

# Review of the December 2007 Flood Event at Doty

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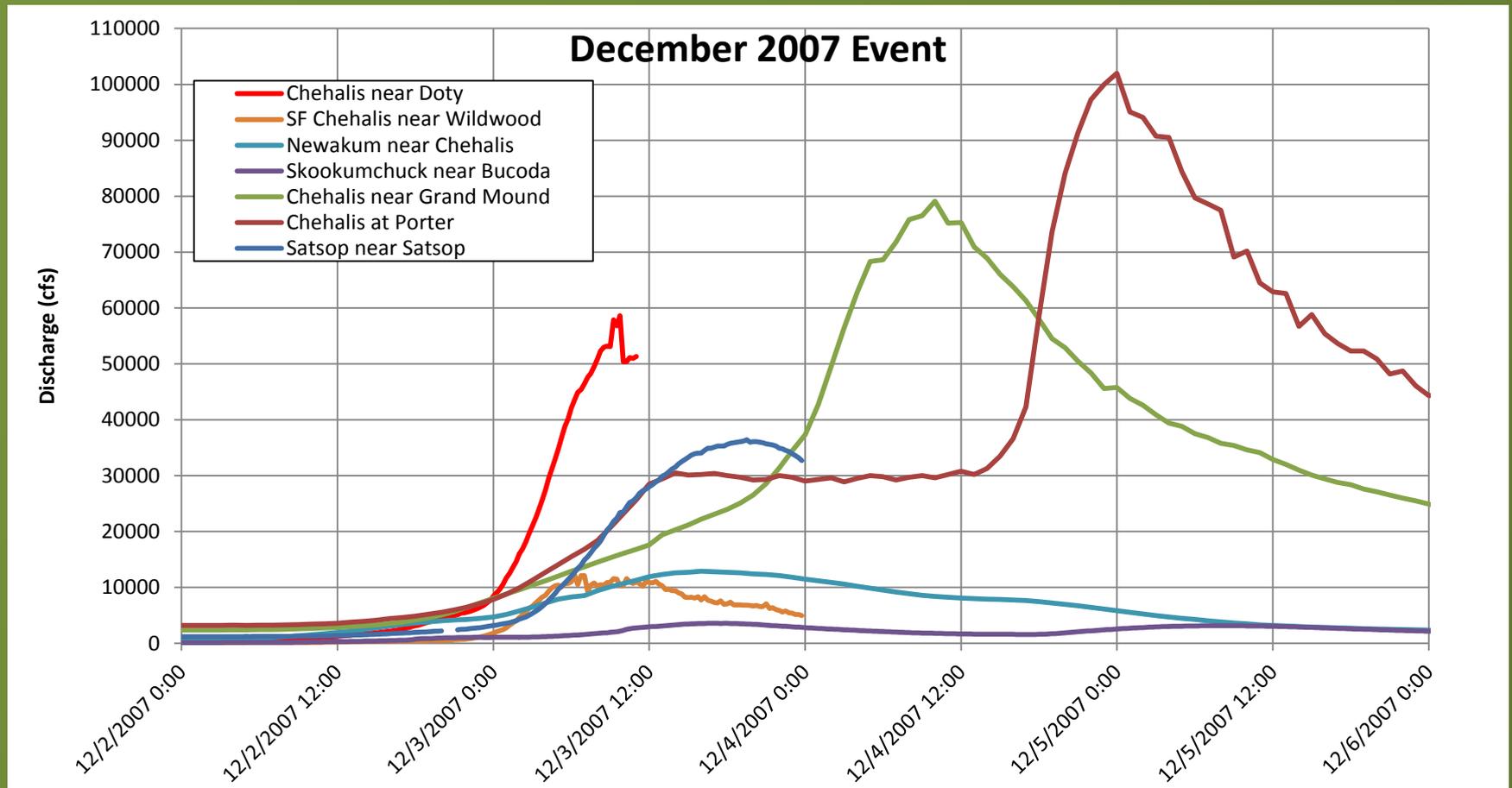
*Technical Workshop*

*Lacey Community Center*

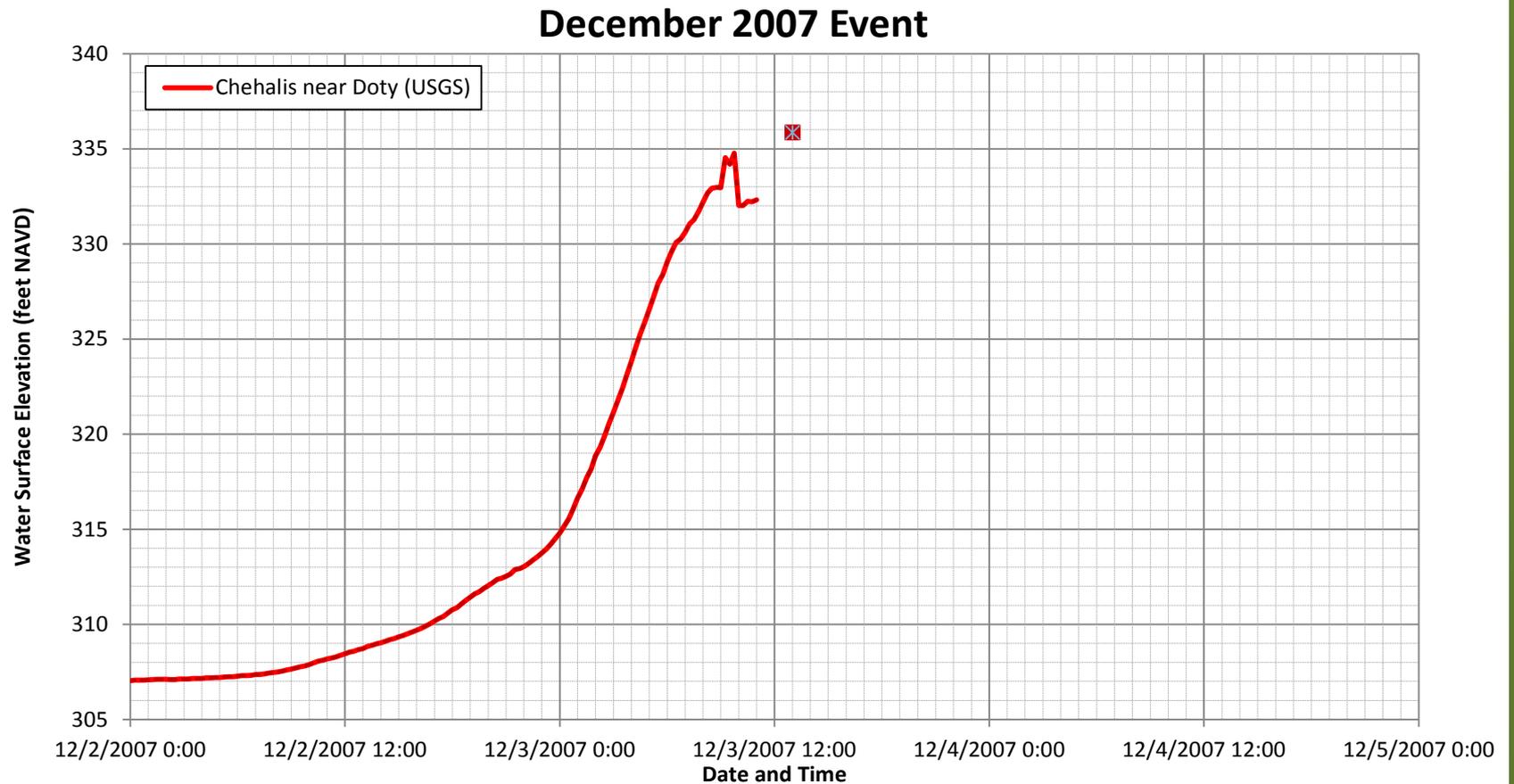
*October 30, 2013*



# December 2007 Flood Event



# Doty gage – failed at 11 AM on December 3, 2007



# Doty Gage Indirect Discharge Measurement

## Slope Area Method –

$$V = \frac{1.49}{n} R^{2/3} \sqrt{S}$$

$$Q = VA$$

Where:

Q = Flow (cfs)

V = Velocity (fps)

n = Manning's N (roughness)

R = Hydraulic radius =  $A/P_w$

S = Slope (ft/ft)

A = Area (ft<sup>2</sup>)

$P_w$  = Wetted perimeter (ft)

# Key Assumption - Manning's N

Selected based on judgment of the hydraulic engineer considering:

1. Bed material
2. Bank vegetation
3. Form roughness (structure and shape)
4. Turbulence
5. Depth of flow
6. Sediment?
7. Wood in transit?

# Channel at site of USGS indirect measurement



## Other key components - Area

Area estimated based on cross section surveys and high water marks (HWMs)

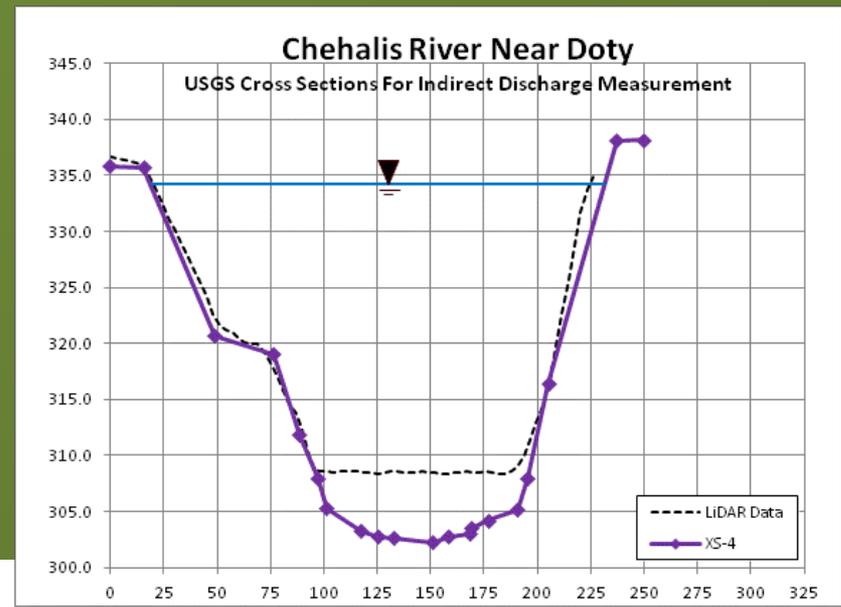
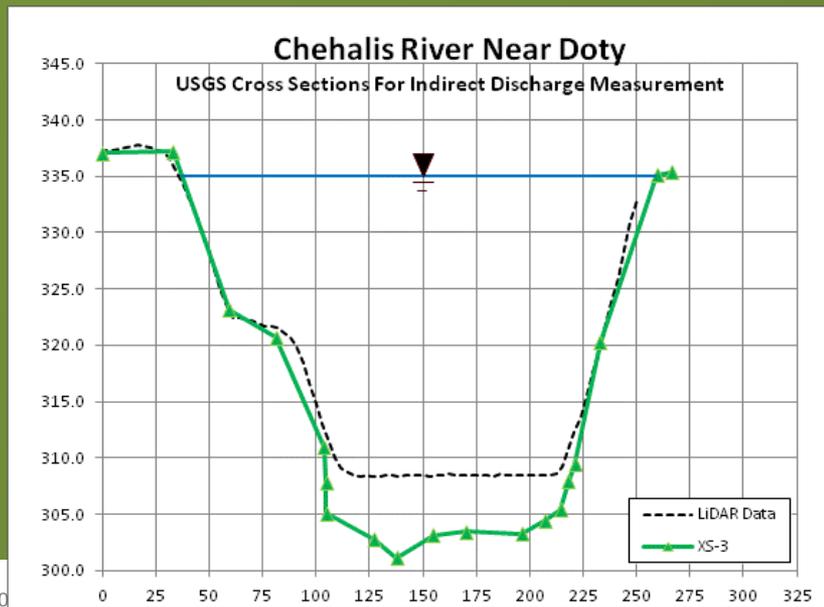
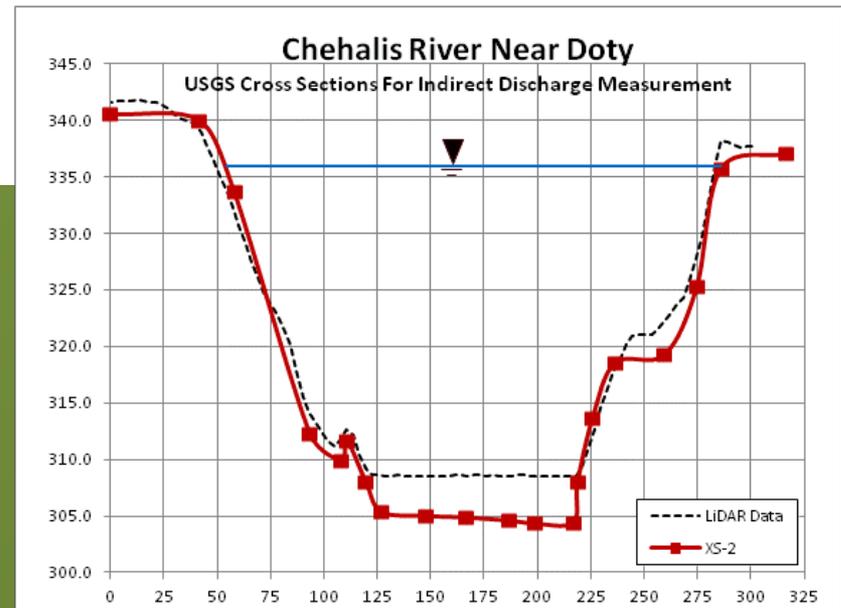
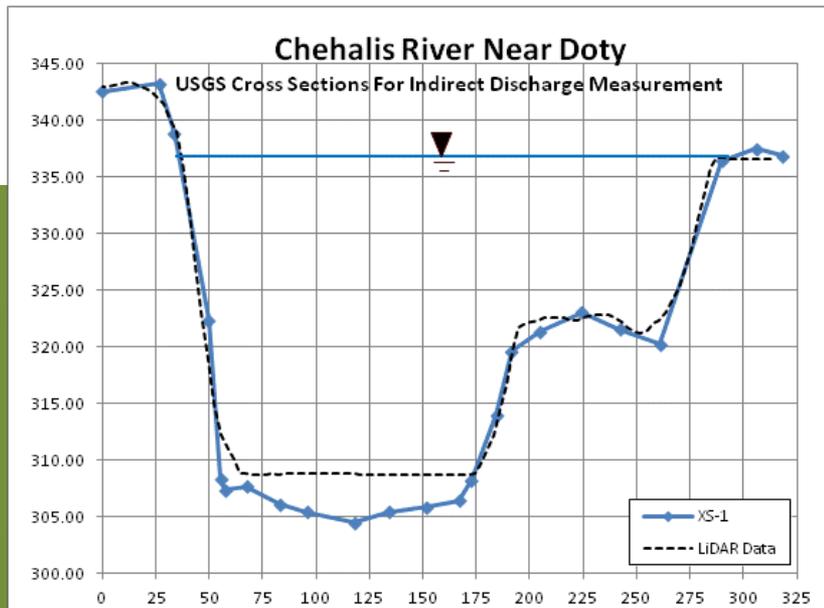
Some potential uncertainties:

1. Wave action at edge of flow ( $\pm 0.5$  feet)
2. Effect of wood on flow area and depth
3. Velocity drawdown in high velocity zone (versus edge)

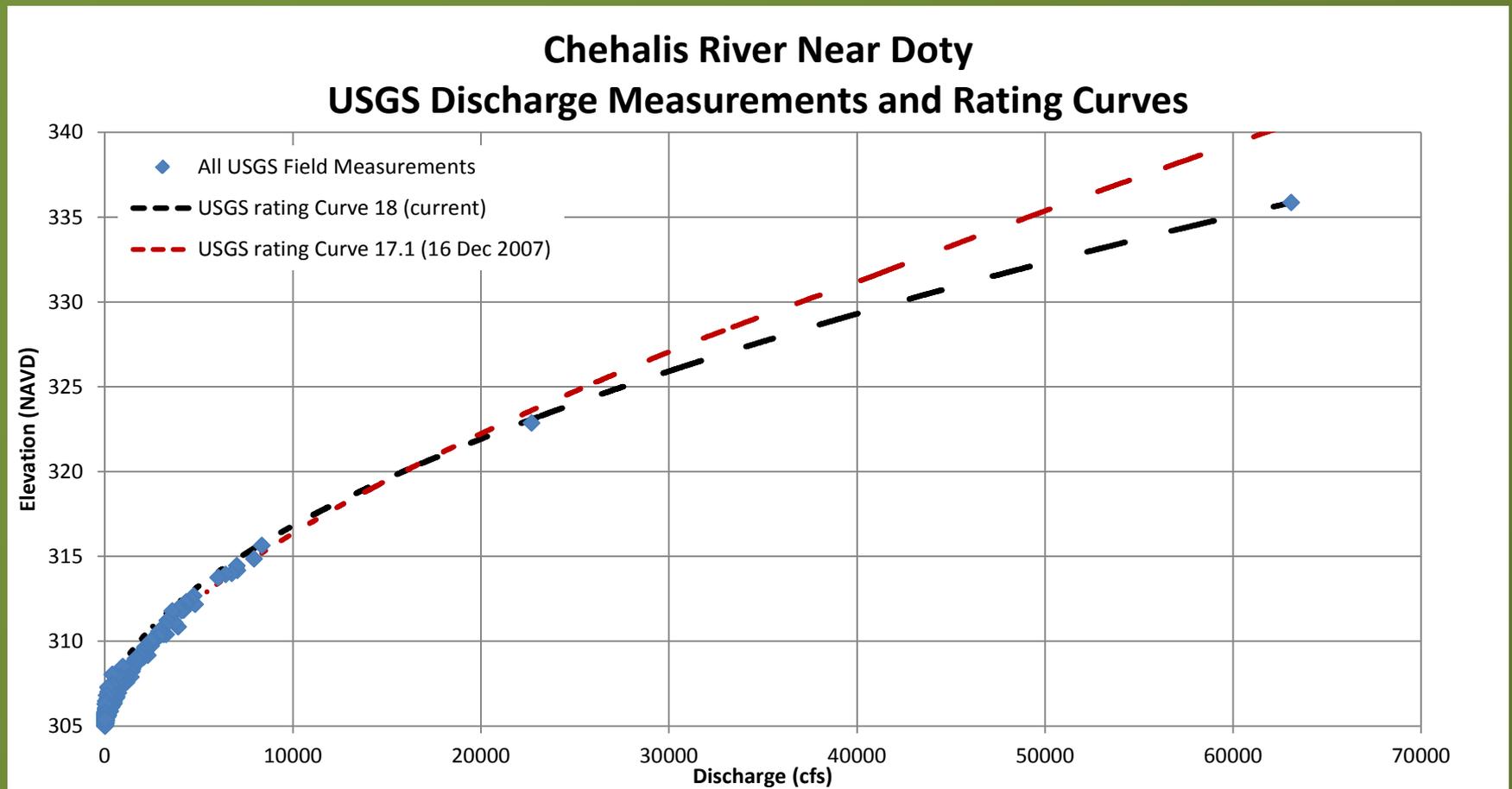
# USGS Survey after Dec 2007 Flood



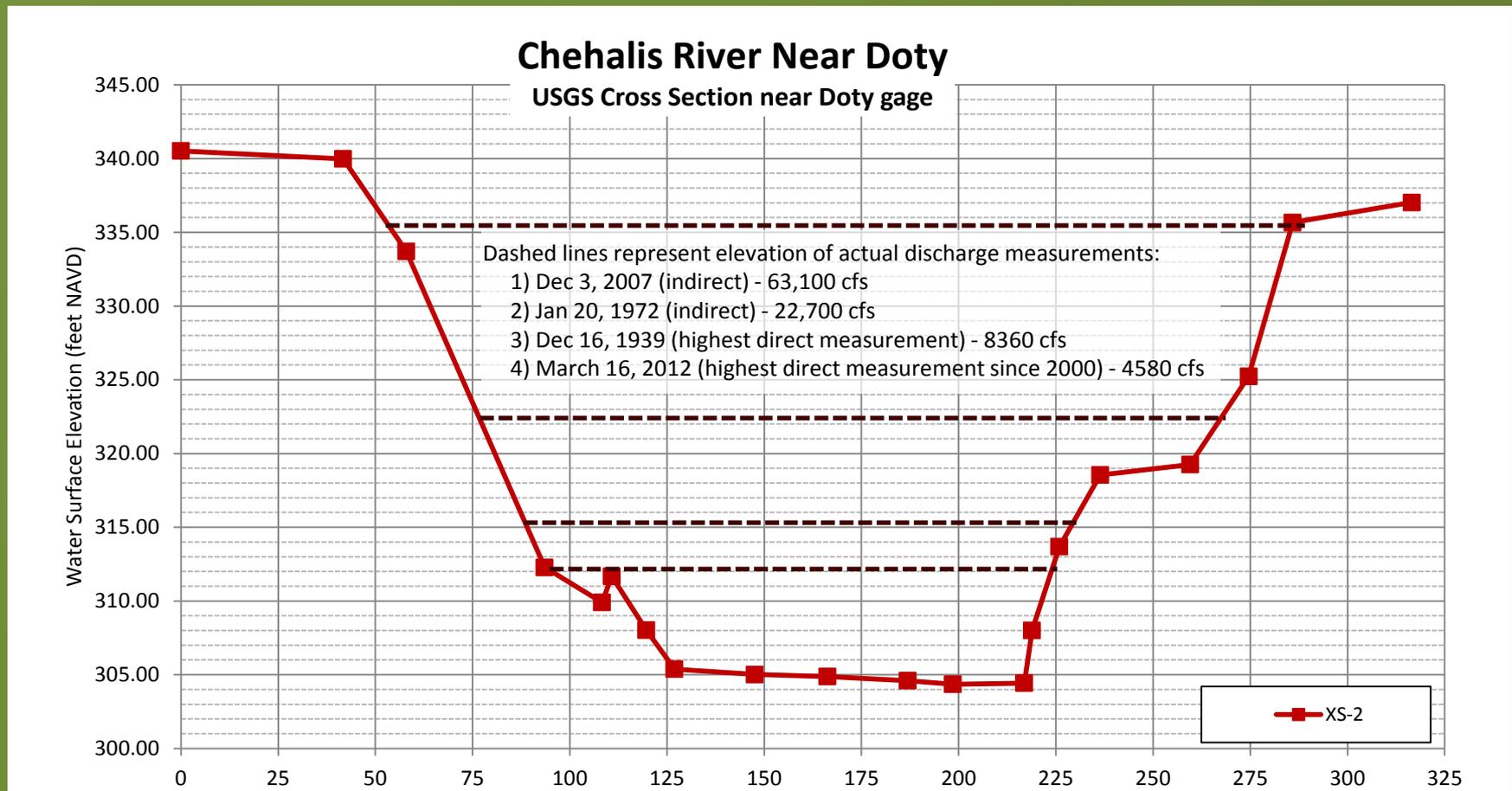
# USGS Cross Sections



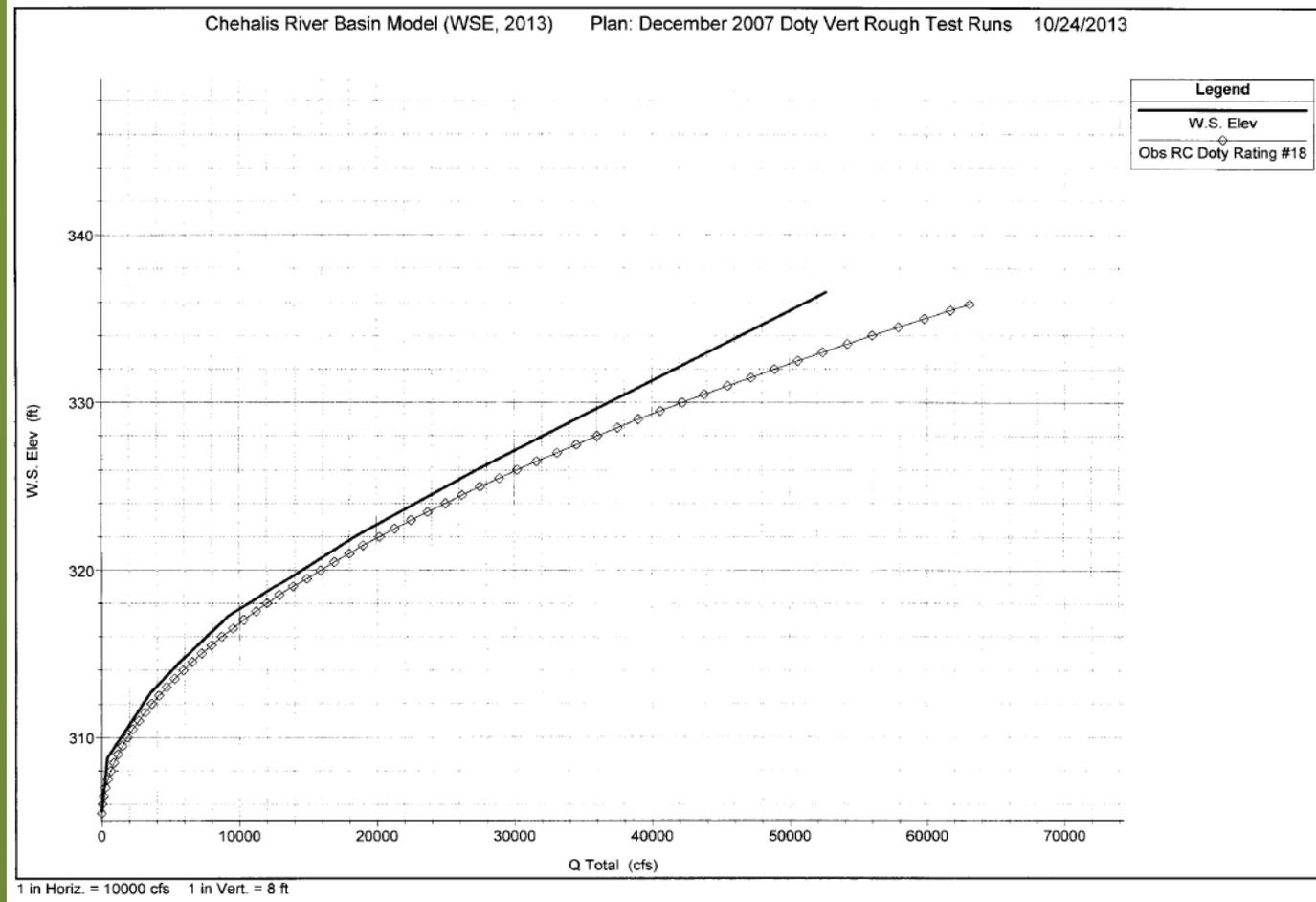
# USGS Rating Curves and Discharge Measurements



