Landowners Guide

to

Fish Habitat

Conservation and Restoration Practices

compiled by

William J. Hauser and Edward W. Weiss

Technical Report No. 01-3 March 2001

ALASKA DEPARTMENT OF FISH AND GAME ***HABITAT AND RESTORATION DIVISION***

Additional copies may be obtained from the Alaska Department of Fish and Game, Habitat and Restoration Division, 333 Raspberry Road, Anchorage, AK 99518 or from the ADF&G – H&R web site: http://www.state.ak.us/local/akpages/FISH.GAME/habitat/hab_home.htm

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Alaska Department of Fish and Game

Frank Rue, Commissioner

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Habitat and Restoration Division
Alaska Department of Fish and Game
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Landowners Guide to Fish Habitat Conservation and Restoration Practices

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PURPOSE OF THIS DOCUMENT

The purpose of this document is to help you – a riparian landowner - to develop good planning and implementation decisions for projects around water bodies, to find and understand good, fish-friendly methods, and to find assistance if you need it. This is NOT a "cookbook" or a construction manual, but it will guide you through the water and land permitting process. The goal is to help you to design improvements to your property that will be not only fish-friendly, but also improve the aesthetics and value of your property.

The INTRODUCTION of this document provides background information and rationale about why the edge or, riparian area, is so important for fish. WHAT DOES THIS MEAN TO YOU? is an introduction and discussion about the permit requirements and YOUR PROJECT links your planning process with those requirements. There are two ways to view the PERMITTING PROCESS: a step-by-step outline and a diagrammatic flow chart. The table of TYPES OF DEVELOPMENTAL ACTIVITIES is a list of actions that you may want to use to improve your property and the table of METHODS is an overview of ways to accomplish some of your goals. The sections, PERMIT APPLICATION FORMS, CONTACTS, and USEFUL WEB SITES, direct you to sources for documents and information. The GLOSSARY helps you to understand some acronyms and terms and the BIBLIOGRAPHY AND SOURCES OF INFORMATION lists documents where information for this document was obtained and similar information sources. INFORMATION SHEETS for more detailed information about METHODS are at the end of the document. Finally, ACKNOWLEDGEMENTS (which are actually located before the Table of Contents) are important because that is where we say thanks to the folks who helped compile this document.

INTRODUCTION

Life on the edge

Life always seems to be on the edge. People always want to push out and away from crowded places and we are always in the search for something different. Fish and wildlife are no different. People want nice quiet places to live and a variety of things to do and eat. Fish and wildlife are no different. As people push to their edge in a search for nice places to live and work and have fun, they often encounter the edge of where fish live and are pushing out to their edge. So as we develop more areas to live and grow, we begin to affect the "edge areas" that are so very important to fish and other wildlife as well. Fish, wildlife and people begin to compete for life on the edge.

Our attitude is simple. People need a place to live. People like to live on the edge. We like to live on an edge that we share with wildlife and fish… but, this creates a dilemma because people affect the places where they live. People have the capability to change their environment. When we modify the edges of our environment to fit our needs, we may also be changing the fish's environment as well. The intent of this document is to help us find ways that allow us to use the edges of our environment without serious damage to the fish's environment.

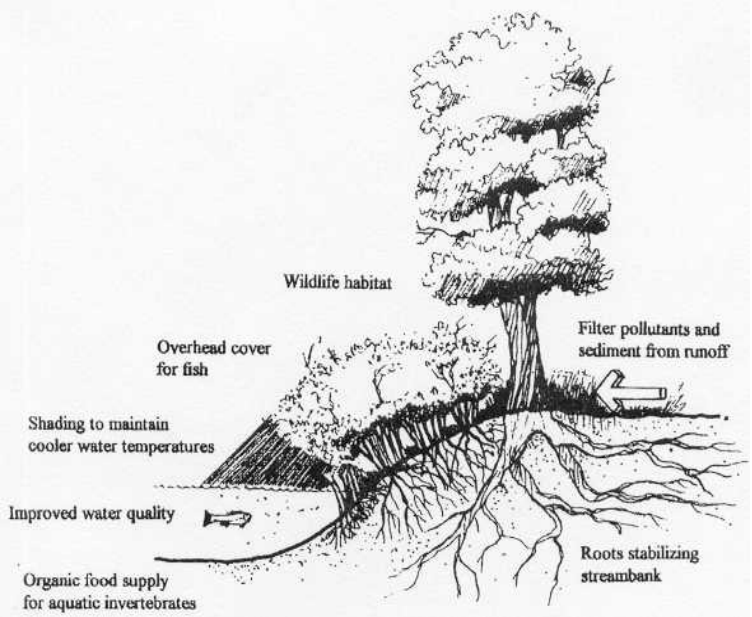
Why is the edge important to fish?

Different parts of a lake or a stream are not equal. Certainly, we cannot have a lake or stream without water and we cannot have fish without water, but the most important parts of a water body are on the edge. The water surface is important because this is one of the pathways for oxygen to get into the water and it provides a pathway for input of organic matter such as detritus and insects. Sunlight also comes through the surface. It is one of the important ingredients in the photosynthesis of plants, which are at the bottom of the food chain. The other edges of a water body are the bottom and the banks. The bottom is a food factory for fish. Most of food for a fish originates on the bottom whether they live in a lake or a stream. Most fish spawn on the bottom. Trout and salmon need a clean, gravelly stream bottom to dig a redd (i.e., a nest where they spawn) and bury their eggs to incubate and hatch.

The banks or edges of streams and lakes are very important edges because they provide a source of fish food. Many nutrients that fall into the water help to drive the food chain. The streambanks and the lakeshores define the shape of the water body and create an interface where plants, bushes and trees can grow. Vegetation along this edge creates a root system that improves the stability of the shore.

This is where life is truly on an edge. This is the edge where people like to live and the edge that provides important habitat for fish, too. This is the edge that people have the power to change and changes to this edge can have a profound affect our fish and wildlife populations.

How important is this edge to the fish? Young chinook salmon cannot tolerate water velocity faster than about six inches per second; so, in a large river like the Kenai River, it has been estimated that over 80% of the young chinook salmon were within 6 feet of the bank. In smaller streams, they are also associated with the banks and woody materials. Young coho salmon prefer slower moving ponds and slough-like areas and they depend on the woody materials, too. Where do they go in winter? Young fish seek out deep holes or ponds. Rocky rubble and woody materials provide places for the small fish to burrow for shelter. Young sockeye salmon usually prefer to rear in lakes but they may also be in slow areas or ponds associated with rivers.



High quality riparian habitat is good for fish and people (illustration from: Bentrup and Hoag)

What does the edge provide for fish?

The streambanks and lakeshores create the edge or "riparian zone" of water bodies and the riparian areas are crucial to the life of the water body and the lives of the organisms that live in the water. First, it provides structure. Roots of trees and other vegetation knit together to hold the soil and rocks to minimize erosion and to contain the water. A stable, non-eroding streambank means that there is less fine material washed into the water. Some erosion is natural and some is needed to replenish the streambed materials and spawning gravel, but excessive siltation in the water is detrimental. Silty water reduces light penetration and lowers photosynthesis. When water loses velocity, it cannot transport the material and the silt begins to coat the bottom. This plugs spawning gravel and smothers fish food organisms and fish eggs. Silty water can also irritate fish gills and cause infection and death.

Eventually, some riparian zone plant roots become exposed and tree branches fall into the water. These are good for fish too. They dissipate hydraulic energy of moving water and slow down erosion. They provide a place for fish food organisms to grow and they provide places for fish to hide from predators. Woody debris in streams also act as strainers to catch and hold drifting organic matter, including carcasses of spawned salmon. The organic matter fertilizes the food chain and creates more fish food in our Alaskan waters which would otherwise be quite sterile and unproductive.

Branches that hang over the water break up the direct sunlight into a pattern of light and shade that compliments the camouflage pattern and colors of the fish. More fish food items drop from tree branches into the water.

Other wildlife use the riparian zone, too. Some, such as moose, are attracted by the lush vegetation. Others, such as bears, may be attracted by the fish where the edges of the water and the land come together. Waterfowl, muskrats and beavers use the water and the vegetation as a home and a food source. A continuous, undisturbed riparian zone is an excellent travel corridor for wildlife.

People on the edge

Natural riparian areas often comprise less than 1 percent of the available landscape; however, they typically support a much higher percentage of fish and wildlife species and perform more ecological functions than upland habitats. Life can be good on the edge, but often, well-intentioned people can overuse the riparian zone and change it to "improve" it for their needs. When this happens, the riparian zone cannot support the fish and wildlife populations or the ecological functions that they normally do.

Many lakes in the Matanuska-Susitna valley are ringed with homes on small lots with lawns, driveways, garages and recreational structures. Residents with permanent and seasonal homes in the riparian zone of lakes and streams throughout the Matanuska-Susitna area have caused many changes that have affected fish and wildlife habitat, water quality and the natural functions of these riparian areas. Cumulative impacts from individual projects along the shoreline of lakes and streams are having an alarming affect on the diverse resources and functions of these riparian areas and the lakes and streams that they border. A small dock here, a lawn there, a shed over there and soon the natural riparian habitats around a lake or river have disappeared.

Data from the Matanuska-Susitna Borough assessors office shows that 60% of the nearly 600 properties with water frontage on Cottonwood Creek, Anderson Lake, Nicklason Lake, Cornelius Lake, Cottonwood Lake, Finger Lake, Mud Lake and Wasilla Lake have been developed.

A 1997 ADF&G study of the Cottonwood Creek drainage documented over 1200 structures (e.g., docks, bank stabilization, houses, roads and lawns) within 75 feet of the normal edge of the water. Structures associated with recreation (docks, boat ramps and beaches), structure development (houses, sheds and pads) and lawns or vegetation thinning each comprised about 25% of all structures inventoried.

A total of 82% of the impacts inventoried during the Cottonwood Creek study were within 25 feet of the water and 52% were within 5 feet or less. Cumulatively, these impacts have caused a great deal of removal or replacement of the riparian vegetation. Lawns and vegetation thinning made up over half of the total length of inventoried impacts along the waterline and comprised nearly 70% of the disturbed areas. Of the 72 miles of shoreline surveyed, 11% or 8.3 miles, had been altered by lawns, vegetation removal or filling.

Most of the impacts in the Cottonwood system also occurred around the lakes. Approximately 70% of the inventoried impacts in the Cottonwood Creek drainage were along the lakeshores of the six main lakes in the system.

Lawns and vegetation thinning or removal accounted for 70% of the disturbed area along the lake shorelines in the Cottonwood study. Approximately 13% of the total riparian area in a 75-foot zone around 6 of the main lakes in the Cottonwood Creek Drainage had been placed in lawns or had vegetation removal or thinning done to it.

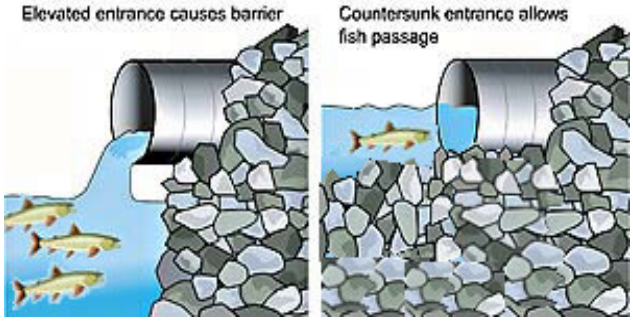
Large open lawns and parks may be nice for viewing and recreation, but they alter the diversity and function of the riparian zone. Lawns usually have few trees, if any, that may fall into the water to provide food sources and cover for fish. Shoreline vegetation, which provides fish cover and food, is usually removed. Fertilizers and pesticides are added to lawns, which run into the water. Sometimes, vegetation is absent or insufficient, and sediment washes into the water, covering fish spawning areas or impacting recreational areas. The percentage of the shoreline area placed in lawns or having vegetation removal adjacent to observed sockeye spawning areas on Wasilla Lake, east Nicklason Lake, Mud Lake and Cottonwood Lake was 41%, 68%, 29% and 22%, respectively. Most wildlife species prefer the natural riparian vegetation to lawns. The removal of riparian vegetation has been linked to the reduced abundance and variety of bird life around lakes. And without continuous stretches of riparian vegetation larger wildlife are less likely to frequent the area or utilize them for travel corridors.

Replacement of the natural riparian vegetation by lawns or other structures can result in many problems for fish, wildlife and the

landowner. Loss of ground water recharge, water quality problems, increased sedimentation, loss of wildlife habitat and travel corridors, loss of food and cover for fish, and increased shoreline erosion have all been linked to development within riparian zones and the removal of natural riparian vegetation. There are also aesthetic effects to be considered, such as increased noise levels and a view of your neighbor's homes or a commercial area versus being able to look out on a relatively undisturbed lake.

When we replace natural vegetation and wetlands with structures such as houses, cabins and sheds and parking lots and roads, we also accelerate runoff by converting porous vegetated soil and wetlands to a hard, impervious surface. Rainfall and snowmelt that normally soaks into the soil, runs off instead, and we help speed it along and prevent it from recharging groundwater. Fertilizers, pesticides, petroleum products, animal wastes (e.g., dogs and waterfowl) are washed by rain from these areas and into the water. When the water is enriched too much, the nutrient cycle is tilted off balance and unwanted algae develop. Exposed soil is also vulnerable to erosion, both during construction and on areas cleared for a view. Erosion is a problem not only for water quality and fish habitat but also for the landowner.

Other activities also have potentially large impacts on fish habitat. Fish passage may be disrupted if road-crossing structures such as bridges and culverts are not located, designed or installed carefully. Adult fish can be blocked from spawning areas and young fish may be prevented from migrating to or from feeding habitat or over-wintering habitat.



The "perched culvert" on the left prevents upstream passage of fish
Adapted from: Canada: Factsheet for culvert web page

In the Cottonwood Creek system, culverts have replaced more than a third of a mile of stream habitat and over 30 illegal ATV ford or crossing sites were identified. These tend to be in reaches with shallow riffles where fish spawn. Culverts and ATV crossing sites directly impacted an estimated 3% of the observed coho salmon spawning habitat in the Cottonwood Creek system. Indirect effects may be even greater. In some individual short spawning reaches as much as 56% of the spawning area was impacted.

Uncontrolled boat launches and excessive foot traffic on shorelines can lead to trampling of protective vegetation and soil compaction. These create instability in riparian areas and lead to erosion and silt in the water. Over 40

unimproved boat launches were found during the 1997 Cottonwood Creek inventory resulting in a total of almost 47,000 square feet of impact. These unimproved sites are often simply places where landowners have cleared a launch down to the water without any regard to bank stabilization, erosion control or revegetation. Likewise the areas denuded of vegetation were inventoried. There were 108 areas of denuded bank related to trails or other uses. These added up to over 87,000 square feet of unvegetated trampled area on over 5,400 linear feet of bank.

What can be done?

While economic growth is important for the Matanuska Valley it is vital that development occurs in a way that safeguards the ecological health of the lakes and streams that draw people to the Matanuska Valley in the first place. We must respect and protect riparian areas. We must acknowledge this importance and we must understand that streams and lakes are dynamic. Streams and lake riparian zones will change. Streams will flood and alter their banks. Lake levels will rise and fall. This is precisely the reason cities are designed with greenbelts around streams and lakes. And this is the reason that any development needs to protect and preserve riparian habitat. It is good for the fish and it is good for people, too. What can we do to share the edge with fish and wildlife?

Our first challenge is to preserve and care for what we have. We must become good stewards of resources that are associated with our waterways. We must learn to recognize and understand the importance of the riparian

Good stewardship practices avoid activities that are not fish-friendly. (illustration from: Henderson, Dindorf and Rozumalski.)

areas to fish, to wildlife and to us. We must learn to use these areas carefully and protect them.

Preserving riparian vegetation to maintain strong banks, good water quality and fish and wildlife habitat is the first part of this challenge. Maintain a vegetative buffer and locate structures away from the lake or stream. Avoid clearing the natural riparian vegetation next to the stream or lake. Leave logs and woody debris in the water. Preserve wetlands that sustain subsurface water flow. Consolidate the development of trails, access points, roads and parking areas to help eliminate unnecessary destruction of riparian vegetation. Incorporate water quality and runoff issues into development and construction plans. Evaluate placement of stream crossings to eliminate destruction of spawning areas or causing a barrier to upstream or downstream fish movements. Tell others about the importance of good riparian area stewardship.

Frequently, we cannot avoid development in the riparian zone and the needs of fish and the desires of the people may conflict. In the absence of being able to preserve, we need to protect. As we acknowledge the importance and role of the riparian areas for fish and wildlife habitat, we need to use methods to develop our property that protect these resources; or, at least, minimize the damage.

