

**The webinar will begin shortly.**

Mahalo for joining us!



KA 'OIHANA OLAKINO

# Groundwater Educational Outreach Webinar Series

Webinar #1: Groundwater and Its Importance as a Resource in Hawai'i

## Presenters:

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**Lauren Cruz, Hawai'i DOH**

**Robert Whittier, Hawai'i DOH**

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KA 'OIHANA OLAKINO

# What Is Groundwater?

**Groundwater** is water that is present within open pore space in sediment and bedrock zone fractures beneath the ground

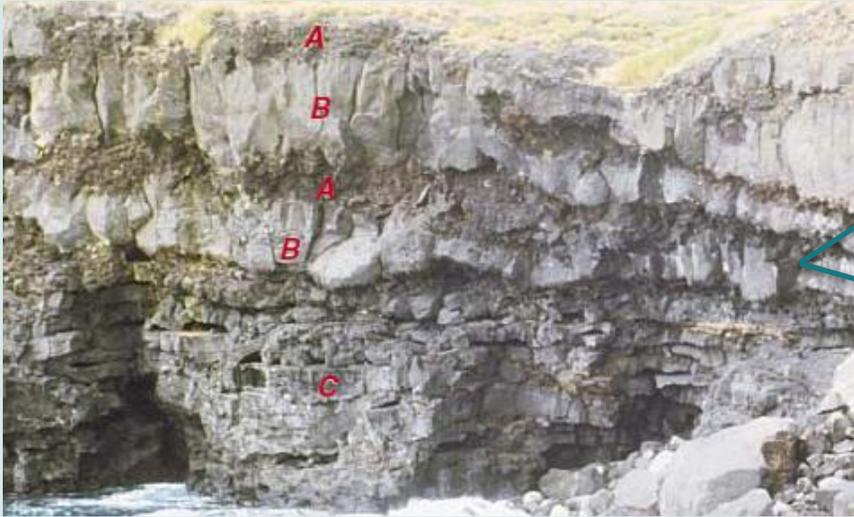
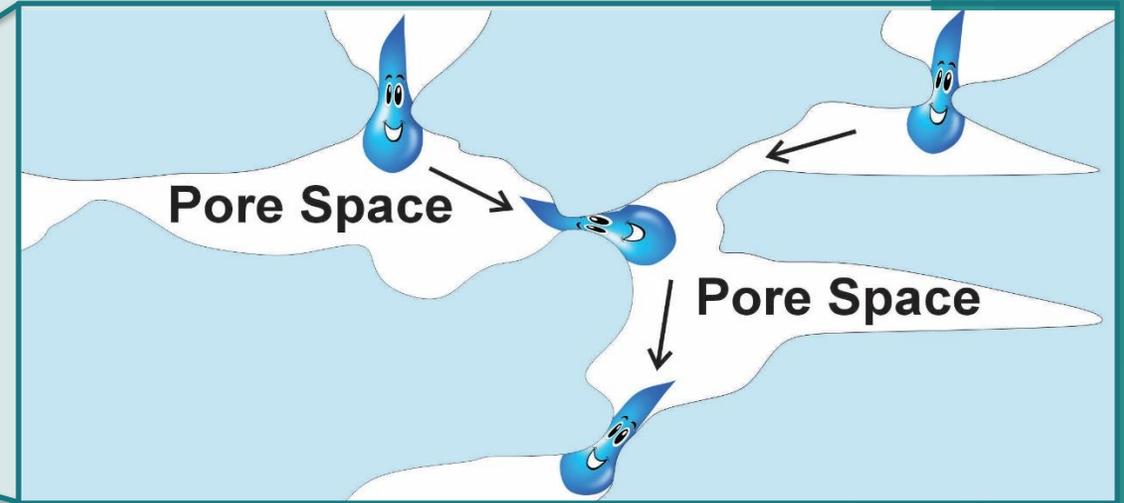
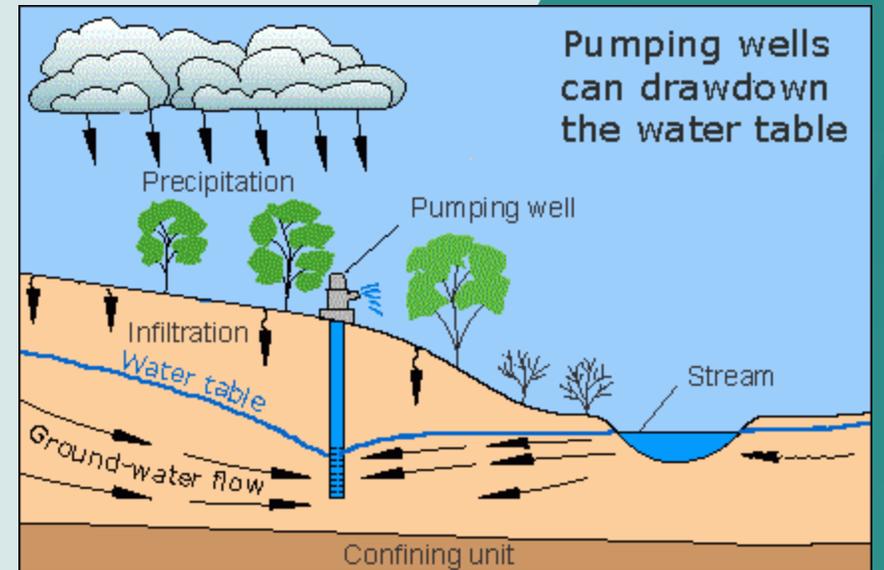


Photo Credit: USGS

**Pete** the water drop :



- Groundwater is one of Hawai'i's most important natural resources
- Used for drinking water, irrigation, industrial/commercial needs
- Groundwater is extracted by pumping wells, treated, and sent through pipes to our homes



# Groundwater is an Important Natural Resource in Hawai'i

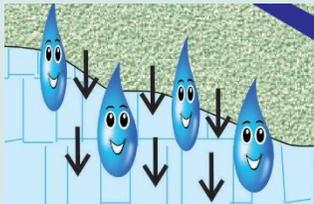
- Why do we care?

**85% of our drinking water comes from groundwater**

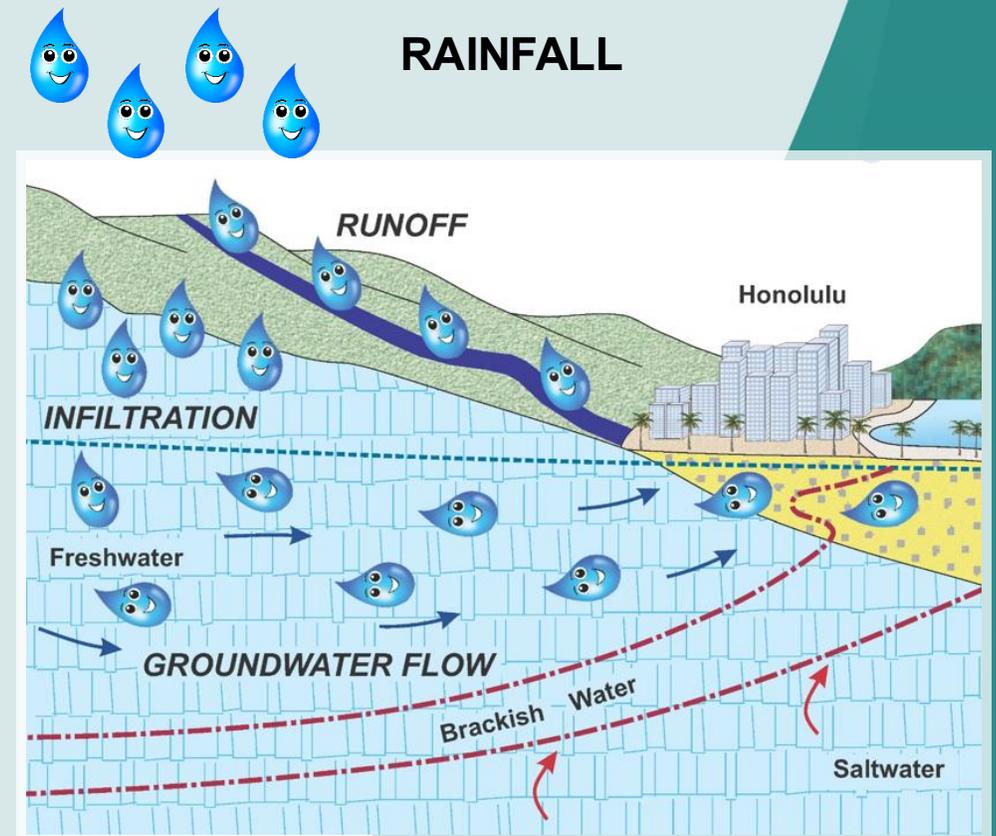
- Where does **Pete** go?



