Mapping “Natural” Floodplains: An Engineering Perspective

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Natural Floodplain Function Alliance Webinar
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Agenda

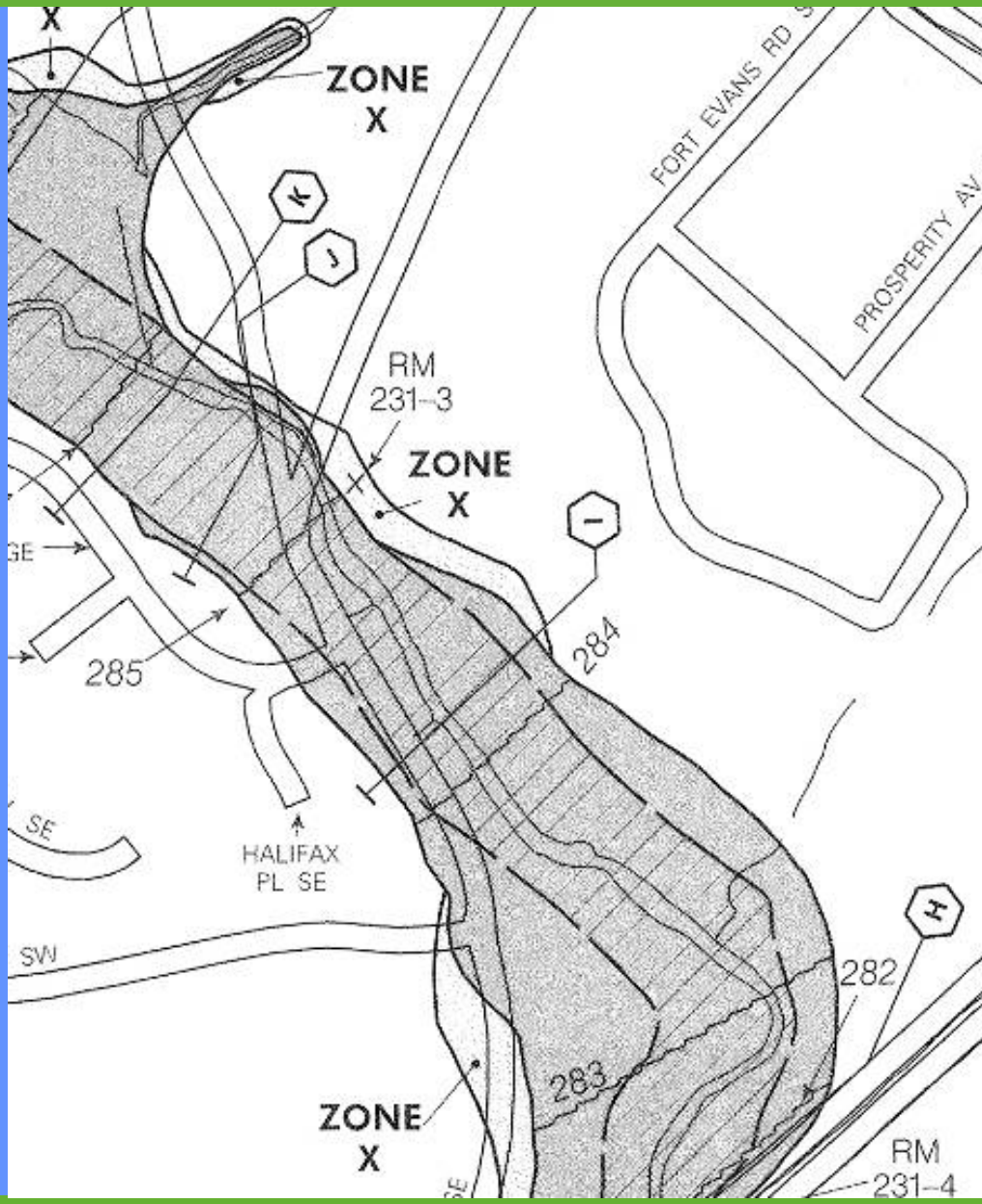
- My questions in 2002
- Limitations of FEMA floodplains
- Mapping “geomorphic” floodplains in 2002
- Mapping “natural” floodplains in 2013
- Mapping other floodplain features
- Findings
- Recommendations
- Your questions?

My Questions in 2002

- *Is there a way to visualize the natural expression of flooding across the landscape, ignoring the land cover disruptions caused by human interventions?*
- *If so, how do you delineate these "natural" floodplains?*
- *How would these "natural" floodplains compare and contrast to the floodplains mapped by FEMA?*

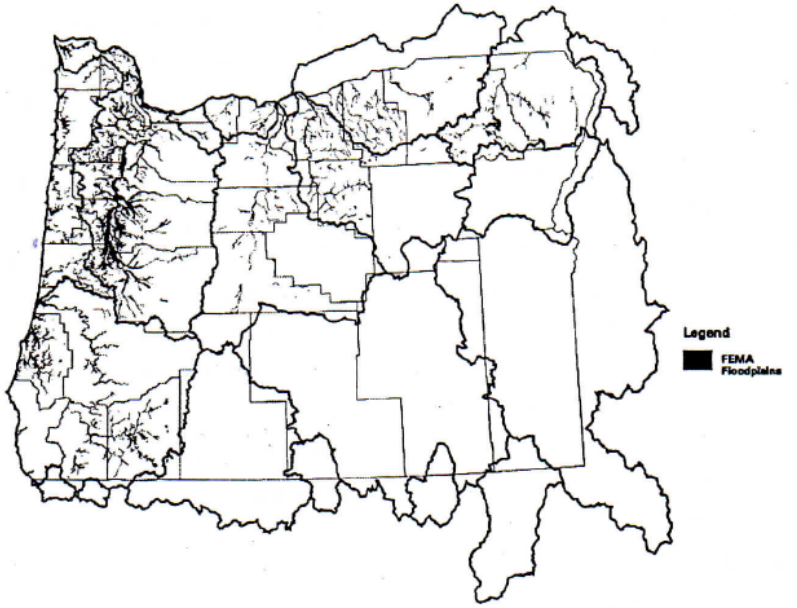
Limitations of FEMA Floodplains

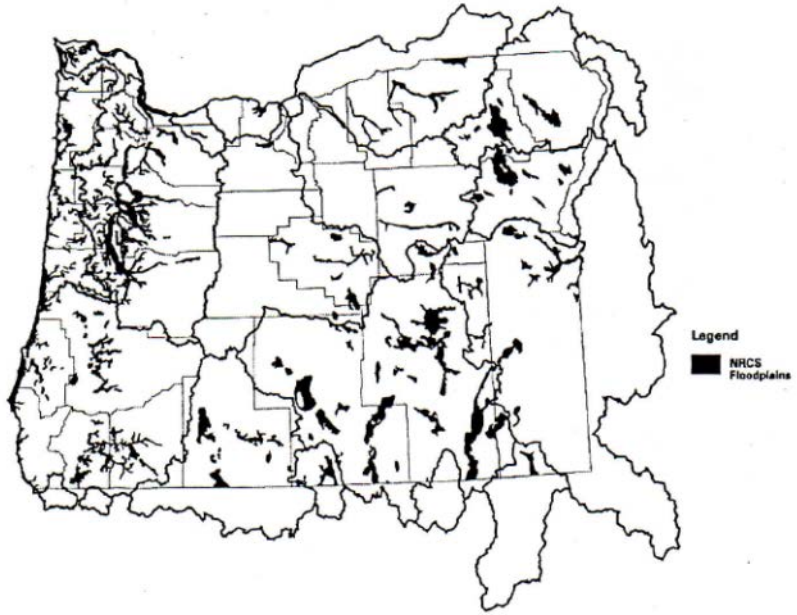
- There are about 3.5 million square miles of FEMA A, V, and Shaded X Zones in the U.S.
- FEMA floodplains are focused in areas with population and insurable properties.
- FEMA Flood Insurance Study (FIS) reports have flood profiles showing 10-, 50-, 100-, and 500-year flood elevations; however, only the 100- and 500-year floodplains are mapped.



