Ground Water-Surface Water Interactions and Public Water Supplies: Two Case Studies

Presented by:

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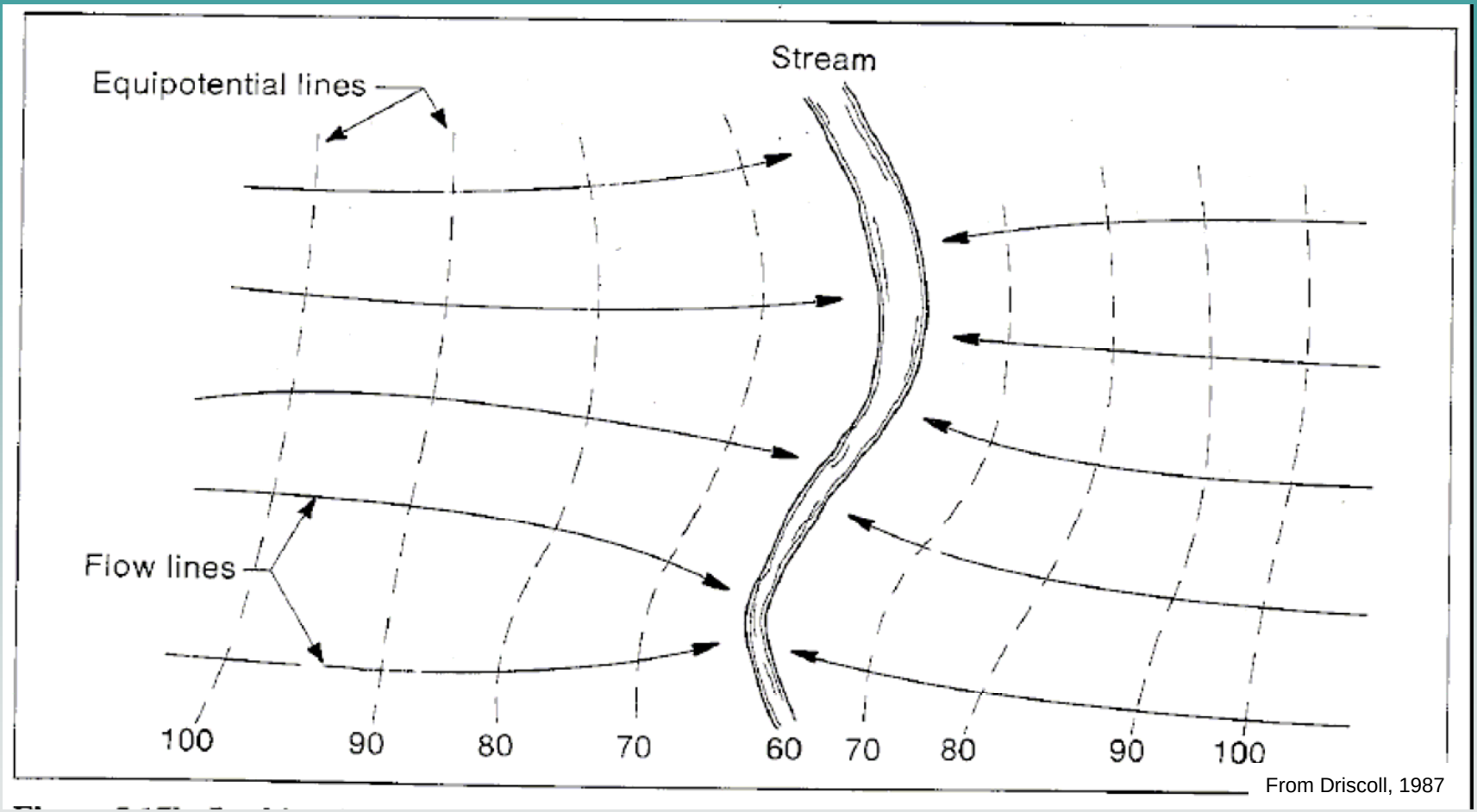
Introduction

- Ground water and surface water resources can be closely interrelated
- Ground water withdrawal can affect surface water and vice versa
- Two public ground water supplies (Kingfield and Rangeley Water Districts) serve as good examples

Technical Review

- I will be talking about ground water in overburden (soil) only.
- Rivers are the surface water focus here, but concepts apply to ponds and lakes as well.
- The water table is the surface below which the soil is completely saturated with water.
- In Maine, the water table is:
  - Always sloped, meaning ground water is always flowing
  - Flow is usually in the same direction of the land slope

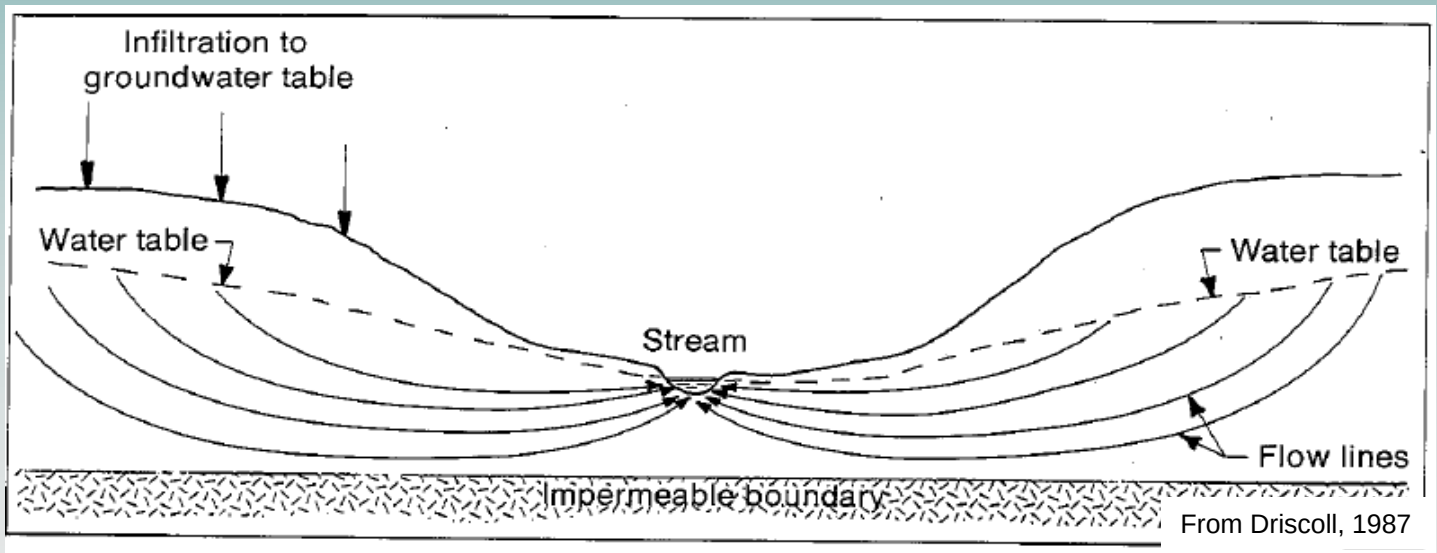
Technical Review (cont.)



