

DAMMED IF YOU DO...DAMMED IF YOU DON'T

Lessons learned from Designing, Permitting and Monitoring Beaver-related Restoration Projects in the Western U.S



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PNW DEWS Drought and Climate Outlook Webinar
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Gordon E. Grant, Susan Charnley, Jason Dunham, Mark B. Hausner, David S. Pilliod, Hannah Gosnell, Jimmy D. Taylor



NORTHWEST
Climate Adaptation
Science Center

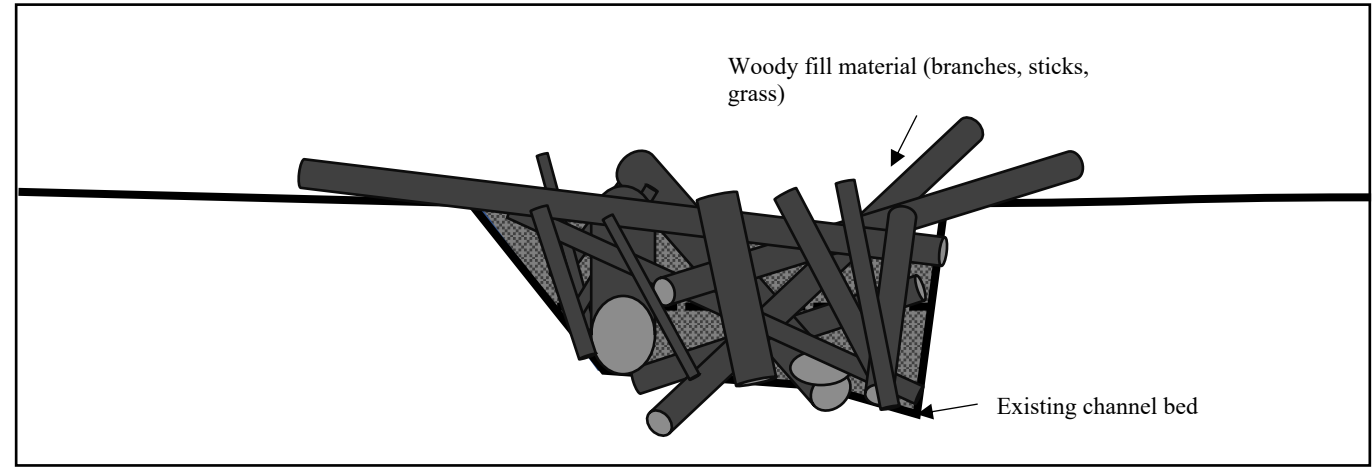
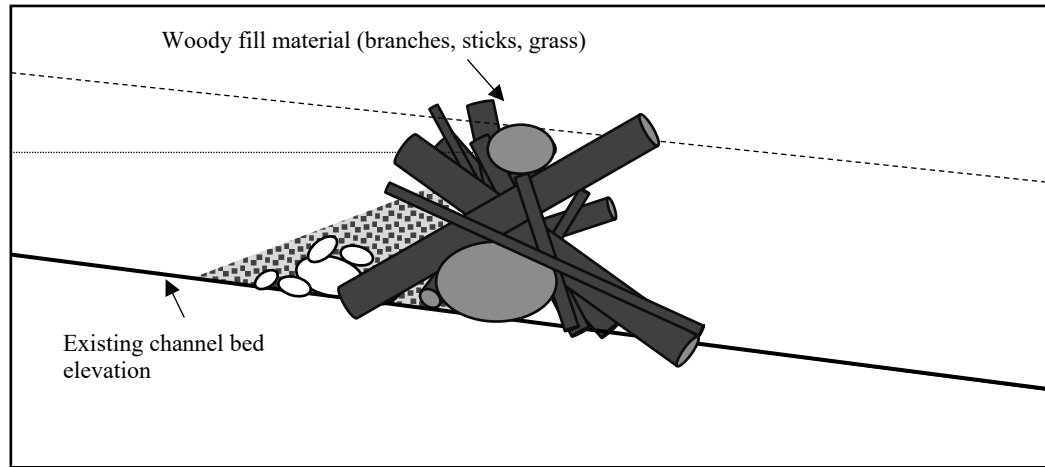
A DAM BY ANY OTHER NAME...



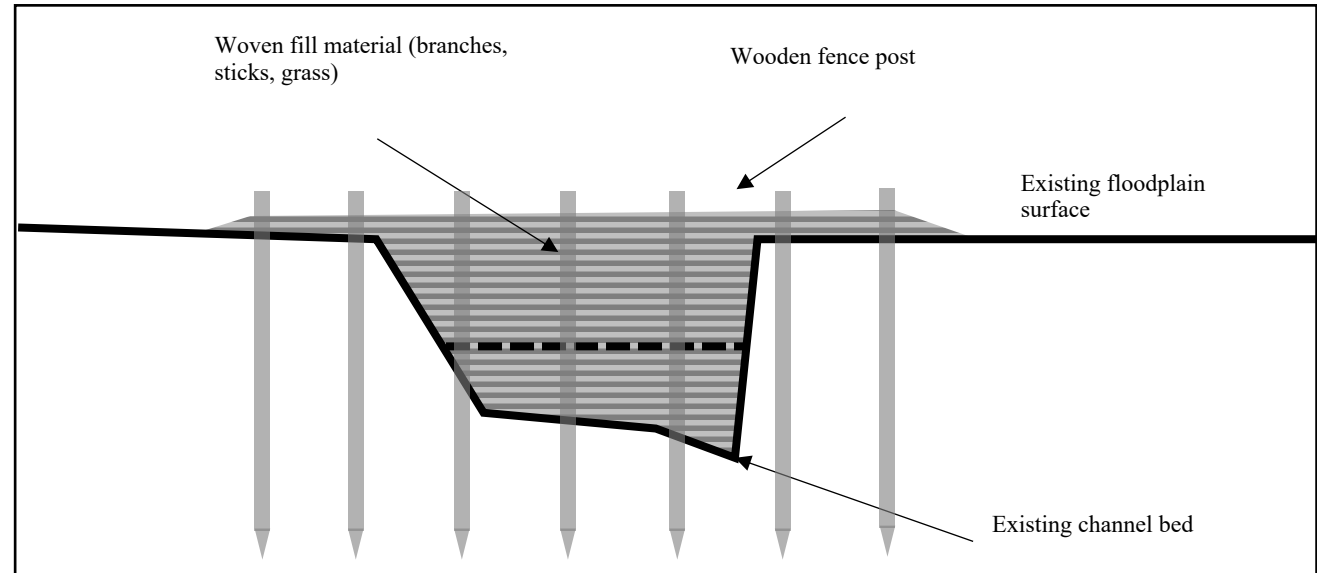
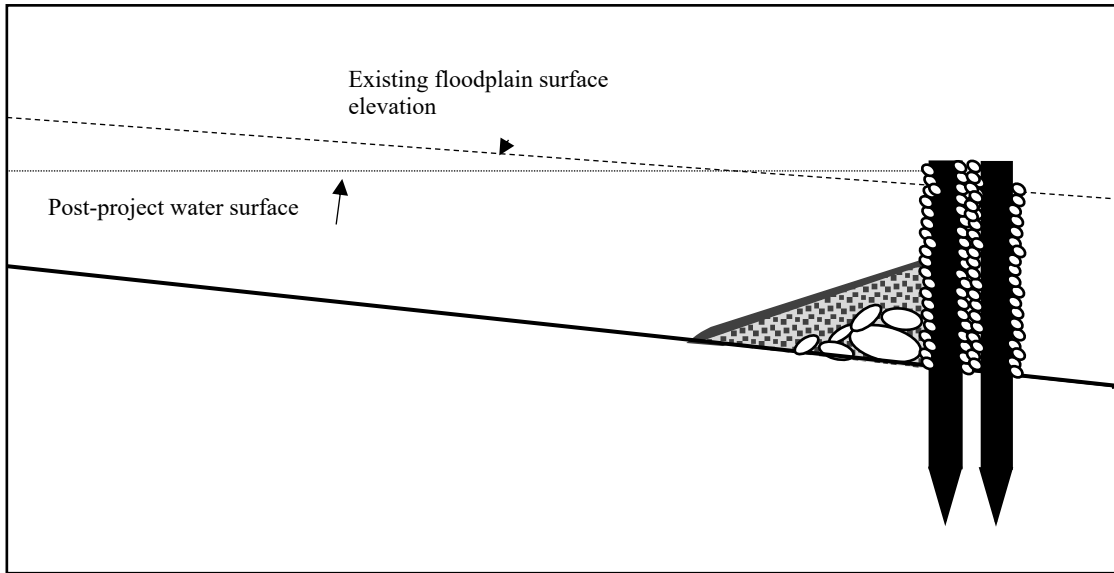
**Plugs, ABDs, check dams,
weirs, aggradation
structures...**

(Photo courtesy Jim Wilcox)

