RIVER MANAGEMENT TRENDS and ISSUES

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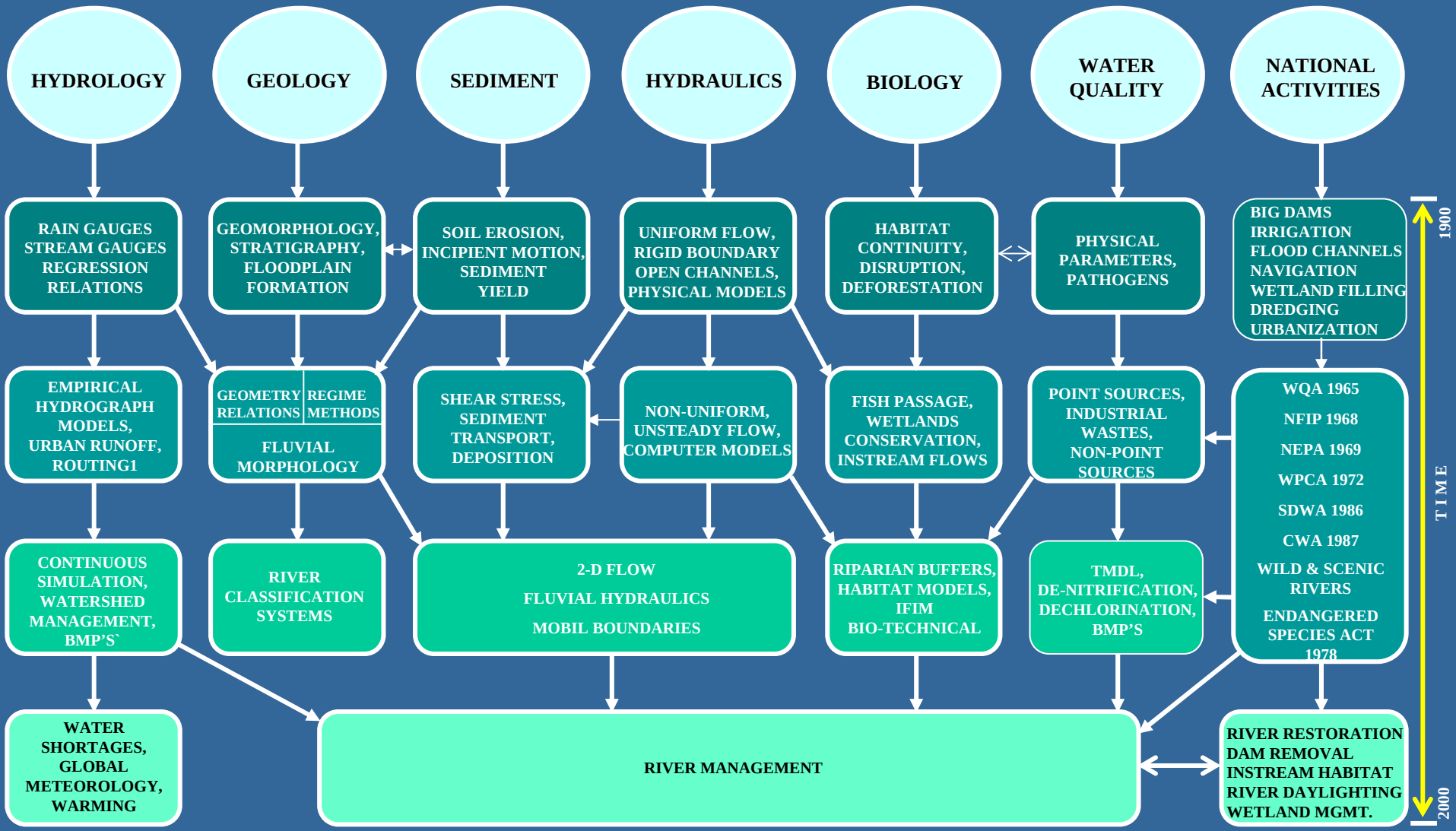
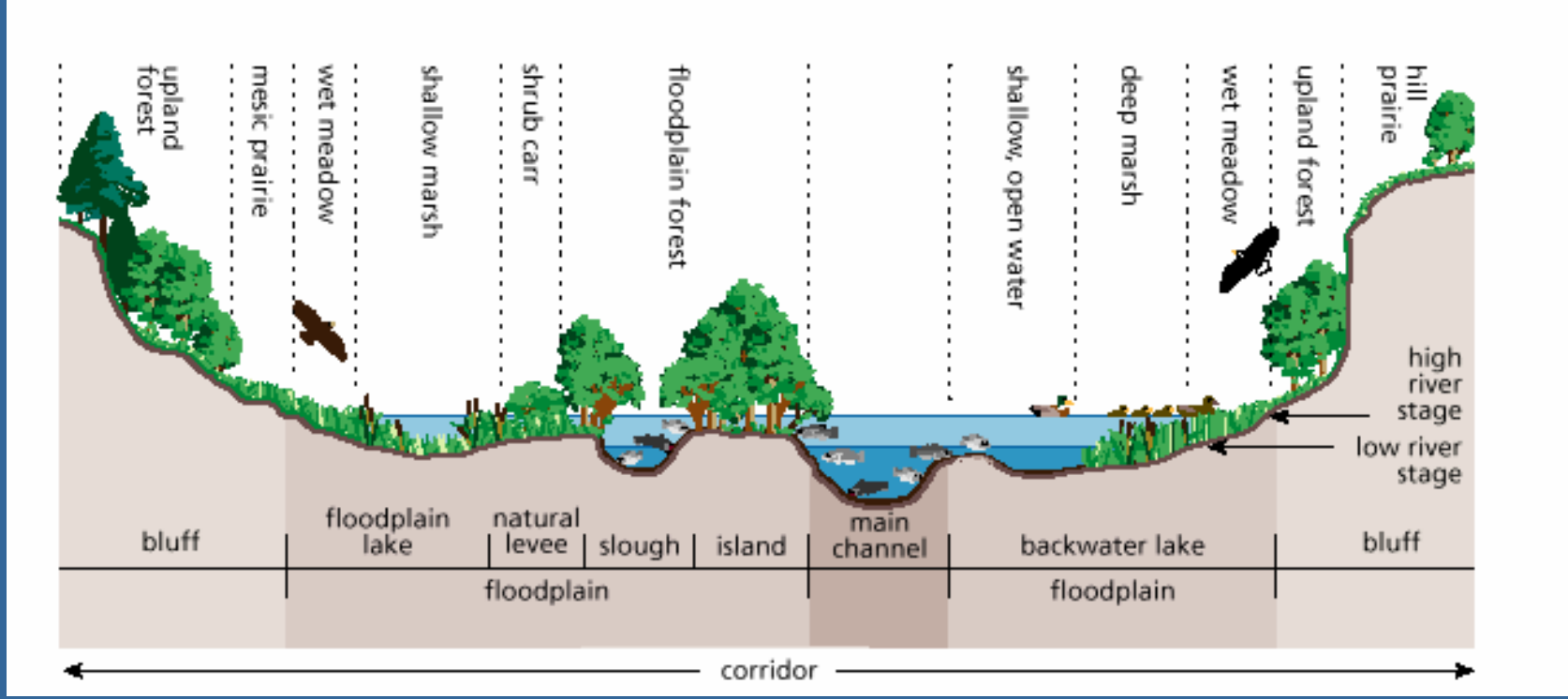
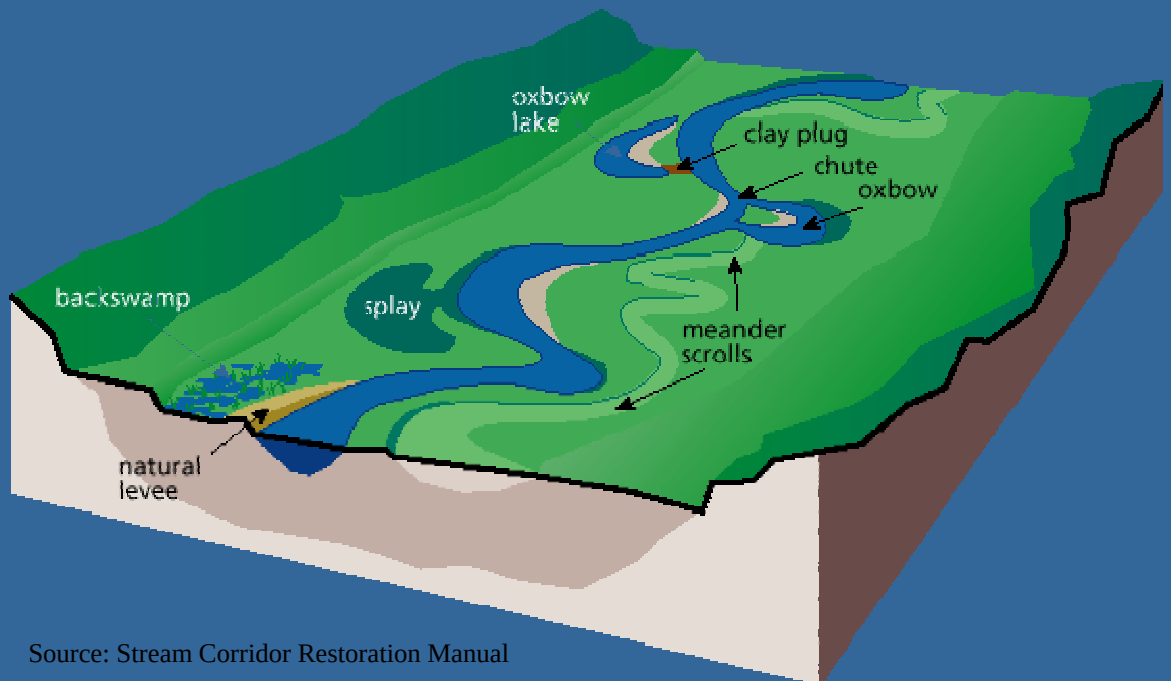
RIVER MANAGEMENT EVOLUTION



