69 Ben Dennis – Attachment

Ben & Leslea Dennis

InStream Conservation

[redacted]

Restoring Endangered Fish & Watersheds

InStream Conservation

Restoring Endangered Fish & Watersheds

Put the Power of Water to Work…

Use proven rock/wood stream habitat restoration, installed facing upstream 25-30 degrees. The power of water and gravity hold these river restoration structures e.g., barbs, log jambs, cross veins, root wads, and J-hooks in place.

The result is less bank erosion and reduced stream sediment loads.

Value – Streams are better able to heal, allowing endangered salmon and steelhead to return, spawn, and thrive in these waters.

The Roman Arch, man's 2,500 year old engineering marvel is still working today

Over 2,500 years ago a new building concept allowed man to design, engineer and construct bridges that span rivers, aqueducts that moved water to cities and fields and built churches, to unprecedented heights.

300 B.C. Pont Ambroix Bridge, France

Today, the ancient Roman Arch concept is helping to restore endangered salmon and steelhead habitat.

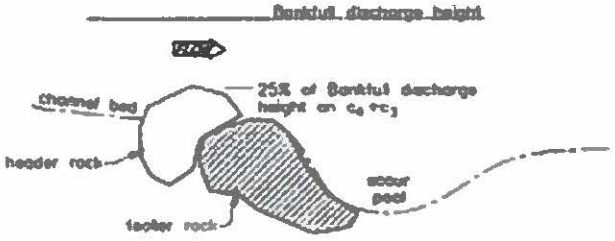
Whether the Roman Arch is used to span a stream, or is integrated into a riverbed, the same basic engineering principals apply. The weight of the structure pressing down, and the pressure of flowing water, forces each building block of the structure to support and reinforce the rest of the structure, thus allowing river structures to be built with a minimum of materials and blend into the natural environment.

Wood rock crossvanes provide deep water habitat

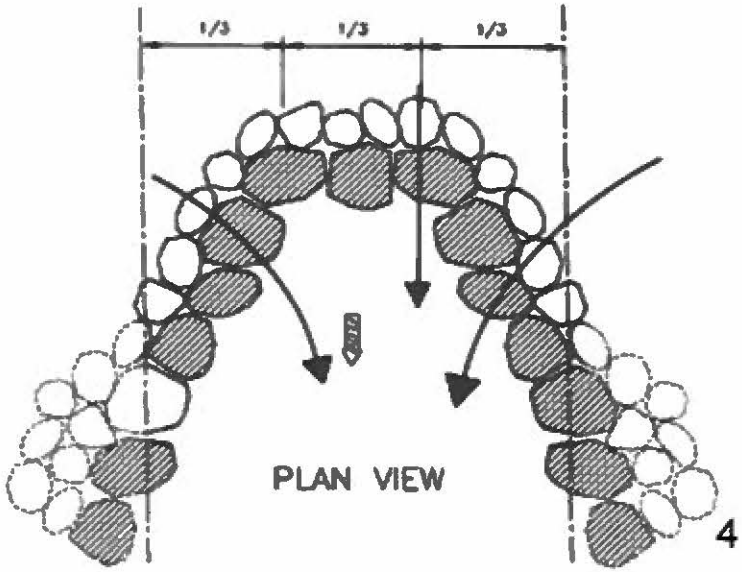
Restoration Technologies

The Ancient Roman Arch concept using gravity and shaped wood and rock, is used to create oxygenated, cool ground water recharged, plunge pools and cover for large fish and fry.

CONCEPTUAL DRAWING OF A ROCK VANE WITH A FISH TRANSITION SECTION

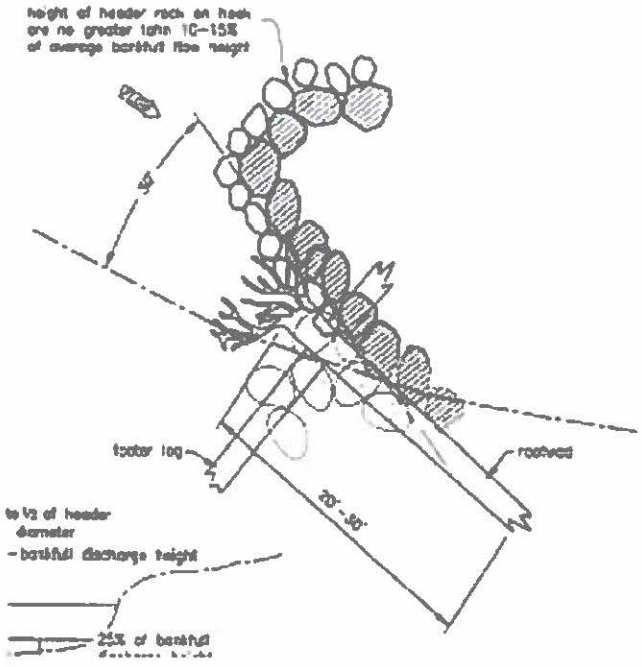


PROFILE VIEW



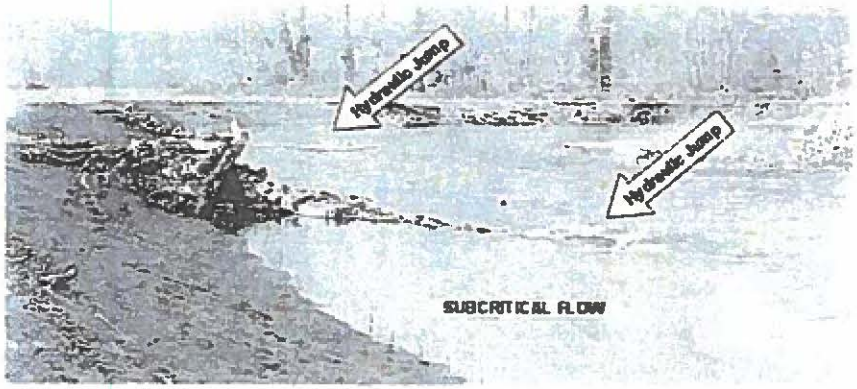
PLAN VIEW

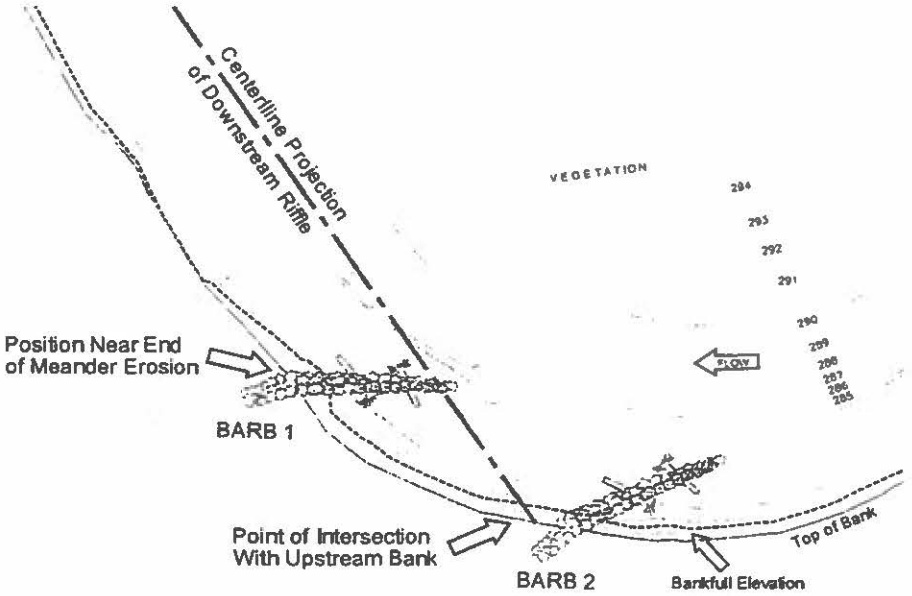
CONCEPTUAL DRAWING OF J-HOOK ROCK VANE W/ROOT WAD

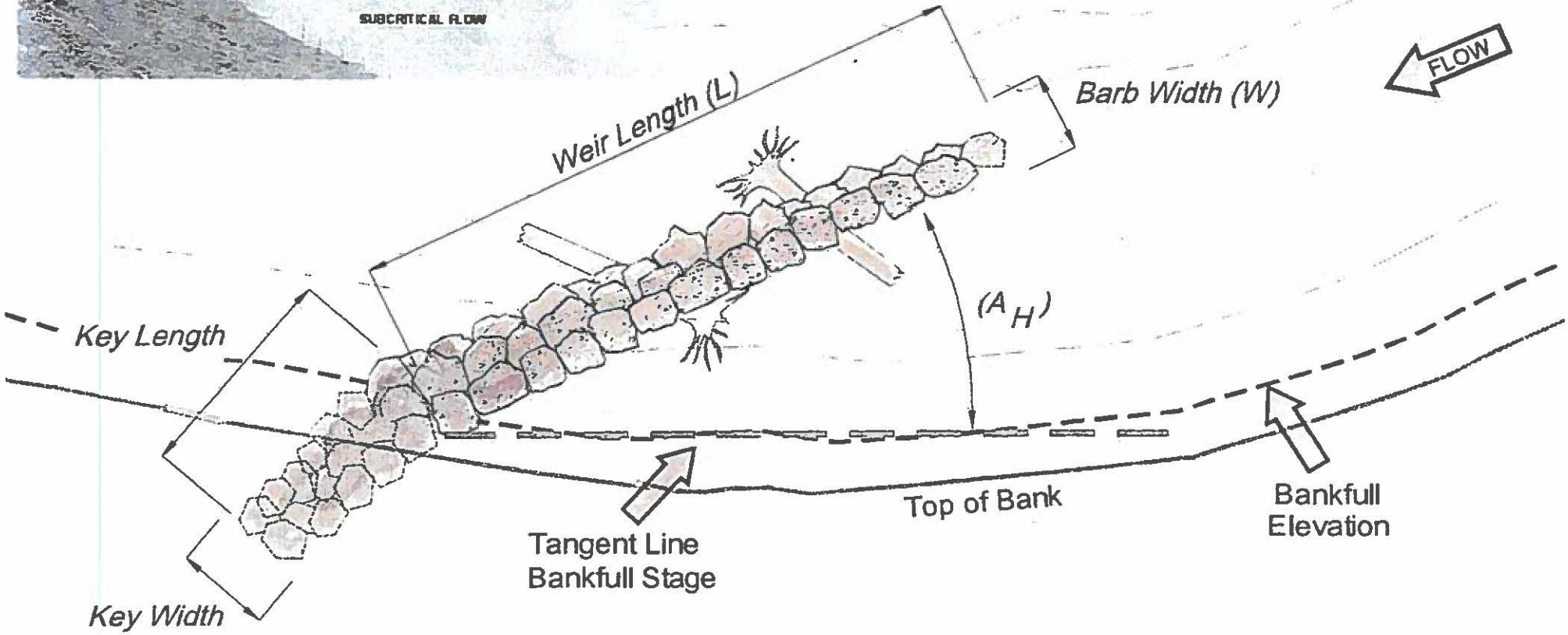


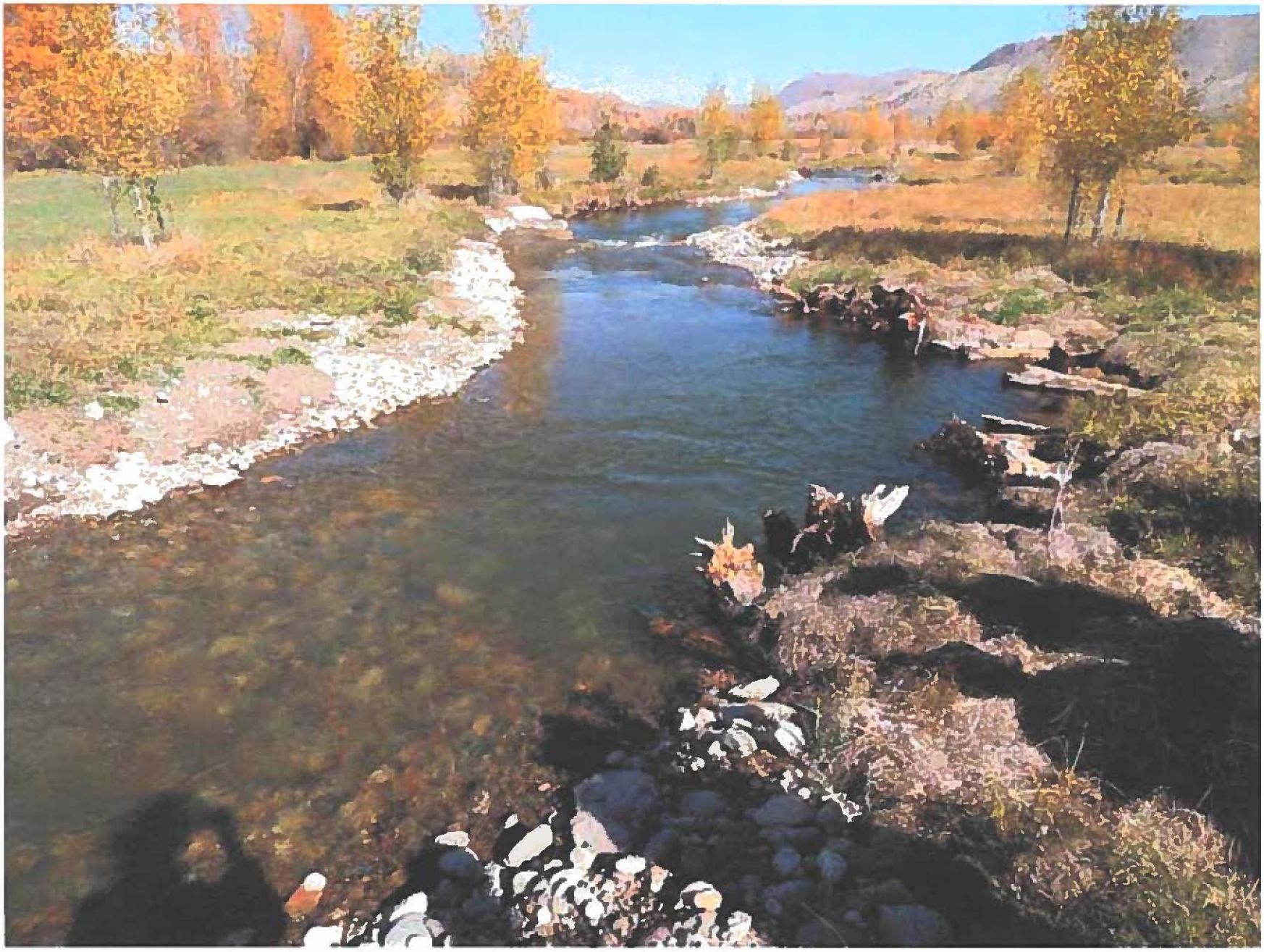
Root Wads and J Hook Rock Vane direct flow to the center of the channel taking stress off banks allowing re-vegetation.