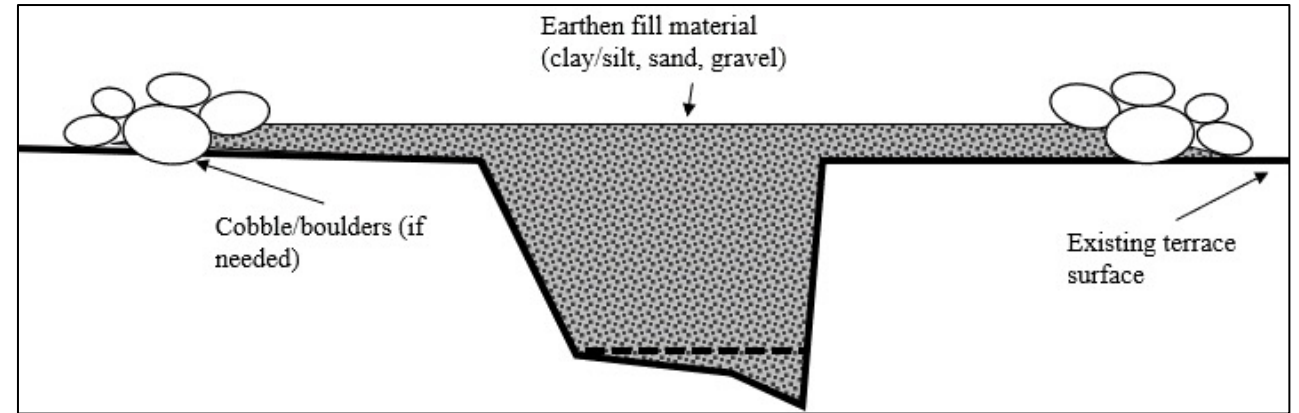
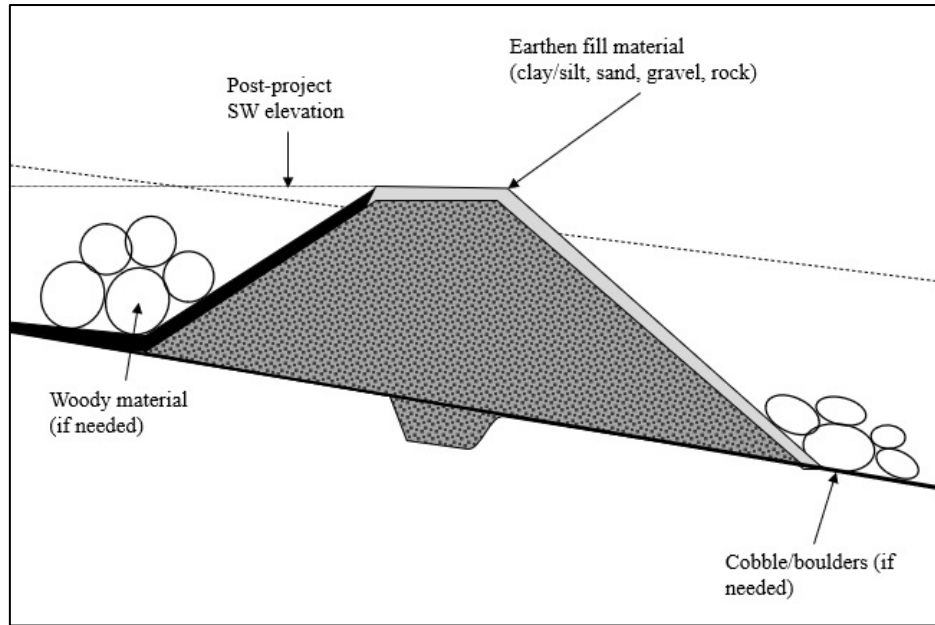
POSTLESS BDA/LOG JAM STRUCTURE DESIGN



BRUSH DAM/BEAVER DAM ANALOG (BDA) DESIGN



AGGRADATION STRUCTURE/ARTIFICIAL BEAVER DAM (ABD) DESIGN



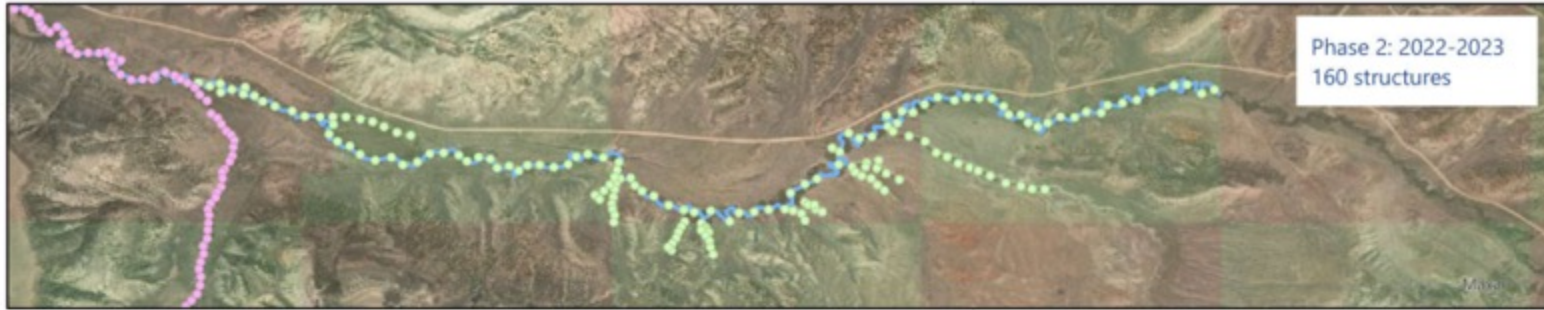
DEMONSTRATION PROJECT: MONTANA (PRIVATE)



DEMONSTRATION PROJECT: MONTANA (PRIVATE)



DEMONSTRATION PROJECT: WYOMING (PUBLIC-PRIVATE)



DEMONSTRATION PROJECT: ARIZONA (PUBLIC)



OPPORTUNITIES

- Relatively cheap
- Potential scalability
- New and existing state and federal funding opportunities
- Public-private partnerships
- Growing body of demonstration projects
- Emerging innovative finance strategies



Charlie Erdman, Trout Unlimited

CHALLENGES

- Regulatory uncertainties
- Unfunded pre-development
- Cross-boundary partnerships
- Need for more research on:
 - Magnitude, scale and duration of potential benefits
 - Appropriate contexts for use
 - Best practices for implementation
 - Maintenance needs
- Workforce
- Timely match funding



High flows cause a plug to blow out on the Upper Feather, CA
(Joe Hoffman)

THANK YOU!



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Nash CS, Grant GE, Charnley S, Dunham J, Gosnell H, Hausner MB, Pilliod DS, Taylor JT. In Press. **Great Expectations: Deconstructing the Process Pathways Underlying Beaver-related Restoration.** *BioScience*.

IIJA FUNDING OPPORTUNITIES

Department of Interior programs include:

- WaterSMART's [Environmental Water Resources Projects](#)
- The [Cooperative Watershed Management](#) program (\$ 100 million through 2026)
- The [Aquatic Ecosystem Restoration and Protection Program](#) (\$ 250 million; funding available beginning in FY 2023)
- Funding for the Lower Basin Drought Contingency Plan (Only \$ 50 Million of \$ 250 million has so far been allocated from the new IIJA funding)
- Cross-Boundary Ecosystem Restoration Projects (DOI (BLM) with USFS) (\$80 million/year through FY 2026)

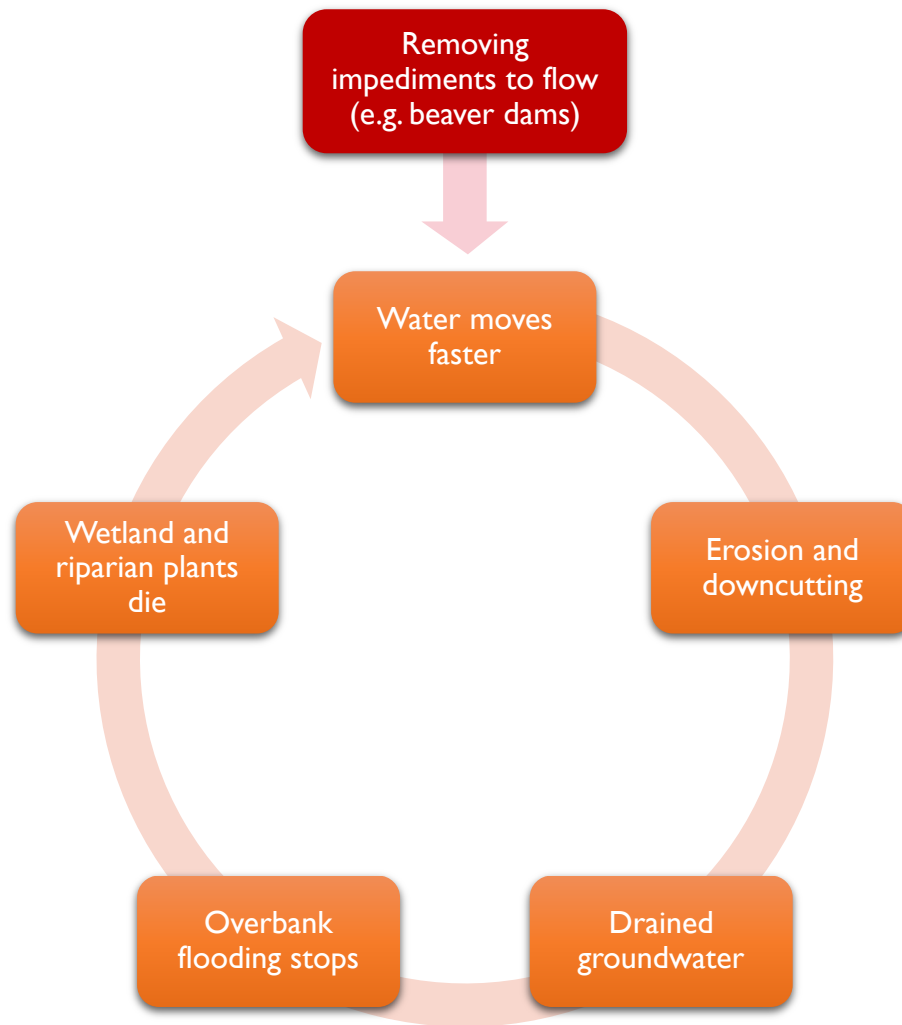
USDA programs include:

- [Joint Chiefs' Landscape Restoration Partnership Program](#) (NRCS/USFS) (\$ 90 million/year 2022 and 2023)
- [Watershed and Flood Prevention Operations](#) (NRCS) (\$ 500 million)
- Collaborative-Based Aquatic-Focused Landscape Scale Restoration Program (USDA/USFS, in cooperation with DOI) (\$ 16 million annually through 2026)

