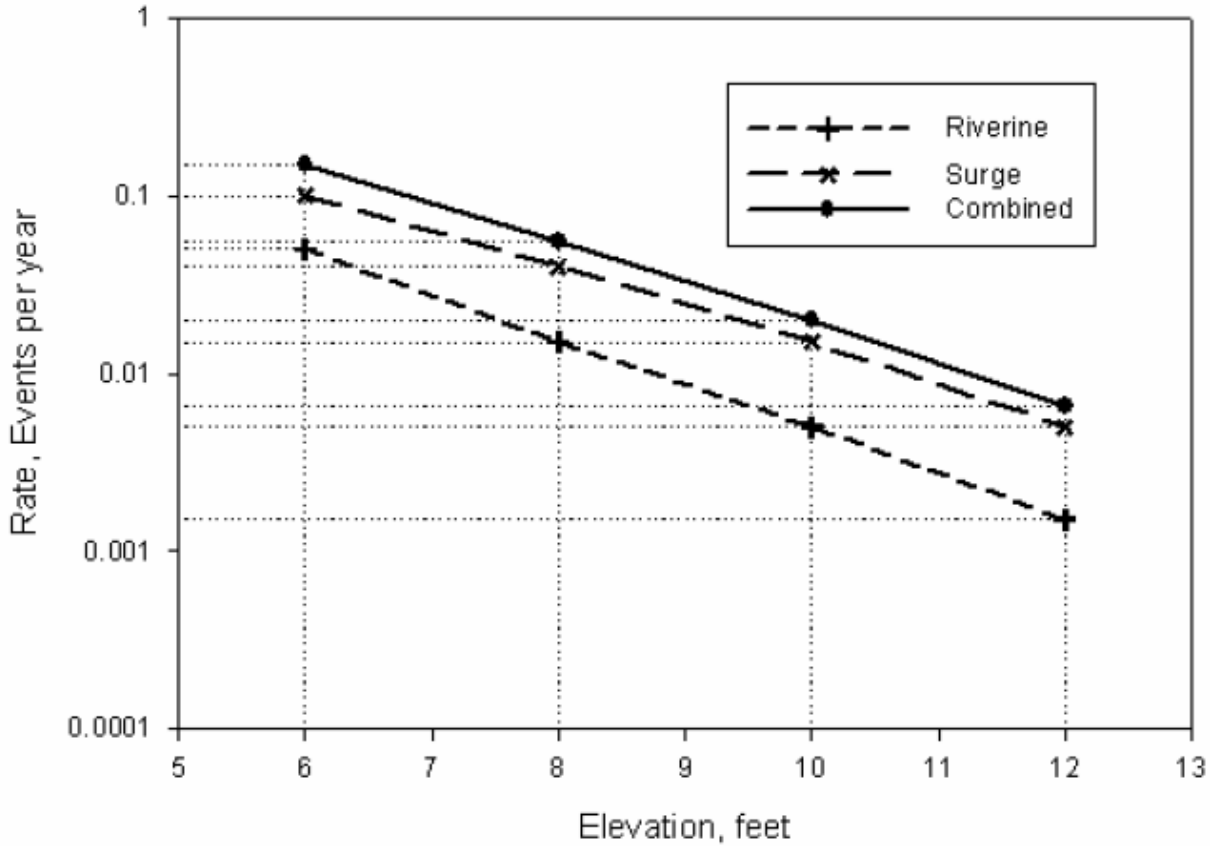

Source: FEMA Guidance for Flood Risk Analysis and Mapping, November 2016

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