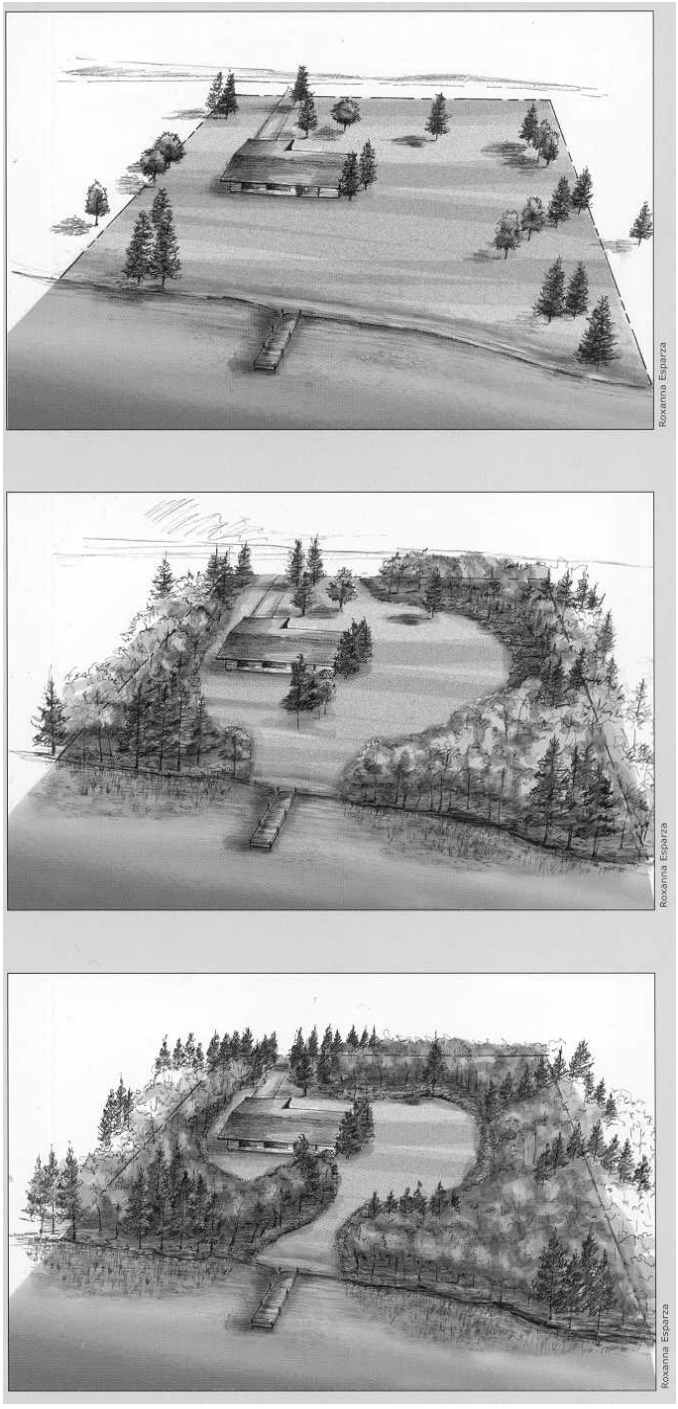
What can be done? Be a good steward. Avoid large, open lawns. Maintain good riparian vegetation with a narrow corridor for you to get to the water. If you already have a large, open lawn, allow natural riparian vegetation to encroach, especially along the shoreline. Consider transplanting to add native woody vegetation to your shoreline. Plan all of your projects so fish habitat will not be lost. Become a better steward of fish habitat as well as your property.

And lastly where perturbations have already occurred we need to look at restoration or rehabilitation. Places outside of Alaska have experienced varying amounts of degradation of riparian areas and private and governmental organizations have been faced with the challenge to control and repair damage that has been done. We are fortunate in Alaska. Few lake and stream systems are severely damaged and few need to be rehabilitated. Fortunately the cumulative effect of replacing or restoring small patches of natural vegetation can ultimately lead to the restoration of larger patches or entire riparian zones, just as the incremental impacts have destroyed them.

People can choose to remove or not to remove riparian vegetation and they can choose to replace it, too. For example, as property owners on the Kenai River began to understand the importance of riparian areas to fish, they became better stewards of their river front property. Beginning in 1995,

many landowners on the Kenai River have participated in a program to protect and rehabilitate streambank fish habitat on the Kenai River. Between 1995 and 1999 cumulative efforts from state/federal cost share projects with private landowners has resulted in the protection of almost 15,000 linear feet of shoreline and the rehabilitation of over 8,900 feet (Hughes 2000).

Since 1998 efforts have also been under way within the Matanuska-Susitna Borough Area to increase public awareness through education and public outreach programs and to carry out restoration of riparian areas and fish habitat. In the last two years 44 shoreline or stream restoration projects have been initiated within the Matanuska-Susitna Borough. Ten of these have already been completed resulting in 589 feet of rehabilitated shoreline or stream bank.



Good stewardship practices avoid intense landscaping (top panel). Preserve or restore riparian vegetation (mid and bottom panel) to maintain good fish and wildlife habitat, improve aesthetics and increase property values. (illustration from: Henderson, Dindorf and Rozumalski.)

WHAT DOES THIS MEAN TO YOU?

The need to implement a permitting process in Alaska is embodied in two documents: The Constitution of the State of Alaska and the Alaska Coastal Management Program (ACMP).

The Alaska Department of Fish and Game (ADF&G) is mandated by the Constitution of the State of Alaska. (Alaska Statute Title 16) which directs the Commissioner of the ADF&G to "manage, protect, maintain, improve, and extend the fish, game and aquatic plant resources of the state in the interest of the economy and general well-being of the state..." (AS 16.05.020). The Habitat and Restoration Division (H&R) has the responsibility under this legal mandate to coordinate the department's involvement and policy on a wide range of activities including: land use and natural resource planning, large and small development projects, water reservations and appropriations, and public access. The division also provides fish and wildlife resource information and technical assistance to public and private land managers and regulatory governmental agencies.

The H&R Division also has specific statutory responsibilities for protecting freshwater anadromous fish habitat under the Anadromous Fish Act (AS 16. 05. 870) and providing free passage of anadromous and resident fish in fresh water bodies (AS 16. 05. 840). Consequently, the ADF&G – H&R maintains the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes* to identify and document anadromous waters for the protection of fish habitat.

This mandate can be accomplished only if we protect and maintain spawning, feeding, overwintering and migratory habitats for fish. Many species of fish depend on a contribution from some part of the riparian areas for some kind of habitat during some part of their life cycle; therefore, it is imperative that to protect fish, we must protect riparian areas and use developmental practices that do not harm this important area.

The ACMP implements legislation passed by the State of Alaska in 1977 - the Alaska Coastal Management Act. The Alaska Coastal Management Program improves stewardship of Alaska's coastal land and natural resources by creating a network of local, state, federal, and applicant interests in the project approval process to ensure that all aspects of a project are considered

during a single review and approval process. The ACMP requires that projects in Alaska's coastal zone be reviewed by coastal resource management professionals and found consistent with the statewide standards of the ACMP and local or Borough Coastal Management Programs. It is called the "consistency review process" and a "finding of consistency" with the ACMP must be obtained before permits can be issued for the project.

The Division of Governmental Coordination (DGC), located in the Office of the Governor under the Office of Management and Budget, is the lead agency for coordinating the ACMP. The DGC is intended to be a central contact liaison for the various agencies that have been charged with the protection of the riparian areas and our aquatic resources.

In addition to the statewide standards adopted through the ACMP, local districts such as the Matanuska-Susitna Borough (MSB) adopt standards that are specific to their district. The statewide and district specific standards adopt policies against which projects are reviewed to protect or guide development of coastal resources such as air, land and water quality, fish and wildlife habitat, subsistence, mining, transportation, timber, energy and utilities. The MSB district coastal habitat policies adopt the statewide standards and also adopt more specific coastal habitat policies. Under the specific MSB policies, proposed uses and activities within 75 feet of the ordinary high water line of rivers, streams and lakes that require local, state or federal authorization must be reviewed and approved to protect water quality and fish and wildlife habitat. Some water dependent structures are allowed, provided that impacts to water quality and fish and wildlife habitat are minimized or mitigated. Other uses can also be allowed if they have no significant adverse impact.

Agencies that have responsibilities for planning and permitting in the coastal zone include:

Agency	Responsibility
Alaska Department of Environmental Conservation (DEC)	Water Quality – industrial, commercial and private discharge into water bodies
Alaska Department of Fish and Game (DFG)	Removal of water or materials from a water body or placement of structures or discharge into an anadromous water body

Agency	Responsibility
Alaska Department of Natural Resources (DNR)	Project on State-owned land or water or crossing State-owned property for access; use of State-owned resources
Alaska Division of Governmental Coordination (DGC)	Facilitate communications and permitting among Municipal, Borough, State and Federal agencies
Matanuska-Susitna Borough	Development in or near water – code compliance
Municipal or Borough Planning departments	Flood hazard determination for any materials placed into a stream
Municipal or Borough Planning departments	Structure setback, vegetative buffer or zoning agreements
U. S. Bureau of Land Management (BLM)	Manage BLM properties
U. S. Coast Guard (USCG)	Bridge, or causeway over tidal waters, navigable rivers, streams or lakes
U. S. Environmental Protection Agency (EPA)	Discharge of materials into wetlands or water bodies or exposure of soils
U. S. Federal Aviation Administration (FAA)	Materials discharge within 5,000 feet of an airport
U. S. Federal Energy Regulatory Commission (FERC)	Installation or operation of a hydroelectric project, natural gas pipeline or an electric transmission
U. S. Forest Service (USFS)	Manage USFS properties
U.S. Army Corps of Engineers (COE)	Dredging, structures or fill in tidal waters, streams, lakes and wetlands

YOUR PROJECT

You need two very important things before you can implement your project: a good plan; and, permit or code compliance.

1. As you begin…

- What do fish need? Remember that the riparian areas are important to fish and wildlife. That means that they are important to you, too. Healthy riparian areas mean healthy fish populations. Riparian areas contribute directly or indirectly to stability of the banks, structure in the water, camouflage, and food.

- What do you need? You want to use your property and you want to be able to access a stream or lake. But you also want to preserve riparian areas so fish and wildlife habitat is not lost and your property is protected and preserved.

2. Background work

- Establish project goals that are both good for fish and meet your needs. Keep it small and simple. Avoid work in wetlands. Avoid or minimize changes to the riparian areas.
- Scheduling. Be sure to allow ample time to do your planning, obtain all permits and hire workers so your project can be started at the most appropriate time. Work in or near the water can be performed only during times that are safe for fish – usually in the spring and early summer or as stipulated by ADF&G.
- Existing Regulations. Understand zoning, structure setback and vegetative buffer constraints established by local governments and restrictions by state and federal agencies.
- Determine the best practices for your development and needs which are also compatible for fish habitat.

3. Site selection and planning

- Create a base map or use an as-built survey to determine existing boundaries (both legal and natural), structures, distances, slopes, drainage and existing vegetation.
- Analyze the base map to evaluate existing use patterns, including types and location of activities, movement patterns, views, etc.
- Design and sketch improvements and proposed changes on a copy of the base map. Consider incorporating or expanding riparian area buffers.

- Timing is important. Certain activities may be permitted only during certain seasons or conditions. It is important to understand legal and environmental limitations that may affect your scheduling. Allow ample time.
- Pre-application assistance. DGC can schedule a pre-application meeting with the permitting agencies to identify any issues and work to resolve them early in the process.
- Use methods that avoid and minimize impacts to streams and lakes. Filling wetlands and placing material below a waterline in salmon waters may not be permitted. Avoid oversized structures, roads, parking areas and access routes. Keep slopes and banks vegetated and consider drainage patterns. Remember that exposure is important. North- or south-facing slopes have different environmental conditions and different planning requirements.

4. Final Consistency Finding and required permits (see: PERMITTING PROCESS)

- Complete the Coastal Project Questionnaire and permit applications
- Receive a Finding of Consistency
- Receive required local, state and federal permits

5. Implementation

- Work within the timeframe designated by ADF&G.
- Implement erosion and sediment control practices during construction.
- Report departures from the permit specifications before you do the work.

6. Maintenance

- Monitor vegetation, project installation and new use of project.
- Perform necessary maintenance as needed.

PERMITTING PROCESS – (OUTLINE)

1. Develop a plan
   a. Start early (allow six months to a year). Consider how you want to use your property, how to protect fish habitat and start your planning
   b. Sketch a simple diagram of existing and proposed conditions and develop a preliminary project plan
      - Contact ADF&G - H&R if there are salmon in the water body (a site visit may be helpful)
      - Consider potential impacts on wetlands and fish habitat
      - Determine local requirements for codes, zoning constraints, structure setbacks or vegetative buffer
   c. Complete a Coastal Project Questionnaire to identify which agency permits are required
      - Identify your project features
      - Update your sketch with more details and different views
   d. Meet with agency representatives to finalize your project plan

2. Submit your Coastal Project Questionnaire with agency permit applications and project plans to:
   - if you are uncertain where it should be submitted, contact the Division of Governmental Coordination
   - if your project requires a permit from more than one agency, submit it to the Division of Governmental Coordination
   - if your project requires only one agency permit, submit the package to that agency

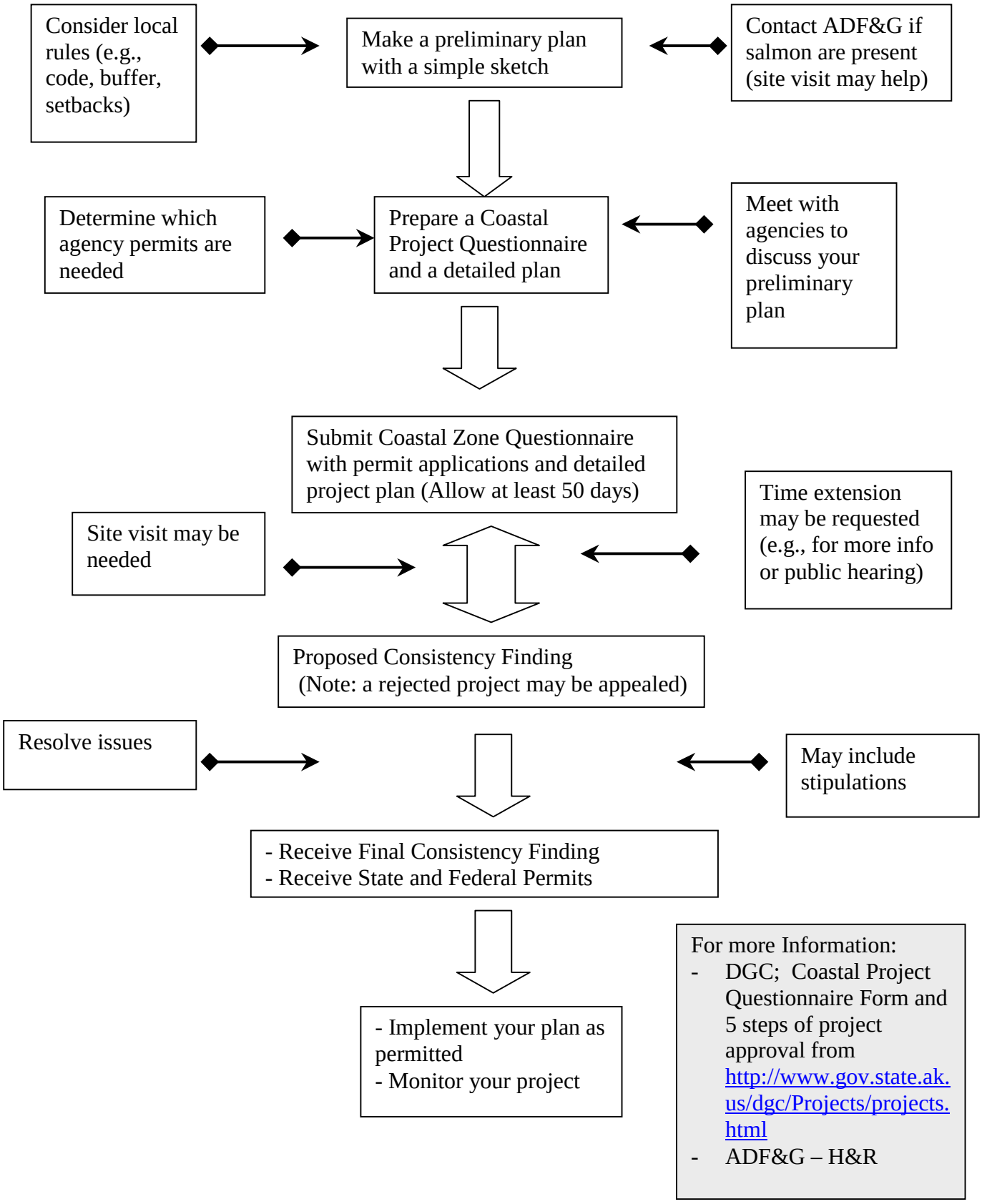
   a. Allow at least 50 days for the review by state and federal agencies and interested public
      - Time extensions may be requested for more information or a field inspection
      - A public hearing may be held (usually not!)
   b. Review the proposed Coastal Consistency Finding
      - Resolve any questions or issues that may be raised
      - Understand any stipulations placed on your project by the agencies
      - Note: If you disagree with the Proposed Consistency Determination, there is an appeal process.
   c. Obtain a Final Coastal Consistency Determination.
      - Receive most state permits within 5 days

3. Implement your project as permitted

4. Monitor and maintain your project.

For more Information:
- DGC; Coastal Project Questionnaire Form and 5 steps of project approval from http://www.gov.state.ak.us/dgc/Projects/projects.html
- ADF&G – H&R

PERMITTING PROCESS – (DIAGRAM)



TYPES OF DEVELOPMENTAL ACTIVITIES

Property improvement activities that may affect the riparian areas. Many of these activities require a permit from one or more local, state and federal agency.