Mapping “Geomorphic” Floodplains in 2002

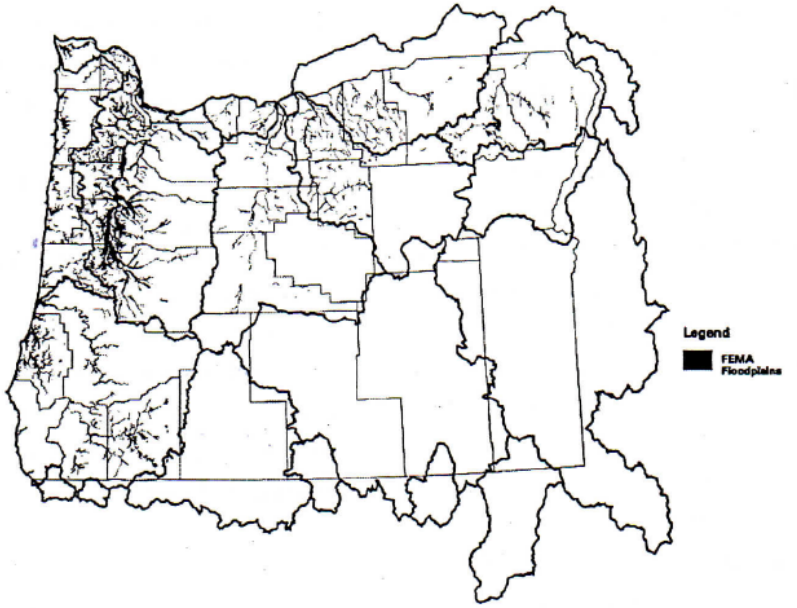
- “Geomorphic” floodplains can be defined by soils subject to flooding.
- Soils data were retrieved from State Soil Geographic Data Base (STATSGO) derived from 1:250,000 scale soils maps.
- These data are coarse and for planning purposes only; i.e., for use above the county level.

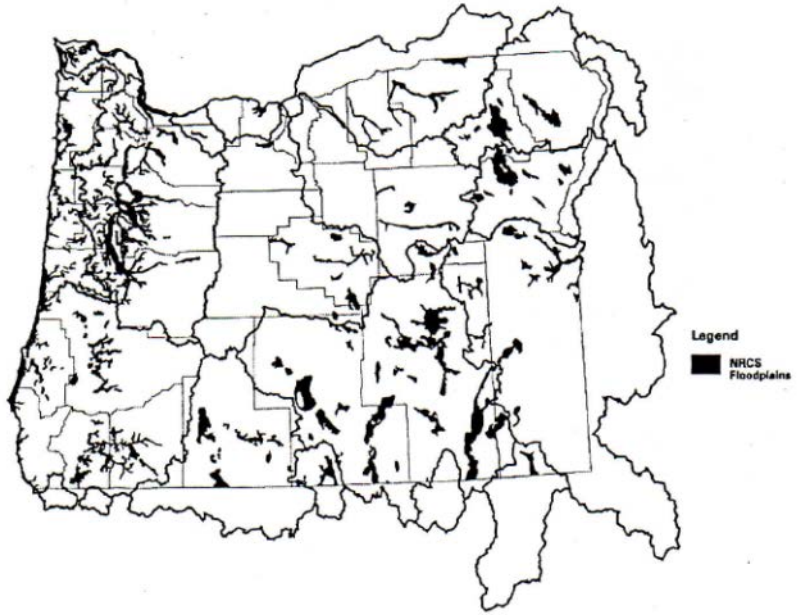




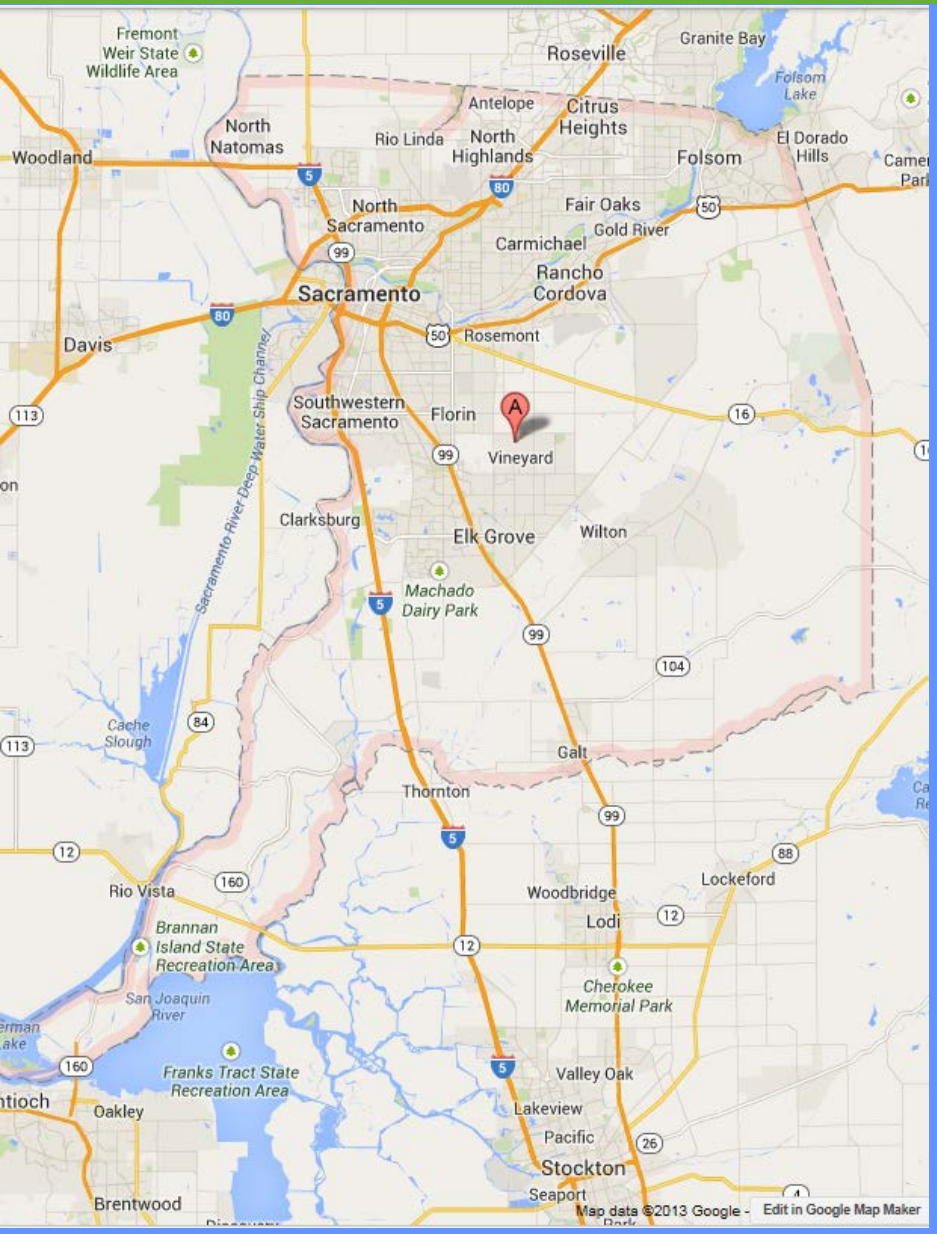
Mapping "Geomorphic" Floodplains in 2002

