Pasco Basin Geology Tour

George V. Last

November 3, 2025

Prepared for the
RemPlex Global Summit 2025
Pacific Northwest National Laboratory

REMPLEX
CENTER FOR THE REMEDIATION OF COMPLEX SITES
@PNNL

IAEA

This tour involves a total of about 2 hours of driving, with about a 30 min. (17 miles [27 km]) to our first stop from the PNNL Discovery Hall. Our second stop involves a 15 min. (0.5 mile [0.8 km]) hike, one way, along an old dirt/gravel road.

Be sure to wear good walking shoes, dress for the weather, carry sunscreen, water, camera, snacks, and any other necessary items.

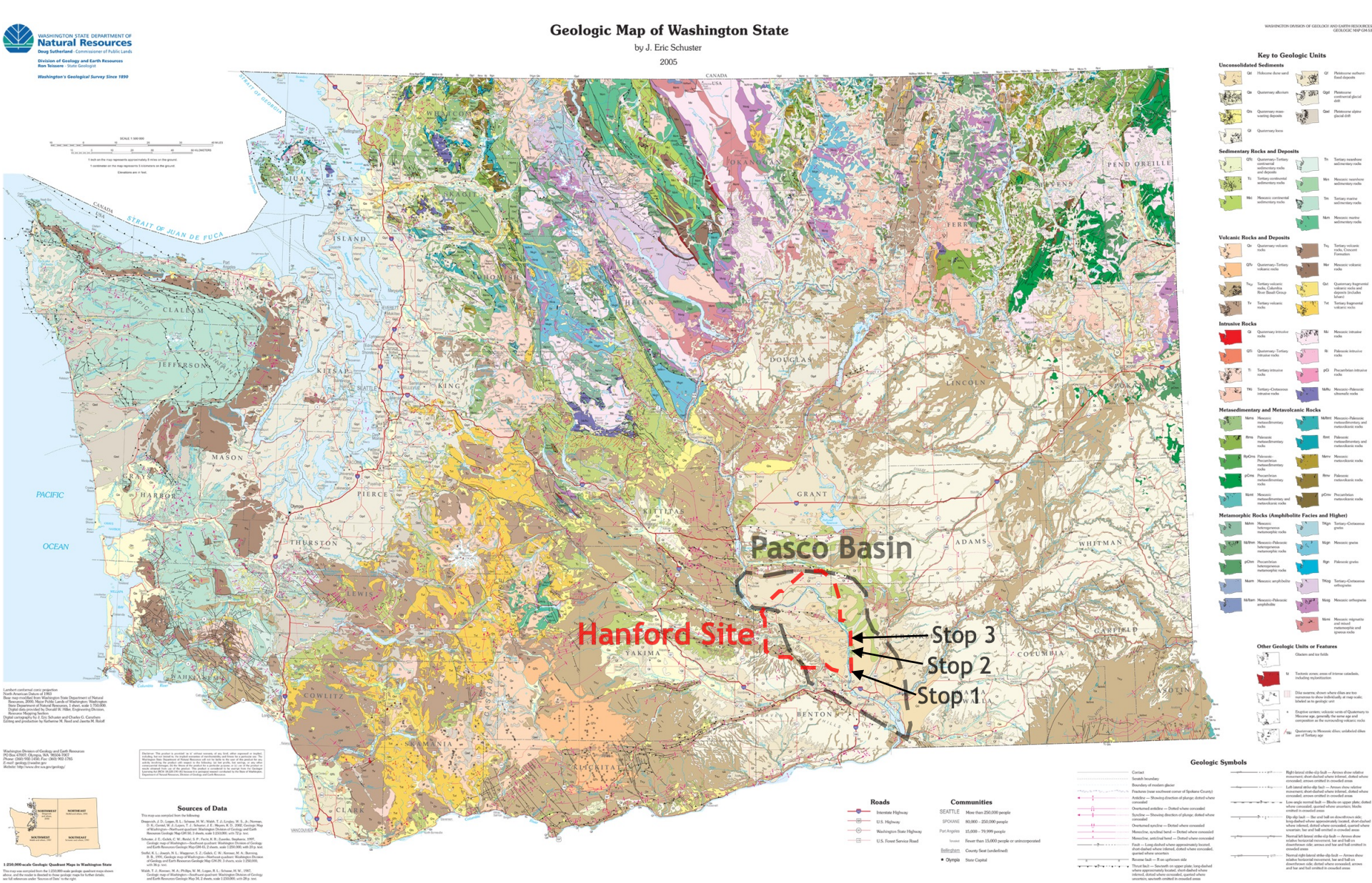
There are no restroom facilities nearby except near our third stop (if necessary) so please plan accordingly.

There are three primary stops for the field trip:

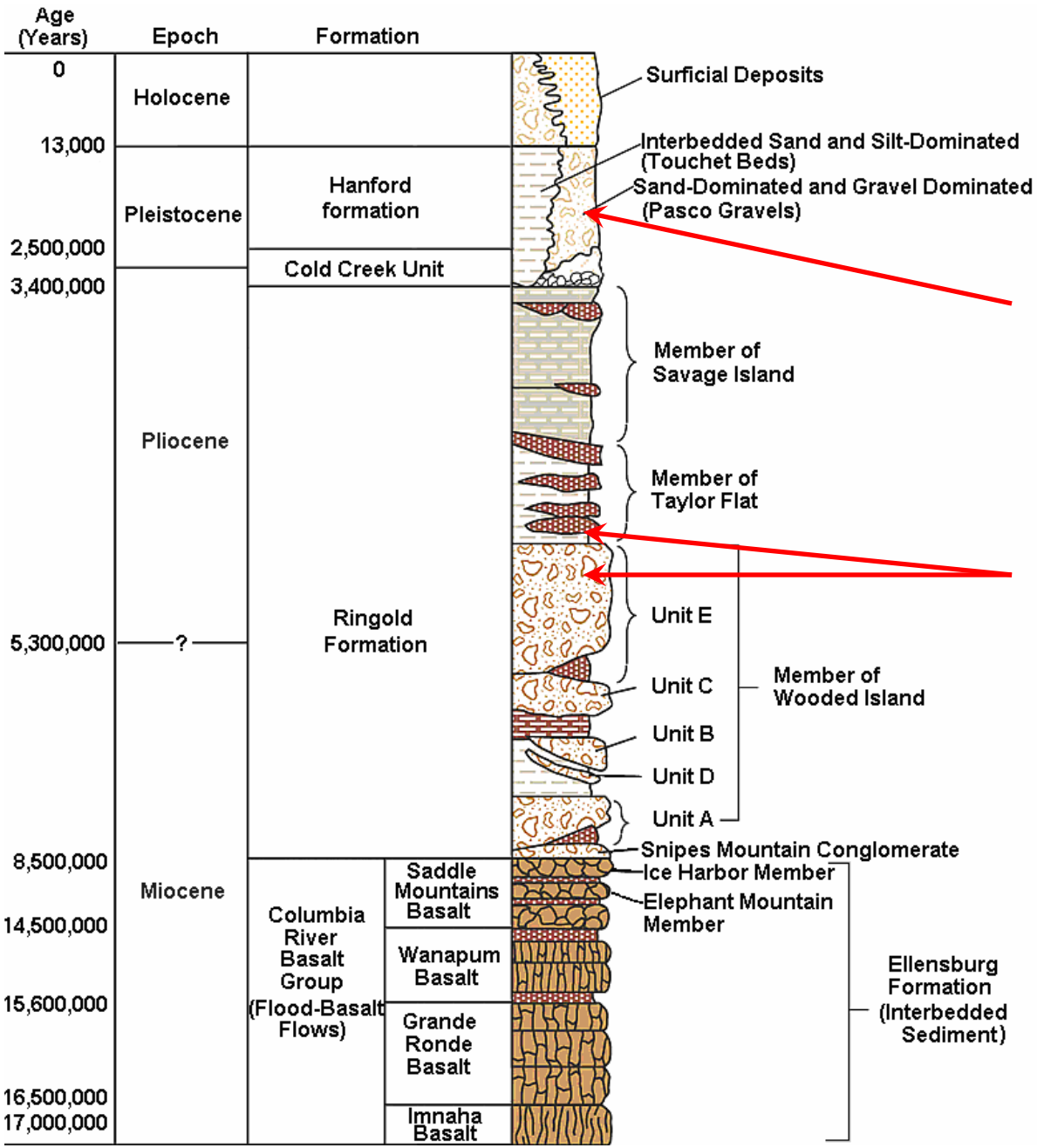
- **STOP 1** will examine Pleistocene Missoula Flood gravels of the Hanford formation
- **STOP 2** will examine the Miocene-Pliocene Ringold Formation
- **STOP 3** will again examine Pleistocene Missoula Flood gravels

Directions to Stop 1

- From Discovery Hall, head south on Stevens Drive and By-Pass Hwy, then merge onto Interstate 182 heading east toward Pasco.
- Take Exit 7b to head north on Broadmore Blvd. Proceed north for approx. 3.4 miles (5.4 km). Note that at Dent Rd. the Broadmore Blvd, changes to Easy Street.
- Turn left on to Fanning Rd. (heading east), then take the next right (Laporte Dr.).
- Take next left on to Columbia River Rd. Continue northwest approx. 5 miles (8 km), and keep left at Sagemoor Road. Park near the fenced quarry on the right (**STOP 1a**).
- *OPTIONAL*. Return to vehicles and proceed north on Columbia River Road. Park near the end of the road, then walk approx. 0.4 miles (10 mins) along Columbia River Road to the landslide (**STOP 1b**).



