RIPARIAN RESTORATION
ZONES of AGREEMENT

July 2015

Blue Mountains Forest Partners

Zones of Agreement for the restoration and management of riparian areas on the Malheur National Forest prepared by the Blue Mountains Forest Partners.

Preface

The Blue Mountains Forest Partners (BMFP) is a diverse group of stakeholders who work together to create and implement a shared vision to improve the resilience and well-being of forests and communities in the Blue Mountains.

This document includes the BMFP's Zones of Agreement (ZOA) for Riparian Restoration. These ZOA began as a compilation of notes from field trips, subcommittee meetings, full group meetings, and a riparian workshop held in John Day, Oregon on October 16, 2014. A drafting subcommittee was then formed to create this document, and several subcommittee and full group meetings were held during 2014 and 2015 to develop agreement on the first iteration of the ZOA. All dates of approval and revision are noted below.

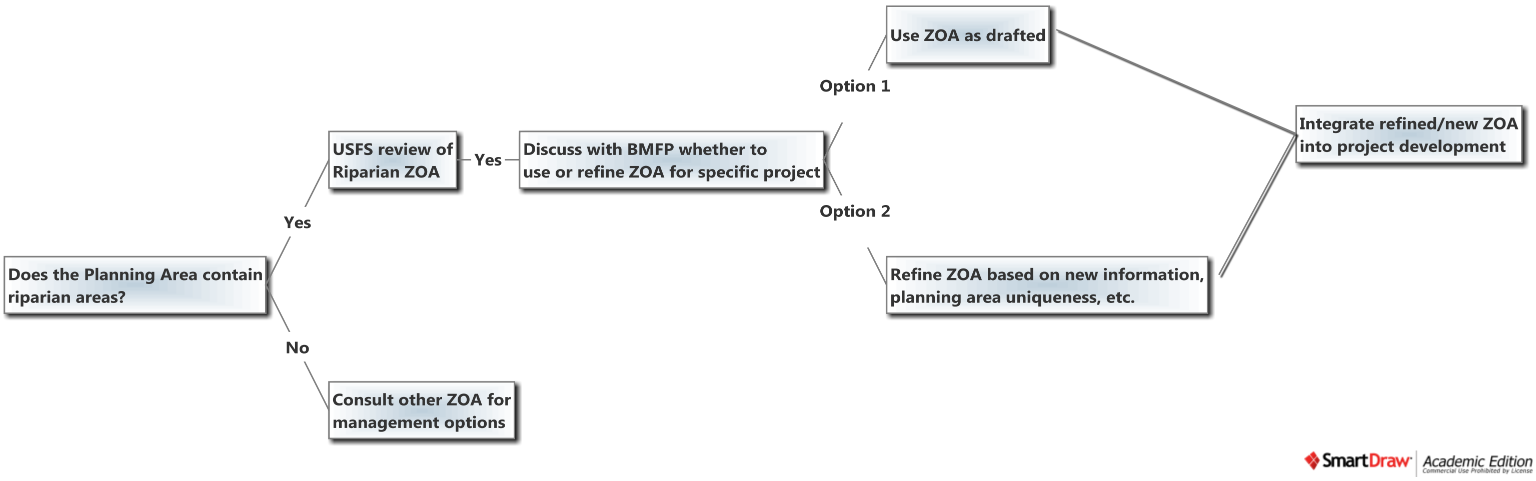
Zones of Agreement serve two purposes.

1. ZOA allow BMFP members and others to clearly understand what BMFP has discussed and agreed to with respect to a particular topic; here, riparian restoration. By documenting our own decisions, and the scientific and social rationale behind them, BMFP will be better able to track our agreements and progress towards addressing disagreements about forest management. This purpose can be thought of as "internal accounting and tracking" of our agreements.

2. The ZOA can be used by the United States Forest Service (Forest Service) to assess and track the level of social agreement around management of a particular forest resource (here, riparian systems) for use in Accelerated Restoration, implementation of the Southern Blues Restoration Coalition's Collaborative Forest Landscape Restoration Program, and other planning efforts.

    - BMFP envisions that as the Forest Service identifies a planning area for treatment, the agency will consult the ZOA for an assessment of the areas of agreement held by BMFP on that topic. The agency may then engage BMFP directly about the ZOA to determine whether they still reflect the thinking of this collaborative group, and whether BMFP would like to see them considered in the planning process as the Forest Service develops its purpose and need for the project: the ZOA can provide a quick overview of the "sideboards" or general sense of the level of agreement around management of a particular forest resource. BMFP and the Forest Service can then work together, along with other stakeholders, to develop project-specific applications of the ZOA as appropriate.

