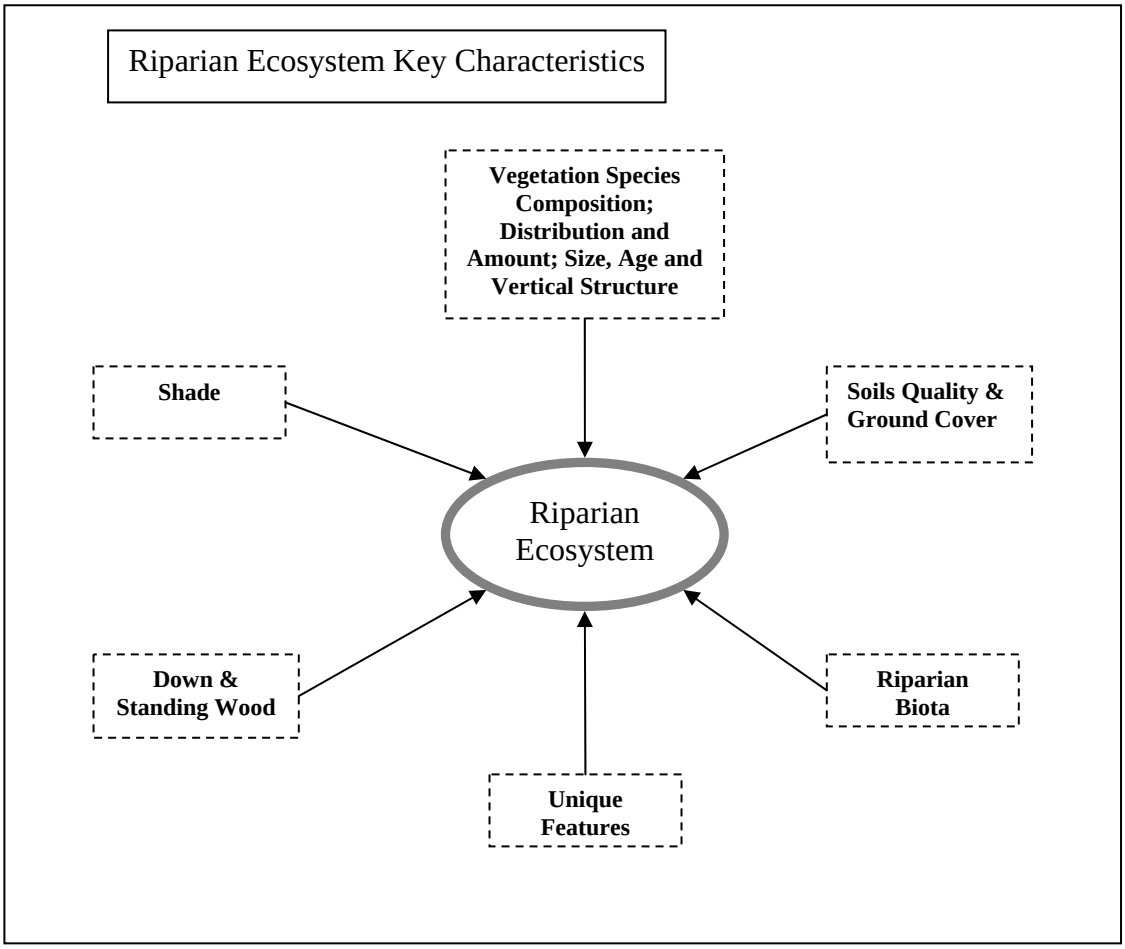
Riparian Ecosystems



Riparian Ecosystems - A transition area between the aquatic ecosystem and the adjacent terrestrial ecosystems identified by soil characteristics or distinctive vegetation communities that require free or unbound water (FSM 2526.05). This includes areas with distinct resource values and characteristics that are comprised of floodplains and uplands areas that have direct relationships with the aquatic system (Gregory *et al*. 1991).

Riparian Ecosystem Components

The basic building blocks of riparian systems include:

- Riparian biota.
- Riparian vegetation type, composition, structure, age and distribution
- Ground cover and soils condition and its contribution to site productivity,

- Unique habitats and features including shade, and dead and standing wood that contribute to for indigenous species; and

There is recognition of the importance of these features within riparian areas, forest management effects, their influence on habitat quality and relation to species status (FEMAT 1993, ICBEMP 1997).

Riparian habitats provide for many native animals and plants, including some that cannot live in other areas. Riparian areas provide wildlife corridors as well as being a refuge for animals in times of drought or fire. Riparian lands also act as corridors of natural vegetation, preventing species from becoming geographically isolated. The roots of vegetation provide essential habitat for fish by protecting overhanging banks, while large branches or trunks that fall into the water also provide shelter from predators. Inclusions or unique plant and animal habitat features within riparian ecosystems may include bedrock outcrops, waterfalls, and talus.

Natural disturbance cycles operating within riparian areas are fires, storms, floods and landslides. These disturbances act independently or in concert that keep the riparian ecosystem in a constant state of change. These disturbances and the transfer of energy create the habitat that riparian associated species depend upon for survival.

How Forest Plan Components Provide for Riparian Ecosystem and Species Diversity

Riparian ecosystem conservation cannot be accomplished by addressing a single risk or limiting factor. It requires a comprehensive approach that establishes a trajectory toward long-term sustainability. One of the forest plan goals is to establish a strategic management framework where rates and patterns of environmental variation are allowed.

The forest plan describes desired disturbance processes, and anticipates that those processes will continue to shape riparian ecosystem physical features and the associated native plant and animal species. Within this context, plan components establish a management framework that provides for habitats where native plants and animals are found. These plan

components are intended as an integrated conservation and restoration strategy; and to manage risk to native plants and animals from specific multiple use activities.

