Presentation
to the

Upper Mississippi River Basin Environmental Management Program Workshop

by

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Engineering Design Handbook

Secondary Channel Modification

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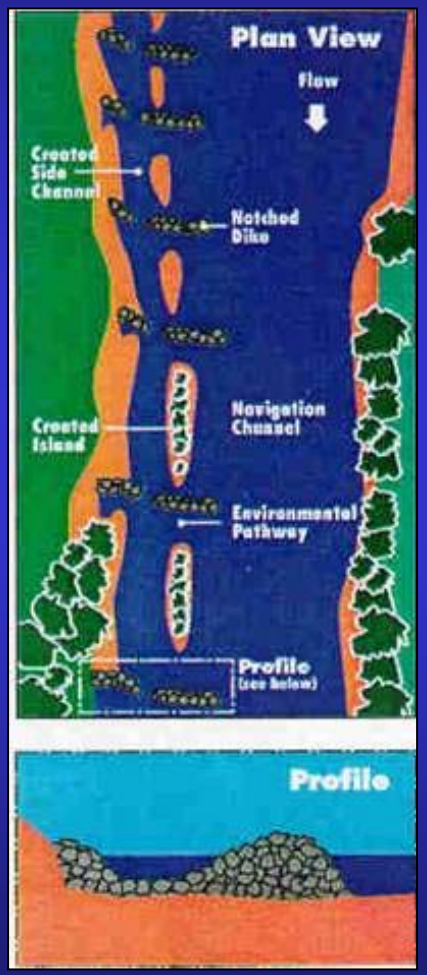
Notched Wing Dams

- Create aquatic diversity by notching the wing dam structures
- Flow will increase in the vicinity of the notch, deepening the pool behind the wing dams
- The creation of small chutes within the dike field, the presence of submerged sandbars, and increased edge habitat are valuable forms of aquatic habitat diversity that benefit the fish and macroinvertebrate communities
- In general, notch width should be 10-25 percent of the riverward length of the structure



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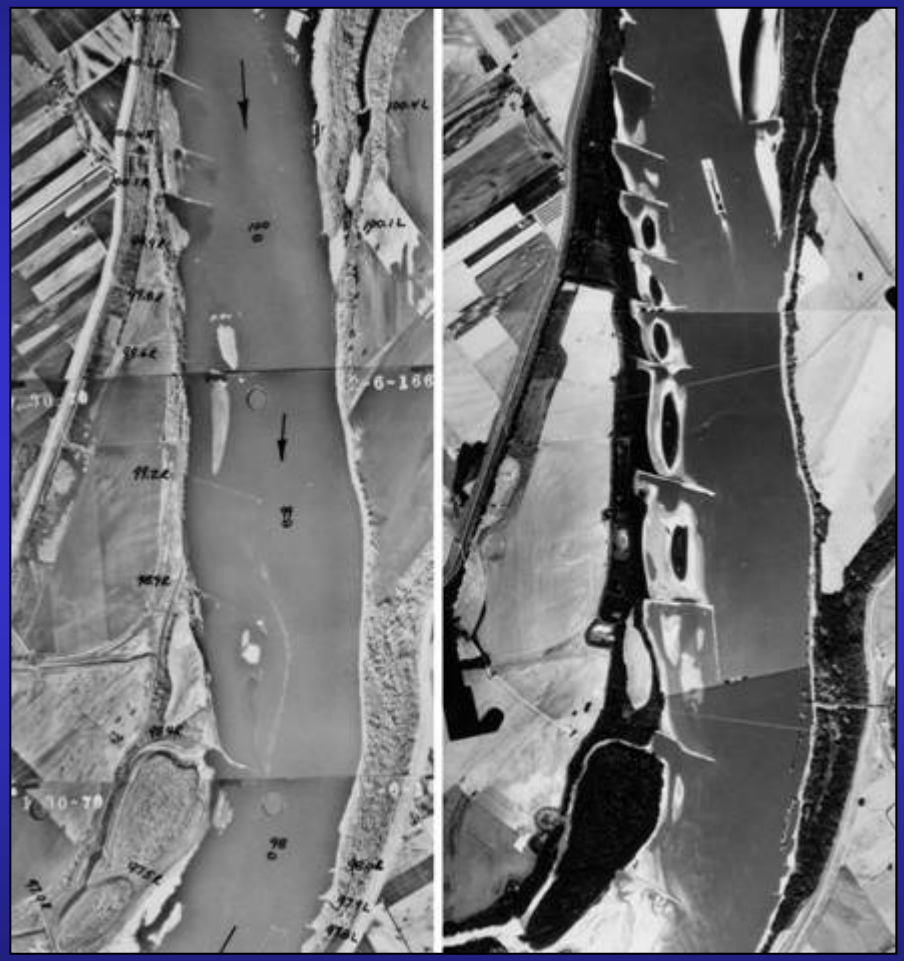
Notched Wing Dams



Mile 100 Islands MMRM 100.0R

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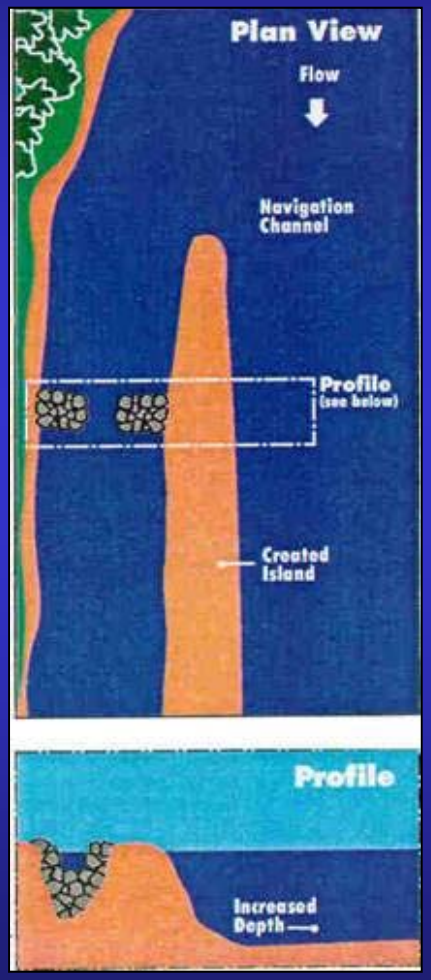
Notched Closure Structure