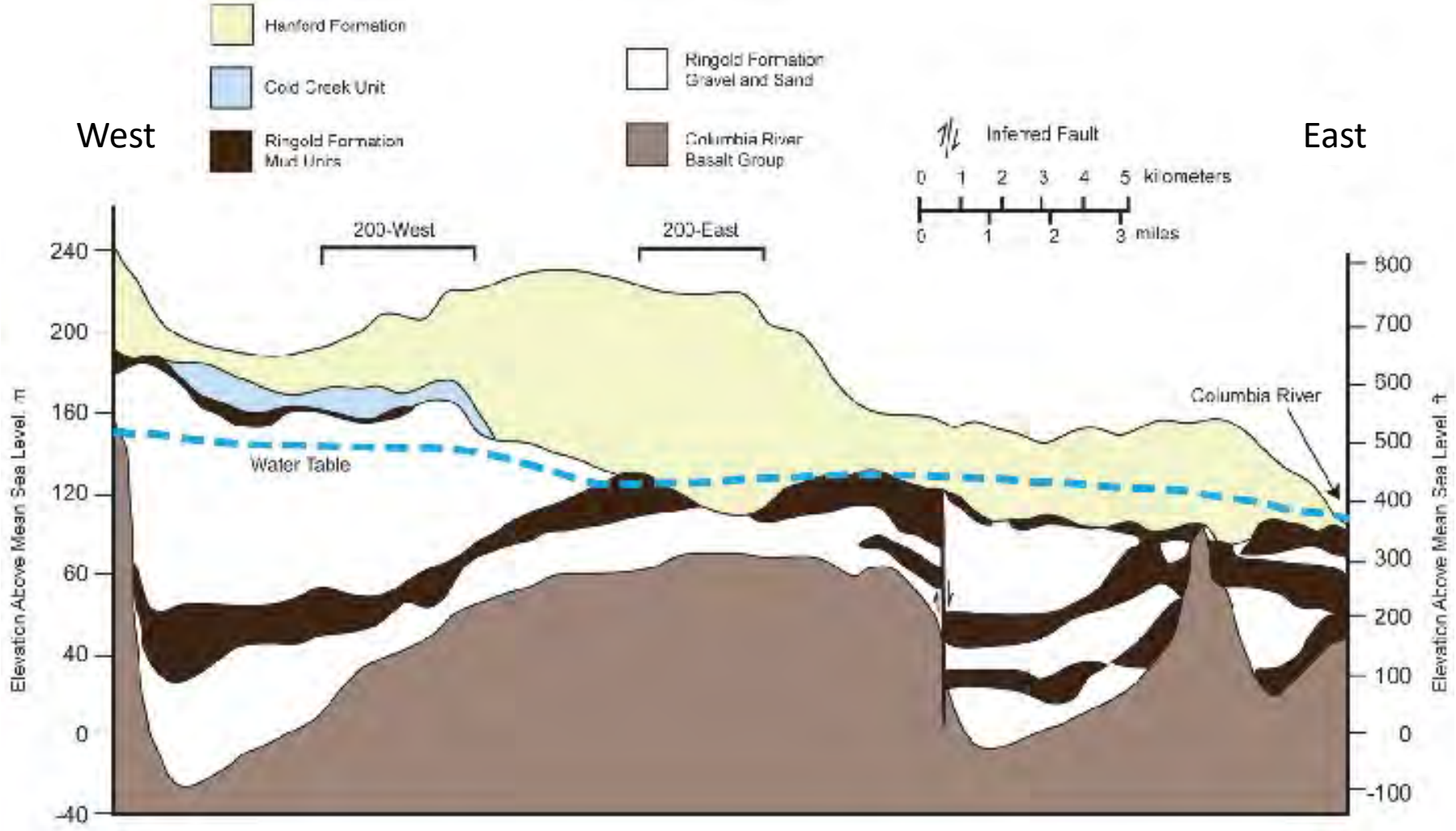
The Hanford Site is located within the Pasco Basin, a structural and topographic basin that formed concurrent with Miocene Columbia River Basalt volcanism some 17 to 6 million years ago. Ancestral rivers have filled the basin with Pliocene sediments(Ringold Formation) and Pleistocene cataclysmic floods sediments (Hanford formation).



Stop 1a, and 3

Stop 1b and 2

The subsurface geologic deposits exert hydrologic and geochemical controls affecting the fate and transport of contaminants.



This generalized west to east geologic cross section through the central Hanford Site, illustrates that Pleistocene flood deposits of the Hanford formation comprise much of the vadose zone (containing most of Hanford's waste), while the unconfined aquifer is composed primarily of the Miocene to Pliocene Ringold Formation.

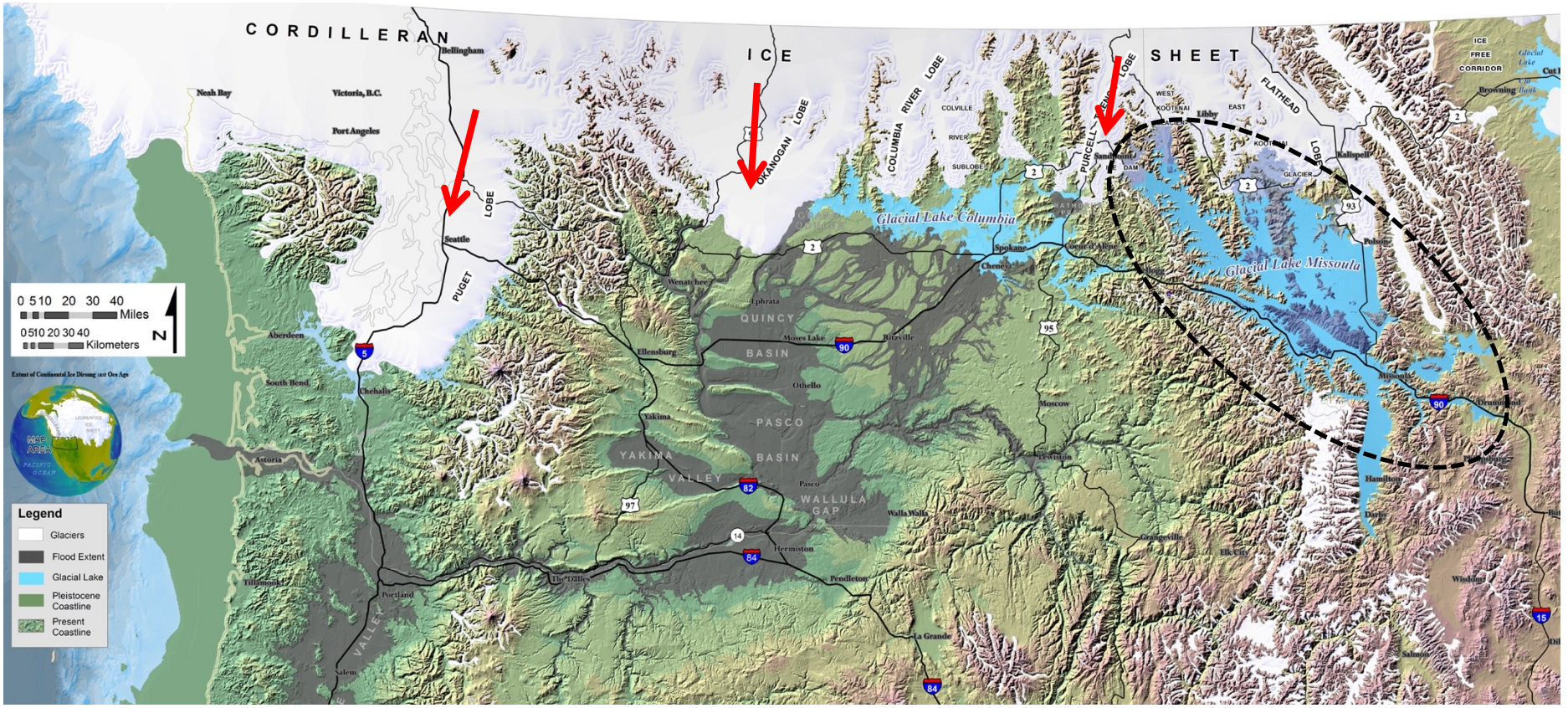
Hanford sand facies, IDF pit, 200 East Area

