

Toxicology 103: Toxics and Regulation

Amy L. Babcock, MPH

Michigan Department of Natural Resources and Environment

517-373-1046

babcocka@michigan.gov

Saginaw Bay Coastal Initiative Speakers Series
May 5, 2010



Extremely Basic “Civics”

- Three branches of government:
 - **Legislative** – makes laws
 - **Executive** – enforces laws
 - **Judicial** – interprets laws

- State laws must be at least as stringent as federal laws



(Some) Federal Environmental Statutes...

- CAA
- CWA
- CZMA
- CERCLA (Superfund)
- EPCRA
- ESA
- FFDCA
- FIFRA
- FQPA
- NEPA
- RCRA
- RHA
- SDWA
- TSCA

...and their Regulatory Agencies



- Army Corps of Engineers
- Environmental Protection Agency
- Fish and Wildlife Service
- Food and Drug Administration
- National Oceanic & Atmospheric Administration



(Some) Michigan Environmental Laws

- PA 368 of 1978 – Public Health Code
- PA 396 of 2002 – Great Lakes Water Quality Bond Authorization Act
- PA 399 of 1976 – Safe Drinking Water Act
- PA 451 of 1994 – Natural Resources and Environmental Protection Act

NREPA's Purpose

- ...to **protect the environment and natural resources of the state**; to codify, revise, consolidate, and classify laws relating to the environment and natural resources of the state; to **regulate the discharge** of certain substances into the environment; to **regulate the use** of certain lands, waters, and other natural resources of the state; to **prescribe the powers and duties** of certain state and local agencies and officials; to provide for certain charges, **fees**, assessments, and donations; to provide certain **appropriations**; to prescribe **penalties** and provide **remedies**; and to repeal acts and parts of acts.



Contents of NREPA

- Article I – General Provisions
- Article II – Pollution Control
- Article III – Natural Resources Management
- Article VII – Repeals
- Articles I-III broken into “Chapters”
 - Chapters broken into “Parts”
 - Some “Parts” have “Parts”

Article II, Ch. 1 – Point Source Pollution Control

- Part 31, Water Resources Protection, states:
 - “A person shall not discharge any waste or waste effluent into the waters of this state unless the person is in possession of a valid permit from the department.”
- Administrative Rules found at:
 - Part 4 – Water Quality Standards
 - Part 8 – Water Quality-Based Effluent Limits
 - Part 22 – Groundwater Quality



Article II, Ch. 1 – Point Source Pollution Control (cont'd)

- Part 41 – Sewerage Systems
- Part 55 – Air Pollution Control
 - Part 2 covers air toxics (including Hg and “criteria pollutants”)
 - Part 15 regulates Hg emissions from coal-fired power plants

Article II

- Ch. 2 – Nonpoint Source Pollution Control
- Ch. 3 – Waste Management
 - Part 111 – Hazardous Waste Management
 - Part 115 – Solid Waste Management
 - Part 121 – Liquid Industrial Waste
- Ch. 4 – Pollution Prevention
- Ch. 5 – Recycling and Related Subjects
- Ch. 6 – Environmental Funding

Article II (cont'd)

- Ch. 7 – Remediation
 - Part 201 – Environmental Remediation
 - Part 7 – Cleanup Criteria
- Ch. 8 – Underground Storage Tanks
 - Part 211 – Underground Storage Tank Regs.
 - Part 213 – Leaking Underground Storage Tanks

Article III – Natural Resources Management

- Ch. 1 – Habitat Protection
- Ch. 2 – Management of Renewable Resources
- Ch. 3 – Management of Nonrenewable Resources
- Ch. 4 – Recreation

“Rule 57” of Part 4 (of Part 31)

- “Toxic substances shall not be present in the surface waters of the state at levels that are or may become injurious to the public health, safety, or welfare, plant and animal life, or the designated uses of the waters.”
- Describes in detail (30 pages) how levels are set

“Designated Uses”

- Industrial, agricultural, and public water supply
- Recreation
- Warmwater and coldwater fisheries, other aquatic life, and wildlife
- Navigation