- Allows flow through the closure structure, keeping side channels from becoming depositional zones
- Usually develops a scour hole downstream of the notch, creating a pool for over wintering habitat
- Reduces the need for environmental dredging while maintaining the integrity of the navigation channel



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Notched Closure Structure

Marquette Chute MMRM 51.0L

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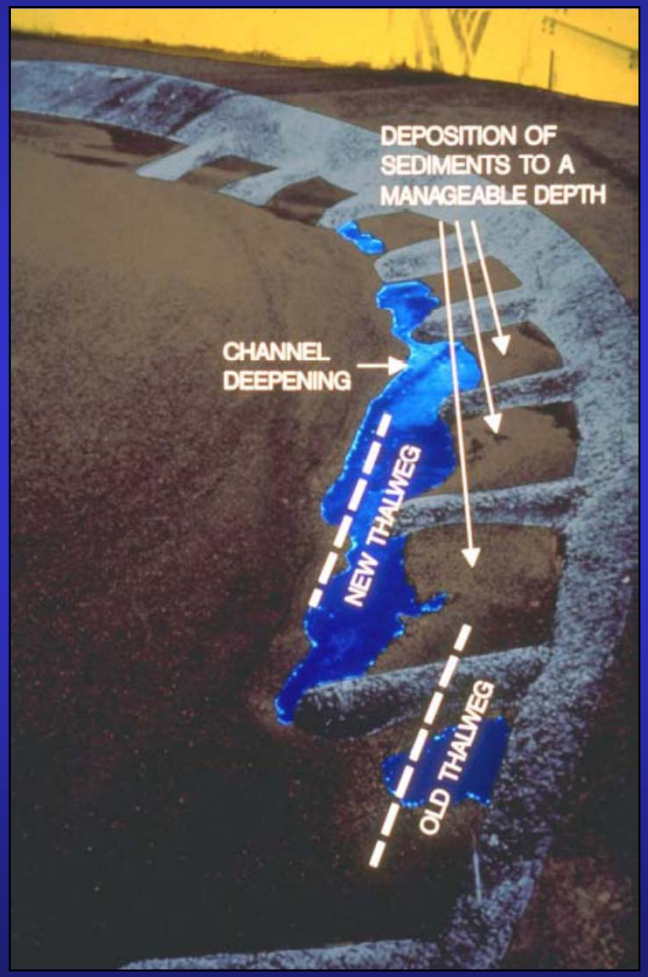
Bendway Weirs

- The bendway weir is a low level, totally submerged rock structure that is positioned from the outside of the bankline of the riverbend and angled upstream toward the flow
- The positioning and alignment of the weirs alters the rivers secondary currents so they shift away from the outside of the bankline'
- Provide both navigation and environmental benefits placing structures on the outside of the bend so the inside remains undisturbed
- Bendway weirs are used in a series



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Bendway Weirs

Nearly 200 weirs on the Mississippi River

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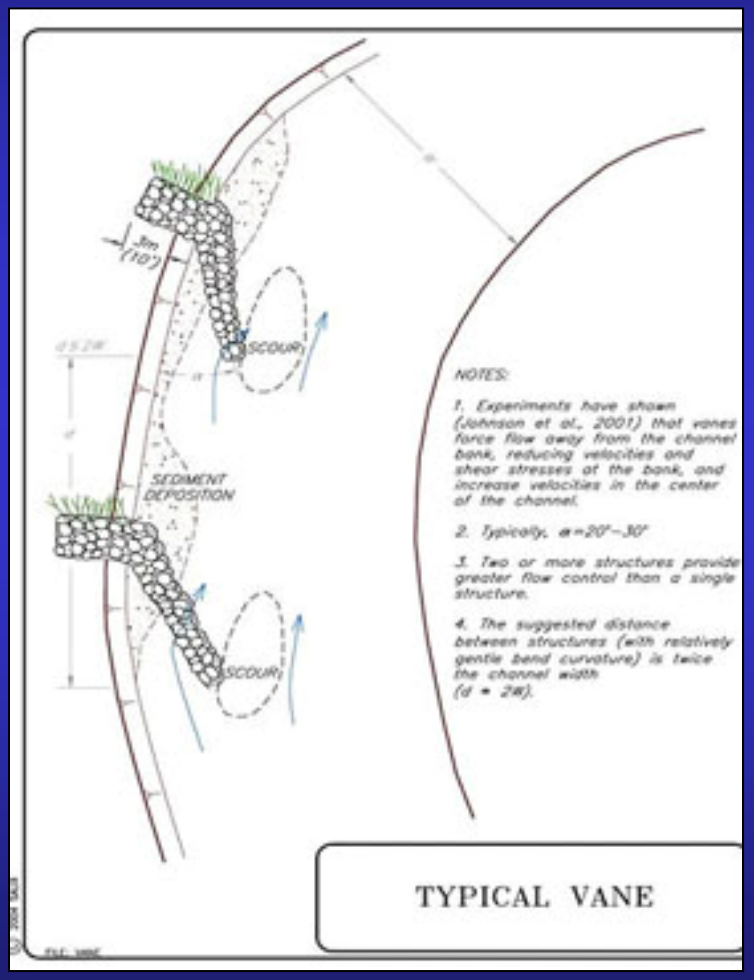
Rock Vanes

- Rock vanes are in-stream structures constructed for the purpose of reducing shear stress on stream banks
- Rock vanes are usually angled upstream at 30° and acts similar to a transverse bar
- Flow travels 90° across the top of the structure and is directed away from the bank
- Rock vanes are typically used in a series with various spacing



