The Howard Hanson Dam & Green River Valley Flood Analysis

Washington State Department of Transportation

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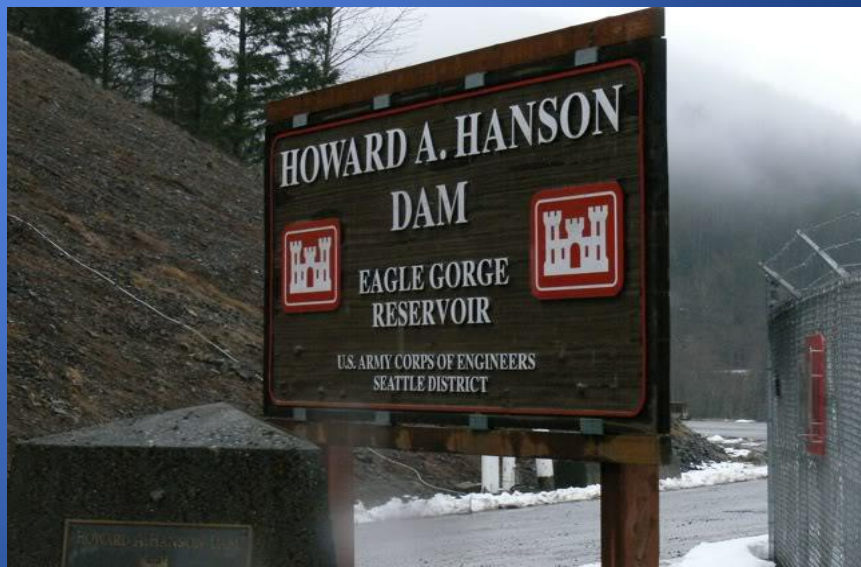
The WSDOT GIS EOC Team



Problems & Issues

- Risk is due to high rates of water seeping through an earthen bank that forms the right-shoulder of the dam. Seepage increase occurred after record high water in January 2009.

  - Record water level reached = 1,189 feet
  - Maximum pool level = 1,206 feet

- Army Corps of Engineers has placed restrictions on the pool elevation of 1,165 feet until repairs are completed, this may take as long as three years (2012).

- With the restricted pool elevation, downstream communities face the highest risk of flooding since 1961.

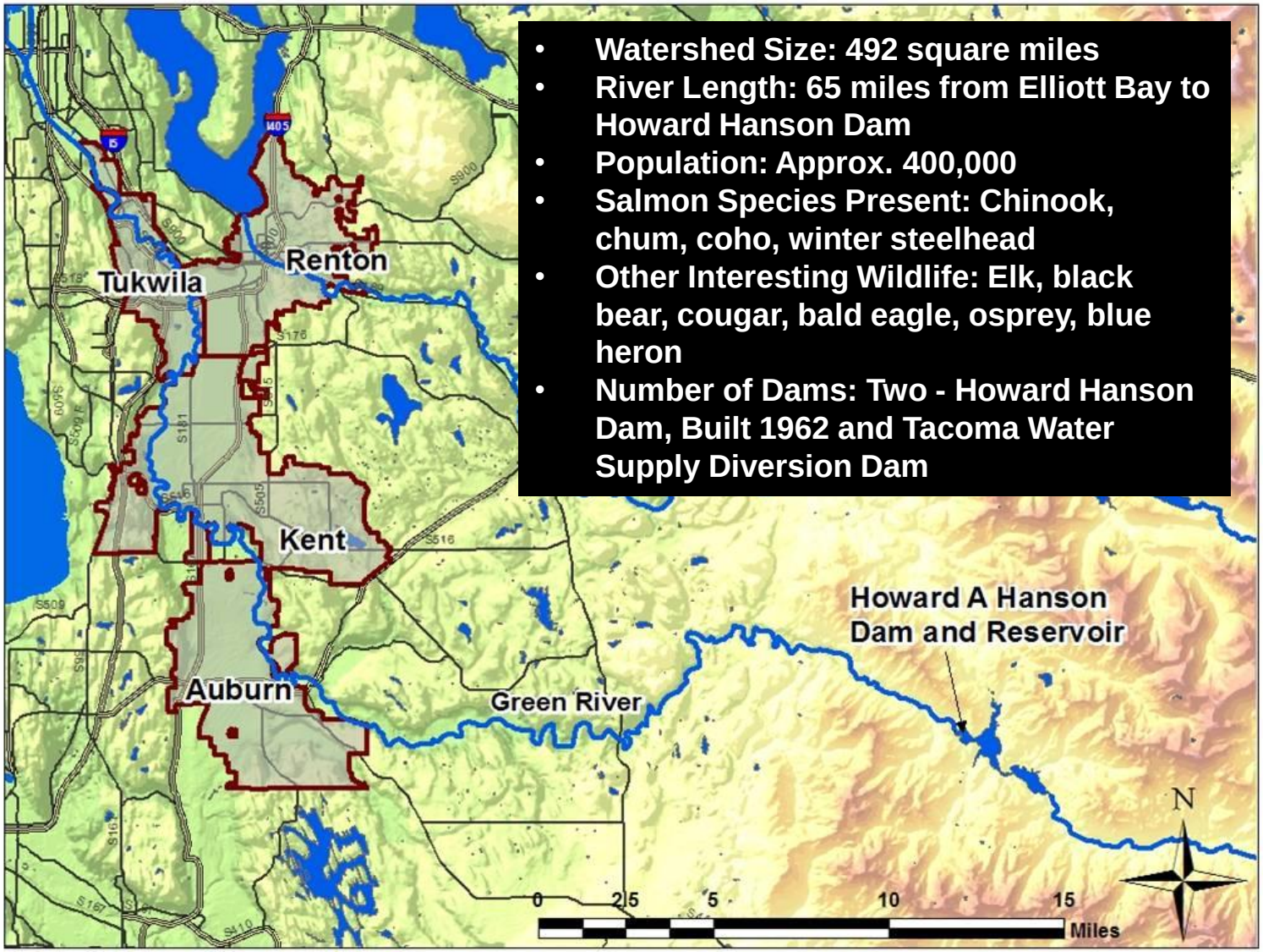
- EMD Issued Directive on September 14th for all State Agencies conduct risk assessments to determine possible impact on State Infrastructure and services within in the Green River Valley.

Note - The dam is not in danger of failing

WSDOT EOC, brought together a small portion of the EOC GIS Team to gather the data on HHD and conduct the impact analysis for the Department.

