CONFEDERATED SALISH AND KOOTENAI TRIBES

Jocko River Master Plan: Executive Summary

A guide to ecological restoration activities in the lower main stem Jocko River corridor

Executive Summary

Prepared by the CSKT Fish, Wildlife, Conservation, and Wildland Recreation Program

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Jocko River Master Plan: A Guide to Ecological Restoration Activities in the Lower Mainstem Jocko River Corridor: Executive Summary

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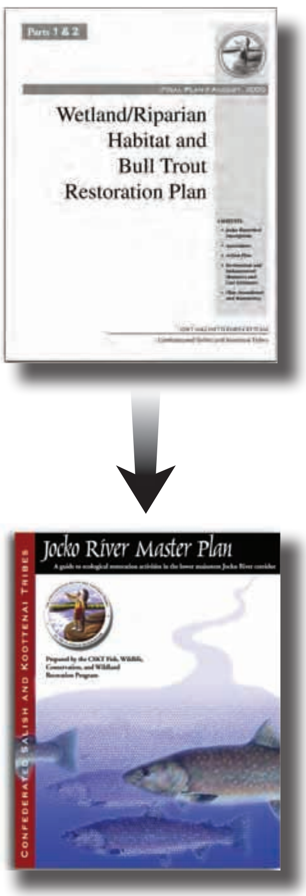
Executive Summary

In 1998, the Confederated Salish and Kootenai Tribes (Tribes) finalized a Consent Decree with the Atlantic Richfield Company (ARCO) to pay for the restoration, replacement, and/or acquisition of injured natural resources in the Upper Clark Fork River Basin as compensation for natural resource damages. Following an extensive natural resources inventory and a restoration-suitability analysis documented in the Tribes' *Riparian/Wetland Habitat and Bull Trout Restoration Plan: Parts I & II (2000)*, the Tribes decided to focus their restoration efforts on the Jocko watershed. They chose the Jocko River because it is most similar in size, stream flow, hydrology, and species composition to Silver Bow Creek and the Clark Fork River, the primary areas of injury in the Upper Clark Fork. The Jocko watershed is also a "core area" for the threatened bull trout and supports a relatively healthy population of westslope cutthroat trout, a Tribal Species of Special Consideration. The suitability analysis also showed that, among the various watersheds considered for restoration, the Jocko is at the greatest risk of further injury from future development.



The Jocko Restoration Plan tiers off the Clark Fork Settlement documents, Part 1 & 2.

Restoration measures are needed because the lower reaches of the Jocko River ecosystem have been substantially disturbed by agriculture, irrigation, livestock grazing, transportation infrastructure, and residential and commercial development. These and other aquatic resource impacts have destabilized much of the river and substantially modified bull trout and westslope cutthroat trout habitat, particularly downstream of the town of Arlee. They have also exacerbated the problem of competition for existing habitat between native and nonnative species and possibly increased the potential for hybridization between native and non-native fishes.

This Jocko River Master Plan (Master Plan) is an integral part of the Jocko watershed restoration effort. It tiers off of the *Riparian/Wetland Habitat and Bull Trout Restoration Plan; Parts I & II* (Restoration Plan). Part I of the Restoration Plan provides background information, while Part II explains our approach to watershed restoration. It states: "The basic goal of watershed restoration is to reestablish the natural processes that existed before the watershed was disturbed. Because we believe a comprehensive approach has a greater chance of succeeding, the goal includes reestablishing natural linkages between the terrestrial, riparian, and aquatic parts of the ecosystem. Our focus, however, will be on the protection and restoration of riparian and wetland areas because they have the greatest influence over the health of the watershed."

The watershed restoration process we have chosen involves four key steps:

1. Assessment
   Determine the watershed's environmental history. Identify the areas with restoration potential and the activities that led to the degraded conditions.

2. Protection
Identify the best available remaining habitats and protect them. Protection of intact ecosystems is typically less expensive and is often of greater importance to the overall restoration effort than restoring degraded systems.