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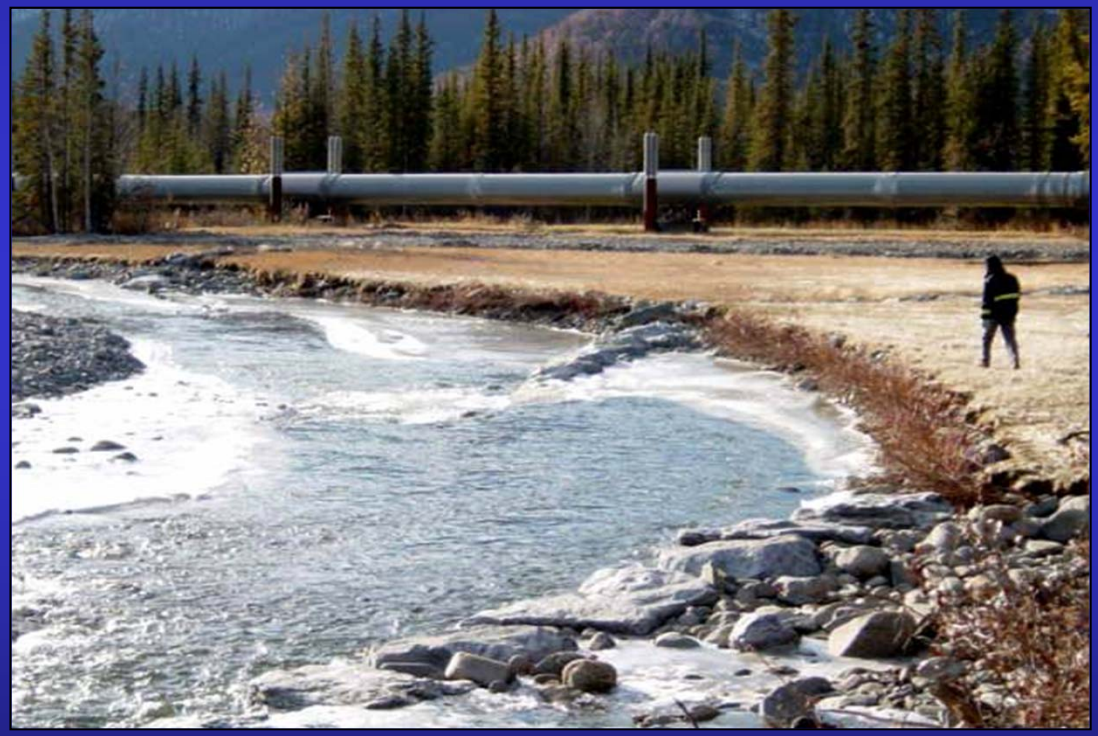
Rock Vanes



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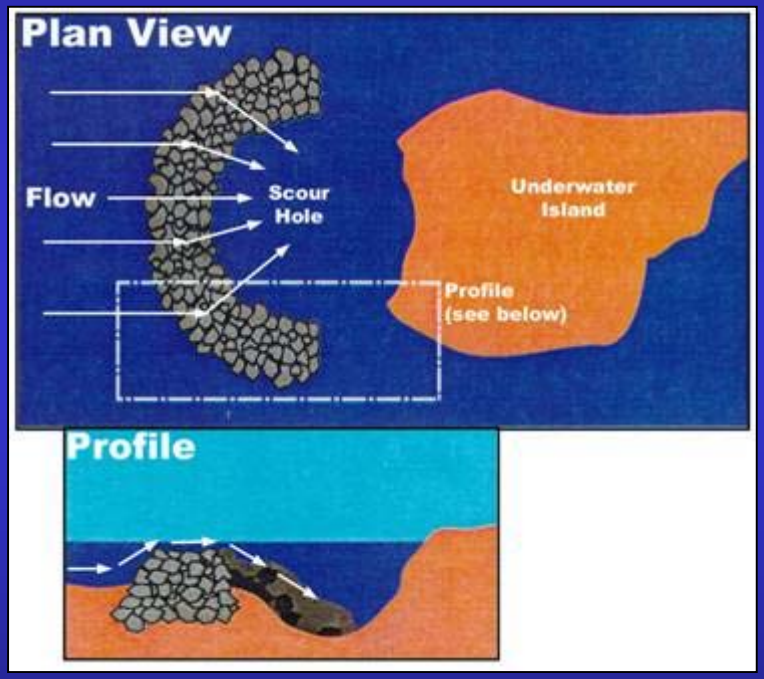
Blunt Nosed Chevron

- Blunt nosed, semi-circular, keyless structure designed to control and maintain flow splits.
- Initially designed to protect island heads and a location for dredge spoil deposit material, the blunt nosed chevron is now used to create aquatic diversity
- Blunt nosed chevrons are typically used in a series and are used for both navigation and environmental purposes