FLUVIAL MORPHOLOGY

- **Form Based Descriptions**
- **Physical Processes**
- **Quantitative Era**





Source: Stream Corridor Restoration Manual

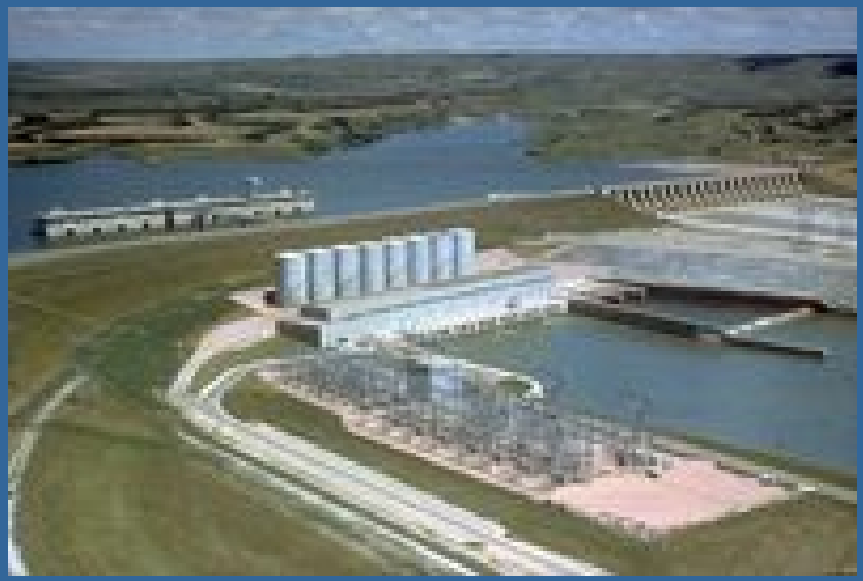
GEOGRAPHIC SCALES

ISSUE	WATERSHED	CORRIDOR	CHANNEL
HYDROLOGY	X	X	X
WATER QUALITY	X	X	X
FLOOD FLOW HYDRAULICS		X	X
BASE FLOW HYDRAULICS			X
AQUATIC HABITAT			X
RIPARIAN ECOSYSTEM		X	X