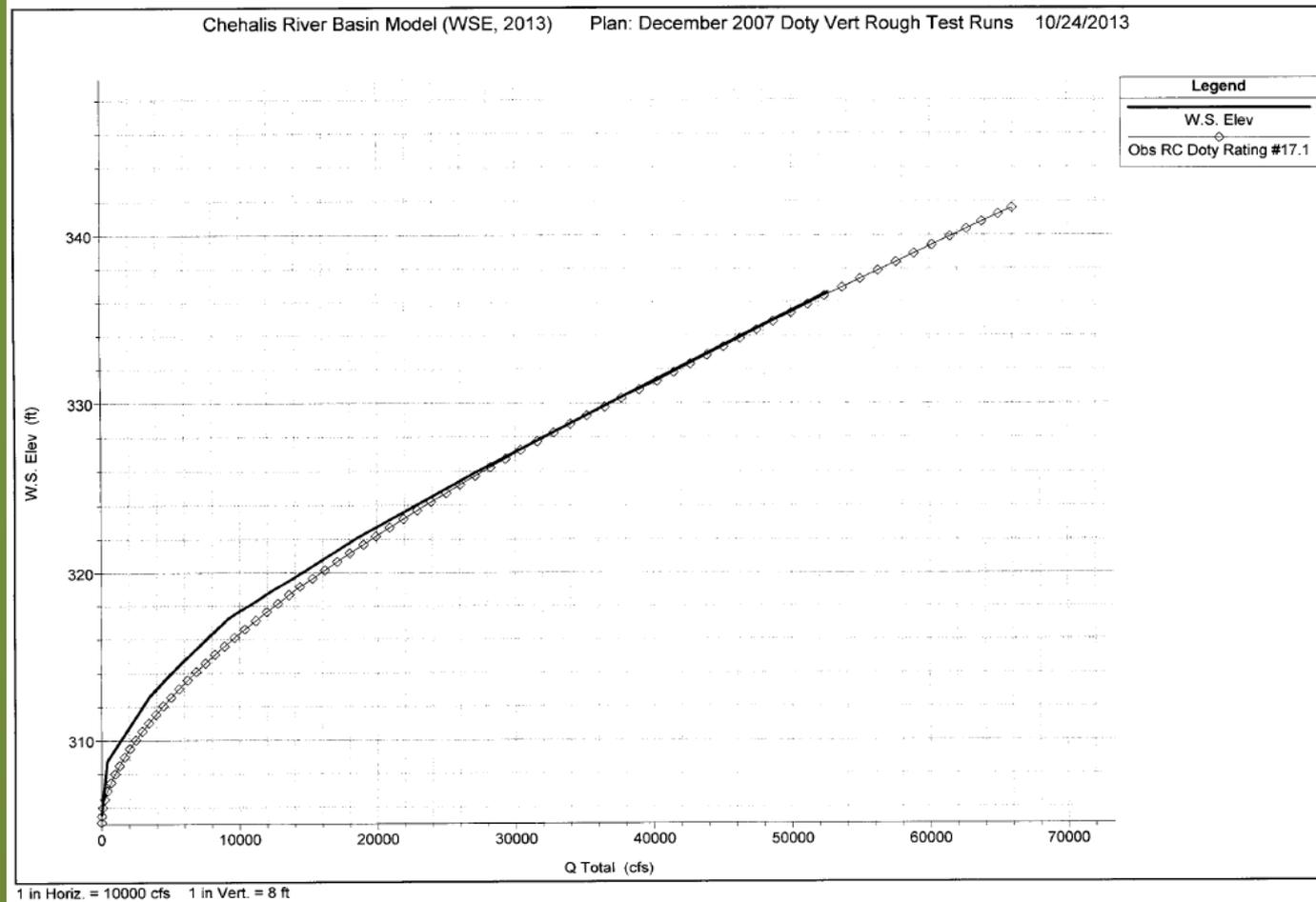
# USGS Rating Curves and Discharge Measurements



