



# *Regulation of Ground Water Storage*

Water Resources Review Committee

August 3, 2017

Kevin Rein, P.E.,

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 a geologic formation in Colorado:

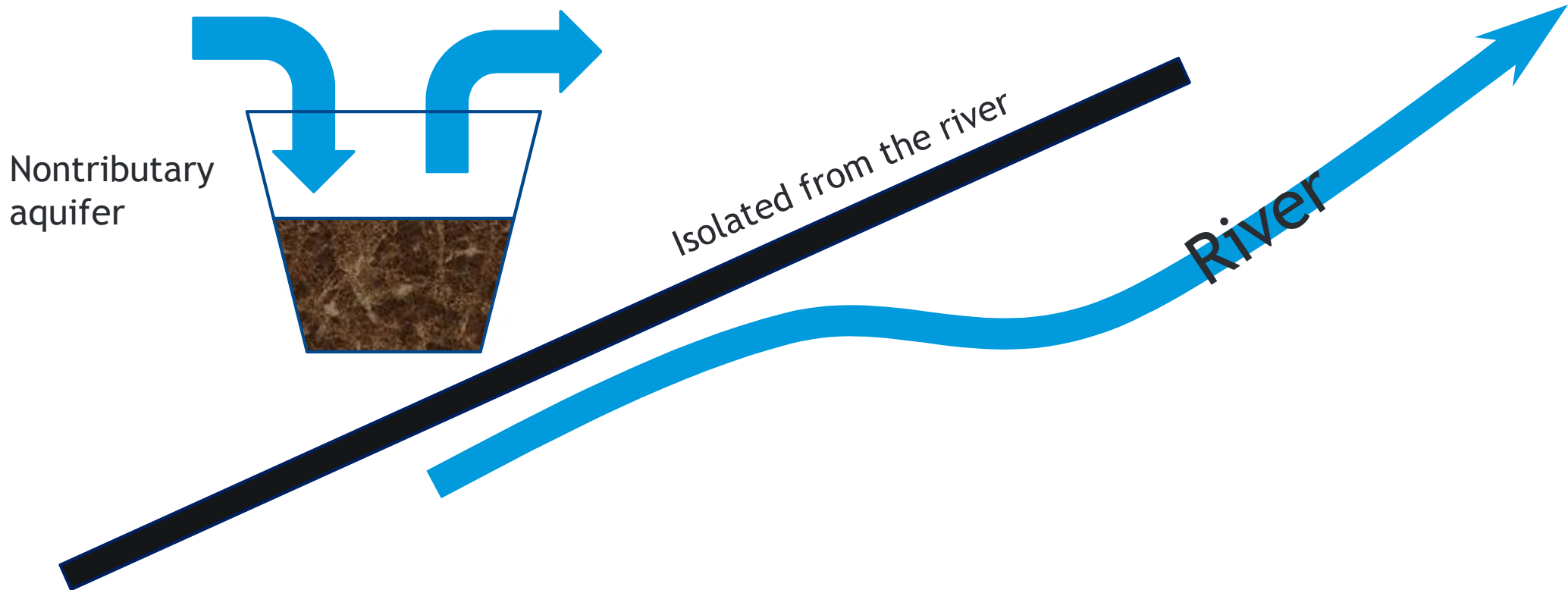
## Static ground water

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,

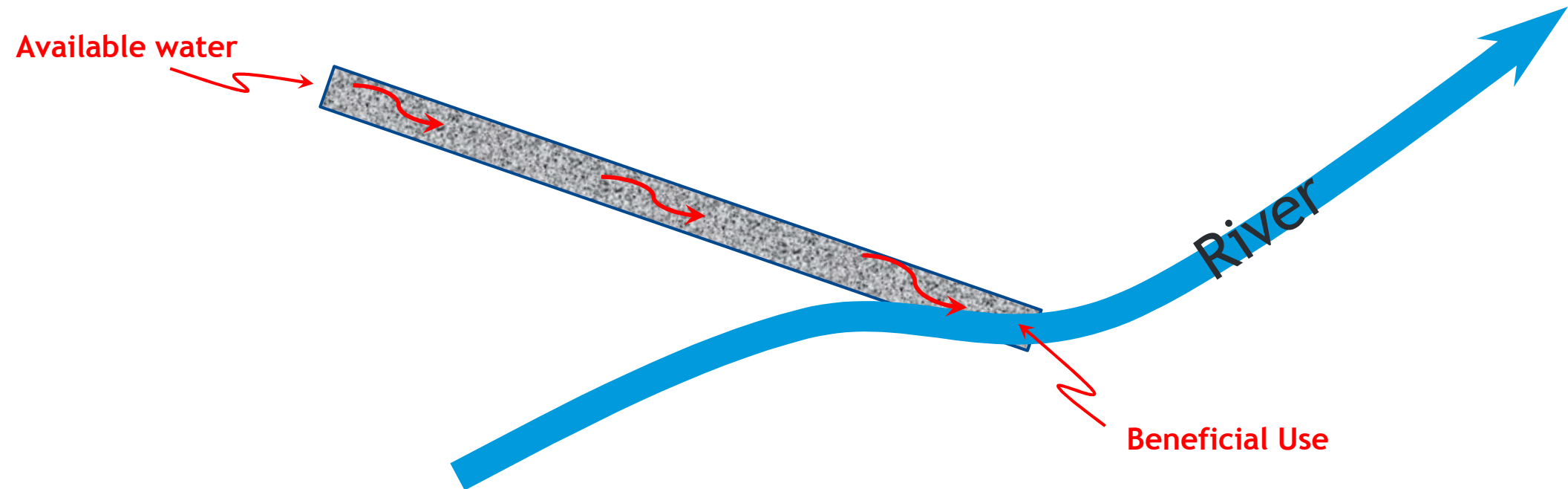
## Transient ground water

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

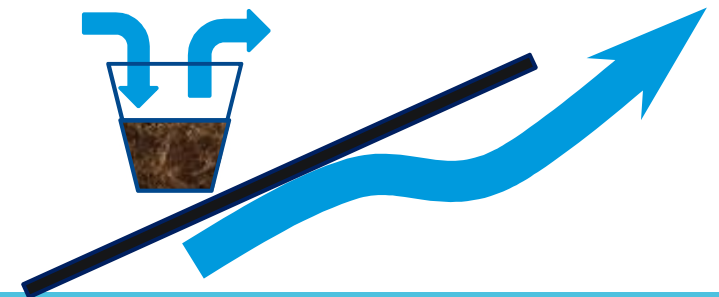
1. As a **bank**, to store water indefinitely,
  - No connection to surface water
