



Regulation of Ground Water Storage

Water Resources Review Committee

September 20, 2016

Kevin Rein, P.E.,

Deputy State Engineer

Division of Water Resources



COLORADO

Department of Natural Resources

Today's Discussion

- Ground water can be stored indefinitely in some formations,
- However, most underground formations have transient ground water; water is held temporarily as it migrates to the river,
- In those formations, regulation depends on the purpose:
 - Place water in the ground to meet a known obligation?
 - Place excess water in the ground to avoid losing it?

Quick Refresher

- Colorado ground water; *connected to surface streams,*
- *“Tributary,”*
- *Law presumes all ground water is tributary to surface streams,*
- Ground water is in a *transient* state, *legally* and *physically,*
- Difficult to actually “store” water in aquifers,
- Exceptions: Denver Basin bedrock aquifers, other nontributary formations.

Considerations when using an Aquifer to Hold Water

What is aquifer storage?

- Use pore space in a geologic formation to hold water,
- Why?

Like 100 years ago, we have water available, but not at the time or place we need it.

Perspective on the Use of an Aquifer

Two different ways we could use that pore space in Colorado:

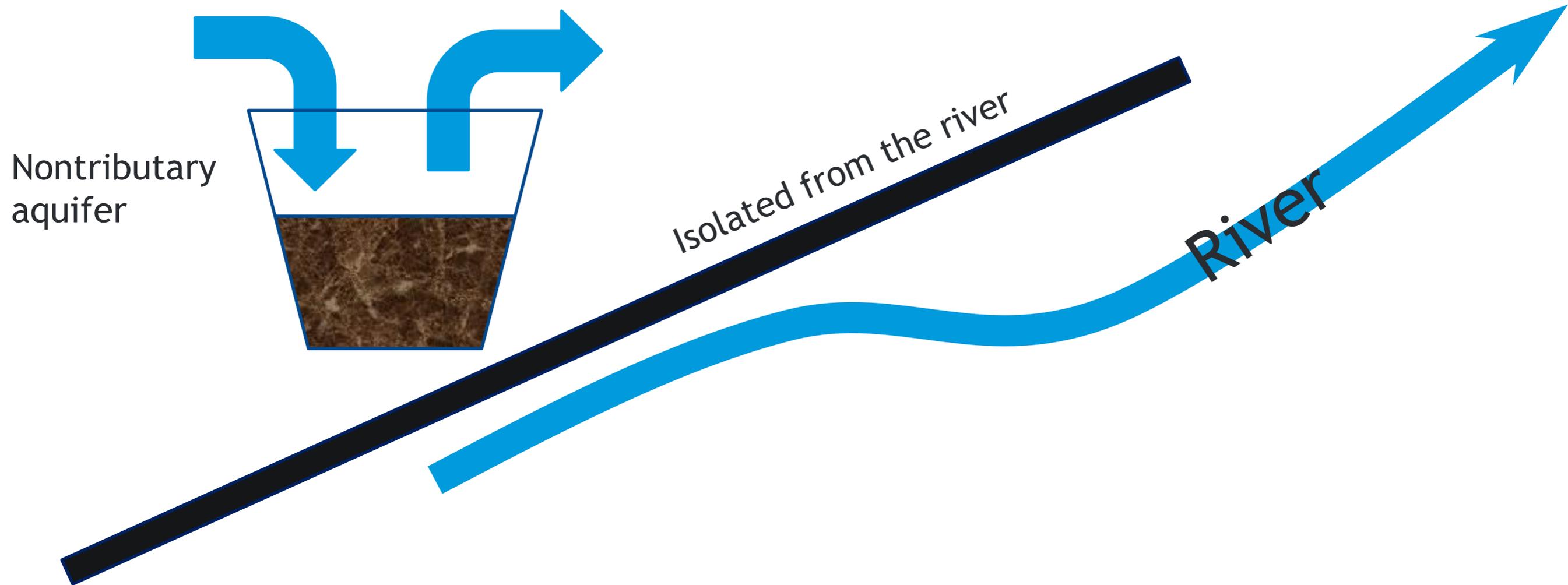
Static ground water

1. As a *bank*, to store water indefinitely,

Perspective on the Use of an Aquifer

Static ground water

1. As a *bank*, to store water indefinitely,



Perspective on the Use of an Aquifer

Two different ways we could use that pore space in Colorado:

Static ground water

1. As a *bank*, to store water indefinitely,

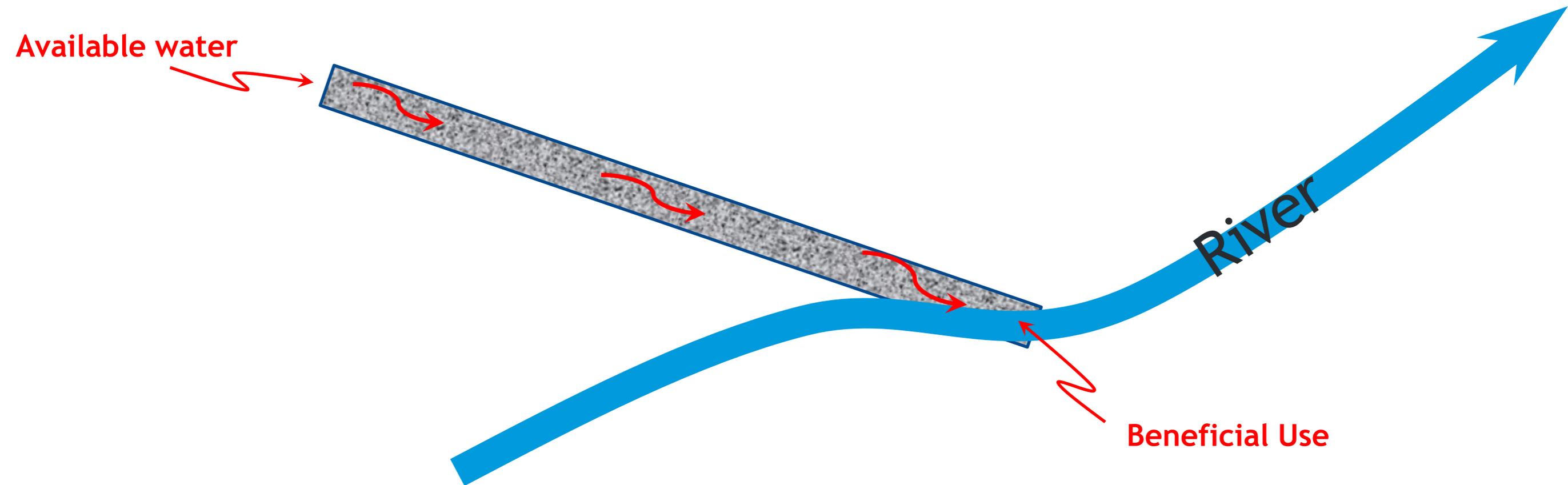
Transient ground water

2. As an underground location to *temporarily hold* water; even as the ground acts as a *pipeline* to carry water to the river.

Perspective on the Use of an Aquifer

Transient ground water

2. As an underground location to *temporarily hold* water; even as the ground acts as a *pipeline* to carry water to the river.



Perspective on the Use of an Aquifer

Static ground water

1. As a **bank**, to store water indefinitely,
 - No connection to surface water
 - Nontributary
 - Lined alluvial storage
 - Withdrawn from the same location it was put in
 - No time limit



