Effects of Ice Age Flooding on the Hydrogeology of the Hanford Site

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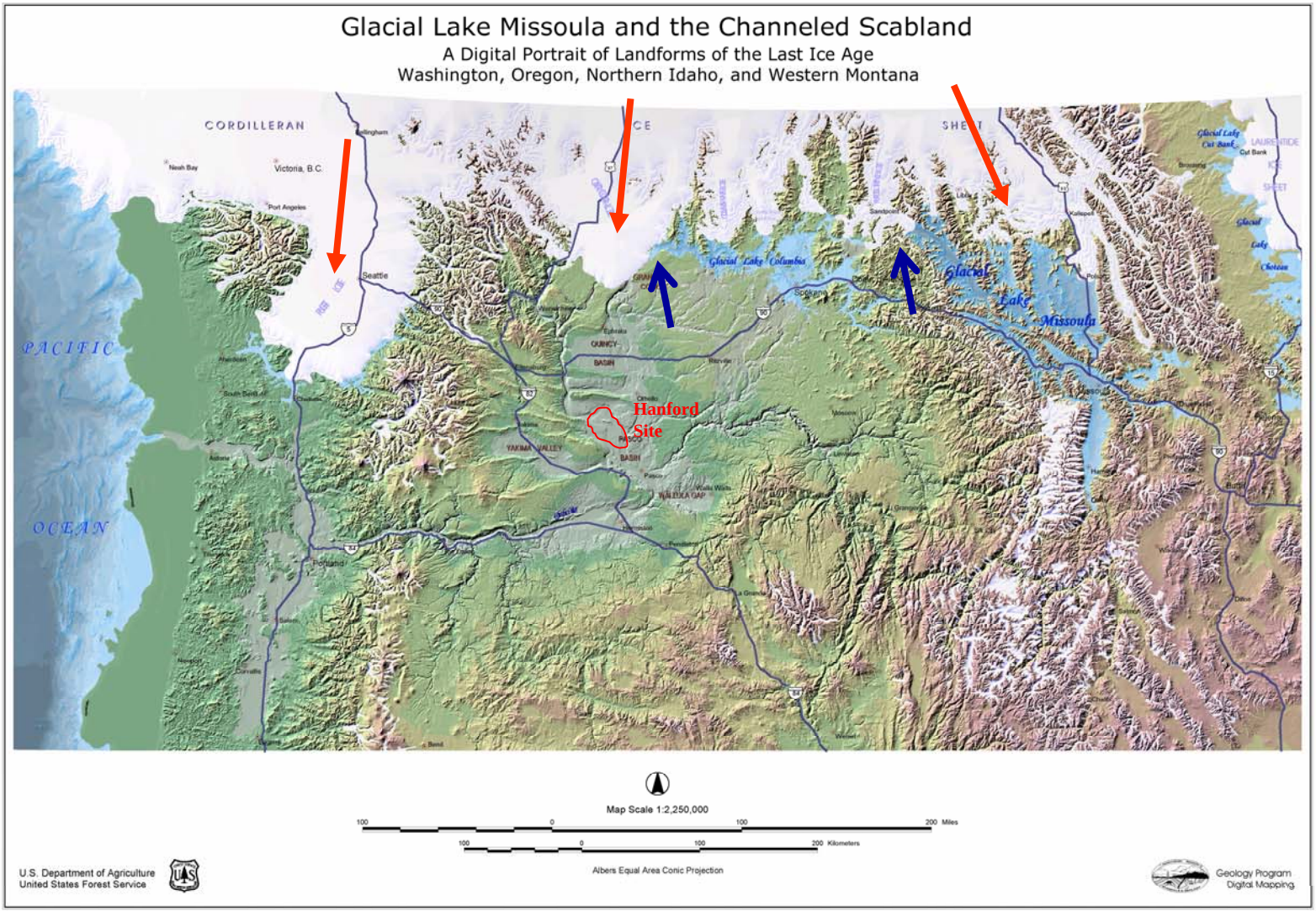
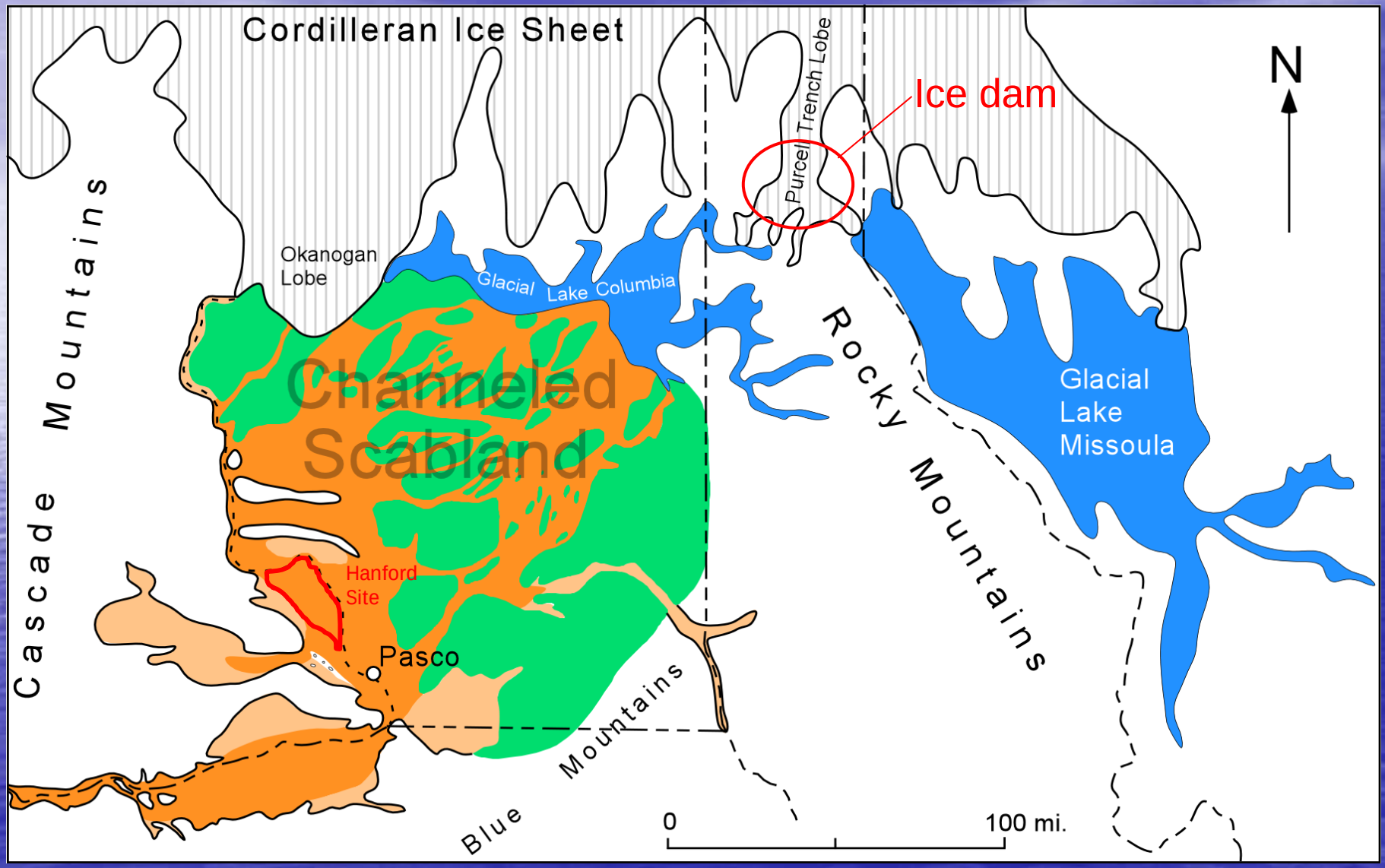
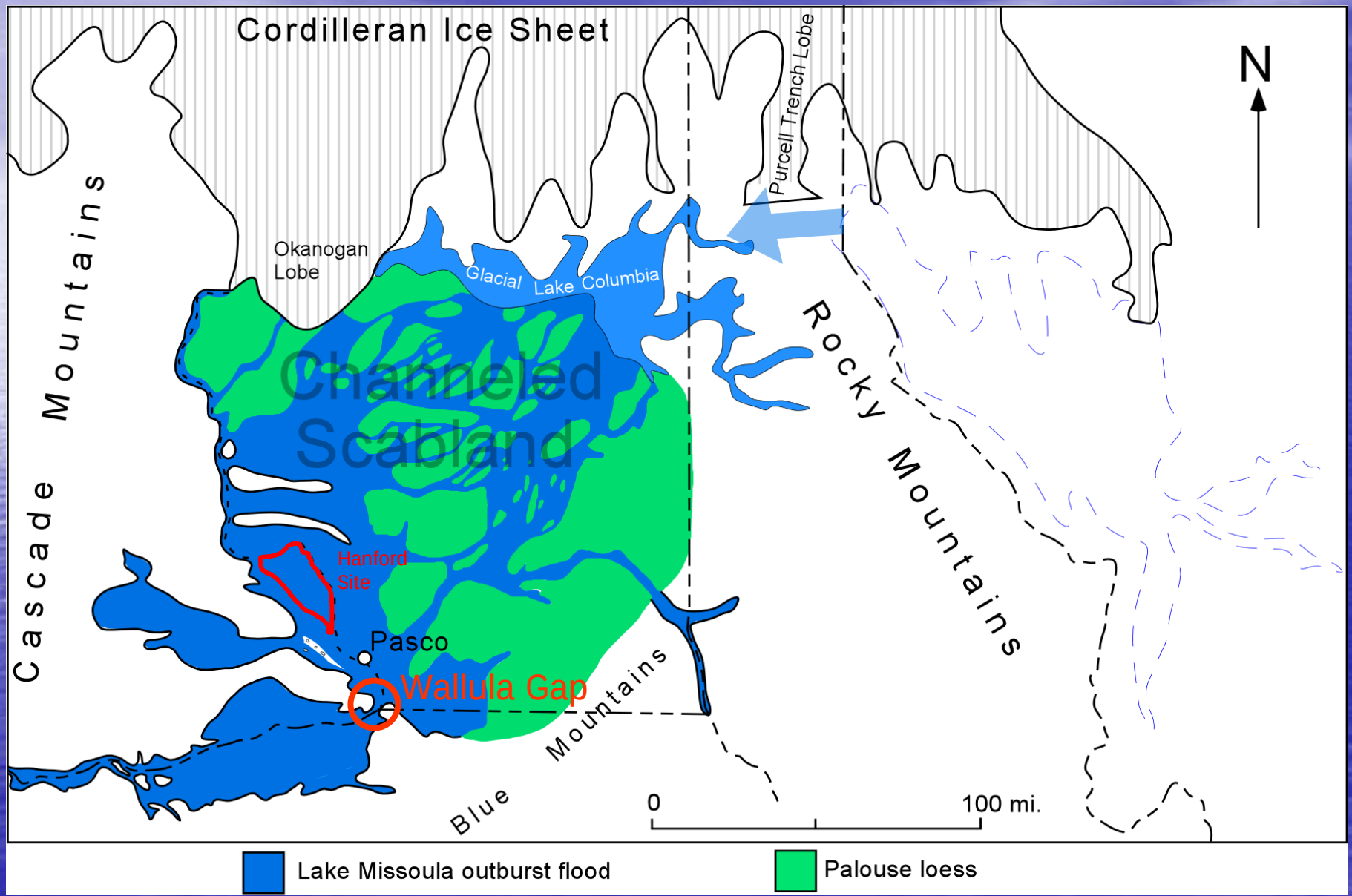
George V. Last