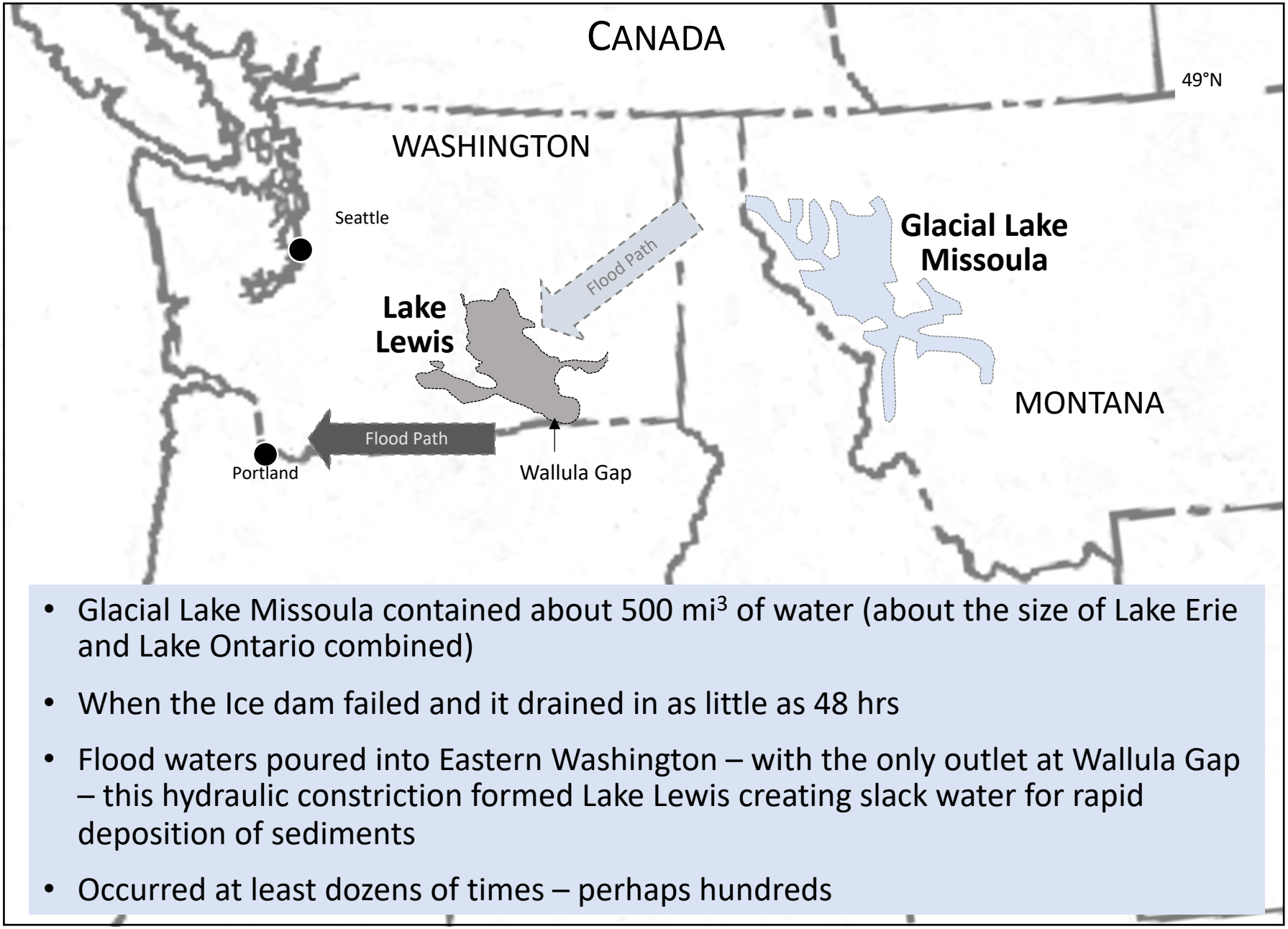
Pasco gravels facies, Pit #13, 200 Area

Hanford formation sediments were deposited by cataclysmic glacial lake outburst floods

The Last Glacial Episode (Late Wisconsinan)

- Began about 28,000 ya and ended about 14,000 ya (max. at about 18,000 ya)
- As the glaciers advanced
  - They carved out Puget Sound trough
  - The Okanogan lobe blocked Columbia River
  - Purcell Trench Lobe dammed the Clark Fork River creating Glacial Lake Missoula