Perspective on the Use of an Aquifer

Static ground water

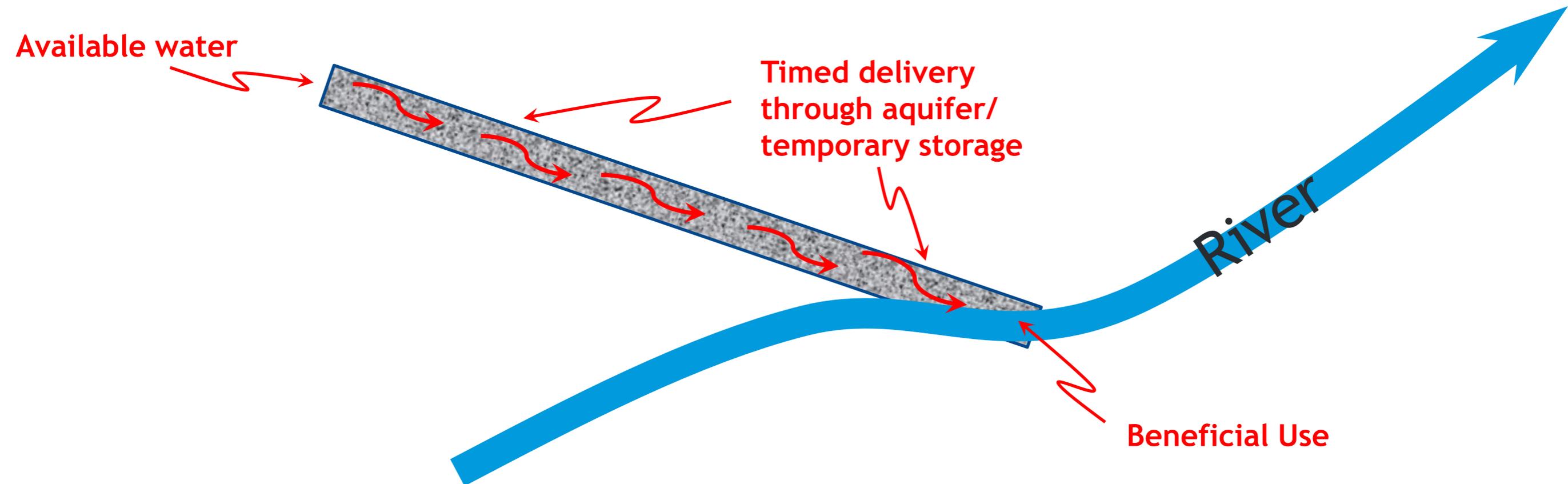
1. As a *bank*, to store water indefinitely,
 - Currently used by several water providers in the Denver Basin bedrock aquifers,
 - Aurora's Prairie Waters Project, for example (lined alluvial formation),
 - Limited to select natural formations or alluvial formations with a construction component (for example, slurry wall).
 - Why?



Perspective on the Use of an Aquifer

Transient ground water

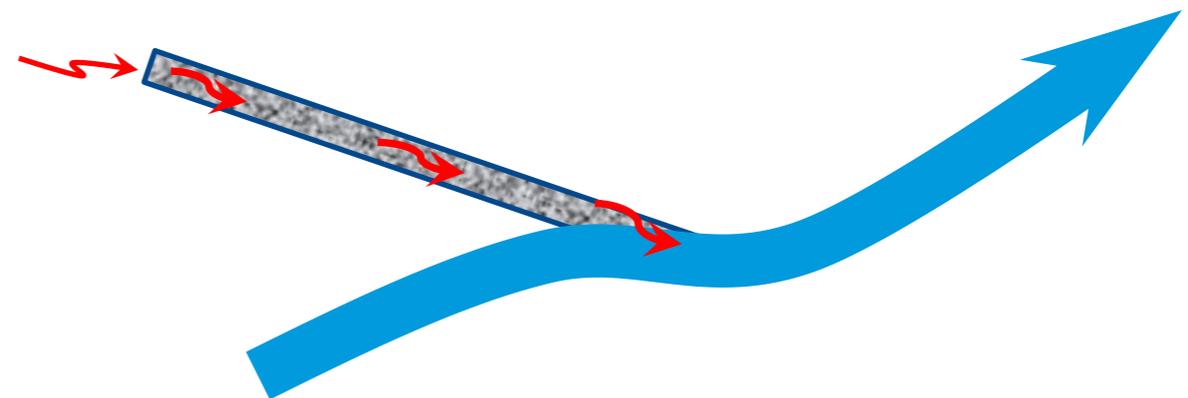
2. As an underground location to *temporarily hold* water; even as the ground acts as a *pipeline* to carry water to the river.