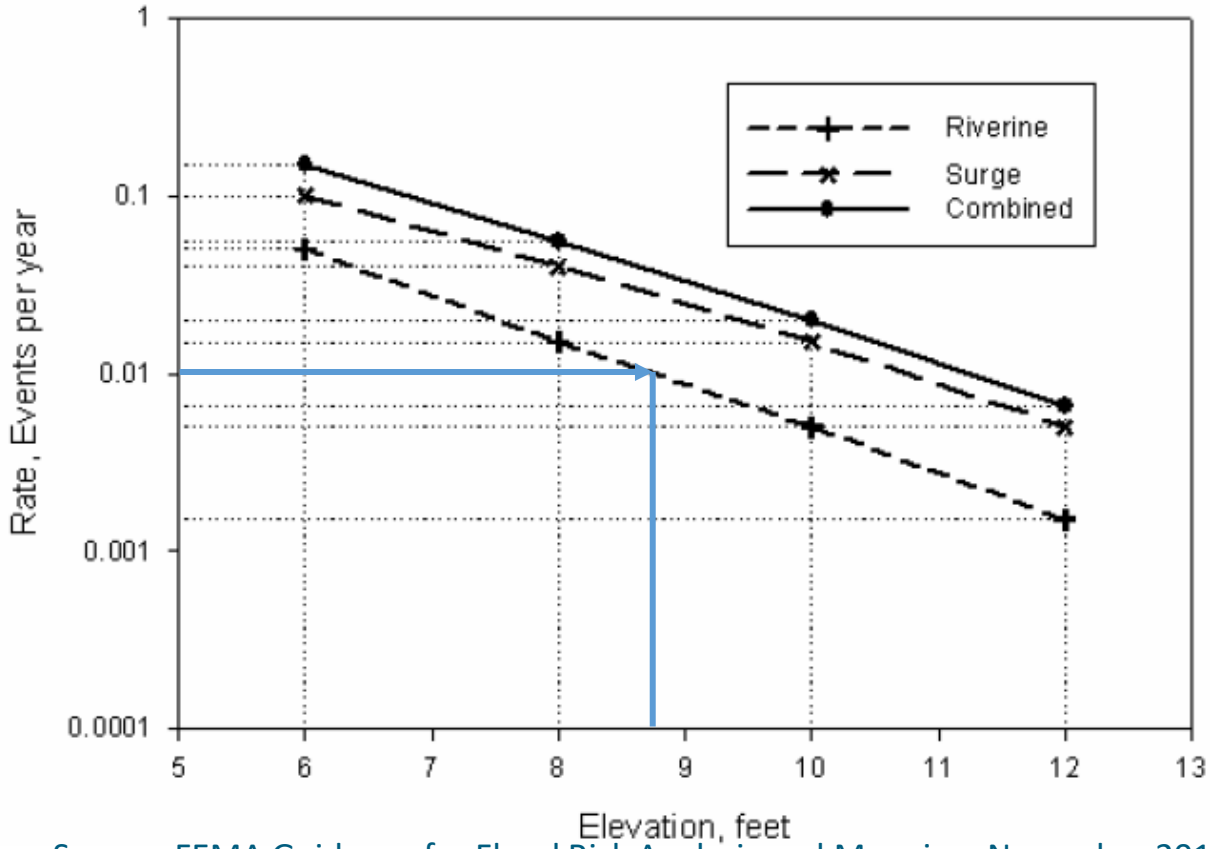

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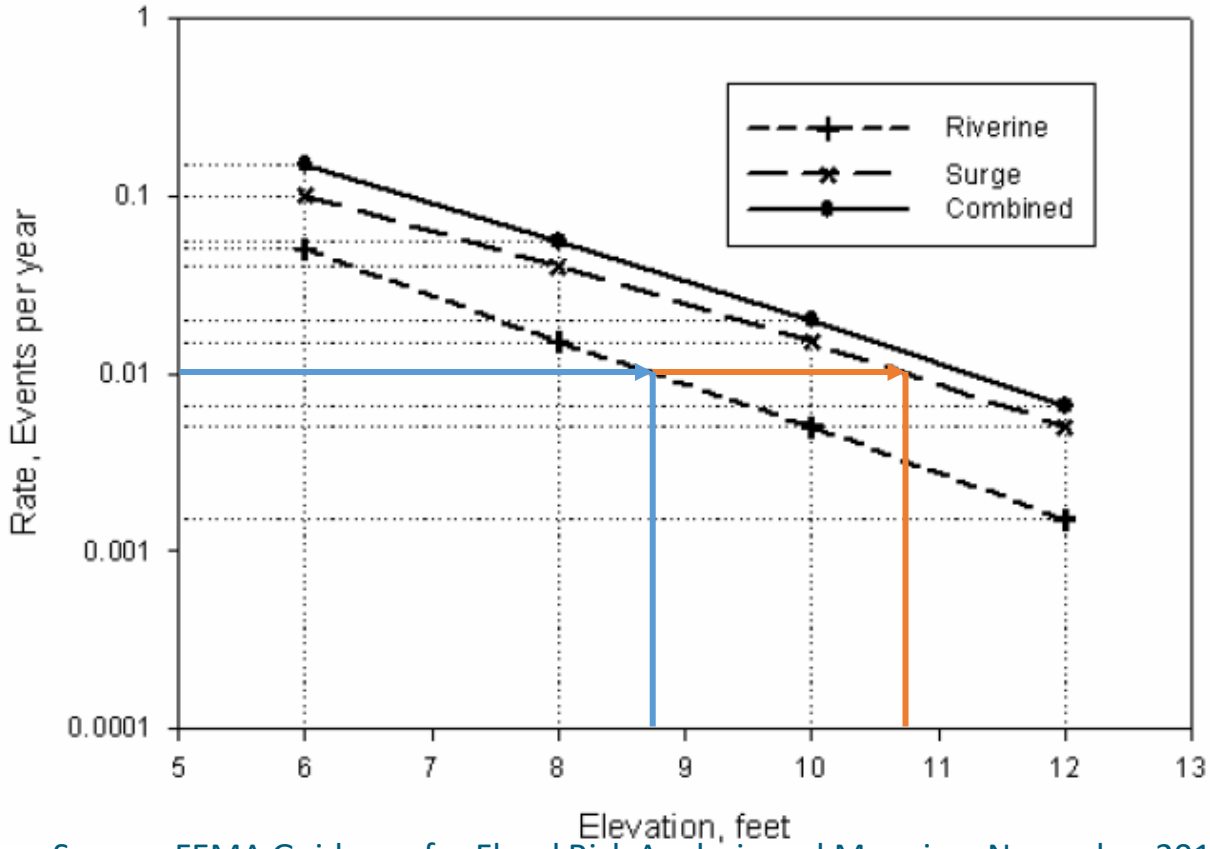

