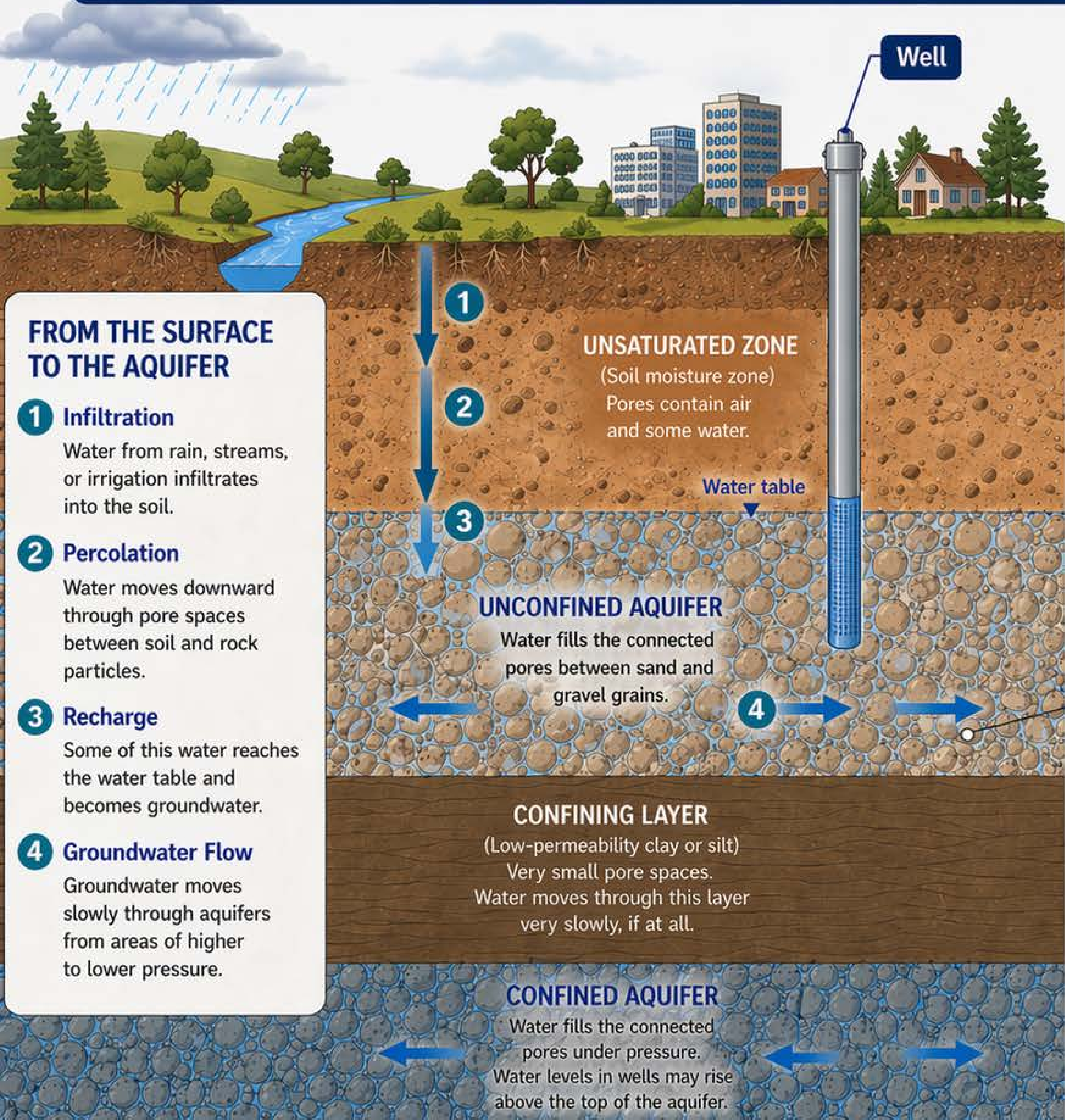
WHAT AN AQUIFER ACTUALLY IS

Aquifers are underground layers of sand, gravel, rock, or sediment that store and transmit groundwater.

An aquifer is NOT an underground lake.
Groundwater fills the tiny spaces (pores and cracks) between grains of rock and sediment.



FROM THE SURFACE TO THE AQUIFER

1 Infiltration
Water from rain, streams, or irrigation infiltrates into the soil.

2 Percolation
Water moves downward through pore spaces between soil and rock particles.

3 Recharge
Some of this water reaches the water table and becomes groundwater.

4 Groundwater Flow
Groundwater moves slowly through aquifers from areas of higher to lower pressure.

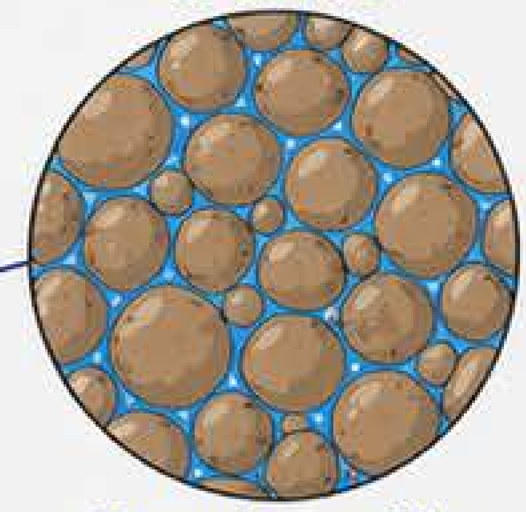
LAND SURFACE

- Rainfall, streams, lakes, and irrigation provide water that can recharge groundwater.
- Some water runs off, some evaporates, and some soaks into the ground.

UNCONFINED AQUIFER

- The upper surface is the water table.
- Water is under atmospheric pressure.
- Wells in this aquifer are often shallower.

WHAT IT LOOKS LIKE UP CLOSE



Groundwater fills pores and cracks
Tiny spaces store and move water.

CONFINED AQUIFER

- Water is under pressure from overlying layers.
- Wells may be deeper.
- Water can rise in the well when tapped.

GROUNDWATER MOVES SLOWLY UNDERGROUND.
It can take days, months, or even years for water to travel short distances.

KEY TAKEAWAYS

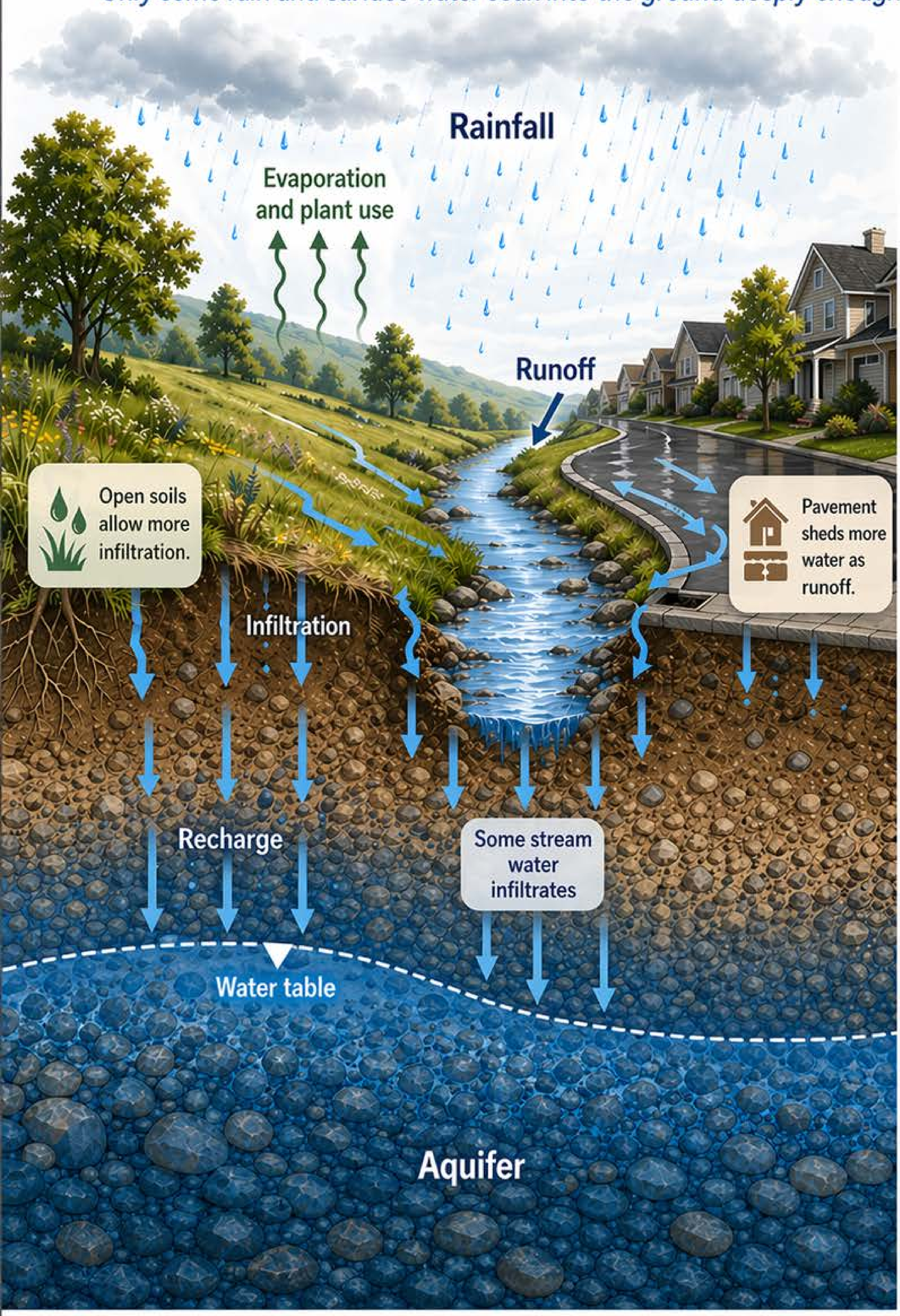
- Aquifers are geologic materials, not empty cavities or lakes.
- Groundwater is stored in pores and cracks and moves very slowly.
- Confining layers can protect water quality but also limit recharge and recovery.
- Not every layer can store, transmit, or yield usable water. it depends on matters.