Activity	**Associated with**	**Potential Habitat Concerns**	**Fish-friendly Considerations**
Roadway	Property development	Increase runoff rate, siltation, erosion, petroleum spills	Minimize surface area Control erosion and runoff Proper location
Structures	Property development; Recreation	Increase runoff rate	Minimize number and size Add vegetation buffer
Parking areas	Property development	Increase runoff rate, erosion & petroleum spills	Minimize surface area Control erosion and petroleum Proper maintenance
Pathways	Property development; Recreation	Increase runoff & erosion	Minimize surface area Proper maintenance Elevated walkways
Landscaping	Property development	Removes woody debris and vegetation from edges	Minimize – especially near the edge Keep or add natural vegetated buffer
Lawns	Property development	Increase fertilizer & runoff	Minimize area; Keep or add natural vegetated buffer
Vegetation clearing	Property development	Removes woody debris from edges Erosion	Minimize Keep or add vegetated buffer
Unimproved ford	Stream crossing	Disrupts fish spawning, rearing, migration Affects riparian habitat, erosion	Illegal Don't do it
Established ford	Stream crossing	Minimizes and localizes impacts in stream	Get a permit Use only as needed
Culvert	Stream crossing	May affect fish passage	Needs proper design, size and installation Consider bridge

Activity	**Associated with**	**Potential Habitat Concerns**	**Fish-friendly Considerations**
Temporary bridge	Stream crossing	Susceptible to wash-out and downstream effect	Needs proper design, size and installation Remove after use
Permanent bridge	Stream crossing	Often narrows channel and increases flow	Needs proper design, size and installation
Beach development	Lakeshore Recreation	Removes bottom structures & bank function	Keep it small Consider floating dock
Boathouse	Lake or stream Recreation	Loss of riparian habitat &vegetation Petroleum spills	Keep it small Control petroleum Prepare for cleanup
Permanent boat launch	Lake or stream Recreation	Increased runoff Uncontrolled expansion Petroleum spills	Needs proper siting & maintenance Control petroleum Prepare for cleanup
Undeveloped boat launch	Lake or stream Recreation	Erosion/ siltation Petroleum spills	Don't do it Use permanent launch
Pier or dock	Lakeshore Recreation	Loss of riparian habitat	Keep it small Allow light-penetration
Bank stabilization/ wave control	Lake or stream	Loss of riparian habitat	Avoid hard surfaces/bulkhead Use bio-degradable materials
Fishing access	Lake & stream Recreation	Loss of riparian habitat & vegetation Erosion	Install open, raised platform or walkway Stand in the water Use a boat
Bank restoration	Lake & stream	Difficult Needs professional Often expensive May need heavy equipment	Use bio-degradable materials Use live vegetation Plan carefully Follow-up

METHODS

Fish-friendly methods and considerations that protect or improve riparian zones (For more information, see: INFORMATION SHEETS):

Technique	**Purpose**	**Role**	**Fish-friendly Considerations**
Planning	Identify needs of fish and landowner Select best techniques	Better to be fish-friendly	Allow lots of time Speed kills
Protect undisturbed riparian areas	Avoid damage to riparian areas	Maintain natural vegetated banks	Better to protect and maintain habitat than to repair it
Timing	Identify best time do the development	Avoid times that are sensitive to fish (e.g., spawning, migration)	Avoid migration times Avoid spawning times
Structure setback	Prevent structures too close to water edge	Allow buffer Protect vegetation	Make it as large as possible Follow local codes
Designated stream crossings (fords, culverts, bridges)	Create safe crossings Avoid sensitive areas and critical times for fish	Reduce impact on fish One good site is better than several bad sites	Design and install carefully
Silt fence	Limit location or timing of silt dispersion	Control or minimize damage from silt dispersion during construction phase Better water quality	Avoid smothering food items Avoid smothering fish eggs Deploy properly
Vegetative buffer	Filter runoff & treat polluted water Catch blowing debris Stabilizes bank	Source of woody debris in water Provides wildlife habitat	Future supply of fish habitat structures Better water quality Bigger is better

Technique	**Purpose**	**Role**	**Fish-friendly Considerations**
Elevated, light-penetrating walkways & piers	Provide access & protects vegetation Allows vegetation to grow	Avoid trampling vegetation Allow access and vegetation	Roots stabilize the soil and prevent erosion Stabilize bank
Revegetation	Re-establish vegetative cover	Control runoff and erosion	More is better Stabilize bank (Avoid over-use of fertilizer)
Transplanting	Re-establish vegetative cover from one site to another	Control runoff and erosion	More is better Stabilizes bank (Avoid over- use of fertilizer)
Grass rolls	Reintroduce herbaceous vegetation in difficult sites	Revegetate grassy shores where simple reseeding won't work and short-term stability	Roots stabilize the soil and prevent erosion (Avoid over- use of fertilizer)
Live-staking of Dormant cuttings	Stimulate revegetation of woody materials	Long-term strategy Hold the soil Stabilize shore	More is better Easy, inexpensive Control erosion
Wood-fiber blankets	Immediate Temporary Combine with other techniques	Provides instant cover Trap sediments Helps revegetation	Use in combination with other techniques Control erosion
Bundles of dormant cuttings (Fascines)	Stimulate revegetation of woody materials	Long-term strategy Hold the soil Stabilize shoreline	Use in combination with other techniques Control erosion
Brush mattress	Immediate Temporary Combine with other techniques	Provides instant cover Trap sediments Stimulate revegetation by woody materials	Use in combination with other techniques Control erosion

Technique	**Purpose**	**Role**	**Fish-friendly Considerations**
Brush layering	Combine layers of dormant cuttings with layers of soil	Stabilize shore Provides instant cover Trap sediments Stimulate revegetation by woody materials	Use in combination with other techniques Control erosion (Expensive)
Hedge brush layering	Combine layers of dormant cuttings and rooted plants with layers of soil	Stabilize shore Provides instant cover Trap sediments Stimulate revegetation by woody materials	Use in combination with other techniques Control erosion (Expensive)
Live siltation	Create fish habitat Trap sediments Allow revegetation by other materials	Provides instant cover Trap sediments Stimulate revegetation by woody materials	Use in combination with other techniques Control erosion
Vegetated cribbing	Brush layering with addition of lumber cribbing	Stabilize shore Extreme technique for extreme erosion	Use in combination with other techniques Control erosion (Expensive)
Spruce tree revetment	Control erosion Reduce scour, waves and water velocity	Trap sediments Reduce erosion Stabilize bank or project toe	Inexpensive Simple Provide instant fish habitat
Root wad revetment	Streambank protection	Usually combine with other techniques Stabilize bank Adds woody materials	Provides fish habitat Uses heavy equipment Control erosion (Expensive)
Coir logs	Provide temporary stability until vegetation is established	Short-term Combine with other techniques	Control erosion Bank stability (Expensive)
Coir logs with rootwads	Increased streambank protection – short and long term	Adds woody materials Stabilize bank	Provides fish habitat Uses heavy equipment Control erosion (Expensive)

The following methods have been used in riparian areas in the past and, although they can be effective, they are not fish-friendly and they are rarely permitted by ADF&G. These methods may be useful, at times, above the waterline and combined with other methods that are fish-friendly.

Technique	**Purpose**	**Role**	**Fish-friendly Considerations**
Rock riprap	Build a solid wall	Harden a bank (may be useful above waterline)	NOT fish-friendly Avoid this Rarely permitted
Rock-filled gabions	Build a solid wall	Harden a bank (may be useful above waterline)	NOT fish-friendly Avoid this Rarely permitted
Cinder-block walls	Build a solid wall	Harden a bank	NOT fish-friendly Don't do it Won't be permitted
Sheet pile/ bulkhead	Build a solid wall	Harden a bank	NOT fish-friendly Don't do it Won't be permitted

PERMIT APPLICATION FORMS

The Coastal Project Questionnaire and the ADF&G fish habitat permit application are available from any ADF&G office or from the DGC office. The ADF&G fish habitat permit application is available from the ADF&G – H&R web site.

CONTACT INFORMATION

Alaska Cooperative Extension Service, UAF Fairbanks State Office - Director's Office CES Building, PO BOX 756180 Fairbanks, AK 99775-1680	(907) 474-7246
Alaska Cooperative Extension Service, UAF Juneau District 1108 "F" Street, STE 130 Juneau, AK, 99801	(907) 465-8749
Alaska Cooperative Extension Service, UAF Anchorage District 2221 E Northern Lights Blvd, STE 118, Anchorage, AK, 99508-4143	(907) 786-6300
Alaska Department of Fish and Game Habitat and Restoration – Region 1 802 3rd Street P.O. Box 240020 Douglas, AK 99824-0020	(907) 465-4290
Alaska Department of Fish and Game Habitat and Restoration – Region 2 333 Raspberry Road Anchorage, AK 99518-1599	(907) 267-2285
Alaska Department of Fish and Game Habitat and Restoration – Region 3 1300 College Road Fairbanks, AK 99701-1599	(907) 459-7289

ALDER (Alaska Land-use Decision-makers Education Resource) Cooperative Extension Service University of Alaska Fairbanks 2221 E. Northern Lights Blvd - #118 Anchorage, AK 99508	(907) 786-6300
Bureau of Land Management 222 W. 7th Avenue #13 Anchorage, AK 99513	(907) 271-5076
Department of Natural Resources General Statewide Information DNR Public Information Center 550 West 7 Th Ave., Suite 1260 Anchorage, AK 99501	(907)269-8400
Department of Natural Resources - Juneau 400 Willoughby Avenue Juneau, AK 99801-1796	(907) 465-4563
Department of Environmental Conservation 410 Willoughby Ave., Suite 105 Juneau, AK 99801	(907) 465-5350
Division of Governmental Coordination (Anchorage) 550 West 7th Avenue - Suite 1660 Anchorage, AK 99501	(907) 269-7470
Division of Governmental Coordination (Juneau) 240 Main Street, P.O. Box 110030 Juneau, AK 99811-0030	(907) 465-3562
EPA – Alaska Ops Office (Anchorage) Federal Bldg. Room 537 222 W 7th Avenue #19 Anchorage, AK 99513-7588	(907) 271-3424
EPA – Alaska Ops Office (Juneau) 410 Willoughby Avenue Suite 100 Juneau, AK 99801-1795	(907) 586-7015

EPA - Region 10 1200 6th Ave. Seattle, WA. 98101	(206) 553-1200 or 1-800-424-4372
Fairbanks North Star Borough 809 Pioneer Road P.O. Box 71267-1267 Fairbanks, Alaska 99701	(907) 458-1000
Federal Aviation Administration 222 West 7th Ave., #14 Anchorage, AK 99513	(907) 271-5646
Federal Energy Regulatory Commission Regional Director 101 S. W. Main Street Suite 905 Portland, OR 97204	(503) 326-5840
Kenai Peninsula Borough 144 N. Binkley Soldotna, Alaska 99669	(907) 262-4441
Kenai River Center 514 Funny River Road Soldotna AK 99669	(907) 260-4882
Matanuska-Susitna Borough 350 E. Dahlia Avenue Palmer, Alaska 99645	(907) 745-4801
Municipality of Anchorage Office of Planning, Development Services, and Public Works 4700 South Bragaw Anchorage, Alaska, 99507	(907)-343-8160
Plant Materials Center DNR - Division of Agriculture HC04 Box 7440 Palmer, AK 99645	907-745-4469
U. S. Coast Guard P.O. Box 25517 Juneau, AK 99802	(907) 463-2025

U. S. Forest Service Chugach National Forest 3301 C Street, Suite 300 Anchorage, AK 99503	(907) 271-2500
U. S. Forest Service Tongas National Forest P.O. Box 21628 Juneau, AK 99802	(907) 586-8863
U.S. Army, Corps of Engineers Regulatory Branch P.O. Box 898 Anchorage, AK 99506-0898	(907) 753-2720 or 1-800-478-2712

USEFUL WEB SITES

ADF&G – H&R Fish Habitat and Special Areas Permits/Forms	http://www.state.ak.us/local/akpages/FISH.GAME/habitat/geninfo/permitforms/permitforms.htm
ADF&G – Habitat and Restoration	http://www.state.ak.us/local/akpages/FISH.GAME/habitat/hab_home.htm
ADF&G Wildlife Notebook Series	http://www.state.ak.us/local/akpages/FISH.GAME/notebook/notehome.htm
Anadromous Waters Catalog and Atlas	http://www.state.ak.us/local/akpages/FISH.GAME/habitat/geninfo/anadcat/anadcat.htm
Alaska Coastal Management Program - DGC	http://www.gov.state.ak.us/dgc/index.html
Anchorage Waterways Council	http://www.anchwaterwayscouncil.org/
Canada: Factsheet for culvert installations	http://www.nwafc.nf.ca/sealane/References/factsheets/fact26.htm
Coastal Project Questionnaire Form	http://www.gov.state.ak.us/dgc/Projects/projects.html
Cook Inlet Keeper	http://www.inletkeeper.org/
DGC	http://www.alaskacoast.state.ak.us
DGC - Alaska Coastal Review Program – Project Review process	http://www.gov.state.ak.us/dgc/Projects/projects.html
EPA – Adopt your Watershed Program	http://www.epa.gov/adopt/
EPA – Beneficial Landscaping Resources in the Northwest and Alaska	http://yosemite1.epa.gov/R10/ECOCOMM.NSF/Blstartpage?OpenPage
EPA – River Corridor and Wetlands Restoration	http://www.epa.gov/owow/wetlands/restore/
EPA Region 10 (Pacific NW & Alaska) Beneficial Landscaping	www.epa.gov/r10earth/bl.htm
Fairbanks North Star Borough	http://www.co.fairbanks.ak.us/

Guidelines for Salmonid Habitat Protection and Restoration, Washington Dept. of Fish and Wildlife - Habitat	http://www.wa.gov/wdfw/hab/salguide/weblinks.htm#strmbank
International Erosion Control Association	http://ieca.org/
Kenai Peninsula Borough	http://www.borough.kenai.ak.us/
Kenai River Center	http://www.borough.kenai.ak.us/KenaiRiverCenter/
Layfield Plastics Geomembranes	www.geomembranes.com
Matanuska-Susitna Borough	http://www.co.mat-su.ak.us/
North American Lake Management Society	http://www.nalms.org/
Oregon Watershed Enhancement Board (Publications in pdf files)	http://www.oweb.state.or.us/
Stream corridor restoration - principles, practices, and processes.	http://www.usda.gov/stream_restoration/ or, http://www.nhq.nrcs.usda.gov/BCS/PMC/pubs/IDPMCpubs-sbg.html
Streambank revegetation and protection techniques	http://www.state.ak.us/local/akpages/FISH.GAME/habitat/geninfo/webpage/techniques.htm
The Bioengineering Group	http://www.bioengineering.com/
The Coastal Project Questionnaire Form	http://www.gov.state.ak.us/dgc/Projects/pcpq.html
The practical streambank bioengineering guide	http://www.nhq.nrcs.usda.gov/BCS/PMC/pubs/IDPMCpubs-sbg.html
USFWS – Partners for Fish and Wildlife	http://partners.fws.gov/index.htm
Washington DFW, Fish Passage Design at Road Culverts, A design manual for fish passage at road crossings, 1999	http://www.wa.gov/wdfw/hab/engineer/cm/toc.htm
Wisconsin Lakes Partnership Program	http://www.dnr.state.wi.us/org/water/fhp/lakes/

GLOSSARY

ACMP	Alaska Coastal Management Program
ADEC	Alaska Department Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
Anadromous	Fish which migrate from the sea, where they grow and mature, into freshwater where they spawn.
Anadromous Waters Catalog and Atlas	Listing of “various rivers, lakes and streams or parts of them" of the state that are important for the spawning, rearing or migration of anadromous fishes.
Bedload	Sediment particles moving over or near the stream bed
Berm	Narrow shelf or small dike placed on a slope to protect an adjacent area
Bioengineering	Use and encouragement of living plant materials to control erosion
Bioengineering	Method of integrating living plant materials with inorganic and organic materials to increase the strength and integrity of soil.
BLM	U.S. Bureau of Land Management
Buffer	Area of vegetation that is maintained around a water body to protect against impacts from the uplands and provide cover for animals that live on the edge
COE	U. S. Army, Corp of Engineers
Coir log	Log-like structure made from interwoven coconut fibers that are bound with coarse biodegradable netting; designed to biodegrade with time
Cover	Anything that provides protection or refuge from predators or adverse conditions
Debris	Miscellaneous scattered or accumulated material; may originate from natural or human source
Deposition	Settlement of materials out of the water column and onto the stream bottom

DGC	Alaska Division of Governmental Coordination
Diversity	Numbers of plants or animals in a community
Ecology	Study of living organisms in their environment
Ecosystem	A community including plants, animals, microorganisms and their non-living environment which interacts with each other
EPA	U.S. Environmental Protection Agency
FAA	U.S. Federal Aviation Administration
Facine	Bundle of dormant cuttings used for bioengineering
FERC	Federal Energy Regulatory Commission
Fish-friendly	Activities which will protect, improve or rehabilitate fish habitat
Geotextile	A textile that is used with soil, rock or earth for added stability or protection
H&R	Habitat and Restoration Division (of ADF&G)
Habitat	Place where a plant or an animal lives which provides life functions, including reproduction, food, escape, and migration
Large organic/ woody debris	Relatively large piece of stable, woody material that intrudes into a water body; complex or irregular woody debris is better for fish
MSB	Matanuska-Susitna Borough
Reach	A specified homogeneous length of a stream
Redd	Pit-like nest dug in the gravel of a stream bottom by a female fish where eggs are laid, fertilized by the male and re-covered with gravel
Revetment	Vertical or sloping facing of erosion-resistant material to protect a soil surface from erosion
Riparian	Of, on, or relating to the banks of a natural course of water; area or zone that is between the aquatic and upland areas; may be periodically flooded
Riprap	Layer of large material – usually rock – placed on a bank to protect it; or, the material itself

Root wad	Tree trunk (bole) with the root fan attached
Sediment	Material weathered from rocks or decomposition of organic material and transported by water or air; or, deposited from water or air or accumulated on a substrate
Setback	Prescribed distance from the edge of a water body where structures may not be placed. Setbacks provide space for buffers.
Substrate	Material on the bottom of a water body
Thalweg	Longitudinal line along a stream bottom that follows the deepest part of the channel
USCG	U.S. Coast Guard
USFS	U.S. Forest Service
Watershed	Land area that surrounds interconnected water bodies
Wetland	Area that may be flooded periodically; usually, with soil or vegetation characteristics different from adjoining non-flooded areas

BIBLIOGRAPHY AND SOURCES OF INFORMATION

(This list is not all-inclusive. It is merely a place to start.
My apologies for those that were missed.)