- Migrating into the ground (infiltration)



- Traveling deep below the ground and eventually returning
- Mixing with the migrating brackish and saltwater zones



# How do we extract groundwater for drinking and other uses?

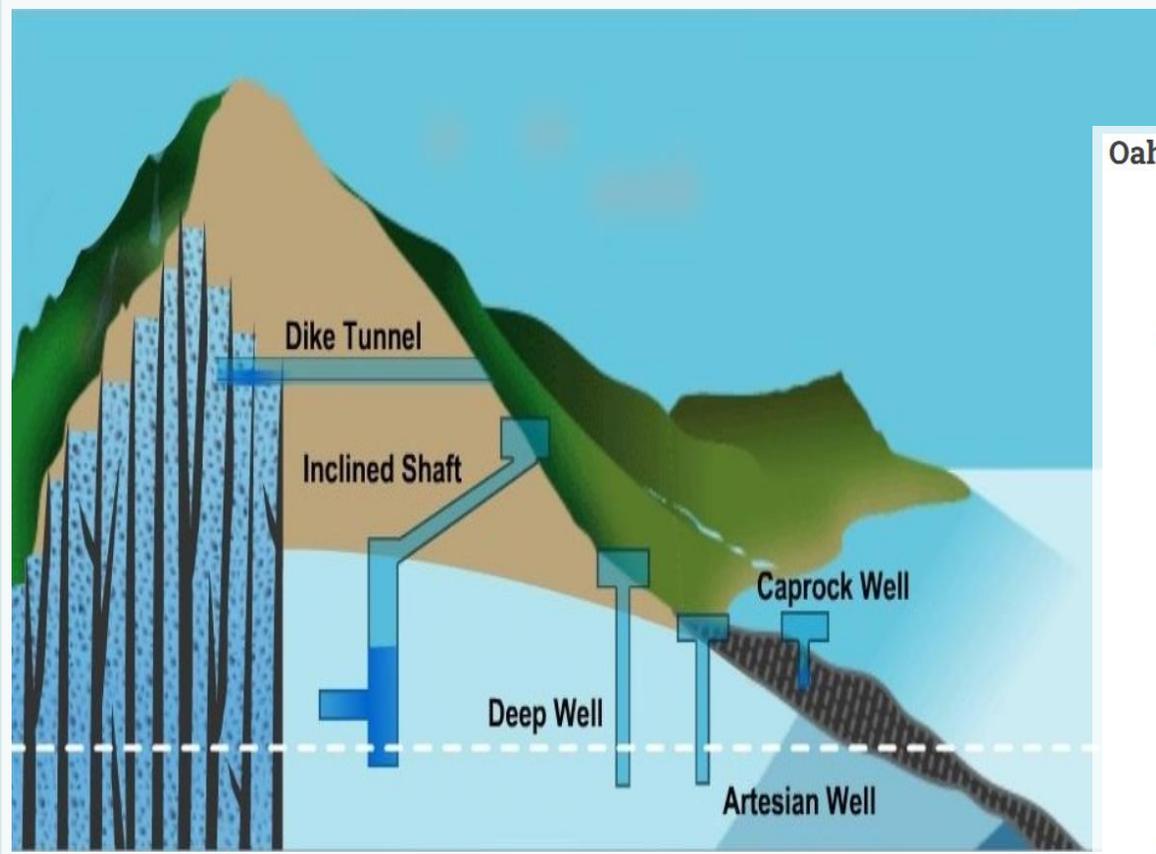
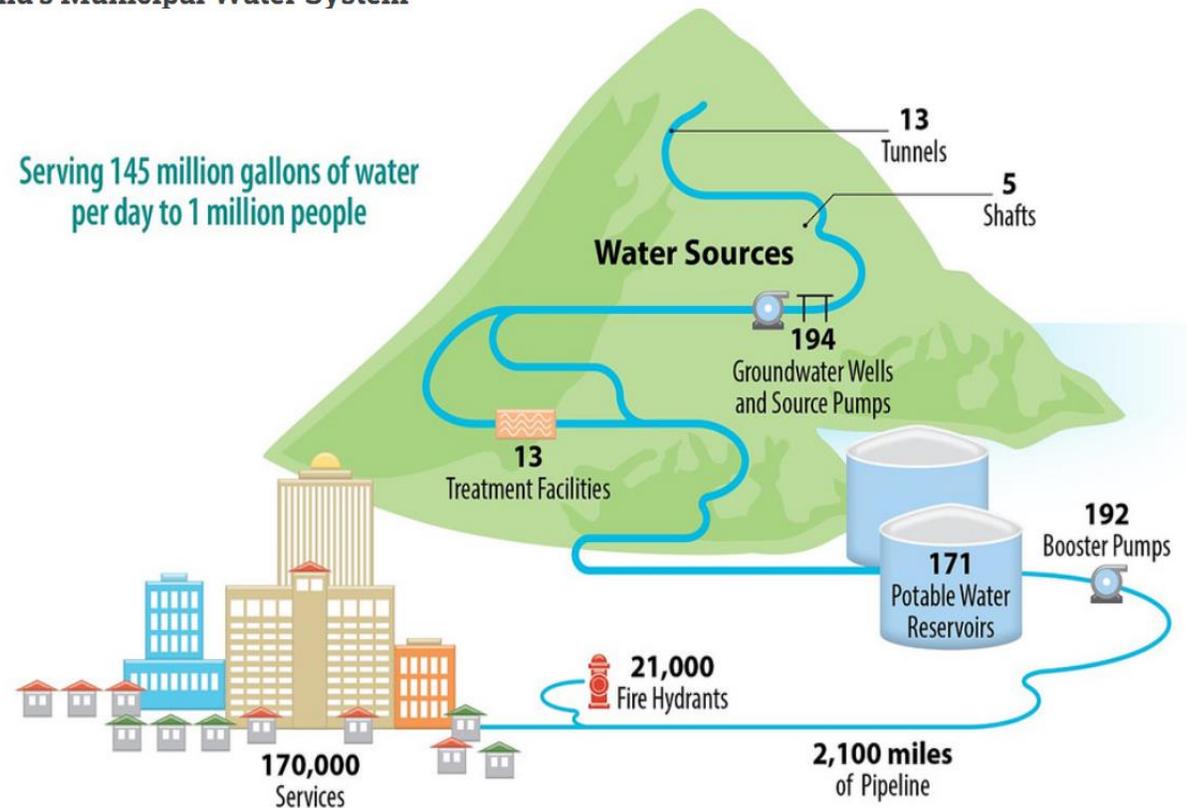


