TCAAP Groundwater Flow and Transport Model Intro

March 15, 2022
RAB Meeting

USGS Upper Midwest

Groundwater Modeling Team

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Who We Are

- Federal science agency that collects, monitors, analyzes, and provides scientific understanding of natural resource conditions, issues, and problems in an unbiased manner.

- The groundwater modeling team for this project is in MN, WI, and MI with combined decades of experience modeling groundwater at a range of scales.

- Our work is published in publicly available data releases + reports

Why make a model of TCAAP?

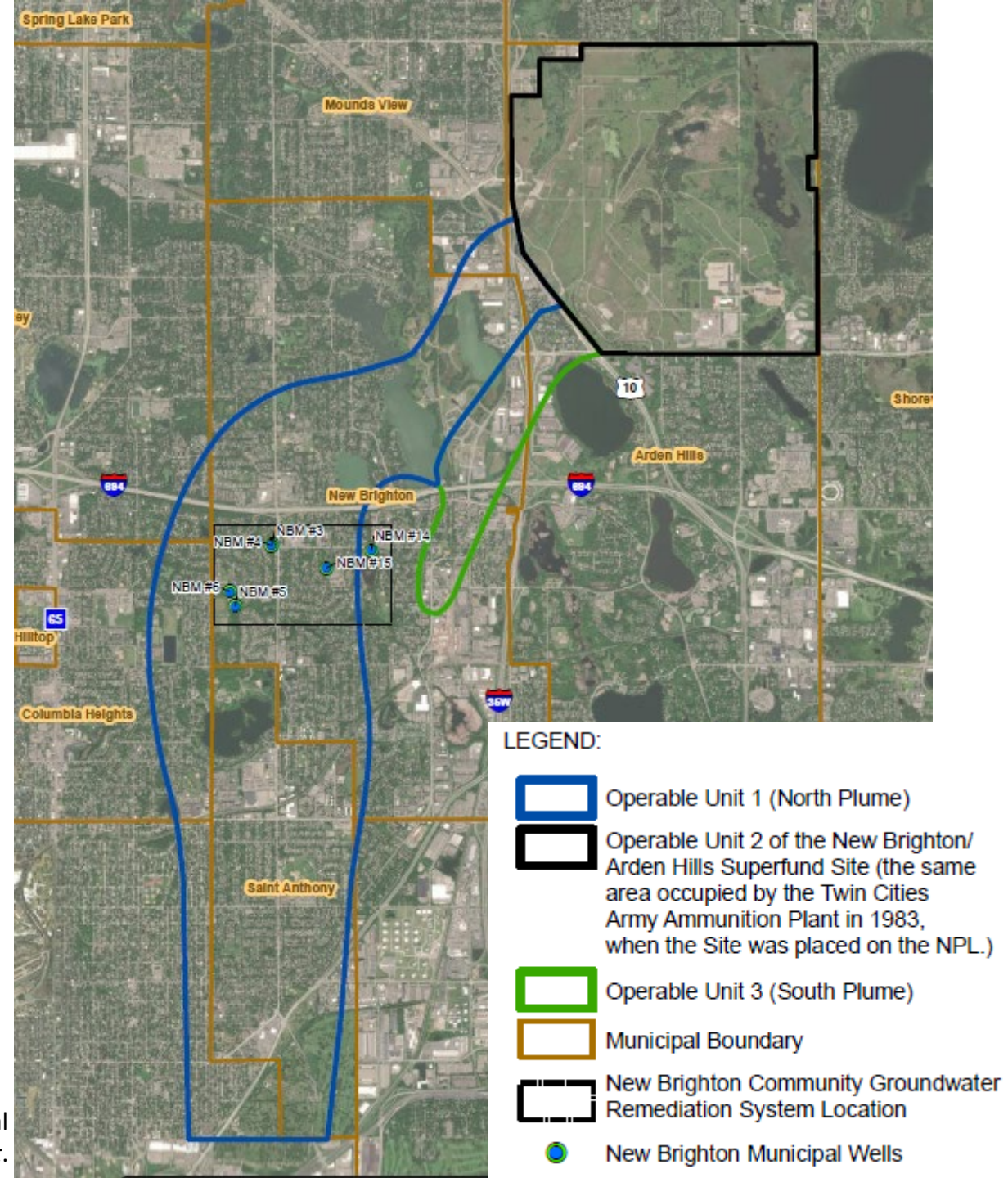ASSIMILATE THE VAST AMOUNT OF DATA THAT HAVE BEEN COLLECTED AT THE SITE

SIMULATE THE EXPECTED PLUME CAPTURE FROM THE NEW SOURCE GROUNDWATER RECOVERY SYSTEM (SGRS)

