

# **Development of Guidelines for Salmonid Habitat Protection and Restoration**

As part of its salmon recovery strategy, the state of Washington is developing guidelines for salmonid habitat protection and restoration. The guidelines will be a series of technical guidance documents and training opportunities addressing many aspects of aquatic habitat protection and restoration. The guidelines will provide nuts and bolts "how to" information for volunteers, planners, and designers of habitat restoration projects as well as designers and operators of facilities and structures that affect freshwater and marine habitats.

Each guidance document is to be self-contained, based on its own guiding principles and scientific background. The guidelines are intended to support salmon habitat restoration projects, provide additional consistency in permitting of habitat restoration projects and other instream projects across the state, and substantiate any changes to current regulations governing aquatic resource management in the state. Currently, white papers are being written summarizing the current state of knowledge for each activity or topic of research, to serve as a basis for the future guidance documents.

The Washington Department of Fish and Wildlife (WDFW), Washington Department of Ecology (Ecology), and Washington Department of Transportation (WSDOT) have cooperatively initiated the process to develop guidelines for salmonid habitat protection and restoration. The guidelines will serve several purposes in providing scientific background for:

- Support for WDFW Endangered Species Act (ESA) compliance strategy and rule development
- Consistency in permitting of projects related to aquatic habitats
- Training curricula
- Successful habitat restoration projects
- Funding decisions for restoration projects.

Despite the clear priority of restoring endangered and threatened species in state waters, the need is ongoing for construction projects, for development of projects affecting aquatic habitats, and for implementing habitat restoration and enhancement projects. All projects that influence the bed or flow of Washington state waters require a hydraulic project approval (HPA), issued by the Department of Fish and Wildlife under the hydraulics code. Hydraulic project approval permits are issued or denied depending upon whether fish and shellfish, and the habitats upon which they depend, are adequately protected as stipulated in the Washington Administrative Code (WAC 220-110).

Under the Endangered Species Act, the federal government requires an agency or entity to receive prior approval for any activities that could harm, harass, kill, or "take" an endangered species. Under Section 10 of the act, a habitat conservation plan (HCP) is drafted by the entity or non-federal agency (agencies without a federal nexus, a federal permit or federal funding)

seeking approval from the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS) for its proposed activities or project. If the habitat conservation plan considered by the agencies provides protection to the listed species and the habitat upon which it depends, approval is granted as an *incidental take* permit. [NOTE: HCP's only apply to Section 10 and non-federal entities]

A project receiving a hydraulic project approval permit from WDFW could potentially harm a listed species or its habitat. It is for this reason that WDFW proposes to develop a compliance agreement with NMFS and USFWS for the hydraulic project approval program, and receive programmatic take authorization for the HPA program. Recipients of a hydraulic project approval could potentially receive take authorization under WDFW's programmatic take approval for the HPA program.

To more comprehensively regulate the activities affecting aquatic habitats and to ensure regulatory consistency with the Endangered Species Act, WDFW will also review the current hydraulic code rules and propose new rules as necessary. It is hoped that these efforts will streamline the hydraulic project approval process and clarify what is required of individuals and organizations to be in compliance with the hydraulic code as it relates to the ESA. The following activities are being reviewed under the proposed the Endangered Species Act compliance strategy and hydraulic code rule review.

- Aquatic plant control (WAC 220-110-331 through 338)
- Conduit crossings (WAC 220-110-100 through 310)
- Mineral prospecting (WAC 220-110-200 through 209)
- Water diversions (WAC 220-110-190)
- Dredging/gravel removal (WAC 220-110-130, 140, & 320)
- Felling and yarding of timber (WAC 220-110-160)
- Stormwater (new)
- On-and over-water structures (WAC 220-110-060, 224, 290, 300, & 330)
- Water crossings (WAC 220-110-070)
- Marine resource issues (WAC 220-110-280 & 285)
- Channel design features (WAC 220-110-080, 150, & 180)
- Bank protection (WAC 220-110-050, 223)
- Aquaculture (new).

The governor's policy directive, *Extinction Is Not an Option: A Statewide Strategy to Recover Salmon*, recommends the integration of four restoration elements for successful restoration of salmon and other aquatic species listed under the Endangered Species Act. The four elements of successful restoration are:

1. Watershed (or aquatic ecosystem) characterization and assessment
2. Protection of existing habitat
3. Science-based remedial action
4. Monitoring, evaluation, and feedback.