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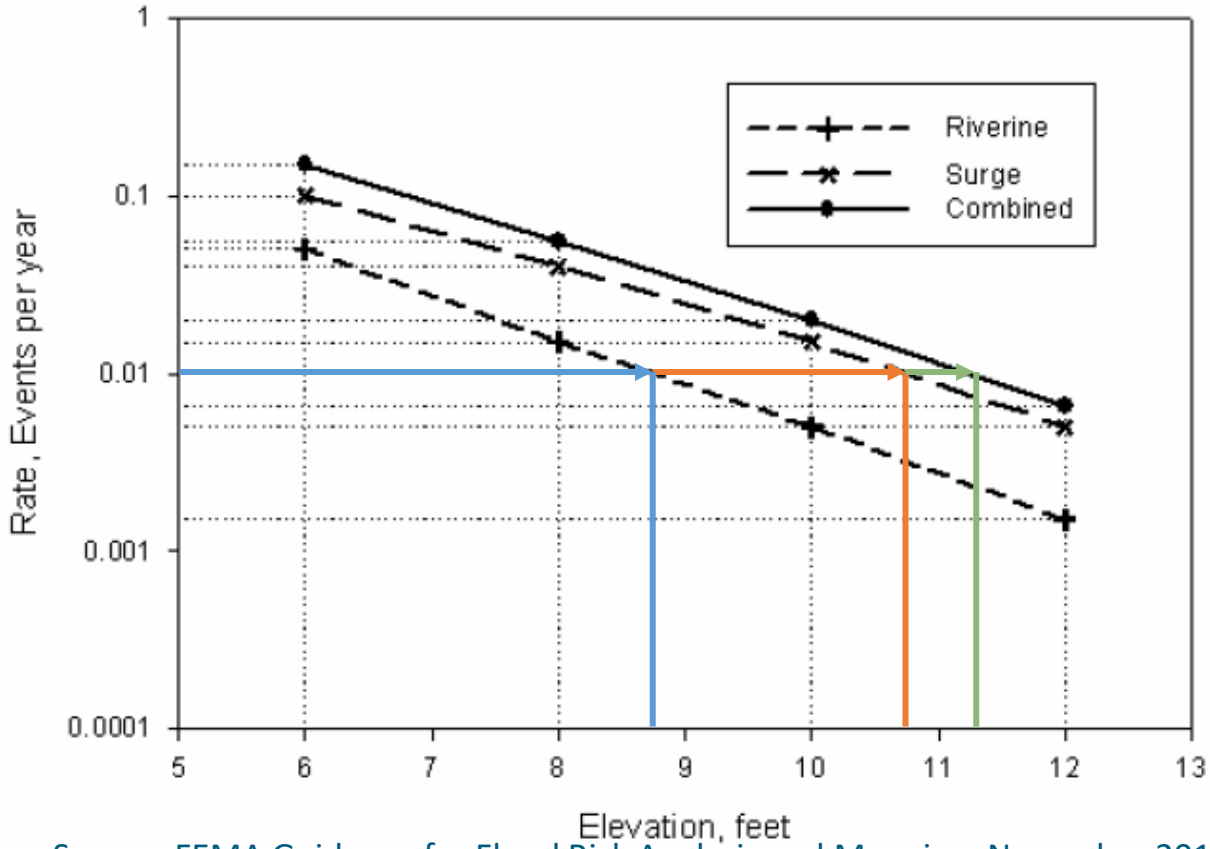