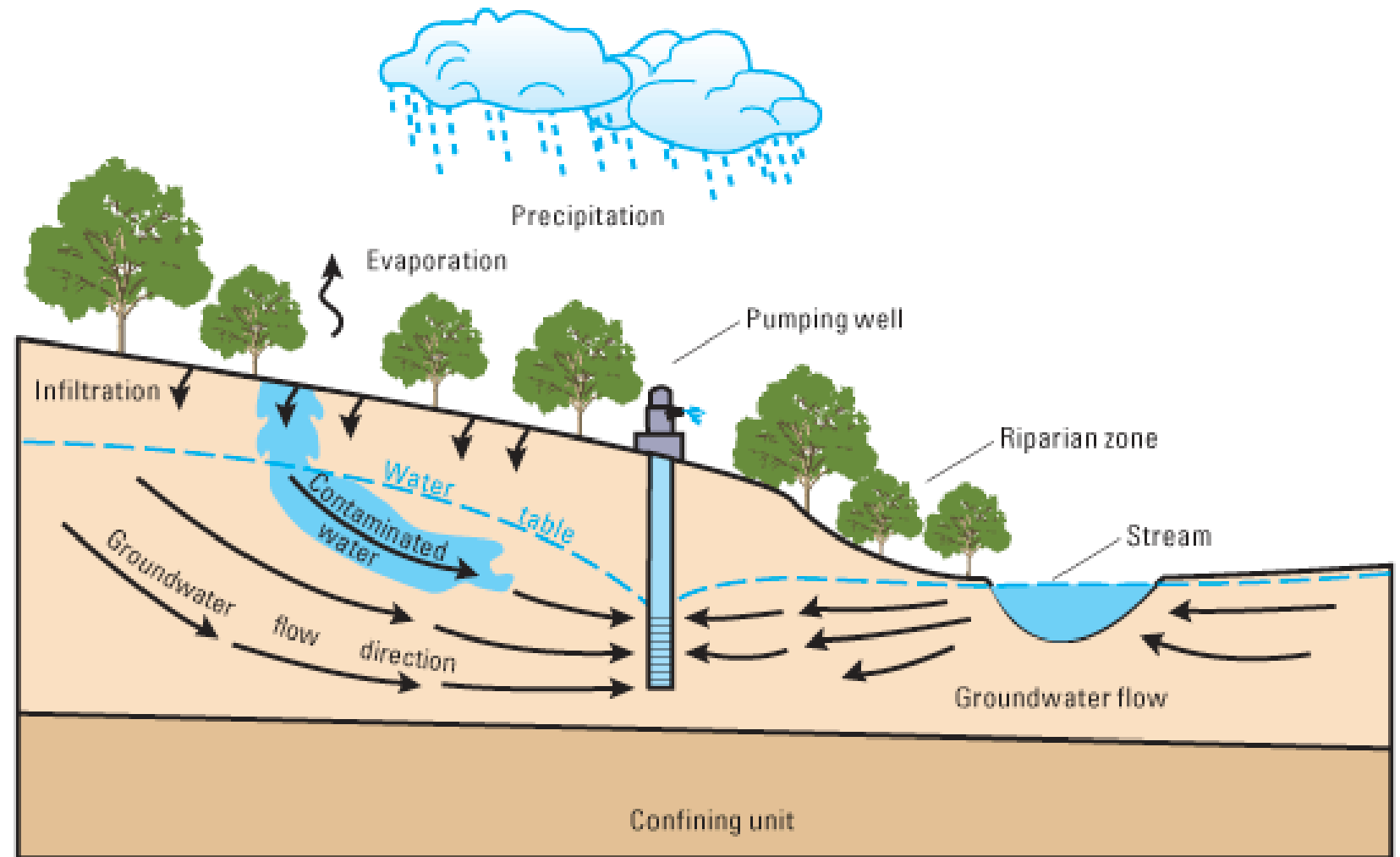UNDERSTAND THE PLUME BEHAVIOR OVER TIME + ANSWER QUESTIONS ABOUT THE GROUNDWATER SYSTEM IN THIS AREA

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Model Focus

- OU1, OU2, & OU3 groundwater plumes

- Contaminants
  - 1,4-dioxane
  - Trichloroethene (TCE)

LEGEND:

Operable Unit 1 (North Plume)

Operable Unit 2 of the New Brighton/ Arden Hills Superfund Site (the same area occupied by the Twin Cities Army Ammunition Plant in 1983, when the Site was placed on the NPL.)

