National Flood Forecasting and Inundation Mapping

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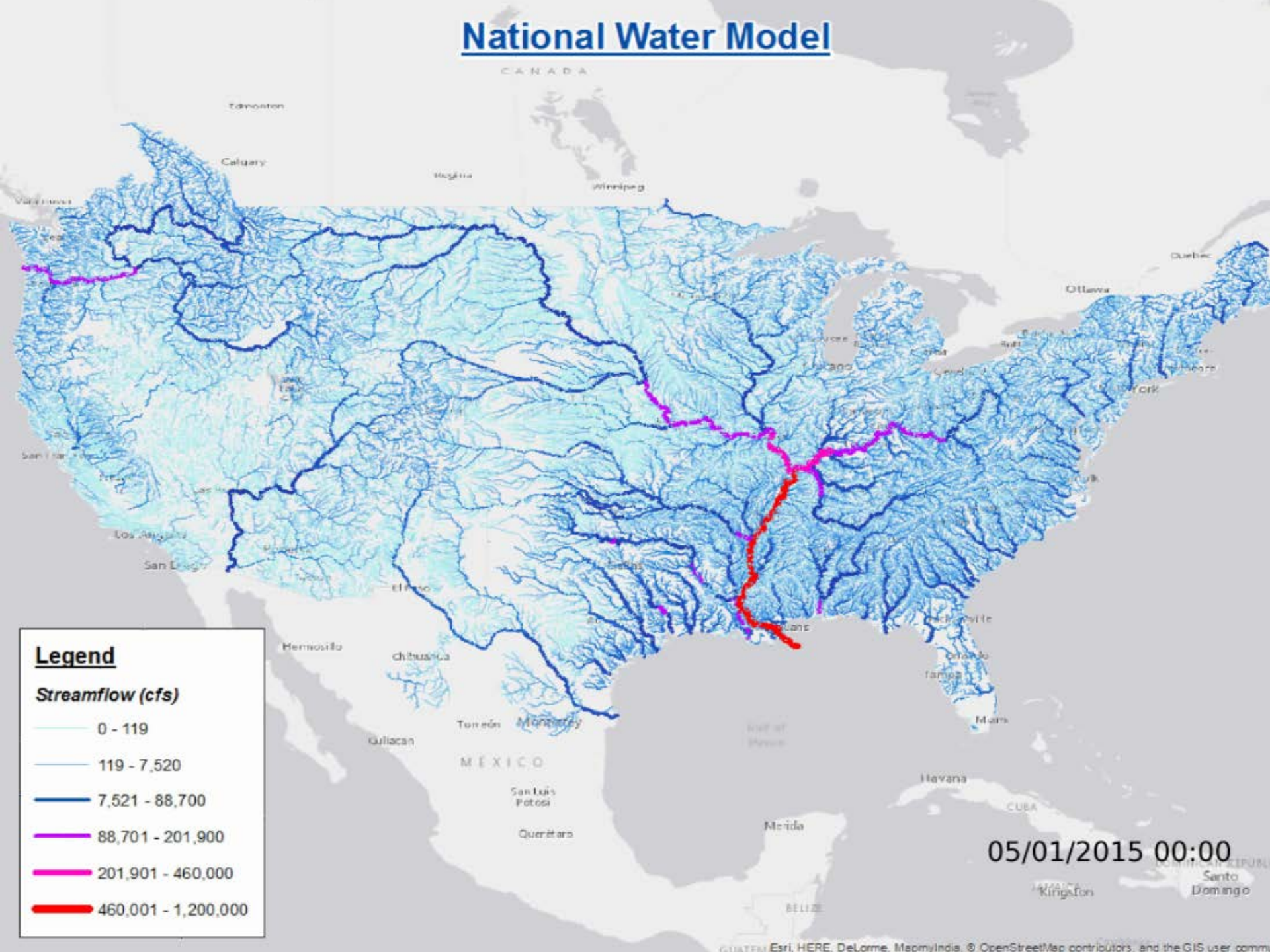
National Water Model



Flow Continuum Model – a national stream network, atmosphere to oceans, coast to coast

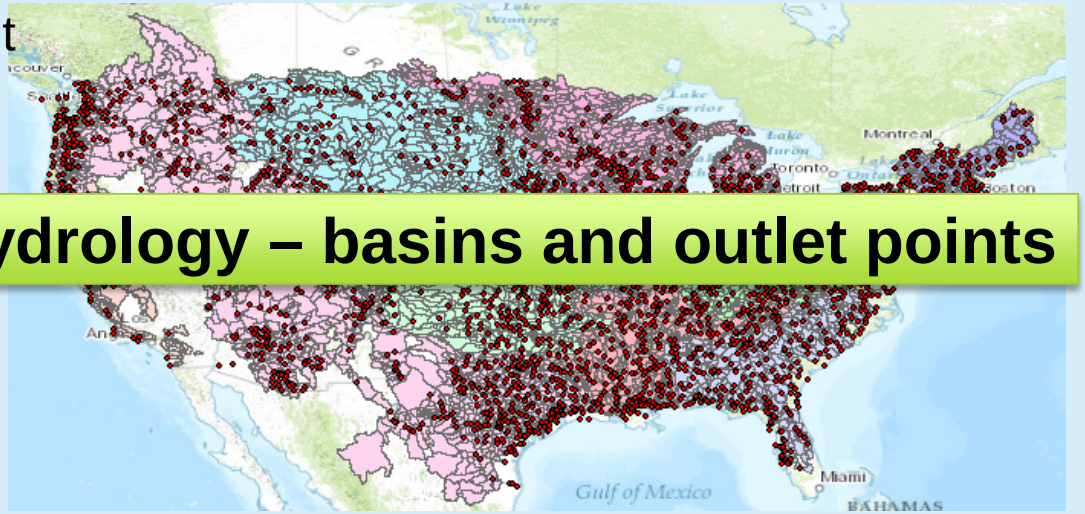
Blanco River at Wimberley

Two basins and one forecast point

becomes ⇩

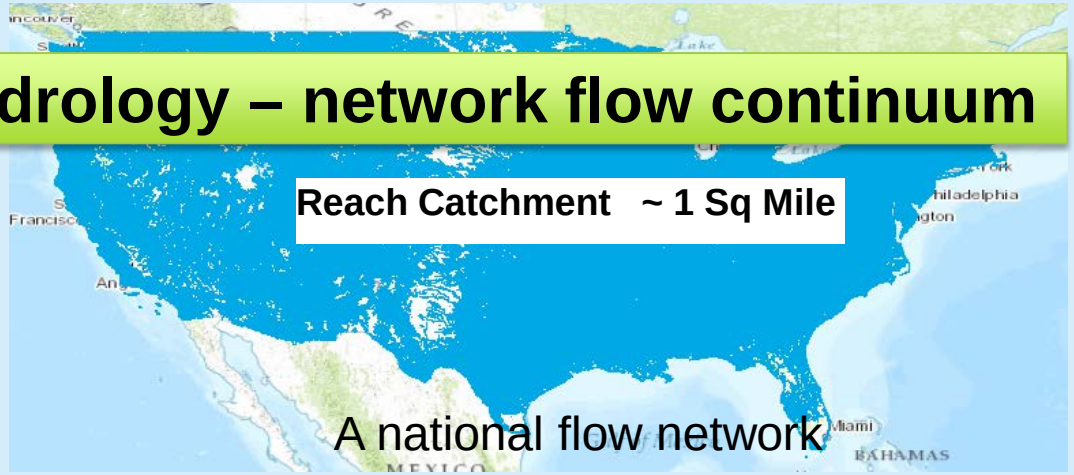
130 Catchments and Flowlines uniquely labelled

Current: 6600 basins and 3600 forecast points



Watershed Hydrology – basins and outlet points

NFIE: 2.7 million stream reaches and catchments



Continental Hydrology – network flow continuum

A national flow network

Experiment for 2016:

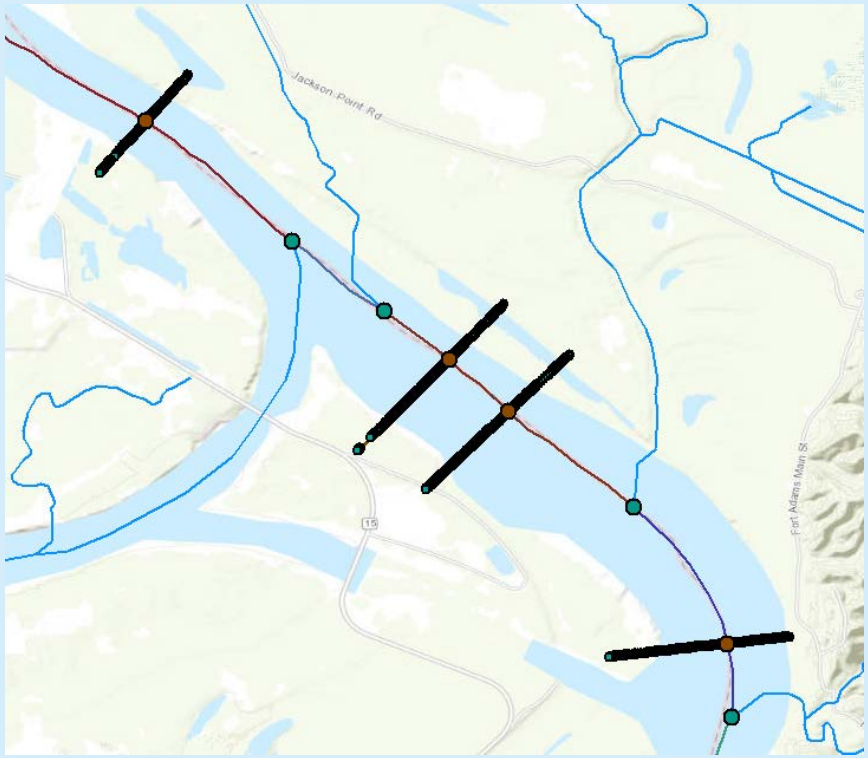
Combine hydrography and elevation to define river channel geometry and flood inundation extent for 5 million km of stream reaches over continental US

National Hydrography Dataset

National Elevation Dataset

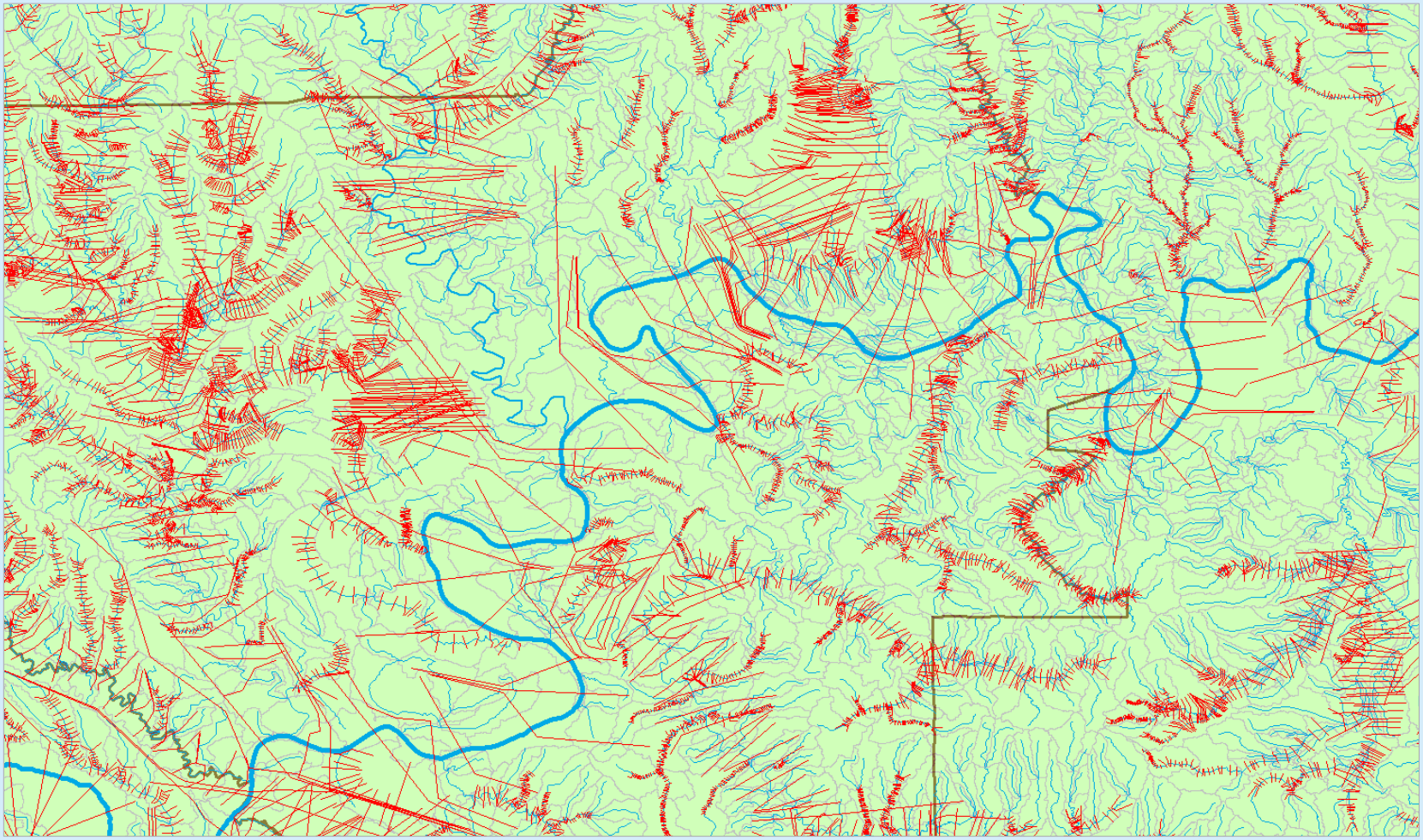
Use the CyberGIS computing facility
at the University of Illinois at Urbana-Champaign

Cross-Sections on Lower Mississippi River for Hydraulic River Routing



173 cross-sections over 543 km, or 3.1 km between cross-sections, on average
41,479 cross-section points (x,y,z) of bed elevation, or 240 points per cross-section, on average