The Pacific Northwest 18,000 Yrs Ago

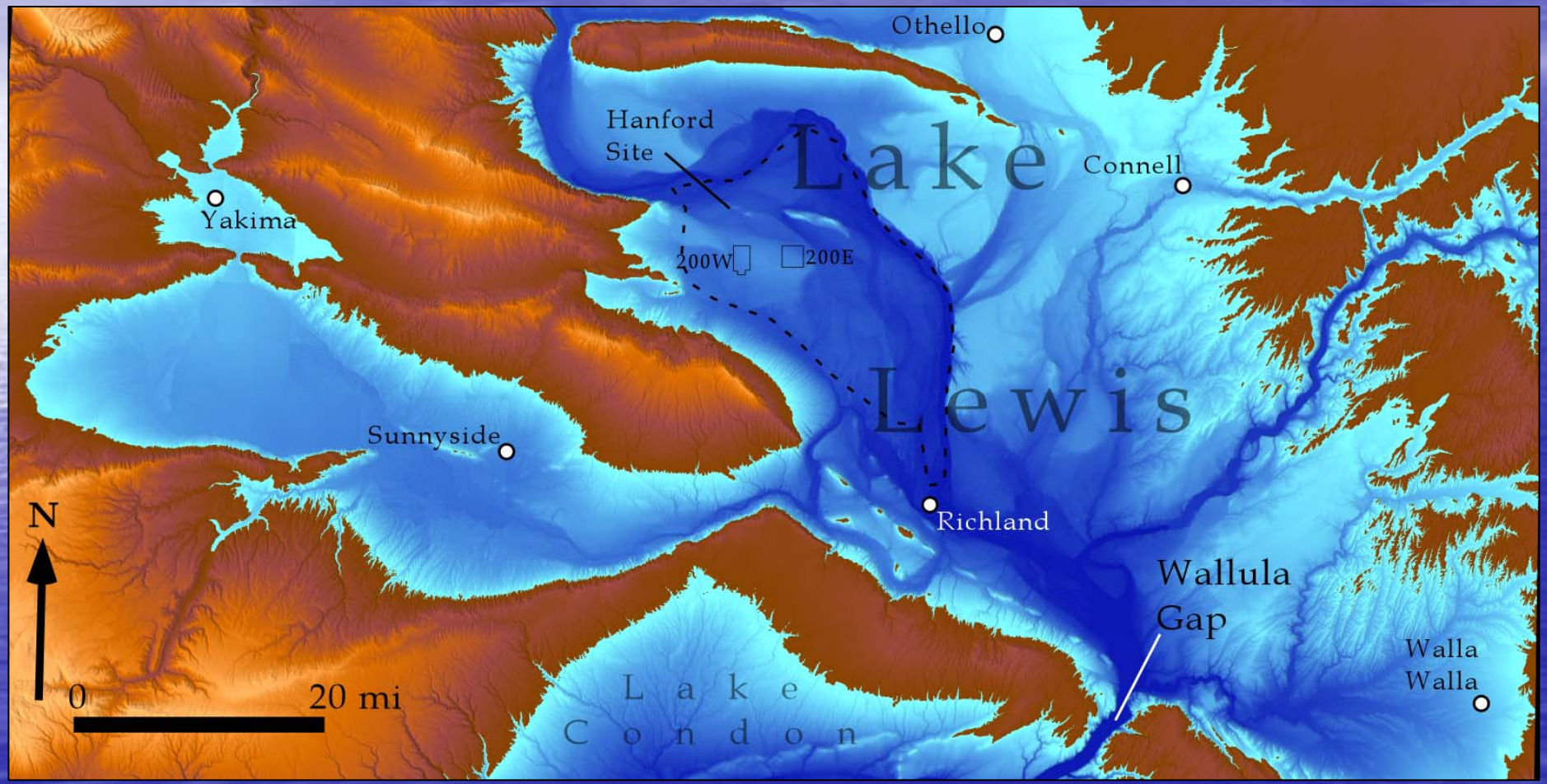


Ice Age Floods

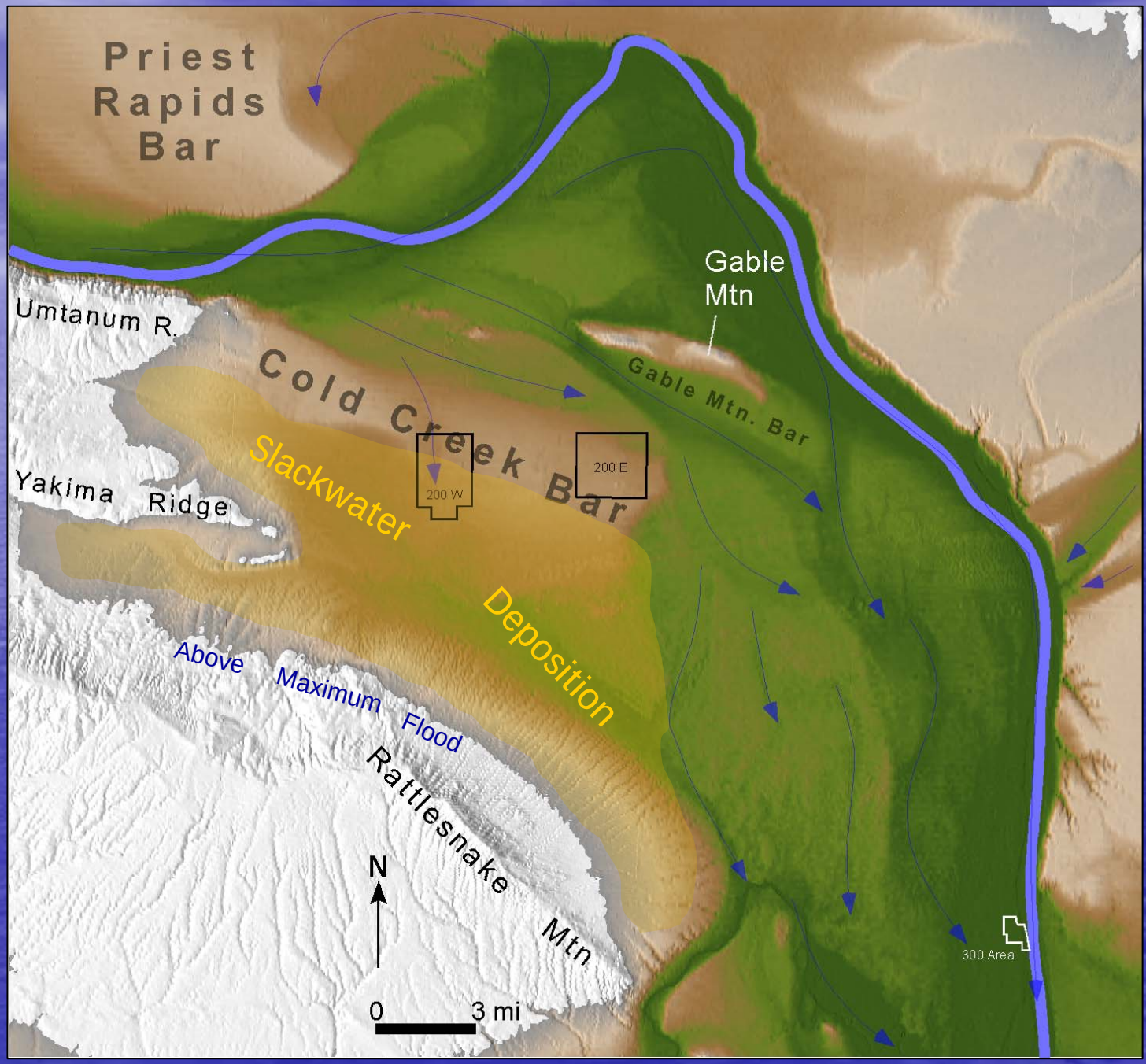



Cordilleran Ice Sheet
Purcell Trench Lobe
N
Okanogan Lobe
Glacial Lake Columbia
Channeled Scabland
Cascade Mountains
Rocky Mountains
Hanford Site
Pasco
Wallula Gap
Blue Mountains
0
100 mi.
Lake Missoula outburst flood
Palouse loess