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Blunt Nosed Chevrons

Cottonwood Island Chevrons

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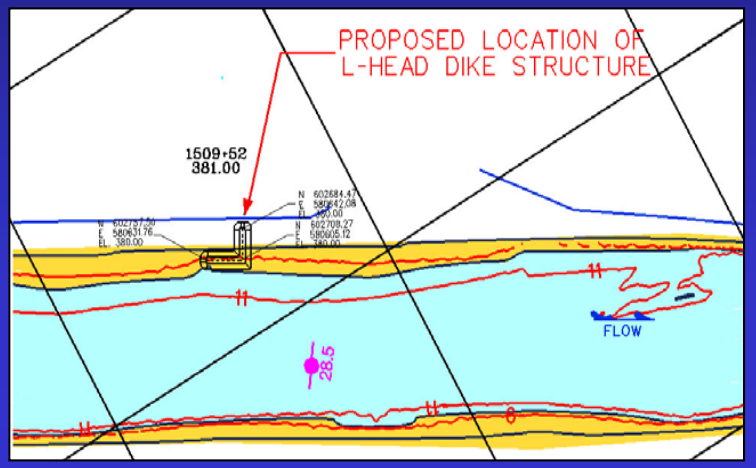
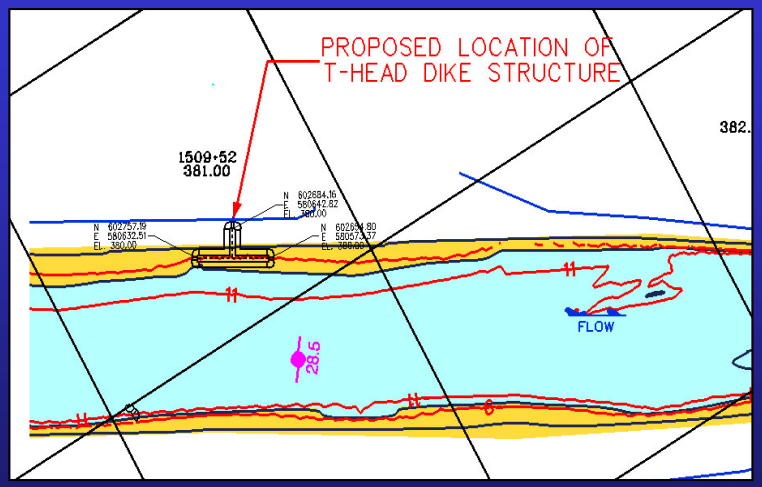
L-Head & T-Head Dikes

- The purpose of the L-Head and T-Head structures are to increase the area of effect by placing a head on the dike
- The head portion of the structure is typically aligned parallel with flow
- The "L" part of the structure located upstream of creates a depositional area and if located downstream creates a scour area
- If design structure using the "T" head both the deposition and scouring will occur





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L-Head Dike

Kansas River at Eudora Bend, KS

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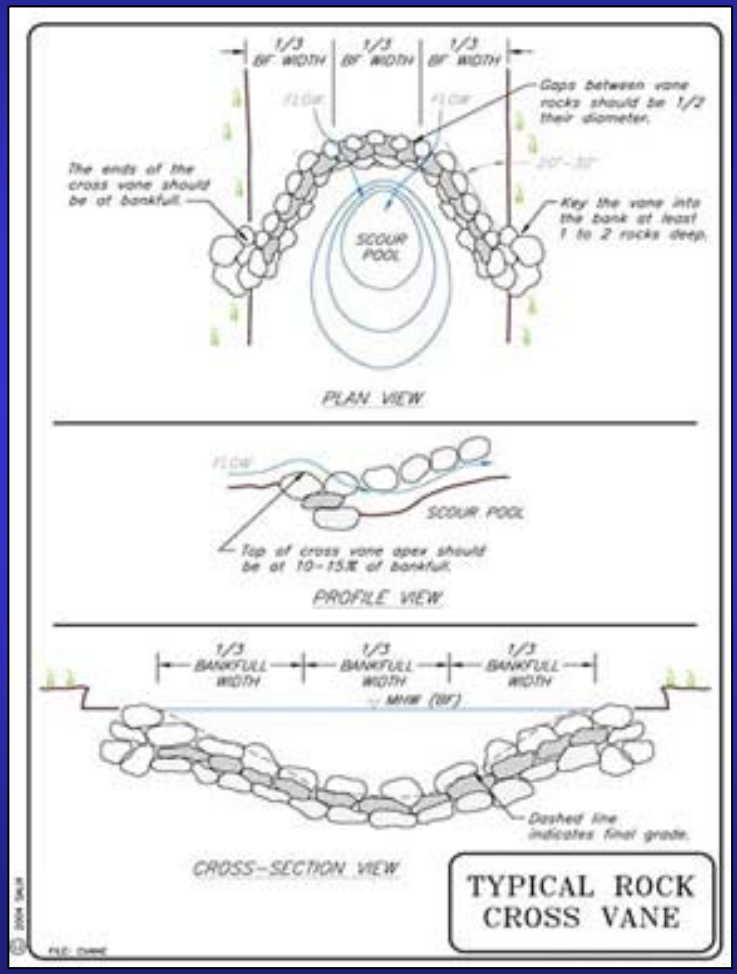
Cross Vanes

- This structure was designed to off-set the adverse effects of straight weirs, and check dams, which create backwater and flat slopes
- Some of the objectives of the structure are to: (1) create instream cover/holding water; (2) take excess shear stress from the near bank and direct it to the center; (3) increase stream depth by decreasing width/depth ratio; (4) increase sediment transport capacity; (5) provide a grade control structure
- Can be used as a single structure or in a series



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Cross Vanes

Mountain stream in Pagosa Springs, CO

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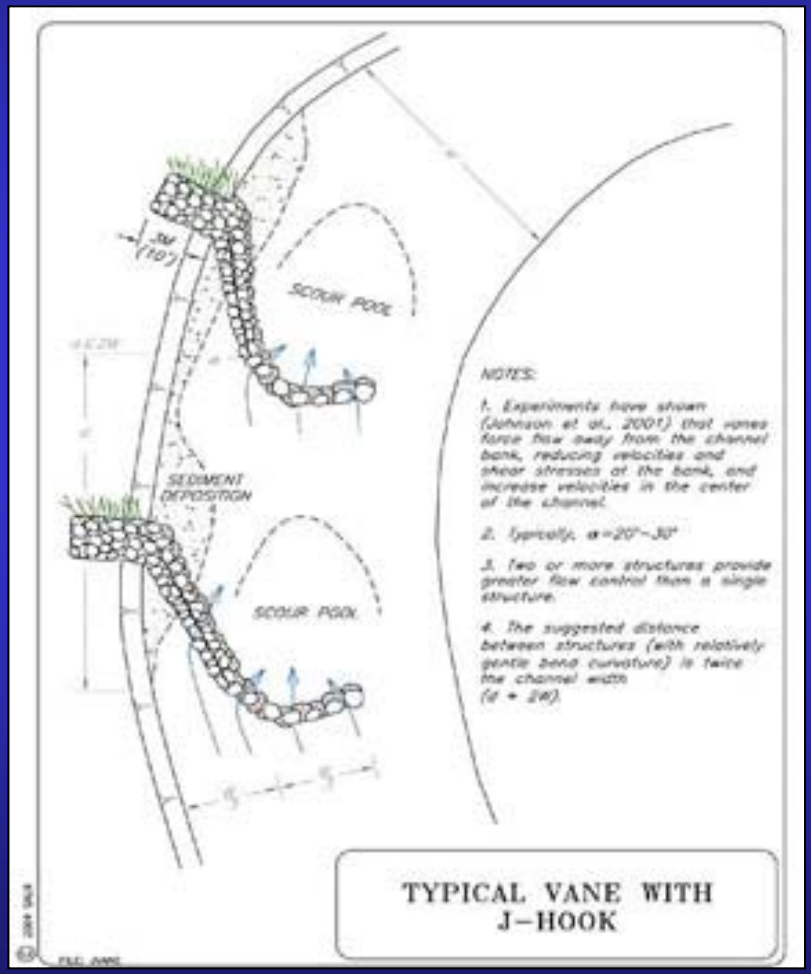
J-Hook Vane