Information Source	Comment
ADF&G. 1999. **Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes.** ADF&G – H&R.	Official list of anadromous waters
ADF&G and ADNR. 1992. **Field guide for streambank revegetation.** 16p.	Handy, quick guide
ADNR. 1993. **Directory of Alaska native plant sources**. Alaska Department of Natural Resources, Plant Materials Center, HC02 Box 7440, Palmer, AK 99645	Lists of suppliers of plants, revegetation consultants & contacts
Bentrup, G. and J. Hoag. 1998. **The practical streambank bioengineering guide**. USDA Natural Resources Conservation Service. Plant Materials Center. Aberdeen, Idaho. 165p.	Good descriptions; for Great Basin; also on web site
Bureau of Land Management. 1989. **Placer mining in Alaska, a guide to mitigation and reclamation**. Publication BLM-AK-GI-021-3809-918. Bureau of Land Management, 222 West 7th, #13, Anchorage, AK 99513. 51p.	Pamphlet with basic information
Canada: **Factsheet for culvert installations**. http://www.nwafc.nf.ca/sealane/References/factsheets/fact26.htm	Design and installation
Desbonnet, A., P. Pogue, V. Lee, and N. Wolff. 1994. **Vegetated buffers in the coastal zone, a summary review and bibliography**. Coastal Resources Center, Rhode Island Sea Grant, University of Rhode Island. Publication RIU-T-93-001. 71p.	Technical review; many references
Federal Interagency Stream Restoration Working Group (FISRWG). 1998. **Stream corridor restoration - principles, practices, and processes**. U.S. Department of Agriculture.	Much detail; professional level; also on web site
Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 1998. **California salmonid stream habitat restoration manual**. Third edition, State of California. The Resources Agency. California Department of Fish and Game. Inland Fisheries Division. Sacramento, CA.	Good diagrams; intended for big projects

Information Source	Comment
Henderson, C., C. Dindorf, and F. Rozumalski. 1999 (?). **Landscaping for wildlife and water quality**. State of Minnesota. Department of Natural Resources. 176p.	Good for lakes
Hughes, D. 2000. **Kenai River rehabilitation and protection program. Final Report**. Alaska Department of Fish and Game. Habitat and Restoration Division. Region II. Anchorage, Alaska. 25p.	Summary of Kenai River streambank projects
Hunt, R. 1992. **Evaluation of trout habitat improvement structures in three high-gradient streams in Wisconsin**. Wisconsin DNR Tech. Bull. 179. 42p.	Technical; good evaluation; good illustrations
Hunter, C. 1991. **Better trout habitat. A guide to stream restoration and management**. Montana Land Reliance. Island Press. Washington, D.C. 321p.	Good information, for lay and professionals
Hynson, J., P. Adamus, S. Tibbetts and R. Darnell. 1982. **Handbook for protection of fish and wildlife from construction of farm and forest roads**. U.S. Fish and Wildlife Service. Biological Services Program. Publication FWS/OBS-82/18. 154p.	To assist permitting agencies with best management practices
Izaak Walton League of America. 1989. **Save our streambanks: a survey of methods**. Izaak Walton League of America, 1401 Wilson Blvd., Level B, Arlington, VA 22209. 23p.	Pamphlet with basic information
Keown, M. 1983. **Streambank protection guidelines… for landowners and local governments**. U.S. Army Engineers Waterways Experiment Station. Vicksburg, Mississippi. 60p.	For local governments and landowners; good illustrations
Liepitz, G. 1994. **An assessment of the cumulative impacts of development and human uses on fish habitat in the Kenai River**. Technical Report 94-6. Alaska Department of Fish and Game, Habitat and Restoration Division. Anchorage, Alaska.	Kenai River habitat study
Muhlberg, G. and N. Moore. 1998. **Streambank revegetation and protection a guide for Alaska**. Alaska Department of Fish and Game. Division of Habitat and Restoration. Technical Report No. 98-3. 58p.	Excellent guide
Owens, P., J. Duffy, L. Finney and B. Grantland. 1998. **A property owners guide to shoreline landscaping in the Matanuska-Susitna Borough**. Department of Planning. Matanuska-Susitna Borough. 350 E. Dahlia Avenue. Palmer, AK. 19p.	Background and planning for Matanuska-Susitna Valley

Information Source	Comment
Rosgen, D. 1996. **Applied River Morphology**. Wildland Hydrology. Pagosa Springs, CO.	Excellent textbook
Seehorn, M. 1985. **Stream habitat improvement handbook**. USDA Forest Service, Southern Region. Tech. Pub. R8-TP 16. 30p.	Excellent illustrations
Soil Conservation Service. 1992. **Kenai River landowner's guide**. U.S. Department of Agriculture. Soil Conservation Service.	Excellent information about Kenai River
Trow Consulting Engineers Ltd. 1996. **Instream sediment control techniques field implementation manual.** Queens Printer for Ontario. Ontario, Canada. 93p.	For field crews, contractors, agencies and consultants
Washington Department of Fish and Wildlife. 1999. **Fish passage design at road culverts**. Available from: http://www.wa.gov/wdfw/hab/engineer/cm/toc.htm	Mostly for engineers & hydrologists
Weiss, Edward W., et al. In progress. **An inventory of the development and fisheries resources in the Cottonwood Creek drainage, Matanuska-Susitna Valley, Alaska.** Alaska Department of Fish & Game, Habitat & Restoration Division, Anchorage, Alaska.	Assessment

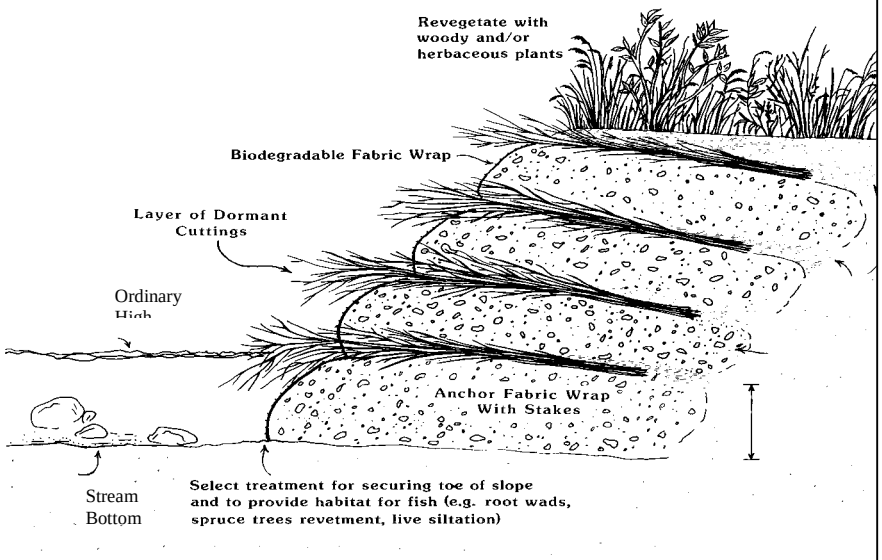
INFORMATION SHEETS

This section provides more detailed information about techniques listed in the METHODS section. Items are arranged alphabetically. Each sheet includes introductory information, a diagram, some description and sources for more information. The information is not intended to be definitive or comprehensive, but these will help you to understand the application and complexity of the method. There is a separate information sheet for the following:

- Brush Layering
- Brush Mat
- Coir Logs
- Elevated, Light-penetrating Walkway
- Erosion Control Fabric
- Floating Dock
- Grass Rolls
- Hedge Brush Layering
- Landscaping
- Live Bundle (Fascines)
- Live Siltation
- Live Staking (Dormant cuttings)
- Livestock Fencing
- Planning
- Revegetation by Transplanting
- Root Wads
- Silt Fence
- Spruce Tree Revetment
- Stream Crossing – Culverts
- Structure Setback
- Timing (a)
- Timing (b) - Generalized schedule of life-history events for salmon and trout in southcentral Alaskan drainages
- Vegetated Cribbing
- Vegetative Buffer

Brush Layering – Information Sheet

Useful for:	Rehabilitate, stabilize and revegetate a bank or slope
Benefits to fish:	Provides temporary stability and fish habitat until the revegetation can provide permanent fish habitat
Benefits to you:	Stable slope or bank with riparian vegetation



Information is from: Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:
- Bentrup and Hoag. The practical streambank bioengineering guide
- ADF&G – H&R

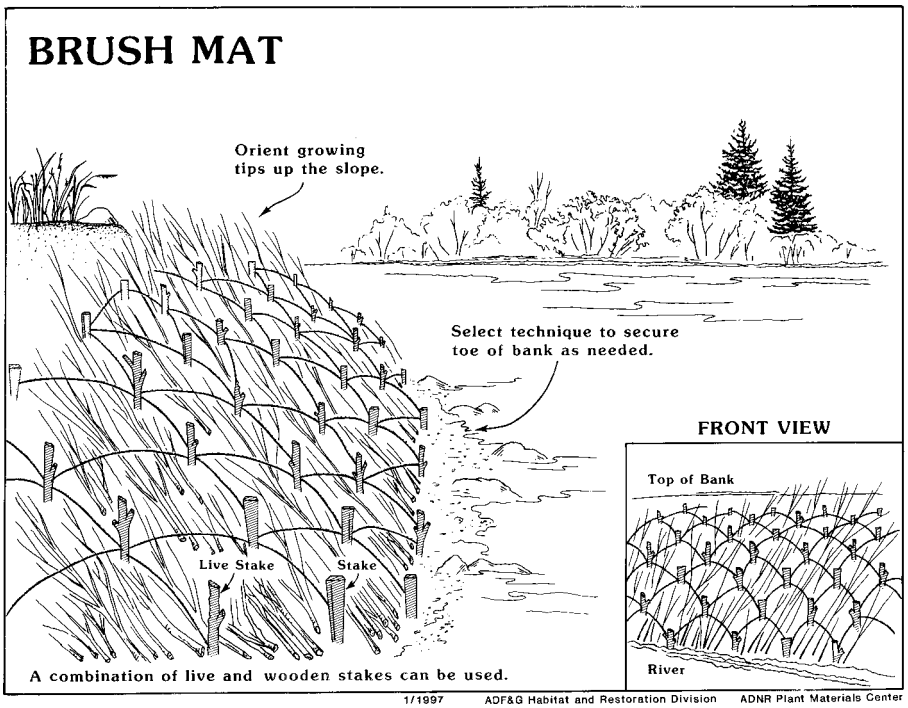
Brush layering is a revegetation technique which combines layers of dormant cuttings with soil to revegetate and stabilize slopes. It is one of the best techniques for this task. Living and non-living brush layers provide fish habitat. Branches are placed on horizontal benches that follow the contour of the slope to reinforce the soil. Steep slopes may require a biodegradable revegetation fabric to hold the soil until the dormant cuttings are rooted. More stability is provided from grass seeding. Brush installed below the ordinary high water (OHW) probably will not survive but this is instant, temporary fish cover.

Use a technique (e.g., live siltation) to secure the toe of the slope. Begin layering at the bottom of the slope at OHW but a layer below OHW creates fish habitat and temporary cover.

Excavate a bench 2 to 3 feet deep so that it angles slightly down and into the slope. Branches are placed on the bench, slightly crisscrossed with the tips extending out of the bench no more than 1/4 their total length. Place soil over the branches and tamp. A revegetation fabric is often used over the soil, anchored by wooden stakes. Repeat the layering process until the desired bank height is reached.

Brush Mat – Information Sheet

Useful for:	Prevent erosion on barren slopes until vegetation can become established
Benefits to fish:	Prevents erosion and deposition of sediment; temporary stabilization of the streambank
Benefits to you:	Temporary stabilization of slope until vegetation becomes rooted



Information & illustration from:
Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:
- Bentrup and Hoag. The practical streambank bioengineering guide
- FISRWG, Stream corridor restoration
Flosi, et al., California salmonid stream habitat restoration manual
- ADF&G – H&R

A brush mat is a revegetation technique that provides a protection to a slope as soon as it is installed. The mat can be constructed with dormant branches of willows and poplar that will root and grow or with any brushy, woody branches to protect the slope from erosion. A brush mat is often combined with other revegetation and/or protection techniques which are used to secure the toe of the slope; e.g., root wads, live siltation, coir logs and spruce tree revetments.

A brush mat is superior to an erosion control fabric because the network of branches is more effective in slowing or preventing erosion. The brush mat materials may grow and provide cover, and the small pockets between overlapping branches trap native seeds and allow them to germinate and grow. During high water, a brush mat traps sediments and eventually the plant growth on the stabilized streambank will provide fish habitat.

Brush mats require large quantities of plant material and the availability of plant material should be carefully evaluated in your planning. Install branches close together, slightly crisscrossed, flat on the bank and perpendicular to the water. The large end is placed at the toe of the slope. Add branches until the soil surface is covered. Brush mats can be installed over rooted plants and live stakes that are planted on a slope. The completed mat will be approximately 4 inches thick. Stake the mat in place with live or dead stakes on 3-foot centers and biodegradable twine or rope in a criss cross pattern; then, drive the stakes deeper to pull the branches tightly against the soil. Add soil over the mat to encourage rooting. A light seeding of grass may help prevent/reduce the loss of topsoil.

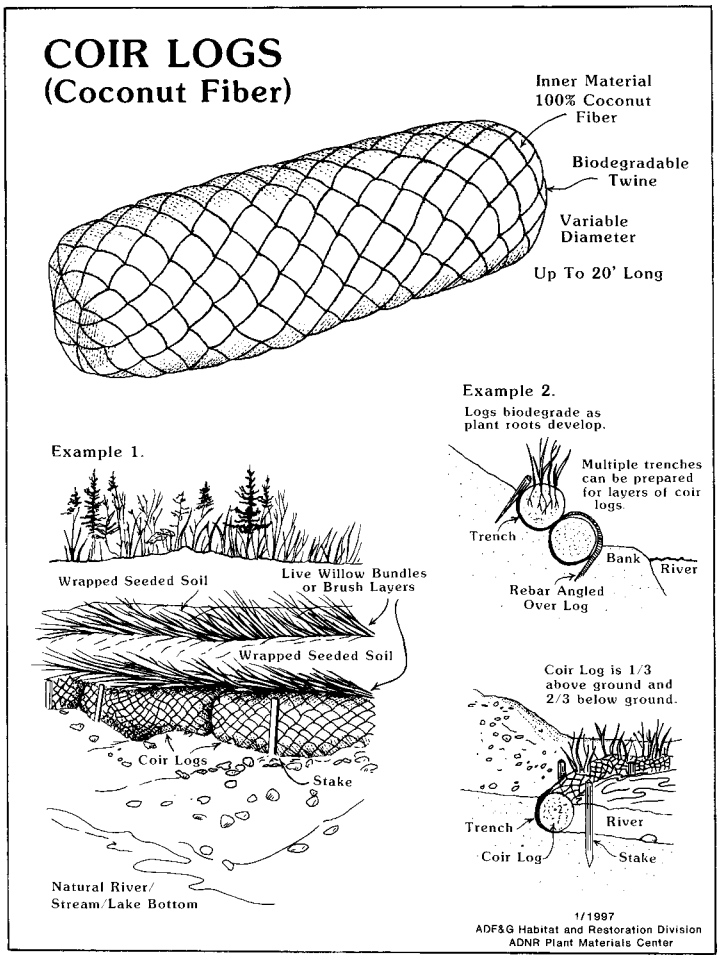
Coir Logs – Information Sheet

Useful for:	Provide immediate, temporary protection to a slope to allow vegetation to establish
Benefits to fish:	Stabilize a bank and reduce erosion and sediment deposition
Benefits to you:	Provides bank stability until vegetation can take over

Coir logs are made from interwoven coconut fibers bound together with biodegradable netting. These are commercially produced in various site-specific sizes. Fiber logs made from other biodegradable materials may also function well.

Uses for coir logs occur in many wetland and upland bank environments. The log provides temporary physical protection to a site while vegetation becomes established. The logs can provide a substrate for plant growth, protect plants adjacent to the log, transition from one revegetation technique to another, and secure the toe of a slope. Both the upstream and downstream ends need to transition smoothly into a stable bank to reduce the potential to wash out.

