Structure-Based Risk Assessments

Depth, Damage… Done!

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October 11, 2016

PRIME AE

Structure-Based Risk Assessments

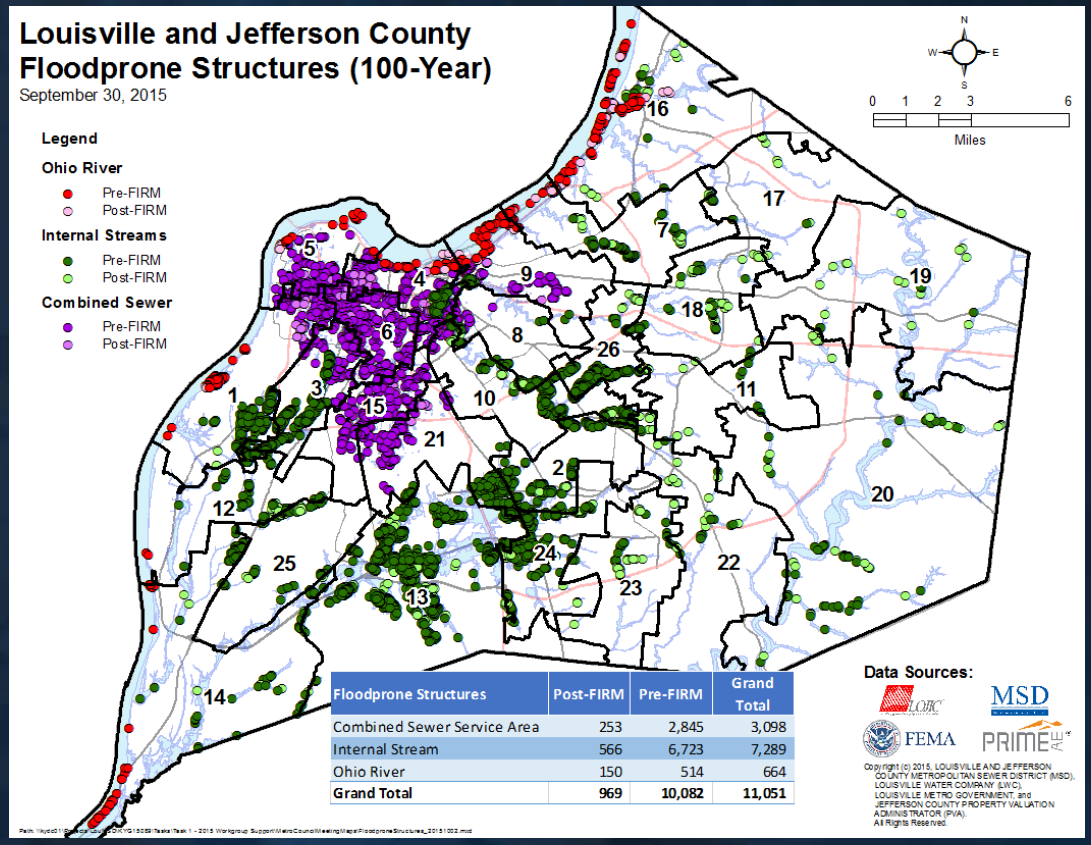
- Latest NFIP Reform
  - BW-12
  - HFIAA
- Local Officials
- Property Owners

Project Examples

- Louisville/Jefferson County, Kentucky
  - Over 11,000 buildings
  - Categorized flood depths (high / moderate / low risk)
  - Long-term mitigation program
- Salina, Kansas
  - Under 1,000 buildings
  - Dataset used to communicate flood insurance rate impacts
  - Prioritize future flood mitigation efforts

Flood Risk Inventory

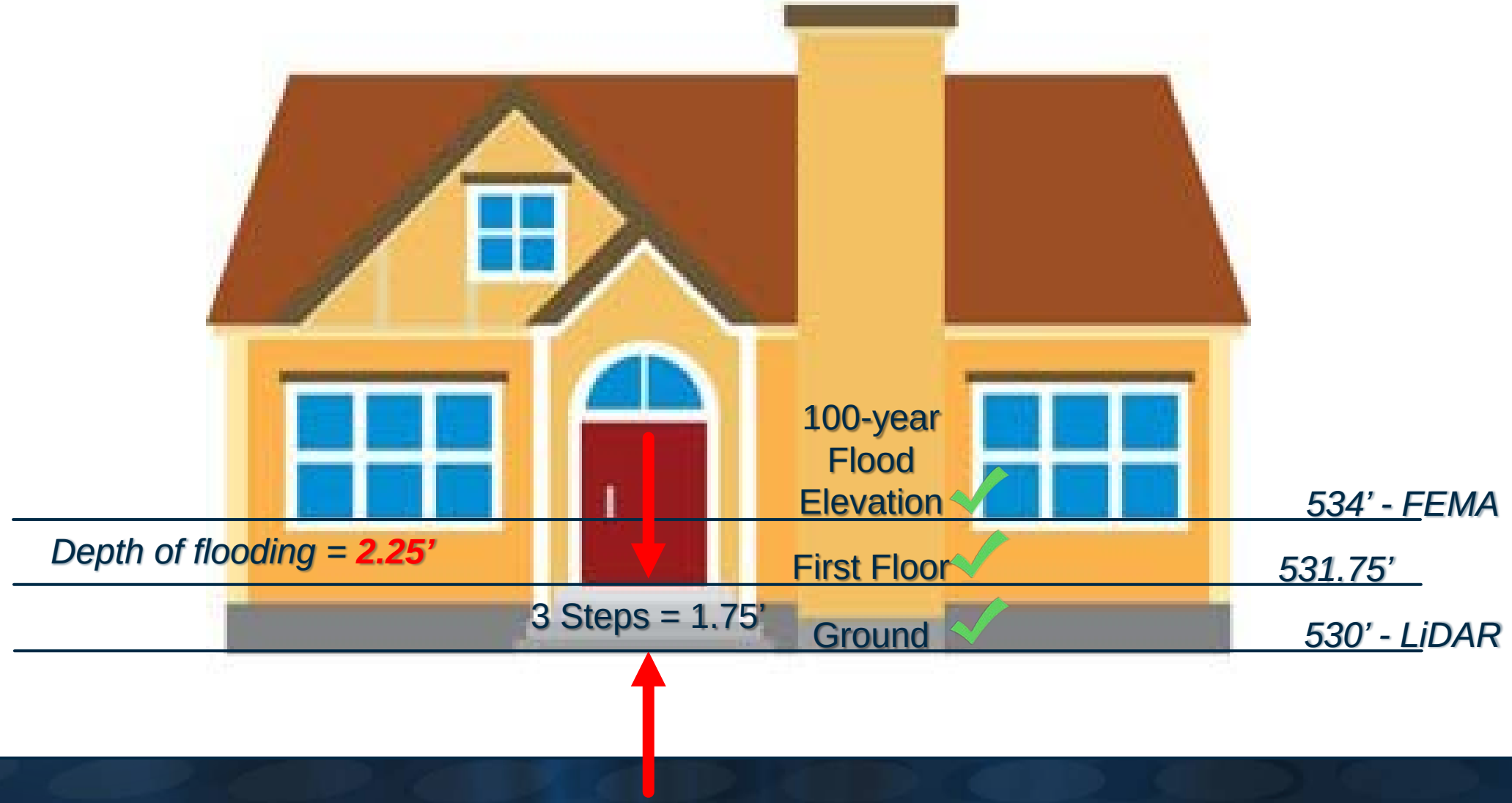
- Structures at risk of flooding
  - Where are they?
  - How many?
  - What's the total value?
  - When were they built?
  - What are the potential damages?
- Not all flooding is the same
  - Depth varies (>15' to -5')
  - Ohio River vs interior streams
  - Combined sewer flooding

