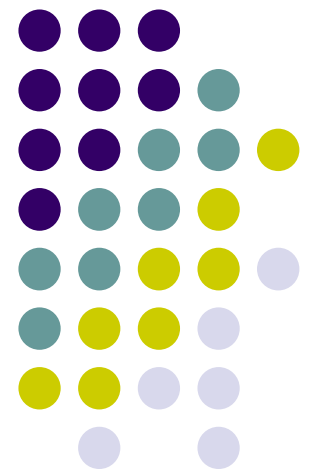


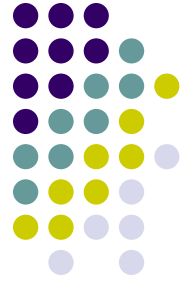
Hazardous Wastes

CE 326 Principles of
Environmental Engineering

February 11, 2008

Tim Ellis, Ph.D., P.E.

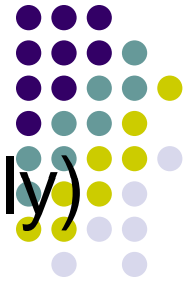




Hazardous Wastes

- Scope of the Hazardous Waste Problem- 250 M per year in U.S. (300-500 world-wide)
- Hazardous Wastes Generators: 20,000
- Treatment Storage and Disposal Facilities (TSDF): 3000
- 93% of hazardous wastes managed by: 60 TSDF's





- Chemical Products Industry (\$125b annually) contributes 50% of hazardous wastes
- Number of Chemicals – 70,000
- New Chemicals Manufactured every year:
1500
- Abandoned Hazardous Wastes
Sites: 50,000





Superfund

- In 1980 Congress passed the

C *omprehensive*

E *nvironmental*

R *esponse*

C *ompensation* and

L *iability*

A *ct*

CERCLA - Superfund





Superfund

- \$1.6b from taxes on c*ru*d*e* o*i*l & commercial chemicals
- every state had to compile a list of hazardous waste sites and submit it to EPA
 - N*a*t*i*o*n*a*l* P*r*io*r*it*i*e*s* L*i*st (NPL)





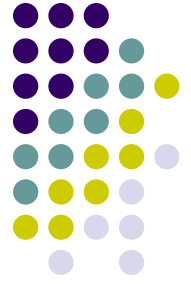
Superfund

- EPA prioritized these sites based on the potential hazard from g*roundwater* (S_{GW}), s*urface* water (S_{SW}), and a i*r* exposure (S_A):

$$S_M = \frac{1}{1.73} \sqrt{S_{GW}^2 + S_{SW}^2 + S_A^2}$$

where S_M is the composite score





Superfund

- There are 1300 sites on the list
- Only 200 sites have been cleaned up
- There are 3 unique things about Superfund
 - 1) ● Ex post facto
 - party can be liable for actions that were previously legal
 - potentially responsible party
 - 2) ● innocent landowner liability
 - anyone who buys property contaminated with hazardous wastes can be liable
 - only way to avoid liability is to make “an appropriate inquiry” prior to purchase