POLICY TAKEAWAY

Aquifer storage depends on geology.
Not every underground layer can store, transmit, or recover water effectively.

How Groundwater Recharge Works

Only some rain and surface water soak into the ground deeply enough to recharge an aquifer.



What happens to rainfall?

1. Some runs off to streams
2. Some evaporates or is used by plants
3. Some infiltrates into soil
4. Some stream water infiltrates and only some becomes groundwater recharge

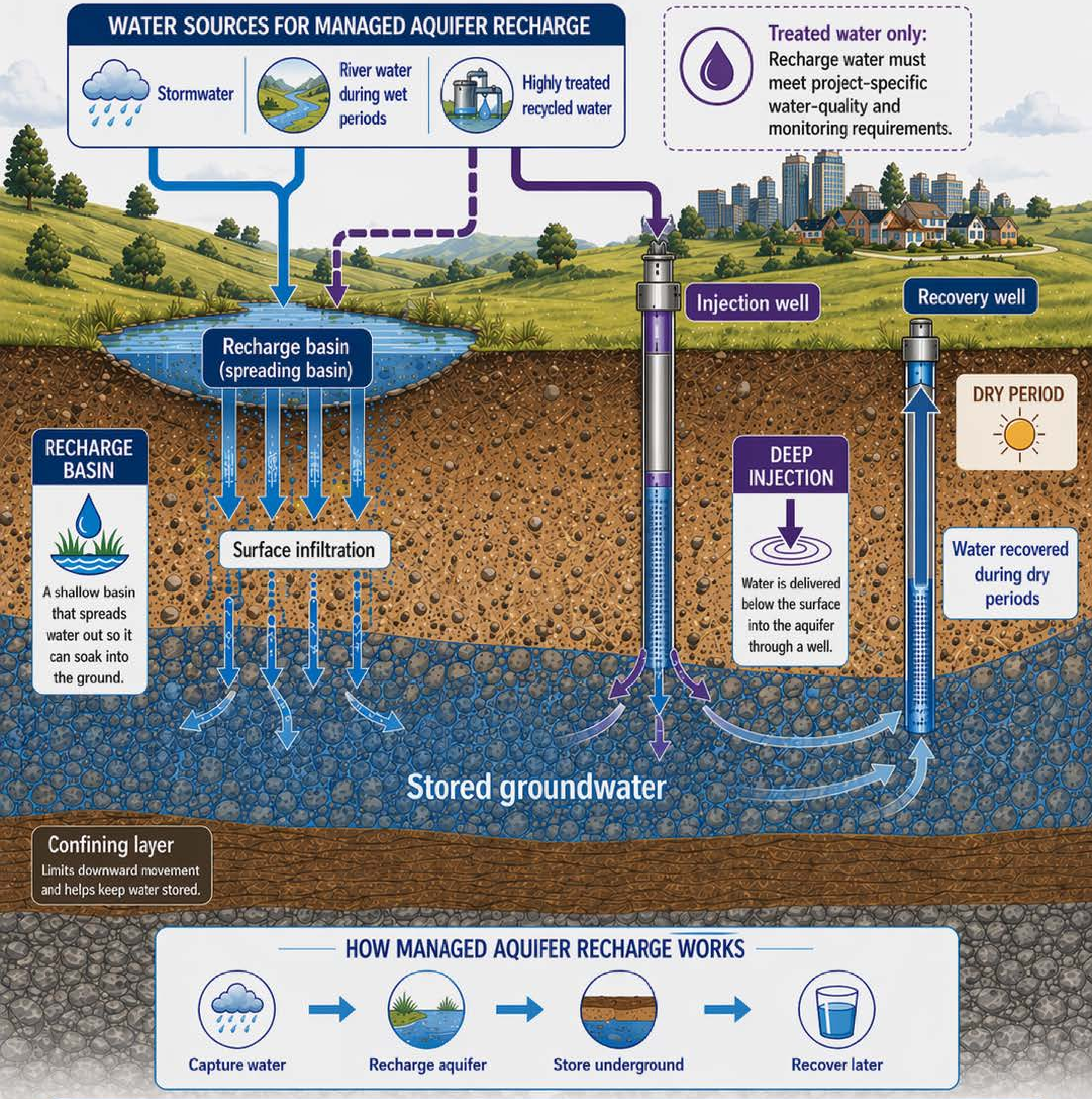
Recharge conditions

More recharge	Less recharge
Permeable soils	Pavement
Open land	Compacted soils
Connected floodplains	Steep runoff pathways

Policy takeaway: Recharge is shaped by land use.
Planning decisions at the surface affect groundwater storage below.

What Managed Aquifer Recharge Means

Managed aquifer recharge intentionally moves water underground so it can be stored and used later.