Cross-Sections for Alabama Rivers compiled in NFIE-I

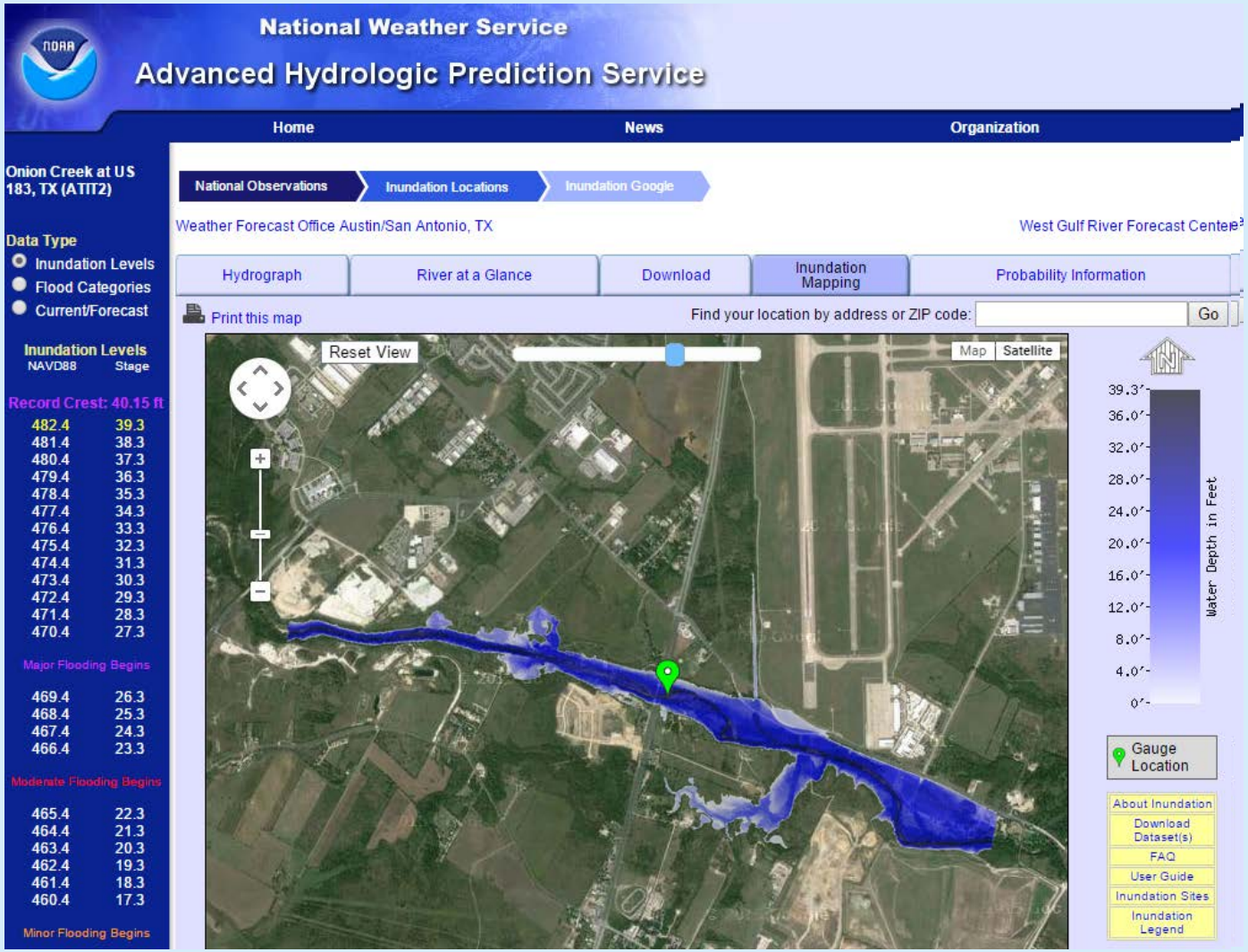


Conclusion: Many studies done independently have lots of overlaps and gaps

NWS Flood Inundation Maps for the US (130 in total)

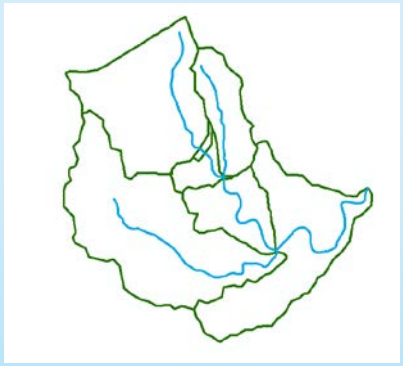
33 maps in Texas (one quarter of total)

Real-Time Flood Inundation Mapping (USGS/NWS)



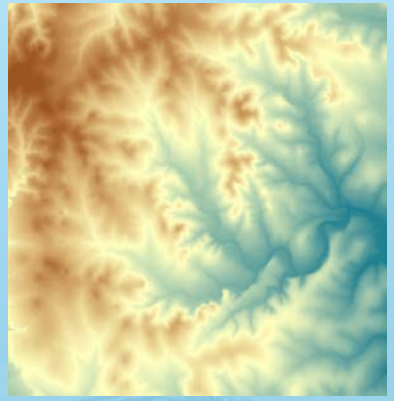
http://water.weather.gov/ahps2/inundation/inundation_google.php?gage=atit2

Flood Inundation Mapping – NHDPlus-HAND Method

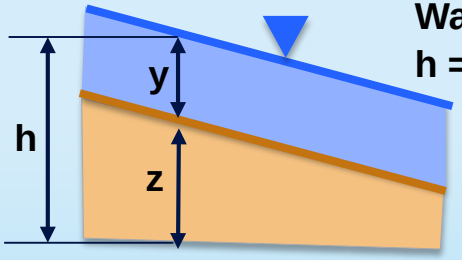


NHDPlus

Catchments and Flowlines

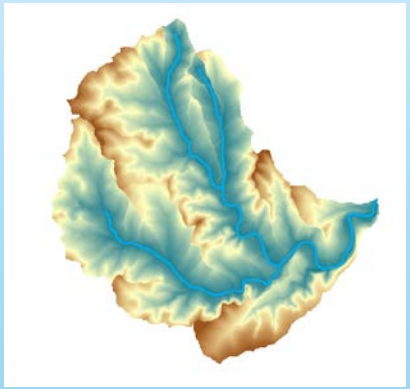


Digital Elevation Model

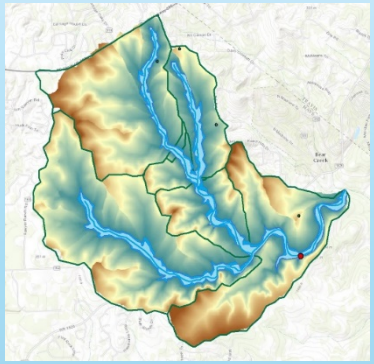


Water surface elevation
h = z + y

Geodetic datum



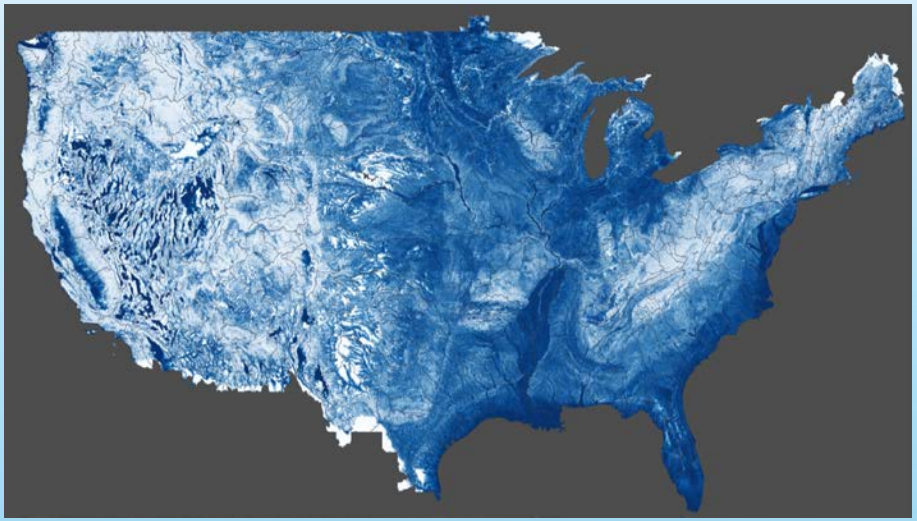
Height Above Nearest Drainage (HAND)
(relative elevation of land surface cell above cell in NHDPlus stream to which it flows)



Inundation map
Height above drainage < 15 ft)

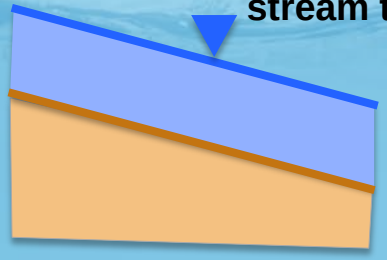
Continental-Scale Flood Inundation Mapping