Maximum Extent of Ice Age Flooding in the Mid Columbia

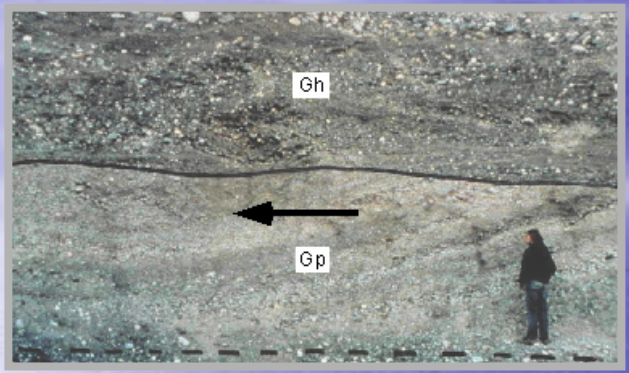


Effects of Last (Late Pleisto-cene) Floods



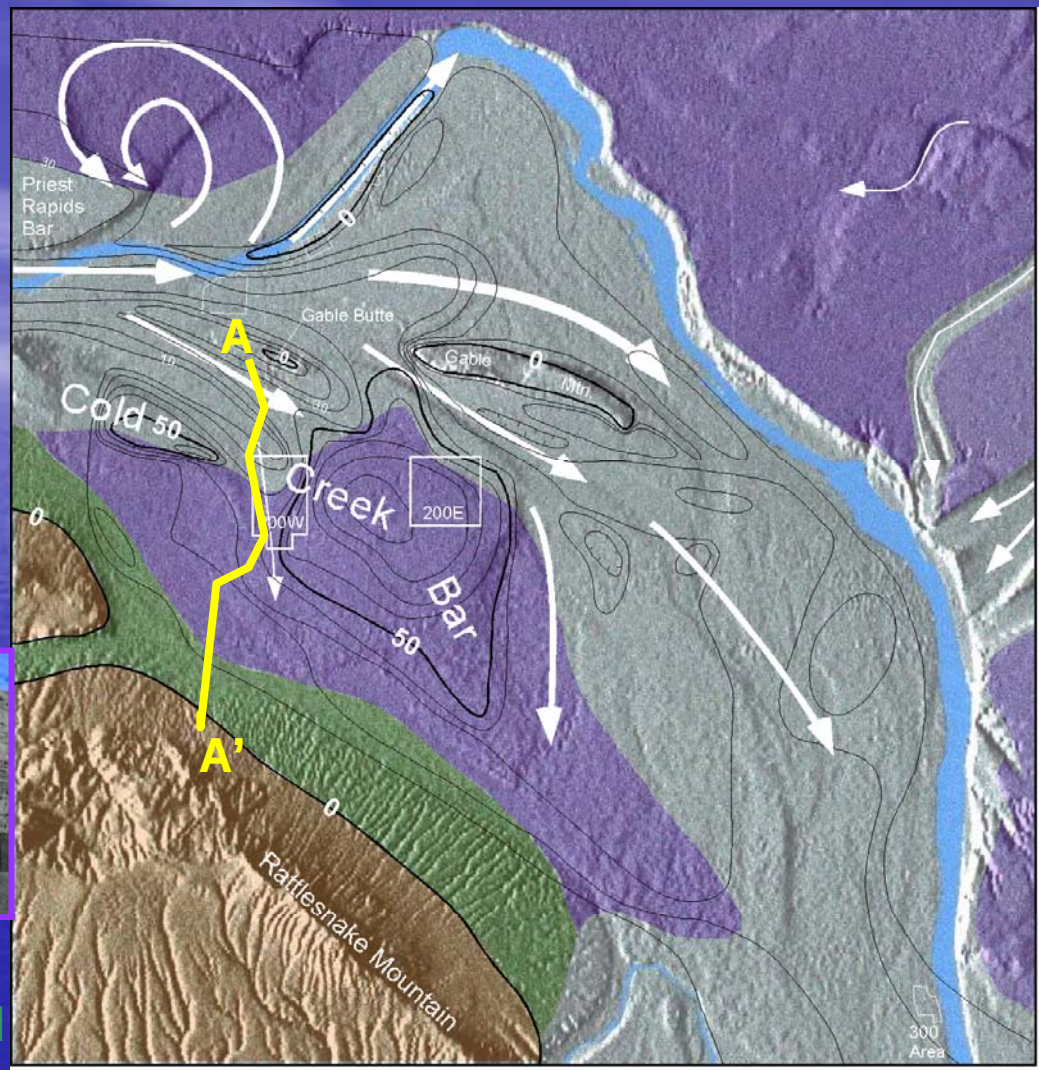
Flood Facies of the Hanford Formation

Gravel-Dominated



Sand-Dominated

Interbedded Sand- and Silt-Dominated



Hanford Formation

- Gravel-Dominated Flood Deposits
- Sand-Dominated Flood Deposits
- Interbedded Sand- and Silt-Dominated Flood Deposits
- Above flood level (>380 m elev.)