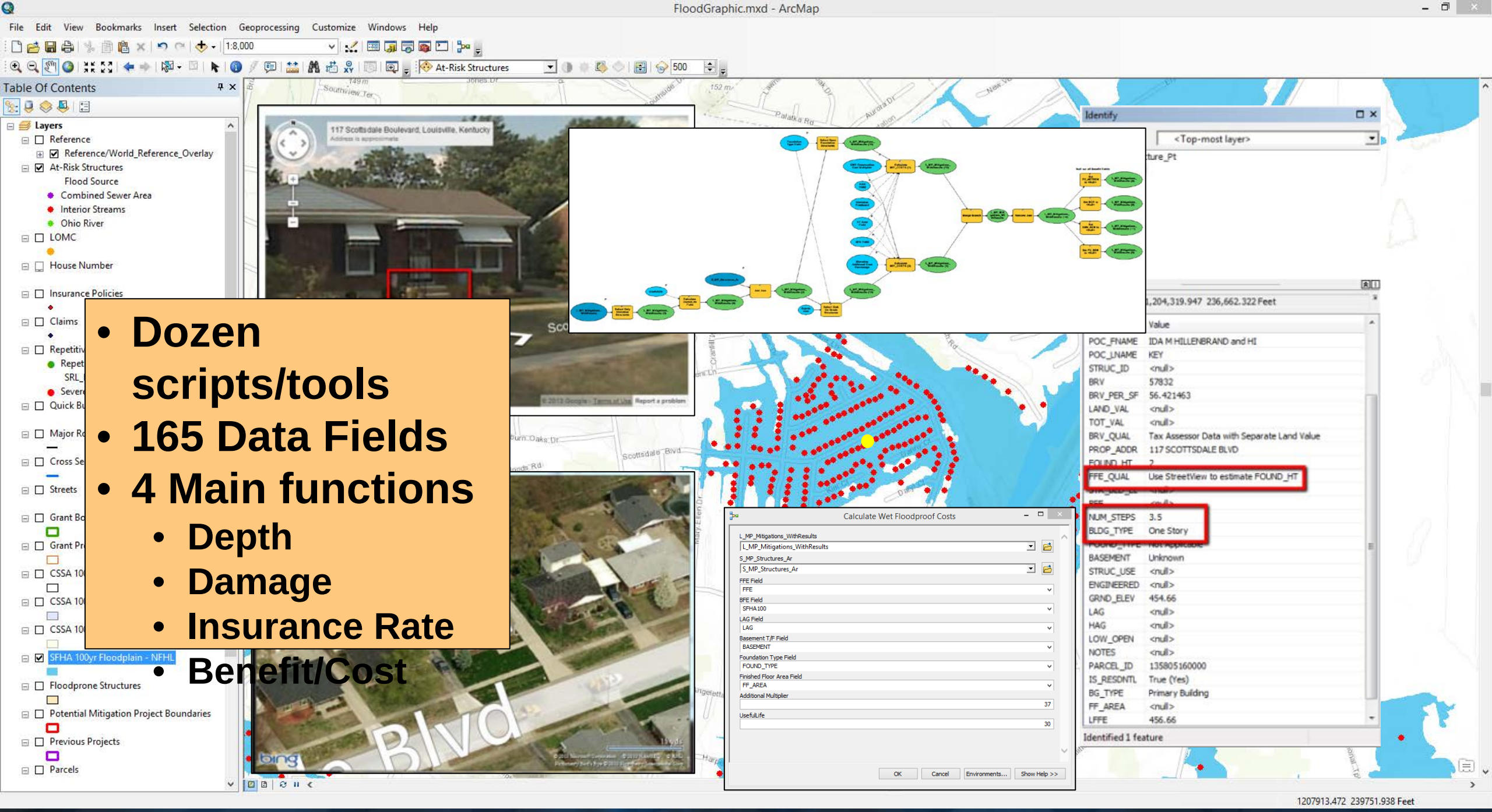


Floodprone Inventory

Estimating Flood Depths

Estimating Flood Depths



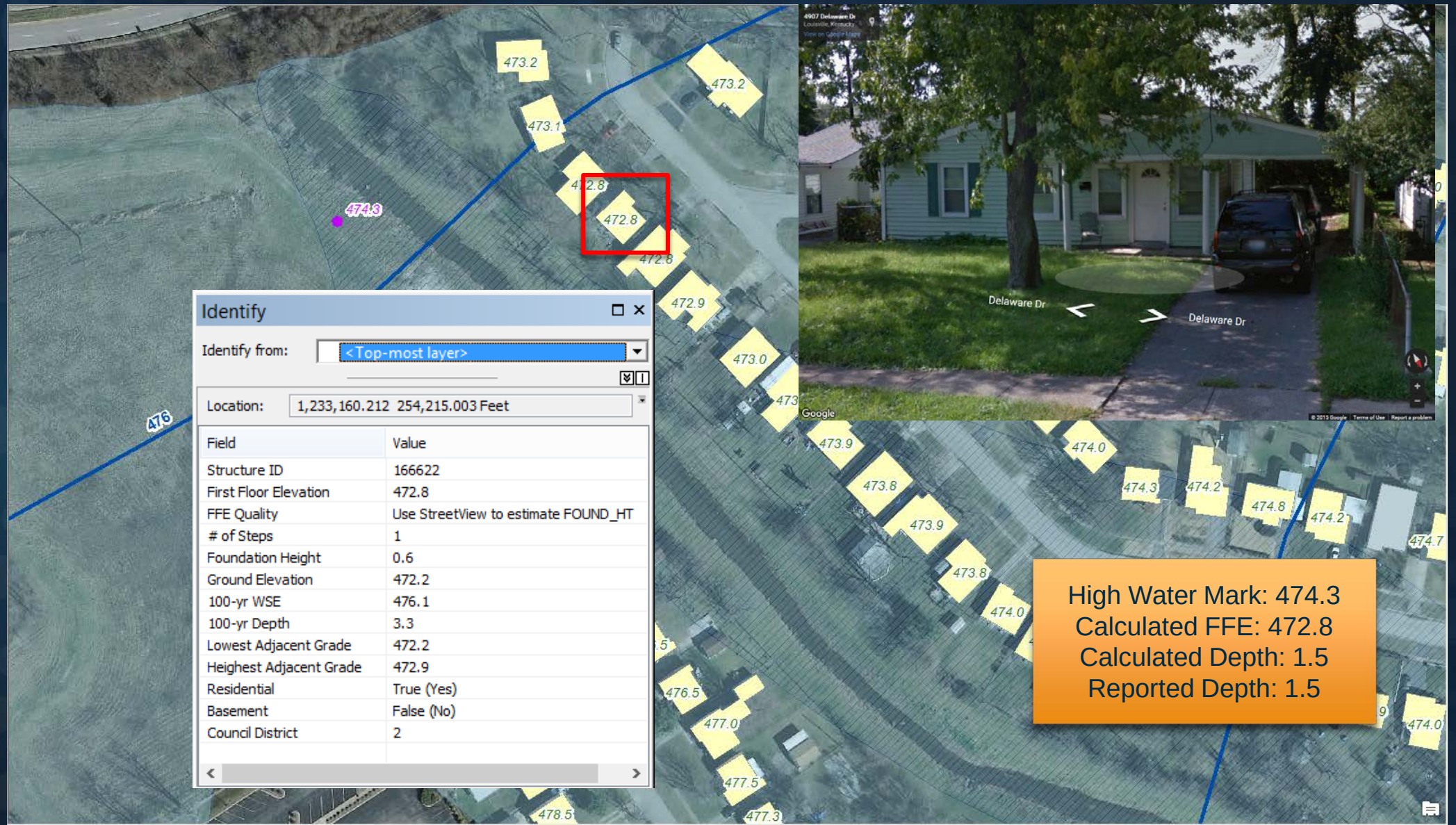


- **Dozen scripts/tools**
- **165 Data Fields**
- **4 Main functions**
  - **Depth**
  - **Damage**
  - **Insurance Rate**
  - **Benefit/Cost**