Reduce Bank Erosion and sediment loads with Stream Barbs

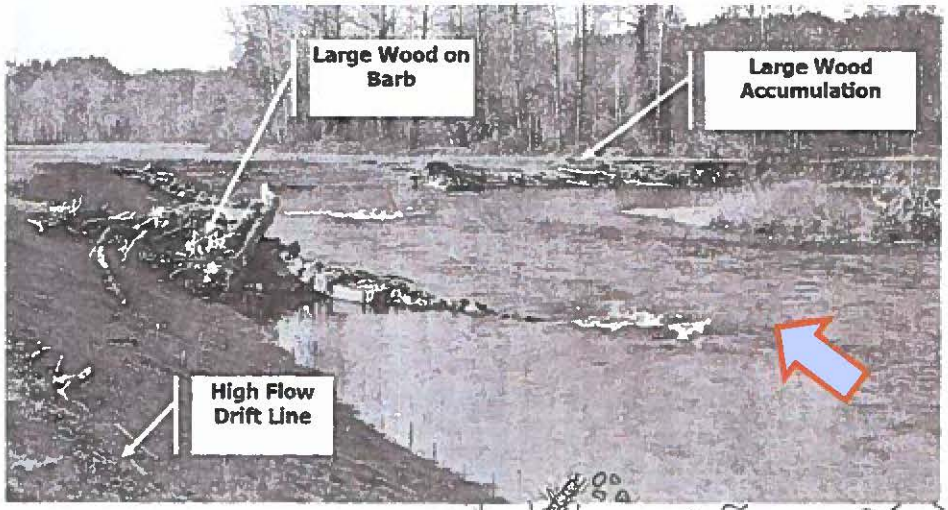








Stream Barbs, Bank Shaping, Riparian Plantings



Rock/wood barbs facing upstream 20 to 30 degrees will reduce bank erosion and sediment loads from stream banks by directing current to the center of the stream, barbs will also collect large wood and provide refuge for juvenile and mature Salmon, Steelhead and Coastal Cutthroat

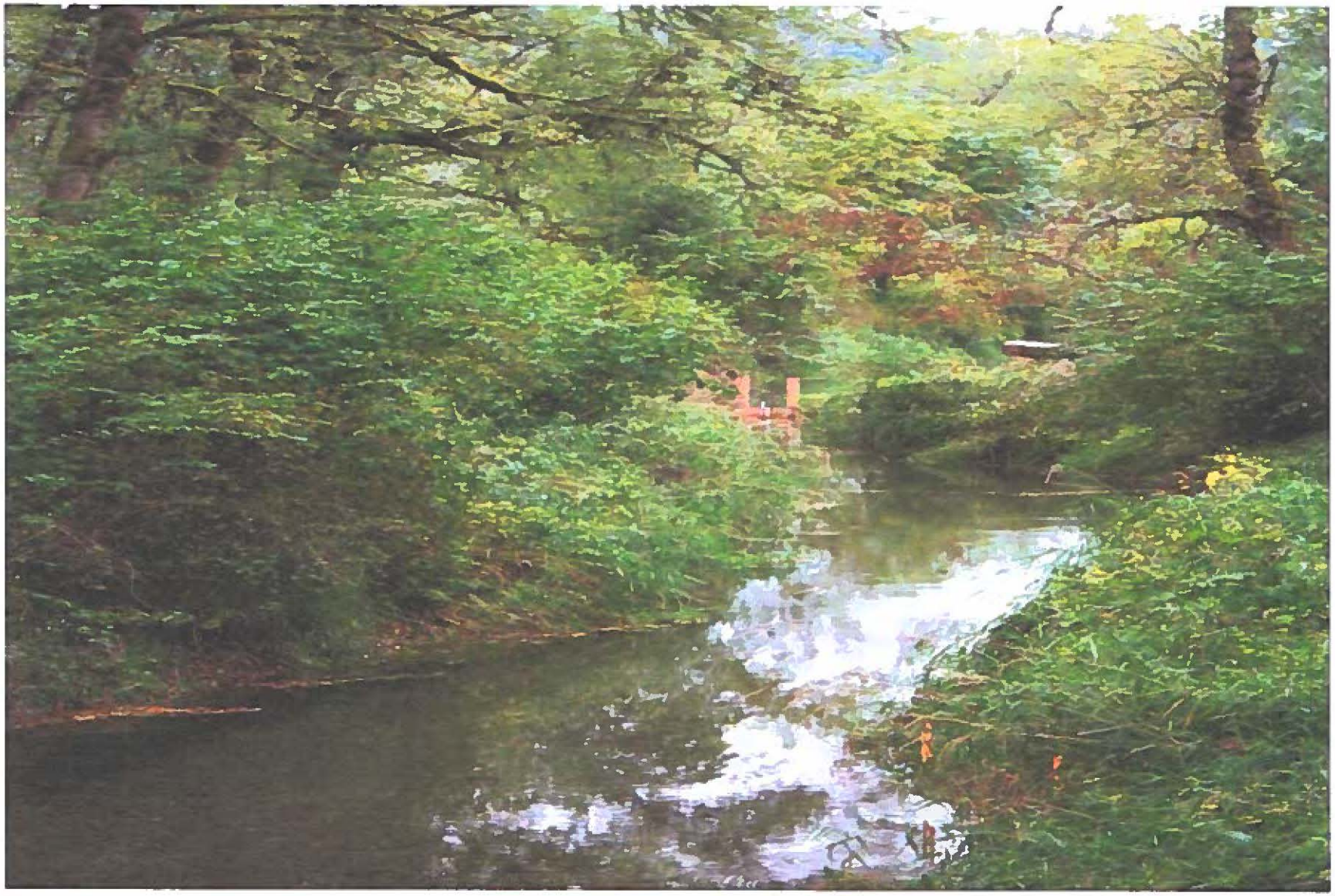
Growing point bar above restoration site continues to erode bank and transport sediments downstream.

DESCHUTES PIONEER PARK RESTORATION

Why We Need Side Channel Habitat on Our Northwest Streams

Cool groundwater-fed side channels with vegetated shade and woody material cover are an important link to the recovery of salmon and steelhead in the East Fork and other Northwest streams.

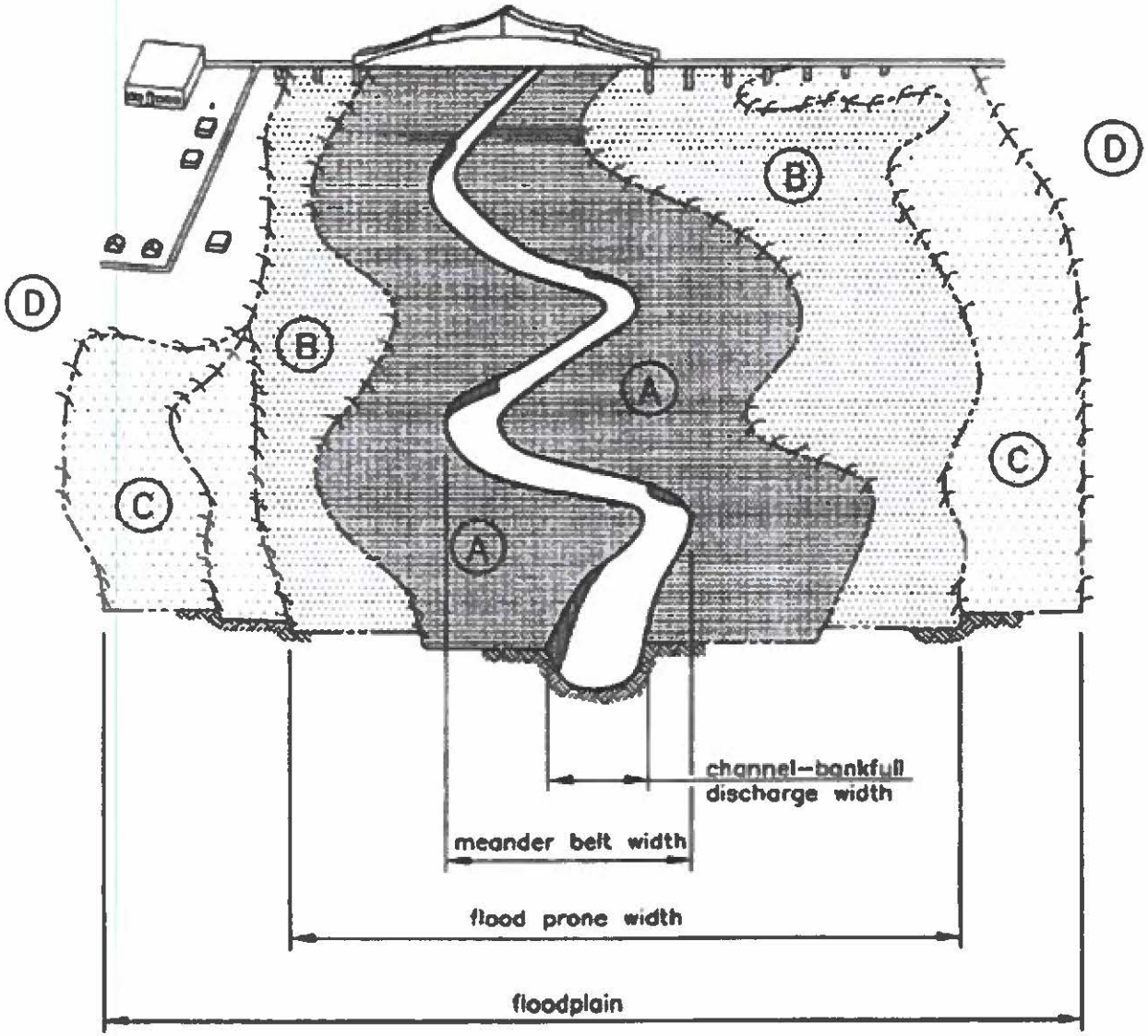
Side channels provide rearing habitat for juvenile salmon and steelhead, as well as refuge for returning salmon, steelhead, and resident juveniles during winter floods



The upper 300 ft. of this 800 ft. ground water fed Swanson East Fork side channel is designed for chum spawning. Chum fry do not stay long after hatching but migrate in mass to the ocean.

Managing flood prone areas for minimal structural damages or losses.

These designated boundaries are based on technical-hydraulic studies that determine flood elevations, cross sectional areas and fringes.



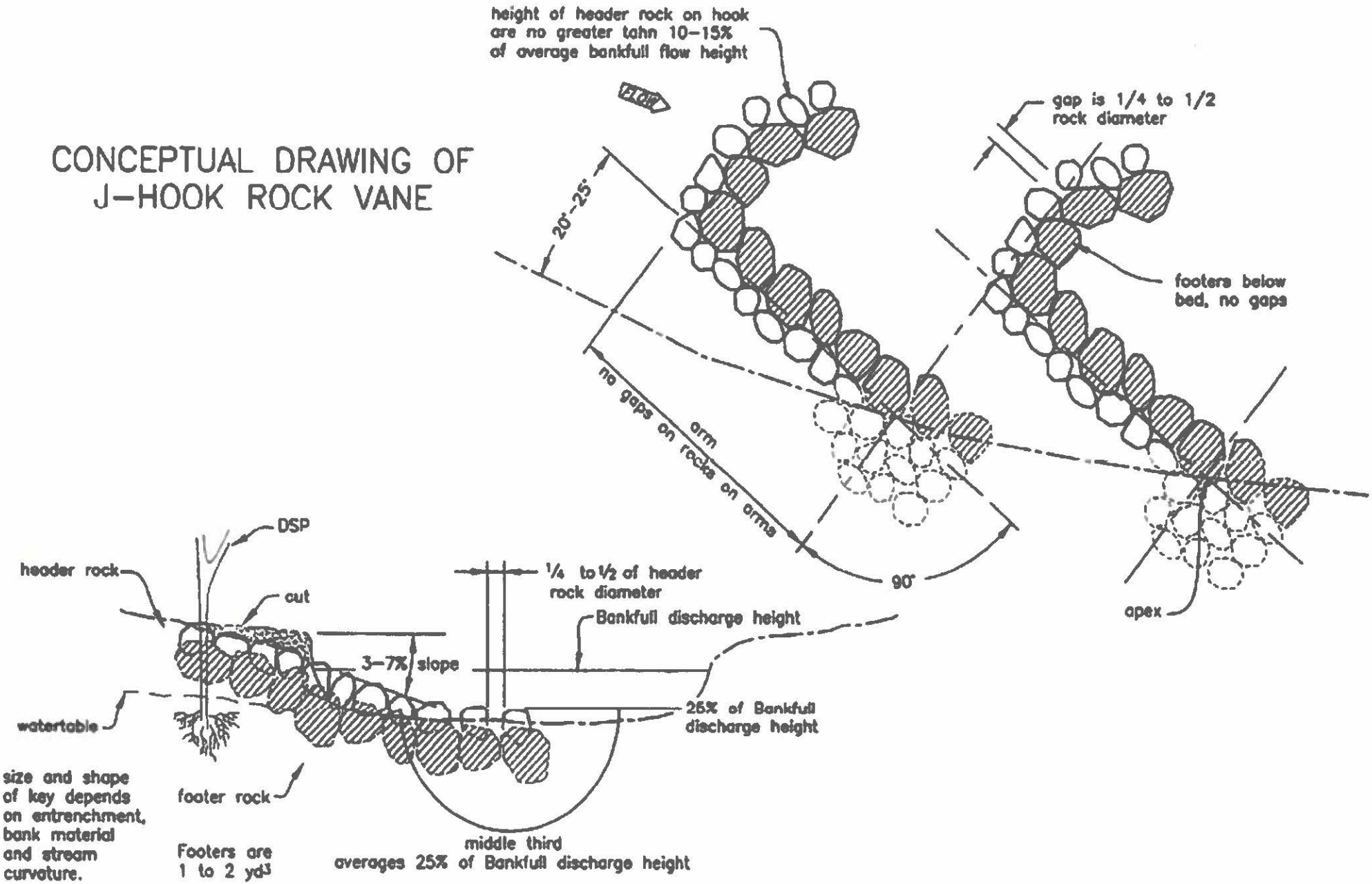
A Recurrence of flood is frequent. Damages to structures are inevitable. Cost of channel control is high. Build only at high risk.