3. Passive Restoration
Modify the activities that are causing the degradation or that are preventing the ecosystem from recovering. Many riparian areas are capable of rapid recovery with a modification of land use.

4. Active Restoration
Actively reconstruct hydrologic, physical, geomorphic, or chemical processes and patterns. In some situations, the impacts to an ecosystem have been so great that simply modifying or stopping the damaging activity is not enough. Without some kind of active restoration the ecosystem will remain degraded indefinitely.

We intend this plan to be an adaptive, living document that will, over time, incorporate new information.

Our restoration efforts target the lower 22 miles of the Jocko River from approximately four river miles upstream of Arlee to the confluence with the Flathead River. In contrast to the headwater sections, the lower river tends to have laterally extensive alluvial channel and floodplain reaches that alternate with laterally constricted channel and floodplain reaches. Groundwater upwelling occurs upstream of floodplain constrictions and initiates gaining stream reaches, spring brooks, and saturated soils. The lower 22 miles also have a heavy overprint of floodplain encroachment, riparian land conversion, and floodplain restriction, including levee construction and transportation rights-of-way.

The Tribes are advancing several other conservation and restoration efforts in the Jocko Drainage. Those efforts, while separate, dovetail with the objectives of this plan, and are reported upon in other, site-specific documents and ARCO annual reports, the latter of which record all efforts in the larger Jocko restoration program.

Purpose and Scope

The purpose of this document is to guide ecological restoration activities within the corridor of the lower main stem of the Jocko River. We synthesize scientific ecological information about the watershed, while focusing on the river's flows and their geomorphic relation to the floodplain. We also outline how restoration projects will be identified, planned, implemented, and monitored over time. Specifically, we describe:

1. Changes within the Jocko River system
We describe the changes that have occurred that led to the need for restoration. We do this by describing historical conditions and how land management and changes in flow regime have led to the existing conditions, essentially a channel environment that is no longer in dynamic equilibrium and that has habitat characteristics well below potential.

2. Restoration strategies and techniques
We present strategies for restoring the Jocko River that are based on sound principals of restoration ecology and that are tied specifically to the historical, existing, and desired future conditions along the Jocko River.

3. Desired future condition
We document restoration targets (our desired future conditions) and identify how they take into account infrastructure limitations imposed by roads, railroads, and the irrigation system.

4. The restoration process
We provide a specific framework for how projects will be planned, funded, permitted, implemented, and evaluated over time.

We envision the restoration of the Jocko River as a watershed-scale effort that will identify and assess linkages between sources of impact and ecological responses.

Each of these themes is described in more detail in the paragraphs that follow.

Changes within the Jocko River System

A variety of human activities have disturbed the Jocko watershed and affected natural processes therein. Natural processes are defined as anything independent of human influences that causes change within the watershed. They include but are not limited to floods, seed dispersal, fluctuations in groundwater levels, fish movement, river channel migration, riverbank erosion, wildfire, wind, and precipitation. These processes can be equated to energy inputs and transfers that drive different functions within the watershed.

Changes that have affected natural processes include:

- irrigation withdrawals from the Jocko River and its tributaries that have altered the river hydrograph;
- floodplain groundwater withdrawals that supply residential wells and active and abandoned fish-rearing facilities;
- conversion of forested and shrub land to agricultural land;
- leveling of land for agriculture that has simplified surface hydrology and interrupted wildlife movement corridors;
- construction of levees and berms, transportation corridors, and river channelization efforts that have confined flood flows, increased sediment transport and channel erosion, and caused extensive channel incision and a loss of floodplain connectivity;
- loss of near-bank riparian vegetation, which has resulted in higher stream temperatures, less woody debris recruitment in the streams, reduced sediment trapping and storage, and elevated rates of bank erosion;
- reduced sediment trapping and storage, which in turn has reduced fish spawning gravels, filled pool habitat, and decreased fish prey;
- construction of bridges that constrict the floodplain and cause backwater effects and increase localized scour;
- floodplain encroachment by residential and commercial building, which has caused the loss of riparian vegetation from the floodplain; and
- introduction of non-native plant, fish, and wildlife species that compete with native species for available habitat space.