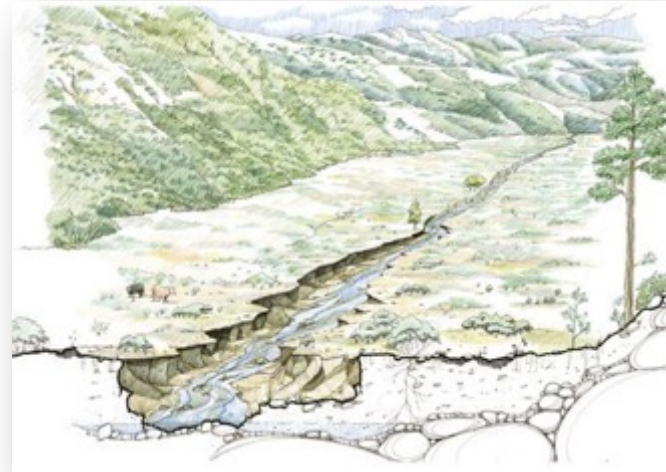
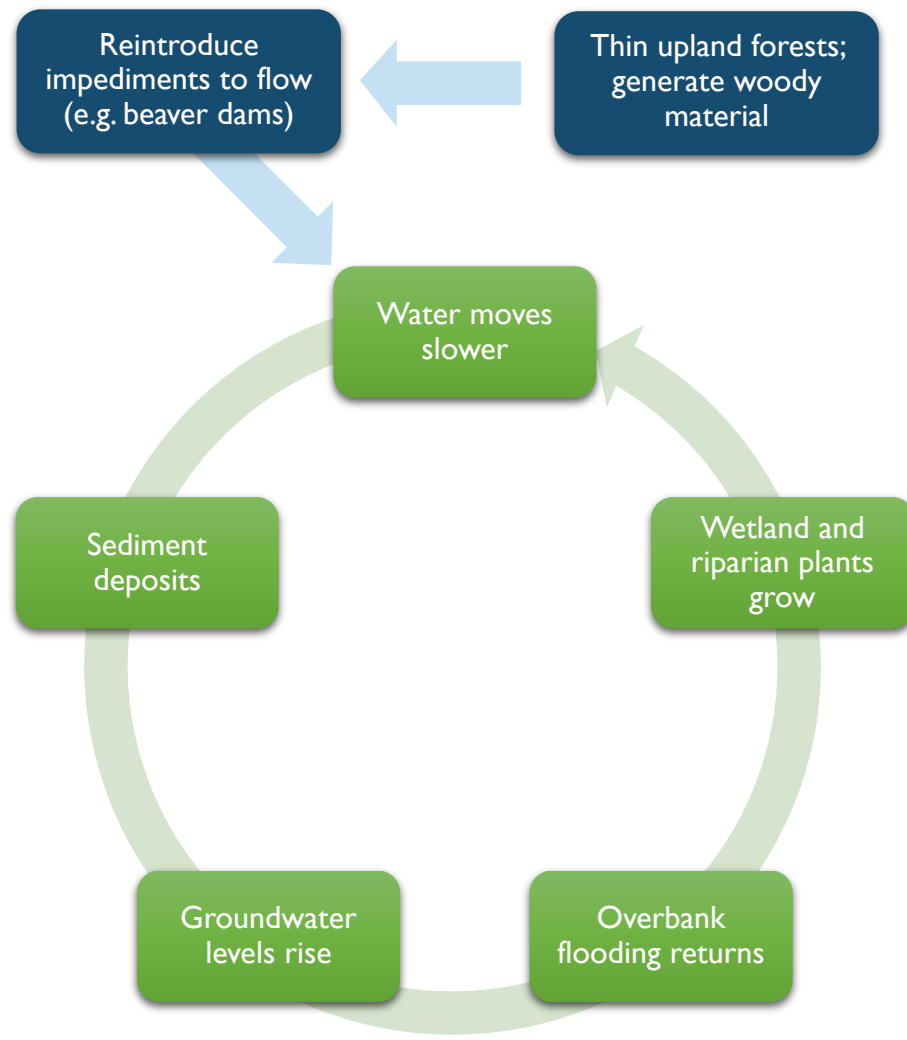
FEMA programs include:

- [Building Resilient Infrastructure and Communities](#) (BRIC) program (\$ 200 million/year through FY 2026)

HISTORICAL DEGRADATION



HYPOTHESIZED RESTORATION



EMERGING OUTCOMES — VALLEY FLOORS

Plug-and-pond restoration before and after on Big Flat Meadow, CA



2001



2006

EMERGING OUTCOMES – VALLEY FLOORS

ABD-based restoration on Camp Creek, near Seneca, OR



2002



2012

Geomorphic principles

- Intact dams create certain outcomes irrespective of location
- Other outcomes are contingent on where, geomorphically, a dam is built
- Dams involve trade-offs – you can't have your water and use it, too
- Dams are fluvial discontinuities, with contradictory effects