  - Nontributary
  - Lined alluvial storage
  - Withdrawn from the same location it was put in
  - No time limit



# *Perspective on the Use of an Aquifer*

## Static ground water

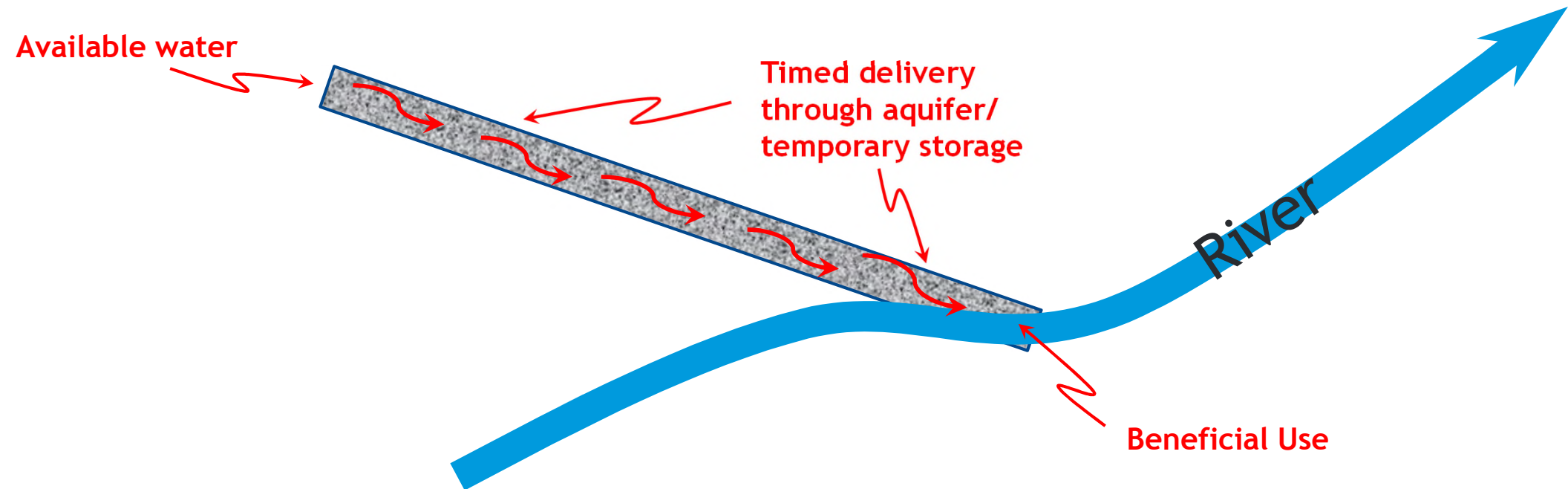
1. As a **bank**, to store water indefinitely,
  - Currently used by several water providers in the Denver Basin bedrock aquifers,
  - Aurora's Prairie Waters Project, for example (lined alluvial formation),
  - Limited to select natural formations or alluvial formations with a construction component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