Perspective on the Use of an Aquifer

Transient ground water

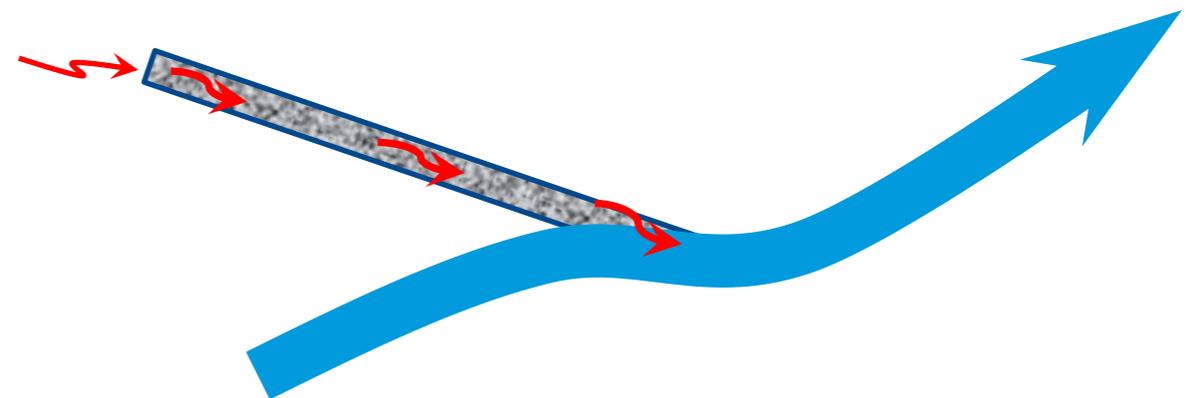
2. Underground location to *temporarily hold* water; ground acts as a *pipeline* to the river,
 - Water placed in a pond or injected in a well,
 - Expect it to travel to the river,
 - Slowly,
 - Uses ground water flow calculations.



Perspective on the Use of an Aquifer

Transient ground water

- **Important Question:** Why would we put water into this formation?
 - Increase in ground water is only temporary,
 - We can't withdraw the water from this location in the future.

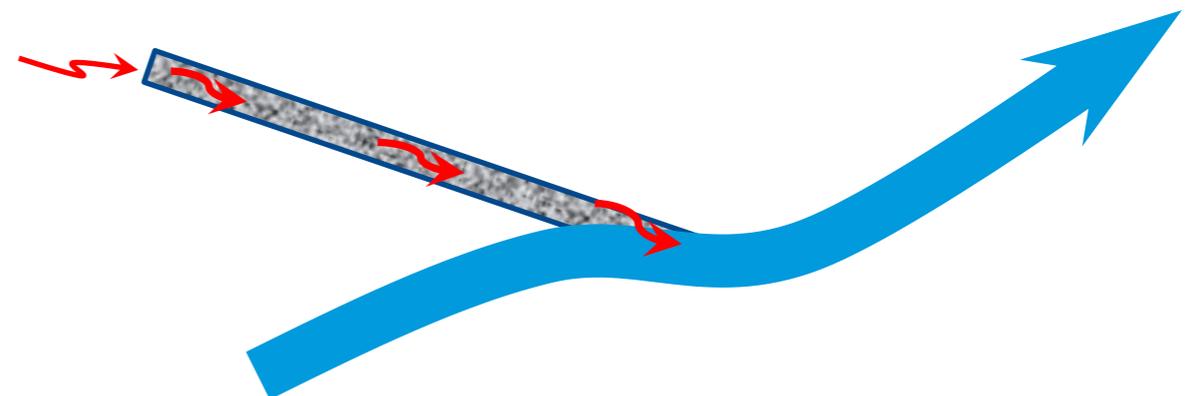


Perspective on the Use of an Aquifer

Transient ground water

- **Answer:** Consider two scenarios:
 1. We have depleted the river and need to make it whole,
 2. We have excess water in the river that we don't want to lose.