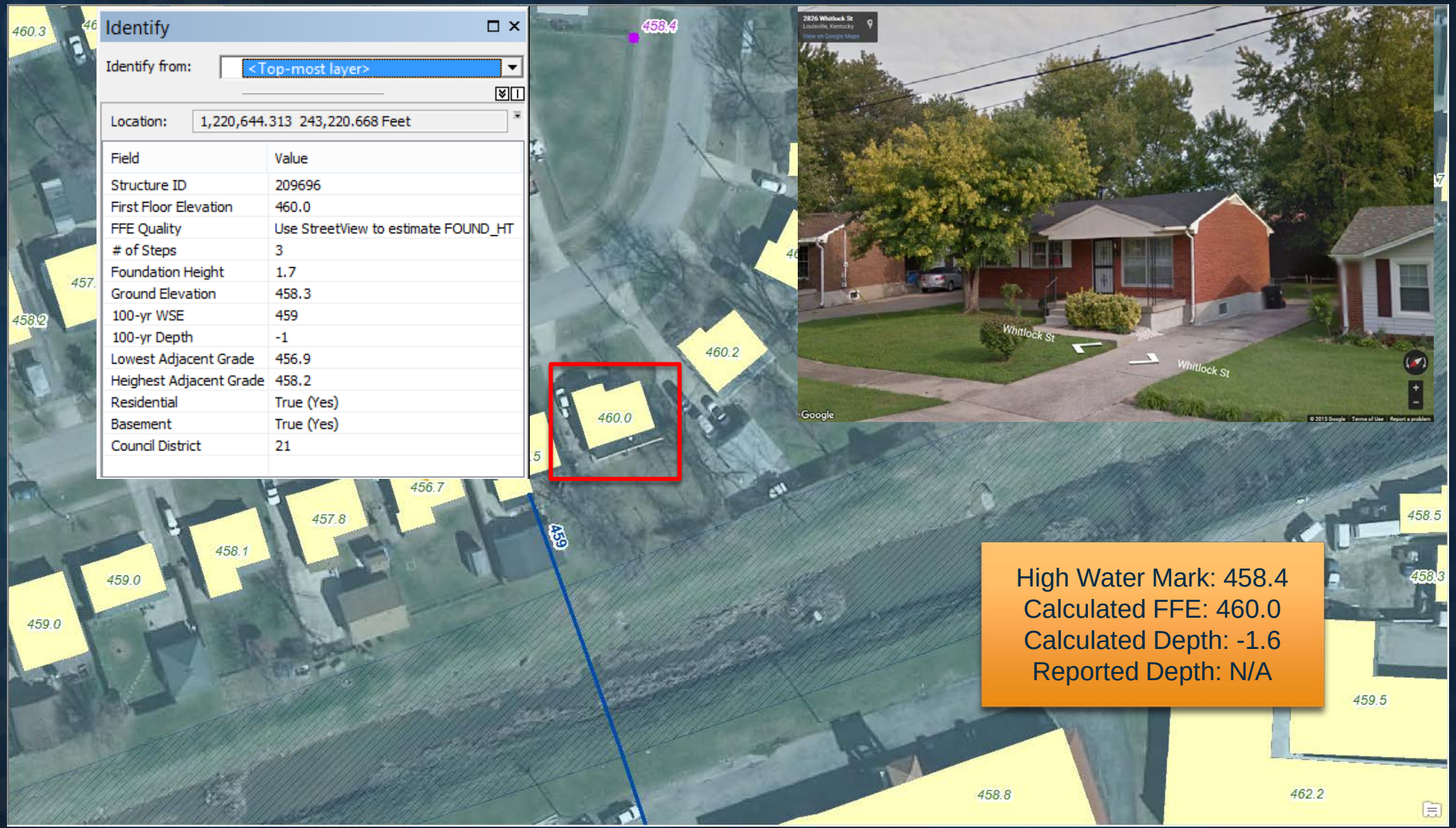
How Close is Close Enough?

- First Floor Elevations
  - Approximately 250 surveyed elevations
  - Calculated elevations
  - Average difference = 2 inches
- Flood Depths
  - Homeowner reported depths (approx. 50)
  - Surveyed high water marks
  - Calculated depths
  - Average difference = 1 inch

Slab on Grade Example



Basement Example

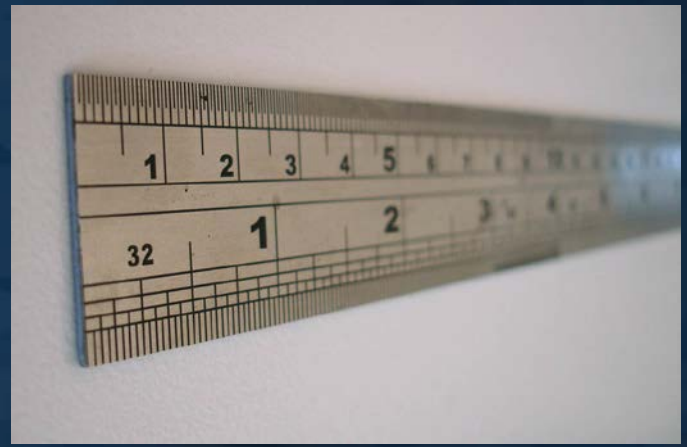


Alternative Approaches

- Elevation Certificates
- Mobile Lidar
  - Line of sight issues
  - Data intensive
  - Cost considerations
- Field Survey
  - Labor intensive
  - Safety concerns
  - Management & coordination

Benefits

- Accurate
  - Within 2 inches (average) of surveyed elevations
  - Within 1 inch (average) of homeowner-reported flood depths
- Affordable
  - 20 times more cost-effective than traditional survey
  - Half the cost of mobile Lidar collection
- Available
  - Dataset can be created in a few weeks



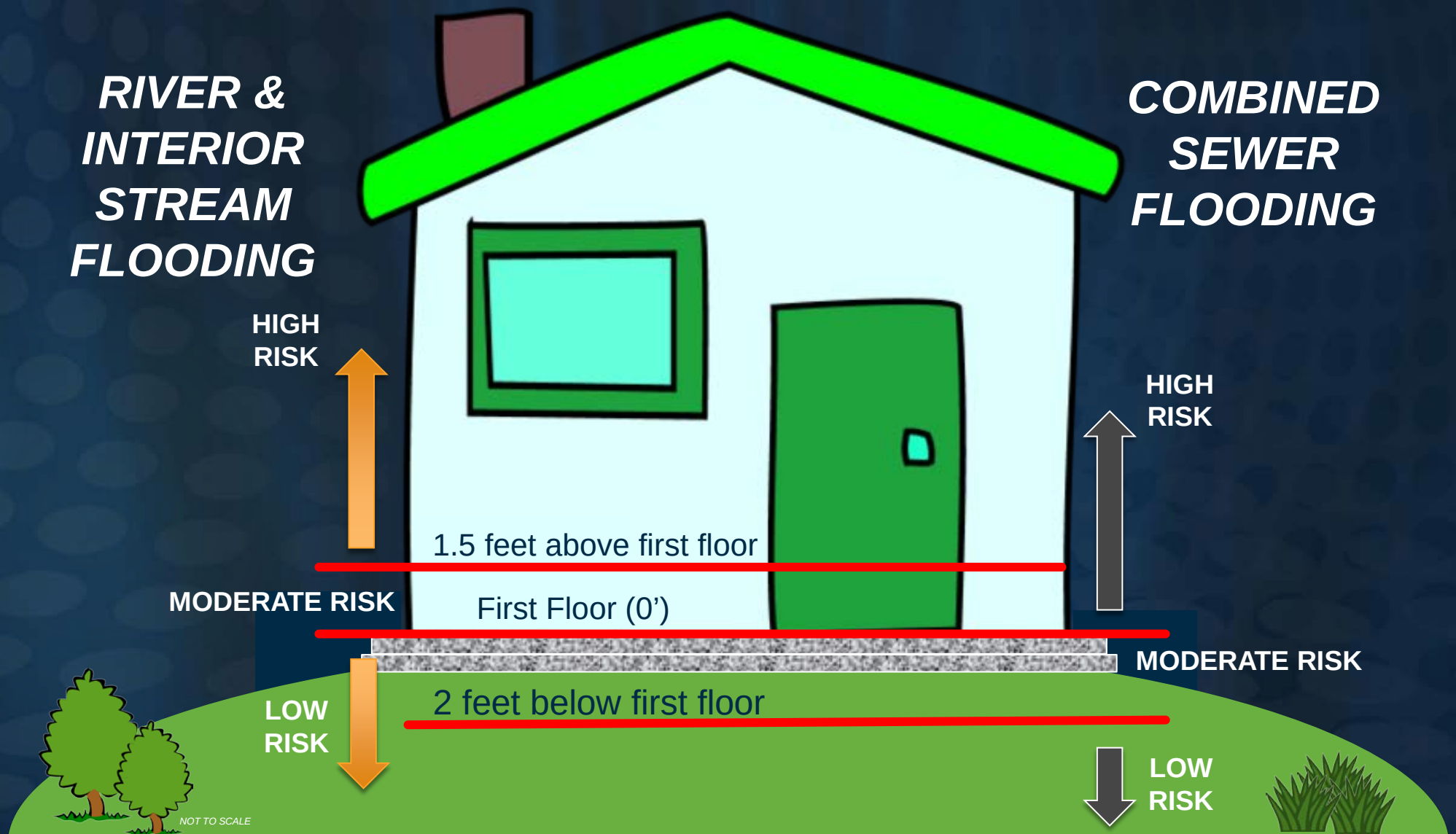
Data Requirements

- Topography
  - Lidar for the ground elevation
  - Terrain dataset suitable for contours
- Flood Hazard
  - Water surface elevations (from FEMA modernized models)
  - Cross sections with elevation attributes
- Structure
  - Building footprint
  - Parcel polygons with structure value / landuse class / year built / foundation type

OK …..so now what?

