

# KENAI RIVER FLOOD STUDY

Flood Risk Review | March 23, 2022



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# Agenda

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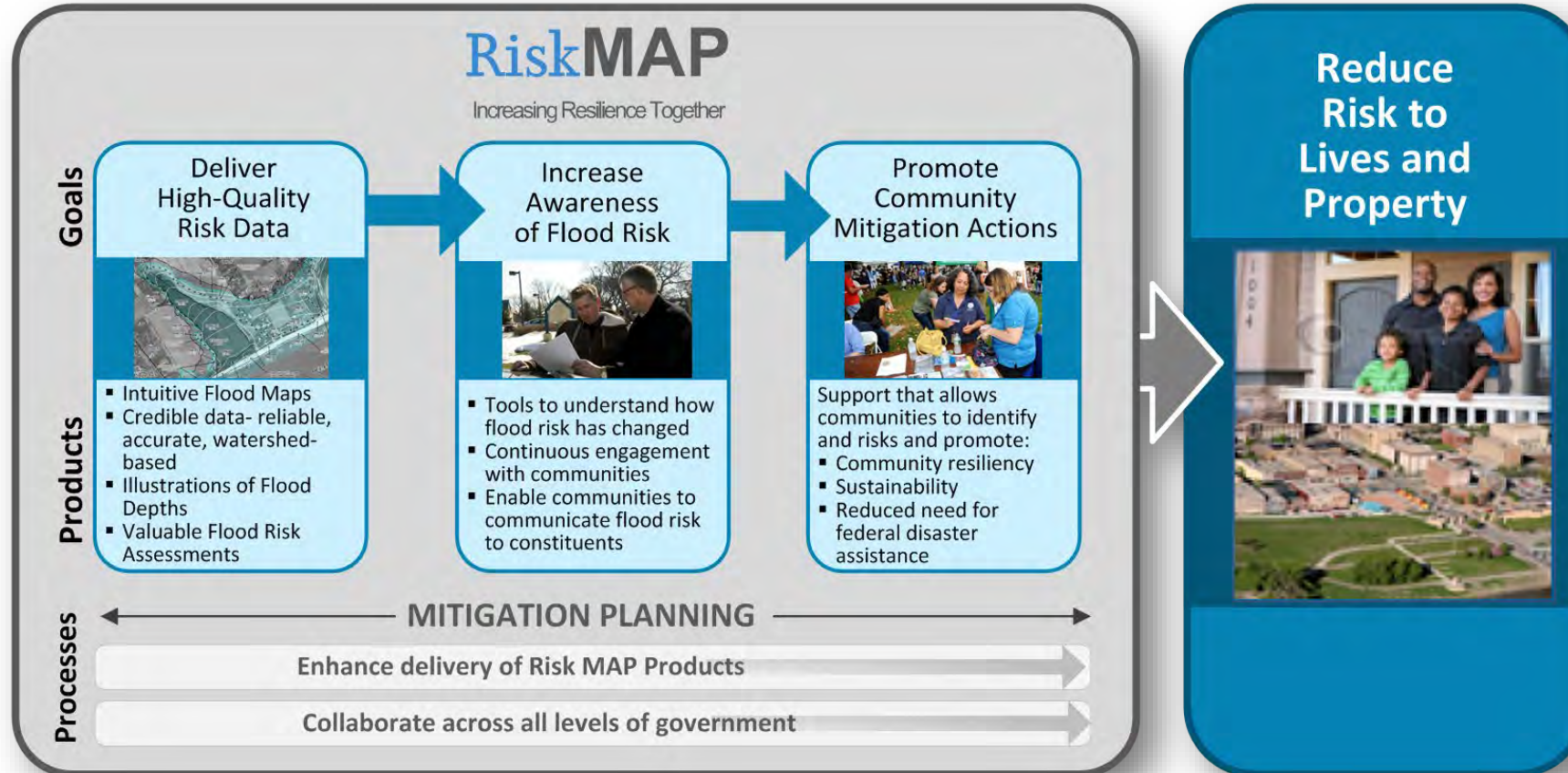
*Photo courtesy Google Earth.*

- Risk MAP, The NFIP & Hazard Mitigation Planning
- Flood Study Background
- Flood Study Methodologies
- Review of Data/Changes from Existing Flood Insurance Rate Maps
- Non-Regulatory Flood Risk Products
- Flood Study Timeline to Effective & Map Adoption Process



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# RiskMAP, The NFIP & Hazard Mitigation Planning



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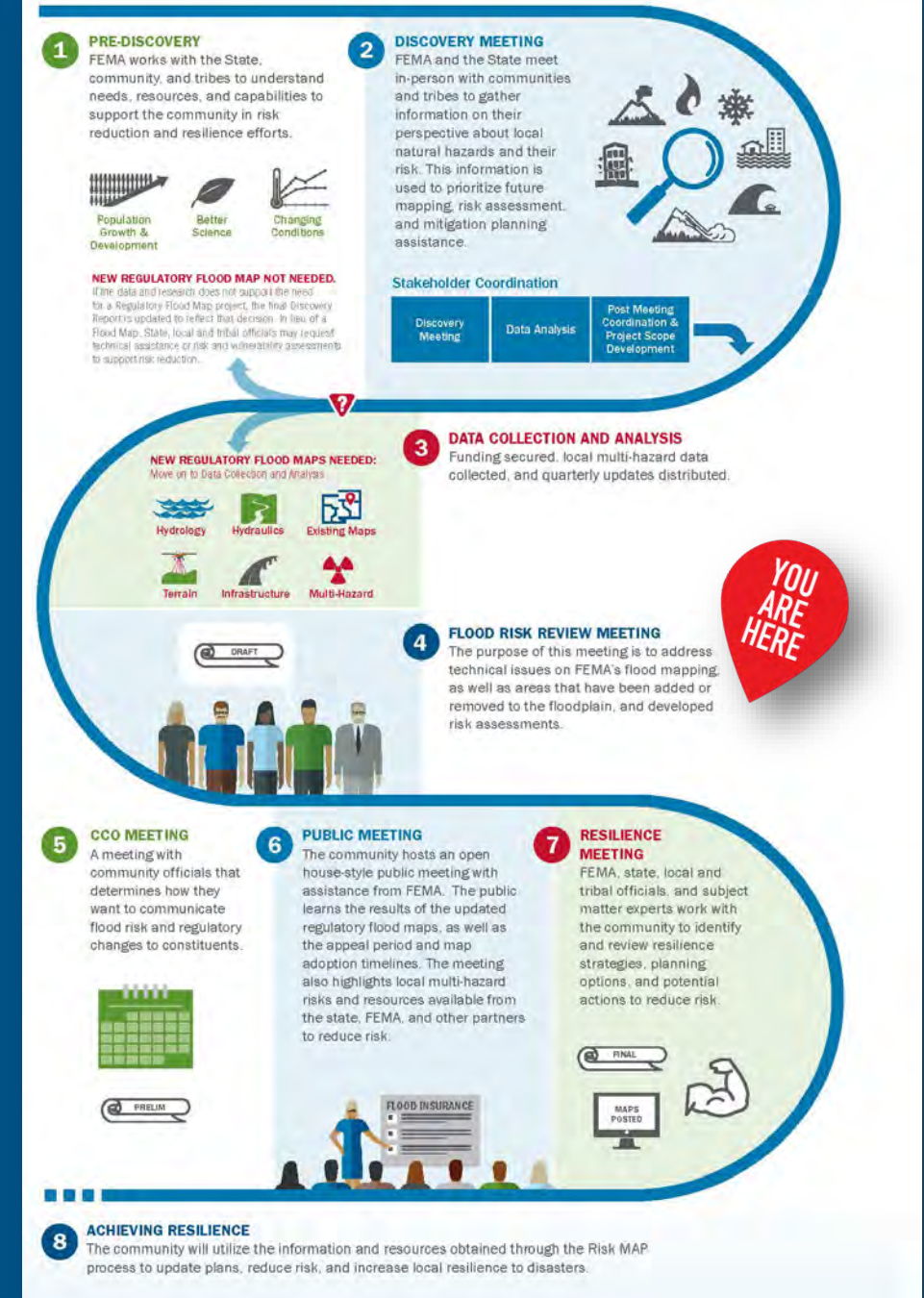


# Risk Mapping, Assessment & Planning (MAP)

- Risk MAP supports community resilience by:
  - Providing high-quality data
  - Building lasting partnerships
  - Supporting long-term hazard mitigation planning
- Outputs to Risk MAP may be:
  - Regulatory or Non-Regulatory
  - Flood-focused or Multi-Hazard focused

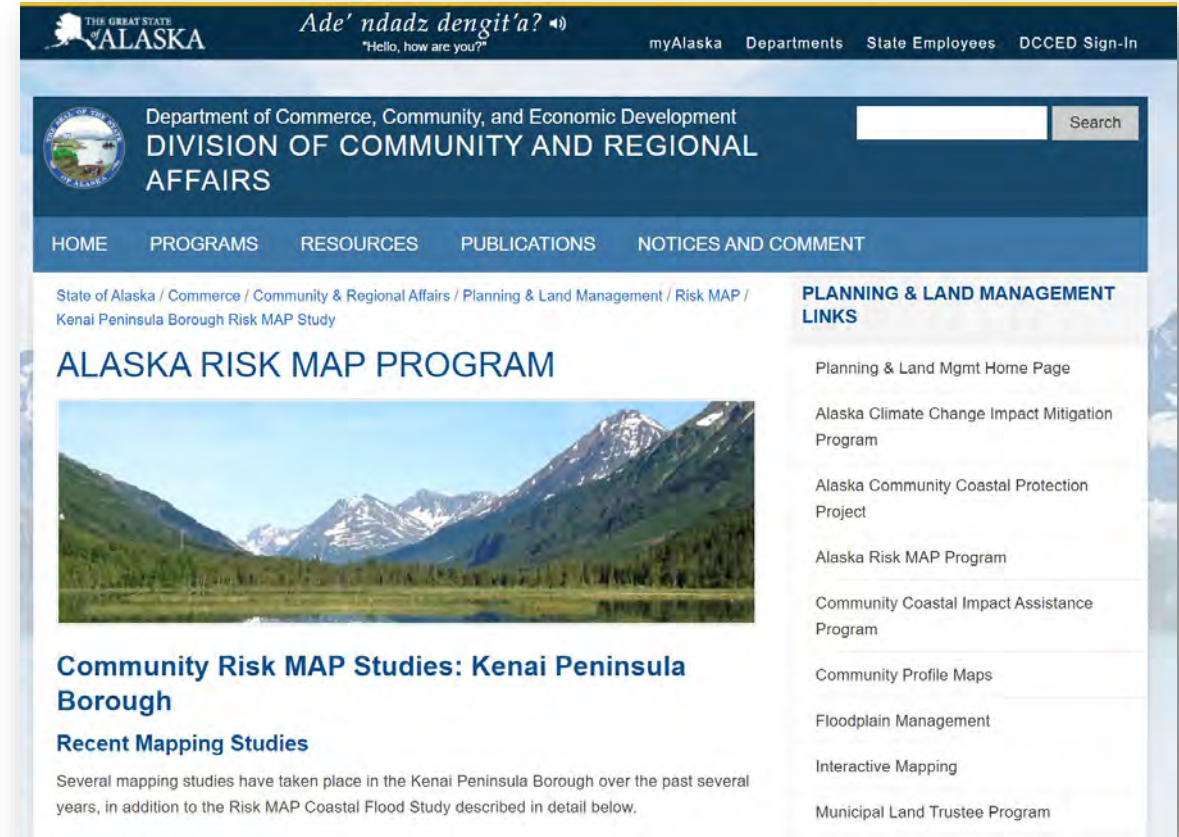


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# Risk MAP in Alaska

- Kenai Peninsula Borough Coastal Study (effective maps 2016)
- Village of Kotlik
- Boroughs of Fairbanks North Star, Matanuska-Susitna, Sitka, Kodiak Island, Ketchikan Gateway
- Cities of Aniak, Bethel, Cordova, Emmonak, Kotzebue, Kwethluk, Valdez



[Risk MAP, Planning & Land Management, Division of Community and Regional Affairs \(alaska.gov\)](http://alaska.gov)



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# NFIP and the Kenai Peninsula Borough