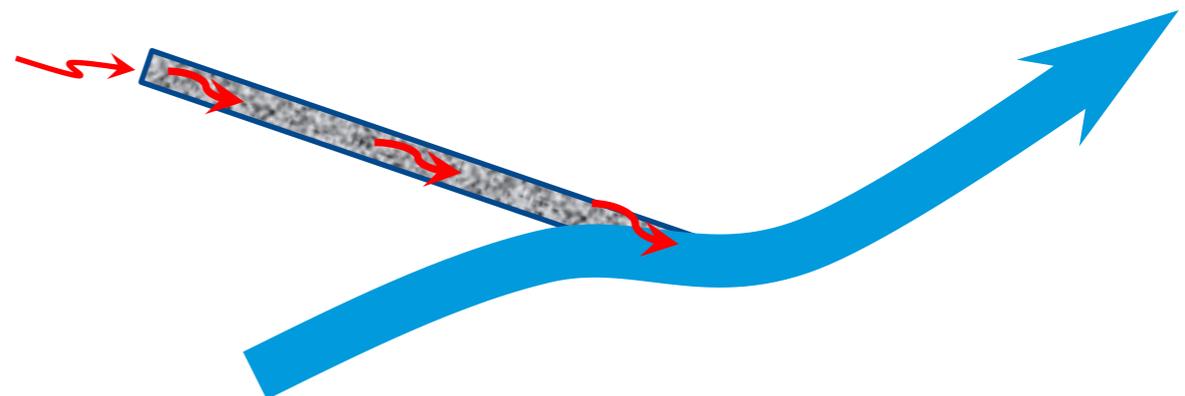
Note: many times, both are happening .



Perspective on the Use of an Aquifer

Transient ground water

- First scenario:
 1. We have depleted the river and need to make it whole,
 - Out-of-priority well depletions,
 - Need to meet return flow obligations.