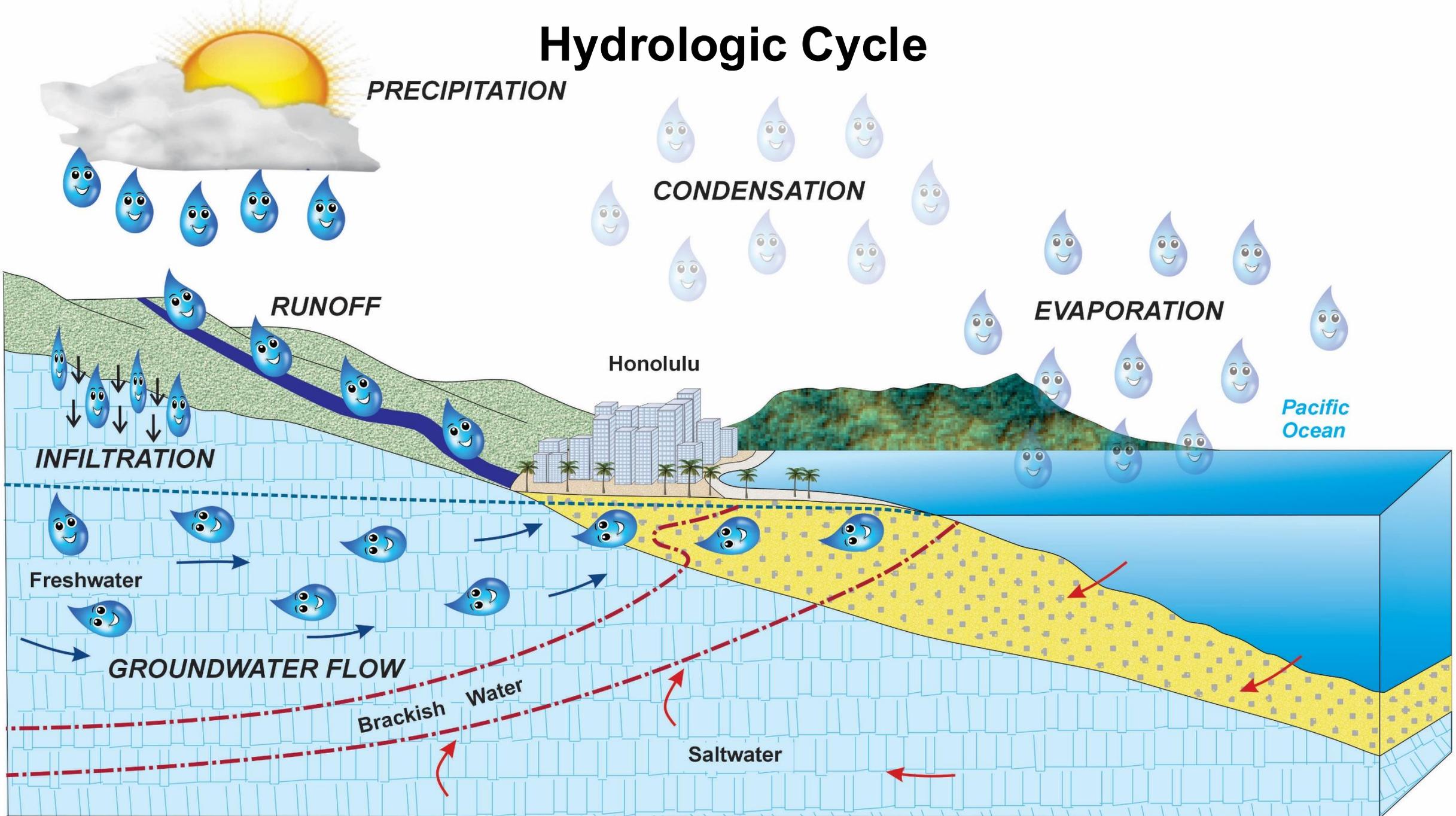
Image Credit: Honolulu Board of Water Supply