- Glacial Lake Missoula contained about 500 mi^3 of water (about the size of Lake Erie and Lake Ontario combined)
- When the Ice dam failed and it drained in as little as 48 hrs
- Flood waters poured into Eastern Washington – with the only outlet at Wallula Gap – this hydraulic constriction formed Lake Lewis creating slack water for rapid deposition of sediments
- Occurred at least dozens of times – perhaps hundreds

STOP 1a – Sagemoor Quarry

N 46.443339°, W 119.254923°, Elev. ~405 ft (123 m)

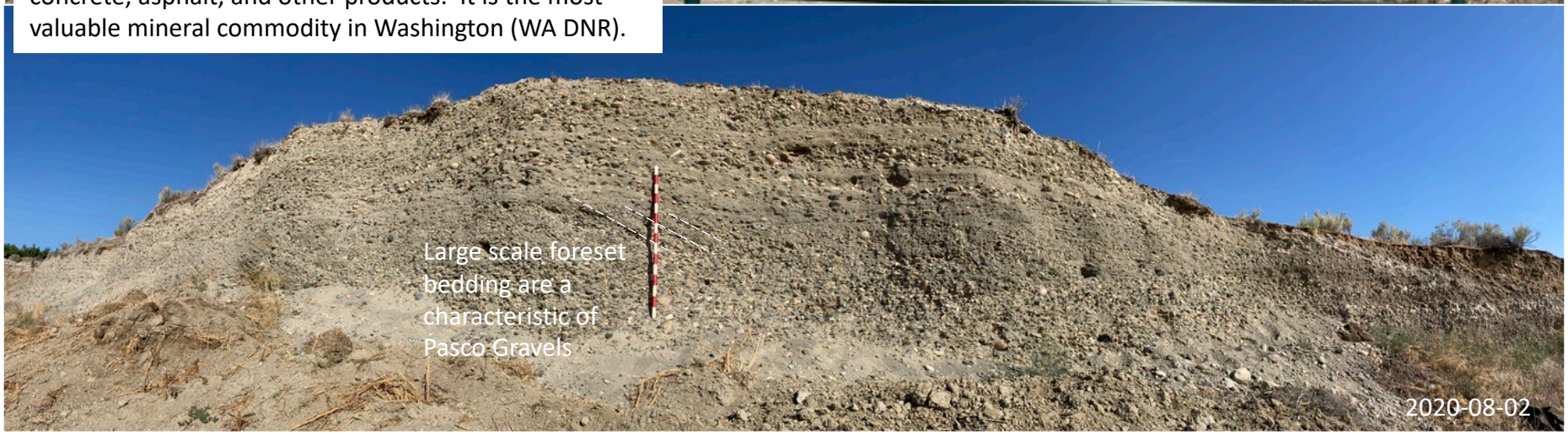
View looking west at Hanford's 300 area (fuel fabrication operations, and experimental and laboratory facilities).

Ice Age floods, mostly from Glacial Lake Missoula, left behind vast deposits of gravel in the Pasco Basin (the so-called Pasco Gravels).