    - BMFP understands that the Forest Service retains the discretion and authority to deviate from these ZOA or any other proposal for action put forth by BMFP or others during the decisionmaking process. This process is displayed visually below:



BMFP expects that monitoring, additional shared learning, and experience may change the content and scope of these ZOA; and we believe that basic baseline information about site-specific riparian systems is necessary for BMFP to evaluate site-specific projects. For example, there are some issues that BMFP did not reach agreement on during the initial development of these ZOA, but may be able to come to agreement on after additional discussion. Similarly, we may find that some ZOA are too prescriptive, and do not warrant integration into project development. BMFP intends these ZOA to be a living document, subject to change based on collaborative discussion and agreement.

For ease of use and clarity, all BMFP documents (meetings, field trip notes, etc.) are referenced as footnotes whereas the scientific literature is cited in parenthesis and then listed in References. Where available, all references are provided as hyperlinks to PDFs and documents available on-line.

Full Group Approval: *July 16, 2015*
Subcommittee Approval: *July 7, 2015*
Revised:

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Introduction

Riparian systems in a dry forest landscape provide a disproportionate amount of plant and wildlife diversity and critical ecological processes, most notably water capture and retention that drives vegetation growth at the watershed and reach scale (Gregory et al. 1991).

Disruption of snowpack, rain, and seasonal temperature patterns (climate change) is predicted to increase the frequency and duration of droughts (IPCC 2007). Dry forest systems, such as those found on the Malheur National Forest (MNF), are predicted to be more heavily impacted through decreased soil-moisture and forest dieback (Allen et al. 2009, Anderegg et al. 2013). Critical to increasing forest resilience is maintaining water through restoration that increases moisture for tree and vegetation growth in upland forest systems (Grant et al. 2013).

Riparian areas are some of the most biodiverse habitats in dry forest systems and serve as important corridors for birds, mammals, and plants (Knopf et al. 1988, Naiman et al. 1993). These habitat types serve terrestrial and aquatic vertebrate species. On the MNF, this includes fish and amphibians and wildlife Management Indicator Species (see Table 7 and 18 in USDA Forest Service, 2014a for details).

Because riparian systems are critically important in the Blue Mountains generally and on the Malheur National Forest specifically, BMFP has undertaken the development of the following Zones of Agreement.

Riparian Restoration Zones of Agreement

1. **WHOLE WATERSHED APPROACH**
As it does with the placement and arrangement of terrestrial restoration activities, the Forest Service should evaluate planning areas for restoration opportunities based on the "biggest bang for the buck," as well as "the greatest good" for multiple resources, and should seek to maximize the impact of restoration treatments. This is especially true if limited dollars for restoration activities is available. The Forest Service should take a *whole watershed approach* to aquatic restoration, meaning it considers a full suite of restorative activities.

2. **HISTORICAL/CULTURAL STRUCTURES**
Where appropriate, the Forest Service, partner agencies, and state and county entities should evaluate the historical/cultural value of structures (mine tailings, historical railroad grades, Native American cultural sites) that may be impeding proper aquatic function and address whether retention of these features is consistent with riparian restoration. If inconsistent, the Forest Service should strive to minimize adverse impacts to these features, consistent with applicable forest plan standards and other laws (National Historic Preservation Act).

3. **LIVESTOCK OPERATORS**
BMFP understands that the Forest Service will work with permittees to facilitate livestock management along with recovery of aquatic/hydrological resources.[1]

4. **LIVESTOCK AND WILD UNGULATES**
Where riparian areas have degraded or impacted conditions from livestock (cattle, sheep, horses) and wild ungulates, the Forest Service should consider fencing or other deterrents in their aquatic restoration treatments.

5. **FIRE**
Like upland areas, riparian areas experienced historic fire, and in many cases are dependent on fire (particularly hardwoods and aspen). BMFP supports the reintroduction of fire into riparian areas, either by direct ignition or by allowing prescribed fire to "back into" riparian areas[2] as one of many tools available to restore riparian areas.

[1] Big Mosquito Riparian Subcommittee Meeting Minutes, 3/12/14.
[2] Big Mosquito Riparian Subcommittee Meeting Minutes, 3/12/14.

6. **ASPEN**

BMFP is very supportive of aspen restoration, and encourages the Forest Service to aggressively restore aspen as part of riparian restoration (see separate BMFP Aspen Restoration ZOA for more details).

7. **WET MEADOW RESTORATION**

BMFP supports meadow restoration/enhancement that cuts and removes conifers or creates down logs and snags (consistent with other Zones of Agreement) where conifers have encroached into meadow habitats, and reintroduces prescribed and wild fire into these systems.[3] These treatments should be tied to the surrounding vegetation type by developing site specific prescriptions for the biophysical group (Warm/Dry meadows, Cool/Dry meadows, and Moist meadows). Meadow boundaries should be determined through analyzing a mixture of site specific products, including but not limited to LiDAR maps, soil mapping done through the Terrestrial Ecological Unit inventory, site visits, and professional judgement and past aerial photographs.