- Decision Support
  - Categorize risk (high/moderate/low)
  - Calculate damages
- Mitigation project prioritization
  - Group structures into smaller areas
  - Prioritize areas of highest risk
  - Rank & sort
- Develop Alternatives

Levels of Risk



Decision Support

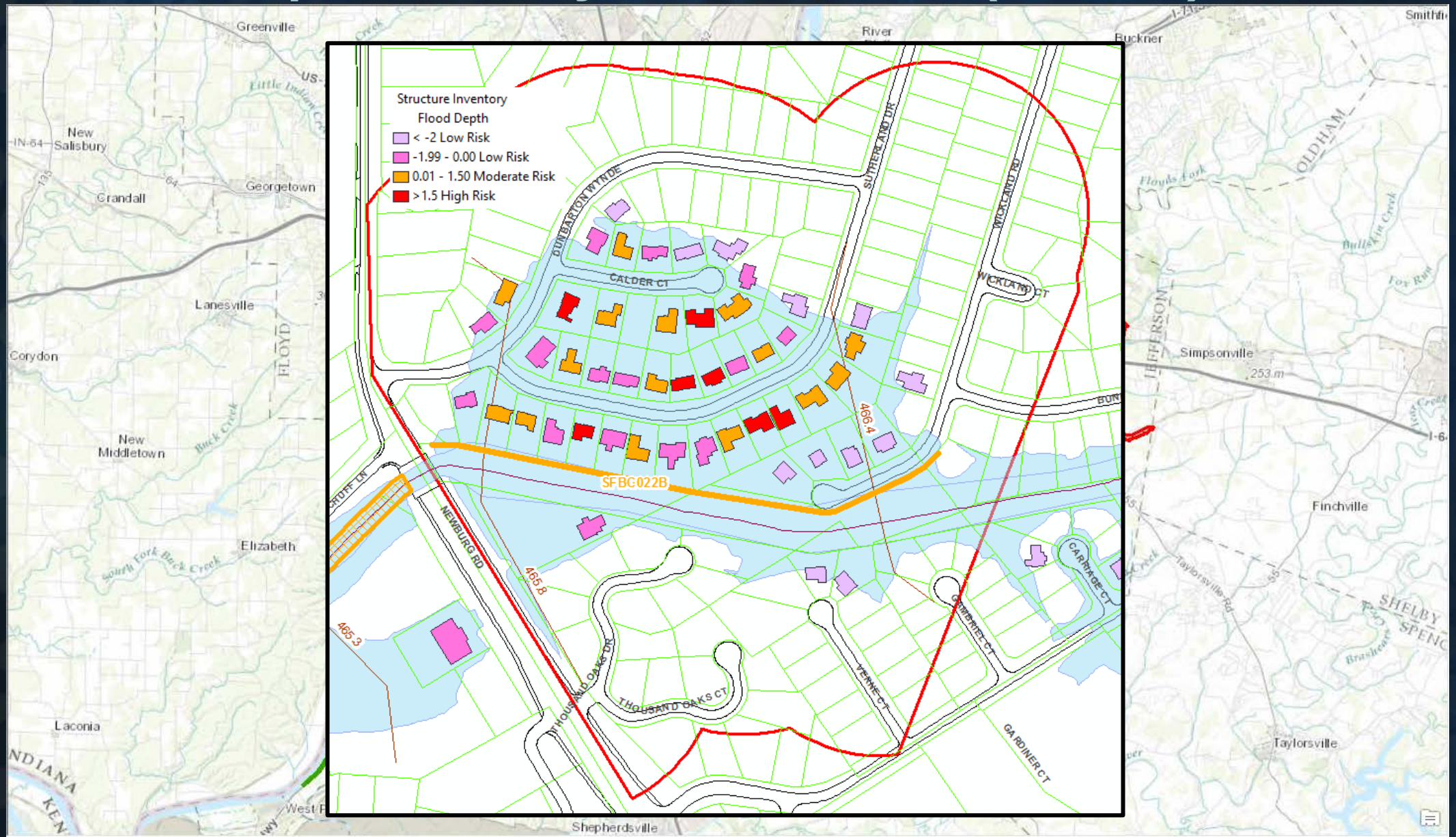
Jefferson County

	Combined Sewer Service Area			Internal Stream Flooding			Ohio River			Jefferson County		
Height Above FFE	Number of Structures	Buyout Total Value	100 Year Damages	Number of Structures	Buyout Total Value	100 Year Damages	Number of Structures	Buyout Total Value	100 Year Damages	Number of Structures	Buyout Total Value	100 Year Damages
Below -2 ft	2,149	$804,033,401	$0	2,779	$814,441,082	$0	119	$829,647,468	$0	5,047	$2,448,121,950	$0
-2 - 0 ft	877	$205,713,549	$3,375,125	3,163	$534,612,832	$28,917,955	98	$161,578,451	$3,639,398	4,138	$901,904,831	$35,932,478
0.1 - 0.4 ft	39	$3,537,096	$509,091	294	$57,730,040	$7,522,265	18	$7,626,213	$1,526,836	351	$68,893,349	$9,558,192
0.5 - 1 ft	12	$2,291,069	$426,550	404	$62,275,957	$12,908,696	24	$6,374,344	$1,393,511	440	$70,941,369	$14,728,757
1.1 - 1.4 ft	9	$808,043	$267,174	200	$35,614,889	$8,398,692	15	$4,569,316	$1,715,635	224	$40,992,248	$10,381,501
1.5 - 2ft	8	$1,016,040	$366,477	190	$28,022,001	$10,099,147	26	$12,031,203	$3,078,339	224	$41,069,244	$13,543,963
2.1 - 3 ft	2	$217,034	$72,504	149	$29,187,413	$12,552,078	35	$22,462,834	$5,968,339	186	$51,867,281	$18,592,921
3.1 - 5 ft	2	$372,511	$124,144	70	$14,516,091	$7,607,403	55	$11,478,285	$4,946,697	127	$26,366,886	$12,678,244
5.1 - 10 ft	0	$0	$0	25	$4,319,109	$4,339,463	127	$45,777,951	$21,214,855	152	$50,097,060	$25,554,318
Above 10 ft	0	$0	$0	8	$1,741,195	$1,502,177	147	$49,645,128	$41,581,290	155	$51,386,323	$43,083,467
Grand Total	**3,098**	**$1,017,988,742**	**$5,141,065**	**7,282**	**$1,582,460,607**	**$93,847,876**	**664**	**$1,151,191,192**	**$85,064,900**	**11,044**	**$3,751,640,542**	**$184,053,841**

Single Family Residential

	Combined Sewer Service Area			Internal Stream Flooding			Ohio River			Jefferson County		
Height Above FFE	Number of Structures	Buyout Total Value	100 Year Damages	Number of Structures	Buyout Total Value	100 Year Damages	Number of Structures	Buyout Total Value	100 Year Damages	Number of Structures	Buyout Total Value	100 Year Damages
Below -2 ft	1,593	$139,115,107	$0	2,403	$329,809,283	$0	85	$43,671,856	$0	4,081	$512,596,246	$0
-2 - 0 ft	578	$48,108,057	$2,970,919	2,688	$304,810,447	$27,964,071	69	$26,493,193	$3,160,996	3,335	$379,411,698	$34,095,986
0.1 - 0.4 ft	33	$3,031,552	$485,807	237	$27,667,087	$6,070,103	12	$5,171,848	$1,408,553	282	$35,870,488	$7,964,463
0.5 - 1 ft	9	$1,147,416	$277,247	341	$32,963,274	$9,394,608	19	$4,356,586	$1,105,776	369	$38,467,276	$10,777,631
1.1 - 1.4 ft	7	$643,733	$201,793	165	$14,548,678	$4,547,646	12	$4,063,295	$1,685,829	184	$19,255,707	$6,435,268
1.5 - 2ft	8	$1,016,040	$366,477	141	$12,867,523	$5,882,040	20	$5,844,954	$2,027,620	169	$19,728,518	$8,276,137
2.1 - 3 ft	1	$75,084	$41,592	118	$15,380,685	$7,381,237	22	$4,751,028	$2,069,170	141	$20,206,797	$9,491,999
3.1 - 5 ft				61	$9,444,553	$5,062,612	37	$4,546,145	$3,144,749	98	$13,990,698	$8,207,361
5.1 - 10 ft				21	$2,296,976	$2,426,810	81	$15,820,450	$12,890,020	102	$18,117,426	$15,316,830
Above 10 ft				5	$1,167,008	$1,195,790	127	$35,961,469	$35,779,951	132	$37,128,477	$36,975,741
Grand Total	**2,229**	**$193,136,990**	**$4,343,835**	**6,180**	**$750,955,515**	**$69,924,917**	**484**	**$150,680,824**	**$63,272,664**	**8,893**	**$1,094,773,328**	**$137,541,416**
High Risk	**58**	**$ 5,913,826**	**$1,372,916**	**346**	**$ 41,156,745**	**$21,948,489**	**287**	**$ 66,924,046**	**$55,911,510**	**691**	**$ 113,994,616**	**$79,232,915**
Mod Risk	**578**	**$ 48,108,057**	**$2,970,919**	**743**	**$ 75,179,039**	**$20,012,357**	**43**	**$ 13,591,730**	**$ 4,200,158**	**1,364**	**$ 136,878,826**	**$27,183,434**
Low Risk	1,593	$ 139,115,107	0	5,091	$ 634,619,731	$27,964,071	154	$ 70,165,049	$ 3,160,996	6,838	$ 843,899,886	$31,125,067

