Development of a 1-Dimensional Unsteady State Model of the Lower Columbia River and Application in Determining a 50% Annual Exceedance Stage Profile

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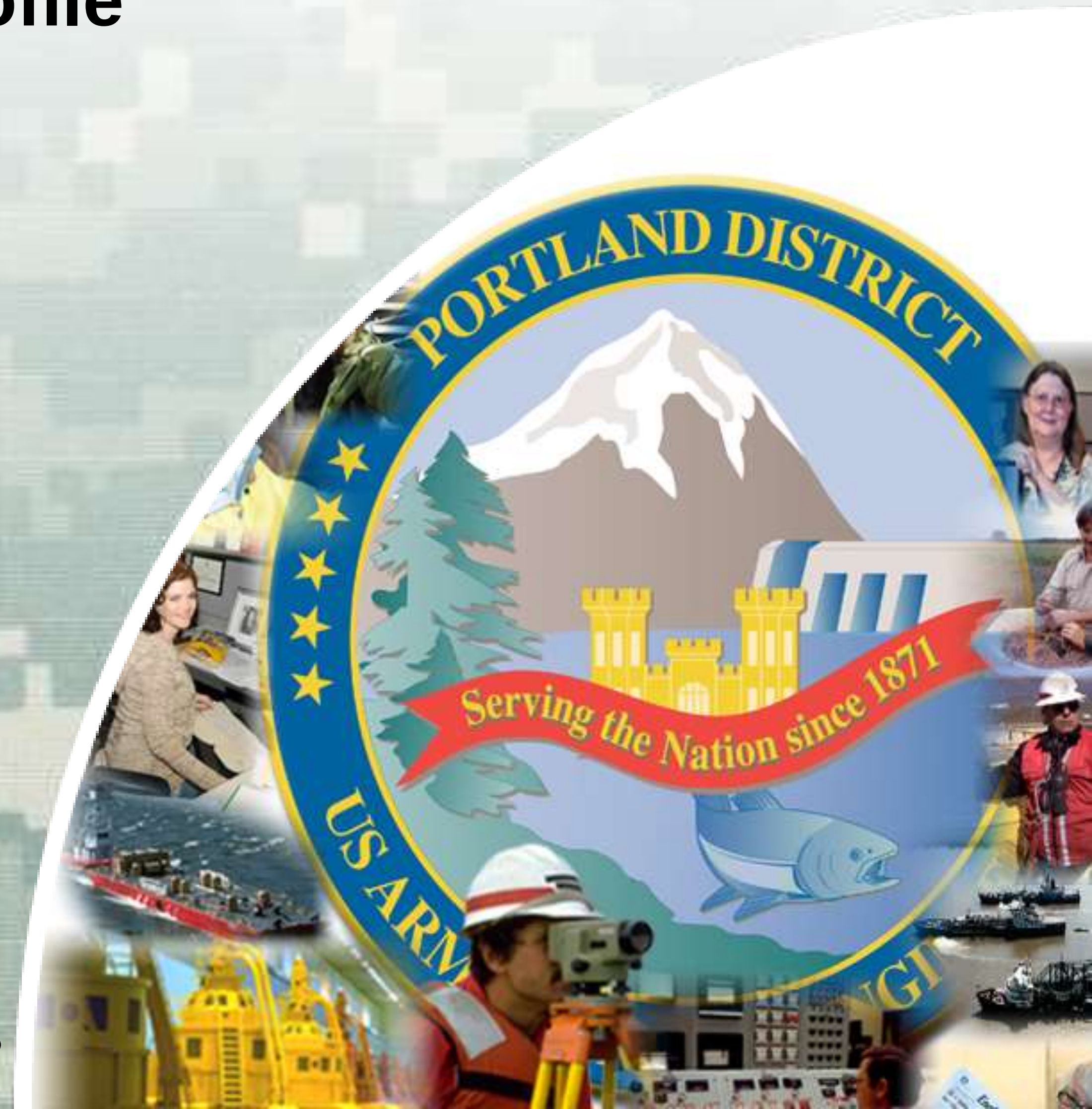

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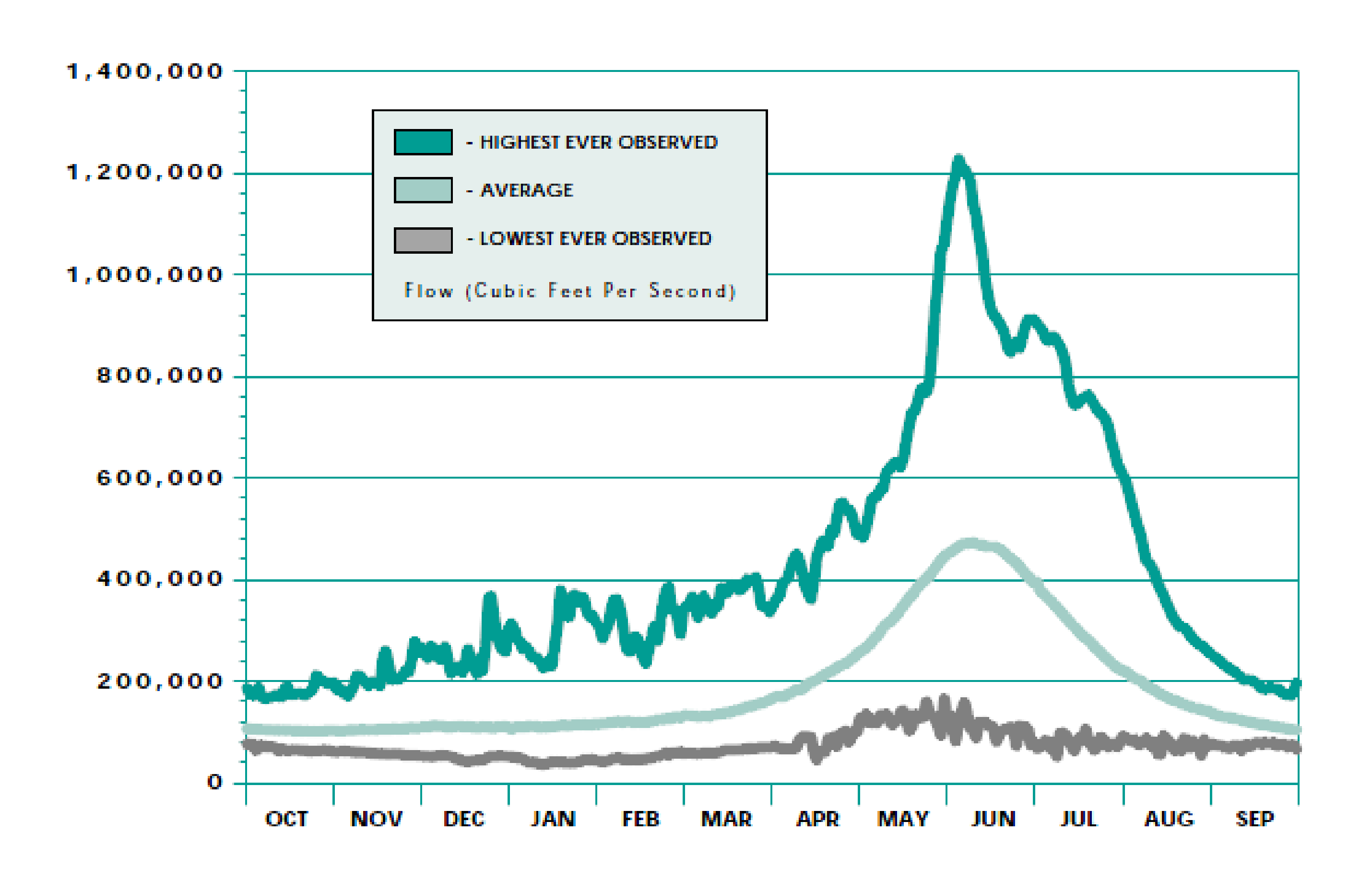
Topics

