4. In-Stream Structures

- Boulders and logs sized to resist washout
- Vanes oriented to provide bank protection & maintain position
- Footers, splash rocks, backer logs, sills, chinking, geotextiles, backfilling to maintain structure stability
- Drops/steps support aquatic organism passage & structure stability

Functions: *Flow Direction & Revetment*

- Streambank protection
- Grade control
- Sediment transport
- Habitat enhancement (pools, aeration, cover)

Structure Criteria:

- Natural materials
- Habitats & passage for aquatic organisms
- Natural sediment transport (alluvial systems)

Do you like these?

Vanes (Boulder or Log)

- Oriented upstream at 20-30 degrees from bank tangent
- Sloping up from channel invert at 3-5 % arm toward bank
- May control grade using J-hook (< 0.5 ft drop)
- May need footers, sills, geotextile to avoid piping/washout

Boulder Vanes

- Single-arm
- J-hook
- Cross-vane

20-30 degrees

3-5 % arm slopes

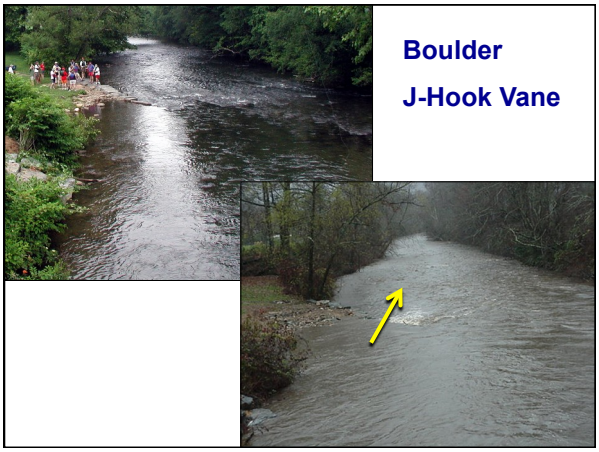
Runaway Truck Ramp

Boulder J-Hook Vane: *Scour Pool*

Boulder J-Hook Vane

Chinking Boulders to Prevent Piping

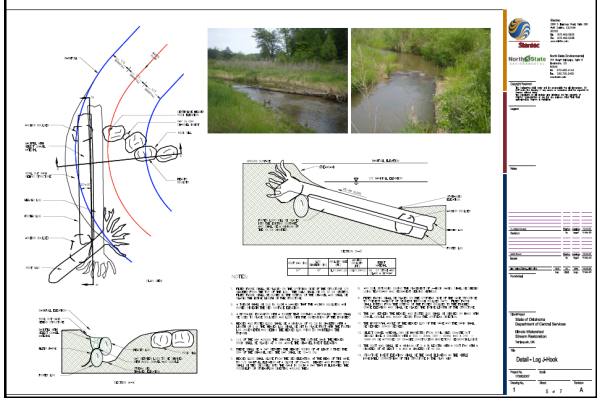
Geotextile Curtain to Prevent Piping



Boulder

J-Hook Vane

Log J-hook Vanes for flow direction & habitat



Multiple Log Vanes

Saugahatchee Creek

2007

2008

Multiple Log Vanes

Saugahatchee Creek

2009 January

2009 July

Multiple Log Vanes: Saugahatchee Creek

Log Vanes (with Toe Wood downstream)

- Auburn NE Sewer
- Redirect flow to allow natural vegetation to stabilize bank

Log Vanes (with Toe Wood downstream)

- 2-4 % arm slopes
- 20-25 degree arm angles
- Sealed with woven geotextile & backer logs

Log Vane (with J-Hook)