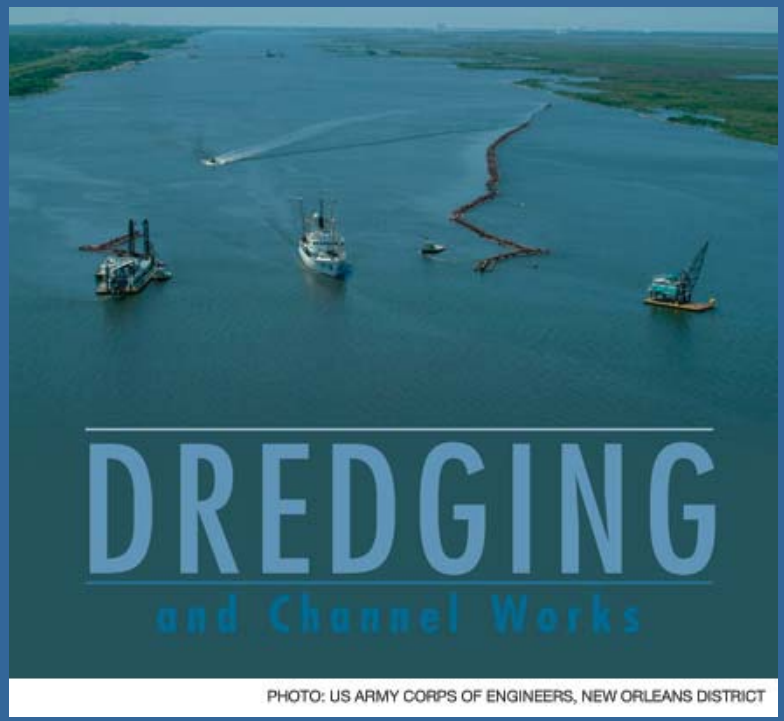
KEY YEARS

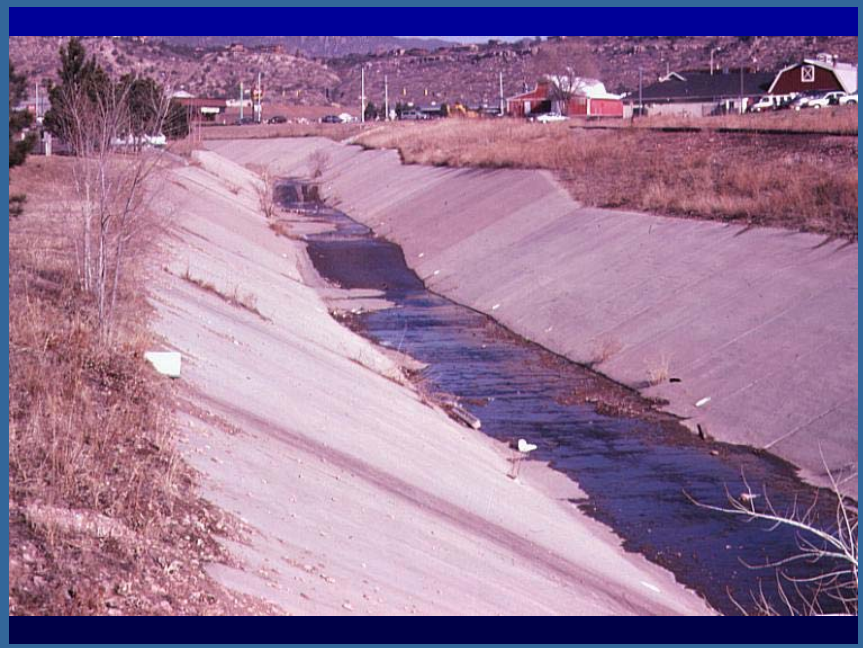
- 1927- Mississippi River Flood
- 1930's - Drought
- 1936, 1938 - Hurricanes
- WW2 - Food & Fiber Needs
- 1969 - NEPA
- 1972 - CWA, Section 404
- 1975 - Teton Dam Failure
- 1993 - Mississippi River Flood
- 2005 - Hurricane Katrina