From Driscoll, 1987

Technical Review (cont.)

- All ground water eventually discharges into surface water through the sides and/or bottom of rivers, ponds, lakes, or the ocean.

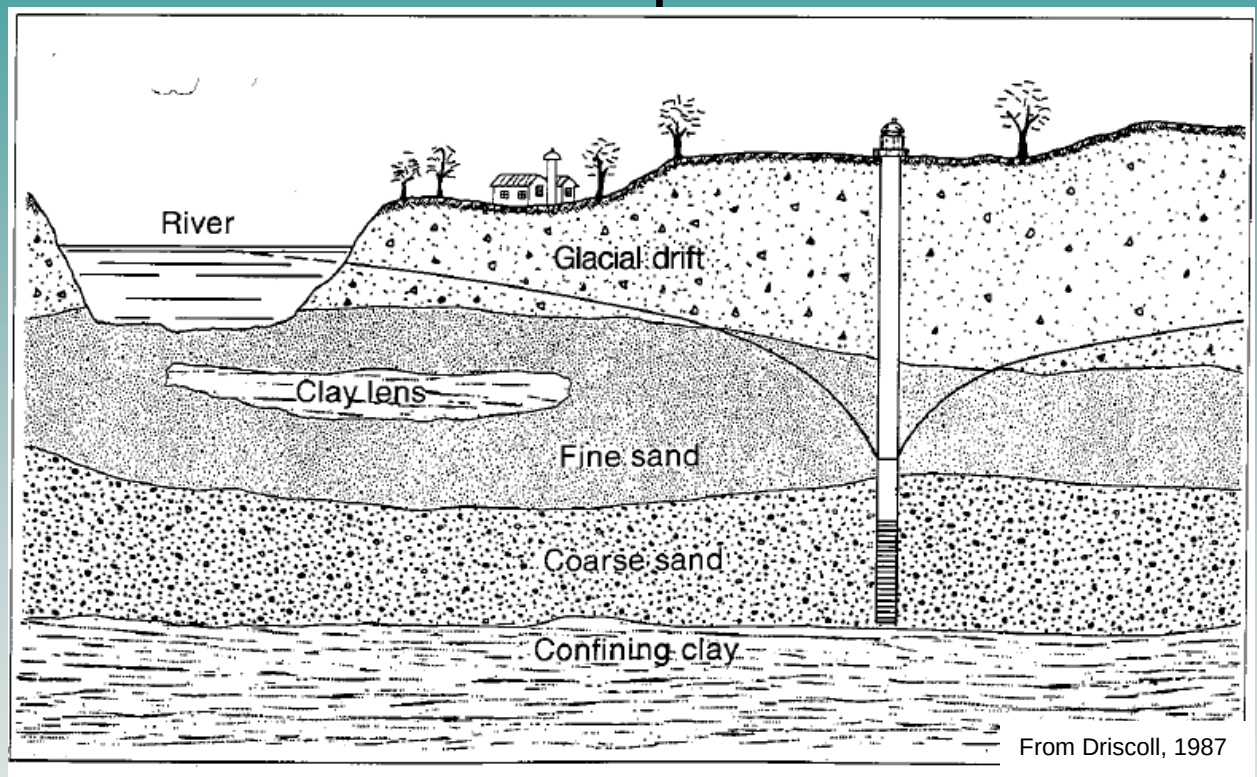


Technical Review (cont.)

- Rivers that receive ground water are called “gaining rivers”.
- But some rivers can naturally contribute water to aquifers (“losing rivers”):
  - When high flow conditions exist and a river is above its banks.
  - When a river flows from a low permeability soil (clay) onto a high permeability soil (sand). The river can switch from gaining to losing.

Technical Review (cont.)

- Pumping a well can also induce flow from surface water to an aquifer.



From Driscoll, 1987

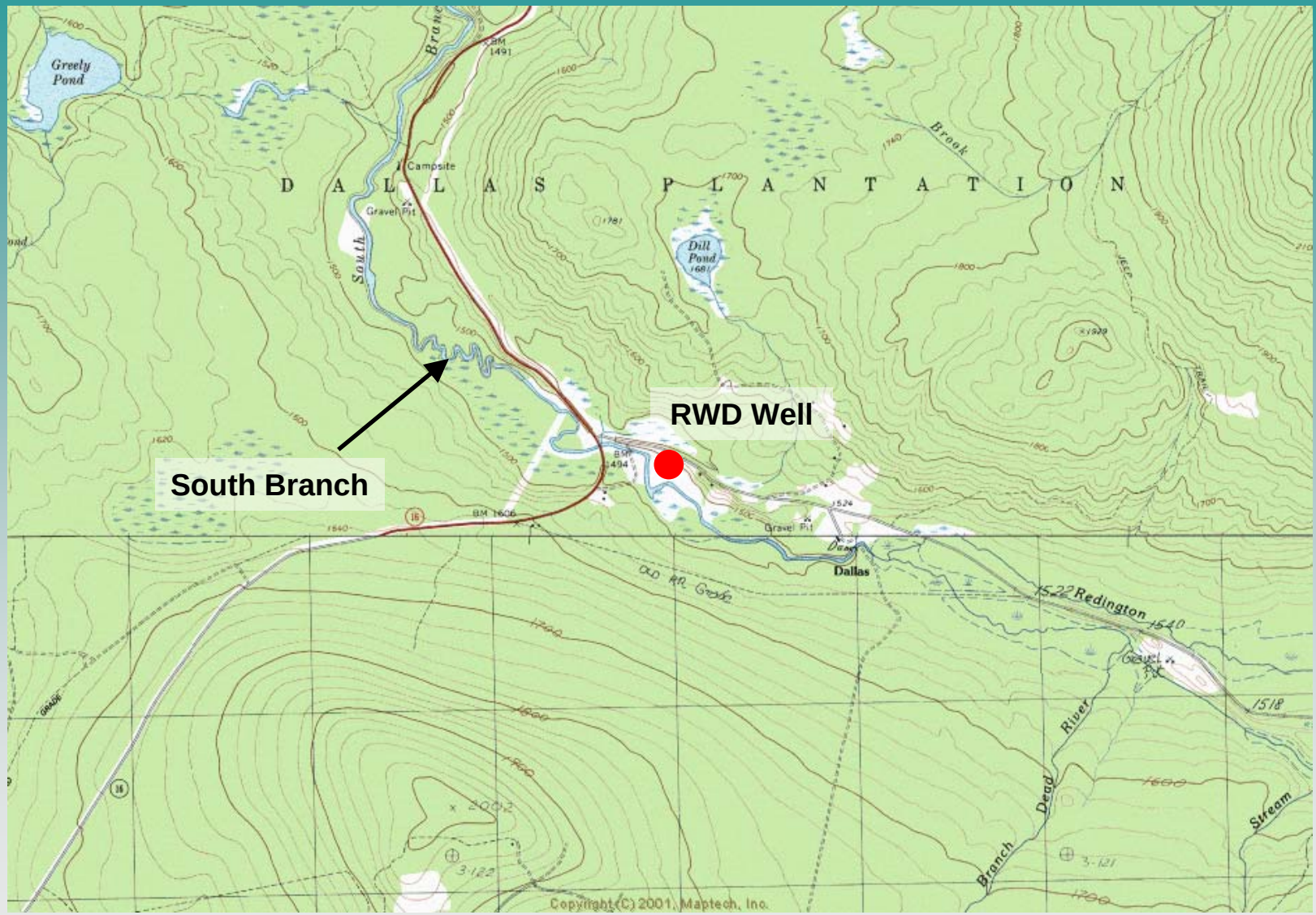
- We can predict how much water a well receives from surface water.