Hydrology

Water is the most important component of any floodplain. Its source, quantity, quality, and timing are key among the many factors that define the character of riparian areas, wetlands, and channels.

In the lower main stem, irrigation diversions have reduced river flows by as much as 50 percent from the historical values in an average year, with more severe reductions in peak discharge in dry versus wet years. The Jocko River has responded to this overall reduction in peak flows by decreasing its channel capacity and sediment-transport capacity. Additionally, irrigation diversions have reduced the frequency of flood flows. Flood flows are important because they recharge floodplain groundwater and support diverse habitats adjacent to the river. Because the entire river ecosystem depends on a natural flow regime, reduced flows due to irrigation and groundwater withdrawals have diminished the overall functioning of the system. These changes limit our ability to restore the system to its historic condition.

Irrigation diversions have reduced river flows by as much as 50 percent from the historical values in an average year, with more severe reductions in peak discharge in dry years.

The channel of the Jocko River has responded in different ways to these changes. Some channel segments have decreased in size and conveyance capacity due to sediment aggradation and vegetative encroachment on the channel margins. However, along several segments, bankside management, including channelization and bank hardening, have restricted the connection between the channel and floodplain and focused stream energy on the active bank margins. In these reaches it is common to see very elevated bank sediment sources and incision adjacent to the disturbance. Downstream of these areas, coarse sediment deposition often leads to an overwidened, braided channel. Agricultural practices that have reduced vegetation on the riverbanks and floodplain have magnified the intensity of these effects. Hence, the cumulative level of floodplain disturbance often masks the reduction of channel size and conveyance capacity directly attributable to stream flow manipulation.

Vegetation and the Floodplain

Floodplain disturbances have simplified natural systems along the river. For example, since 1937, total cover of woody vegetation within the floodplain has decreased by 40 percent. The black cottonwood (*Populus trichocarpa*) and ponderosa pine (*Pinus ponderosa*) forest that historically occupied a major part of the river corridor contained some 50 native vascular plant species that included trees, shrubs, forbs, grasses and grass-like plants. The agricultural land that has replaced much of this forest habitat typically has fewer than five non-native and no native grass species. Similarly, floodplain areas with sloughs, brush piles, downed logs, and small areas of high ground have been cleared and graded flat. This has further reduced floodplain habitat diversity. Overall, topographic diversity has been reduced on the floodplain, and in several areas surface soil horizons have been disturbed. These actions appear to have intensified the magnitude of weed species establishment along the river corridor.

Fish Assemblage and Habitat

Currently, there are thirteen fish species in the Jocko River, six of which are salmonids. Historically, only three salmonids occupied the system: mountain whitefish (*Prosopium williamsoni*), bull trout (*Salvelinus confluentus*), and westslope cutthroat trout (*Oncorhynchus clarki lewisi*). Rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), and brook trout (*Salvelinus fontinalis*) have all been introduced and now occur in self-sustaining, wild populations. They pose an enormous threat to the native bull trout and westslope cutthroat trout populations[1].

Five key measures of fish habitat quality suggest the system is functioning well below optimum: water temperature is elevated, large woody debris is scarce, pool frequency and quality is generally poor, stream-bank condition is poor, and channel width-to-depth ratios are higher than they were historically.

Many of the currently viable, native salmonid populations occur in headwater areas and isolated tributaries. We are addressing these areas in the overall watershed restoration effort, but not directly in this plan. Preserving the connection between headwater fish refugia, the lower Jocko River, and the Flathead River system is critical to maintaining or expanding the distribution of native salmonids.

Riparian habitats like those found along the lower main-stem Jocko River support the highest diversity of breeding birds of any habitats in the western United States.