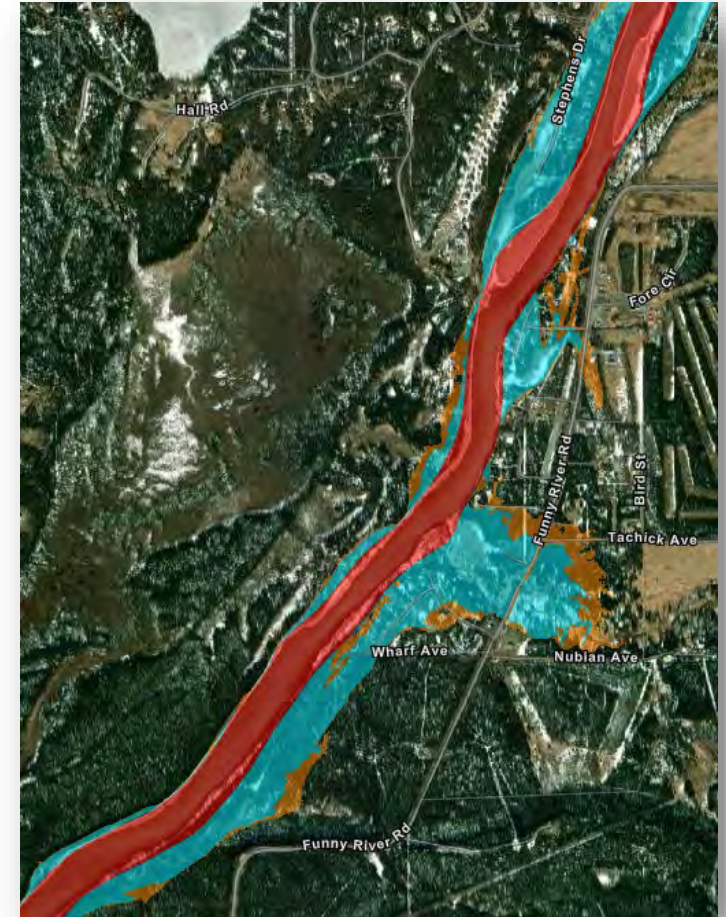
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- Kenai Peninsula Borough, Homer, and Seward participate in the National Flood Insurance Program as well as the Community Rating System
- Kenai & Soldotna do not participate
- KPB floodplain maps are not all updated by this study:
  - 1981: Original FIS and mapping
  - 1999: First revision, Big Eddy area
  - 2016: Third revision, Coastal Hazard Analysis
- Purpose of the National Flood Insurance Program (NFIP): reduce economic loss caused by flood events
  - 257 NFIP policies
  - \$73 million in property covered
  - 75 paid losses (since 1978)
  - \$600,000 paid (since 1978)
  - CRS Class 9, 5% discount to all policyholders



# Key Responsibilities for NFIP-participating Communities

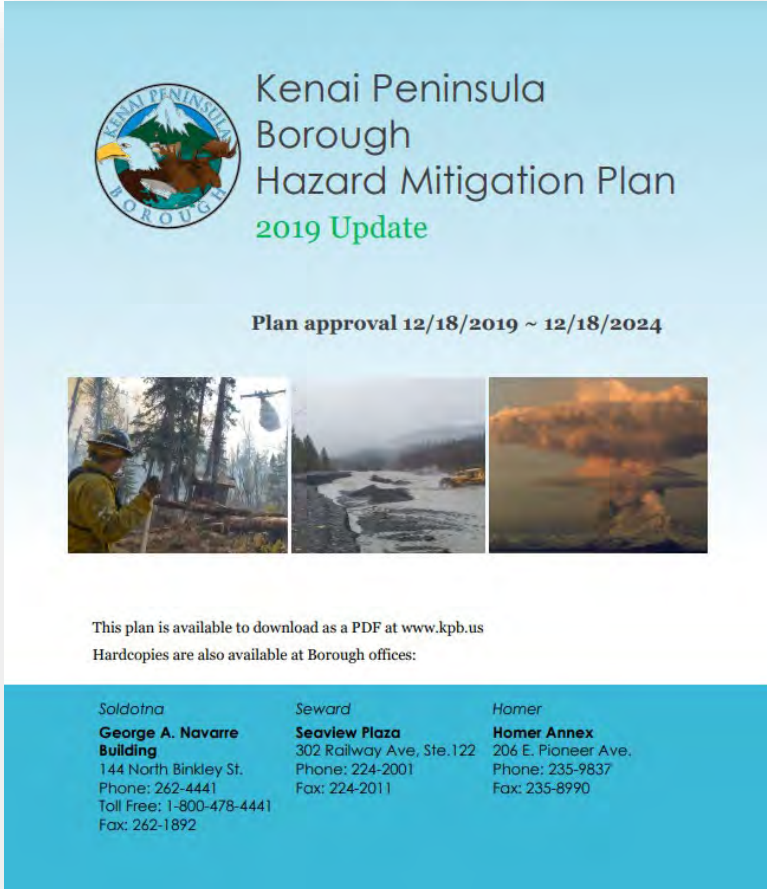
- Determine whether proposed development activities are in SFHAs.
- Review development proposals to ensure compliance with requirements of floodplain management regulations and building codes.
- Require new subdivisions and development proposals with more than 50 lots, or larger than 5 acres, to include BFEs.
- Issue or deny permits for floodplain development.
- Inspect all development in SFHAs to ensure compliance.
- Maintain records of issued permits, elevation data, inspections and enforcement actions.
- Assist in preparation and revision of floodplain maps.
- Help residents obtain information on flood hazards, floodplain map data, and compliant construction measures.



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# Hazard Mitigation Planning in the Kenai Peninsula Borough

- 2019 All-Hazard Mitigation Plan
  - [2019 Kenai Peninsula Borough Hazard Mitigation Plan.pdf \(kpb.us\)](https://www.kpb.us/2019-Kenai-Peninsula-Borough-Hazard-Mitigation-Plan.pdf)
  - Flood and Coastal Erosion, Wildfires, Earthquakes, Weather, Tsunamis, Volcanoes, Avalanches and Human-Caused Hazards
- Updated every five years (expires Dec 2024)
  - City of Kenai, Annex C
  - City of Soldotna, Annex F
- DR-4638-AK, Declared Jan 2022 for Severe Storms, Straight-line Winds, Flooding, Landslides, and Mudslides (Oct 29, 2021 – Nov 1, 2021)
  - [Designated Areas | FEMA.gov](https://www.fema.gov/designated-areas)



The cover page of the Kenai Peninsula Borough Hazard Mitigation Plan 2019 Update features a light blue background. At the top left is the Kenai Peninsula Borough logo, which includes a mountain, a river, and a fish. To the right of the logo, the title "Kenai Peninsula Borough Hazard Mitigation Plan 2019 Update" is displayed in a serif font, with "2019 Update" in green. Below the title, the text "Plan approval 12/18/2019 ~ 12/18/2024" is shown. In the center, there are three small images: a firefighter in a yellow jacket, a road covered in snow and ice, and a large fire with thick smoke. At the bottom, there is a section for contact information, divided into three columns for Soldotna, Seward, and Homer, each with a building name, address, phone, fax, and toll-free number. A note at the bottom left states that the plan is available as a PDF at www.kpb.us and that hardcopies are available at Borough offices.

Kenai Peninsula  
Borough  
Hazard Mitigation Plan  
2019 Update

Plan approval 12/18/2019 ~ 12/18/2024

This plan is available to download as a PDF at [www.kpb.us](http://www.kpb.us)  
Hardcopies are also available at Borough offices:

<b>Soldotna</b> <b>George A. Navarre Building</b> 144 North Binkley St. Phone: 262-4441 Toll Free: 1-800-478-4441 Fax: 262-1892	<b>Seward</b> <b>Seaview Plaza</b> 302 Railway Ave, Ste.122 Phone: 224-2001 Fax: 224-2011	<b>Homer</b> <b>Homer Annex</b> 206 E. Pioneer Ave. Phone: 235-9837 Fax: 235-8990
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# Benefits and Uses of Completed Analysis

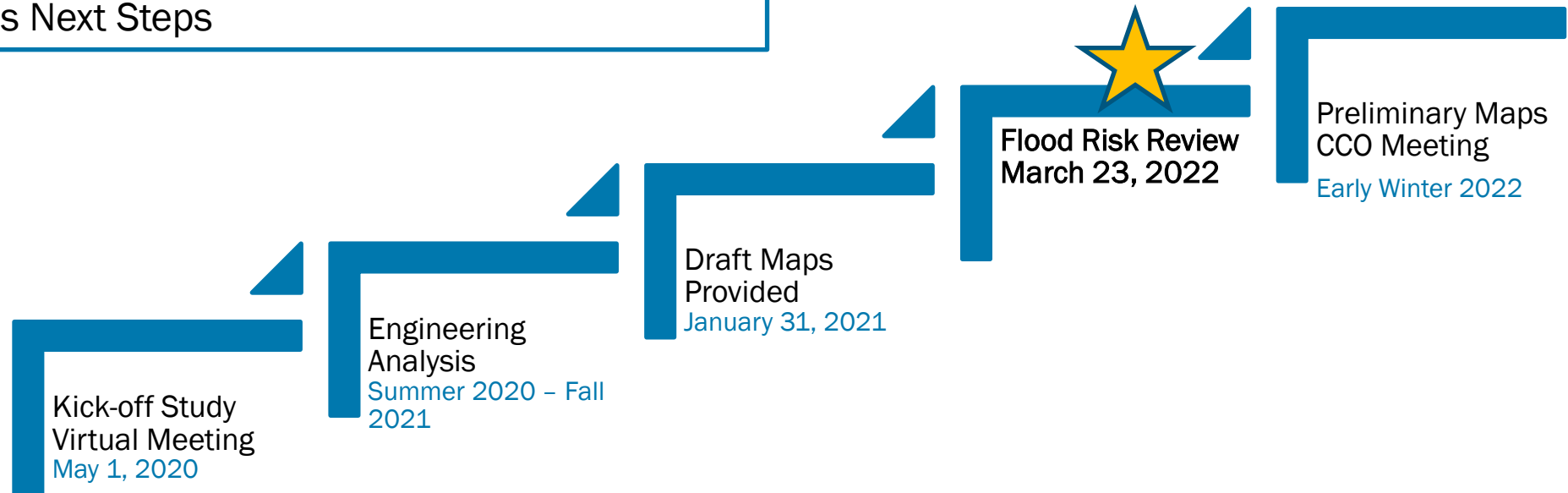
- Supplement regulatory products (FIRM/FIS)
- Best available information for BFE determinations for development and Letter of Map Amendments. Possibly Letters of Map Revision.
- Can be used for planning efforts – emergency, mitigation, preparedness, land use, and capital improvements
- Provide data to inform Hazard Mitigation Plans
- Models are intended to be upgradable or enhanced. No need to start from scratch.



# Study Progress

## *Flood Risk Review Meeting Objectives*

- Review methodology, analysis and draft maps
- Discuss Next Steps



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# Scope of Work

## USACE – Alaska District

- 1-D detailed analysis for 47 miles, outlet of Skilak Lake to mouth of Kenai River
- Multi-frequency analysis (10%, 25%, 50%, 1% and 0.2%)
- Water surface elevation and depth grids
- 1-ft increment inundation (for gages)

## STARR II

- Floodway modeling and mapping



- ✓ National Weather Service developed calibrated model with 1995 and 2012 flood events.

