Appendix A2. Project design standards for riparian, wetland, upland, coastal, and estuarine habitat restoration.

General Requirements

1. Knowledgeable and trained personnel (*e.g.*, biologist, hydrologist, or engineer) must be involved in the design and implementation of habitat restoration projects.
2. Deposition of fill materials in any habitat must not violate Federal, State, county, or local regulations and guidelines as set forth by the Oregon Division of State Lands, U.S. Army Corps of Engineers, or other regulatory agencies.
3. Hydric soils from wetlands and topsoil from riparian and upland areas must be salvaged, stockpiled, and then replaced in appropriate project areas during construction activities. It may not be appropriate to reuse these soils if they are contaminated with toxic materials or contain reproductive parts (*e.g.*, seeds, bulbs, and rhizomes) of invasive, non native, or noxious vegetation.
4. Berms and dikes that are breached or constructed must meet appropriate Federal and State engineering and safety standards.
5. Berms and dikes that are breached, removed, or constructed must not cause the artificial entrapment of fish and other aquatic species in areas adjacent to them. Artificial entrapment refers to man-made habitat changes or structures (*e.g.*, isolated ditches, depressions, or other topographical changes) that would not allow the passive surface flow of water to return to a stream channel as water levels recede.
6. A project specific biological assessment must be written for constructed berms and dikes adjacent to a fish bearing stream[32] containing federally listed anadromous fish species. This process may result in NOAA Fisheries issuing a biological opinion under the Endangered Species Act for the project. The Fish and Wildlife Service must review and approve the designs for these structures adjacent to non anadromous stream reaches.
7. Appropriate pollution and erosion controls must be implemented as they apply to specific restoration activities.

Livestock Fencing

1. Livestock fence installations must be reviewed and approved by the Fish and Wildlife Service before installation to ensure compliance with wildlife compatible fence designs.
2. Woven wire fence installations must be limited to areas around buildings and barns.
3. The durability of fencing materials must meet intended livestock management objectives.
4. An electric fence (hard-wired or solar powered) is a preferred alternative to a traditional wire fence.

---

[32] "Fish bearing streams" refer to perennial and ephemeral streams that are known to contain one or more native fish species. A stream is assumed "fish bearing" unless a presence/absence or other appropriate survey has been completed to prove otherwise.

5. Cross-pasture fencing should be combined with perimeter pasture fences to promote better pasture management.
6. Fences must not be constructed in areas where natural barriers restrict livestock movements.
7. Fences must not be constructed on steep hillsides.
8. Fences must not restrict the natural movement of any wildlife species, especially deer, elk, and pronghorn.
9. Adjustable or lay-down fences/panels should be constructed in areas of high deer, elk, and pronghorn use and within traditional migration corridors for these species.
10. Pole-topped fences should be constructed in areas where elk frequently cross back and forth. This will help to reduce fence damage and repair costs.
11. Fences in or near areas where sage grouse are known or suspected to occur should be designed and constructed as follows:
    - Increase the visibility of fences occurring within 0.5 miles of seasonal sage grouse habitats to prevent injuries to flying grouse (*see item 14 below*).
    - Use smooth wire for the top and bottom wires, not barbed wire.
    - Avoid creating potential raptor perches within 1.5 miles of seasonal sage grouse habitats by reducing fence post height to four feet or less. Where fence posts must exceed this height, modify the top of the posts (*e.g.*, cut the top of wooden posts to a steep point).
    - Fences within 1.5 miles of seasonal sage grouse habitats should maximize the setback distance from streams, ponds, springs, seeps, and wet meadows to accommodate grouse flight lines. Avoid constructing fences across water sources.
12. Maintain a clear line of sight along a fence line for a distance of at least ten feet to make it more visible to wildlife.
13. Fences should be constructed at least 100 feet from the perimeter of a wetland to reduce potential collisions with flying waterfowl and large wading birds.
14. Tie colored flagging on the top wire of all new fences to make them more visible to wildlife. For a more permanent visible marker, slide PVC pipe (*i.e.*, one to two foot lengths) onto one of the upper fence wires during construction. Use white PVC pipe or paint the pipe with a bright color for more visibility.

Livestock Stream Crossings

1. Livestock crossings must not be located in areas where compaction or other damage may occur to sensitive soils and vegetation (*e.g.*, wetlands) due to congregating livestock.
2. Livestock must be encouraged to loaf away from crossing locations.
3. Livestock crossings must be designed and constructed to accommodate reasonably foreseeable flood risks, including associated bedload and debris, and prevent the diversion of stream flow out of the channel and down an adjacent road if there is a crossing failure.
4. Locate livestock crossings where native riparian vegetation will not have to be cleared to install the structure.
5. Suspended livestock crossings must be load rated for its intended use (*e.g.*, type of livestock, farm equipment, and vehicles to cross the structure).