Catchments and Flowlines

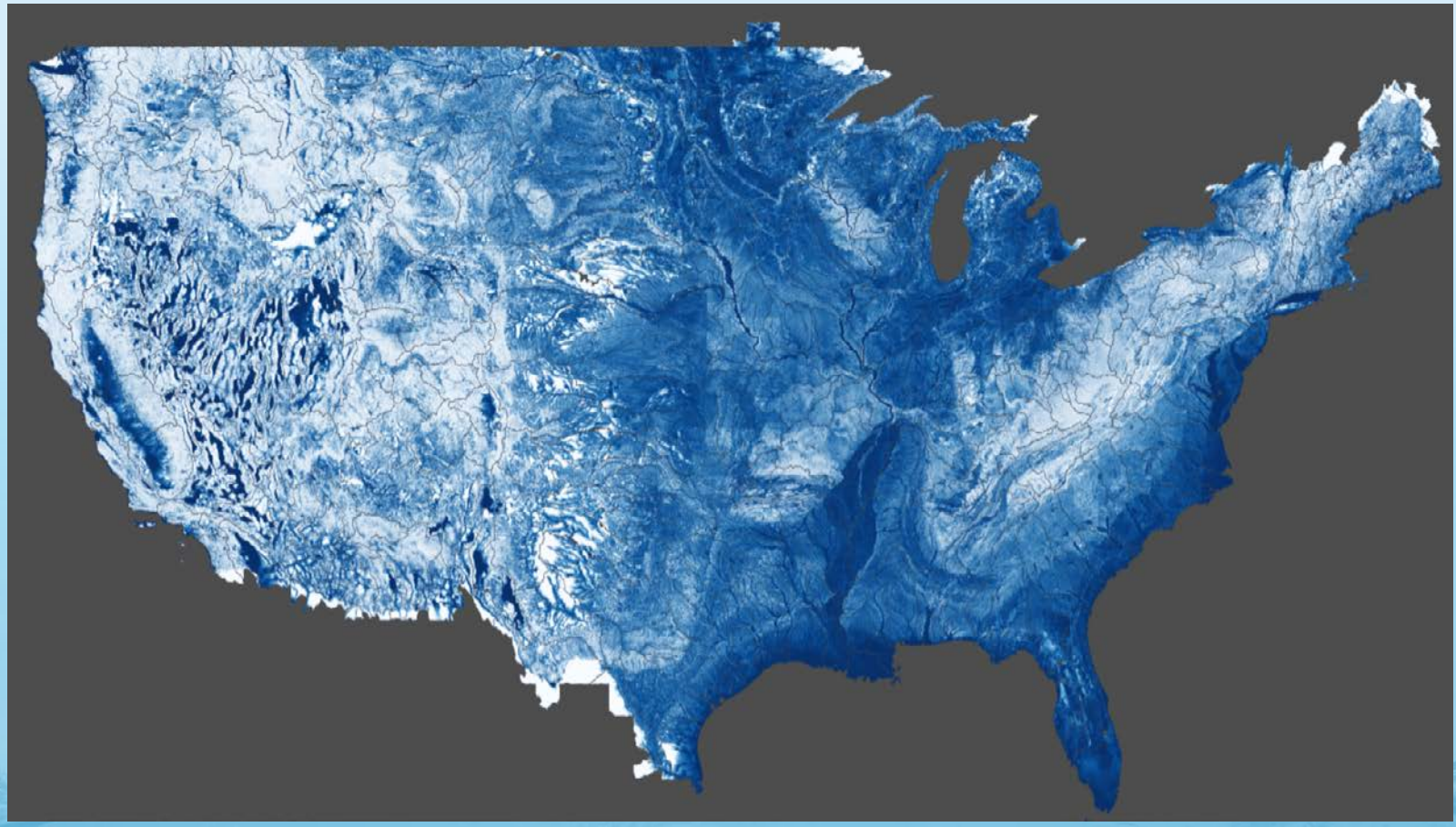


Digital Elevation Model

Height Above Nearest Drainage (HAND)
(relative elevation of land surface cell above cell in stream to which it flows)



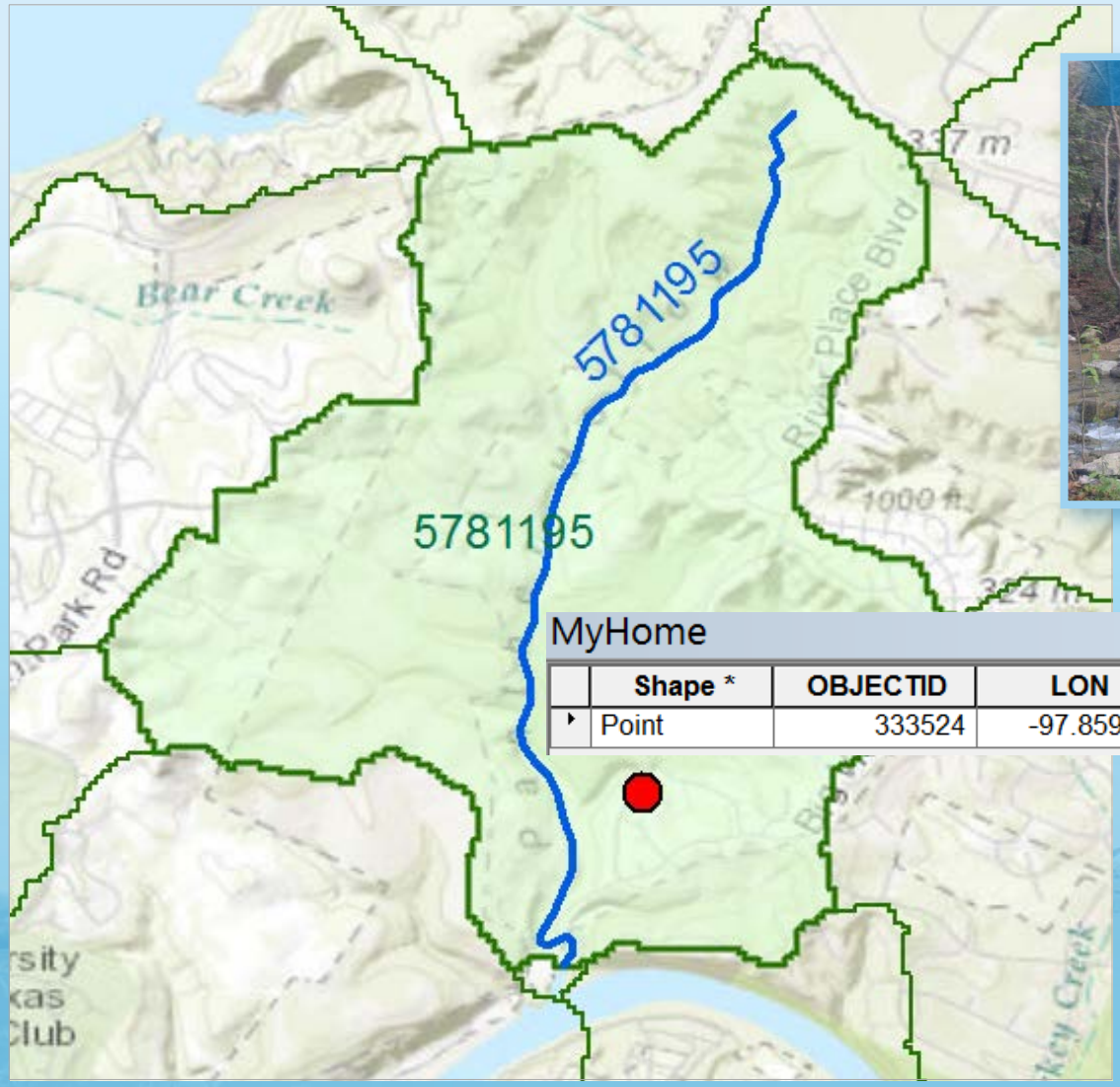
Height Above Nearest Drainage for the Continental United States