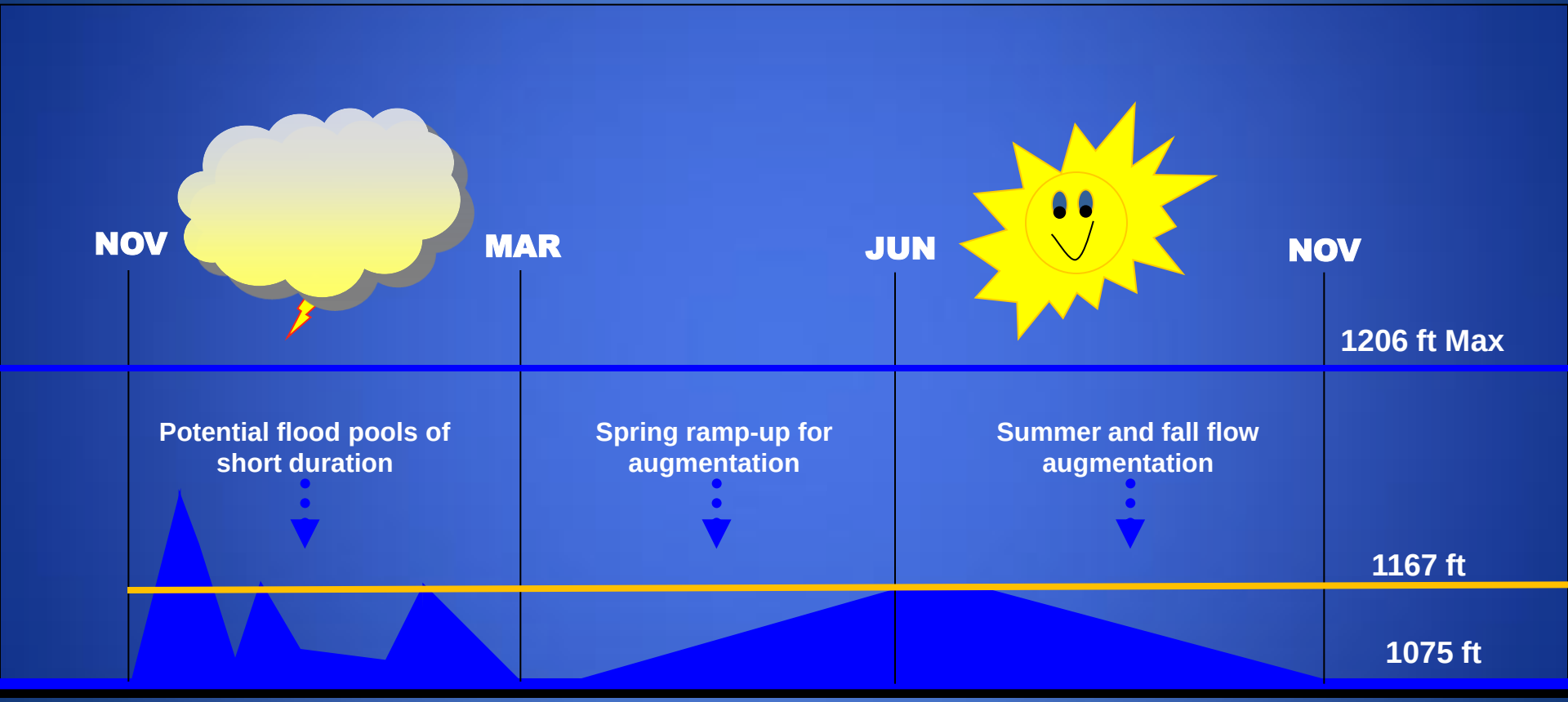
- **Joe Schmit acted as liaison between Executives and other agencies to find out requirements**
- **Rich Daniels put together the imagery received from various sources and did the spatial/3D analysis to reconfigure the LIDAR, TINS, and other formats to determine elevation data**
- **Oai Tang put together the specialized information needed by maintenance- such as pits/quarries, culverts, storm water, facilities, fuel & equipment storage**
- **Diane McGuerty gathered data from the FEMA, State EOC, King CO, NW Region and other specialty offices. Data includes imagery, survey data, CAD drawings, detours, geocoding & device locations**

Green River Valley Watershed



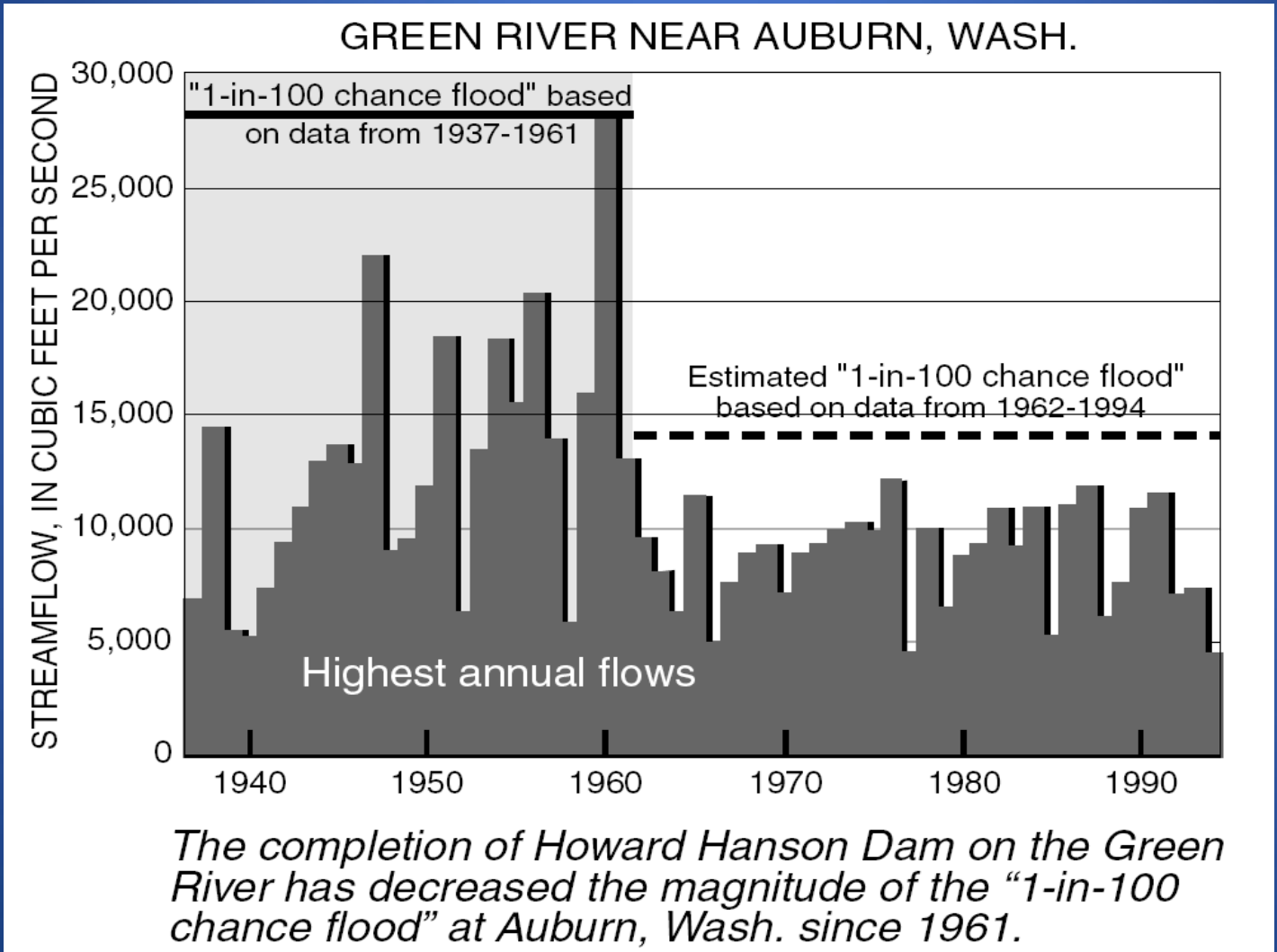
- Watershed Size: 492 square miles
- River Length: 65 miles from Elliott Bay to Howard Hanson Dam
- Population: Approx. 400,000
- Salmon Species Present: Chinook, chum, coho, winter steelhead
- Other Interesting Wildlife: Elk, black bear, cougar, bald eagle, osprey, blue heron
- Number of Dams: Two - Howard Hanson Dam, Built 1962 and Tacoma Water Supply Diversion Dam