BIG DAM ERA

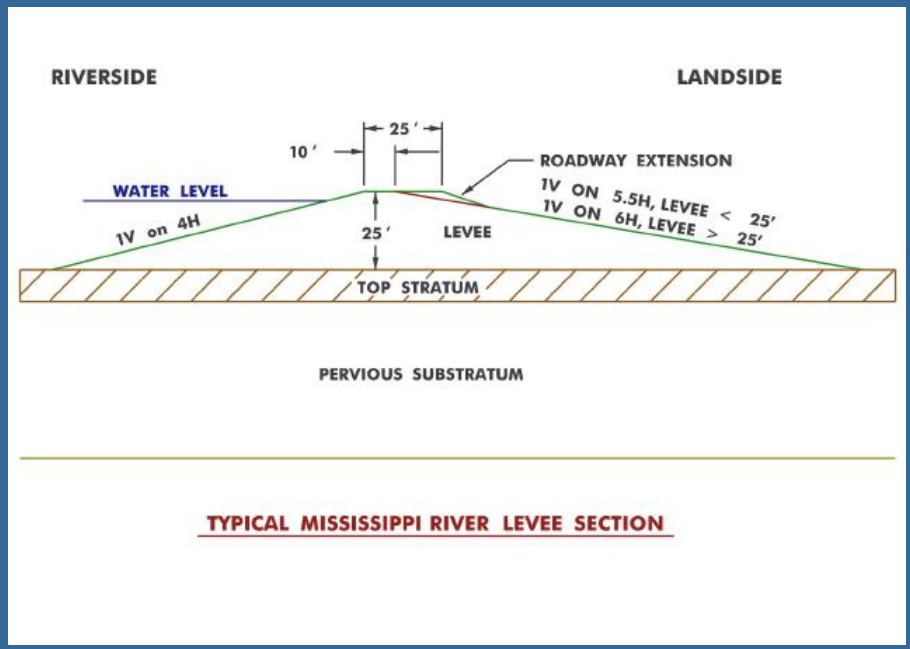


CHANNELIZATION





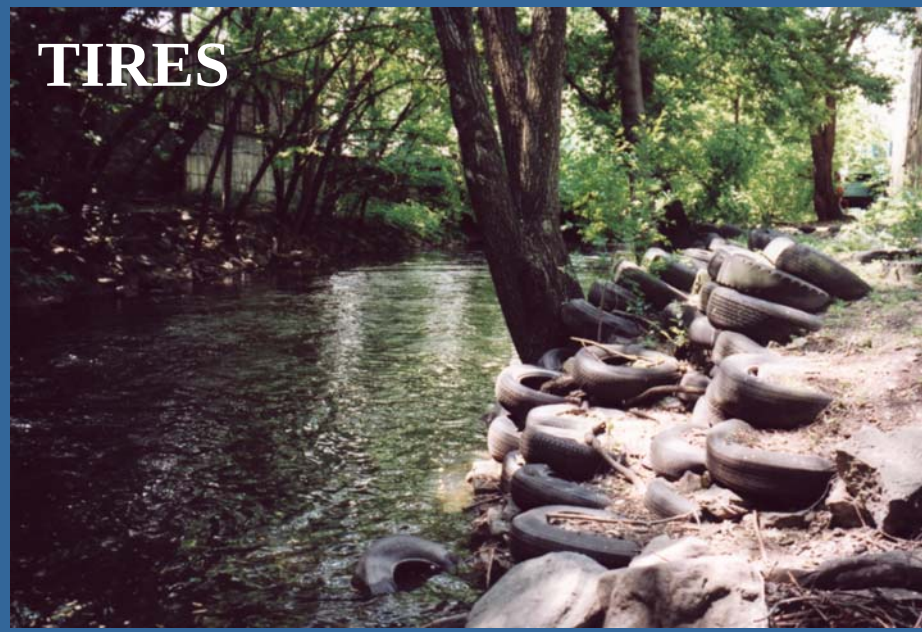
DIKES



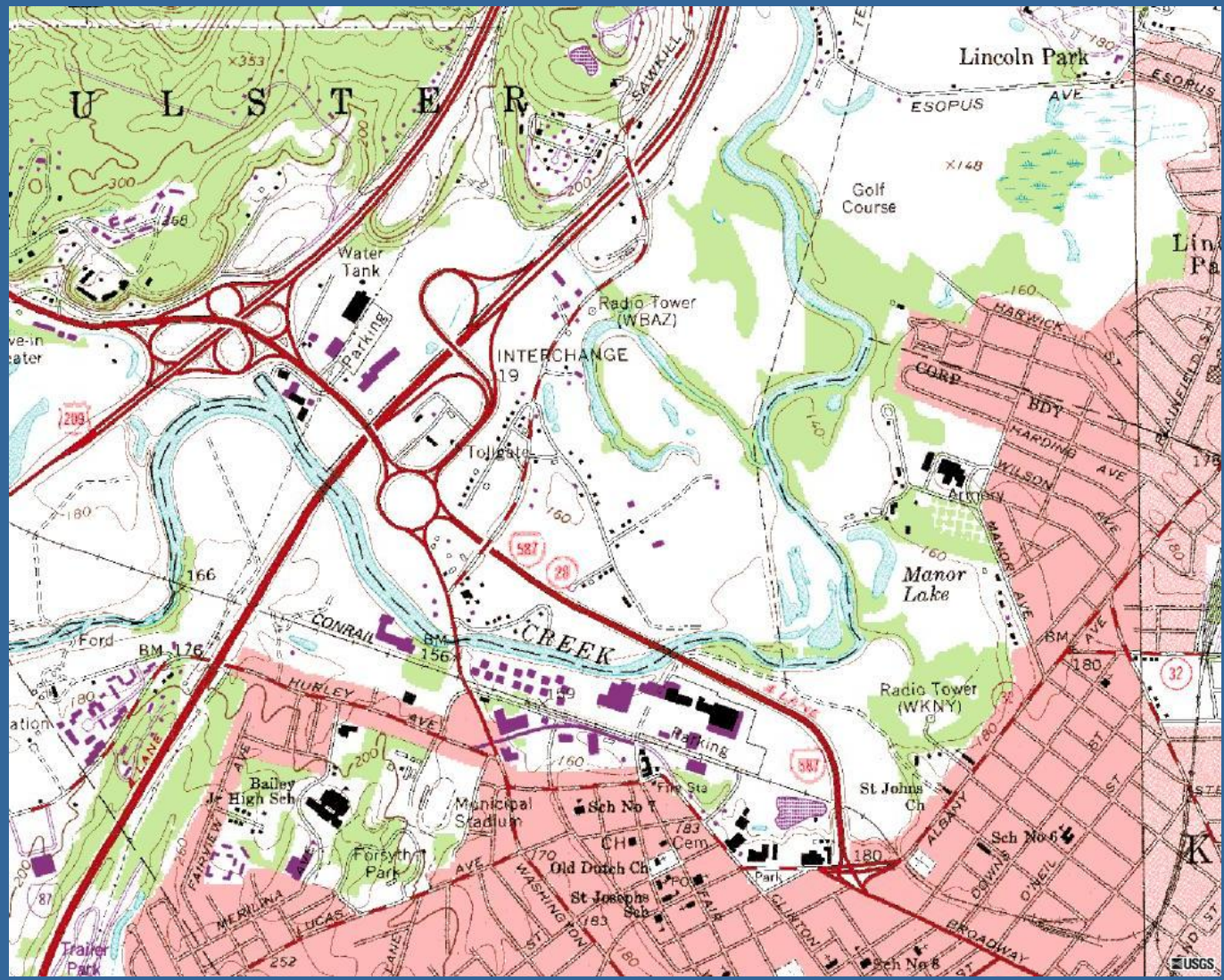
TYPICAL MISSISSIPPI RIVER LEVEE SECTION

DEFENSIVE ARMOR

RIPRAP



DEVELOPMENT



GEOMORPHIC MODELS

- **Conceptual** (Simon, Schumm, Montgomery)
- **Empirical** (HGR, Reference Reaches)
- **Statistical** (Blench, Julien, Hey& Thorne)
- **Analytical** (Chang, White, Yang, Copeland)
- **Numeric Simulation** (1-D, 2-D, Hydrodynamic)

CONCEPTUAL CLASSIFICATION MODELS

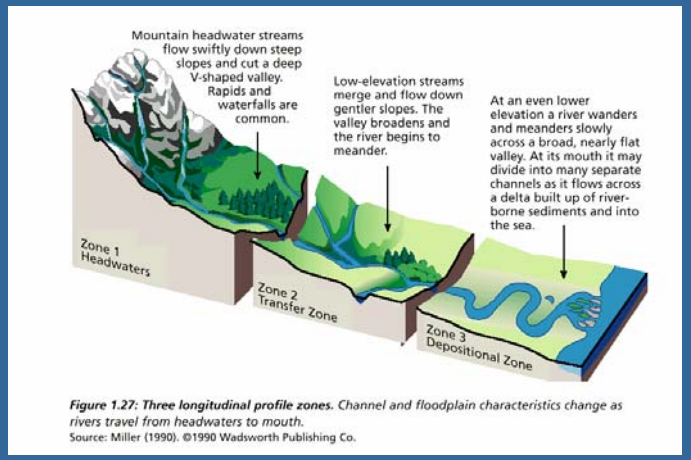


Figure 1.27: Three longitudinal profile zones. Channel and floodplain characteristics change as rivers travel from headwaters to mouth.
Source: Miller (1990). ©1990 Wadsworth Publishing Co.