Install the logs to ensure contact with soil along the entire length. Usually, make a shallow trench to partially bury the log. The coir log span should never span open space between rocks, logs or uneven ground. Tie adjacent logs together and stake. Flowing water, especially during breakup, disturb the log if it is not secure. Wooden stakes, curved rebar and earth anchors have been used to anchor these logs successfully. Sod or sprig coir logs when they are placed in locations that will provide adequate moisture for plant growth. Small holes can be created in the surface of the logs and sprigs, or small plugs of suitable plant species can be transplanted into the log.



Information and illustration from: Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:

- Bentrup and Hoag. The practical streambank bioengineering guide
- ADF&G – H&R

Elevated, Light-penetrating Walkway – Information Sheet

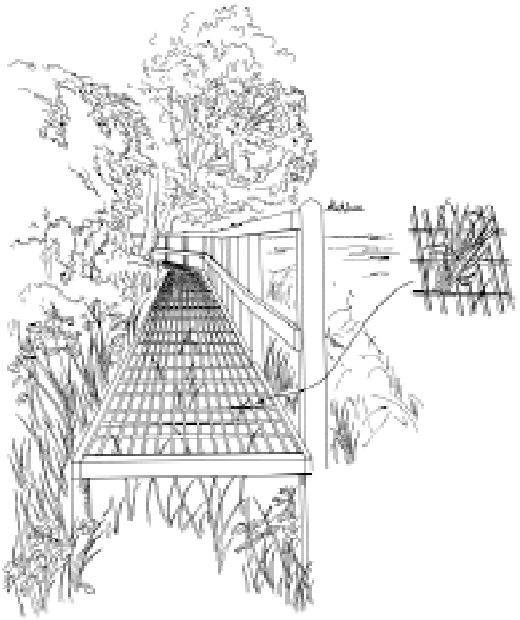
Useful for:	Provide access to waterbodies across vegetated riparian areas without harming the vegetation
Benefits to fish:	Maintains the integrity and function of the riparian areas; sustains riparian fish habitat
Benefits to you:	Convenient access to water, fishing and boats; less lawn to maintain means that you have more time for fishing

Elevated, light-penetrating walkways are a protection technique which provides access while protecting riparian habitat. Walkways should be constructed in a manner which allows riverbank vegetation to grow unimpeded.

Materials: Walkways can be constructed of a variety of materials; expanded metal, aluminum, fiberglass, and wood.

Construct walkways to protect the integrity of the existing riverbank. If it is necessary to drive posts into the bank for walkway support, care should be taken to avoid placing posts too close to the edge of the bank. Walkways can be placed on above-ground supports, such as the tripod.

- Avoid handrails when possible to reduce barriers to wildlife movement.
- Stairs or ladders can easily be attached to elevated, light-penetrating walkways to provide access into lakes or streams.
- Floating docks can be connected to walkways to provide boating access.
- Walkways can be cantilevered over a river. This will provide good fishing access and protect riparian habitat.

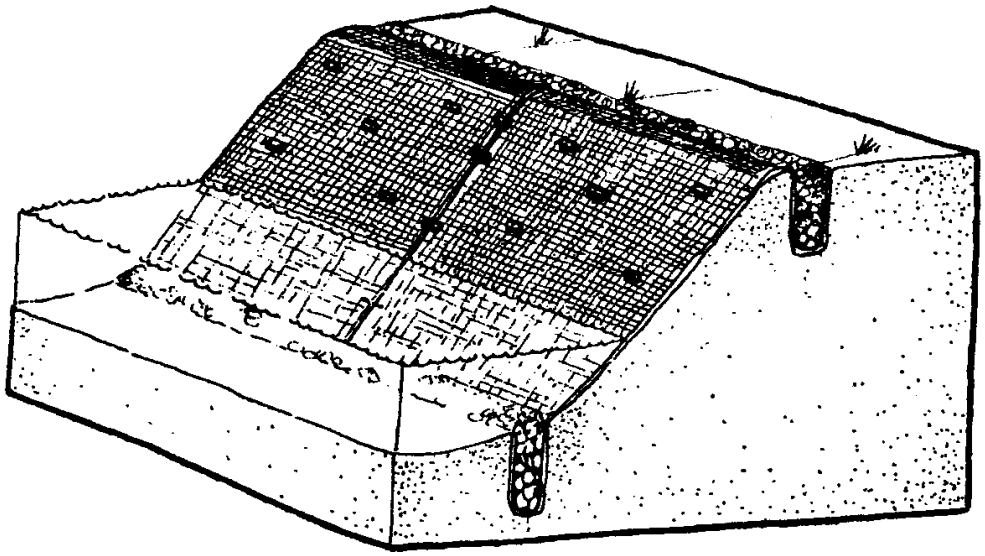


Information and illustration from:
Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:
- ADF&G – H&R
- Kenai River Center

Erosion Control Fabric – Information Sheet

Useful for:	Prevent erosion on barren slopes until vegetation can become established
Benefits to fish:	Prevents erosion and deposition of sediment; temporary stabilization of the streambank
Benefits to you:	Temporary stabilization of slope until vegetation becomes rooted



Information and illustration from: Bentrup and Hoag, The Practical Streambank Bioengineering Guide

Erosion control fabrics are commercially-available products that can be used to prevent erosion on slopes until vegetation can become established to stabilize the slope. Erosion control fabrics are constructed from a variety of materials such as coconut fiber, jute and straw mulch encased in plastic netting. A tightly-woven coconut fiber blanket is a good durable option for applications on streambanks.

Erosion control fabrics cannot be used alone. Dormant cuttings, and transplanted herbaceous mats, plugs and sprigs can be planted through the fabric and seeds can be spread underneath the fabric. It is important to have well-established vegetation by the time the erosion control fabric decomposes in several years and the fabric must be properly installed, anchored and maintained until the vegetation can stabilize the streambank on it's own.

For more information:
- FISRWG, Stream corridor restoration
- ADF&G – H&R

Floating Dock – Information Sheet

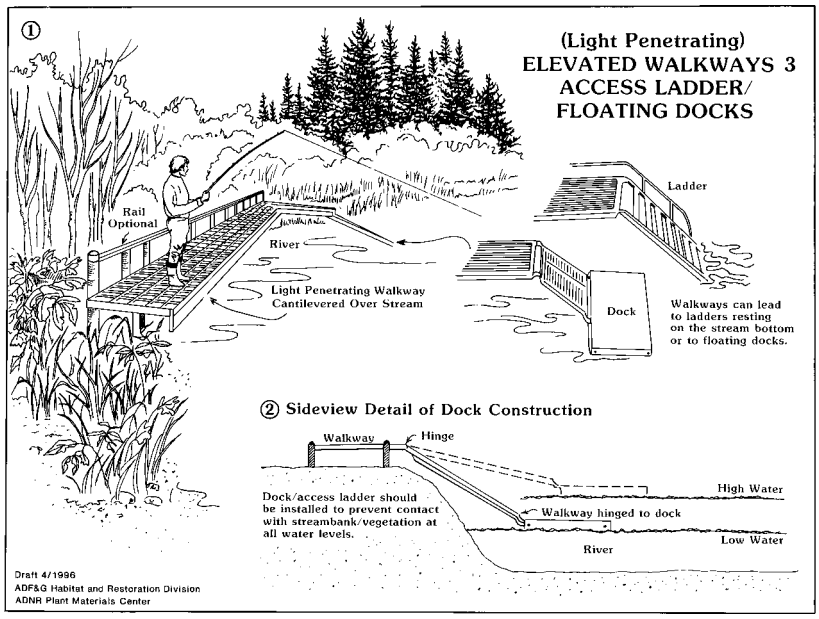
Useful for:	Providing access to the water
Benefits to fish:	Minimizes or avoids damage to the bank of the waterbody; retains integrity of an intact riparian area
Benefits to you:	Allows easy access to the water and boarding your boat

A floating dock improves access for loading and unloading your boat and is a great platform to fish from. It is good for the fish, too. When you access your boat directly from shore, you create a break in the shoreline. This leads to erosion and disturbance of the riparian vegetation.

There are many commercially-available sources for materials to build a floating dock. The best idea is to design and incorporate it directly into an elevated, light-penetrating walkway.

An alternate method that may create a more stable platform is to drive piles to support the dock. Either way, the idea is to access your boat and the water without destroying the shore vegetation that is so important to the fish.

Stairs or ladders can be attached to elevated, light-penetrating walkways to access floating docks



Information and illustration from:
Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:
- ADF&G – H&R
- Kenai River Center

Grass Rolls – Information Sheet

Useful for:	Revegetate denuded areas where simply seeding will not work
Benefits to fish:	Re-establish riparian vegetation and reduce or eliminate sediment runoff
Benefits to you:	Re-establish vegetation and simultaneously provide bank stability

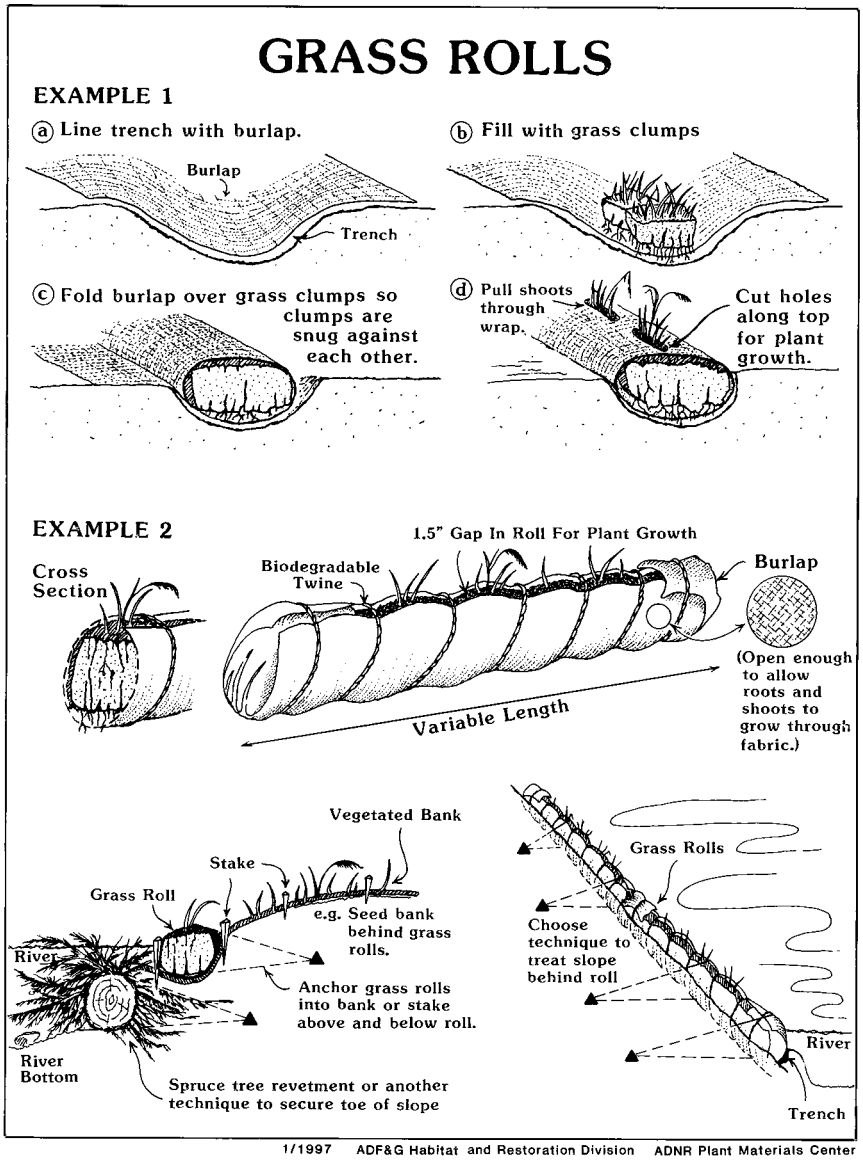
Grass rolls are often used to revegetate shorelines and banks where grasses and grass-like plants have been lost and where seeding is impractical due to fluctuating water levels or other conditions. Clumps of sod are placed tightly together, with shoots pointing up, in a sausage like structure which is bound with burlap and twine and the roll is anchored in place. This technique reintroduces herbaceous vegetation while providing some structural stability. Ultimately, a dense root system will form for structural protection to the site. The leaves hang over the water to provide rearing habitat for fish.

Construct a grass roll by laying out a length of burlap; place clumps of sod tightly together in the middle of the burlap. Bluejoint reedgrass is the primary grass used and it should be collected away from the banks. Other grasses may not form the dense sod characteristic of Bluejoint.

Wrap the sides of the burlap over the sod clumps to make a sausage-like roll. Tie the roll every few inches with twine. Cut holes in the burlap to expose the shoots. Create the roll onsite so that the length of the roll or rolls match the length of the area being planted.

Install the sod roll in a shallow trench along the ordinary high water level after the toe of the slope has been protected. Anchor the grass roll securely. Stakes may be adequate for anchoring a grass roll in low-energy environments such as protected lakeshores. Revegetate adjacent areas, too. Both the upstream and downstream ends of the grass roll need to transition smoothly into a stable bank, or vegetation.
Grass rolls can also be used for wetland revegetation with sedges or grass.

Grasses and sedges are particularly sensitive to foot traffic and should be protected by elevated walkways or planted in areas with restricted access for better survival.



Information and illustration from:
Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:
- ADF&G – H&R

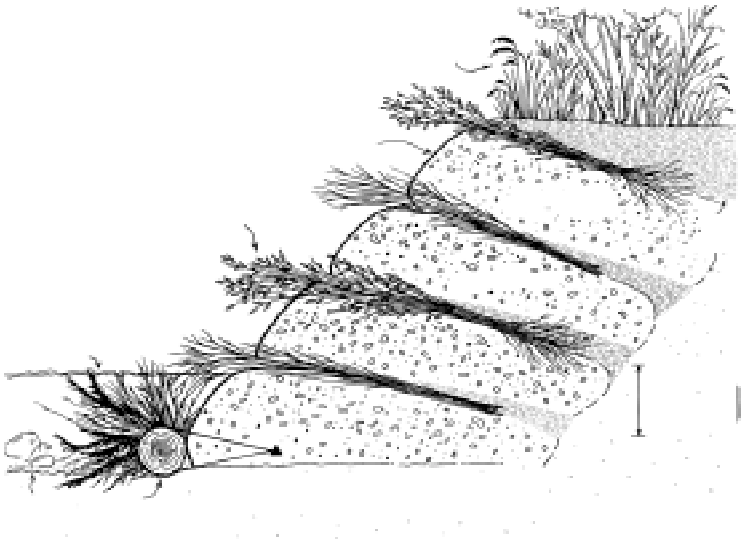
Hedge-Brush Layering – Information Sheet

Useful for:	Rehabilitate, stabilize and revegetate a bank or a slope
Benefits to fish:	Provides temporary stability and fish habitat until the revegetation can provide permanent fish habitat
Benefits to you:	Stable slope or bank with riparian vegetation

Hedge brush layering is a variation of brush layering (see Brush Layering) but this technique combines layers of both dormant cuttings and rooted plants with soil to revegetate and stabilize a streambank. Greater plant diversity can be provided with a hedge brush layer than with a simple brush layer. Rooted plants that do not root readily, such as alder, scouler and bebb willow, can be included. A mixture of species may allow the revegetation project to blend with existing vegetation.

Branches and transplants are placed on horizontal benches that follow the contour of the slope and provide reinforcement to the soil. The transplants will add stability quickly as their roots become anchored. Relatively steep slopes can be stabilized with this technique if a biodegradable revegetation fabric is used to hold the soil in place between the plant layers. The front of the wrapped soil layer can be lightly seeded with grasses to increase soil stability while the woody plants become established. Overhanging branches provide fish habitat.

Choose a technique to secure the toe of the slope and follow the layering method of Brush Layering with alternating layers of plants and soil.



Information and illustration from:
Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:

- Bentrup and Hoag. The practical streambank bioengineering guide
- FISRWG, Stream corridor restoration
- Soil Conservation Service, Kenai River landowner's guide
- ADF&G – H&R
- Kenai River Center

Landscaping – Information Sheet

Useful for:	Creating a pleasant environment for people that does not harm fish habitat
Benefits to fish:	Minimizes damage to riparian vegetation
Benefits to you:	Use and enjoy your property and minimize maintenance activities and costs

Part of your property development plan will include landscaping. One way to cut costs of development and maintenance that is also beneficial to the fish is to leave most of the native plants along the shore. You may want to do some thinning or pruning and allow some access, but the fish and other wildlife depend on that vegetation. You will have less grass to mow, less fertilizer to buy and more time to enjoy the view or go fishing.

The best approach is to build your landscape plan before you develop the property, but if you already have a big open lawn, consider transplanting native trees, bushes and herbs –– especially along the shore. You may lose some of your view, but your property value will probably increase and your view will improve because you will have more variety and more colors that change with the seasons along with more wildlife.