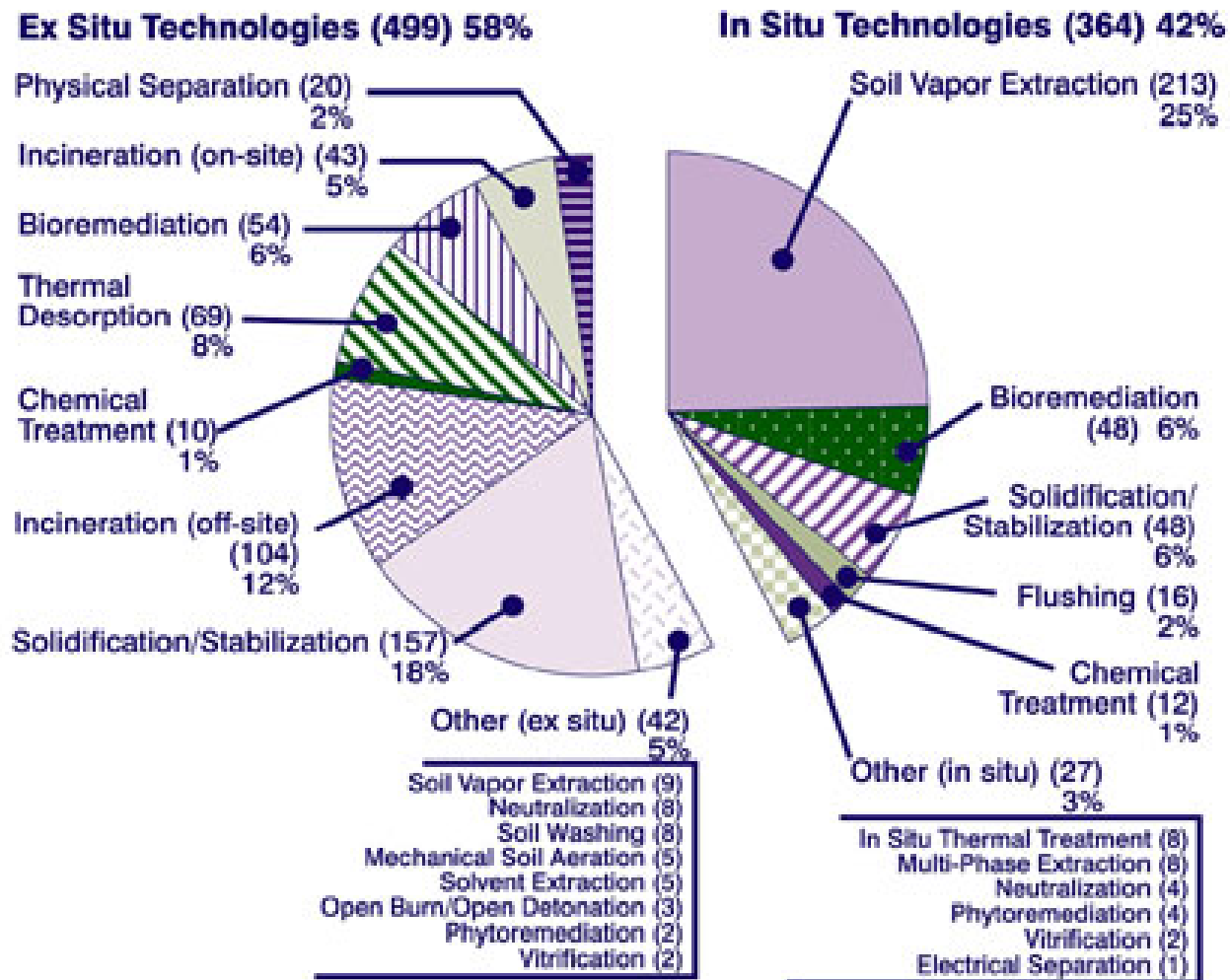
Superfund

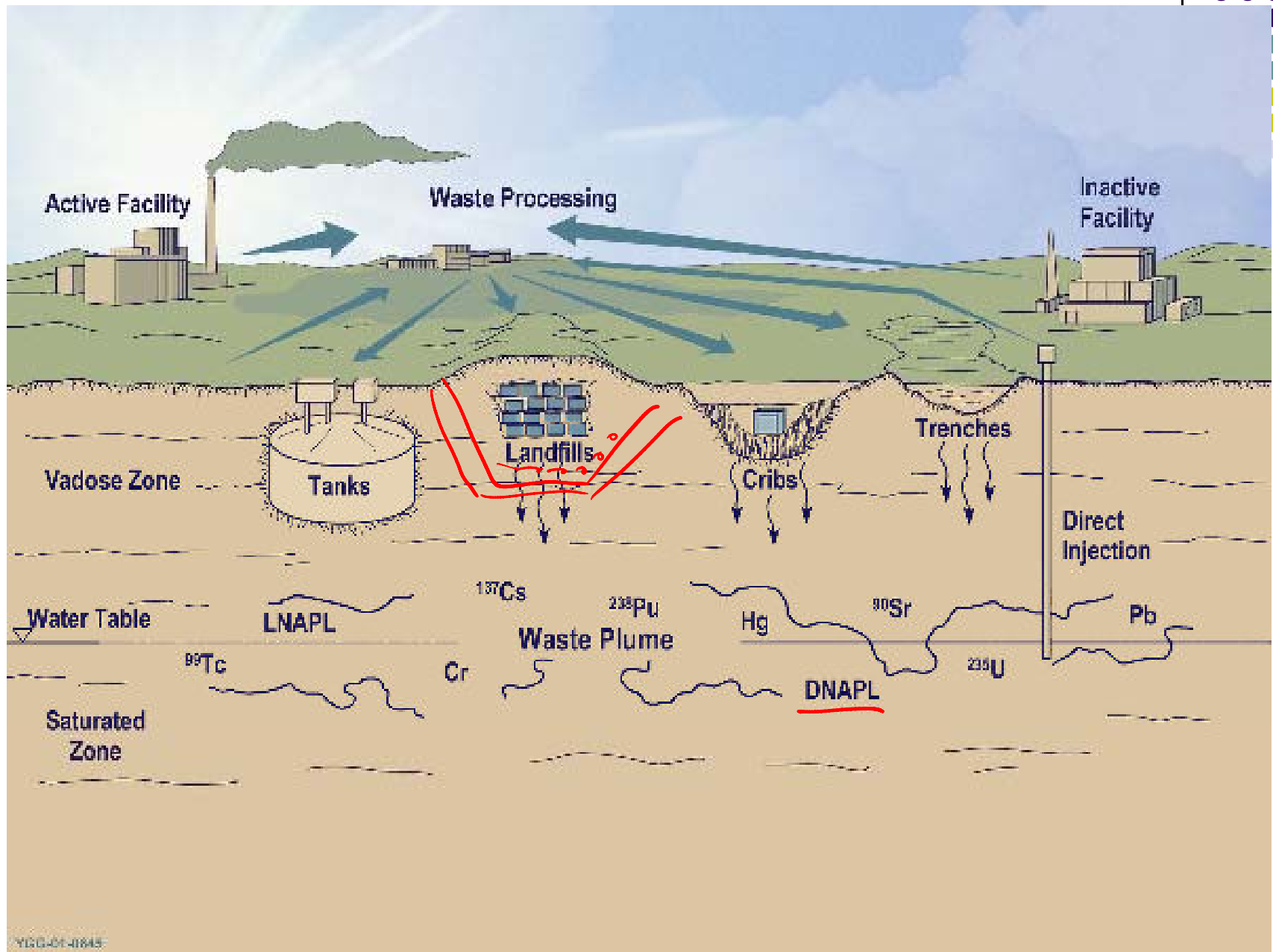
- Joint & Several Liability
 - liability can be shared between parties or any one party may be liable for entire cleanup
 - “deep pockets”
 - EPA only needs to sue one party
