Hydrogeology

www.soest.hawaii.edu/GG/FACULTY/aly/GG455_handouts.html

GG455

Instructor: Aly I. El-Kadi (POST 709, x66331), elkadi@hawaii.edu

Schedule: TR 1:30 - 2:45 (POST 708)
W (lab) 1:30 - 4:20 (POST 702/835)

Coursework will Include: (1) completing problem sets, (2) completing laboratory assignments and field trip reports, (3) mid-term exam, and (4) final exam.

Lecture Topics
See handout

Grades
– 33% Homework and lab/field reports
– 33% Midterm
– 33% Final

Lab Exercises
1. Capillary rise, porosity, and specific yield laboratory determinations
2. Hydraulic conductivity determination using laboratory columns
3. Sandbox (pumping test) experiment
4. Tracer tests
Field Trips
1. Well drilling site
2. Board of Water Supply Beretania pump station and Halawa Shaft
3. BWS dike complex water development tunnel (Waihee shaft)
4. Springs
5. A clean-up site
6. Manoa landslide site
7. Others?
Water Quality Report

Maui Department of Water Supply:
www.mauiwatert.org/waterquality.html

Honolulu Board of Water Supply:
www.hbws.org/cssweb/display.cfm?sid=1081

Hawaii Department of Water Supply:
www.hawaiidws.org/ocrpage.htm

Kauai Department of Water:
www.kauaiwater.org/waterqualityrpt_pdf.asp
Regulated Primary Contaminants

Unregulated Contaminants

Memorandums

In the report, every part per million (ppm) is the same as one milligram of the contaminant in one liter of water (mg/L).

For parts per billion perspective, one part per billion (ppb) is approximately one second to 1.5. When one part per billion (ppb) is over small lot - about 1 second to 1.5. When
The water serving ... has been tested and meets Federal and State standards

| Compounds Substances in the Chlorination System | Concentration | Unit | Value | Range | Maximum | MCL | MCL Violation
|-----------------------------------------------|---------------|------|-------|-------|---------|----|----------------
| Hex-lu (Redundant Plant) | ppb | 1598 | 849 | 0.005 | 100 | 0.5 | 0
| Hex-lu (Redundant Plant) | ppb | 1598 | 849 | 0.005 | 100 | 0.5 | 0

*Revised weekly percentage calculation

*Data from the most recent testing done in accordance with regulations

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Hydrologic (water) cycle:

Endless circulation of water between earth, ocean, and atmosphere
Saline water in oceans = 97.2%
Ice caps and glaciers = 2.14%
Groundwater = 0.61%
Surface water = 0.009%
Soil moisture = 0.005%
Atmosphere = 0.001%
Types of water

- Surface (open) water:
  - Lakes, rivers

- Subsurface or groundwater

“When the well’s dry, we know the worth of water.”

Benjamin Franklin (@1740)
THE BURDEN OF THIRST

Kenya

Out of women in rural areas spend up to 40 hours a day walking to a water source. This leaves little time for work and children's education. A single drop of water can mean the difference between life and death in a water crisis.

India

In India, people gather around a well to collect water. The lack of clean water sources leads to diseases and poor health conditions.
AMERICANS USE ABOUT 100 GALLONS OF WATER AT HOME EACH DAY • MILLIONS OF THE WORLD’S POOREST
SUBSIST ON FEWER THAN FIVE GALLONS • 46 PERCENT OF PEOPLE ON EARTH DO NOT HAVE WATER PIPED TO
THEIR HOMES • WOMEN IN DEVELOPING COUNTRIES WALK AN AVERAGE OF 3.7 MILES TO GET WATER • IN 15
YEARS, 1.8 BILLION PEOPLE WILL LIVE IN REGIONS OF SEVERE WATER SCARCITY

Angola

A seller of clean well water — ten cents a bag — has no problem finding a buyer in a jarum in Luanda, Angola. In 2008 the presence of contaminated water in the city led to one of Africa’s worst cholera epidemics, with 80,000 Angolans infected.