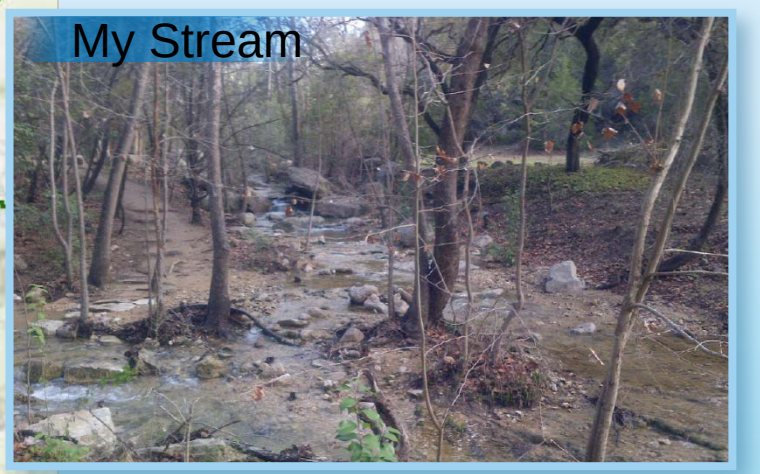


Source: Yan Liu, University of Illinois at Urbana-Champaign

http://141.142.168.44/nfiedata/maps/#source=..%2Fyanliu%2Fviz%2Fhuc6.json&extent=-128.3203125_22.1484375_-66.884765625_55.634765625

My Home Catchment and Address Point



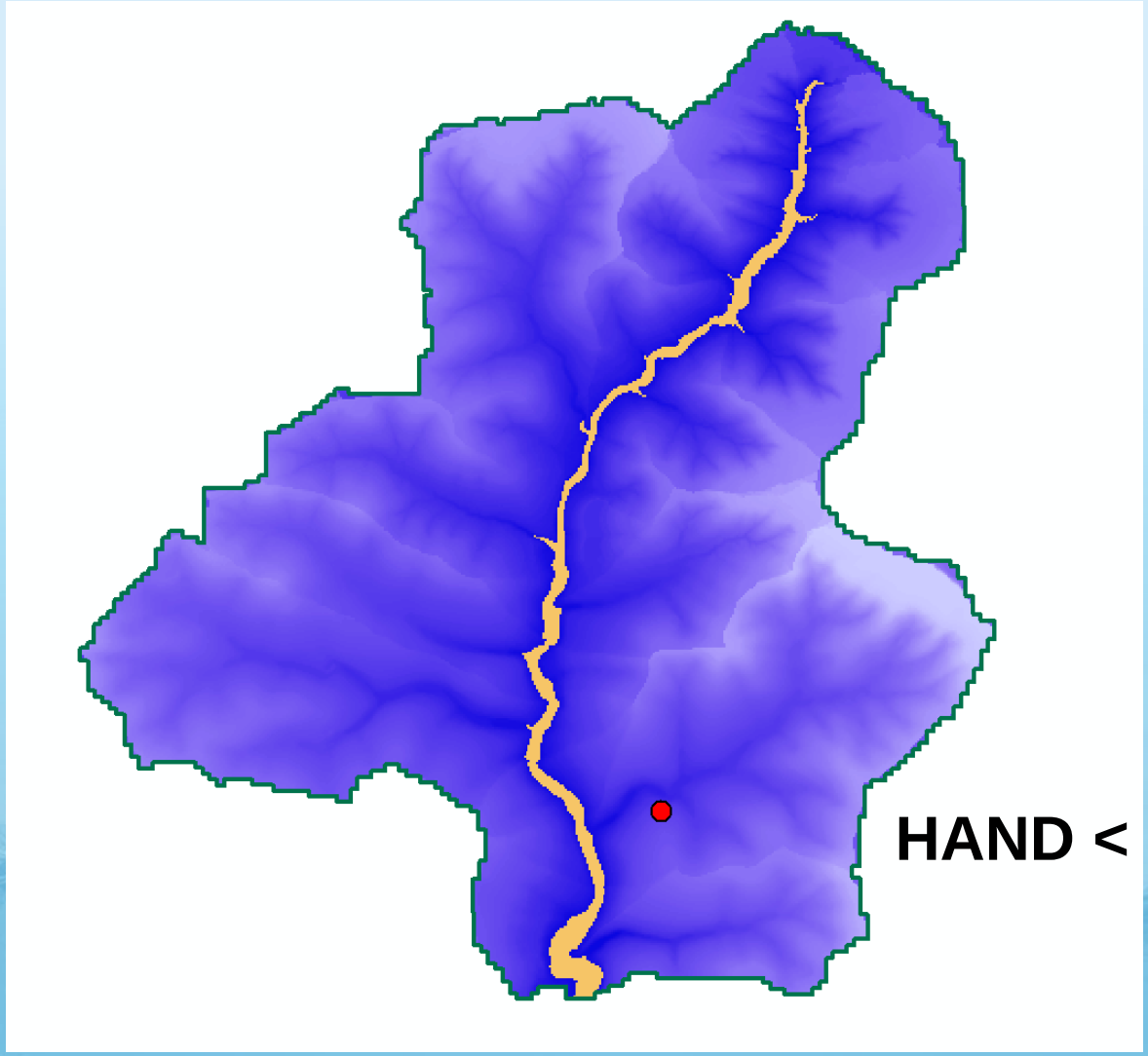


Panther Creek

MyHome

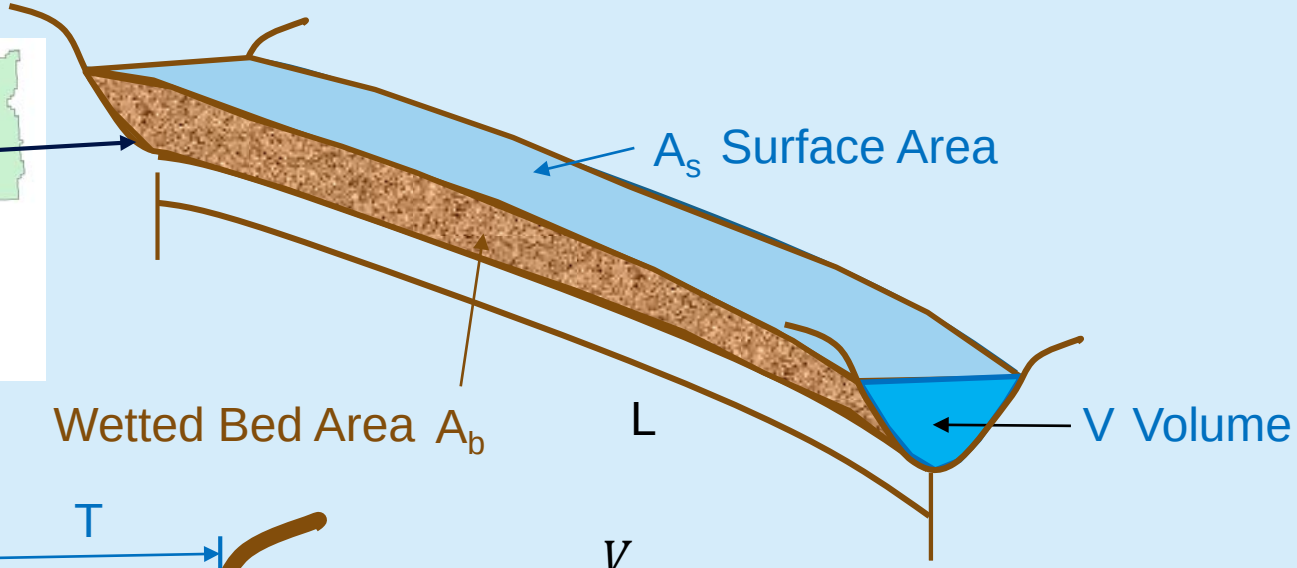
	Shape *	OBJECTID	LON	LAT	NUMBER_	STREET
▸	Point	333524	-97.859838	30.363981	3728	Josh Lane