 - that party must sue other parties to recoup cleanup cost

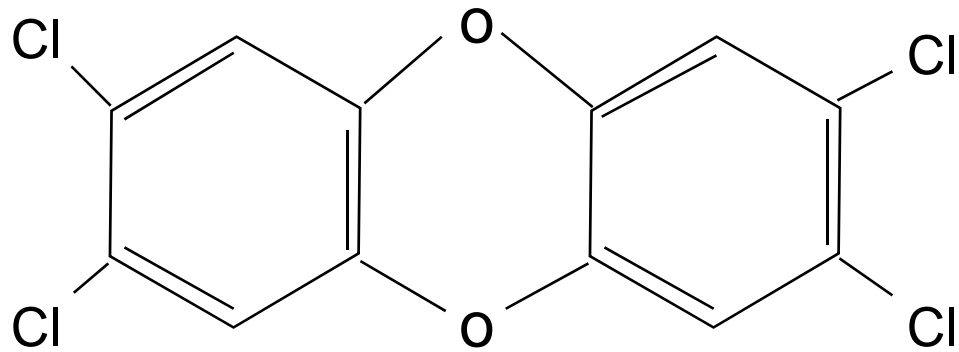




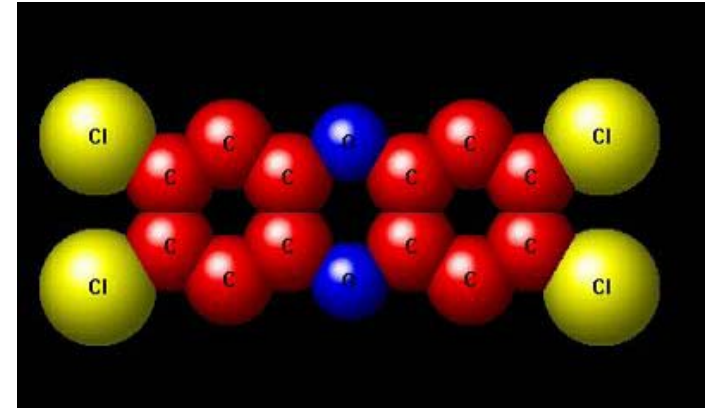
**Figure 7: Superfund Remedial Actions:
Source Control Treatment Projects (FY 1982 - 2002)***