6. Abutments for livestock bridge crossings (*e.g.*, railroad car and constructed bridges) must be armored and placed above the bankfull elevation[33] of the stream.
7. Culverts used for livestock stream crossings on fish bearing streams must follow project design standards for fish passage improvements (*see Appendix A4*).
8. Minimize the number of livestock crossings installed on a landowner's property. Locate the crossings where they will best meet livestock management objectives.
9. The maximum width of a non hardened ford livestock crossing must be not exceed ten feet.
10. Each livestock crossing must be fenced to restrict livestock access to the stream channel. Fencing can be installed as a temporary or permanent installation, depending on local stream conditions and grazing management requirements.

Hardened Livestock Fords

1. Construct a hardened livestock ford where stream banks are naturally low.
2. The stream bank, channel, and approach lanes in the pasture must be stabilized with native vegetation, geotextile fabric, and angular rock to reduce chronic sedimentation problems; however, these materials must not impede natural channel migration potential.
3. Livestock fords must not be constructed within known or suspected spawning areas, or within 300 feet upstream of such areas if they may adversely affect them.
4. Livestock fords must be designed to allow the passage of juvenile and adult fish at normal seasonal stream flows.
5. The maximum width of a hardened ford must be not exceed eight feet.
6. Follow other appropriate project design standards under Livestock Stream Crossings.

Livestock Watering Facilities

1. Livestock off-channel watering facilities must not be located in areas where compaction or other damage may occur to sensitive soils and vegetation (*e.g.*, wetlands) due to congregating livestock.
2. Livestock watering facilities should be constructed in a manner that meets its primary purpose while providing additional benefits to wildlife. Facilities must be designed to prevent the entrapment of wildlife if they are installed to provide multiple benefits.
3. A solid, dry surface is recommended around all watering facilities to prevent ground saturation, runoff, and erosion. A concrete pad or a plastic/geotextile/gravel grid must be constructed around a facility to minimize or eliminate these problems.
4. Float-controlled devices in all watering facilities must be inspected weekly to ensure that they are operating properly and not contributing to excess water overflow.
5. A natural spring used as water source must be protected from livestock degradation by fencing off the perimeter of the spring and developing a low impact water withdraw system.

---

[33] "Bankfull elevation" means the bank height inundated by a 1.5 to 2 year average recurrence interval and may be estimated by morphological features such average bank height, scour lines and vegetation limits.

6. Pump intakes for livestock watering facilities must to be screened according to NOAA Fisheries' fish screen criteria when they are placed in a stream channel.
7. Ponds used for livestock watering must be constructed according to all State and local requirements and the following criteria.
    - Ponds must not be constructed within the channel (*i.e.*, water course) of a perennial, intermittent, or ephemeral stream.
    - Ponds must not be directly filled (*i.e.*, diverted) from any fish bearing stream unless the diversions are screened according to NOAA Fisheries' fish screen criteria. A water over-flow or by-pass device must also be installed to prevent excessive water diversion.
    - Consider placing ponds where they can be naturally filled by snow melt, rainfall, or overland surface flows, or through an existing domestic water supply.
    - Costs (*e.g.*, labor, materials, and supplies) associated with the construction of ponds that will be stocked with native and/or non-native fish are not reimbursable with Fish and Wildlife Service restoration program funding.

Prescribed Burns

1. A prescribe burn plan must be reviewed and approved by the Fish and Wildlife Service before conducting the burn. The plan must set biological and ecological goals based on local site conditions and evaluate factors that may affect the outcome of the prescribed burn. Always consider non burning alternatives whenever possible.
2. A prescribed burn must be conducted in a manner that is consistent with appropriate Federal, State, county, and local regulations, including smoke management regulations.
3. All permits and official authorizations must be secured before conducting a prescribe burn.
4. Adjacent landowners and the local fire department must be notified of all burn activities in advance.
5. A contingency plan should be developed for reestablishing control of a prescribed burn in situations where the burn escapes containment boundaries. The plan must also address the reestablish of native vegetation in these areas within the season of disturbance.
6. Prescribed burns are not authorized within riparian[34] and wetland areas, and must also be located at least 100 feet away from the edge of perennial and ephemeral stream channels.
7. Prescribed burns adjacent to riparian areas should occur during periods when appropriate moisture content will reduce unintended spread to riparian areas. Spring burns are preferred over

[34] "Riparian areas" are defined as two site potential tree heights (of native, site potential vegetation) located from the channel migration zone (defined as the area defined by the lateral extent of likely movement along a stream reach as shown by evidence of active stream channel movement over the past 100 years, *e.g.*, alluvial fans or floodplains formed where the channel gradient decreases, the valley abruptly widens, or at the confluence of larger streams). These areas are plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic water bodies. Riparian areas have one or both of the following characteristics: 1) distinctively different vegetative species than adjacent areas, and 2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. These areas are usually transitional between wetland and upland areas.