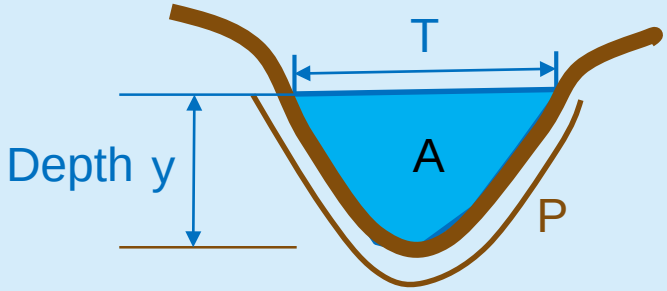
Height Above Nearest Drainage at my Home



Reach Hydraulic Parameters

Comid	y	A	R	P	T	V	Ab	As
5781175	3							
5781175	4							





$A = \frac{V}{L}$ Cross Section Area

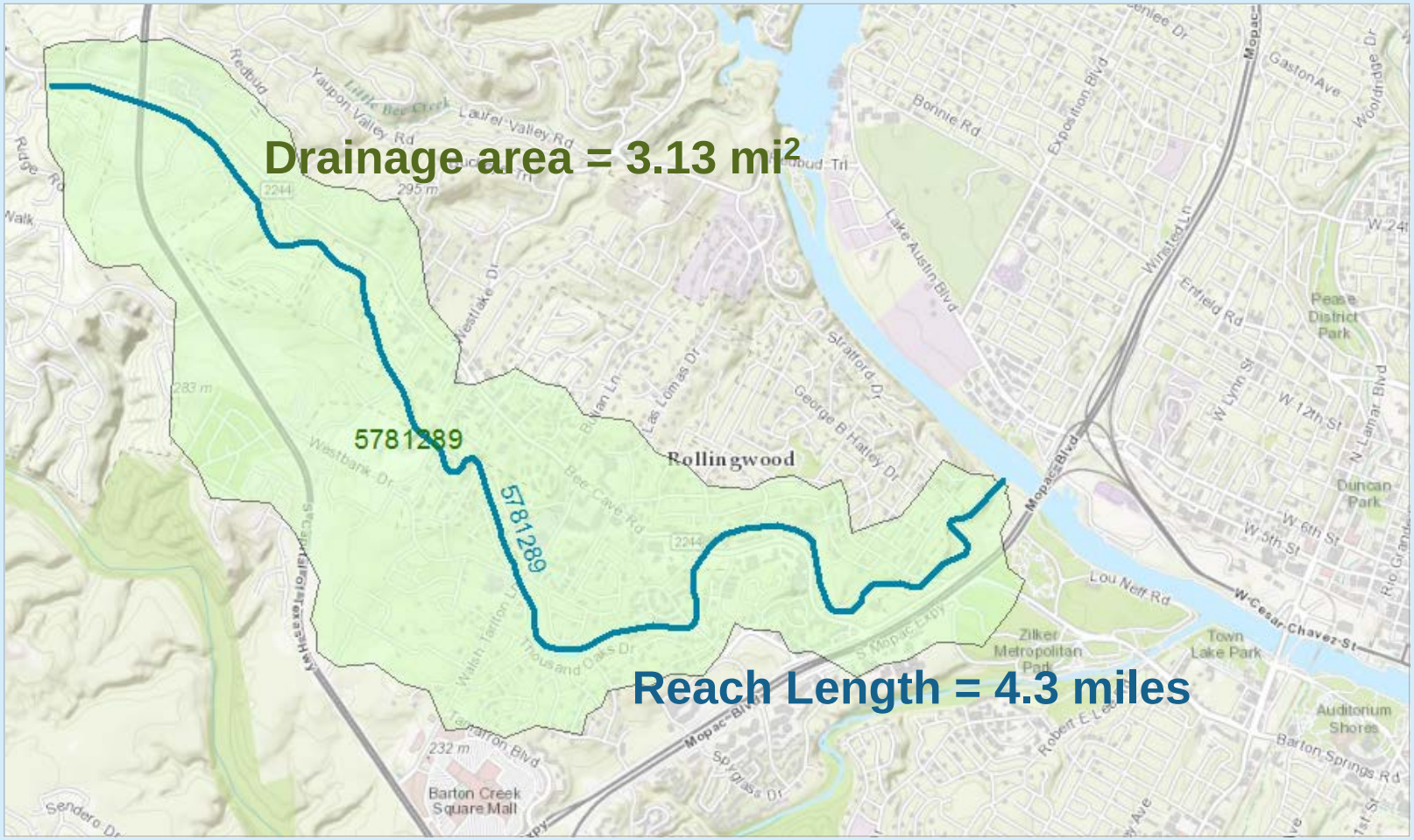
$P = \frac{A_b}{L}$ Wetted Perimeter

$T = \frac{A_s}{L}$ Top Width

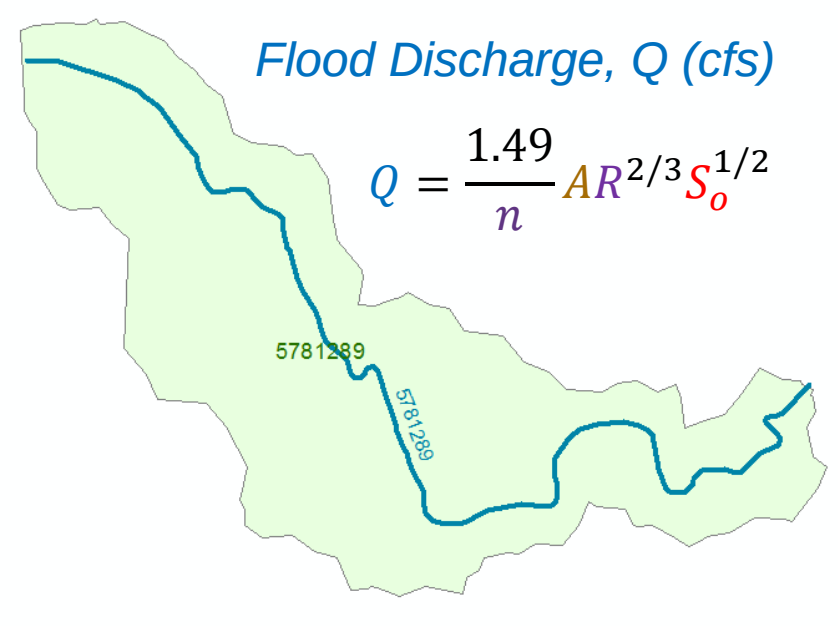
$R = \frac{A}{P}$ Hydraulic Radius