The combination of these ecosystem diversity and species diversity plan components provide a trajectory towards ecological conditions that in turn provide for native plant and animal species found within riparian ecosystems. However, there are specific life history requirements of high risk or rare species that may require specific plan components (fine filter) to assure their continued existence within the plan area. Based upon the life history and habitat requirements for riparian dependent species and the comprehensive riparian plan components, no additional plan components (fine filter) were identified. Overall, the watershed and riparian habitat plan components address the most significant features for this species group; abundance of clean cold water, complex habitat features, stable banks, etc.

Riparian Biota

Biological evaluation of organisms found within riparian habitats focused on those native plant and animal species typically found within the National Forest boundary. These riparian associated animals[1] include the Columbia River tiger beetle (sand bars), Idaho giant salamander (cold streams and lakes), Coeur d'Alene salamander (low-elevation waterfall splash zones), black swift (waterfalls), bald eagle, land mollusks, harlequin duck, and fisher. Riparian areas provide important habitat features for many sustaining other species, although these attributes may also be provided in the terrestrial uplands. For instance, dead and down trees provide forage and cover for woodpeckers and grasshoppers; and dense continuous vegetation provide foraging, thermal cover and travel corridors for elk and lynx.

To facilitate evaluation of native animal species diversity and the how plan components provide sustainable riparian environments, this evaluation focused on two amphibian species, Coeur d'Alene Salamander (*Plethodon idahoensis*) and Idaho Giant Salamander (*Dicamptodon aterrimus*). This group may prove as useful surrogates for other riparian

[1] See description of riparian plant community in the following section.

dependent or associated species. The reasons for focusing on amphibians as riparian ecosystem indicators include:

a. More is known about them, and therefore are more likely to discern important environmental relationships.
b. Their life history requires a terrestrial–aquatic interface.
c. They are widely distributed, which allows for broad-scale comparisons.
d. They are potentially more sensitive to disturbance than other species groups.

Habitat Needs

The amphibian group requires stream environments that have clean, cold water; along stream courses and near springs and seeps. Larvae of both species are aquatic. Adults are more terrestrial and seek cover under logs, bark, rocks, and other surface debris, typically in the riparian zones of streams and lakeshores but also in other moist upland environments.

Stressors

Human stressors (threats) to the amphibian group include habitat fragmentation, climate change, dewatering, dams, stream sedimentation, channel modifications, chemical pollution, and introduced predatory species. The level of Forest Service control over threats to the amphibian group is variable. Table 1 provides a summary.

Table 1. Degree of Forest Service control on stressors.

Stressor	Relative Degree of Forest Service Control[2]
Sediment (road system)	High
Non-native fish species	Low
Stream habitat connectivity	High
Mining	Moderate
Grazing	High
Mixed Ownership	Low
Dewatering	Low

[2]Control over threats is also influenced by the relative proportion of Forest Service ownership in any given watershed or stream network.

In some cases natural disturbances can exacerbate the level of stress on the amphibian group. For example, forest fires that burn in areas with dense networks of roads can cause a high potential of sedimentation.

Forest Plan Guidance: Forest plan components which apply to riparian biota were documented by cross-referencing to the specific plan components and briefly described (Table A).

Table A. Nez Perce National Forest plan components for riparian biota.

Forest Plan Components Section Reference	Plan Component Description
1.3.7.2	Water quality and quantity desired conditions.
1.3.7.3	Riparian vegetation desired conditions.
1.3.7.4	Aquatic habitat desired conditions.
1.3.7.5	Native and desired non-native aquatic species status and distribution desired conditions.
2.3.6.1	Watershed restoration objectives.
2.3.6.7	Aquatic habitat improvement objectives.
2.3.6.9	Aquatic program partnerships objective.
2.6.1	Riparian conservation area suitability.
3.2.7.5	Riparian vegetation guidelines.

By providing ecological conditions that sustain the amphibian species group, the critical assumption is the ecological conditions necessary to sustain other riparian associated animals are also provided. Even though these assumptions seem reasonable, there is some uncertainty because of the limited life history information on the most species in relation to the amphibian species evaluated. The higher risk scenario is that an individual species may have a unique habitat requirement that is not accounted for in the plan desired ecological conditions (coarse filter). The forest plan monitoring program includes riparian habitats and the process for adapting management plans based upon new information or changes in ecosystem characteristics.

Riparian vegetation types include forested and non-forested settings. Vegetation within forested riparian areas is described in breakland, upland and subalpine settings. The measurable characteristics include species composition and structure, distribution of size classes and openings. Species diversity groups influenced includes the **Terrestrial and Riparian Habitat Biota, and Cold Water Groups.**

Description: Riparian vegetation is particularly important because it supports high diversity of ecological processes and wide range of human activities. A well vegetated riparian area stabilizes river banks and slows flood flows so more water and nutrients can be processed on the floodplain. Without abundant deep-rooted plants, floods may strip topsoil from the floodplain and bank erosion can occur.

Primary production from riparian vegetation connects the aquatic ecosystem to the terrestrial ecosystem food web. Riparian vegetation provides important food sources including leaves, fruit and stems that fall into the stream and on adjacent uplands for a variety of aquatic and terrestrial animals. In addition, riparian vegetation is important in carbon sequestration - related to greenhouse gases and air quality.

Weather patterns, climate and natural disturbance regimes combine to create a landscape pattern of various species.