Normal Green River Flow Pattern at Howard Hanson Dam



Pool elevation in feet above sea level

Why is this a Problem?
Green River Valley Highest Annual Flows 1937-1994

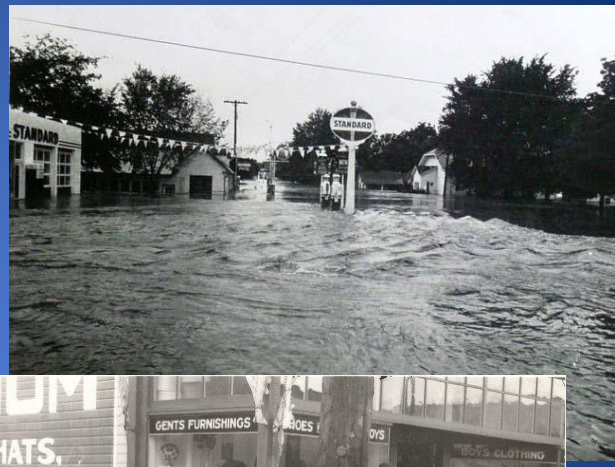


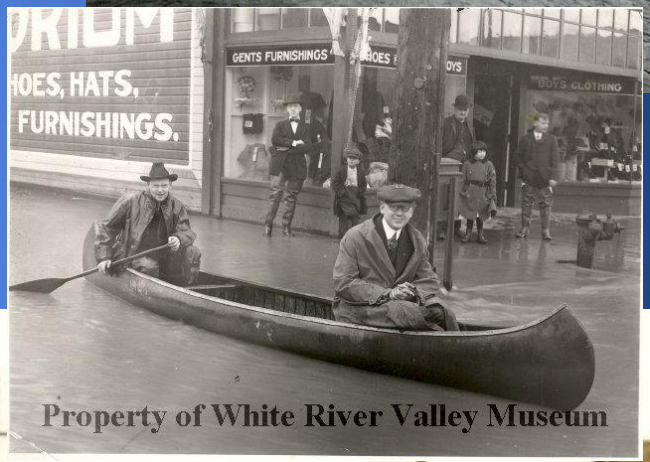
The completion of Howard Hanson Dam on the Green River has decreased the magnitude of the "1-in-100 chance flood" at Auburn, Wash. since 1961.

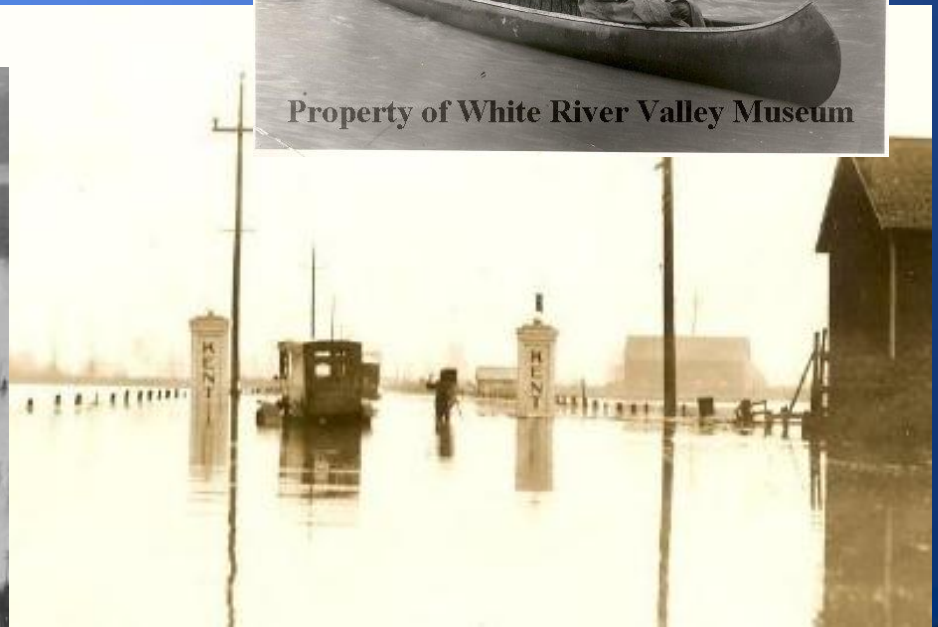
The last major flood in 1959 reached a water level of 69.7 ft at Auburn. Flood stage is 61.7 ft

Prior to 1961

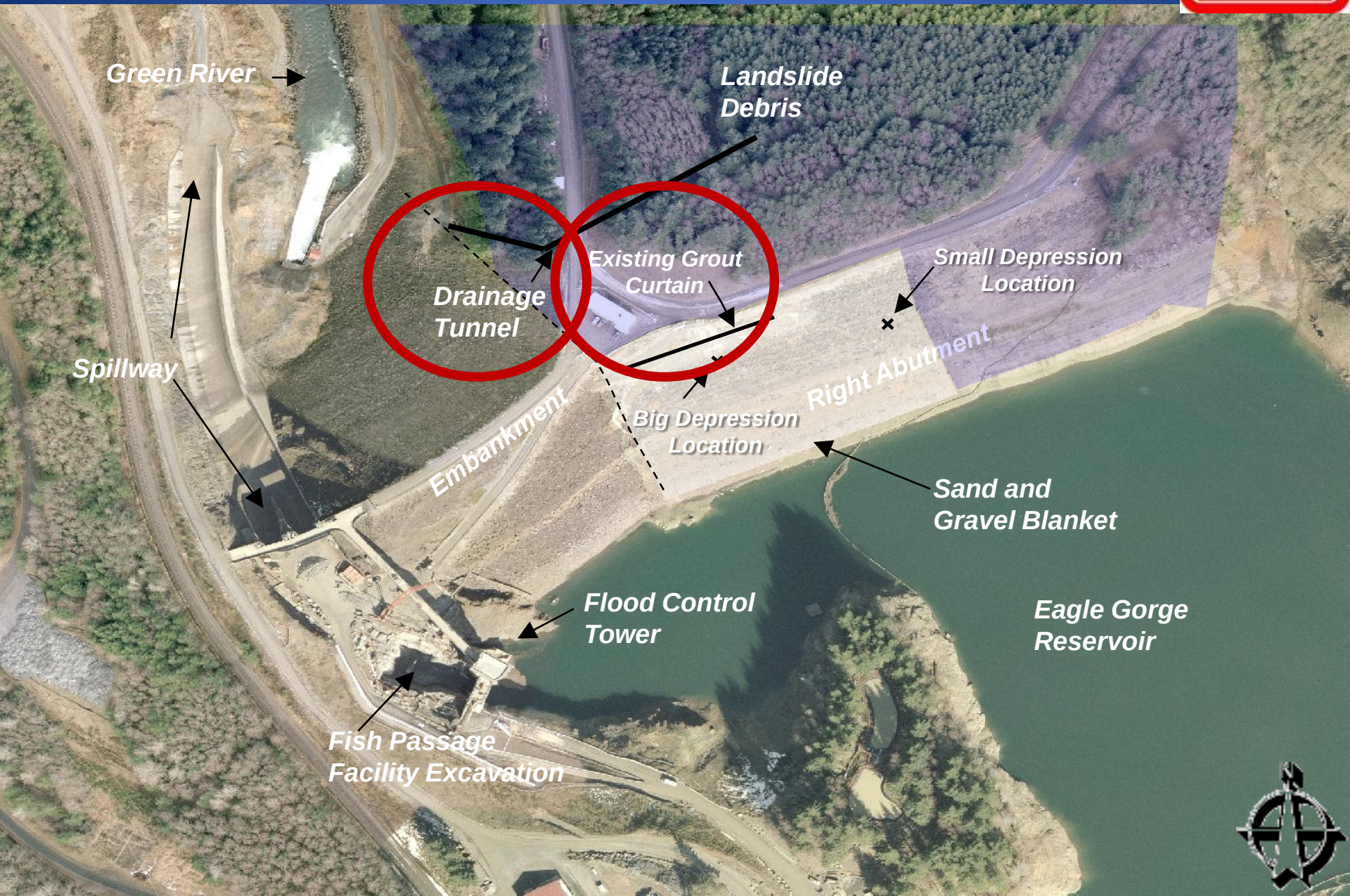
- Prior to 1961 the Green River was expected to overflow its banks nearly every winter. The entire valley from Boeing Field to Auburn would be underwater,
- Kent was only negotiable by boat. Livestock would drowned, chickens and cats were marooned in the trees, and Longacres Race Track in Renton (south of I-405) would be two or three feet under water.