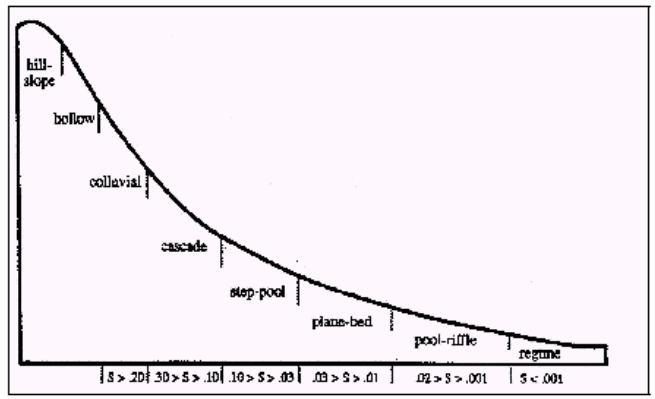
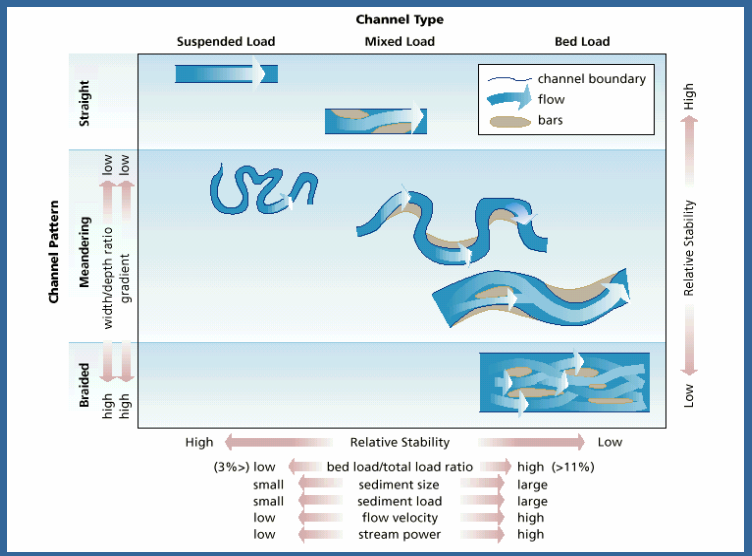
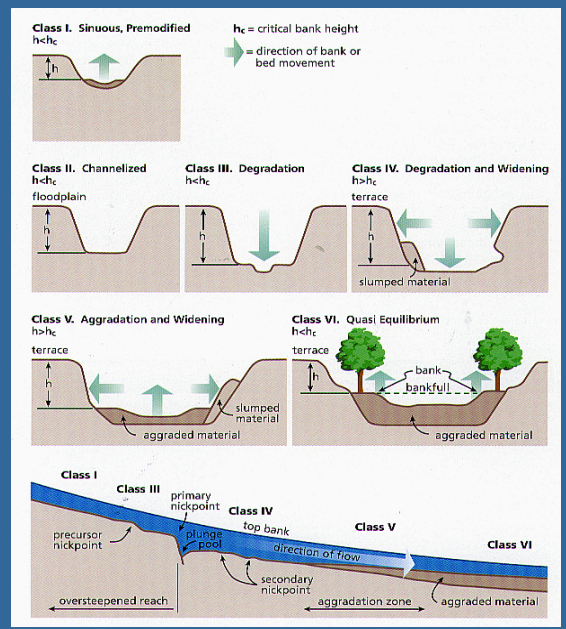


Figure 4.23. Idealized long profile from hillslopes and unchanneled hollows downslope through the channel network showing the general distribution of alluvial channel types (from Montgomery and Buffington 1997).[49]





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TECHNICAL FOUNDATIONS

- **1927-FORTIER & SCOBEY, Allowable Velocity**
- **1930-LACEY, Regime Theory**
- **1936-SHIELDS, Sediment Entrainment Diagram**
- **1936-WOODWARD & POSEY, Standard Step Method**

Fluids

- Rigid Boundary Uniform Flow Hydraulics
- Non-Uniform Flow
- Unsteady Flow
- 2-D Flow Mobile Boundaries

Fluvial Morphology

- Regime Geometry Eq
- Hydraulic Geometry Equations
- Reference Reaches
- Modified Regime Equations

Sediment

- Sediment Yield
- Incipient Motion Threshold Velocity
- Steady State Sediment Transport
- Sediment Continuity & Dynamics

THE EMPIRICAL AGE

- 1950-Einstein, Sediment Transport Theory
- 1951-Blench, Updated Regime Theory
- 1953-Leopold & Maddock, Channel Geometry
- 1955-Lane, Tractive Stress Theory
- 1957-Simon, American Regime Theory
- 1963-Colby, Sediment Transport

MOBILE BOUNDARIES

ANALYTICAL EXTREMAL HYPOTHESIS

- 1980,1988- CHANG, minimize stream power
- 1981- YANG, minimize energy expenditure
- 1982- WHITE, maximize sediment transport
- 1994- COPELAND, minimize energy grade line slope
- 1998- MILLER, maximize bedload transport