- *Wildfire:* Stand-replacing fire is tied to higher fuel loads and multiple canopy layers, as well as fuel moisture conditions. Mixed severity fires are more variable, and perhaps more weather dependent. They may occur where there are high fuel loads and multiple canopies if the weather has been moist and fuel moistures are moderate to high. The same site may experience stand-replacing fire when the weather has been drier and fuel moistures are low. Low-severity fires are associated with lower fuel loads and single canopy layers often found on dry sites or high moisture levels often found in riparian areas. With a variety of fire severities across the landscape, wildlife that need more dense stands can find their favored habitats, as can species that require more open conditions.

- *Insects:* Most bark beetles that kill trees are attracted to larger size classes. Defoliators are more likely to kill smaller host trees growing under a canopy of host trees. Most insects, without other disturbance factors, advance succession in forests, favoring shade-tolerant species and multiple canopy layers. Overall stand density is reduced (Byler and Hagle 2000).
- *Disease:* Most diseases result in less dense forests or younger size classes. They also strongly tend to increase coverage of shade-tolerant climax tree species (Byler and Hagle 2000).
- *Wind events:* These events can alter the distribution and amount of canopy cover and structural conditions.

Management Influences: Listed below are the primary land management actions that directly influence riparian vegetation. The actions italicized are ones that have the greatest potential to influence riparian vegetation.

- *Vegetation treatments in riparian conservation areas:* Harvest and other vegetation treatments in riparian conservation areas can greatly influence the species composition and structure, distribution of size classes and openings.
- *Roads in riparian conservation areas:* Roads result in a form of semi-permanent vegetation removal. Ground disturbance can also provide a seed bed for introduced plant species.
- *Dams and diversions:* Dams and diversions create changes in water flow that often results in pooling or widening of a water body, or lowering ground water tables. Drying out and flooding of vegetation resulting from a water storage facility over time results in riparian vegetation die off.
- *Facilities and campgrounds in riparian conservation areas:* Facilities and campgrounds create openings in the vegetation canopy. Many campgrounds and other recreational facilities are located in riparian conservation areas because people often like to be near water to recreate. In addition to the opening created by the campground or facility there is sometimes additional areas opened for safety reasons through the removal of ‘hazard’ trees.

- *Fire management:* Fire suppression efforts that create fire lines and safety zones in the RCA can result in significant localized change in riparian vegetation size class. Prescribed fires in riparian conservation areas can also result in more patchy vegetation distributions with smaller openings in the vegetation canopy.
- *Placer mining:* Placer mining operations include areas to gather streambed material, sort it, and deposit it. Placer mining often results in clearing riparian vegetation. Species composition, size class and distributions are often dramatically reduced due to placer mining.
- Grazing: Grazing and trampling can influence stream bank vegetation. Livestock can greatly reduce native shrub, forb and grass vegetation, which may be replaced by invasive plant species.

Forest Plan Guidance: Forest plan components which apply to riparian vegetation characteristics were documented by cross-referencing to the specific plan components and briefly described (Table V).

Table V. Nez Perce National Forest Plan components for riparian vegetation species composition and structure, distribution of size classes and openings.

Forest Plan Components Section Reference	Plan Component Description
1.3.1	Provides species composition and size classes that would be present if landscape dynamics (fire, insects and pathogens are the primary agents) were fully functioning.
1.3.1.2	Breaklands riparian tree species composition, size, age, and distribution desired condition.
1.3.1.3	Uplands riparian tree species composition, size, age, and distribution desired condition.
1.3.1.4	Subalpine riparian tree species composition, size, age, and distribution desired condition.
1.3.2	Desired condition of grassland riparian meadow native plant species.
1.3.7.3	Describes desired condition of vegetation composition and structure are similar to what would be expected with natural disturbance processes functioning.
1.3.7.3	Allows and describes desired disturbance processes in riparian areas.
2.3.6.6	Flood plain, wetlands and riparian habitat restoration objective 100 ac.
2.6.1	RCA suitability statement
3.2.7.4	Vegetation management guidance
3.2.7.5	RCA guidelines (1, 2, 3, 4 and 5)

Riparian Plant Species Group

This species group includes forested riparian, broadleaf riparian, canyon riparian, and mid- to low-elevation riparian meadows plant guilds, which contain 22 species and one plant communities, including four species of concern (SOC), 18 species of interest and one plant community of interest (SOI) (Table R). Distribution, habitat information, and population data for each species are available from the various sources cited in the plan component documents, including the Idaho Conservation Data Center and NatureServe database.

Table R. Species of concern (SOC), species of interest and plant community of interest (SOI) found within the riparian areas on the Nez PerceNational Forest.

Species	Common Name	Species Category (TEP* / SOC / SOI)
Cardamine constancei	Constance's bittercress	SOC
Cladonia andereggii	Anderegg's reindeer lichen	SOC
Collema curtisporum	Short-spored jelly lichen	SOC
Corydalis caseana ssp. *hastata*	Case's corydalis	SOC
Asplenium trichomanes	Maidenhair spleenwort	SOI
Carex leptalea	Bristle-stalked sedge	SOI
Carex synchnocephala	Manyhead sedge	SOI
Helodium blandowii	Blandow's helodium	SOI
Hierochloe odorata	Sweetgrass	SOI
Hookeria lucens	Light hookeria moss	SOI
Lobaria scrobiculata	Pored lungwort	SOI
Pentagramma triangularis	Gold-back fern	SOI
Petasites frigidus var. *palmatus*	Sweet coltsfoot	SOI
Pilophorus acicularis	Nail lichen	SOI
Polypodium glycyrrhiza	Licorice fern	SOI
Rhizomnium nudum	Naked rhizomnium	SOI
Rubus spectabilis	Salmonberry	SOI
Sedum leibergii	Leiberg's stonecrop	SOI
Sphaerophorus globosus	Ball-bearing lichen	SOI
Sphagnum mendocinum	Peatmoss	SOI
Thelypteris nevadensis	Sierra woodfern	SOI
Triantha occidentalis ssp. *brevistyla*	Short-styled triantha	SOI
Deciduous hardwoods	Cottonwood, willow, alder, dogwood, and birch, are the primary ones	SOI
***TEP** = USFWS Threatened, Endangered or Proposed		

Habitat Description: This set of guilds is associated with streams, wet meadows and their related floodplains that have regular flooding and deposition of sediments. Habitats include

streams that have *Populus trichocarpa* (black cottonwood), riparian shrub (alder, willow, dogwood, birch, etc.), and shrub/herbaceous communities along them.