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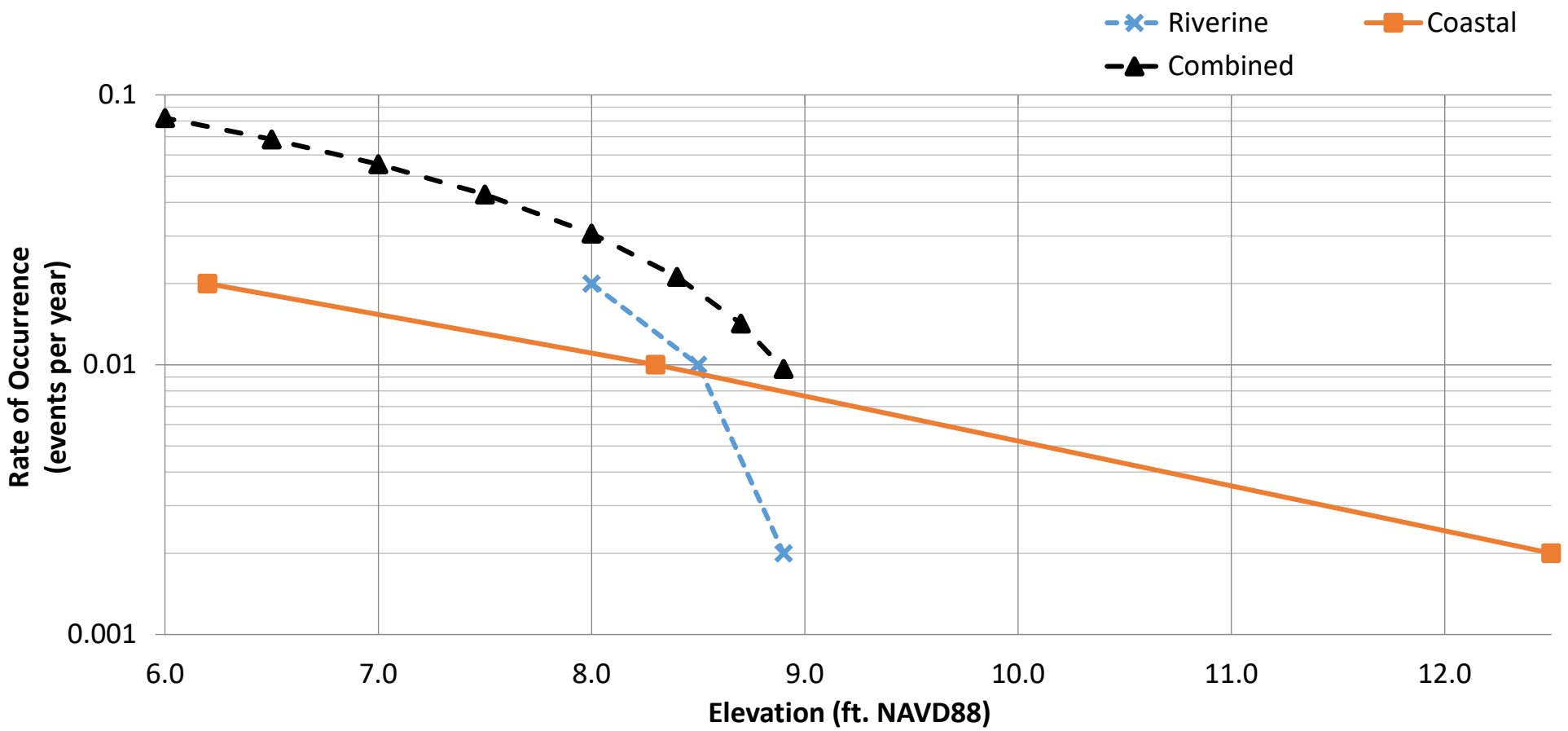
Combined Probability Analysis – Past Examples



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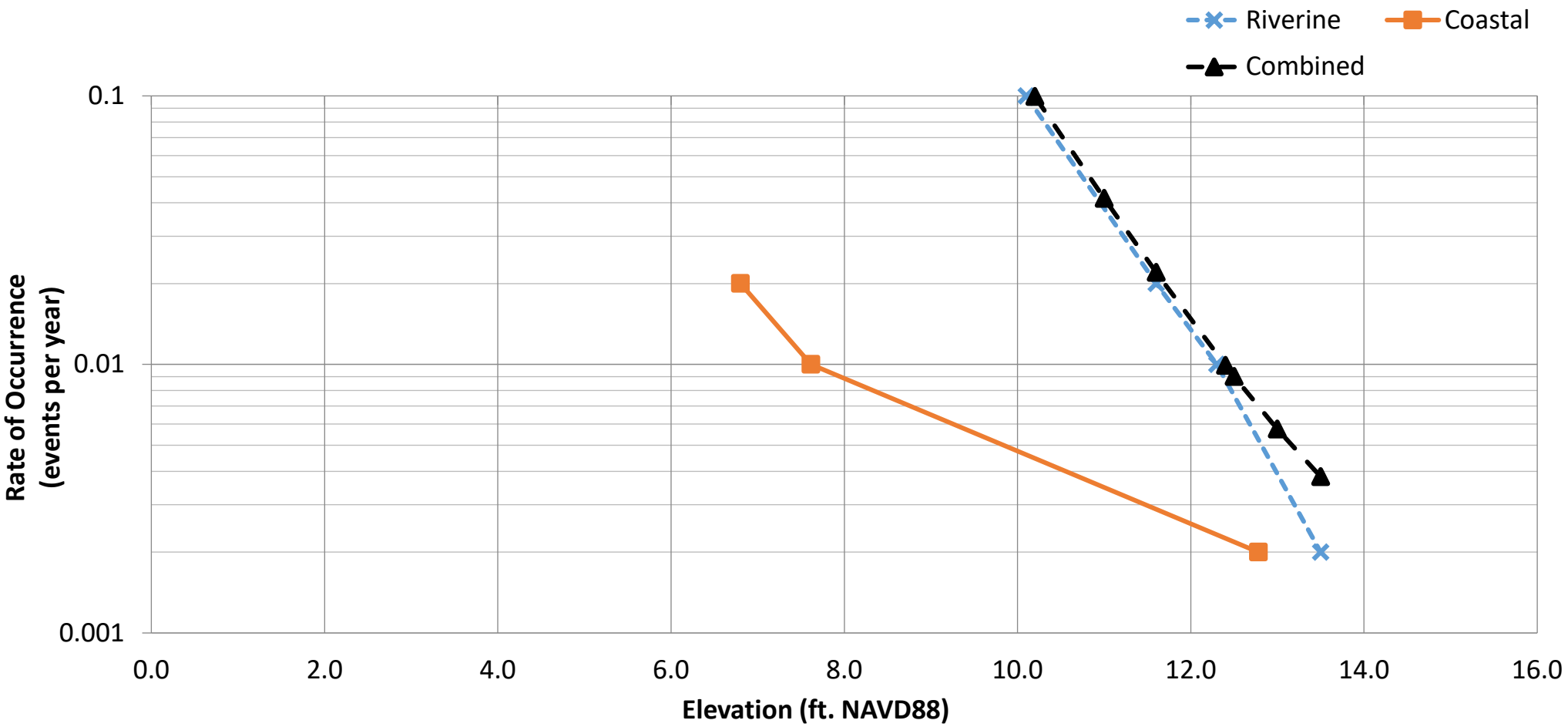

