SURFACE WATER QUALITY REGULATIONS AND IMPACTS ON SURFACE WATER AND SEDIMENTS

ENVE 264

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Presented by

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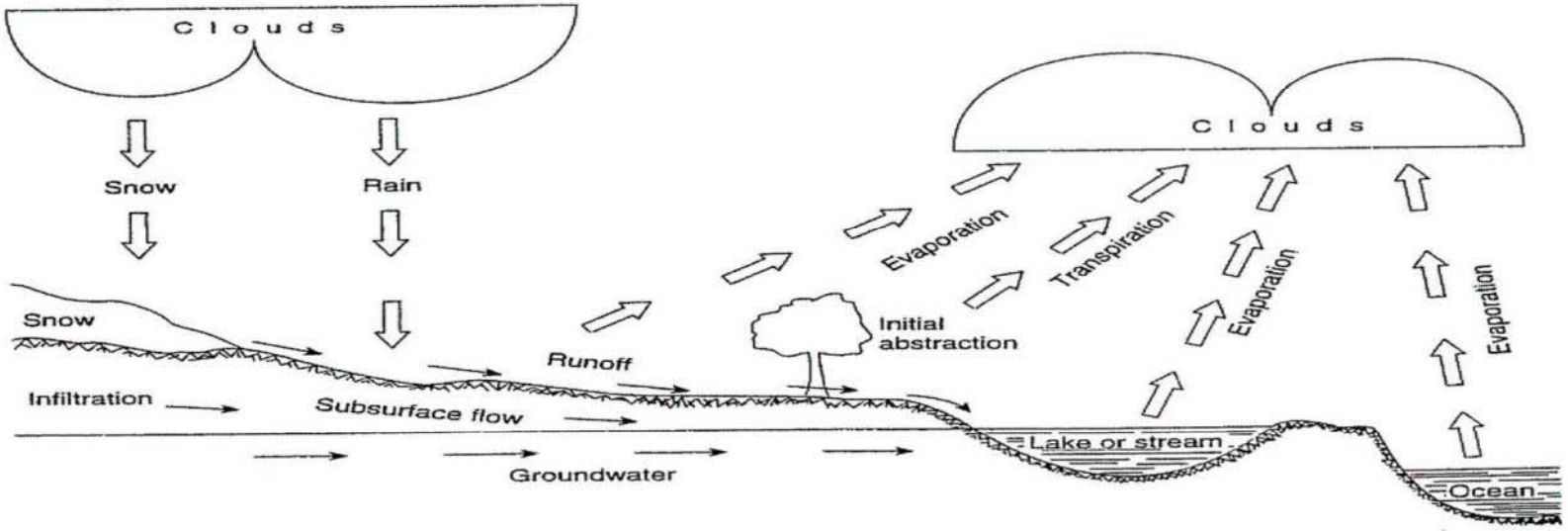
HYDROLOGIC CYCLE
(Linsley and Franzini 1979, pg. 10)

FIGURE 7.1
Hydrologic Cycle (*Source:* Adapted from Linsley and Franzini, 1979, p. 10).



Comparison of Air Quality Regulations terminology to Surface Water Quality Regulations terminology:

Air Quality	Surface Water Quality
point, line, and area sources	point and non-point sources
NAAQS (national ambient air quality standards)	water quality criteria based on water usage
emission limits	effluent limits
air pollution control technologies (best available control technology-BACT) (maximun available control technology – MACT)	wastewater treatment (best practicable control technology-BPCT) (best available control technology-BACT)
hazardous air pollutants	toxic pollutants

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HISTORY OF PAST FEDERAL SURFACE WATER-QUALITY LEGISLATION

YEAR	LAW	INTERPRETATION
1899	River and Harbors Act	Prohibited discharge of refuse into waterways that would interfere with navigation without a permit from the U.S. Army Corps of Engineers
1948	Water Pollution Control Act	Provided limited Federal assistance to local goverments for construction of municipal wastewater treatment facilities
1956	Federal Water Pollution Control Act	Increased Federal financial assitance for municpal wastewater treatment facilities
1965	Water Quality Act	Required states to develop state water quality standards for interstate waters, and created the Federal Water Pollution Control Administration to establish broad guidelines and approve state standards. Increased Federal assistance for municipal wastewater treatment facilities