Rule 57 Aquatic Values

- **Final Acute Value** used to calculate the **Aquatic Maximum Value**
 - "...highest concentration...to which an aquatic community can be exposed briefly without resulting in unacceptable effects..."
 - $FAV \div 2 = AMV$
 - FAV is "end-of-pipe"; AMV is "ambient"
- Requires EC_{50} or LC_{50} data from tests lasting from 48 hours to 96 hours

FAV Calculation

(vii) Using the 4 selected GMAVs, and Ps, calculate the tier I FAV as follows:

$$S^2 = \frac{\sum ((\ln \text{GMAV})^2) - \frac{(\sum (\ln \text{GMAV}))^2}{4}}{\sum (P) - \frac{(\sum (\sqrt{P}))^2}{4}}$$

$$L = \frac{\sum (\ln \text{GMAV}) - S(\sum (\sqrt{P}))}{4}$$

$$A = S(\sqrt{0.05}) + L$$

$$\text{Tier I FAV} = e^A.$$

Rule 57 Aquatic Values (cont'd)

- **Final Chronic Value** – level that prevents “injurious or debilitating effects” from “repeated long-term exposure...relative to the organism’s lifespan...”



- Requires life cycle test data or use defaults
 - 7-day (ceriodaphnids)
 - 21-day (daphnids)
 - 24-day (fish)
 - 90-day (salmonids)

FCV Calculation

(K) The tier I FCV equation is written as follows:

$$\text{tier I FCV} = e^{(L[\ln \text{ water quality characteristic}] + S - L[\ln Z])}$$

Where:

L = pooled chronic slope.

S = ln(tier I FCV at Z).

Z = selected value of the water quality characteristic as used in subparagraph (h) of this paragraph.

Rule 57 Wildlife Value

- "...maximum ambient water concentration...at which adverse effects are not likely to result in population-level impacts...from lifetime exposure through drinking water and aquatic food supply..."
- Calculated for BCCs only
- Designed to protect fish-eating organisms

WV Calculation

(a) Tier I wildlife values for the BCCs listed in table 5, with the exception of the wildlife values listed in table 4, shall be calculated using the following equation:

$$WV = \frac{\frac{TD}{UF_A \times UF_S \times UF_L} \times Wt}{W + \sum(F_{TLi} \times BAF_{TLi}^{WL})}$$

Rule 57 Wildlife Values

- Mammalian species represented by

- Mink
- Otter



- Avian species represented by

- Eagle
- Kingfisher
- Herring gull



Rule 57 Human Health Values

- **Human Cancer Value:**
“...maximum ambient water concentration ...at which a lifetime of exposure...will represent...risk of contracting cancer of **1 in 100,000...**”
- **Human Noncancer Value:**
“...maximum ambient water concentration...at which adverse noncancer effects are **not likely to occur...**from lifetime exposure...”

HCV and HNV Calculation

(d) Human health cancer values shall be derived using the following equation:

$$\text{HCV} = \frac{\text{RAD} \times \text{BW}}{\text{WC} + [(\text{FC}_{\text{TL3}} \times \text{BAF}_3) + (\text{FC}_{\text{TL4}} \times \text{BAF}_4)]}$$

(e) Human noncancer values shall be derived using the following equation:

$$\text{HNV} = \frac{\text{ADE} \times \text{BW} \times \text{RSC}}{\text{WC} + [(\text{FC}_{\text{TL3}} \times \text{BAF}_3) + (\text{FC}_{\text{TL4}} \times \text{BAF}_4)]}$$

Key Assumptions in HCVs & HNVs

- Drinking water intake = 2 L/d
- “Incidental ingestion” = 0.01 L/d
- Total fish consumption of 15 g/d
 - Bioaccumulation in fish is accounted for
- Body weight = 70 kg
- Lifetime = 70 years
- HNVs assume 80% of exposure due to water

Rule 57 "Drivers" (in ug/L)

Carcinogen and/or high BAF result in very small acceptable concentrations

HCV_{drink/nondrink}

- PCBs – 0.000026
- Chlordane – 0.00025
- Toxaphene – 0.000068

Wildlife Value

- 2,3,7,8-TCDD – 0.00000000031
- Mercury – 0.0013
- DDT – 0.000011

“Rule 2204” of Part 22 (of Part 31)