B Recurrence of flood is still frequent enough to cause significant damage. Structures must be designed to be more resistant to flood damage. (NOT recommended to build here).

C Recurrence of flood frequency is high enough for concern. If building occurs however, alterations to structures should be incorporated.

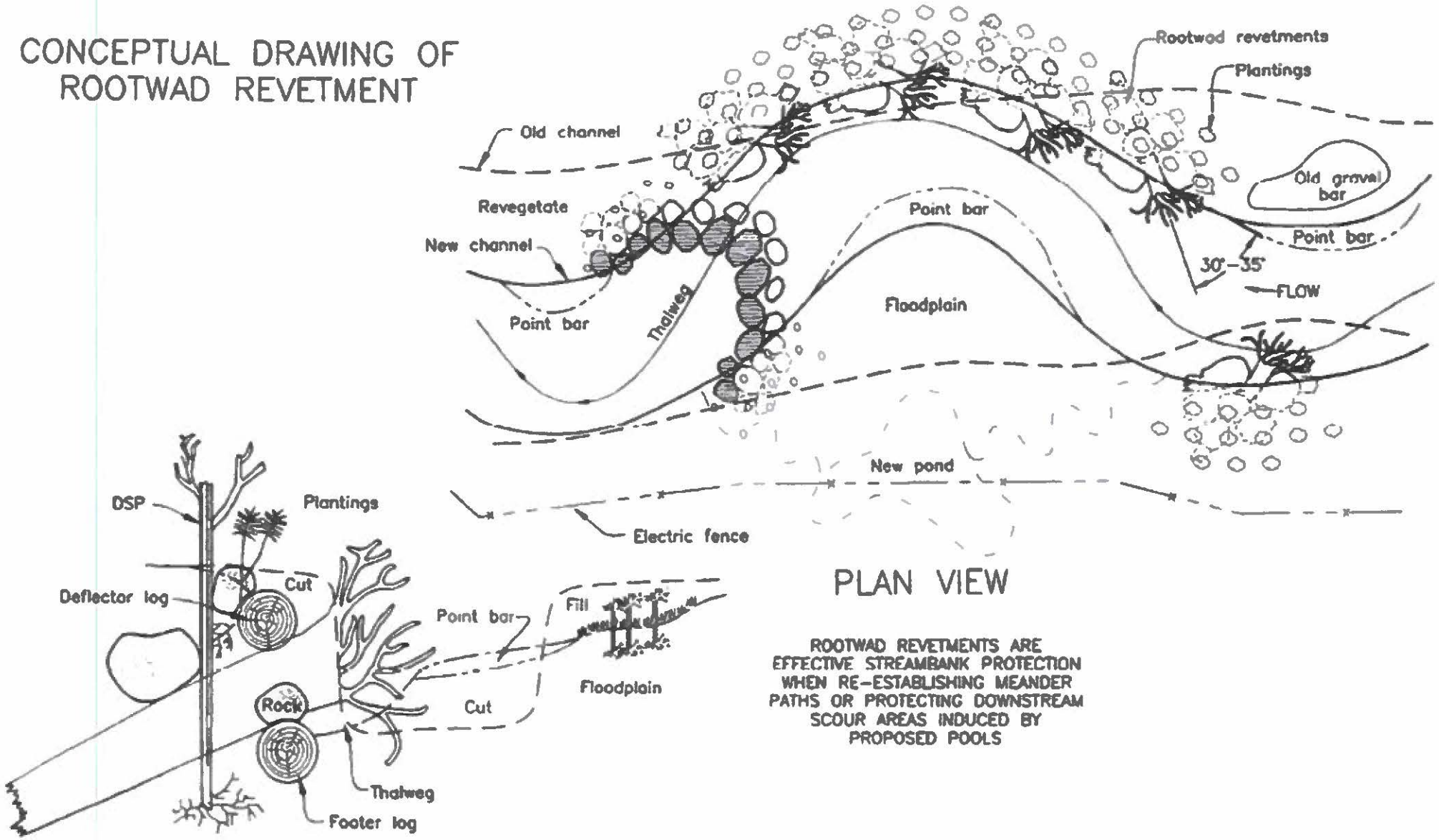
D Floodway fringe, structures are not part of project flood limit. Potential to damage structures by flood are low to none.

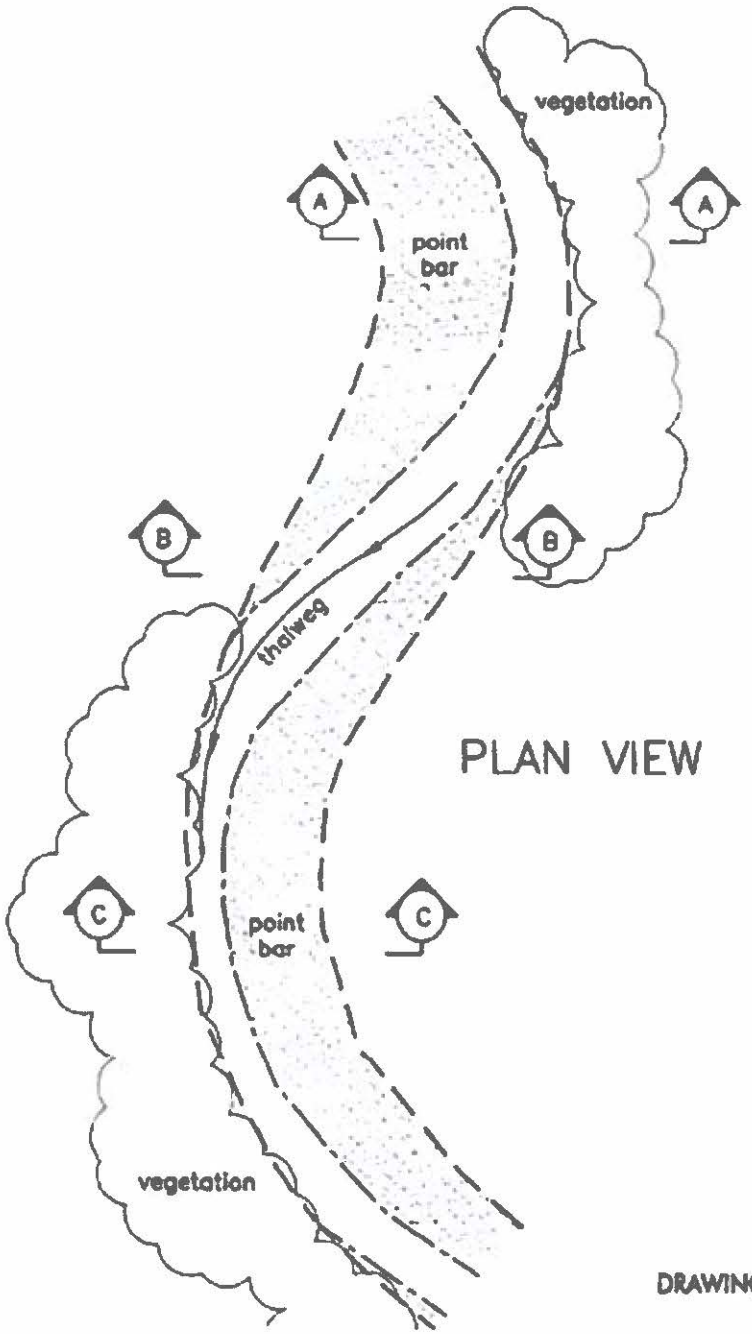
CONCEPTUAL DRAWING OF J–HOOK ROCK VANE



SECTION VIEW

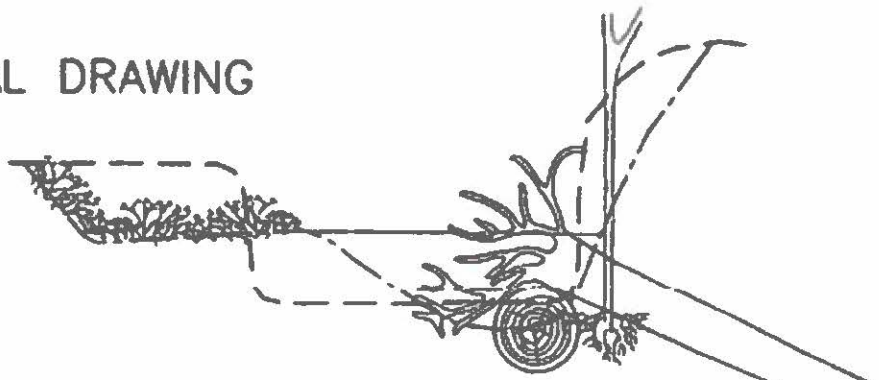
Treatment mix to address a range of problems