## Oahu's Municipal Water System

Serving 145 million gallons of water per day to 1 million people



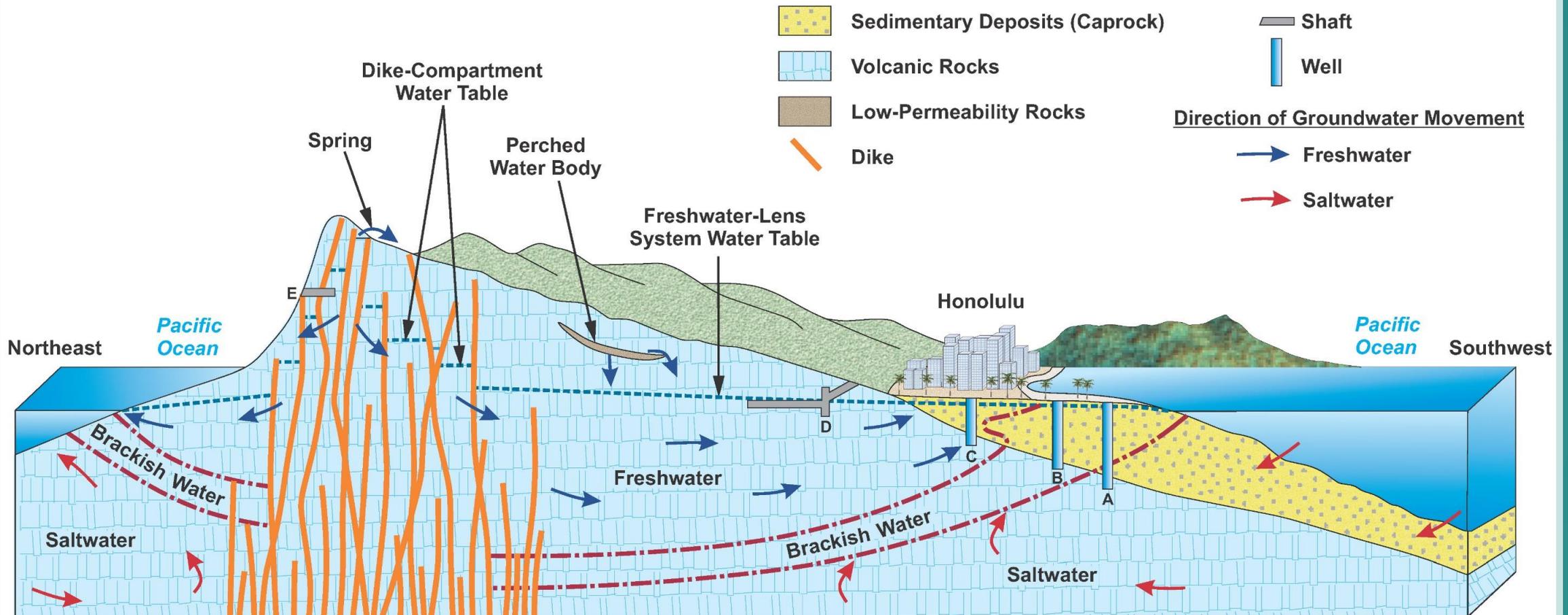
# Hydrologic Cycle



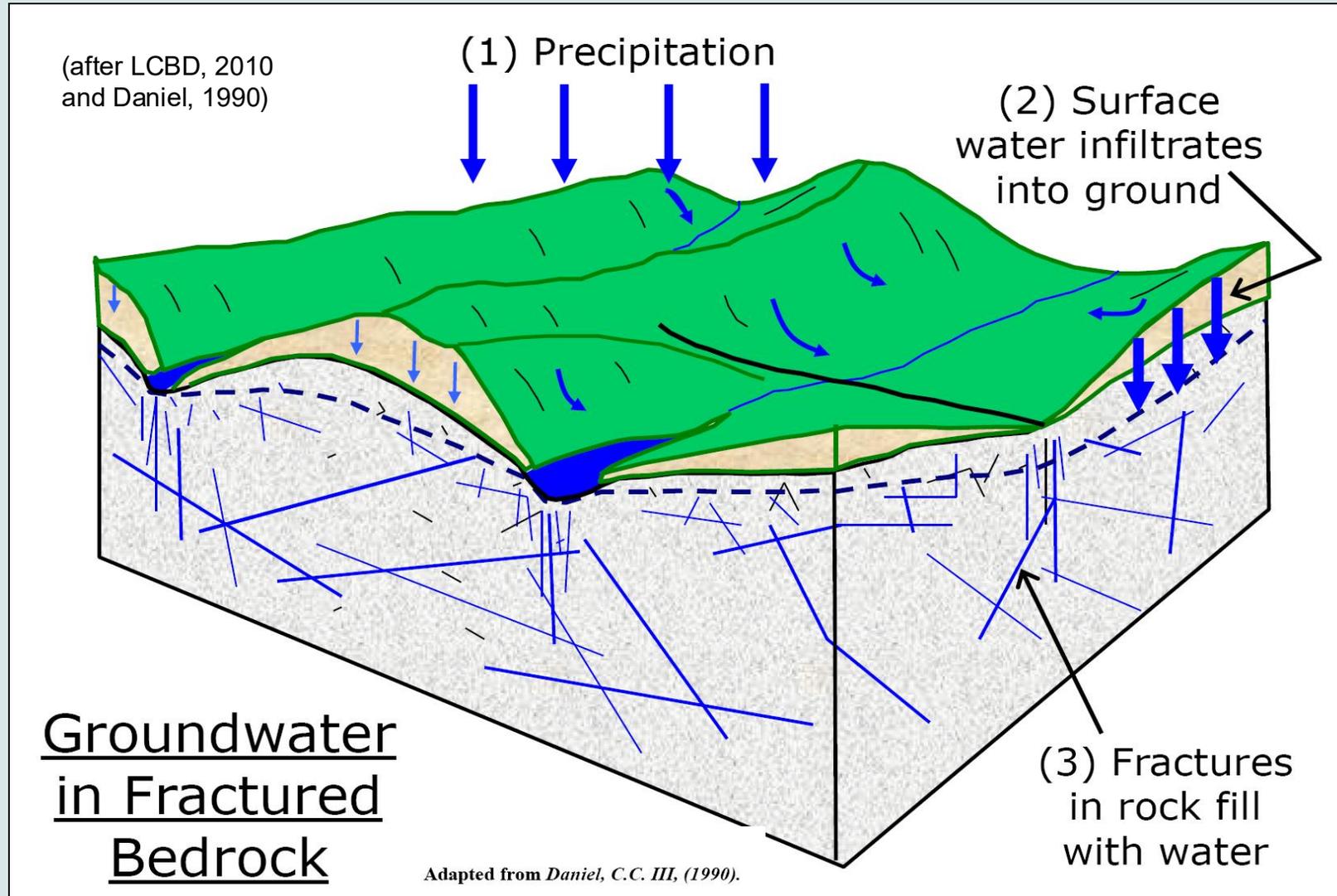


# What is an Aquifer?

- **Aquifers** are the zones located below land surface that store groundwater in extractable and usable quantities



# How are Aquifers Formed in Fractured Rock?



# Two Types of Aquifers

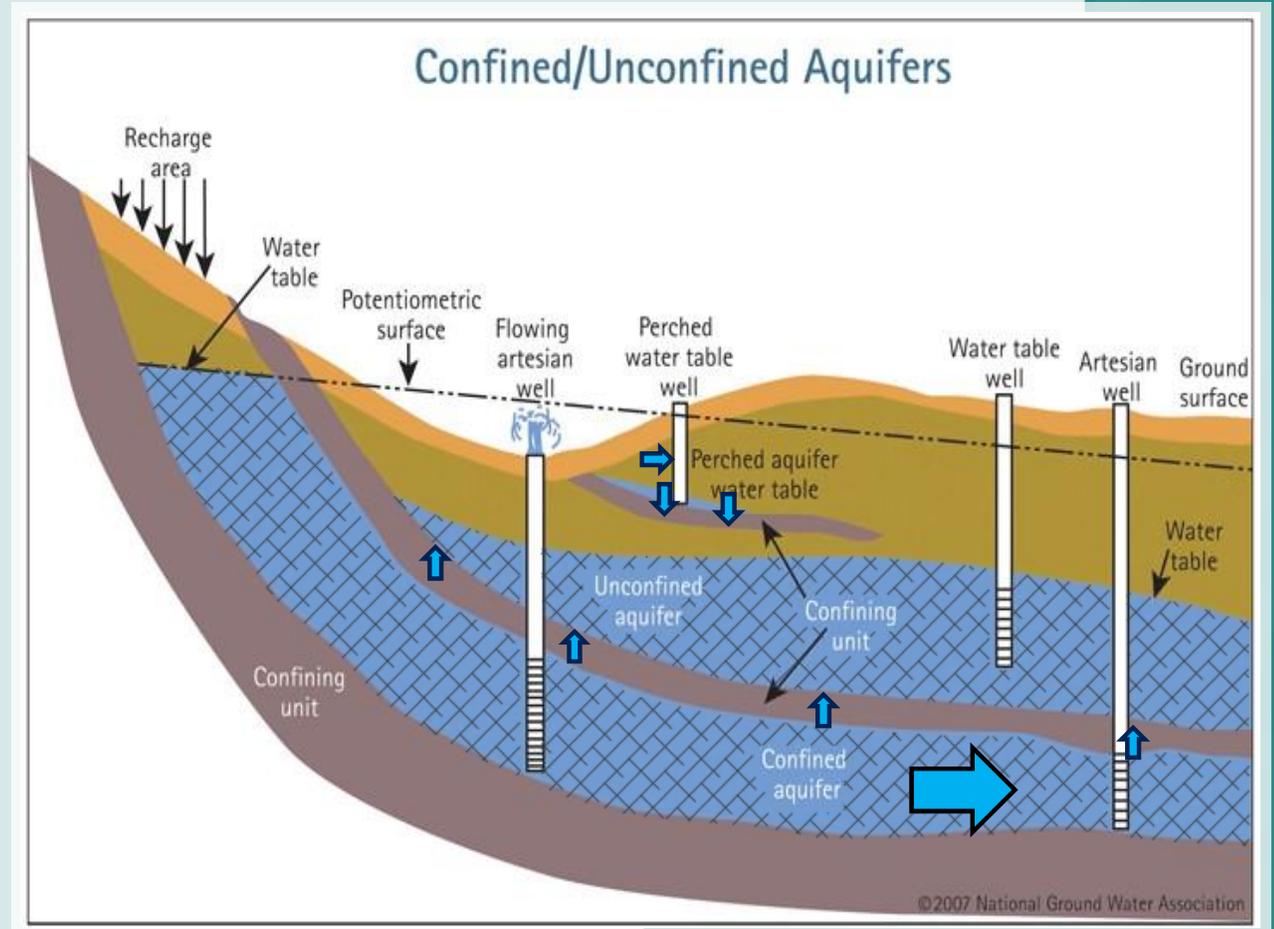
## Unconfined Aquifer

- Has a **water table** forming its top boundary
- Above water table, pores and fractures are partially filled in with groundwater (**unsaturated zone**)
- Below water table, pores and fractures are fully filled in the aquifer
- Dense (less fractured) zone (**aquitard**) forming its bottom

## Confined Aquifer

Restricted Above/Below

- Has aquitards forming its top and bottom
- Subsurface water in confined aquifers is under greater pressure
- Water can flow out in artesian wells and springs