Fall burns since they produce "cooler" fires resulting in a mosaic of treated and untreated areas. Soil moisture is also more available in the Spring resulting in quicker plant regrowth. However, seasonal timing of a prescribed burn must meet its primary purpose.

8. Qualified personnel in the use of fire must be involved in all aspects of a prescribed burn.
9. Project personnel assisting with a prescribed burn must have access to proper protective clothing (Nomex), boots, gloves, helmets, goggles, face shields, and two-way radios with a weather channel.
10. Appropriate fire suppression equipment must always be located at the project site during a prescribed burn.
11. Chemical retardants, foam, and other additives must be prevented from entering any water source, except in situations where overriding immediate safety exist.
12. All participants must attend a planning session before completing a prescribed burn and be informed of contingent burn plans in the event of a wildfire.
13. Potential affects to aquatic habitats must be considered when a prescribed burn will occur near these areas (*e.g.*, wetlands, permanent or ephemeral streams).
14. A prescribed burn must not occur in areas with moderate to high erosion potential, unless complete revegetation will occur thirty days before the rainy season.
15. Prescribed burning of slash material or invasive/non native vegetation must be planned and managed to maximize the benefits and reduce the detrimental effects of a burn.
16. Develop a site plan for rapid native revegetation after a prescribed burn.
17. Sedimentation and erosion controls, as appropriate, must be installed at all prescribed burn sites. Controls must remain in place and be maintained until vegetation is established at these sites.

Soil Stabilization

1. Designs for soil bio-engineered stabilization projects must be reviewed and approved by the Fish and Wildlife Service before completing project activities.
2. Whenever possible, soil stabilization efforts must employ natural or bio-engineering techniques.
3. The following materials must not be used for stabilization:
    - broken pieces of asphalt and concrete.
    - metal refuse and debris (*e.g.*, metal refuse containers, car bodies, and tires).
    - organic waste materials (*e.g.*, discarded lumber, pressure treated wood products, and herbaceous vegetation).
    - stream channel materials (*e.g.*, woody debris and gravels collected within the channel), unless materials were initially removed during construction activities.
4. Straw used as mulch must not be moldy, caked, decayed, or otherwise of low quality. Ensure that the mulch does not contain invasive or non native plant seeds or other reproductive parts.
5. Stream bank protection techniques depend on the mechanisms of stream bank failure operating at site- and reach-scale.[35] Appropriate techniques must be employed to minimize or eliminate

[35] For guidance on how to evaluate streambank failure mechanisms, streambank protection measures, and use of an ecological approach to management of eroding streambanks, see, *e.g.*, Washington Department of Fish and

adverse affects to natural stream and floodplain functions by limiting actions that are expected to have long-term adverse effects on aquatic habitats. The following bank protection techniques are approved for use individually or in combination:

- Planting woody trees and shrubs or other planting variations (*e.g.*, live stakes, brush layering, facines, and brush mattresses).
- Planting herbaceous vegetation, where available records *(e.g.*, historical accounts and photographs) show that trees and shrubs did not exist on the site within historic times.
- Installing deformable soil reinforcements consisting of soil layers or lifts strengthened with fabric and vegetation.
- Installing coir logs (*i.e.*, long bundles of coconut fiber), straw bales, straw logs, or other similar non-toxic biodegradable materials used individually or in stacks to trap sediment and provide a growth medium for plants.
- Reshaping stream banks and grading slopes to reduce bank slope angles without changing the location of the bank toe; increase roughness and cross-section; and provide more favorable vegetative planting surfaces.
- Installing floodplain roughness (*e.g.*, floodplain tree and large woody debris rows, live siltation fences, brush traverses, brush rows, and live brush sills) to reduce the likelihood of avulsion in areas where natural floodplain roughness is poorly developed or has been reduced.
- Installing floodplain flow spreaders (consisting of one or more rows of trees and accumulated debris) to spread flow across the floodplain.
- Install flow-redirection structures[36] such as barbs, vanes, or bendway weirs, when designed as follows, unless otherwise approved by the Fish and Wildlife Service.
    - No part of the flow-redirection structure may exceed bank full elevation, including all rock buried in the bank key.
    - Build the flow-redirection structure primarily of wood or otherwise incorporate large wood at a suitable elevation in an exposed portion of the structure or the bank key. Placing the large woody debris near streambanks in the depositional area between flow-direction structures to satisfy this requirement is not authorized, unless those areas are likely to be greater than one meter in depth, sufficient for salmon rearing habitats.
    - Fill the trench excavated for the bank key above bankfull elevation with soil and top with native drought tolerant vegetation.
    - The maximum flow-redirection structure length must not exceed one-quarter of the