Most dams increase surface water storage

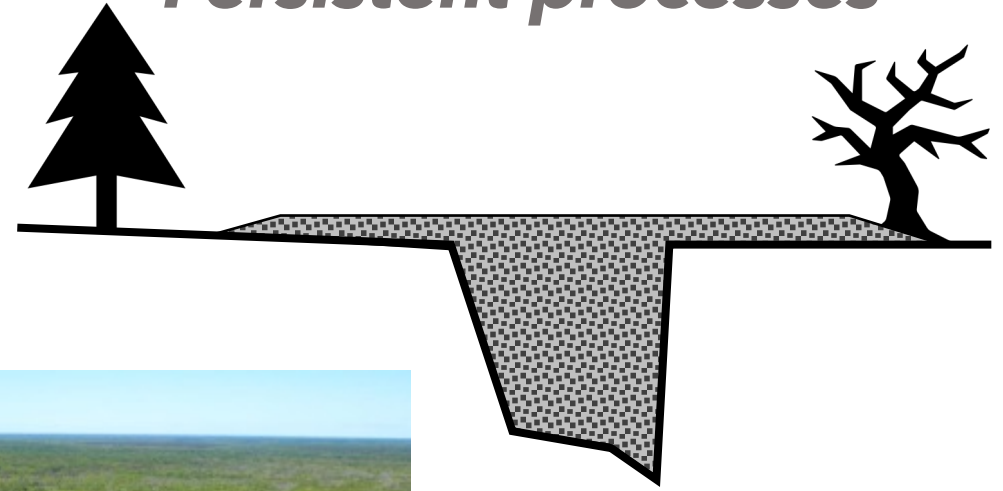


What a dam does depends on how long it lasts

Dynamic processes

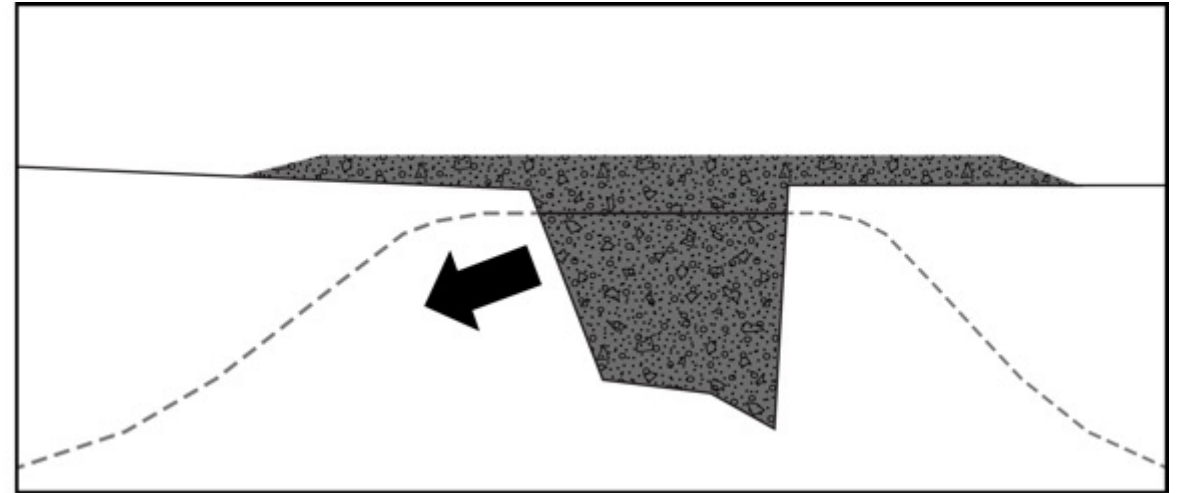
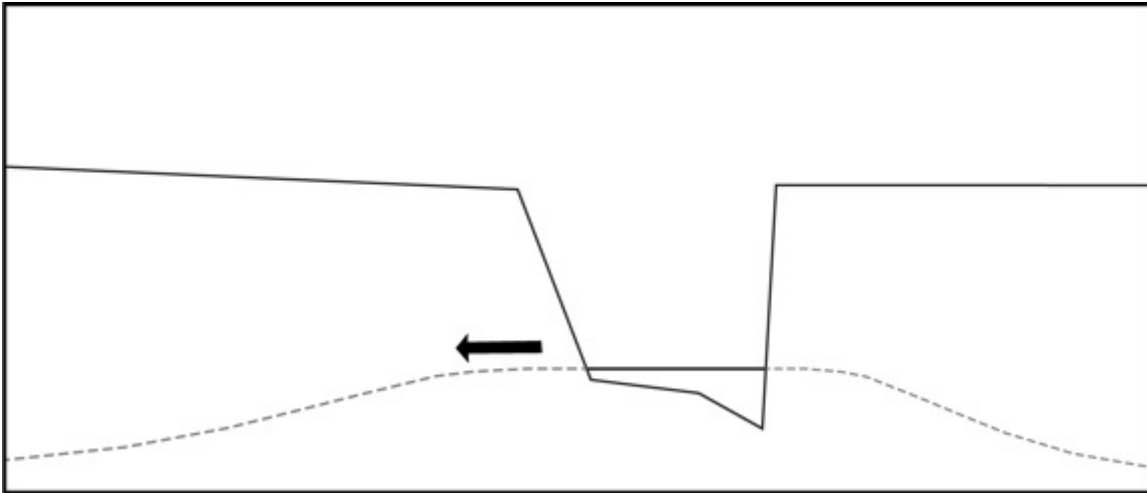
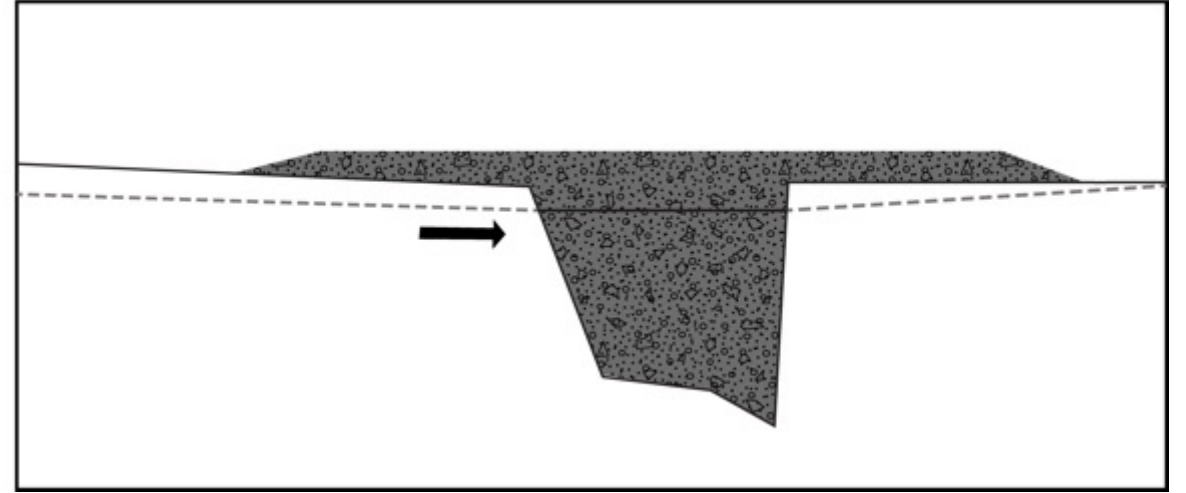
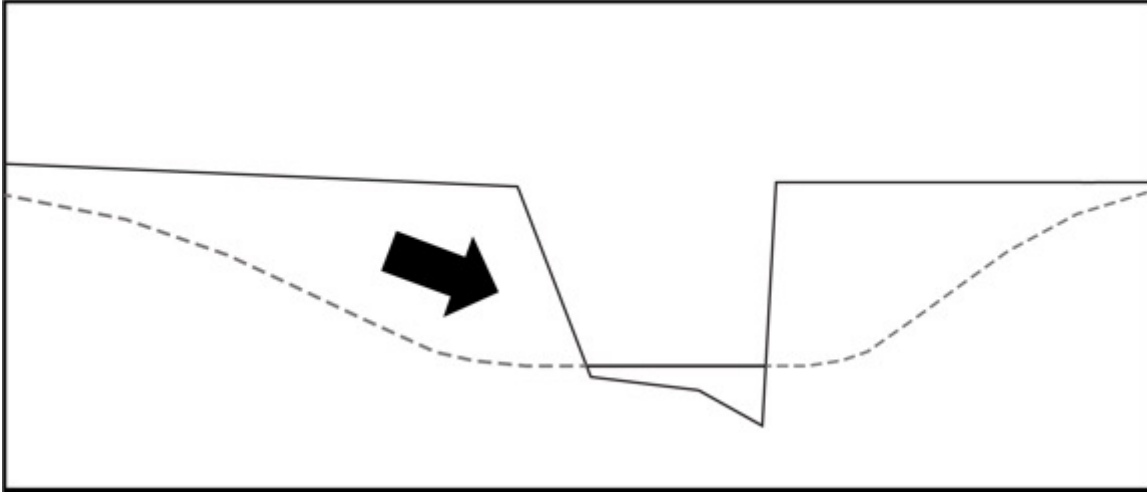


Persistent processes



GRAPHIC: V. ALTOUNIAN/SCIENCE PHOTO LIBRARY PHOTO: PARKS CANADA

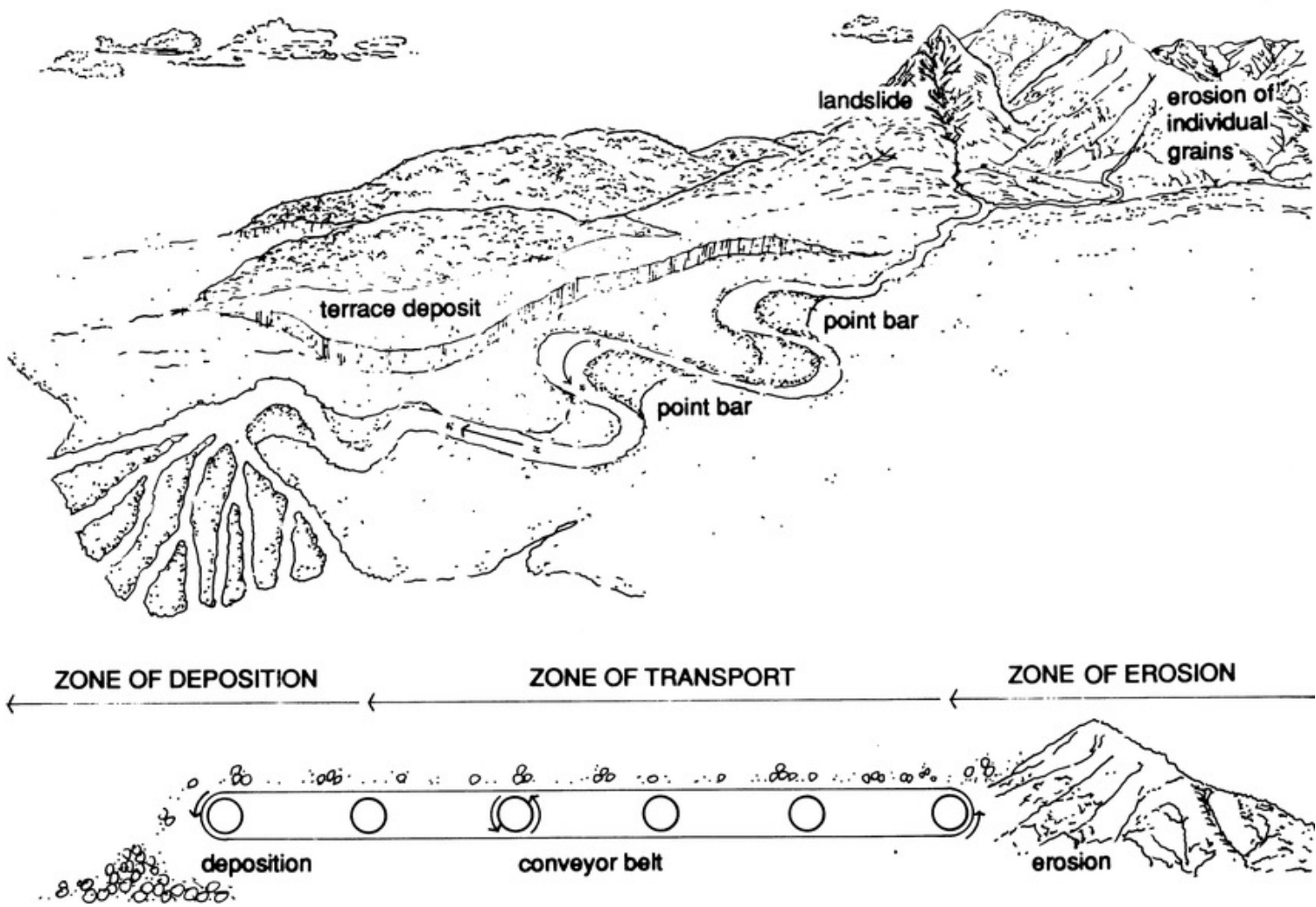
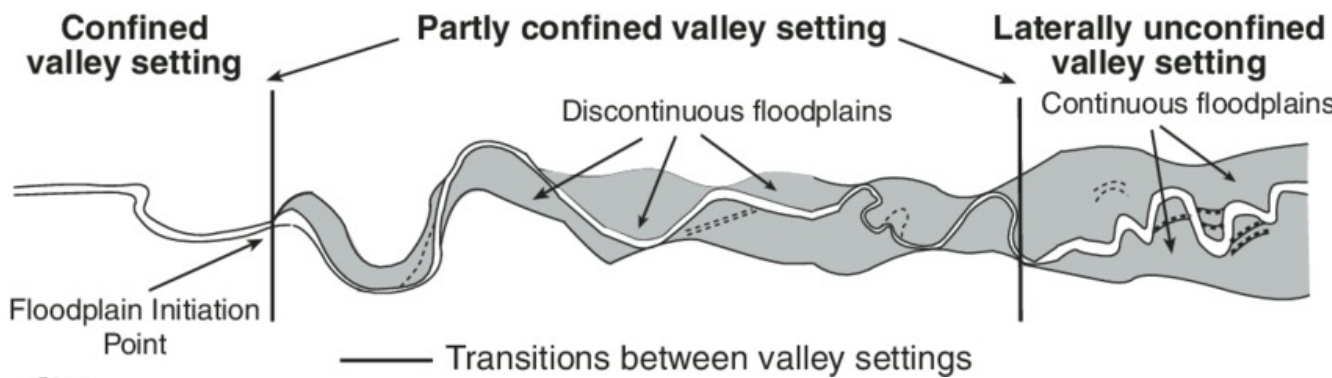
Effects on groundwater will depend on antecedent condition