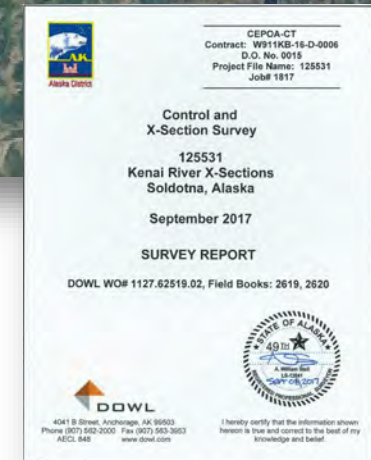
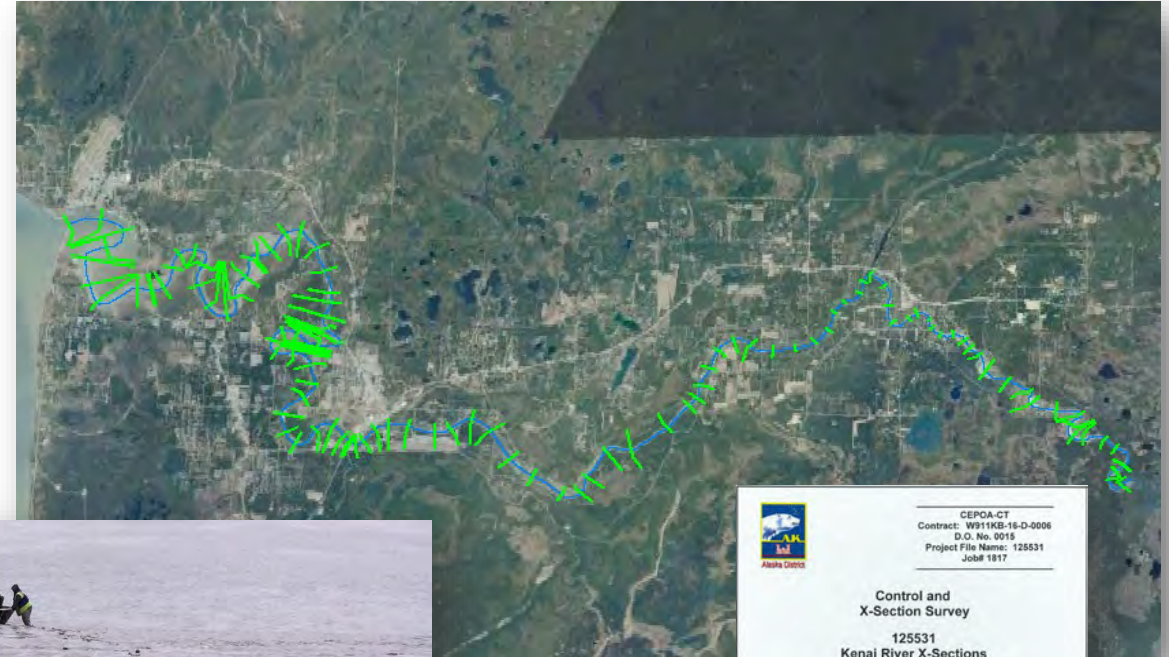
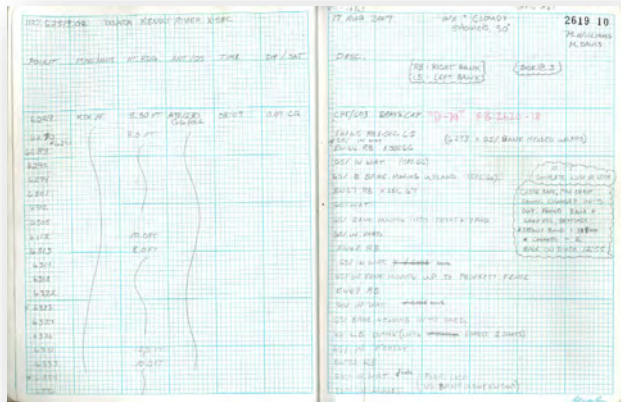


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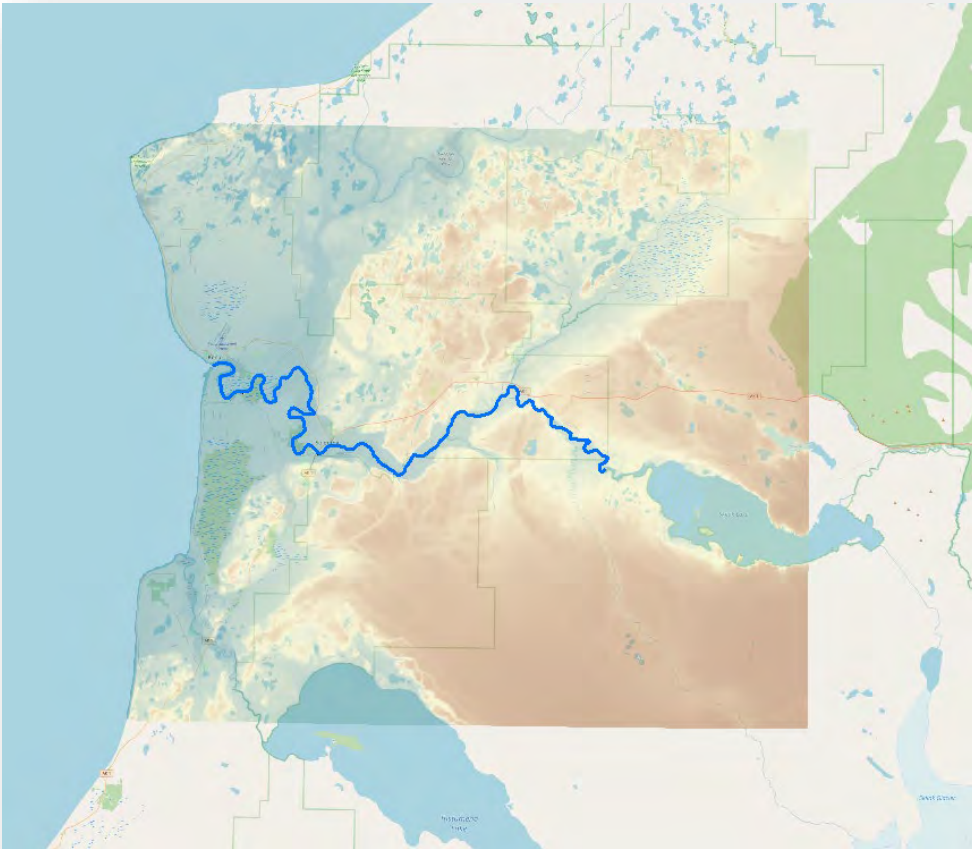
# 2017 River Survey

- USACE – Alaska District & FEMA
  - 113 Channel cross-sections (via contract with DOWL in 2017)

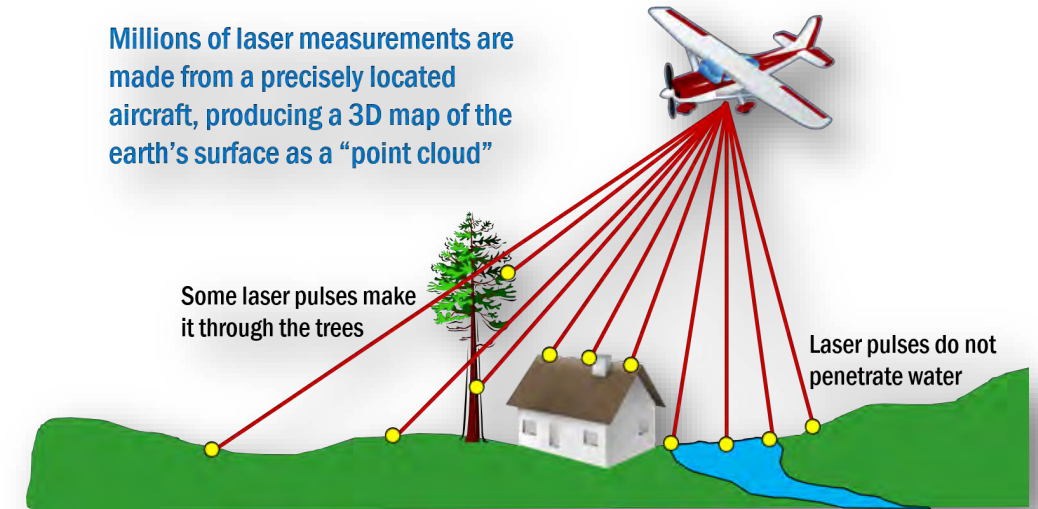


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# Study Terrain Data



Terrain Data: 2008 Western Kenai Lowlands Lidar



LiDAR coverage in the Borough may also be found on the Kenai Peninsula Borough Risk MAP Project Story Map: <https://arcg.is/11q0PX0>



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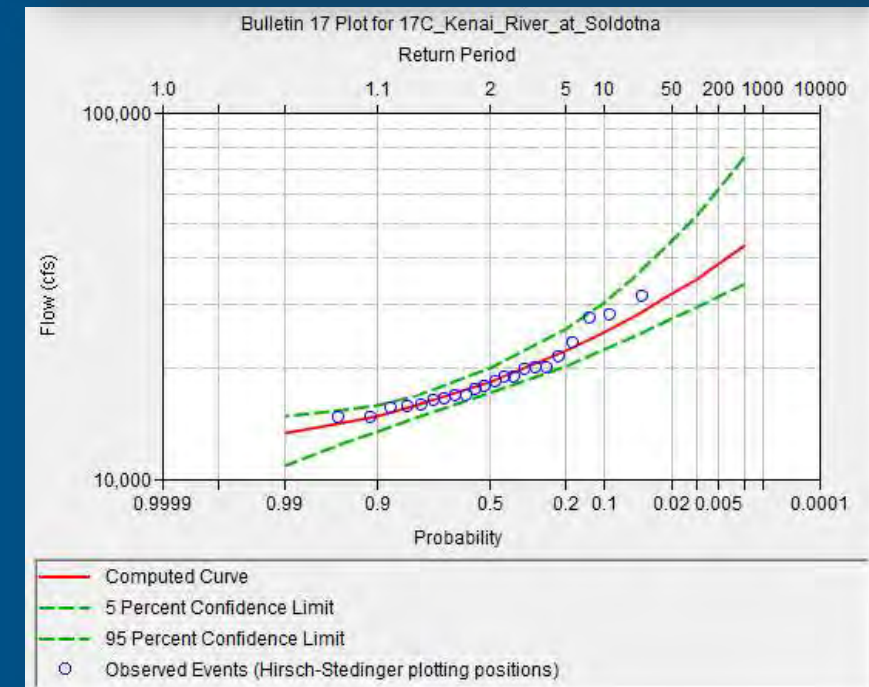


# Study Hydrology - Calculations

- Gage data and regression equations were used to determine peak flows for the 10%, 4%, 2%, 1%, 0.2% and 1%-plus annual exceedance probability (AEP) flood events.
- HEC-SSP statistical analysis was used on peak events for USGS river gage near Soldotna (USGS Site 15266300) to determine gage-based peak flows.
- Regression analysis was used to calculate flow values via StreamStats (USGS) at 4 locations along the Kenai River:
  - Upstream of Killey River
  - Upstream of Moose River
  - Upstream of Funny River
  - Downstream end of Kenai River
- Final flow values were computed at each of the 4 locations along the Kenai River by weighting the transferred gage values with the regression values.



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# Study Hydrology – Updated vs Effective

- All updated flow values are greater than the effective (May 1981) flow values
  - Weighting of gage flows with regression-based flow values
  - 42 additional years of gage record at Soldotna gage

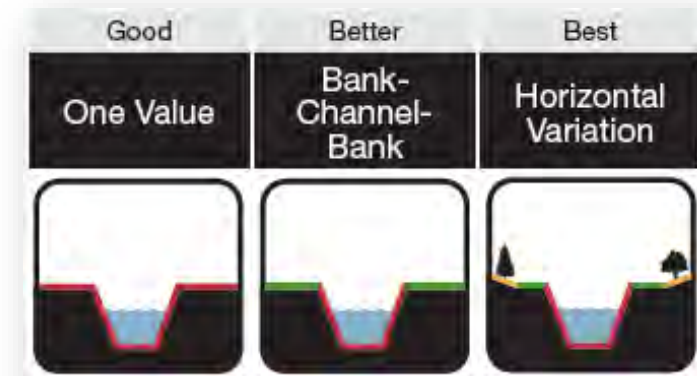
Study	Location	Drainage Area (mi <sup>2</sup> )	AEP Event Discharge (cfs)				Percent Difference			
			10%	2%	1%	0.20%	10%	2%	1%	0.20%
Effective	At outlet of Skilak Lake	1,257	22,100	28,600	31,500	39,400	49	47	46	41
Current	Upstream of confluence with Killey River	1,260	32,914	41,955	45,969	55,515				
Effective	Downstream of Killey River	1,484	23,800	30,600	33,700	43,700	38	37	36	28
Current	Upstream of confluence with Moose River	1,510	32,914	41,955	45,959	55,956				
Effective	Downstream of Moose River	1,748	25,600	32,700	35,900	44,300	29	28	28	26
Current	Upstream of confluence with Funny River	1,790	32,914	41,955	45,969	55,956				
Effective	At mouth	2,162	28,000	37,300	38,300	47,000	18	12	21	26
Current	At downstream end of Kenai River	2,170	32,914	41,955	46,293	59,032				



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# Hydraulic Methods

Methodology	Zone A	Zone AE
HEC-RAS Steady-State model	✓	✓
Banks modeled	✓	✓
Roughness based on land cover (Horizontal Variation)	✓	✓
Structures assumed (bridges, culverts)	✓	✓
Surveyed Bath. and Struct.		✓
Calibrate to observed event (1996)		✓
Floodway analysis		✓



# Hydraulic Methods - Floodway

[Floodway Analysis and Mapping Guidance \(fema.gov\)](https://www.fema.gov/floodway-analysis-mapping-guidance)