Reach Catchment 5781289

Eanes Creek, Rollingwood, Texas

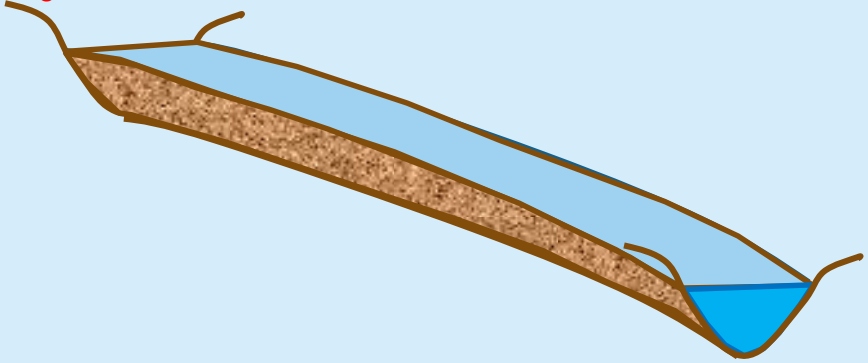


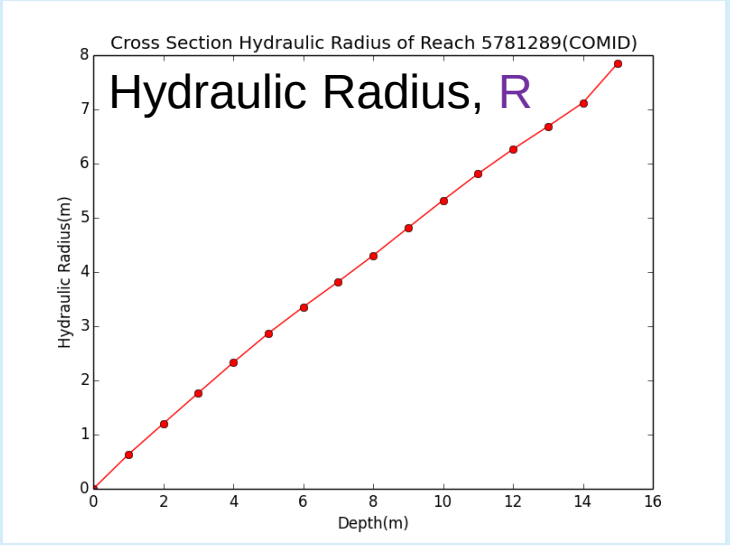
Discharge Computation



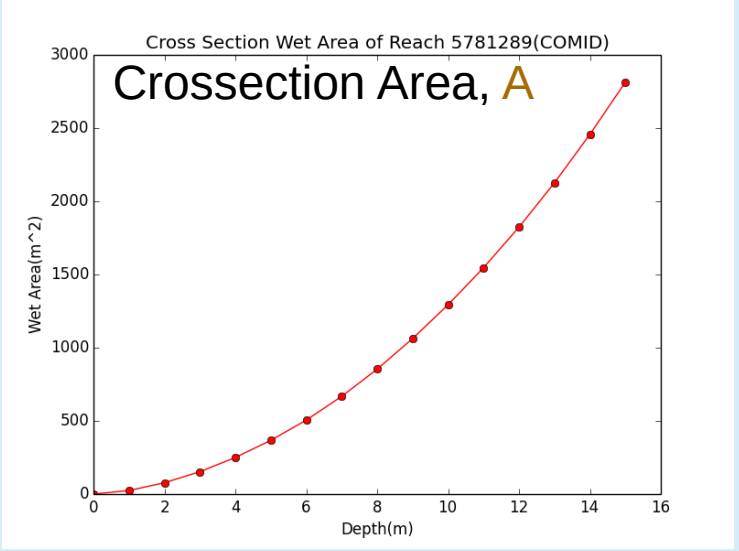
n = 0.035 Manning roughness of channel

S_o = 0.0163 Bed slope

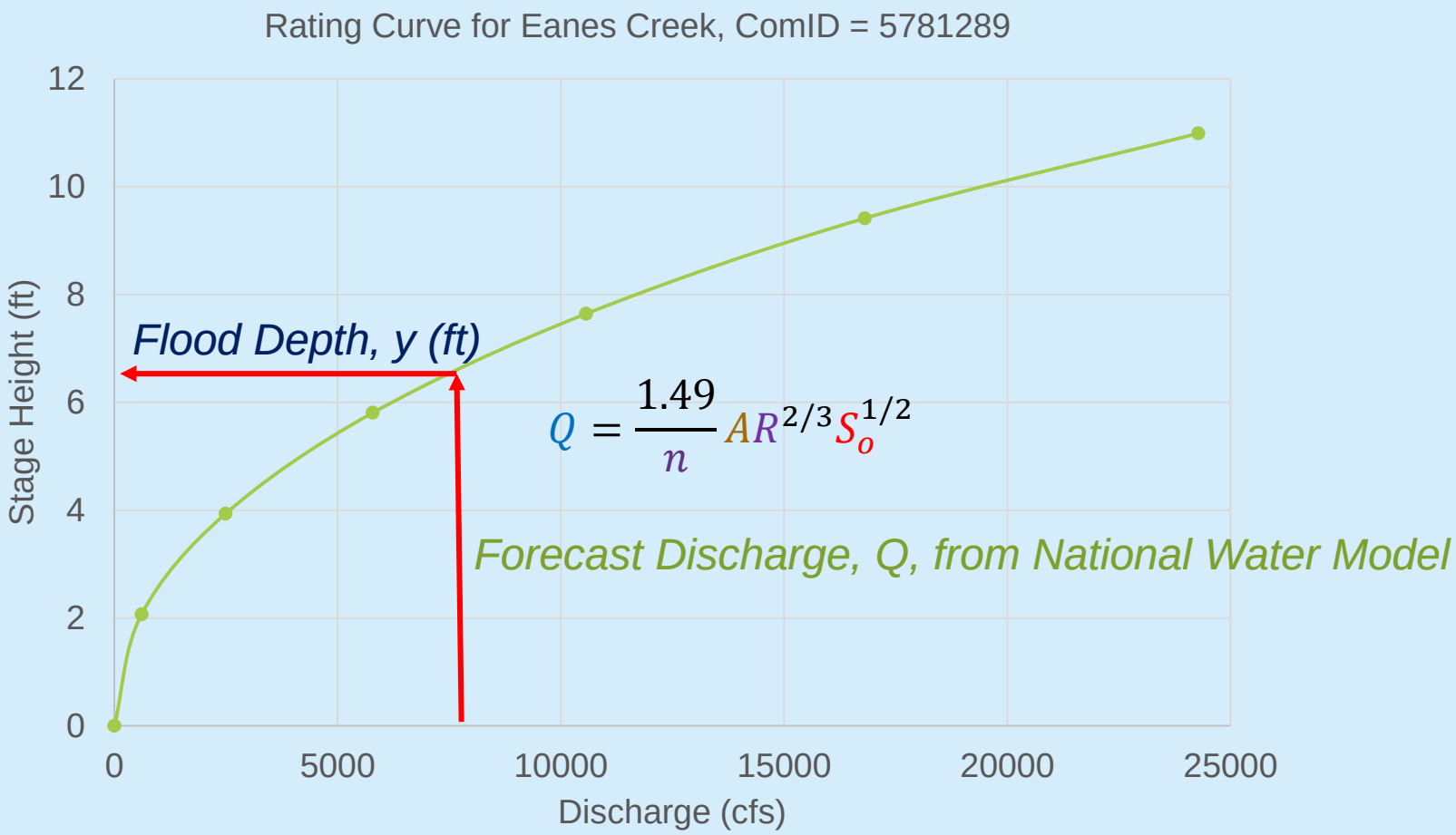




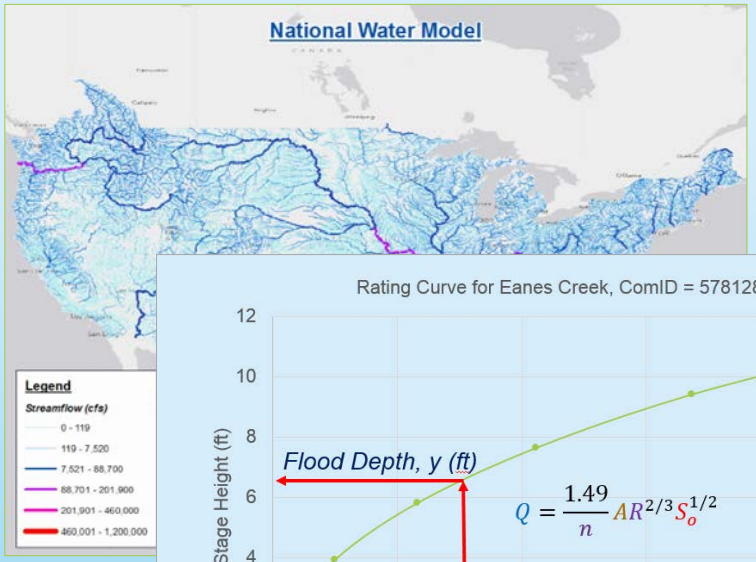
Flood Depth, h (ft)