- These structures are designed to re-direct velocity distribution and high velocity gradient in the near bank region, stabilize stream-banks, dissipate energy in deep, wide and long pools created below the structure
- Can be used as a single structure or in a series



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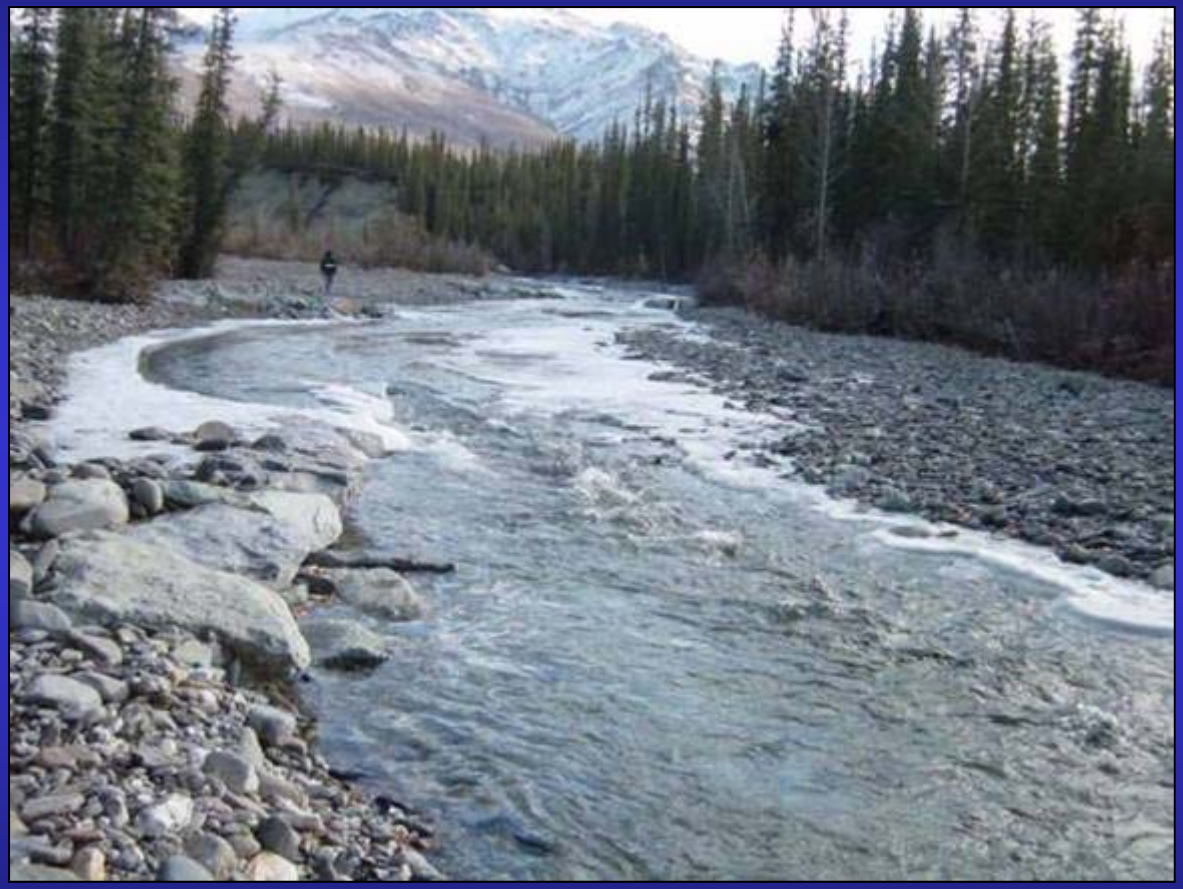
J-Hook Vane