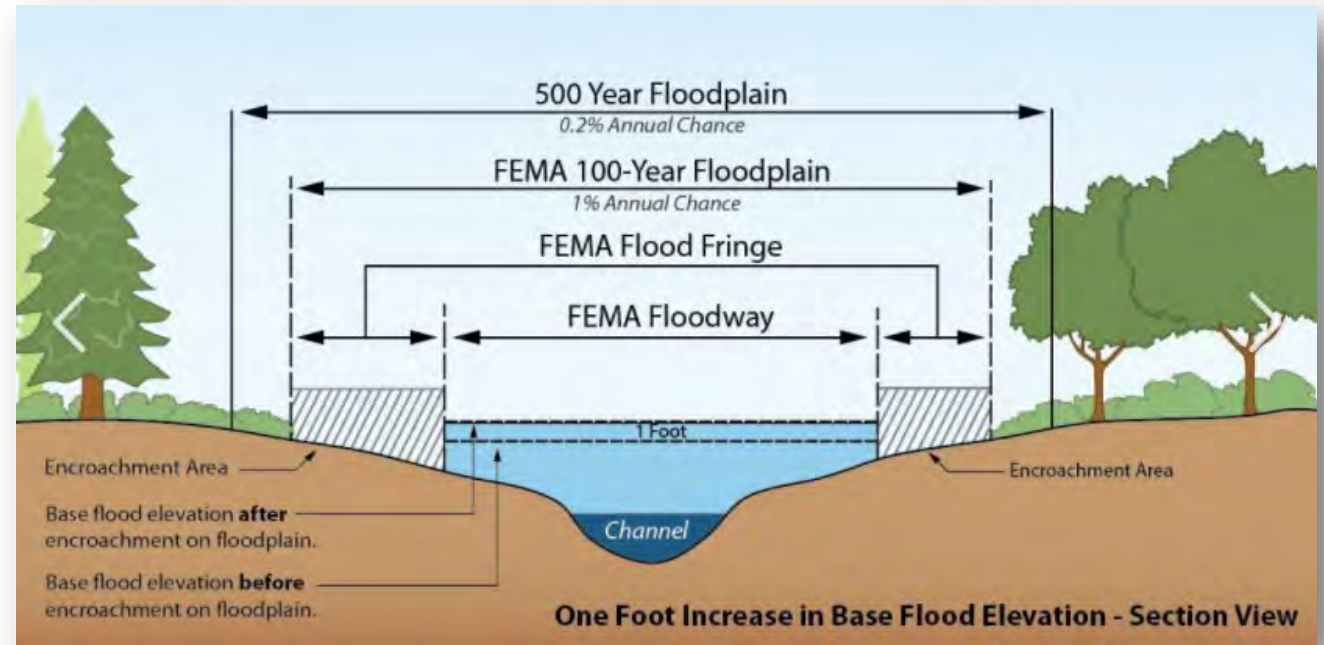
44 CFR  
59.1

Definitions: “Regulatory Floodway” means the channel of a river or other watercourse and the adjacent land ***areas 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  
60.3(d):

When the Administrator has provided a notice of the final base flood determinations within zones A1-30 and/or AE on the community’s FIRM ...and has provided data from which the community shall designate its regulatory floodway, the community shall:

- (1) ...
- (2) Select and adopt a regulatory floodway on the principle that the area chosen for the regulatory floodway must carry the waters of the base flood, ***without increasing the water surface elevation of that flood more than one foot at any point.***



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# Hydraulic Methods - Floodway

## Why Delineate a Floodway?

- Preventing increases in damages to upstream buildings
- Limiting development in the most hazardous areas
- Protecting natural functions of floodplains
- Having a floodway considerably reduces the administrative burden of regulating floodplain development

44 CFR 60.3(d)(3)

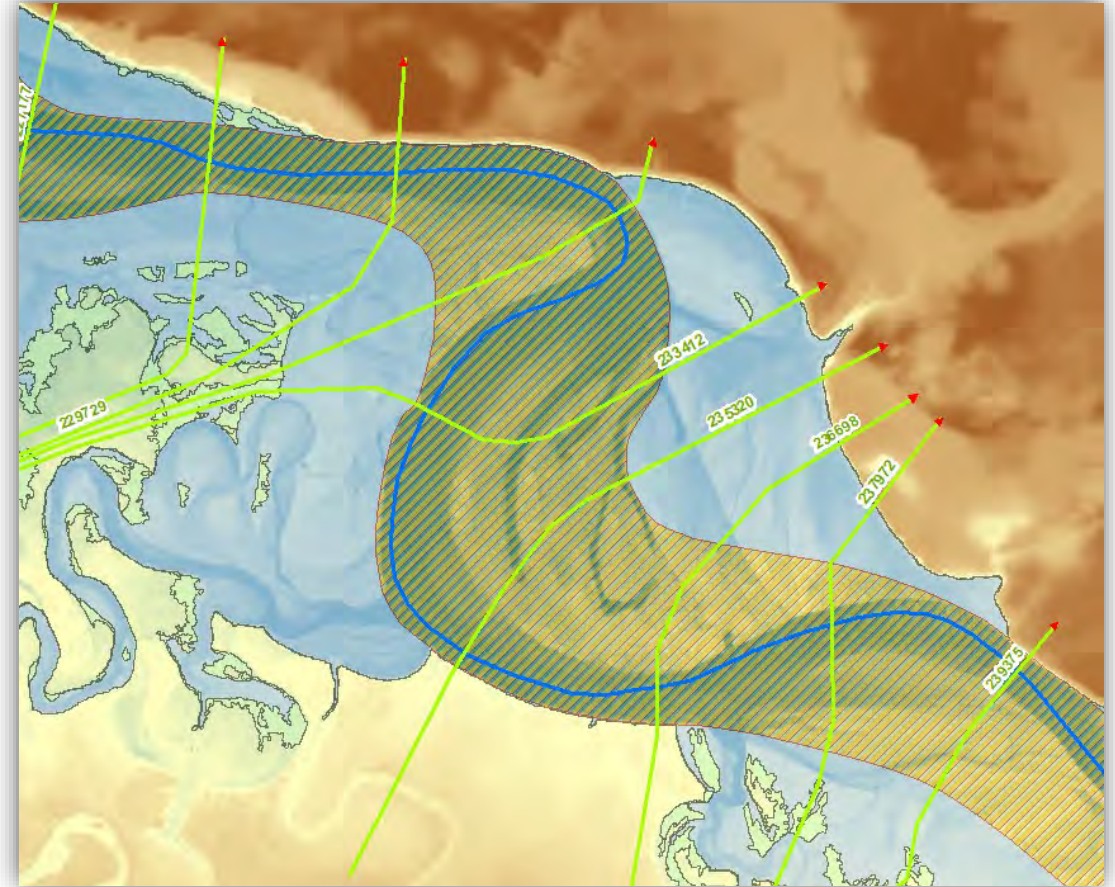
***Prohibit encroachments in the floodway***, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway ***unless it has been demonstrated through hydrologic and hydraulic analyses*** performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in the flood levels within the community during occurrence of the base flood discharge.



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# Summary of Kenai River Hydraulic Model

- HEC-RAS version 5.0.7 utilized
- 47 miles long detailed (Zone AE) study
- 6 included flood events and Floodway
  - FW Surcharges from 0.0 to 1.0 feet
- Surveyed channel bathymetry on most XS
- Includes 2 modeled bridge crossings
- Updated flood elevations are higher than effective on average for most cross sections

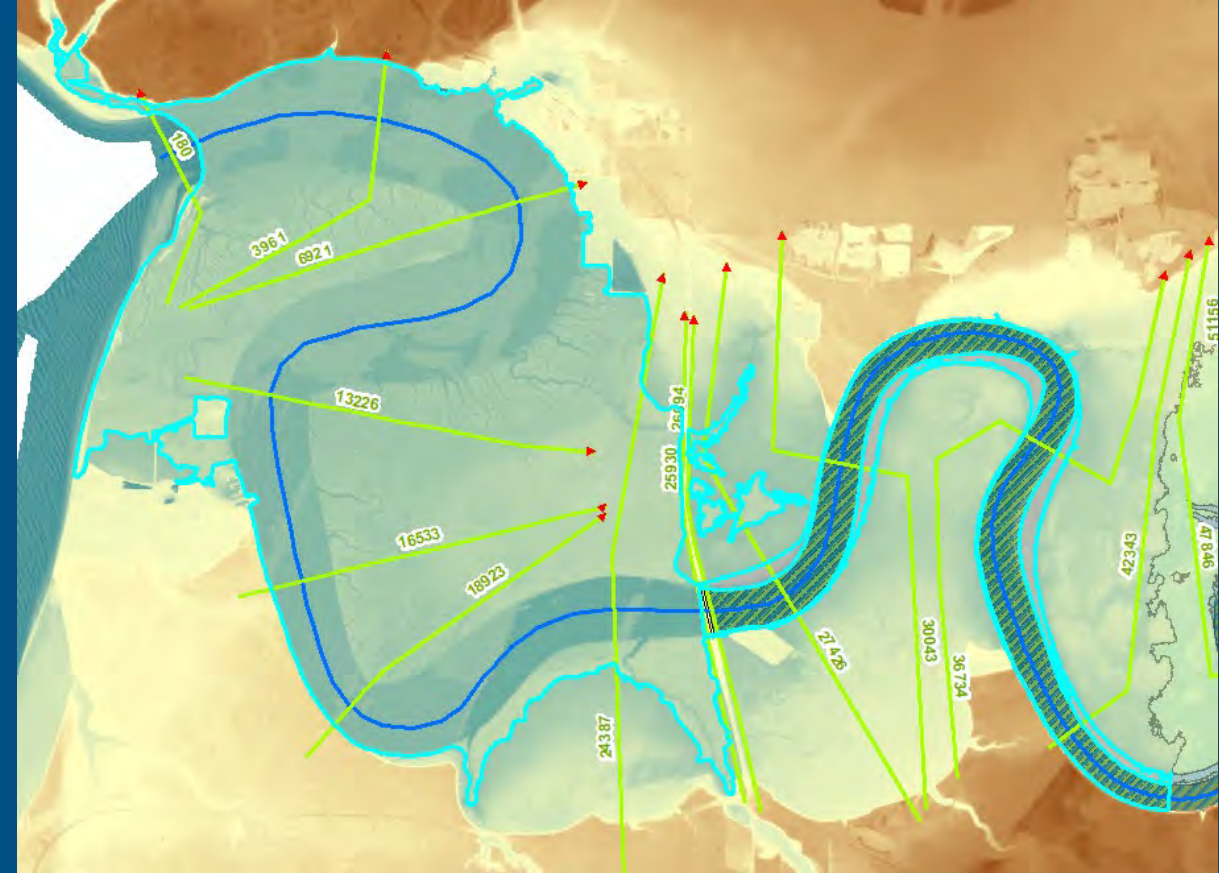


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# Special Study Considerations

- Flooding at the downstream end of the Kenai River model is controlled by coastal flooding from Cook Inlet.
  - The effective coastal study was performed in 2013.
  - Most of the coastal influence is downstream of the Kenai River Bridge.
- Though studied, floodway will not be mapped on the downstream side of the bridge within the effective coastal floodplain.
- This effort only updated the Kenai River.
  - Zone A tributaries not updated at this time: Beaver Creek, Slikok Creek, Soldotna Creek, Funny River, Moose River, Killey River