Case Studies

Rangeley Water District

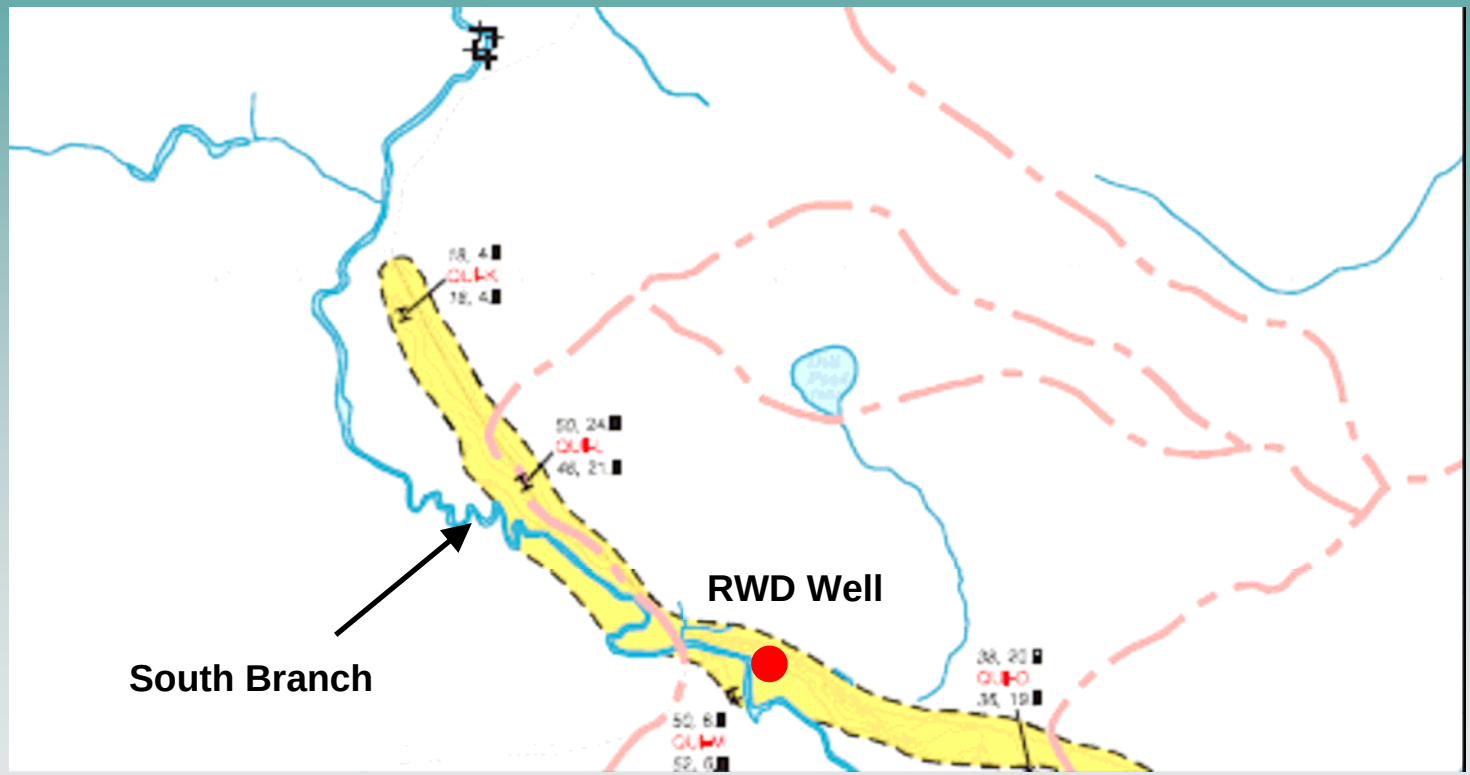
- Serves 965 in Rangeley area from a well drilled in 1995. Well is in Dallas Plt. northeast of town.
- When pumping, rate is 250 gpm for about 80,000 gallons per day (60 gpm annual average).
- Well located within 200 feet of the South Branch of the Dead River (South Branch).