# Perspective on the Use of an Aquifer

## Transient ground water

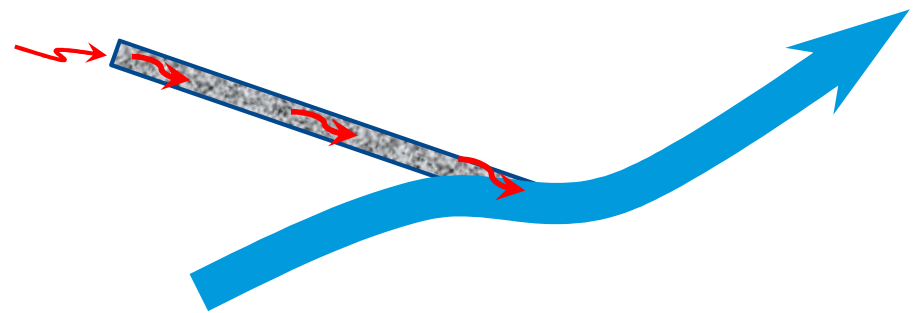
2. As an underground location to *temporarily hold* water; even as the ground acts as a *pipeline* to carry water to the river.



# *Perspective on the Use of an Aquifer*

## Transient ground water

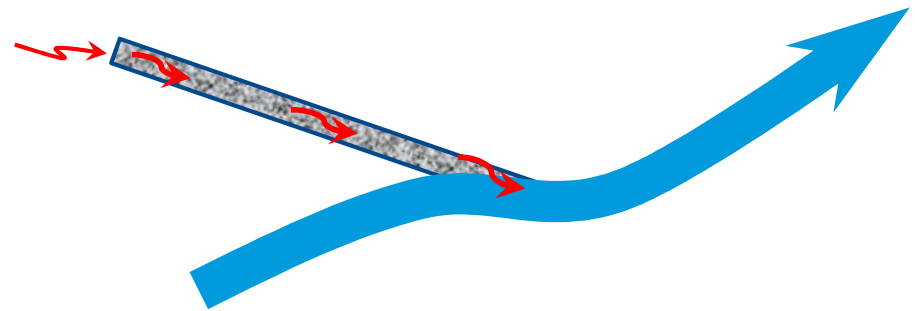
2. Underground location to *temporarily hold* water; ground acts as a *pipeline* to the river,
  - Water placed in a pond or injected in a well,
  - Expect it to travel to the river,
    - Slowly,
    - Uses ground water flow calculations.