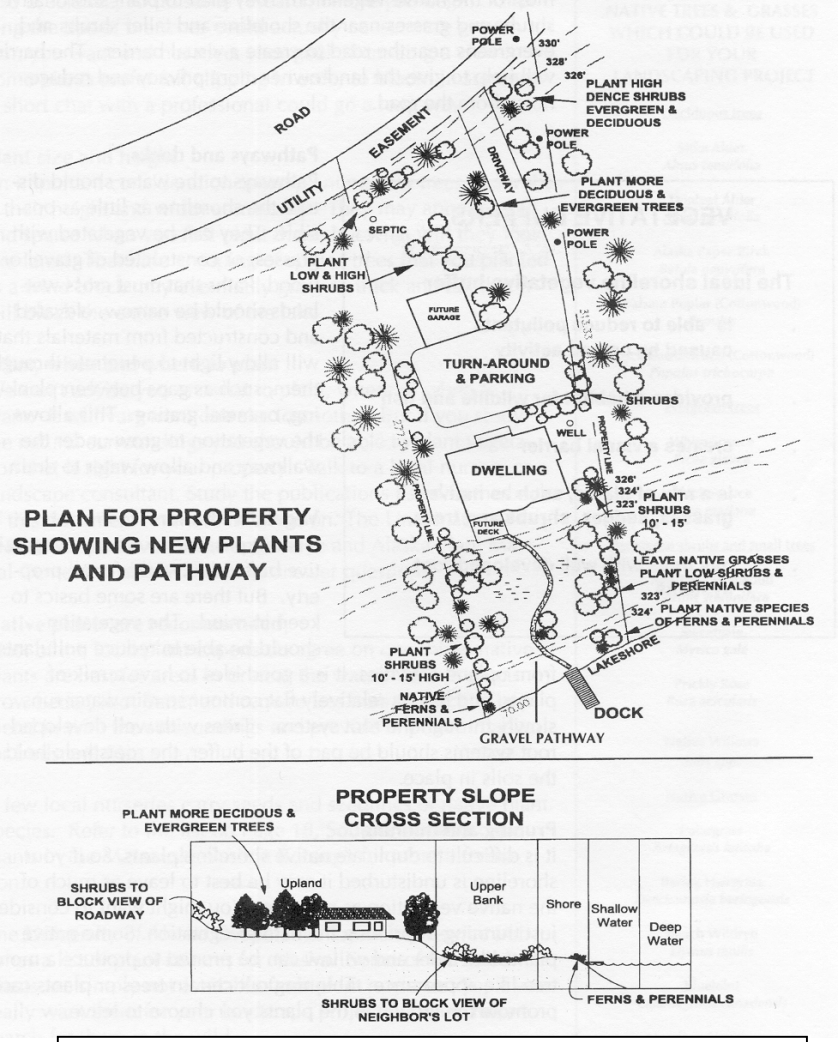


Illustration is from: Owens, Duffy, Finney and Grantland, A Property Owners Guide to Shoreline Landscaping in the Matanuska-Susitna Borough

For more information:

- Henderson, Dindorf, and Rozumalski, Landscaping for wildlife and water quality
- Soil Conservation Service, Kenai River landowner's guide
- ADF&G - H&R

Live Bundle (Fascines) – Information Sheet

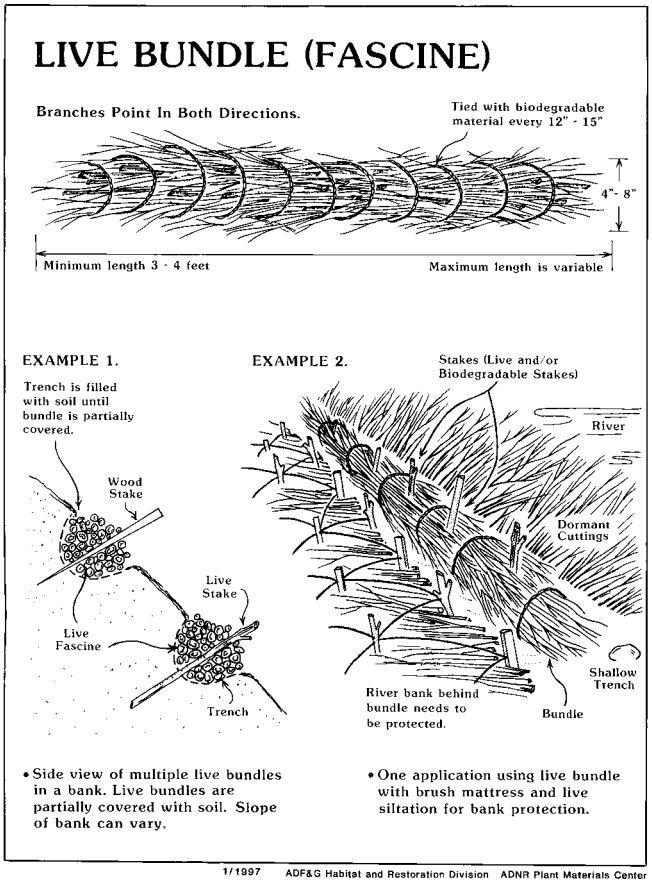
Useful for:	Quickly establish revegetation to stabilize slopes; often used with other techniques
Benefits to fish:	Vegetation stabilizes the shore, reduces siltation, provides shade and woody debris falls into the water
Benefits to you:	Easy technique; quick results; inexpensive; hand labor

Live bundles, or Fascines, are a group of dormant branches bound together to create a log-like structure that will root, grow, and provide plant cover quickly. The bundle is used to revegetate and stabilize slopes, secure the toe of banks or provide a transition from one revegetation technique to another (e.g., a brush mat to a live siltation). Bundles are planted in shallow trenches and provide immediate physical protection to a site before plant growth begins. Bundles create spaces that collect native seeds and water.

Tie several dormant branches 1/2 to 1 1/2 inches in diameter together with cut ends in opposite directions to create a bundle about 4 or more inches in diameter. It is tied with biodegradable twine, approximately every 1 to 2 feet to any length by overlapping branches as the bundle is formed.

Install bundles by placing them in a shallow horizontal trench, approximately 3 inches deep for a 4 inch diameter bundle. Anchor with long stakes or live willow stakes through the bundle. Cover at least half of the diameter of the bundle with soil.

Place bundles end to end or overlapping to form a continuous planting around the contour of the slope. Plant in single or multiple rows or in a staggered pattern to reduce the erosion potential of a site.



Information and illustration from: Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:

- Bentrup and Hoag. The practical streambank bioengineering guide
- FISRWG, Stream corridor restoration
- Soil Conservation Service, Kenai River landowner's guide
- ADF&G – H&R

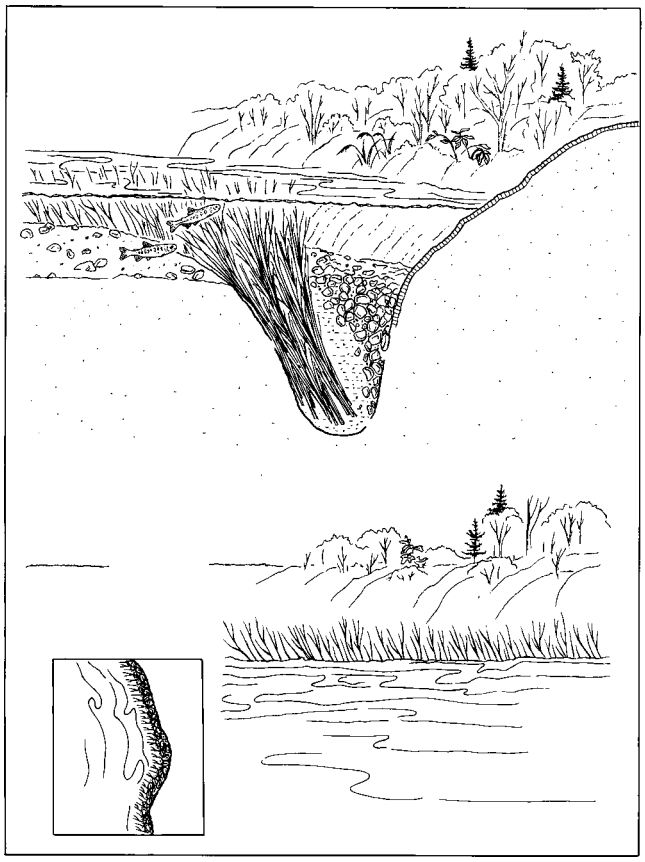
Live Siltation – Information Sheet

Useful for:	Establish woody brush cover to secure the toe of a slope, trap sediments and create instant fish habitat. Often used with other techniques.
Benefits to fish:	Stable shoreline reduces erosion and siltation; woody vegetation provides shade and in-water cover habitat
Benefits to you:	Easy technique; quick results; inexpensive; hand labor

Live siltation is a revegetation technique to secure the toe of a slope, trap sediments and create fish rearing habitat. The system can be constructed as a living or a non-living system at the water's edge. This technique is particularly valuable for providing immediate cover and fish habitat while other revegetation plantings become established.

The dormant branches need to be at least 3 feet long with side branches still attached. If a living system is planned, Feltleaf, Pacific or Sitka willow is recommended but any woody plant material; e.g., alder, can be used for a non-living system.

Construct a 2 foot deep, V-shaped trench at the ordinary high water (OHW) level, parallel with the toe of the bank. Lay a thick layer of willow branches in the trench with 1/3 of their length above the trench. Angle branches outward with at least 40 branches per yard. Backfill with a gravel-soil mix and secure the surface with large washed gravel. Both ends of the live siltation construction need to transition smoothly into a stable streambank. More than one row of live siltation can be installed. A living and growing siltation system typically is installed at OHW but a non-living system can be constructed below OHW.



Information and illustration from:
Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:
- Bentrup and Hoag. The practical streambank bioengineering guide
- ADF&G – H&R
- Kenai River Center

Live Staking – Information Sheet

Useful for:	Establish woody brush cover to stabilize a slope. Often used with other techniques.
Benefits to fish:	Stable shoreline reduces erosion and siltation; woody vegetation provides shade and in-water cover habitat
Benefits to you:	Easy technique; quick results; inexpensive; hand labor

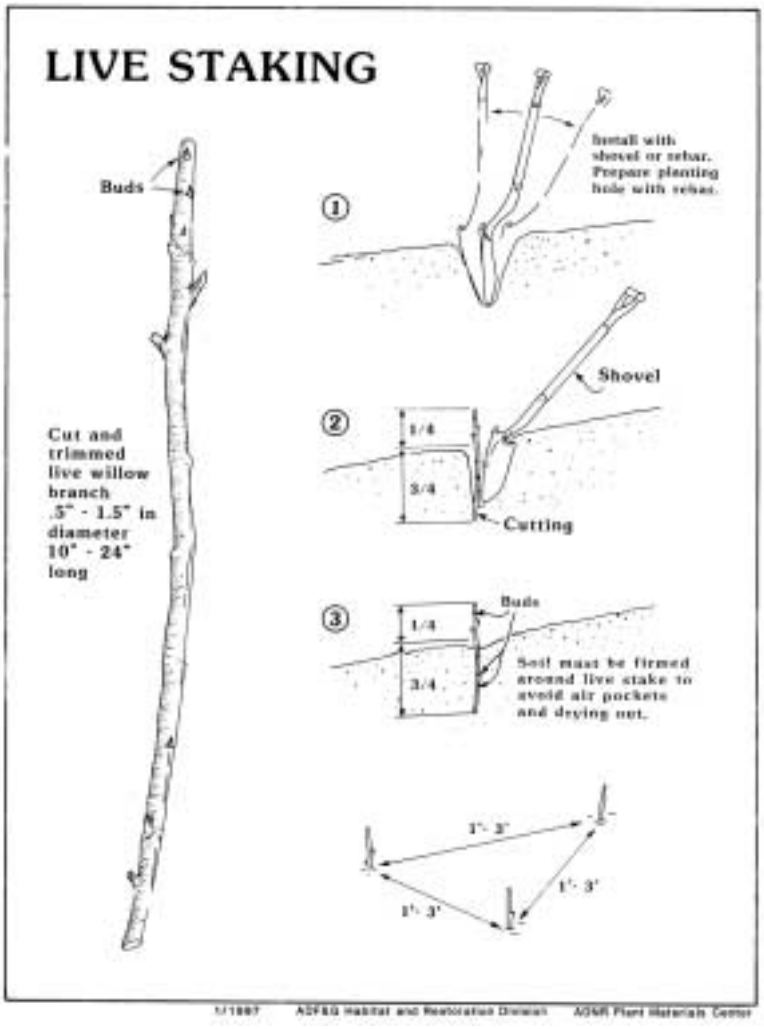
Live staking is a simple technique that installs a dormant cuttings directly into the ground. This technique is often utilized where single stem plantings will provide adequate plant cover, slope stability and fish habitat. Live staking may be combined with other revegetation techniques to anchor bundles, brush mats and erosion control fabric.

Prepare live stakes from a dormant cutting making pieces 10 to 24 inches long, 1/4 to 1/2 inches or more in diameter. Discard flower buds ("pussy willows") which are usually at the top of a branch that was produced during the past growing season. At least one or two leaf buds - which are smaller than flower buds - must be present near the top of each live stake.

Select planting sites carefully since live stakes require moist soils. Watering is not required; but, occasional deep watering usually increases survival and growth and encourages deeper rooting than frequent light watering.

Plant stakes upright 1 to 3 feet apart as vertically as possible, with at least 3/4 of the stake below ground. Allow one or two leaf buds above ground to maximize the surface area for rooting so a good healthy root system can develop.

Moist soil is needed during rooting - at least 4 to 6 weeks after planting. Survival rates at drier sites may be increased if larger cuttings are used.



Information and illustration from: Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

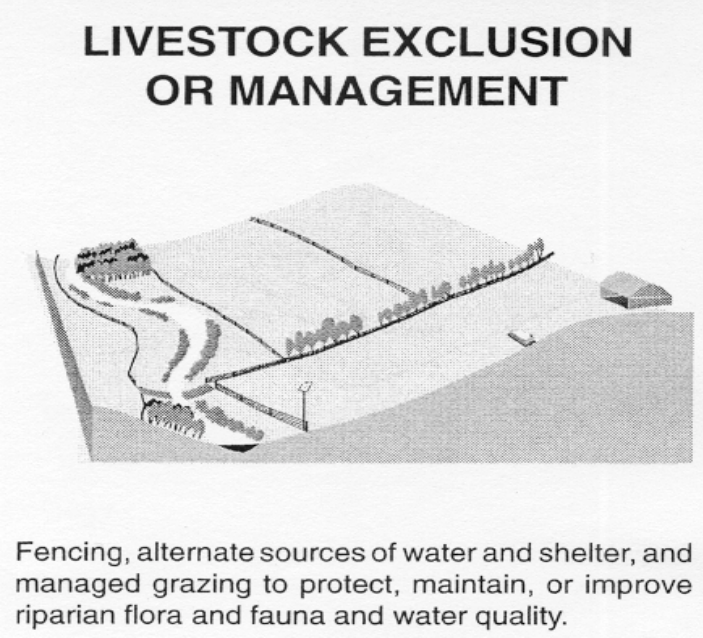
For more information:
- Bentrup and Hoag. The practical streambank bioengineering guide
- Flosi, et al., California salmonid stream habitat restoration manual
- Soil Conservation Service, Kenai River landowner's guide

Livestock Fencing – Information Sheet

Useful for:	Controlling adverse impacts to streambanks and fish habitat that may be caused by livestock in riparian areas
Benefits to fish:	Streambank habitat is preserved; woody debris remains in riparian areas
Benefits to you:	Livestock have access to water but do not harm the riparian vegetation

This is usually not a problem in Alaska, however, uncontrolled access for livestock into streambanks and riparian areas has led to severe instability of streambanks and vegetation in some areas. Install fencing to exclude livestock from the riparian areas to preserve fish habitat and water quality.

Provide limited access by livestock to the stream to restrict damage to a small "safe" location. Create a fenced corridor across the stream to create a ford if access to the opposite bank is necessary. Rotate livestock grazing to other locations during sensitive time periods such as when fish are migrating.



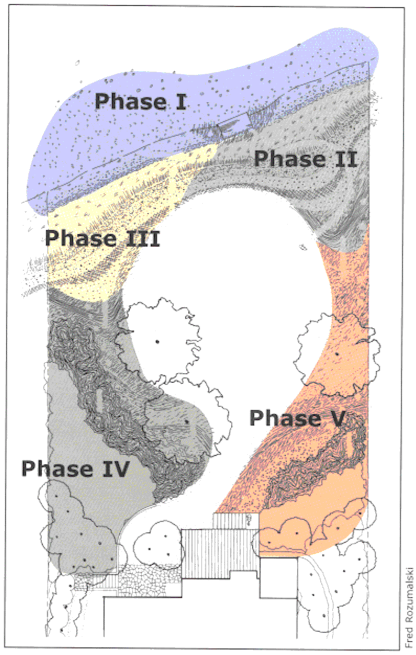
Fencing, alternate sources of water and shelter, and managed grazing to protect, maintain, or improve riparian flora and fauna and water quality.

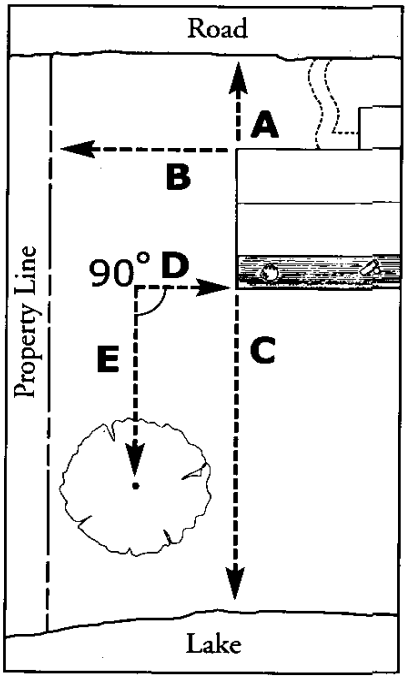
Illustration is from: Federal Interagency Stream Restoration Working Group, Stream corridor restoration - principles, practices, and processes

For more information:
- FISRWG, Stream corridor restoration
- Hunter, Better trout habitat
- ADF&G – H&R

Planning – Information Sheet

Useful for:	Understand what you want to accomplish, how to do it, how much time it will require and the costs before you begin.
Benefits to fish:	You can plan and design your project in a fish-friendly manner.
Benefits to you:	Save time, money and frustration.