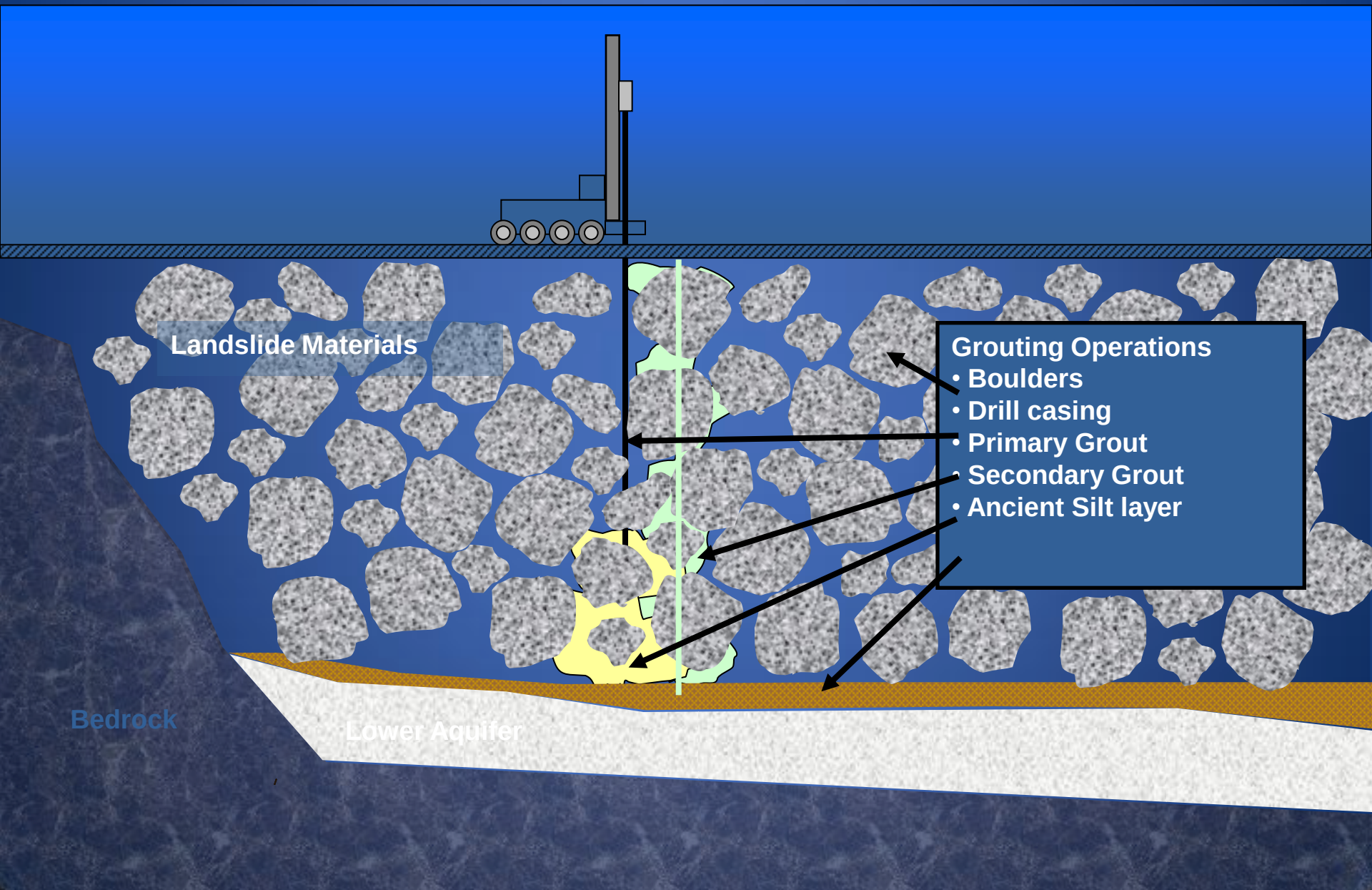
Howard Hanson Dam



Drainage Tunnel

Drainage Tunnel Improvement Construction

Grout Curtain Construction



Grout Curtain Construction

U.S. Corp of Engineers Flood Scenarios

Scenarios A25, A50, and A100 provide the best low, moderate, and high scenarios

Run Name	Peak Flow at Auburn gage (cfs)	Discharge (cfs)	Notes:
A25	13,900	8,800	No levee breach, a pool restriction of 1165 and 4% annual chance exceedance inflow to Howard Hanson Dam.
C100	17,600	11,000	No levee breach, a pool restriction of 1185 and 1% annual chance exceedance inflow to Howard Hanson Dam.
A50	19,500	13,500	No levee breach, a pool restriction of 1165 and 2% annual chance exceedance inflow to Howard Hanson Dam.
A100	25,000	19,200	No levee breach, a pool restriction of 1165 and 1% annual chance exceedance inflow to Howard Hanson Dam.
A100B	25,000	19,200	Includes levee breach, a pool restriction of 1165 feet, and 1% annual chance exceedance inflow to Howard Hanson Dam.