Grouped Project Areas (400+)

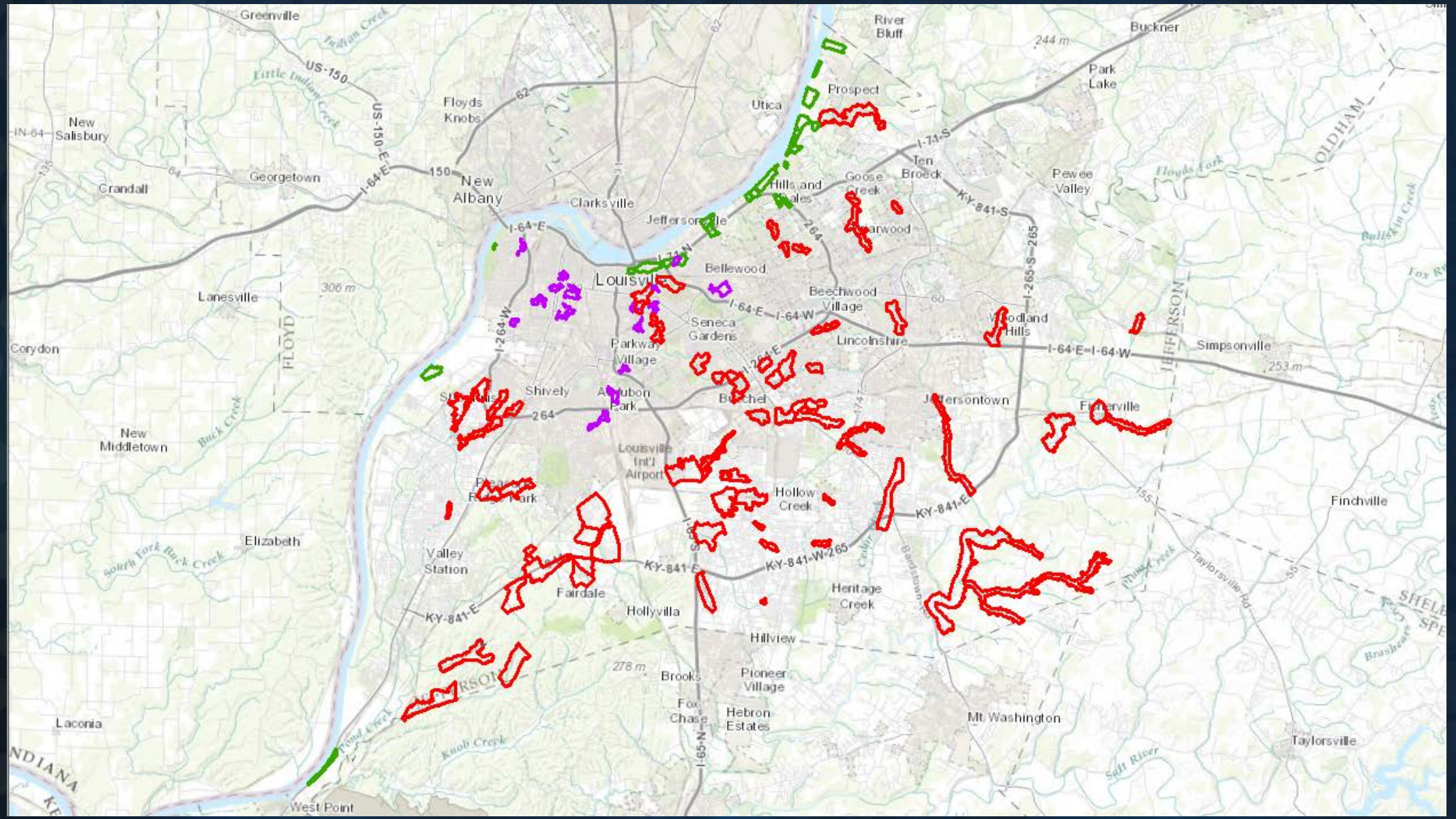


Prioritization

- Prioritization Method
  - Flood Depth (>=1.5’ or > 0’ in CSSA)
  - Value of calculated 100-year damages
  - Amount of prior flood insurance claims
  - Number of repetitive loss properties
  - Number of severe repetitive loss properties

- Each factor was ranked and normalized
- Ranks were then averaged
- Validated against recent grants & acquisition areas

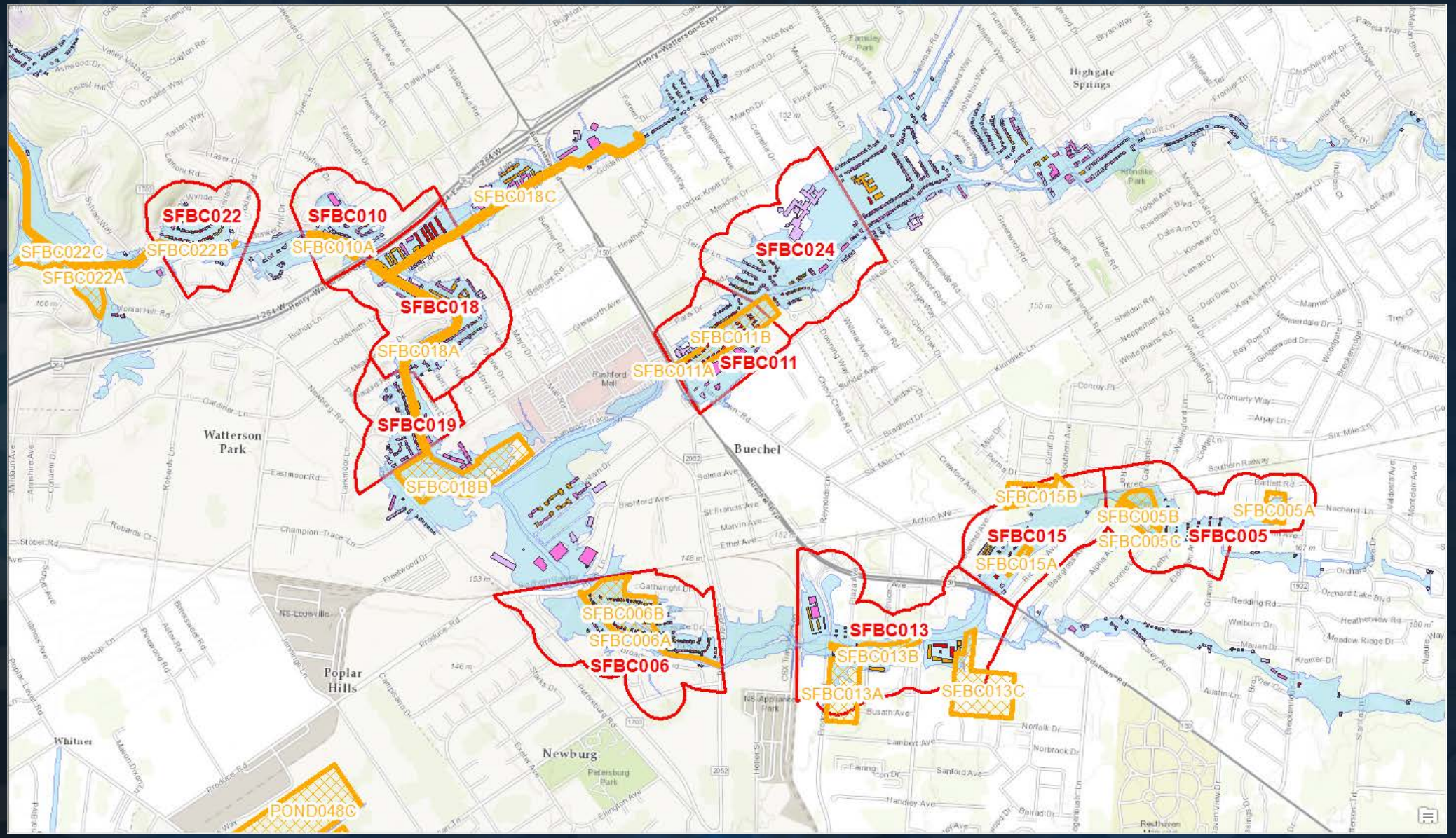
High Risk Areas (100+)