Marion Creek, AK

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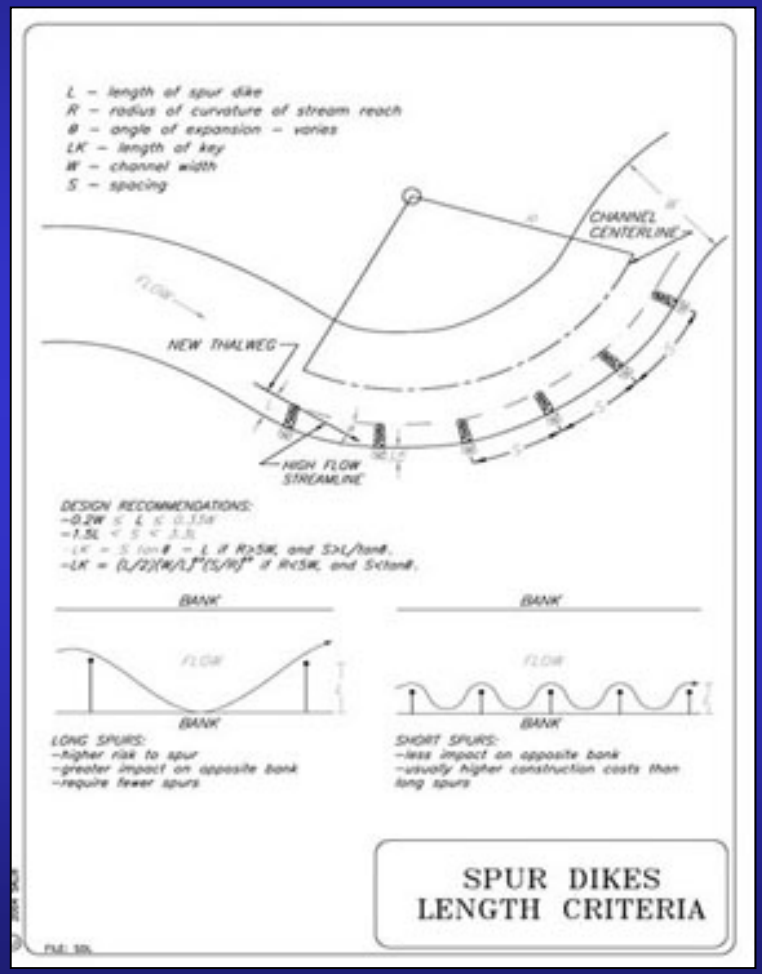
Spur Dikes

- These structures are used in river training as contraction works to establish normal channel width; to direct axis of flow; to promote scour and sediment deposition where required; and to trap bedload to build up new banks
- These structures are typically used in a series



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Alternating Dikes

- Alternating dikes can typically be used in side channels that are long and straight
- The dikes are placed along both banklines in an alternating configuration
- The design creates a sinuous flow pattern in areas that previously had homogeneous flow
- The river bed is also altered with the development of scour holes off the end of each dike
- These structures are used in a series

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Alternating Dikes

Santa Fe Chute

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Hard Points in Side Channel

- Hard points are a concentration of stone or other material placed at regular intervals along the eroding bank
- The hard points work by resisting the acting forces associated with bank failure
- Success depends on the ability of the stone to launch into the scour hole formed from the hard point
- These structures are used in a series

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Hard Points in Side Channel

Duck Island Side Channel

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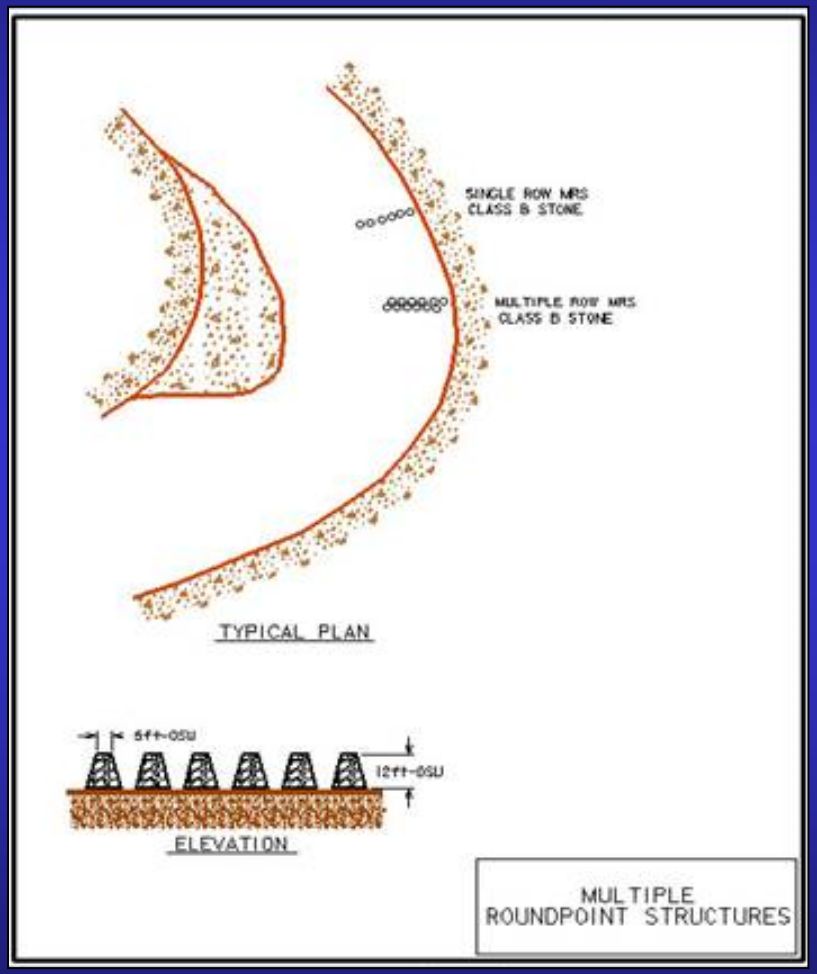
Multiple Roundpoint Structures

- Multiple Roundpoint Structures (MRS) are used to create bathymetric and flow diversity in streams and rivers
- The structures induce scouring off the tips of the structures and create depositional areas with the increased roughness generated by the structures
- The MRS are generally built to 2/3 bankfull and the grade of stone needed is channel dependent