COE Flood Scenarios

Based on pre 1961 data:

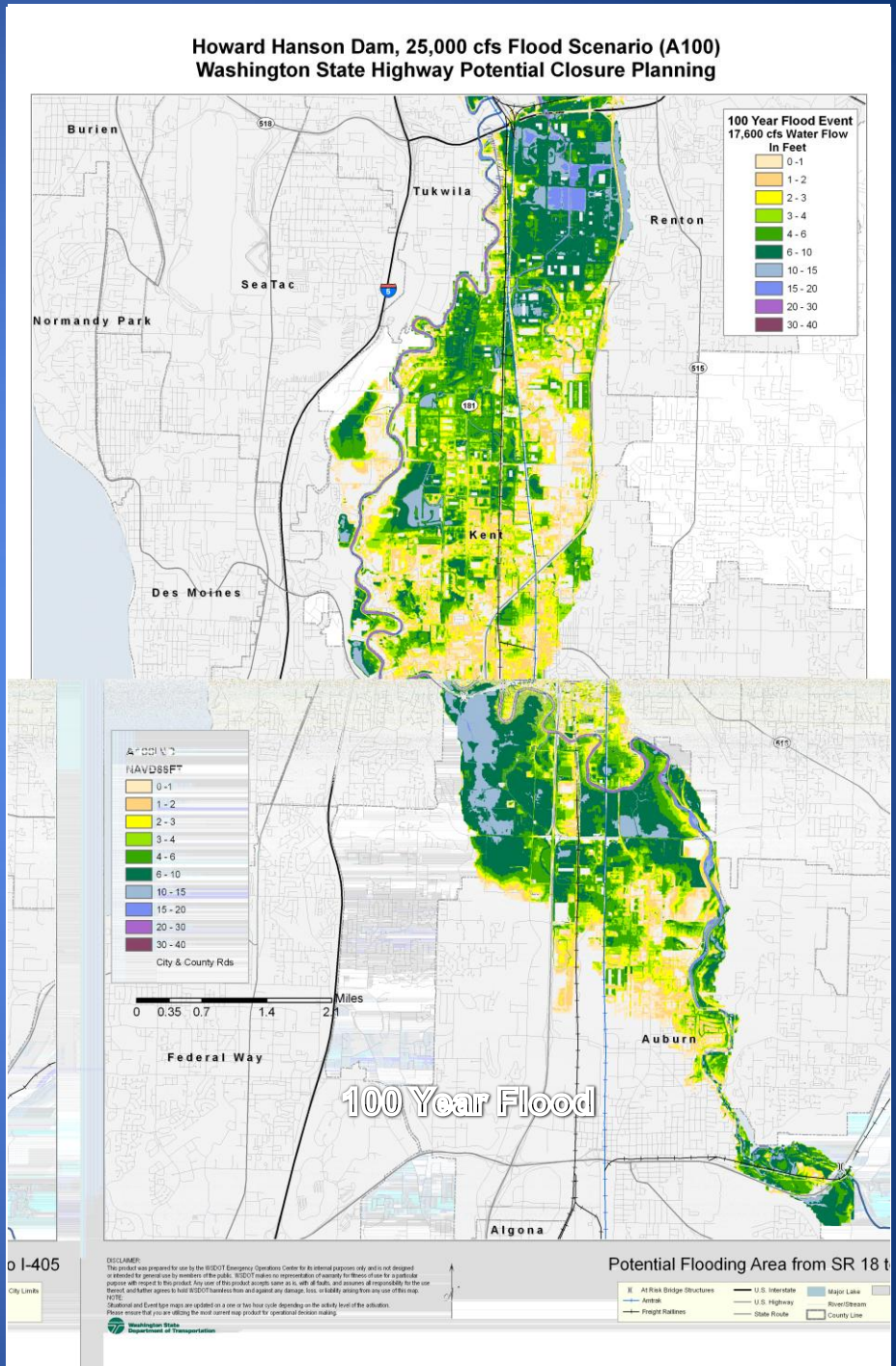
A25 is approximately the 2-year flood

C100 is approximately the 7-year flood

A50 is approximately the 10-year flood

A100 is approximately the 100-year flood

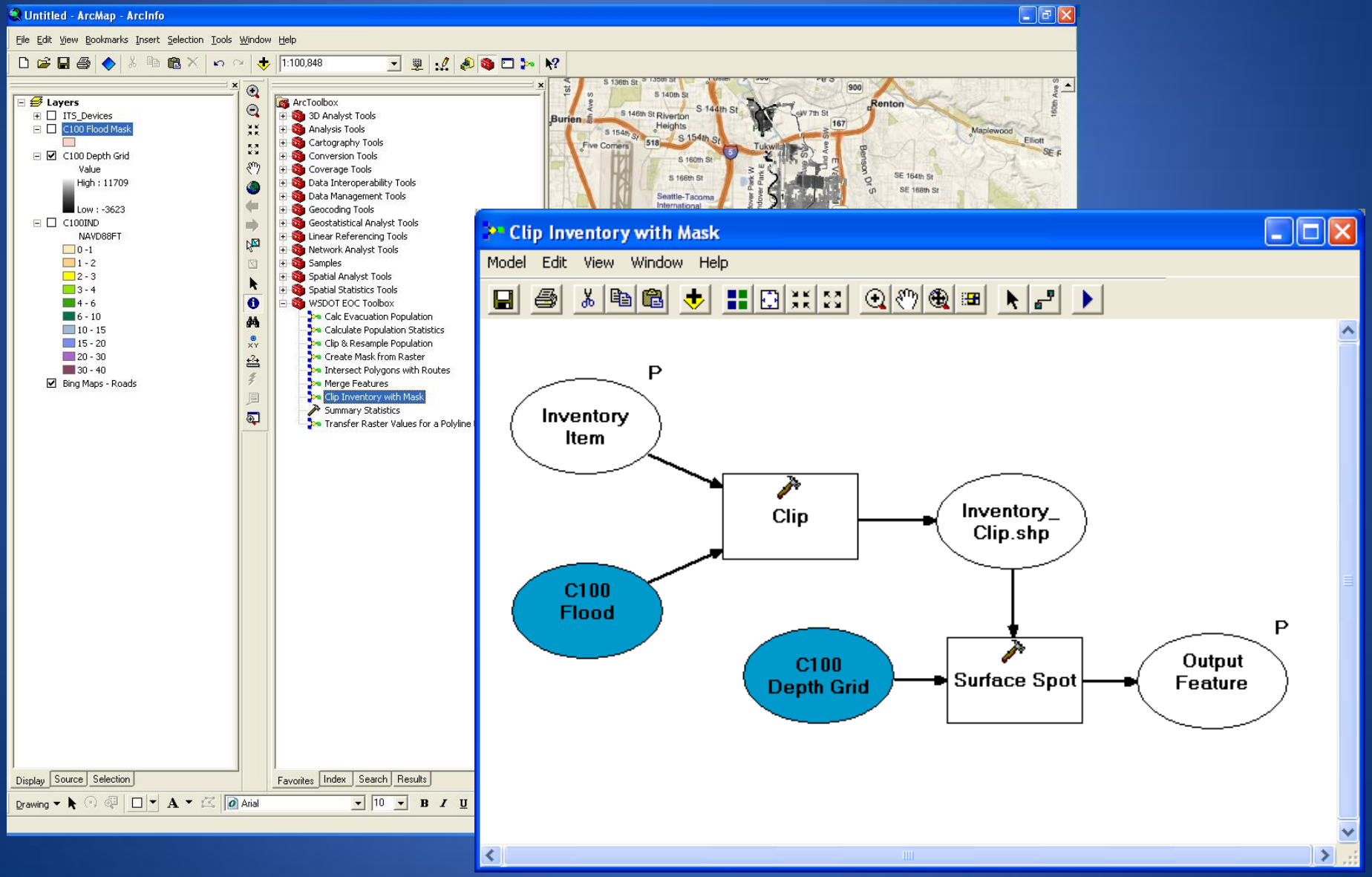
C100 Chosen as the 'base line' flood for impact analysis by the State Emergency Management Division.