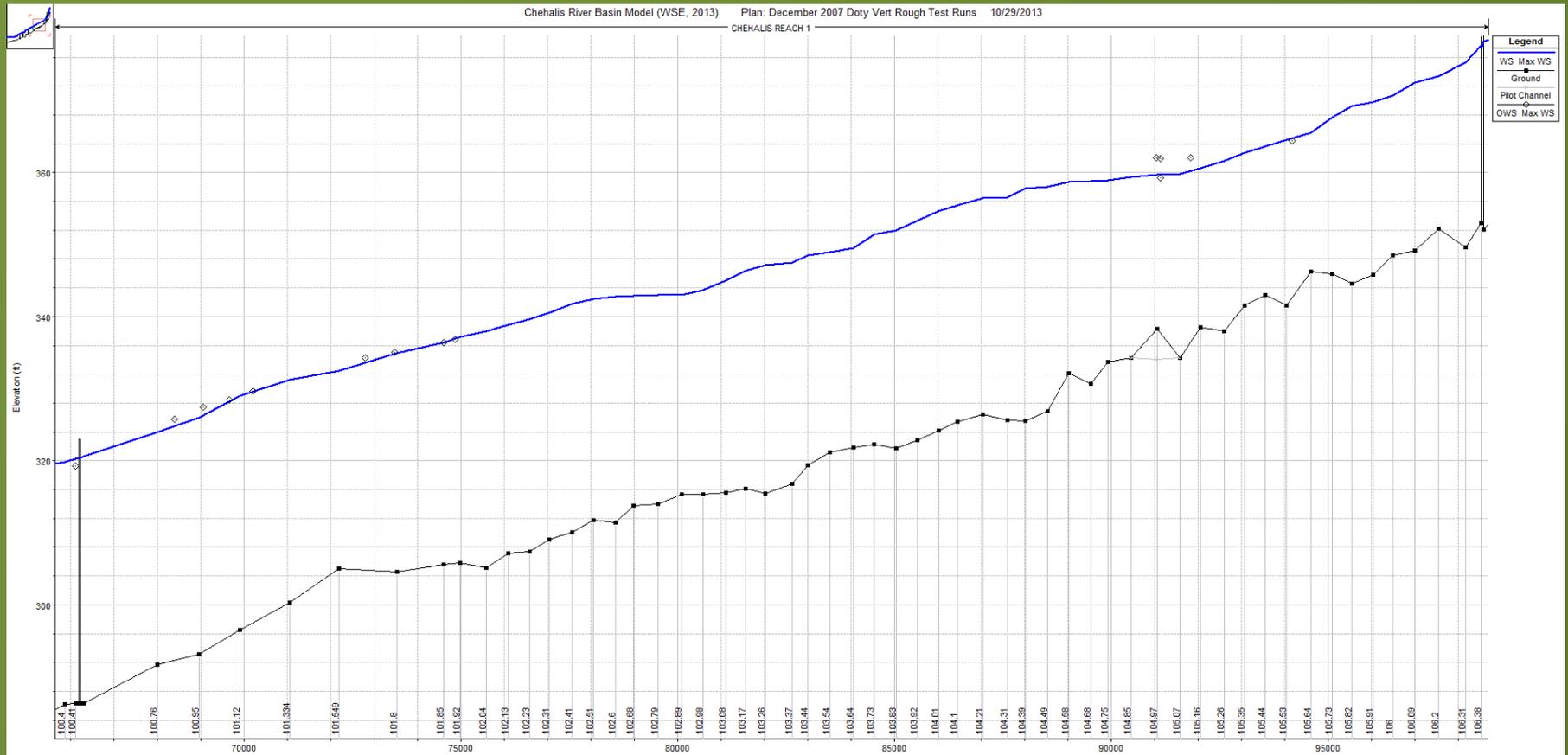
# WSE HEC-RAS Model v. Rating 18



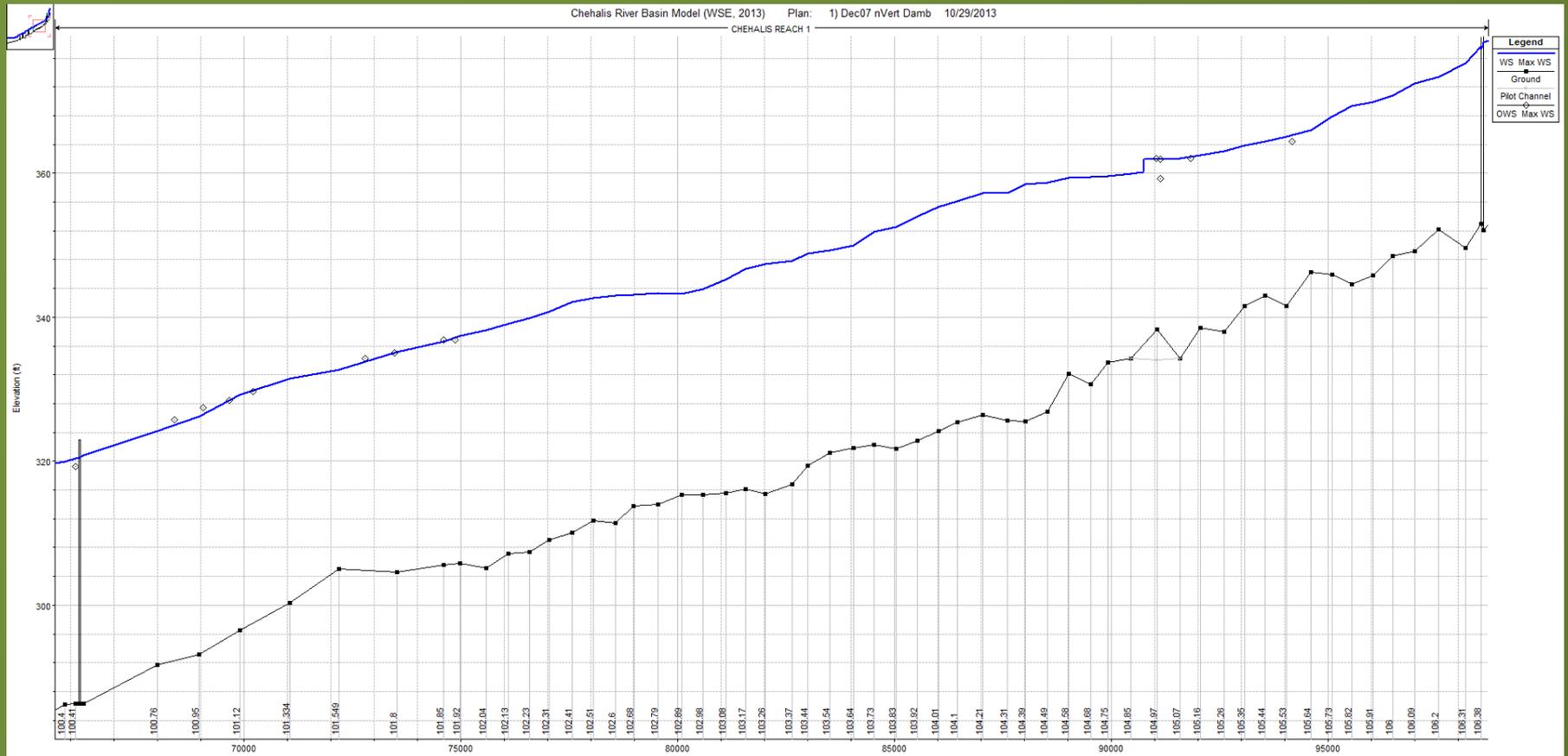
# WSE HEC-RAS Model v. Rating 17.1



# HEC-RAS Model calibration - Elk Creek Road to Pe Ell (without log jam)



# HEC-RAS Model calibration - Elk Creek Road to Pe Ell (with log jam, before failure)



# USGS