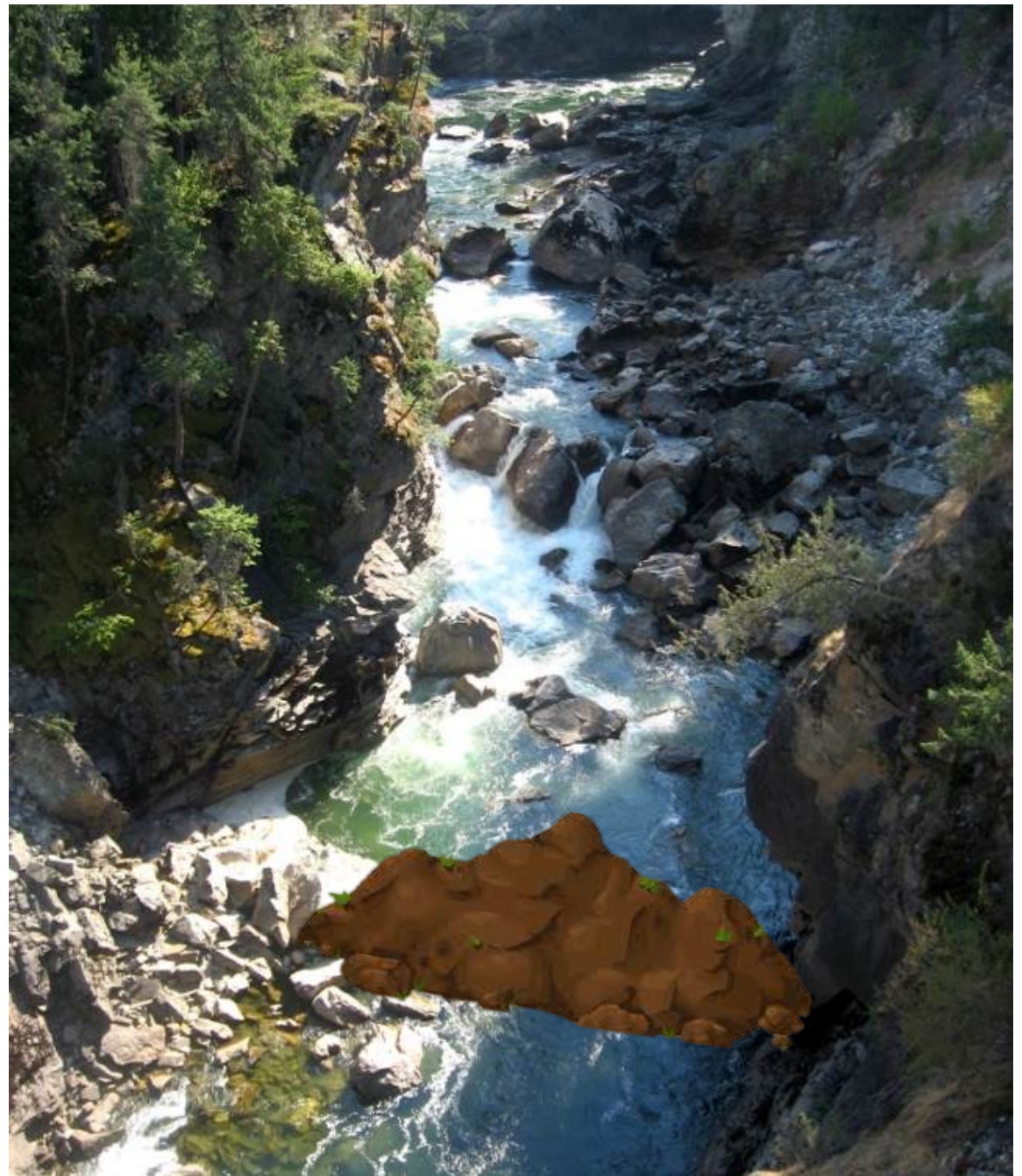
In-channel structures involve trade-offs



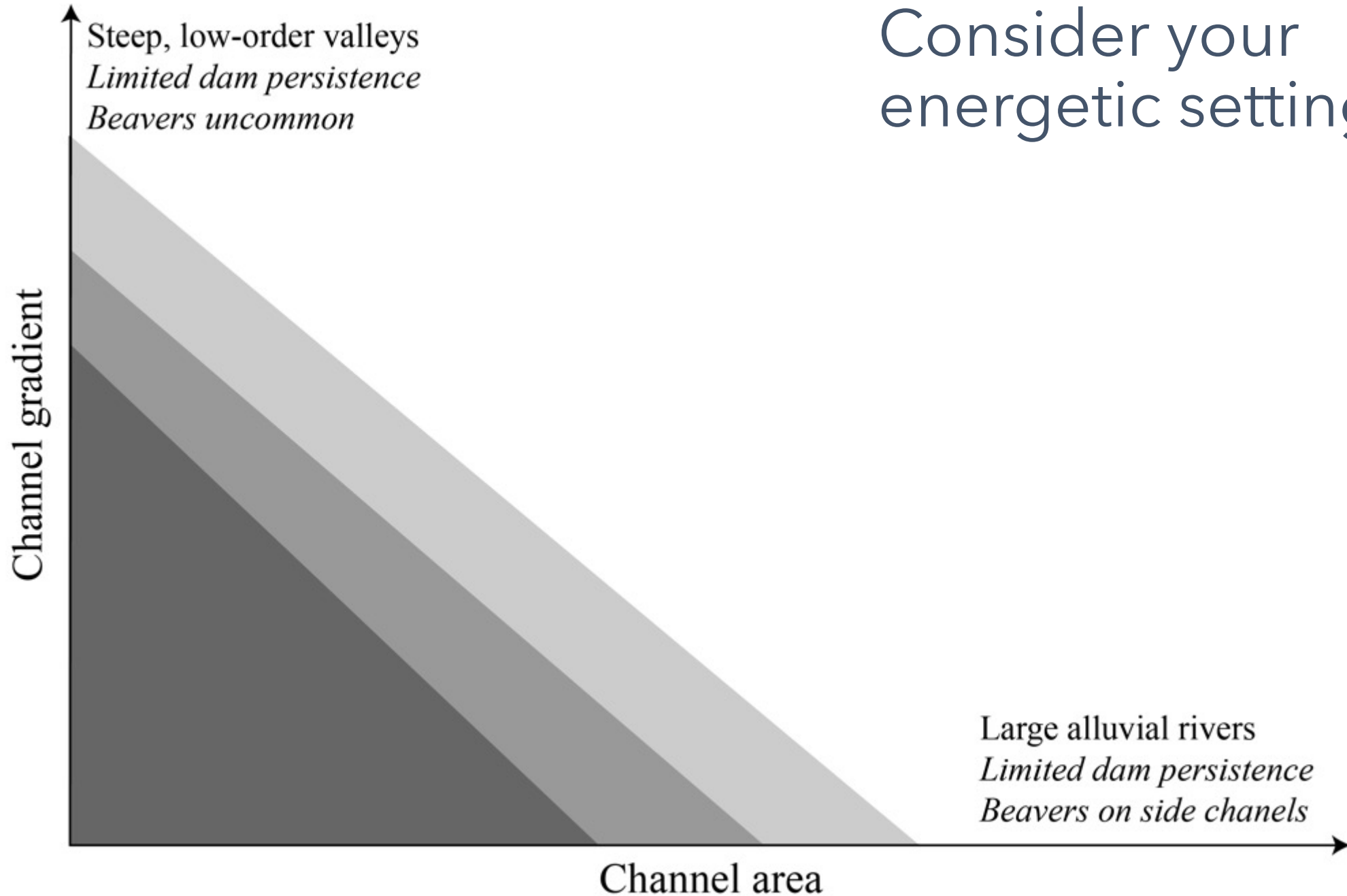
Consider your energetic setting



Consider your context



Consider your
energetic setting



Ecological principles

- Consideration of what is currently limiting vegetation and species
- Many streams already have beavers, with contradictory effects
- Not all beavers build dams...
- ...but when they do, it's driven by their survival needs



Considering social context



See Taylor and Singleton, 2014 for more tools to mitigate negative consequences of beavers

How does restoration affect late season streamflow?

