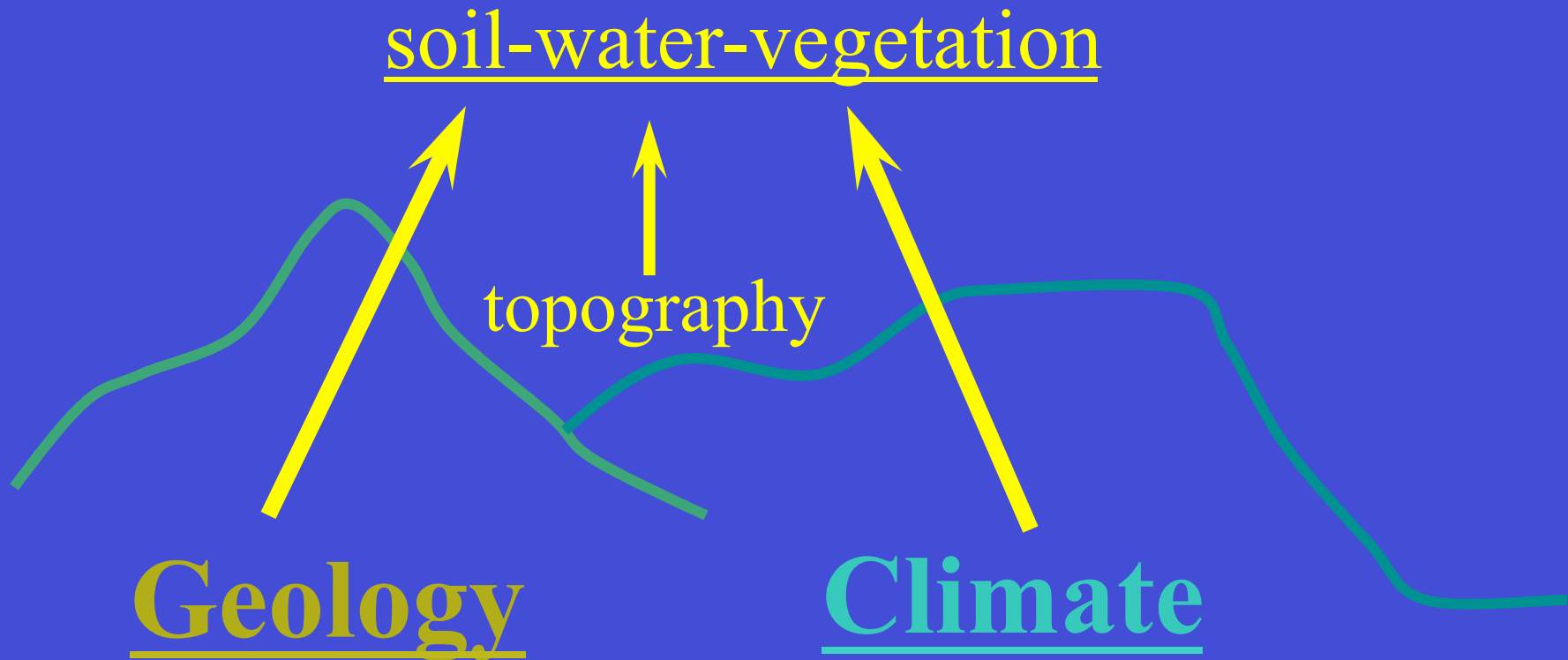


Watershed Functioning & Stream Processes

Stream processes integrate the physical and biological processes occurring across the contributing watershed.