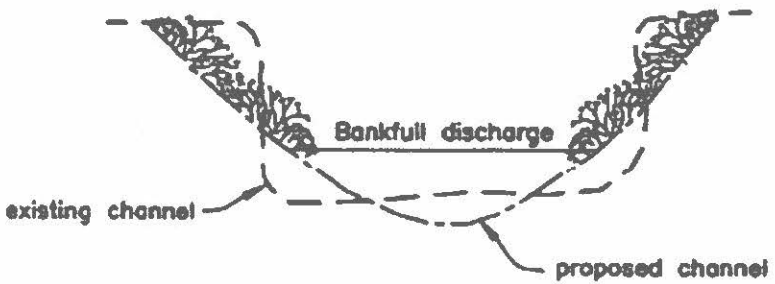


PLAN VIEW

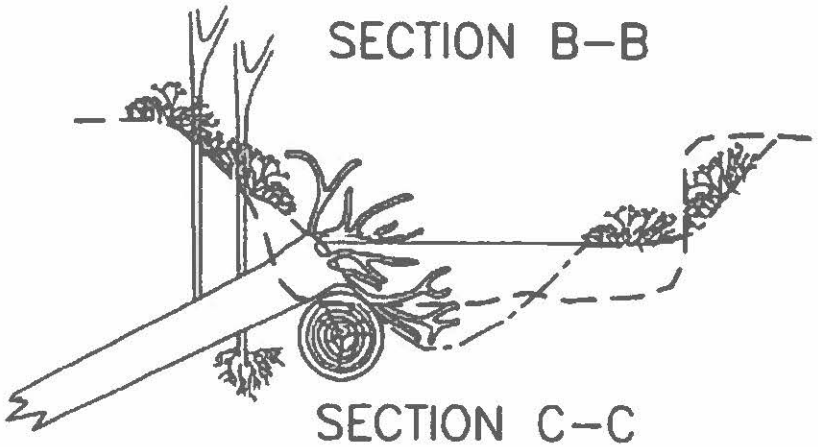
CONCEPTUAL DRAWING



SECTION A–A



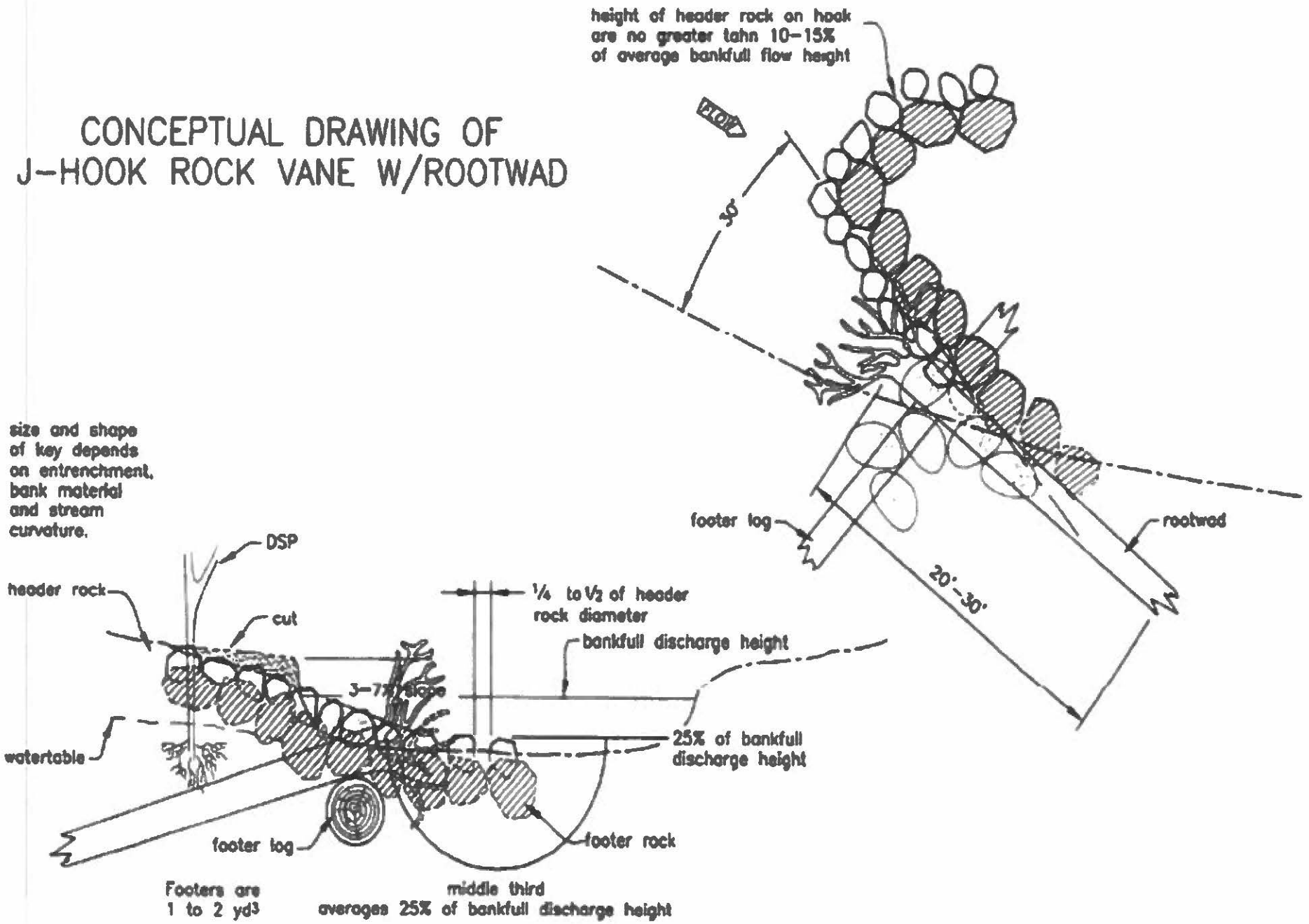
SECTION B–B



SECTION C–C

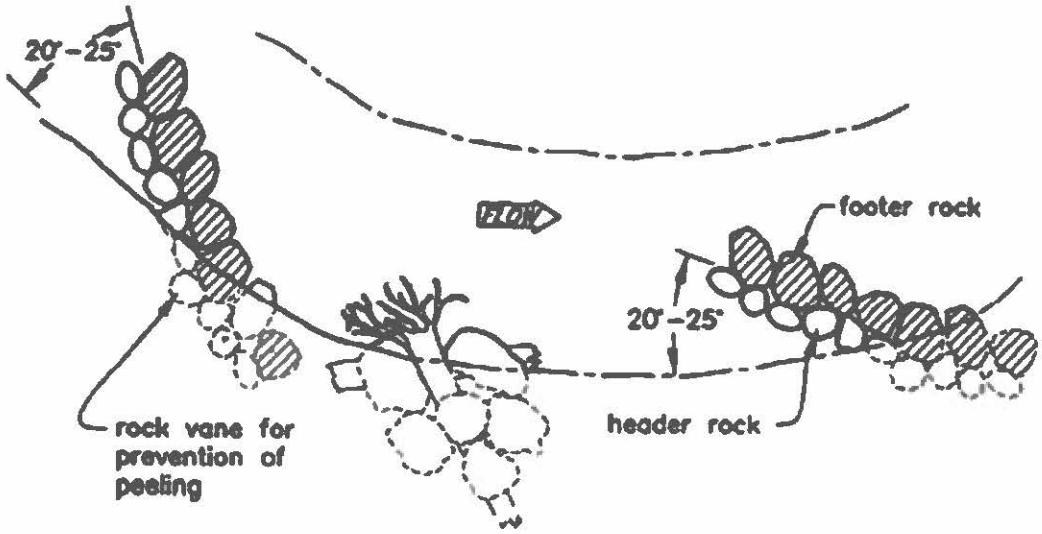
DRAWINGS NOT TO SCALE

CONCEPTUAL DRAWING OF J-HOOK ROCK VANE W/ROOTWAD

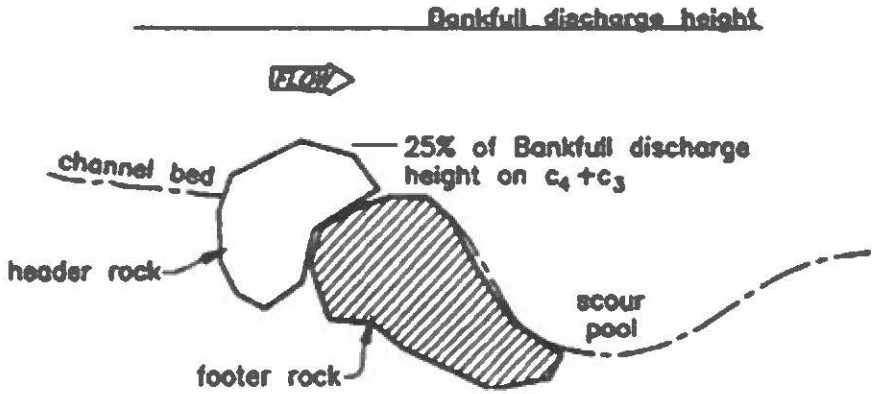


SECTION VIEW

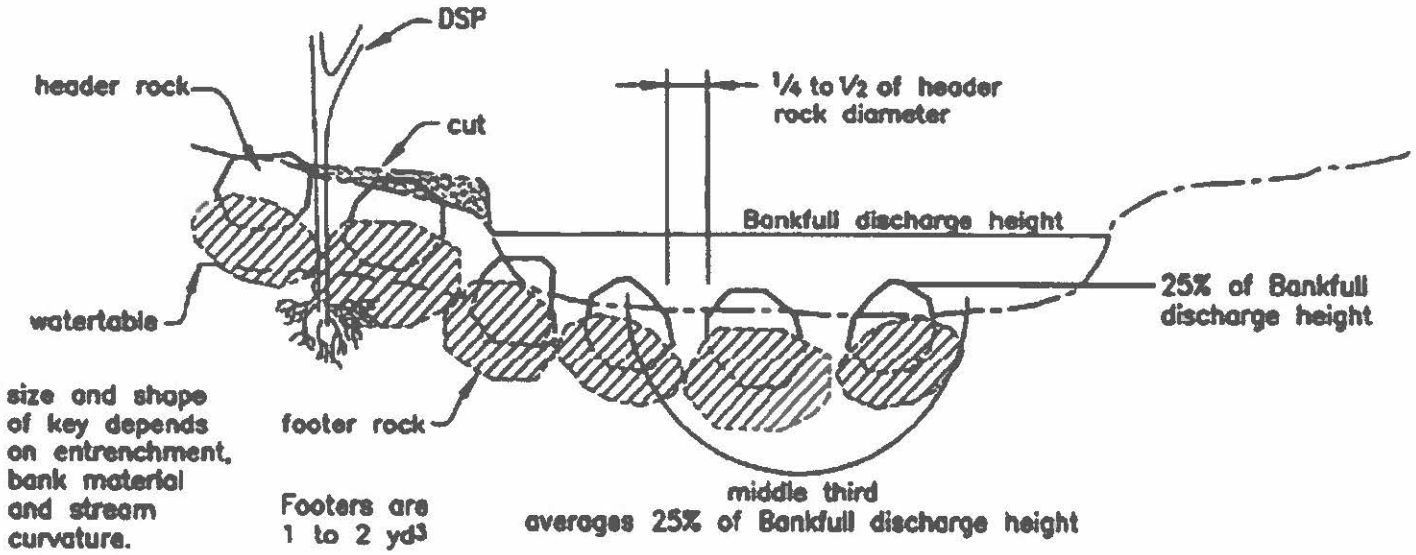
CONCEPTUAL DRAWING OF ROCK VANE



PLAN VIEW

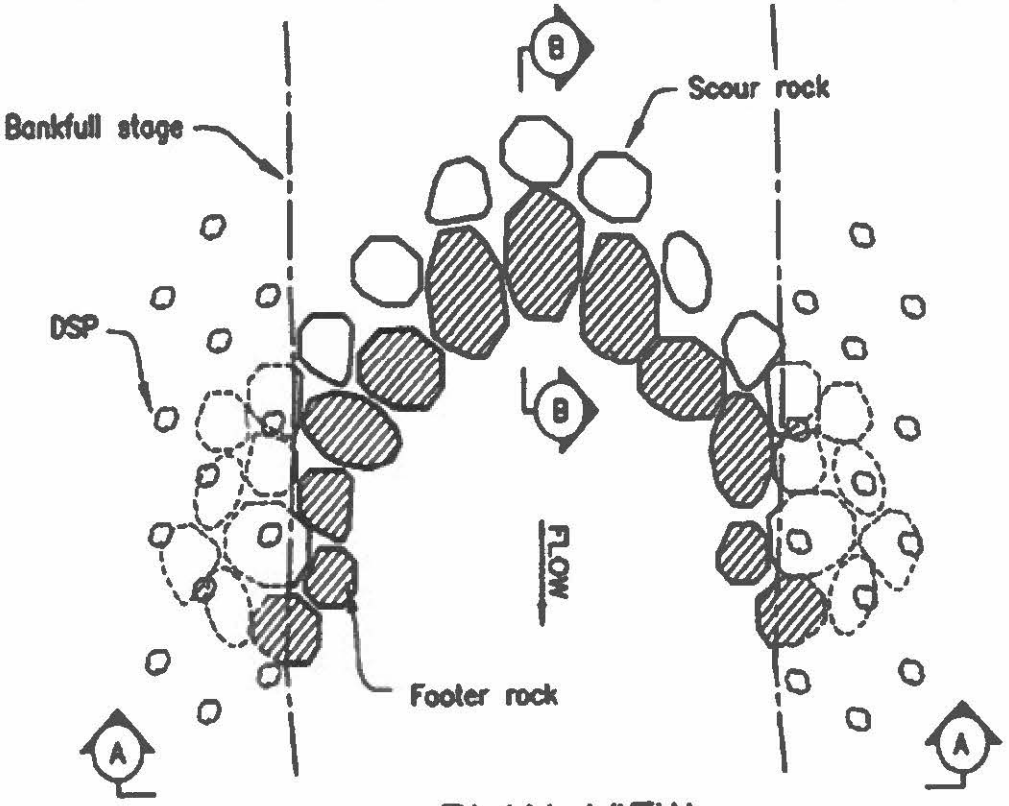


PROFILE VIEW

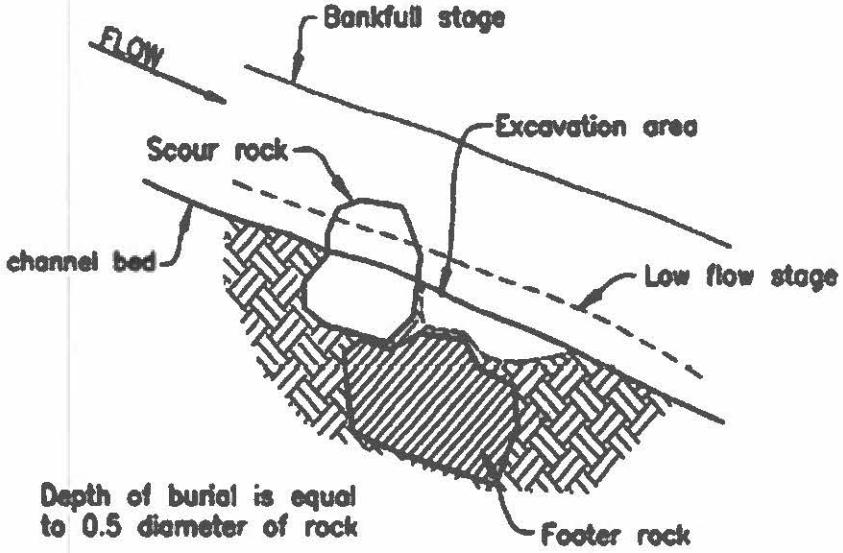


SECTION VIEW
(LOOKING UPSTREAM)