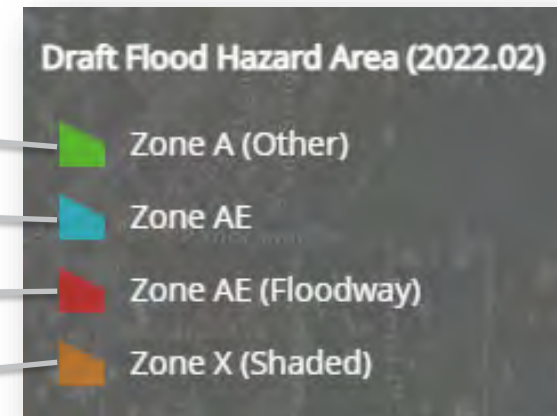
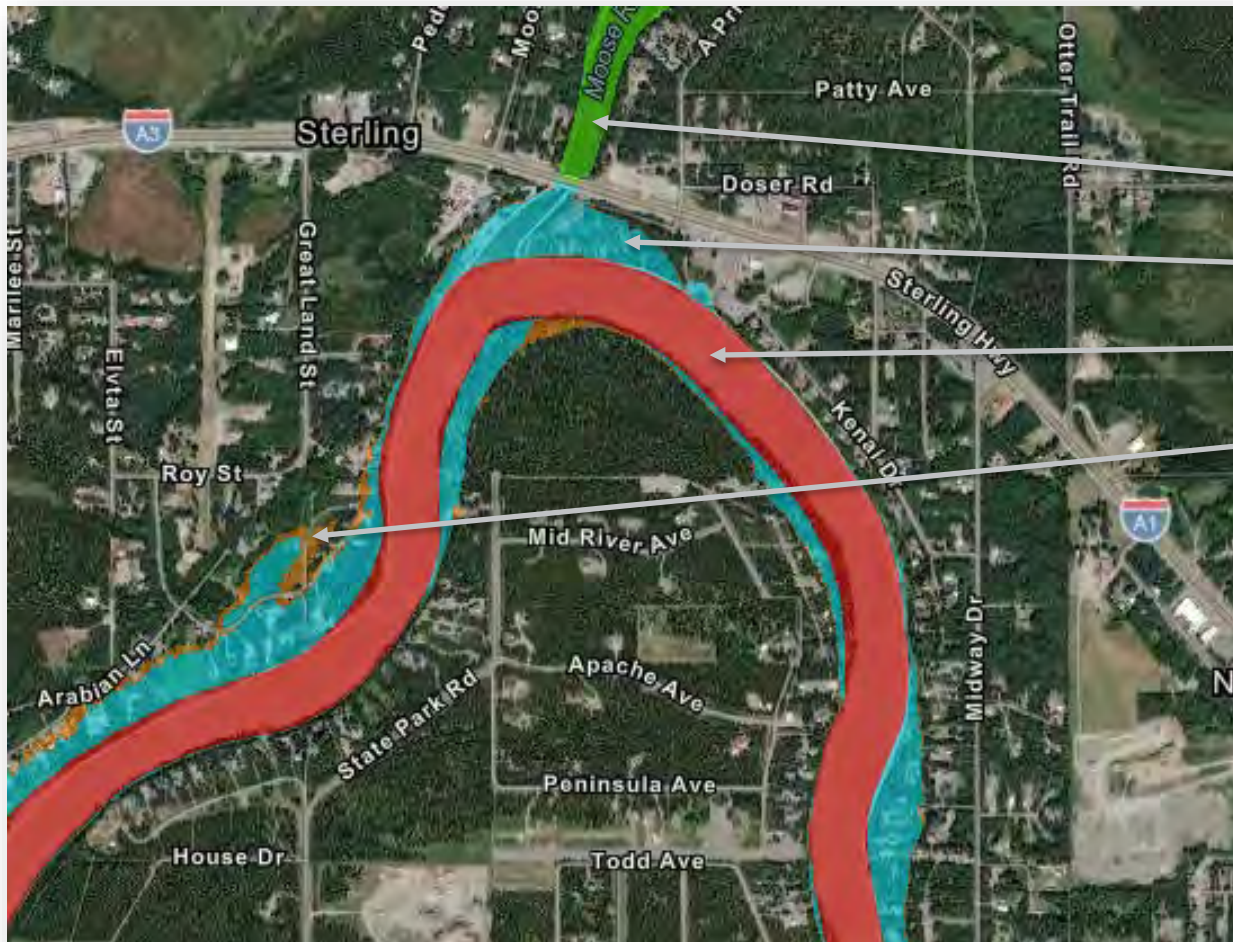


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# Reviewing the Digital Workmaps

<https://arcg.is/11qOPX0>



**Zone A (Other):** Effective Zone A not updated at this time (map will remain as-is)

**Zone AE:** 1%-annual-chance event (100-yr) with Base Flood Elevations (BFE)

**Zone AE Floodway:** 1%-annual-chance event floodway with elevations

**Zone X (Shaded):** 0.2%-annual-chance event (500-yr)

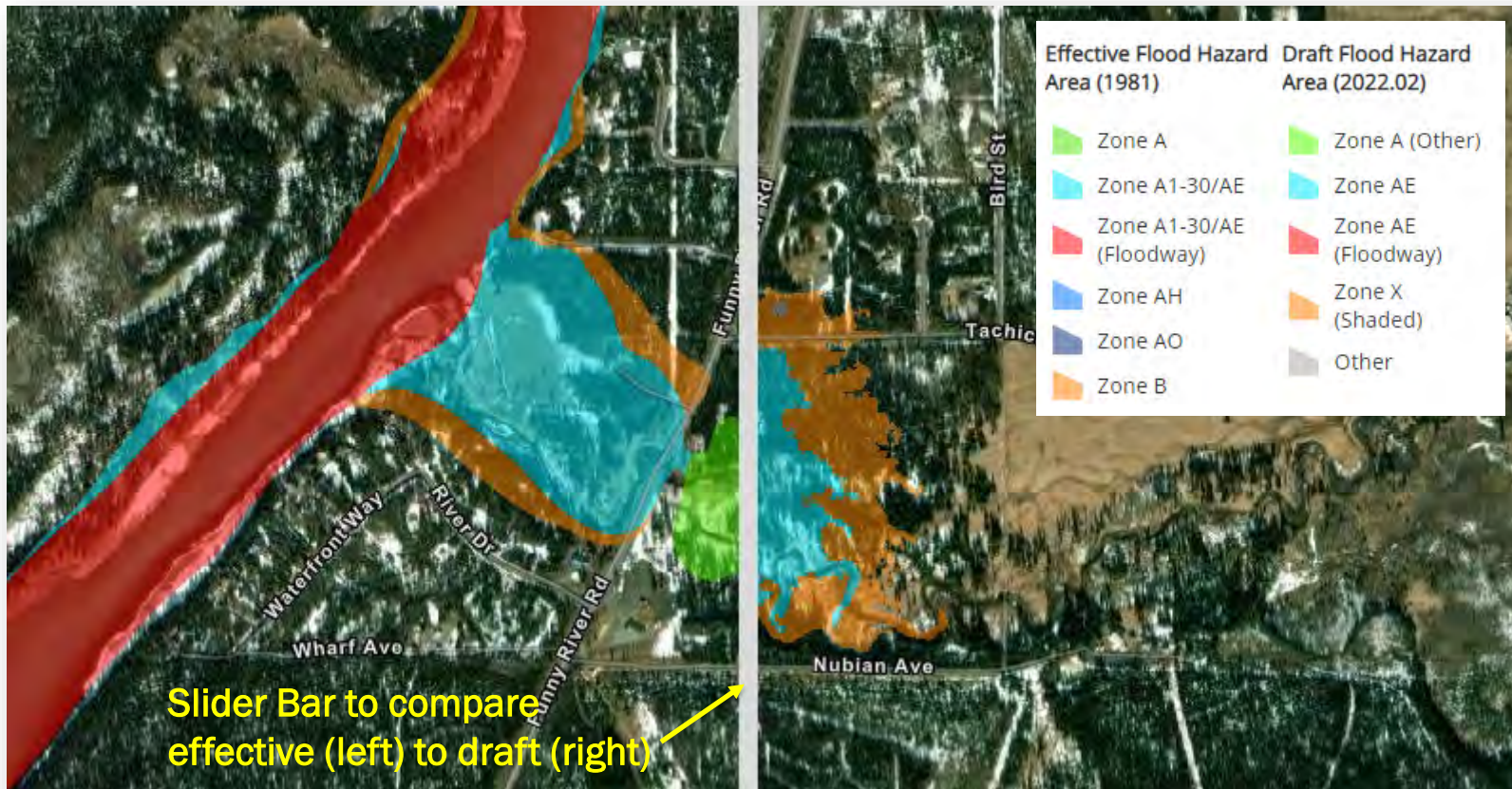


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# Reviewing the Digital Workmaps – Slide Comparison

<https://arcg.is/0On4vq>



**Zone A (Other):** Effective Zone A not updated at this time (map will remain as-is)

**Zone AE:** 1%-annual-chance event (100-yr) with Base Flood Elevations (BFE)

**Zone AE Floodway:** 1%-annual-chance event floodway with elevations

**Zone X (Shaded):** 0.2%-annual-chance event (500-yr)



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# Study Results

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
AO	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)

1981 Effective



2022 Draft



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# Study Results

1981 Effective



2022 Draft

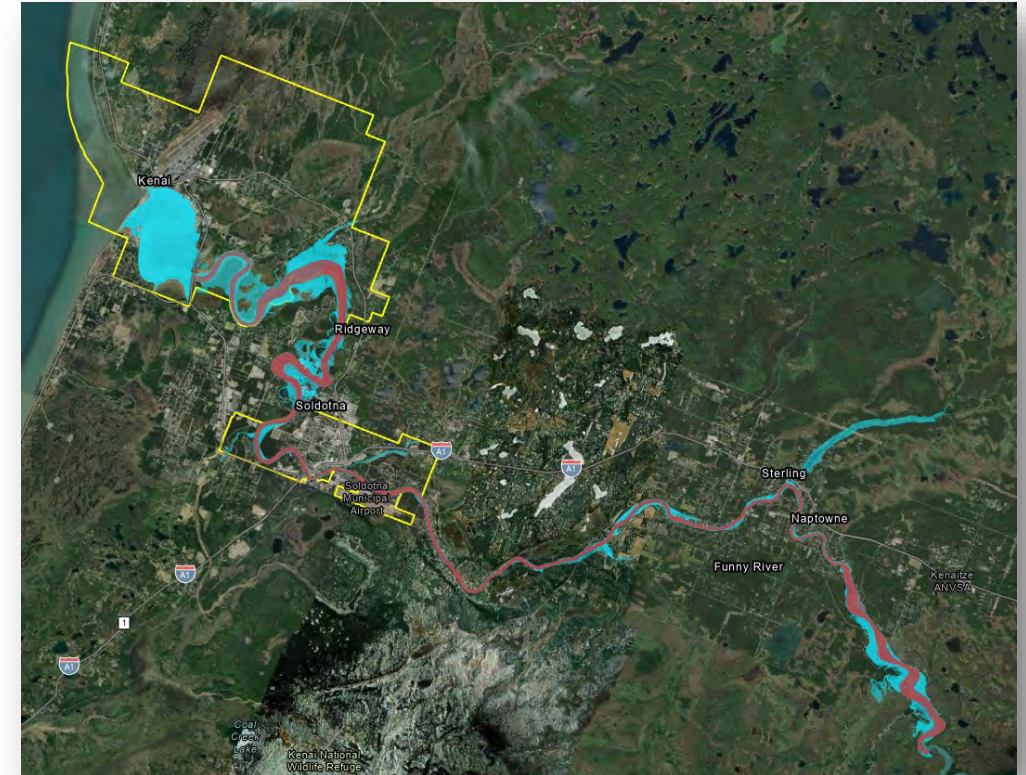


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# Special Flood Hazard Area (SFHA) - Estimated Structure Assessments

- An initial estimation of Effective vs Draft map structure assessments to assist in determining potential impacts of new SFHA areas
- Estimated building locations based on ORNL (2011) dataset
- Included Floodplain (SFHA) plus Floodway structure analysis
- “Study area” defined by 200-foot buffer beyond the Kenai River (draft + effective) floodplain areas
- Assessments can be useful to help identify overall area trends and potential “hot spot” areas of map changes
- Caveats include:
  - *All structure locations are approximate!! (auto-generated)*
  - *Does not include recent development (i.e. buildings after 2011)*
  - *Potential for missed or multiple structures on a single parcel*
  - *Many structures may be accessory buildings*



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# Structure Assessment (Estimated) Results

- Effective vs Draft Special Flood Hazard Areas (SFHA)

JURISDICTION	STRUCTURE COUNT (STUDY AREA)	IN EFFECTIVE SFHA	OUTSIDE EFFECTIVE SFHA	IN DRAFT SFHA	OUTSIDE DRAFT SFHA	PERCENT IN EFFECTIVE SFHA	PERCENT IN DRAFT SFHA	NET CHANGE
Kenai, City of	159	8	151	7	152	5%	4%	-1
Soldotna, City of	233	61	172	5	228	26%	2%	-56
Kenai, Unincorporated Areas	1796	873	923	926	870	49%	52%	53
<b>Total</b>	<b>2,186</b>	<b>942</b>	<b>1,244</b>	<b>938</b>	<b>1,248</b>	<b>43%</b>	<b>43%</b>	<b>-4</b>
JURISDICTION	STRUCTURE COUNT (STUDY AREA)	REMAINS OUTSIDE SFHA	REMAINS IN SFHA	ADDED TO SFHA	REMOVED FROM SFHA			
Kenai, City of	159	147	3	4	5			
Soldotna, City of	233	170	3	2	58			
Kenai, Unincorporated Areas	1796	763	766	160	107			
<b>Total</b>	<b>2,186</b>	<b>1,078</b>	<b>772</b>	<b>166</b>	<b>170</b>			