$$\Delta Q_{VF,out} = A(ET^U - ET^R) + (\Delta S^U - \Delta S^R)$$



b) Does restoration increase evapotranspiration? **Yes***

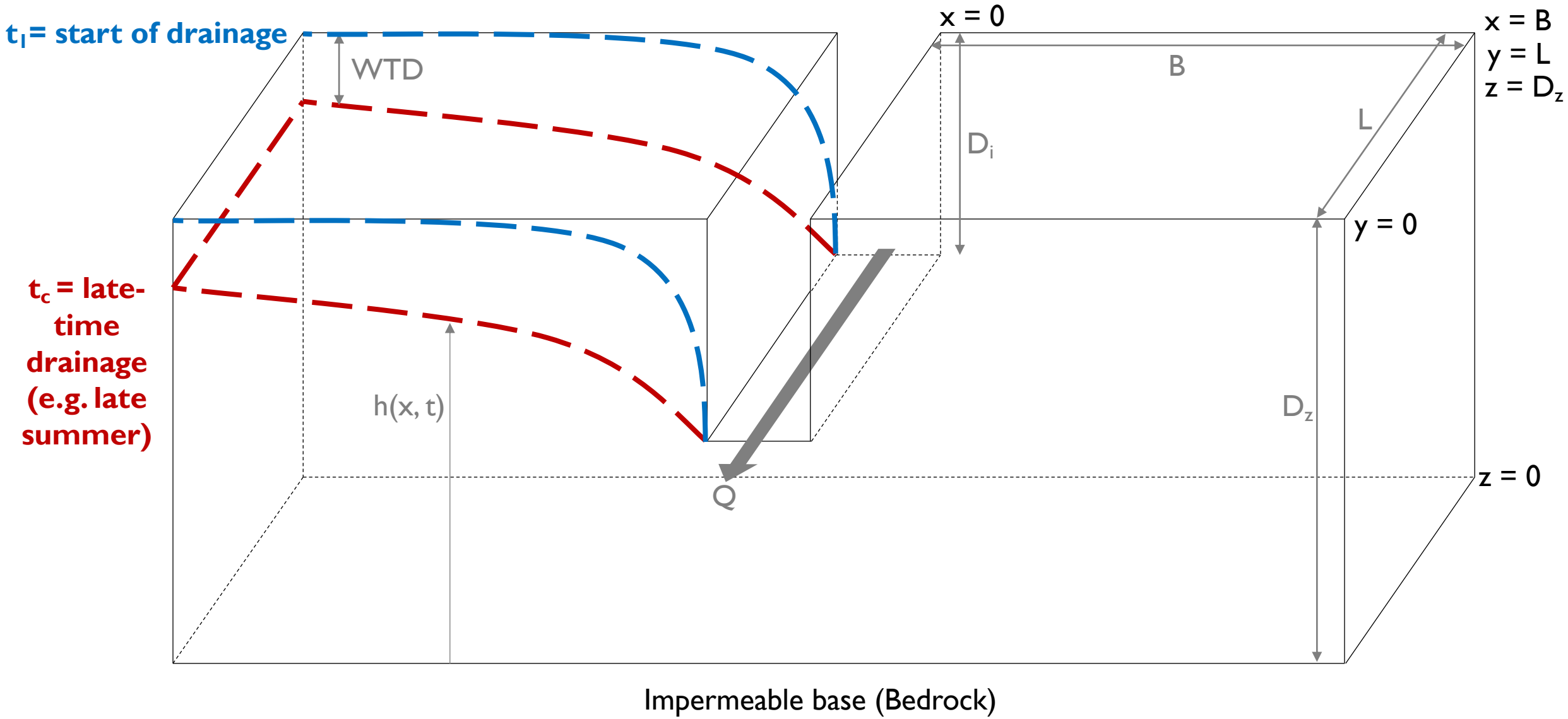


a) Does restoration increase storage?
Yes...and no

c) Do the temporal patterns of either change?

Yes*

Boussinesq modeling framework can address **physically-based** changes



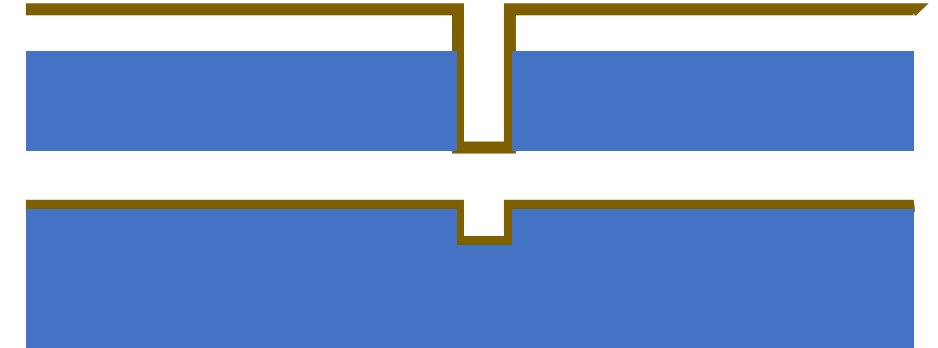
Does restoration increase groundwater storage?

Yes...and no

Total storage increases

Incised (3m) = 1,620,000 m³

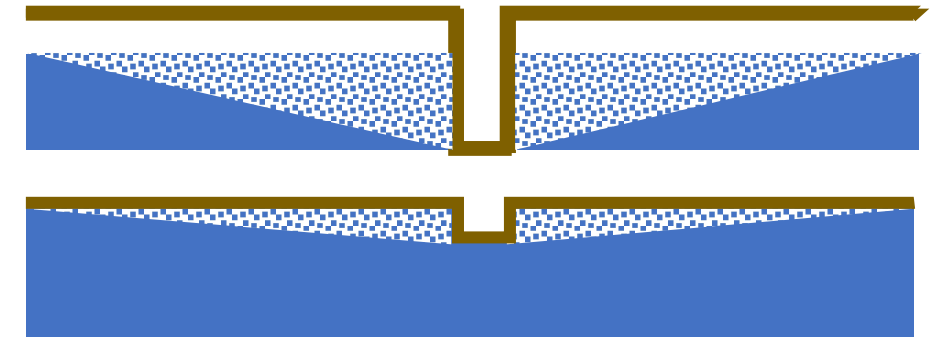
Restored (0.33 m) = 1,800,000 m³



Laterally drainable storage decreases

Incised (3m) = 80,000 m³

Restored (0.33 m) = 13,200 m³



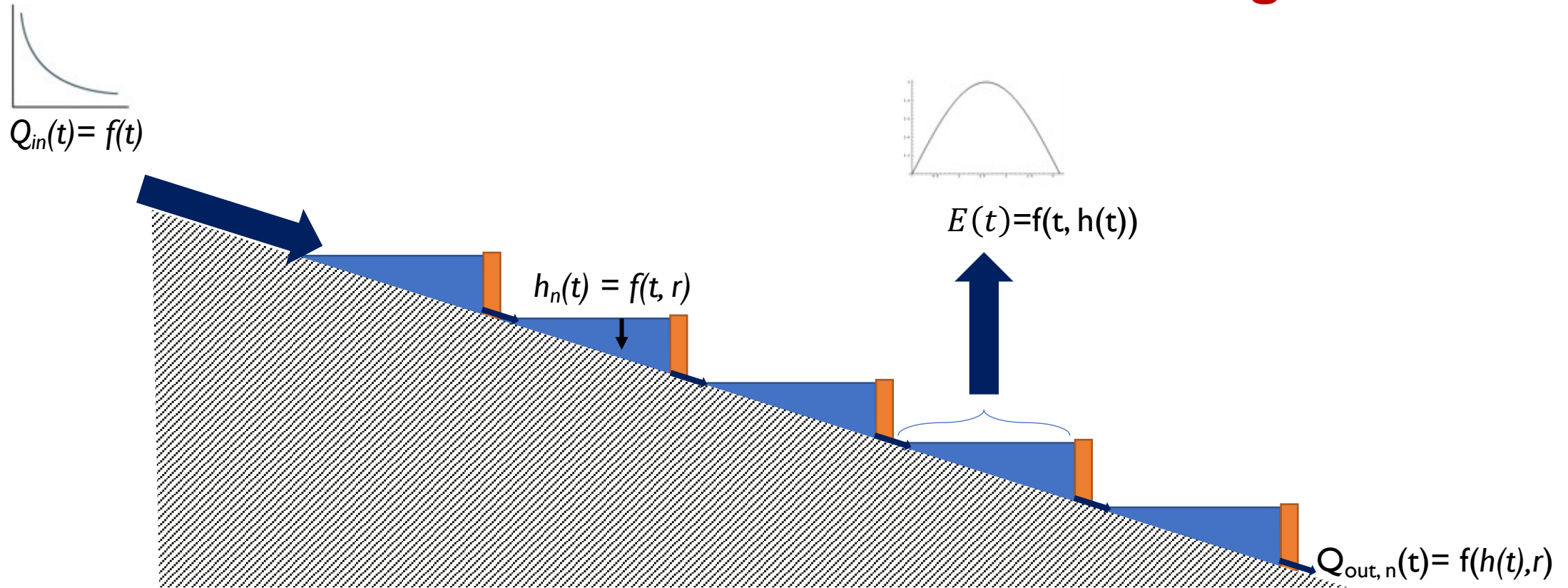
Longitudinally drainable storage increases (theoretically)

Incised (3m) = 280,000 m³

Restored (0.33 m) = 386,800 m³

Does restoration increase surface storage?

Yes...depending on designs/duration



Does restoration increase evapotranspiration?

