Tri-Service Infrastructure Systems Conference & Exhibition

2-5 August 2005

John B. Smith
Watershed Approach to Stream Stability and Benefits Related to the Reduction of Nutrients
Mississippi Delta Headwaters (MDH) Project
Mississippi Delta Headwaters (MDH) Project

Authorizations

- SECED in 1970’s (PL 93-251)
- WRDA 1986 (PL 99-662)
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
Yazoo Basin, MS
Mississippi Delta Headwaters Project
(Demonstration Erosion Control)
Channel Straightening
EFFECT OF CHANNELIZATION

CHANNEL BED
LOWERING OF BASE LEVEL FOR TRIBUTARY STREAM (AFTER SIMON, 1977)
Knickzone
Effects of Degradation
Effects of Degradation
Effects of Degradation
Effects of Bank Erosion
Gully Erosion
Channel Degradation
Deposition in Lower Reaches
Dredging
Systems Approach to Watershed Analysis
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
Typical MDHP Structures

- Grade Control Structures
- Riser Pipes
- Bank Stabilization
- Floodwater Retarding Structures
Reestablish Grade with Grade Control Structure
Low Drop Grade Control Structure

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BOX CULVERT GRADE
CONTROL STRUCTURE

ROADWAY

DOWNSTREAM

UPSTREAM

CHANNEL THALWEG

CHANNEL THALWEG

Ground
High Drop Grade Control Structure
One Corps Serving the Armed Forces and the Nation
Riser Pipe
One Corps Serving the Armed Forces and the Nation
Bank Stabilization

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Bank Stabilization

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Floodwater Retarding Structure
MDHP Monitoring Program
MDHP Monitoring

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

Stage (ft - NGVD)

Before MDHP

After MDHP

Jan-60 Jun-65 Dec-70 Jun-76 Nov-81 May-87 Nov-92 May-98 Oct-03
Effects of MDH Project on Long-Term Sediment Delivery
Yalobusha River Canal Thalweg Profile

Observed Thalweg Profile
Projected Stable Thalweg Slope
<table>
<thead>
<tr>
<th>Watershed</th>
<th>Bed &amp; Bank Erosion no/GCS (1000m³)</th>
<th>Bed &amp; Bank Erosion w/GCS (1000m³)</th>
<th>Percent Reduction in Bed &amp; Bank Erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batupan Bogue</td>
<td>180,000</td>
<td>90,000</td>
<td>50%</td>
</tr>
<tr>
<td>Hickahala</td>
<td>14,000</td>
<td>4,500</td>
<td>68%</td>
</tr>
<tr>
<td>Long</td>
<td>30,000</td>
<td>14,500</td>
<td>52%</td>
</tr>
<tr>
<td>Hotophilia</td>
<td>5,500</td>
<td>950</td>
<td>83%</td>
</tr>
</tbody>
</table>
Over 500 samples collected in FY 2000

Average total phosphorus content approximately 200 mg/kg or (0.4 lbs/ton)
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

<table>
<thead>
<tr>
<th>Watershed</th>
<th>Bed &amp; Bank Erosion Reduction (1000 tons/yr)</th>
<th>Phosphorus Retained (1000 lbs/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batupan Bogue</td>
<td>3000</td>
<td>1200</td>
</tr>
<tr>
<td>Hickahala</td>
<td>300</td>
<td>120</td>
</tr>
<tr>
<td>Long</td>
<td>550</td>
<td>220</td>
</tr>
<tr>
<td>Hotophpha</td>
<td>150</td>
<td>60</td>
</tr>
</tbody>
</table>
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.
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
Potential for Nitrogen Reduction and Control
Modification to Longitudinal Stone Toe-Dike
A: Nitrogen Removal
B: Control
C: Nitrogen & Phosphorus Removal
## Preliminary Findings of Nutrient Removal Rates

<table>
<thead>
<tr>
<th>Organic Amendment</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>30%</td>
<td>N/A</td>
</tr>
<tr>
<td>Sawdust only</td>
<td>60% to 80%</td>
<td>N/A</td>
</tr>
<tr>
<td>Sawdust &amp; Aluminum Hydroxide</td>
<td>60% to 80%</td>
<td>&gt;90%</td>
</tr>
</tbody>
</table>
Conceptual Diagram of Bank Stabilization
Structure Modified to Control Nutrients
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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