- “The discharge shall not be, or not be likely to become, injurious.”
- “...the discharge shall not create a facility as defined in part 201...”
- Part 22 discharges default to Part 201 Generic Residential Drinking Water Criteria

Part 201 DWC Calculation

EQUATION FOR CARCINOGENIC EFFECTS:

$$DWC = \frac{TR \times BW \times AT \times CF}{SF \times EF \times ED \times IR_{dw}}$$

EQUATION FOR NONCARCINOGENS:

$$DWC = \frac{THQ \times RfD \times BW \times AT \times RSC \times CF}{EF \times ED \times IR_{dw}}$$

Part 201 (of NREPA)

Establishes groundwater and soil cleanup criteria for several exposure pathways and zoning classifications

Groundwater

- Drinking water
- Venting to surface water
- Volatilization to indoor air
- Direct contact

Soil

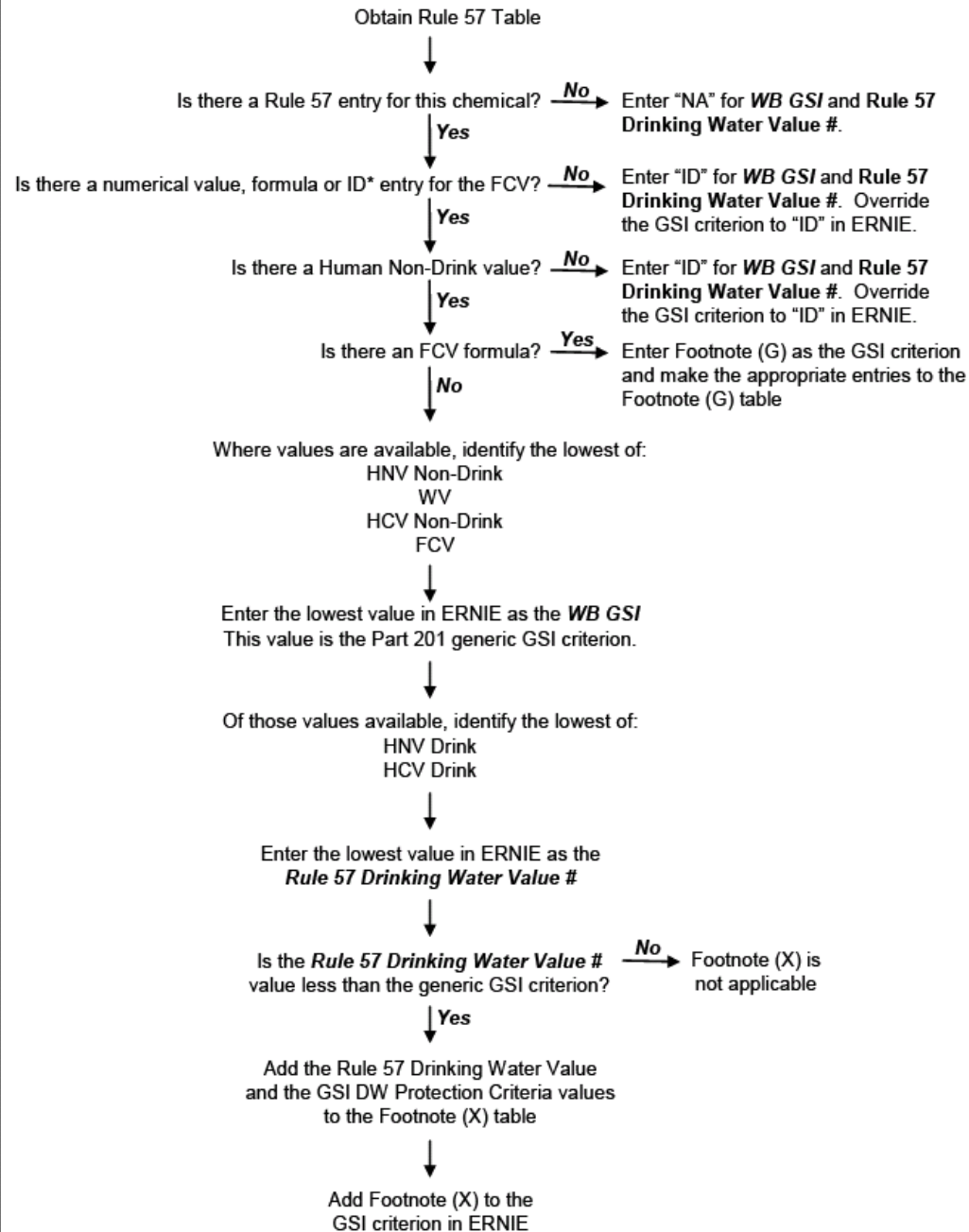
- Protection of groundwater
- Volatilization to indoor air and ambient air
- Inhalation of particulate matter
- Direct contact