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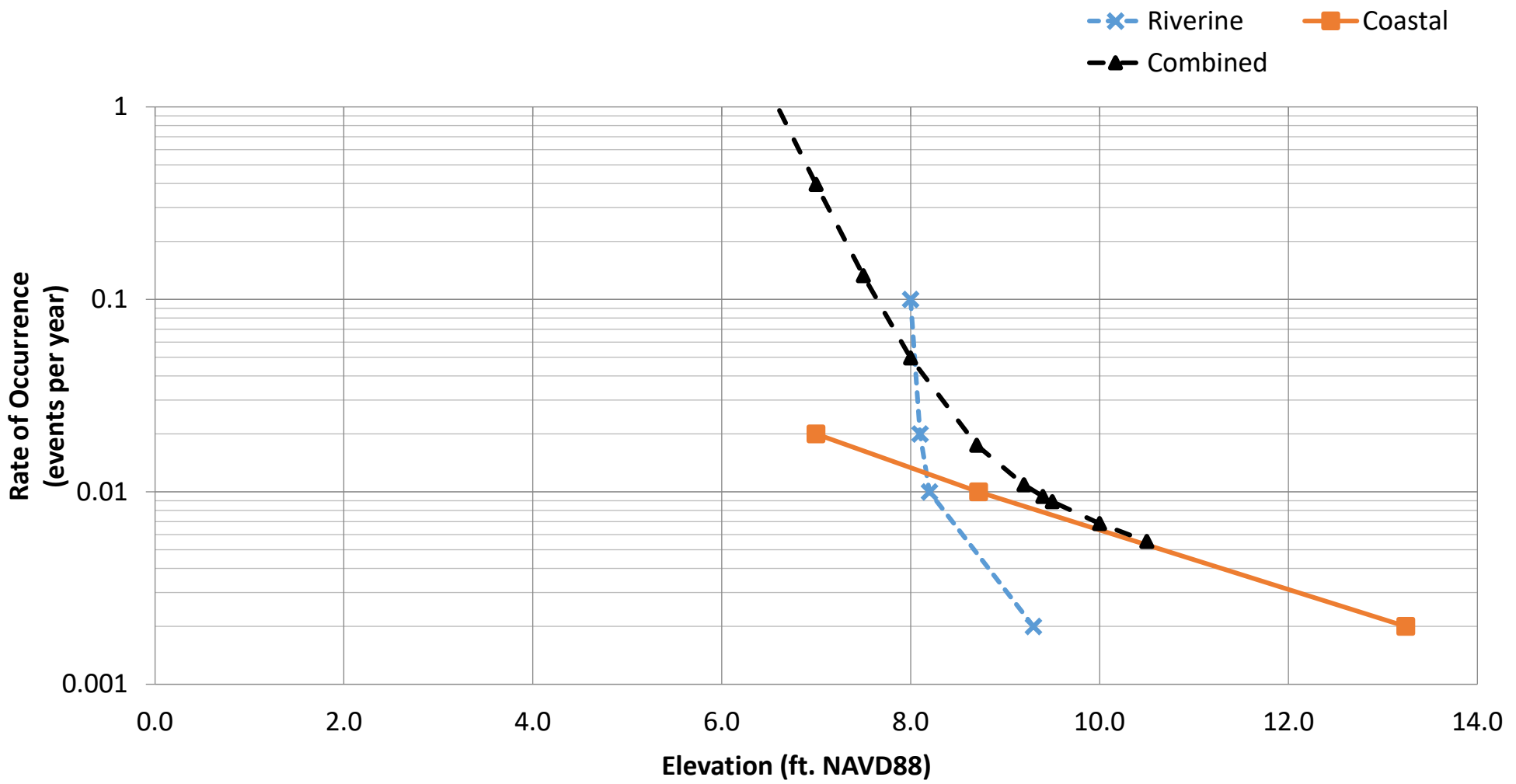