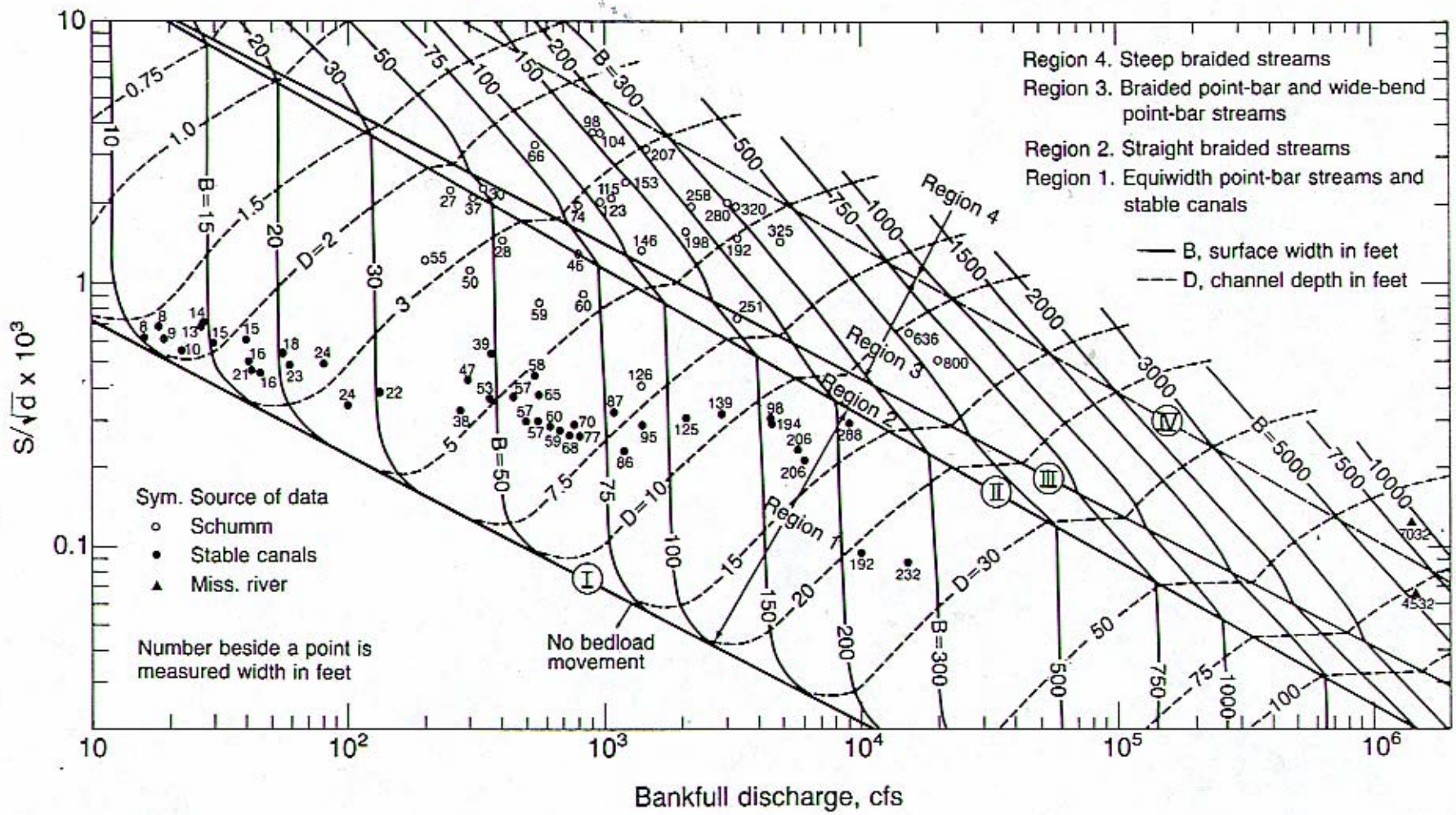


FIG. 6.—Regime Channel Geometry for Sand-Bed Rivers

ANALYTICAL METHODS AND PARAMETERS

	FIXED BOUNDARY CHANNEL	MOBILE BOUNDARY CHANNEL	CROSS SECTION			WATER PROFILE	RIVER PATTERN	BED STABILITY	MODIFIED HYDROLOGY	SEDIMENT TRANSPORT	STABILIZATION ANALYSIS
			AREA	SHAPE	VELOCITY						
HYDRAULIC THEORY	X		X		X	X		X	X		X
REGIME METHOD	X	X	X	X	+-	+-		X	X	+-	X
COMPARATIVE SECTIONS AND REFERENCE REACHES		X	X	X	X		X	X			
HYDRAULIC GEOMETRY CURVES		X	X	X			X				
ADVANCED HYDRAULIC AND SEDIMENT TRANSPORT	X	X	X	X	X	X	+-	X	X	X	X

WATERSHED MASTER PLANNING PROCESS

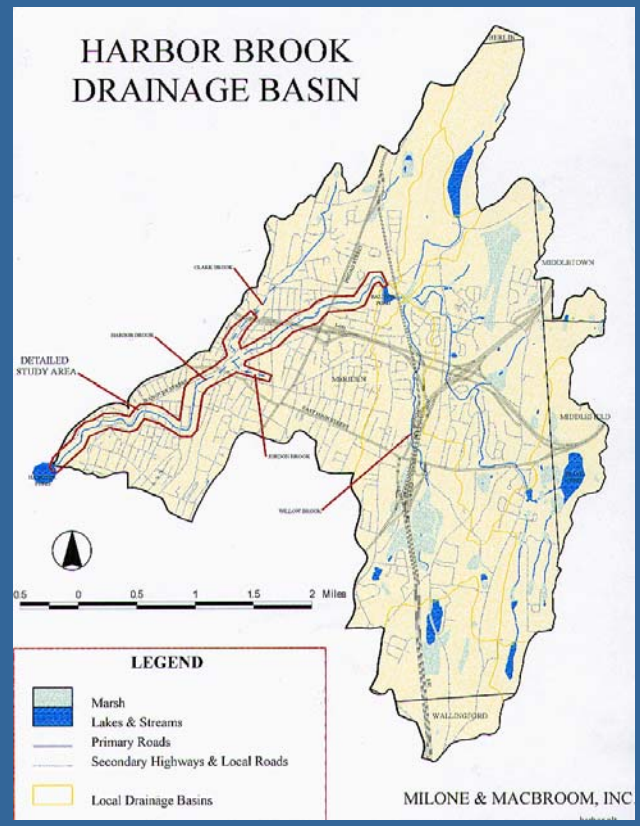
- Identify & Involve Stakeholders
- Explore Goals & Objectives
- Collect Existing Data
- Document Current Conditions
- Identify Problems & Issues
- Develop Future Vision & Specific Objectives
- Evaluate Alternatives & Strategies
- Prepare Implementation Plan

TYPTICAL WATERSHED GOALS

- Physical
- Ecological
- Social
- Economic

PHYSICAL GOALS

- **Flood Damage Reduction**
- **In-stream Flow Maintenance**
- **Erosion Control**
- **Sediment Management**
- **Water Quality**
- **Bank Stability**



CHANNEL MECHANICS *

	Surface Erosion	Gully & Gorge	Channel Enlarge	Increased Sinuosity	Valley Widening	Lateral Migration
Upper Fall Creek	L	L	L	L	L	L
Lower Fall Creek	M	H	L	L	M	M
Virgil Creek	M	L	L	L	M	M
Salmon Creek	H	H	L	L	M-H	M
Gulf Creek	H	H	M	L	L	L
Six Mile Creek	L	M	M	H	L	H
Upper Cayuga	M	H	M	L	H	L
Lower Cayuga	L	H	H	M	L	H
Buttermilk Creek	L	M	L	L	L	L
Enfield Creek	M	H	M	L	L	L
West Branch Creek	L	M - H	M	L	L	L