Cleaning Up the Toxics of Concern

	Groundwater	Soil
PCBs	*	*
2,3,7,8-TCDD	0.00001 (GSI)	0.09 (DCC)
Mercury	0.0013 (GSI)	50 (GSIP)
Chlordane	2.0 (DWC)	31000 (DCC)
DDT	0.02 (GSI)	57000 (DCC)
Toxaphene	1.0 (GSI)	860 (GSIP)

All values in ppb (i.e., ug/L for groundwater and ug/kg for soil)





Determining Part 201 Generic GSI

Where values are available, identify the lowest of:

HNV Non-Drink

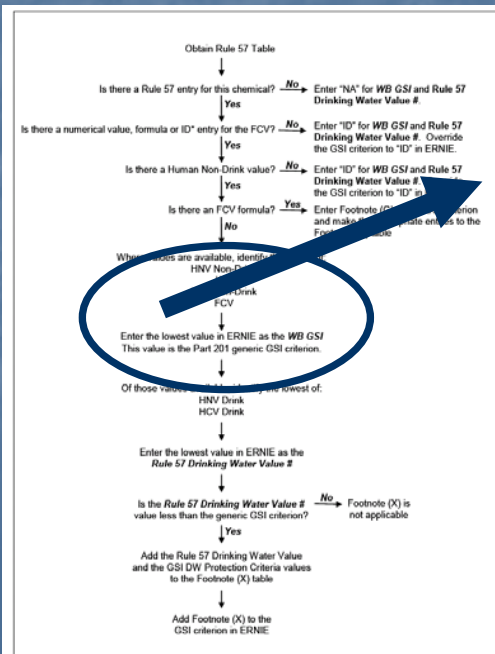
WV

HCV Non-Drink

FCV



Enter the lowest value in ERNIE as the **WB GSI**
This value is the Part 201 generic GSI criterion.