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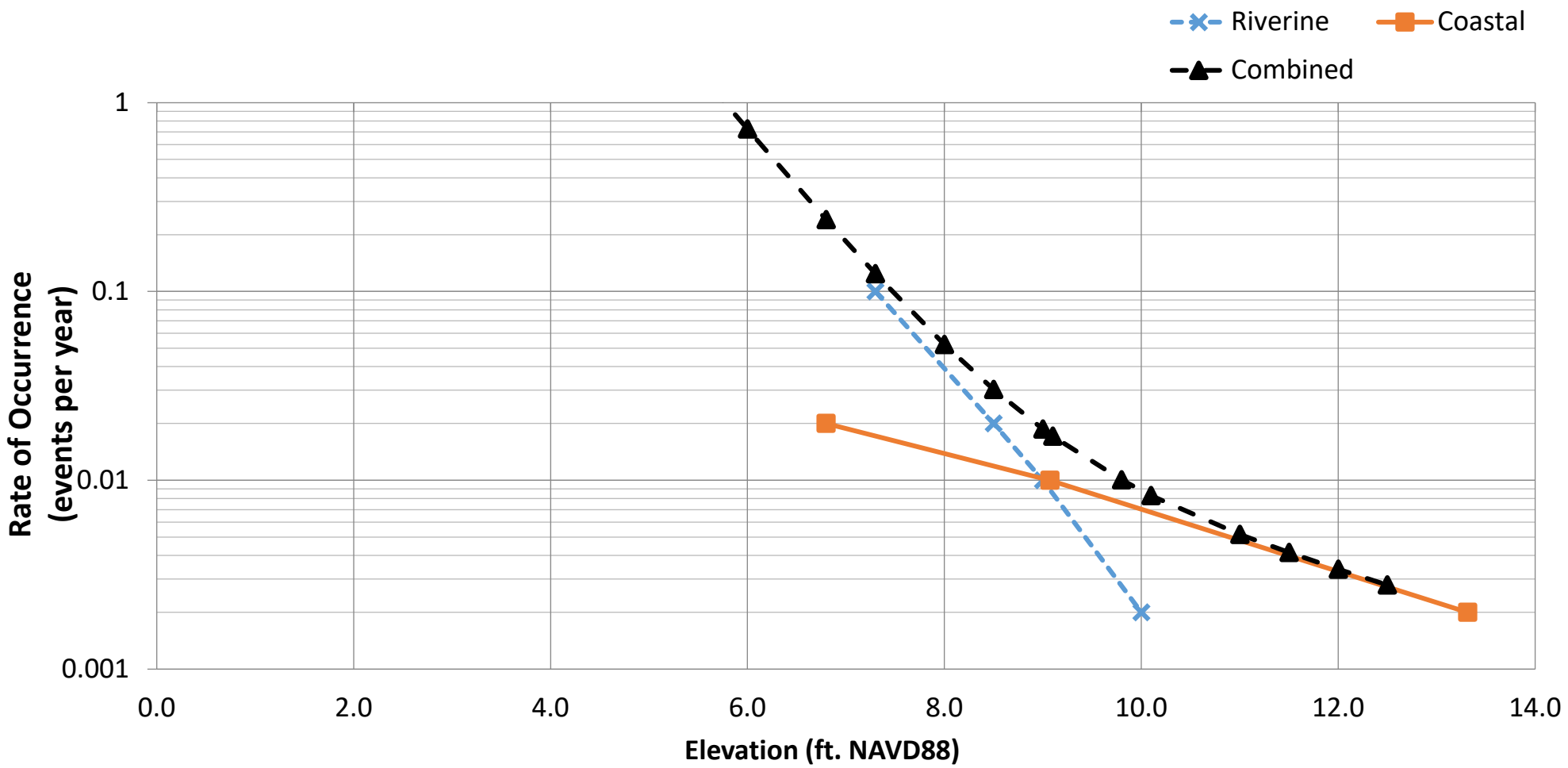
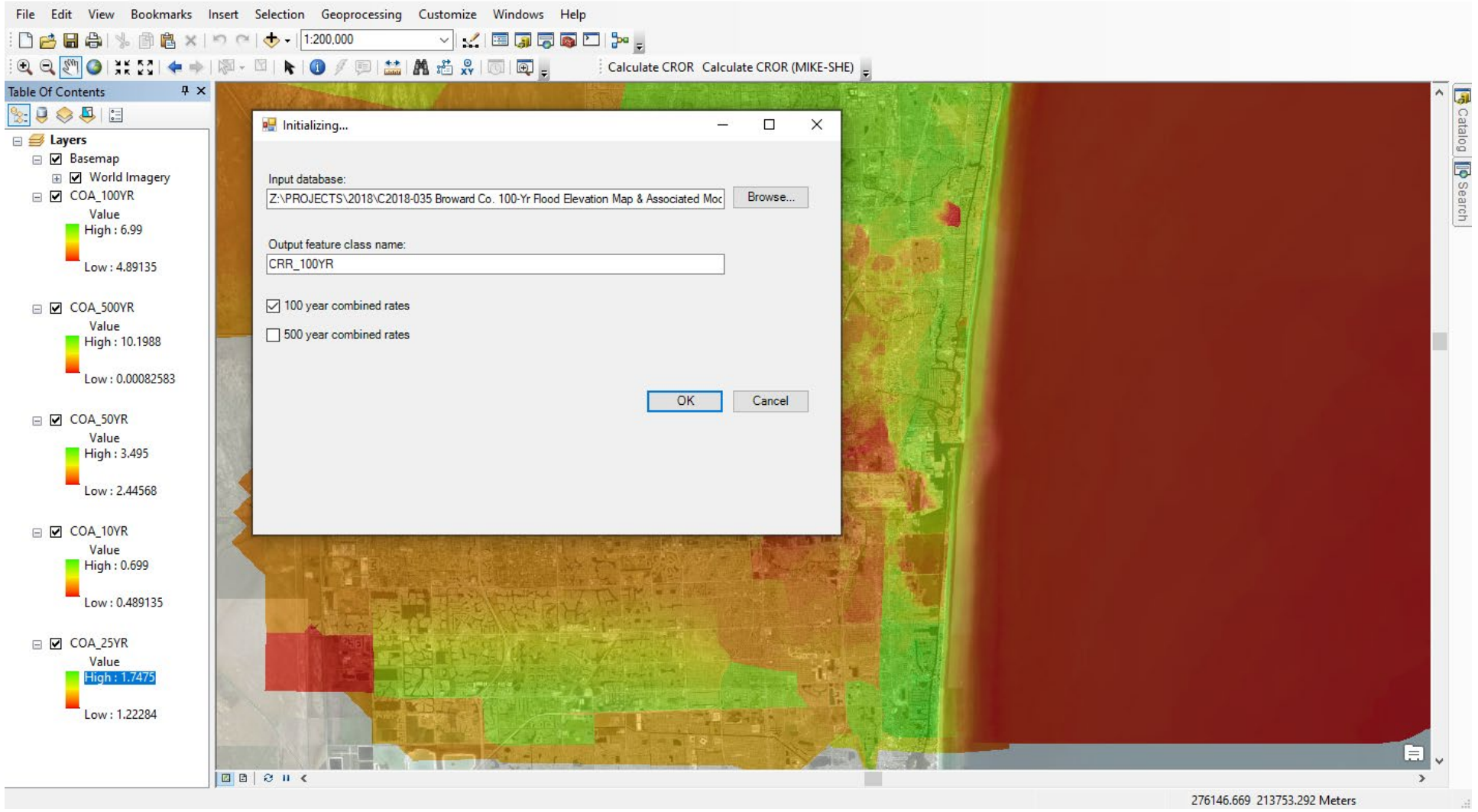