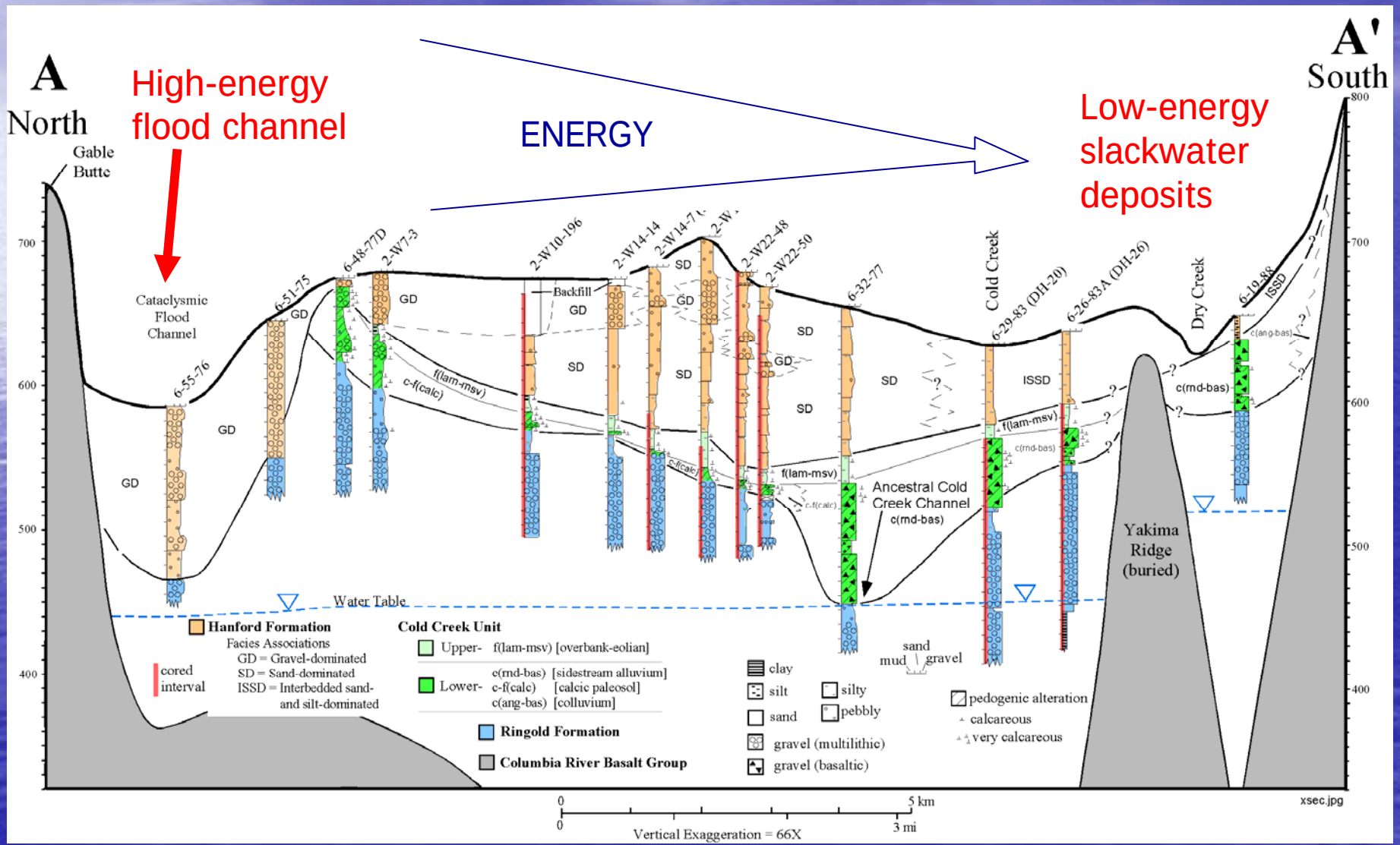
Contour interval = 10 m

0 10 20 km

0 2 4 6 8 10 mi

N

North-South Cross Section Across Cold Creek Bar

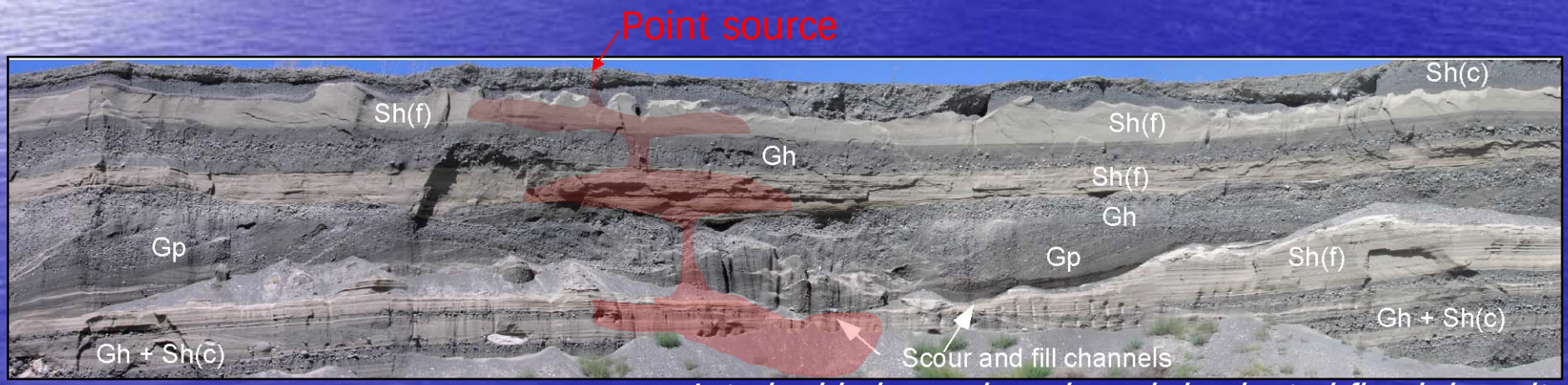


Effects on the Vadose Zone

- Lateral spreading of moisture/contaminants along multiple bedding interfaces
- Perching atop slackwater beds
- Vertical movement along clastic dikes

- Flood strata highly anisotropic, heterogeneous and discontinuous, especially in coarser, high-energy flood deposits

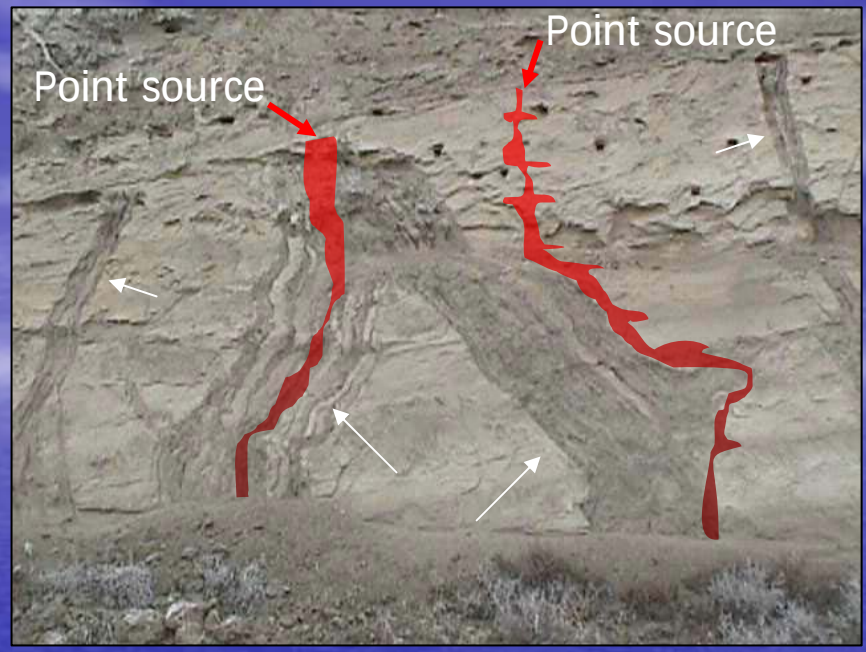
- Slackwater beds more continuous



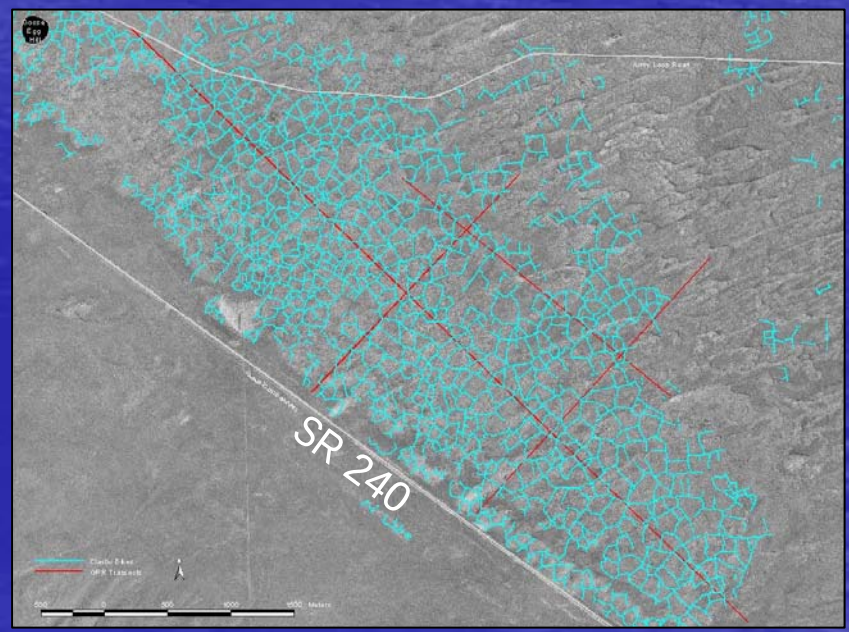
Interbedded gravel- and sand-dominated flood deposits

Clastic Dikes

- Most caused by liquefaction of slackwater flood deposits during or soon after flooding, perhaps as a result of seismicity
- Vertical conduits or barriers for moisture/contaminants, especially in vadose zone



Cross-sectional view



Plan view

Effects on the Saturated Zone

- More-rapid movement of contaminants along paleochannels filled with highly transmissive flood gravels

Contaminant Plumes Reflect Location of Buried Paleoflood Channels

Tritium plume moves along buried channel that trends SE from Gable Gap through 200E Area

Plume bifurcates at a less-permeable Ringold Fm. high that protrudes above the water table