L = Low M = Medium H = High

*Based upon limited observations – Subject to change

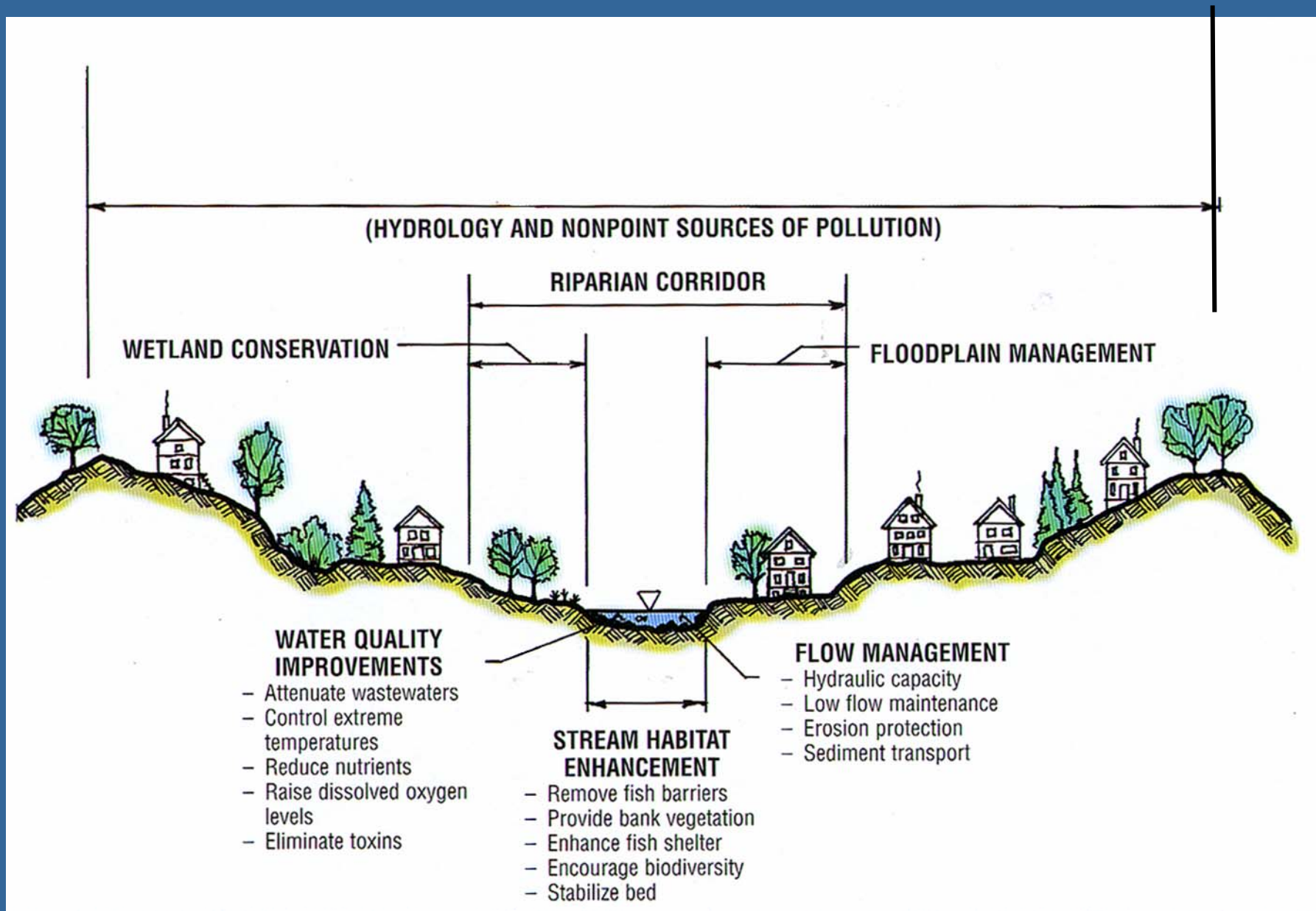
ECOLOGICAL GOALS

- Water Quality
- Aquatic Habitat
- Rare Species
- Fish Passage
- Wetlands
- Invasive Species
- Diversity

SOCIAL GOALS

- Public Access
- Recreation
- Education
- Historic Preservation
- Infrastructure
- Water Supply
- Emergency Preparedness