Operable Unit 3 (South Plume)

Municipal Boundary

New Brighton Community Groundwater Remediation System Location

New Brighton Municipal Wells

Figure modified from Figure 2-1 in the Fiscal Year 2020 *Annual Performance Report*.

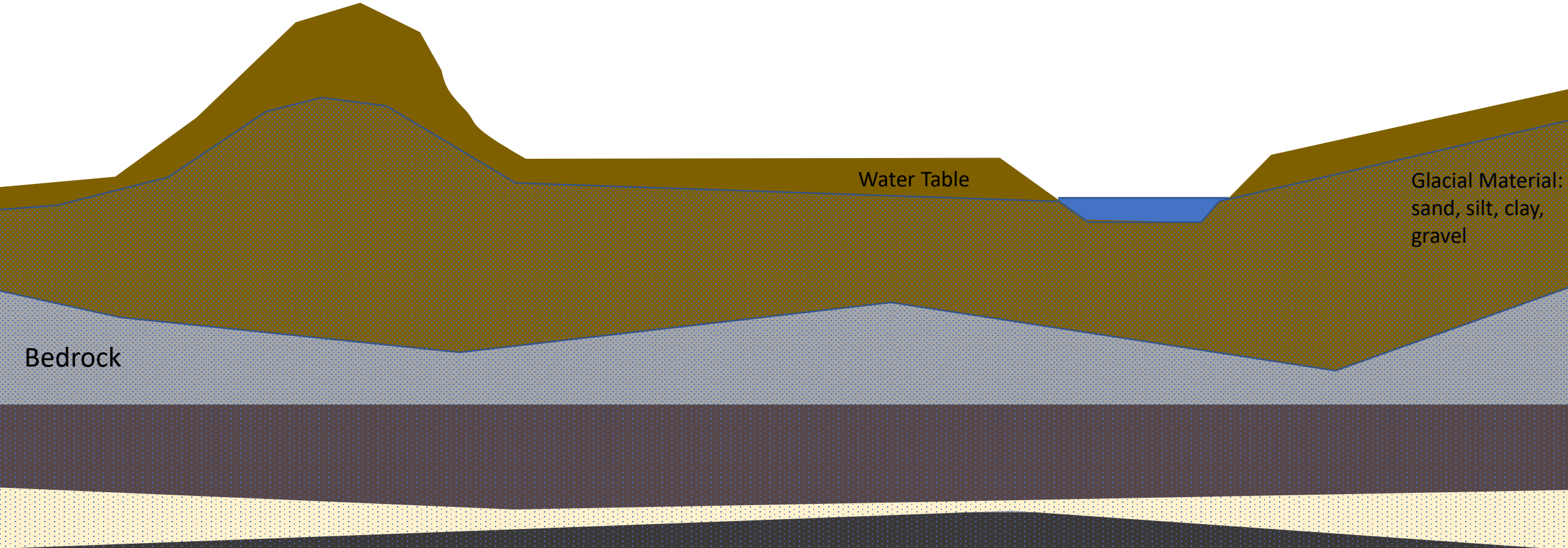USGS
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What is a groundwater flow + transport model?
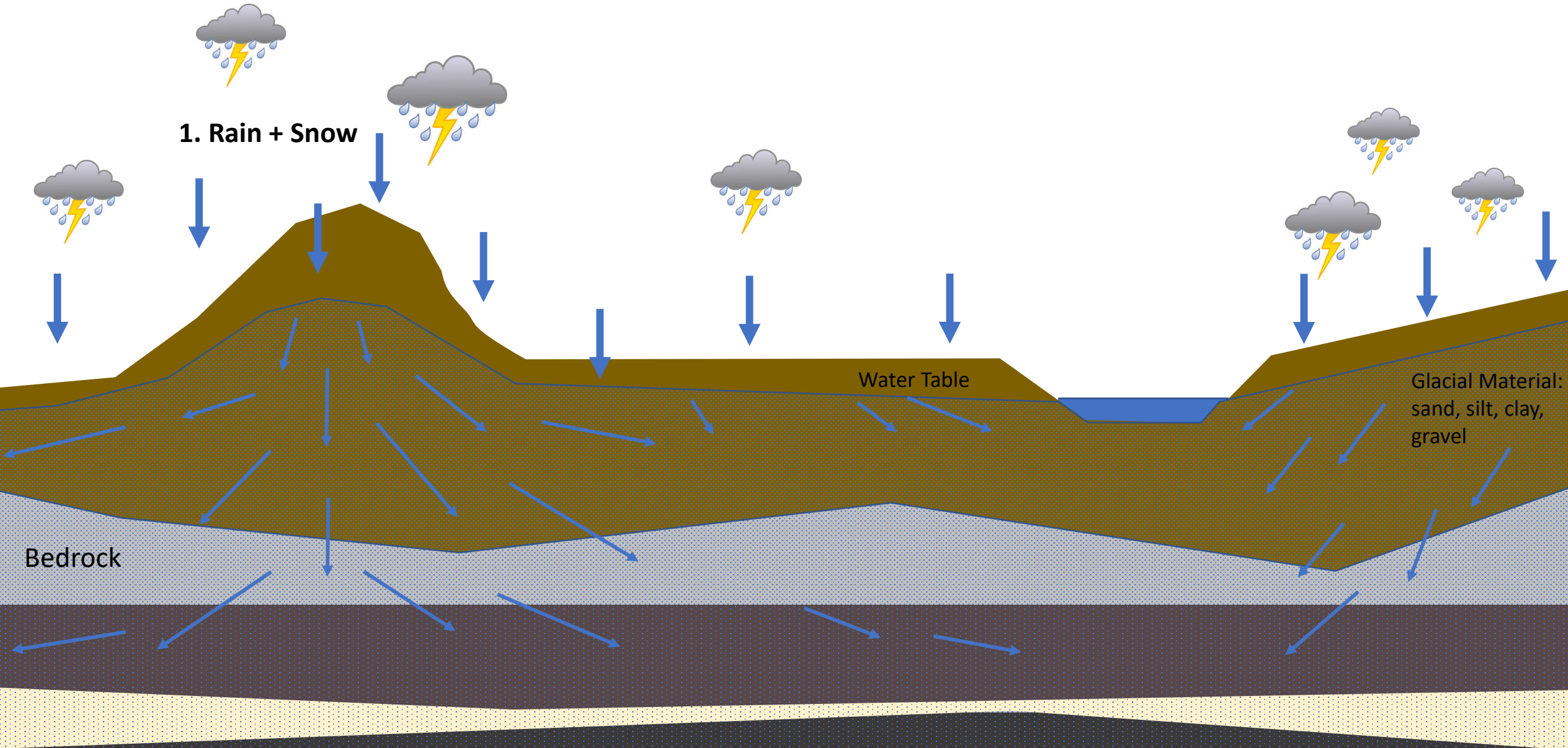
- <u>Groundwater flow:</u> the path water takes from where it enters the ground to where it exits the system.