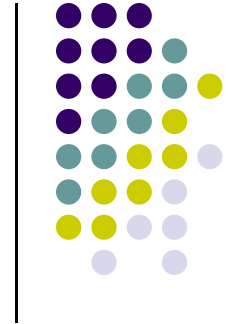
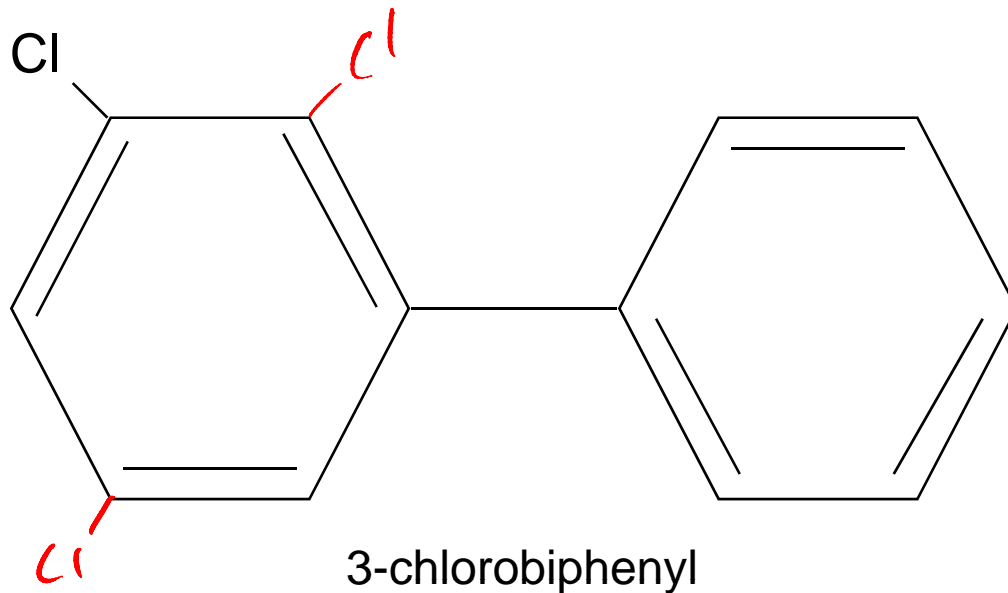


2,3,7,8 TCDD



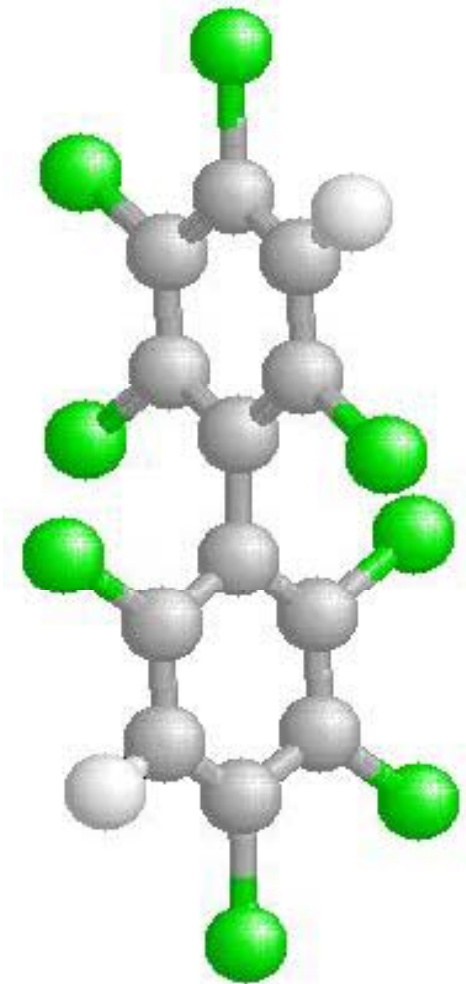
dioxin

- dibenzo - p - dioxin
- over twenty different isomers
- byproduct of herbicide/pesticide manufacture
- created during incineration of hazardous wastes
- contaminant in 2,4-D, agent orange and others
- carcinogenic, teratogenic, mutagenic, embryo-toxic
in animal studies ↳ birth defects
- bioaccumulate in fatty tissue
- no known link to human effects




polychlorinated biphenyl (PCB)

- over 200 isomers
- different chlorine composition (Araclor 1248)
- virtually indestructible - useful as transformer fluid (in every transformer: 1930 - 1970)
- toxic effects to exposed workers noted in 1937
- environmental contamination realized in 1969
- 1.26 pounds produced prior to 1977
- led to Toxic Substances Control Act of 1976



What makes a waste hazardous?