Log J-Hook Vane

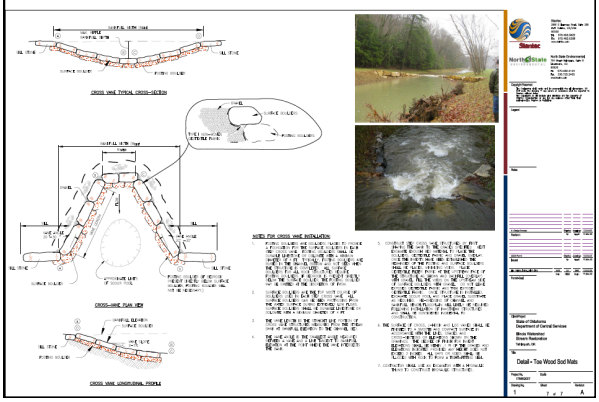
Log J-Hook Vane

Log J-Hook Vane

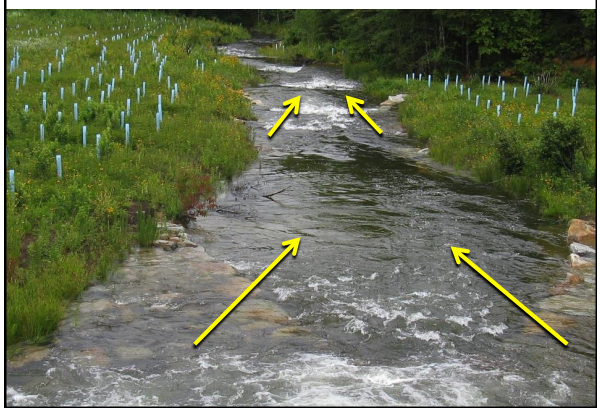
Boulder Cross Vane

- Direct flow in new channel alignment
- Grade control and scour pool
- Footer boulders & geotextile

Cross Vanes for flow direction & grade control



Boulder Cross Vanes: *Grade Control*



Boulder Cross Vane: *Grade Control*

Double-Drop Boulder Cross Vane

Double-Drop Offset Boulder Cross Vane

Double-Drop Offset Boulder Cross Vane

Cross-Vane (Double-Drop): Grade control, flow direction, scour

Arm slope = 2.5 / 50 = 5%; Arm angles = 25 degrees

Max drop over each step = 0.5 ft

Riffle Morphology: Bankfull Width = 25 ft; Depth = 2.2 ft

Floodprone Width = 55 ft

Entrenchment Ratio, ER = 55/25 = 2.2

Cross Vane (logs embedded)

Cross Vane (logs embedded)

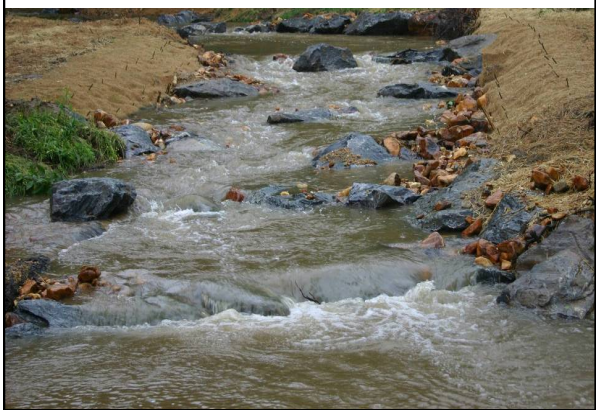
Offset Boulder Cross Vane at a Bridge

Boulder W-Vane

Boulder
W-Vane

Pool Maintenance

Constructed Riffle



Constructed Riffle (Rock & Roll)

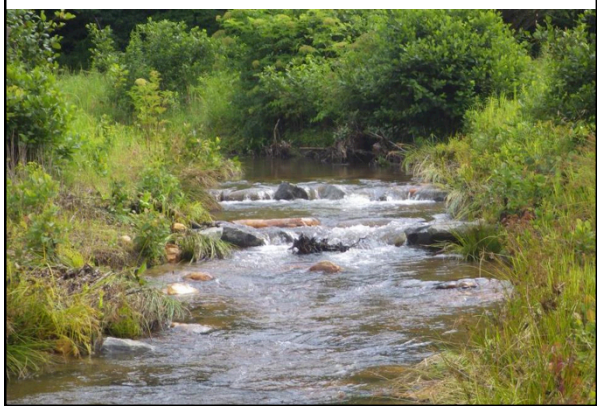
Constructed Riffle (Rock & Roll)

Constructed Riffle with Embedded Wood

- Undercut bed 2 ft and backfill with gravel, cobble, boulders, wood
- Cut thalweg 0.5 ft deep