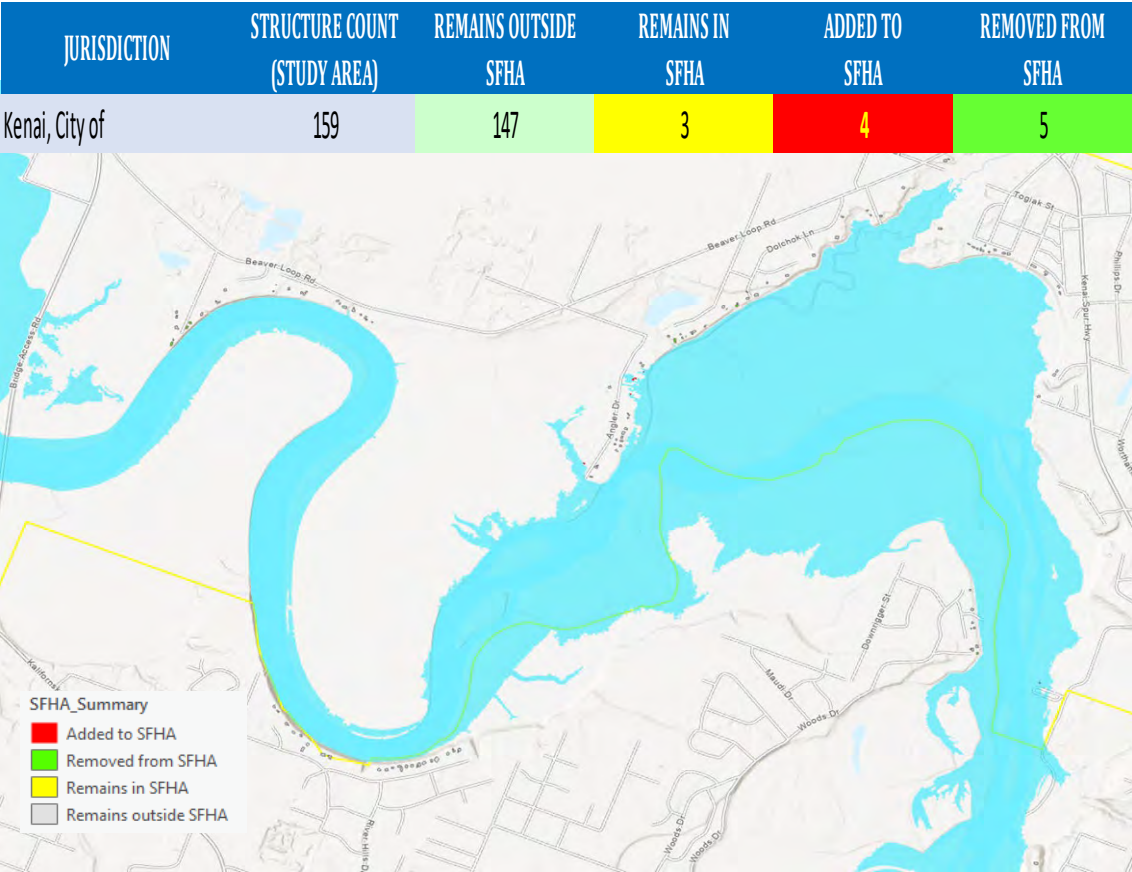
- Effective vs Draft Floodway

JURISDICTION	STRUCTURE COUNT (STUDY AREA)	IN EFFECTIVE FLOODWAY	OUTSIDE EFFECTIVE FLOODWAY	IN DRAFT FLOODWAY	OUTSIDE DRAFT FLOODWAY	PERCENT IN EFFECTIVE FLOODWAY	PERCENT IN DRAFT FLOODWAY	NET CHANGE
Kenai, City of	159	0	159	1	158	0%	1%	1
Soldotna, City of	233	40	193	0	233	17%	0%	-40
Kenai, Unincorporated Areas	1796	253	1,543	237	1559	14%	13%	-16
<b>Total</b>	<b>2,186</b>	<b>293</b>	<b>1,893</b>	<b>238</b>	<b>1,948</b>	<b>13%</b>	<b>11%</b>	<b>-55</b>
JURISDICTION	PARCEL COUNT (STUDY AREA)	REMAINS OUTSIDE FLOODWAY	REMAINS IN FLOODWAY	ADDED TO FLOODWAY	REMOVED FROM FLOODWAY			
Kenai, City of	159	158	0	1	0			
Soldotna, City of	233	193	0	0	40			
Kenai, Unincorporated Areas	1796	1429	123	114	130			
<b>Total</b>	<b>2,186</b>	<b>1778</b>	<b>123</b>	<b>115</b>	<b>170</b>			

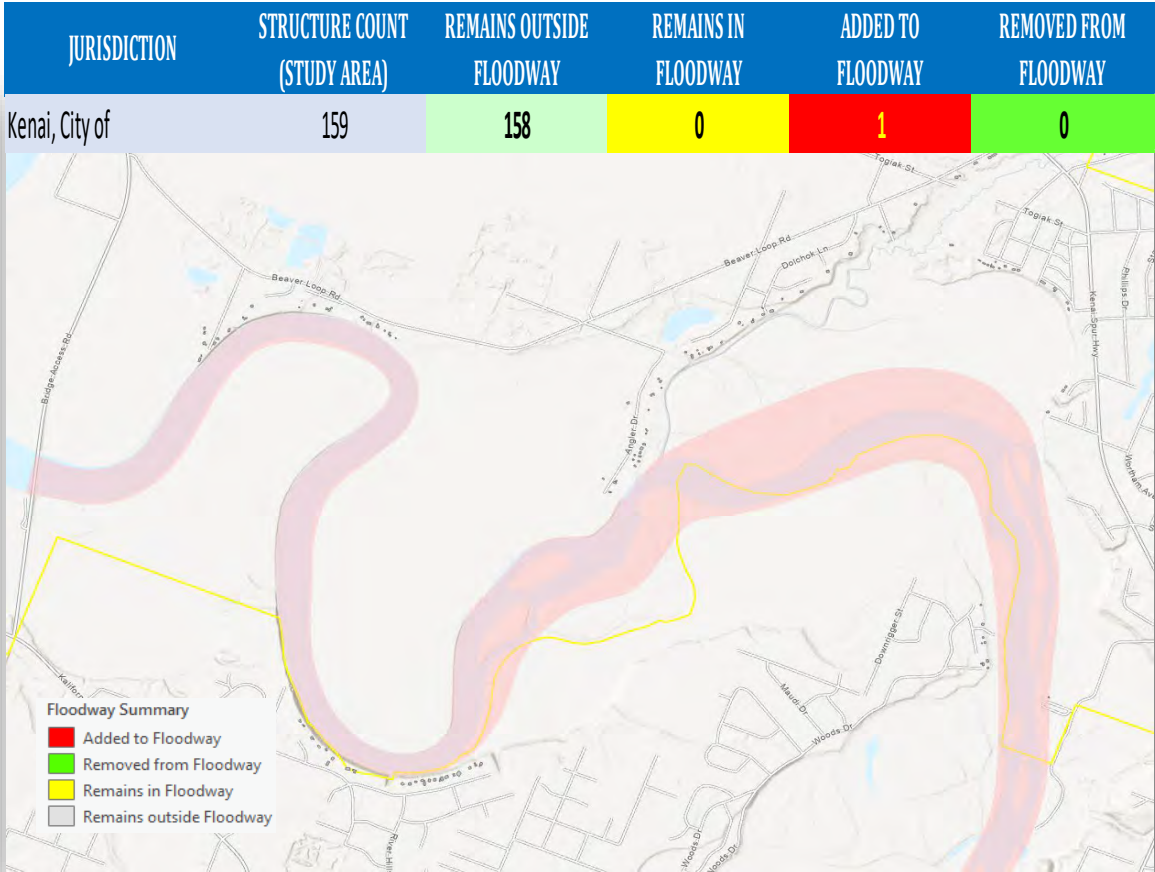


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# Structure Assessment (Estimated) – City of Kenai



Draft Special Flood Hazard Area (SFHA)



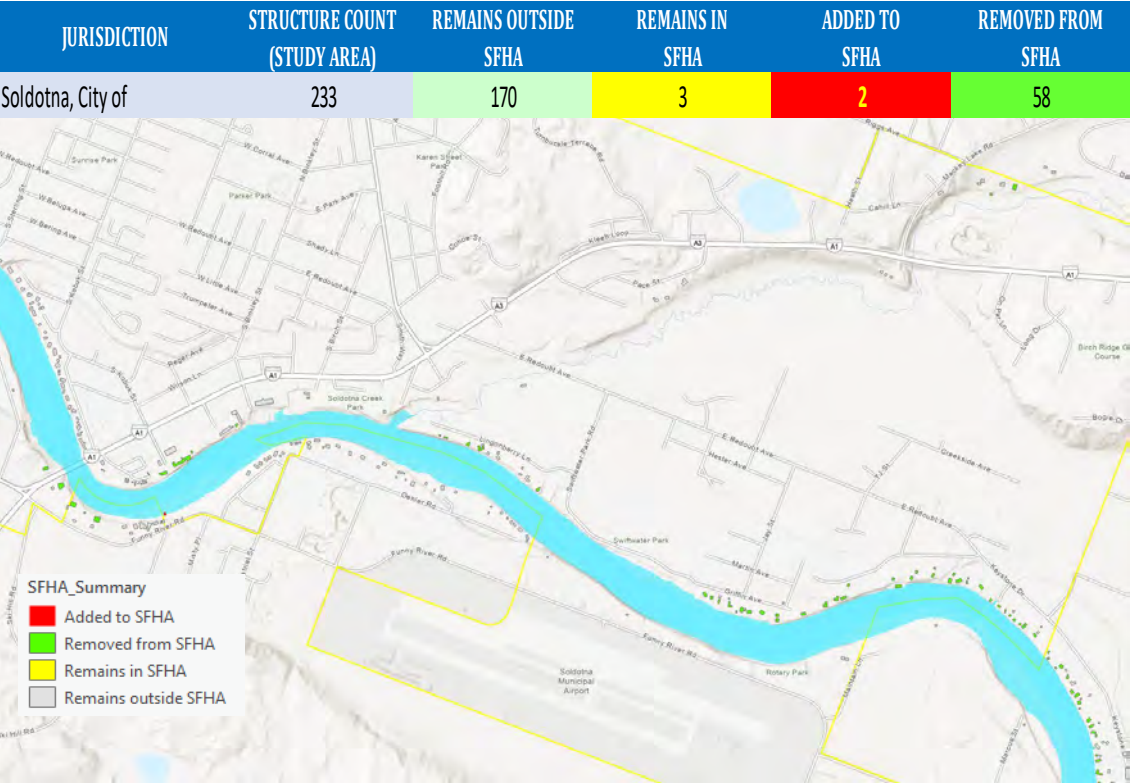
Draft Floodway



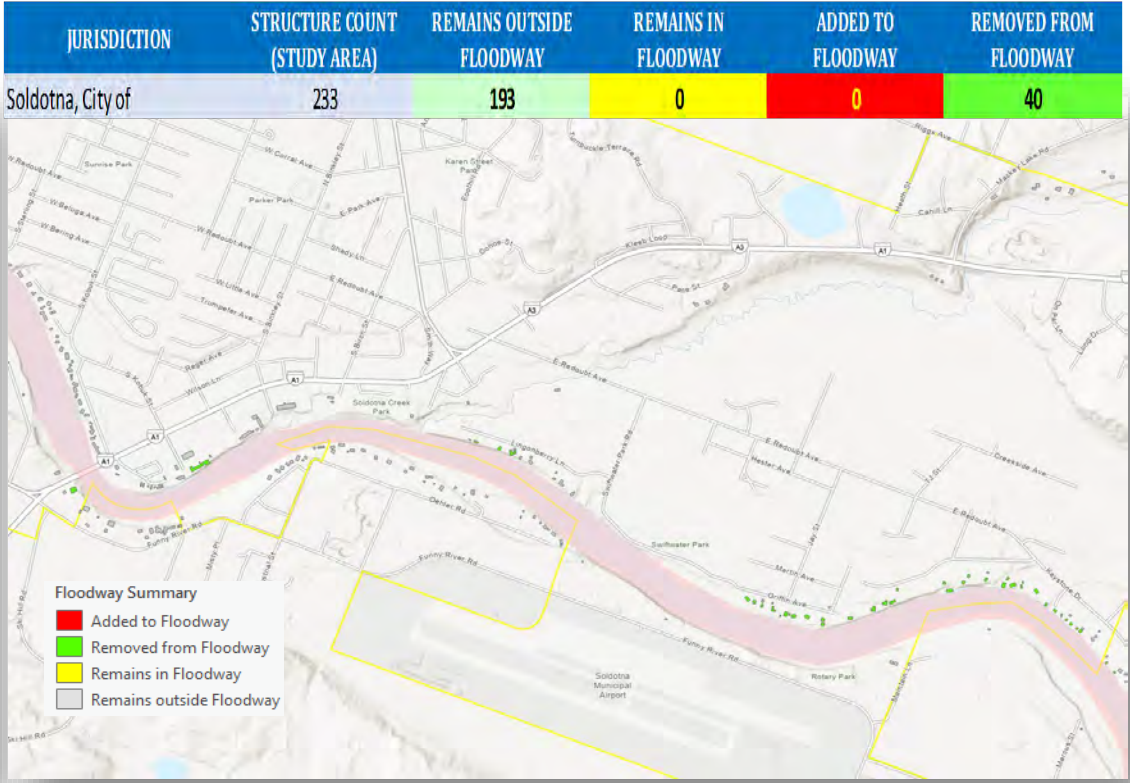
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# Structure Assessment (Estimated) – City of Soldotna