- Potentially dangerous to human health or the environment
- Causes adverse physiological effects
- Official EPA definition
 - On EPA list (it must be discarded to be classified as a waste) or
 - Exhibits certain characteristics



Hazardous Waste Accumulation Area

Hazardous Waste in this area will be picked up on a regular basis.

Don't forget Special wastes: Batteries, aerosols, e-waste, sharps, lamps, ballasts, mercury thermometers. Visit our web site for more details:
www.safety.uwm.edu

Link tag number on carboy to inventory sheet	Contents
10046	2-Propanol
10047	Phenol
10048	Toluene

Label container completely with the full name of the chemical (no abbreviations, symbols, or structures).
US&A cannot pick up unknown chemicals!

If your container is full before your scheduled pick up, call x4999 or 2883. Please give your name, building, room#, how many containers you need and a brief description of the waste.

University Safety & Assurances
www.safety.uwm.edu

RCRA - haz wastes
CERCLA - abandoned sites

Listed Wastes (Appendix C)

- F Wastes
 - from non-specific sources
 - e.g. chlorinated solvents
 - Trichloroethylene *TCE*
 - Methylene chloride
- K Wastes
 - from specific sources
 - e.g. wood preserving wastes (contain creosote and possibly arsenic)



Listed Wastes (Appendix C)

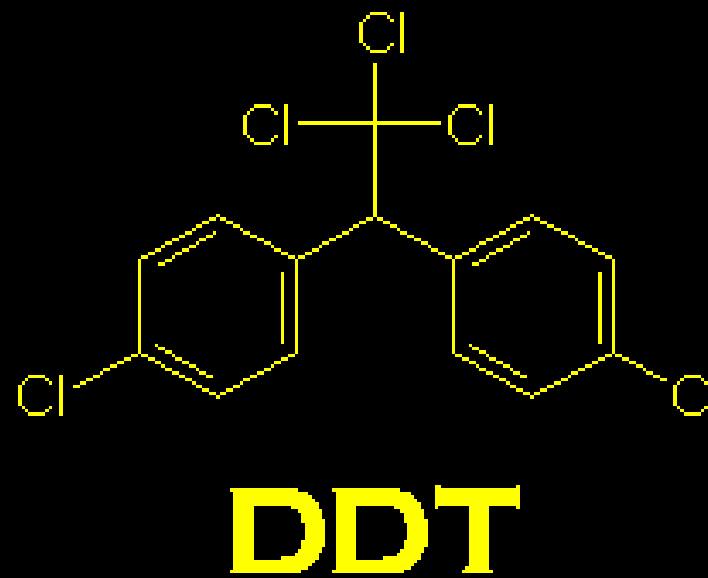
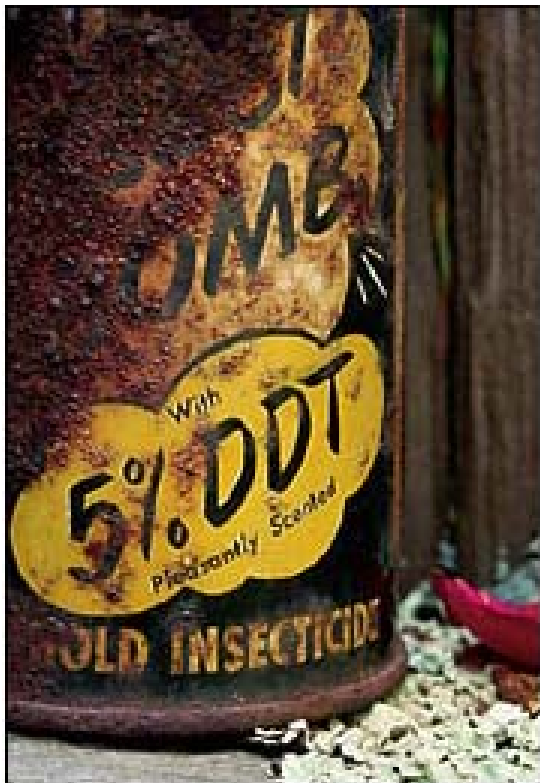
- P Wastes
 - off spec products and intermediates
 - acuteley toxic
 - e.g. toxaphene
- U Wastes
 - off spec products and intermediates
 - generally toxic
 - DDT