Yes...but changes in water source unclear

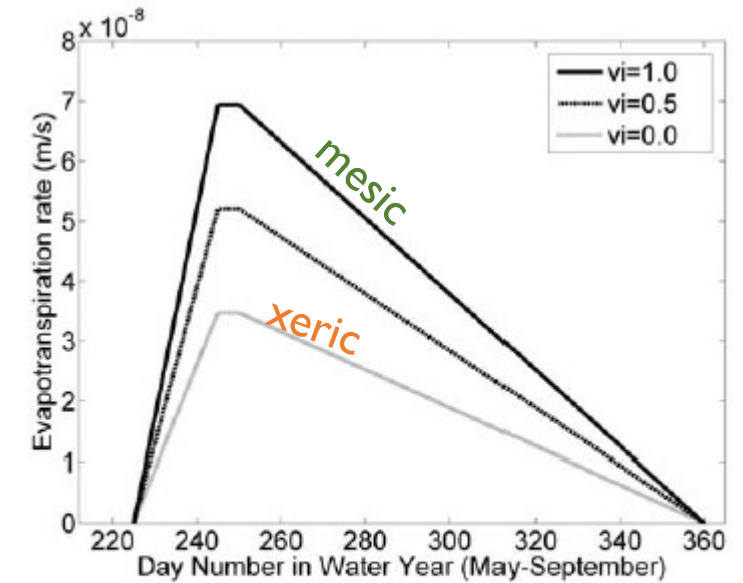
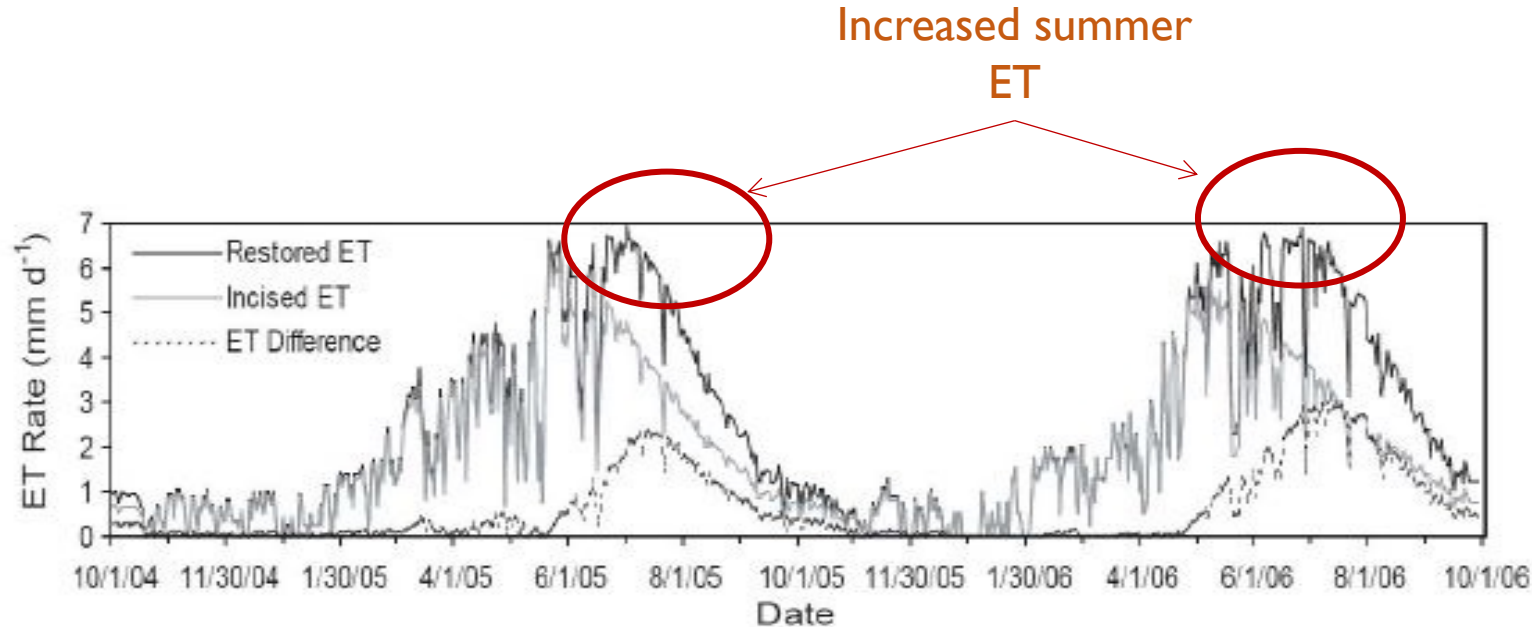
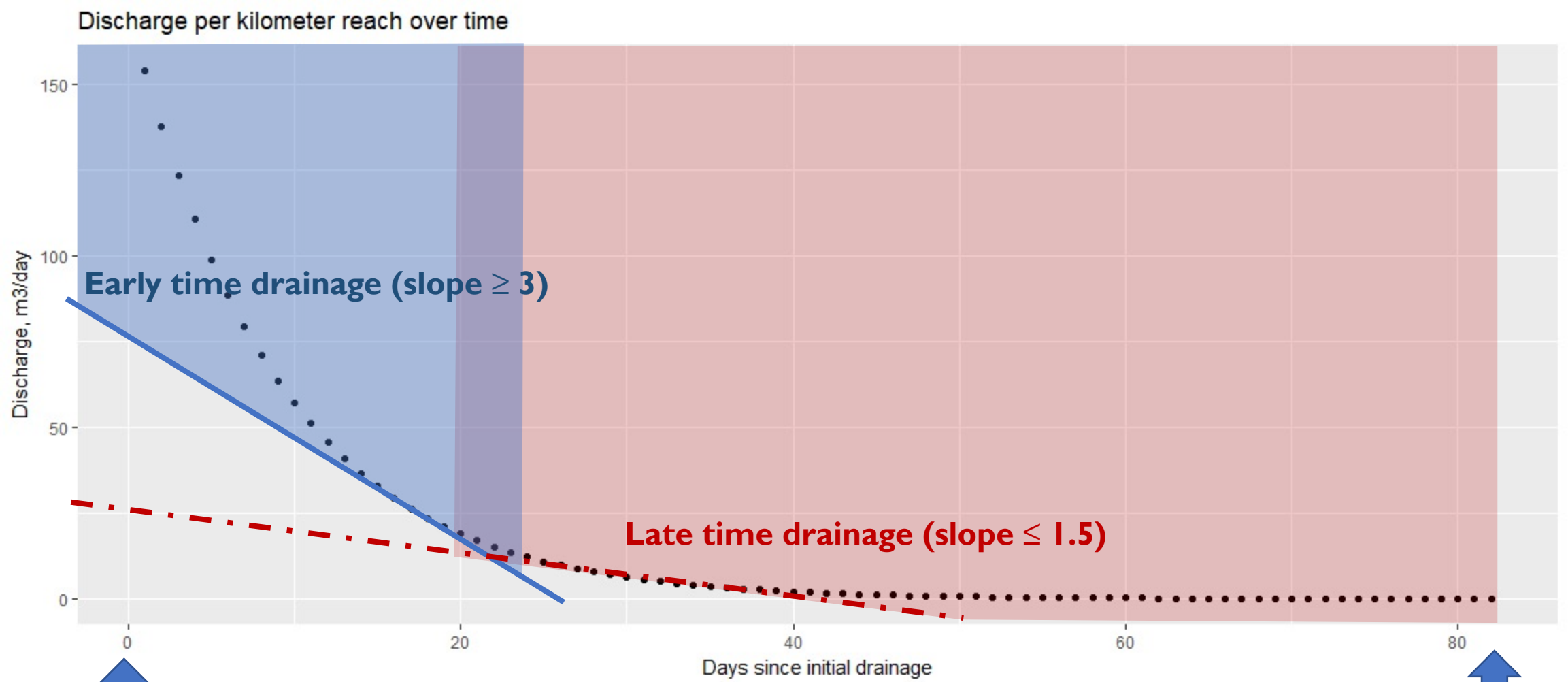


Figure 8. Growing season evapotranspiration rates used in simulations for vegetation indexes (v_i) of $v_i = 1$ (100% mesic), $v_i = 0.5$ (50% mesic and 50% xeric), and $v_i = 0.0$ (100% xeric).

Plants will use more water if more water is available

Mesic plants will use more water than xeric

Does restoration change late season streamflow?

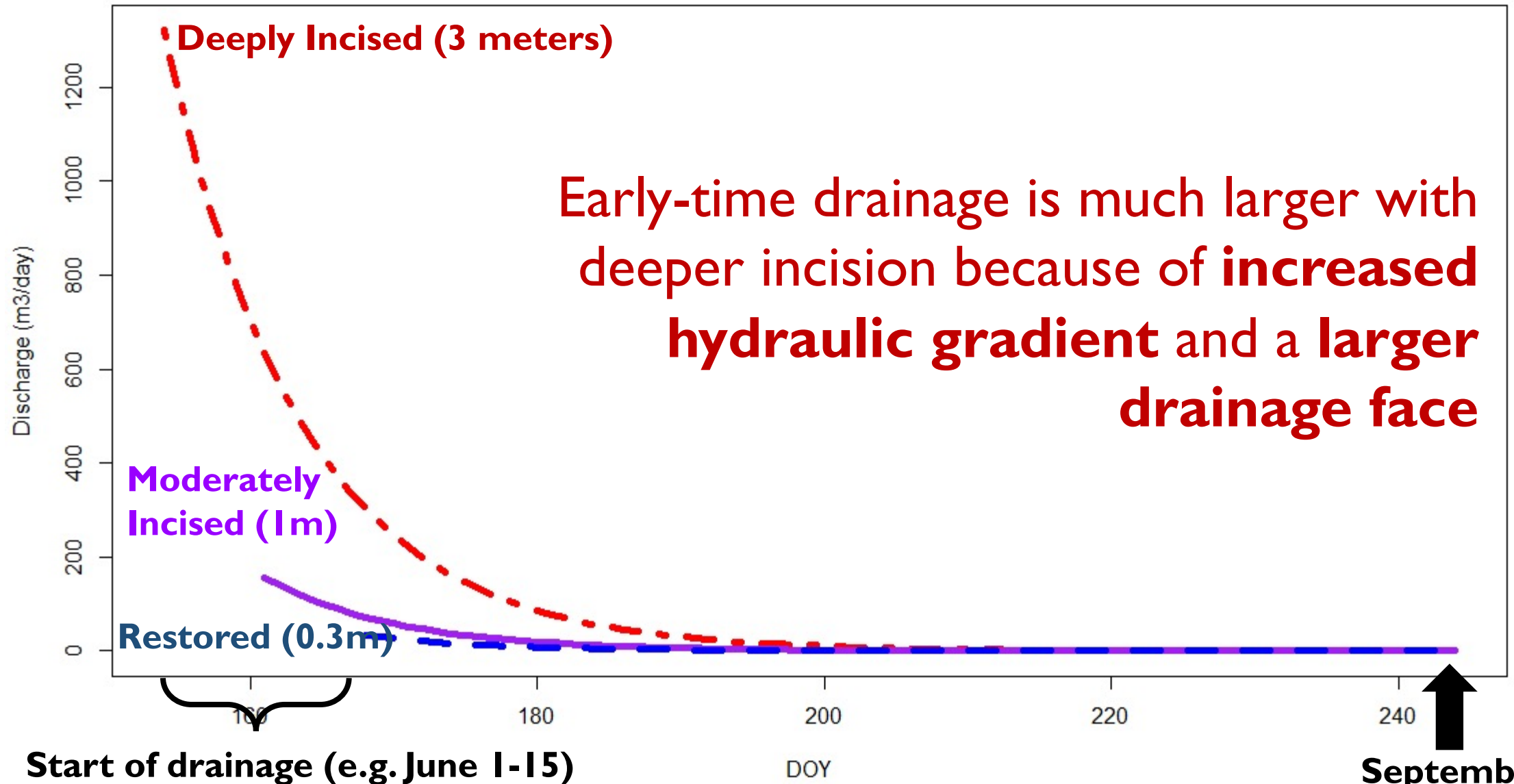


Start of drainage (e.g. June 1)