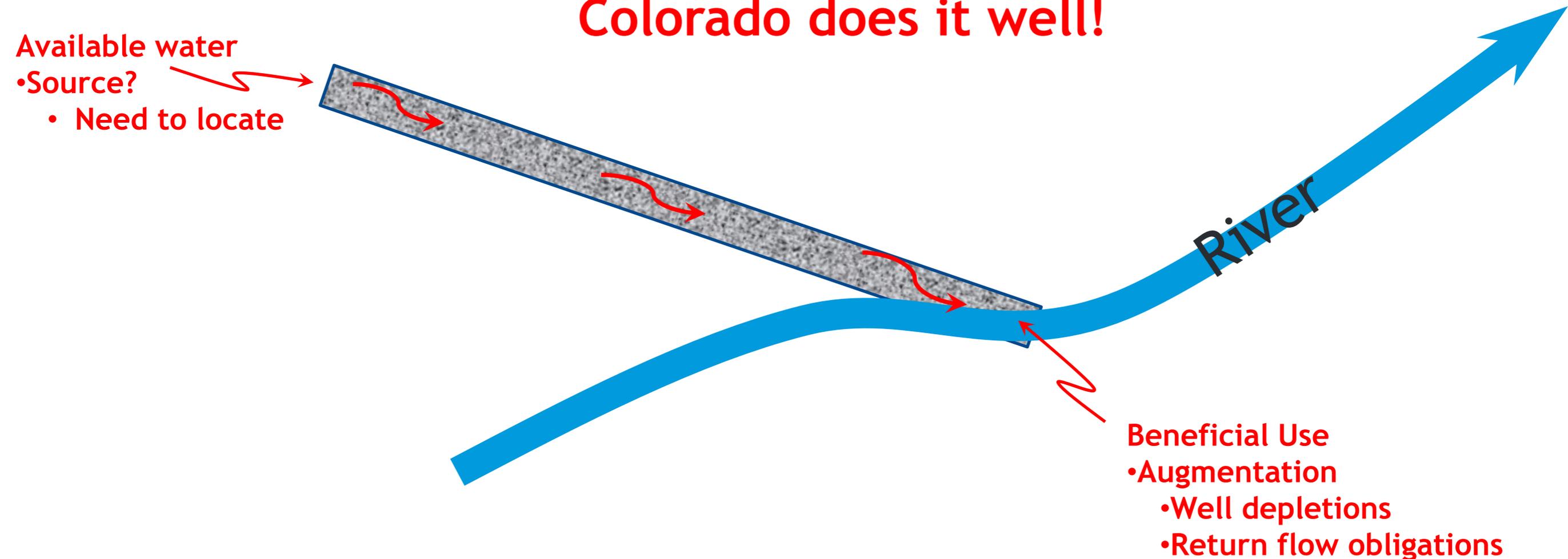


Perspective on the Use of an Aquifer

Transient ground water

1. We have depleted the river and need to make it whole.

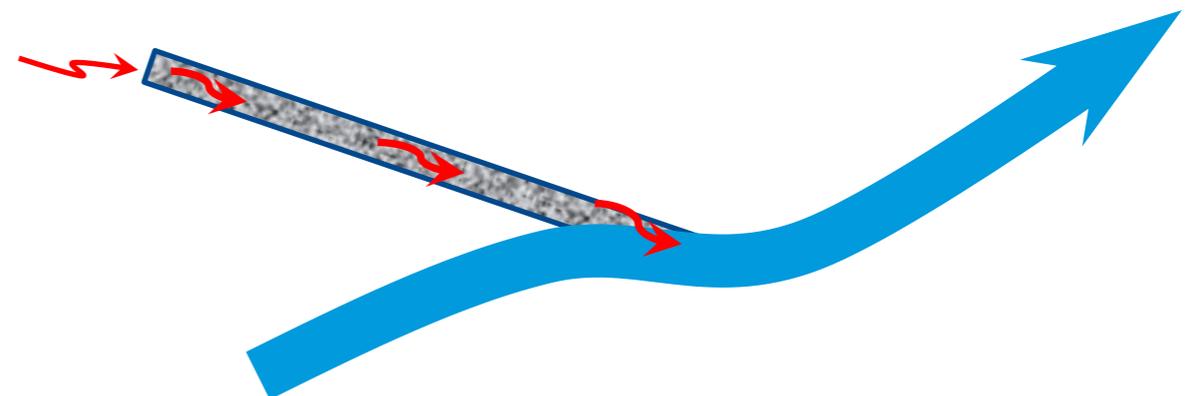
**This is common practice,
Colorado does it well!**



Perspective on the Use of an Aquifer

Transient ground water

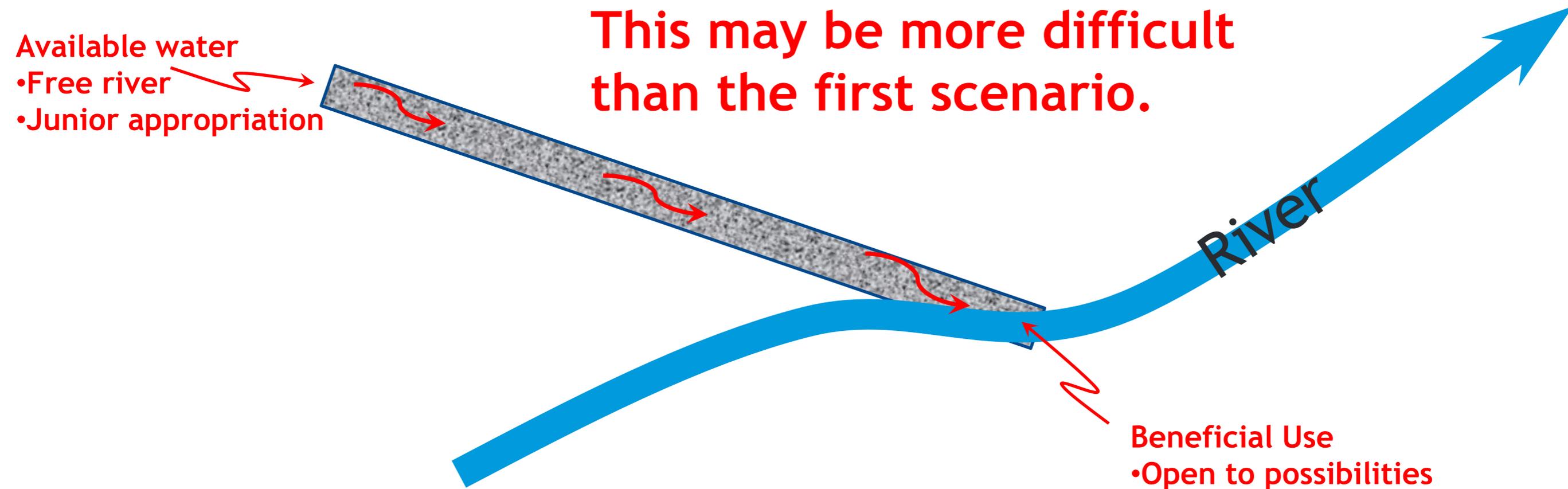
- Second scenario:
 2. We have excess water in the river that we don't want to lose.
- Objective: Retain water that is available but not needed at that place and time (Storage!); driven by availability of water, not a known obligation at the river,