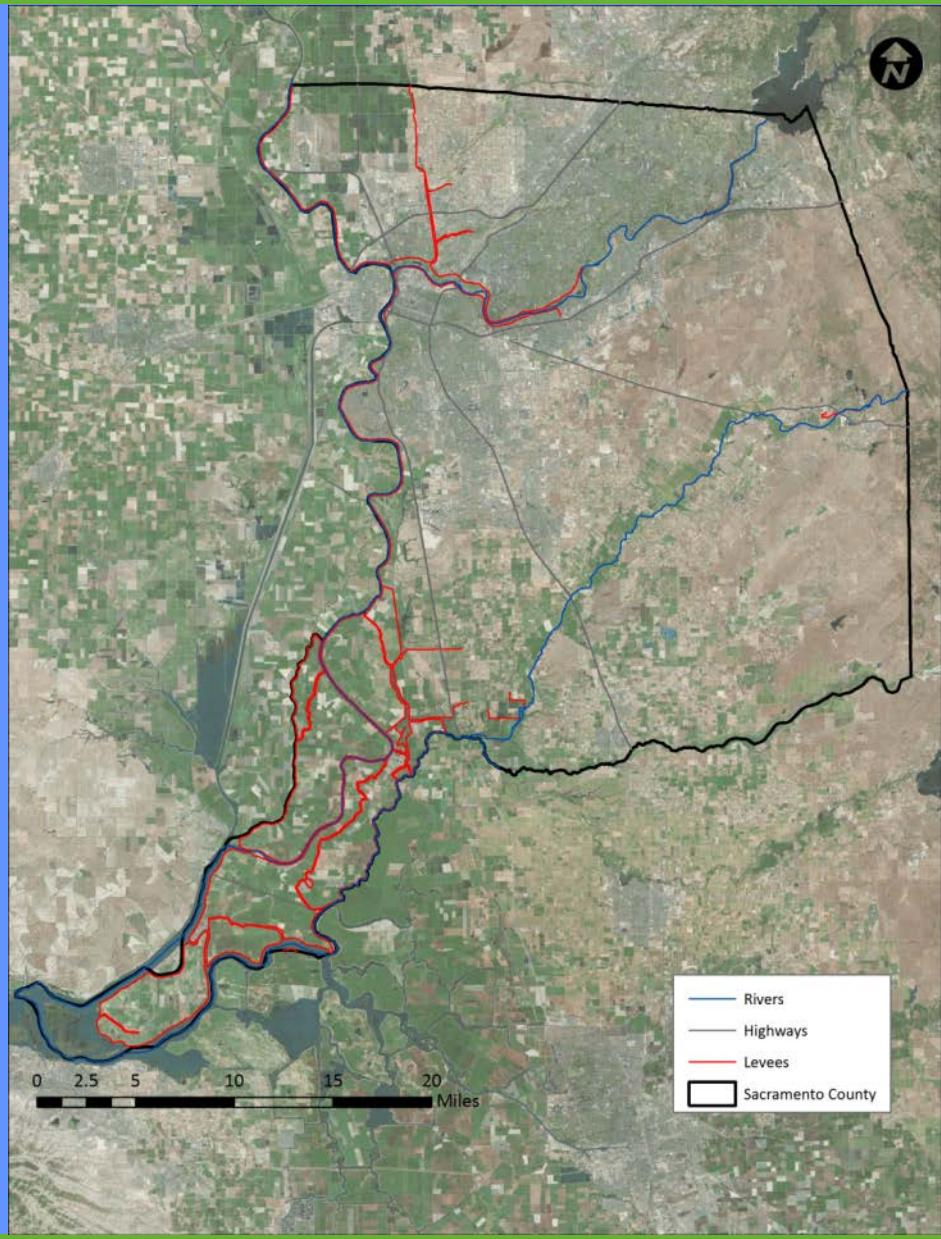
- Geomorphic floodplains delineated based on map units with 10% or more of the soils subject to rare, occasional , or frequent flooding.
- Reference *Development of an Integrated River Management Strategy* available at: http://yosemite.epa.gov/R10/ecocomm.nsf/webpage/Tillamook+Bay+Integrated+River+Management+Strategy





Mapping “Natural” Floodplains in 2013





NRCS Soils Data

- STATSGO data are compiled from 1:250,000 scale soils maps and are appropriate for state-wide applications but is not precise enough for counties.
- SSURGO data are compiled from 1:12,000 to 1:63,360 scale soils maps and are appropriate for county-level
- SSURGO data were obtained from the Web Soil Survey.

http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

FEMA Flood Zone Data

- Flood zones are geographic areas that FEMA has defined according to varying levels of flood risk.
- These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. Each zone reflects the severity or type of flooding in the area.
- This study focused on A Zones (100-year) and Shaded X Zones (500-year).

Moderate to Low Risk Areas

In communities that participate in the NFIP, flood insurance is available to all property owners and renters in these zones:

ZONE	DESCRIPTION
B and X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. Are also used to designate base floodplains of lesser hazards, such as areas protected by levees from 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.
C and X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level.

High Risk Areas

In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to all of these zones:

ZONE	DESCRIPTION
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
AE	The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
A1-30	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
AO	River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
A99	Areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.

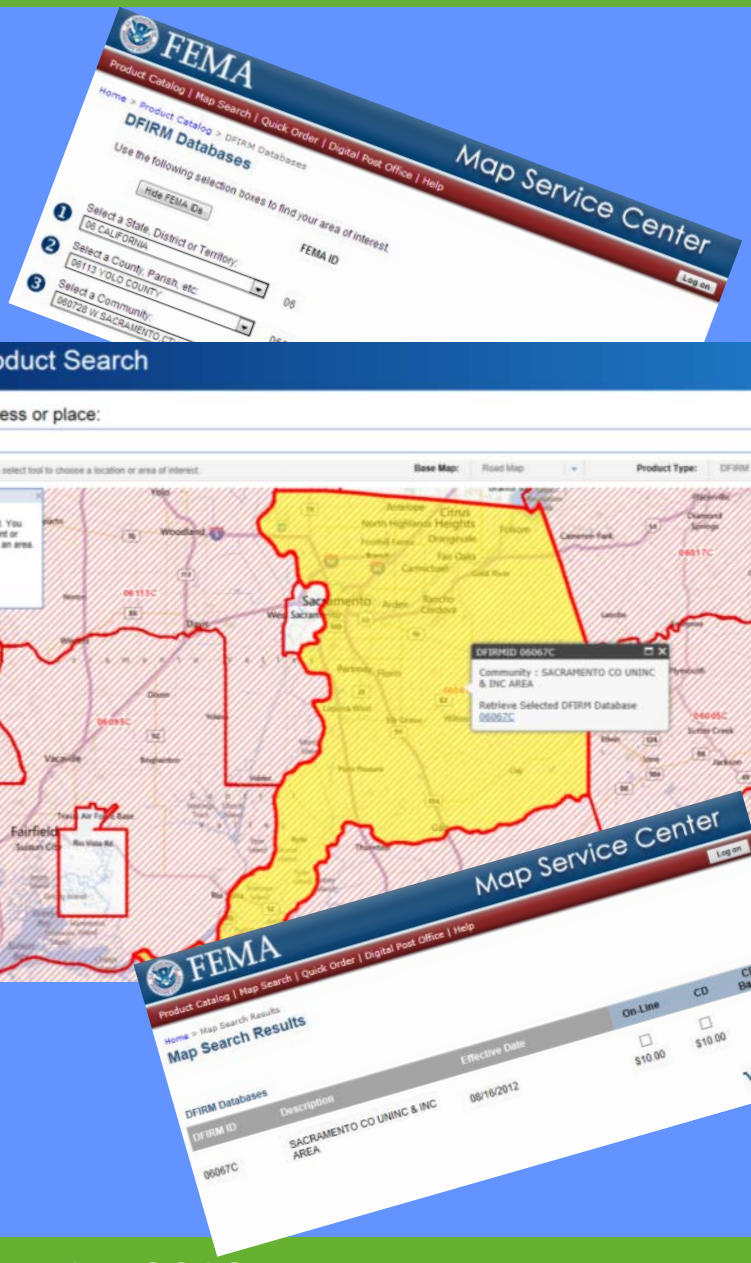
High Risk - Coastal Areas

In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to all of these zones:

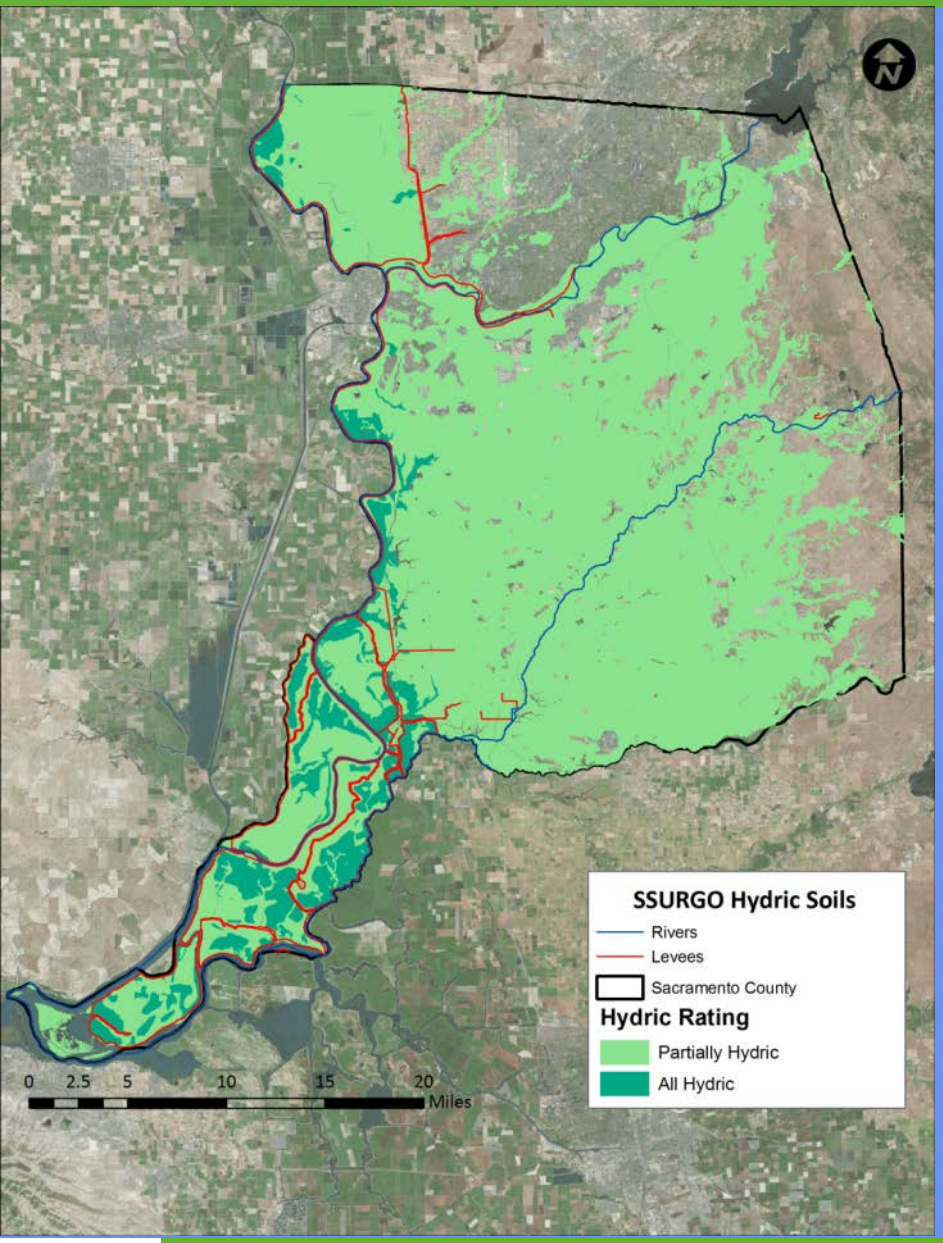
ZONE	DESCRIPTION
V	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. No base flood elevations are shown within these zones.
VE, V1 - 30	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

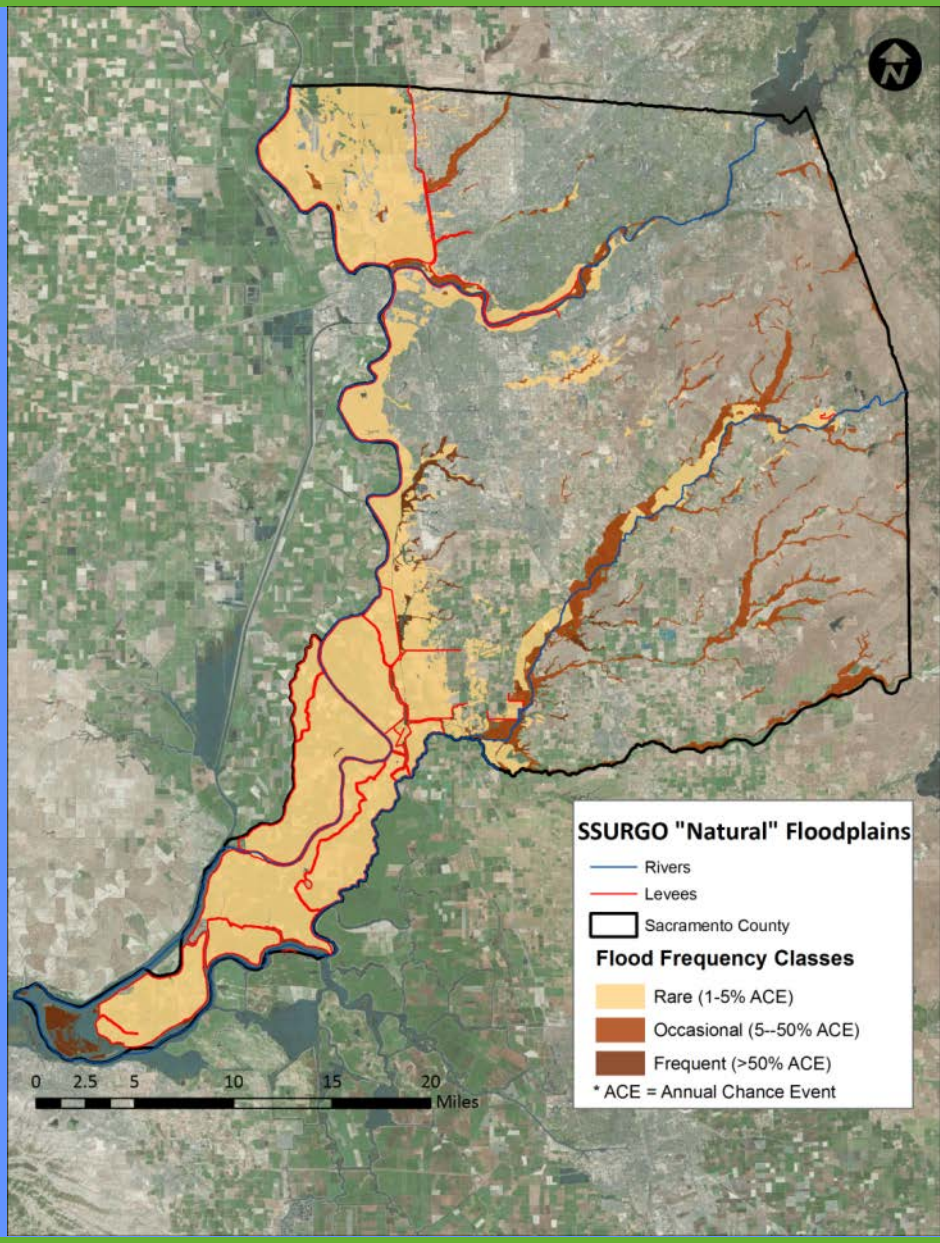
FEMA Flood Zone Data

- FEMA DFIRM (Digital Flood Insurance Rate Map) data were obtained from the Map Service Center (MSC) at https://msc.fema.gov.
- DFIRMs provide a digital version of the FEMA flood insurance rate map that is designed for use with digital mapping and analysis software.
- FEMA DFIRM data can be downloaded by U.S. county.