8. **RECREATIONAL AREA THINNING**

In developed areas with high recreational value (i.e., Magone Lake), restoration treatments should be more intense, in order to protect recreational values and provide the public with emergency escape routes in the event of wildfire. Prescriptions should be based existing Zones of Agreement, but may involve the removal of additional trees in order to protect resource values, and should include the careful placement of skips, gaps, clumps, and groups in order to protect the visual quality of the area. The Forest Service is encouraged to conduct outreach to the recreating public to explain the proposed vegetative changes, which may take some visitors who have become accustomed to the existing conditions by surprise. The Forest Service is also encouraged to include interpretive signage for the recreating public.[4]

9. **LARGE WOODY DEBRIS/COARSE WOODY DEBRIS (LWD/CWD)**

The primary issue regarding large and coarse woody debris is that many wood-dominated riparian systems on the MNF have departed from wood loading levels known to provide for proper riparian processes and functions due to past silvicultural practices. Proper wood loading levels are important for proper aquatic processes and functions.

10. **BEAVERS**

BMFP supports the use of in-stream “beaver support structures” that encourage native species to assist in riparian restoration. Monitoring of the efficacy of these structures should occur. BMFP is also interested in beaver reintroduction, and encourages the USFS to explore this opportunity in the future.[5]

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[3] Full Group Meeting Minutes, 2/20/14.
[4] Magone Project Field Trip Minutes, 7/16/14.
[5] Summit Project Tour Minutes, 8/19/14; Camp/Lick Field Trip Minutes, 9/17/14.

11. LAKE RESTORATION

BMFP supports the introduction of "fish cribs" and "fish sticks" into lakes (i.e., Magone Lake) to provide fish and wildlife habitat. The efficacy of these structures, and any disadvantages for recreationalists, should be monitored.[6]

12. ROADS

Roaded access to the Malheur National Forest is important to many people for many reasons. However, some roads are causing aquatic resource damage. The Forest Service should undertake an analysis at the project level to determine what roads are causing aquatic resource damage, and propose road treatments and stream realignment to address the adverse effects of those road segments.[7] The NEPA analysis for road-related work should explain the tradeoffs associated with opening/maintaining roads vs. treatment.

13. CULVERTS

BMFP supports culvert repair, replacement, and upgrades to improve fish passage and other aquatic processes.[8]

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[6] Magone Project Field Trip Minutes, 7/16/14.
[7] Riparian Conservation Workshop, 11/22/13.
[8] Full Group Meeting Minutes, 2/20/14.

Additional Topics

These topics were discussed by BMFP, but there is not yet agreement on them.

Mine tailing remediation
Some members are concerned that these are historic structures, and have archeological value; other members would like to see mine tailings removed where they are adversely affecting proper aquatic function and process. While there is not universal agreement on this issue, BMFP encouraged the USFS to consider moving forward with this work, after adequate explanation and mitigation (i.e., interpretive signing, etc.).[9]

Historic railroad grade remediation
Like with mine tailing remediation, some members are concerned that these features have archeological and recreational value and should be retained, whereas other members believe that even if not entirely removed from the landscape (which may not be feasible), restoration work should occur that reduces the adverse impacts these structures are having on the landscape (i.e., cutting holes in the grade to allow streams to meander through them).[10]

Commercial thinning in riparian areas
Some members of BMFP would like to see riparian areas considered for vegetation management. These members point out that riparian areas can be overstocked and not properly functioning, just like many upland areas are outside of historic or sustainable conditions. Other members note that the focus of riparian areas should be aquatic function, and that timber production is not appropriate in these areas. There is a good deal of scientific information around riparian management, and an exploration of this data – along with field review – may be useful to developing agreement in the future.[11]

[9] Full Group Meeting Minutes, 3/20/14; Big Mosquito Riparian Subcommittee Meeting Minutes, 3/25/14; Full Group Meeting Minutes, 4/17/14. One BMFP collaborator has noted: "In his dissertation, Mark Tompkins evaluates all the scientific literature that supports restoring floodplains. Please, if it appears unclear that this restoration work will do any good, please take a look at the supporting science in Chapter 1 of this dissertation. https://sunsite.berkeley.edu/WRCA/restoration/pdfs/MTompkins_phd06.pdf

[10] Big Mosquito Riparian Subcommittee Meeting Minutes, 3/25/14; Camp/Lick Field Trip Minutes, 9/17/14.

[11] Full Group Meeting Minutes, 2/20/14.

Further Refinement and Considerations

These topics came up during the development of these Zones, and are suggested for future conversation and potential Zone development:

Potential Zones of Agreement for all the Tools in the Aquatic Restoration EA
The Aquatic Restoration environmental assessment and biological opinion has cleared the National Environmental Policy Act (NEPA) and Endangered Species Act (ESA) process. Many tools discussed in this document are in the Aquatic Restoration EA. It may be helpful to the group and our Forest Service partners to review those tools.