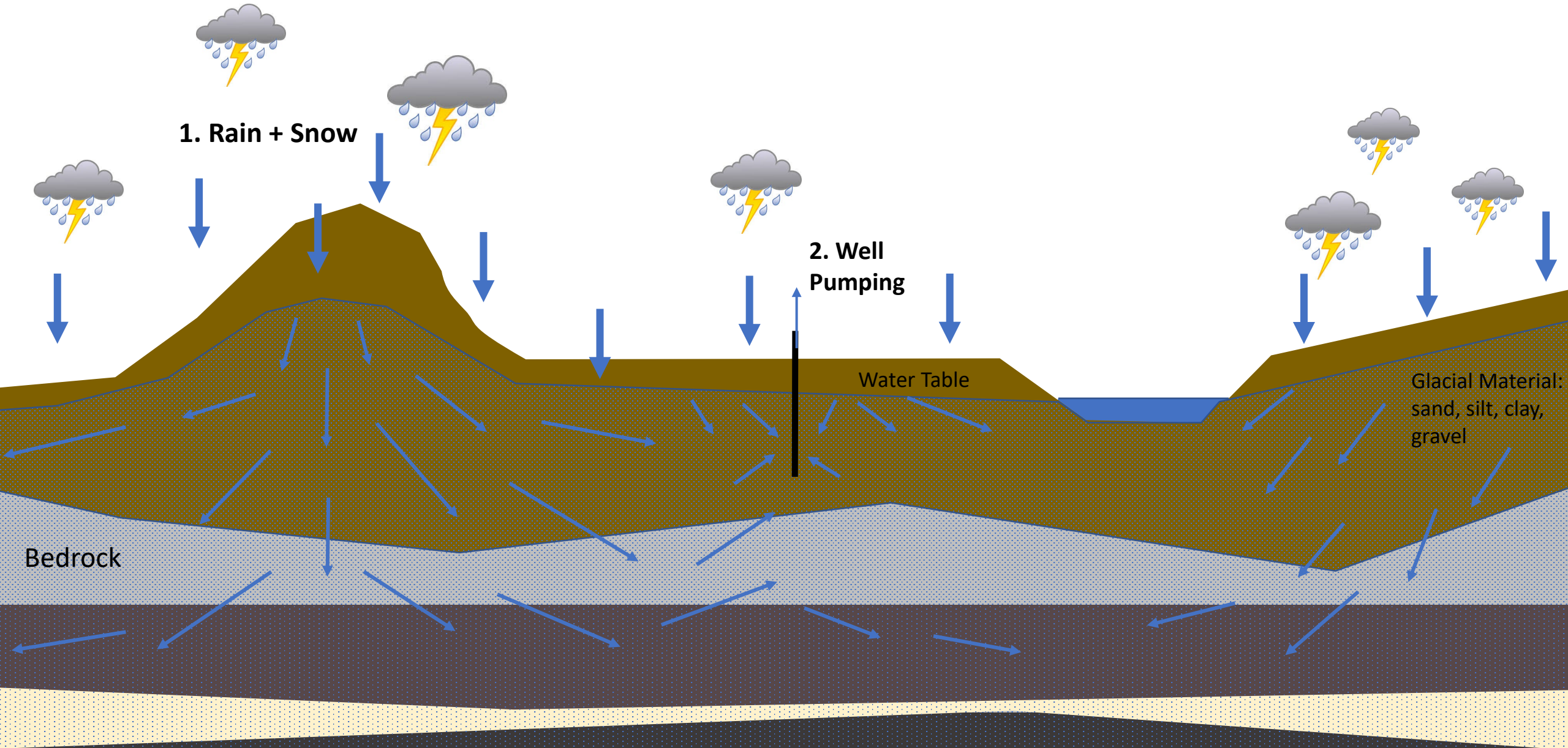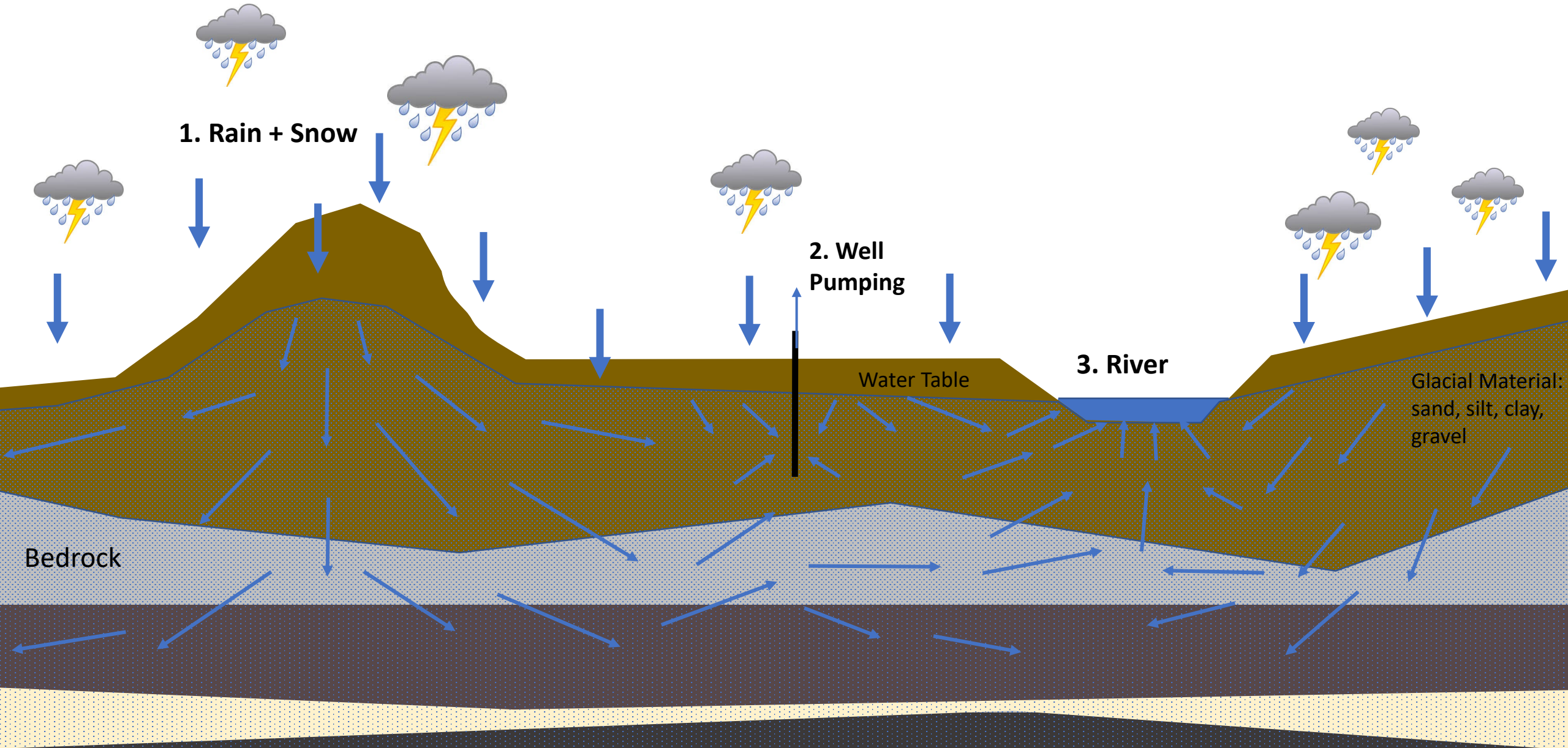- <u>Groundwater transport:</u> how a chemical moves with groundwater.