Watershed Components



Watershed Functioning

The interactions among soil, water and vegetation, overlaid on the topography of the watershed, result in yields of streamflow and sediment with patterns of timing, quantity, and quality characteristic of each watershed (i.e., the watershed 'signature')

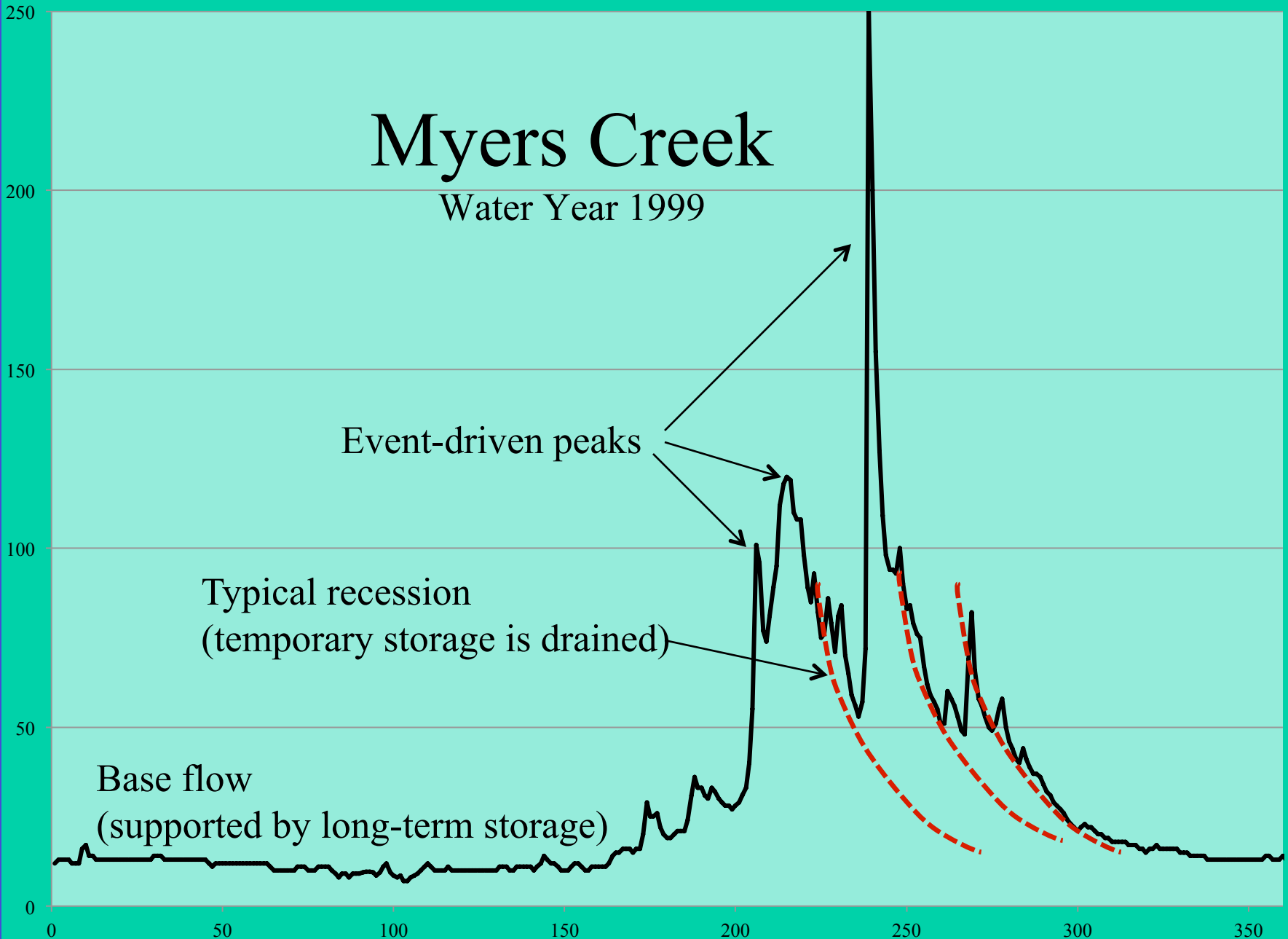
Myers Creek

Water Year 1999

Event-driven peaks

Typical recession
(temporary storage is drained)

Base flow
(supported by long-term storage)



Rule of Thumb: Slower is better

Surface flow is fleeting.

