

Appalachian Ecosystem Restoration; Stream Restoration Techniques and Case Studies in "Coal Country"

Prepared For:

The West Virginia Mine Drainage Task Force
2014 Symposium

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STREAM RESTORATION DEFINITION

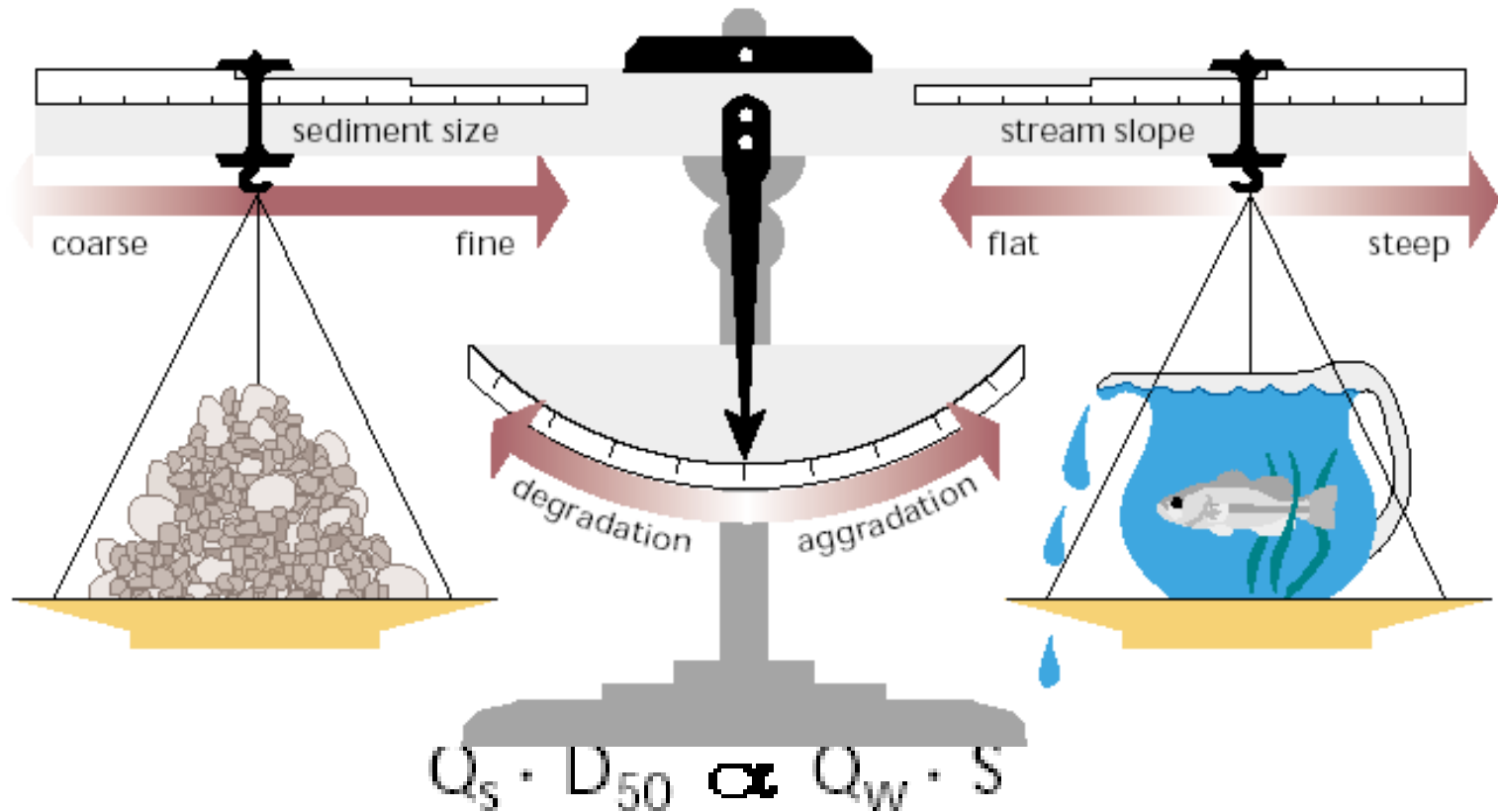
"Restoration is defined as establishing natural **stability** and proper function of rivers." (ROSGEN, 1997)

"Stream Channel Restoration refers to actions to convert an incised, unstable stream channel to a natural **stable** condition, considering recent and future watershed conditions." (USACE, 2004)

"Stream restoration re-establishes the general structure, function, and self-sustaining behavior of a stream system to a better functional condition; **stabilizes** or reverses stream aggradation or degradation; and enables more diverse aquatic habitats. " (FHWA, 2004)