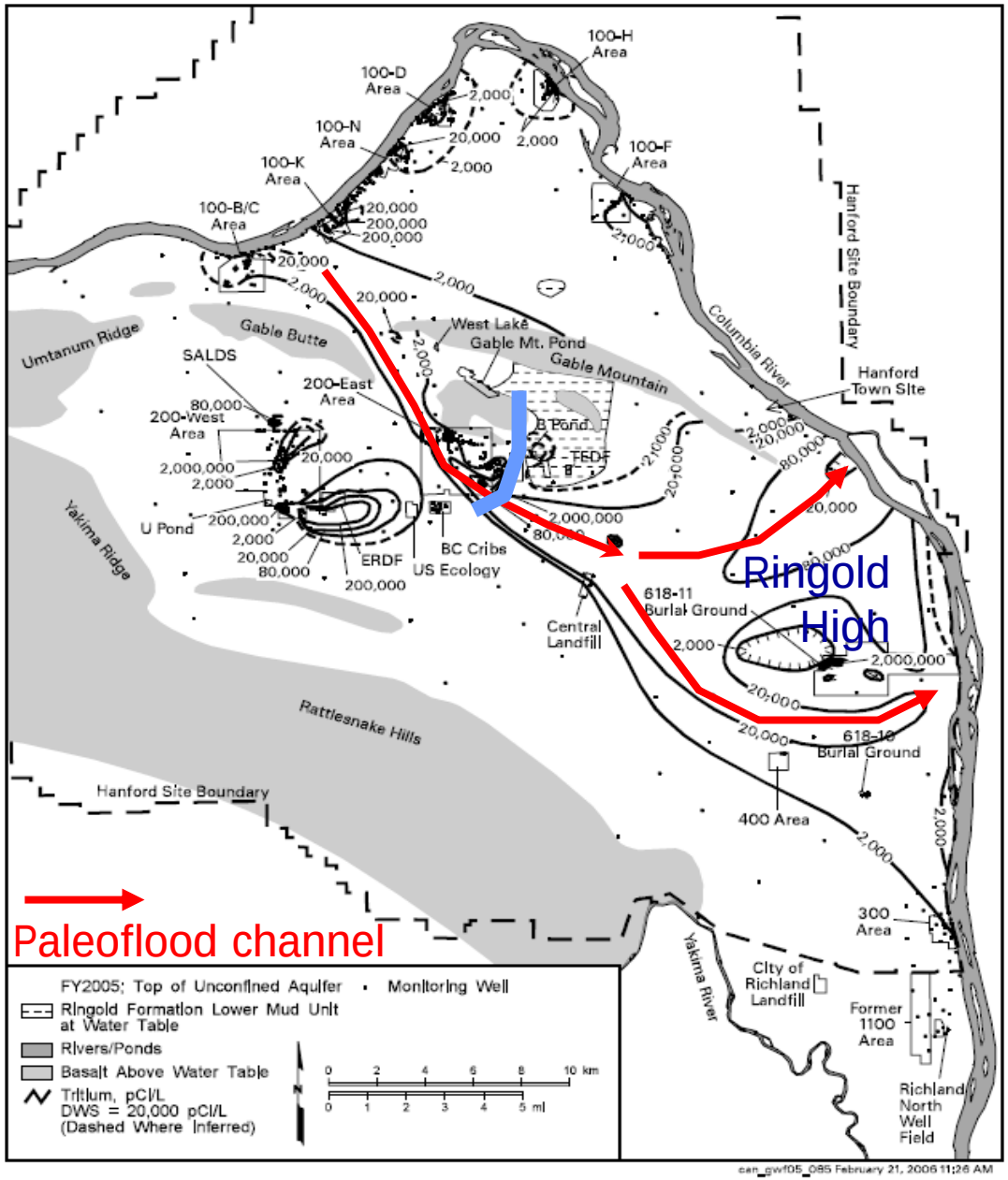
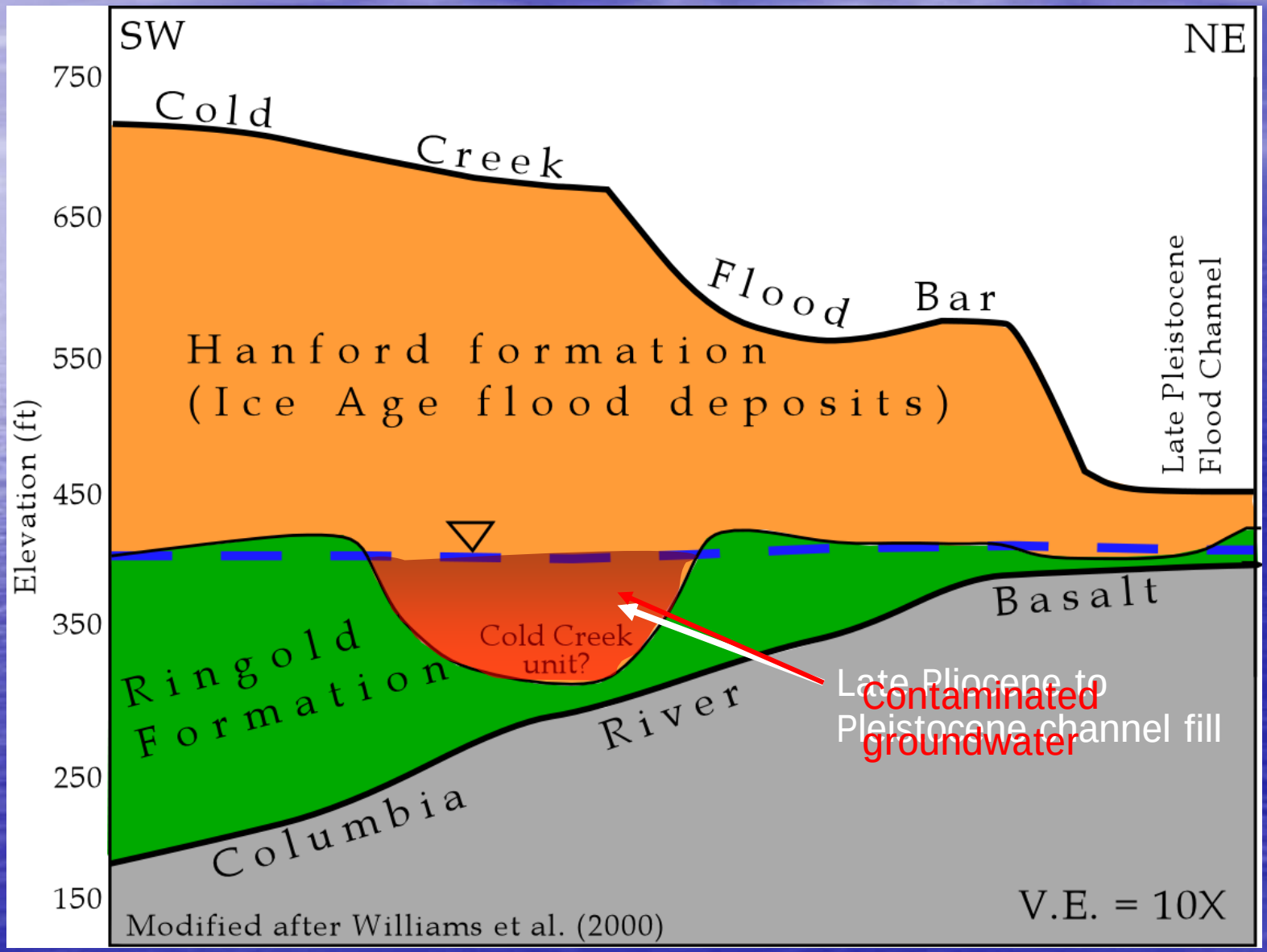