Assess Mitigation Alternatives

- Assess highest risk project areas
- Identify non-structural & structural alternatives
  - Acquisition, structure elevation, flood-proofing
  - Basin, berm, floodwall, channel improvement, culvert
- Assess “most probable” alternatives
- Model the impacts (H&H analysis)
  - Challenge: not all streams have up-to-date models
- Calculate benefits
  - Challenge: FEMA benefit/cost calculations appear to be undervaluing damages when compared to recent Louisville events

Mitigation Alternative Analysis

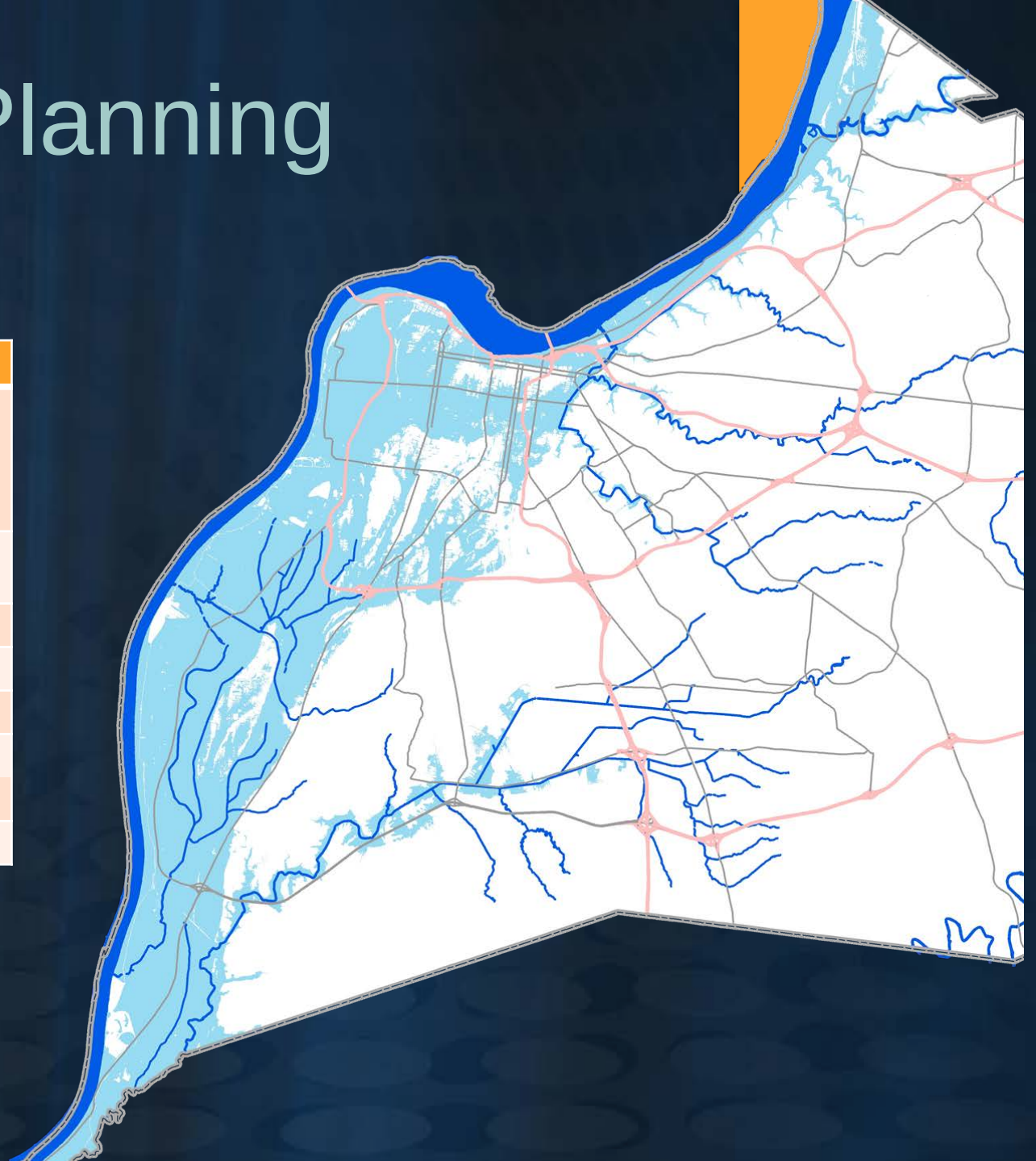


Additional Results

- Mitigation alternatives
  - 150 conceptual structural measures (i.e. projects)
    - Flood storage basins
    - Channel improvements
  - Long-term mitigation program
- Comprehensive flood risk inventory
  - Expedited grant applications
  - Target the “right” areas
  - Can support tracking substantial damage

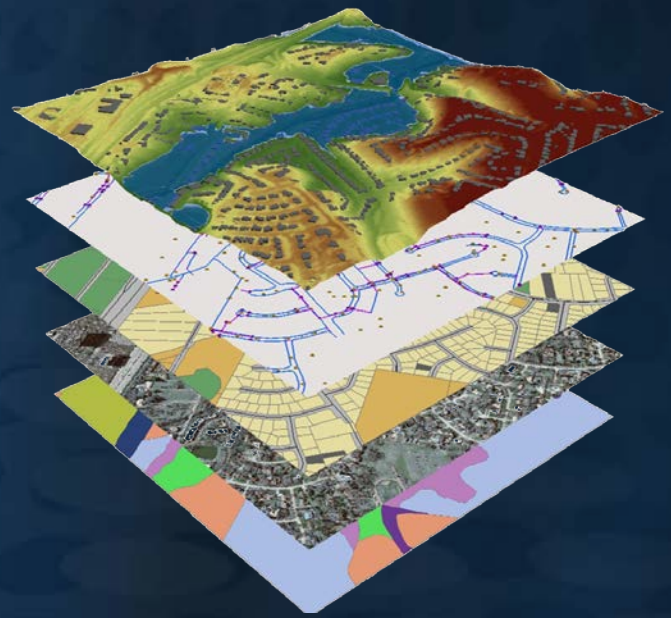
Catastrophic Flood Planning

Flood-prone Structures			
Property Class	Ohio River 500-yr & Levee Overtop	Interior	Total
Residential (includes Condos)	65,086	4,038	69,124
Commercial	8,332	1,145	9,477
Industrial	1,599	86	1,685
Other	3,905	235	4,140
Subtotal	**78,922**	**5,504**	**84,426**
Previously measured	(10,659)	(3,626)	(14,285)
Total	**68,263**	**1,878**	**70,141**