Natural water storage (e.g. soil mantle, aquifers, wetlands, snowpack, etc.) that attenuates the movement of water is the key to watershed functioning and productive stream habitat.





Soil

Watershed Functioning & Soils

The soil mantle is a natural storage reservoir.

Water stored in the soil is a primary source of streamflow between storms or periods of snowmelt.

Depth & texture govern soil water storage; slope and distance to the drainage network govern the rate and timing of delivery.



Vegetation - the ‘skin’ of the Watershed

Vegetation – Effects on the Soil

- Strength (resistance against erosion)
- Cover (protects against surface sealing)
- Root channels increase permeability (macropores)
- Decaying organic matter characterizes topsoil (influencing properties and structure)

Vegetation – Effects on Water

- Interception (reducing effective precipitation)
- Roughness (slowing surface runoff, increasing infiltration)
- Evapotranspiration (returns soil moisture to the atmosphere)
- Shading (reduces evaporation of soil moisture)

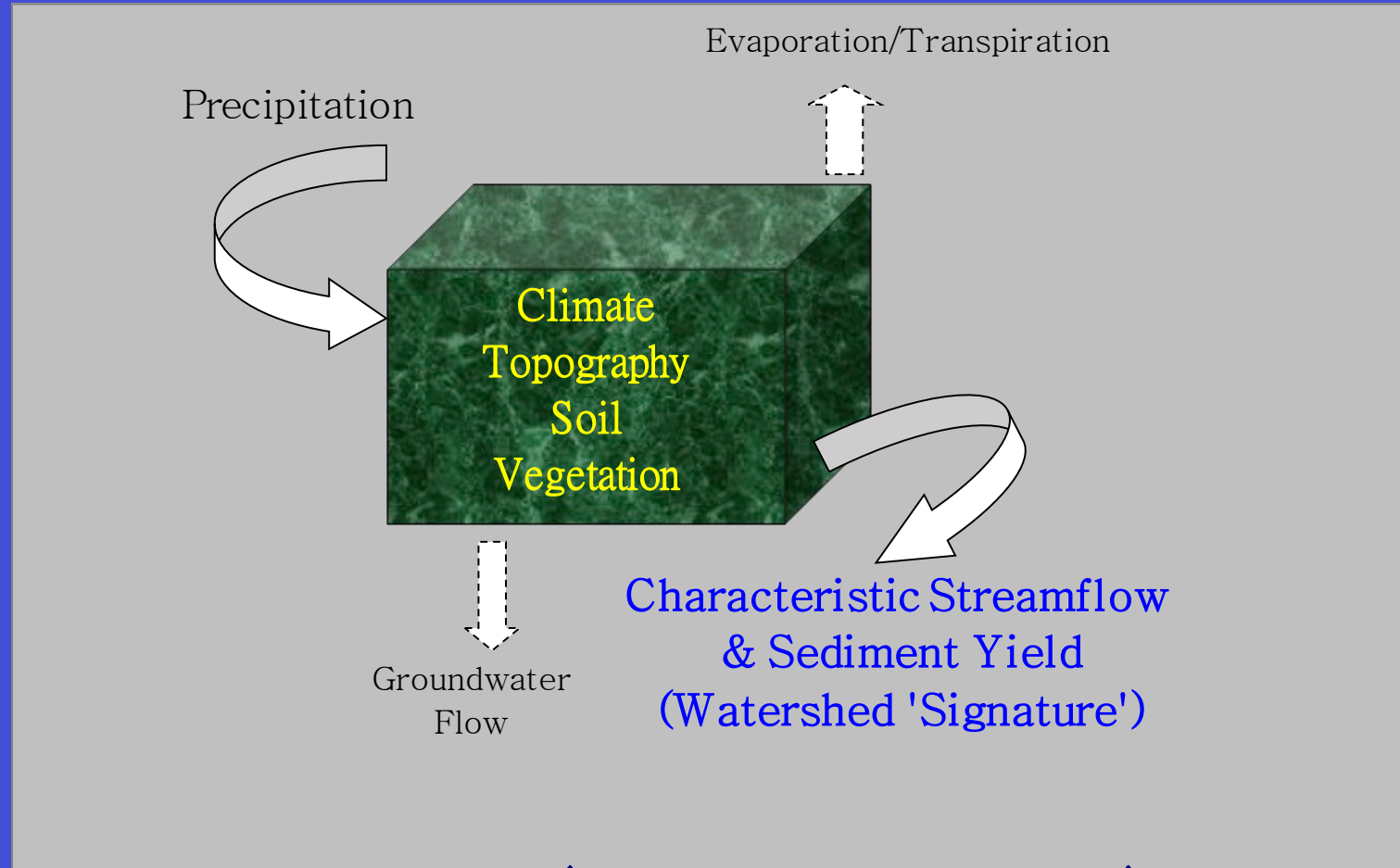
Bottom line:

Water use by vegetation reduces total water yield.

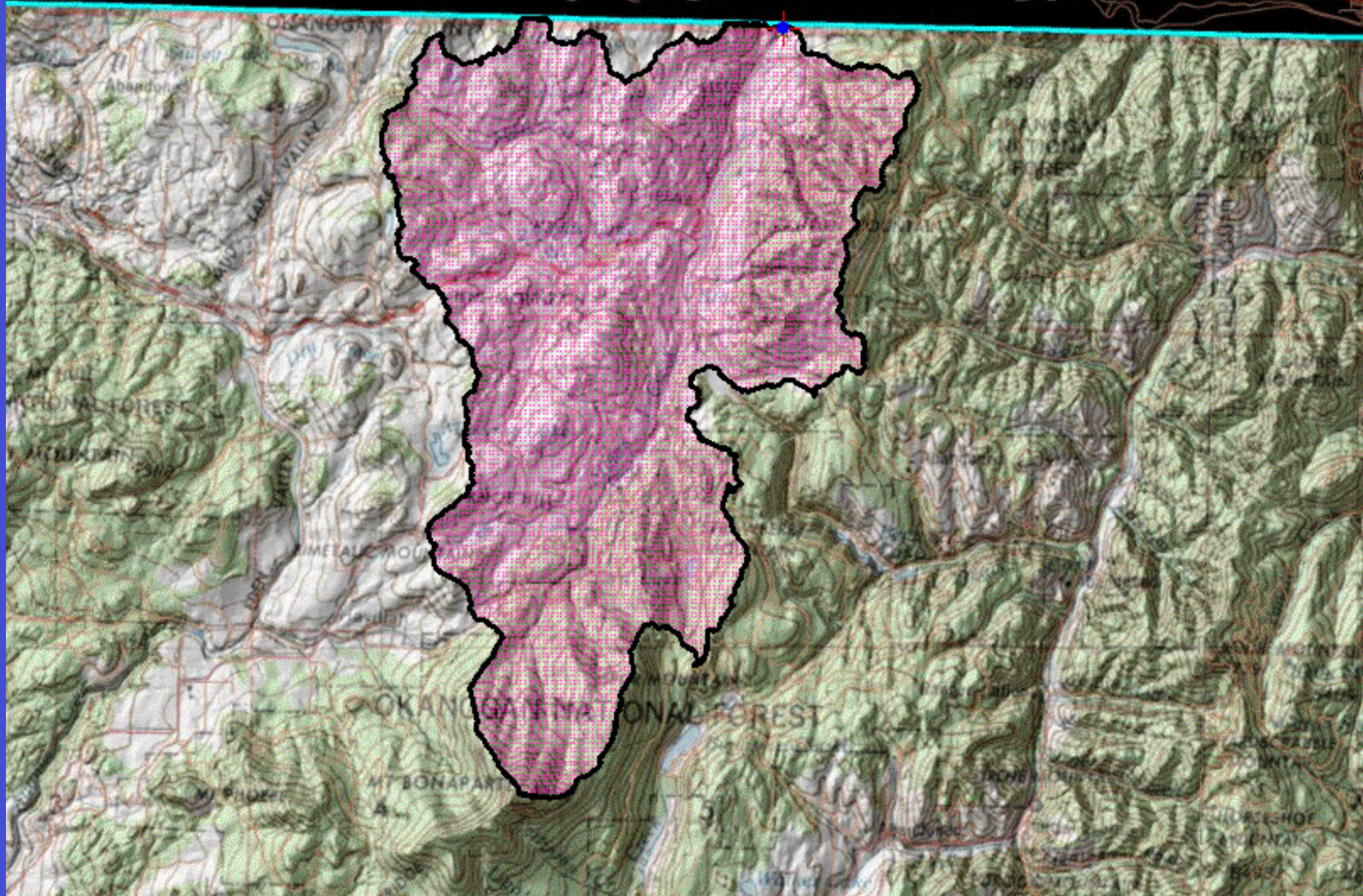
The combined influences of vegetation and soil also greatly attenuate the movement of water through the watershed, dampening peak flows, sustaining streamflow during dry periods, and maintaining high water quality.