DDT

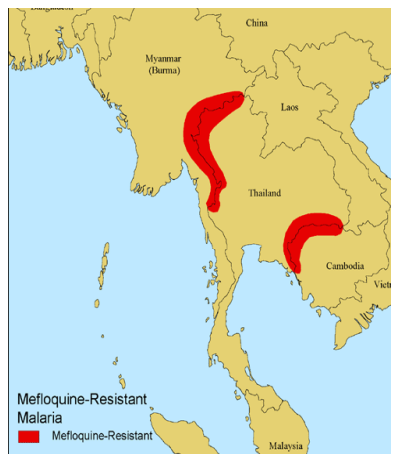
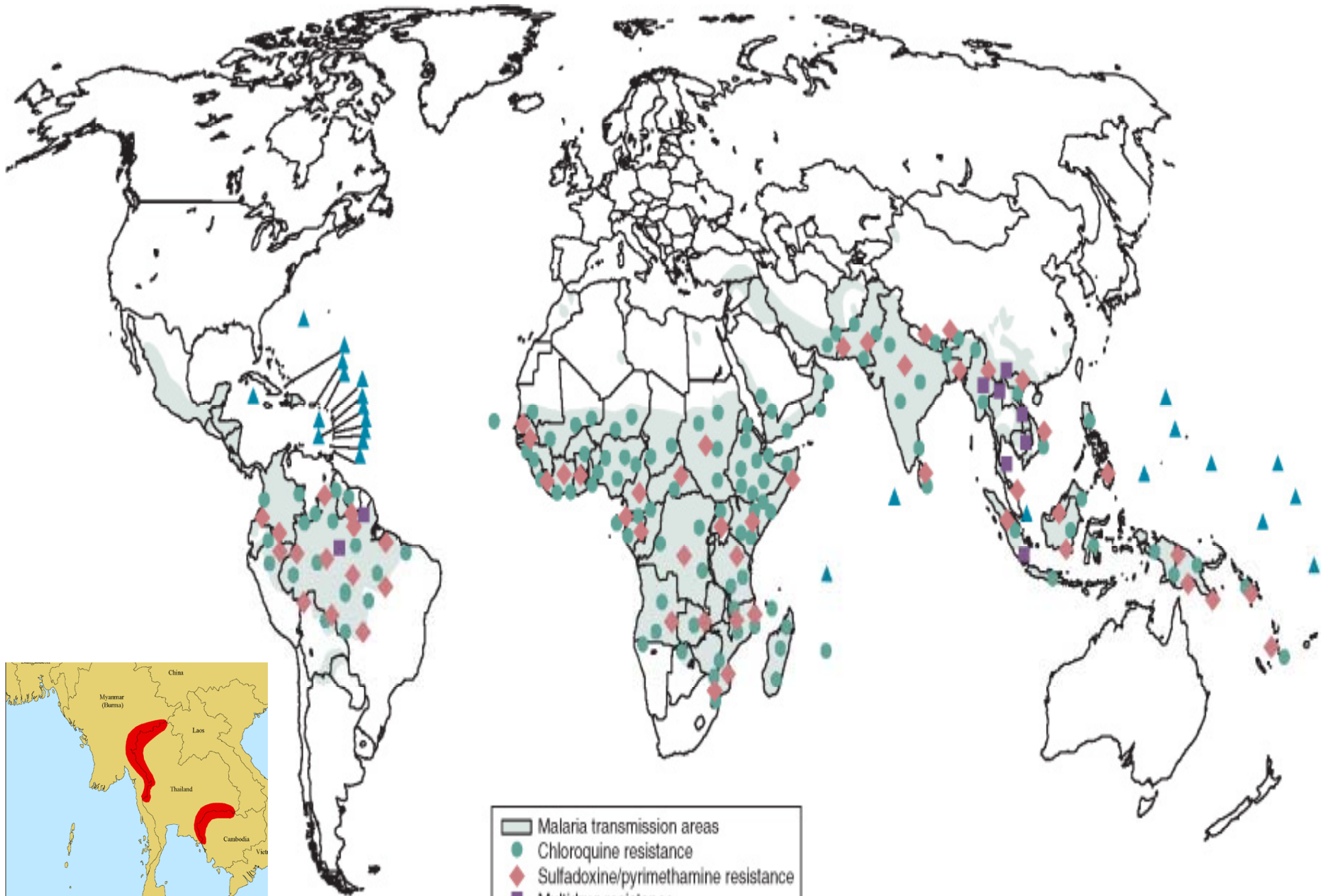
- Organochlorine