The approach recommended in the governor's *Statewide Strategy to Recover Salmon* requires not only regulatory consistency and cooperation between state and federal agency policies, permits, and protocols, but also the development of comprehensive and integrated guidelines for carrying out aquatic habitat restoration and mitigation projects.

The WDFW/Ecology/WSDOT Guidelines for Salmonid Habitat Protection and Restoration project is an attempt to produce such guidelines. A series of guidance documents produced in this effort will facilitate the consistent application of good science and practice for resource management and for individual project design and operation in or near aquatic systems. Each self-contained guidance document will apply to site-specific issues and also ecosystem-based strategies for restoration. The series will help coordinate state and federal efforts to manage state aquatic habitats and species by providing common language, techniques, and scientific background for regulators and habitat developers and restorers. The guidance manuals are intended to serve as resources for designers of structures and for private landowners and engineers whose activities influence aquatic habitat. Designers using these manuals are assumed to have a basic background in hydraulic engineering, hydrology, and structural design. However, appendices in each manual will provide basic information on these and related subjects.

The specific activities of several other agencies and programs will need to be coordinated with these guidelines to ensure consistency, as follows:

- The National Resource Conservation Service field office technical guides (FOTG's)
- The Endangered Species Act compliance strategy developed by WDFW for its hydraulic project approval program
- Design and approval process for projects under 2SHB 2879 permit streamlining
- Rule changes under the Shoreline Management Act, the Floodplain Management Act, and the hydraulics code, to ensure consistency with the Endangered Species Act
- Project selection and funding for habitat restoration.

Guidelines are currently proposed for each of the following activities: stream bank protection, fish passage and screens, fish passage at road culverts, stream channel design, gravel removal and freshwater dredging, marine dredging, on- and over-water structures, water-crossings, conduit crossings, floodplain development, aquaculture, and aquatic plant control. Several of these are proposed but will not be developed at this time because of funding limitations.

To ensure that regulations and related guidelines are based upon the best available science, a series of white papers is being written by local and agency experts addressing each of these topics. Each white paper will summarize the current state of knowledge pertaining to the activity or topic being researched. Thus, the white papers will serve as the basis for the guidelines drafted for each topic, and will substantiate proposed changes to regulatory language drafted for the state hydraulic code.

Three draft guidance manuals will soon be available for stream bank protection and fish passage topics:

- **Integrated stream bank protection guidelines (ISPG)**, prepared by Inter-Fluve and WDFW:  
*Design considerations for integrated stream bank protection: mechanisms and causes of failure (general bank erosion, scour, avulsion, mass failure, subsurface entrainment), shear, vertical distribution of shear, habitat, risk, site- and reach-based assessment, channel form, channel process (equilibrium and disequilibrium). Mitigation considerations: duration and extent of impacts (construction, lost habitat, etc.), lost opportunity, emergency bank protection. Project design includes decision-making matrices for selecting appropriate solutions.*
- **Fishway guidelines**, prepared by Ken Bates (WDFW) and Bryan Nordlund (NMFS):  
*Pre-design data requirements and considerations, design considerations for fishway entrances (entrance pool and transportation channel design), auxiliary water systems (diffuser and water supply source), fish ladders (pool and weir fishways, vertical slot fishways, roughened channels, hybrid fishways), fishway exit, tributary fish passage, upstream juvenile fish passage, flap gates, fishway flow control. Design considerations: types and applications of screen styles (drums, fixed plate, traveling, pump screens, infiltration galleries), screen design criteria, hydraulic design, fish bypass systems, debris management.*
- **Fish passage at road culverts**, prepared by Ken Bates (WDFW) (available on the web at <http://www.wa.gov/wdfw/hab/engineer/cm/toc.htm>):  
*Culvert design options: no-slope, hydraulic and stream simulation. Design considerations for fish passage at road crossings: culvert siting, culvert barriers, new culverts, channel profile, log sills, plank controls, roughened channels, boulder controls, flood capacity, migration timing, high/low flow, fish species and size, culvert hydraulics, streambed simulation, baffles, channel backwater, culvert elevation. Other considerations of design: channel headcut and regrade, maintenance, water quality, ecological connectivity, habitat loss, channel impacts, construction impacts, risk of culvert failure.*

To ensure that the guidelines drafted are comprehensive and reflect the best available science, the draft guidance manuals have been reviewed in several informal workshops attended by regional experts, users, and regulators in each topical area. It is expected that the guidance manuals in these topic areas will be completed in the fall of 2000. Each of these manuals is described in more detail below.