Case Studies: RWD



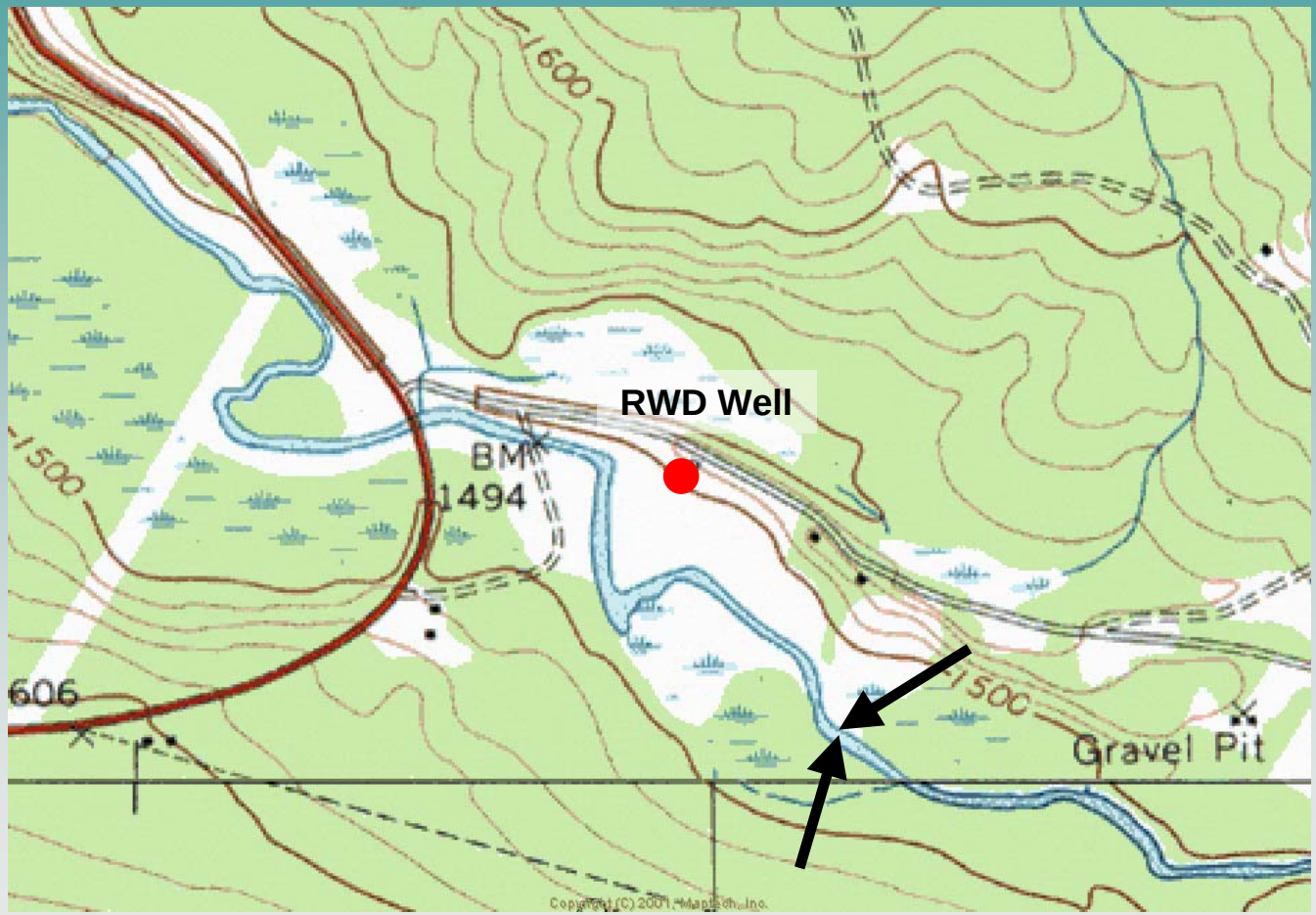
Case Studies: RWD

- South Branch valley filled with 50 to 70 feet of sand and gravel. Very narrow aquifer.



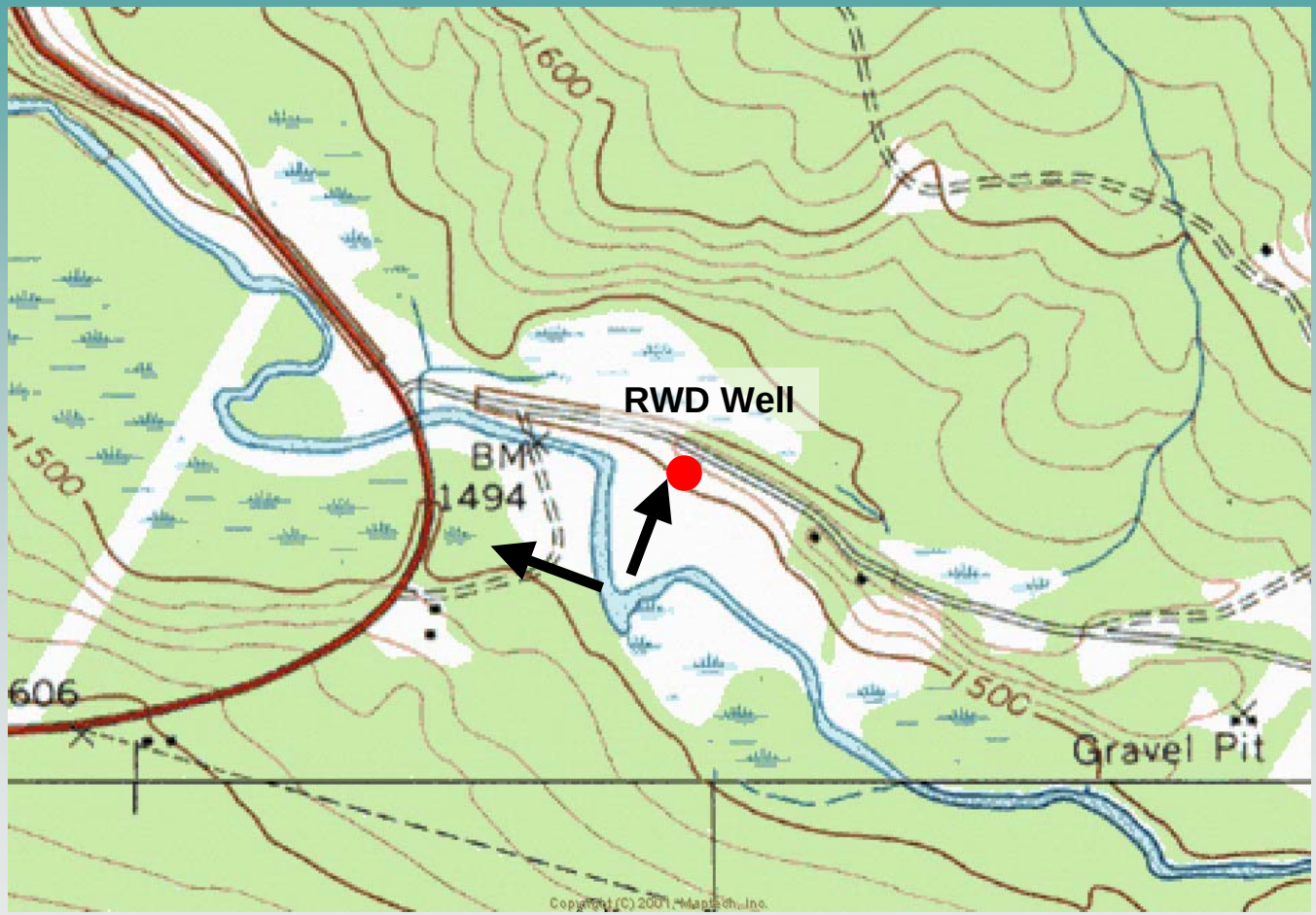
Case Studies: RWD

- Ground water flow follows topography and generally discharges to river.



Case Studies: RWD

- But river near well is probably “losing” flow to the aquifer based on well elevations.