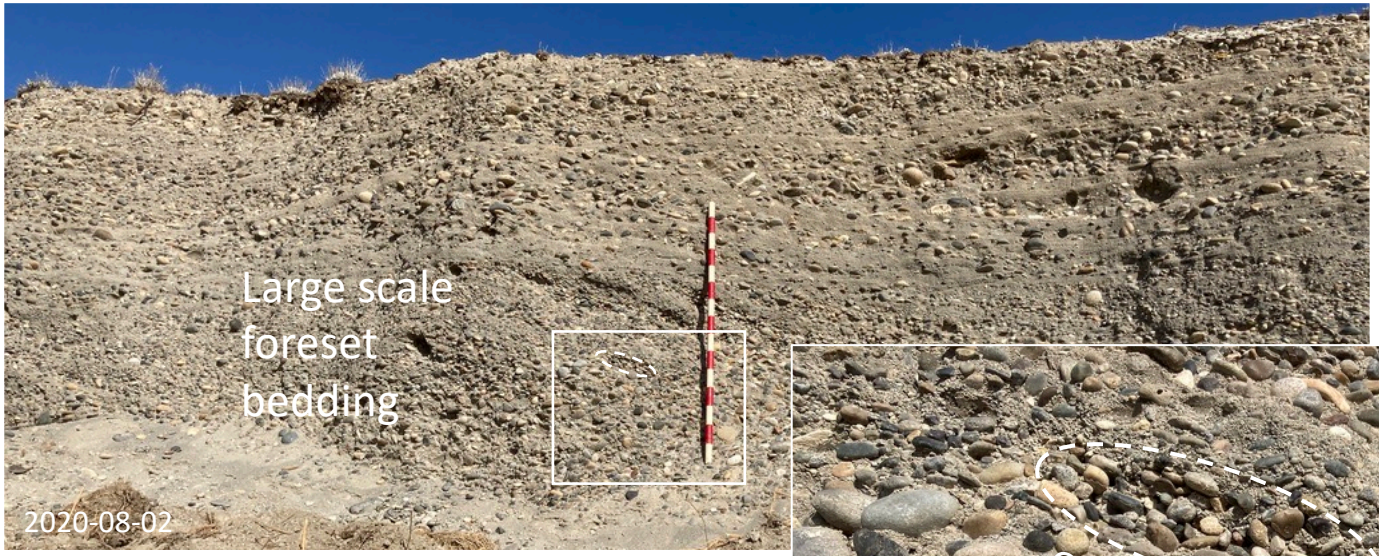
See Panorama Below

2020-08-02

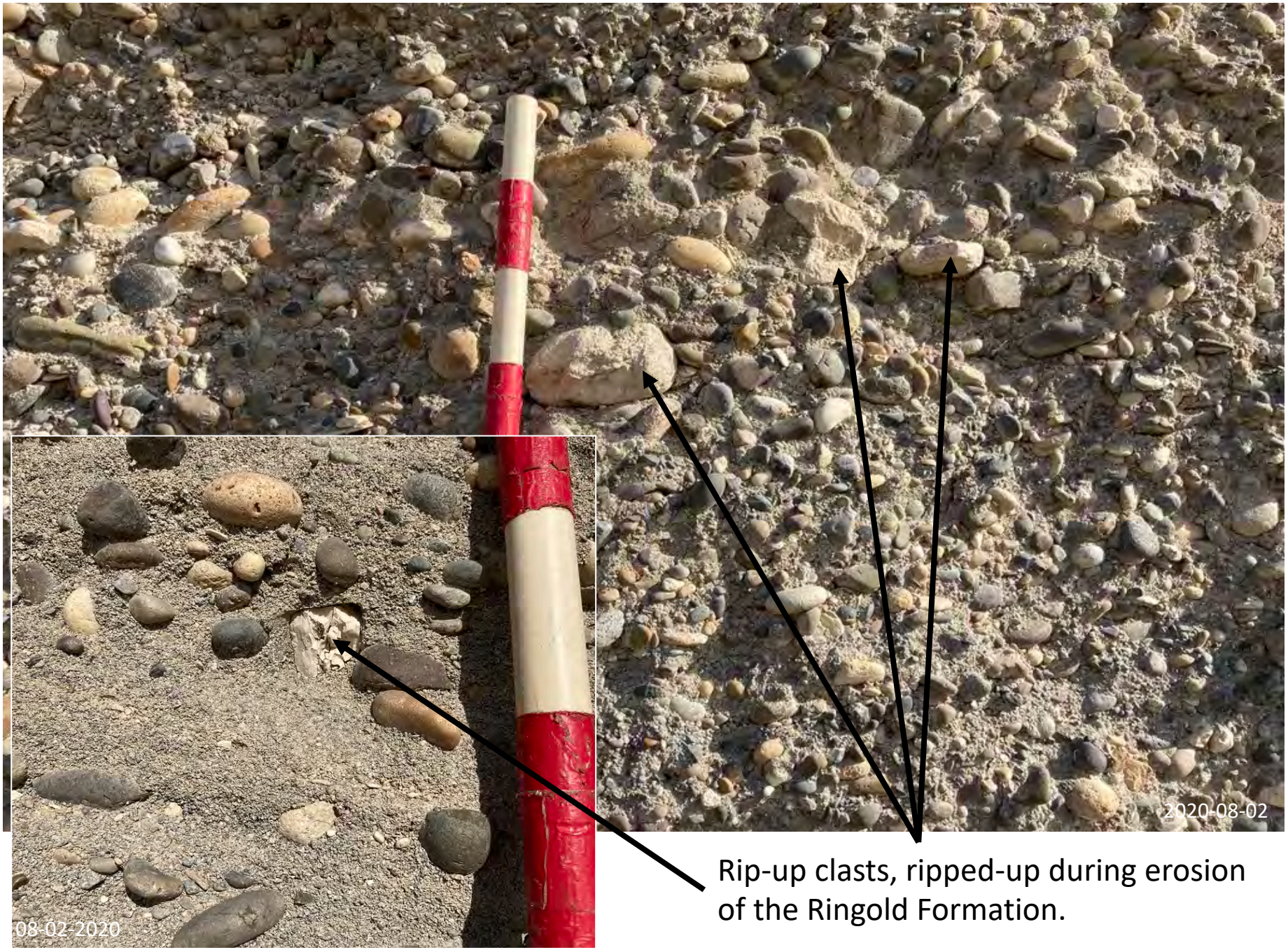
Sand and gravel are quarried to produce aggregate for concrete, asphalt, and other products. It is the most valuable mineral commodity in Washington (WA DNR).