### **Integrated Stream Bank Protection Guidelines**

The purpose of the integrated stream bank protection guidelines (ISPG) manual is consistent with the goals defined in the governor's *Statewide Strategy to Recover Salmon*. As stated in the

most recent ISPG draft (February 16, 2000), “The purpose of these guidelines is to provide advice for the management of stream and river banks and associated uplands as part of healthy ecosystems. More specifically the guidelines are presented to provide a technical framework for evaluating eroding stream banks and for developing solutions to identified problems.” The manual is intended for designers of bank protection treatment including private landowners and engineers. The guidelines are also intended for land managers, since many of the needs for bank protection comes from decisions regarding land management policies and plans.

The final integrated stream bank protection guidelines manual will consist of two general sections: a section outlining stream functions, bank erosion assessment, and stabilization design (Phase One), and a section illustrating specific activities or design techniques that avoid or minimize impacts on aquatic habitat (Phase Two). Phase One, which is nearly complete, outlines how to select structures or activities that are appropriate for a specific stream type or site. Phase Two, to be completed in August 2000, provides design details, case studies, and examples of specific bank protection techniques.

The integrated stream bank protection guidelines document has undergone several iterations in the process of becoming a completed guidance manual. Work began in 1998. After a first draft was completed, a series of five informal workshops were conducted around the state to introduce the guideline and get initial feedback. A formal review workshop was held in Ellensburg in 1998 to elicit feedback from experts in stream bank protection and restoration. The enthusiastic response generated 28 pages of condensed comments that were subsequently integrated into a second draft document. The critical comments expanded the scope of the guidelines appreciably, to include more information on site- and reach-based assessment and other considerations such as risk, deformable bank protection, shear and scour analysis, and design objectives. Most notably, a series of decision-making matrices was developed to aid managers and project designers in determining site characteristics and in choosing appropriate bank protection treatments. In addition, appendices on geomorphology and hydraulics were added.

Inter-Fluve and WDFW worked together to complete this second draft and the decision-making matrices, which were reviewed by an informal peer audience in Lacey on February 16, 2000. This workshop generated 8 pages of comments, which were supplemented by additional comments submitted via email.

### **Fishway Guidelines**

Draft guidelines, originally written in March 1992, updated in March 1999, and again in April 2000, address the design of fish passage facilities at dams for upstream migrating fish, as well as the design of fish protection screens at irrigation and hydroelectric diversions. Given anticipated listings of additional fish populations under the Endangered Species Act, considerations for resident and anadromous species have been included in the most recent draft. The guidelines apply to fish passage systems ranging from main stem fish passage structures in large rivers to fishways on small streams.

These draft documents have been reviewed through a series of workshops since 1992. They have served as background material for training sponsored by USFWS through the National Conservation Training Center. An informal peer-review workshop is scheduled to elicit feedback from regional experts in hydraulic engineering and fish passage.

Like the integrated stream bank protection guidelines, the fishway guidelines provide managers, developers, and designers with information related to site assessment and design, as well as specific techniques and case studies.

### **Fish Passage at Road Culverts**

The draft guidance was written in March 1999. Revisions are ongoing, and the current draft can be reviewed on-line at <http://www.wa.gov/wdfw/hab/engineer/cm/toc/htm>. This document addresses fish passage issues associated with the design of permanent, new, retrofit, or replacement culverts at road crossings. The draft has been reviewed through a series of five training workshops held throughout the state in 1999. An informal peer-review workshop is scheduled in order to elicit feedback from regional experts in hydraulic engineering, culvert design, and fish passage.

Like the integrated stream bank protection guidelines, the culverts guidelines provide managers, developers, and designers with technical information useful for site assessment and site-appropriate culvert design. Appendices provide information on site analysis, hydrology, and specific case studies.

