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Tri-Service Infrastructure Systems Conference & Exhibition

2-5 August 2005

John B. Smith

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Watershed Approach to Stream Stability
and
Benefits Related to the Reduction of Nutrients

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Mississippi Delta Headwaters (MDH) Project

One Corps Serving the Armed Forces and the Nation

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Mississippi Delta Headwaters (MDH) Project

Authorizations

- SECED in 1970's (PL 93-251)
- DEC Emergency Jobs Appropriations Act 1983 (PL 98-8)
- WRDA 1986 (PL 99-662)

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Purpose of MDH Project

- Erosion Control
- Sediment Management
- Flood Control
- Environmental Enhancement
- Demonstrate Innovative Technologies for Watershed Treatment

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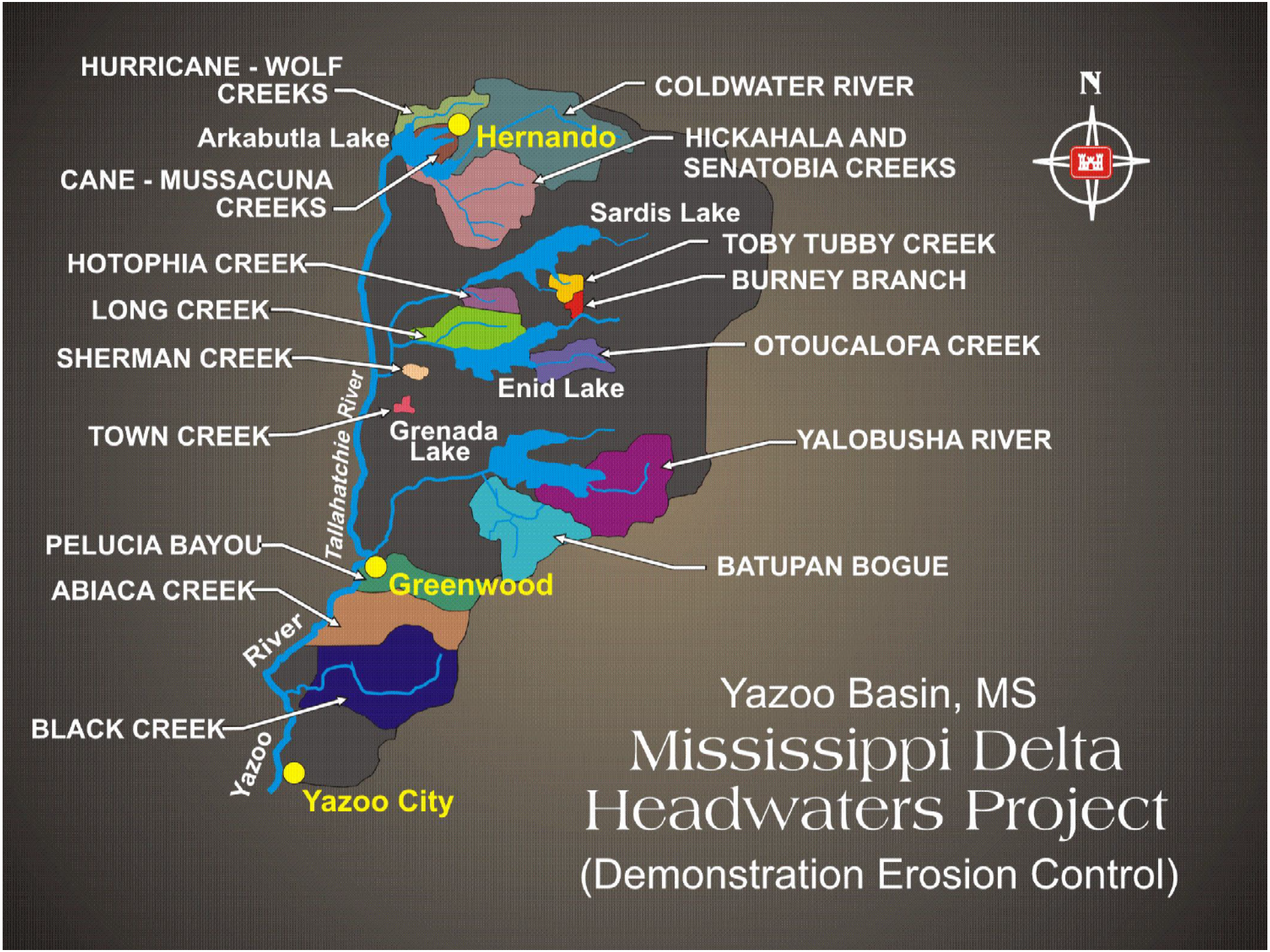
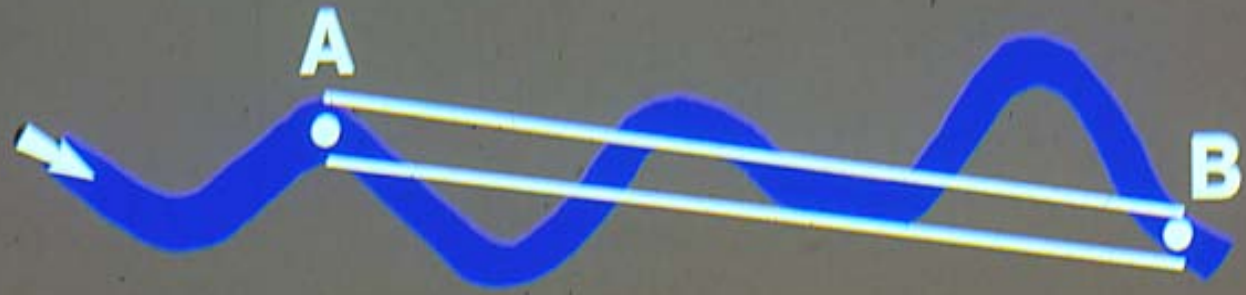
Participating Agencies

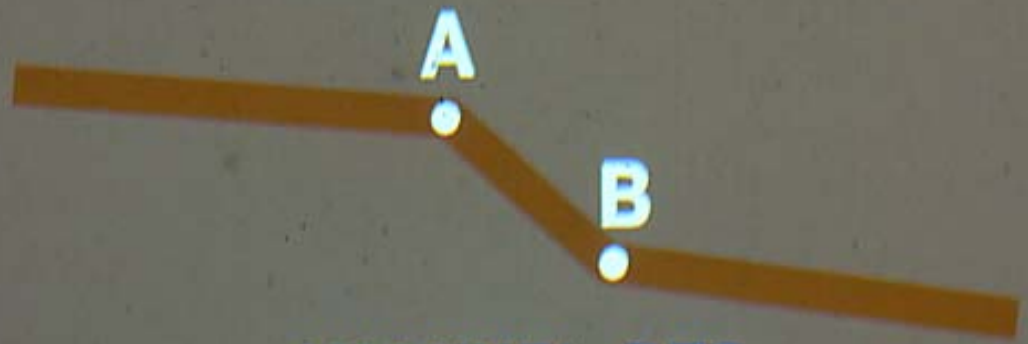
- Corps of Engineers, Vicksburg District
- NRCS
- Engineer Research Development Center
- USDA Sedimentation Laboratory
- University of Mississippi Center for Computational Hydraulics
- USGS