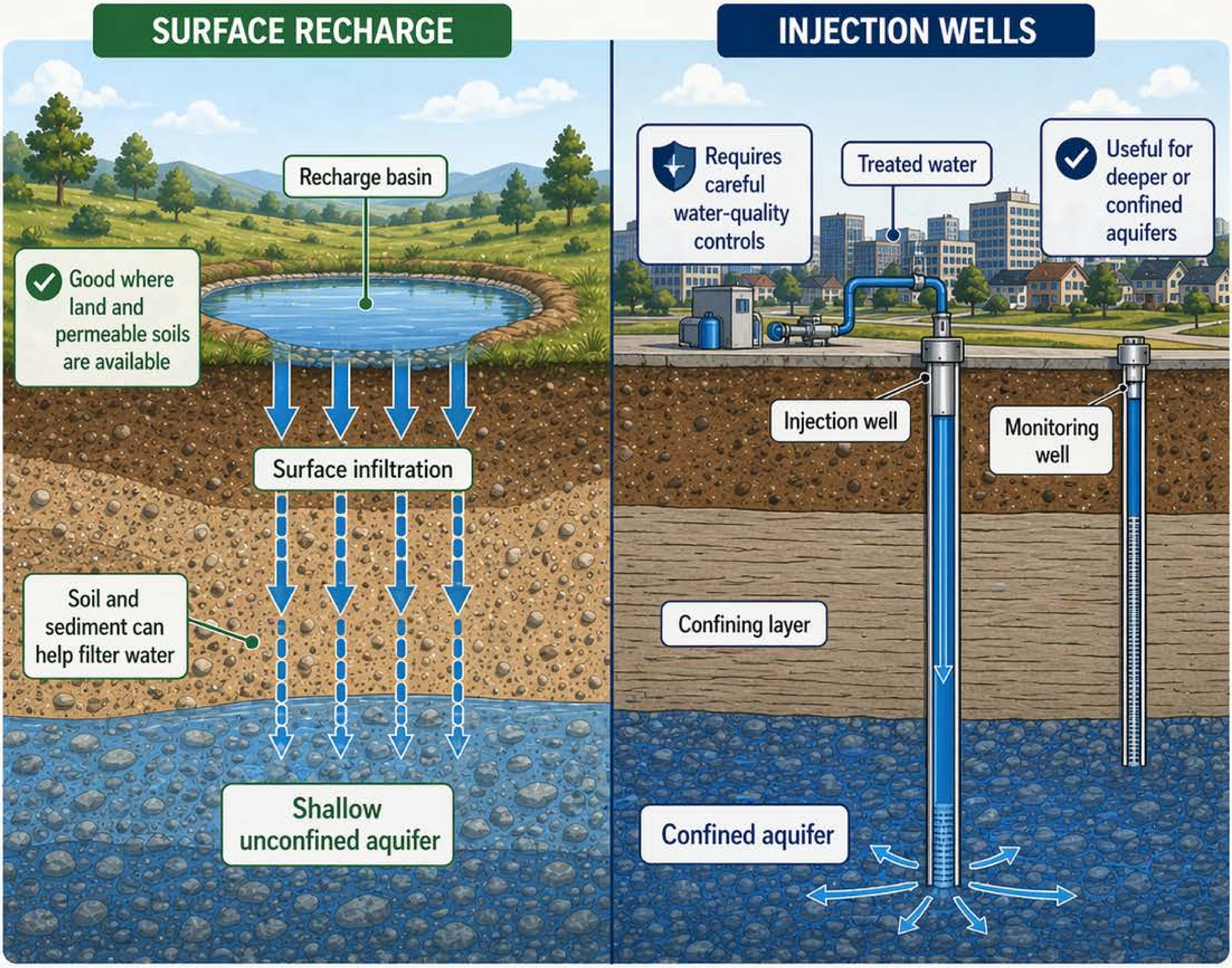


Policy takeaway:
MAR turns suitable aquifers into underground storage infrastructure.

- Builds drought resilience
- Protects water supplies
- Supports sustainable water management

Surface Recharge vs. Injection Wells

Two common managed aquifer recharge methods fit different aquifers, water sources, and site conditions.



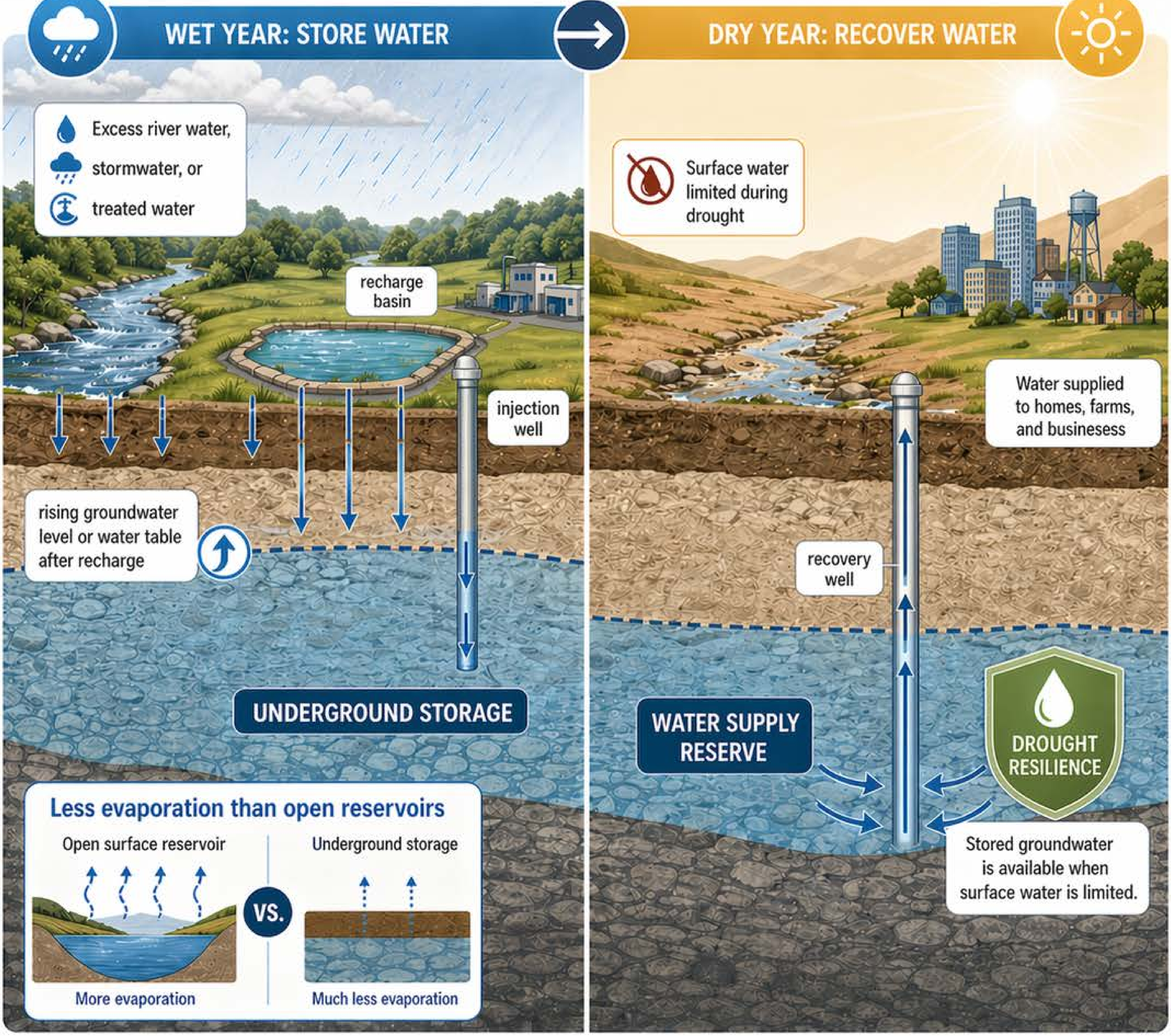
BEST FIT

Surface recharge	Injection wells
✓ Land available	✓ Limited land
✓ Shallow aquifer	✓ Confined aquifer
✓ Permeable soils	✓ Treated water needed

Policy takeaway: The right recharge method depends on geology, land availability, water quality, and project goals.

Why Aquifer Storage Can Help with Drought

**STORE WATER UNDERGROUND WHEN IT'S AVAILABLE.
RELY ON IT WHEN IT'S NOT.**



ONE TOOL IN A BROADER WATER STRATEGY

- Conserve water
- Protect watersheds
- Improve water efficiency
- Plan and collaborate
- Build and maintain storage (surface and groundwater)