Draft Special Flood Hazard Area (SFHA)



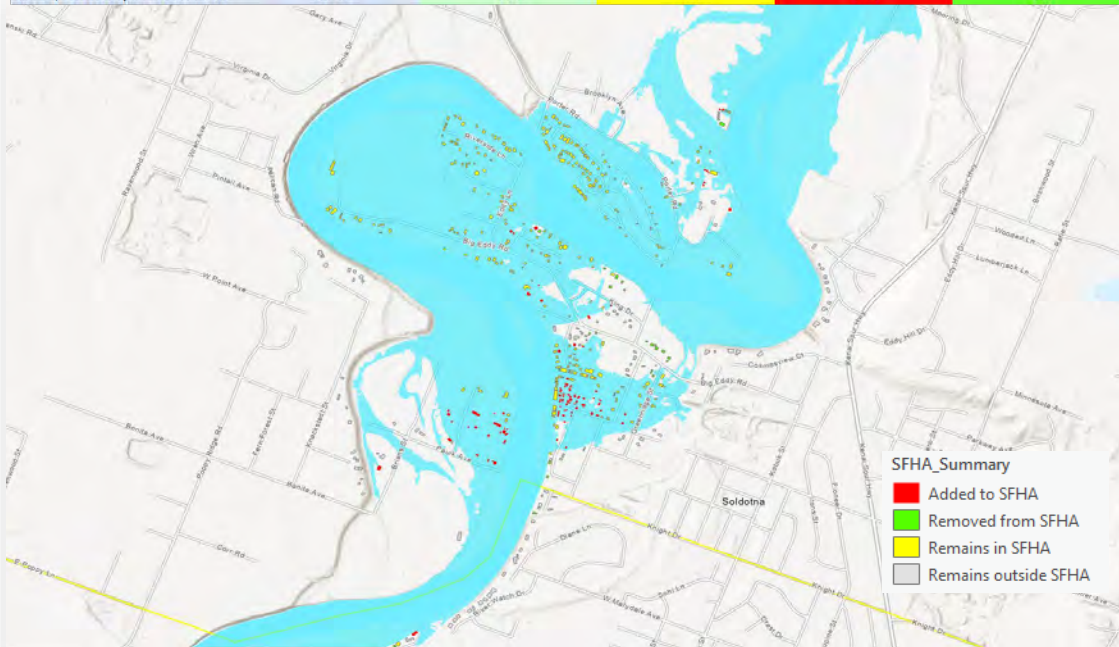
Draft Floodway



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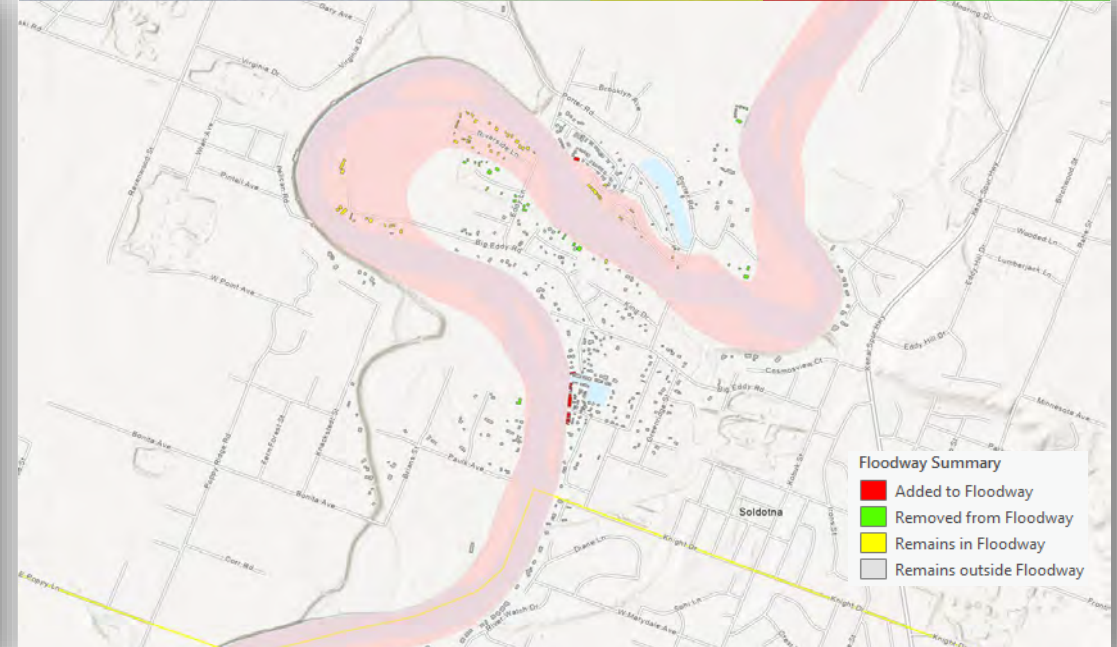
# Structure Assessment (Estimated) – Unincorporated Areas

JURISDICTION	STRUCTURE COUNT (STUDY AREA)	REMAINS OUTSIDE SFHA	REMAINS IN SFHA	ADDED TO SFHA	REMOVED FROM SFHA
Kenai, Unincorporated Areas	1796	763	766	160	107



*Draft Special Flood Hazard Area (SFHA) – Soldotna to Kenai*

JURISDICTION	STRUCTURE COUNT (STUDY AREA)	REMAINS OUTSIDE FLOODWAY	REMAINS IN FLOODWAY	ADDED TO FLOODWAY	REMOVED FROM FLOODWAY
Kenai, Unincorporated Areas	1796	1429	123	114	130



*Draft Floodway – Soldotna to Kenai*

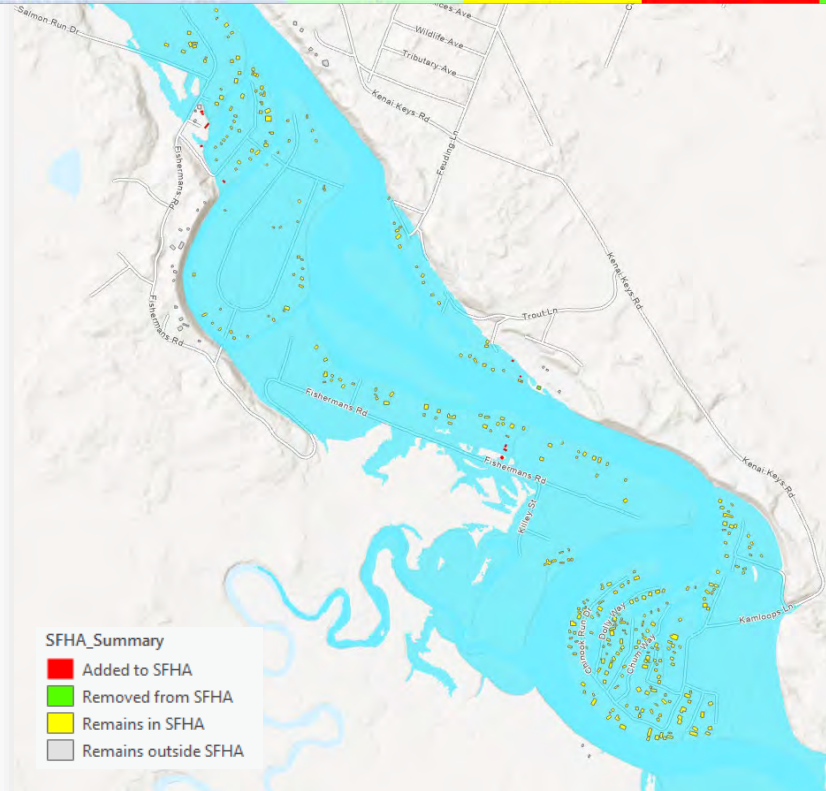


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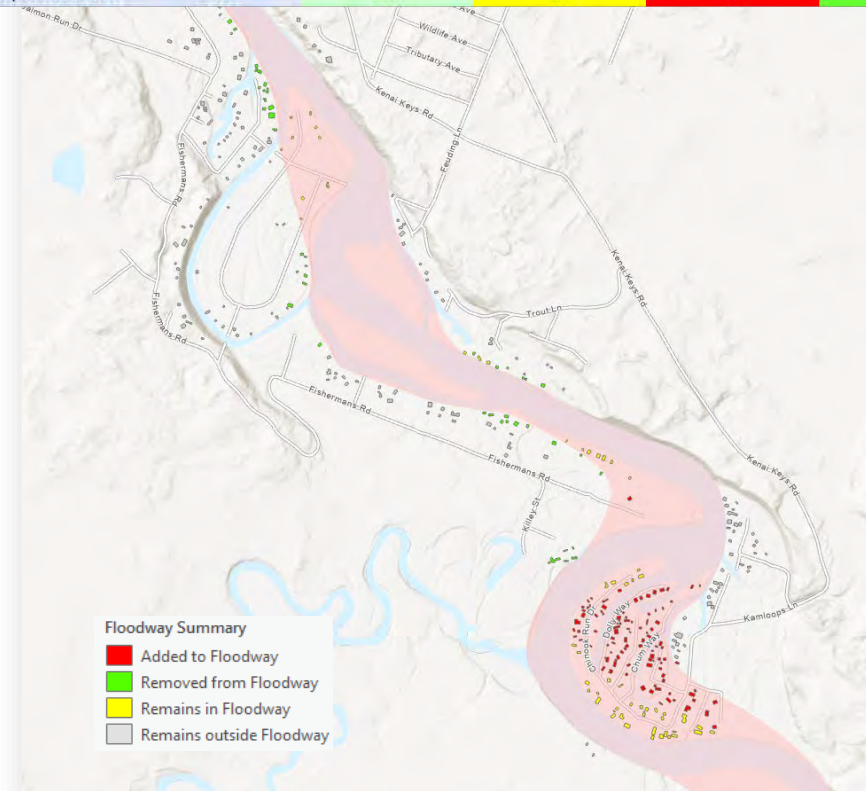
# Structure Assessment (Estimated) – Unincorporated Areas

JURISDICTION	STRUCTURE COUNT (STUDY AREA)	REMAINS OUTSIDE SFHA	REMAINS IN SFHA	ADDED TO SFHA	REMOVED FROM SFHA
Kenai, Unincorporated Areas	1796	763	766	160	107



*Draft Special Flood Hazard Area (SFHA) – near Killey River*

JURISDICTION	STRUCTURE COUNT (STUDY AREA)	REMAINS OUTSIDE FLOODWAY	REMAINS IN FLOODWAY	ADDED TO FLOODWAY	REMOVED FROM FLOODWAY
Kenai, Unincorporated Areas	1796	1429	123	114	130



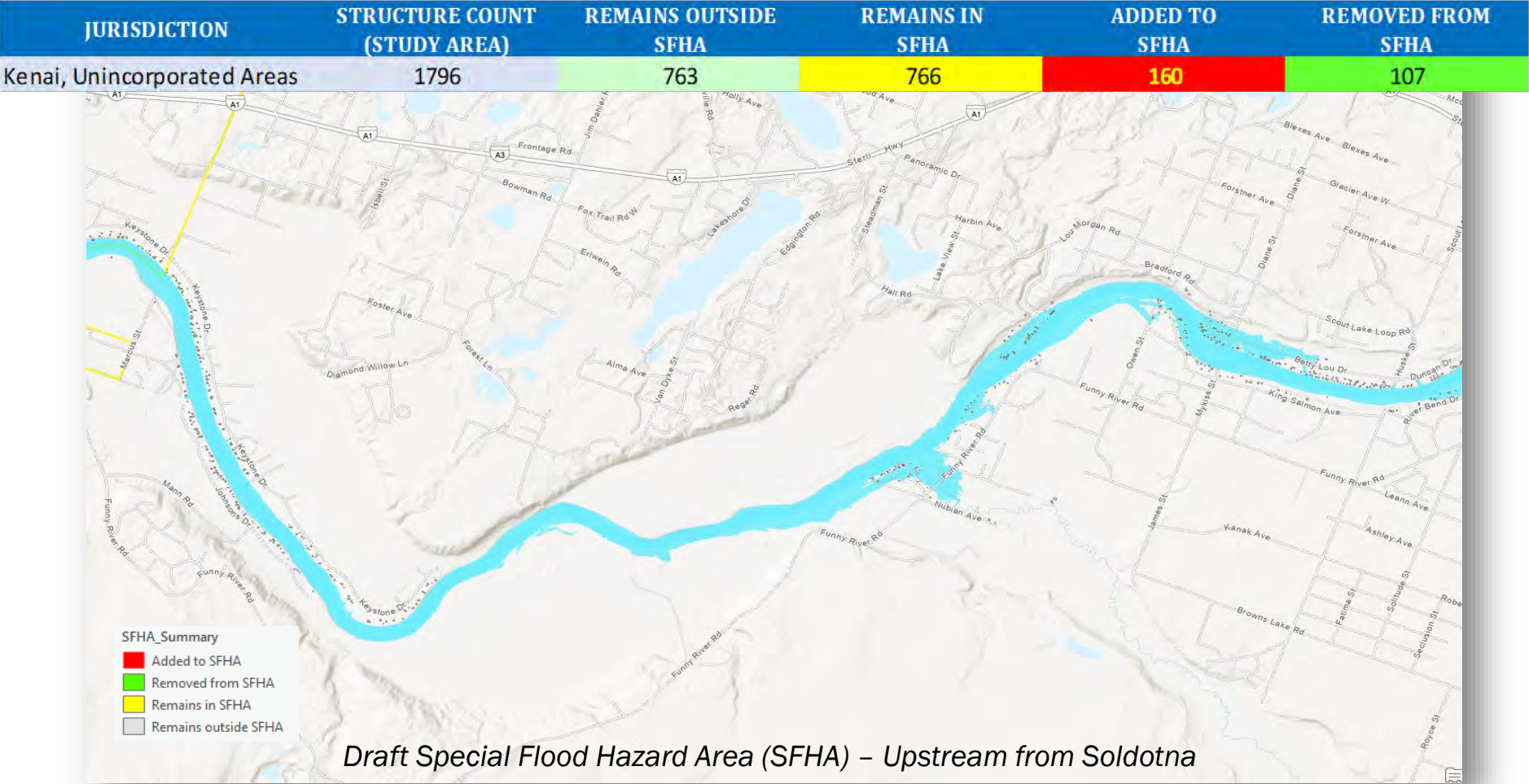
*Draft Floodway – near Killey River*



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# Structure Assessment (Estimated) – Unincorporated Areas