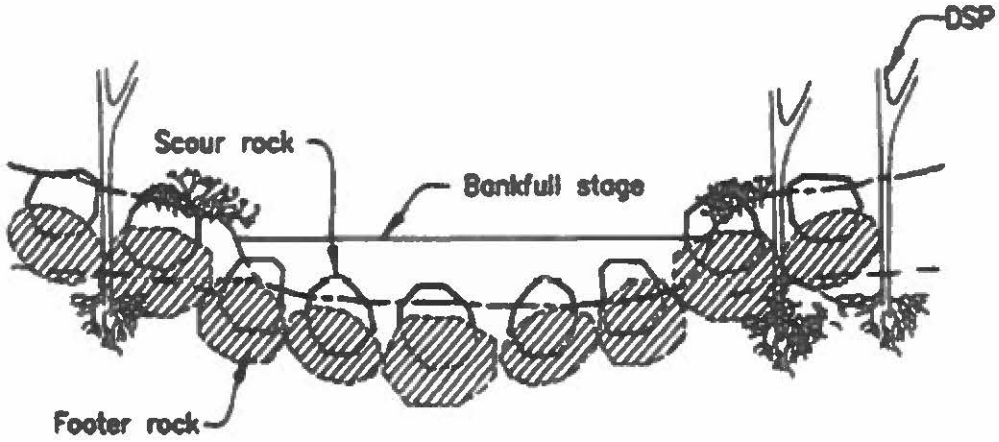
CONCEPTUAL DRAWING OF VORTEX ROCK WEIR



PLAN VIEW

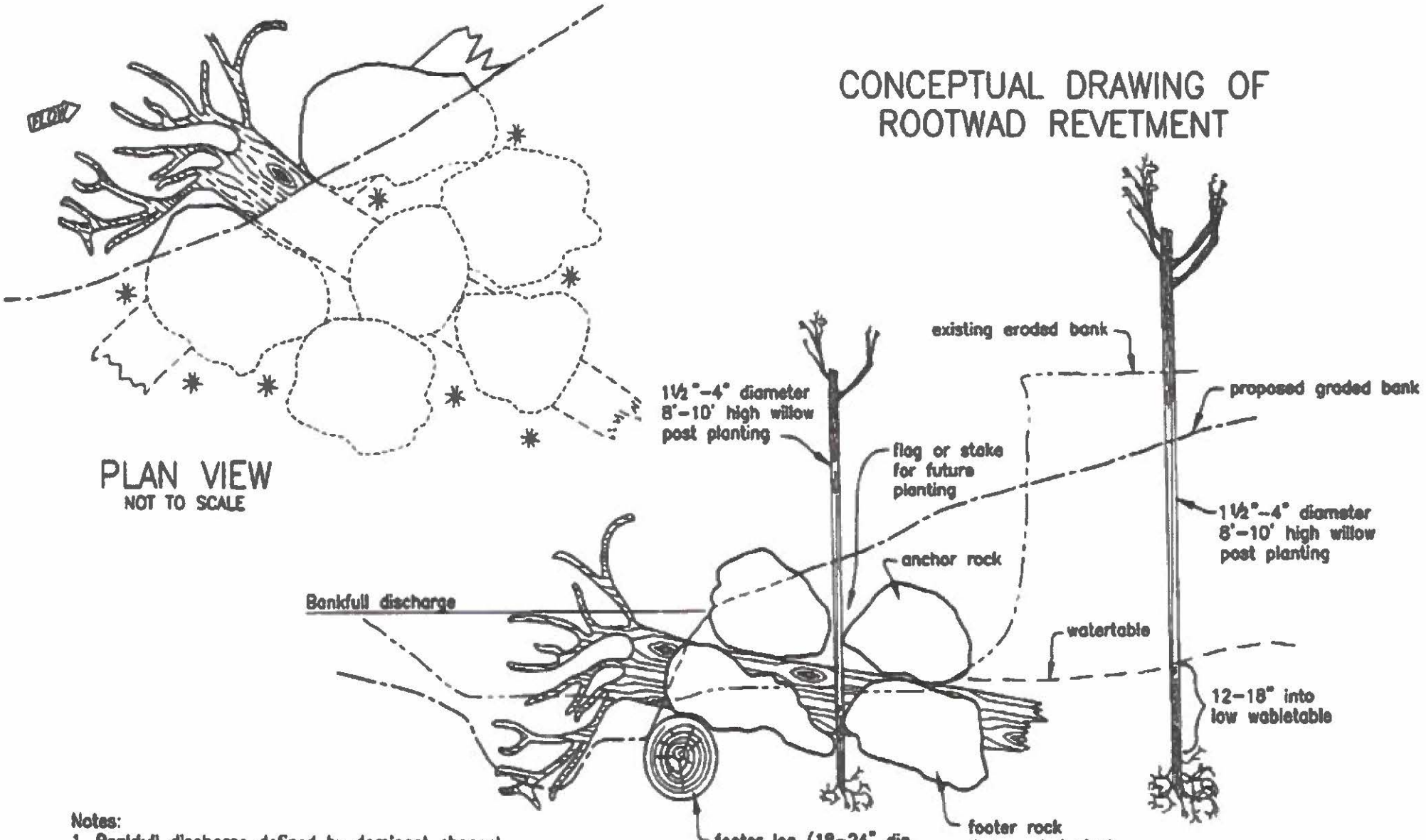


SECTION B–B



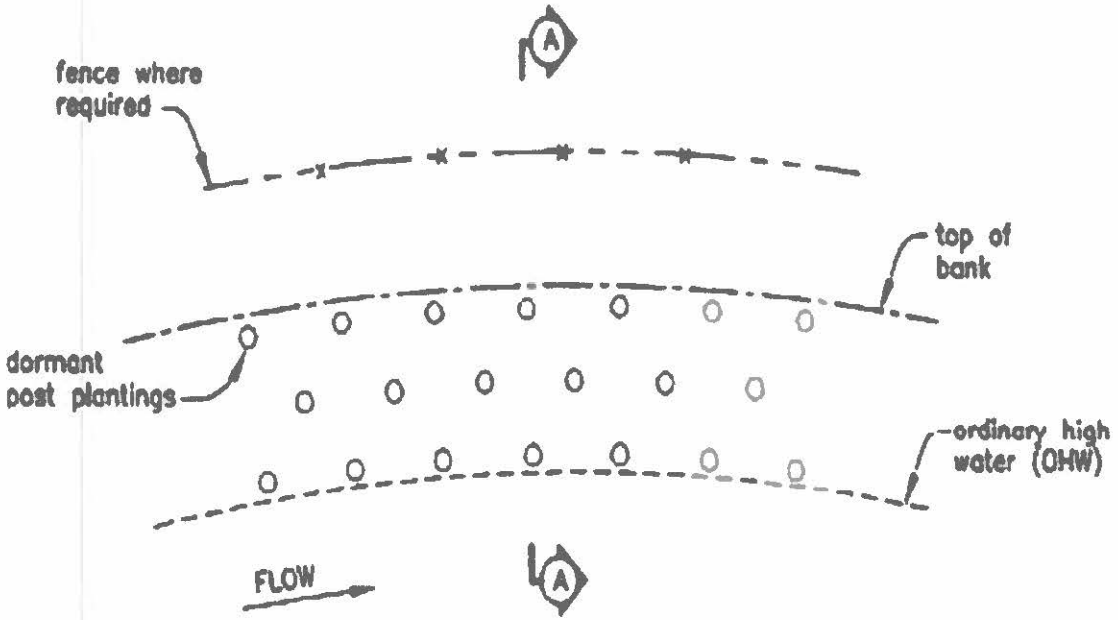
SECTION A–A
(LOOKING UPSTREAM)

CONCEPTUAL DRAWING OF ROOTWAD REVETMENT

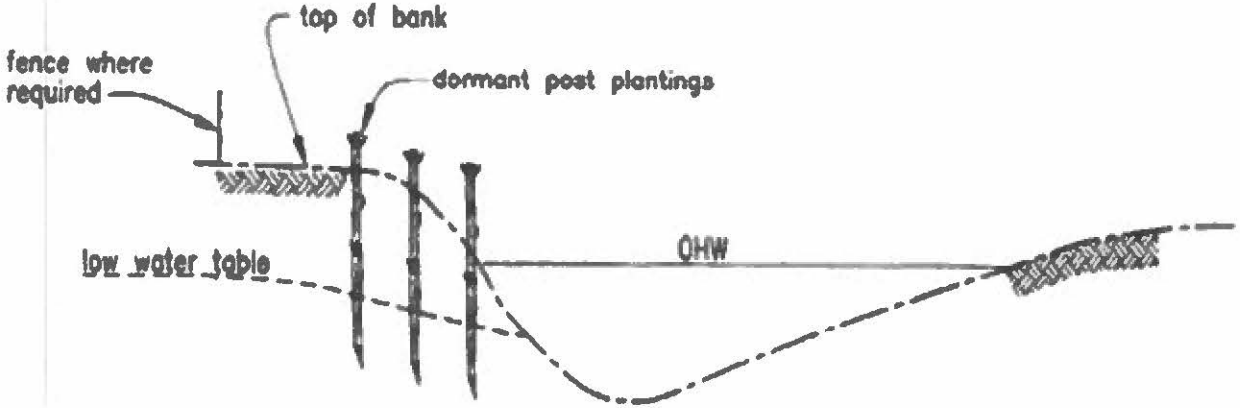


Notes:
1. Bankfull discharge defined by dominant channel shaping flow, not top of bank.
2. Rootwads are typically 12–15 feet in length and placed 15–20 feet on center depending on curvature flow, streambank stratigraphy and root ballsize.

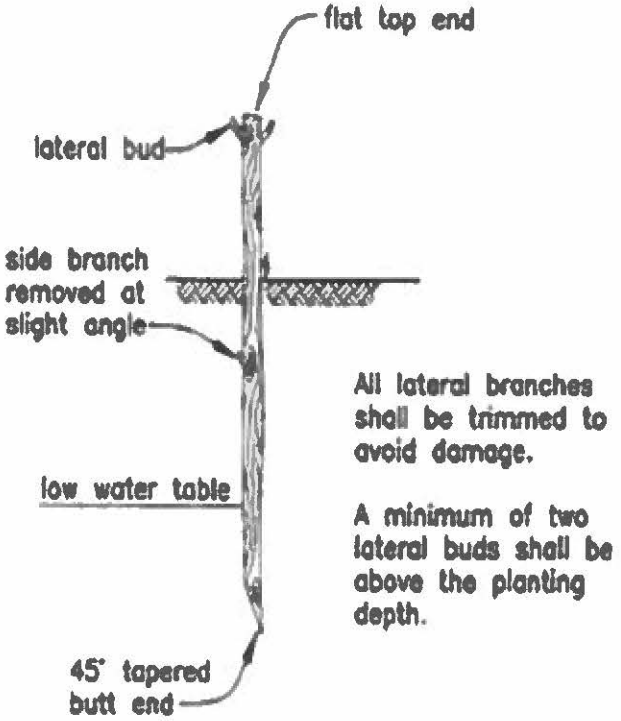
CONCEPTUAL DRAWING OF DORMANT POST PLANTING