Beaver ZOA expansion
Consider expanding this Zone to include the ecosystem modifier role beaver can play in riparian systems.

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Appendix A: Supporting Information for Framework and Introduction

Management of riparian areas on the MNF is guided by the Malheur National Forest Land and Resource Management Plan (USDA Forest Service, 1990), as amended by the *Implementation of Interim Strategies for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and portions of California* (known as PACFISH), the *Inland Native Fish Strategy* (known as INFISH), and their corresponding biological opinions.

In addition, riparian restoration has been included in forest-wide Aquatic Restoration Environmental Assessment (hereafter Aquatic Restoration EA; USDA Forest Service, 2014a) and Decision Notice (USDA Forest Service, 2014b). The Aquatic Restoration EA is supported by a programmatic aquatic restoration biological opinion (ARBOII) prepared jointly by the United States Fish and Wildlife Service and National Marine Fisheries Service (2013).

Based on the best available science, experience, and expert judgment, we made assumptions in the development of these Zones of Agreement which include the following considerations.

- **Dynamic systems.** Riparian systems are dynamic, but are also intimately related to upland habitats.

- **Function and process.** Protecting and restoring proper *riparian function and process*, rather than *existing conditions*, should guide restoration projects.

- **Legacy effects.** Proper riparian process and function can be affected by management decisions, including road construction/use and domestic grazing, and is likely to be influenced by stressors outside of our immediate control (climate change).

- **The role of fire.** In the Blue Mountains, riparian areas are fire-dependent, in that they evolved with wildfire, and when properly functioning, are resilient to fire and other disturbance agents. Stand-replacing wildfires are a naturally occurring ecological disturbance process for cool/moist plant association groups (Stine et al. 2014). These wildfires, when followed by thunderstorms before ground-stabilizing vegetation regrows, can saturate hillslopes and draws and induce debris flows. Debris flows are also a natural disturbance process that provides a sediment supply in a variety of size classes necessary for proper aquatic function.

- **The importance of dead wood.** Stream functions and processes require dead wood in order to provide habitat for wildlife and to control the rate and amount of stream flow and runoff. Historical practices once targeted for removal large wood in streams, although contemporary research and monitoring demonstrate that in-stream wood is necessary for proper aquatic function.[12]

- **Climate change.** In the Blue Mountains, a 3.5 degree Fahrenheit increase in air temperature is expected by 2080, resulting in increased proportion of winter precipitation falling as rain rather than snow, and more rapid melting of what snow does fall. As a result, the average snowpack critical for maintaining stream flows during the dry summer months will be reduced. This alteration will cause lower base stream flows, elevate stream temperatures during critical summer months, and increase the frequency and duration of streams going dry.

- **Time frames and active vs. passive restoration.** Channel incision effects occur on time scales of 10-50 years, whereas aggradation (channel and valley building) can take 500-1000 years; and many of these time frames are longer than humans can easily comprehend and measure. Consequently, sometimes restoration will result in short-term adverse impacts to water quality, process, and function that will have greater environmental benefits in the longer term – even if this generation of collaborators is no longer present to experience the benefits. Similarly, some riparian areas will benefit greatly from active restoration, whereas others may benefit from passive restoration.

- **Monitoring is critical.** Effective monitoring is critical to ensuring the desired outcomes and efficacy of riparian restoration treatments, and to building social agreement around active management.[13]

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[12] Riparian Conservation Workshop, 11/22/13.
[13] See generally, *Monitoring Riparian Restoration Treatments* (7/20/14).

Appendix B:
Supporting Information for
Selected Riparian Zones of Agreement

The following information is provided for background only, and does not represent consensus agreement by BMFP.

7. LIVESTOCK AND WILD UNGULATES

FUNCTIONS and PROCESSES
Process that late seral riparian vegetation and channel form from proper ungulate management provides include nutrient production and delivery, shading, root reinforcement of banks, coarse wood supply, sediment retention, litter fall, flood storage, pool and bar formation, channel movement, pond formation.

Functions that late seral riparian vegetation and channel form provides include moderation of water temperatures through shading and hyporheic flows,[14] promoting water storage and riparian-dependent vegetation communities, retaining nutrients that form the basis of stream food webs, creating hiding cover or altering depth and substrate to provide spawning and rearing areas for fishes, and ultimately providing quality habitat for both terrestrial (ungulates, turkey, beaver) and aquatic organisms within riparian systems.

DESIRED CONDITIONS
Riparian hardwoods and herbaceous vegetation play an important role in shading, nutrient input, insect food webs for aquatic systems, and habitat for terrestrial systems. Shrubs, woody vegetation, and hardwoods may show browsing but are not suppressed from chronic herbivory from elk and deer. Hardwoods such as aspen, cottonwood, and alder should be escaping browse height (8') and recruiting into the overstory. Sedge plant communities dominate meadow stream banks and provide narrow and deep channel forms with abundant undercut banks.