- Purpose of Model
- 1-D HEC-RAS Model Development
  - Terrain
  - Model Geometry
  - Inflow Hydrograph
  - Calibration
- 50% Annual Exceedance Stage Profile Development

Purpose

- Support the US Entity in the 2014-2024 Columbia River Treaty Review
- Provide hydraulic metrics associated with flood consequences
  - Inundated Areas
  - Peak Stages
  - Stage Duration
- Development was Focused on Damaging Floods

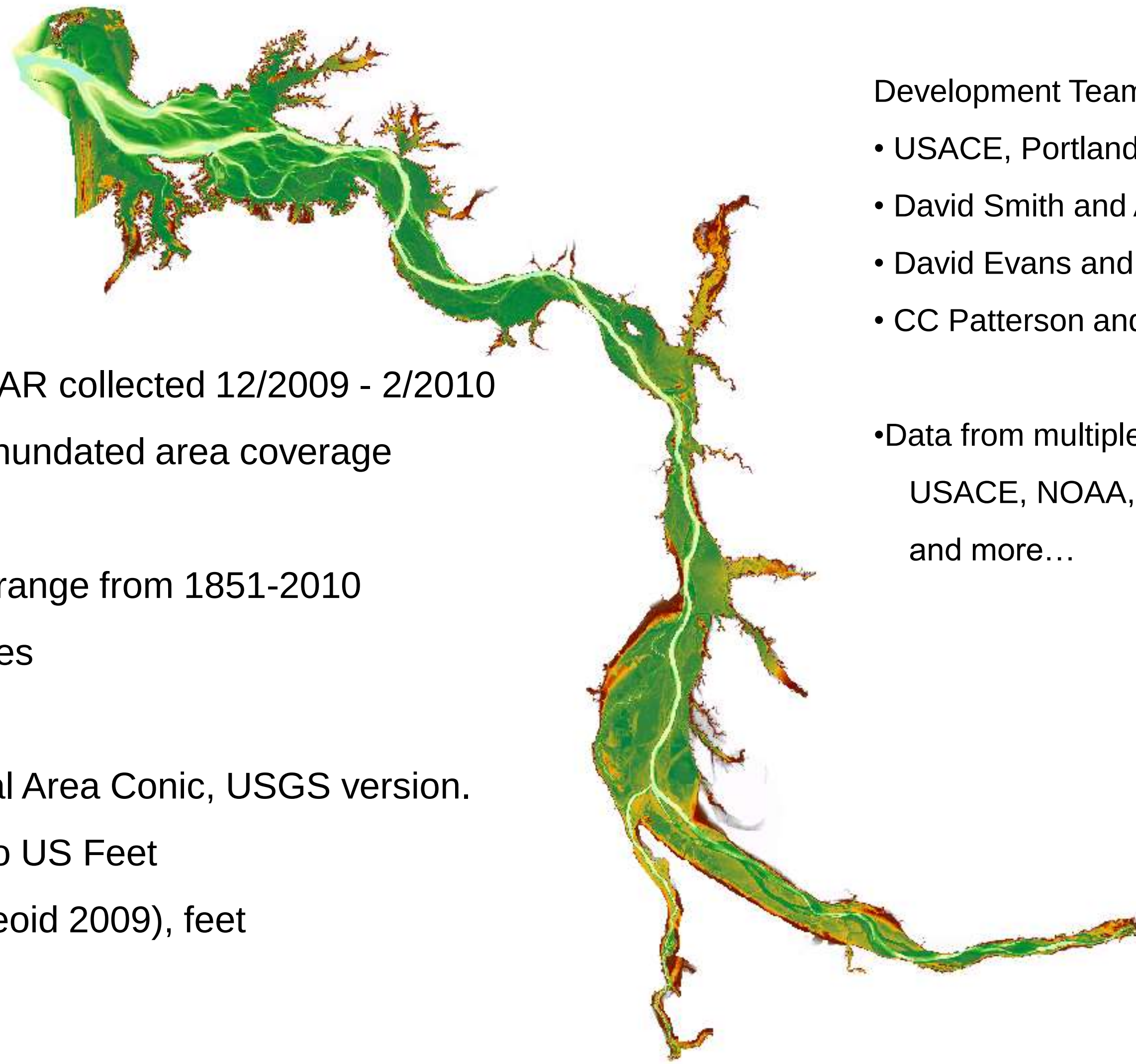
Purpose



Design Range of Flows

Terrain Development

Combined 1 meter Topographic and Bathymetric DTM



- Topographic:
  - 1 meter LiDAR collected 12/2009 - 2/2010
  - 0.2% AEP inundated area coverage
- Bathymetric:
  - Data dates range from 1851-2010
  - Quality Varies
- Datum:
  - Albers Equal Area Conic, USGS version. Modified to US Feet
  - NAVD88 (Geoid 2009), feet

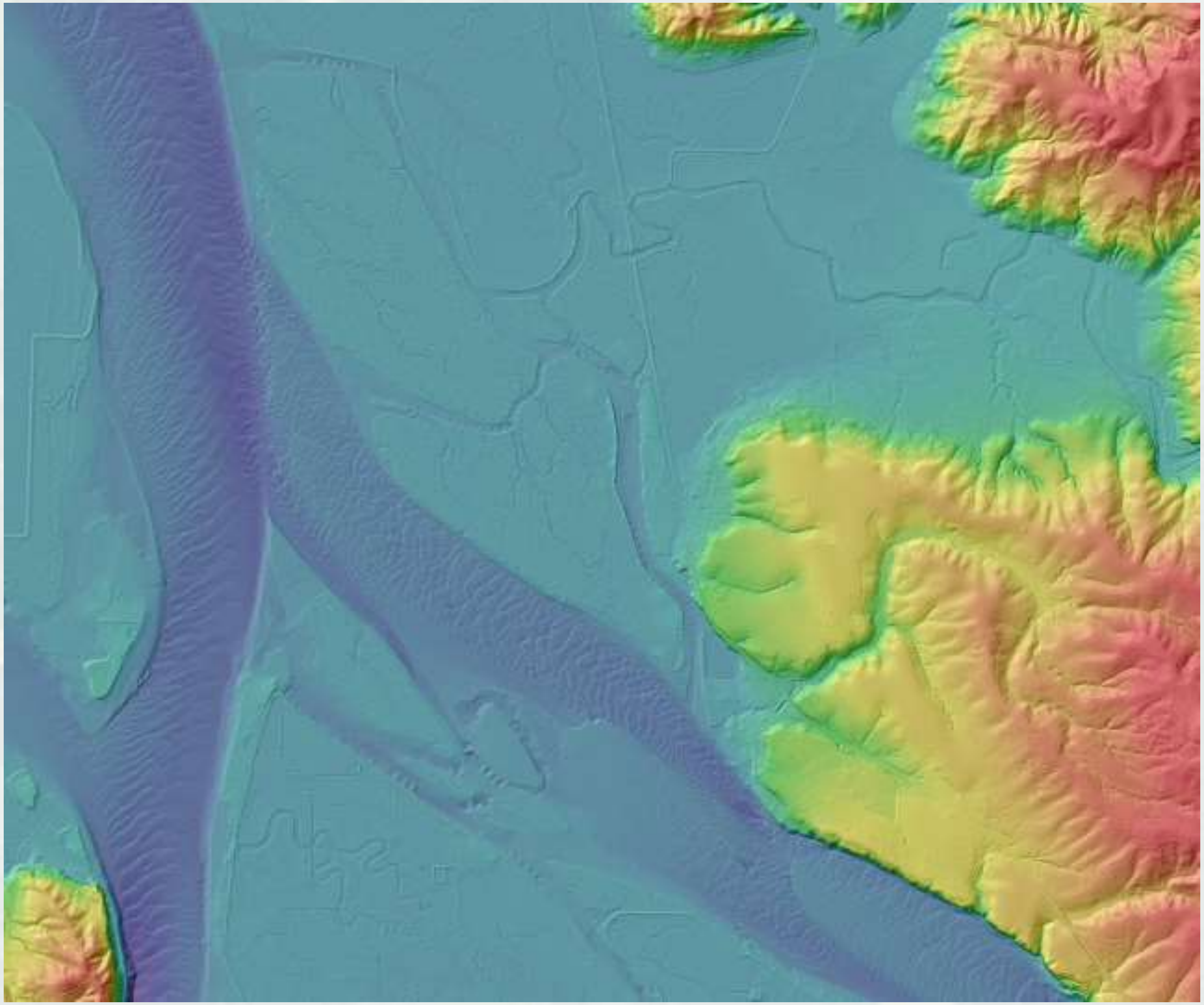
Development Team:

- USACE, Portland District
- David Smith and Associates, Lead
- David Evans and Associates, Sub
- CC Patterson and Associates, Sub

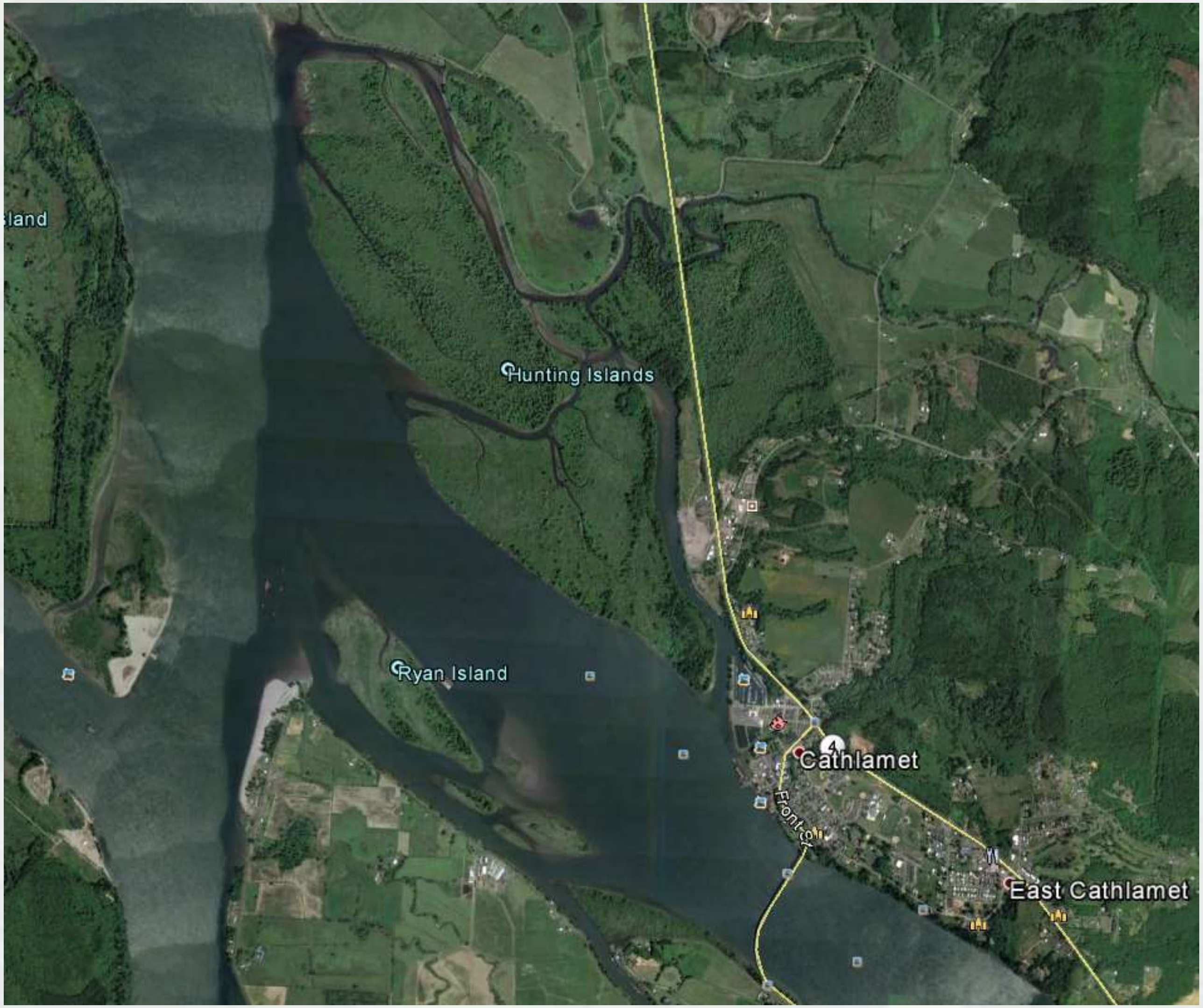
- Data from multiple sources:

  USACE, NOAA, LCREP, US BOR, and more…

Terrain Development



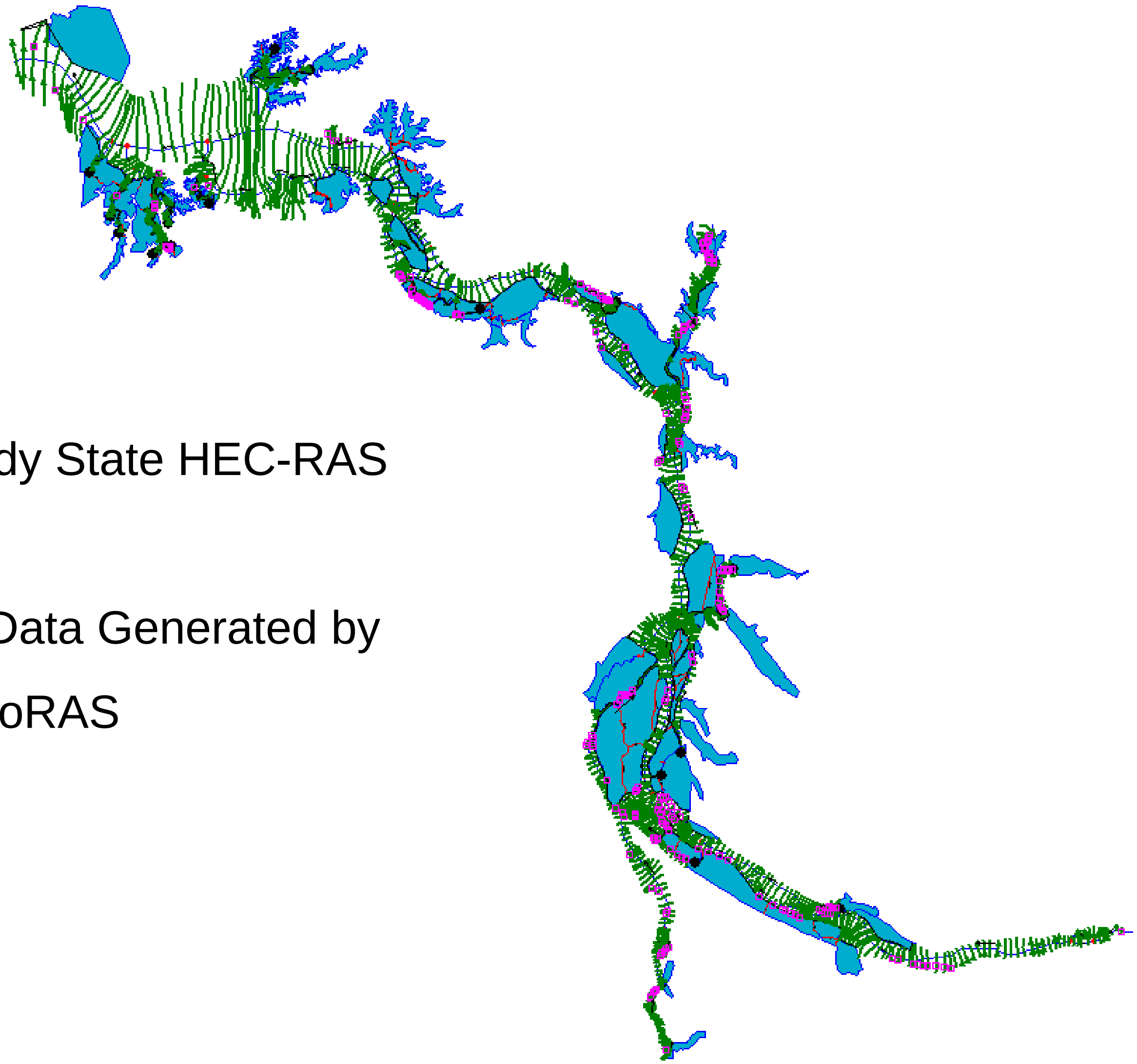
Terrain Development



Terrain Development

Combined 1 meter Topographic and Bathymetric DTM

Model Geometry Development

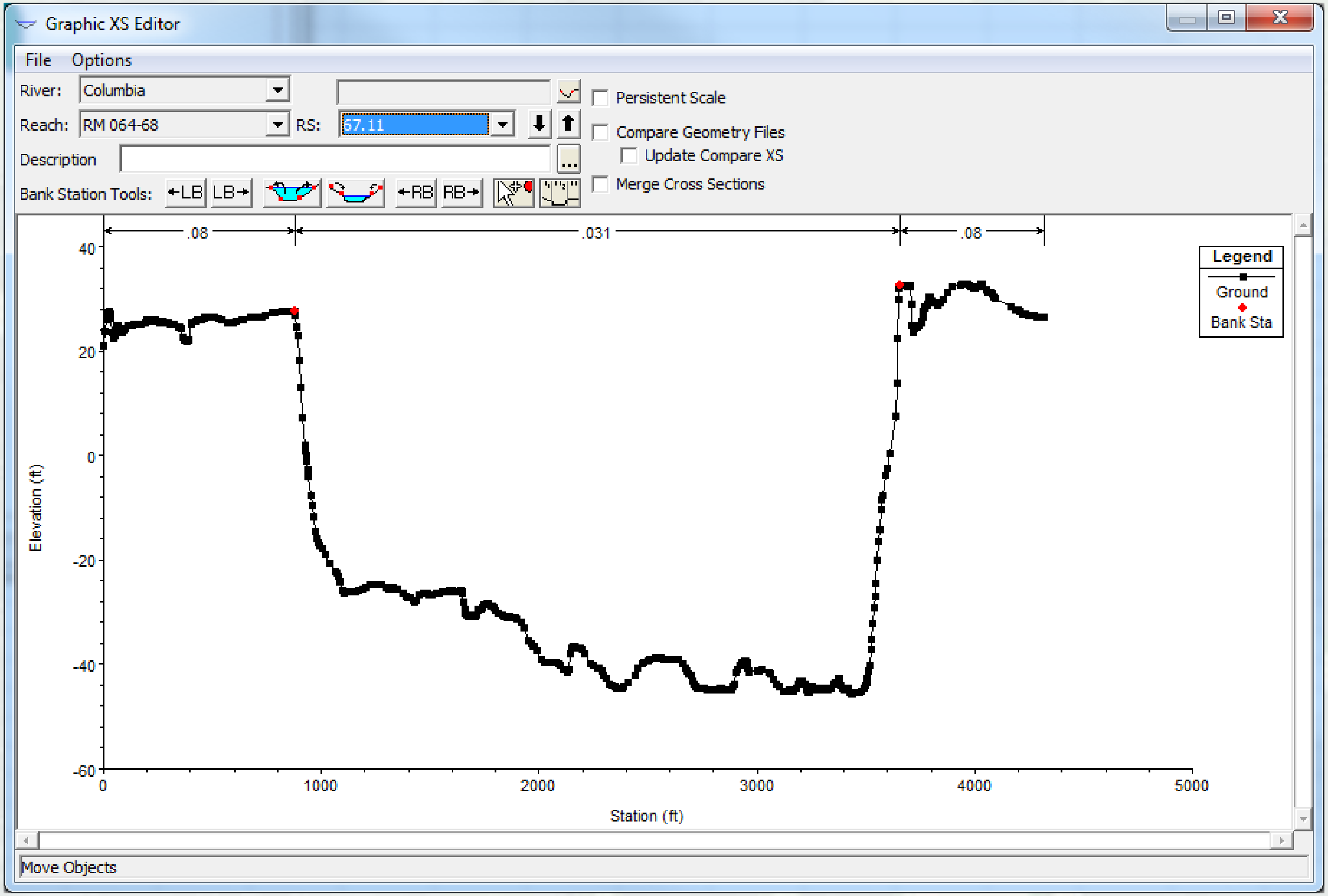


1-D Unsteady State HEC-RAS

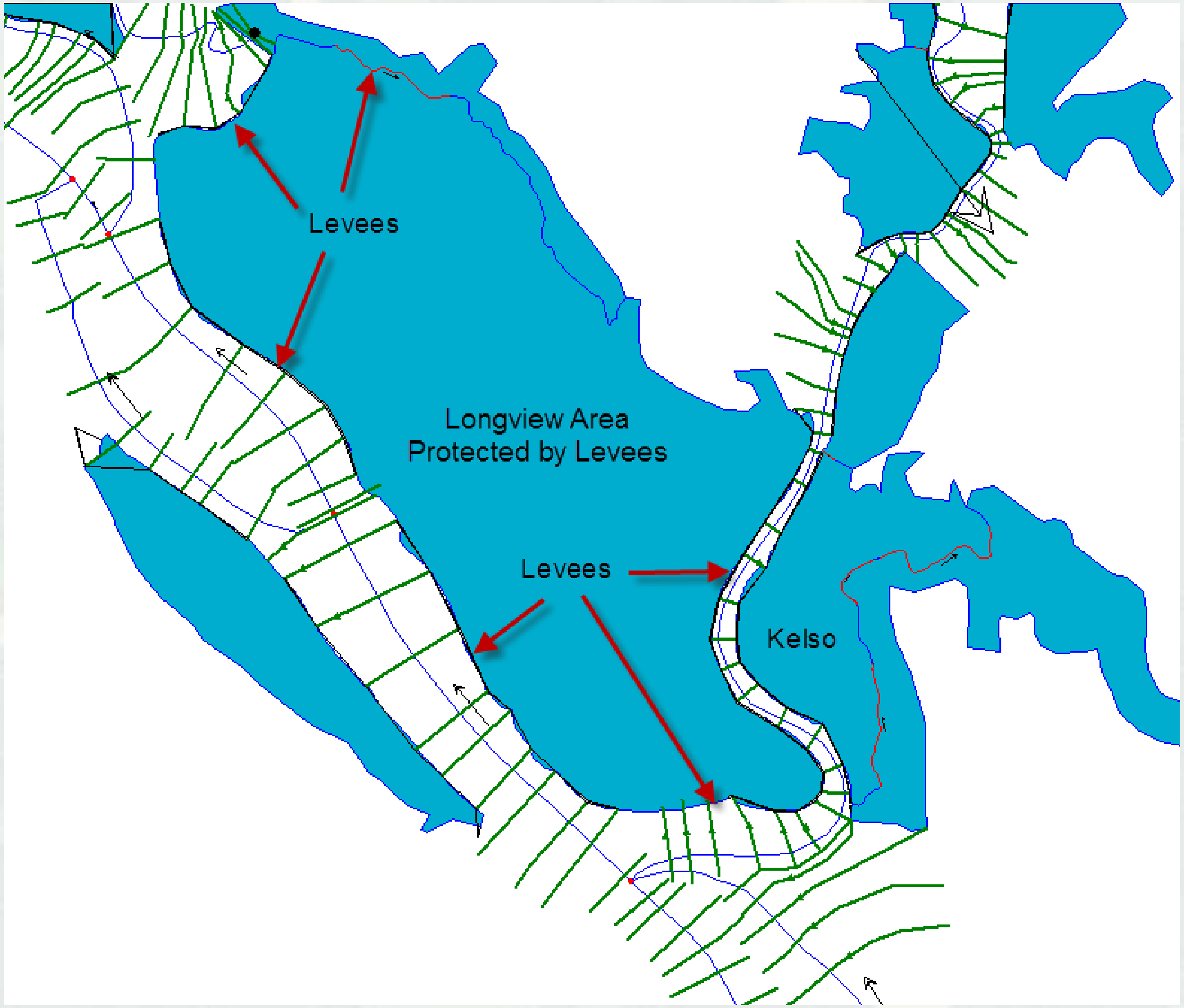
Geometric Data Generated by

HEC-GeoRAS

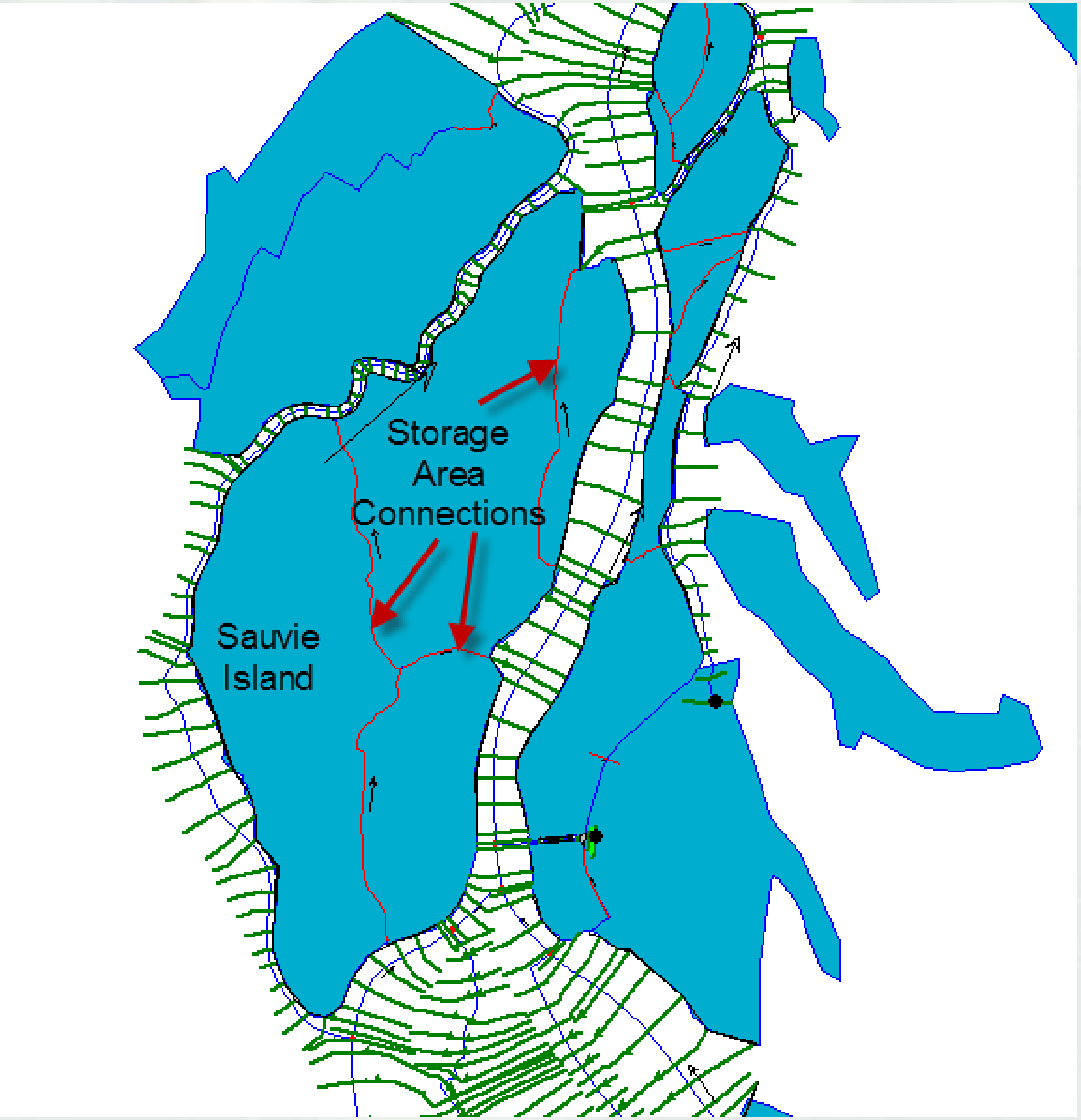