# *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.

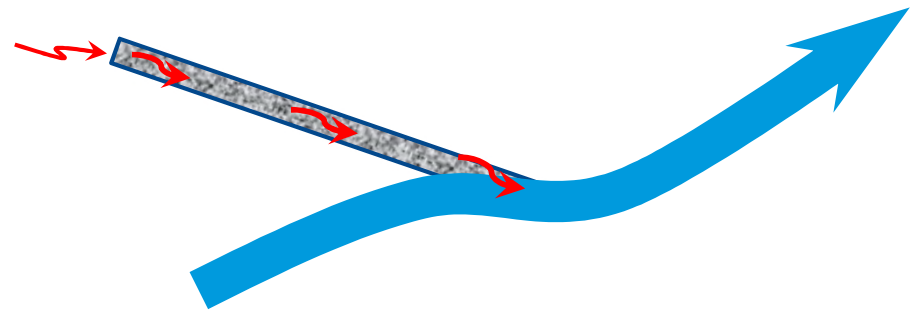


# *Perspective on the Use of an Aquifer*

## 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.

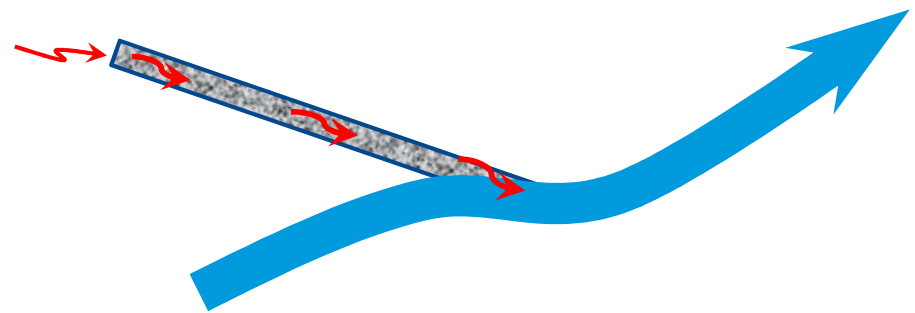
Note: many times, both are happening .