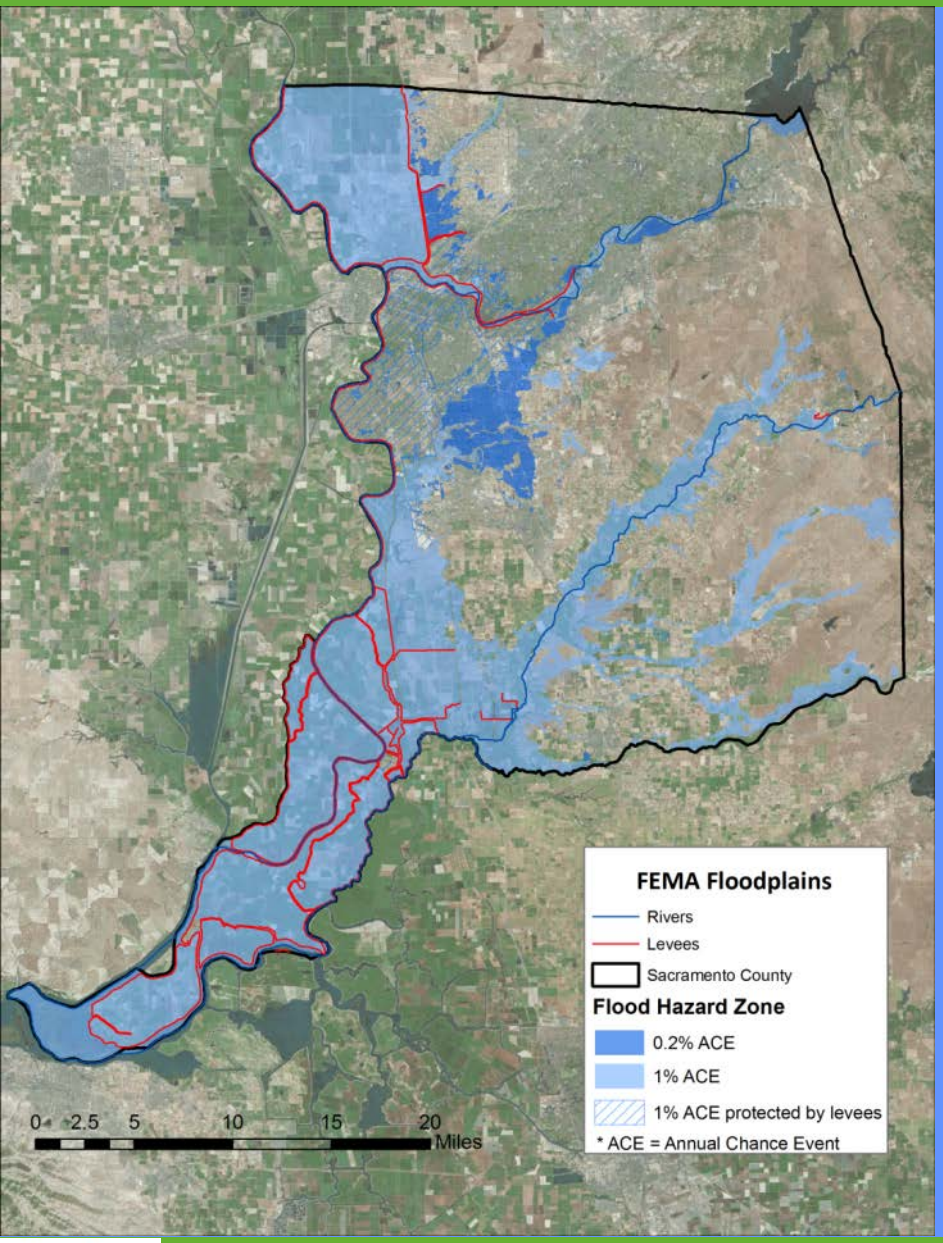


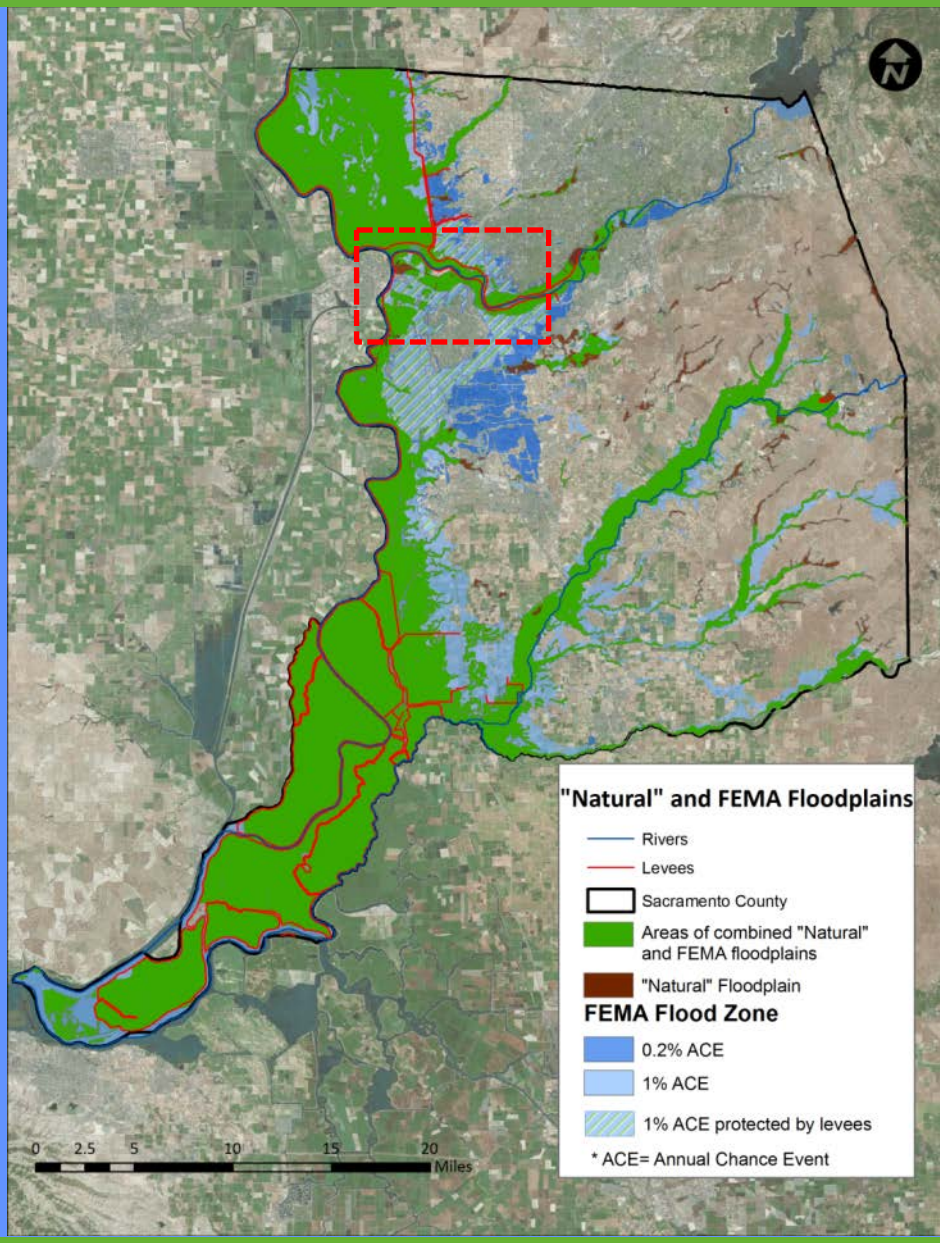
Sacramento County Soils Data



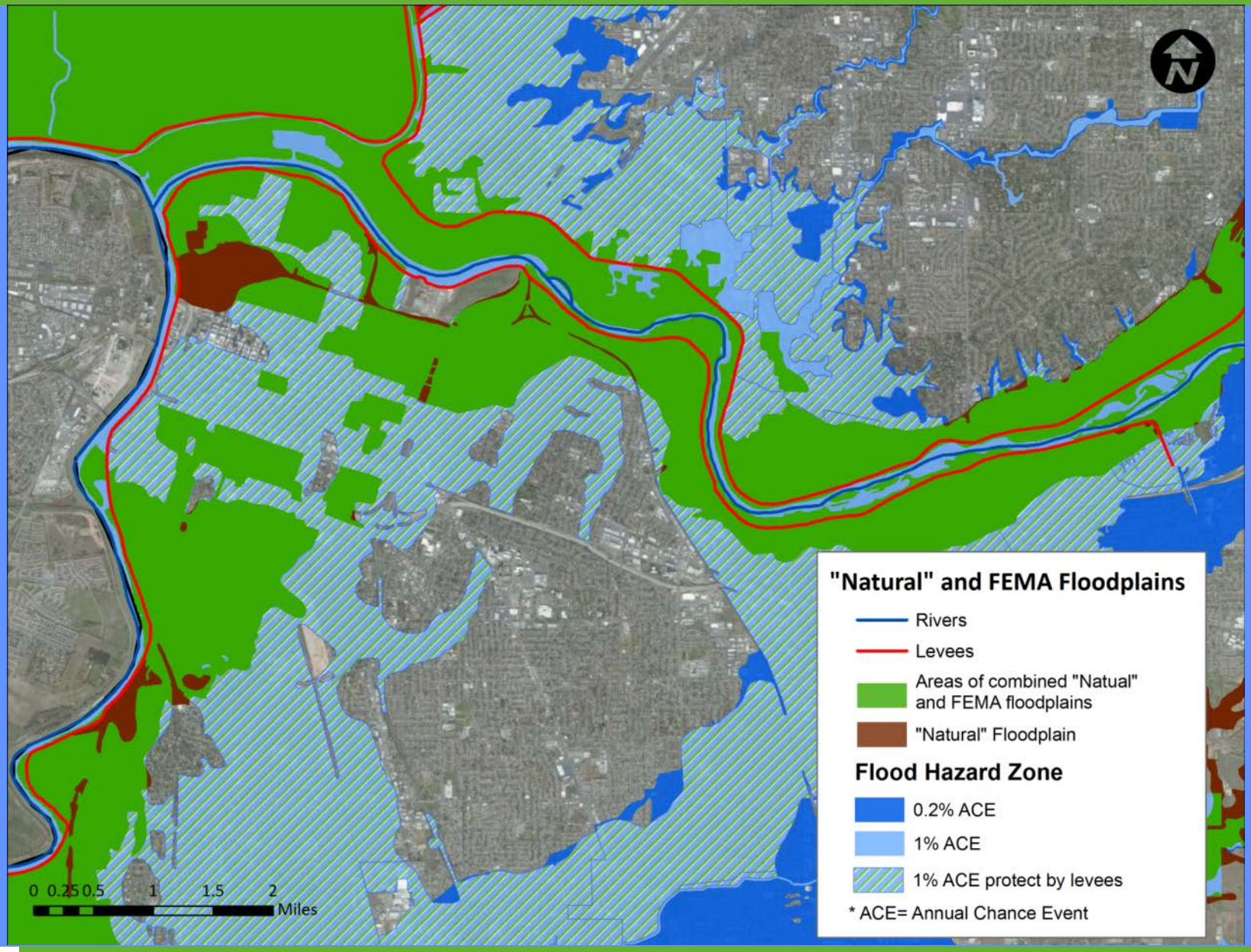


Sacramento County Floodplain Data

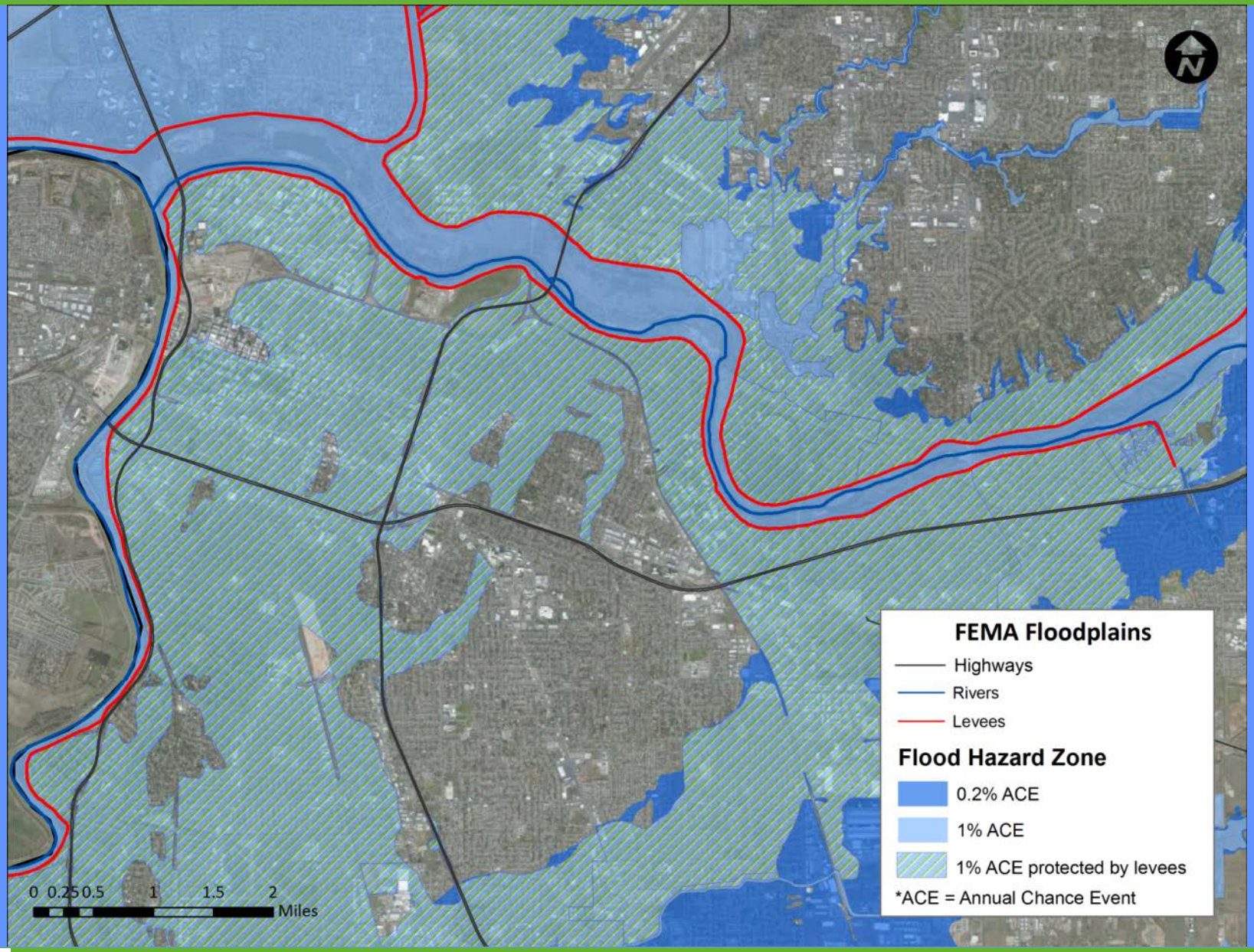




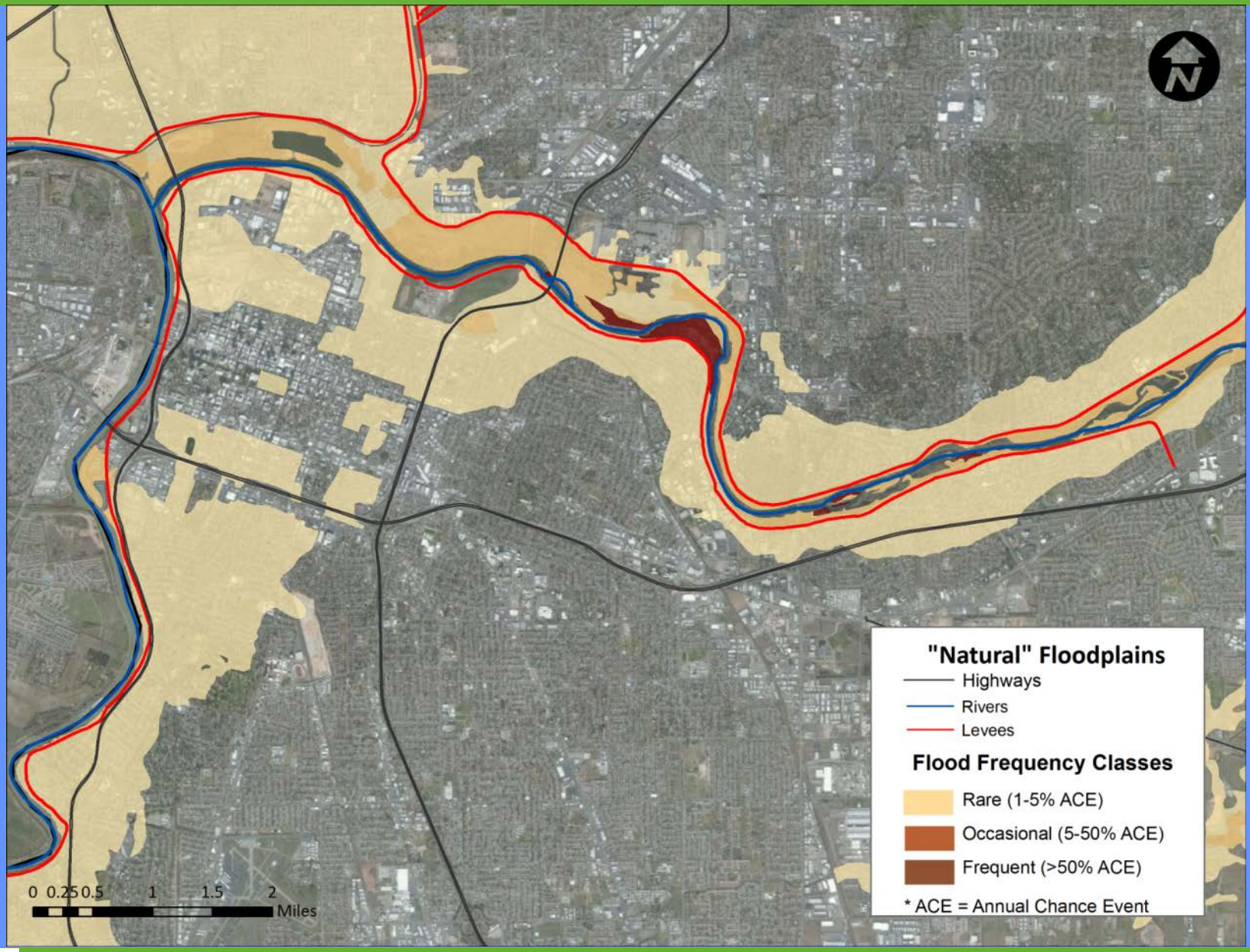
Sacramento Midtown Floodplains



Sacramento Midtown FEMA Floodplains



Sacramento Midtown Flood Prone Soils



Mapping Other Floodplain Features

- Height Above River (HAR) - ArcGIS tool initially developed in 2010 by University of Nevada Reno (UNR) for riparian/ecological investigations to view heights above a floodplain terrain surface relative to a changing river surface.