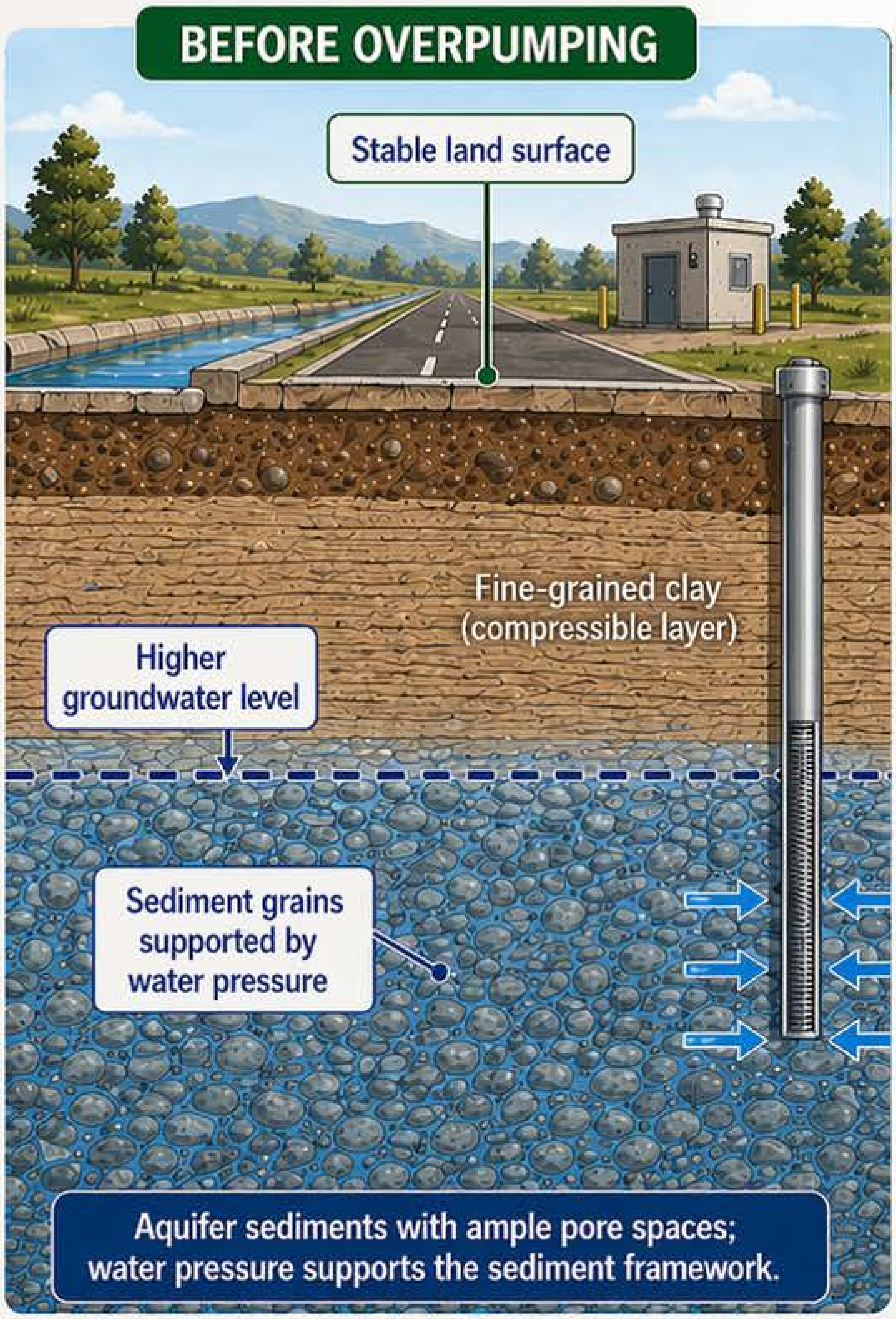
Aquifer storage helps build resilience, but it has limits.

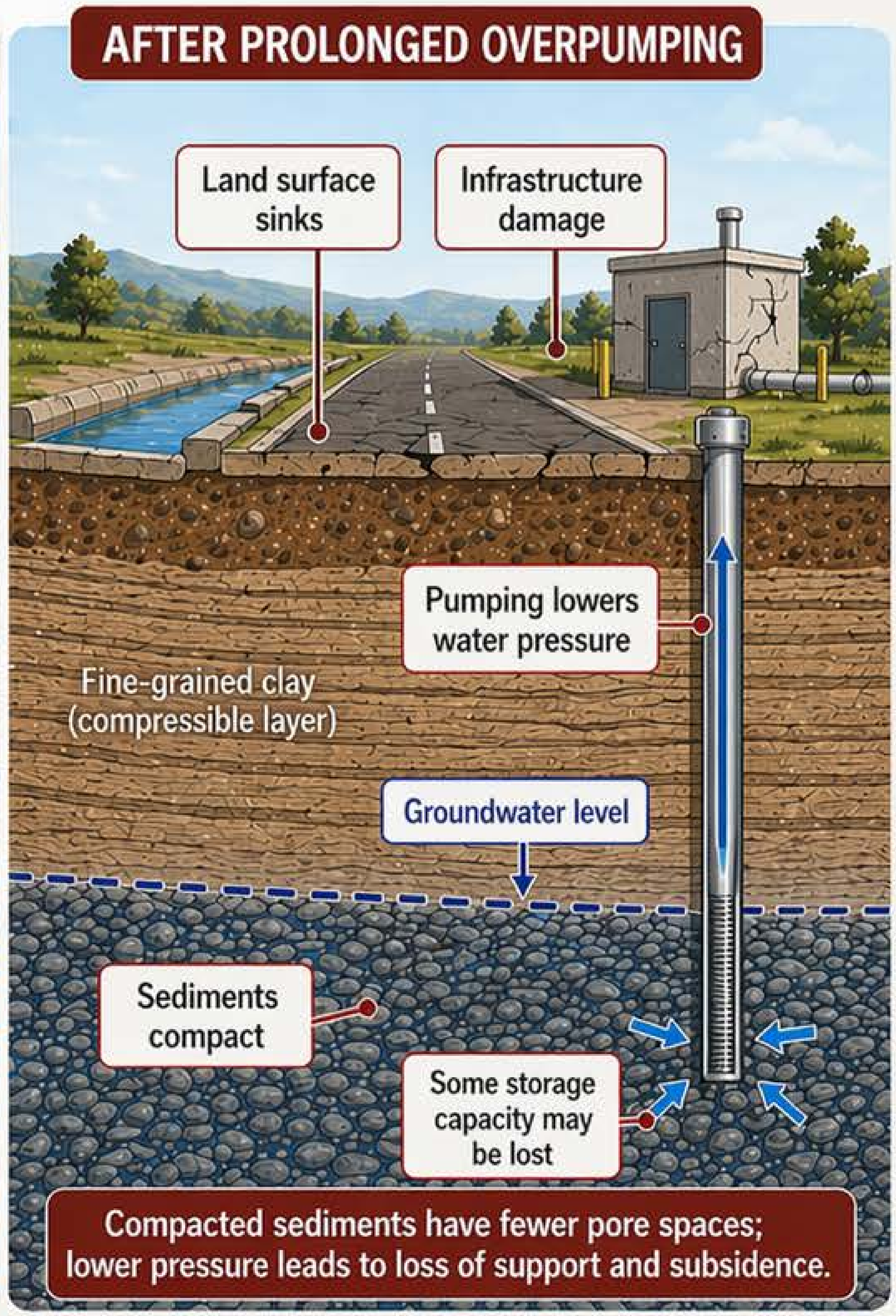
- Depends on local geology and water quality
- Storage size is finite
- Not a substitute for conservation and planning

Policy takeaway: Managed Aquifer Recharge is most useful when planned **before drought,** not only during drought.

How Groundwater Depletion Can Cause Land Subsidence

Excessive groundwater pumping lowers water pressure, compacts aquifer sediments, and causes the land surface to sink.