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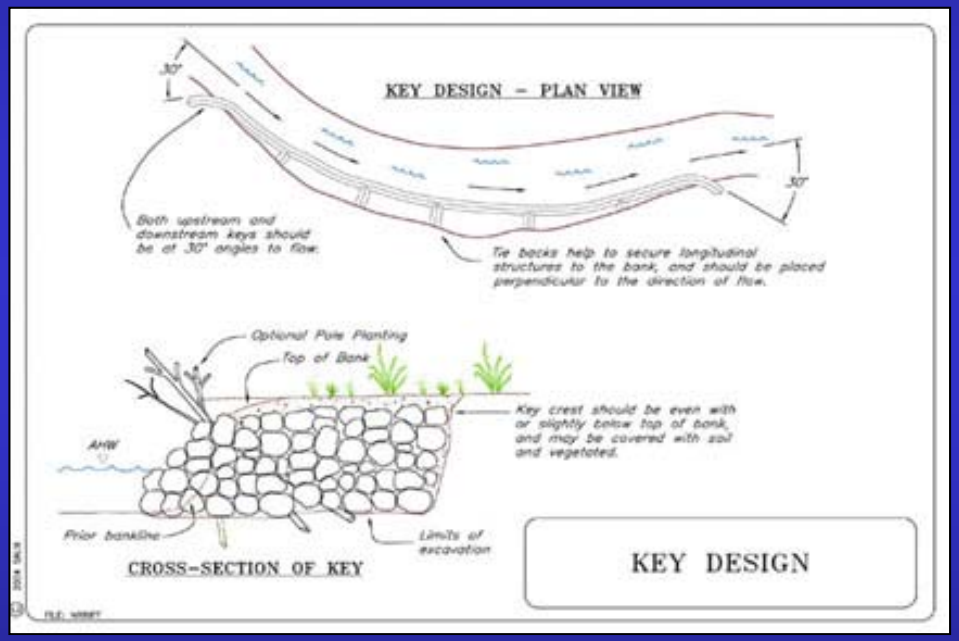
Environmental Dredging

- **Environmental Dredging is used to reopen secondary channels that have silted in over time**
- **To maintain the environmental benefits of secondary channels it is sometimes necessary to mechanically dredge to keep channel connectivity**

Longitudinal Peak Stone Toe Protection

- Longitudinal Peak Stone Toe Protection (LPSTP) is a continuous stone dike comprised of well sorted, self launching stone, placed at, or slightly streamward of, the toe of the eroding bank
- The LPSTP does not necessarily follow the toe exactly, but can be placed to form a “smoothed” alignment through the bend



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Longitudinal Peak Stone Toe Protection

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Wood Pile Structures

- Woody pile structures are basically logs that are driven in to the river bed to create roughness and form a river training structure
- Prior to the 1960's almost all structures placed in the Middle Mississippi River were of the woody pile type
- Form macroinvertebrate habitat

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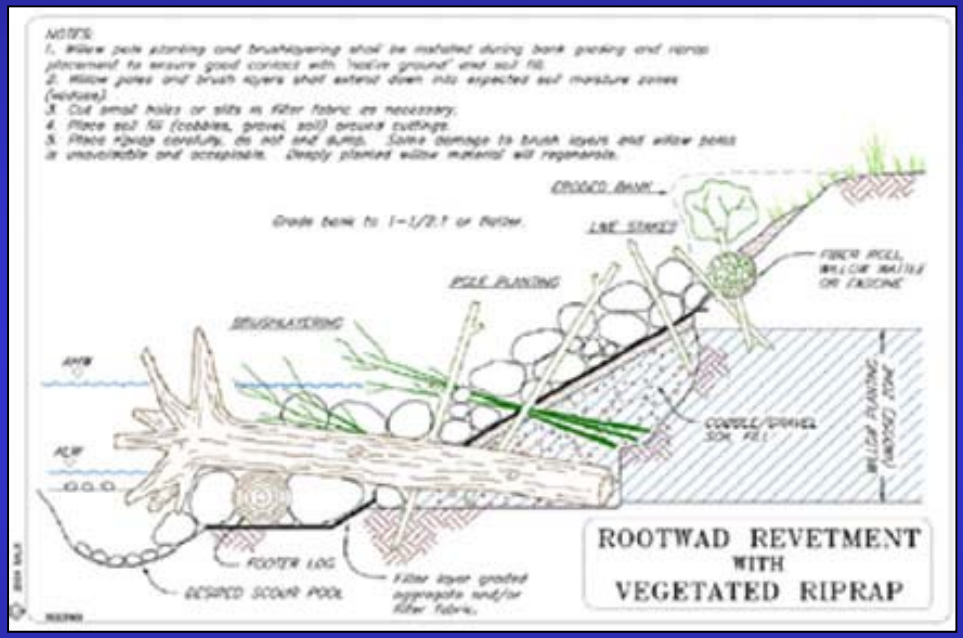
Rootwad Revetment

- **Rootwad Revetment objectives are: to protect the bank from erosion; provide in-stream and overhead cover for fish; provide shade, detritus, terrestrial insect habitat; look natural, and; provide diversity of habitats**



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Rootwad Revetment

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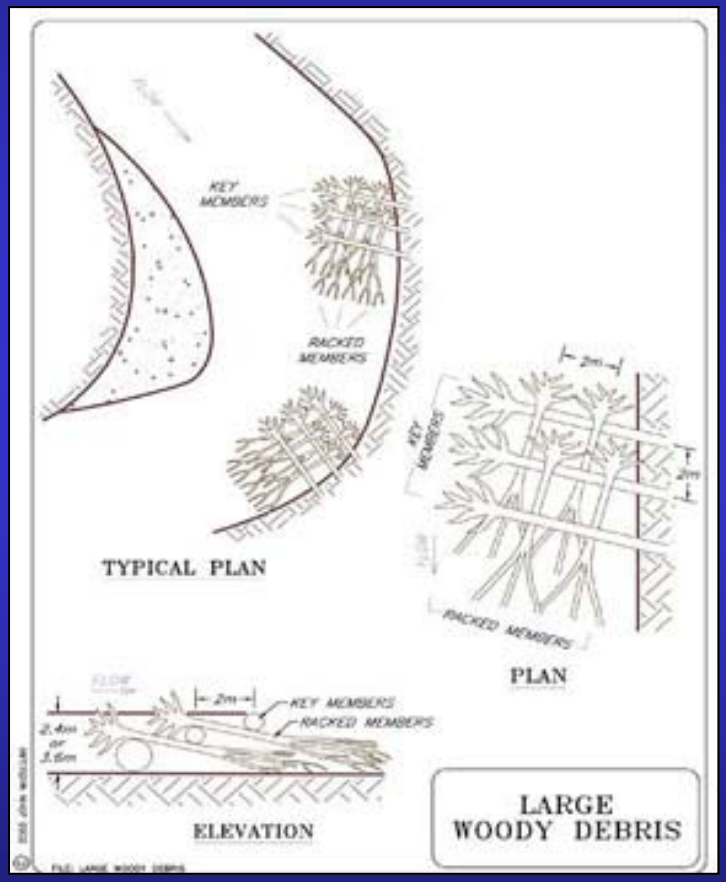
Woody Debris