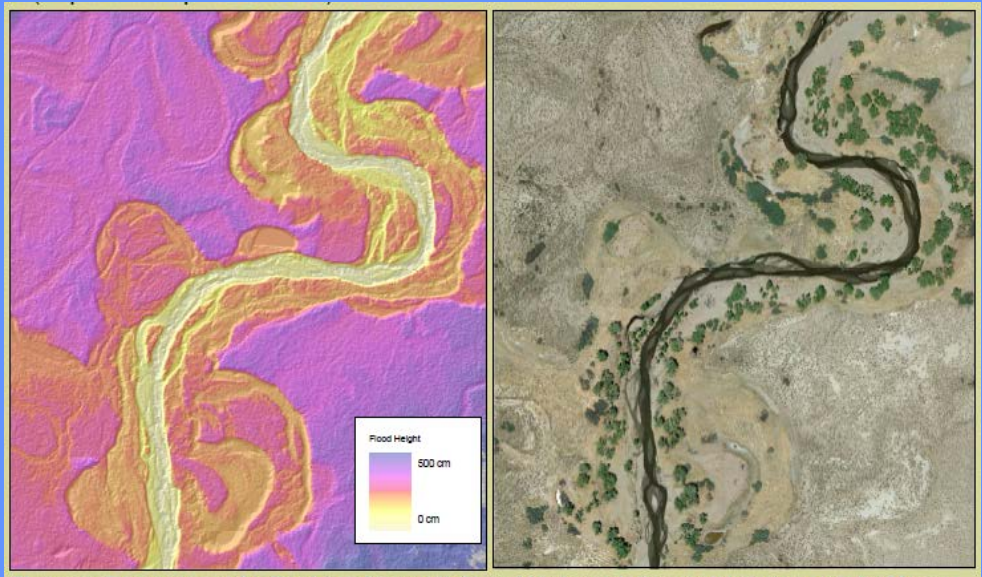
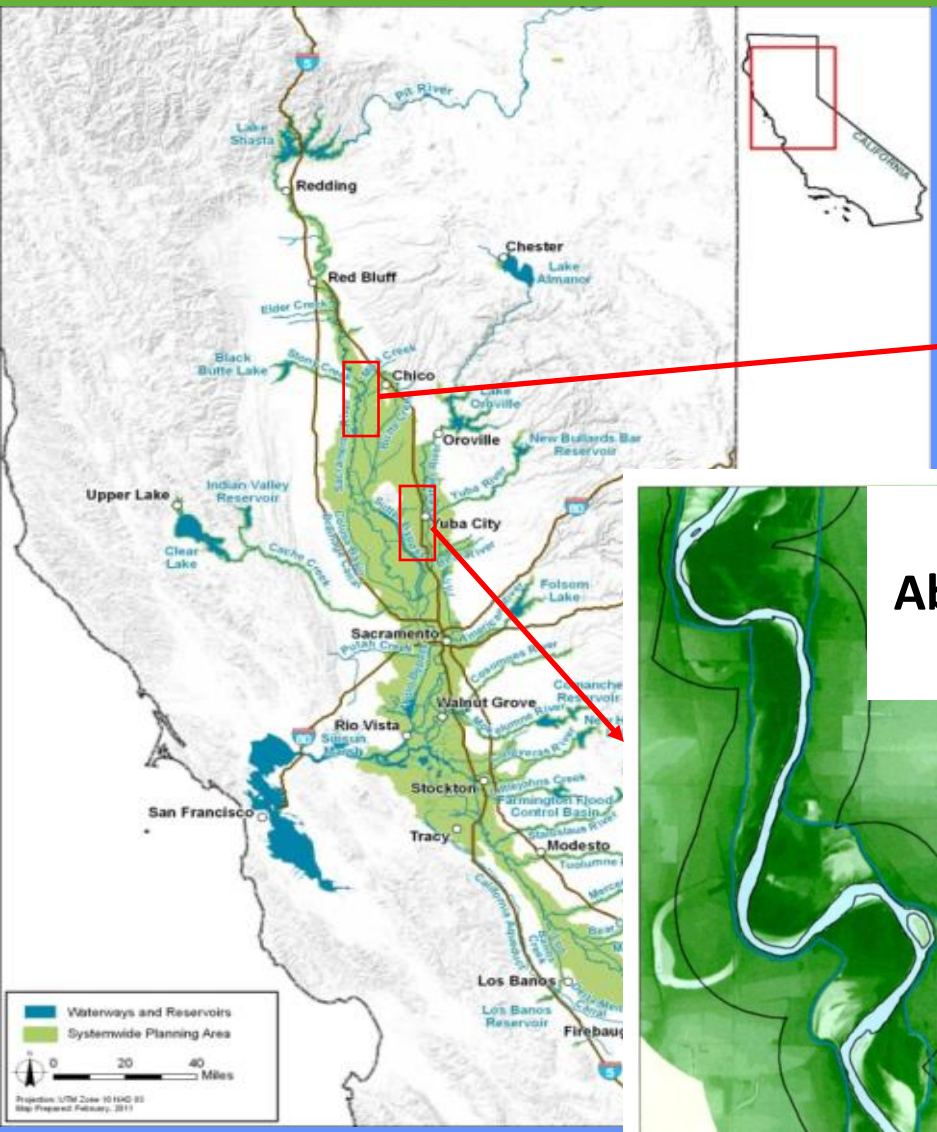


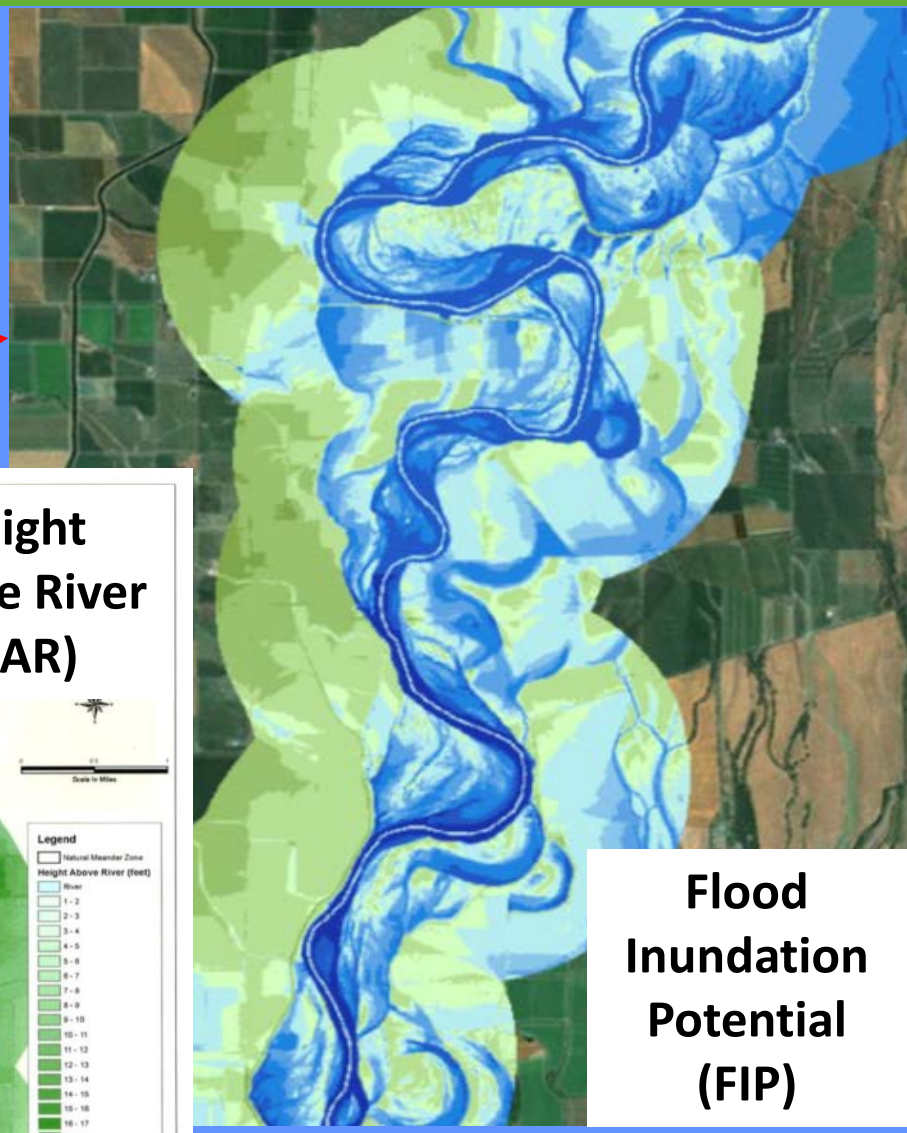
Figure 8: Comparison of a flood height map (left) and high resolution aerial photograph for Mason Valley in the Walker River Basin.