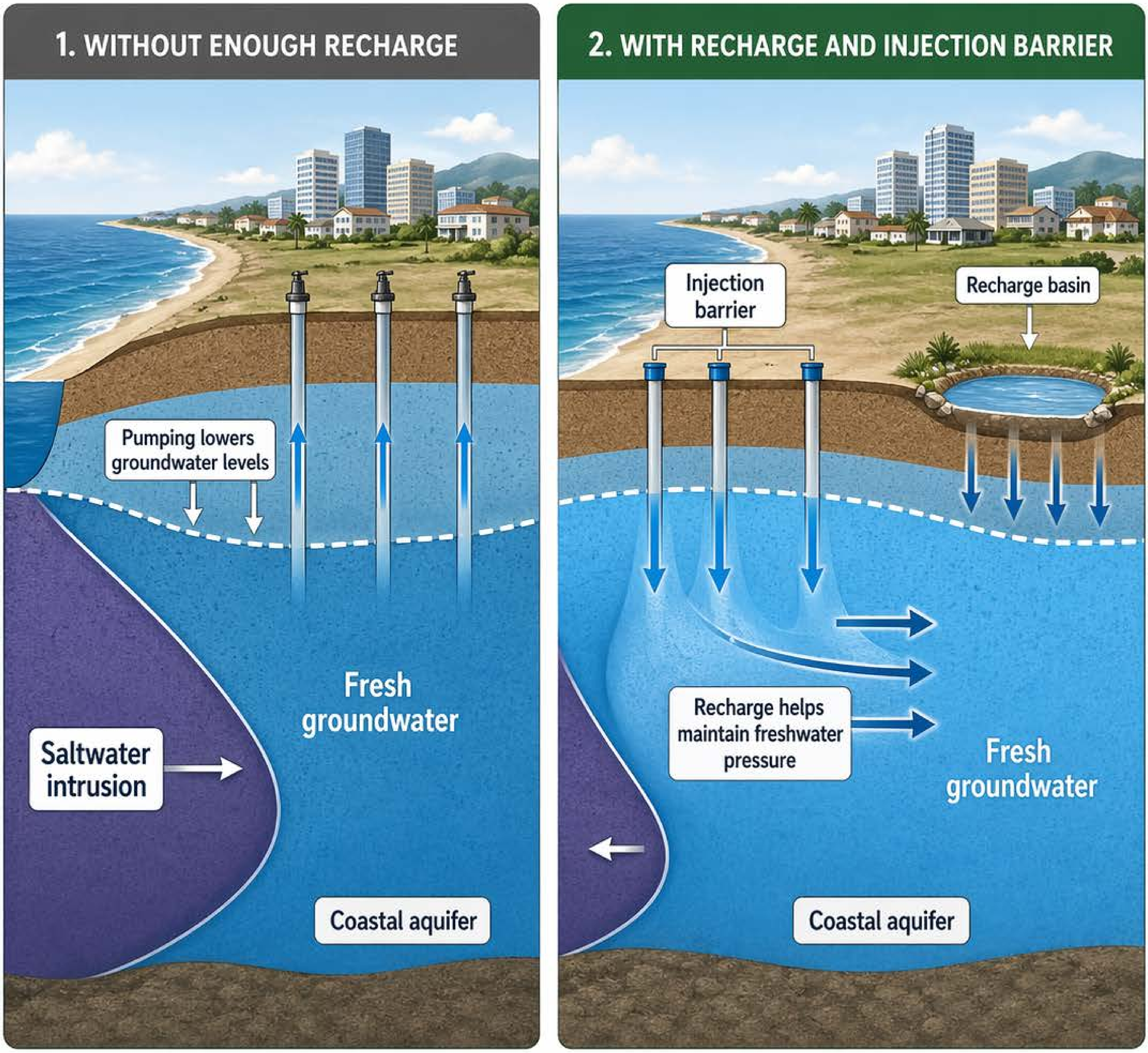


Some compaction may be permanent.

- Overpumping can lower groundwater pressure.
- When fine-grained sediments compact, the ground above can sink.
- Some lost storage capacity cannot be fully recovered.

Policy takeaway: Groundwater management protects both water supply and infrastructure. Preventing subsidence is easier than reversing it.

How Recharge Can Help Protect Coastal Aquifers



Policy takeaway: In coastal areas, recharge can protect water supply by helping keep saltwater out of freshwater aquifers.

Where Recharge Water Comes From

Managed aquifer recharge (MAR) projects can use different water sources, each with different availability, reliability, treatment needs, and policy tradeoffs.

River water

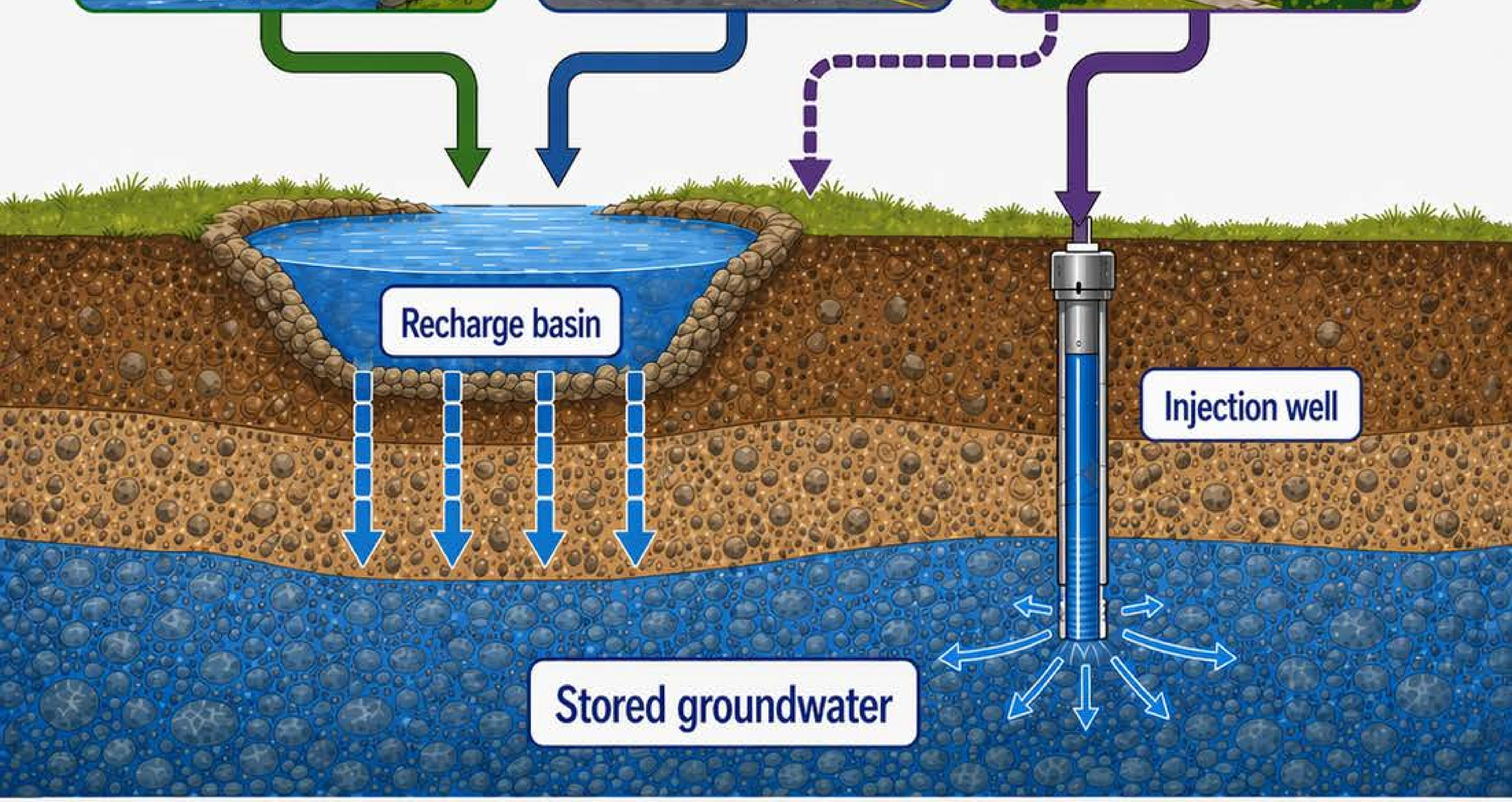
- Available mainly during wetter periods
- May compete with other uses