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HISTORY OF MODERN FEDERAL SURFACE WATER QUALITY LEGISLATION

YEAR	LAW	INTERPRETATION
1972	Federal Water Pollution Control Act Amendments	Greatly increased federal assistance for municipal wastewater treatment facilities including meeting secondary treatment requirements. Instituted uniform technology-based effluent limitations on industrial discharges. Required National Pollutant Elimination Discharge System (NPDES) Permits. USACE charged with dredge and fill permits.
1977	Clean Water Act	States authorized to take over NPDES Permit Program. First addition of priority toxic pollutants to the Federal program.
1981	Municipal Wastewater Treatment Construction Grant Amendments	Reduced Federal assistance for municipal wastewater treatment facilities.
1987	Clean Water Act or "Water Quality Act"	Emphasized regulation of toxic substances. Phased out Federal grants for construction of municipal wastewater treatment facilities. Required USEPA to develop stormwater runoff control egulations. Required states to prepare nonpoint source management programs.

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FEDERAL CLEAN WATER ACT LAW REQUIREMENTS

SECTION	TITLE	REQUIREMENTS
101	Goals	Established National goals of fishable, swimmable waters by 1983 and the elimination of pollutant discharges into navigable waters by 1985
201-219	Construction Grants Program	Provided Federal money for municipal wastewater treatment facilities
301	Effluent Limitations	Imposed multitiered effluent limitations on existing sources including those to streams and to POTWs
302	Water Quality Related Effluent Limitations	Authorized more stringent effluent limitations in order to meet in-stream water quality
303	Water Quality Standards	Required states to adopt and triennially review water quality criteria and standards and to identify where effluent limts are insufficient to achieve the standards
304	Federal Water Quality Criteria and Guidelines	Required USEPA to adopt water quality criteria and guidelines for effluent limitations, pretreatment programs and adminstration of the NPDES Program
306	New Source Performance Standards	Requires USEPA to establish new source performance standards reflecting best demonstrated control technology
307	Toxic and Pretreatment Effluent Standards	Requires dischargers of toxic pollutants to meet effluent limits reflecting best available technology economically achievable. Requires USEPA to establish pretreatment standards to prevent discharges from interfering with POTWs.

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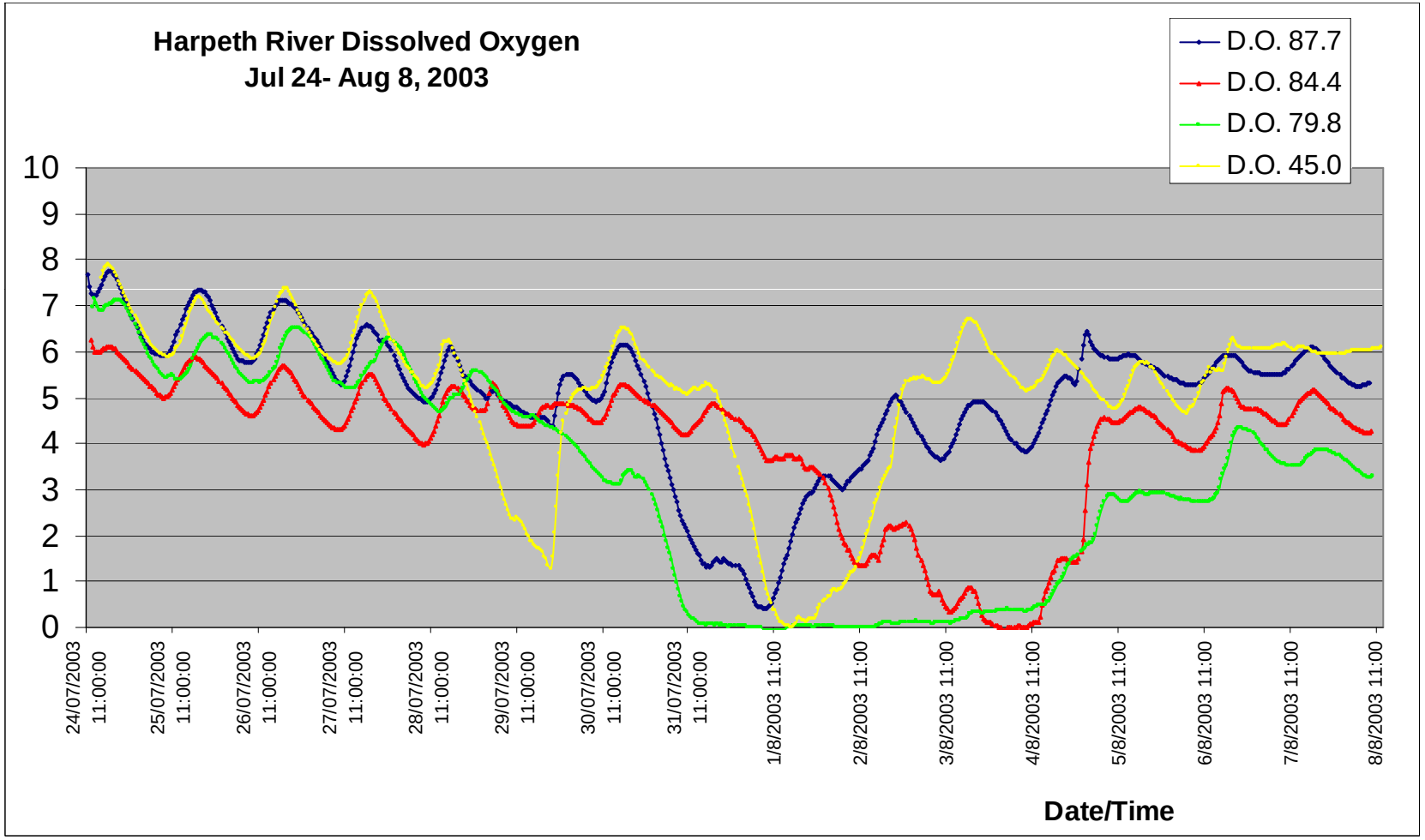
Harpeth River