HURRICANE - WOLF CREEKS
COLDWATER RIVER
N
Arkabutla Lake
Hernando
HICKAHALA AND SENATOBIA CREEKS
CANE - MUSSACUNA CREEKS
Sardis Lake
TOBY TUBBY CREEK
HOTOPHIA CREEK
BURNEY BRANCH
LONG CREEK
SHERMAN CREEK
OTOUCALOFA CREEK
Enid Lake
Tallahatchie River
TOWN CREEK
Grenada Lake
YALOBUSHA RIVER
PELUCIA BAYOU
BATUPAN BOGUE
ABIACA CREEK
Greenwood
River
BLACK CREEK
Yazoo
Yazoo City
Yazoo Basin, MS
Mississippi Delta Headwaters Project
(Demonstration Erosion Control)

Channel Straightening

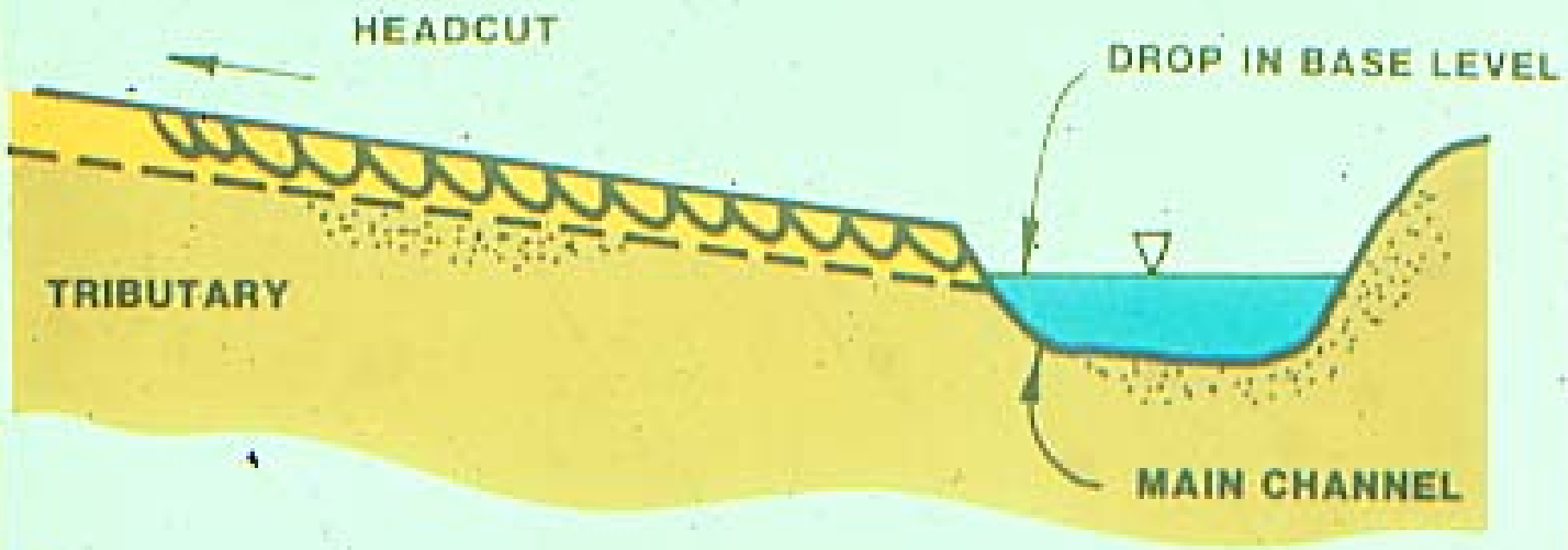
EFFECT OF CHANNELIZATION





CHANNEL BED

$$Q^{0}S^{+} \propto Q_{s}^{+}D_{50}^{0}$$



LOWERING OF BASE LEVEL FOR TRIBUTARY STREAM (AFTER SIMON, 1977)