Moreno Valley, Riverside, CA: population 28,100 (1980); 132,000 (1992)
Water supply problems
Transportation

California aqueduct: up to 3000 ft, 600 miles, 3 million acre ft/year (120 billion ft³/year)
Shortage

Lake Shasta (California)
1987-1993 drought

Drought Monitor
(http://drought.unl.edu/dm)

U.S. Drought Monitor

January 5, 2010

This Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for climate assessment.

http://drought.unl.edu/dm
Floods

Manoa 2004 flood
Land deformation, Arizona

A stranded bus caused by land subsidence in Arizona, Arizona Land deformation, Arizona

Bangladesh

A flooded street in Bangladesh, Bangladesh Land deformation, Bangladesh
Landslides, Oahu, Hawaii

Landslides East Oahu
1989 Alani Paty landslide, Hawaii

Costs, $34 million (2000 dollars)—The very slow-moving Alani-Paty landslide near the City of Honolulu, Hawaii, damaged houses, streets, and utilities on 60 lots of a residential neighborhood built on a debris apron. The slide is similar to several others near Honolulu that have caused millions of dollars in property damage. The slide area showed signs of movement in the mid or late 1970s and residents have reported damage to houses and streets during and immediately following rain periods, especially during the winters of 1987 and 1988.
Alani Paty Landslide

Sinkholes
Spectacular, sudden collapse of the land surface commonly accompanies the formation of a sinkhole, such as this one that formed at Winter Park, just north of Orlando, Fla., in 1981.
Aerial picture of Florida sinkhole lakes

Water quality problems
Agricultural sources of contamination

Pesticides, fertilizers, herbicides and animal waste. Examples:

- excess chemicals
- spillage of fertilizers and pesticides during handling
- runoff from the loading and washing of pesticide sprayers or other application equipment
Home sources of contamination

- Septic tanks and cesspools: Bacteria, viruses, nutrients.
- Paints, synthetic detergents, solvents, oils, medicines, disinfectants, pool chemicals, pesticides, batteries, gasoline, diesel fuel
- Fertilizers, herbicides, insecticides, fungicides
Industrial sources of contamination

- Car service stations, dry cleaners, electrical component or machine manufacturers, photo processors
  - Chemical spillage, leakage, or improper handling.
  - Waste disposal in cesspools, dry holes, septic tanks.
  - Cleaning off holding tanks or spraying equipment on the open ground
  - Leakage from underground and above ground storage tanks holding petroleum products, acids, solvents and chemicals
- Mining operations: the process itself or waste disposal
Natural sources of contamination

- Magnesium, calcium, chlorides, arsenic, boron, and selenium.

The effect of these natural sources on groundwater quality depends on the type of contaminant and its concentration.

Examples:
- Gas stations
- Landfills
- Cesspools
- Military installations
- Pineapple cultivation
High risk of pollution

Examples

- Car repair shops
- Sewer Lines
- Golf courses
- Septic systems
- Diversified Agriculture: e.g. Orchards

Medium risk of pollution

Examples:

- Car washes
- Above ground storage tanks
- Hospitals
- High schools & Universities
- Parks
Mine: Colorado
Iron oxide+
oxides of lead,
zinc, copper,
and manganese

Baton Rouge "Cancer Alley",
Louisiana
Florida, industrial waste (including dioxin)
Water Conservation

Reduce runoff
Reduce lawn water use

Efficient toilets
Groundwater
Dowsing
Groundwater:
US: 40% of public water supply
 33% of irrigation
 17% of industry
Hawaii:
 99% of public water supply
 50% of other uses

Most people have no idea how important groundwater is. It's the source of drinking water for more than 67 percent of the nation's rural population and for about half of the total population.
Solutions for water problems?

- Understanding
- Protection
- Recycling
- Conservation
Oahu groundwater source delineations
(areas that should be protected)

Legend
Land Use
- Agriculture
- Conservation
- Rural
- Urban
- Groundwater Zone C
- Groundwater Zone B

Polymers
Hope?
Useful web sites

- USGS (www.usgs.gov)
- US EPA (www.epa.gov)
- Water Resources Research Center (http://www.wrrc.hawaii.edu/)
- Local USGS Office (http://hi.water.usgs.gov/)