Wildlife

Riparian habitats like those found along the lower main-stem Jocko River support the highest diversity of breeding birds of any habitats in the western United States. Historical breeding bird communities along the Jocko River consisted of mostly neotropical migrants inhabiting deciduous habitat. Present day plant communities support many of the same bird species as well as non-native species like rock doves (*Columbia livia*), European starlings (*Sturnus vulgaris*), and house sparrows (*Passer domesticus*). These non-natives occupy nesting locations, compete for forage opportunities, and some are nest predators. A few native species, for example, least Flycatcher (*Empidonax minimus*) and Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*), are no longer found along the Jocko River.

Between 1993 and 2000, we conducted several amphibian and reptile surveys along the Jocko River, documenting four species along the lower main stem: long-toed salamander (*Ambystoma maculatum*), Columbia spotted frog (*Rana luteiventris*), Pacific chorus frog (*Pseudacris regilla*), and painted turtle (*Chrysemys picta*).

[1] *Bull trout are currently listed as Threatened under the Endangered Species Act. The Jocko River drainage was defined as a "core area" for bull trout in the* Middle Clark Fork River Drainage Status Review *by the Montana Bull Trout Scientific Group (MBTSG 1996). Core areas are considered strongholds for bull trout because they provide significant spawning and rearing areas (MBTRT 1998). Because it is a core area, the Jocko River is important in the overall recovery of the species within Montana. Currently bull trout occur primarily in the upper reaches of the Jocko River, above its confluence with Finley Creek. Westslope cutthroat trout are currently not protected under the Endangered Species Act; however, they were petitioned for listing pursuant to the Endangered Species Act and are a Tribal Species of Special Consideration and a State of Montana Species of Special Concern. The Jocko River watershed supports a relatively healthy population of westslope cutthroat trout.*

Mammal species using the river for food and as a travel corridor include: bobcat (*Felis rufus*), red fox (*Vulpes vulpes*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), mountain lion (*Puma concolor*), black bears (*Ursus americanus*), and grizzly bears (*U. arctos horribilis*). A few species—beaver (*Castor canadensis*), muskrat (*Ondatra zibethica*), and river otter (*Lontra canadensis*)—depend exclusively on the river for survival.

Cultural Resources

The Jocko River Watershed is an important cultural resource to members of the Confederated Salish and Kootenai Tribes. It serves as a place to hunt, fish, harvest food and medicinal plants, and conduct many other traditional practices. In 1974, the South Fork of the Jocko Primitive Area was set aside by the Tribal Council as a recreational and cultural use area. In 1979 use of the area was restricted to Tribal members and their families. In 1990, the South Fork of the Jocko Primitive Area was expanded to include several drainages to the northwest. Logging is no longer permitted in the area. The Jocko Range, which includes a portion of the South Fork of the Jocko Primitive Area and which borders the federally designated Rattlesnake Wilderness, contains one of the largest roadless tracts on the Reservation. The mountains are crossed by a series of backcountry trails that lead to high mountain lakes. The entire area is valued for its pristine environment and opportunities for solitude. Recent natural resource mitigation awards from the relicensing of the Kerr Hydroelectric Facility and ARCO afford the opportunity to protect and enhance this critical watershed for native species so that future generations of Tribal members may enjoy it as well. The Arlee Celebration Grounds, located just outside of Arlee, is the site of the annual Fourth of July Powwow Celebration, one of the largest cultural events on the Reservation.

Restoration Strategies and Techniques

Basic Concepts

Our conceptual approach to restoration is based on a combination of field experience and a review of the scientific literature. Most of the restoration strategies and techniques that we have selected are aimed at restoring natural processes that will result in a sustainable ecosystem structure. Descriptions of some of the key concepts underlying many of our restoration strategies follow.

Ecological Flows

Often, minimum instream flows are used as a measure of the water requirements of native fish populations. However, the concept of an ecological flow recognizes that river systems are too complex to set flow thresholds in terms of simple minimums and maximums. Hill et al. (1991) define four types of flows that support the ecological and geomorphic components of a river system: instream flows, channel-maintenance flows, riparian-maintenance flows, and valley-maintenance flows. These flows affect conditions in the channel, channel shape, streambank vegetation succession, and floodplain shape respectively.