Harpeth River Dissolved Oxygen
Jul 24- Aug 8, 2003
D.O. 87.7
D.O. 84.4
D.O. 79.8
D.O. 45.0
10
9
8
7
6
5
4
3
2
1
0
24/07/2003 11:00:00
25/07/2003 11:00:00
26/07/2003 11:00:00
27/07/2003 11:00:00
28/07/2003 11:00:00
29/07/2003 11:00:00
30/07/2003 11:00:00
31/07/2003 11:00:00
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3/8/2003 11:00
4/8/2003 11:00
5/8/2003 11:00
6/8/2003 11:00
7/8/2003 11:00
8/8/2003 11:00
Date/Time

FEDERAL CLEAN WATER ACT LAW REQUIREMENTS (continued)

SECTION	TITLE	REQUIREMENTS
309	Enforcement Authorities	Authorizes compliance orders and administative , civil, and criminal penalties for violations of the Act.
319	Nonpoint Source Management Programs	States must identify waters that cannot meet water quality standards due to nonpoint sources, identify activities responsible for the problem, and prepare maangement plans identifying controls and programs for specific sources.
402	NPDES Permit Program	Establishes a National permit program, the pollution discharge elimination system (NPDES), that may be administered by EPA or by delegated states.
404	Dredge and Fill Operations	Requires a permit from the USACE for the disposal if dredged or fill material into navigable waters with the concurrence of the EPA unless associated with normal farming.
505	Citizen Suits	Authorizes citizen suits against any person who violates an effluent standard or order, or against EPA for failure to perform a nondiscretionary duty.
509	Judicial Review	Authorizes judicial review of certain EPA rulemaking actions in the U.S. Court of Appeals

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FEDERAL WATER POLLUTION CONTROL ACT OF 1972 (FWPCA)

- New approach from the 1970 Clean Air Act
- Congress rejected ambient environmental quality (AAQS) in favor of Technology-Based Effluent Limitations (Effluent Limit Guidelines or ELGs contained in 40 CFR 425-471
- National Pollutant Discharge Elimination System permits were required for all point source discharges
- Provided MONEY for municipal wastewater treatment facilities
- Required minimum water quality standards in receiving streams – primarily dissolved oxygen, temperature, pH and solids.