Headcut

Knickzone

Effects of Degradation

Effects of Degradation

Effects of Degradation

Effects of Bank Erosion

Gully Erosion

Channel Degradation

Deposition in Lower Reaches

Dredging

Levee Break

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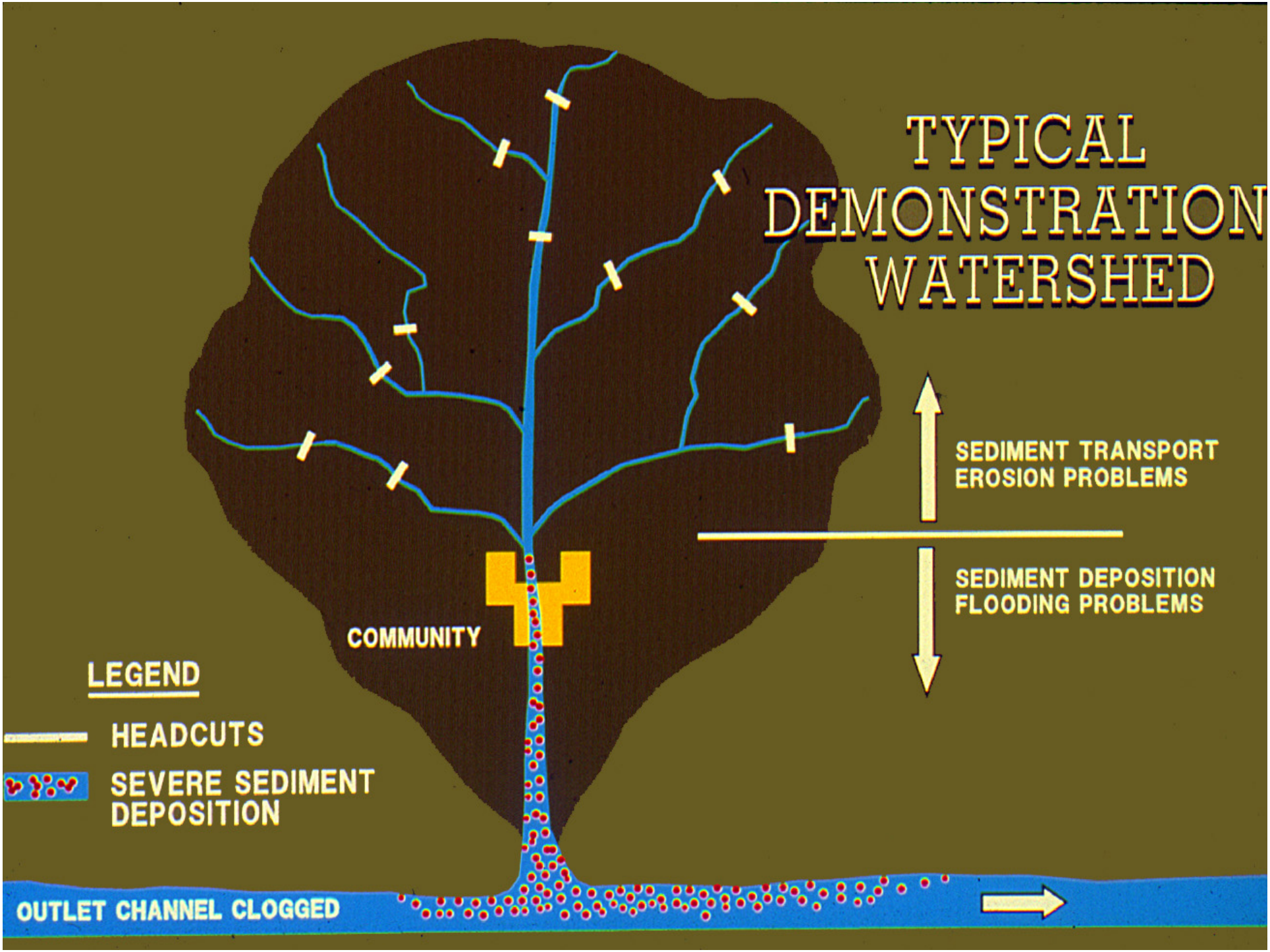
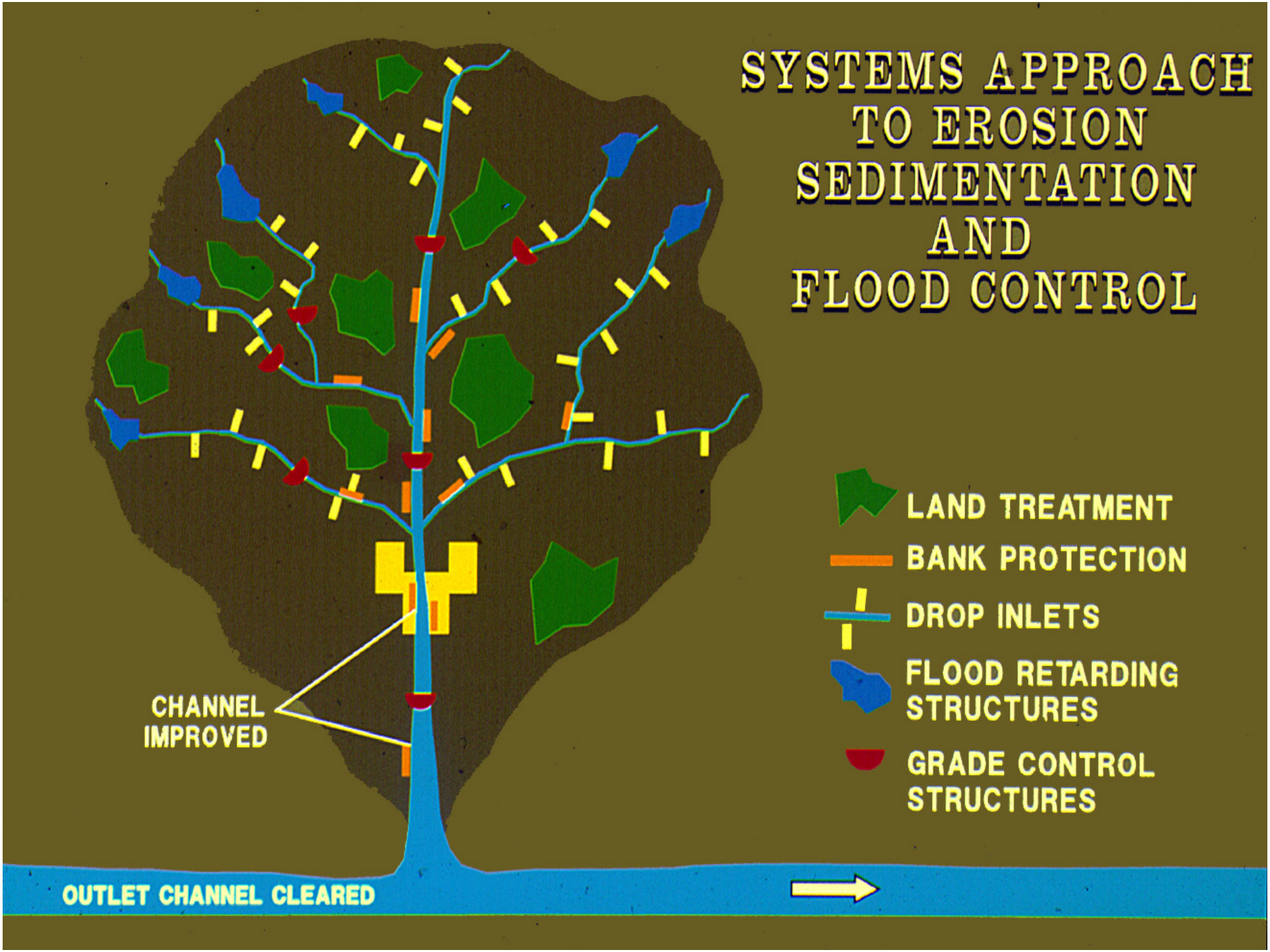
Systems Approach to Watershed Analysis


TYPICAL
DEMONSTRATION
WATERSHED
SEDIMENT TRANSPORT
EROSION PROBLEMS
SEDIMENT DEPOSITION
FLOODING PROBLEMS
COMMUNITY
LEGEND
HEADCUTS
SEVERE SEDIMENT
DEPOSITION
OUTLET CHANNEL CLOGGED


SYSTEMS APPROACH
TO EROSION
SEDIMENTATION
AND
FLOOD CONTROL
LAND TREATMENT
BANK PROTECTION
DROP INLETS
FLOOD RETARDING
STRUCTURES
GRADE CONTROL
STRUCTURES
CHANNEL
IMPROVED
OUTLET CHANNEL CLEARED