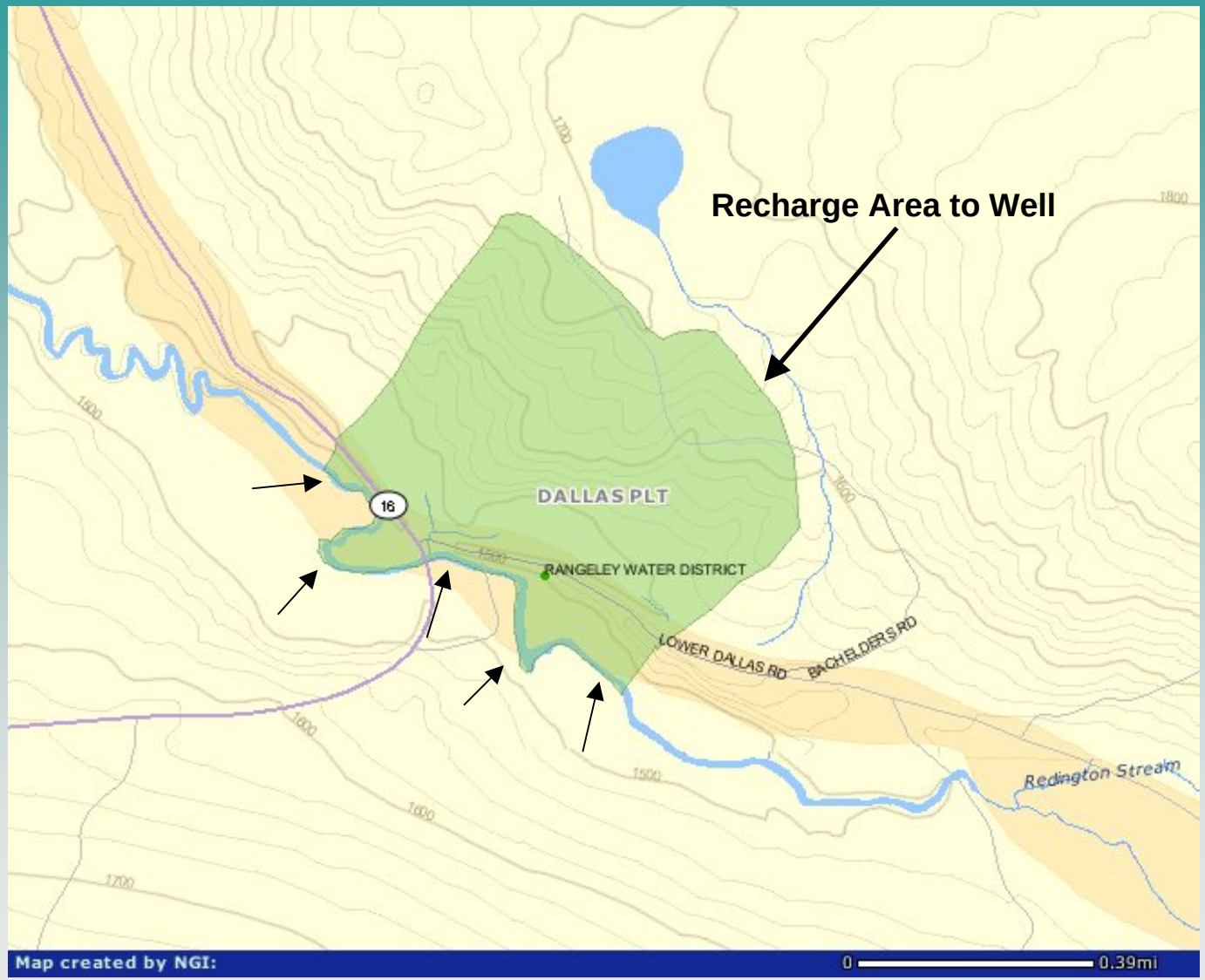
Case Studies: RWD

- The fact that the river is losing flow suggests some of it is captured by the well.
- How much? Not known.
- Stream flow in July 2005 (low flow):

  14 cfs = 6,300 gpm

- A pumping rate of 250 gpm equals only 0.6 cfs or about 4% of the river flow (pumping is only part-time).
- This assumes that 100% of the well recharge comes from the stream, which is not possible.

Case Studies: RWD



Case Studies: RWD

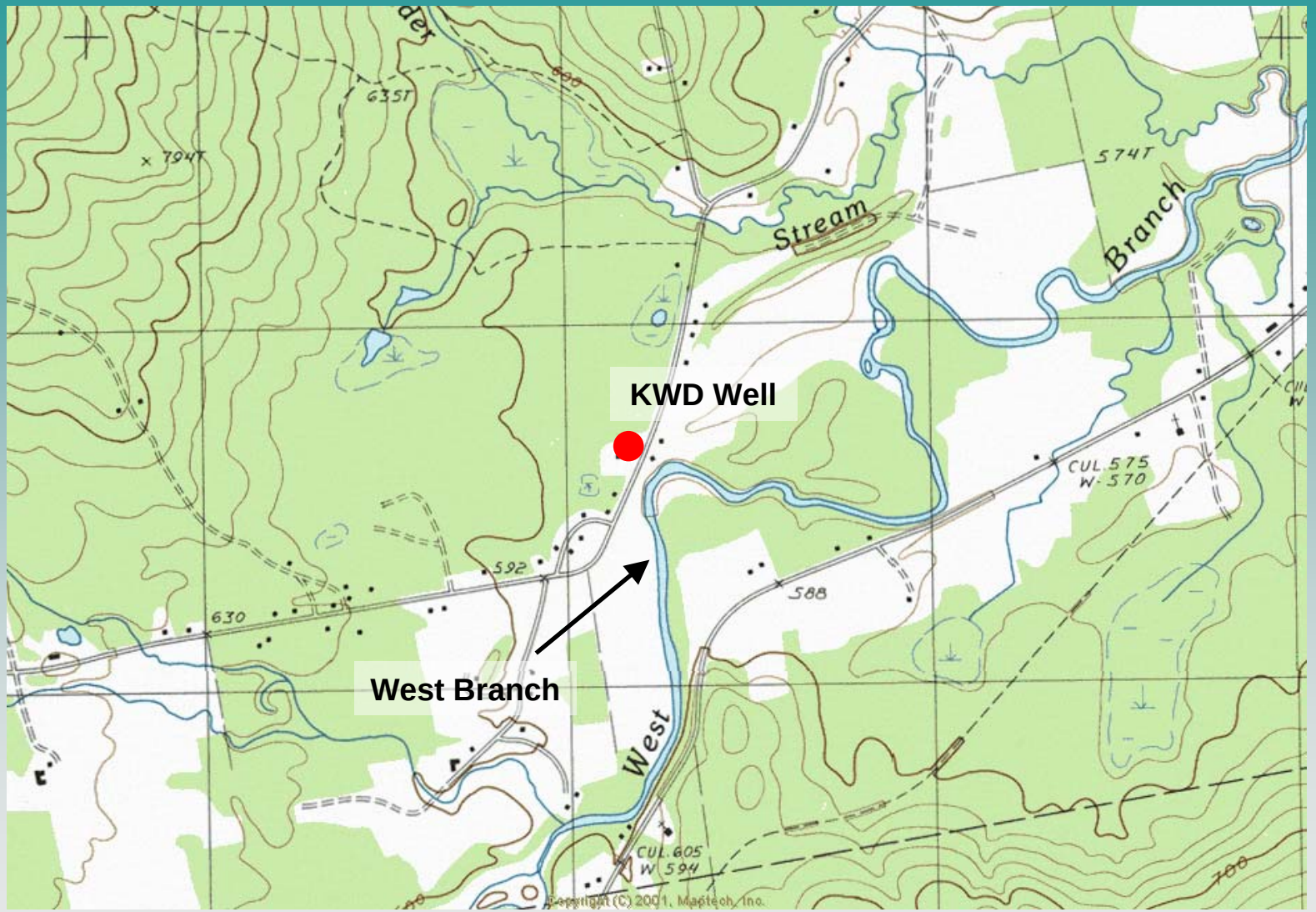
- LURC permit restricts RWD withdrawal to 224 gpm (0.5 cfs) if the river flow is at or below 17 cfs.
- 17 cfs represents a hypothetical summer low flow condition based on basin size.
- Maintaining a minimum flow is protective of river ecosystem.
- New data suggests river flow goes below this volume naturally (14 vs.17 cfs).
- Could RWD withdrawal significantly affect river flow?