Part 201 DCC Calculation

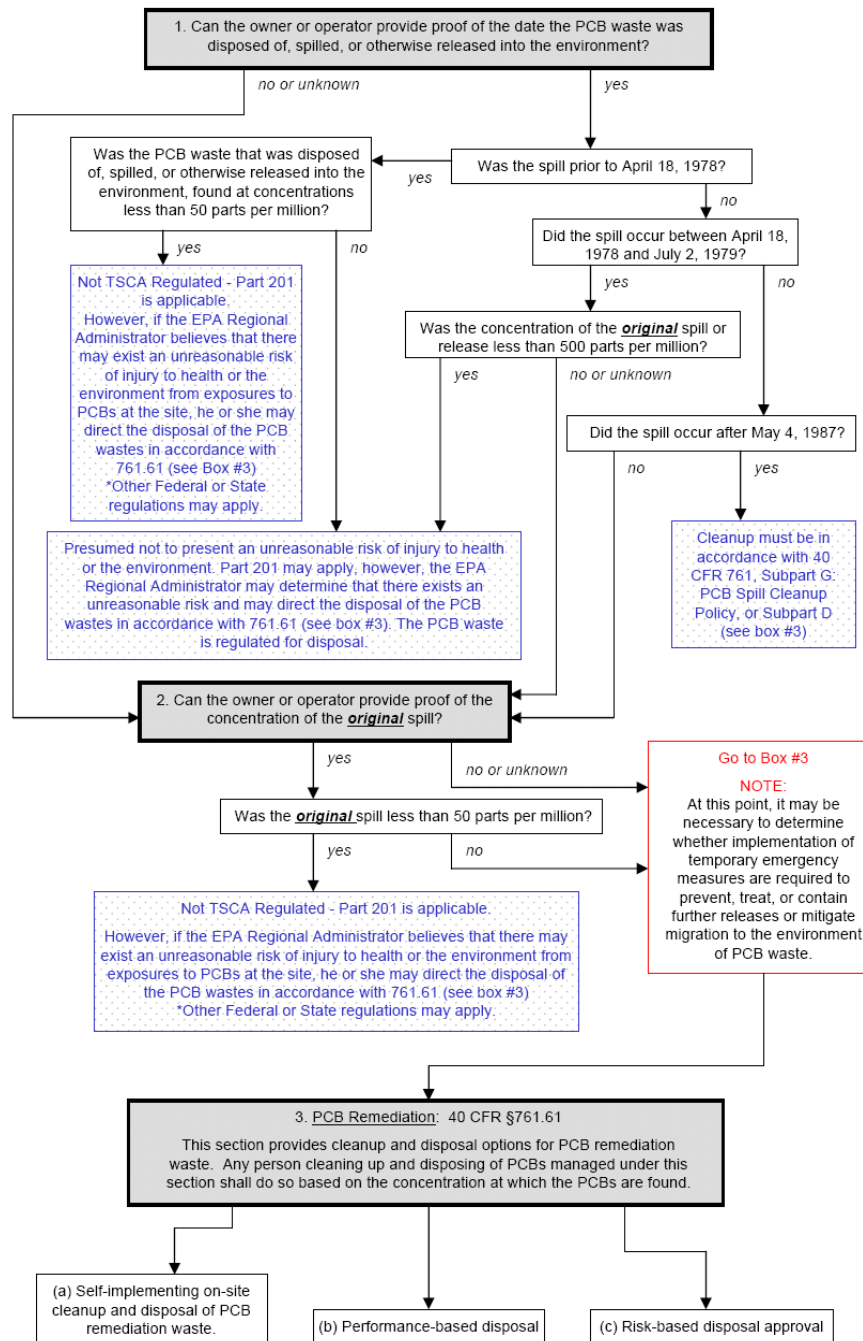
EQUATION FOR CARCINOGENS:

$$DCC = \frac{TR \times AT \times CF}{SF \times [(EF_i \times IF \times AE_i) + (EF_d \times DF \times AE_d)]}$$

EQUATIONS FOR NONCARCINOGENS:

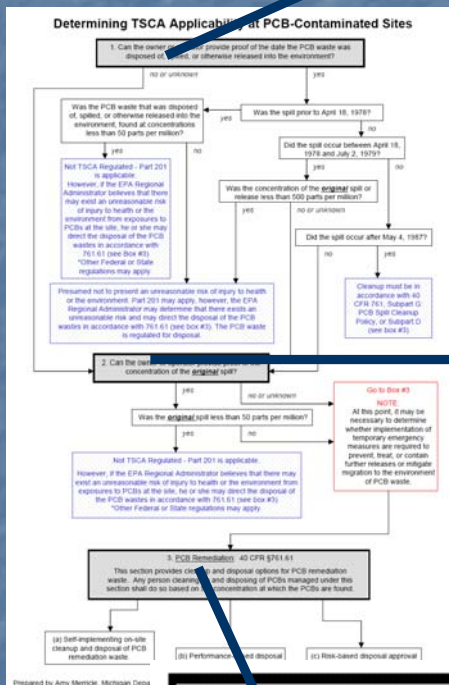
$$DCC = \frac{THQ \times RfD \times AT \times CF \times RSC}{[(EF_i \times IF \times AE_i) + (EF_d \times DF \times AE_d)]}$$

Determining TSCA Applicability at PCB-Contaminated Sites



Determining PCB Cleanup Approach

1. Can the owner or operator provide proof of the date the PCB waste was disposed of, spilled, or otherwise released into the environment?



2. Can the owner or operator provide proof of the concentration of the original spill?

3. PCB Remediation: 40 CFR §761.61

This section provides cleanup and disposal options for PCB remediation waste. Any person cleaning up and disposing of PCBs managed under this section shall do so based on the concentration at which the PCBs are found.

Links to More Information

- <http://www.legislature.mi.gov>
- http://www.michigan.gov/deq/0,1607,7-135-3307_4132---,00.html
- <http://www.epa.gov/lawsregs/>