These species generally require moist (or saturated) soil conditions throughout the growing season. Some of the lichens use the bark of deciduous trees and shrubs that grow in the riparian zone as their supporting substrate. In some cases, shade or partial shade (such as along ecotonal margins) is an important habitat component, in other cases, full or partial sunlight is an important need.

Management Influences: Listed below are the primary Forest Service management activities that may have direct or indirect impacts on species within riparian habitats:

- Ground disturbance activities such as road and trail construction reconstruction and maintenance, vegetation treatments, fire suppression, mining, and recreation use (either motorized or non-motorized). These activities may result in changes to the hydrologic regime, or introduction and spread of invasive plant species which compete with and displace native plants.
- Fire suppression effects to vegetation succession. Some species are adapted to different intensities of fire. When fires are suppressed, the ability to reproduce and expand may be interrupted.
- Activities that may trample or remove plants such as the collection of special forest products, animal grazing, and woods workers.
- Herbicide application and drift.

One stressor beyond Forest Service control includes long- and short-term climate change, which may increase the risk of desiccation due to increased and prolonged summer temperatures and/or drought conditions.

Forest Plan Guidance: Plan components that contribute to sustaining the riparian plant species group were documented by cross-referencing to the specific plan components and briefly described (Table P).

Table P. Nez Perce National Forest Plan components for sustaining the riparian plant community.

Forest Plan Components Section Reference	Plan Component Description
1.3.1.2	Desired ranges of forest Dominance types including references to riparian forest composition and disturbance for Breaklands.
1.3.1.3	Desired ranges of forest Dominance types including references to riparian forest composition and disturbance for Uplands.
1.3.1.4	Desired ranges of forest Dominance types including references to riparian forest composition and disturbance for Subalpine.
1.3.2	Desired conditions for grassland and shrubland vegetation, including riparian meadows.
1.3.3	Desired conditions for Rare Plants, with the desired condition that habitats for rare plants be conserved.
1.3.4.1	Desired conditions for riparian wildlife habitats.
1.3.5	Desired condition that invasive weeds not dominate the ecosystem.
1.3.7.3	Desired conditions for riparian vegetation, disturbance types and levels of disturbance.
2.3.6.6	Objectives to improve riparian vegetation on 100 acres.
3.2.7.5	Guidelines to maintain or improve riparian vegetation related to riparian function.

Summary: The forest plan recognizes the role of riparian sites in ecosystem diversity, and provide for continuity of this type. Within this context, the forest plan contains ecosystem diversity components designed to maintain or enhance this unique habitat.

The combination of these ecosystem diversity and species diversity components within the forest plan provides for ecological conditions that in turn provide for this guild of plant species.

Soil is a characteristic part of riparian and terrestrial ecosystems. Species diversity and all species groups ultimately depend on soil quality and long term soil productivity.

Description: Soil quality is the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation (FSM R-1 supplement No. 2500-99-1. 11/12/99 and Northern Region Soil Quality Monitoring Protocol: Technical Report, Shovic, draft 3-15-07).

Soil quality can be described in biological terms (relating to productivity), or physical terms (relating to stability). Productivity is generally related to soil nutrients and capacity for vegetation regeneration and growth. Stability is generally related to soil particle size and cohesion properties.

In an ecosystem setting, soils provide both these abiotic and biotic roles. The primary soil functions are to provide:

- Sustenance of biological activity, diversity, and productivity
- Soil hydrologic function (infiltration, water storage and transport)
- Filtering, buffering, immobilizing, and detoxifying organic and inorganic materials, and storing and cycling nutrients and other materials.
- Storing and cycling nutrients; and
- Providing support for buildings and other structures (trees) and to protect archeological and cultural features.

Unique combinations of landforms, climate, geologic parent material, and soils determine (in part) the distribution of plant species across the landscape. For example, some rare plant species will only occur in soils with high moisture content, such as the licorice fern, an endemic species in the riparian ecosystem. The soil environment provides a habitat for a variety of terrestrial animals such as burrowing mammals and land mollusks found near soil surface.

Soil disturbance and the loss of surface organic matter can interrupt the nutrient and carbon cycle and can reduce available habitat for many dependant plant and animal species. Other plant species such as western larch may depend on soil disturbance to expose mineral soil which provides a seed bed for regeneration and a competitive advantage for establishment over other plant species such as Douglas-fir.

Common landscape-scale natural disturbances to soils in terrestrial ecosystems are fire, floods, and storms. These natural disturbances act independently and together in affecting

surface erosion and landslide processes. Fires can cause the complete combustion of surface organic matter, and scorch topsoil creating nutrient and carbon cycle deficits and negatively affecting physical and biological soil conditions. Storm events can uproot trees exposing soils to erosion processes. Floods can rapidly remove and replace soils in riparian areas.

Management Influences: All forest management causes some level of soil disturbance. However, some levels of disturbance may be "detrimental" to long term soil productivity and stability (soil quality). Detrimental soil disturbances include the effects of significant compaction, puddling (smearing and sealing the soil surface), displacement, rutting, severe burning, surface erosion, loss of surface organic matter, and soil mass movement.