Case Studies: KWD

Kingfield Water District

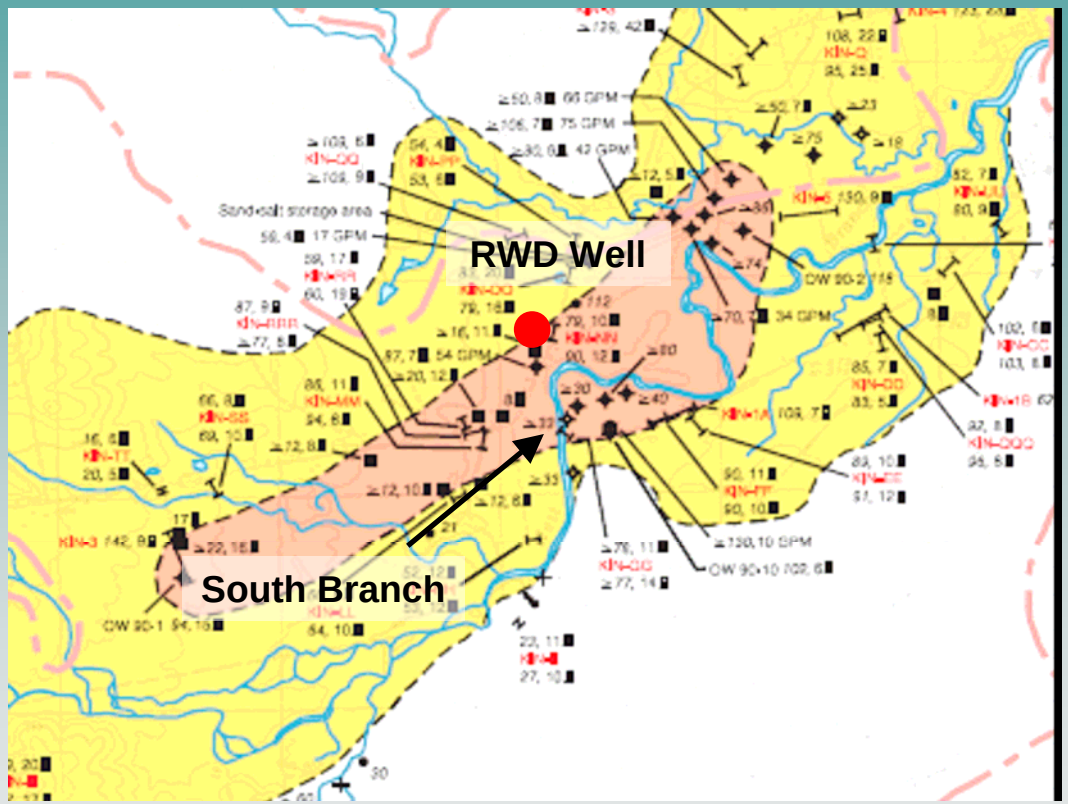
- Serves 1,000 in Kingfield from a well drilled in 1994. Well is in valley west of Town.
- When pumping, rate is 275 gpm for about 65,000 gallons per day (45 gpm annual average).
- Well located within 300 feet of the West Branch of the Carrabassett River (West Branch).

Case Studies: KWD



Case Studies: KWD

- South Branch valley filled with over 100 feet of sand and gravel. Much bigger than Rangeley.



Case Studies: KWD

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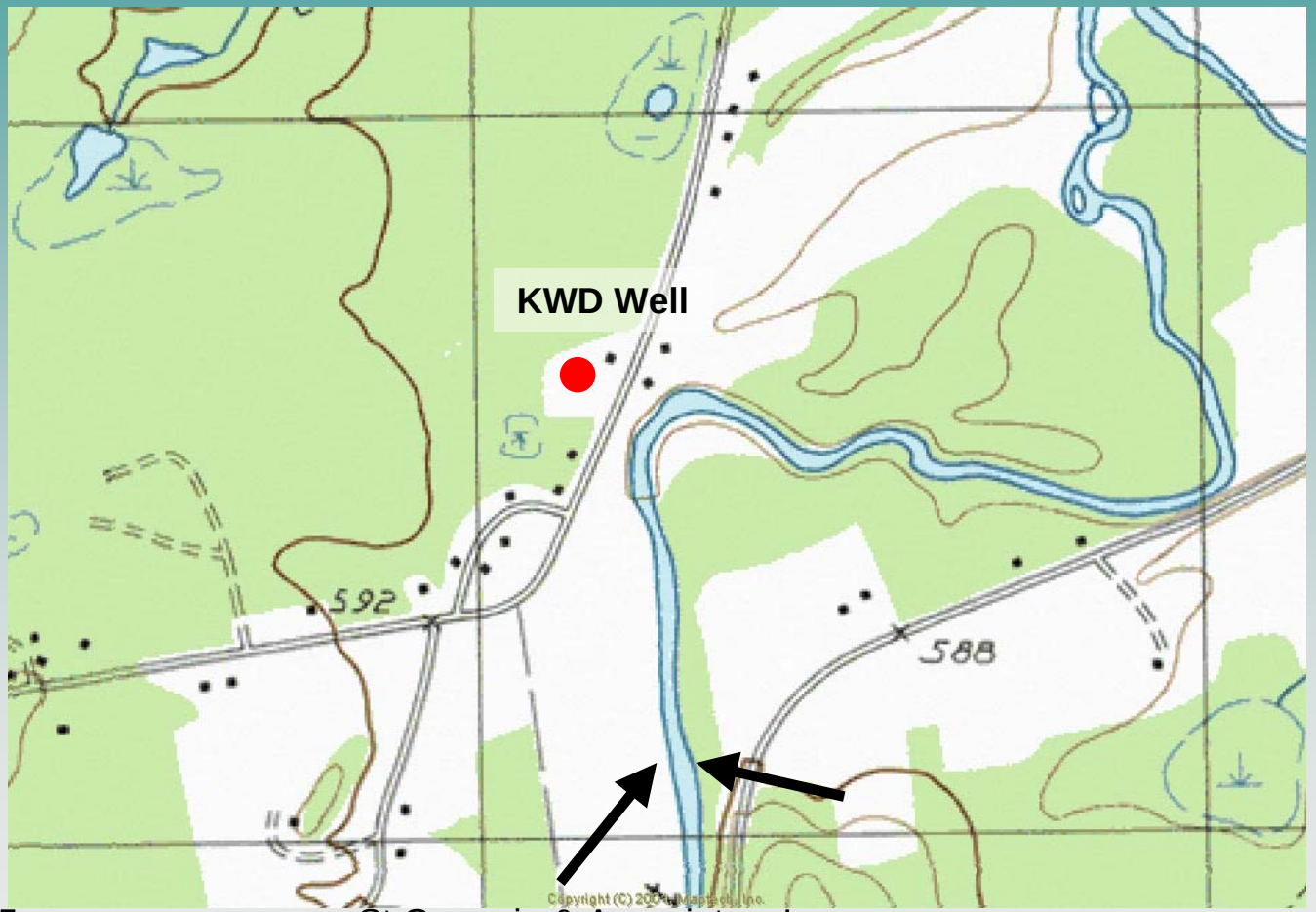
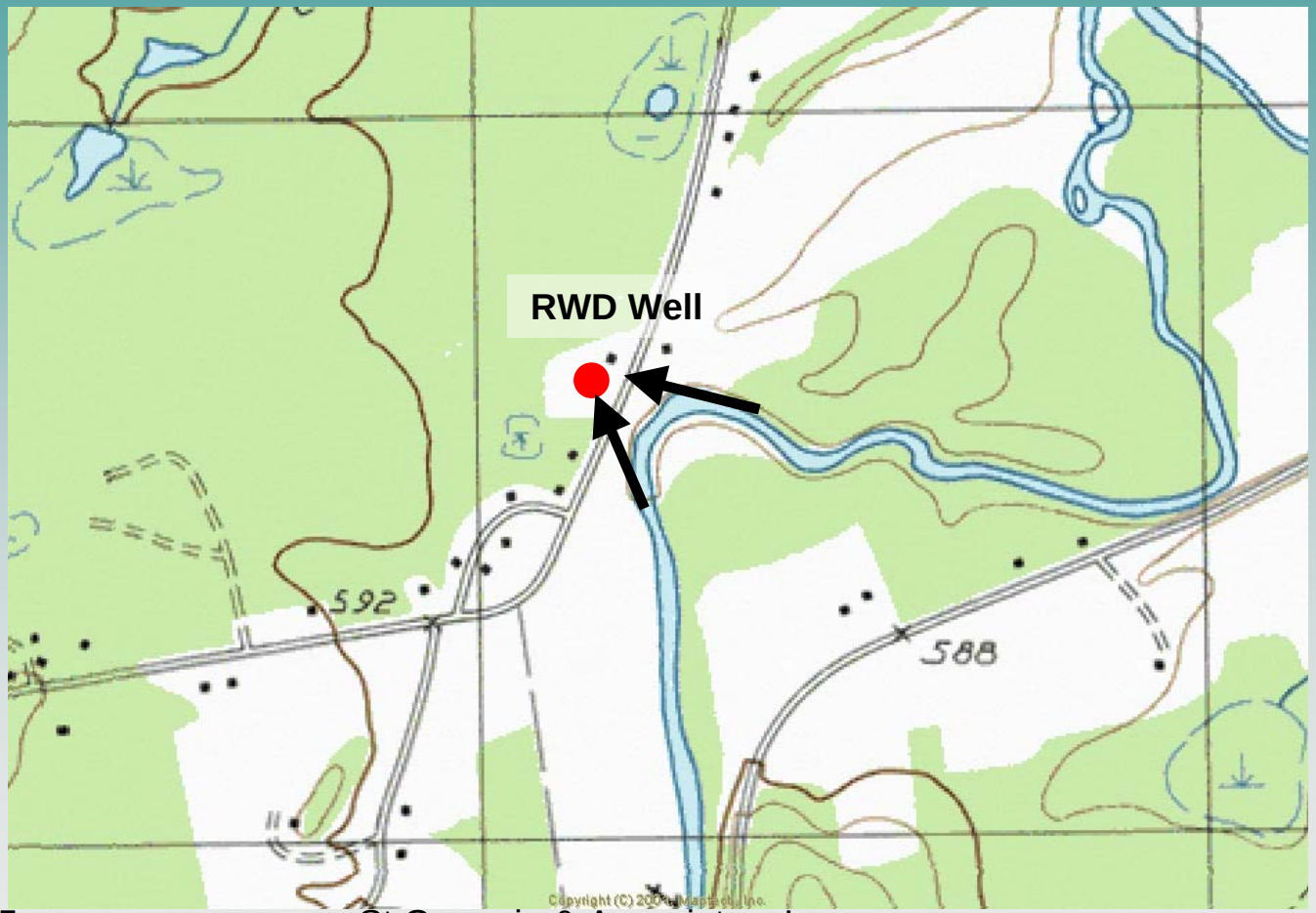