LANE'S BALANCE DIAGRAM



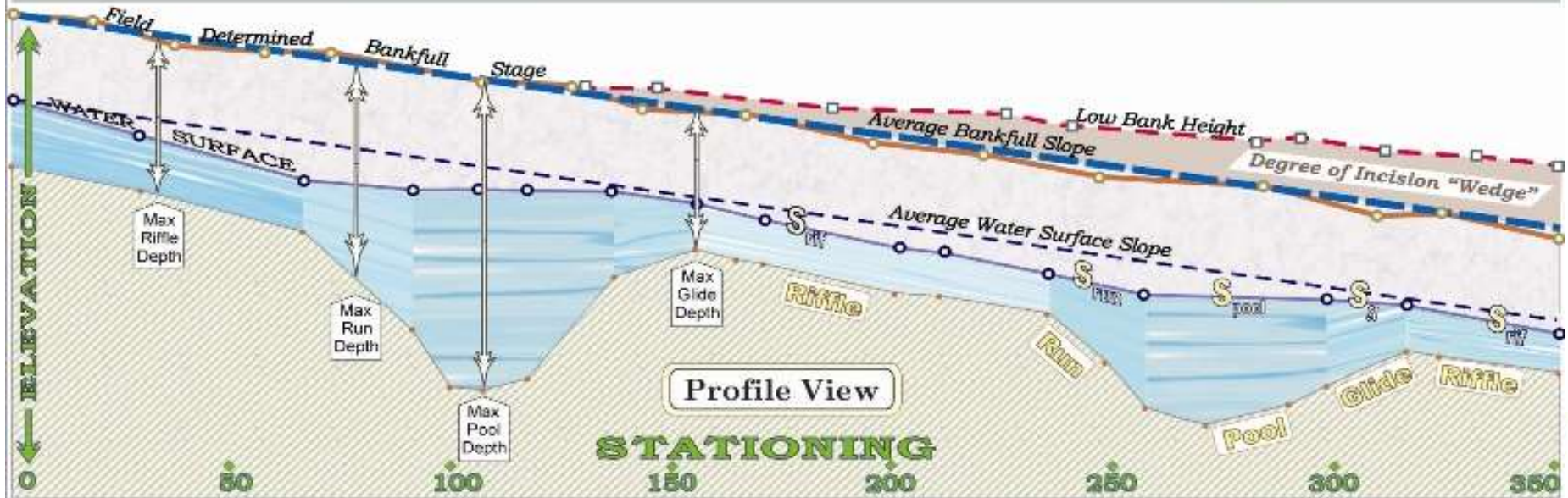
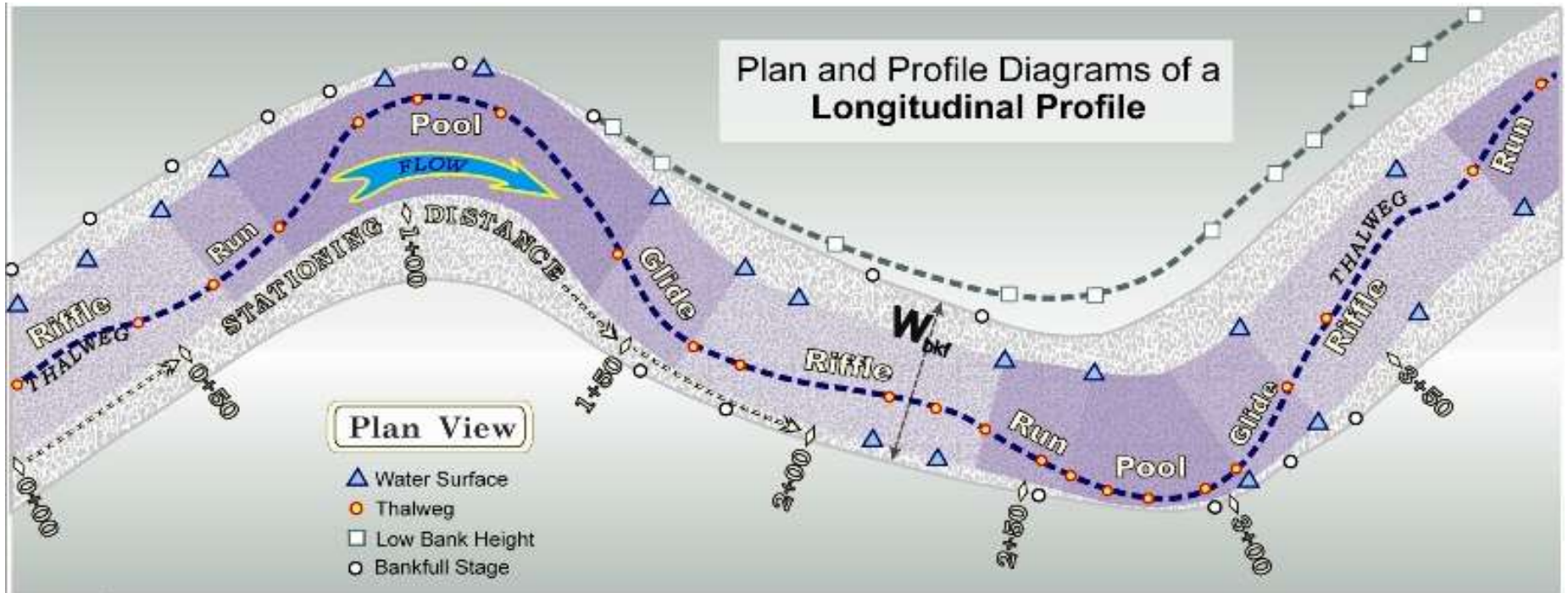
Stream power is the rate of energy dissipation against the bed and banks of a river or stream per unit downstream length.

$$\Omega = \tau V$$

The transport of bed particles in a stream is a function of the fluid forces per unit area...the tractive force or **shear stress** (τ), acting on the streambed.