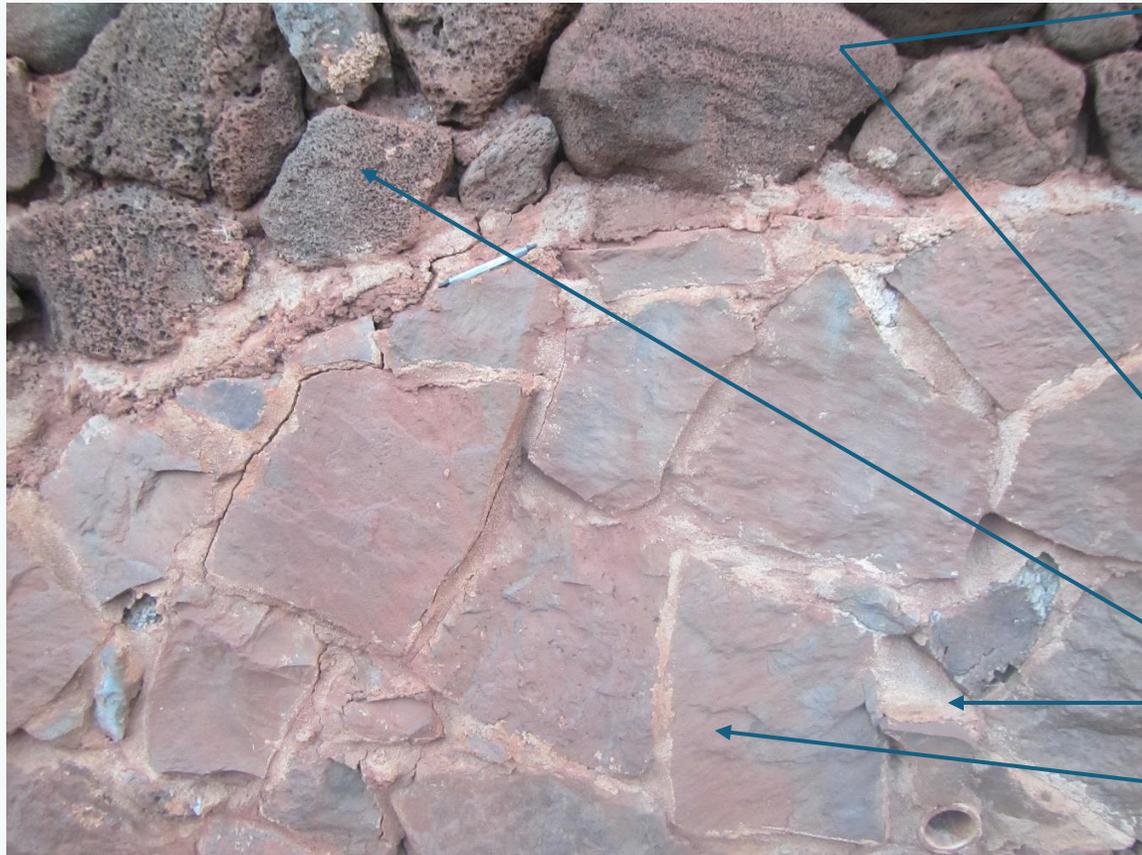


# What is Porosity?

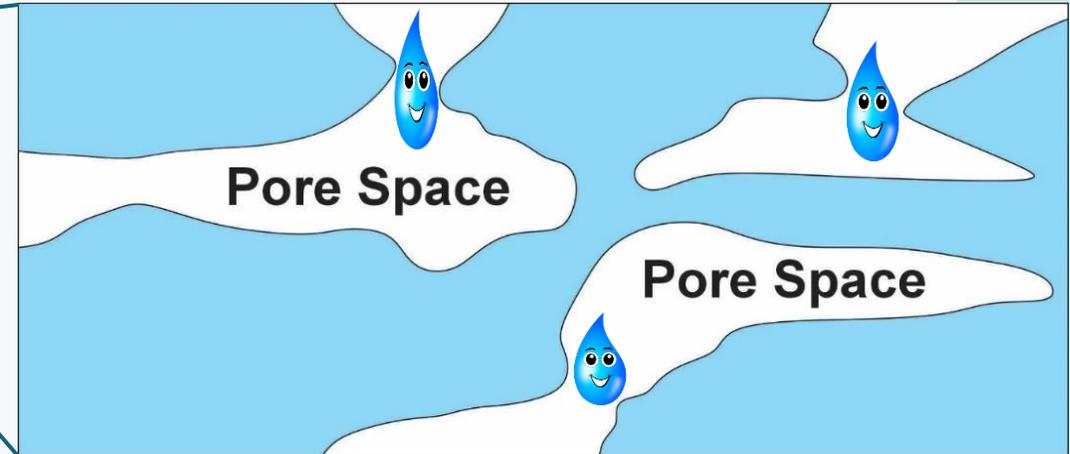


**Porosity:** The fraction of subsurface soil, sediment, and rock occupied by open **pore space** (fractures and space between sediments)

Dual Porosity of Volcanic Rock in Hawai'i



Zoomed-In View



- Disconnected pore space has limited groundwater flow
- Interconnected pore space has more groundwater flow

Higher porosity rock

Lower porosity rock

Porosity can decrease by filling up cracks



# What is Hydraulic Conductivity?

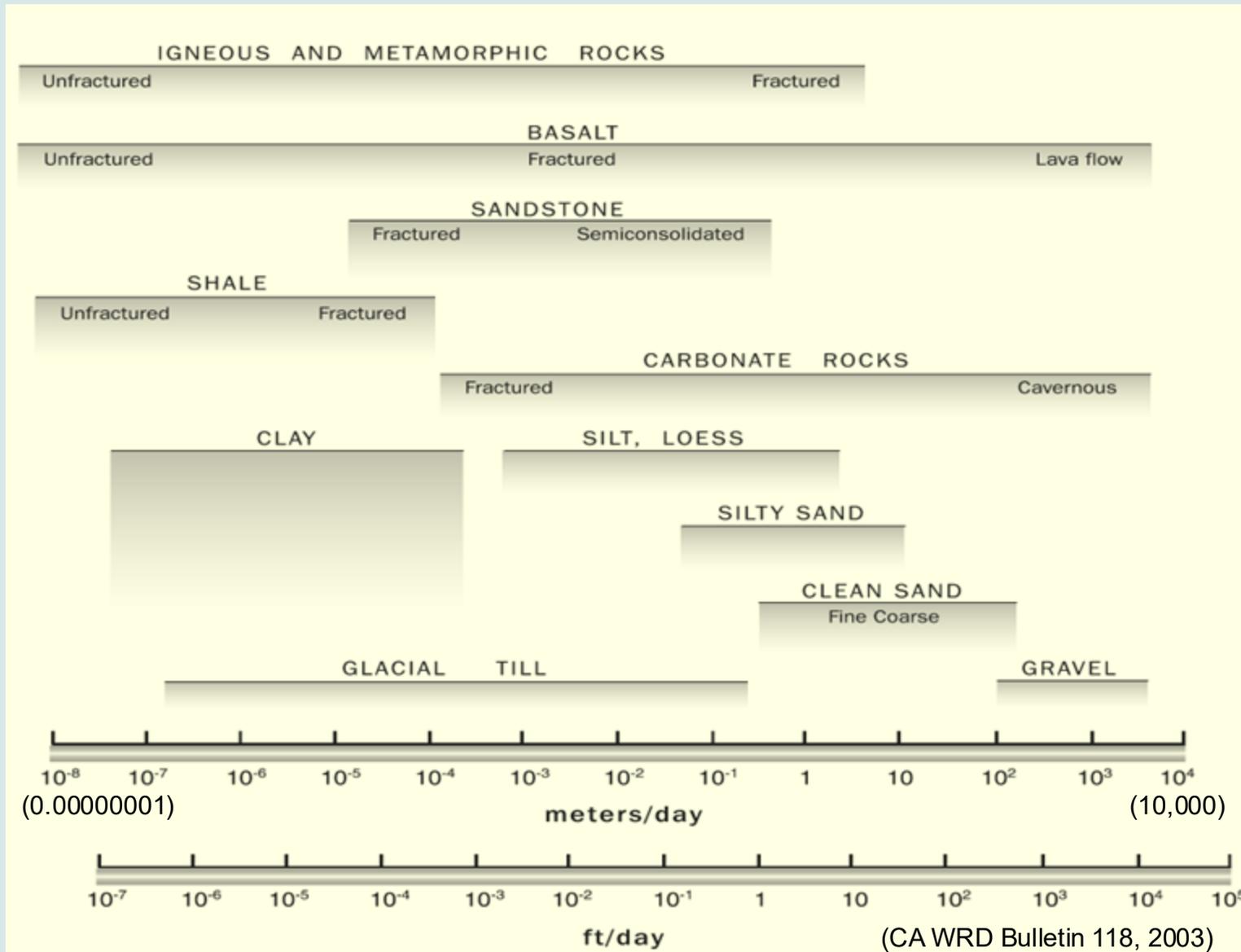
- A measure of the rock and sediment's ability to transmit water
- A function of interconnected porosity