Case Studies: KWD

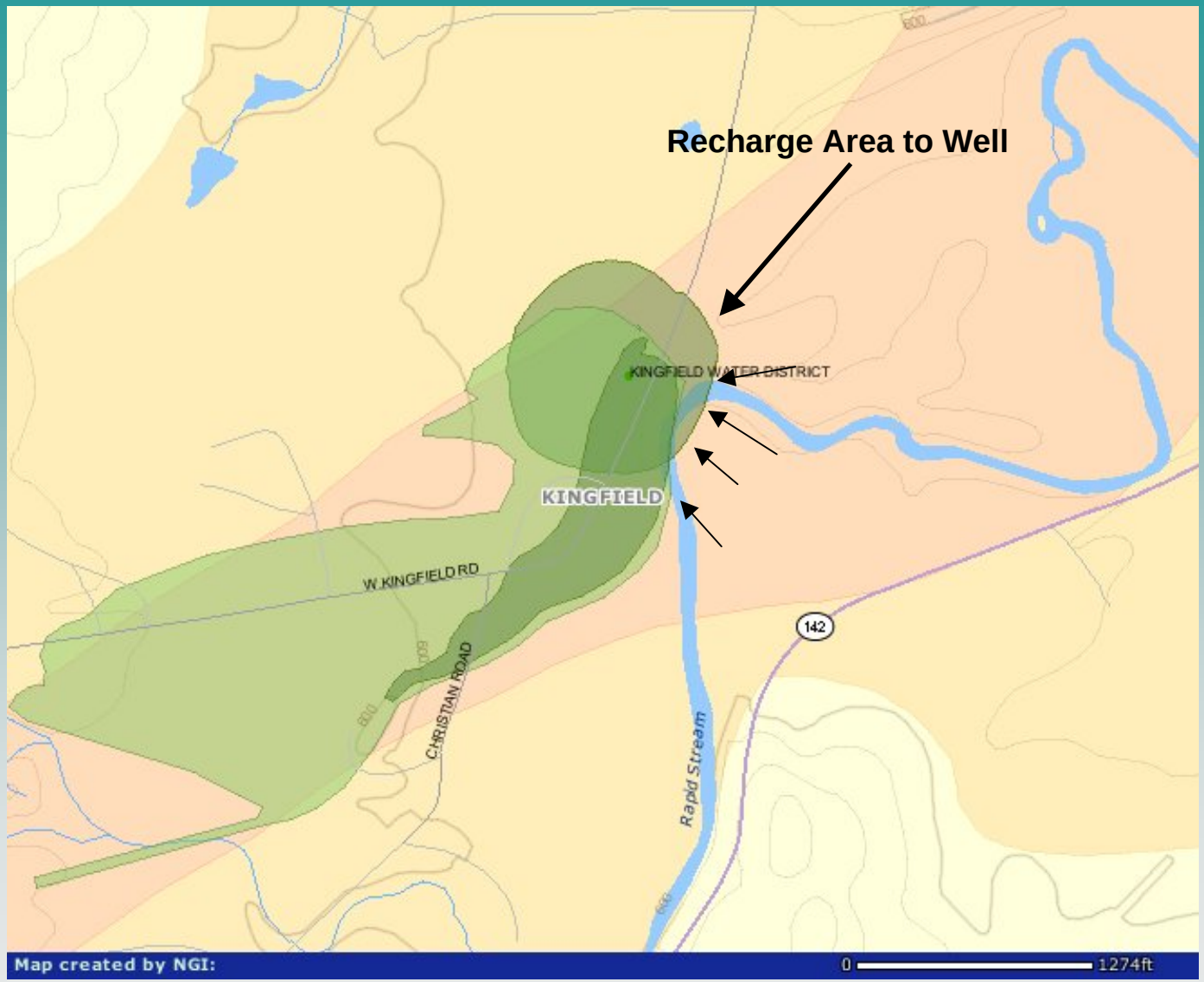
- But river near well is “losing” flow to the aquifer due to well pumping based on calculations.