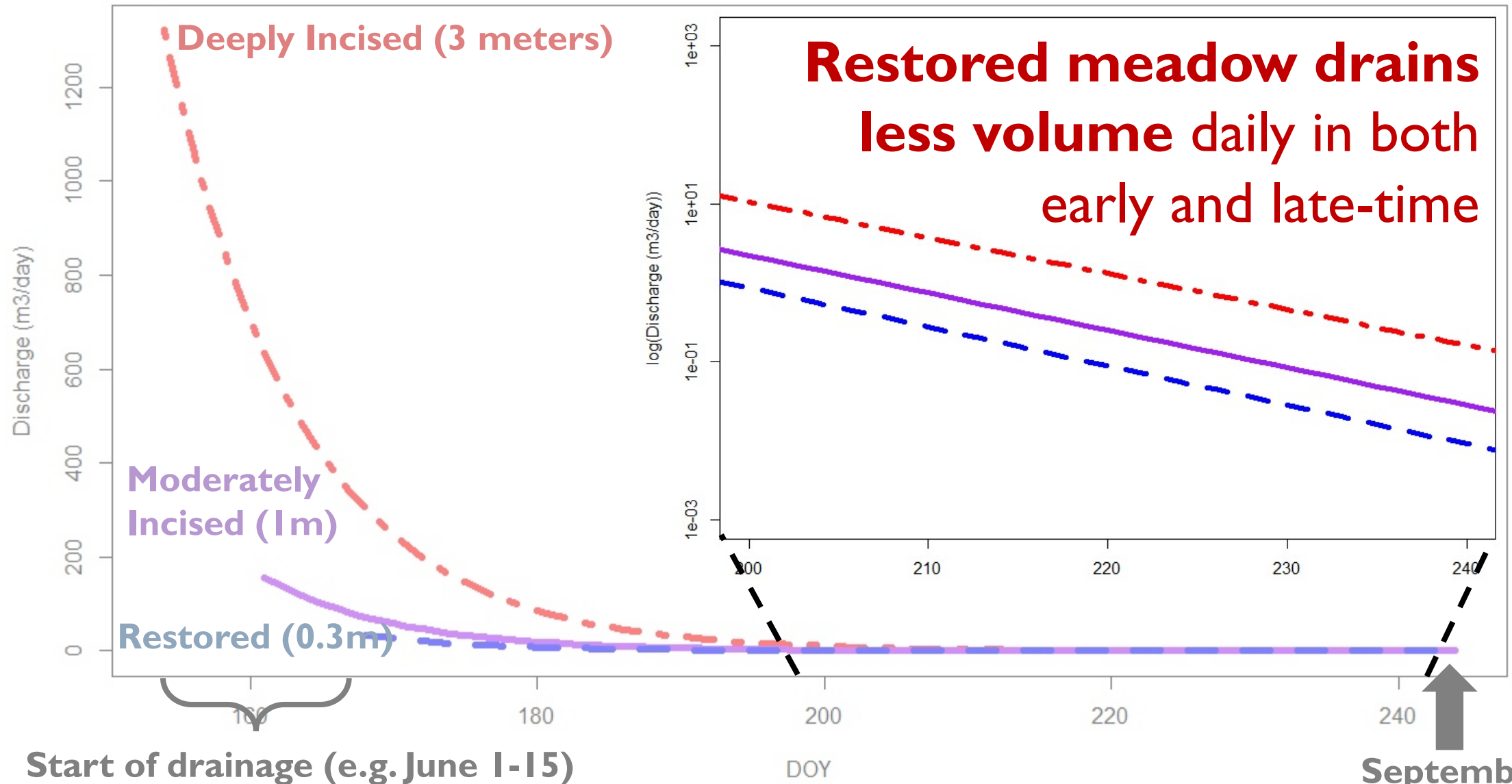


Late summer index date (e.g. September 1)

Daily drainage volumes for incised meadows in summer months

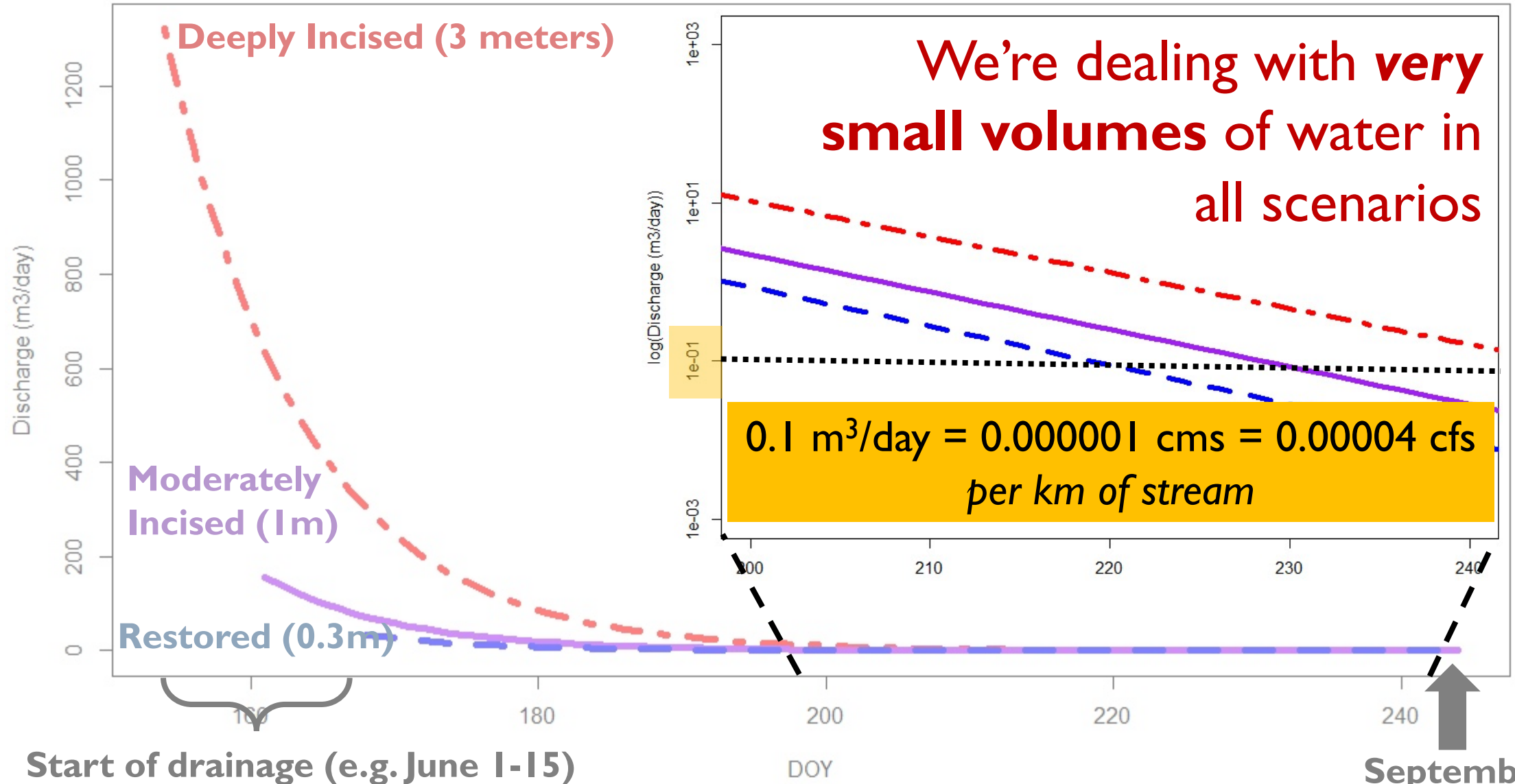


Daily drainage volumes for incised meadows in summer months




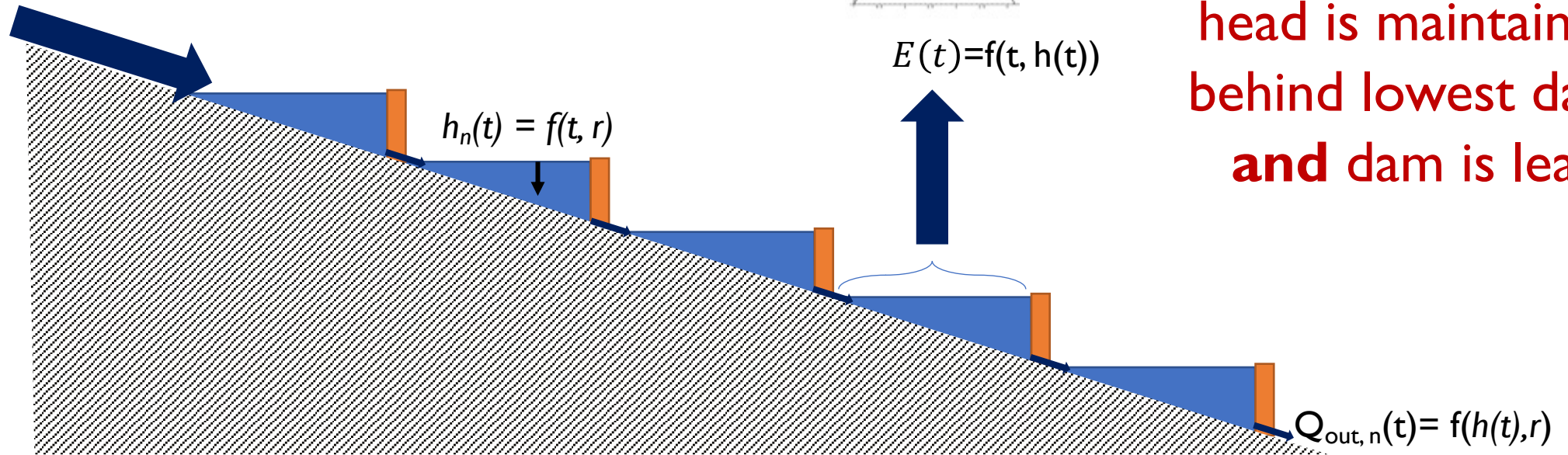
September 1
Nash et al. 2018

Daily drainage volumes for incised meadows in summer months



Does restoration change late season streamflow?


$$Q_{in}(t) = f(t)$$



Transient surface storage **can** translate to late season streamflow provided head is maintained behind lowest dam **and** dam is leaky