When measuring a landscape, measure distances at right angles from a fixed point on the house.

Illustration is from: Henderson, Dindorf and Rozumalski, Lakescaping for wildlife and water quality

Thoughtful planning is a huge asset to both you and the fish as you carry out your project. Plan ahead; allow ample time.

Think about what you want and think about how that can be done in a fish-friendly manner. Make a simple sketch. Review fish-friendly techniques and considerations. Contact ADF&G – H&R for ideas and comments. Complete the Coastal Project Questionnaire to determine which state, federal and local agencies require a permit. Determine if you must comply with a structure setback. Allow for a vegetative buffer.

Develop your final plan and submit the Coastal Project Questionnaire and Permit Applications for Consistency Review.

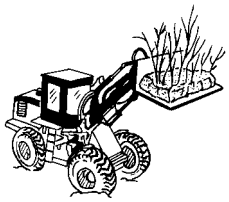
Plan ahead to know what season any in-water work will be permitted and any stipulations that may be required.

Careful and thoughtful planning and allowing ample time will pay off in better design, less cost and less frustration.

For more information:
- Bentrup and Hoag. The practical streambank bioengineering guide
- FISRWG, Stream corridor restoration
- Flosi, et al., California salmonid stream habitat restoration manual
- Henderson, Dindorf, and Rozumalski, Landscaping for wildlife and water quality
- Owens, et al., A property owners guide to shoreline landscaping in the Matanuska-Susitna Borough
- Soil Conservation Service, Kenai River landowner's guide
- ADF&G – H&R

Revegetation by Transplanting – Information Sheet

Useful for:	Stabilize and revegetate a slope quickly
Benefits to fish:	Establishes riparian vegetation for cover and source of woody materials
Benefits to you:	Stable shoreline; reduces erosion



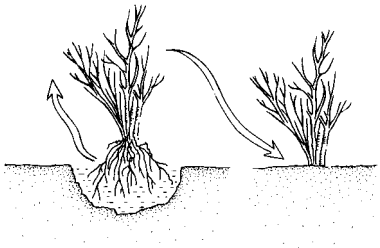
Transplanting is a revegetation technique that removes a plant, or plants with roots and shoots from one site to be replanted at another. Transplanting can take several forms generally distinguished by size: vegetation mats, plugs, sprigs and transplants (single plants). Locate a donor site; e.g., where plants will be destroyed by construction. The conditions of the donor site need to be similar to those at the transplanting site. The best time to transplant is when plants are dormant.

A **vegetative mat** is the largest transplant – from one to several feet square and may contain woody and/or herbaceous vegetation. The greatest benefit is that vegetative cover is provided immediately when the mat is placed at the new location. Mats often contain many species, especially native plants otherwise available. Harvest a vegetative mat by cutting, transporting and setting the shoots and root/soil mass into a block.

Plugs are smaller than vegetative mats and often contain only one species. Plugs are harvested and transported to the planting site. Plugs are well suited for planting in wetlands, constructing grass rolls or being divided into sprigs. A plug may range from 2 to 10 inches in diameter. Include as many roots and soil as possible.

A **sprig** is the smallest transplant unit, consisting of a single shoot and roots. Grasses and sedges are often transplanted as sprigs. Species with a rhizomatous (underground stem) growth form are most suited for sprigging. Sprigs are often planted in wetlands or into coir logs. A plug can be separated into sprigs but keep the plant material moist and avoid drying during handling.

Transplant generally refers to a single plant that is relocated to a new site. Trees, shrubs and well-established perennials are candidates for transplanting. Transplants are most frequently used in landscaping applications, however, transplants can add diversity to revegetation projects. Transplants provide a means to include species that do not root readily from dormant cuttings in revegetation plantings; for example, they can be planted on a streambank before a brush mat is installed.



Information and illustration from: Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:

- Flosi, et al., California salmonid stream habitat restoration manual
- Owens, et al., A property owners guide to shoreline landscaping in the Matanuska-Susitna Borough
- Soil Conservation Service, Kenai River landowner's guide
- ADNR, Directory of Alaska native plant sources

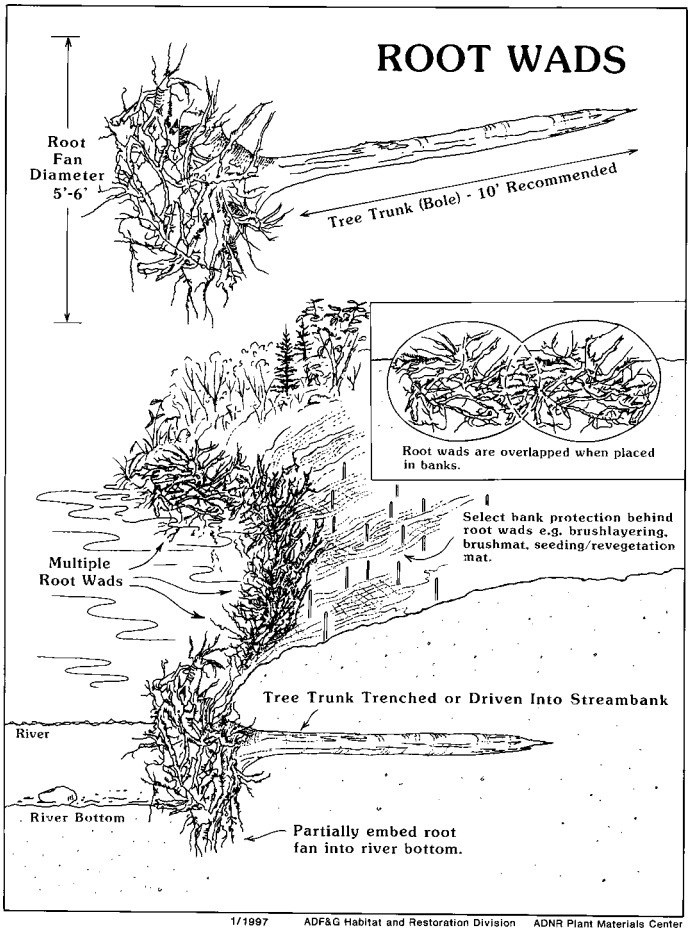
Root Wads – Information Sheet

Useful for:	Stabilize a bank; prevent erosion; provide fish habitat
Benefits to fish:	Provides in-water woody debris for excellent habitat; controls erosion and silt deposition
Benefits to you:	Stable shoreline; reduced erosion

Root wads are used to make a streambank protection revetment, that provides immediate riverbank stabilization, protects the toe of slope and provides excellent fish habitat, especially for juveniles. Root wads are particularly well suited for higher velocity rivers and severely eroded riverbanks. They provide toe support for bank revegetation techniques and collect sediment and debris that will enhance bank structure. Root wads usually require the use of heavy equipment for collection, transport and installation.

Collect root wads from forested areas being cleared for development, or remove them selectively. Larger diameter trees (e.g., 12(+) inches) can be pushed over with intact root fans when soils are not frozen. Remove tree tops, leaving the boles at least 10 feet long with root fans attached. Optimal root fans are 5 feet or more in diameter.

A common installation method excavates a trench into the riverbank deep enough to accommodate the bole which is placed into the prepared trench and back-filled. The bole is typically embedded at the level of the riverbed, perpendicular to the river, with the fans parallel to the bank. This requires that the riverbed be excavated to partially bury the root fan. Another method bores a hole into the riverbank to accommodate the bole or simply drive a pointed tree bole into the bank. Root wads should be installed so root fans overlap to provide continuous cover along the bank area being treated. The fans should be positioned to undulate with the natural bank, providing additional cover for fish.



Information and illustration from: Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:

- Bentrup and Hoag. The practical streambank bioengineering guide
- FISRWG, Stream corridor restoration
- Flosi, et al., California salmonid stream habitat restoration manual
- ADF&G – H&R
- Kenai River Center

Silt Fence – Information Sheet

Useful for:	When off-site transport of sediment cannot be prevented, silt fences help to isolate the work area from a waterbody and contain the suspended materials and limiting the zone of disturbance.
Benefits to fish:	Controls potential damage by preventing silt from clogging spawning gravels, smothering food and aquatic plants as well as direct damage to fish; e.g., gill or eye damage
Benefits to you:	Maintains aesthetic value of clean water

Sediment in water is a hazard to fish. Fine, suspended sediment – silt – may have many effects depending on the type of silt, the concentration and duration of exposure. Fish may be affected by direct, abrasive effects on gill membranes or clogging of gills. Darkened water obscures vision for feeding and causes stress, which increases disease risk. Indirect effects include clogged spawning areas and smothered fish eggs, aquatic vegetation and fish food organisms. Silt may transport toxicants.

The best approach to control sediment in waterbodies is to control it at the source. Restrict the work area and isolate it from the waterbody. Avoid removing vegetation. The backup approach is to intercept and control the suspended materials in an isolated area where it can safely settle or be removed. This prevents moving water from transporting the sediments off site.

The function of temporary, flexible, semi-permeable silt barrier or "fence" is to separate or deflect natural flow around the work area while allowing some circulation. Particles can settle out in the limited area. Silt barriers are not used to filter turbid waters. Silt barriers must be properly installed and maintained.

Stop sediments before they are a problem so you don't need to deal with them after they leave the work site.

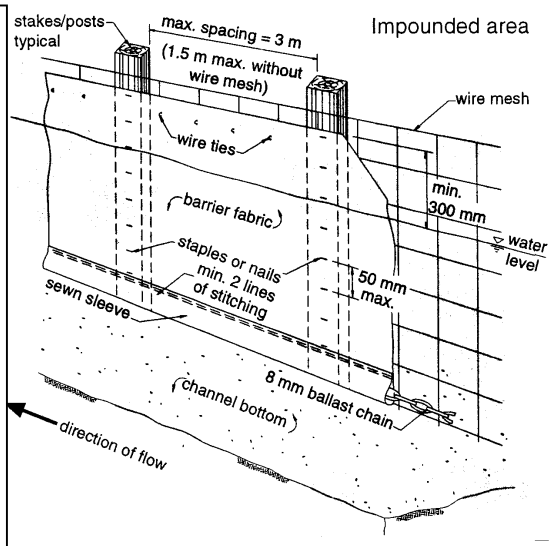
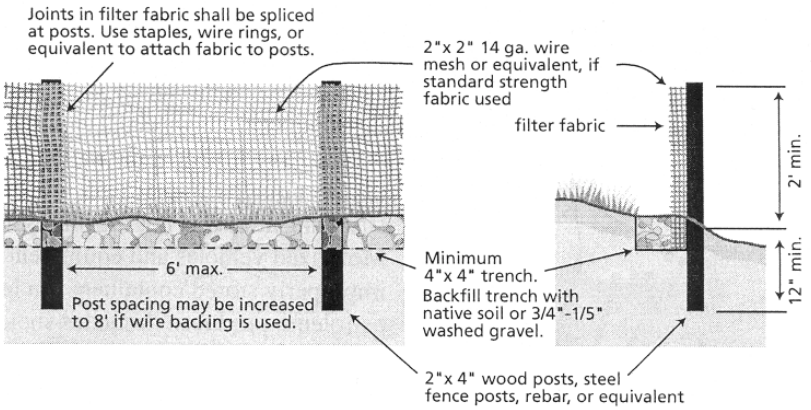


Illustration from: Trow Consulting Engineers Ltd., Instream sediment control techniques field implementation manual

For more information:

- Trow Consulting Engineers Ltd., Instream sediment control techniques field implementation manual
- FISRWG, Stream corridor restoration
- ADF&G _ H&R



Note: Filter fabric fences shall be installed along contour whenever possible.

Illustrtration is from: Federal Interagency Stream Restoration Working Group, Stream corridor restoration - principles, practices, and processes

Spruce Tree Revetment – Information Sheet

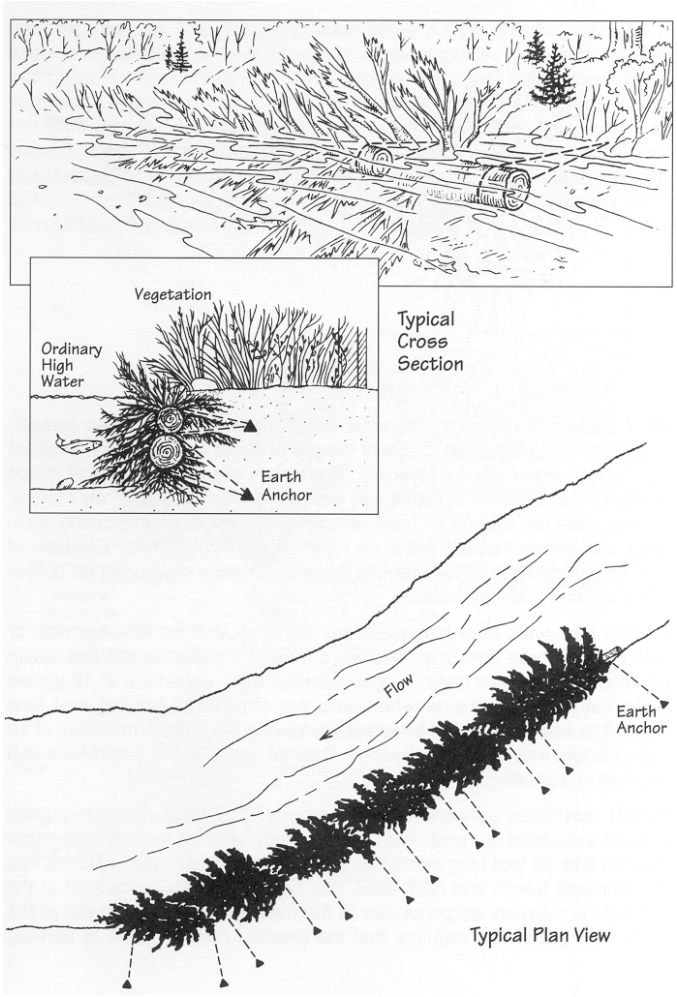
Useful for:	Preventing bank erosion; attenuates wave action; useful in combination with many other methods
Benefits to fish:	Provide instant fish cover and place for food organisms
Benefits to you:	Prevents loss of shoreline; inexpensive

Spruce tree revetments protect streambanks from erosion and provide increased bank stabilization. This is an excellent, relatively inexpensive and functional bank stabilization technique. Spruce trees deflect water flow away from the bank aiding in protection from scour and erosion. They trap sediment, and over time, aid in rebuilding bank structure and establishing long-term bank stability. The tree limbs reduce water velocities; provide cover for juvenile fish and a source of organic debris.

Spruce tree revetments are often used in combination with revegetation techniques. They provide immediate cover for fish until living plant cover is provided by other revegetation techniques.

Install spruce trees parallel to the streambank and overlap 1/3 to 1/2 of their length in a shingle fashion. The top of the tree should be orientated downstream. Care should be taken to avoid unnecessary damage to or removal of tree limbs. The trees are secured tightly to the bank with cable and earth anchors.

Maintain new spruce tree revetments by replacing or adding new trees. Fresh, bushy trees can usually be cabled directly in front of the original revetment.



Information and illustration from: Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

For more information:

- Bentrup and Hoag. The practical streambank bioengineering guide
- ADF&G – H&R
- Kenai River Center

Stream Crossing - Culverts – Information Sheet

Useful for: Properly designed, installed and maintained culverts provide safe and easy upstream and downstream passage for migrating fish, including young and adults of all species during all seasons.

Benefits to fish: One, good, proper stream crossing is better than several un-authorized crossing but fish must be able to navigate the culvert. Use of authorized crossings minimizes siltation and disruptions to migratory fish.

Benefits to you: Safe, comfortable stream crossings with no surprises.