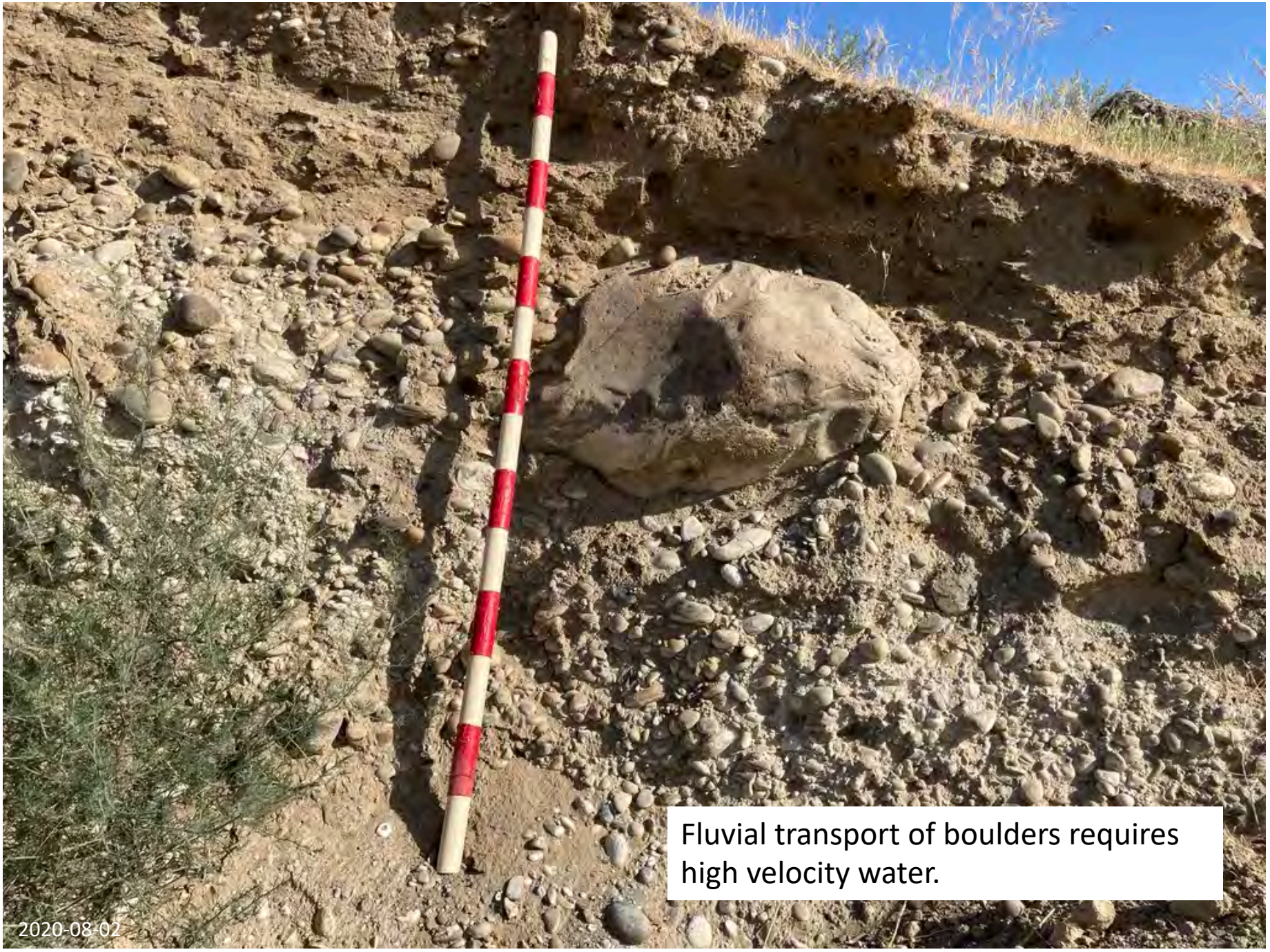
Pasco Gravels



Chaotic open-framework, clast supported to matrix (sand) support gravels. Lots of basalt.



Rip-up clasts, ripped-up during erosion of the Ringold Formation.


Fluvial transport of boulders requires high velocity water.
2020-08-02

Calcium carbonate deposition is a natural soil forming process following deposition. In general, the more calcium carbonate, the older the deposit. These deposits are fairly young – probably from of the last Ice Age floods (~ 15,000 ya).

Directions to Stop 2

- Return to vehicles and proceed north on Columbia River R.
- Take sharp right, east, on to W Sagemoor Rd. Continue 3.4 miles (5.4 km).
- Turn left (north) on to Tayler Flats Rd. Proceed 4 miles (6.4 km).
- Turn left (west) on to W Fir Rd. Follow it 1.9 miles (3 km), then left around Sagemoor farm facilities, and proceed down the hill towards the Columbia River. *Note that the road is no longer asphalt*.
- Take next left on to N Columbia River Rd, and then left into an unimproved parking area (**STOP 2**).
- Exit vehicles and walk along N Columbia River Rd for about 0.4 miles (0.6 km) to view exposures of the Ringold Formation.