ADDITIONAL REQUIREMENTS UNDER FWPCA

- **States could establish their own regulations, as long as they were at least "as stringent"**
- **NPDES permits established effluent limits for discharges and penalties for non-compliance**
- **Effluent limits expressed as:**
  - Mass limitations e.g. kg BOD/1000 cu m of feedstock
  - Concentration limits e.g. mg/L of BOD
- **Effluent Limits Based On:**
  - Technology
  - Receiving Surface Water Quality Standards
  - Toxicity
- **Technology needed to treat a specific wastewater discharge may need to go beyond the typical technology employed**
- **States have developed "water quality criteria" for specific parameters based on water usage**
- **Non-point sources are important as well (stormwater runoff from urban areas, agricultural lands, animal feedlots, etc.**
- **Current approach being promoted by the USEPA is to regulate the TMDL which results from both point- and non-point sources.**

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CONVENTIAL POLLUTANTS REGULATED

- **Organics**
  - Carbonaceous Biochemical Oxygen Demand (CBOD)
  - Chemical Oxygen Demand (COD)
  - Total Organic Carbon (TOC)
- **Nutrients**
  - Nitrogen compounds
  - Phosphorous compounds
- **Solids**
  - Acidity/Alkalinity
  - Salts or Total Dissolved Solids

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TOXIC POLLUTANTS REGULATED

- 89 Priority Pollutants (includes volatiles, semi-volatiles, metals, pesticides/herbicides, PCBs)
- TDS
- Ammonia
- Bioaccumulative Constituents
- Heavy Metals
- Teratogens (not specifically regulated)