WATERSHED MANAGEMENT

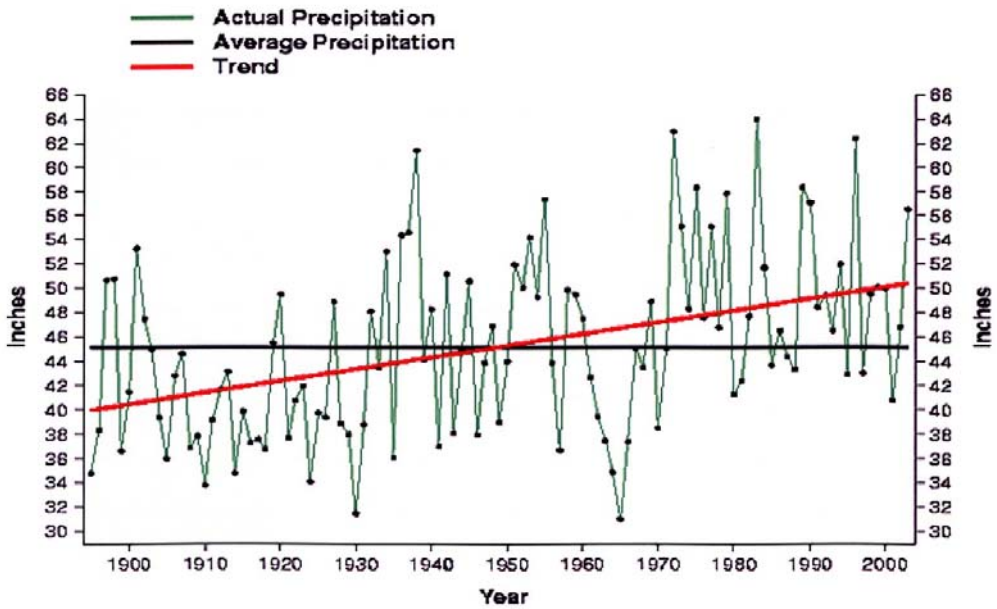


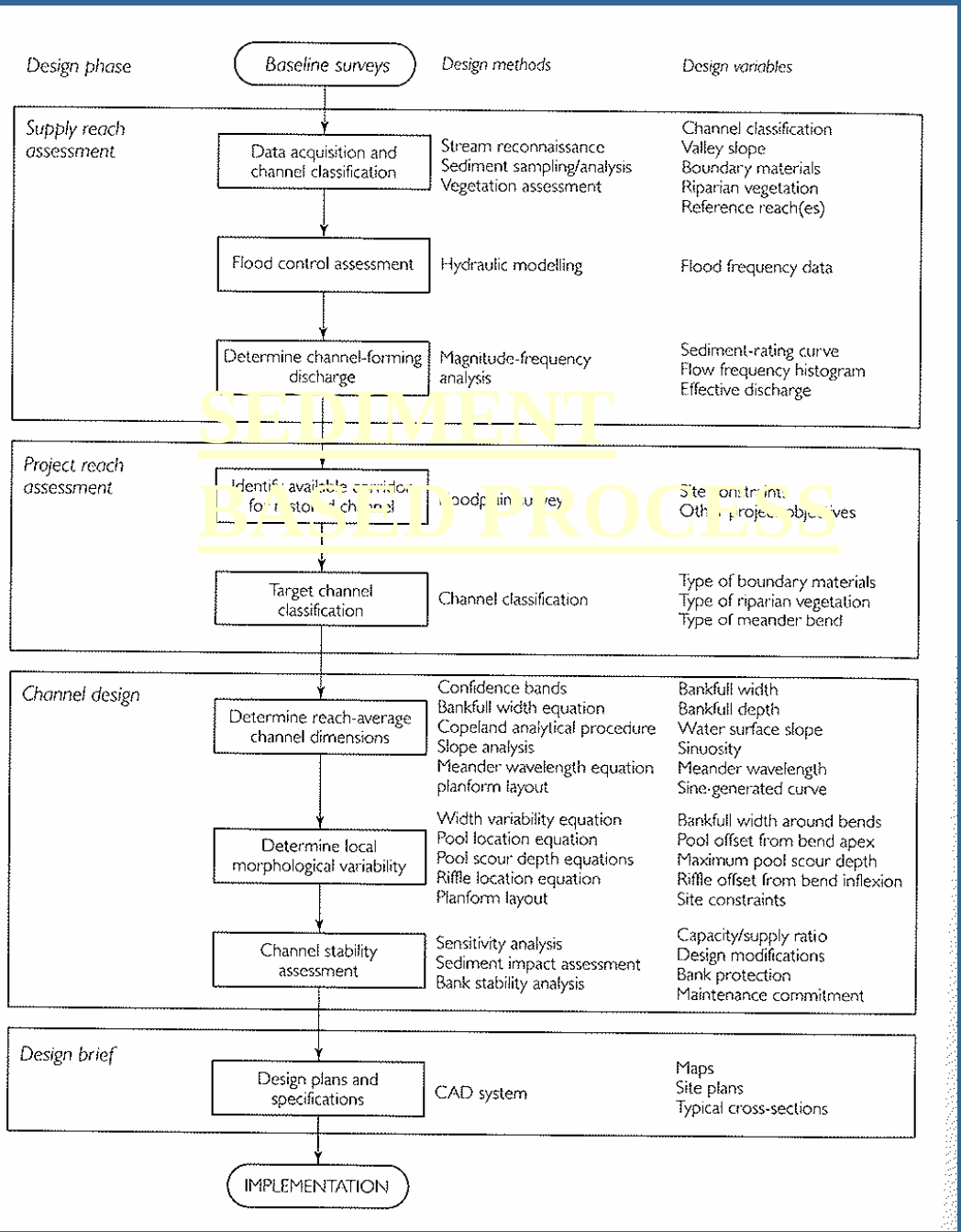
Climate At A Glance

Annual Precipitation
Connecticut

Annual 2003: 56.52 Inches Rank: 100

Annual 1895 - 2003 Average = 45.21 Inches
Annual 1895 - 2003 Trend = 0.96 Inches / Decade



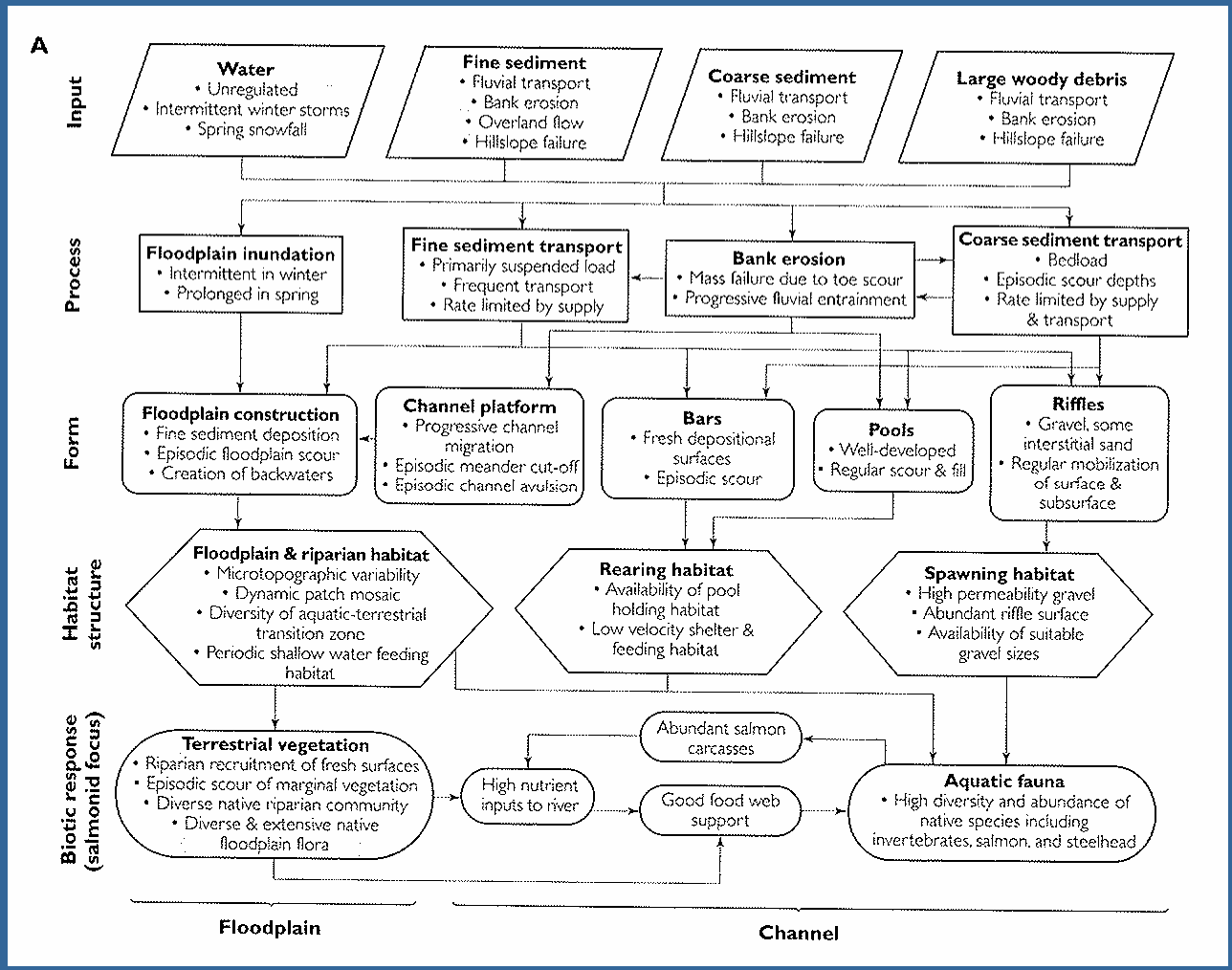


WATERSHED SCALE

ANALYTICAL SEDIMENT MODEL

Soar & Thorne, 2001

HABITAT MORPHOLOGY CONCEPTUAL MODEL



Stillwater Scientific, 2004

APPLIED LITERATURE

- **1988- Chang, *Fluvial Processes***
- **1993- Newbury, *Stream Analysis and Fish Habitat Design***
- **1995- Allan, *Stream Ecology***
- **1996- Rosgen, *Applied River Morphology***
- **1998- FISRWG, *Stream Corridor Restoration***
- **1998- ASCE, *Proceedings, Ecosystem Restoration Conference***
- **2001- USACOE, *Hydraulic Design of Stream Restoration Projects***
- **2005- Brierley & Fryirs, *Geomorphology and River Management***
- **2005- Palmer et al, *National River Restoration Science Synthesis***