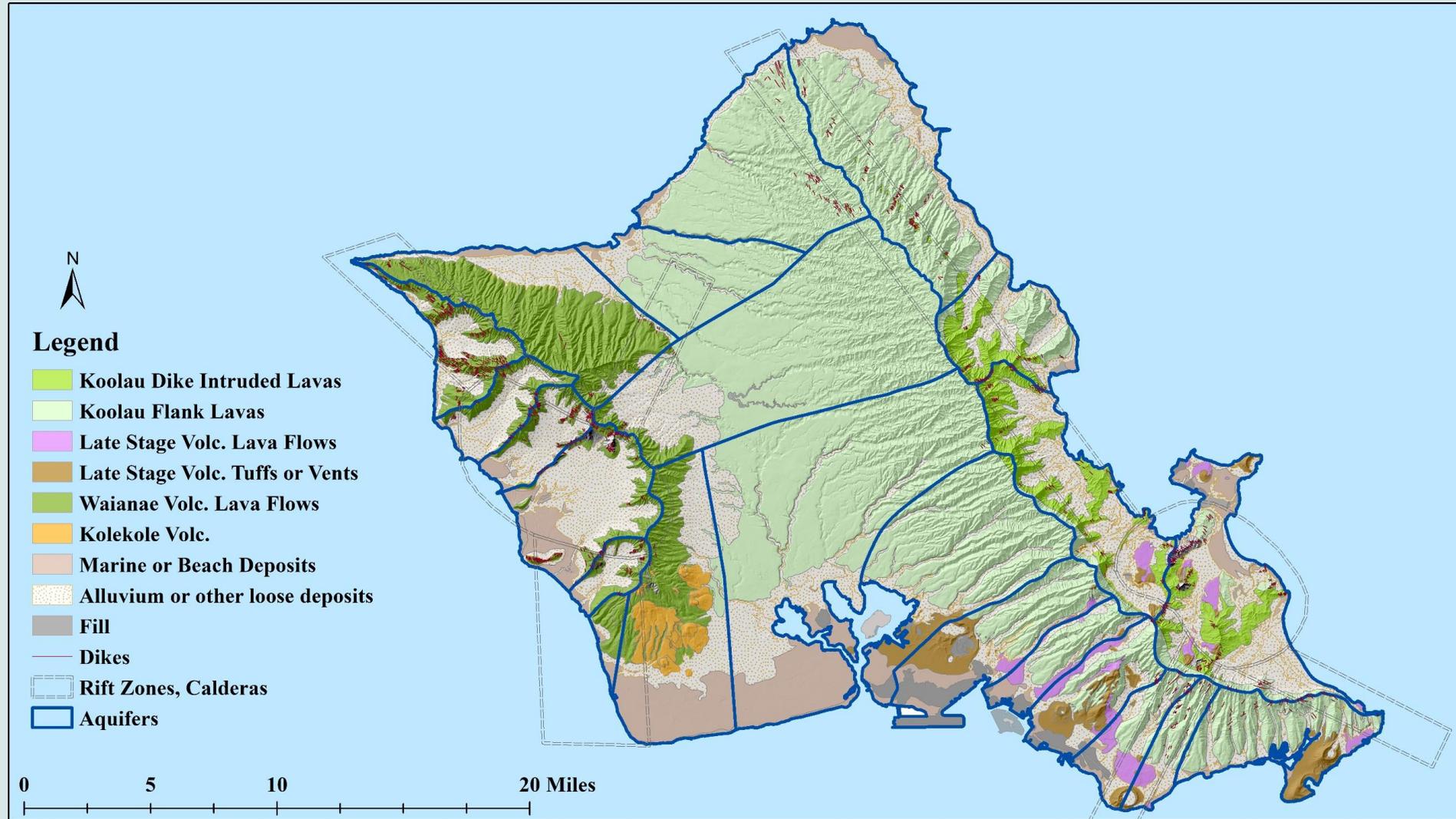
- Rock and clay can have high porosity but low hydraulic conductivity (small pores)



# Hydraulic Conductivity Ranges

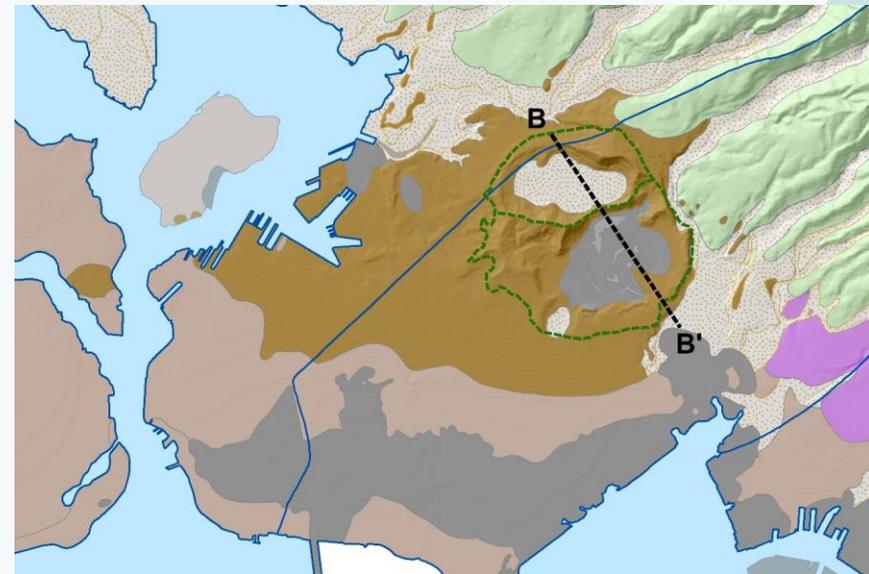
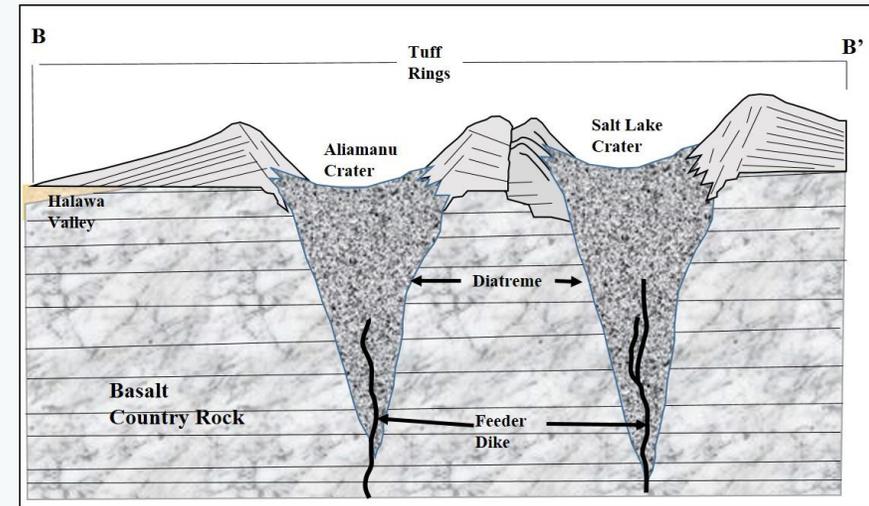


# Geologic Map View of O'ahu



# Salt Lake Tuff Ring Complex

- Explosive eruptions of late-stage volcanism
- Ash deposits are surface expression of these violent events
- A magma source is required for these explosions to occur
- Gravity Survey suggested dense sub-surface structures associated with the SLTRC may extend outside of the Tuff Rings