Model Geometry Development



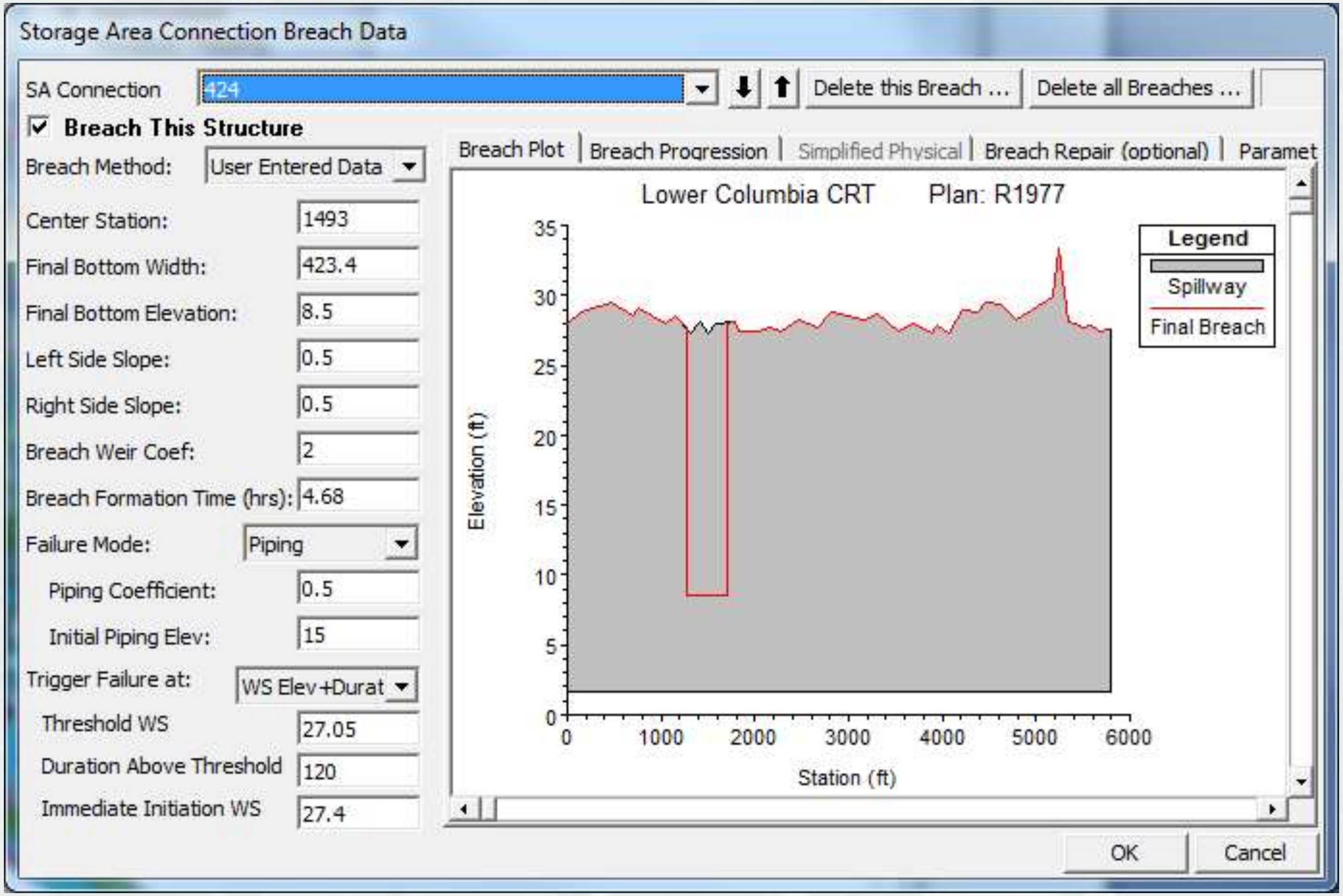
Model Geometry Development



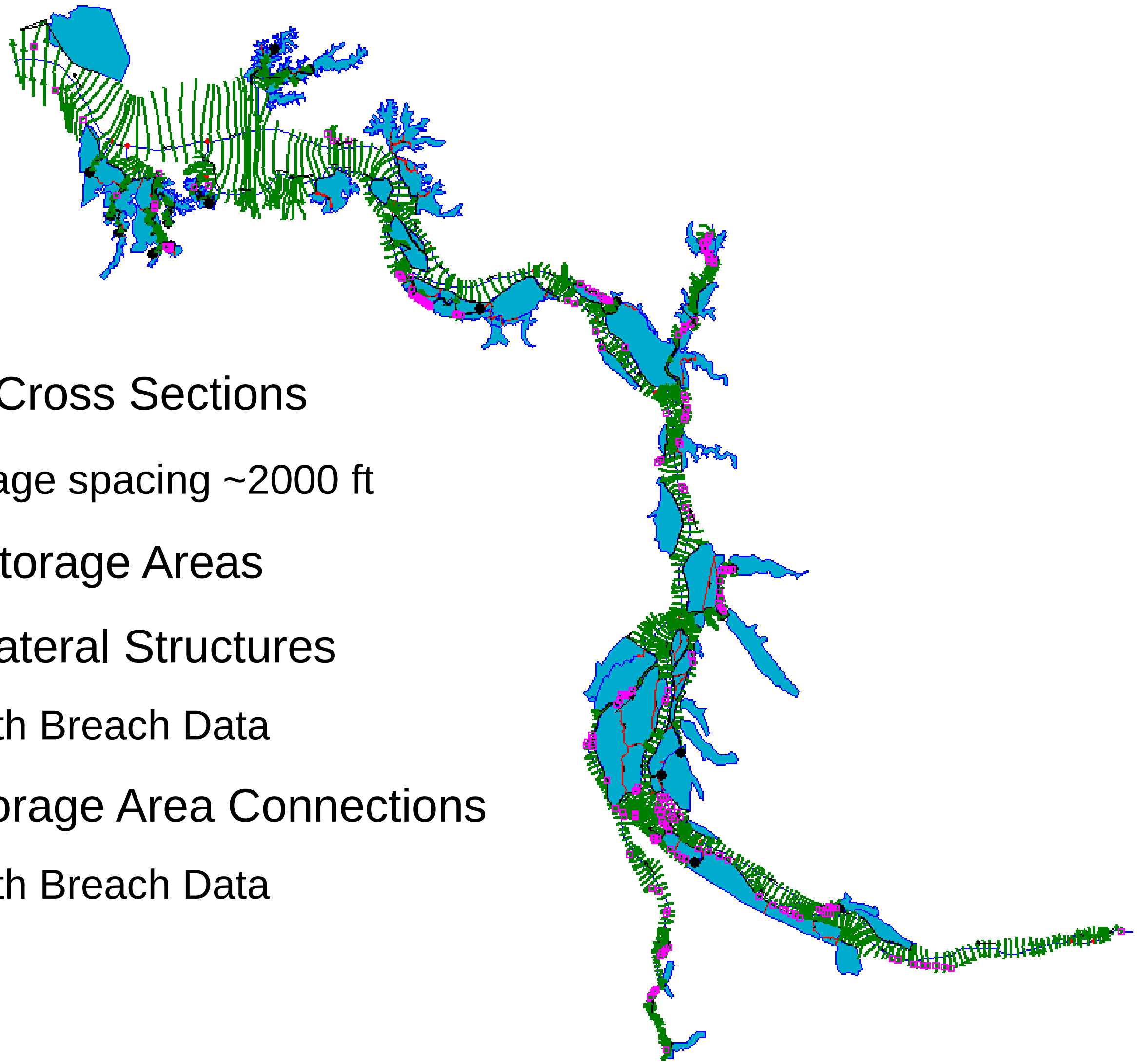
Model Geometry Development



Model Geometry Development



Model Geometry Development



1449 – Cross Sections

Average spacing ~2000 ft

162 – Storage Areas

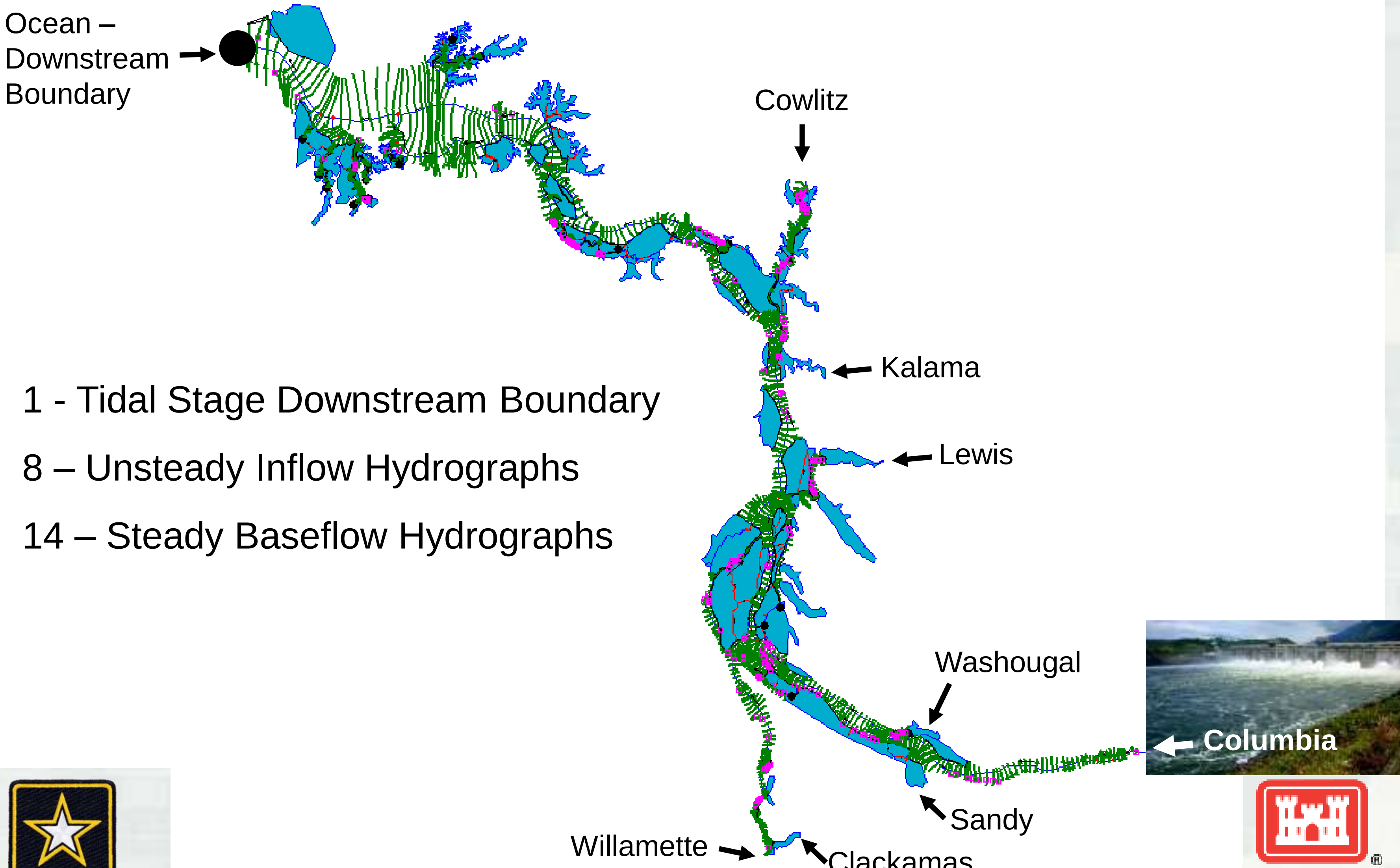
208 – Lateral Structures

61 with Breach Data

77 – Storage Area Connections