PLAN VIEW

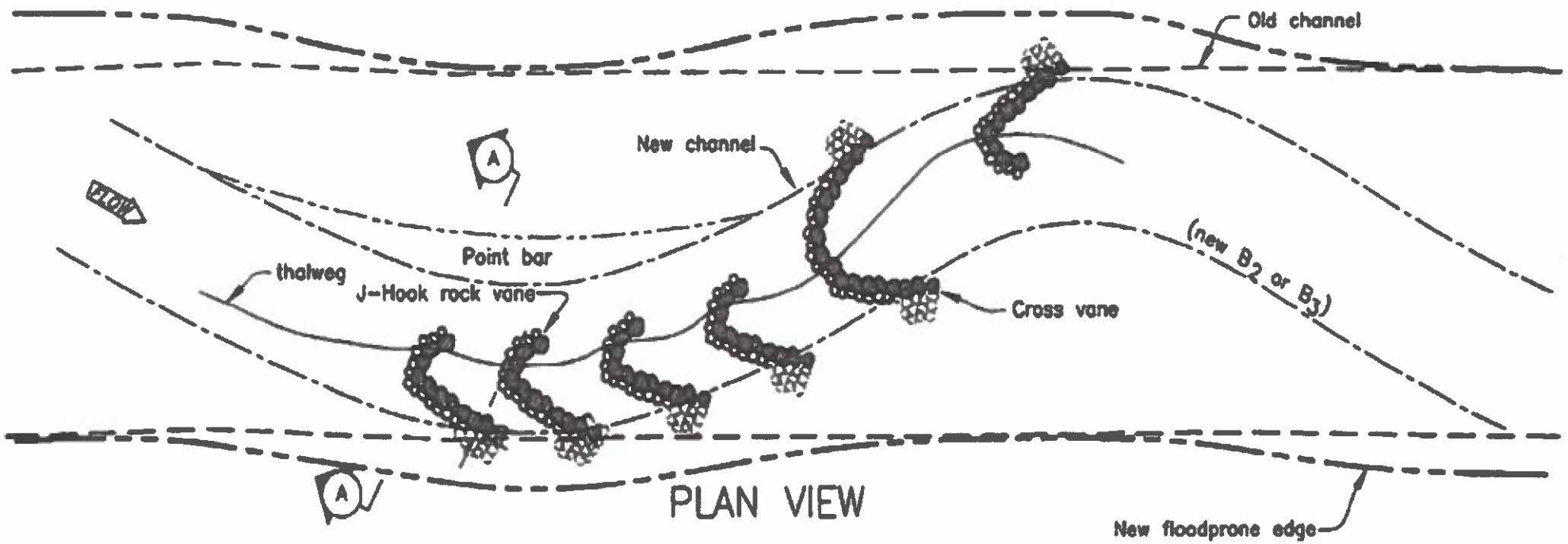


SECTION A–A

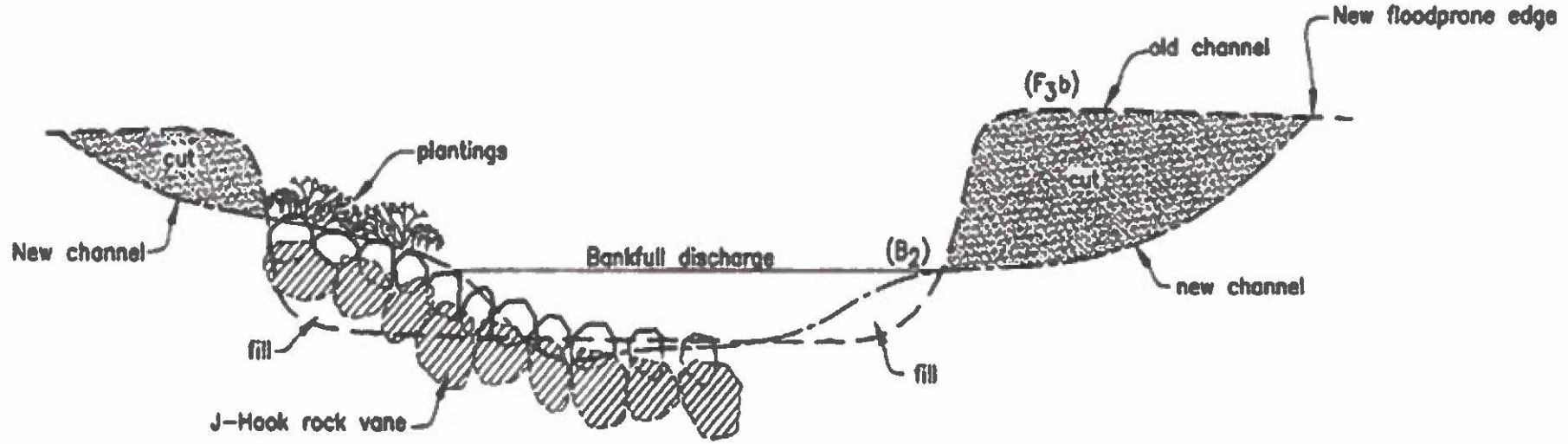


PLANT DETAIL

CONCEPTUAL DRAWING OF PRIORITY 3, GEOMORPHIC APPROACH

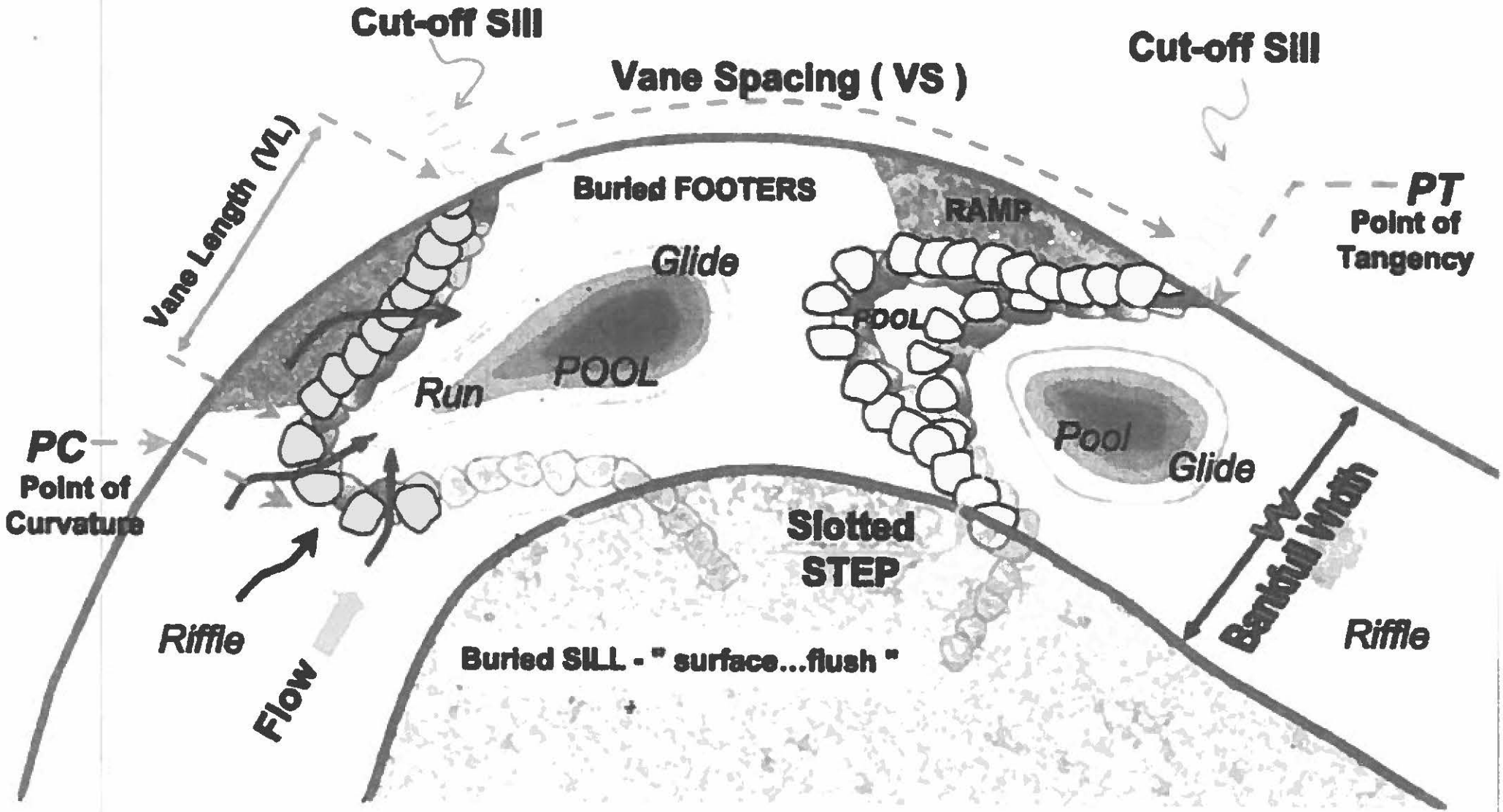


PLAN VIEW



SECTION A–A

Location & Spacing: J-Hook Vane-with sill.....Cross-Vane with Step & sills

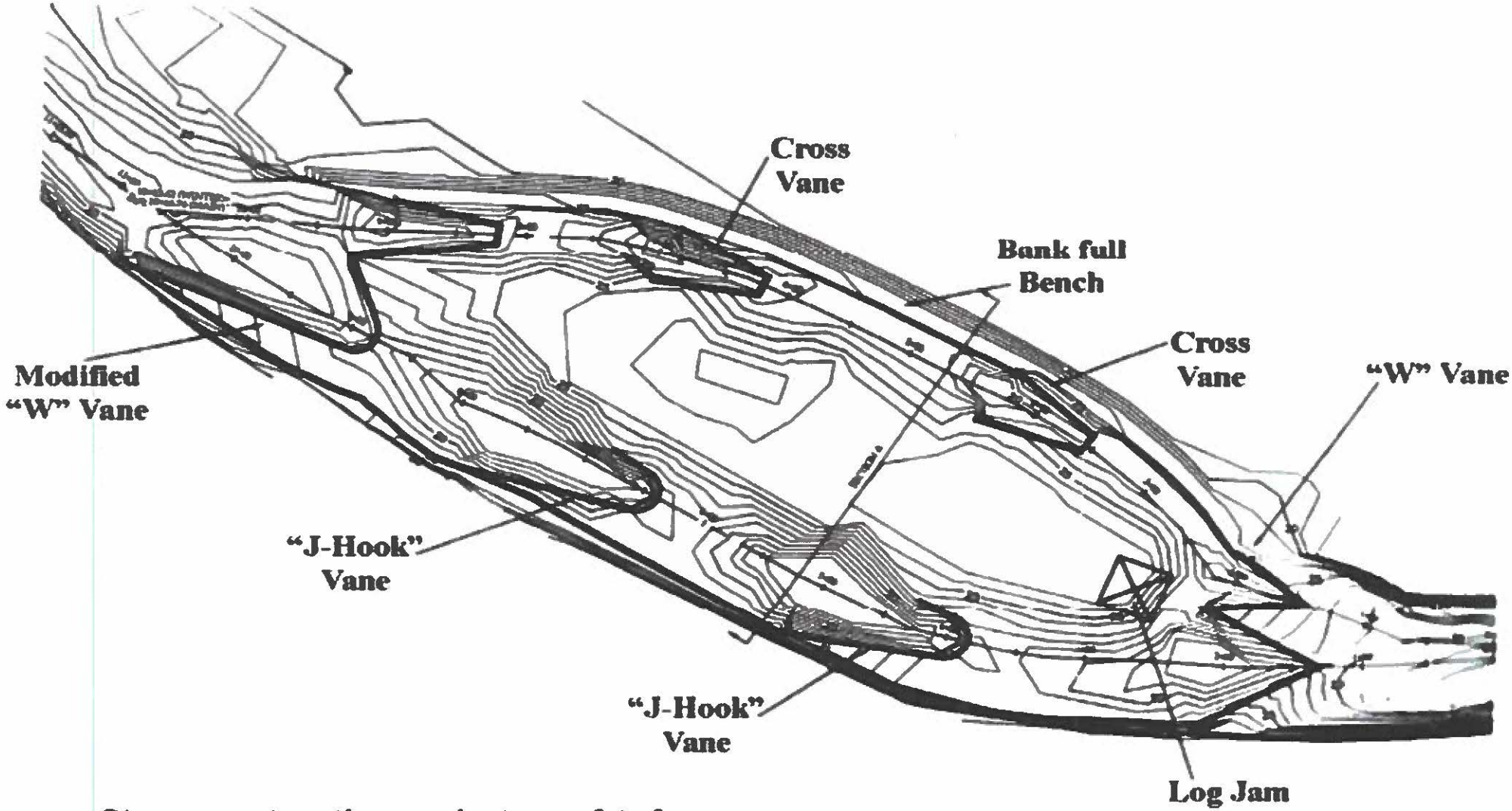


800 Ft. Gray's River Habitat Enhancement SW Washington

This complex project uses 1 strategically placed rock/wood log jamb, 2 rock W-vanes top & bottom, 2 rock cross vanes and 2 rock J-hook vanes that deflect flows away from the bank reducing bank erosion and creating fish habitat. Project was monitored the last 5 years with excellent ratings.

Log structure and rock W-veins direct flow to center of the river

Rock J-hooks direct flow away from bank



Stream restoration projects need to be monitored for:

- How successful the project is in providing deep cool water pools and spawning/rearing habitat.
- A transparent audited monitored system of how the project has met its goals overtime, and how the taxpayer as well as the fish have benefited.

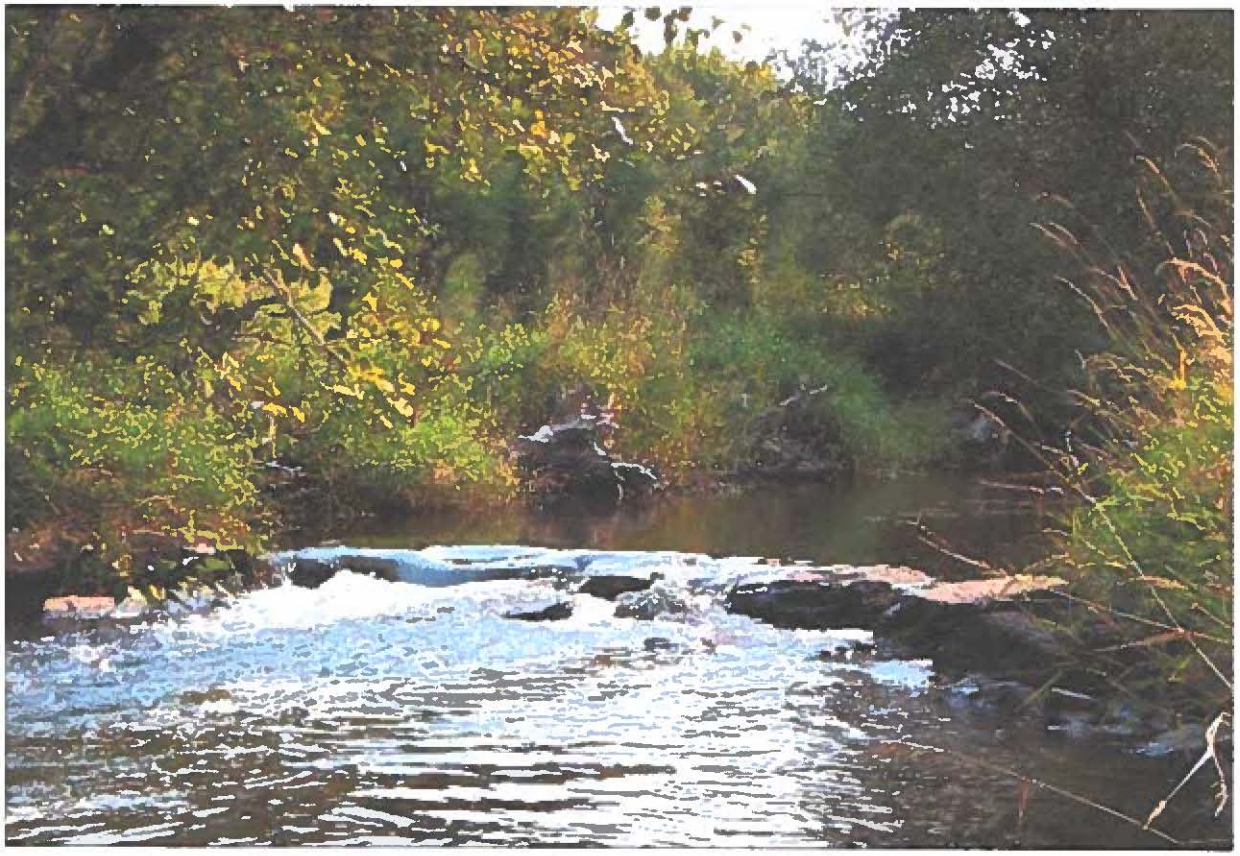
USDA Natural Resources Conservation Service

Restoration Checklist

Does your river restoration project provide:

- River water that tumbles over rock/wood veins adding oxygen and mixing with cooler water, providing fish-friendly habitat
- Plunge pools that provide cover; cool groundwater inflow for large fish and fry
- Vanes, barbs, and J-hooks that direct flow to the center of the channel; taking stress off banks, allowing for re-vegetation
- Pool tail-outs that provide quality salmon and steelhead spawning habitat
- Porous rock/wood structures that allow upstream sediment to move through reach, keeping spawning gravel clean
- Provide low risk to boaters and recreational uses

Contact Ben Dennis at [redacted] to volunteer to help restore habitat for wild and endangered fish in our watersheds, tributaries on the East Fork Lewis River in Clark County and Southwest Washington.



InStreamConservation

Restoring SW Washington's Endangered Fish & Watersheds

[redacted]

Note: All projects shown are monitored for success

InStreamConservation News

Restoring Washington's Endangered Fish & Watersheds

Published every so often | Volume 5 Winter 2016

Heavy erosion and log jamb just below Pioneer Park 1/10/16.

Reduce Sediment Loads Save Millions!

Sixty-five years ago, the Deschutes River Estuary was dammed in an effort in part, to create a lake and extend 5th Avenue across the river. The dam was supposed to cover sediment in the estuary with water. Ironically, it filled the Deschutes Basin with even more sediment and turned the Basin into a freshwater marsh.

About 1/3 of the watershed is part of a huge privately owned tree farm. The basin is already prone to heavy runoff and slides during winter storms.

Building roads and logging on the upper watershed made the problem worse.

While environmental laws have brought improvements since the 1970's, there are still problems. Fine sediment smothers salmon redds.

Over the years, roads, sand and gravel operations, livestock and many other activities along the river, contributed to the problem.

The dam forced the Deschutes Basin to "choke" even more, on the extra sediment.