Figure 2.1-5. Average FY 2005 Tritium Concentrations on the Hanford Site, Top of Unconfined Aquifer

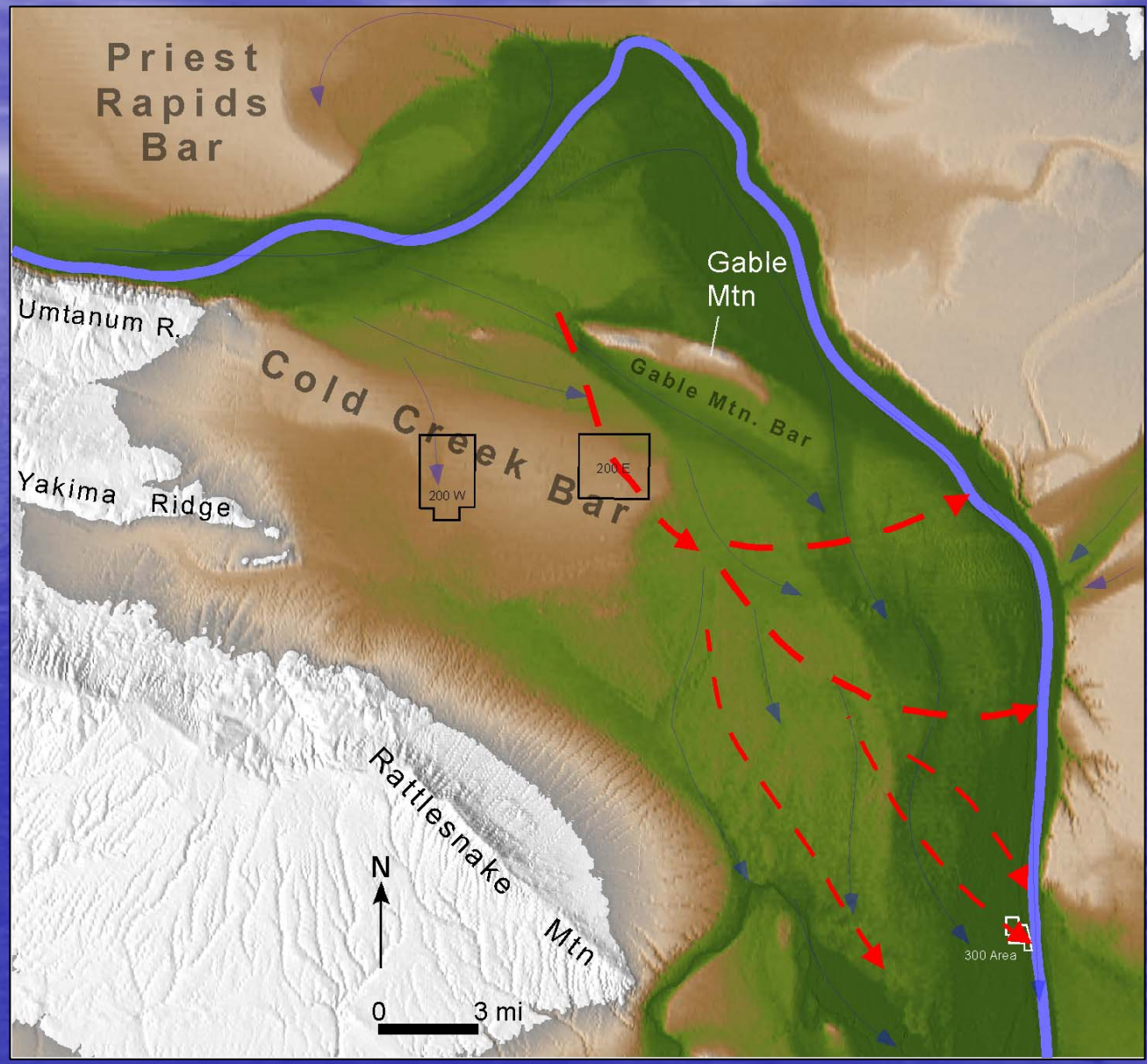
From Hartman et al. (2006)

Cross Section Across Buried Channel



Buried Paleoflood Channels

- Latest flood channels different than earliest floods
- Compared to earliest floods, channels have shifted north and east
- Earliest flood channels formed before Cold Creek Bar in place
- With successive floods Cold Creek Bar prograded eastward causing channel shift



Summary

- Knowing the processes and dynamics of Ice Age flooding is critical to an understanding of the hydrogeologic system and development of realistic conceptual hydrogeologic models