http://arcscripts.esri.com/details.asp?dbid=16792%20

- Flood Inundation Potential (FIP) – Similar to HAR, but modified to view relative heights and depths from a hypothetical flood profile.

HAR and FIP Applied in the Central Valley





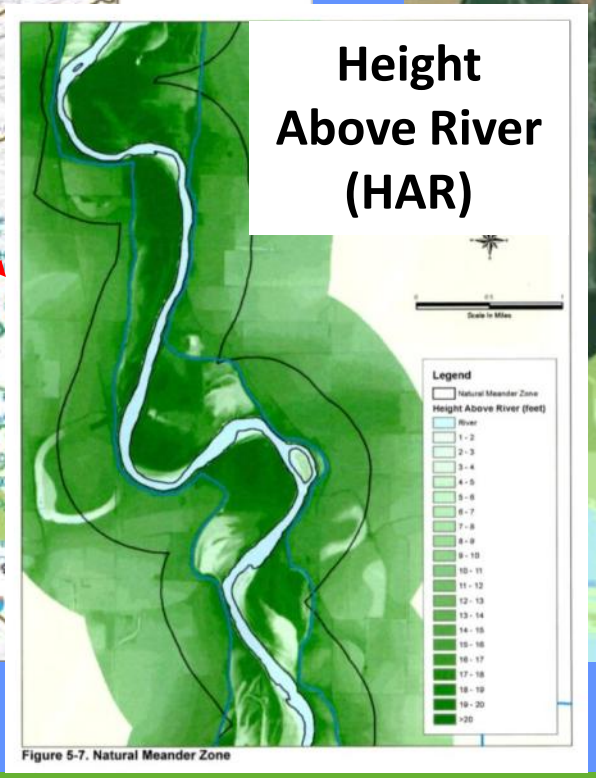
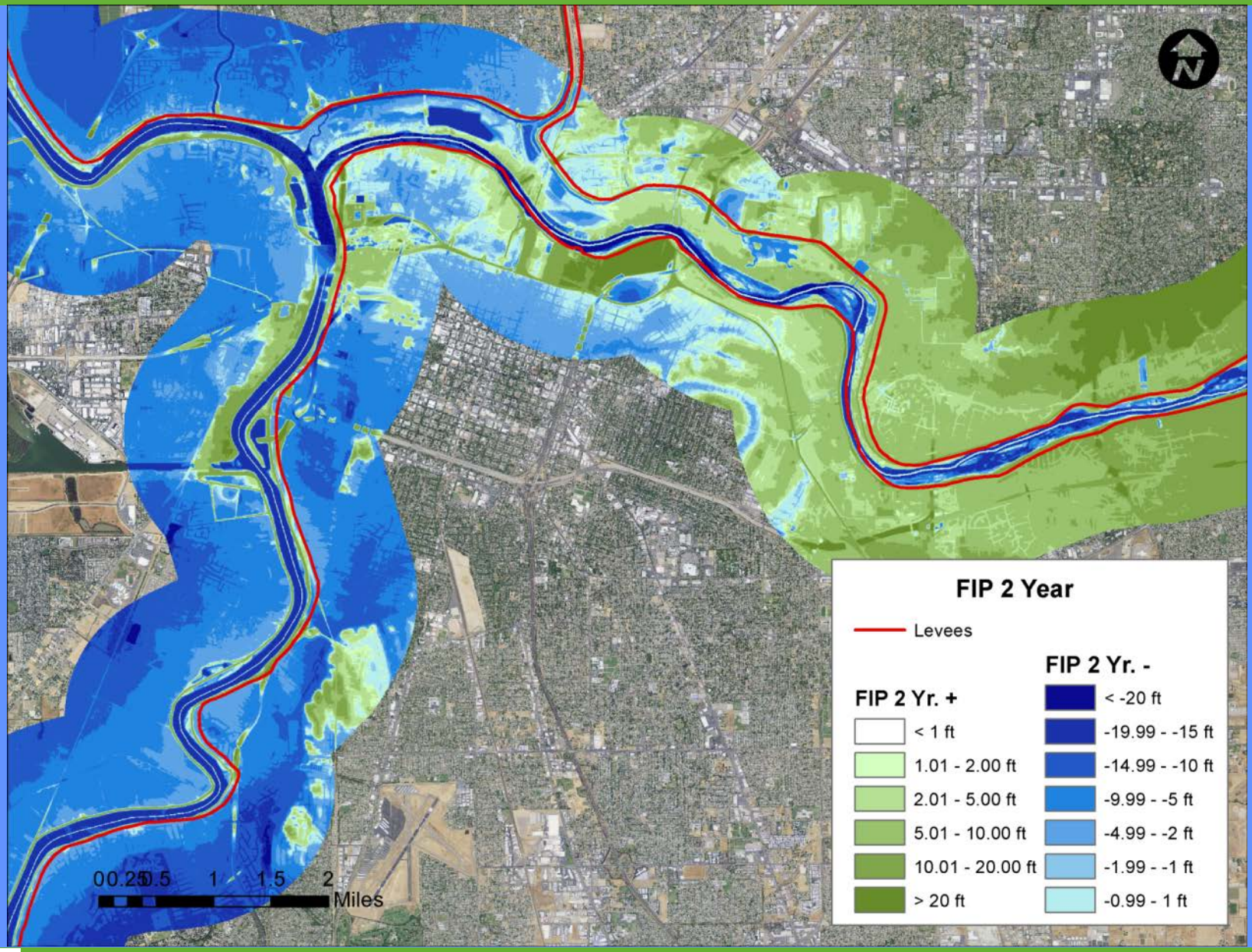


Figure 5-7. Natural Meander Zone

Flood Inundation Potential (FIP)

50% ACE Flood Inundation Potential (FIP)



Findings

- NRCS soils data and FEMA floodplain data are readily available over the Internet for GIS applications.
- NRCS flood frequency classes generally coincide with FEMA data; i.e., 1% ACE (Annual Chance Event), 2% ACE, 5% ACE, 10% ACE, 50% ACE.
- In Sacramento County there are about 370 mi^2 of FEMA floodplains and 286 mi^2 of "natural" floodplains, with about 252 mi^2 of land area where both types of floodplains overlap.
- Other GIS techniques, such as HAR and FIP utilize topography and flood profiles and can indicate "natural" floodplain characteristics of depth and extent and morphology for designated flood events by projecting floodplains landward of flood control features such as levees. Note, however that this does not replace floodplain modeling because projected flood levels do not account for the actual movement of floodwaters.

Recommendations

- Use soils data in investigations of flooding, especially for floodplain restoration projects.
- Apply soils data from the reach scale to the watershed scale and to larger spatial scales.
- Utilize soils data to map “natural” floodplains and augment floodplains defined by FEMA, which are derived for insurance purposes.
- Associate the spatial relationships of flood prone soils and their flood frequency class to observed water surfaces or hypothetical floodplains using GIS tools such as HAR and FIP.
- Utilize HAR and FIP output to provide a topographic and geomorphic context for viewing flood prone soils.

Acknowledgements

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Your Questions?

"Super-Natural" Floodplains by Rob Gonsalves

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