$$\tau = \gamma DS$$

Natural Channel Design



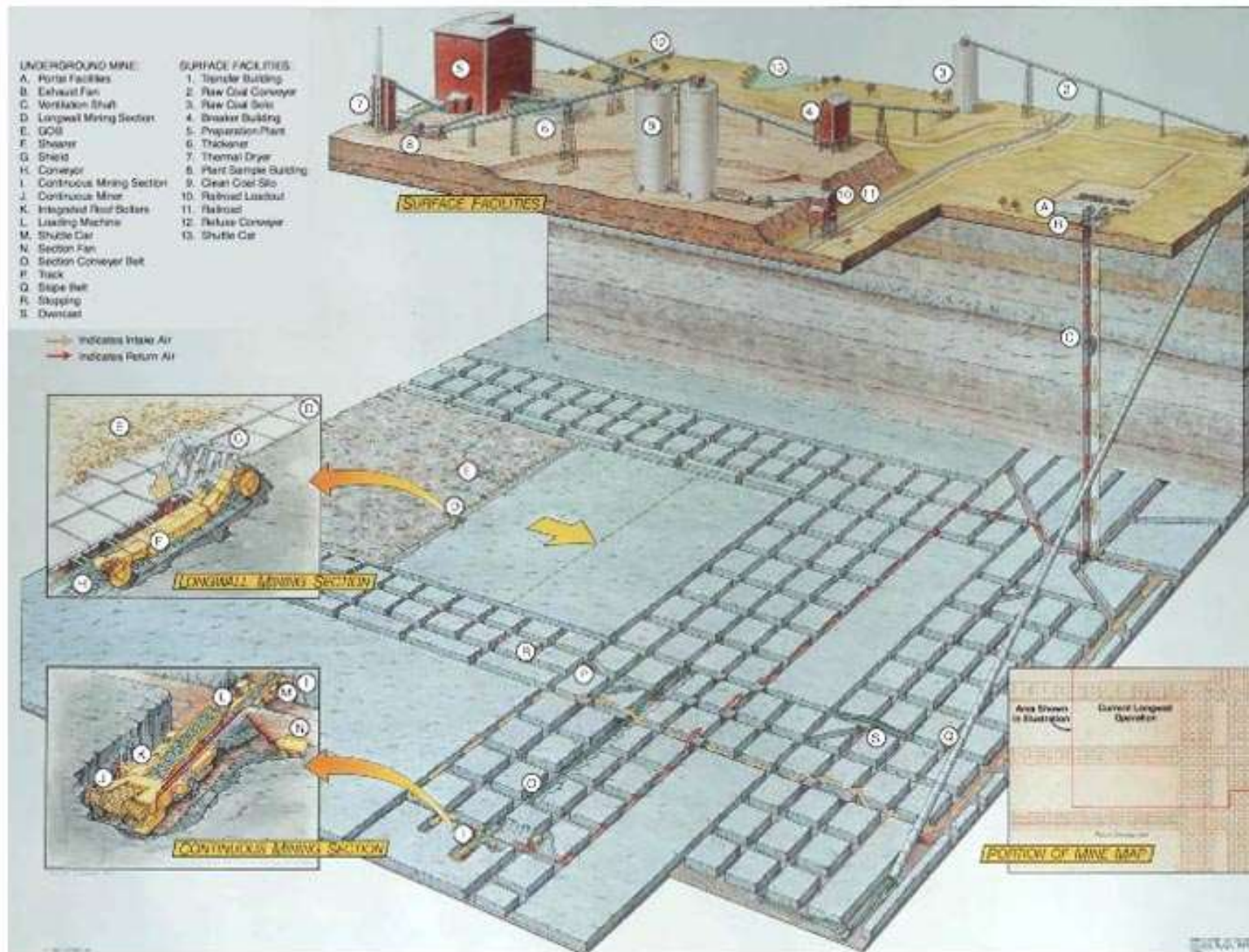
Longwall Mining

- ▶ Longwall mining is a form of underground coal mining where a long wall of coal is mined in a single slice (typically 0.6–1.0 m thick). The longwall *panel* (the block of coal that is being mined) is typically 3–4 km long and 250–400 m wide.