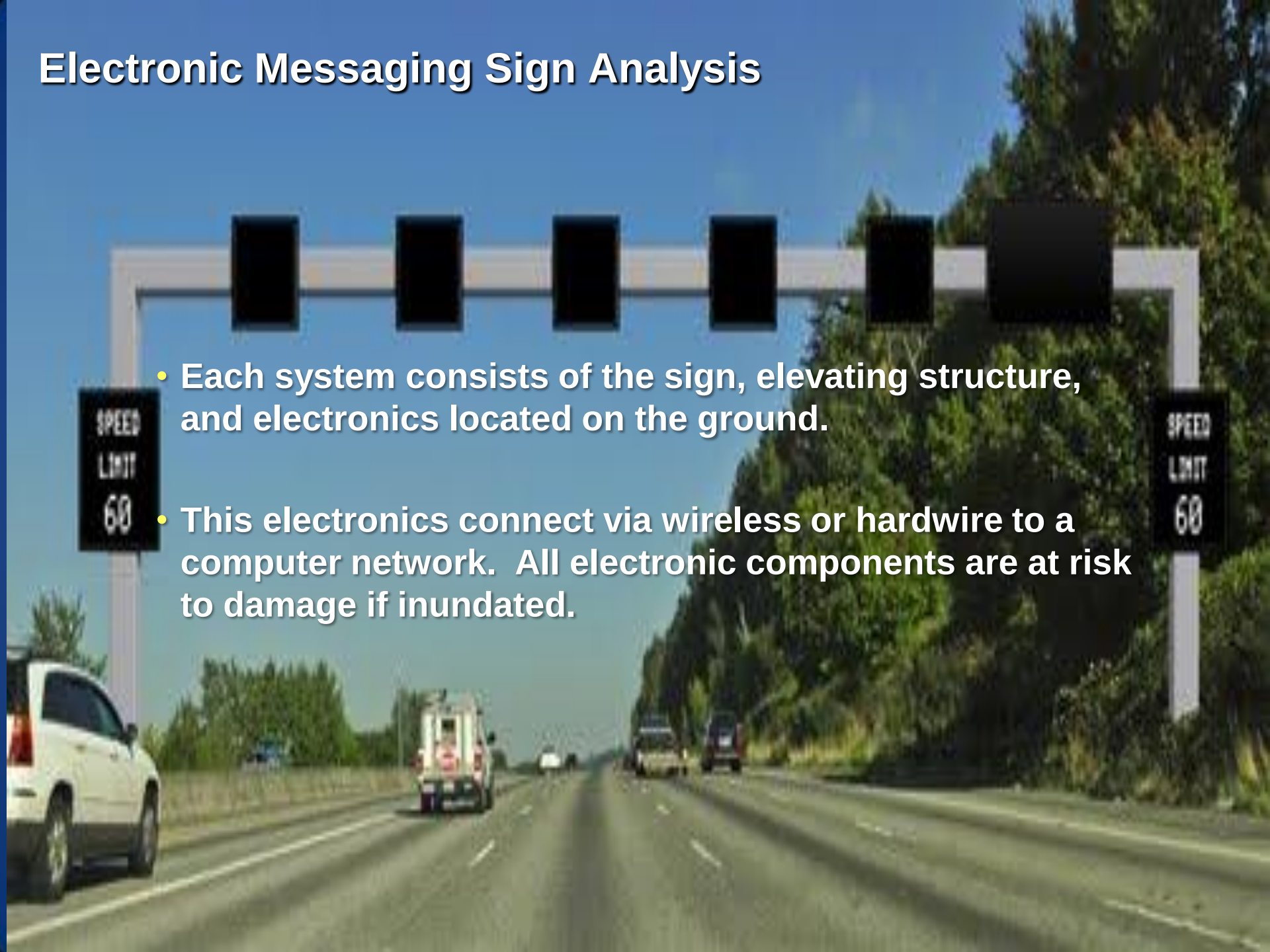
WSDOT Flood Impact Assessment Procedure

1. Created ‘Foot Print’ of C100 flood area & a LIDAR water depth grid derived from FEMA flood models
2. Identified assets that may be at risk by determining if they fell within the C100 flood foot print.
3. Identified the risk to infrastructure for each asset type
4. For items that could be damaged or “lost” if inundated we determined the expected depth of water
5. Lastly, methods to mitigate the risk were identified (e.g., sand bagging, elevating, tie down,or relocating).

ArcGIS Impact Model – Used to Identify Features that fell Within the C100 Flood Foot Print.