- Large woody debris (LWD) provides roughness, reducing velocities and overhead cover fishes, substrate for aquatic invertebrates and can be a source for organic material
- LWD dissipates flow, energy resulting in channel stability and improved fish migration
- LWD that are commonly placed can be categorized as three types: whole trees, logs, and root wads



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Woody Debris

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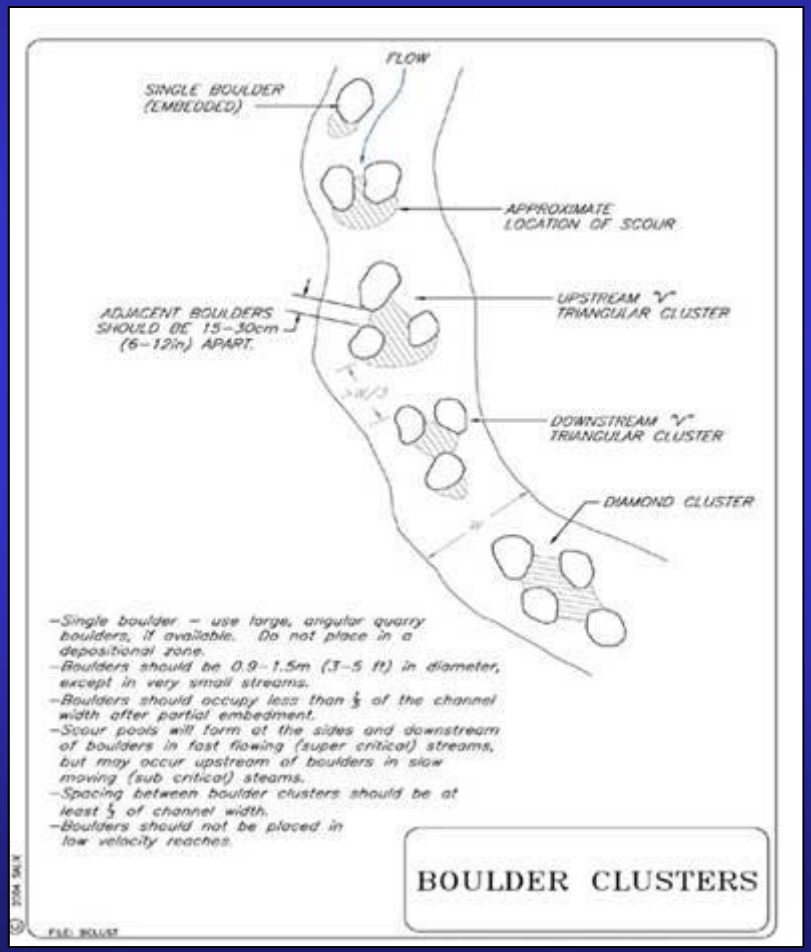
Boulder Clusters

- Boulder Clusters are stones placed in a flowing channel with the top of the stone set at an elevation slightly lower than the typical base-flow water surface elevation
- When sited correctly, the accelerated flow over the tops of the stones will change from sub critical to supercritical flow, and further downstream back to sub critical
- The stones provide resting areas and in channel refugee for fish



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Boulder Clusters

Eighteen Mile Creek Newfane, NY

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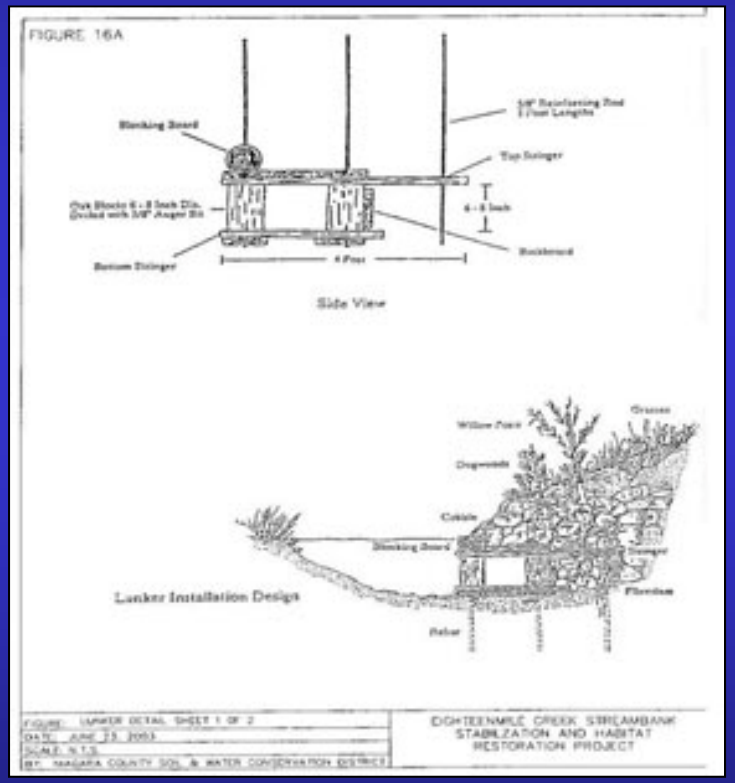
Fish LUNKERS

- Little Underwater Neighborhood Keepers Encompassing Rheotatic Salmonids (LUNKERS) is an engineered, overhanging-bank structure designed to provide habitat for aquatic fishes while providing bank stability
- A LUNKER is typically 8 ft long, 1 to 2 ft tall, and 3 ft deep, constructed of hardwood with open front and ends
- The area bankward of the LUNKER is filled with riprap, and either stones, or soil



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Fish Lunkers

Eighteen Mile Creek Newfane, NY