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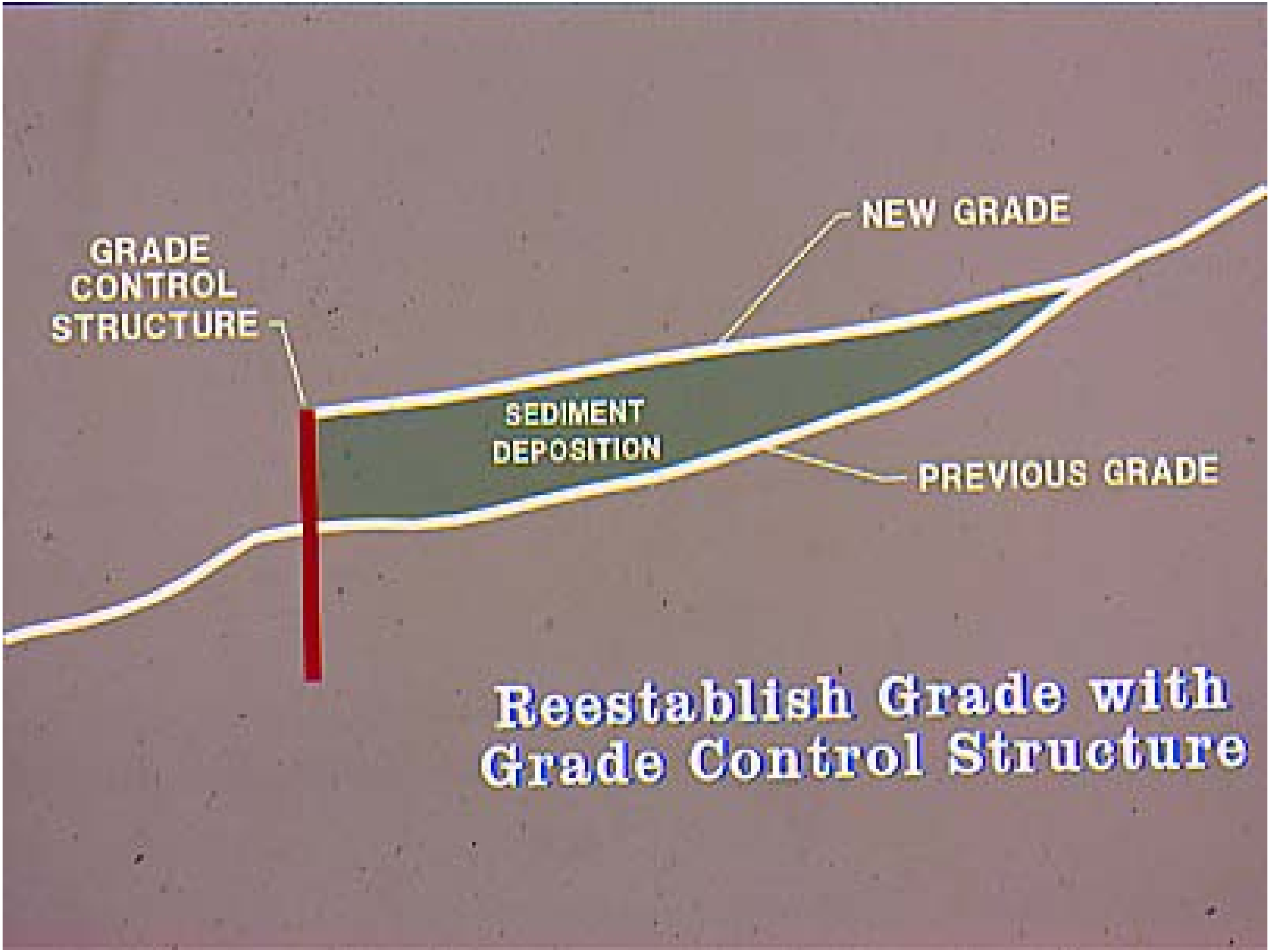
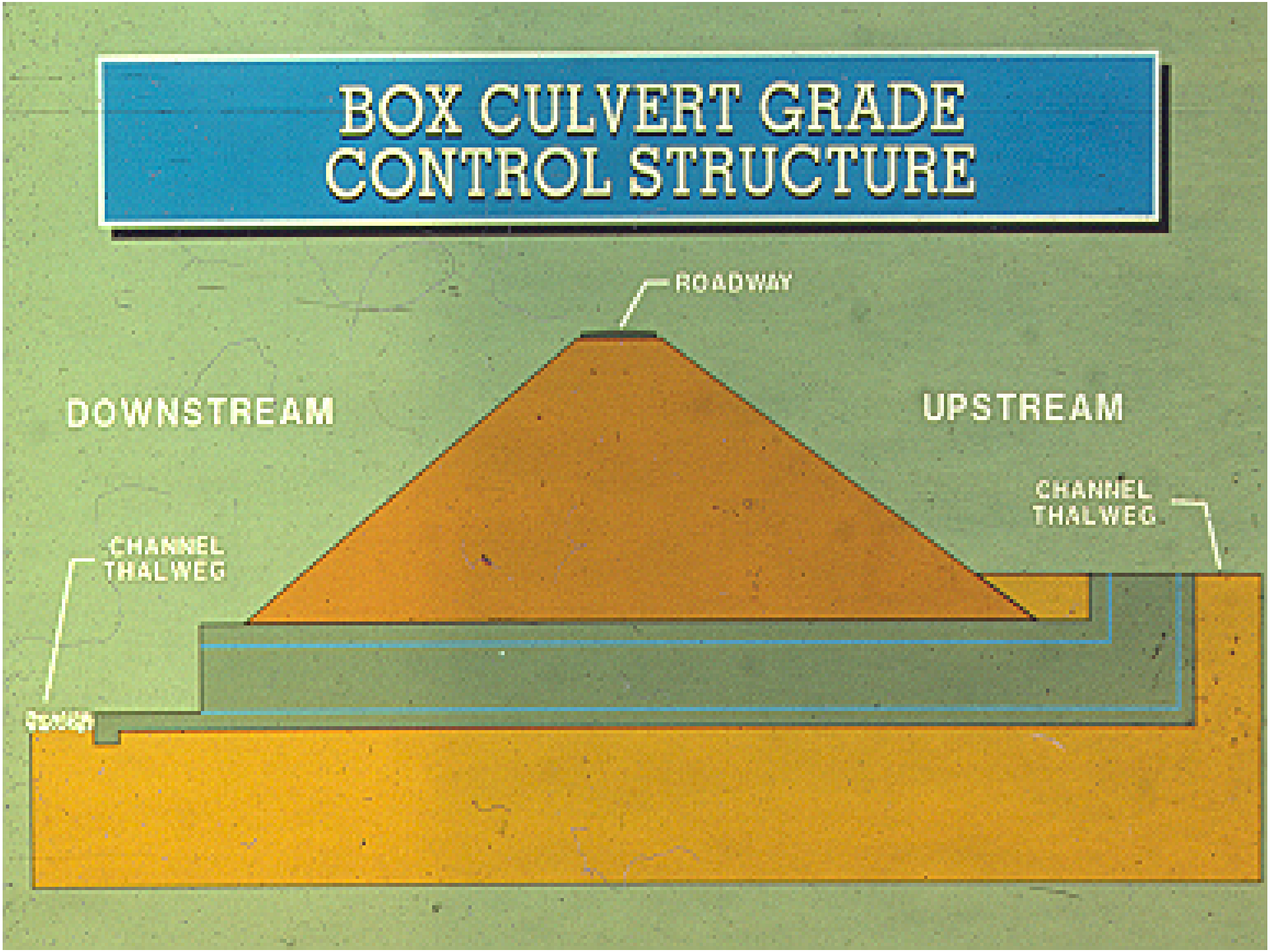
Typical MDHP Structures