# *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 from a change of water right.

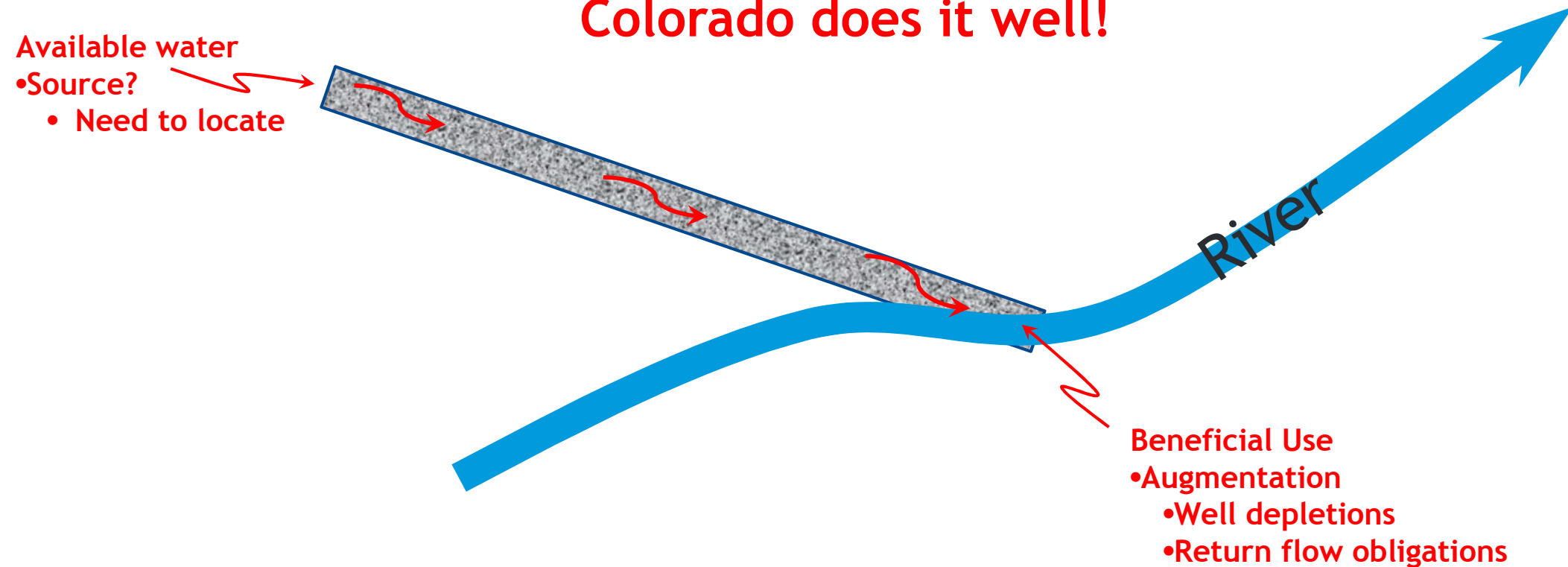


# Perspective on the Use of an Aquifer

## Transient ground water

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

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

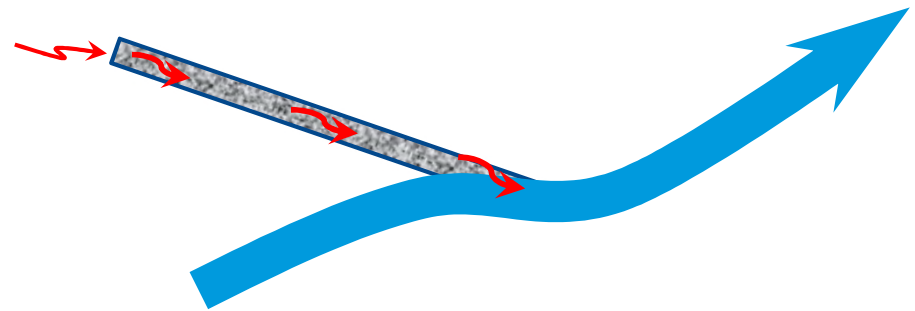




# *Perspective on the Use of an Aquifer*

## Transient ground water

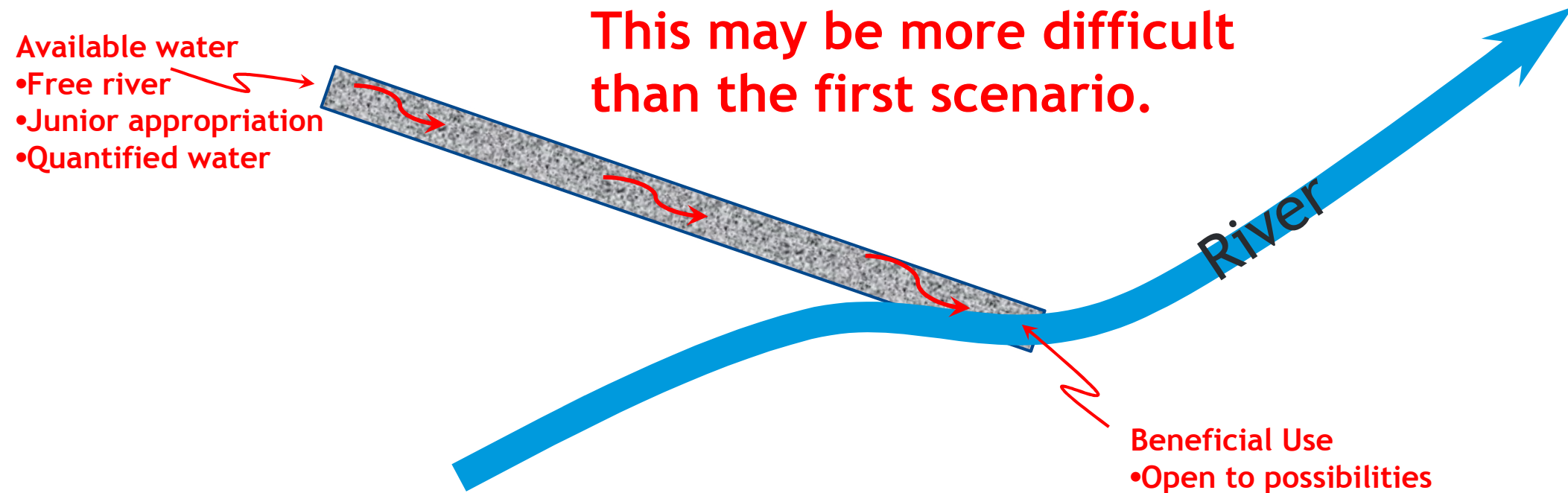
- Second scenario:
  2. We have excess water in the river that we don't want to lose.
- Objective: Retain water that is available but not needed at that place and time (Storage!); driven by availability of water, not a known obligation at the river,