Consistently during winter floods, the Deschutes River deposits an average of 35,000 cubic yards of sediment a year. Since 1951, the dam was built under the present 5th Avenue Bridge. Over the last 65 years the volume of sediment could fill a football stadium the height of 1,300 feet, the river has deposited well over 2 million. cubic yards of sediment. Two dredges, in 1978 and 1986, moved about 16% of this, 314,000 cubic yards, to build parklands and wetlands. Any future dredging would have to be completely removed from the Basin and sent to landfills.

Salmonids need brackish water to adjust to differences between fresh and saltwater zones. Without an estuary, there is no transition time causing salmon smolts to become stressed, and possibly die. During warm summer months, the Capitol Lake basin does not meet Federal water quality standards.

That is because of high levels of phosphorus, fecal coliform, algae blooms and high water temperatures.

Heavy erosion at Pioneer Park 1/10/16.

This deadly brew causes a very deadly low oxygen environment.

All of these combined impacts negatively stress departing and returning salmon, steelhead and cutthroat trout. The low oxygen, high temperature and toxin in a dammed, non-flushing basin calls for all of us to find a solution. The solution: a free flowing (dam-free) river and a recovered natural estuary.

Over the years, the Squaxin Island Tribe, Thurston County Conservation District, South Puget Sound Salmon Enhancement Group, Stream Team, Thurston Regional Planning Council, Wild Fish Conservancy, Capitol Lake Partners, Cities of Olympia and Tumwater, State Department of Ecology, Dept. of Natural Resources, Washington Department of Fish & Wildlife and the Dept. of Information Services, have actively researched degrading fish and bird habitat in the Capitol Lake Basin. Collectively, these public and private groups have yet to formally determine the right steps to regain health for an estuarial Deschutes River basin.

So far, community consensus is to create a healthy Capitol Lake by removing the dam on the 5th Avenue Bridge and letting the Deschutes Estuary heal itself.

Deschutes Falls 1/7/16.

According to a study of management alternatives, keeping the dam to maintain Capitol Lake could cost up to $97 million more than restoring the estuary, and that was before the invasion of the New Zealand mudsnail raised dredging costs even more.

What's been continually missed is reducing sediment loads on the Deschutes River to the volumes of the 1850's, when oysters thrived in a healthy estuary.

How? Ask the real experts, leaders in the field, who have evaluated thousands of miles of river habitat at successfully completed hundreds of river restorations, across the U.S.

Who? Stream and Fluvial Geomorphologists and Hydrologists who live and work in the Pacific Northwest. Their unparalleled experience is needed. NOW!

Here are 4:

Dr. Barry Southerland PhD.
CPESC#514WNTSC,NRCS
Fluvial Geomorphologist..
Part of the team evaluating the devastating OSO slide on the North Fork Stillaguamish River that killed 43 people.
[redacted]

Dr. Frank Reckendorf PhD. Private consultant/ retired NRCS, WNTC, Fluvial Geomorphologist
[redacted]

Russ Lawrence, P.El, M.Sc. Fluvial Geomorphologist
Streamfix [redacted]

Richard Dyrland Ms—Supervisory Hydrologist
[redacted]

FLUVIAL MORPHOLOGY is a science devoted to understanding rivers both in their natural setting as well as how they respond to human induced changes in a watershed, in the process, restoring the watersheds to health.

InStream Conservation
Restoring Endangered Fish & Watersheds
Ben Dennis
[redacted]

Put the power of water to work,

using proven rock/wood stream habitat restoration---barbs, log jambs, cross veins, root wads, J hooks---installed facing upstream, 25-30 degrees.
The power of water and gravity will hold the structures in place, reducing bank erosion and in-stream sediment loads, allowing river structures to be created with a minimum of materials blending into the natural environment.

Value---streams will be better able to heal, allowing endangered salmon and steelhead to return, spawn and thrive in these waters.

InStream Conservation
Restoring Endangered Fish & Watersheds
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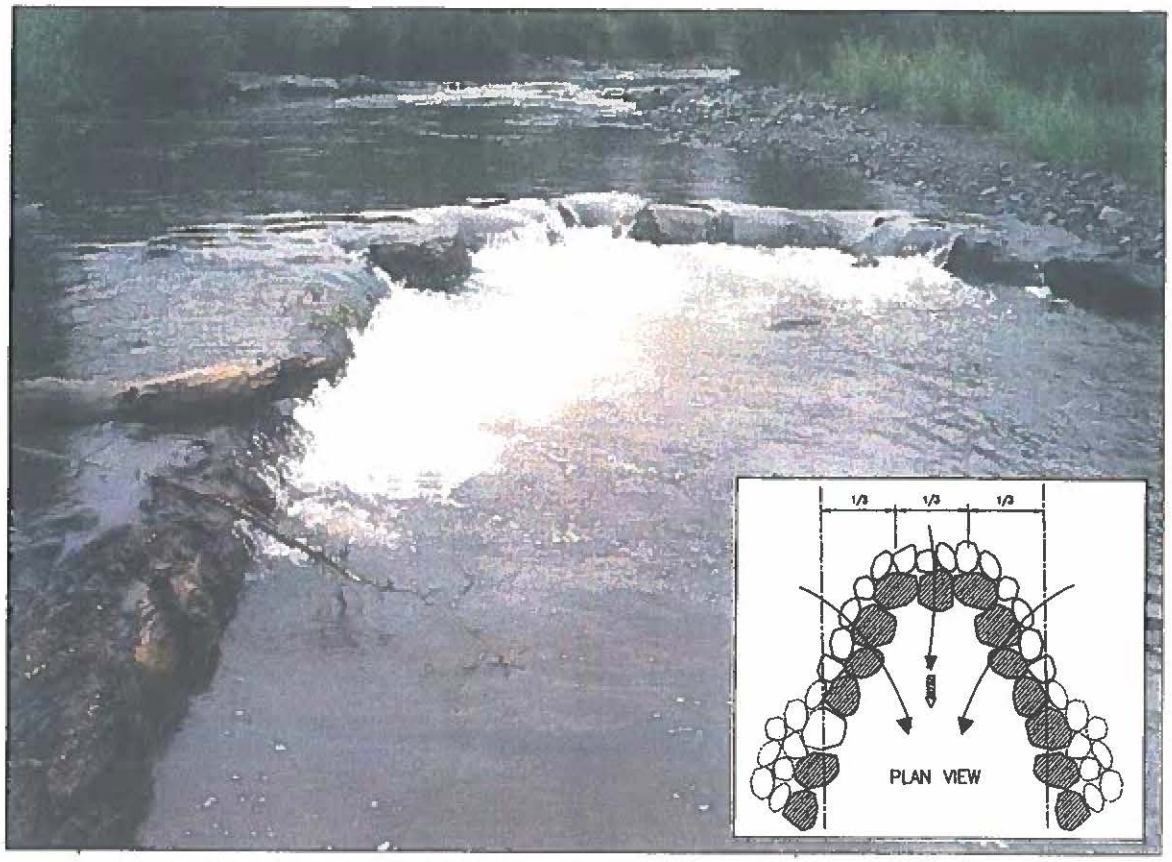
[redacted]

Proven Fish Friendly Habitat Restoration Techniques

Time tested Roman Arch Technology eliminates erosion by directing current away from stream banks to the middle of the channel, while creating cool ground water recharge plunge pools, and tail outs that provide cover for juvenile and returning ESA listed salmon and steelhead.



Root wads and rock/wood J Hook Vanes direct flow away from banks removing erosion stress while creating fish cover and habitat.

Root wads face up-stream 30° to 45°.

J Hooks face up-stream at a 30° angle.

The proceeding examples are just three of many effective restoration technologies. One kind of restoration does not fit all the problems at a particular stream site. A mix of treatments is often needed. For more information on fish friendly science/stream engineering based habitat restoration google the Natural Resource Conservation Service (NRCS) 654 Handbook at their internet site. (nrcs.usda.gov.) or NRCS NEH-654.

InStreamConservation
Restoring SW Washington's Endangered Fish & Watersheds
[redacted]

InStreamConservation News

Restoring SW Washington's Endangered Fish & Watersheds

Published every so often Summer 2013

300 B.C. Pont Ambroix Bridge, France

The Roman Arch, mans 2,500 year old engineering marvel is still working today

Over 2,500 years ago a new building concept allowed man to design, engineer and construct bridges that span rivers, aqueducts that moved water to cities and fields and built churches, to unprecedented heights.

More recently, the Roman Arch concept is helping to restore endangered salmon and steelhead.

Whether the Roman Arch is used to span a stream, or is integrated into a riverbed, the same basic engineering principals apply. The weight of the structure pressing down, or pressure of flowing water, forces each building block of the structure to support and reinforce the rest of the structure, thus allowing river structures to be built with a minimum of materials and blend into the natural environment.

Wood/rock crossvanes help provide deep water habitat

Roman Arches create deep pool habitat for endangered salmon & steelhead

In the summer during critical low flows and high temperatures, deep holding plunge pools provide cool upwelling oxygenated water, cover and feeding areas for juveniles and resting places for returning wild salmon and steelhead. Upwelling pressure from groundwater and deep pools also enhance flows thru tailwater gravel, where wild salmon and steelhead seek to spawn. This prime habitat increases survival of eggs and emerging fry. When creating deep holding pool habitat, wood and rock are used to mimic the natural environment, restore proper stream functioning, remove stress from banks and move current energy to the middle of a stream. This helps banks heal and allows growth of new trees and vegetation.

Combining deep pools, riffle run tail-out habitat with increasing nutrient distribution, either with salmon carcass or analog pellets, plus restoring sidechannel holding areas for juvenile fish, can go a long way toward improving our threatened and endangered wild salmon and steelhead populations.

Stream restoration projects need to be monitored for:

- How successful the project is in providing deep cool water pools and spawning/rearing habitat.
- A transparent, audited, monitored system of how the project met its goals overtime, and how tax & rate payer, as well as endangered salmon & steelhead, benefit.

Note: All projects shown are monitored for success

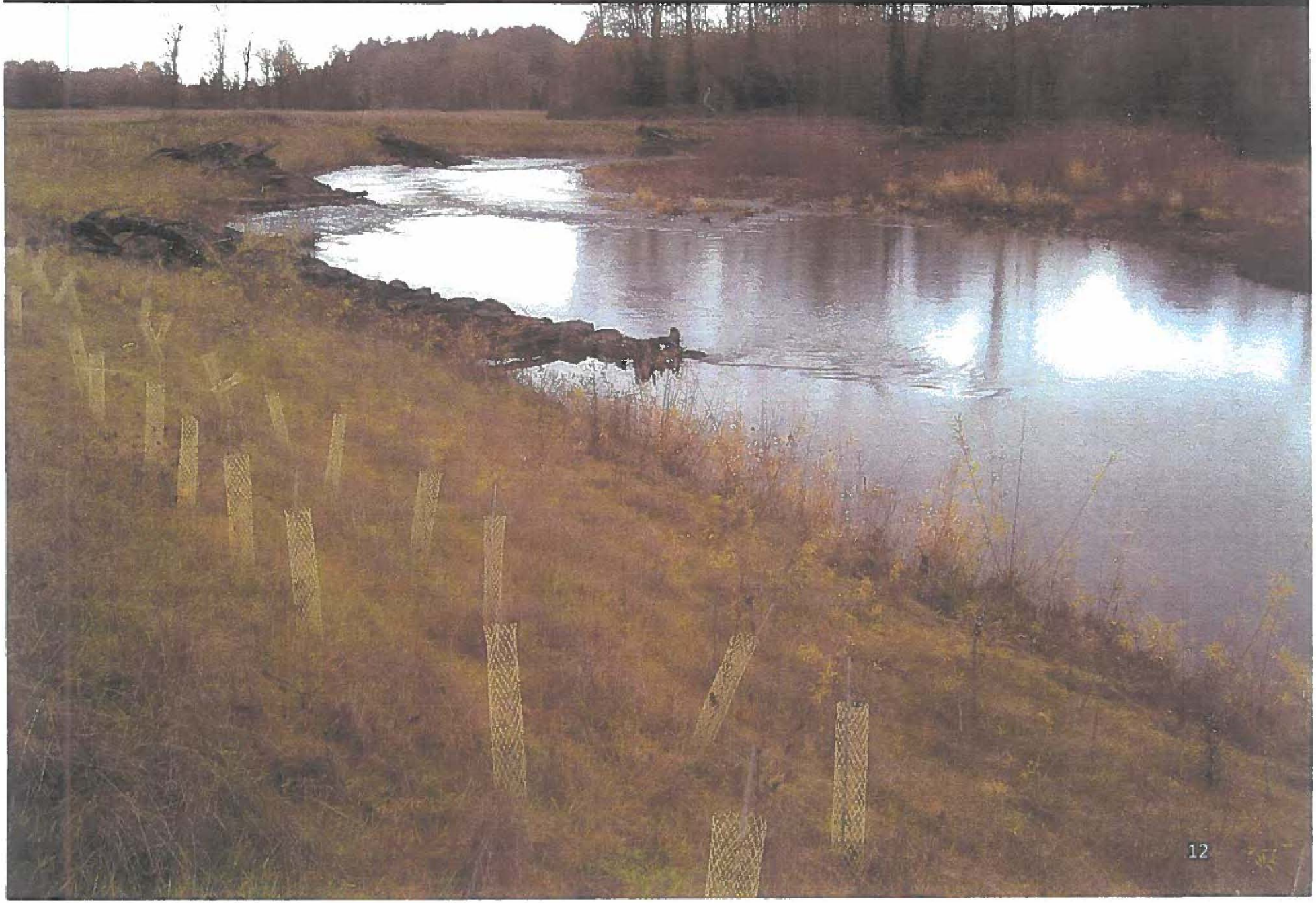
Volunteers interested in restoring our rivers and helping save our endangered wild & native salmon & steelhead contact: [redacted]

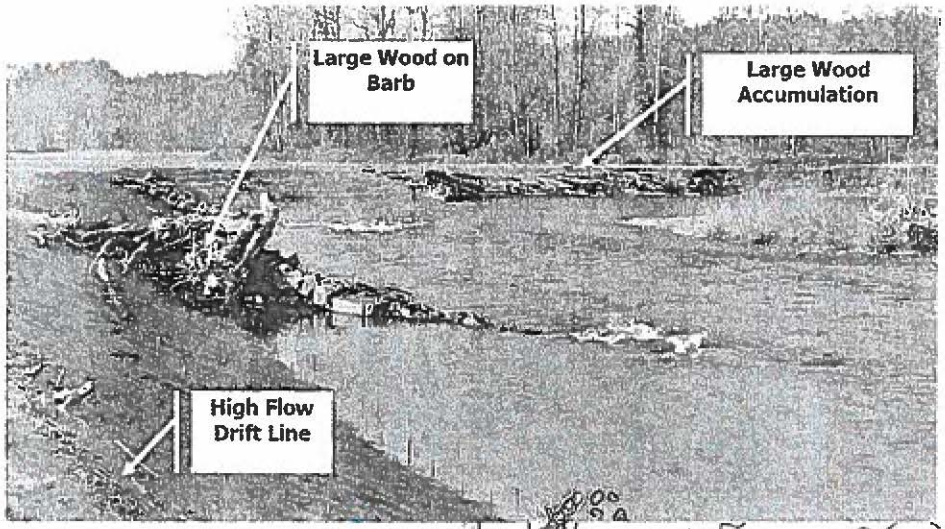
InStreamConservation

Restoring SW Washington's Endangered Fish & Watersheds

[redacted]

Stream Barbs, Bank Shaping and Riparian Plantings





Rock/wood barbs facing upstream 20 to 30 degrees will reduce bank erosion and sediment loads from stream banks by directing current to the center of the stream, barbs will also collect large wood and provide refuge for juvenile and mature Salmon, Steelhead and Coastal Cutthroat

Growing point bar above restoration site continues to erode bank and transport sediments downstream.