- Grade Control Structures
- Riser Pipes
- Bank Stabilization
- Floodwater Retarding Structures


GRADE
CONTROL
STRUCTURE
NEW GRADE
SEDIMENT
DEPOSITION
PREVIOUS GRADE
Reestablish Grade with
Grade Control Structure

Low Drop Grade Control Structure


BOX CULVERT GRADE CONTROL STRUCTURE
ROADWAY
DOWNSTREAM
UPSTREAM
CHANNEL THALWEG
CHANNEL THALWEG

Box Culvert Grade Control Structure

High Drop Grade Control Structure

Riser Pipe

Bank Stabilization

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Bank Stabilization

Floodwater Retarding Structure

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MDHP Monitoring Program

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MDHP Monitoring

- 33 monitoring sites (40 miles of stream)
- Field investigations and surveys
- Data collection
- Geomorphic, hydraulic, and sediment transport analyses
- Environmental studies

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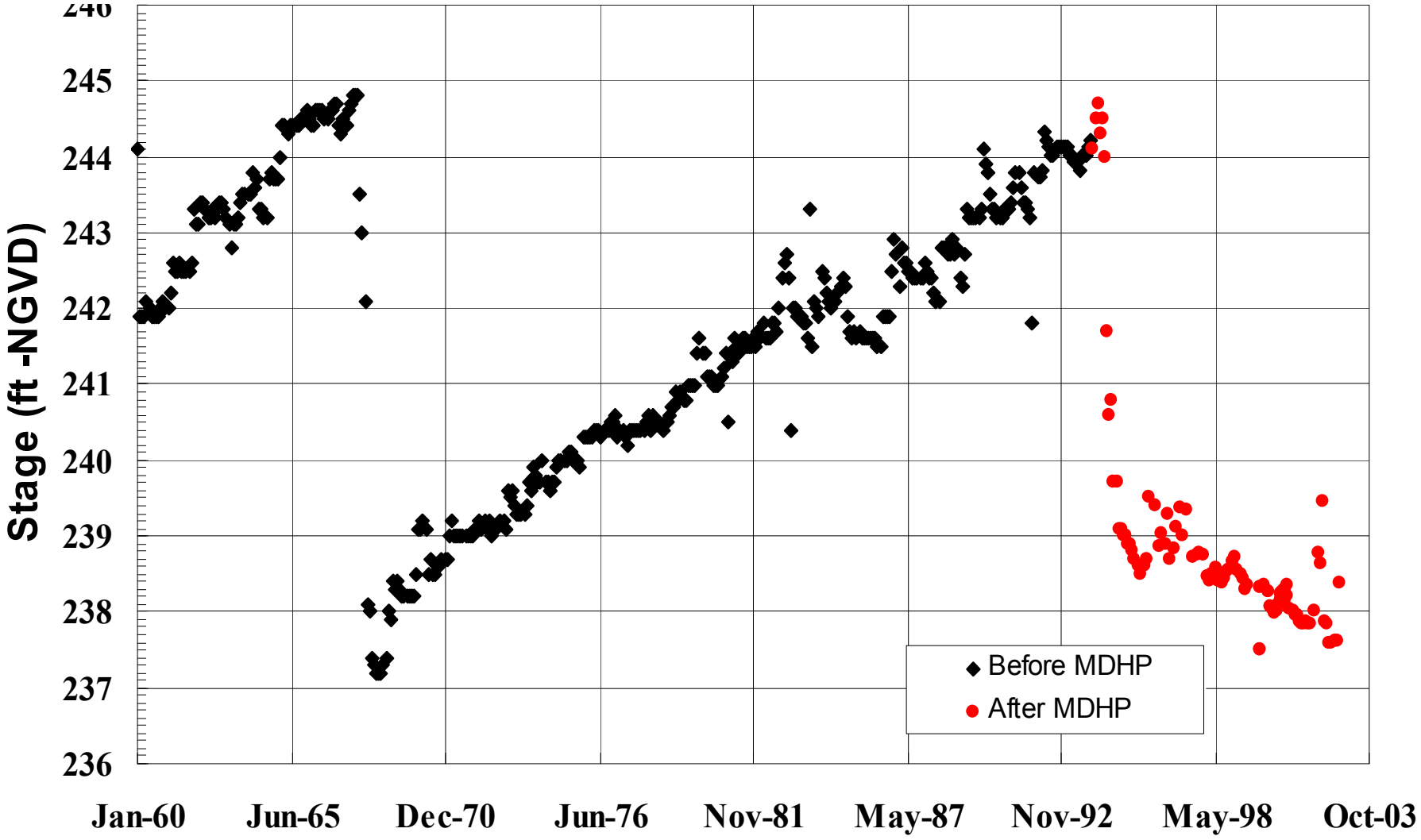
Results of MDHP Program

- Channel Response
- Structure Performance
- Environmental Impacts
- Impacts on Sediment Yield
- Design Guidance for Systems Approach to Watershed Rehabilitation