### **Preparation of White Papers**

A series of white papers is being written summarizing the current state of knowledge for each topic of research, to provide the scientific basis for the habitat protection and restoration guidelines and to support anticipated rule changes. Each white paper addresses the adverse (and beneficial) impacts of development and land management activities on aquatic habitat, and also researches potential mitigation measures for adverse impacts. Following are the topics being addressed in the white paper series:

- Over-water structures—marine
- Over-water structures—freshwater
- Over-water structures—treated wood issues
- Water crossings
- Channel design
- Marine resource issues
- Floodplain and riparian issues
- Dredging and gravel removal—marine
- Dredging and gravel removal—freshwater.

The following topics will be addressed in the future as funding permits:

- Conduit crossings
- Aquatic plant control
- Small landowner forest practices
- Finfish aquaculture
- Shellfish aquaculture.

Each white paper includes the following elements: overview of the guidelines project, overview of the subject white paper, guiding principles, assessment of the state of knowledge, summary of existing guidance, recommendations for the guidance documents, glossary of technical terms, bibliography, and an appendix containing other references and information sources. Like the draft guidance manuals, each white paper will be reviewed by multi-agency and multi-state panels of experts in informal peer review workshops scheduled for late October and November 2000. The comments and recommendations generated in these workshops will be incorporated into the final white papers.

The timeline for completing the white paper project is approximately one year, with authors completing drafts in late August, attending peer review workshops to receive feedback on their drafts in late October and early November, and incorporating review comments into final documents by March 2001. In the meantime, the draft white papers will be used in development of the any proposed hydraulic code rules.

## **Issues Addressed in White Papers**

The issues being addressed in the white paper series are diverse, ranging from topics of design and operation of specific structures to the assessment of ecological impacts associated with structures and activities affecting aquatic habitats. Ultimately, the white papers will provide the scientific reasoning behind the guidelines that will be drafted to manage, protect, and restore aquatic habitats in Washington.

Topics addressed in each white paper are summarized below.

- **Over-water structures—marine**  
*Marine issues associated with the following structures: docks, piers, floats, rafts, log rafts, boat ramps, hoists, launches, boat houses, house-boats and associated moorings, marinas, driving and removal of pilings, trash booms and trash racks, work barges, and dolphins, as well as marine-dredging issues.*
- **Over-water structures—freshwater**  
*Freshwater issues associated with the following structures: docks, piers, floats, rafts, log rafts, boat ramps, hoists, launches, boat houses, house-boats and associated moorings, marinas, driving and removal of pilings, trash booms and trash racks, work barges, and dolphins.*

- Over-water structures—treated wood issues  
*Issues associated with the use of treated wood in over-water and on-water structures.*
- Water crossings  
*Location, design, and ecological considerations for new bridges; existing bridge maintenance, modifications, and retrofits; column skew angle; scour; debris; beach access; fords; and non-fish-passage culvert issues. Also considered: conflicts between highway clear zones and riparian habitat issues.*
- Channel design  
*Design and ecological considerations for new channels, habitat restoration and mitigation, channel relocation and realignment, channel modification for habitat and stability, placement of large woody debris (including removal and relocation), placement of boulders (including smaller rocks and substrate), off-channel ponds (rearing and other), off-channel channels (new floodplains, high-flow bypass), gradient control structures, habitat enhancement activities and structures.*
- Marine resource issues  
*Design and ecological considerations associated with structural shoreline stabilization (bulkheads, beach nourishment, biotechnology), nonstructural stabilization (setbacks, vegetation management, ground/surface water management), estuary restoration, vegetation (eelgrass, kelp beds, wetlands, estuaries).*
- Floodplain and riparian issues  
*Ecological impacts of floodplain fill (levees, road approaches, other fill); instream structures (weirs, groins, barbs, spurs); bulkheads; vegetative additions; diversion of floodplain and hyporheic flow (i.e., subsurface water movement) via forcing, floodway conveyance, or relocation; levee removal; channel confinement; hyporheic zone issues including floodplain gravel pits.*
- Dredging and gravel removal—marine  
*Hydrologic and ecological effects (physical and chemical) of construction and maintenance dredging in saltwater areas associated with navigation channels, marinas, sediment clean-up, as well as other commercial developments.*
- Dredging and gravel removal—freshwater  
*Hydrologic and ecological effects of in-channel bar scalping, risks and avulsions associated with floodplain pits, freshwater dredging, instream sediment sumps, gravel pits, gravel removal.*

The extensive range of topics addressed in the white paper series will provide a comprehensive scientific foundation for proposed rule changes and guidance documents.