12 with Breach Data

Inflow Hydrograph Development

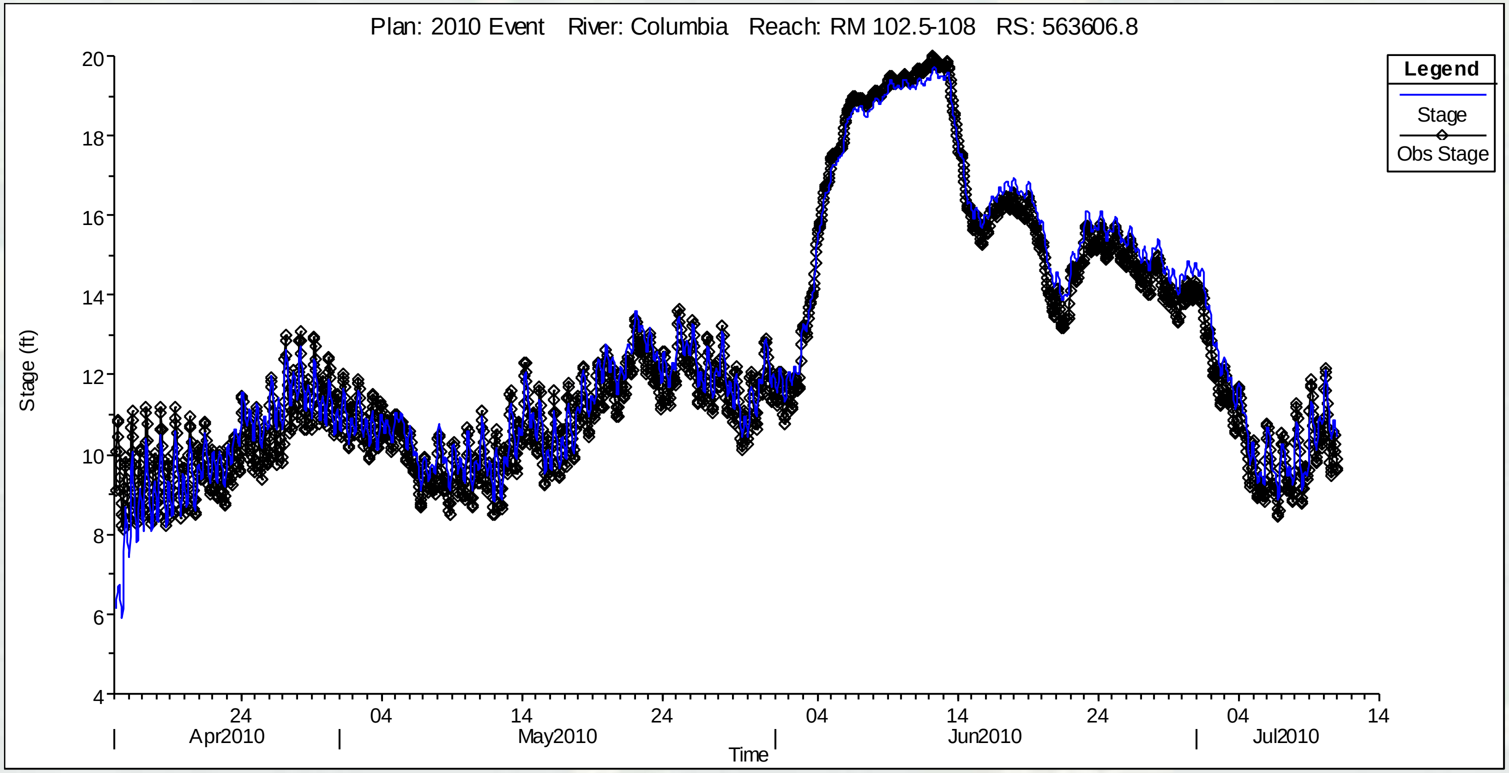


1 - Tidal Stage Downstream Boundary

8 – Unsteady Inflow Hydrographs

14 – Steady Baseflow Hydrographs

Flood Calibration



Computed and Observed Stages on Columbia River at Vancouver for 2010 Event

50% AEP Stage Profile Development

Why develop the profile?

Survival Benefits Unit water surface profile was defined in Section 2., ERTG