DESCHUTES PIONEER PARK RESTORATION

InStreamConservation News

Restoring Washington's Endangered Fish & Watersheds

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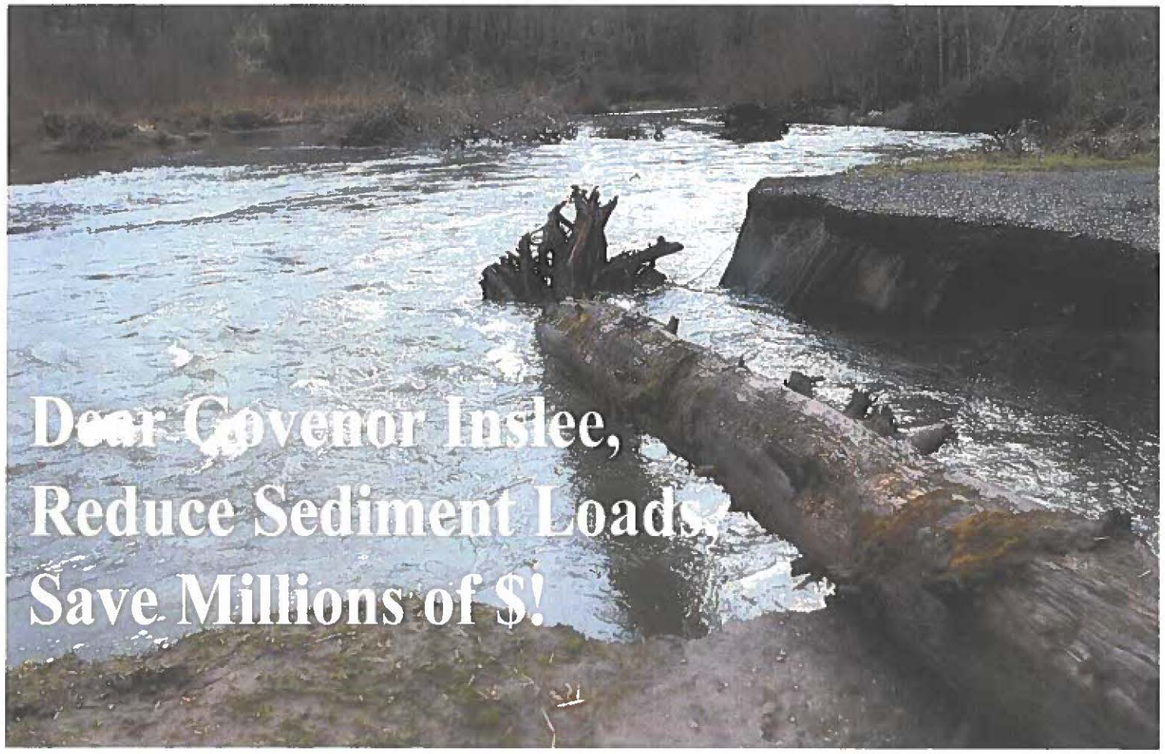


Over 1500 feet of bank erosion at Pioneer Park continues to smother fish redds and fill Capitol Lake.

Presently, thousands of cubic yards of sediment from eroding banks on the Deschutes River continue to smother fish redds and fill Capitol Lake, while public and private agencies search for solutions. It's time to put proven bank stabilization techniques used in the rest of the country to work in restoring our Deschutes River. Let's bring back a healthy estuary where oysters thrived in the 1930's.

Sixty-five years ago, the Deschutes River Estuary was dammed in an effort in part, to create a lake and extend 5th Avenue across the river. The dam was supposed to cover sediment in the estuary with water. Ironically, it filled the Deschutes Basin with even more sediment and turned the Basin into a freshwater marsh.

About 1/3 of the watershed is part of a huge privately owned tree farm. The basin is already prone to heavy runoff and slides during winter storms.

Building roads and logging on the upper watershed made the problem worse.

While environmental laws have brought improvements since the 1970's, there are still problems. Fine sediment smothers salmon redds.

Over the years roads, sand and gravel operations, livestock and many other activities along the river, contributed to the problem.

The 5th avenue dam forced the Deschutes Basin to "choke" even more, on the extra sediment.

Consistently during winter floods, the Deschutes River deposits an average of 35,000 cubic yards of sediment a year, since the dam was built under the present 5th Avenue Bridge in 1951. Over the last 65 years the volume of sediment could fill a football stadium the height of 1,300 feet, the river has deposited well over 2 million.cubic yards of sediment. Two dredges, in 1978 and 1986, moved about 16% of this 314,000 cubic yards, to build parklands and wetlands. Any future

Heavy Erosion, High Risk to Floaters, 4/20/17

dredging would have to be completely removed from the Basin and sent to landfills.

Salmonids need brackish water to adjust to differences between fresh and saltwater zones. Without an estuary, there is no transition time causing salmon smolts to become stressed, and possibly die. During warm summer months, the Capitol Lake basin does not meet Federal water quality standards.

That is because of high levels of phosphorus, fecal coliform, algae blooms and high water temperatures. This deadly brew causes a very deadly low oxygen environment.

All of these combined impacts negatively stress departing and returning salmon, steelhead and cutthroat trout. The low oxygen, high temperature and toxin in a dammed, non-flushing basin calls for all of us to find a solution.

Over the years, the Squaxin Island Tribe, Thurston County Conservation District, South Puget Sound Salmon Enhancement Group, Stream Team, Thurston Regional Planning Council, Wild Fish Conservancy, Capitol Lake Partners, Cities of Olympia and Tumwater, State Department of Ecology, Dept. of Natural Resources, Washington Department of Fish & Wildlife and the Dept. of Information Services, have actively researched degrading fish and bird habitat in the Capitol Lake Basin. Collectively, these public and private groups have yet to formally determine the right steps to regain health for an estuarial Deschutes River basin.

Deschutes Falls 1/7/16.

What's been continually missed is reducing sediment loads on the Deschutes River to the volumes of the 1930's, when oysters thrived in a healthy estuary.

How? Ask the real experts, leaders in the field, who have evaluated thousands of miles of river habitat at successfully completed hundreds of river restorations, across the U.S.

Who? Stream and Fluvial Geomorphologists and Hydrologists who live and work in the Pacific Northwest. Their unparalleled experience is needed. NOW!

Here are 4:

Dr. Barry Southerland PhD.
CPESC#514WNTSC,NRCS
Fluvial Geomorphologist..
Part of the team evaluating the devastating OSO slide on the North Fork Stillaguamish River that killed 43 people.
[redacted]

Dr. Frank Reckendorf PhD. Private consultant/ retired NRCS, WNTC, Fluvial Geomorphologist
[redacted]

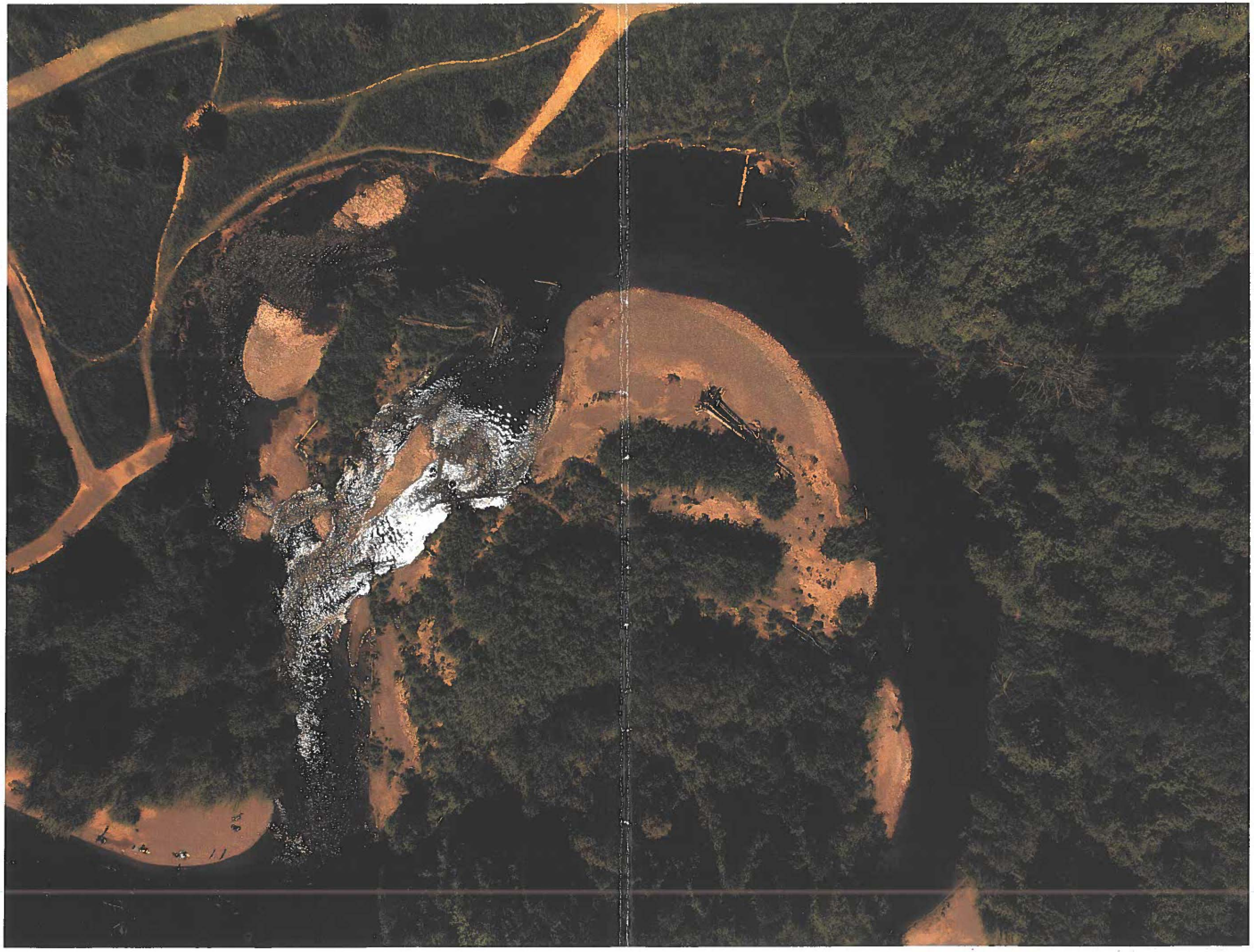
Russ Lawrence, P.El, M.Sc. Fluvial Geomorphologist
Streamfix [redacted]

Richard Dyrland Ms—Supervisory Hydrologist
[redacted]

In 2016, Richard Dryland received the prestigious "Presidents Fishery Conservation" award from the American Fishery Society, for contributions that advance aquatic resource conservation and the restoration of Eco Systems, habitat for salmon, steelhead and other aquatic populations.

FLUVIAL MORPHOLOGY is a science devoted to understanding rivers both in their natural setting as well as how they respond to human induced changes in a watershed, in the process, restoring the watersheds to health.

InStream Conservation
Restoring Endangered Fish & Watersheds
Ben Dennis
[redacted]



The following is a USDA Natural Resources Conservation Service Restoration Checklist

Does your river restoration project provide:

- River water that tumbles over rock/wood veins adding oxygen and mixing with cooler water, providing fish-friendly habitat
- Plunge pools that provide cover; cool groundwater inflow for large fish and fry
- Vanes, barbs and J-hooks that direct flow to the center of the channel; taking stress off banks, allowing for re-vegetation
- Pool tail-outs that provide quality salmon and steelhead spawning habitat
- Porous rock/wood structures that allow upstream sediment to move through reach, keeping spawning gravel clean
- Provide low risk to boaters and recreational uses

Are you ready to restore our rivers, help save our endangered wild and native salmon, steelhead and native cutthroat trout? Then please contact Ben Dennis (360)819-4307

InStream Conservation
Restoring Endangered Fish & Watersheds
Ben Dennis
[redacted]

A Technical Review of the Columbia Habitat Monitoring Program's Protocol, Data Quality & Implementation

Submitted to:

Bonneville Power Administration

March 16th, 2018

Submitted by:

Dave Rosgen, Ph.D., Brandon Rosgen, & Darcie Geenen:
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[redacted]