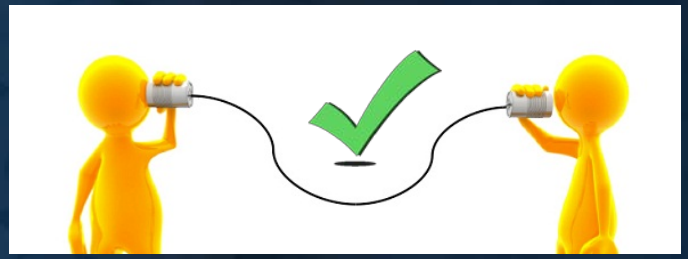
Structure-Based Risk Assessments

- Flood risk inventory
- Mitigation alternatives analysis
- Risk communication



Flood Risk Communication

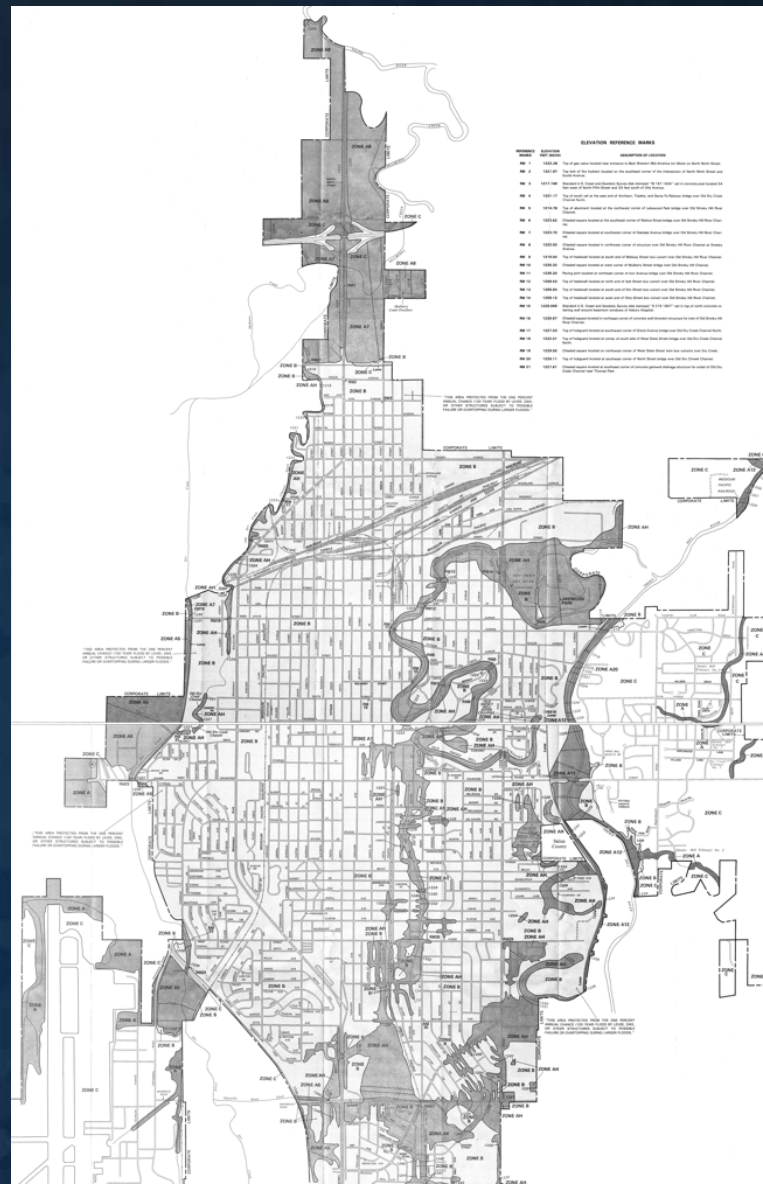
- Communicate “Full Risk Rate”
  - Subsidies will eventually expire
- Change the conversation
  - From “in/out” to “above/below”
  - From zones and elevations to depths and dollars
- Message varies depending on
  - Individual structure characteristics
  - Depth of flooding
  - Purchase requirements



Flood Insurance Rate Impacts

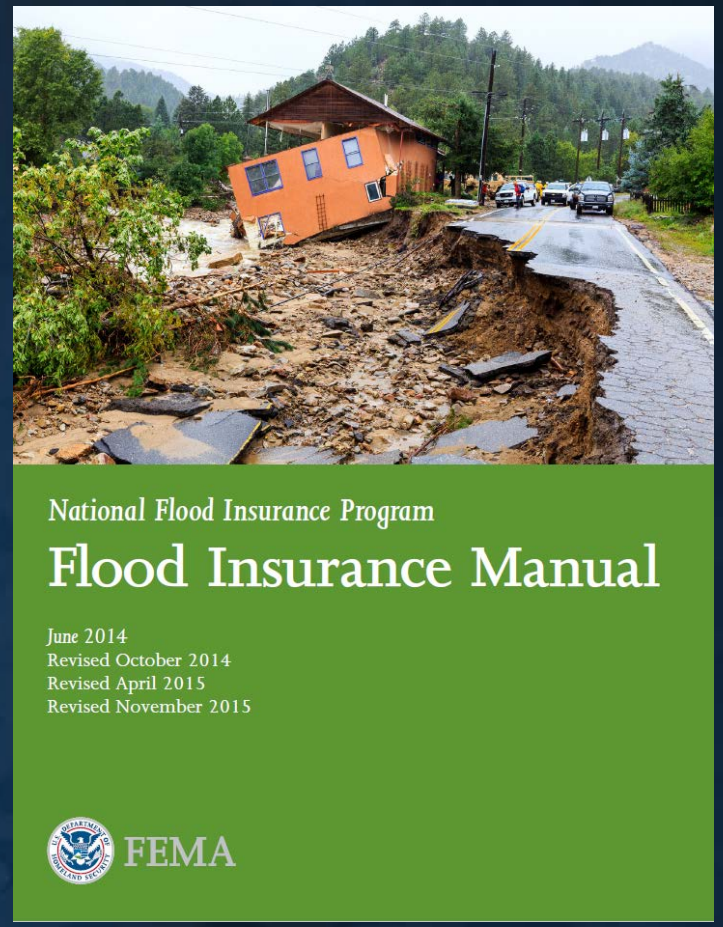
- Salina, Kansas (2015 pop. 47,700)
  - Effective study was from 1986
    - Un-modernized, Q3 product
  - New FIRM
    - SWMM model for interior drainage
    - Removed Zone A streams
  - Accredited levee protects 40% of town
  - Comparisons
    - Effective vs. proposed studies
    - With vs. without federal subsidy*

* FEMA Flood Insurance Manual – November 2015



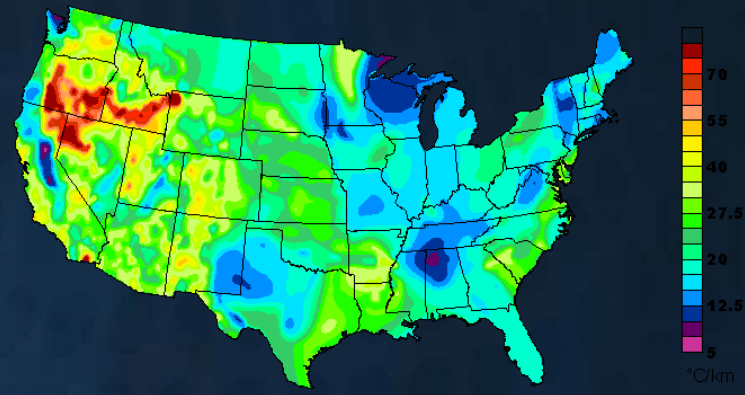
Salina Study Statistics

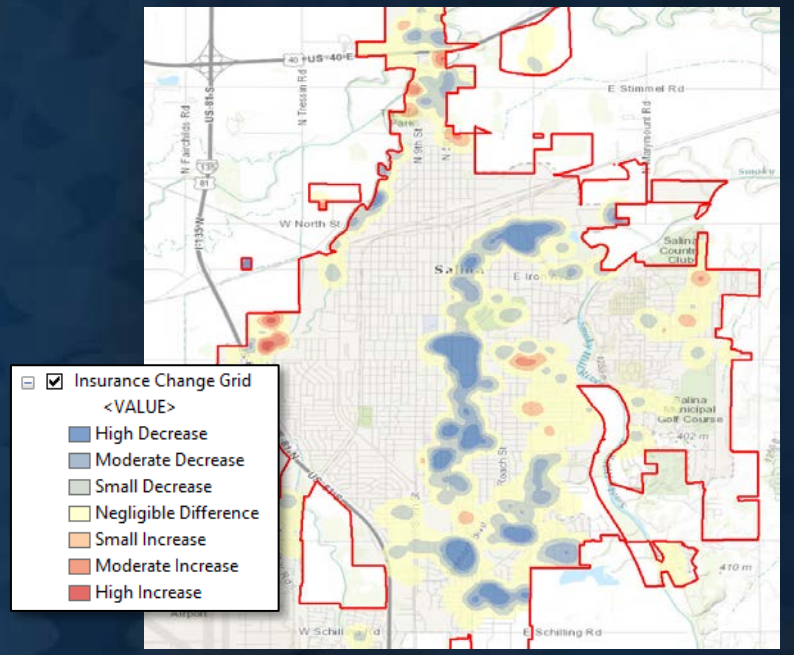
- 1009 structures in effective SFHA
  - 699 pre-FIRM (i.e. built before 1976)
  - 1,871 LOMAs
- 418 structures in proposed SFHA
  - 112 new structures added
  - 703 structures removed (50% would be impacted by a levee failure)
  - 306 structures “no change”