Constructed Riffle with Embedded Wood

Riffle with Embedded Logs



Riffle with Embedded Logs

Riffle with Embedded Logs

Riffle with Log Rollers

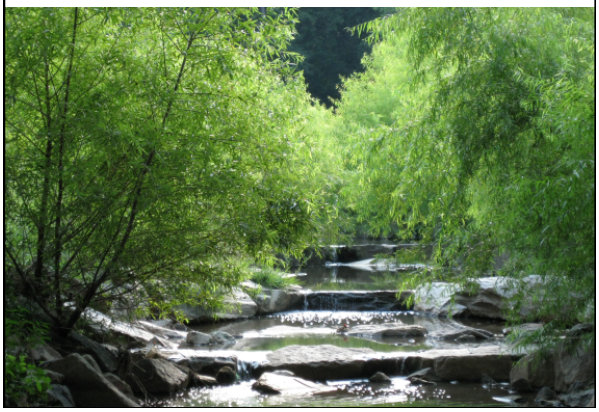
Riffle with Log Rollers

1st Order Streambed Transplant

Substrate transfer from old channel to new channel

1st Order Streambed Transplant: *5 Yrs Later*

Constructed Step-Pool: Boulder

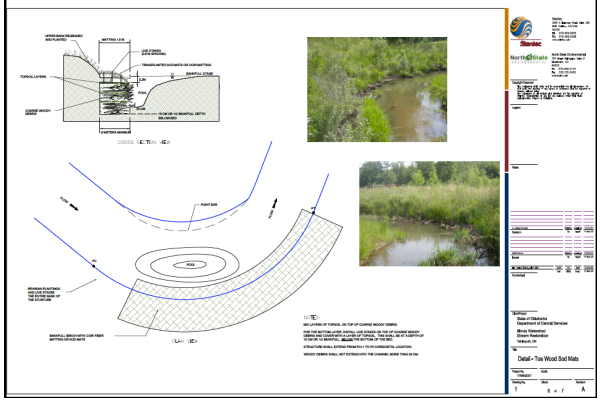


Step-Pool + Cross Vane: *Terminus Priority 1*

Toe Wood Revetment

- Layers of logs and brush under water in pools
- Live cuttings above water (silky dogwood, elderberry)
- Matting, seed, transplanted alders on top

Toe Wood for bank protection, roughness, habitat



Toe Wood Revetment

Illinois River Site 7:
Tyner Creek - Clovis
(450 ft perennial)

Bank Grading
Bench with Transplants
Toe Wood
Trees/shrubs

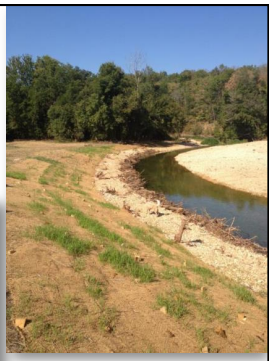
Construction: July, 2012

Illinois River Site 7:
Tyner Creek – Clovis

Toe Wood & Transplanted Sycamores

Illinois River Site 7:
Tyner Creek – Clovis

On-site materials only

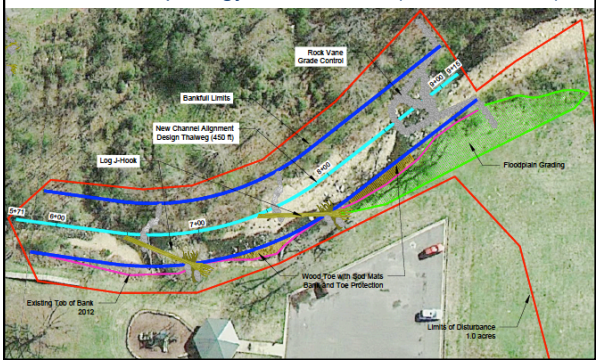


Planting:
March, 2013

After Flood:
April, 2013

***Case Study*: Illinois River Site 4: Fels Park**

Channel Morphology: Riffle – Pool (Meander Bend)



Existing Condition: Incised, vertical bank, stress outside bend

Existing Condition: Stormwater outfall pipe

Log J-Hook Vane: Flow direction, bank protection, habitat

Arm slope = 1.2 / 30 = 4%; Arm angle = 25 degrees

Log J-Hook Vane with Boulder sill hook & geotextile

Toe Wood for bank protection, roughness, habitat

Log J-Hook Vane: Downstream of stormwater pipe

Storm Flow: Flow direction + Bank protection

Storm Flow: Flow direction + Bank protection

Planting:
March, 2013

May, 2013

Stream Crossings

- Aquatic organism passage
- Minimize geomorphic impacts
- Pass flood flows

Culvert Replacement in 1st Order Stream

Goal: Maintain natural bed conditions

Culvert with Buried Bottom: 2008

Culvert with Buried Bottom: 2011