Supplementary Notes (PJ Shlachtman, Miller book)

Supply, Renewal and Use of Water Resources

Water

- 97% by volume is found in the ocean
- 3% is fresh water with 2.997% locked up in ice caps and glaciers
- 0.003% easily available as soil moisture, usable groundwater, water vapor, lakes and streams

Hydrologic Cycle

- Canada – 20% of world's fresh water
- China – 7% of world's fresh water

Surface Water

Surface Runoff – water that flows into streams, lakes, wetlands and reservoirs
Watershed (drainage basin) -a region from which water drains into a stream, lake, reservoir, or other body of water.

Groundwater

Zone of Saturation – below the surface where voids are filled with water
Water Table – the surface of the zone of saturation
Aquifer – porous sand, gravel or bedrock through which groundwater flows
Recharge area

- an area of land through which water passes downward or laterally into an aquifer
- Natural recharge or lateral recharge

Water mining – removal of water from an aquifer that exceeds its replenishment

How do we use the world's fresh water?

- 65% – irrigate farm land (agriculture)
- 25% – energy production
- 10% – domestic and municipal use

Too Little Water

Causes of Freshwater Shortages

*Dry climate *Drought *Desiccation *Water Stress

How Can Water Supplies be Increased?

- Build dams and reservoirs
- Bring in surface water from another area
- Withdraw groundwater
- Desalination
- Improve the efficiency of water use

Dams

- capture and store water from rain and melting snow; then released as desired to produce elec. power, irrigate land, control flooding below the reservoir and provide water to towns
- can reduce downstream flow to a trickle (Colorado River)
- reduce biodiversity
  - Danube's Iron Gate dam
  - China's Three Gorges project (Yangtze River)

- Malaysia's Bakun dam – would be the world's highest

Transferring water from one place to another

*James Bay Watershed *Aral Sea Watershed

Salt Rain – salty dust picked up by rain

How they are dealing with this problem of the Aral Sea

- charging farmers more for irrigation water
- decreasing irrigation water quotas
- introducing water-saving technology
- dev. a regional integrated water management plan
- planting protective forest belts
- using underground water
- improving health services
- slowing the area's rapid population growth

Tapping groundwater and converting salt water to fresh water

Overuse of groundwater can cause:

- aquifer depletion
- aquifer subsidence
- intrusion of salt water into aquifers

Ways to slow groundwater depletion include

- controlling population growth
- not planting water-thirsty plants in dry areas
- wasting less irrigation water

Desalination

1. Distillation
2. Reverse Osmosis

- Uses vast amount of electricity.
- Distribution of desalinated water is also costly
- Process produces large quantities of brine (contains high levels of salt and minerals)

Cloud Seeding

- Add chemicals to clouds to promote rain
- Legal issues over the ownership of water in clouds
- Tow massive icebergs to arid coastal areas.

Using Water More Efficiently

- 65-70% of water used throughout the world is wasted: evaporation, leaks, etc.
- In U.S., artificially low water prices – government subsidies
- Multiple water resource management responsibility

How can we waste less water in irrigation?

- Line irrigation ditches (50-60% efficiency)
- Use high efficiency center-pivot sprinkler system (70-80% efficiency)
- LEPA – low energy precision application sprinklers (75-85% efficiency)
- High-efficiency trickle or drip irrigation systems (80-90% efficiency)
- Computer-controlled systems to monitor soil moisture and irrigate as needed.

- Organic Farming – requires ~1/4 water of conventional farming.

How can we waste less water in industry, homes and businesses?

- Recycle aluminum (97% less water)
- Xeriscaping (use of dry climate vegetation) and drip irrigation for gardens and other vegetation
- Eliminate leaks
- Eliminate single rate billing systems (apartments and 1/5 of US public water systems)
- Rebates for installing water-saving devices (showerheads, toilets)
- "Negaliters" or "Negagallons" are savings in water used.

Salmon – anadromous (living in both fresh and salt water environments)

- salmon ranching
- To build up the salmon runs'
  - build hatcheries upstream
  - transport young salmon around dams
  - makes streams off limits for hydropower
  - obliterate old logging roads to reduce runoff of silt

Too Much Water

- Natural flooding
- Floodplain
- Humans contribute to flood deaths and damage by removing vegetation, living in the floodplains, through urbanization (highways, parking lots, etc.).

How can we reduce flooding risks?

Channelization (straightening and deepening streams)

- reduces upstream flooding, increases upstream bank erosion and downstream flooding and deposition of sediment

Building levees and dams

- increases water's capacity for doing damage downstream
- destruction happens downstream from each levee
- the levee race
- Flood control dam – the reservoir gradually fills up with sediment
- gives a false sense of security

Restoring wetlands

Instituting floodplain management

- The best approach from an environment viewpoint
- "Sooner or later the river (or ocean) always wins"

A Sustainable Water Future

- preserve the ecological integrity of water supply systems
- waste less water
- allow fair access to water
- give people a say in how water resources are developed and used.

Three underlying forces that can lead humans to use water in an unsustainable way:

- depletion or degradation of a shared resource
- population growth
- unequal distribution or access

A key to reducing water waste is for governments to phase out subsidies