Stormwater

- Episodic and seasonal
- Can reduce flooding and capture runoff

Treated wastewater

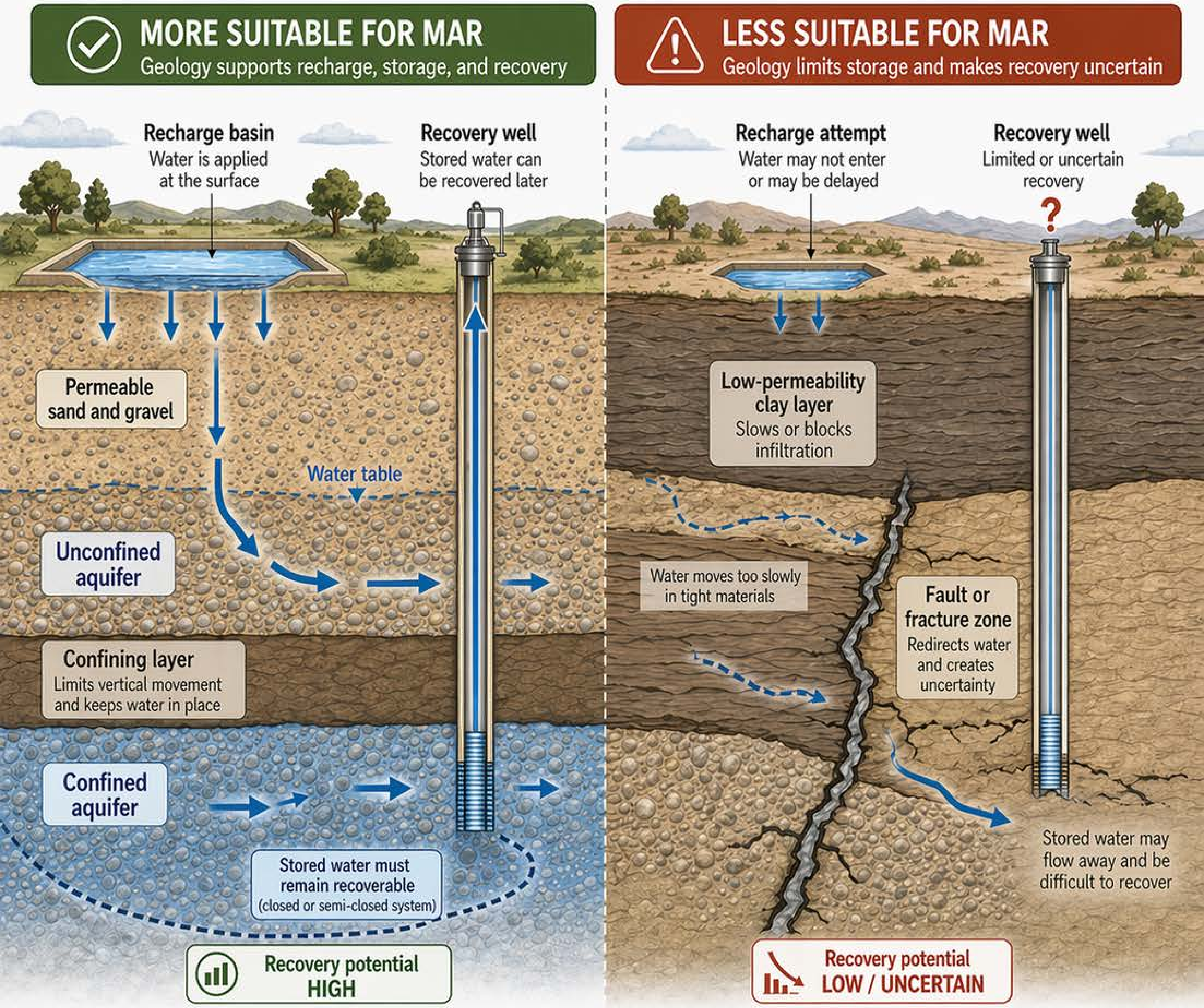
- More reliable supply
- Requires treatment, monitoring, and public trust



Policy takeaway: Recharge projects depend as much on source-water planning as on aquifer geology.

How Geology Determines Whether MAR Will Work

Managed aquifer recharge (MAR) works best where geology allows water to enter, be stored underground, and be recovered later.



More suitable for MAR

- Permeable materials
- Storage space in the aquifer
- Water can be recovered later
- Groundwater flow can be predicted and monitored

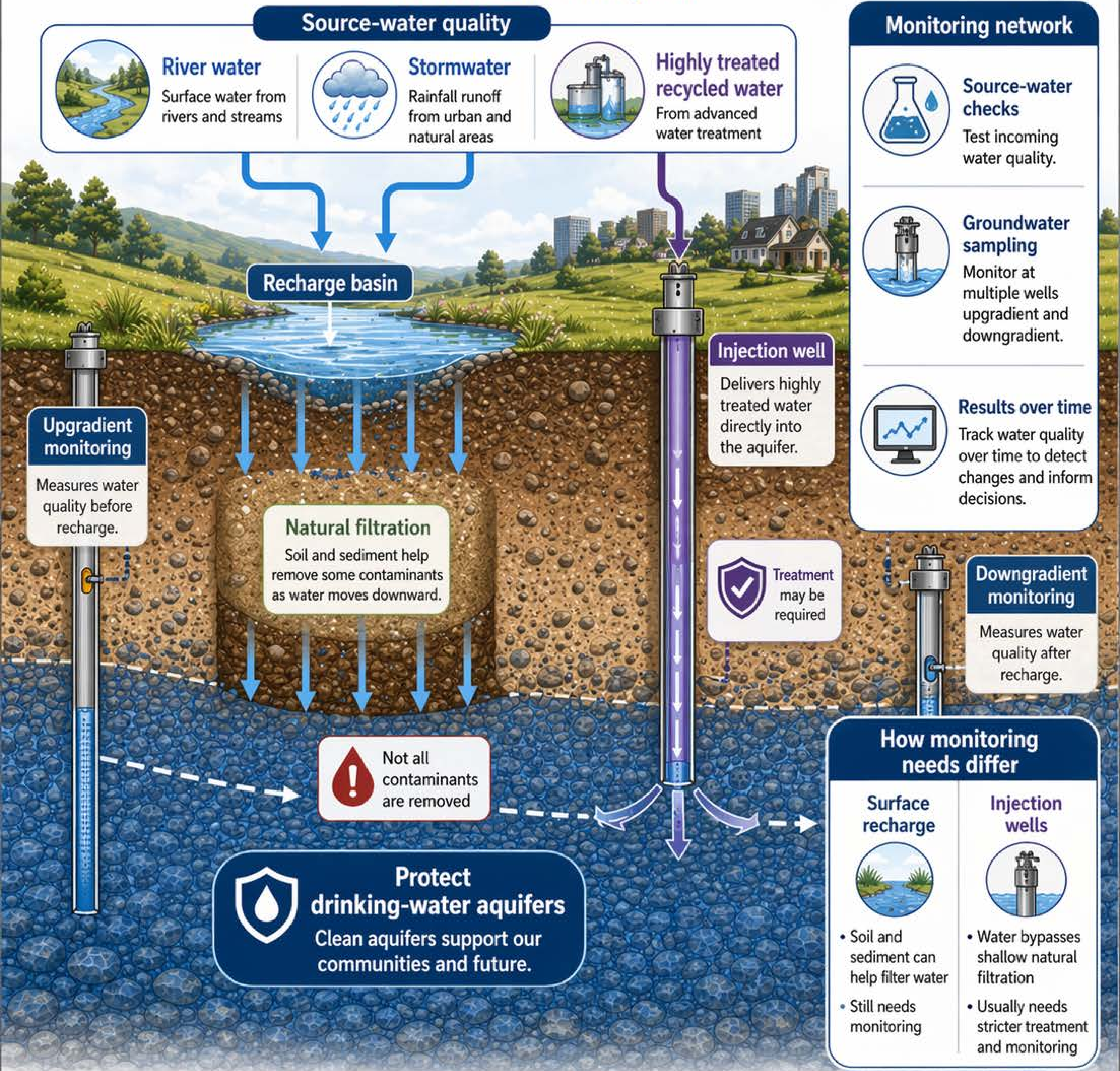
Less suitable for MAR

- Thick clay layers
- Water moves too slowly or too quickly
- Stored water may flow away
- Faults or barriers create uncertainty

Policy takeaway: MAR is a geology-dependent water strategy.
A suitable aquifer must be able to accept, store, and release water.

Why Water Quality Monitoring Is Central to Recharge Projects

Recharge water quality must be understood before, during, and after water enters an aquifer.

