Organics in Drinking Water

- natural compounds - decay of biological materials, food processing plants, feedlots
- anthropogenic compounds - insecticides, herbicides, seepage from municipal or industrial waste dumps, sewage, industrial cooling water, deposition from the atmosphere

- often survive drinking water treatment
- potential for adverse health effects

e.g. Great Lakes
  - supply drinking water for millions of people
  - fish in Great lakes have an abnormally high incidence of cancer
  - chemicals detected in water and in fish

- difficult to link cause and effect
  - human exposure via ingestion significantly different from that of fish living in contaminated water
  - exposure is often at levels well below those known to cause toxic effects

Dose Response Curve (Fig 7.4)

- concentrations of environmental concern are almost always below the range of doses where biological responses are observed - must extrapolate to lower doses
- does the dose-response curve remain linear at lower doses?
  - yes - goes through the origin, zero response for zero dose, low dose likely to cause some effect in some people
  - no - there is a threshold dose, below which there is no response
- regardless, effects are observed in fish and this is cause for concern

Geosmin

- natural occurring contaminant in drinking water
- monoterpene produced by *Actinomyces sp*
- smells of newly dug earth or beets cooking - not pleasant in drinking water

Removal of organics

- activated carbon
  - removes most organics
  - finite capacity - must be reactivated
  - expensive
- aeration
  - only effective for volatile species
  - depends on Henry's law equilibration

Read section 7.5 on other water treatments

Waste Disposal

Landfilling

- waste dumped on ground, usually covered with soil
- secured sites designed to minimize seepage
- unsecured sites (most older sites) not
- waste decomposes, ground settles, methane (and other gases) released
- seepage depends on soil type - clay layer above and below used to secure sites and prevent seepage
- leachate can find its way to aquifers leading to contamination far from the site
- once aquifer is contaminated, it is virtually impossible to remediate

e.g. Site in NJ contaminated with 2 tonnes of VOC's

- water pumped out at 1200 L/min
- before remediation, 10 ppm VOC
- after pumping for 6 years, <0.1 ppm
- 4 years after pumping ceased, 13 ppm
- remediation efforts did not address source of contamination

- unsecured sites are also sources of air pollution

e.g. Majority of airborne PCB's over US are from transformers dumped in hazardous waste dumps

Industrial Waste

e.g. Love Canal

- late 1800's, canal to by-pass Niagara Falls was supposed to provide hydroelectric power but failed financially
- left open ditch 15 m wide, 1.6 km long and 3-13 m deep
- starting in the 1940's the ditch was used for chemical disposal
- eventually filled with 20 000 t of waste and sealed with a clay cap
- homes built around area, roads crossed it (breaching clay cap), school built on the site
- 1970's, rain/snow infiltrate breached cap, toxic chemicals found in school yard and basements of nearby homes
- people evacuated, relocated, houses expropriated
- US$140 million spent in an attempt to rehabilitate the area
- 2 areas still considered uninhabitable

- unfortunately residential development on old dump sites in not uncommon and can create a myriad of problems for homeowners including settling of the land, and chemical contamination