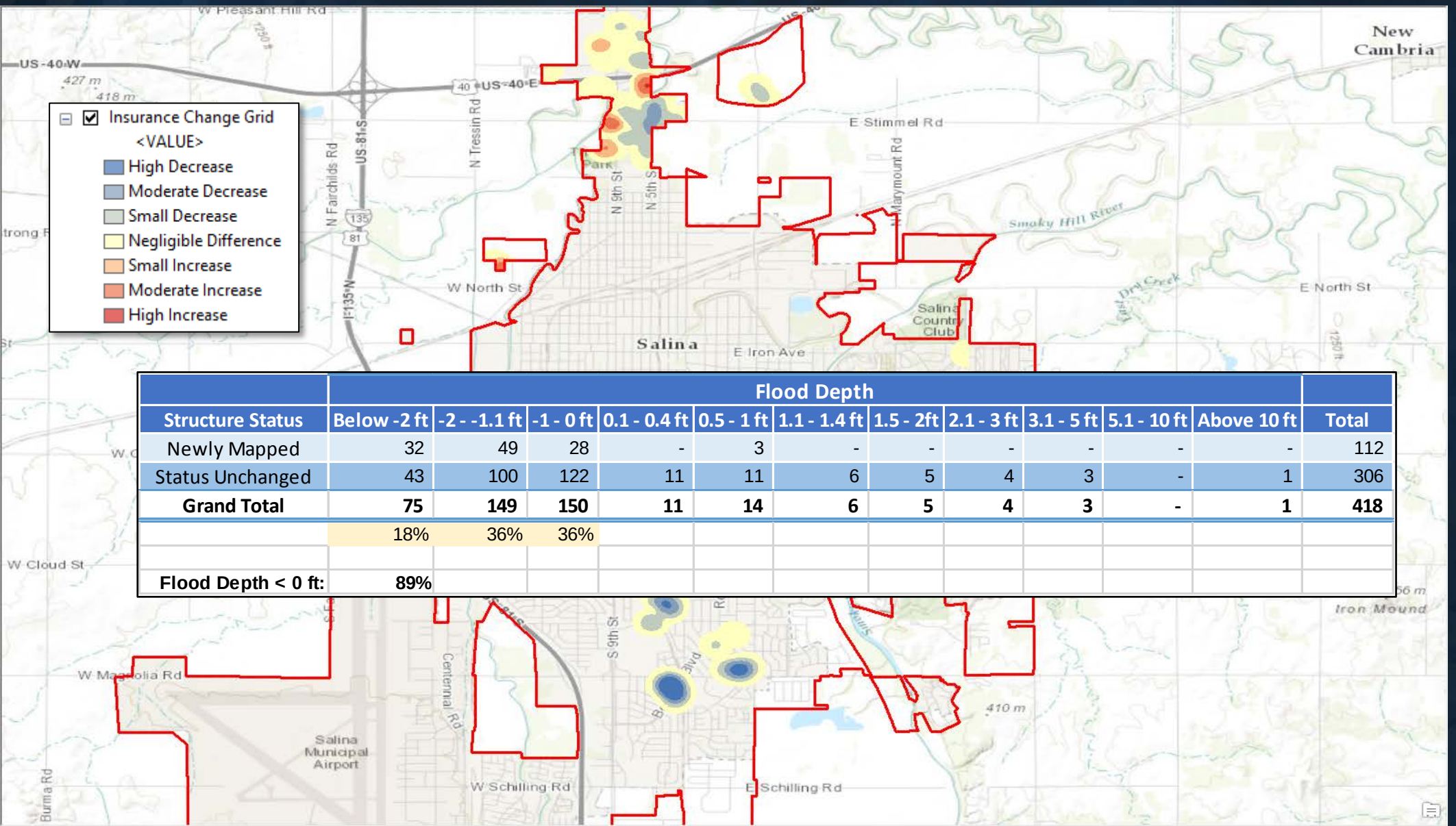
Impact Hot Spots

- Changes Since Last FIRM – only better!
- Areas of significant rate change
  - Calculations are performed for each structure
  - Impacts are aggregated
  - No individual rates or premiums are shown
- How to use this for outreach?
  - Structures newly mapped into SFHA
  - Structures removed from SFHA
  - Structures with “no change”





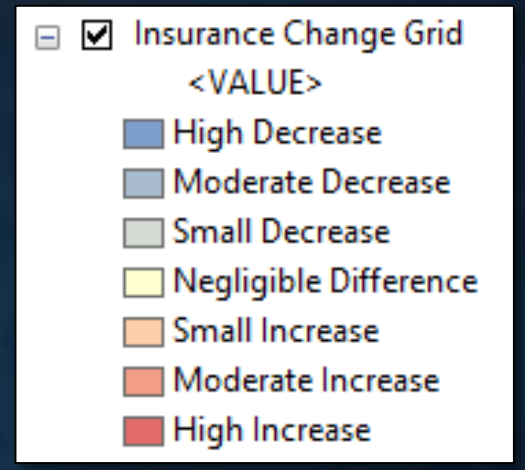
Decision Support



	Flood Depth											
Structure Status	**Below -2 ft**	**-2 - -1.1 ft**	**-1 - 0 ft**	**0.1 - 0.4 ft**	**0.5 - 1 ft**	**1.1 - 1.4 ft**	**1.5 - 2ft**	**2.1 - 3 ft**	**3.1 - 5 ft**	**5.1 - 10 ft**	**Above 10 ft**	**Total**
Newly Mapped	32	49	28	-	3	-	-	-	-	-	-	112
Status Unchanged	43	100	122	11	11	6	5	4	3	-	1	306
Grand Total	**75**	**149**	**150**	**11**	**14**	**6**	**5**	**4**	**3**	**-**	**1**	**418**
	18%	36%	36%									
Flood Depth < 0 ft:	**89%**											

Salina Results

- Outreach to local officials is ongoing
- Messaging is very different than before
  - Information is more substantive
  - Move the discussion towards mitigation
  - Outreach can be tailored to varied situations
    - People that no longer are required to carry a policy
    - People that are newly added
    - People that are still in, but rates are decreasing
    - People that are still in, but rates are increasing



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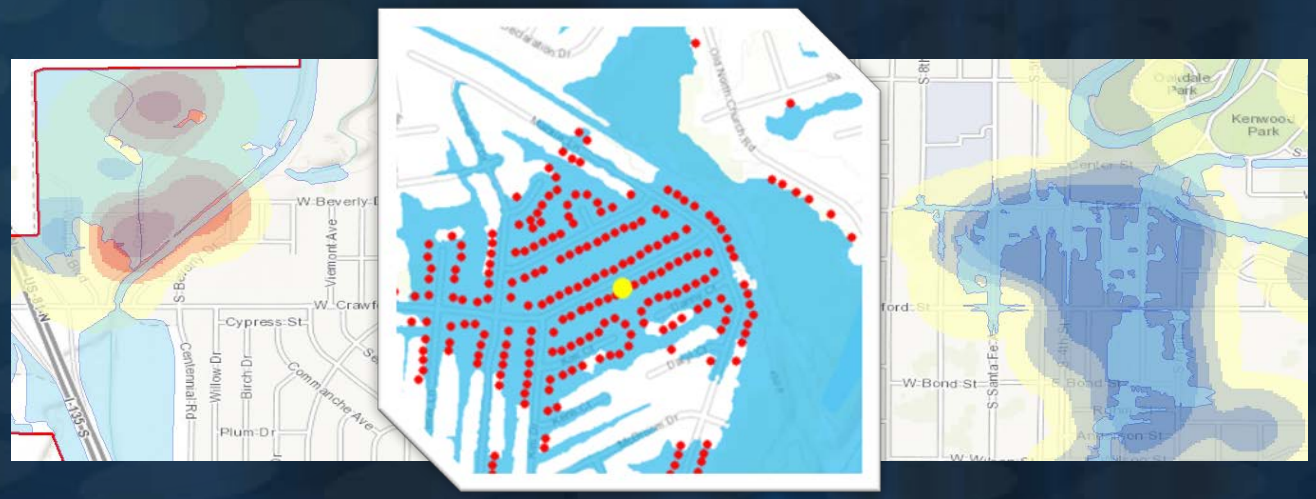
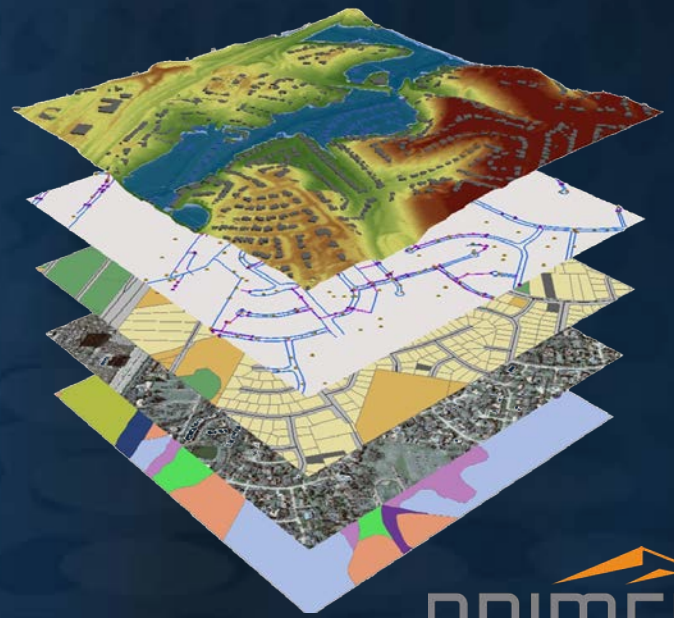
Future Advancements

Better Risk Assessments

- Improved mitigation planning
- Improved communication
- Improved risk reduction





Questions

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Thank You!