Peak Flow Estimate v. WSE Estimate

USGS – 63,100 cfs  $\pm 15\%$

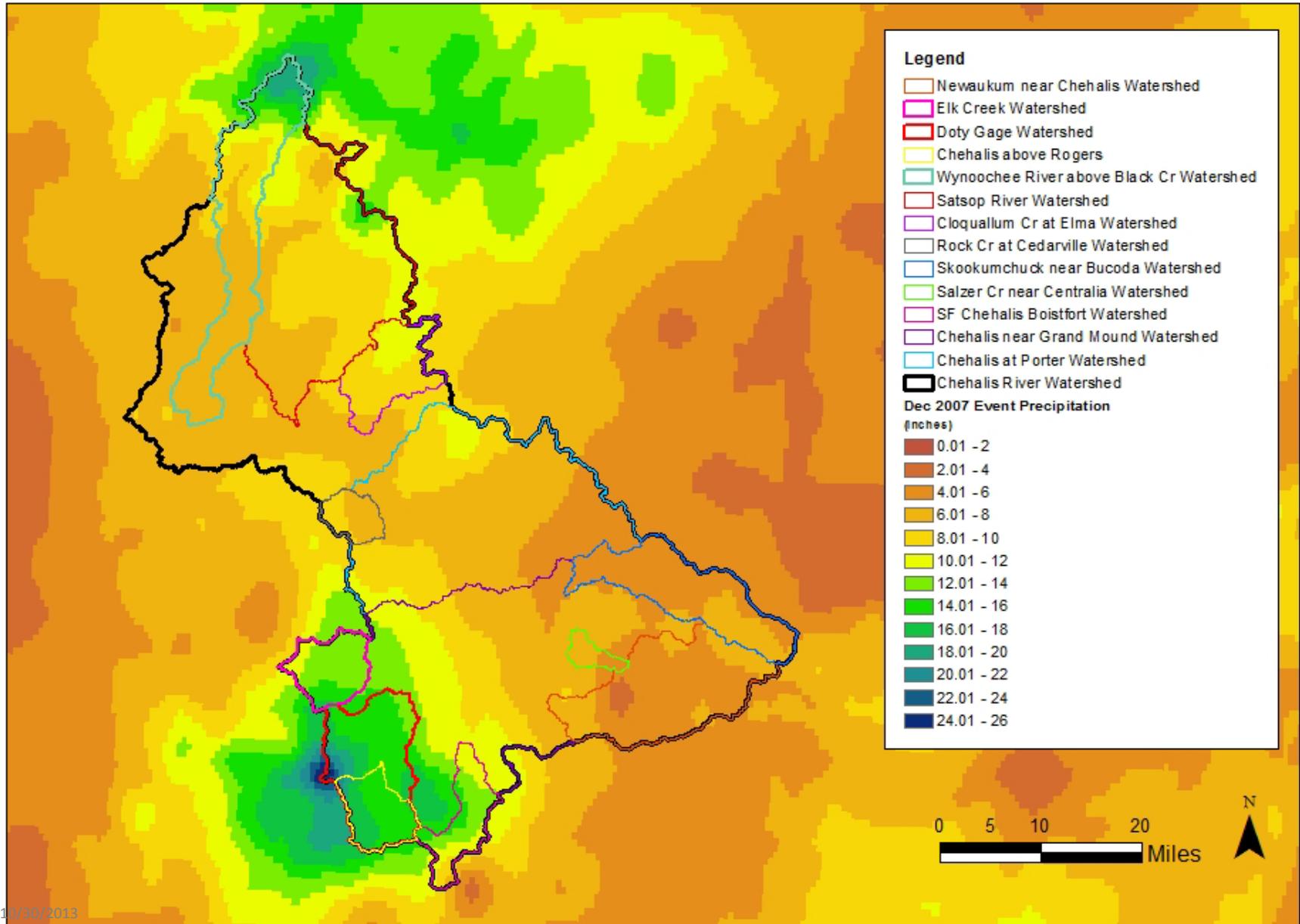
WSE – 52,600 cfs

Difference – WSE estimate 16% less than USGS

Reasons for difference:

1. Manning's n value (USGS 0.04, WSE 0.045)
2. Cross section locations and properties
3. HEC-RAS unsteady model versus slope area