Document 2011-01; ***"Use the 2-year flood elevation or EHHW (mean highest monthly tide), whichever is higher".***

50% AEP Stage Profile Development

Approach:

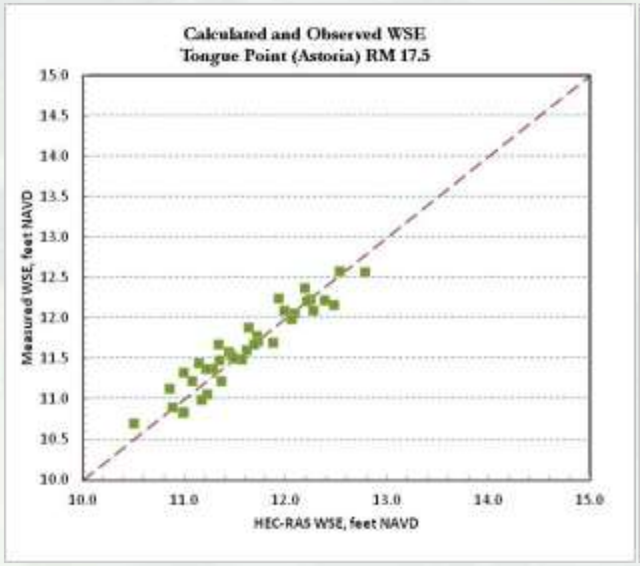
- Develop a continuous observed inflow data set that represents the current conditions (1973-2010).
- Calibrate model to annual peak stages
- Calculate annual peak stages for period of record
- Calculate 50% AEP stage