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# Additional Support

- Based on Risk MAP community needs, FEMA can support additional understanding of flood risk and other hazard needs through **data acquisition, hazard mapping, risk assessments, modeling of mitigation scenarios, and planning support.**
- Recent examples:
  - *LiDAR acquisition for City of Homer*
  - *Landslide and Bluff Stability studies for City of Homer*
  - *2018 Risk Assessment (Kenai Peninsula Borough)*
- Data can be integrated into plans, inform mitigation opportunities, and be a part of a broader **Resilience Workshop** conversation.



For details and links, see the KPB Risk MAP Portfolio:

<https://arcg.is/11q0PX0>



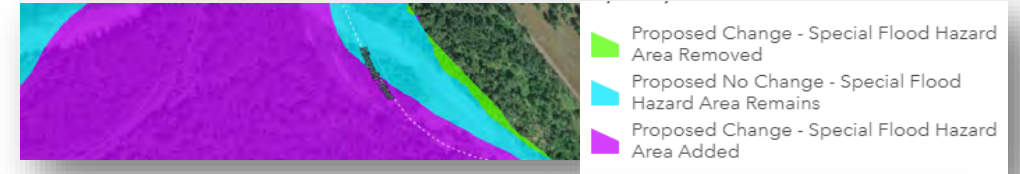
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# Coming Soon: Non-Regulatory Flood Risk Products (FRPs)

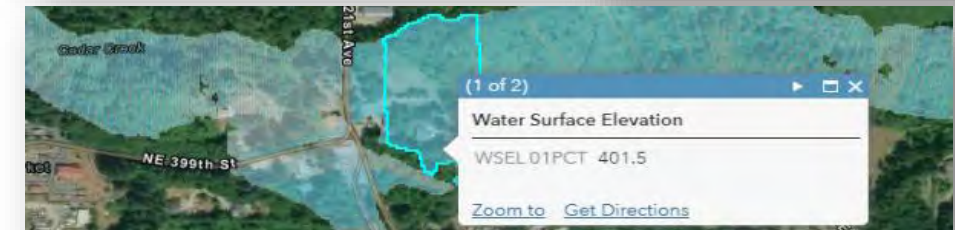
## Changes Since Last FIRM

Identifies areas where flood risk has increased, decreased, or remained the same.



## Water Surface Elevation Grid

Water Surface Elevation Grids provide a way to find flood elevations for the entire floodplain.



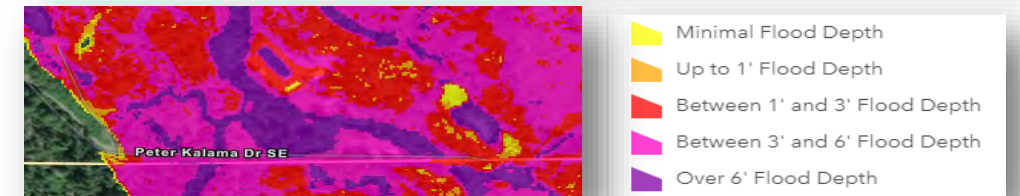
## Plus Grid

Plus Grids display exposure to a flood event, assuming there is a 1-, 2-, or 3-foot rise relative to the 1% annual chance water surface elevation.



## Flood Depth Grid

Flood Depth Grids illustrate the flood depth, in feet above the ground surface, to demonstrate the variability of flood depths in floodprone areas.



FEMA

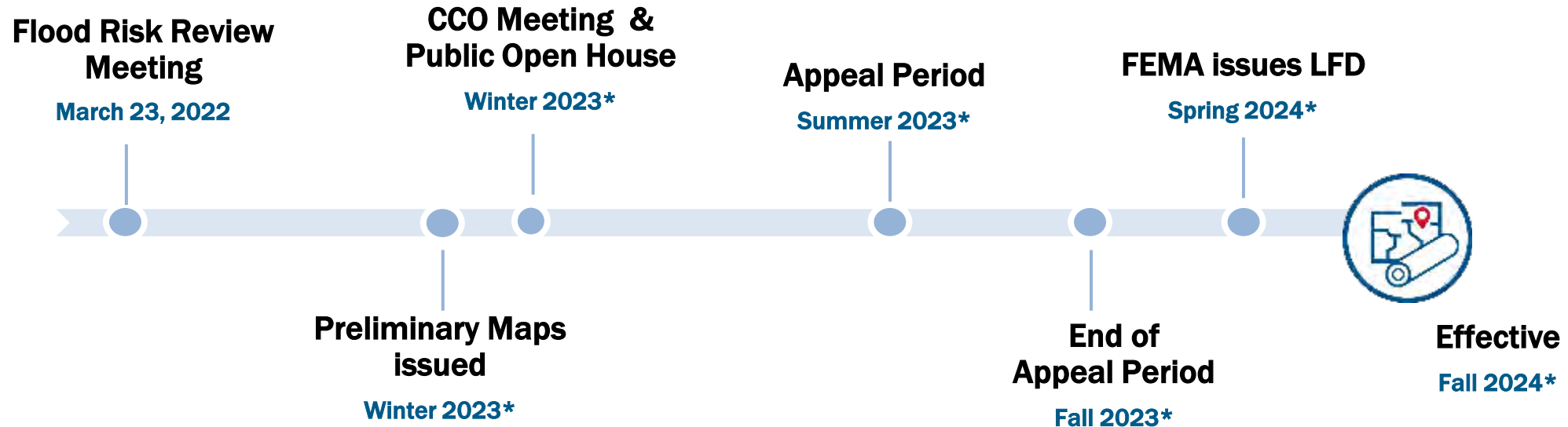


# Project Timelines Toward Map Adoption

## “Letter of Final Determination”

To communities and publishes the BFEs in the Federal Register

Communities have 6 months to adopt the study before the data becomes “effective”. Failure to adopt results in suspension from NFIP

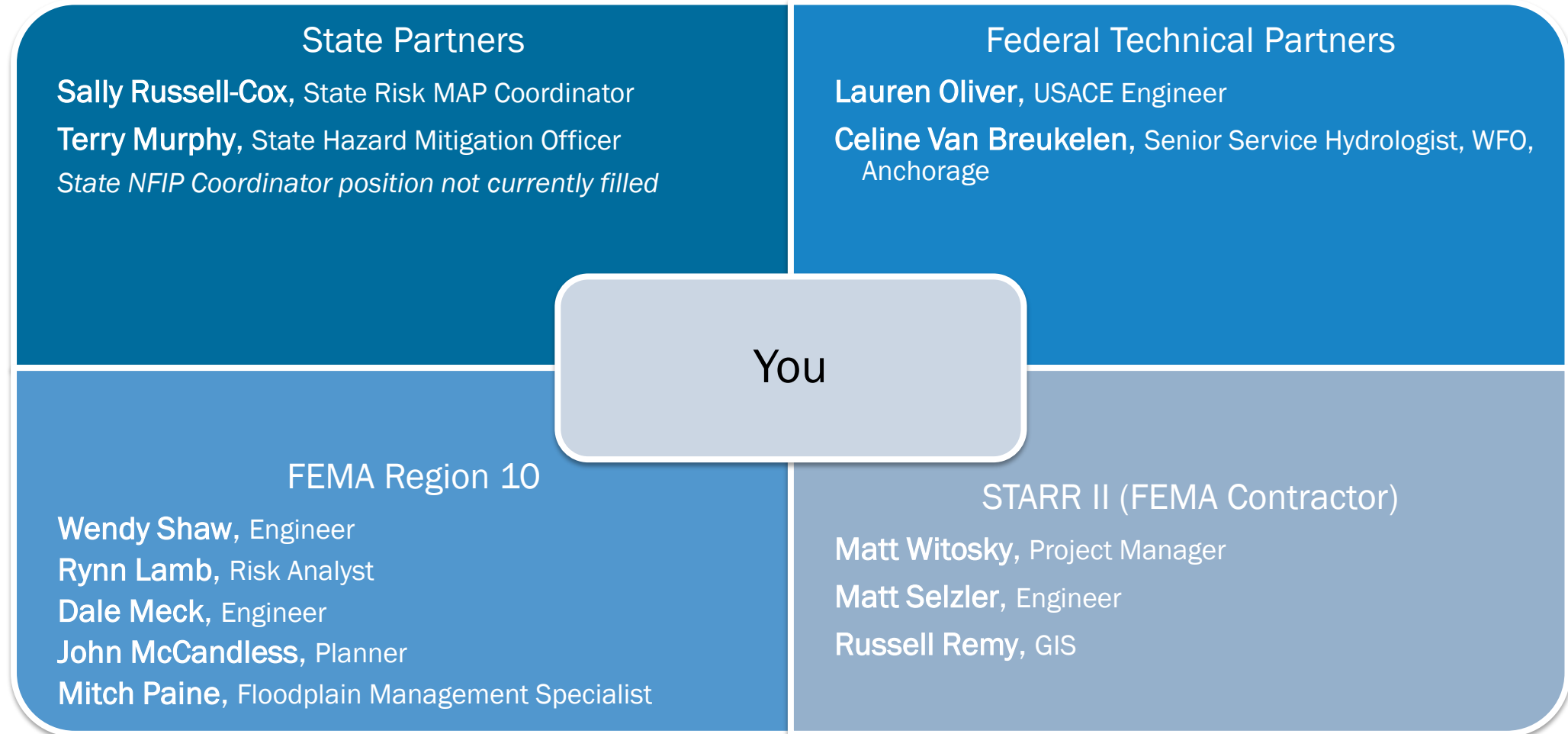


\* Dates estimated



# FEMA

# Risk MAP Team



# FEMA



# Review Questions

- ☐ Are the new or revised floodplains consistent with your local knowledge of the flooding sources?
- ☐ Is water going somewhere it physically can not go?
- ☐ Are important map elements missing (roads, structures, bridges, culvert, etc.)?
- ☐ Are streams and significant features labeled correctly

Submit comments by April 22, 2022 to:

Wendy Shaw, FEMA Region 10, [wendy.shaw@fema.dhs.gov](mailto:wendy.shaw@fema.dhs.gov)



# Hazard Mitigation Planning in the Kenai Peninsula Borough

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- 2019 Flood & Erosion Mitigation Ideas: Protection Goals (Table 2.39)
  - ✓ Limit or minimize flooding effects in the Borough
  - ✓ Identify at-risk populations
  - ✓ Identify, enhance and utilize existing resources
  - Improve KPB Roads
  - ✓ Improve floodplain management
  - Minimize coastal erosion
- 2019 Flood & Erosion Mitigation Ideas: Prevention Goals (Table 2.40)
  - ✓ Prevent or limit flood damage in the Borough
  - ✓ Improve the KPB CRS Rating
  - ✓ Identify priority projects and areas
  - ✓ Project coordination
- 2019 Flood & Erosion Mitigation Ideas: Education Goals (Table 2.41)
  - ✓ Use each hazard event as an educational activity
  - ✓ Encourage participation from the public