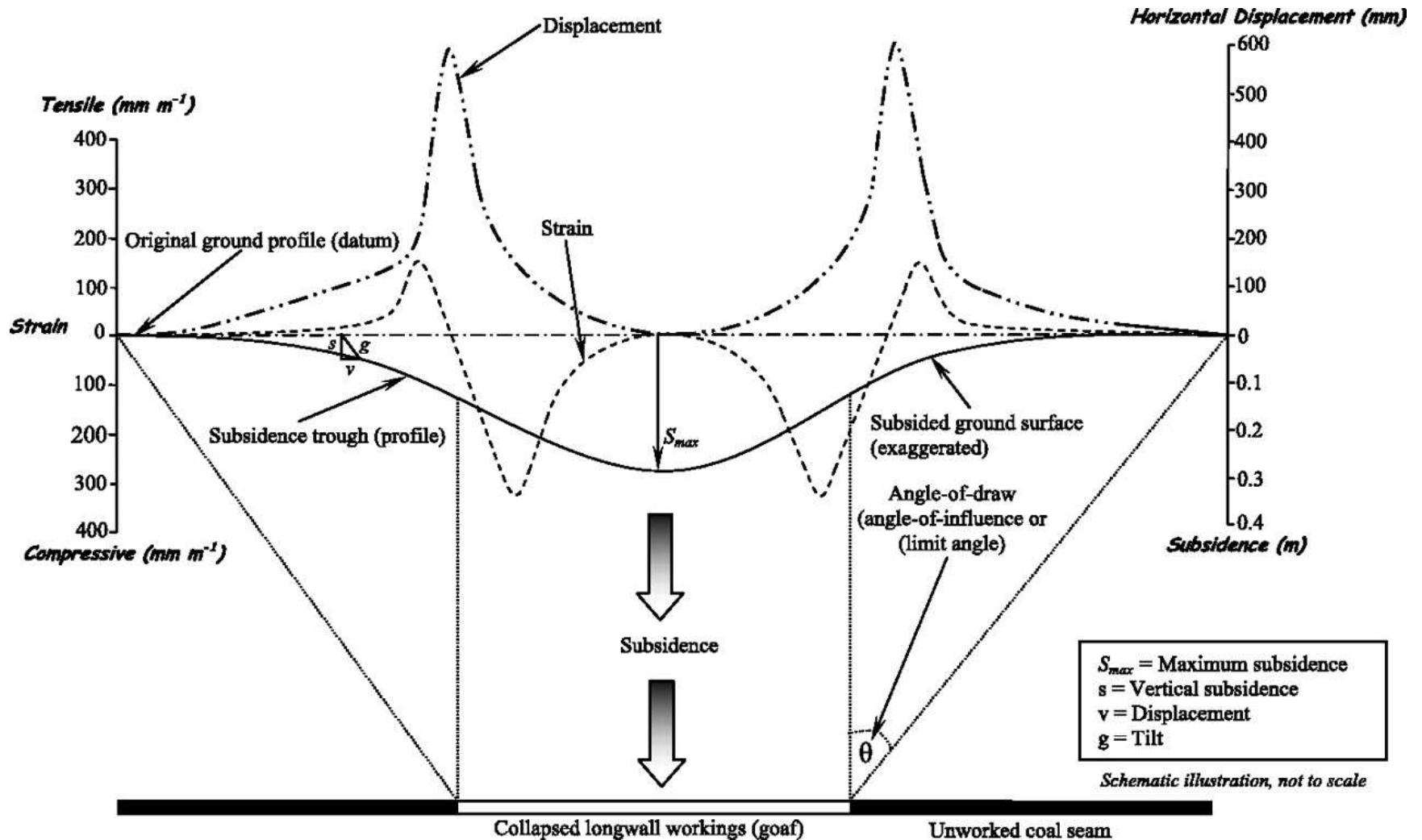


http://en.wikipedia.org/wiki/Longwall_mining

Longwall Mining

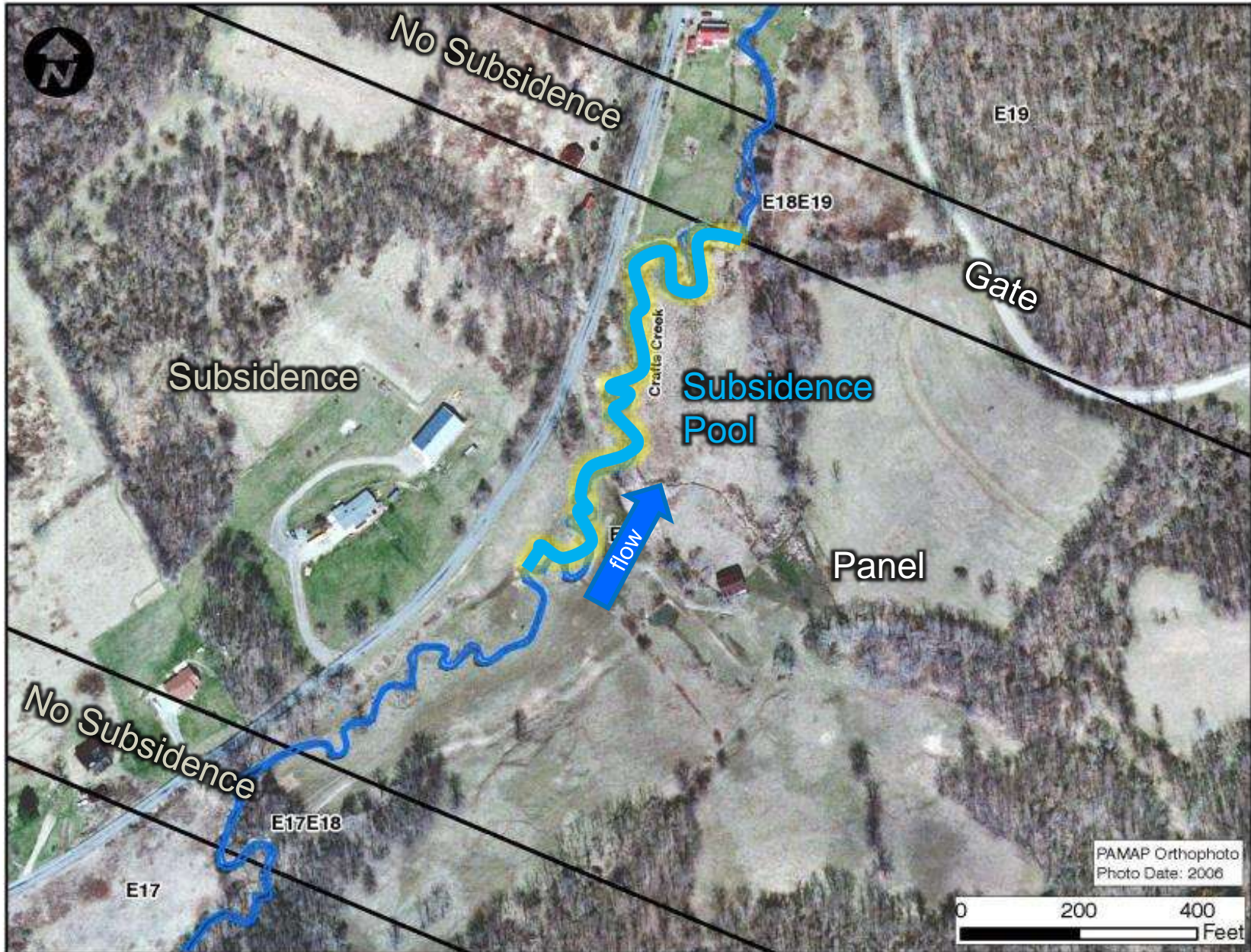


Longwall Mining Subsidence