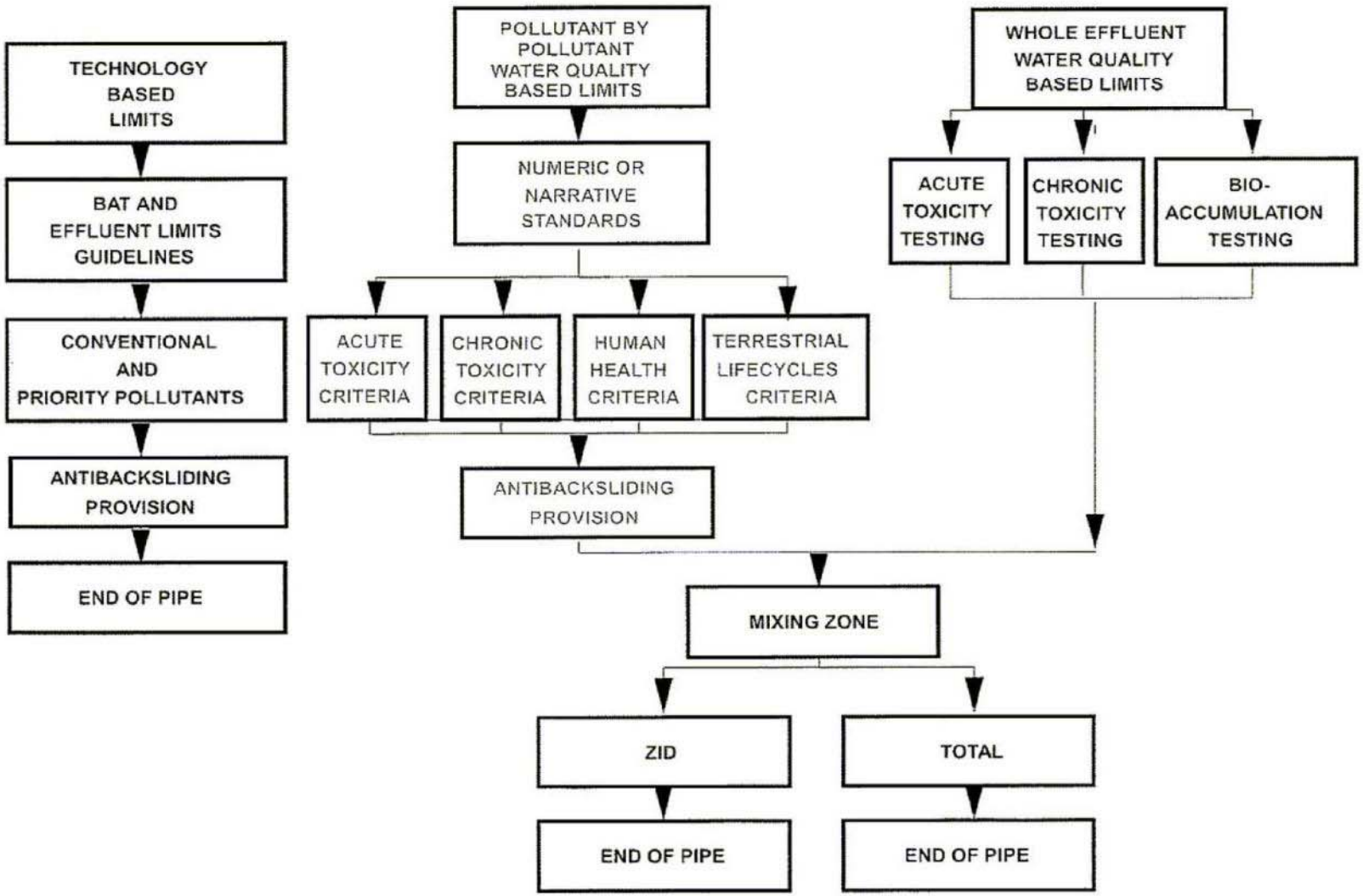

FIGURE 2
CLEAN WATER ACT OF 1987
WATER QUALITY-BASED TOXICS CONTROL

WATER QUALITY STANDARDS AND PLANNING

Load Allocation (LA)	The portion of a receiving water's loading capacity that is attributed either to one of its existing or future non-point sources of pollutions or to natural (background) sources
Wasteload Allocation (WLA)	The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water-quality-based effluent limitation.
Total Maximum Daily Load (TMDL)	The sum of the individual WLAs for point sources and Las for non-point sources and background sources. TMDSs can be expressed in terms of mass per time, toxicity, or other appropriate measures
Water-Quality-Limited Segment	Any segment of which the water quality does not meet applicable standards, and/or is not expected to meet applicable standards, even after the application of technology-based effluent limitations
Water Quality Management (WQM) Plan	A state- or areawide waste-treatment management plan developed and updated in accordance with the provisions of Sections 205(j), 208, and 303 of the CWA and subsequent regulations. The biennial report required by Section 305(b) is related to the WQM plan.
Best Management Practice (BMP)	Methods, measures, or practices determined by a state or designated area-wide planning agency to be the most effective practicable means (including technological, economic, and institutional considerations) of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals – that is, the best means of meeting the particular non-point source-control needs. BMPs include, but are not limited to, structural and non-structural controls, and operations and maintenance procedures, as wells as schedules of activities, prohibition of practices, and other management practices to prevent or reduce runoff pollution.

TABLE 4500-O:I SOLUBILITY OF OXYGEN IN WATER EXPOSED TO

Temperature °C	Oxygen Solubility mg/L. Chlorinity: 0	5.0	10.0	15.0	20.0	25.0
0.0	14.621	13.728	12.888	12.097	11.355	10.657
1.0	14.216	13.356	12.545	11.783	11.066	10.392
2.0	13.829	13.000	12.218	11.483	10.790	10.139
3.0	13.460	12.660	11.906	11.195	10.526	9.897
4.0	13.107	12.335	11.607	10.920	10.273	9.664
5.0	12.770	12.024	11.320	10.656	10.031	9.441
6.0	12.447	11.727	11.046	10.404	9.799	9.228
7.0	12.139	11.442	10.783	10.162	9.576	9.023
8.0	11.843	11.169	10.531	9.930	9.362	8.826
9.0	11.559	10.907	10.290	9.707	9.156	8.636
10.0	11.288	10.656	10.058	9.493	8.959	8.454
11.0	11.027	10.415	9.835	9.287	8.769	8.279
12.0	10.777	10.183	9.621	9.089	8.586	8.111
13.0	10.537	9.961	9.416	8.899	8.411	7.949
14.0	10.306	9.747	9.218	8.716	8.242	7.792
15.0	10.084	9.541	9.027	8.540	8.079	7.642
16.0	9.870	9.344	8.844	8.370	7.922	7.496
17.0	9.665	9.153	8.667	8.207	7.770	7.356
18.0	9.467	8.969	8.497	8.049	7.624	7.221
19.0	9.276	8.792	8.333	7.896	7.483	7.090
20.0	9.092	8.621	8.174	7.749	7.346	6.964
21.0	8.915	8.456	8.021	7.607	7.214	6.842
22.0	8.743	8.297	7.873	7.470	7.087	6.723
23.0	8.578	8.143	7.730	7.337	6.963	6.609
24.0	8.418	7.994	7.591	7.208	6.844	6.498
25.0	8.263	7.850	7.457	7.083	6.728	6.390

NOTE:

RATES OF EROSION FROM VARIOUS LAND USES

TABLE 7.12

REPRESENTATIVE RATES OF EROSION FROM VARIOUS LAND USES

Land use	Erosion rate		
	Metric tons/km^2-yr	Tons/mi^2-yr	Relative to forest = 1
Forest	8.5	24	1
Grassland	85	240	10
Abandoned surface mines	850	2,400	100
Cropland	1,700	4,800	200
Harvested forest	4,250	12,000	500
Active surface mines	17,000	48,000	2,000
Construction	17,000	48,000	2,000

Note: Rainfall is approximately 30 in/yr.
Source: U.S. Environmental Protection Agency, 1973, p. 6.