Water



MYERS CREEK WATERSHED





Disturbance

Disturbance

A discrete event that disrupts ecosystem, community or population structure, and changes resources, substrate availability, or the physical environment.

Periodic large- and small-scale disturbance is critical to ecosystem functioning –

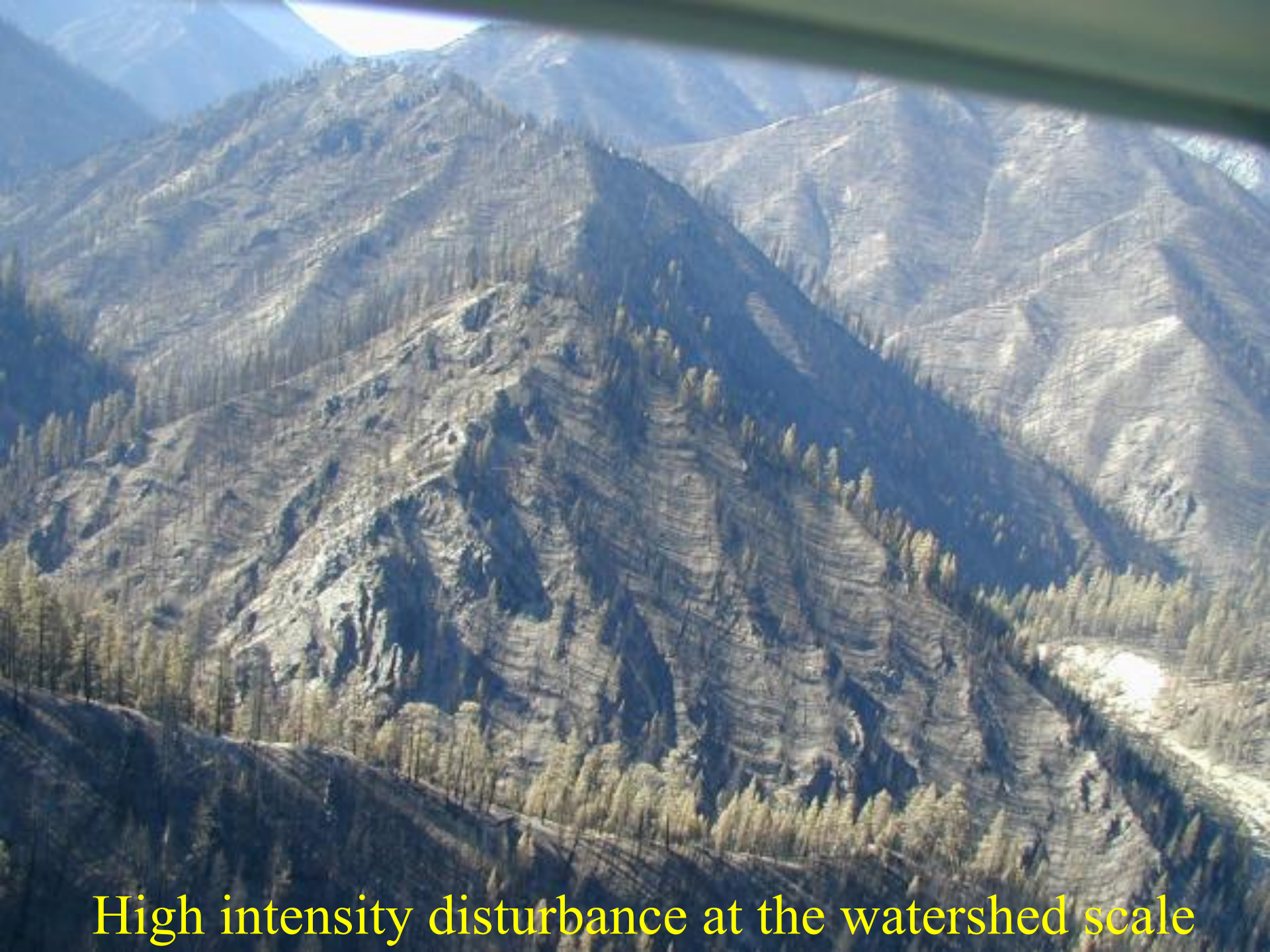
- 1) Preventing the vegetative community from maintaining a homogeneous climax state, and
- 2) Resetting the ‘**successional clock**’