Donnelly 2007

Longwall Mining Stream Impacts

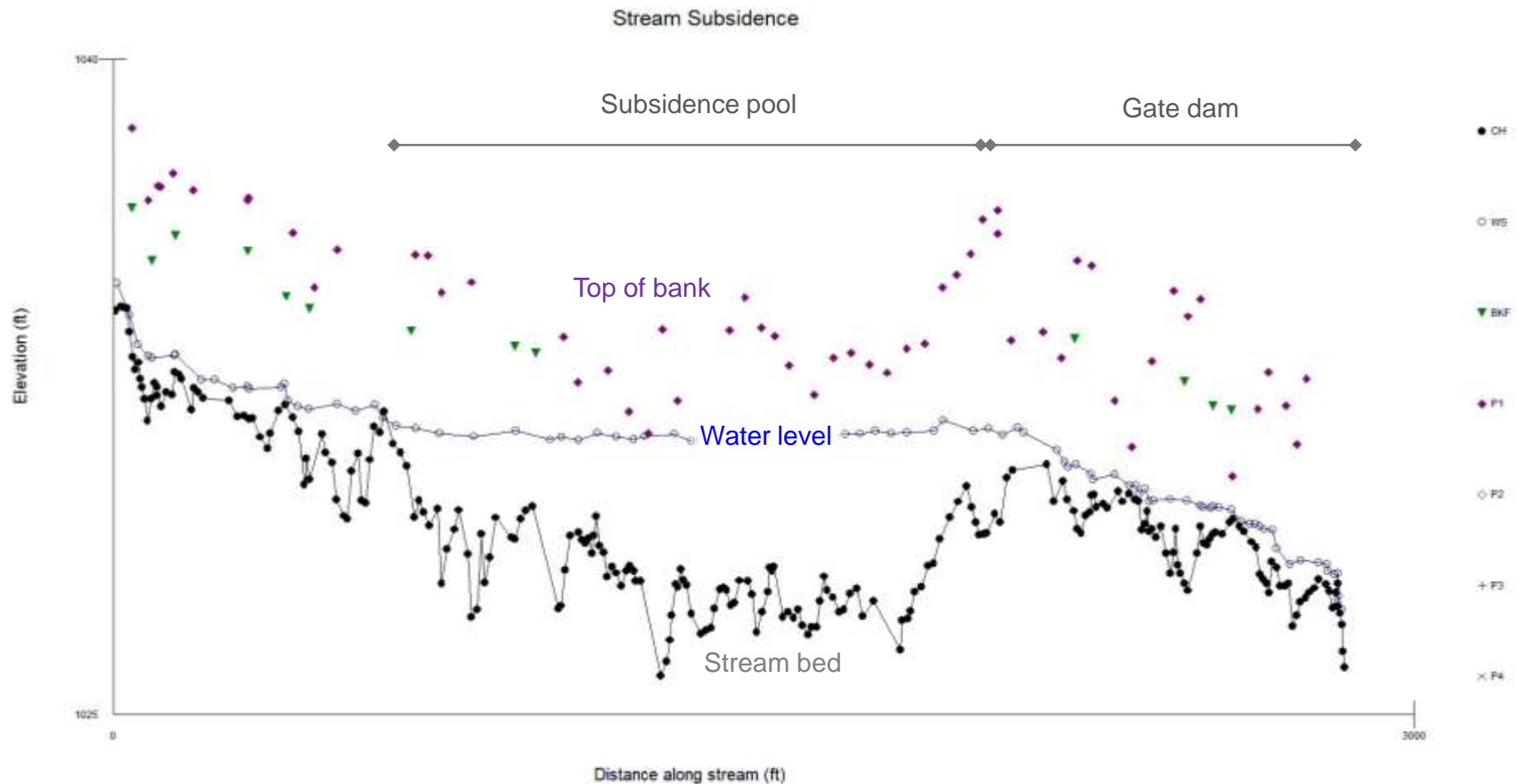


Longwall Mining Stream Impacts



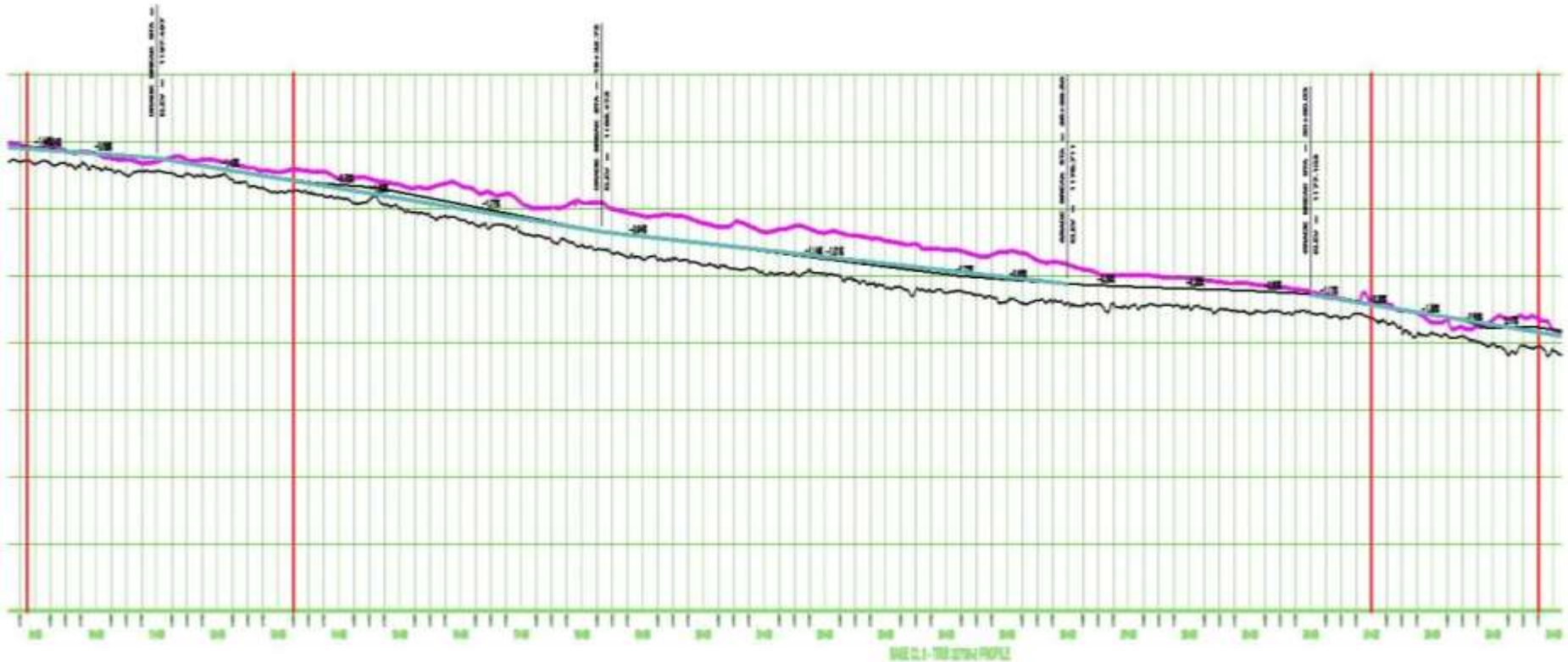