## Who Is Involved?

The experts involved in the white paper/guidelines project represent a variety of agency, private, government, commercial, and academic interests.

- Overwater structures:
  - Marine—Charles Simenstad (University of Washington, School of Fisheries)
  - Freshwater—Jose Carrasquero (Herrera Environmental Consultants)
  - Treated wood issues—Ted Poston (Battelle)
- Water crossings:
  - Steve Thompson (Washington Department of Transportation)
- Channel design:
  - Dale Miller (Inter-Fluve)
- Marine resource issues:
  - Ron Thom (Battelle)
- Floodplain and riparian issues:
  - Sue Bolton (University of Washington, Center for Streamside Studies)
- Dredging and gravel removal:
  - Marine— Charles Simenstad (University of Washington, School of Fisheries)
  - Freshwater—Contract being negotiated as of June 30, 2000.

## Guiding Principles

All of the white papers and each resulting guidance manual will be based on guiding principles, to comprehensively and consistently address activities affecting aquatic habitat and species. These principles embody the ecological values, assumptions, and priorities considered in framing the scope of research efforts for the white papers and in prioritizing issues and recommendations for guidelines documents. Similarly, the guiding principles have been considered in drafting language to update the hydraulic code and hydraulic project approval process to ensure Endangered Species Act compliance. The guiding principles were developed by the Departments of Fish and Wildlife, Transportation, and Ecology steering committee members, and by the WDFW committees reviewing the current hydraulic code rules, including representatives of NMFS and USFWS.

The guiding principles explicitly encapsulate current assumptions about how ecosystems work and the management, operation, and design approaches preferred to ensure the proper functioning of natural systems. The guiding principles listed below are general statements outlining the assumptions that provide the ecological basis for the management guidelines and rule-making efforts, and for each white paper. Outlining the assumptions underlying the white

papers and the resulting guidelines will enable future managers to reassess the effectiveness of the aquatic habitat protection and restoration guidelines in light of new developments in scientific understanding and future technological discoveries.

The principles that underlie all of the white paper topics — the universal guiding principles are divided into three categories:

- Ecosystem function
- Habitat impact mitigation
- Resource management and project planning.

In each of the categories listed above, statements progress from general to more specific. Following the list of universal guiding principles, the topic-specific guiding principles are outlined. These are the guiding principles embodying ecological assumptions pertinent to the specific activities addressed in each white paper.

## **Universal Guiding Principles**

### ***Universal Guiding Principle for Ecosystem Function***

1. At their natural rate, biological, ecological, and geological processes provide and maintain, throughout multiple scales of time and space, dynamic and generally beneficial habitat functions in shoreline, estuarine, riparian, and other habitats. These functions include but are not limited to the following:
  - Ecosystem complexity, formation, and evolution
  - Ecological connectivity
  - Species diversity, adaptation, and survival
  - Temperature
  - Light
  - Salinity
  - Vegetation (bank, shoreline, bed, etc.)
  - Substrate
  - Shoreline processes (e.g., erosion, accretion, and salinity)
  - Water quality and quantity
  - Invertebrate production and sustained food web function
  - Hydraulic processes (e.g., shoreline, bank, and bed erosion; channel migration and evolution; sedimentation; and debris influences).

### ***Universal Guiding Principles for No Loss of Habitat or Ecological Function***

1. Net ecological benefit is a goal; no loss of habitat or ecological functions is a requirement.

2. To ensure no loss of habitat, avoidance of actions that adversely affect habitat is preferred. Where unavoidable, adverse impacts should be minimized, and compensatory mitigation should be provided to restore, replace, monitor, and adaptively manage affected habitat.
3. Compensatory mitigation measures, which should take into consideration the spatial and temporal scale and feasibility of a project, should continue for the duration of the impact.
4. Appropriate mitigation measures should effectively manage risk on multiple temporal and spatial scales, addressing long-term impacts, offsite impacts, interrelated impacts, and interdependent impacts.
5. Compensatory mitigation efforts can adopt different general approaches or mitigation targets to ensure no loss of habitat or ecological function, such as:
  - Restoration of pre-project conditions, function for function (site-specific scope—mitigation is onsite and in-kind)
  - Restoration of properly functioning habitat (intermediate or reach-based scope—mitigation may be offsite and out-of-kind)
  - Enhancement of limiting factors (i.e., factors that limit productivity of an ecosystem; broad or watershed-based scope—mitigation may be offsite and out-of-kind).