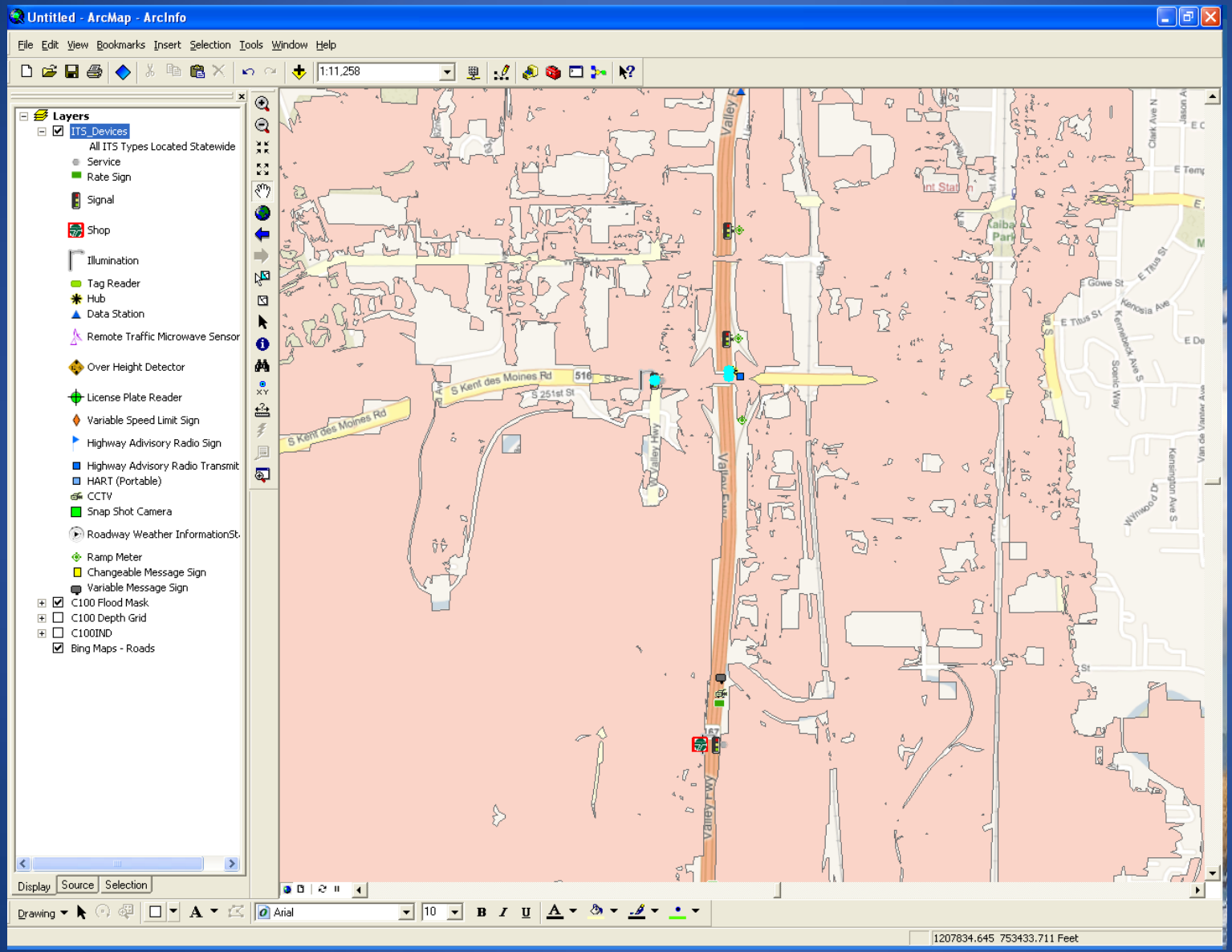


Electronic Messaging Sign Analysis



- Each system consists of the sign, elevating structure, and electronics located on the ground.
- This electronics connect via wireless or hardwire to a computer network. All electronic components are at risk to damage if inundated.

Step by Step Overlay for Electronic Messaging Signs



Of the159 signs, meters, luminaries, data stations, an EM signs to in the valley, 17 are subject to inundation.

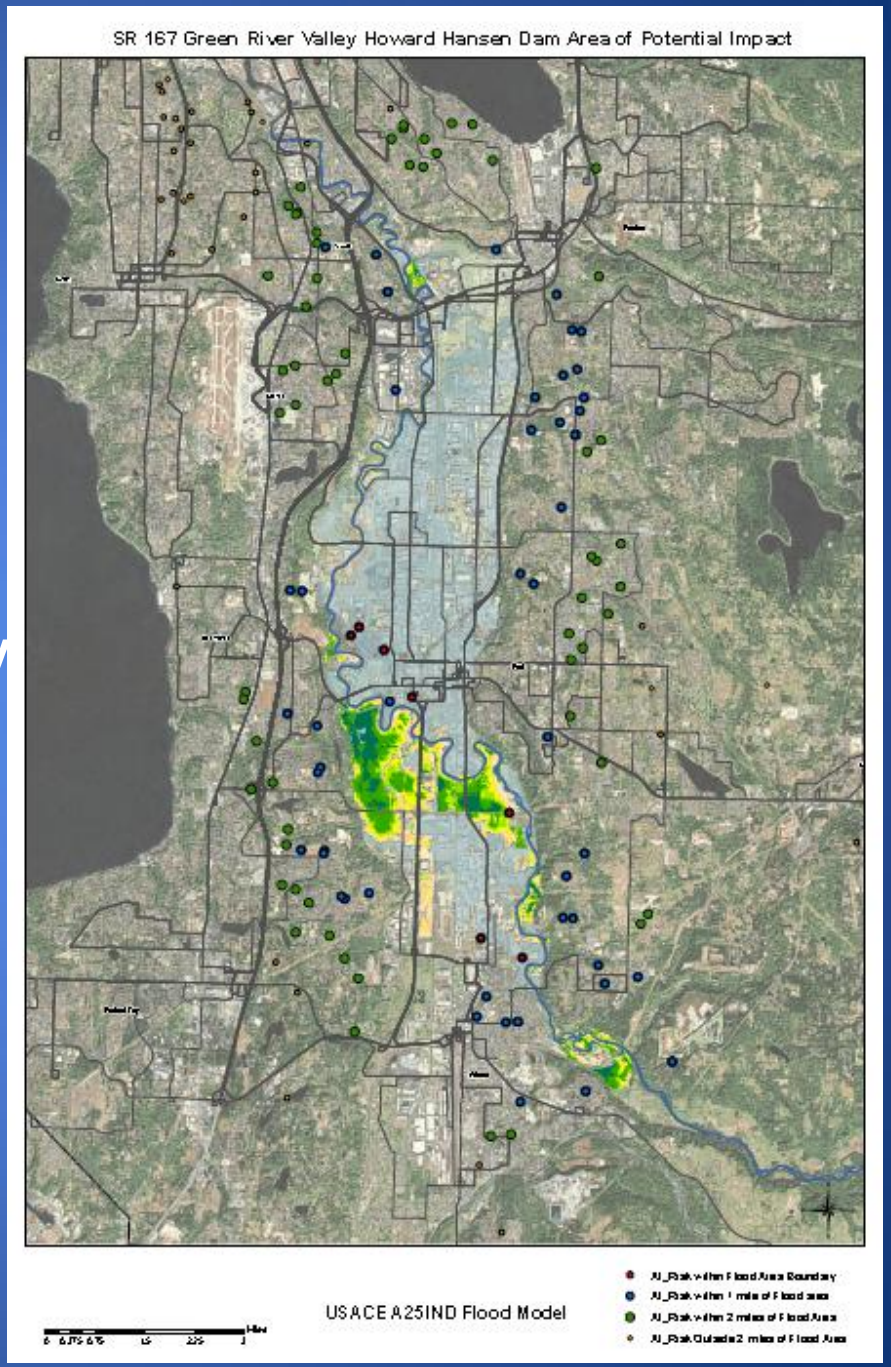
Inundation Depth & Mitigation Efforts

- The expect depth of inundation was then calculated using the model. This greatly reduced the number of features at risk since many are elevated on sign bridges or on poles.

- For the remainder, GPS crews visited and surveyed each site and options for mitigating the risk were identified and implemented.