Under natural circumstances, disturbances (e.g., fire, disease, landslides, and flooding) within an ecosystem occur with characteristic **frequencies**, **intensities**, and **extents**.

Thus, every ecosystem evolves with (is driven by) a particular **disturbance regime**.

Within a given ecosystem, the variability of size, intensity, and frequency of different disturbance events creates a **mosaic** of vegetation at various successional stages.

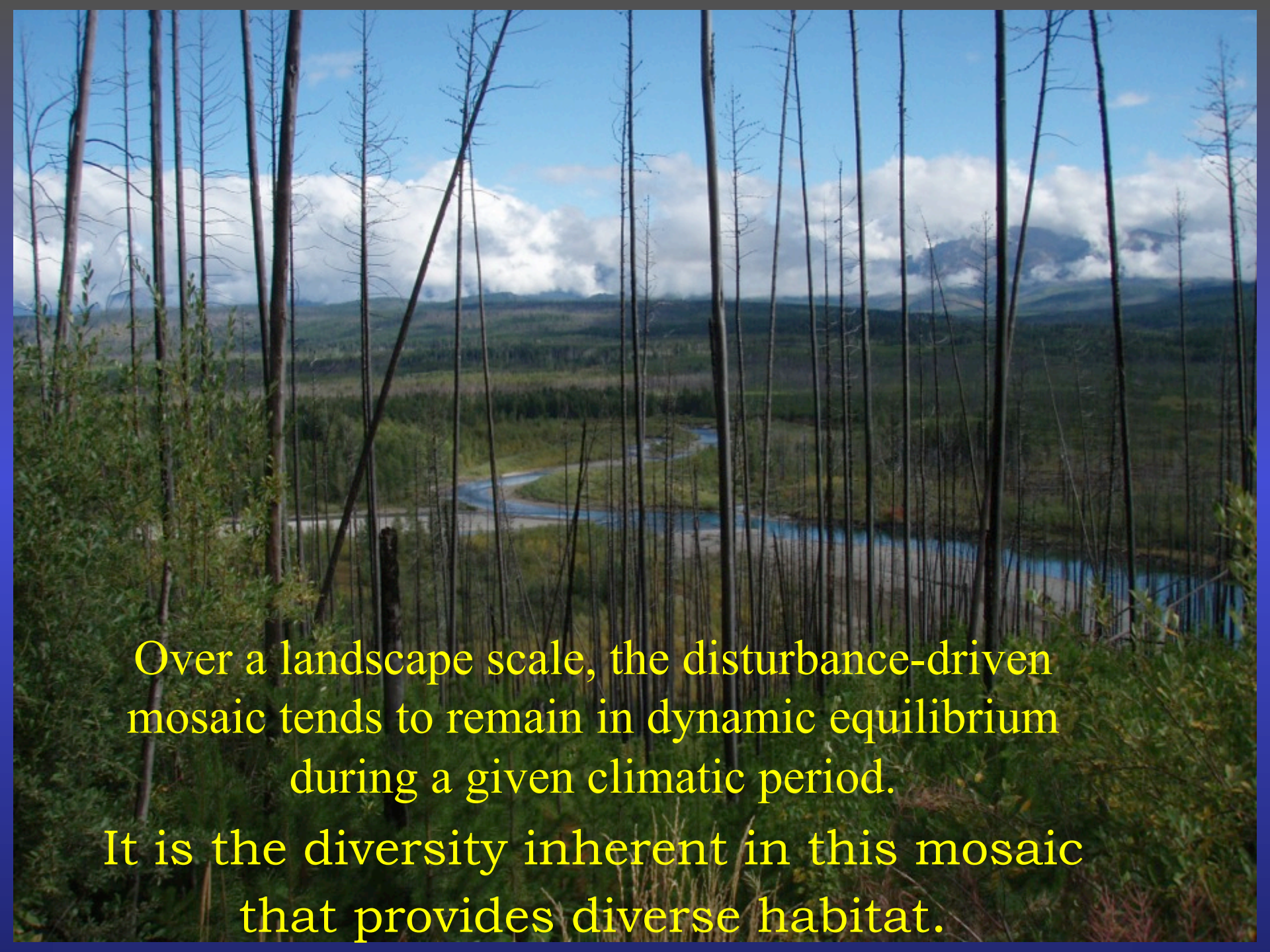




High intensity disturbance at the watershed scale

Small scale, high intensity
disturbance





Over a landscape scale, the disturbance-driven mosaic tends to remain in dynamic equilibrium during a given climatic period.

It is the diversity inherent in this mosaic that provides diverse habitat.

Disturbance & vegetative regeneration; Succession

Succession is the process of change in the plant species composition and structure over time following disturbance as pioneering species give away to more persistent, longer lived species.