### ***Universal Guiding Principles for Resource Management and Project Planning***

1. Adopt a holistic approach that employs ecologically relevant units of management, such as watersheds.
2. Err on the side of caution in management, design, and construction processes, to reach conservative decisions that favor natural ecological functions, by considering historical processes and minimizing impacts on natural features and existing habitats.
3. Integrate natural geomorphic processes (e.g., channel migration, channel evolution, hydrologic changes, erosion, sedimentation, accretion, and debris influences) into project planning in lakes, reservoirs, and floodplains, and in riparian, near-shore, marine, and estuarine environments.
4. Incorporate monitoring and principles of adaptive management as integral components of restoration, mitigation, and management activities in lakes, reservoirs, and floodplains, and in riparian, shoreline, marine, and estuarine areas.
5. Promote appropriate uses of riparian, shoreline, and floodplain systems through responsible land use practices that maintain natural processes and recognize the potential for cumulative effects.

6. Use the standard of best available science and technology for designing and evaluating project designs as well as restoration strategies and activities:
  - Identify the physical, chemical, and biological processes that may affect the success of the project or restoration strategy.
  - Restore and maintain habitats to optimal conditions for spawning, rearing and migration.
  - Use qualified experts to analyze, design, and construct specific projects and analyze the effectiveness of restoration strategies.
  - Ensure that monitoring and contingency planning are included in project design.

## **Topic-Specific Guiding Principles**

### ***Guiding Principles for Channel Design***

1. Any modification or activity influences channel conditions.
2. Deformable or freely moving or migrating channels are essential for habitat (generating flow, sediment, large woody debris, ice, and substrate variability)
3. Enhancement activities should demonstrate net ecological benefits.
4. Projects should be performed or evaluated using the watershed approach.
5. Representative reach design is a preferred approach where properly functioning reaches exist.
6. Design should promote natural functions and processes (e.g., equilibrium channel as appropriate, floodplain function and capacity, lateral scour, large woody debris, bedload recruitment, and sediment budget).
7. Channel relocation and modification can be a valuable habitat restoration tool.
8. Debris and gravel can be reintroduced into a system by loading or placement of materials. Loading is generally preferred, as the river itself distributes the sediments to needed areas. However, placement is often more appropriate in urbanized areas or areas with increased risk considerations.

### ***Guiding Principles for Dredging and Gravel Removal from Channels or Floodplains***

1. Removing sand or gravel has an impact upon the natural gravel budget as well as the hyporheic and floodplain functions of a system (i.e., temperature, complexity and diversity of macroinvertebrates, nutrients, formation of side channels, etc.).

2. The limits and dynamics of a system should be considered. The full impacts of an activity should be considered and mitigated (e.g., upstream and downstream, on different spatial and temporal scales).
3. Removal rates should be based on watershed and reach analysis rather than site-specific analysis.
4. Opportunities for reach and watershed mitigation should be explored in cooperation with other stakeholders.
5. Removal rates of sand and gravel are adjustable based on annual variability of sediment transport, necessitating ongoing monitoring efforts.
6. Removal of sand and gravel for flood hazard management should be based on an acceptable flood goal.
7. The above-listed activities pose the following risks:
  - River capture or redirection of river flow
  - Change in ground water elevation
  - Changes in the distribution or characteristics of water (e.g., location, temperature, ground water interactions, hyporheic zone activities, and nutrient levels)
  - New channel formation
  - Change in stream bank stability
  - Change in spawning or rearing habitat
  - Reduction or alteration of available refuge, or concentration of nonnative fishes
  - Impacts on species diversity and complexity and ecological connectivity.
8. The value of sediment transport to deltas and marine areas should be recognized, and dredging and filling operations should be limited in order to protect near-shore marine and estuarine habitats and functions.

### ***Guiding Principles for Dredging and Gravel Removal from saltwater areas***

Being developed as of June 30, 2000.

### ***Guiding Principles for Management of Floodplains and Riparian Corridors***

1. Connectivity between hyporheic zone and surface waters should be maintained.
2. Floodplain capacity should be preserved, maintaining a zero-rise floodplain policy.
3. Channel confinement can have significant ecological impacts.