TOOLS
Cattle, elk, and deer can act as an ungulate suite in that they may use riparian habitats across the same or multiple seasons having a cumulative effect (Stewart et al. 2002). Cattle spend a disproportionate amount of time in the riparian area and tend to over-utilize the forage that grows there (Clary and Webster 1989), largely due to upland grasses curing out around mid-July. Heavy use of riparian areas by livestock can negatively impact streambank erosion, morphology, and undercutting, in addition to soil compaction and degrading instream and terrestrial habitat (Kauffman et al. 1983, Gillen et al. 1985, Vavra et al. 2007). Chronic herbivory from deer and elk can suppress or remove woody species, shrubs, and hardwoods

[14] See Appendix A, page 18 for a definition of this process.

(Opperman and Merenlender 2000; Seager et al. 2013), altering nutrient input and shading for aquatic ecosystems and degrading terrestrial habitat. Livestock accessing a stream for water may trample banks and weaken root reinforcing herbaceous vegetation, negatively altering a stream though channel widening. Livestock grazing is thought to have the most potential effects to riparian areas in depositional valleys (slopes less than 3%).

The most effective means to decrease livestock impact is through fencing, upland water development, or low stress stockmanship (Gillen et al. 1985; Garnskopp 2001). Livestock fencing can work in areas with low ungulate densities, but deer and elk fencing should be used when chronic herbivory is a concern (Case and Kauffman, 1997; Opperman and Merenlender 2000). Areas where fencing is not feasible or only a deterrent is needed, the felling of trees to create hinging or jackstraw can be an effective tool (Seager 2010, Kota and Bartos 2010). Since conifer encroachment can interact with herbivory to decrease or eliminate hardwoods and shrubs, tools for addressing both should be used when needed (see Riparian Thinning and Meadow Restoration in this document). We recognize that fencing is expensive and must be maintained and that deterrents must be monitored for effectiveness due to varying herbivory pressure. If fencing is listed as an integral part of the Forest Service management plan for restoration, we would expect it to be installed in the same time frame as the other restoration activities.

Water source development should also protect native species (particularly amphibians)[15] and ensure that water is returned to the stream system.[16] Troughs would be placed far enough from the stream or surrounded with a protective surface to prevent sediment delivery to the stream. Steep slopes would be avoided, as well as areas where compaction or damage could occur to sensitive soils, slopes, or vegetation due to congregation of livestock. Livestock water developments would have a float valve or similar device, a return flow system, a fenced overflow area, or similar means to minimize water withdrawal and potential runoff and erosion. Additional details on these tools are described in the Aquatic Restoration EA (USDA Forest Service, 2014a). The effectiveness of these techniques has to be monitored.[17]

8. WET MEADOW RESTORATION

PROCESSES and FUNCTIONS

Processes that wet meadows provide include hyporheic flow, nutrient production and delivery, root reinforcement, sediment retention and storage, litter fall, flood storage, floodplain building, and primary production.

Functions that wet meadows provide include surface water storage in the short term, high water table maintenance and sediment accumulation, biodiversity contribution, moderation of water temperatures through hyporheic flows, riparian-dependent vegetation communities, retaining nutrients that form the basis of stream food webs, creating hiding cover to provide

[15] Full Group Meeting Minutes, 2/20/14; Big Mosquito Riparian Subcommittee Meeting Minutes, 3/12/14.
[16] Big Mosquito Riparian Subcommittee Meeting Minutes, 3/12/14.
[17] Riparian Conservation Workshop, 11/22/13; Big Mosquito Riparian Subcommittee Meeting Minutes, 3/12/14; Camp/Lick Field Trip Minutes, 9/17/14.

habitat for wildlife, and ultimately providing quality habitat for both terrestrial and aquatic organisms within riparian systems.

DESIRED CONDITIONS

Wet meadows would have wetland obligate vegetation species that would dominate the lower elevations driven by an elevated water table. Hydrologic processes would be landform dependent, meaning sheetflow processes spread water laterally out across the meadow. Warm Dry meadows would have open-grown ponderosa pine individuals and/or small groups around slightly higher elevations of the meadow boundary. Cool Dry or Moist meadows would likely have western large or Engelman spruce around the edges.