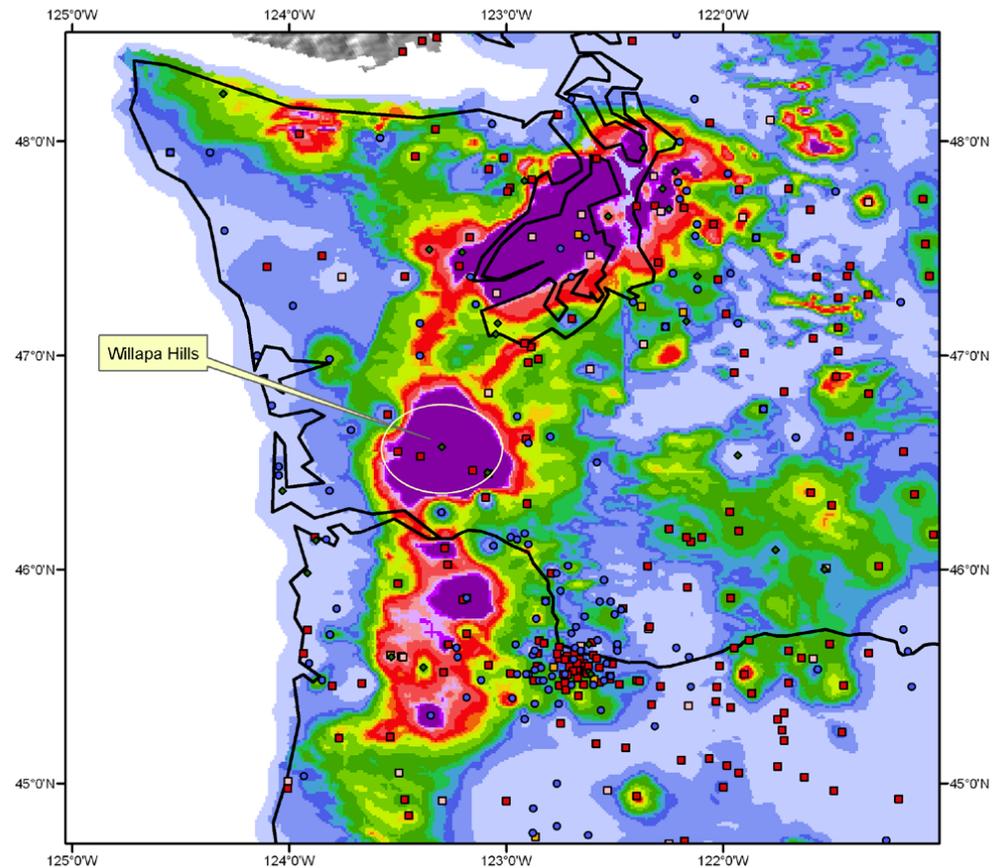
# Other Supporting Info – precipitation and hydrology



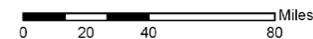
# Precipitation Recurrence

Based on maximum 24-hour period during December 3, 2007 flood event

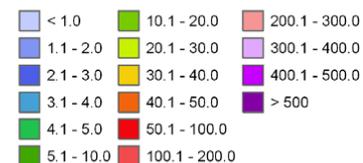
NEXRAD based data ground controlled using 496 precipitation stations



**Average Recurrence Interval of Maximum 24-hour Precipitation (inches)**  
**During 96 hour Period Between**  
**December 1, 2007 (0700 Z) to December 5, 2007 (0700 Z)**



### Average Recurrence Interval (years)



### Stations

- Daily
- Hourly
- Hourly Estimated
- Hourly Pseudo
- ◆ Supplemental



MetStat/AWA December 2009

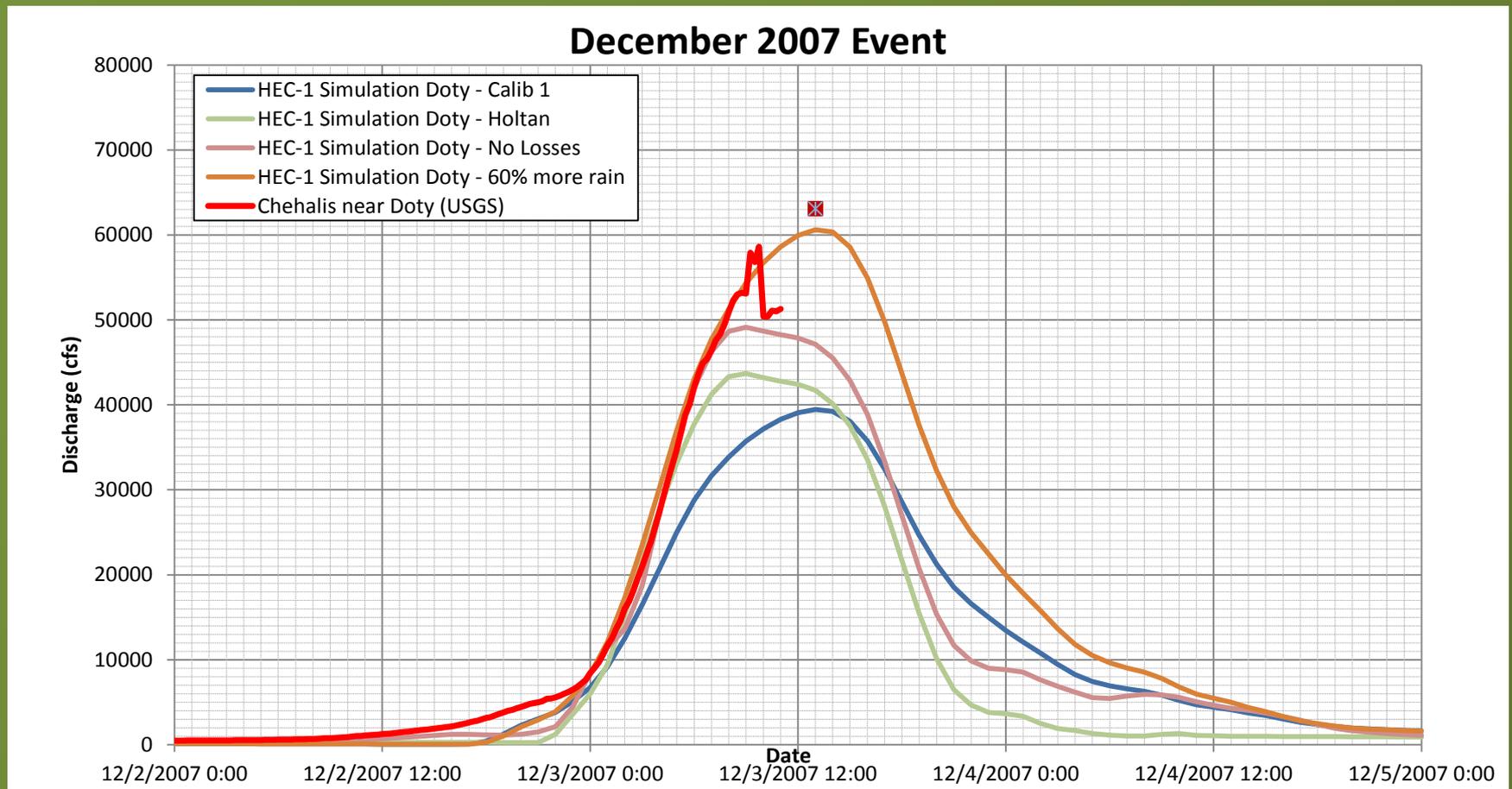
# December 2007 Precipitation Statistics