The Panama Canal (1905-1910)

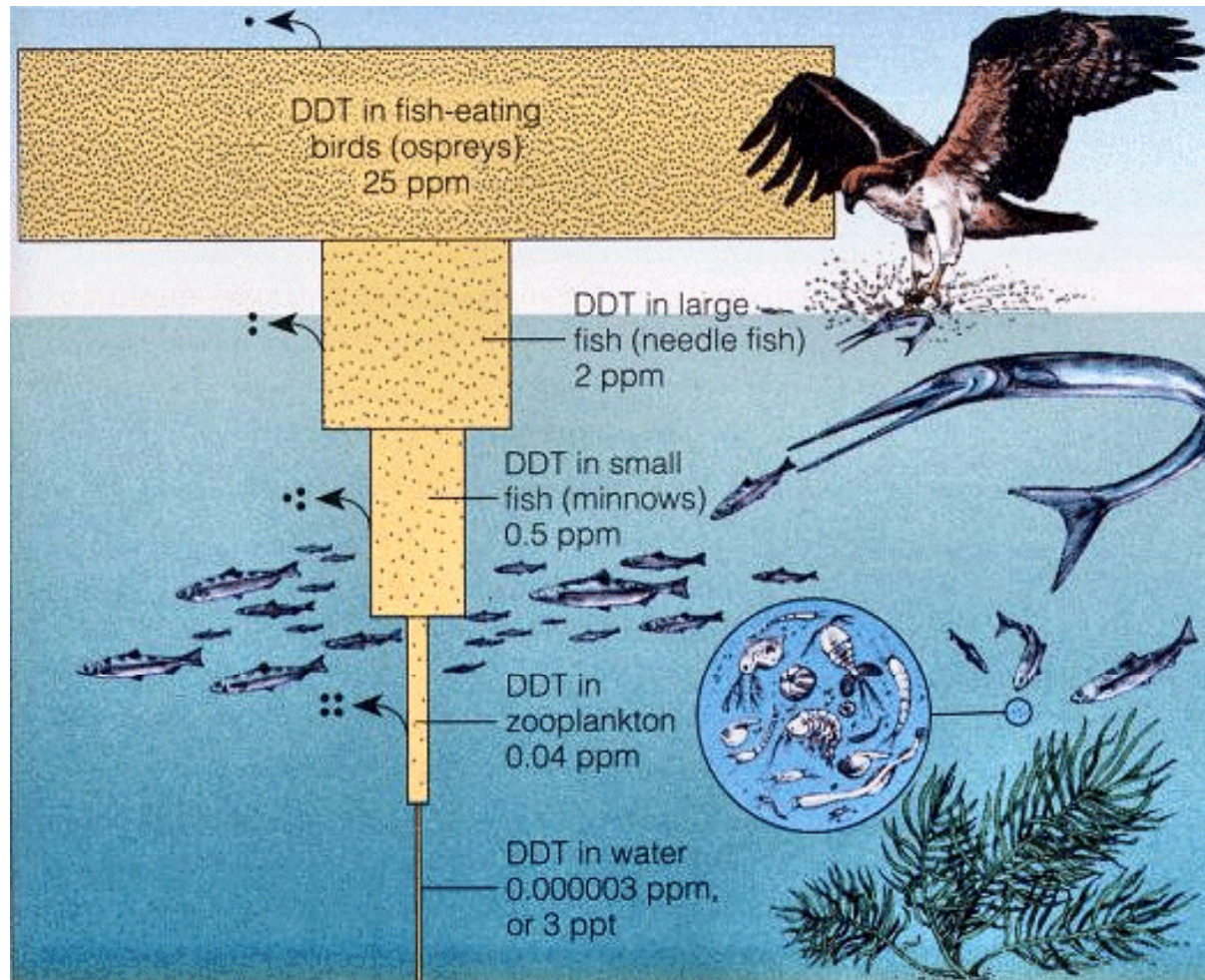
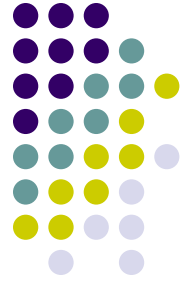
- The construction of the Panama Canal was possible only after yellow fever and malaria were controlled.
 - These diseases were a major cause of death and disease among workers.
- In 1906, there were over 26,000 employees working on the Canal.
 - 21,000 were hospitalized for malaria during their work.
 - By 1912, there were over 50,000 employees, and the number hospitalized decreased to 5,600.
 - They used an integrated program of insect and malaria control.