50% AEP Stage Profile Development

Annual Peak Calibration

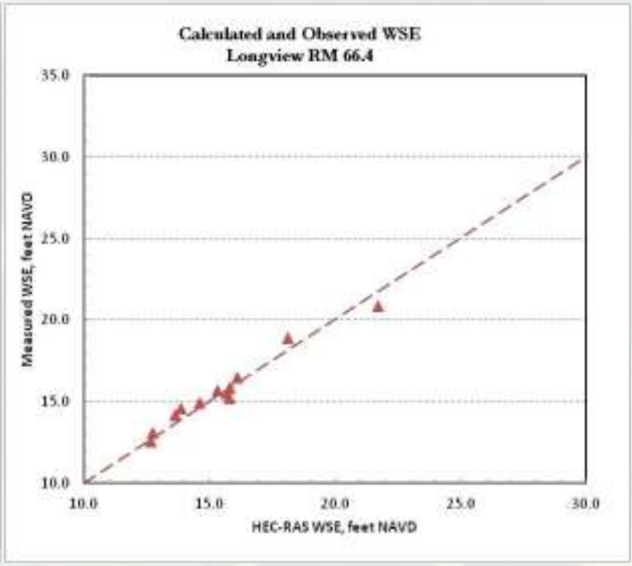
Tongue Point

Tidally Dominated



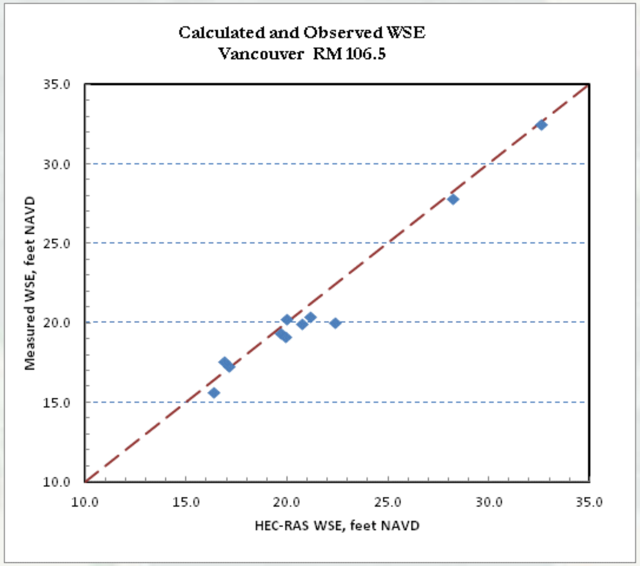
Longview

Tide-Flow Mixed Peaks

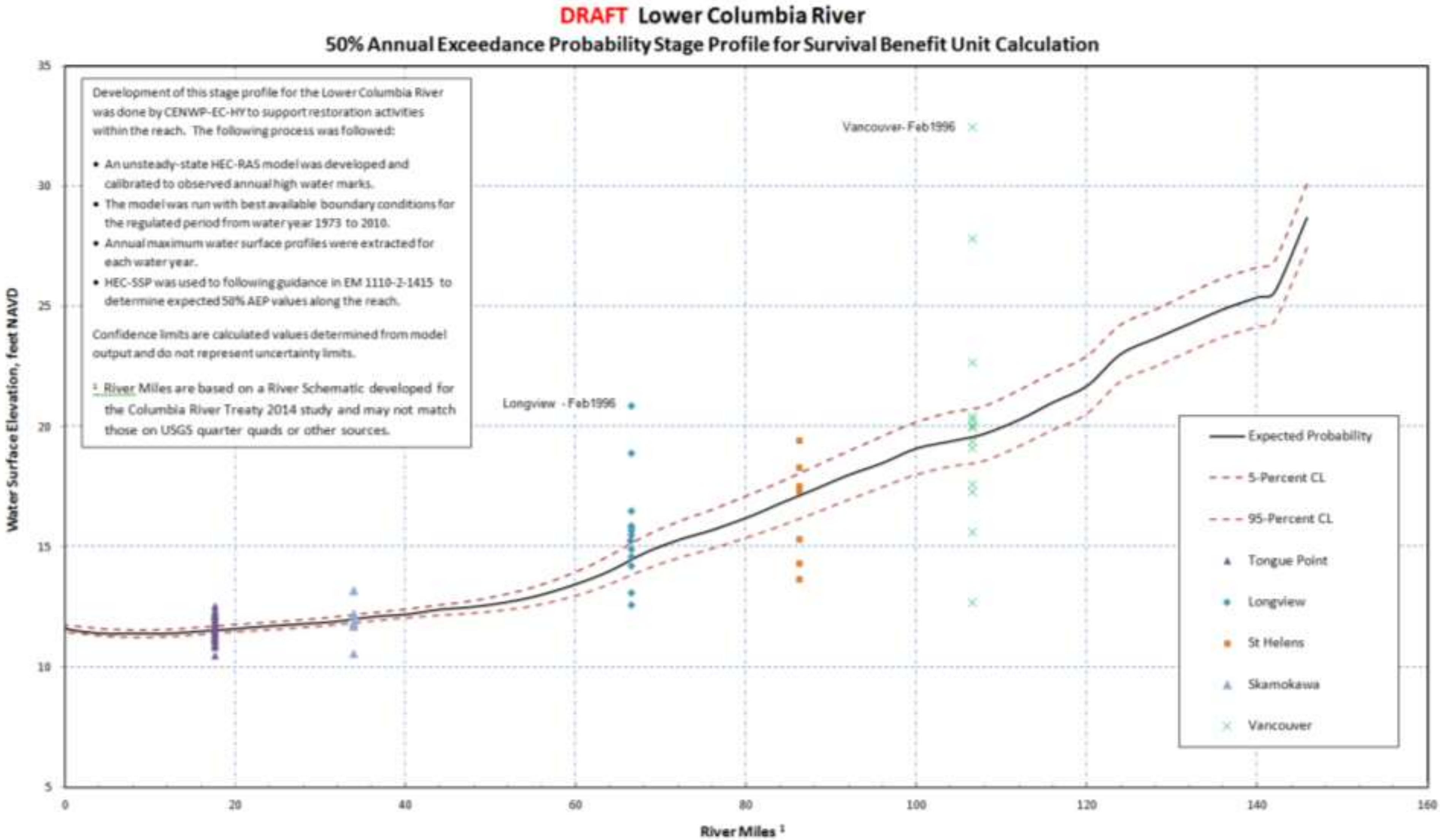


Vancouver

Flow Dominated



50% AEP Stage Profile Development



50% AEP Stage Profile Development

	Water Surface Elevation, feet NAVD		
RM [1]	Expected Probability	5-Percent CL	95-Percent CL
145.87	28.7	30.1	27.4
142.04	25.6	26.9	24.4
140.15	25.4	26.6	24.2
136.05	24.9	26.2	23.7
132.13	24.3	25.6	23.2
128.19	23.7	24.9	22.5
123.99	23.0	24.2	21.9
120.07	21.7	22.9	20.6
115.93	21.0	22.2	19.9
112.10	20.3	21.5	19.2
107.86	19.7	20.8	18.6
104.06	19.4	20.6	18.4
100.00	19.1	20.2	18.0
96.06	18.5	19.6	17.5
92.06	18.0	19.0	17.0
88.04	17.4	18.3	16.4
83.92	16.8	17.7	15.9
80.65	16.3	17.2	15.5
75.98	15.7	16.5	14.9
72.12	15.3	16.1	14.6
68.15	14.8	15.4	14.1
63.99	14.0	14.6	13.5
60.41	13.5	14.0	13.0
55.84	13.0	13.4	12.6
51.85	12.7	13.0	12.4
47.70	12.5	12.7	12.2
44.06	12.4	12.6	12.2
40.24	12.2	12.4	12.1
36.35	12.1	12.3	11.9
31.89	11.9	12.1	11.8
28.07	11.8	12.0	11.7
23.76	11.7	11.8	11.6
20.24	11.6	11.8	11.5
16.35	11.5	11.7	11.4
12.18	11.4	11.6	11.3
8.47	11.4	11.5	11.2
4.65	11.4	11.6	11.3
1.70	11.5	11.7	11.4
0.15	11.6	11.7	11.5

Acknowledgements

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Portland District, USACE