- *Timber removal:* Log skidding and operating heavy equipment can cause detrimental soil disturbance (compaction, puddling, rutting and displacement, loss of organic material) and result in decreased water infiltration and increased erosion potential. Productivity can be reduced through lowering of rooting potential and water holding capacity, decreased biological potential, and removal of the organically-enriched surface soil.
- *Fire suppression:* Suppression of fire causes fuel loads to accumulate above natural levels in some forest types. When wildfire occurs in these areas, the intensity and severity are often higher than they would be with more natural levels of fuel. However, many forest types (such as lodgepole pine) have evolved under high-intensity wildfires, and soils have evolved within this system. No measurable effects on soils occur in these ecosystems. Fire suppression activities such as construction of fire lines can cause detrimental soil disturbance by removing and compacting existing soils.
- *Prescribed fire:* Effects of fire can result in variable amount and distribution of ground exposure. Low intensity fires generally have little influence on ground litter removal, water infiltration and subsequent surface erosion. However, high intensity burns with high surface fuel loadings can change the physical and chemical properties of soils, and can substantially reduce overall soil productivity and quality. Fire line and safety zone construction can expose soil to erosion, result in spread of invasive species, and can reduce productivity through compaction and removal of surface soil.

- *Grazing:* Livestock grazing can have a variety of effects in terrestrial and aquatic environments. Grazing can compact the soil and reduce vegetative cover. This can result in reduced soil productivity and can cause unacceptable vegetatiive composition changes, as well as an increase in invasive species Livestock trampling and hoof chiseling in riparian zones can cause streambank erosion and associated sedimentation.
- *Permanent roads, mine sites, and rock quarries:* These features cause permanent soil surface removal. Compacted surfaces reduce water infiltration, and alter surface and subsurface water flow. Loss of ground cover can reduce the micro-habitat for a variety of terrestrial organisms, and can indirectly affect aquatic organisms.
- *Facilities and campgrounds:* Construction and use of campgrounds and facilities compact soil surfaces and reduce habitat for terrestrial organisms, and can even largely remove soil as a biological environment. Limiting water infiltration may result in a loss of micro-habitats, and can provide a sediment source to nearby streams. Associated human activities such as off-highway vehicle use on trails and stream bank trampling can also negatively affect soil productivity and stability.

Ground cover is a measurable characteristic within riparian and terrestrial ecosystems. Species diversity, most species groups, and indeed the soil itself all depend on the preservation of ground cover.

Description: Ground cover can be provided by live vegetation, rocks, or organic material such as logs, litter and duff. Ground cover protects the underlying soil from surface erosion due to raindrop impact, wind, and overland flow of water. It helps to maintain soil moisture which is important for nutrient cycling, infiltration, and conditions micro fauna and flora. Ground cover also provides nutrients to the soil as it decomposes and organic material for carbon cycling.

Larger physical components of ground cover (such as logs) provide habitat for macro-vertebrates. Small animals such as salamanders often make their homes under logs and rocks.

Animals that burrow under the litter and duff obtain some insulation from heat and cold. Overhanging ground cover can provide overhead protection for aquatic organisms.

Loss of ground cover can result in harsh, exposed habitats. In addition, lack of ground cover can result in loss of surface soil and sometimes underlying soil layers as well. Transported to streams, this material can result in high sediment-loading to aquatic habitats.

Management Influences: Ground cover is affected by most forest management activities, but the following have larger impacts:

- *Timber removal:* Log skidding and operating heavy equipment can cause temporary removal of ground cover, and sometimes permanent loss if associated with climatic changes, and if surrounding vegetation contains invasive species that reduce cover.
- *Fire suppression:* Suppression of fire causes fuel loads (and ground cover) to accumulate above natural levels in some forest types. These may result in higher-intensity fires and removal of ground cover outside of limits of natural variability. However, many forest types (such as lodgepole pine) have evolved under high-intensity wildfires, and cover types have evolved within this system. No measurable effects on cover types occur in these ecosystems. Fire suppression activities such as construction of fire lines can cause temporary or permanent changes in ground cover by removing vegetation and compacting existing soils.
- *Facilities and campgrounds:* Construction and use of campgrounds, and facilities compact soil surfaces and reduce habitat for terrestrial organisms, and can even largely remove soil as a biological environment. Limiting water infiltration may result in a loss of micro-habitats, and can provide a sediment source to nearby streams. Associated human activities such as off-highway vehicle use on trails and stream bank trampling can also negatively affect soil productivity and stability. Though the construction and use of these can directly affect ground cover, all these can also indirectly affect future cover by changing ecosystem parameters and subsequent vegetation composition and vigor.
- *Permanent roads, mine sites, and rock quarries:* These features cause permanent ground cover removal. Compacted surfaces reduce water infiltration and alter surface

and subsurface water flow. Loss of ground cover can reduce the micro-habitat for a variety of terrestrial and aquatic organisms. In riparian areas loss of ground cover from roads can reduce the micro-habitat for riparian dependent species such as amphibians.