# Perspective on the Use of an Aquifer

## Transient ground water

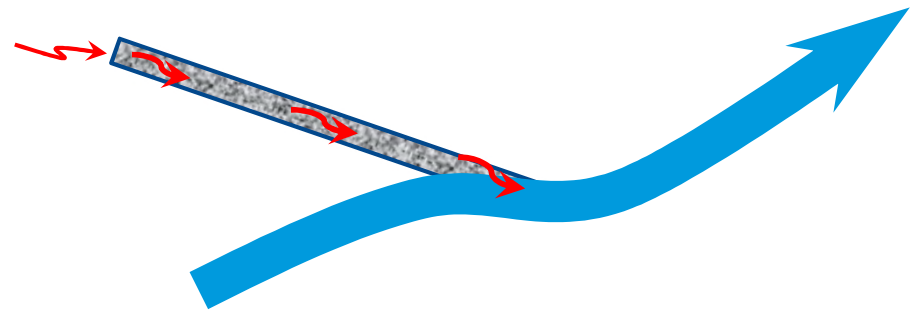
2. We have excess water in the river that we don't want to lose,



# *Perspective on the Use of an Aquifer*

## Transient ground water

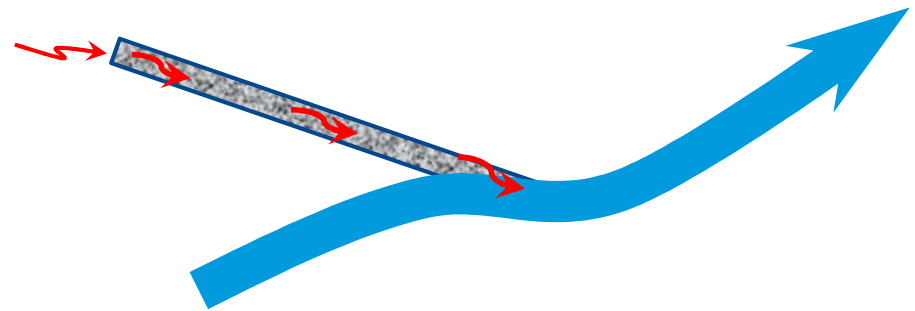
- Second scenario, opportunities:
  - Not limited to nontributary formations,
  - Not limited to situations where there is an obligation like well pumping depletions,
  - Capture water; wherever/whenever there is “water available.”



# *Perspective on the Use of an Aquifer*

## Transient ground water

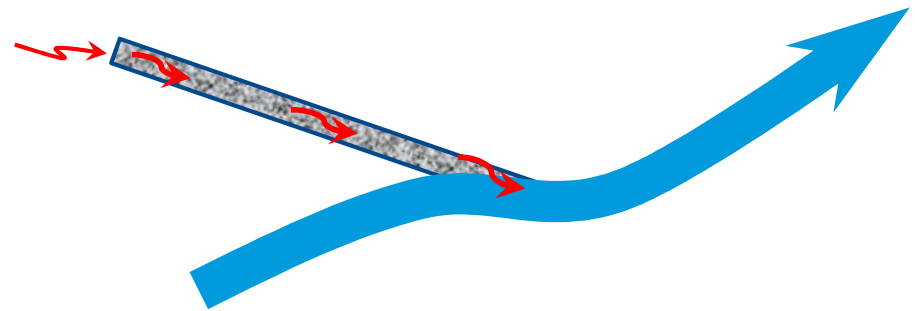
- Second scenario, limitations:
  - Matching supply, infrastructure, and beneficial use,
  - Color of water: free river, junior appropriation, changed senior right,
  - Who does this?
  - Speculation concerns.



# *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:

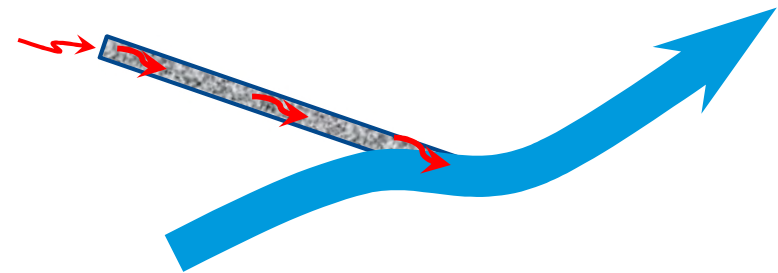
1. Nontributary and lined alluvial storage
  - Objective: store water,
  - Legal and administrative structure is in place,
  - Water users are doing it,
  - Rules do not address non-Denver Basin formations



# 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.**