Perspective on the Use of an Aquifer

Transient ground water

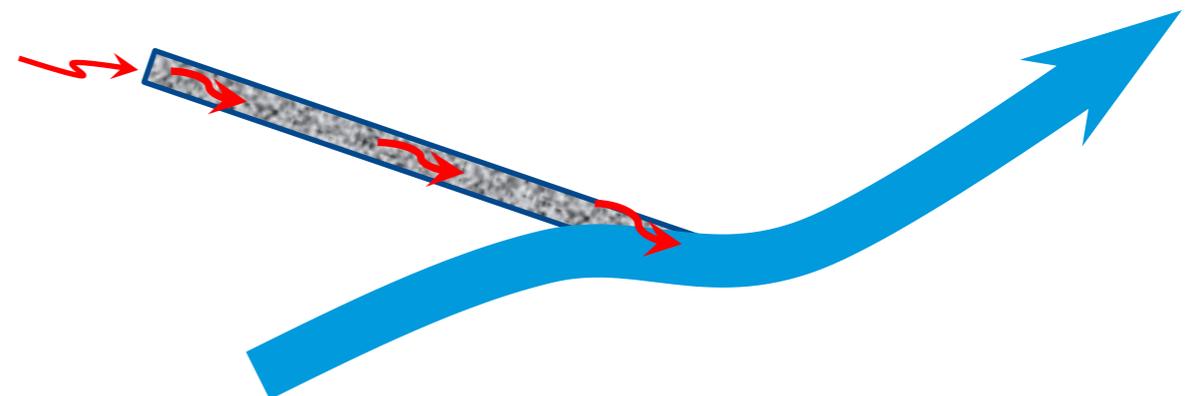
2. We have excess water in the river that we don't want to lose,



Perspective on the Use of an Aquifer

Transient ground water

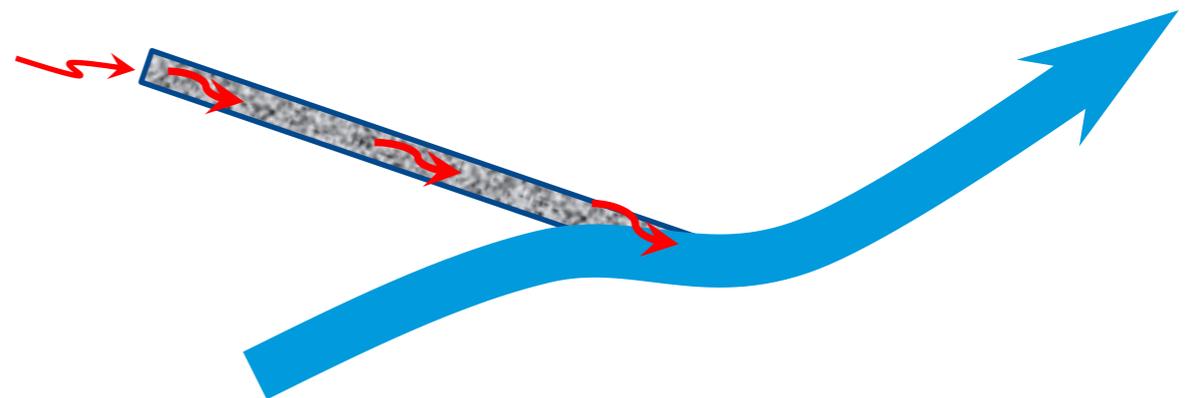
- Second scenario, opportunities:
 - Not limited to nontributary formations,
 - Not limited to situations where there is an obligation like well pumping depletions,
 - Capture water; wherever/whenever there is “water available.”