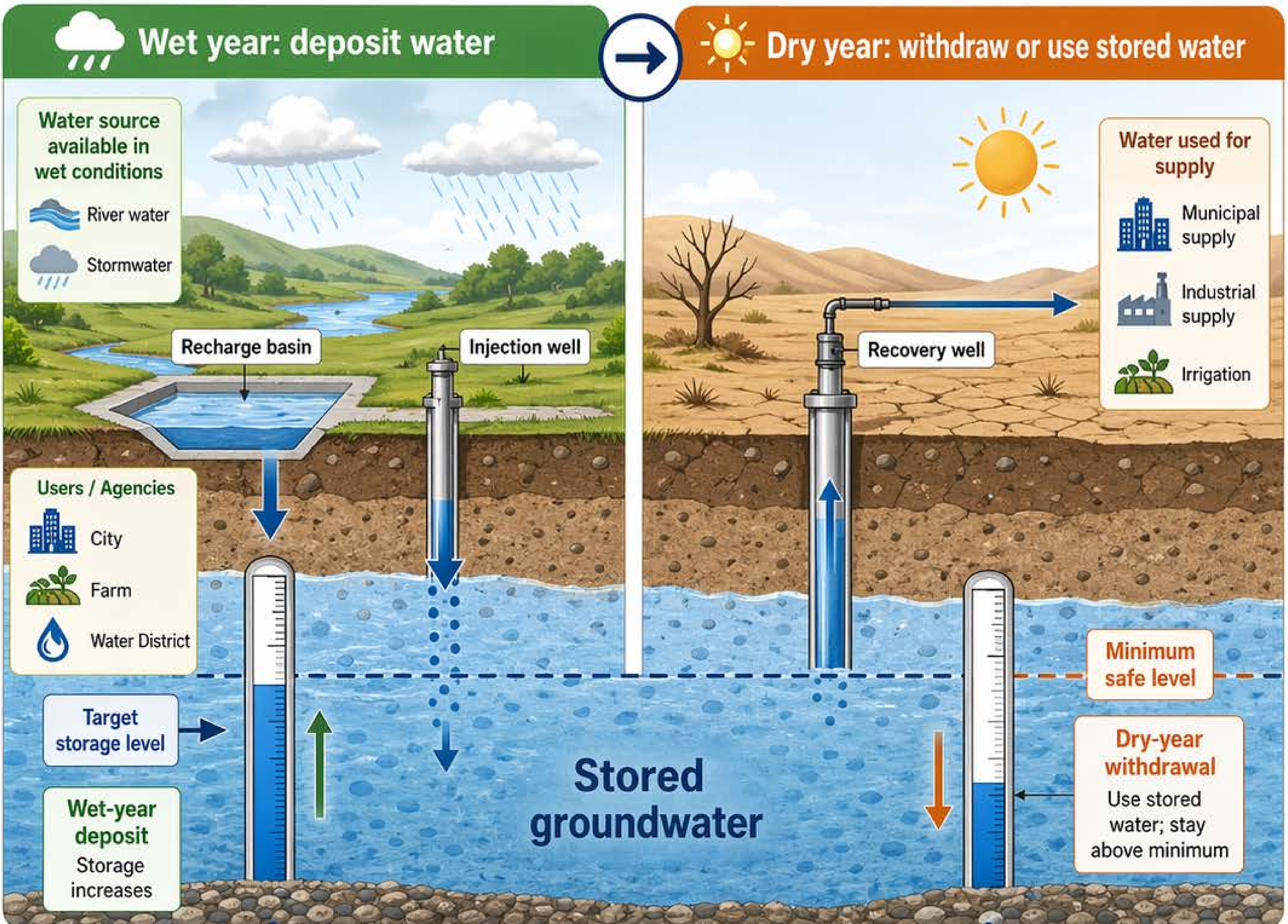


Policy takeaway:
Recharge projects must be designed around water quality, monitoring, and public trust.

- ✓ Understand water quality before, during, and after recharge
- ✓ Monitor to protect groundwater and public health
- ✓ Build confidence through transparency and accountability

What Water Banking Means

Water banking stores water underground in wet years and tracks how it can be recovered later in dry years.



Water accounting and operating rules

Ownership and rules

Define who can deposit, store, and recover water.

Recovery rights

Define who can recover, how much, and when.

Water accounting

Deposits	+ 6,200 AF
Storage	12,400 AF (Acre-feet)
Withdrawals	– 4,100 AF

Operational thresholds

Stay within established levels to protect the resource.

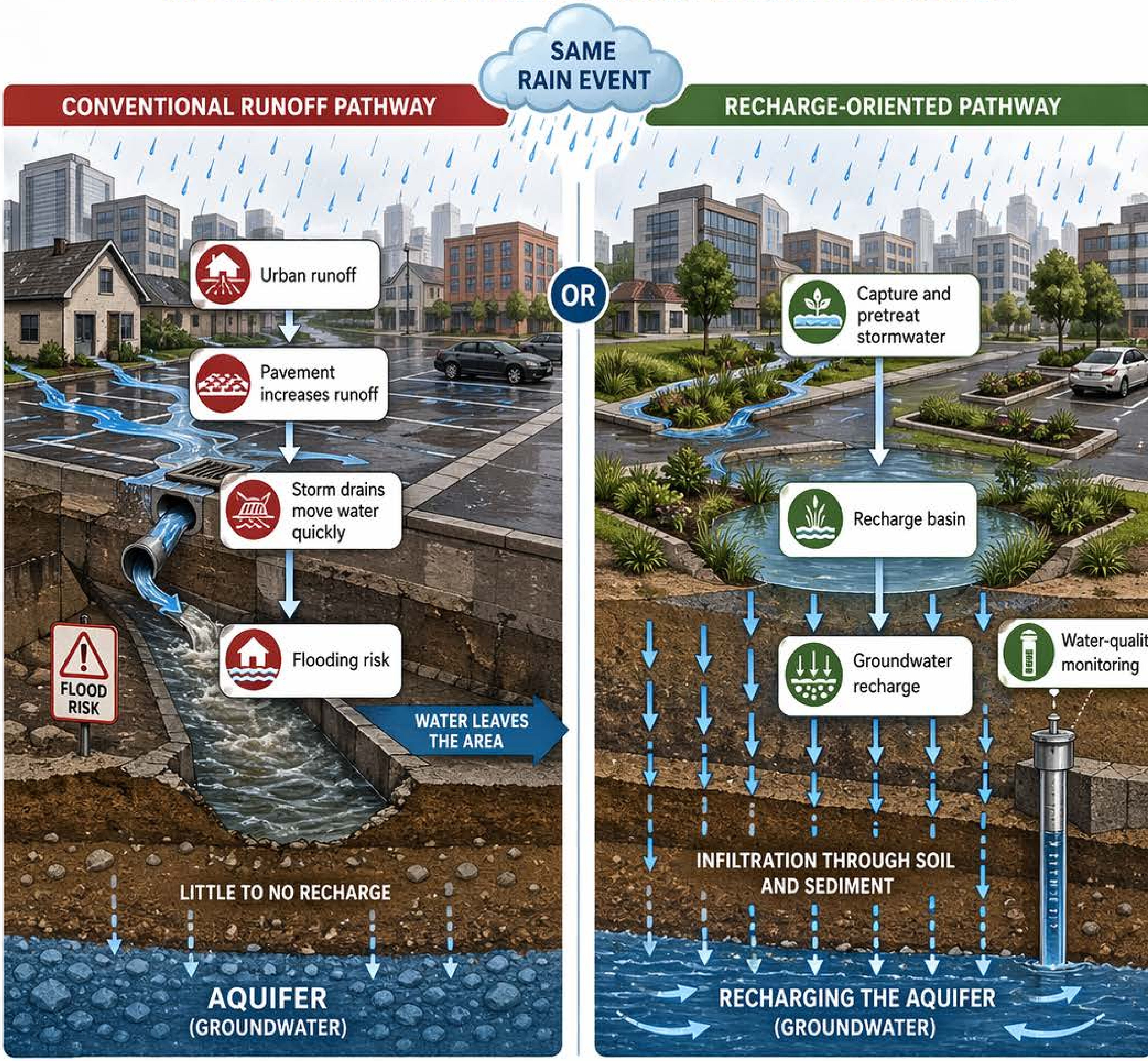
- - - **Target storage level**
Plan for the future.

- - - **Minimum safe level**
Do not go below.

Policy takeaway: Water banking requires both underground storage and clear rules for accounting, ownership, recovery, and limits.

Why Recharge Is Also Stormwater Policy

THE SAME RAINFALL. DIFFERENT CHOICES. DIFFERENT OUTCOMES.