# Local-Scale Geologic Volcanic Deposits in Hawai'i



Lava Tube

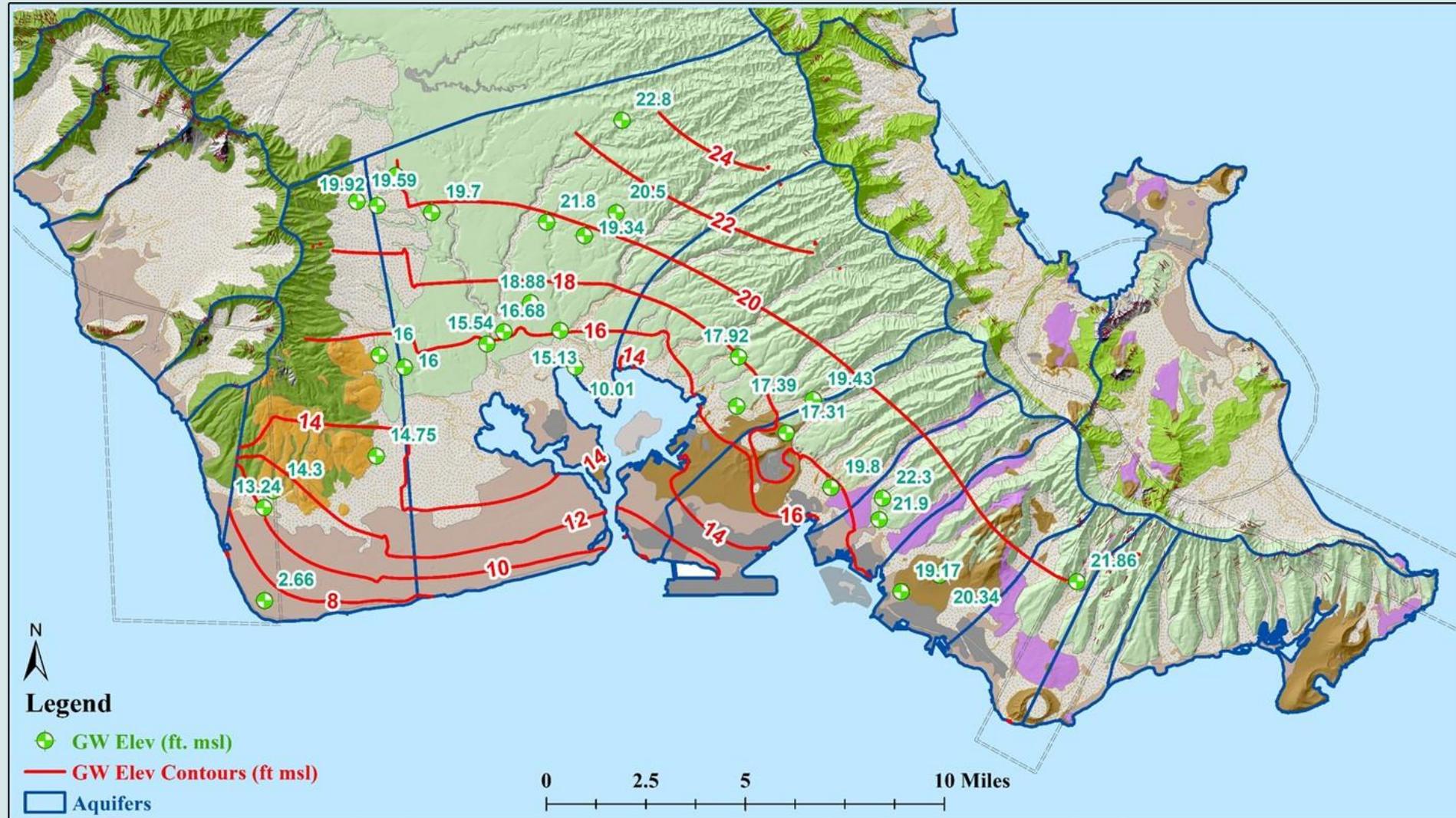


Pahoehoe Lava Flow

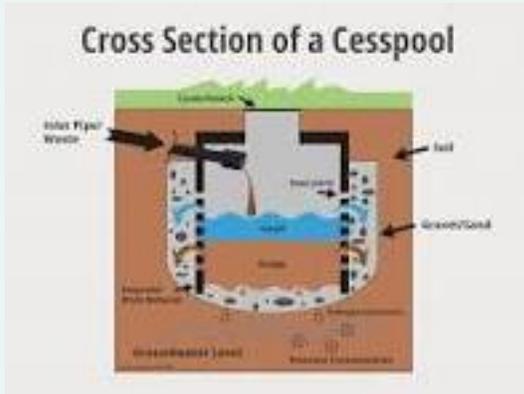
'A'a Lava Flow



# Map of Groundwater Elevations and Aquifers



# Potential Impacts to Groundwater and Exposure Pathways



Cesspools



Military and Industrial



Pete is no longer clean

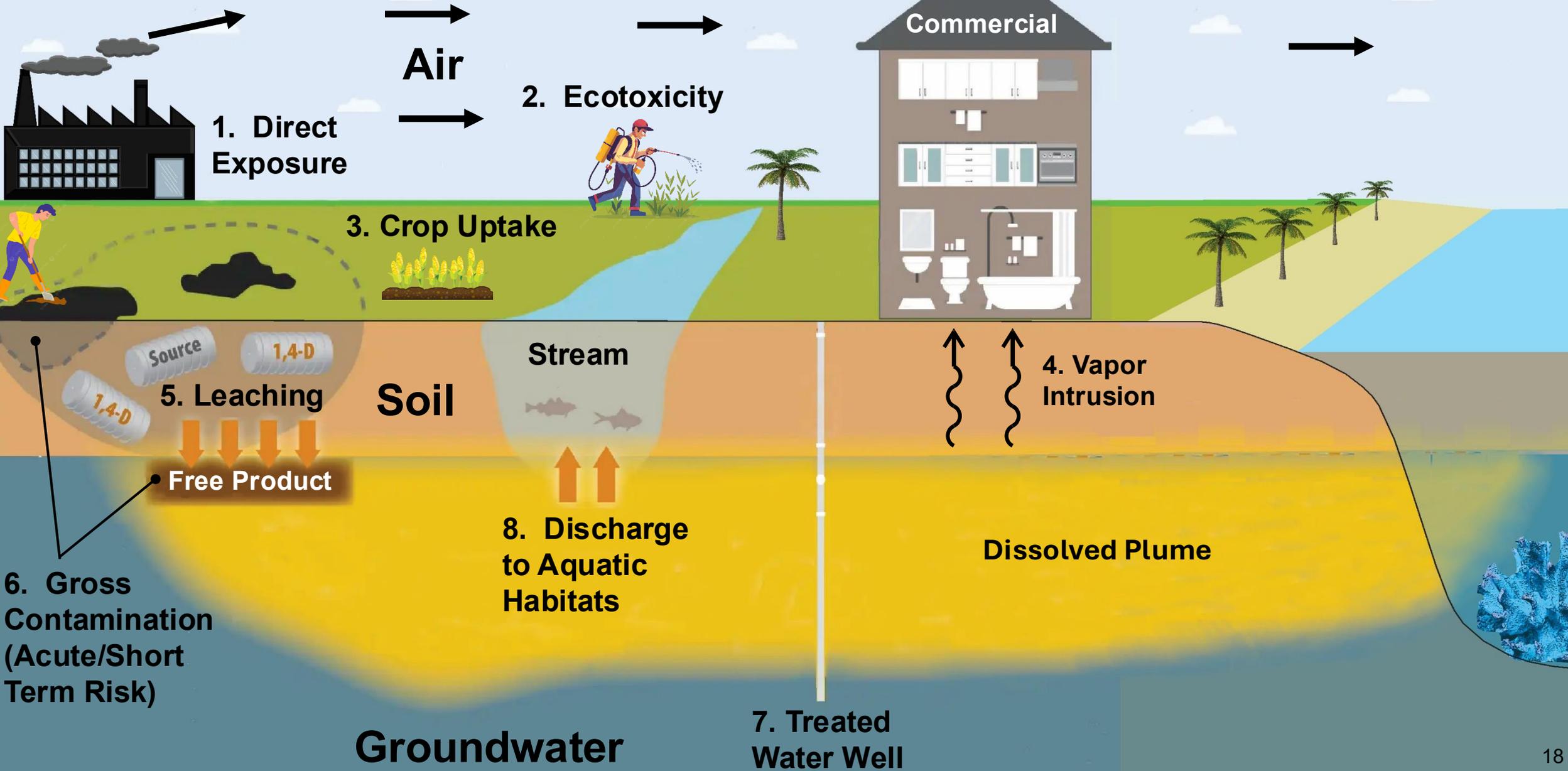


Underground Storage Tanks



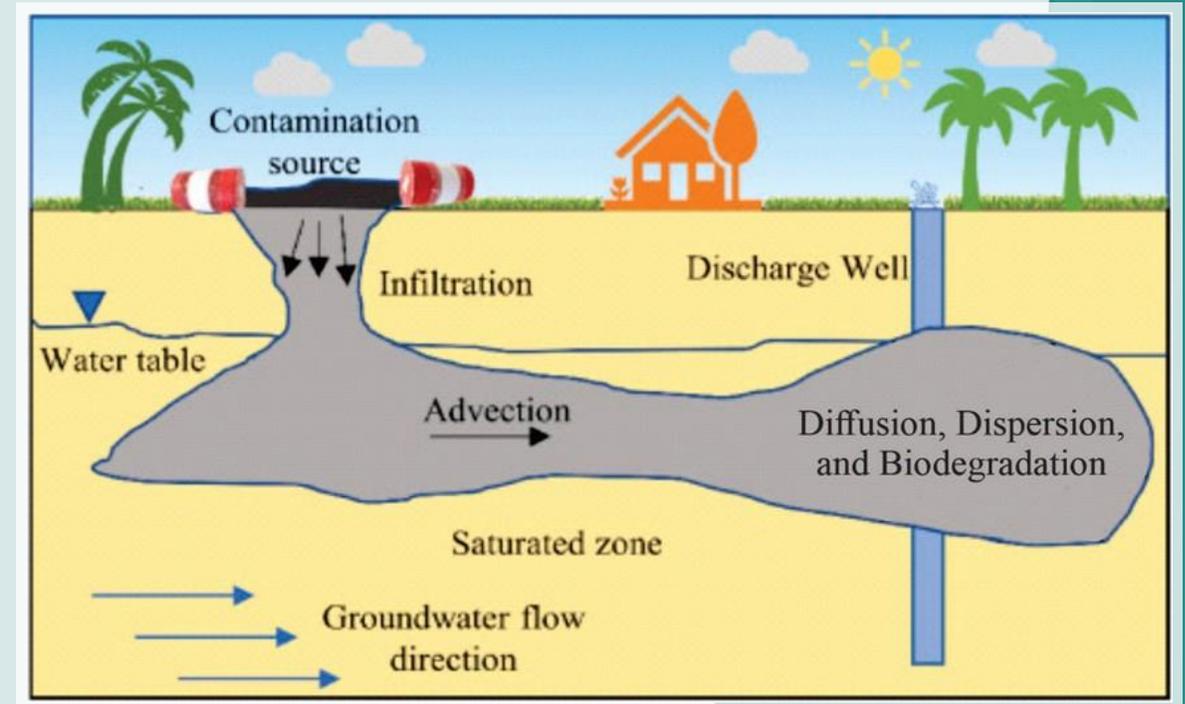
Agriculture and Pesticides

# Potential Environmental Hazards Posed by Contaminated Air, Soil, and Groundwater

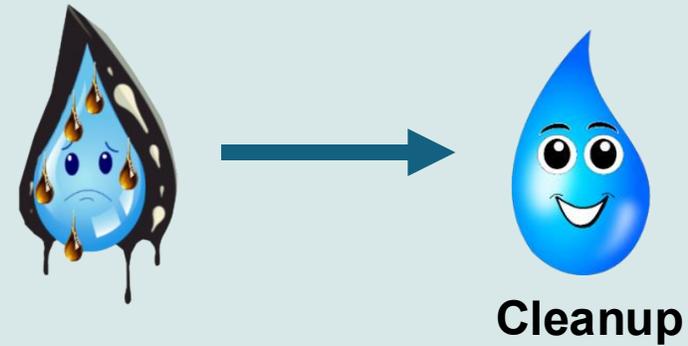
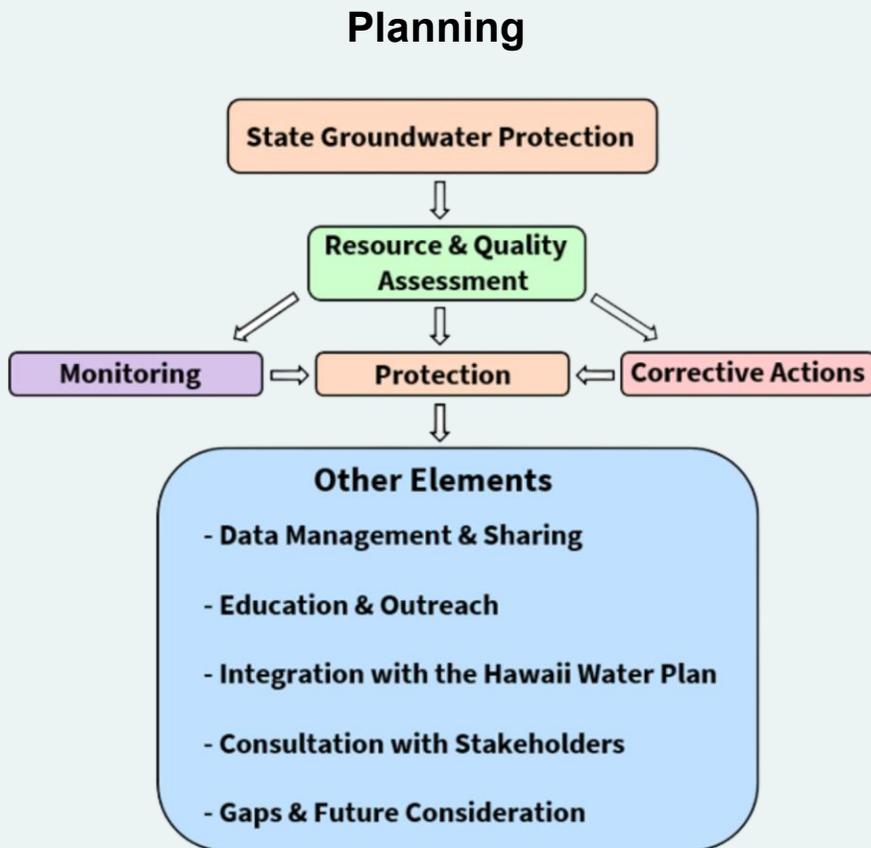


# Movement and Fate of Contaminants in the Subsurface

- Spills and downward transport
- Dissolved phase vs. floating/sinking transport
- Contaminant plume migration
  - Carried by groundwater (advection)
  - Spreading and mixing (dispersion and diffusion)
- Plume break-down by natural bacteria (biodegradation)
- Not all contaminants biodegrade rapidly



# Sustainability, Pollution Prevention, and Groundwater Remediation in Hawai'i



# Next Webinar: Basics of Groundwater Flow

If you have further questions or would like more information on a specific topic, please send us an email at:

**[curtis.pruder@doh.hawaii.gov](mailto:curtis.pruder@doh.hawaii.gov)**



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