TOOLS

Conifers should be felled with a chainsaw or tipped with an excavator and placed into or directly adjacent to the stream channel. The prescription for felling conifers should strive to return the meadow back to historical conditions through active and/or passive restoration techniques. In Warm Dry meadows, this may require felling young (<150 years old) conifers. In Cool Dry or Moist meadows, retain certain species such as western larch or Engelmann spruce that historically resided in the meadow, and fell all other conifers. To protect stream shading, passive restoration techniques may be used to leave some trees along the stream and allow them to perish as the water table rises. Trees should be placed in a manner where branches interact with the stream to capture sediment, increase sinuosity or transition from gulley erosion to sheetflow processes, and ultimately reduce gullying.[18] As sediment is captured by the added roughness, the water table is expected to rise, soaking in more water during snowmelt runoff and storing more water in the soil column later into the summer. This will provide for expanded herbaceous and shrub communities laterally to the gulley flow direction. Riparian hardwoods and/or sedge plugs may be planted to facilitate stream root reinforcement and shading where needed.[19]

Channel reconstruction may be warranted to fill in the gulley of a meadow with alluvial, fine textured soil.

9. LARGE WOODY DEBRIS/COARSE WOODY DEBRIS (LWD/CWD)

PROCESSES AND FUNCTIONS

Process that LWD provides include channel and floodplain roughness that dissipates stream energies and encourages sinuosity, sorting of sediments, scouring of pools, promotion of leaf/twig influx, providing a diversity of stream velocities, and connection of the stream with its floodplain.

Functions that LWD provides include moderation of water temperatures through hyporheic flows, promoting water storage and riparian-dependent vegetation communities, retaining nutrients that form the basis of stream food webs, creating hiding cover or altering depth and

[18] Big Mosquito Riparian Subcommittee Meeting Minutes, 3/12/14.
[19] Big Mosquito Riparian Subcommittee Meeting Minutes, 3/12/14.

substrate to provide spawning and rearing areas for fishes, and ultimately providing quality habitat for both terrestrial and aquatic organisms within riparian systems.

DESIRED CONDITION

The desired condition is for streams in project areas to have appropriate wood loading levels as well as adequate sources for future wood recruitment that provide for above-identified processes and functions to be maintained in balance with the watershed; these levels would meet or exceed Forest Plan management objectives.

TOOLS

Where current wood loading levels and sources for future wood recruitment are inadequate to facilitate proper functions and processes, the Forest Service may use this suite of tools: tree-tipping on site or from uplands, felling and/or placement with UTV and log arch. Other tools that may be used are: placement of boulders and pre-digging scour pools where appropriate for stream type; a detailed description of the tools and their effects on riparian management objectives are described in the Aquatic Restoration EA (USDA Forest Service, 2014a).

Appendix C:
Processes and Functions: in detail

The following information is provided for background only, and does not represent consensus agreement by BMFP.

PROCESSES
Processes that drive habitat formation and biological responses in stream systems occur at both the watershed scale and the reach scale (Beechie et al. 2013). They are outlined here in detail so they can be referenced throughout the document.

Watershed Scale Processes:

I. Runoff and stream flow
- Interception – rainfall captured in the tree canopy where it evaporates
- Snow accumulation and melt - storage of water as snow thorough winter and release to streams during spring or summer melt
- Surface runoff – water delivered to streams by overland flow
- Subsurface flow – water delivered to streams by flow through the soil layer
- Hyporheic flow – water delivered beneath and alongside the stream bed where mixing occurs between shallow groundwater and surface water
- Groundwater flow – water delivered to streams via flow below the soil layer

II. Erosion and sediment supply
- Surface erosion – erosion of the soil surface by rain splash or overland flow
- Mass wasting – mass movement of soil by landslides, debris flows, and gullying
- Soil creep – gradual downslope movement of the soil mantle by gravity

III. Nutrient delivery
- Nutrient production and delivery – delivery to streams via litter fall, photosynthesis, dissolved nutrients, or anadromous fishes

Reach Scale Processes:

I. Riparian vegetation processes
- Shading – blockage of solar insolation by vegetation
- Root reinforcement of banks – additional soil cohesion of stream banks provided by roots
- Wood supply – delivery of dead trees to streams
- Sediment retention – trapping of sediment on bars and floodplains by vegetation
- Litter fall – leaf litter, needles and branches delivered to streams

II. Stream flow and flood storage
- Routing and stream flow – movement of water through stream channels

- Flood storage – slowing and temporary storage of flood waters on floodplains and in side channels

III. Sediment transport and storage
    - Sediment transport – movement of sediment by stream flow, in suspension or as bedload
    - Sediment storage or retention – deposition and storage of sediment in the stream channel, sometimes induced by wood, vegetation, or beaver dams
    - Floodplain building – deposition of suspended sediments on floodplain surfaces, sometimes augmented by the influence of vegetation

IV. Channel, floodplain, and habitat dynamics
    - Pool or bar formation – formation of pools and bars by hydraulic scour and deposition, often influenced by wood
    - Channel movement – channel movement by bank erosion (lateral migration) and avulsion
    - Pond formation – construction of beaver dams that create ponds

V. Organic matter transport and storage
    - Transport and storage of seeds and plants – seeds and plants transported by stream flow, and trapped in backwaters and on bars
    - Transport and storage of detritus – organic detritus (leaves, twigs, needles) transported by stream flow and trapped by bed material, wood jams, and in pools and backwaters

VI. Instream biological processes
    - Primary production – algae and aquatic plant production by photosynthesis driving aquatic food webs
    - Secondary production – production of aquatic invertebrates that consume algae, plants, leaf litter, and other organic matter
    - Feeding/predation – consumption of algae, plants, or invertebrates by fishes and other organisms; also predation of fishes by other fishes
    - Competition – competition among plants, invertebrates, or fishes for space or food resources

FUNCTIONS
Functions flow from the above processes and have key relationships to environmental goods and services (Naiman et al. 2005). Those functions, indicators that the functions exist, effects of the functions, and goods/services provided are outlined here in detail so they can be referenced throughout the document.