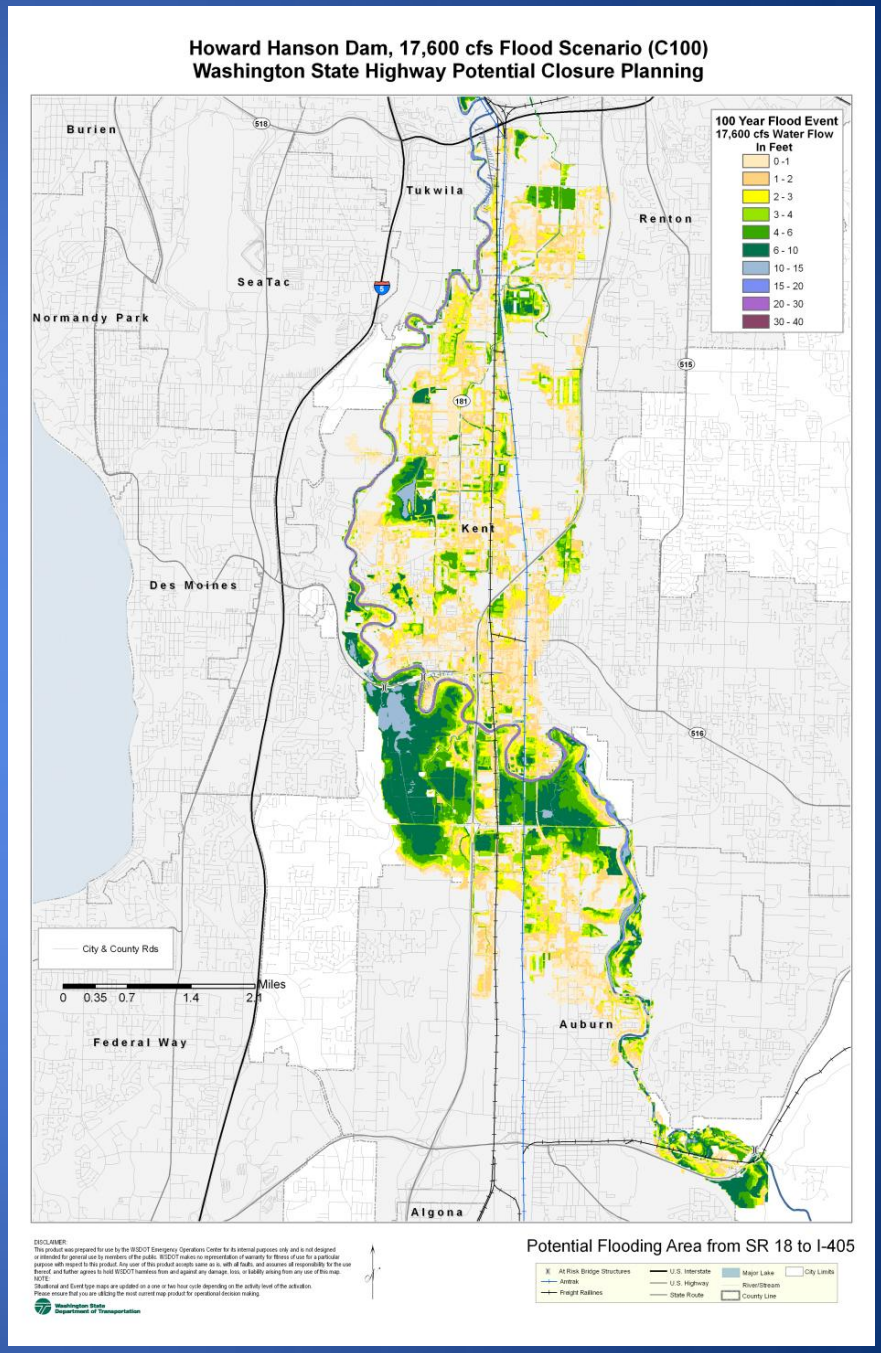
In addition to Infrastructure, the addresses of WSDOT owned or leased facilities were Geocoding and overlayed on the the flood mask to determine if they were at risk.

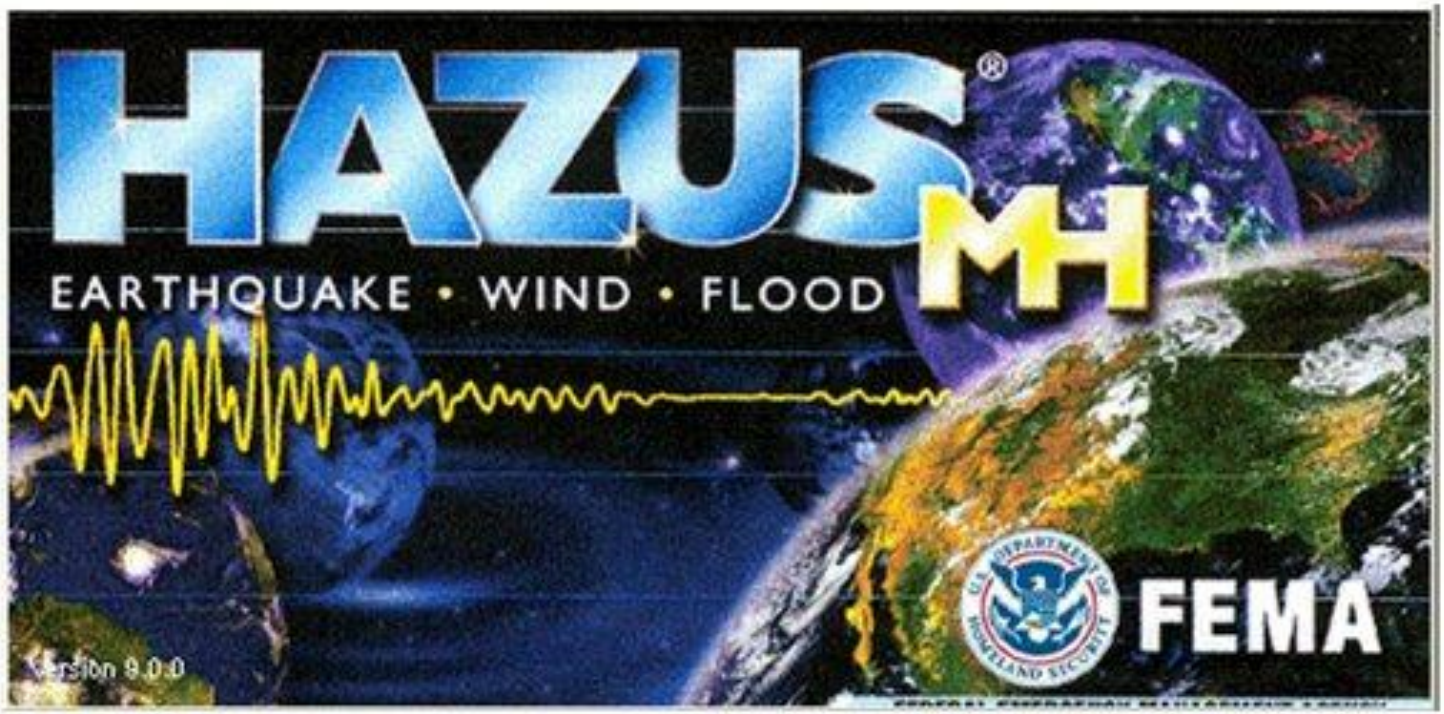
WSDOT's Kent Maintenance Facility will be subject to 3-4 ft of flooding under the C100 scenario.



Evacuation Routes

- A follow on analysis was conducted to determine the State Routes that could be flooded by the C100 Scenario
- At the height of the C100 flood the following State Routes would be partially closed:
  - SR 18
  - SR 167
  - SR 181
  - SR 516
  - And On-Ramps to I-405

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Green River Temporary Measures

Locations			
	Hesco	**Super Sacks**	**Sandbags**
Auburn	10,500		100,000
Kent		21,000	500,000
Renton		11,000	250,000
Tukwila	10,500	9,000	100,000
King County	6,500		100,000
Seattle District		34,000	1,250,000
Totals	27,500	75,000	2,300,000

Howard Hanson Dam & Green River Valley Impact Analysis

1. This was the largest pre-flood impact analysis ever done in the State of Washington
2. This was a joint Federal-State-Local Effort
3. Every State Agency was required to:
   - identify owned, leased, or mission critical infrastructure that was within the C100 flood zone, and
   - Identify and implement mitigation measures for the items identified at risk
4. Impacted Counties and Cities conducted the similar analyses
5. Utilities and all large employers in the valley were contacted by EMD and were involved in the hazard identification process.
6. In support of this effort FEMA produced new flood maps for the Valley and encouraged residence of the Green River Valley to obtain FEMA Flood Insurance.