Perspective on the Use of an Aquifer

Transient ground water

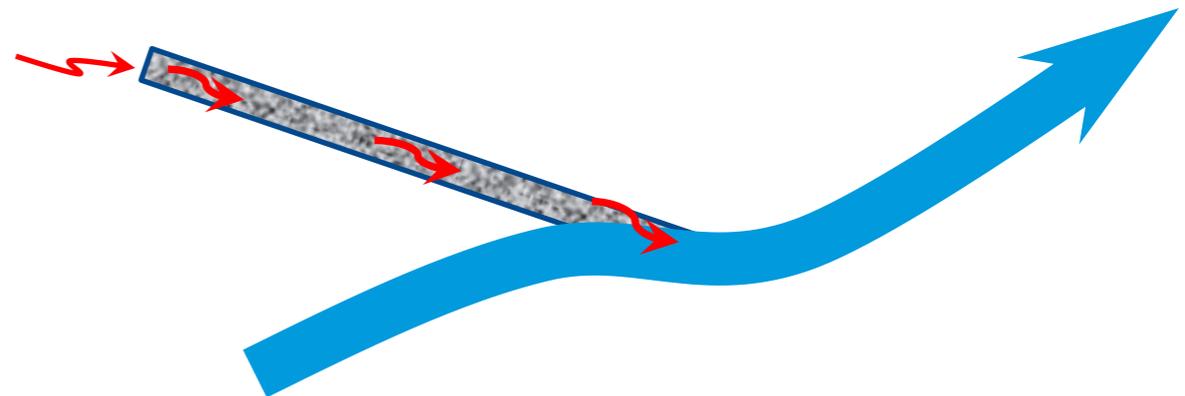
- Second scenario, limitations:
 - Matching supply, infrastructure, and beneficial use,
 - Color of water: free river, junior appropriation, changed senior right,
 - Who does this?
 - Speculation concerns.



Perspective on the Use of an Aquifer

Transient ground water

- Second scenario, limitations:
 - What could be the intent?
 - Make water available for appropriation,
 - Lease for a presently unidentified use,
 - Return to aquifer again?
- Discuss this.



Summary

We can use underground formations to hold or convey water in two different ways:

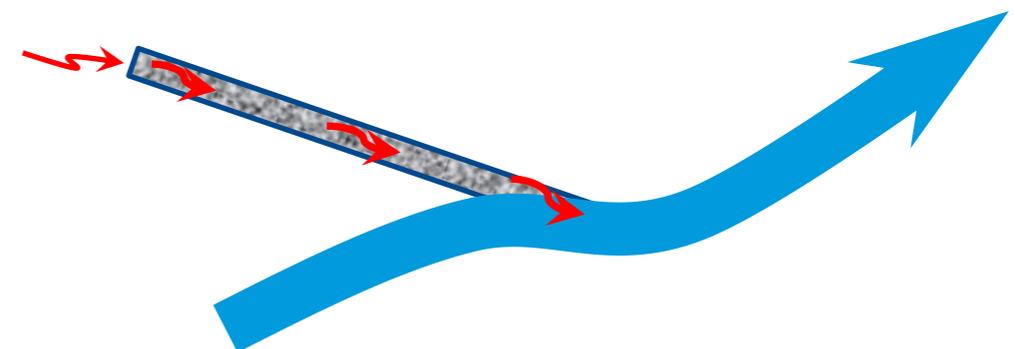
1. Nontributary and lined alluvial storage
 - Objective: store water,
 - Legal and administrative structure is in place,
 - Water users are doing it,
 - Rules do not address non-Denver Basin formations



Summary

We can use underground formations to hold or convey water in two different ways:

2. Underground location to **temporarily hold** water; ground acts as a **pipeline** to the river,
 - Objective: meet an obligation at the stream
 - Legal, administrative, and engineering framework is in place,
 - Water users are doing it,
 - Objective: capture excess water,
 - Legal and administrative framework is not certain,
 - We are not currently doing it,
 - Speculation concern.



Summary

We can use underground formations to hold or convey water in two different ways:

2. Underground location to *temporarily hold* water; ground acts as a *pipeline* to the river,
 - Objective: meet an obligation at the stream
 - Legal, administrative, and engineering framework is in place,
 - Water users are doing it,
 - Objective: **capture excess water,**
 - Legal and administrative framework is not certain,
 - We are not currently doing it,
 - **Speculation concern.**