Minimum Monthly Gage Readings on Hickahala Creek



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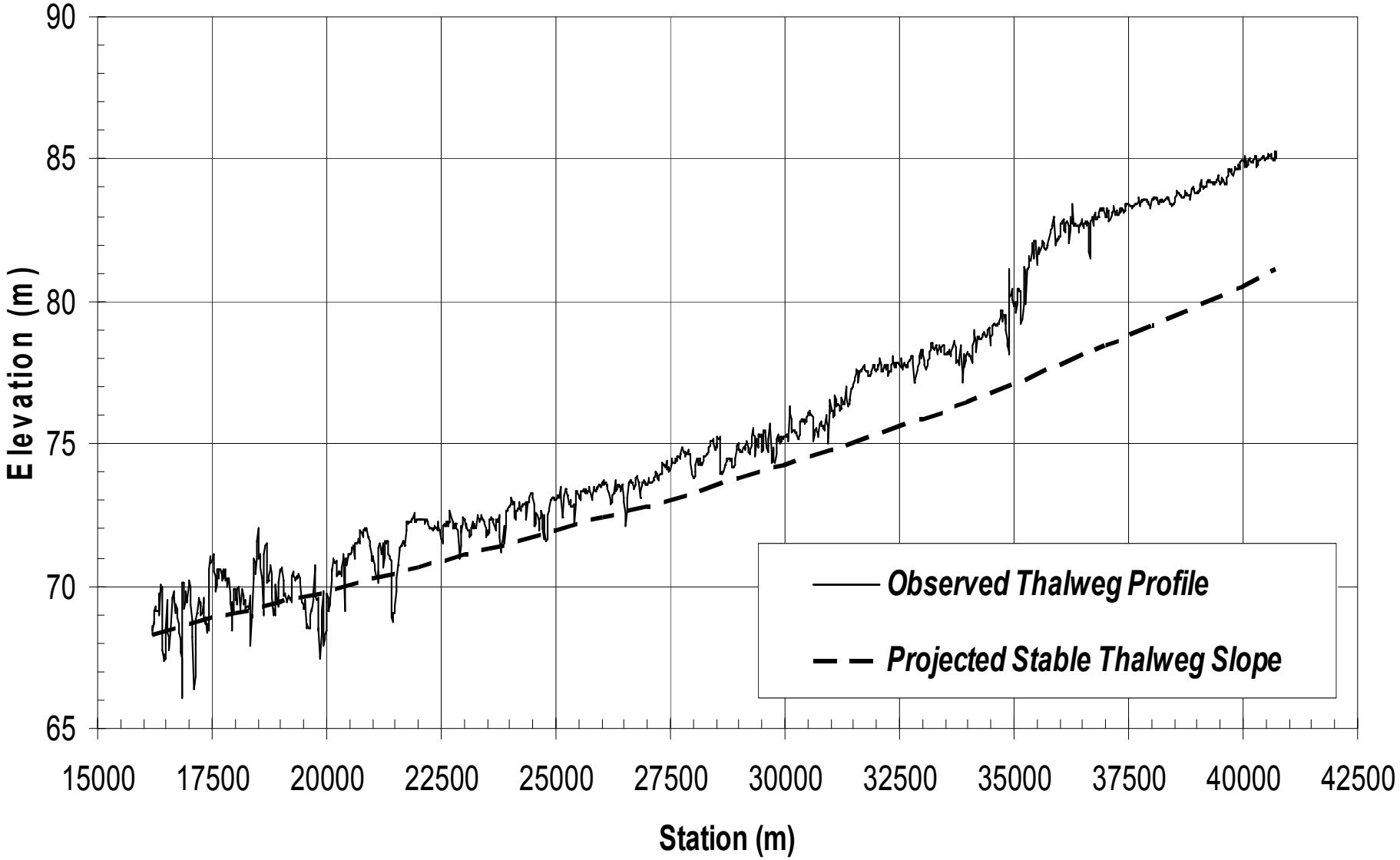
Effects of MDH Project on Long-Term Sediment Delivery

Yalobusha River Canal Thalweg Profile



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Watershed	Bed & Bank Erosion no/GCS (1000m3)	Bed & Bank Erosion w/GCS (1000m3)	Percent Reduction in Bed & Bank Erosion
Batupan Bogue	180,000	90,000	50%
Hickahala	14,000	4,500	68%
Long	30,000	14,500	52%
Hotophia	5,500	950	83%

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Phosphorus Reductions Due to MDHP Project Features

- Over 500 samples collected in FY 2000
- Average total phosphorus content approximately 200 mg/kg or (0.4 lbs/ton)

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Impacts of Excess Nutrients

- Negative impacts to fish and other wildlife
- Economic impacts resulting from phosphorus removal, BMP
- Contribution to hypoxia problem in the Gulf of Mexico

Phosphorus Reduction Based on 50 Year Response

Watershed	Bed & Bank Erosion Reduction (1000 tons/yr)	Phosphorus Retained (1000 lbs/yr)
Batupan Bogue	3000	1200
Hickahala	300	120
Long	550	220
Hotopha	150	60

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Agricultural best management practices (BMPs) have indicated that some non-point source management programs spend in excess of $185 per lb of phosphorus reduction per year.

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Phosphorus Benefits
Batupan Bogue

- 10% of actual annual phosphorus reduction or 120,000 lbs/yr
- 10% of $185/lb or $18.5/lb
- $2,220,000/yr benefits

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Potential for Nitrogen Reduction and Control

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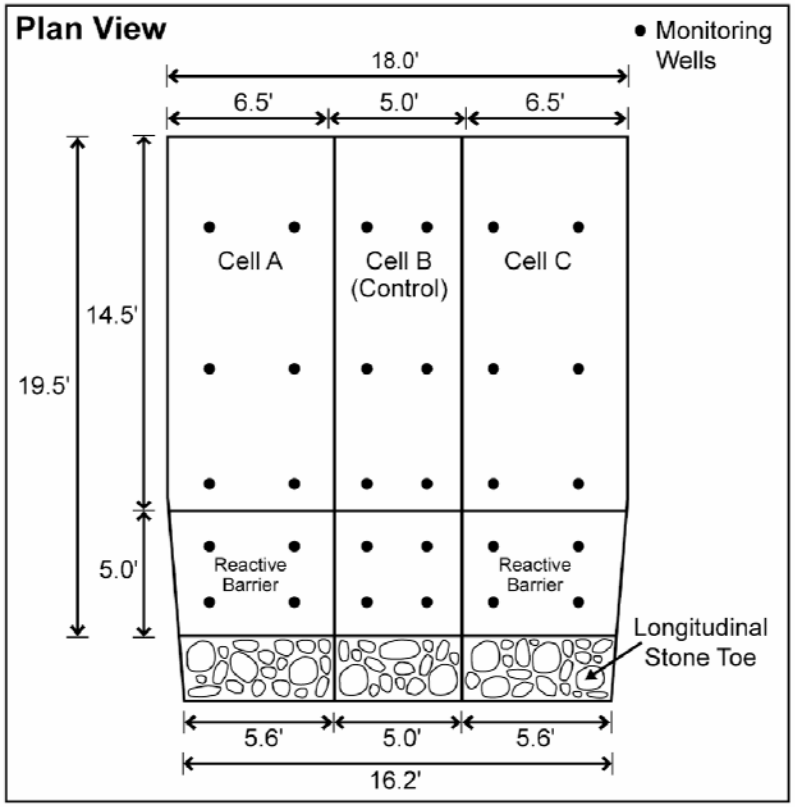
Modification to Longitudinal Stone Toe-Dike