All four types of flows influence fish habitat. Instream flows maintain minimum water flow in critical habitat units, keeping riffles wet and pools inundated. Channel-maintenance flows provide the stream power to transport sediment and maintain sediment budgets as well as maintain high quality spawning gravels. Riparian flows affect overhanging bank cover and the availability of large wood for complex instream habitat. Valley-maintenance flows, although infrequent, determine the architecture of the floodplain environment and the interconnection between the floodplain and active channel.

Ecological Function

Ecological functions are the measurable products that arise from water, geology, climate, vegetation, wildlife, and fish co-existing as components of an ecosystem. Since the 1980s, the government agencies regulating activities in natural systems have sought ways to measure impacts to these systems. Initially, they measured impacts in terms of how much area was affected by a particular activity. Recently, however, scientists have developed methods to measure changes in natural systems in terms of ecological function. For the Jocko River, we chose the method described in *A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Riverine Floodplains in the Northern Rocky Mountains* (Hauer et al. 2002), hereafter referred to as HGM. We selected HGM because it was developed by researchers in the northern Rocky Mountains specifically for rivers similar to the Jocko and because it is quantitative in nature, allowing us to evaluate our progress towards meeting the goals outlined in the Consent Decree.

Healthy River Structure

The lower 22 miles of the Jocko River flow through sediments that the river has transported in the recent past and so is referred to as an alluvial river. Alluvial river systems are self-formed: their pattern and size are the result of interactions between sediment and water movement in the recent past. (This contrasts with a bedrock river, where the river is only able to modify the floodplain environment at very slow rates through abrasion of the bedrock itself.) While in places the lower main stem is constrained by bedrock, steep canyons, railroads, roads and bridges, in alluvial sections it migrates back and forth across its floodplain.

Trush et al. (2000), in the Proceedings of the National Academy of Sciences, described ten attributes of alluvial rivers and how they relate to water policy and management. The attributes broadly characterize a unifying set of natural processes that, when supported, will maintain dynamic geomorphic and ecological processes and the habitats that derive from them. Our restoration strategies address processes encompassed by these attributes:

1. Differential Flows

   Differential flows refer to both the annual and interannual variability in stream flow, simplified and described above as the instream, channel, riparian, and floodplain flows that are necessary to support biological life cycles and geomorphic stability. Our restoration strategies are designed to repair the processes that are dependent upon these flows.

2. Alternate Bar Sequences

   Alternate bar sequences are regularly spaced deposits of alluvial material — sand, gravel and cobble — and often integrated woody debris. The types of sediments and how they are sorted reflect how the river expends its energy by scouring and subsequently depositing its sediment load during channel-forming and higher magnitude flows. Bar deposits are typically located on the inside of a meander bend opposite pools, although alluvial bars form behind obstructions, such as mid-channel bars, and as alternating features in lower sinuosity reaches. Their development is critical to the reestablishment of riparian plant communities along the river margin. Active restoration strategies include reestablishing conditions that maintain bar deposits.

3. Channel and Floodplain Interconnection

   Channel and floodplain interconnection refers to the connection between the river and its floodplain. In situations where this has been lost, the channel is incised or below the level of the floodplain. Consequently, floods are no longer able to disperse onto the floodplain. Instead, they focus their power and erosive energy on bank margins, disrupting the dynamic equilibrium between water yield and sediment load that characterizes natural alluvial rivers. Within-stream processes affected by the loss of connection include pool infilling, excessive bank instability, and alternating patterns of incision and channel braiding. Floodplain processes affected include soil saturation and floodplain scour and fill. One of our key restoration strategies is to ensure channel and floodplain interactions by raising river-bed elevation or moving the channel to pre-disturbance locations, where it can access its floodplain.