Longwall Mining Stream Impacts

► Stream Subsidence Profile



Longwall Mining Stream Impacts

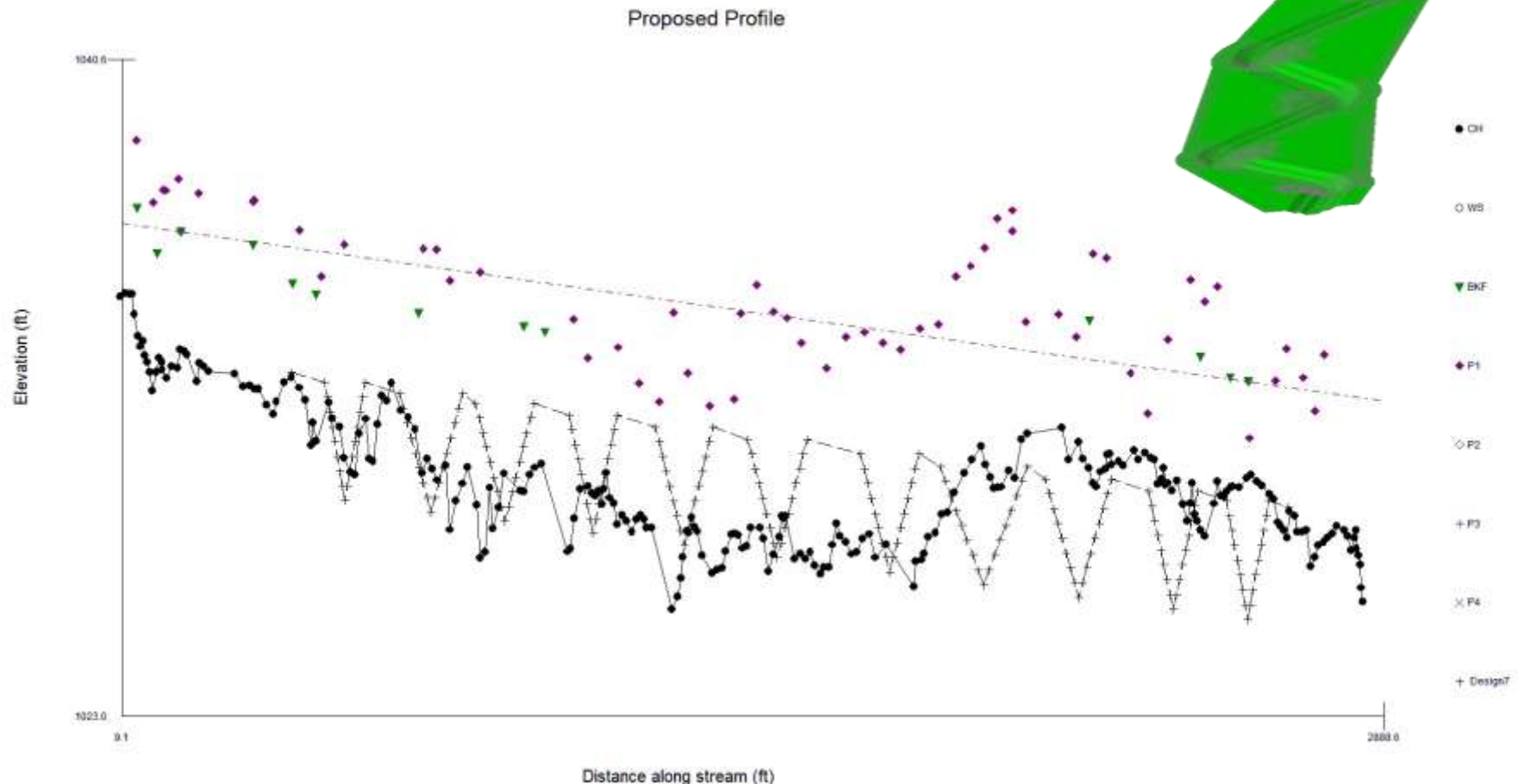
- Pre and Post mining surfaces using LIDAR