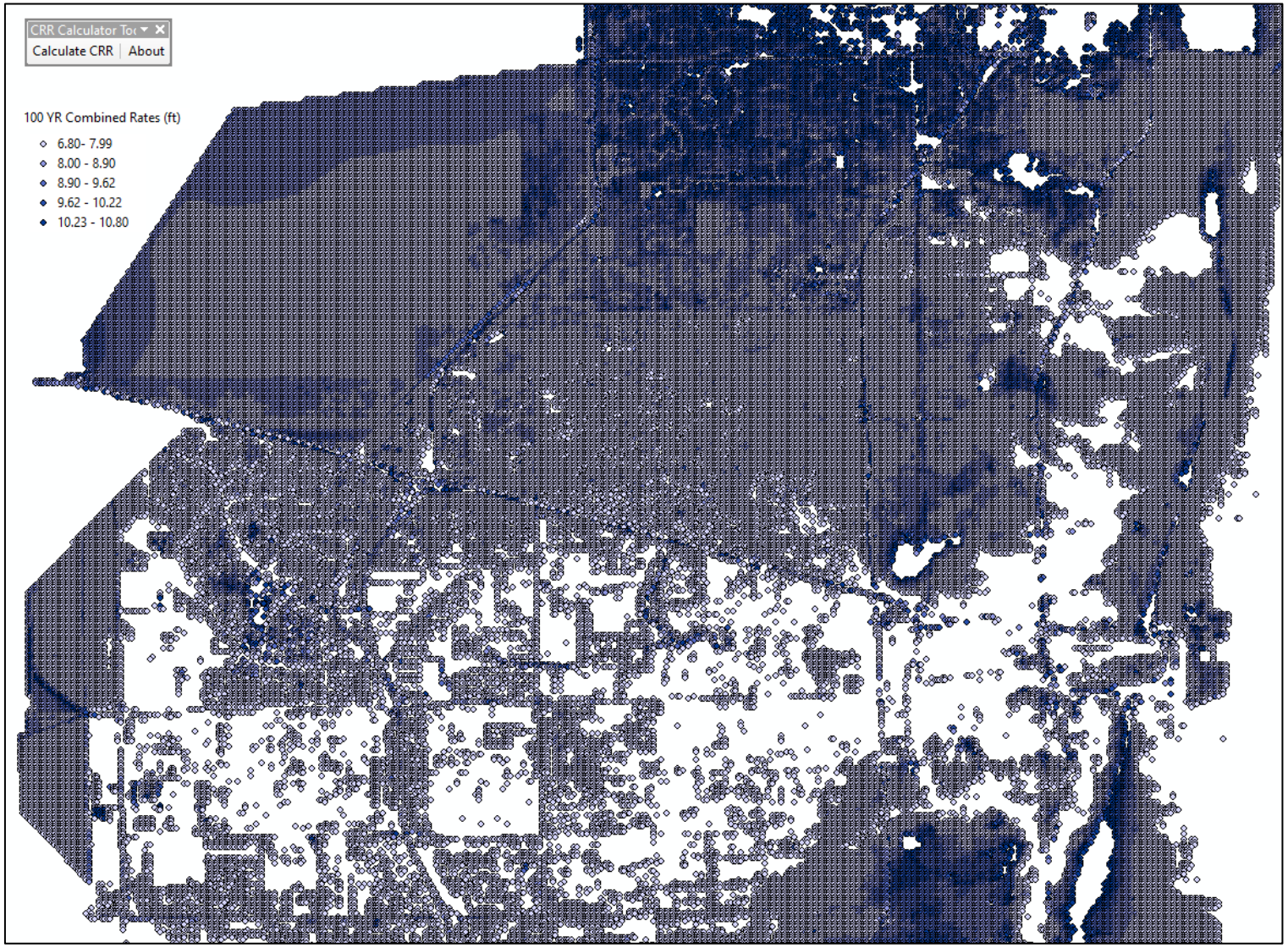
Improved Method

- ArcGIS plug-in (CROR Tool) input menu



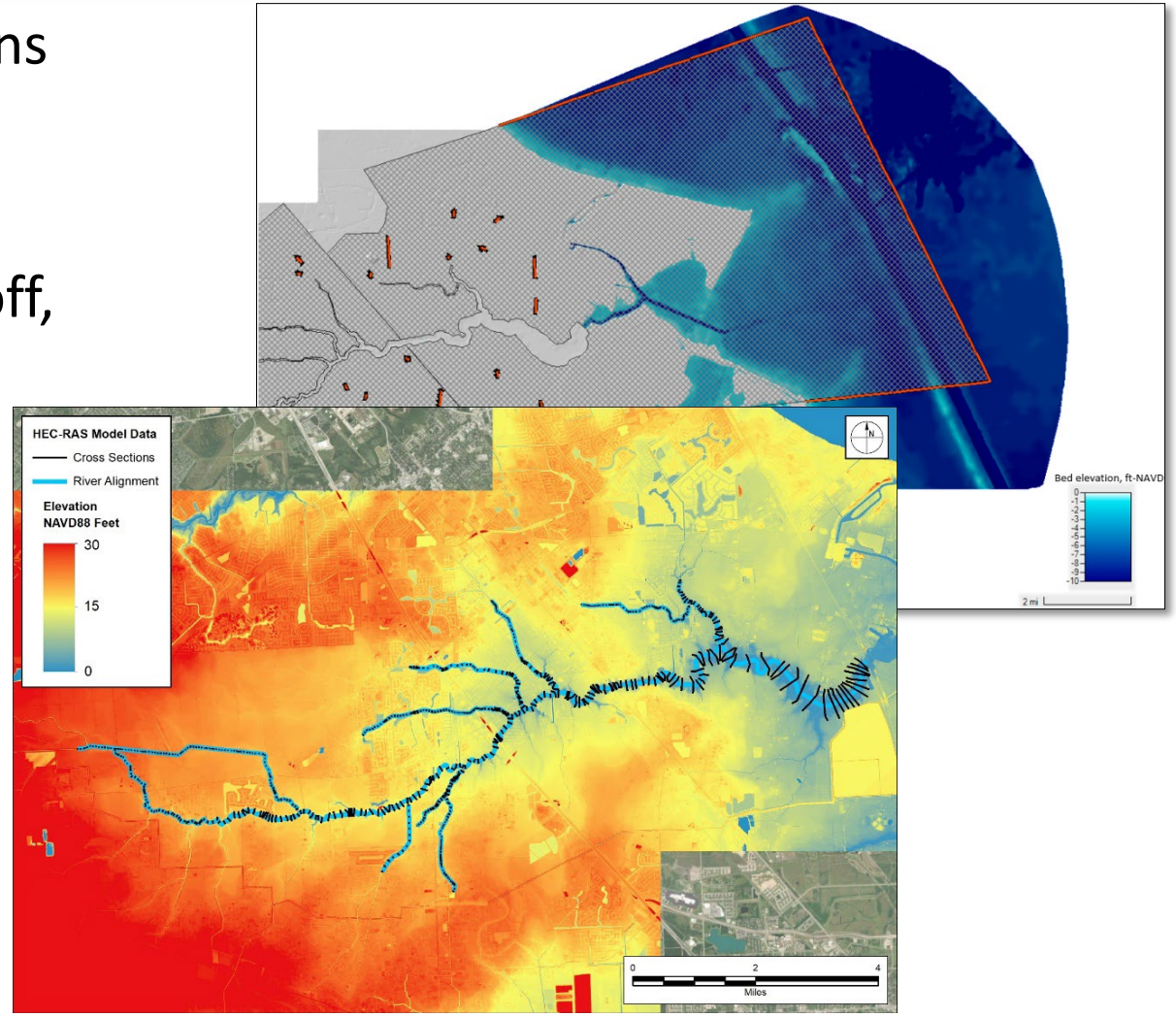
Improved Method

- Outputs of CROR Tool showing points at 100 yr return period



In Progress - Texas General Land Office (GLO) River Basin Flood Study; Riverine and Coastal Analysis

- Rainfall/riverine and coastal/surge contributions
  - 2D HEC-RAS modeling
  - Updated regional USACE coastal study
- Dynamic processes of concurrent rainfall, runoff, and coastal storm surge
  - Examine model results in comparison to important historical storms
    - Tropical and extra-tropical
  - Apply rain-on-mesh hydrology
  - Single-segment stage boundary conditions



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