Mid succession

Early Succession

Primary succession

Multiple stages of
succession



The climax
community is
starting to assert
dominance

Secondary succession following fire

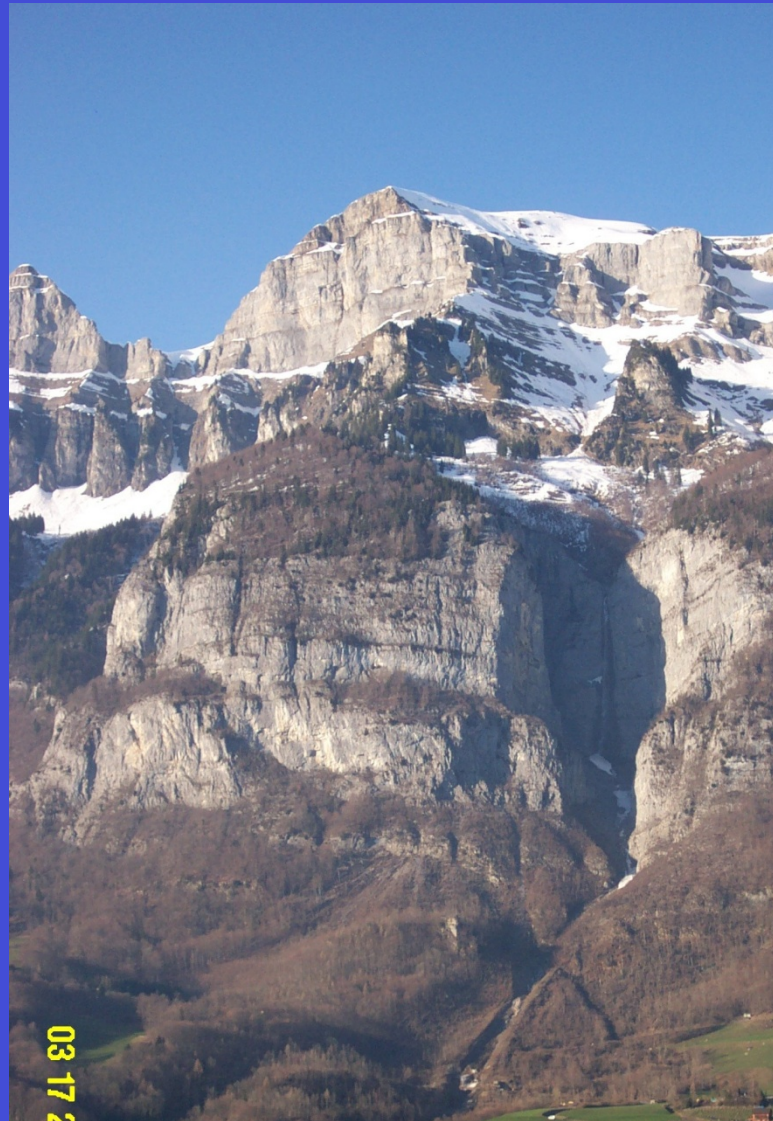




Ponderosa/bunchgrass, high frequency, light intensity understory fire. Maintains status quo watershed functioning. Altering this disturbance regime alters natural watershed function



Lack of flooding has eliminated cottonwood regeneration



Erosion & Sediment Yield



Surface erosion



Mass wasting



Bank erosion

Erosion rates

-episodic & linked to disturbance regime and weather, peaking during storms or periods of rapid snowmelt

Sediment is a major watershed product naturally transported and discharged by stream systems.

In the same way that a given watershed produces a characteristic streamflow regime, it also has a characteristic **sediment budget** over time.

Sediment is the building block of the stream system. The quantity and character of sediment inputs to the stream system is a major driver of channel processes.

Alluvial Stream Processes

Alluvial streams, like Myers Creek, are formed in sediments previously transported and stored by the stream. They have created their own channel boundaries. They are also characterized by the presence of floodplains.



The morphology of alluvial streams is created by interactions among energy, water, sediment, and structural elements (such as large wood or boulders)



... mediated by the stabilizing influence of vegetation.



Channel form adjusts towards equilibrium, whereby the energy of the streamflow is just sufficient to maintain a balance between sediment delivery and sediment export

Sediment capture, riparian regeneration & dynamic equilibrium