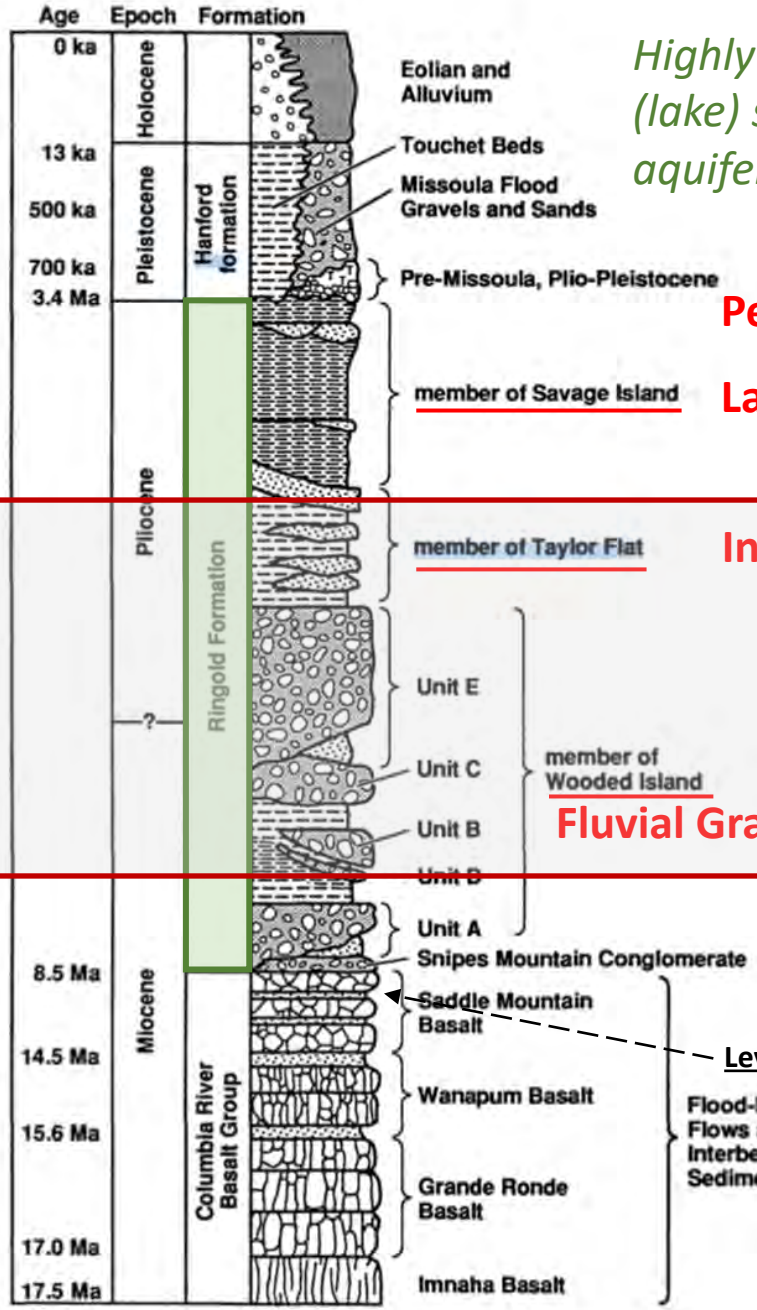
STOP 2 – Fir Road / Wooded Island

N 46.444522°, W 119.254661°, Elev. 380 ft (166 m)

View looking west down W Fir Rd toward the Columbia River. Rattlesnake Mountain lies in the distance.

Ringold Formation

Highly stratified (layered) fluvial (stream) and lacustrine (lake) sediments that form most of the unconfined aquifer system.



Pedogenic carbonate (Caliche/Calcrete) — Cold Creek Unit

Lacustrine Deposits

STOP 1b and 2

Interbedded fluvial sand and overbank fines

Units C & E - Fluvial gravel separated by an unnamed, but widespread paleosol sequence

Units B & D - Fluvial gravel and intercalated overbank/paleosol deposits

Fluvial Gravel

Lower Mud - Paleosols and lacustrine deposits

Unit A - Fluvial gravel and lesser fluvial sand

Levey Interbed

After Lindsey et al. 1992 and Lindsey 1996

Member of Wooded Island

Well rounded gravel consisting of quartzite, other metamorphics, porphyries, diorite, and other igneous rock types are indicative of Columbia River and Salmon/Clearwater Rivers.

Member of Wooded Island, Facies association I - Clast- and matrix-supported, pebble to cobble gravel with a fine to coarse sand matrix and intercalated fine to coarse sand and silt lenses (Lindsey 1996).

Member of Wooded Island

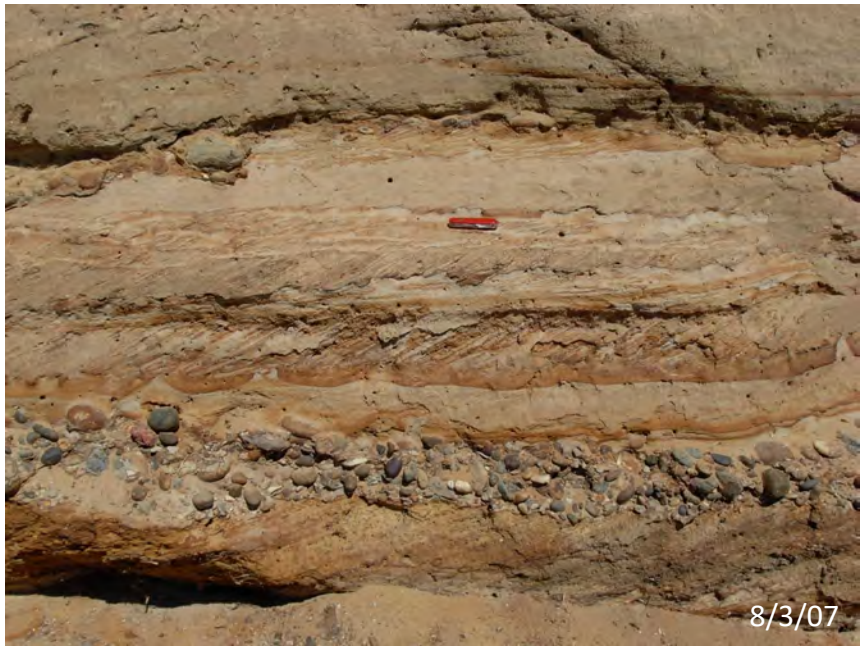
- Fluvial Gravels of the Ringold Formation and Snipes Mountain Conglomerate were deposited from ~8.5 Ma to 5 Ma
  - After youngest flood basalts
- Deposited in braided plains of the ancestral Columbia and Salmon/Clearwater Rivers

Note the dark, manganese rich, and yellowish, limonite rich, secondary mineralization.

Member of Taylor Flat

Interbedded fluvial sand and overbank fines

Facies association II - Fine to coarse, generally quartzofeldspathic, sand.



The member of Taylor Flat records deposition in sandy fluvial channels and on adjacent floodplains and overbank areas that formed between 5.5 and 4.5 Ma (Lindsey, 1996).

Optional Stop 2b.

Hanford formation sand facies with clastic dike

Directions to Stop 3

- Return to vehicles and proceed east on W Fir Rd. for 3 miles (4.8 km)
- Turn left (west) on to Ringold Rd. Proceed NW 3 miles (4.8 km).
- Take a sharp left on to Ringold Rd. and proceed o,7 miles (1.1 km).
- Turn left on to the gravel access road into the quarry and park. (**STOP 3**).

STOP 3 – Ringold Quarry

N 46.505771°, W 119.252207°, Elev. ~500 ft

Panoramic view looking west from the gravel quarry. Note Rattlesnake Mountain in the distance.

The quarry is used to extract sand and gravel from the Pleistocene Hanford formation's Pasco Gravels.

Note the large scale foreset bedding characteristic of Pasco Gravels.

Ringold Springs