- Malaria transmission areas
- Chloroquine resistance
- Sulfadoxine/pyrimethamine resistance
- Multidrug resistance
- Malaria-free islands

Biomagnification



Characteristic Wastes

- Ignitibility
 - Liquid with $< 24\%$ alcohol
 - Has a flash point $< 60^{\circ}\text{C}$
 - Capable of spontaneous combustion
 - Ignitable compressed gas
 - oxidizer



Characteristic Wastes

- Corrosivity
 - Aqueous pH ~~<~~ 2 or ~~>~~ 12.5
 - Corrodes steel at a rate of 6.35 mm/y at 55°C



Characteristic Wastes

- Reactivity
 - Normally unstable
 - Reacts violently with water
 - Forms explosive mixtures with water
 - Generates toxic vapors
 - Cyanide or sulfur containing waste



Characteristic Wastes

- Toxicity (EP Toxicity test)
 - Liquid extract from acid extraction has to meet the required standard
 - e.g.:
 - ~~5~~ 5.0 mg/L arsenic
 - ~~5~~ 0.5 mg/L benzene
 - ~~5~~ 0.20 mg/L vinyl chloride



EP Toxicity

EPA HW No. ^a	Constituent	Regulatory level (mg/L)
D004	Arsenic	5.0
D005	Barium	100.0
D018	Benzene	0.5
D006	Cadmium	1.0
D019	Carbon tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium	5.0
D023	o-Cresol	200.0 ^b
D024	m-Cresol	200.0 ^b
D025	p-Cresol	200.0 ^b
D026	Cresol	200.0 ^b
D016	2,4-D	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13 ^c
D012	Endrin	0.02
D031	Heptachlor (and its epoxide)	0.008
D032	Hexachlorobenzene	0.13 ^c
D033	Hexachloro-1,3-butadiene	0.5
D034	Hexachloroethane	3.0
D008	Lead	5.0
D013	Lindane	0.4
D009	Mercury	0.2
D014	Methoxychlor	10.0
D035	Methyl ethyl ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0 ^c
D010	Selenium	1.0
D011	Silver	5.0
D039	Tetrachloroethylene	0.7
D015	Toxaphene	0.5
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D017	2,4,5-TP (Silvex)	1.0
D043	Vinyl chloride	0.2

Cradle to Grave

- RCRA requires a manifest system to track hazardous wastes from its source of generation to ultimate disposal
- Generator required to maintain records and assume responsibility for the waste along the way



UNIFORM HAZARDOUS WASTE MANIFEST	1. Generator's US EPA ID No.	Manifest Document No.	2. Page 1 of	Information in the shaded areas is not required by Federal law.
3. Generator's Name and Mailing Address			A. State Manifest Document Number	
4. Generator's Phone ()				
5. Transporter 1 Company Name 6.				
7. Transporter 2 Company Name 8.				
9. Designated Facility Name and Site Address 10.				

EPA Uniform Hazardous Waste Manifest

Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2000-0404. Expires 7-31-86

UNIFORM HAZARDOUS WASTE MANIFEST	1. Generator's US EPA ID No.	Manifest Document No.	2. Page 1 of	Information in the shaded areas is not required by Federal law.
3. Generator's Name and Mailing Address			A. State Manifest Document Number	
4. Generator's Phone ()				
5. Transporter 1 Company Name 6.				
7. Transporter 2 Company Name 8.				
9. Designated Facility Name and Site Address 10.				
11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)			12. Containers No. Type	13. Total Quantity
14. Unit Wt/vol			L. Waste No.	
J. Additional Descriptions for Materials Listed Above			K. Handling Codes for Wastes Listed Above	
15. Special Handling Instructions and Additional Information				
16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classed, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations. Unless I am a small quantity generator who has been exempted by statute or regulation from the duty to make a waste minimization certification under Section 3002(b) of RCRA, I also certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and I have selected the method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment.				
Printed/Typed Name			Signature Month Day Year	
17. Transporter 1 Acknowledgement of Receipt of Materials				
Printed/Typed Name			Signature Month Day Year	
18. Transporter 2 Acknowledgement of Receipt of Materials				
Printed/Typed Name			Signature Month Day Year	
19. Discrepancy Indication Space				
20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.				
Printed/Typed Name			Signature Month Day Year	

Hazardous Waste Landfill