- *Prescribed fire:* Effects of fire can result in variable amount and distribution of ground exposure. Low intensity fires generally have little influence on ground litter removal, water infiltration and subsequent surface erosion. However, high intensity burns with high surface fuel loadings can change the physical and chemical properties of soils, and can substantially reduce overall soil productivity and quality. Fire line and safety zone construction can expose soil to erosion, result in spread of invasive species, and can reduce productivity through compaction and removal of surface soil. Hence, fire can not only remove all ground cover, but may play a role in temporarily or permanently changing subsequent revegetation patterns and resulting cover.
- *Fuels reduction:* In addition to the direct effects of tree removal and heavy equipment, removal and maintenance of the reduced levels of ground fuels to below natural levels result in a net loss of ground cover. This may result in reduced vegetative productivity and habitat for terrestrial and aquatic species.
- *Grazing:* Livestock grazing can have a variety of effects in terrestrial and aquatic environments. Grazing can compact the soil and reduce vegetative cover. This can result in reduced vegetative productivity and can cause unacceptable vegetative composition changes, as well as an increase in invasive species. Livestock trampling and hoof chiseling in riparian zones can cause reduction in cover as well as detrimental changes in vegetative composition.

Forest Plan Guidance: Forest plan components which apply to riparian soil quality and ground cover characteristics were documented by cross-referencing to the specific plan components and briefly described (Table Q).

Table Q. Nez Perce National Forest Plan components for riparian soil quality and ground cover.

Forest Plan Components	
Section Reference	Plan Component Description

1.3.7.1	Desired conditions that soil physical processes reflect process and patterns as if landscape dynamics were fully functioning; surface soil erosion amount diminishes rapidly following disturbance.
1.3.7.3	Desired conditions that ground cover is typically comprised of organic litter, shrubs, grasses and forbs; exposed mineral soil is less than 1% in conserve-designated subwatersheds and less than 5% in restore-designated subwatersheds
2.3.6.5	Soil and water improvements objective 1,800 ac.
2.3.6.6	Flood plain, wetlands and riparian habitat restoration objective 100 ac.
2.6.1	RCA suitability statement
3.2.7.4	Ground-disturbing activities guideline
3.2.7.5	RCA guidelines (1, 2, and 4)

Shade is a measurable characteristic within the riparian ecosystem and applies to riparian conservation areas in the forest plan and supporting documentation. Species diversity groups influenced includes the **Cold Water and Riparian Habitat Biota Groups (T&E, SOC, & SOI Aquatics).**

Description: The ecosystem characteristic of shade is closely linked to water and air temperatures, riparian microclimate, and overhead cover for organisms in both aquatic and riparian habitats. The amount of solar radiation reaching a water body largely determines the amount of primary productivity that occurs within that water body. Primary productivity forms the foundation for the aquatic-based food web.

One of the most significant water quality characteristics for the Cold Water Group is water temperature. Water temperature is directly correlated to the amount of solar radiation reaching a water body. The amount of shade or openings in riparian ecosystems influences the amount of solar radiation reaching the aquatic habitat. For aquatic species, particularly those dependent upon cold water, high water temperatures can lead to stress and eventually death due to lack of oxygen. For amphibians that breathe through their skin cool microclimates provided by shade in riparian habitats are essential for keeping skin surfaces moist thus enabling oxygen exchange.

The width of riparian ecosystems and associated vegetative cover correlates well with degree of shade (Bechta *et al.* 1987). Effectiveness of streamside forest to provide shade varies with topography, channel orientation, extent of canopy opening above the channel, and forest structure, particularly the extent of both under- and over-story. Because riparian ecosystems are influenced by a variety of natural disturbances (fire, floods, etc), the degree of shade may vary through time.

Management Influences: Listed below are the primary management actions that influence shade. Italicized actions are ones that have the greatest potential influence.

- *Vegetation treatments in riparian conservation areas:* Harvest and other vegetation treatments in riparian conservation areas can greatly influence the amount of shade available to aquatic habitats. Both live and dead trees provide shade to aquatic habitats. In severely burned riparian conservation areas, standing dead trees often are the only shade available for many years until trees and other vegetation grow tall enough to provide shade. In addition, the disturbance of understory non-tree species during harvest operations, especially operations using ground-based equipment, can reduce shade.
- *Roads in riparian conservation areas:* Openings in the vegetation canopy created by roads increase the amount of shade reaching the ground. Where roads parallel or cross aquatic habitats, road-created openings can greatly increase the amount of solar radiation reaching an aquatic habitat.
- *Dams and diversions:* Dams and diversions create changes in water flow that often results in pooling or widening of a water body. Larger water bodies have less area influenced by shade and greater area available to solar radiation. Flooding of vegetation behind a water storage facility over time results in vegetation die-off and barren shoreline/bank areas which have little to no shade.
- *Facilities and campgrounds in riparian conservation areas:* Facilities and campgrounds create openings in the vegetation canopy. These openings result in less shade. Many campgrounds and other recreational facilities are located in riparian conservation areas because people often like to be near water to recreate. In addition

to the opening created by the campground or facility there is sometimes additional areas opened for safety reasons through the removal of 'hazard' trees.

- *Fire management:* Fire suppression efforts that create fire lines and safety zones in the RCA can result in significant localized reductions in shade. Prescribed fires in riparian conservation areas can also result in shade reduction, but it tends to be patchier with smaller openings in the vegetation canopy.
- *Placer mining:* Placer mining operations include areas to gather streambed material, sort it, and deposit it. Placer mining often creates open work areas within an RCA with little vegetation retained. Shade can be dramatically reduced due to placer mining.
- Grazing: Grazing can influence shade in riparian conservation areas dominated by non-forested vegetation. Livestock can greatly reduce shrub, forb and grass vegetation, which in non-forested systems can provide a large percent of the available shade to an aquatic habitat. In addition, livestock trailing, chiseling, and trampling of shoreline and stream bank areas can result in less shade provided by overhanging banks.

Forest Plan Guidance: Forest plan components which apply to riparian shade characteristics were documented by cross-referencing to the specific plan components and briefly described (Table S).

Table S. Nez Perce National Forest Plan components for riparian shade characteristics.