---

Wildlife, Washington Department of Transportation, and Washington Department of Ecology, *Integrated Streambank Protection Guidelines*, various pagination June 2002 (http://www.wa.gov/wdfw/hab/ahg/strmbank.htm), and Federal Interagency Stream Restoration Working Group, *Stream Corridor Restoration: Principles, Processes, and Practices*, various pagination October 1998 (http://www.usda.gov/stream_restoration/newgra.html).

[36] See *e.g.*, Natural Resources Conservation Service Technical Notes (Engineering - No. 12 and 13, respectively), *Design of Stream Barbs*, July 2001 and *Design of Rock Weirs*, February 2001 (http://www.id.nrcs.usda.gov/technical/engineering/index.html).

bankfull channel width.

- Place rock individually with an excavator without end dumping the rock from a haul vehicle.
- If two or more flow-redirection structures are built in a series, place the flow-redirection structure farthest upstream within 150 feet or 2.5 bankfull channel widths from the flow-redirection structure farthest downstream.
- When appropriate, plant native woody riparian vegetation at disturbed sites and in areas adjacent to the project to improve the riparian habitat.

6. Whenever possible, use large wood as an integral component for all stream bank protection treatments[37]. Minimize or eliminate the use of sheet pile, riprap, gabions, cable, concrete, and/or similar materials in stream bank protection projects.
   - Large wood should be intact and not decayed with untrimmed root wads (where available) to provide functional refugia habitat for fish. Use of decayed or fragmented wood is not acceptable.
   - Rock may be used instead of large wood for the following purposes and structures. The size of rock that is used must not impair natural stream flows into or out of secondary channels. Whenever possible, place topsoil over the rock and plant with native woody vegetation.
     - As ballast to anchor or stabilize large woody debris components of an approved bank treatment.
     - To fill scour holes to protect the integrity of the project, if the rock is limited to the depth of the scour hole and does not extend above the channel bed.
     - To construct a footing, facing, head wall, or other protection necessary to prevent scouring, downcutting, fill slope erosion, or another type of failure at an existing flow control structure (*e.g.*, culverts and water intakes), utility line, or bridge support.
     - To construct a flow-redirection structure as described above (*see item 5*).

---

[37] See, *e.g.*, Washington Department of Fish and Wildlife, Washington Department of Transportation, and Washington Department of Ecology, *Integrated Streambank Protection Guidelines*, Appendix I:Anchoring and placement of large woody debris, June 2002 (http://www.wa.gov/wdfw/hab/ahg/strmbank.htm); Oregon Department of Forestry and Oregon Department of Fish and Wildlife, *A Guide to Placing Large Wood in Streams*, May 1995 (http://www.nwr.noaa.gov/1salmon/salmesa/4ddocs/lrgwood.pdf), and Natural Resources Conservation Service Technical Notes (Engineering - No. 15), *Incorporation of Large Wood Into Engineering Structures*, June 2001 (http://www.id.nrcs.usda.gov/technical/engineering/index.html).

Silvicultural Treatments[38]

Juniper Tree Removal: Riparian and Upland Habitats

1. Riparian and upland juniper tree harvest plans must be reviewed and approved by the Fish and Wildlife Service before completing project activities.
2. Silvicultural activities in riparian areas are limited to juniper tree removal.
3. Juniper tree removal in riparian or upland areas must not result in significant soil disturbances that may cause increased sedimentation and erosion.
4. Only fifty percent of the juniper trees greater than ten inches in diameter at breast height may be removed in a riparian project area in order to limit the reduction in shade to adjacent permanent or ephemeral water bodies. The remaining juniper trees may be removed when native vegetation is planted or released in these areas to reestablish baseline shading conditions before the removal of juniper trees.
5. At least ten percent of the juniper trees greater than ten inches in diameter at breast height must be retained for wildlife in an upland project area.
6. Removed juniper trees may be used for soil bio-engineered stabilization and fish habitat structures, as appropriate.
7. Slash materials should be gathered by hand or with light machinery to reduce soil disturbance and compaction. Avoid accumulating or spreading slash in upland draws, streams, and springs. Slash control and disposal activities must be conducted in a manner that reduces the occurrence of debris in aquatic habitats.