Hydrology and Sediment Dynamics Functions:

I. Surface water storage in the short term, as indicated by the floodplain connected to the stream channel; the effect is attenuation of downstream flood peaks which reduces damage from floodwaters.
II. High water table maintenance, as indicated by presence of flood-tolerant and drought-intolerant species; the effect is maintenance of vegetation structure in arid climates which contributes to regional biodiversity by providing habitat.
III. Sediment accumulation and transportation, as indicated by riffle-pool sequences, point bars, and terraces; the effect is contribution to fluvial geomorphology which creates predictable yet dynamic channel and floodplain dynamics.

Biochemistry and Nutrient Cycling Functions:

I. Organic carbon production, as indicated by a balanced biotic community; the effect is the provision of energy to maintain aquatic and terrestrial food webs which support populations of organisms.
II. Biodiversity contribution, as indicated by high species richness or plants and animals; the effect is maintenance of reservoirs for genetic diversity which contributes to biocomplexity.
III. Chemical constituent cycling and accumulation, as indicated by healthy chemical and biological indicators; the effect is interception of nutrients from runoff which supports aquatic and terrestrial food webs

Habitat and Food Web Maintenance Functions:

I. Streamside vegetation maintenance, as indicated by presence of shade-producing canopy; the effect is shading of streams during warm seasons which maintains conditions for cool-water fish.
II. Support of characteristic terrestrial vertebrate populations, as indicated by appropriate species having access to riparian areas; the effect is allowance of daily and seasonal vertebrate movements which provides for wildlife hunting and viewing.
III. Support of characteristic aquatic vertebrate populations, as indicated by fish migrations and population maintenance; the effect is allowance of migratory fish to complete their life cycle which provides fish for food and recreation

Appendix D:
Notes from Riparian Thinning: discussion and drafts

As mentioned earlier in these Zones, BMFP does not currently have agreement on commercial thinning in riparian areas. The text below preserves the discussion as it presently stands: there is not *consensus agreement on this topic, and it is only included here as a starting point for future discussions.*

RIPARIAN THINNING – from earlier drafts for future consideration

Riparian areas are places where aquatic function, and not timber production, is the management direction. Consequently, commercial timber harvest in these areas is expected to be rare, will be consistent with other Zones of Agreement (Franklin/Johnson/Van Pelt), and will only occur when riparian management objectives for wood loading are met and timber harvest would not retard meeting riparian management objectives into the future.[20] However, commercially valuable material may be a by-product of riparian restoration, and if not necessary for in-stream coarse woody debris or wildlife needs, it may be removed and the economic value captured.[21] The purpose of riparian treatments is to emulate disturbance pathways (i.e. wildfire) from the surrounding upland forest types (i.e., warm-dry, cool-moist, etc.), increase the heterogeneity of structural classes across the landscape, residual tree size post-thinning, encourage the growth and expansion of riparian hardwoods, restore historical species composition (i.e., reduce lodgepole pine incursion and favor ponderosa pine and larch establishment), add roughness to flood energies to capture gravels and create fish habitat (pools).[22]

Streamside shade is critical to maintaining stream temperatures that provide suitable habitat to biotic instream species (fish) for their extensive life cycle histories. Establishing the natural potential riparian vegetation communities that would have developed will benefit water quality as well as terrestrial and aquatic wildlife (bull trout) that depend on cold, clean water. Streamside shade within 1 site potential tree of the waterway (~150 feet) is particularly important.[23]

FUNCTIONS and PROCESSES

Processes that riparian corridors provide include hyporheic flow, nutrient production and delivery, root reinforcement, sediment retention and storage, litter fall, flood storage, floodplain building, and primary production.

Functions that riparian corridors provide include surface water storage in the short term, high water table maintenance and sediment accumulation, biodiversity contribution, moderation of

[20] Full Group Meeting Minutes, 2/20/14.
[21] Big Mosquito Riparian Subcommittee Meeting Minutes, 3/12/14.
[22] Summit Project Tour Minutes, 8/19/14.
[23] Riparian Conservation Workshop, 11/22/13.

water temperatures through hyporheic flows, riparian-dependent vegetation communities, retaining nutrients that form the basis of stream food webs, creating hiding cover to provide habitat for wildlife, and ultimately providing quality habitat for both terrestrial and aquatic organisms within riparian systems.