Precipitation

Evaporation

Pumping well

Infiltration

Water Table

Contaminated water

Riparian zone

Stream

Groundwater flow direction

Groundwater flow

Confining unit

https://pubs.usgs.gov/fs/2012/3004/

Groundwater Flow Schematic

Water Table

Glacial Material: sand, silt, clay, gravel

Bedrock

Groundwater Flow Schematic

1. Rain + Snow

Water Table

Glacial Material: sand, silt, clay, gravel

Bedrock

Groundwater Flow Schematic

Groundwater Flow Schematic

Groundwater Flow Schematic

1. Rain + Snow

2. Well Pumping

3. River

Water Table

Glacial Material: sand, silt, clay, gravel

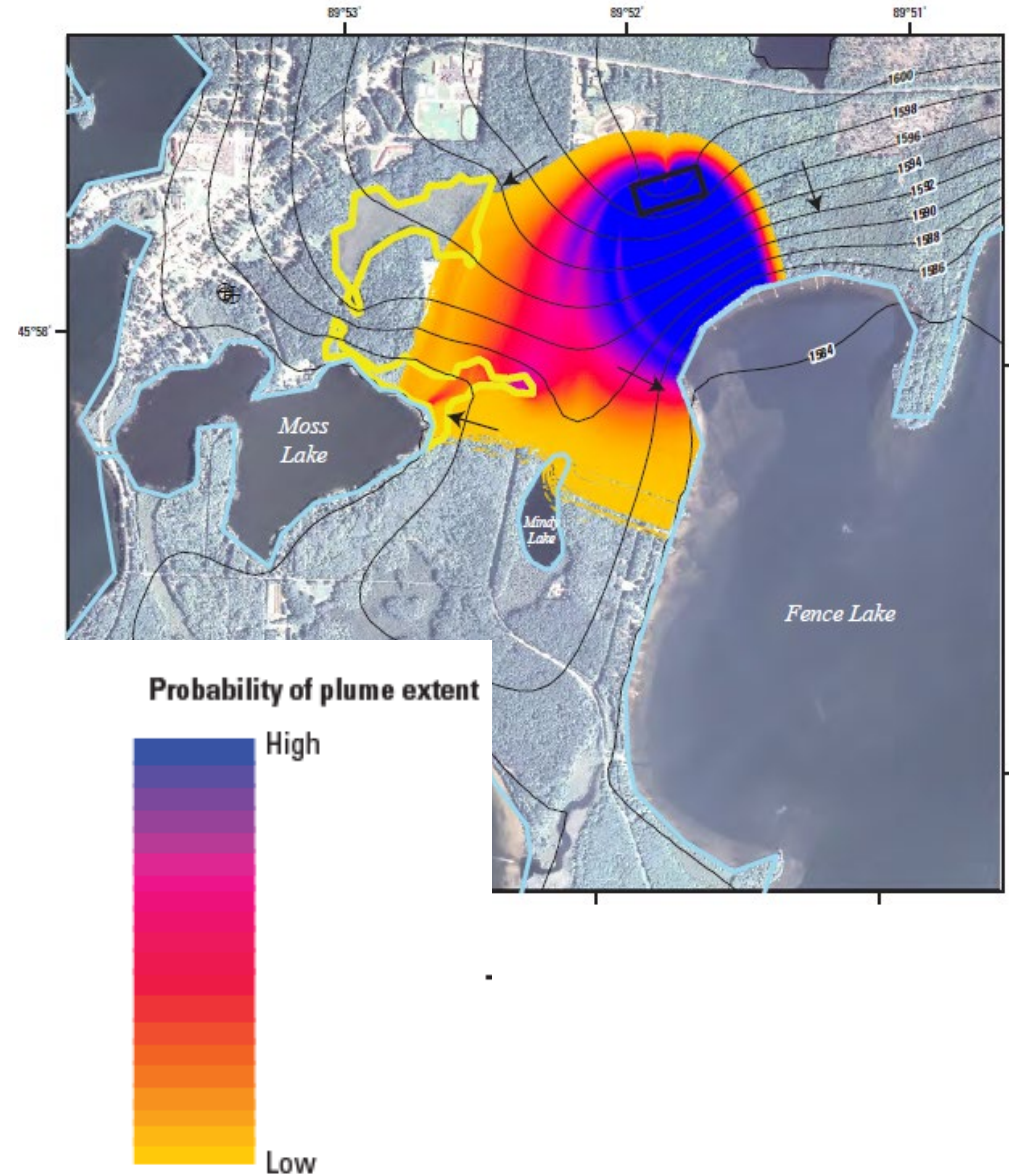Bedrock

4. Regional Groundwater Flow
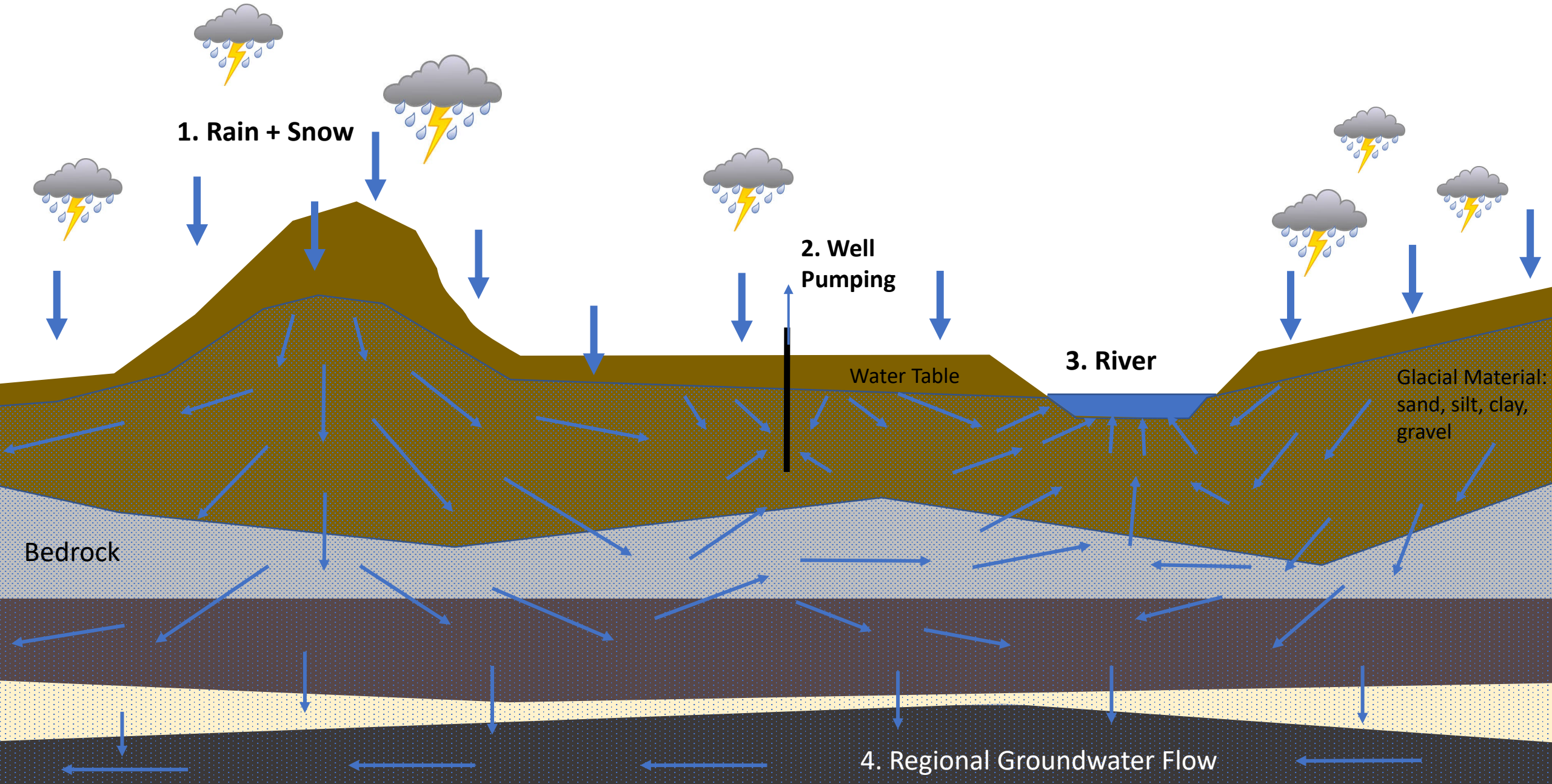
Contaminant Transport Modeling

- Processes that impact transport
  - Groundwater flow
  - Sorption (attachment) of contaminants to soil and rock particles
  - Degradation of contaminants
  - Biological reactions involving contaminant
  - Local-scale variability in subsurface
  - Contaminant density (sometimes)
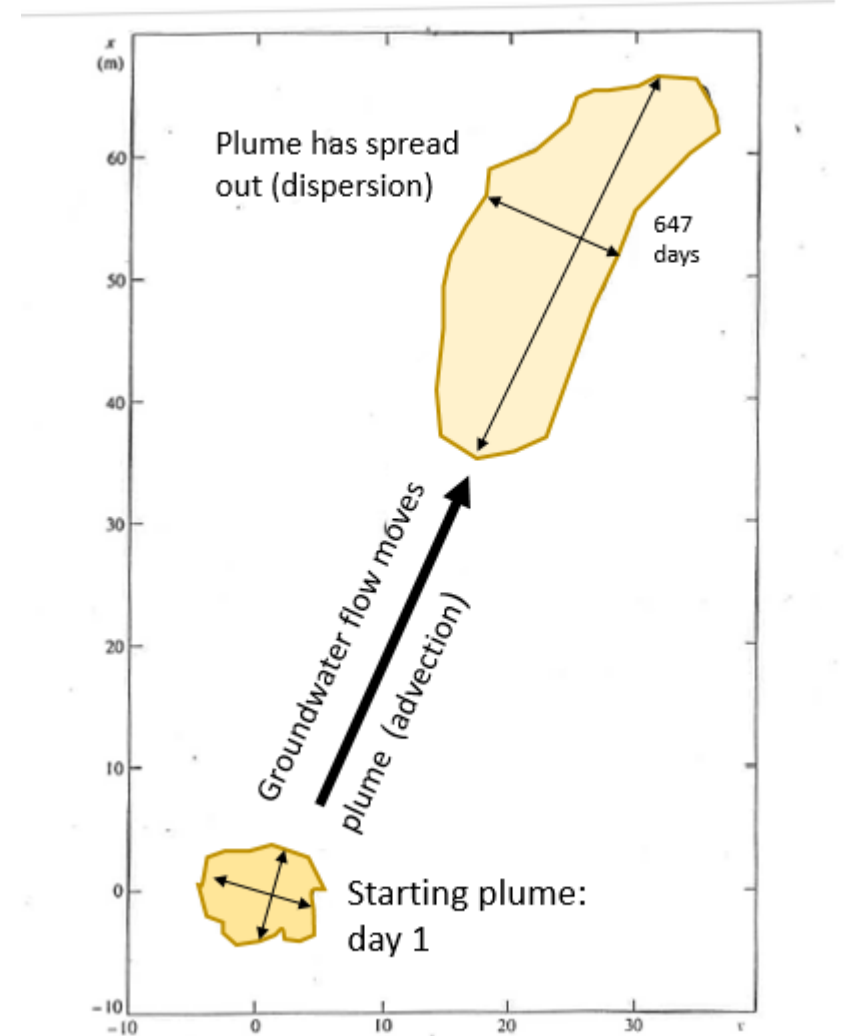
Uncertainty

- Model properties that effect both flow and transport are often not well known (uncertain)
- Our office specializes in understanding model results in the context of this uncertainty
  - Example on right: Monte Carlo approach using 100s of model runs across a range of properties
    - Get model result + an associated probability

Probability of plume extent

High

Low

Next Steps

3. Run pumping scenarios

2. Calibrate the model + add transport (next year)

1. Build the groundwater flow model (this year)

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