Forest Plan Components Section Reference	Plan Component Description
1.3.7.1	Allows and describes desired disturbance processes in riparian areas. Road densities in riparian conservation areas desired condition less than 1 mi/sq. mi.
1.3.7.4	Desired condition for specific water temperatures for the cold water group.
2.3.6.5	Road decommissioning and soil/water improvement objectives 150 miles
2.3.6.6	Flood plain, wetlands and riparian habitat restoration objective 100 ac.
2.6.1	RCA suitability statement
3.2.7.1	TMDL guidance
3.2.7.4	Vegetation management guidance

3.2.7.5	RCA guidelines (1, 2, and 4)
3.3.18	Streamside utility lines

Down and standing wood is a measurable characteristic within the riparian ecosystem group and applies to riparian conservation areas in the forest plan and supporting documentation. Species diversity groups influenced includes the **Cold Water and Riparian Habitat Biota Groups (T&E, SOC, & SOI Aquatics).**

Description: Down and standing wood in riparian areas serves many functions. Because of its close contact with the soil, downed wood provides moist, cool microclimates for organisms. Small animals often seek downed woody debris for hiding cover. When riparian woody debris extends into, or overhangs an aquatic habitat it can provide cover for aquatic organisms as well. As woody debris decomposes it contributes nutrients and carbon to the soil component of the ecosystem. The role of downed wood is essential to soil formation and productivity.

Down wood also provides ground cover. When down wood is in contact with the soil surface it can prevent surface erosion through interception of surface runoff. Down wood in riparian areas can help to prevent surface runoff from carrying sediment into a water body, such as a stream. Standing wood in riparian areas provides shade and habitat for cavity nesting birds. Standing dead trees are popular areas for many bird species to perch and nest.

The interaction of woody debris and aquatic habitats is very dynamic. Down wood in aquatic habitats affects the formation and distribution of habitat units, provides cover and complexity, and acts as a substrate for biological activity (Swanson et al. 1982, Harmon et al. 1986). Woody debris jams, and root wads can provide especially favorable complex habitats for fish. Wood can also influence channel morphology and the formation of pools (Bisson et al. 1987). Downstream transport rates of sediment and organic material are often controlled in part by storage of this material behind wood debris (Bescha 1979).

Down and standing wood in riparian areas provides wildlife habitat. Dead wood contributes to biological richness in many ways: as substrate, cavity sites, foraging sites, nesting or denning sites, food storage sites, runways and cover or shelter (Bull et al. 1997). The relationships of wildlife to woody material are extremely complex, and are analyzed by individual wildlife species or species groups such as big game, woodpeckers, small mammals, raptors, songbirds, carnivores, amphibians, and reptiles (Bunnell et al. 2002).

Natural disturbances that may affect the amounts of down and standing wood include fires, storms, floods and landslides. These natural processes usually reduce the level of standing and down vegetation. Wood recruitment to aquatic habitats can occur through a variety of methods. Common sources of wood include: falling in, blow-down, landslides, and beaver activity. Most wood entering aquatic habitats comes from the riparian area closest to the aquatic habitat within approximately one tree height (FEMAT 1993).

Management Influences: Listed are the primary land management actions that directly influence down and standing wood. The actions italicized are ones that have the greatest potential to influence down and standing wood.

- *Timber harvest:* Generally, long-term recruitment of large wood is reduced. Short-term increases of down wood may be seen where cull trees are felled. Log skidding and operating heavy equipment displaces down wood and ground litter.
- *Roads:* Roads that parallel or cross riparian areas create openings that reduce the amount of large wood recruitment. Dead standing trees are often removed along roadways for safety reasons through the removal of 'hazard' trees and firewood harvest.
- *Facilities:* Similar to roadways effects, permanent removal of forested vegetation reduces dead wood recruitment. Dead standing trees are often removed around facilities for safety reasons through the removal of 'hazard' trees and firewood harvest.
- Fire: Intensity of fire within riparian areas can result in variable amount and distribution of standing and down wood. Light intensity fires generally have little influence on large dead wood removal. Moderate to high intensity fire may remove

virtually all existing dead wood, and create a significant number of dead trees. Fire line and safety zone construction in or near riparian areas will reduce standing dead trees.

Forest Plan Guidance: Forest plan components which apply to riparian down and standing wood characteristics were documented by cross-referencing to the specific plan components and briefly described (Table W).

Table W. Nez Perce National Forest Plan components for riparian down and standing wood.

Forest Plan Components Section Reference	Plan Component Description
1.3.1	Desired condition to perpetuate the distribution of woody debris
1.3.7.3	Desired condition for standing snags ranging from 13 to 19 per acre on breaklands, 13 to 17 per acre on uplands, and 12 to 19 per acre on subalpine settings
1.3.7.3	Desired condition for down wood at the upper end of desired levels by setting. On breaklands, the range for riparian wood is 10 to 15 tons per acre; on uplands, 20 to 40 tons per acre; and on subalpine settings, 15 to 20 tons per acre.
1.3.7.4	Desired condition for large woody debris (applies to forested systems): Near-natural patterns in size and amount of in-channel large woody debris and potential wood on stream banks and flood plain
2.3.6.6	Flood plain, wetlands and riparian habitat restoration objective 100 ac.
2.3.6.7	Stream habitat improvement objective of 150 miles of stream.
2.6.1	RCA suitability statement
3.2.7.4	Vegetation management guidance
3.2.7.5	RCA guidelines
3.2.7.5	Guideline for trees felled in riparian conservation areas for safety concerns

Unique Features

The riparian ecosystem may include unique biotic and abiotic features which provide specialized habitat for plant and animal species. These features may be small ecosystems within the larger system such as a cave, or may be physical environment that provides certain site characteristics providing a niche for a particular species such as a rock outcrop or talus slope. No matter the size or complexity of the unique features, all ecosystem components are interconnected through a constant exchange of matter and energy. Change in any one

ecosystem component will cause subsequent changes throughout the system. Unique features identified in the aquatic ecosystem are caves, talus and rock outcrops.