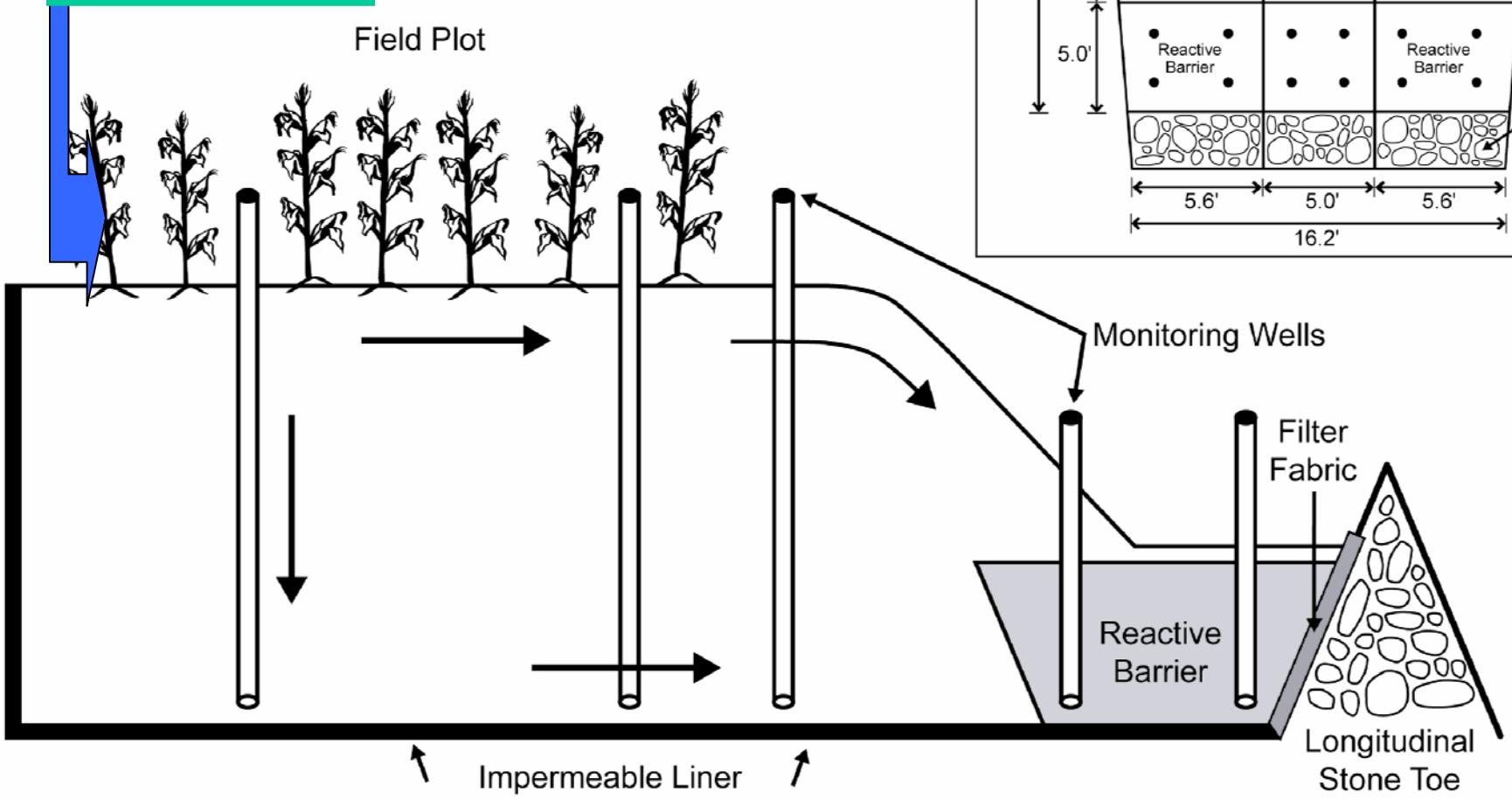
A: Nitrogen Removal

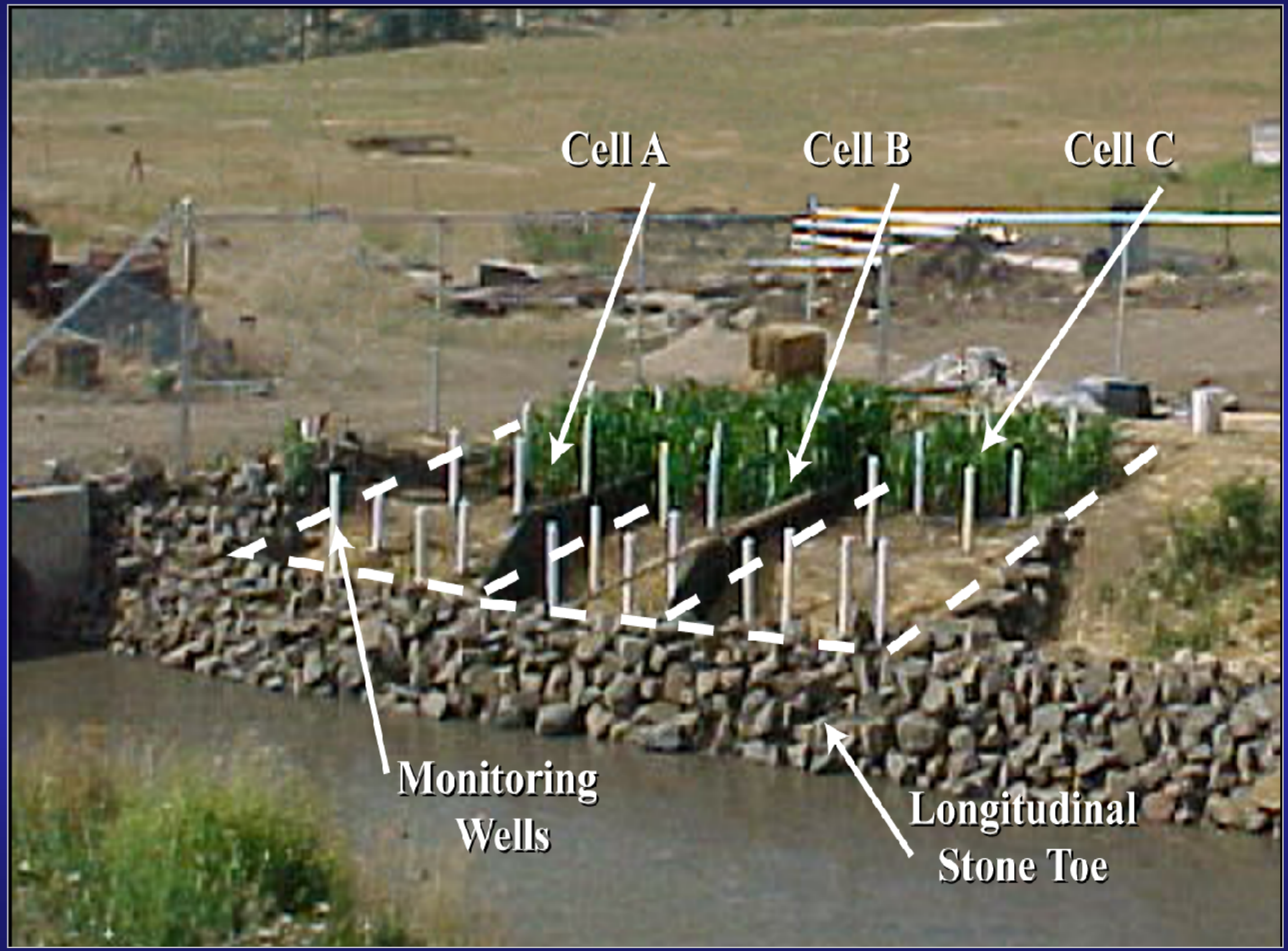
B: Control

C: Nitrogen & Phosphorus Removal



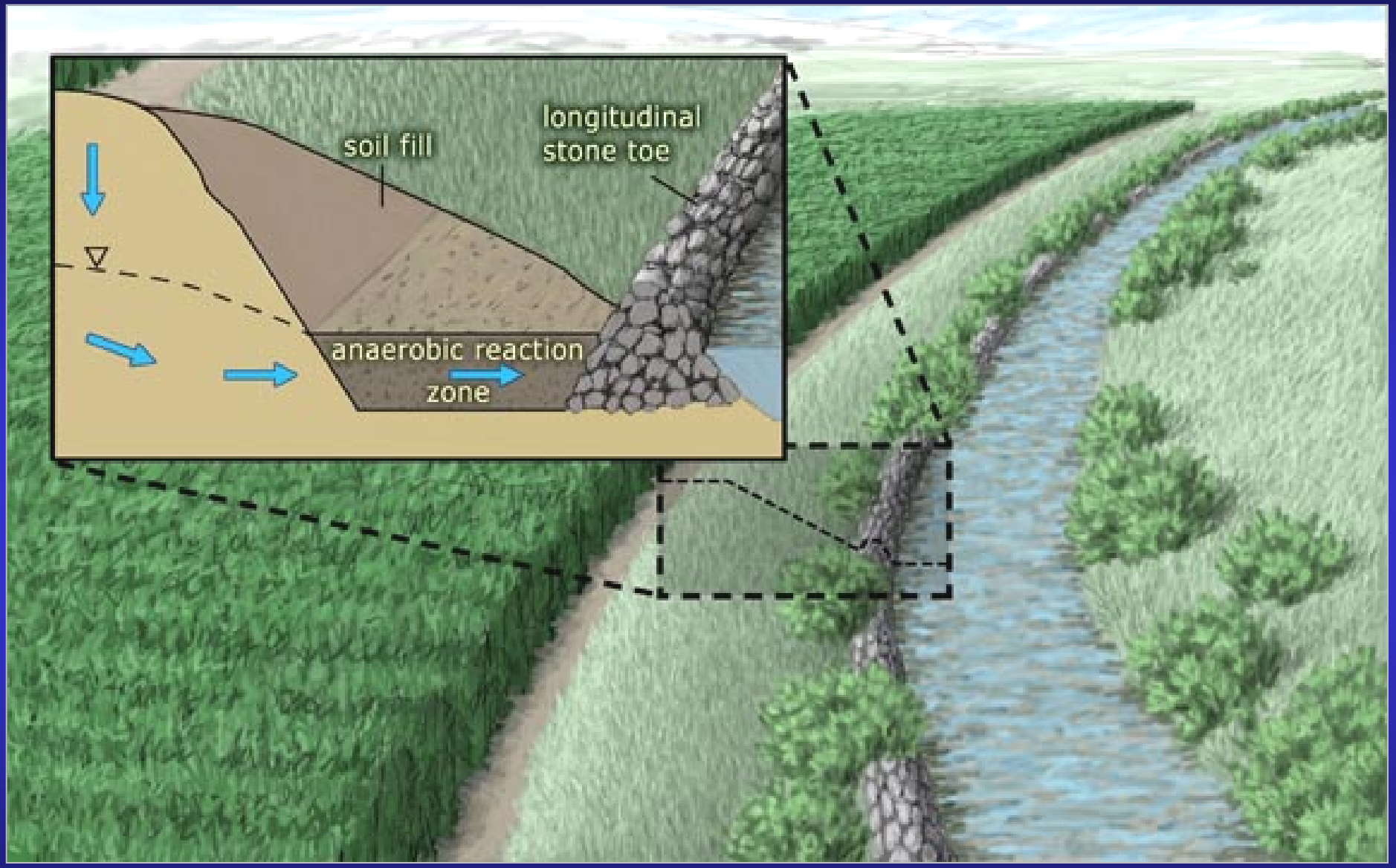
Irrigation/ Fertilization




Cell A
Cell B
Cell C
Monitoring Wells
Longitudinal Stone Toe

Preliminary Findings of Nutrient Removal Rates

Organic Amendment	Nitrogen	Phosphorus
None	30%	N/A
Sawdust only	60% to 80%	N/A
Sawdust & Aluminum Hydroxide	60% to 80%	>90%



Conceptual Diagram of Bank Stabilization
Structure Modified to Control Nutrients

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Benefits of the MDH Project

- Improved understanding of effects of watershed treatments on sediment delivery
- Quantified benefits of watershed treatment measures, particularly with respect to channel stability, sediment delivery and reduction of pollutants
- Improved design guidance for systems approach to sediment management
- Development of effective, lower cost environmentally friendly stabilization measures


Questions?
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