- Need to capture the pre-mining hydraulic slope to calculate bankfull discharge.

Longwall Mining Stream Restoration

- ▶ Designers should take advantage of the subsidence with a Priority I restoration to minimize earthwork quantities.



Longwall Mining Stream Restoration

- ▶ Completed Subsidence Mitigation
- ▶ Pooling remediated
- ▶ Facet slopes and habitat restored
- ▶ Stream banks stabilized



Surface Mining

- ▶ "Strip mining" is the practice of mining a seam of mineral, by first removing a long strip of overlying soil and rock (the overburden). It is most commonly used to mine coal and lignite (brown coal). Strip mining is only practical when the ore body to be excavated is relatively near the surface. This type of mining uses some of the largest machines on earth, including bucket-wheel which can move as much as 12,000 cubic meters of earth per hour.



Video provided by Roger Wolfe, West Virginia DEP

Surface Mining Stream Impacts



Photo provided by Roger Wolfe, West Virginia DEP

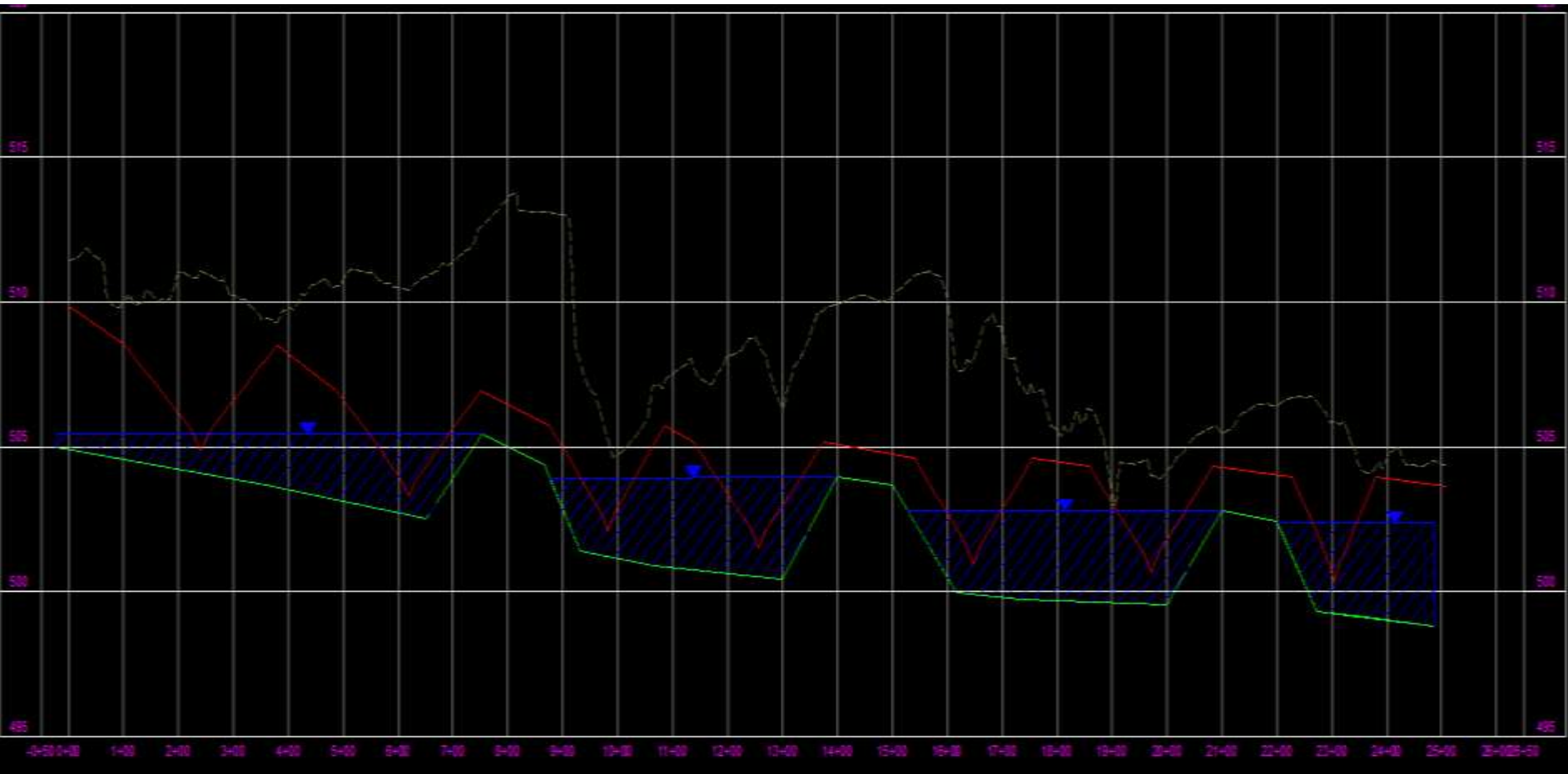
Surface Mining Stream Restoration

- ▶ Geo synthetic liner



Surface Mining Stream Restoration

- ▶ Creating perched water with the GCL minimizes hydrostatic rebound and creates intermittent flow patterns during low flow seasons.