Talus: Talus is the accumulation of broken rocks, usually coarse and angular, lying at the base of cliffs or other steep slopes from which they have been derived (Bates and Jackson 1984). These areas provide specialized habitats for a variety of ecologically restricted species, including such organisms as mollusks, amphibians and non-vascular plants. Talus slopes range from moist to dry, depending on the aspect and location with respect to climatic patterns (such as terrain-influenced rain shadows). Rocky substrates also occur on slopes and ridges, and may consist of shale or gravel material. Such areas are often ecologically harsh, and provide habitat for rare plant species.

Rock Outcrops: On a landscape scale, cliffs and rock outcrops are relatively rare, unique habitats. Once altered or destroyed, they cannot be replaced. Cliffs are steep, vertical, or overhanging rock faces, and rock outcrops are that part of a geologic formation or structure that appears at the surface of the earth. Outcrops can also include areas of bedrock that are covered by surficial deposits such as alluvium (Bates and Jackson 1984). The diverse topographic and environmental characteristics of such geologic settings often maintain rare vegetation associations and rare species. The ecological processes that occur on cliffs and rock outcrops are also unique. Spring and early summer precipitation, runoff, and ephemeral seeps are examples of such unique or seasonal processes or features. These habitats may be found in valley bottoms, montane, subalpine and alpine zones. Some bedrock types, such as limestone or granite, provide chemically differentiated substrates to which certain plant species, mollusks, or other organisms are restricted. This type of ecological restriction is known as edaphic endemism.

Caves: Caves are natural cavities, recesses, chambers, or series of chambers and galleries beneath the surface of the earth (Bates and Jackson 1984). The geologic formations in a given geographic area strongly determine the formation of caves. Formations that are more erosive, such as limestone, are most likely to have caves, and these are often sensitive or fragile to human impacts. Caves in granite are unusual, and unlike limestone caves, they are

not sensitive or fragile. Geologically, the eastern portions of the National Forests in Idaho and Montana lend themselves to the formation of caves, owing to the predominance of limestone bedrock in these areas. Caves provide unique habitat for several wildlife species.

Management Influences. The primary land management actions that directly influence flow regime or water quality can change habitat characteristics for species dependent on rock environments. Primary disturbances include road and trail construction, reconstruction and maintenance and construction. Mining and recreation use may have direct impact to rock substrate and species presence.

Forest Plan Guidance: Forest plan components which apply to unique features within riparian ecosystems were documented by cross-referencing to the specific plan components and briefly described (Table U).

Table U. Nez Perce National Forest Plan components for unique features within riparian ecosystems.

Forest Plan Components Section Reference	Plan Component Description
1.3.4.1	Desired condition for special habitats (wet fractured bedrock, rocky outcrops, calcareous geology, caves) are available for wildlife use.
3.2.4	Unique habitats guideline.

Integration: Plan components for land management actions that may influence riparian features were reviewed for conflict or compatibility with achieving riparian features desired condition (Table I). The focus of this review was plan components other than the riparian plan components. Criteria established for this matrix review include:

- Was there direct reference to the riparian features?
- Were there risks and uncertainties that might result in desired conditions not being met and therefore this characteristic not being able to contribute to ecosystem diversity?
- Did plan components allow for natural processes to occur (is the process hindered?) that will provide for the characteristic.

Table I. Results of forest plan components review to assess degree of compatibility or conflict with riparian features desired conditions.

Forest Plan Contents	Vegetation	Wood	Soils	Shade	Remarks
Forest Vegetation	+	+	o	+	Desired condition supports natural disturbance processes in riparian conservation areas.
Grassland and Shrubland Vegetation	+	o	+	o	Desired condition supports natural disturbance processes in riparian conservation areas.
Terrestrial Wildlife Habitat	+	+	o	+	Supports through reference riparian conservation area desired conditions.
Invasive Weeds	+	o	o	o	Desired native species dominance.
Soil Productivity	o	+	+	o	Indirect support.
Designated Wilderness	+	+	+	+	Desired condition supports natural disturbance processes in riparian conservation areas.
Research Natural Areas	+	+	+	+	Desired condition supports natural disturbance processes in riparian conservation areas.
Recommended Wilderness Areas	+	+	+	+	Desired condition supports natural disturbance processes in riparian conservation areas.
Road Management	o	o	+	o	Supports reducing chronic sediment and reduces road density effects.
Motorized and Non-Motorized Recreation Use	o	o	+	o	Motorized travel on designated routes only.
Dispersed Recreation	o	o	+	o	Soil resources protected through desired conditions.
Developed Recreation Sites	+	o	+	+	Includes a RCA desired condition for stream banks, cover and shade.
Recreation Special Uses	o	o	o	o	
Timber Availability	o	+	o	+	Timber production is not suitable in riparian conservation areas.
Wildland Fire, Fuels and Air Quality	+	+	o	--	Supports forest vegetation desired condition. Allows for some losses anticipated with wildland fires.
Livestock Management	o	o	o	o	
Minerals	o	o	o	o	
Utilities and Communication Sites	+	+	o	+	Guideline on riparian placement and stream crossings.
Administrative Facilities	o	o	o	o	
Matrix values: Forest plan contents supports (+), did not address (o), or conflicts (--) with ecosystem sustainability element.					

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