### ***Guiding Principles for Management of Marine Resources***

1. The quality and quantity of functional habitat necessary to sustain and restore healthy marine life communities in marshes, sandflats, mudflats, and kelp beds, and in riparian, rock-gravel, unvegetated subtidal, unvegetated intertidal, vegetated intertidal, and open-water/pelagic areas should be maintained, restored, or improved.
2. In marine, estuarine, and tidally influenced marine environments, management actions should provide ecosystems that contain productive, balanced, integrated communities of organisms having species composition, abundance, diversity, structure, and organization comparable to that of natural ecosystems in the region.
3. Shoreline processes (including substrate erosion, transport, and deposition) should be managed on a drift sector basis, identifying areas with similar substrate movement characteristics.
4. Development should avoid shoreline modifications to prevent adverse impacts on natural features, shoreline processes, and existing habitats.
5. Proposed shoreline modifications should incorporate natural processes, consider historical processes, and minimize impacts on natural features and existing habitats in their design and construction.
6. Replacement of shoreline structures (e.g., armoring) should strive to restore beach area, natural shoreline features, and shoreline processes. Removal of these structures is preferred.
7. Restoration of lost estuarine processes and functions is essential to aquatic ecosystem health.
8. Pre-disturbance estuarine conditions (e.g., marsh elevation and distributary channel configuration) should be adopted as the basic template for successful long-term, self-maintaining estuarine restoration.
9. Critical estuarine habitat occurs on a continuum of temperature and salinity in the transition from fresh to marine water. All major habitats on this continuum should be represented in a comprehensive restoration.
10. The position of the project in the estuary may be more important than its size. A full tidal prism is essential for sediment flushing, maintenance of natural estuarine geometry, and productive biological functions.

### ***Guiding Principles for On- and Over-water Structures***

1. Alteration of the temporal or spatial distribution or concentration of species (e.g., migration and schooling) should be avoided.
2. Alteration of migration patterns, concentrations, or timing of fish populations, which may result in increased predation or susceptibility to predation, should be avoided.
3. Alterations to the bed (i.e., substrate) and natural rates and distribution of vegetative growth should be avoided.
4. Natural ambient light levels should be maximized to avoid adverse shade-related impacts on water, substrate, the food chain, etc.
5. Use of materials that leach deleterious or toxic chemicals into adjacent aquatic ecosystems should be avoided.
6. Temporary or seasonal structures are preferred over permanent structures.
7. Repair or replacement of existing structures should be designed in accordance with current regulations.
8. Materials with the greatest longevity and the least overall impact are preferred (e.g., consider replacement timeframe, pile quantity and spacing, and light transmission).
9. Nongrounding structures are preferred.

### ***Guiding Principles for Water Crossings***

1. Preferred design retains or restores natural channel conditions.
2. Ecological connectivity should be maintained.
3. Work in geologically unstable areas should be avoided.
4. Cumulative impacts of culverts should be considered in assessing direct loss of habitat.
5. Disturbance of stream bank vegetation should be minimized.

## **Development of Guideline Documents, Outreach Programs, and Products**

Following completion of the white papers, agency specialists and expert consultants will develop guidelines through a process similar to that described here for the integrated stream protection guidelines and fish passage guidelines. The guidelines are expected to be living documents that

will need updating and expansion over time. Funding will be requested to maintain them as viable and current guidance documents.

Additional products will be developed for outreach purposes. Some guidelines will be published in the form of pamphlets. All guidelines will be published on the Internet and on compact discs. Workshops will be conducted throughout the state to distribute the guidelines as well as to receive input for maintaining the guidelines. The workshops will form a curriculum for regulators, contractors, and individuals interested in salmonid habitat protection and restoration.

## **Conclusion**

It is hoped that the white papers and guidance manuals produced as part of the Guidelines for Salmonid Habitat Protection and Restoration project will help to integrate the approaches adopted by state agencies for restoring and regulating aquatic resources. Changes in the way activities are regulated and implemented, as necessitated by increased Endangered Species Act listings, will be more effective and more easily understood and supported if they are substantiated by a comprehensive foundation of scientific understanding, explicit priorities and assumptions, and consistent language.

These statewide guidelines are intended to effectively and simply inform citizens of their options and responsibilities by clearly describing the adverse impacts on aquatic resources that can result from public and private activities, and explaining how these impacts can be avoided, minimized, or mitigated.

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