STORMWATER POLLUTION FOR SELECTED URBAN LAND USES

TABLE 7.13

STORMWATER POLLUTION FOR SELECTED URBAN LAND USES

Land use	Density[a]	Nitrogen[b]	Phosphorus[b]	Lead[b]	Zinc[b]
Residential, large lot (1 acre)	12%	3.0	0.3	0.06	0.20
Residential, small lot (0.25 acre)	25%	8.8	1.1	0.40	0.32
Townhouse apartment	40%	12.1	1.5	0.88	0.50
High-rise apartment	60%	10.3	1.2	1.42	0.71
Shopping center	90%	13.2	1.2	2.58	2.06
Central Business District	95%	24.6	2.7	5.42	2.71

[a]Based on percentage of the land covered by impervious (hard surface) material.
[b]Pounds per acre of land per year.
Source: Marsh, 1991, p. 161.

WHOLE EFFLUENT TOXICITY

- **Acute Toxicity**
  - Freshwater
    - Fathead Minnows
    - Cerriodaphnia (water fleas)
  - Saltwater/Estuaries
    - Sheepshead Minnows
    - Mysid Shrimp (Gulf) or Grass Shrimp (Cold waters)
  - Chronic Toxicity
    - Fish species – growth
    - Water fleas – reproduction
    - Algae - growth

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Bioassay Test

SEDIMENT QUALITY REGULATIONS

- **No Federal Regulations on Sediment Quality**
- **Risk-based Concentrations Established by Some States**

TEXAS SEDIMENT PERMISSABLE CONCENTRATION LIMITS (PCLs)

CONSTITUENT	METHOD	UNITS	TCEQ PCL	05 AAT 48 D	05 AAT 48 DD
PHYSICAL/CHEMICAL					
Moisture content	160.3	%	no PCL	22.1	23.4
Total Organic Carbon (TOC)	5310B	mg/kg	no PCL	4,260	1,190
PAHs					
Total PAHs	--	ug/kg	no PCL	131,945	222,390
Total cPAHs	--	ug/kg	no PCL	12,775	18,450
1-Methylnaphthalene	8270C SIM	ug/kg	8,700,000	4,400	7,200
2-Methylnaphthalene	8270C SIM	ug/kg	490,000	7,400	12,000
Acenaphthene	8270C SIM	ug/kg	7,400,000	12,000	20,000
Acenaphthylene	8270C SIM	ug/kg	7,400,000	230	270
Anthracene	8270C SIM	ug/kg	3,700,000	5,100	7,900
Benzo(a)anthracene	8270C SIM	ug/kg	16,000	3,800	6,100
Benzo(a)pyrene	8270C SIM	ug/kg	1,600	1,500	***2,000***
Benzo(b)fluoranthene	8270C SIM	ug/kg	16,000	2,400	3,100
Benzo(g,h,i)perylene	8270C SIM	ug/kg	3,700,000	640	570
Benzo(k)fluoranthene	8270C SIM	ug/kg	160,000	1,100	1,400
Chrysene	8270C SIM	ug/kg	1,600,000	3,700	5,000
Dibenz(a,h)anthracene	8270C SIM	ug/kg	1,600	210	220
Fluoranthene	8270C SIM	ug/kg	4,900,000	18,000	35,000
Fluorene	8270C SIM	ug/kg	4,900,000	11,000	21,000
Indeno(1,2,3-cd)pyrene	8270C SIM	ug/kg	16,000	65	630
Naphthalene	8270C SIM	ug/kg	2,500,000	9,400	19,000
Phenanthrene	8270C SIM	ug/kg	3,700,000	38,000	60,000
Pyrene	8270C SIM	ug/kg	3,700,000	13,000	21,000
PCP					
Pentachlorophenol	8270C	ug/kg	56,000	NA	NA
METALS					
Arsenic	6020	mg/kg	110	1.60 J	2.59 J

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