Typical places for plant establishment.
Erosion and deposition are roughly equal



Sediment
deposition
creating sites for
plant
establishment



Multiple age classes establishing
on a meander

Channel & Floodplain

- For the purposes of the routing and storage of water and sediment, streams and their floodplains comprise a single system.
- Channel/floodplain connectivity is critical to maintaining dynamic equilibrium in alluvial channels.



Channel Stability

- Strength (erosion resistance)

- Bed & bank material (cobble, gravel, sand, silt, clay)
- Root strength of streambank vegetation

- Energy Dissipation

- friction (channel/floodplain surface roughness)
- turbulence (form roughness) – bends, drops, pools, riffles, debris jams, etc.
- Sediment transport (work)

Channel Degradation

(loss of dynamic equilibrium; simplification)

- In degrading streams, energy dissipation is generally dominated by excessive erosion and deposition;
- In degraded (stable) streams, energy dissipation is generally dominated by surface roughness &/or sediment transport.



The need for restoration is usually created by channel adjustment (i.e., excessive erosion or deposition) in response to changes imposed by human activities



Spoiler alert! Do we want to touch on Myers Creek existing conditions & restoration issues now? Or is it time to go outside & play?

Existing Conditions & Restoration Issues



- Loss of structural elements (beaver dams?) leading to channel incision
- Channelization?
- Loss of floodplain connection
- Overly stable laterally (reed canarygrass)
- Very little in-channel sediment capture
- Sand bed mobilizes before critical shear force necessary to erode banks develops