Surface Mining Stream Restoration



Surface Mining Stream Restoration



Surface Mining Stream Restoration



High Wall Mining

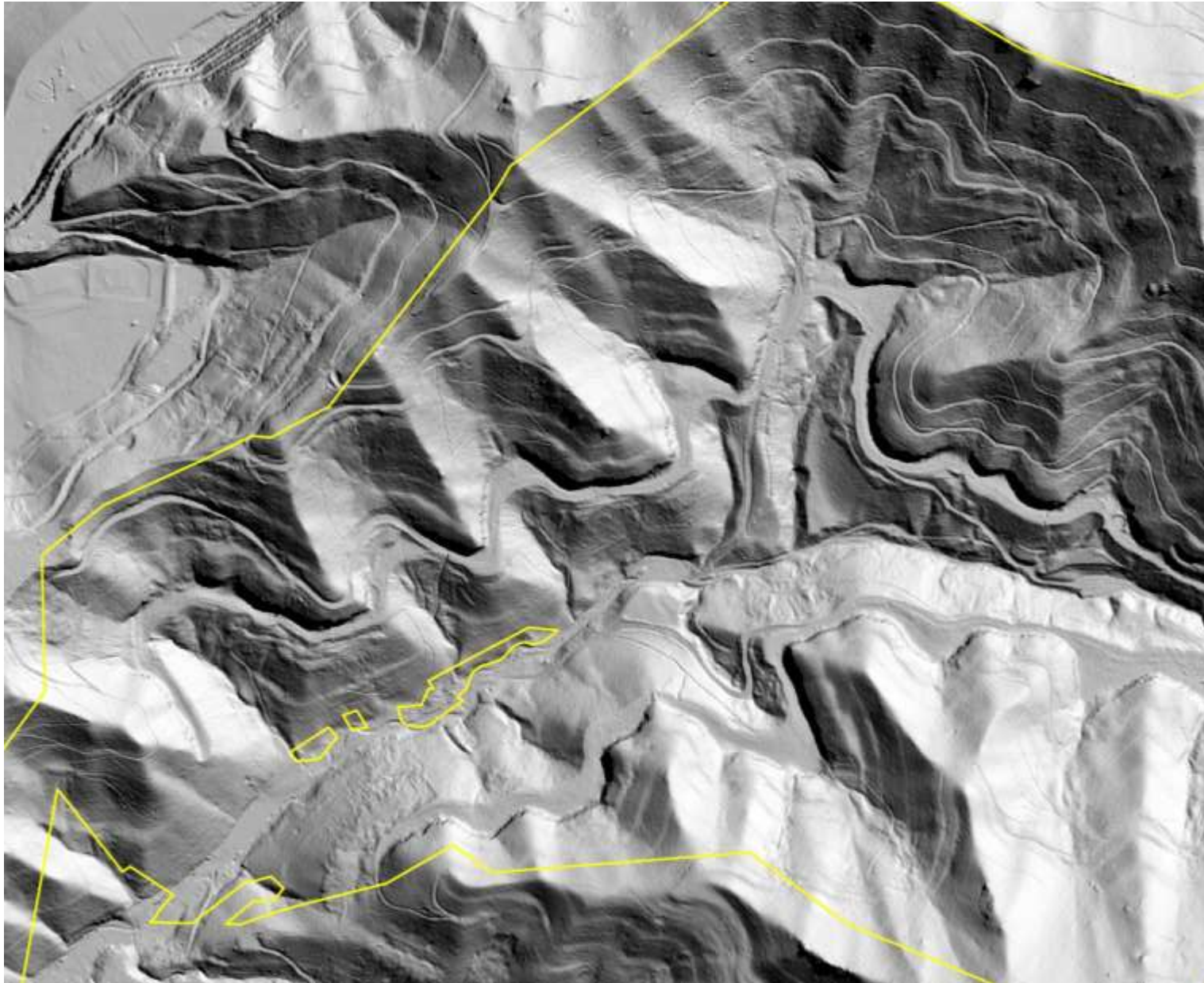
- ▶ Highwall mining is a form of surface mining that evolved from auger mining. In Highwall mining, the coal seam is penetrated by a continuous miner propelled by a hydraulic Pushbeam Transfer Mechanism (PTM). A typical cycle includes sumping (launch-pushing forward) and shearing (raising and lowering the cutterhead boom to cut the entire height of the coal seam).



High Wall Mining



High Wall Mining Stream Impacts



High Wall Mining Stream Restoration

► UT to Pendleton Run

- Primary goal was to convey water away from deep mine workings.
- Technique to achieve the goal included a geosynthetic liner and natural channel design.



Before



After

High Wall Mining Stream Restoration

► UT to Pendleton Run (1 Year Later)



Thank you!
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