<b>Basin</b>	<b>Gage No.</b>	<b>WSDOT Ave. 100yr24hr precip</b>	<b>Dec 2007 Event</b>	<b>Ratio (Dec2007:100yr24hr)</b>
Doty - Chehalis	12020000	7.04	16.00	2.27
Elk Creek	12020500	6.89	13.35	1.94
SF Chehalis at Boistfort	12021000	5.99	12.17	2.03
Newaukum	12025000	5.15	5.61	1.09
Skookumchuck	12026400	4.82	5.90	1.23
Grand Mound - Chehalis	12027500	5.39	9.37	1.74

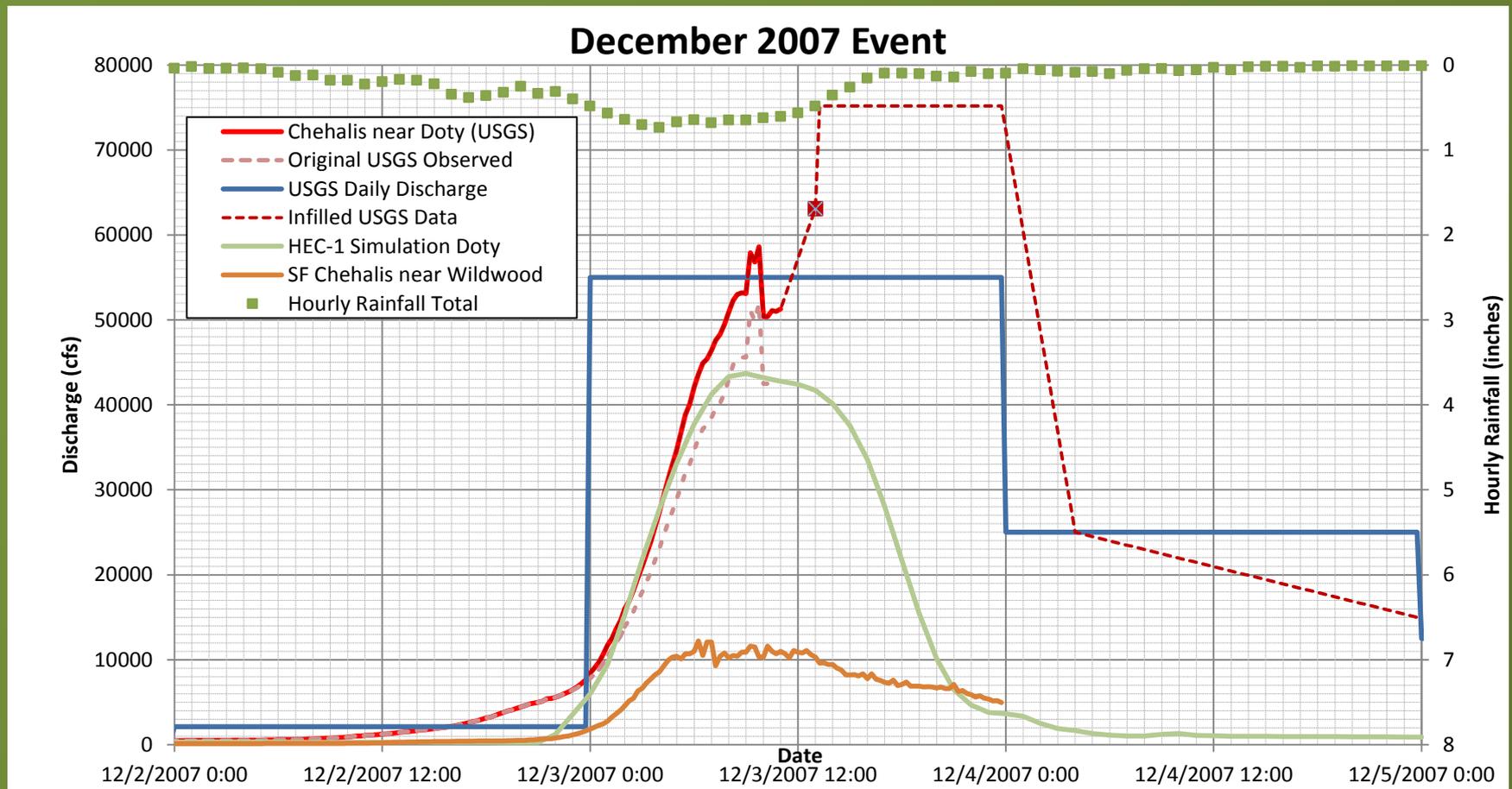
# Simple HEC-1 Hydrologic Model

- Uses SPAS Hourly Precipitation data for 1 - 4 Dec 2007
- 3 sub-basins (Thrash Creek, potential dam site, Doty gage)
- Ignored snowmelt contributions
- Several simple loss methodologies and basin transforms tried
- Straddle-Stagger river routing
- “Calibrated” to early part of event
- Required large initial losses
- Used for sensitivity tests (no losses, more rainfall, etc.)

# Simple HEC-1 Hydrologic Model



# Doty gage – daily flow volume



# Doty gage – daily flow volume

Basin average rainfall – 1-4 December 2007 = 16.0”

Basin average runoff – 2-5 December 2007 = 32.4”

Daily discharge for December 3<sup>rd</sup> is not possible  
given hourly discharges through 11 AM and  
estimated peak discharge

Currently discussing this with USGS

# Potential Implications on Hydrology

Percent Chance Exceedence	Return Period (years)	USGS Doty Gage Computed Frequency Curve - Flow (cfs)				
		All Observed Data		Dec 2007 Event Set to 52,660 cfs		Dec 2007 Event Removed
		1939 - 2012	With Historic Period	1939 - 2012	With Historic Period	1939 - 2012
0.2	500	59,000	54,000	54,000	50,000	39,000
0.5	200	47,000	43,000	43,000	41,000	34,000
<b>1</b>	<b>100</b>	<b>39,000</b>	<b>37,000</b>	<b>37,000</b>	<b>35,000</b>	<b>30,000</b>
2	50	32,000	30,000	31,000	29,000	26,000
4	25	26,000	25,000	25,000	24,000	22,000
10	10	20,000	19,000	19,000	19,000	18,000
20	5	15,000	15,000	15,000	15,000	14,000
50	2	9,900	9,900	10,000	9,900	10,000
80	1.25	6,900	7,000	7,000	7,000	7,100
90	1.11	5,900	6,000	5,900	6,000	6,000
95	1.05	5,200	5,300	5,200	5,300	5,300
99	1.01	4,300	4,400	4,300	4,300	4,200

Note: <sup>1</sup> All frequency analyses based on the methods of Bulletin 17B of the Hydrology Subcommittee, Interagency Advisory Committee on Water Data, Revised September 1981

<sup>2</sup> Frequency analyses conducted using US Army Corps of Engineers HEC-SSP Software