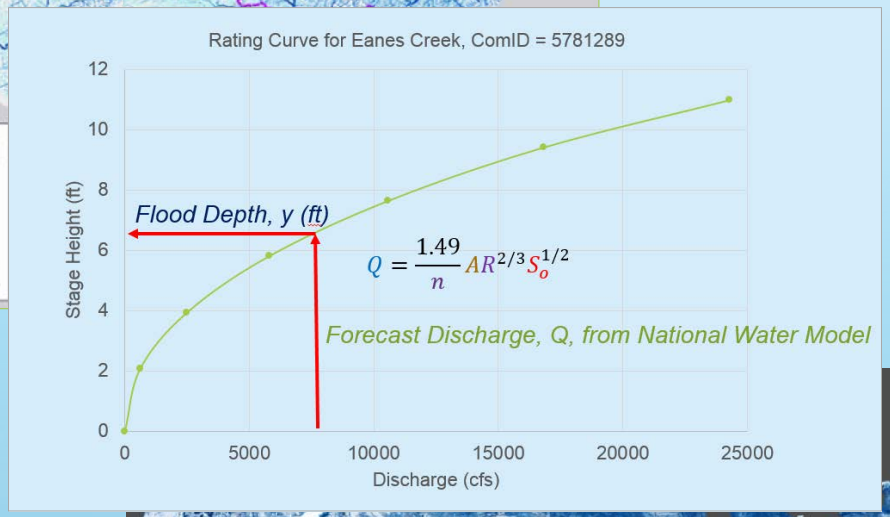
Rating Curve for Eanes Creek



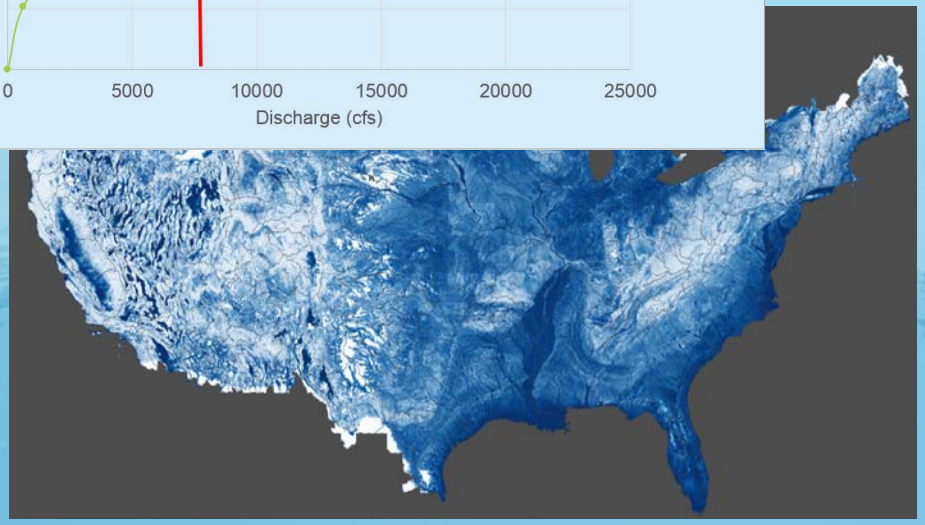
Continental-Scale Flood Inundation Mapping



1



2



3

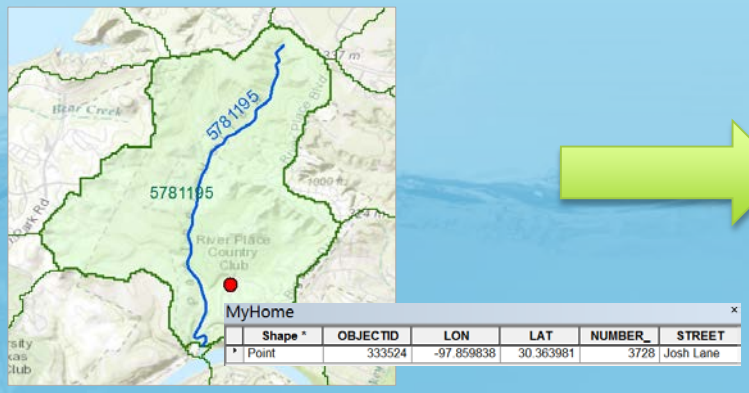
1. Forecast discharge with National Water Model

2. Convert discharge to depth using rating curve

3. Convert depth to inundation using HAND

Principles for Flood Inundation Mapping

- Continental flow network continuum
- Top down not bottom up
- Separate modeling from mapping
- Terrain continuum rather than cross-sections
- Stream bed as stage height datum
- Height Above Nearest Drainage for inundation
- Geospatial image services for mapping
- Address Points to connect with Emergency Response



One Water = Water Resources + Water Pipes

Elevation Depth

$$Z + Y + V^2/2g$$

Water Resources

Hydraulic Head

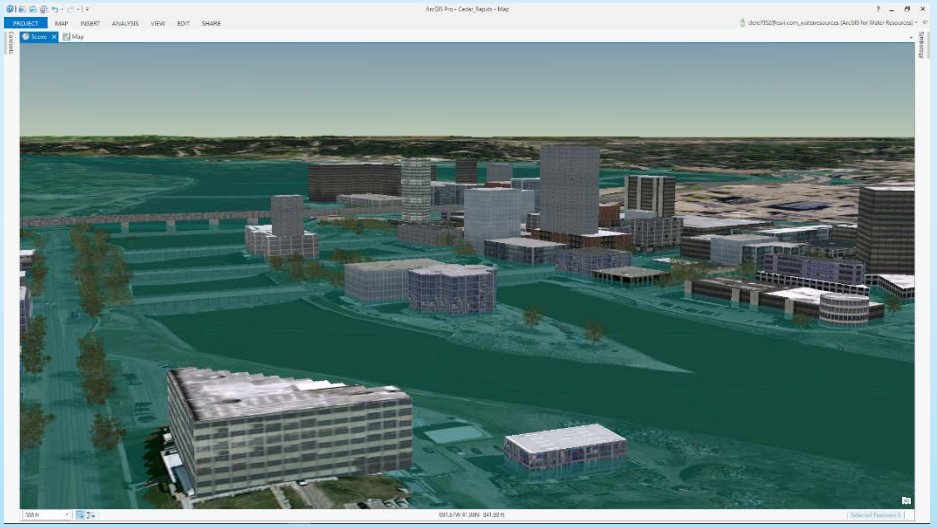
(Potential Energy of Water)

Water Pipes

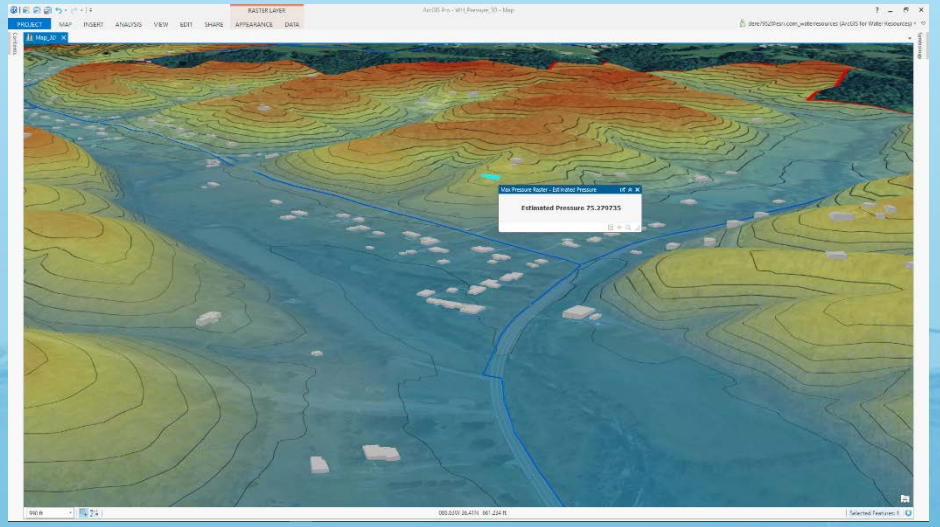
$$Z + P/\gamma + V^2/2g$$

Elevation Pressure Head

Terms in Bernoulli's Equation



Flood Inundation Map for Cedar Rapids, Iowa



Pressure zone map for water pipes model in a city