Conventional runoff pathway

- Faster runoff
- More flood stress
- Water leaves the area

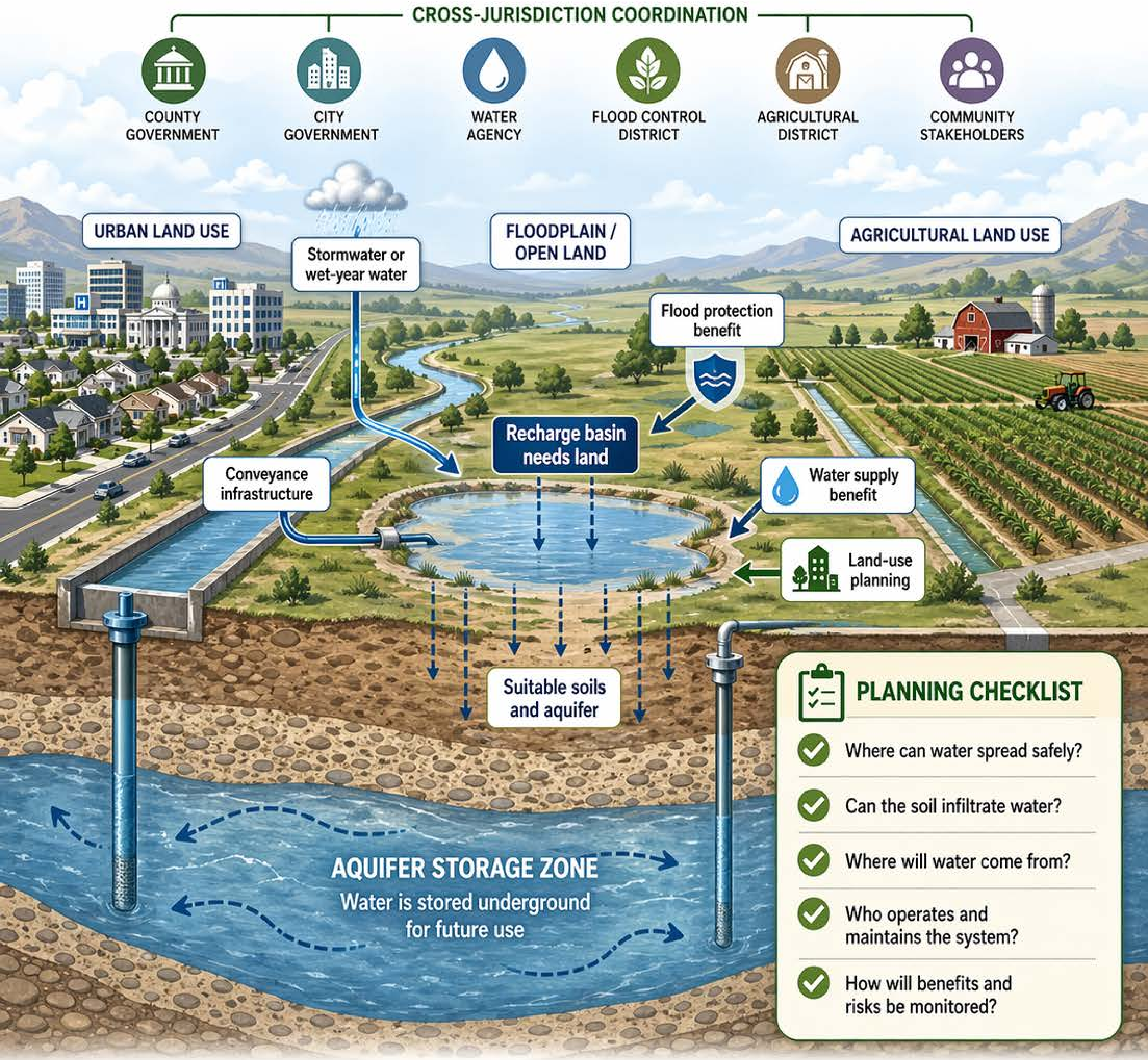
Recharge-oriented pathway

- Capture stormwater
- Reduce peak runoff
- Recharge groundwater where suitable

Policy takeaway: Stormwater policy can also be groundwater policy when runoff is captured, treated, and recharged safely.

How MAR Connects Water Supply, Flood Protection, and Land-Use Planning

Managed Aquifer Recharge (MAR) works best when water supply, flood management, and land-use planning are coordinated together.



Policy takeaway: MAR projects work best when water supply, flood management, and land-use decisions are planned together.

Why Governance Matters as Much as Geology

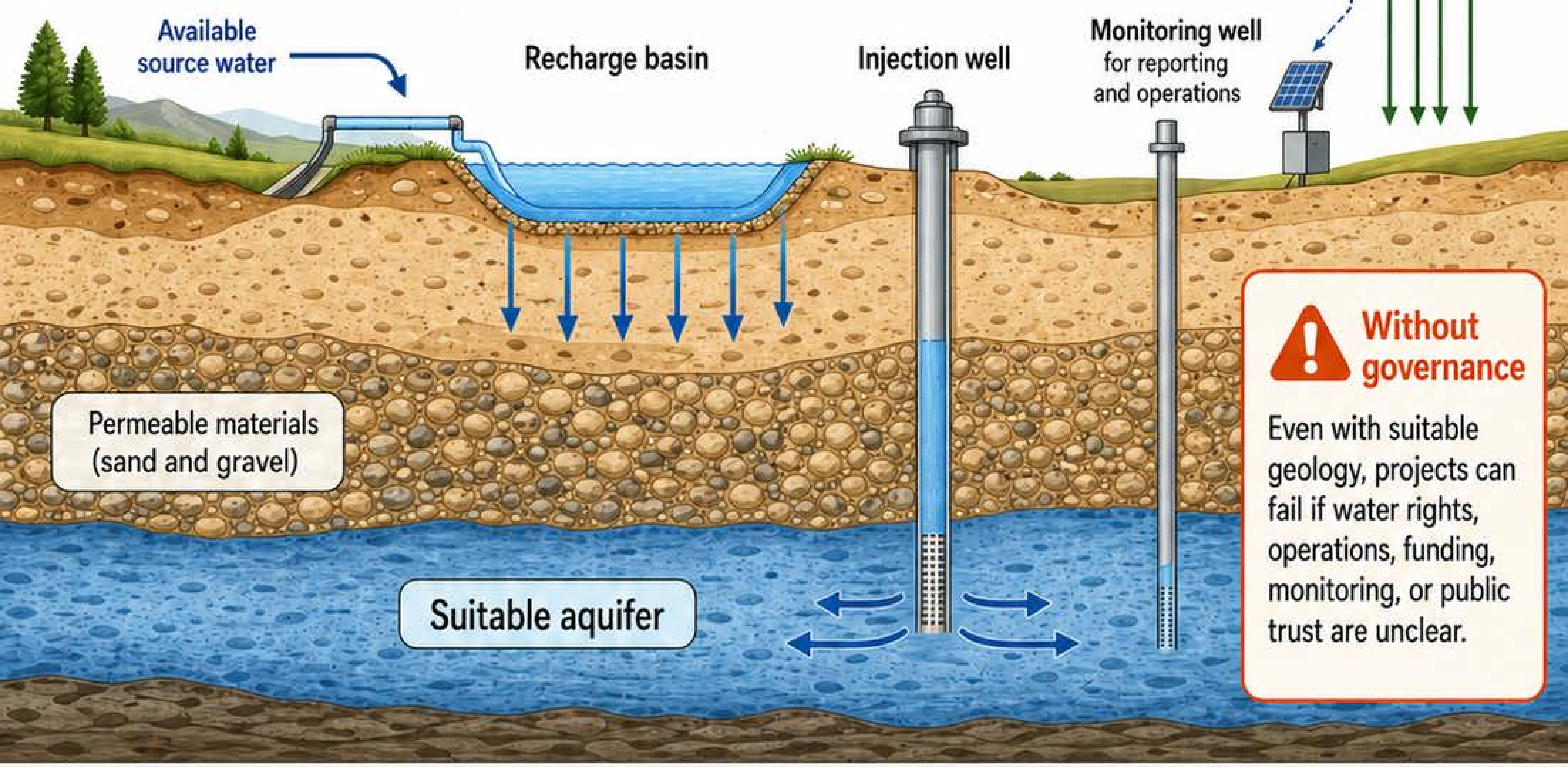
Managed aquifer recharge (MAR) depends on both subsurface conditions and human systems: rules, funding, water rights, monitoring, operations, accountability, and public trust.

Geology makes recharge possible

- Suitable aquifer
- Permeable materials
- Storage capacity
- Recoverable water
- Available source water

Governance makes recharge workable

- Water rights
- Operating rules
- Funding and maintenance
- Monitoring and reporting
- Public trust
- Agency coordination



Policy takeaway: *Geology determines whether recharge can work;* governance determines whether it will work over time.