Case Studies: KWD

- According to calculations, 50-60% of water entering the well is from the river.
- With a pumping rate of 275 gpm, 50% = 0.3 cfs from river (pumping is only part time).
- River flow is not known but this likely represents a small percentage of it.

Case Studies: KWD



Case Studies: KWD

- KWD “withdrawal” from river currently not regulated.
- DEP is working on surface water withdrawal regulations that include reference to ground water:

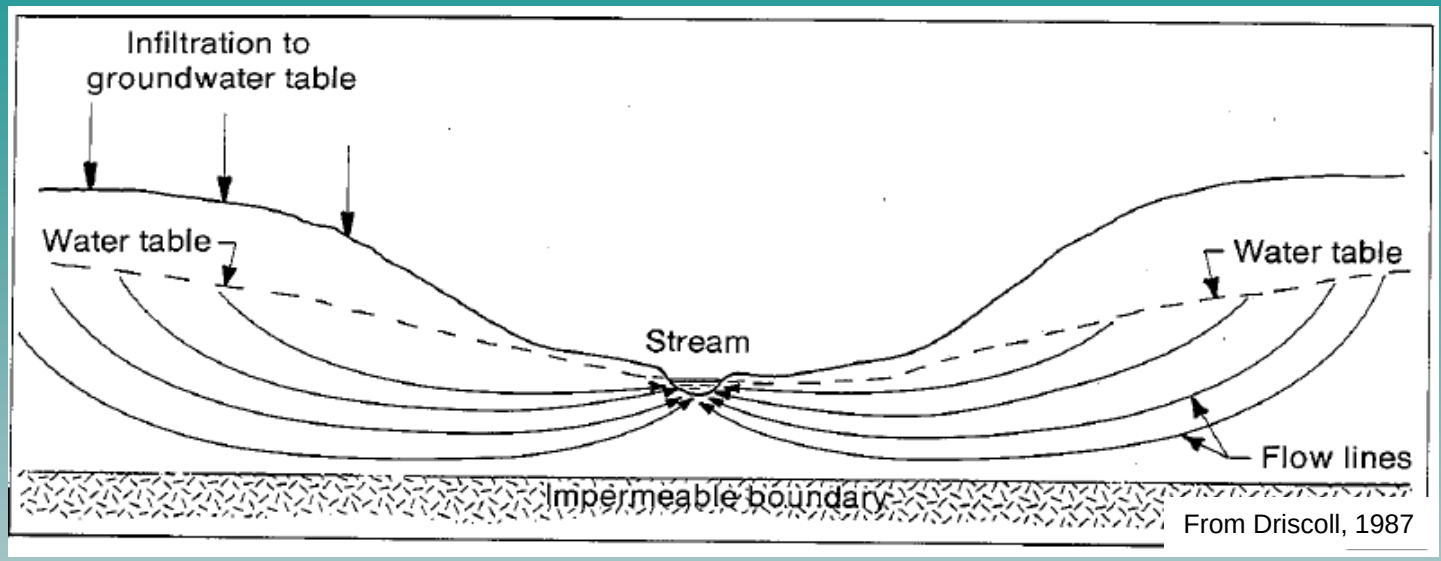
[Draft] Ch. 587-B.4. Flow standards for Class A, B, and C waters. Water flow in Class A, B, or C waters must be sufficient to protect all water quality standards…

Withdrawal…or other direct or indirect removal (e.g. groundwater extraction)…that causes the natural flow to be altered shall occur as provided below…

Conclusions

- Ground water system closely tied to surface water.
- Withdrawals from one resource could affect the other.
- River flow and pond/lake volumes normally much greater than ground water withdrawal volumes.
- But high ground water withdrawal rates close to small streams could take significant quantities of flow.

Conclusions



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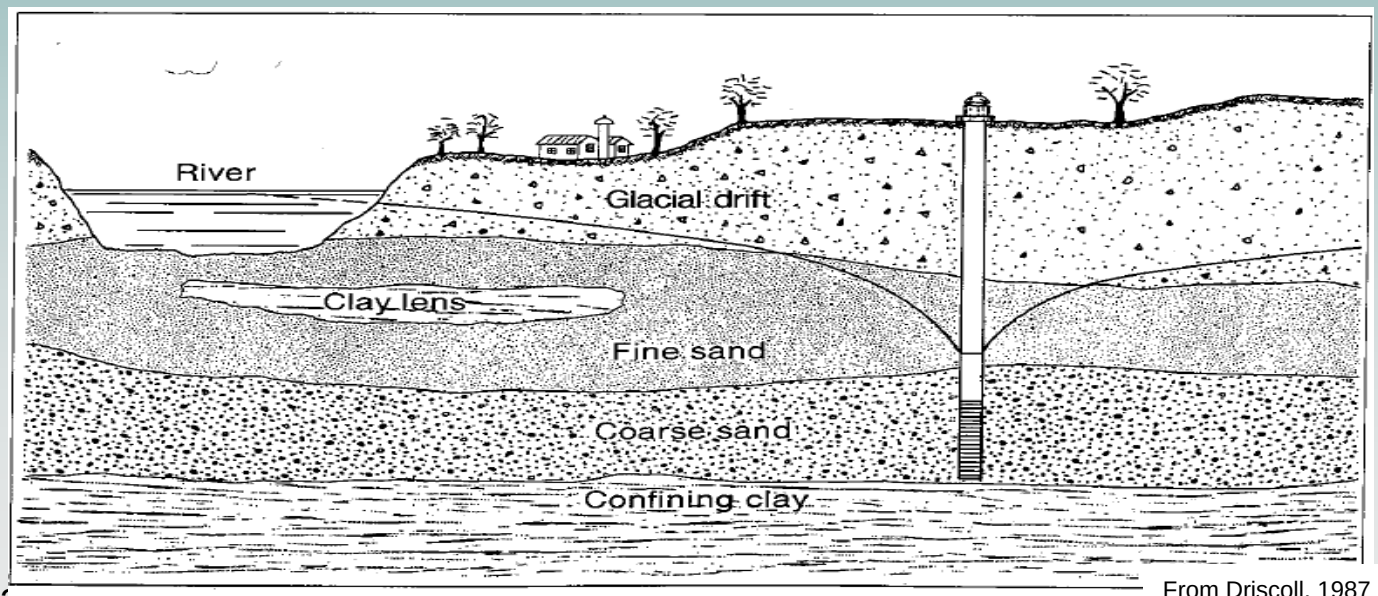

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