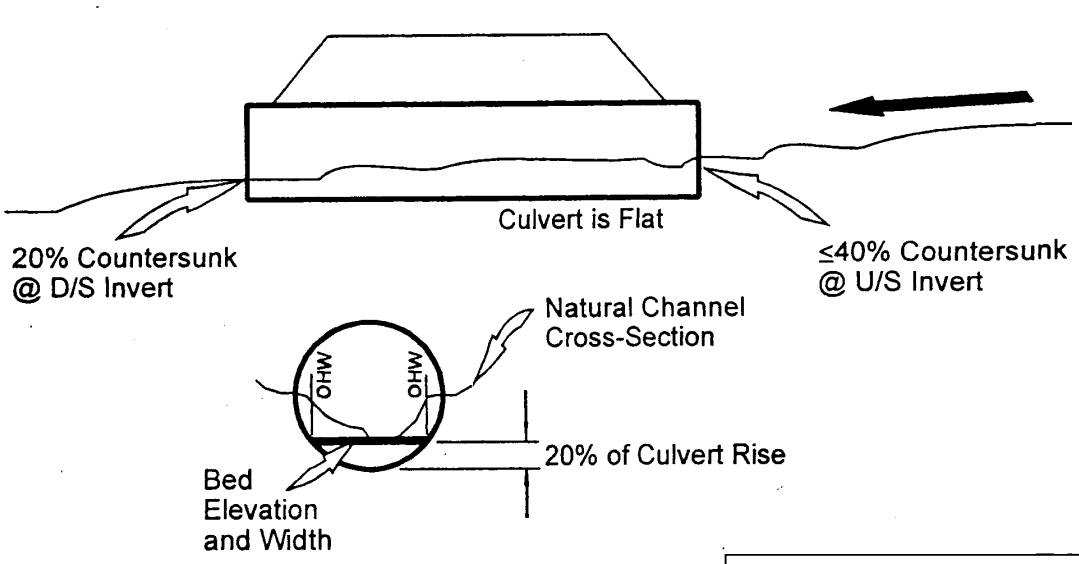


Illustration is from: Washington Department of Fish and Wildlife. Fish passage design at road culverts

Why do we cross the stream? To get to the other side… and there are many ways to accomplish a crossing. Many are not fish friendly. In remote areas fords may be used, but a permit from ADF&G is required. Use one designated ford instead of several. When a bridge or a culvert is installed, they must be properly and carefully designed, installed and maintained. Effective road crossings on streams allow for fish passage that will accommodate all species, all sizes at all times of the year. Hundreds of miles of spawning or rearing habitat in Alaskan streams are not available to fish because of culverts that can move people over the stream and water downstream but not fish through the culvert. Usually, bridges are preferred over culverts because the natural stream bottom is undisturbed, but culverts are more common.

You need a permit from ADF&G before you can install a culvert or ford a stream.

For more information:
- ADF&G – H&R Division Culvert Installation Permit or web site
- FISHPASS Program for culvert installations – web site
- Canada: Factsheet for culvert installations – web site

Structure Setback – Information Sheet

Useful for:	Allows space for vegetation along the shore of a waterbody and allows an uninterrupted corridor for movement of wildlife.
Benefits to fish:	Reduces hazard of contaminants and erosion and siltation from construction activities.
Benefits to you:	Reduces hazard of property loss when a flood happens.

Structure setbacks are useful to allow space for natural habitat along waterbodies that is so important for both fish and wildlife. Riparian vegetation stabilizes the banks, controls erosion, filters runoff to stabilize water quality and is a source of nutrients and cover for fish. Wildlife need continuous vegetative cover where they can migrate. Structural setbacks help to keep fuel, paint and other contaminants - which are often used around structures – farther from the water.

Structure setbacks are not required by regulation for all waterbodies in all parts of Alaska, but setback requirements have been established in many for many streams and areas. Usually, different kinds of structures have different requirements. Although specific requirements vary, ADF&G recommends a *minimum* of 100ft on both sides of the waterbody.

It is imperative that you check with your local government and ADF&G to determine the requirements for a structure setback on your property. Even if it is not required, the space created by a structure setback makes sense for the fish and for you.

For more information:

-FISRWG, Stream corridor restoration
-Henderson, Dindorf, and Rozumalski, Landscaping for wildlife and water quality
-Owens, et al., A property owners guide to shoreline landscaping in the Matanuska-Susitna Borough
-Soil Conservation Service, Kenai River landowner's guide

Timing (a) – Information Sheet

Useful for: Schedule your project implementation to avoid sensitive fish life history stages
Benefits to fish: Improves chances for survival
Benefits to you: Improve your project planning and scheduling

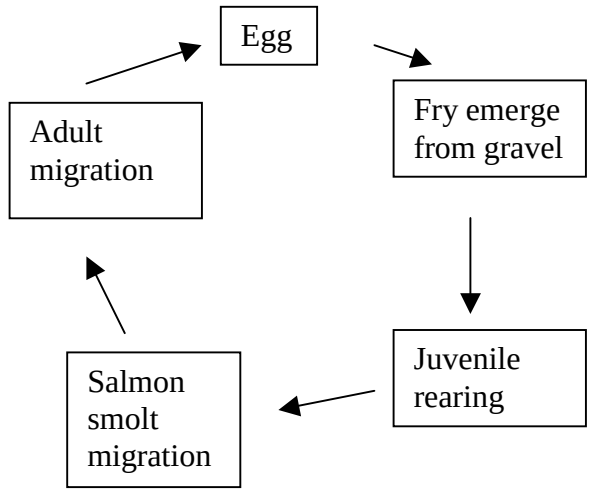
The timing and scheduling for your project is important to you because it is important for the fish. Your ADF&G permit for in-water work may stipulate the time periods when the work will be allowed. Usually, this will be between May 15 and July 15. There are two important reasons for this. First, in-water work will be allowed when it will be least hazardous to the fish that may be present. (see: *Note*, below) This will depend on the particular waterbody, species and type of proposed activity. Second, this is usually the time of high water conditions for streams in southcentral Alaska. Consequently, silt that may result from your activities will be washed out of the system.

Fall, winter and early spring are poor times to schedule most in-water work activities because flows are low and silt is liable to be deposited in spawning areas and smother fish eggs. Summer is a poor time to schedule in-water work because silt is liable to smother food organisms that are important to growing fish.

Work in wetlands, lakes and streams which are used year-round by juvenile salmon will require special measures to control sediment and avoid habitat loss.

(*Note*: Considering the general schedule of life history events of salmon and trout, the safest time for in-water work is usually mid-May to mid-July. ADF&G-H&R may prescribe another time depending on local conditions.)

Salmonid Life Cycle

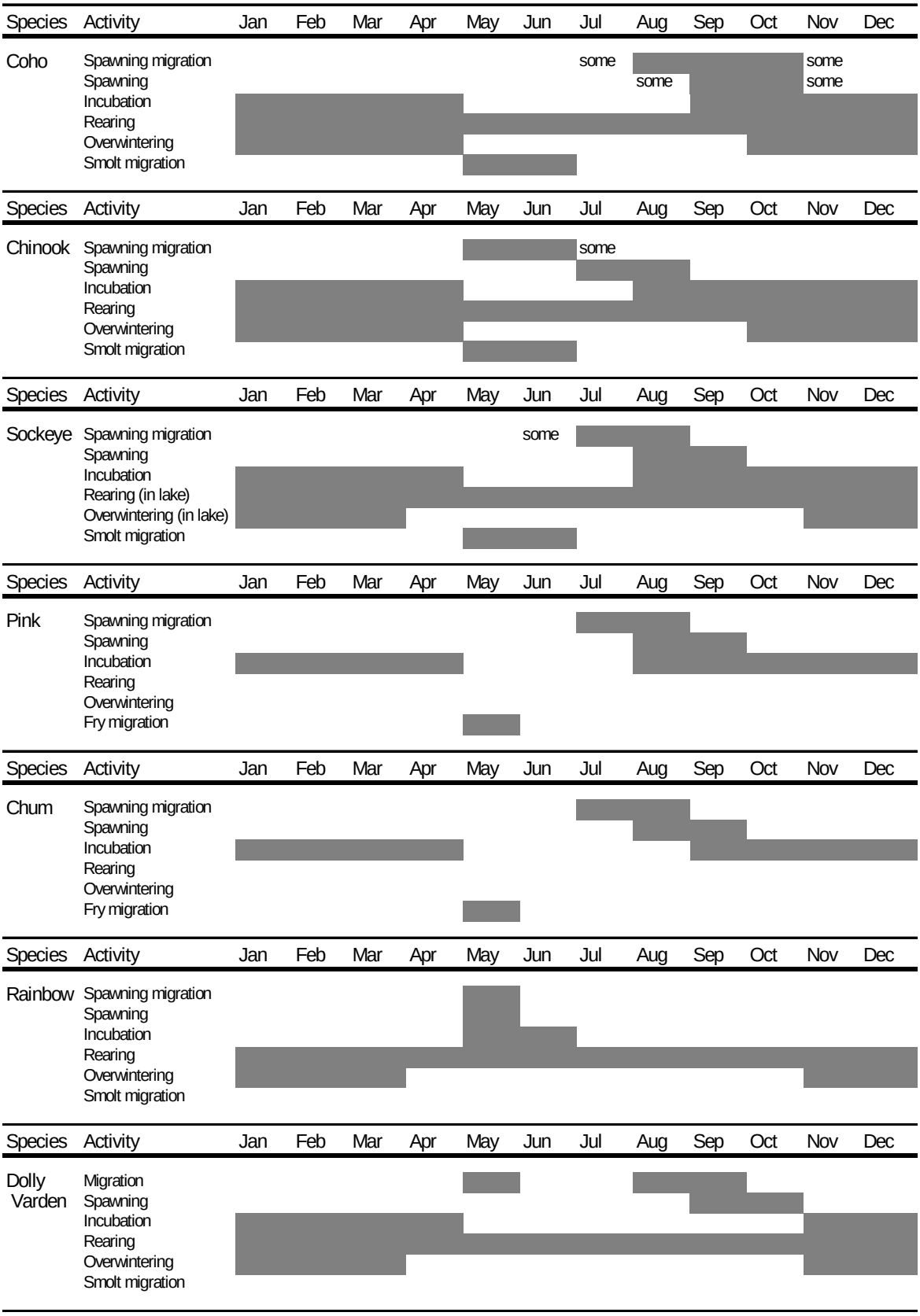


Generalized critical life history stages for salmonids in southcentral Alaska.

Species	Critical Stage	Time
Salmon	Fry migration	May
Salmon	Smolt migration	May-June
Salmon	Spawning	July - October
Rainbow	Fry migration	June-July
Rainbow	Spawning	May - June
Dolly Varden	Fry migration	June-July
Dolly Varden	Smolt migration	May-June
Dolly Varden	Spawning	October
Dolly Varden	Adult migration	June and August

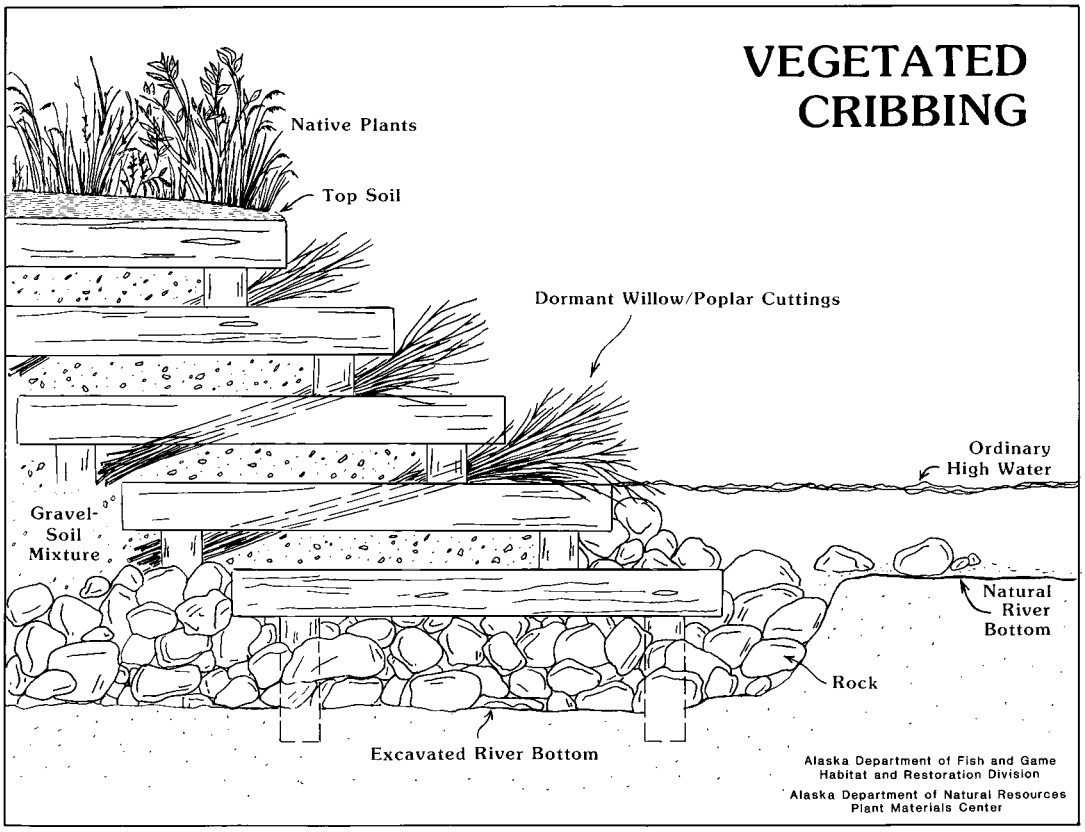
For more information:
- ADF&G – H&R
- ADF&G Wildlife Notebook Series:
http://www.state.ak.us/local/akpages/FISH.GAME/notebook/notehome.htm

Timing (b) - Generalized schedule of life history events for salmon and trout in southcentral Alaskan drainages.



Vegetated Cribbing – Information Sheet

Useful for:	Rehabilitate, stabilize and revegetate a bank or a slope
Benefits to fish:	Provides temporary stability and fish habitat until the revegetation can provide permanent fish habitat
Benefits to you:	Stable slope or bank with riparian vegetation



Vegetated cribbing is a technique reserved for use at sites where other revegetation techniques may not provide sufficient protection from erosion.

This technique combines layers of wrapped soil and plant material similar to brush layering with the addition of a protective cribbing. Untreated timbers are notched and keyed into each other to create a crib-like structure. Cross timbers are periodically installed to increase stability.

Layers of cribbing can be added to reach desired height of bank. The layers can be built vertically or stepped back into the slope with deep or shallow steps. If soil is exposed on any of the layers temporarily, seed to protect from erosion.

Information and illustration from: Muhlberg and Moore, Streambank revegetation and Protection – a guide for Alaska

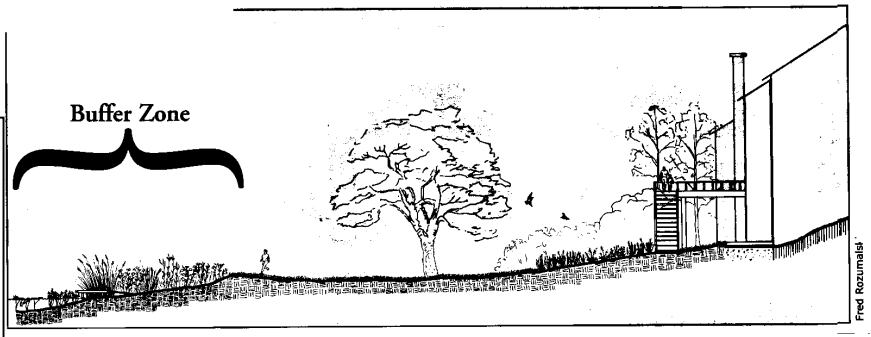
For more information:
- Soil Conservation Service, Kenai River landowner's guide
- ADF&G – H&R
- Kenai River Center

Vegetative Buffer – Information Sheet

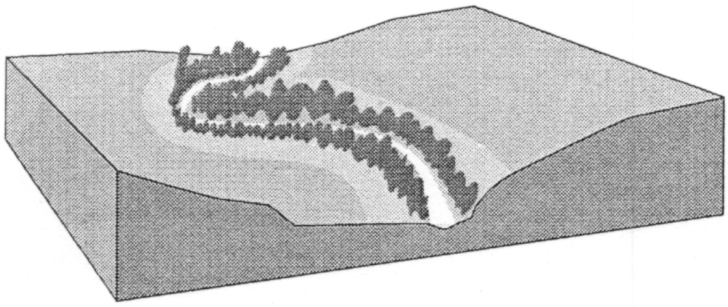
Useful for:	Provides a corridor of vegetation along the shore of a waterbody to attract and allow movement of wildlife and filters runoff and blowing debris from the water.
Benefits to fish:	Provides shade and a source of woody debris. Stabilize streambank.
Benefits to you:	Less lawn to mow; see more wildlife. Stabilize streambank.

Vegetative buffer zones are needed to retain natural habitat along waterbodies that is so important for both fish and wildlife. Riparian vegetation stabilizes the banks, controls erosion, filters runoff to stabilize water quality and is a source of nutrients and cover for fish. Woody vegetation from the riparian areas fall into the water to create hiding places for fish and surfaces for fish food to grow. Wildlife rely on riparian vegetation and need continuous vegetative cover where they can migrate.

Buffer zones are not required by regulation for all waterbodies in all parts of Alaska, but streamside riparian buffer requirements have been established in many for many streams and areas and for the timber industry. Although specific requirements vary, ADF&G recommends a *minimum* of 100ft on both sides of the waterbody. Some highly-responsible logging operations have established self-imposed buffers that are even wider; up to 200 feet adjacent to salmon streams and lakes and wetlands.



RIPARIAN FOREST BUFFERS



Streamside vegetation to lower water temperatures, provide a source of detritus and large woody debris, improve habitat, and to reduce sediment, organic material, nutrients, pesticides and other pollutants migrating to the stream.

For more information:
- FISRWG, Stream corridor restoration
- Henderson, Dindorf, and Rozumalski, Landscaping for wildlife and water quality
- Owens, et al., A property owners guide to shoreline landscaping in the Matanuska-Susitna Borough
- Soil Conservation Service, Kenai River landowner's guide

Illustrations are from: Federal Interagency Stream Restoration Working Group, Stream corridor restoration - principles, practices, and processes; and, Henderson, Dindorf, and Rozumalski, Landscaping for Wildlife and Water Quality