Water Pollution
Reading
• Today Ch. 16
• Wed Ch. 12 to page 292

Point and Non-Point Sources
Point: Easier to recognize and monitor
Non-Point: Diffuse sources, often difficult to identify and monitor

Residence Time
Reservoir Capacity/Steady State Flux = 20 minutes
20 gallons
1 gallon/minute
1 gallon/minute

Surface Water Transport and Storage by Water and Sediment
Sediment residence time > water residence time

Table 16.1
Residence Times of Selected Major and Minor Elements in Seawater with Respect to Modern Influx Through Surface Runoff

<table>
<thead>
<tr>
<th>Element</th>
<th>Concentration (ppm)</th>
<th>Residence Time (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>chlorine</td>
<td>18.98 (1.9%)</td>
<td>66,000,000</td>
</tr>
<tr>
<td>sodium</td>
<td>16,580 (1.0%)</td>
<td>109,000,000</td>
</tr>
<tr>
<td>magnesium</td>
<td>1275</td>
<td>12,000,000</td>
</tr>
<tr>
<td>calcium</td>
<td>880</td>
<td>1,000,000</td>
</tr>
<tr>
<td>potassium</td>
<td>780</td>
<td>7,000,000</td>
</tr>
<tr>
<td>bromine</td>
<td>40</td>
<td>100,000,000</td>
</tr>
<tr>
<td>silicon</td>
<td>3.0</td>
<td>100,000</td>
</tr>
<tr>
<td>phosphorus</td>
<td>0.07</td>
<td>100,000</td>
</tr>
<tr>
<td>aluminum</td>
<td>0.01</td>
<td>100</td>
</tr>
<tr>
<td>iron</td>
<td>0.01</td>
<td>100</td>
</tr>
<tr>
<td>nitrogen</td>
<td>0.0004</td>
<td>100,000</td>
</tr>
<tr>
<td>mercury</td>
<td>0.000008</td>
<td>100,000</td>
</tr>
<tr>
<td>lead</td>
<td>0.000003</td>
<td>100</td>
</tr>
</tbody>
</table>
Feedlots

Industrial Discharges

Surface Water
Point Sources

Sewage Effluent
Reduced dissolved oxygen due to decay of organics

Algal blooms (eutrophication) due to nutrient release
Further reduction in DO

Surface Water
Deposition of Airborne Contaminants

DDT persistence

Mercury Sources and Bioaccumulation

Surface Water
Agricultural Contaminants

Herbicides and Pesticides

N and P Fertilizers leading to Eutrophication
Surface Water

Sediment

Sediment control with detention ponds

- Turbid water
- Reduces light
- Blankets fish food and nests
- Fills lakes or reservoirs
- May provide a source of nutrients

Surface Water

Contaminated Sediment - Fox River PCBs

Carbonless copy paper production led to approx. 30 million lbs of PCBs between 1954 and 1971

Surface Water

Sediment Remediation Options

Dredging
Releases PCBs to the water column during removal process
Dredged sediment must be disposed of in a secure landfill

In-situ containment
Potential for erosion and transport during high flows

Surface Water

Aeration to Reverse Eutrophication

BEFORE
AFTER
Ground Water
Superfund Remediation Strategies

Common Remediation Strategies

Source Removal
Pump-and-Treat

Remediation Strategies

Pump-and-Treat with Barrier
Steam Injection, Vacuum Extraction

Remediation Strategies

Natural Attenuation by Biodegradation
Ground Water Remediation Strategies

Permeable Reactive Barriers