Conifer/Hardwood Silvicultural Treatments: Upland Habitats

1. Upland silvicultural treatment plans must be reviewed and approved by the Fish and Wildlife Service before completing project activities.
2. Silvicultural treatments must not occur if they remove or degrade occupied or suitable unsurveyed habitats for federally listed terrestrial species.
3. Silvicultural treatments that would reduce vegetative habitat and cover must not occur in snowshoe hare habitat. Snowshoe hare habitat is considered areas where live limbs (*e.g.*, tree, brush, and limbs) can be reached by hares at snow depth.
4. Silvicultural treatments may occur in upland project areas that are at least 500 feet (*i.e.*, measured as a straight line distance from the nearest edge of the stand to the stream channel) from a fish bearing stream that contains federally listed aquatic species. The timber stand must also be on a slope of less then twenty percent to the stream channel.
5. Silvicultural treatments may occur in upland project areas that are at least 250 feet or two site potential tree heights away (*i.e.*, which ever is greater) away from a fish bearing stream that does

[38] "Silvicultural treatments" refers to removing or girdling dominate hardwood or conifer trees, removing understory vegetation to release existing hardwood or conifers trees; pre-commercial thinning timber stands to reduce hardwood or conifer stocking rates; planting hardwood or conifer seedlings to establish or reestablish timber stands; and removing ground fuels to reduce fuel loading.

not contain federally listed fish species. The timber stand must also be on a slope of less then twenty percent to the stream channel.

6. Silvicultural treatments may occur in upland project areas that are at least 125 feet or two site potential tree heights (*i.e.,* which ever is greater) away from a non-fish bearing stream. The timber stand must also be on a slope of less then twenty percent to the stream channel.
7. If the status of a stream (*i.e.,* whether it contains federally listed species) is unknown, then silvicultural treatments in upland project areas must adhere to requirements addressed in item 4 above.
8. Timber yarding techniques used during silvicultural treatments must not cause excessive soil disturbances and compaction.
9. Slash materials should be gathered by hand or with light machinery to reduce soil disturbance and compaction. Avoid accumulating or spreading slash in upland draws and springs. Slash control and disposal activities must be conducted in a manner that reduces the occurrence of debris in aquatic habitats.
10. Silvicultural treatments on upland project sites should maintain a visual barrier of undisturbed vegetation next to open roads to minimize or eliminate wildlife disturbances.
11. A project specific biological assessment must be written for silvicultural treatments that do not meet the criteria above. This process may result in NOAA Fisheries and the Fish and Wildlife Service issuing biological opinions under the Endangered Species Act for the project.

Revegetation Techniques

1. Native vegetation must be planted on disturbed project sites, where appropriate, and protected from further disturbance until new growth is well established. Non native vegetation may be used, but is subject to the conditions addressed in Appendix A1 under Restoration Materials (*see items 1, 2, and 3*).
2. Temporary or permanent fencing must be installed, as necessary, to prevent livestock access to revegetated sites.
3. Native vegetation should be salvaged, as appropriate, from areas where soil disturbance will be occurring on a project site and replanted later at the site.
4. Vegetative planting techniques must occur during the optimal planting period for the respective plant species and not cause major soil disturbance whether planting is done by manual labor or mechanical equipment.
5. Purchase plant materials from reputable suppliers or growers. These materials must be properly stored, handled, and planted.
6. Seeds used to grow seedlings should have been collected in an area where the environmental conditions (*e.g.,* elevation and range) closely match those on project sites. Refer to a tree seed zone map and ensure that every purchased box or bag of seedlings are clearly marked with the seed zone and elevation.
7. Improve seedling growth by removing competing plant species (*e.g.*, grasses) around them.
8. Employ the proper methods to protect seedlings from animal, insect, and environmental damages. Periodically examine seedlings for damages and diseases.

9. Surface application of plant fertilizers must be applied at agronomic rates, but not within fifty feet of any aquatic habitat.
10. Control and removal of invasive and non native plant species must be completed in a manner that eliminates the accidental dispersal of seeds or reproductive plant parts to other locations. Project personnel must complete the following tasks:
    - clean all equipment, vehicles, and tools used at a project site before going to a new location.
    - shake out all work clothes worn before leaving a project site.
    - change work clothes (*e.g.*, coveralls, gloves, and hats) if workers will be going to a new location.
    - launder work clothes frequently.
    - properly dispose of all invasive and non native plant materials removed during a treatment in a timely manner.