Water temperatures in the Middle Fork John Day Subbasin can be characterized into two different conceptual systems. These two systems differ because of their drainage efficiency. Subwatersheds like Big and Deadwood Creek that originate from high elevation glacial troughs have much cooler water in their headwaters. Whereas subwatersheds like Camp Creek do not have glacial trough landforms and tend to have juvenile fish kills because of water temperatures. ODFW (Jeff Neal) suggested that opening the canopy in Deadwood and Big Creek may have positive results for fish life cycle histories.

DESIRED CONDITIONS

Riparian corridors have vegetative assemblages that mimicked the species composition, density and structural stages that would have existed on the landscape given historical disturbance processes (e.g. wildfire, flooding). Riparian stands are more productive sites because of the presence of water. Given the historical disturbance processes would have continued, tree densities would have been lower than existing, a higher proportion of fire tolerant species and more structural diversity across the riparian areas. This would have allowed for openings in the canopy where riparian hardwoods would have dominated. Yet, there also would have been patches of denser areas with a mix of early and late seral species. Lower gradient areas would have extensive beaver dams with elevated water tables and more willow, cottonwood, dogwoods and other riparian hardwoods (depending on the site). The natural potential vegetation would provide quality habitat for the terrestrial and aquatic species that depend on these corridors for various parts of their life cycle history. Conifer canopy replacing hardwood canopy in riparian areas within the Blue Mountains was associated with a decrease in bird diversity and density (Bryce, 2006).

TOOLS

Conifers should be felled with a chainsaw or tipped with an excavator and placed into or directly adjacent to the stream channel. The prescription for felling conifers should strive to return the riparian corridor back to historical conditions through active restoration techniques. In Warm Dry meadows, this may require felling young (<150 years old) conifers. In Cool Dry or Moist meadows, retain certain species such as western larch or Engelmann spruce that historically resided in the meadow, and fell all other conifers. To protect stream shading, passive restoration techniques may be used to leave some trees along the stream and allow them to perish as the water table rises. Trees should be placed in a manner where branches interact with the stream to capture sediment, increase sinuosity and ultimately decrease stream power. As sediment is captured by the added roughness, the water table is expected to rise, soaking in more water during snowmelt runoff and storing more water in the soil column later into the summer. This will provide for expanded herbaceous and shrub communities laterally to the valley fall. Riparian hardwoods may be planted to facilitate stream root reinforcement and shading where needed.

An example of a silviculture prescription used for the Big Mosquito Planning Process includes:

<u>EXAMPLE</u>: Warm/Dry Riparian Thinning Prescription:
To move stands to the desired future condition, this prescription will have two components: the floodplain RHCA and the upland RHCA. The upland RHCA will be thinned from below using variable density thinning to 80 ft^2/ac. Leave trees in order of species preference: western larch, ponderosa pine, Douglas-fir, grand fir, lodgepole pine, and cut all western juniper that do not exhibit old tree characteristics. Leave approximately 5%-15% of the upland RHCA untreated as wildlife leave patches, except in wildlife corridors that overlap the RHCA. In wildlife corridors, leave approximately 10%-25% untreated so as to maintain canopy cover above 2/3 site potential.

The floodplain RHCA will have periodic openings ¼ to 1 acre in size created to stimulate or enhance the recruitment of hardwoods. The openings will consist of 20%-30% of the floodplain RHCA. These openings will be placed in areas that have high probability of hardwood recruitment or enhancement such as where live hardwoods are currently occurring, and where evidence suggests that hardwoods occurred in the past.[24]

<u>EXAMPLE</u>: Cool/Moist Riparian Thinning Prescription:
For this prescription the floodplain and upland RHCA will have three components: openings, variable density thinning, and leave patches. Leave patches will consist of approximately 45%-65% of the RHCA. Openings will consist of approximately 15%-25% of the RHCA. Openings will leave 0-40 ft^2/ac of basal area of early seral species and will be ¼ to 1 acre in size, with the potential to increase that size to 2 acres if stream shading recovers as planned.

The variable density component will consist of approximately 45%-65% of the RHCA. Thin throughout the diameter range to 80-180 ft^2/ac basal area to leave a multi strata stand. Leave trees should consist of approximately 30%-40% late seral species that include Engelmann spruce, Pacific yew, grand fir, and Douglas-fir. The remaining leave trees should be early seral species that include ponderosa pine, western larch, western white pine, and lodgepole pine.[25]

[24] Big Mosquito Riparian Subcommittee Meeting Minutes, 3/12/14.
[25] Big Mosquito Riparian Subcommittee Meeting Minutes, 3/12/14; Camp/Lick Field Trip Minutes, 9/17/14.