A river that is connected to its floodplain, has a natural flow regime, and that is allowed to migrate unrestricted across that floodplain is more likely to exhibit the other attributes of a natural, healthy alluvial river. Thus, restoration actions can indirectly influence other attributes of an alluvial river. These other attributes include (Trush et al. 2000):

- Channel bed materials move periodically;
- Depositional bars are periodically scoured and renewed;
- The amount and size of sediment moving into the system equals the amount and size of sediment moving out of the system;
- Floodplains are frequently inundated by riparian flows (another way to say the river is connected to its floodplain);
- Large floods occasionally change the shape of the floodplain by scouring depressions in some areas and depositing sediment in other areas;
- Riparian plant communities are sustained by certain flows; and
- Groundwater is connected to the river channel.

Similarly, the functions that the HGM methodology measures are based on these attributes, as are each of our restoration strategies.

Throughout this document, we discuss restoring the river's structure in terms of Rosgen's (1994, 1996 and 1998) Natural Channel Design philosophy. This approach emphasizes the importance of understanding natural channel evolution when designing a restoration project. At its heart is the concept of dynamic equilibrium (Lane 1955)—a river pattern adjusts to maintain a balance between water and sediment loads. Impacts associated with various land uses can disturb the river pattern and other ecological habitat elements that are dependent on it. Natural channel design is a well-grounded, practical application of river science that bridges the gap between research and the implementation of active restoration projects.

Maintaining a Comprehensive Ecosystem Approach

Stanford et al. (1996) provide an example of a conceptual framework for thinking about river restoration at the watershed scale. Upstream river reaches are sources of nutrients and sediment that tend to accumulate in downstream alluvial reaches. Fish, plants, and animals inhabit niches along this river continuum. Because the lower 22 miles of the Jocko River are part of an alluvial section that stores sediments, coarse and fine woody material, and nutrients, they have inherently high biodiversity, which is one of the reasons the reach has the highest priority for restoration work.

Stanford et al. (1996) developed a list of protocols for restoring regulated rivers. While the Jocko River is not regulated by a single large dam, it is regulated by a large irrigation infrastructure and so many of the same protocols apply. They include:

1. Consider the whole river continuum
In addition to work described in this document, the Tribes are working to improve flow regimes, eliminate fish entrainment into canals, reduce sediment inputs from forest roads, shift grazing to less fragile places within the watershed, and manage populations of non-native species throughout the watershed.

2. Restore habitat complexity but let the river do the work
Restoring the river requires some physical rebuilding of the channel and floodplain. However, this rebuilding is limited to what is necessary to allow natural river processes to work and naturally reconstruct river and floodplain habitat over the long term.

3. Maximize fish passage efficiency
Eliminate barriers that limit the ability of healthy fish populations to connect with and repopulate areas of formerly degraded habitat. Because of the presence of abundant non-native populations, this protocol will be balanced with the need to separate intact native fish populations from areas populated by non-native fish species.

4. Minimize non-native fish introductions
This has already occurred. Managing existing non-native populations is essential to restoring populations of native fishes.

5. Be wary of trying to directly control riverine food webs
Experience in other river systems suggests that attempting to directly control non-native fish populations may hurt native populations as well. It may be better to focus on restoring natural flow regimes and other river and floodplain processes that will favor native species over non-native species.

6. Use adaptive management
Adaptive management means acknowledging that ecosystems are complex, and we must be willing to adapt our restoration approaches based on what we learn by monitoring early restoration efforts. Our first large project completed in 2004 is referred to as the Demonstration Reach project. While it was intended as a way to demonstrate restoration strategies, it also provides a way to monitor the effectiveness of various strategies. What we learn will inform future restoration projects.

Passive Versus Active Restoration

For the purposes of this document, we define passive restoration as changing the way land is managed to remove the impacts that impinge on the natural processes required for the ecosystem to function properly. Passive restoration is appropriate where natural processes can be restored within an acceptable time frame. Active restoration is defined as physically modifying ecological components where negative changes to processes have reduced the system's ability to recover by itself within an acceptable time frame.

The Restoration Plan (CSKT ARCO-Settlement ID Team 2000) outlines a restoration strategy that utilizes passive techniques first and implements active measures only after it has been determined that passive restoration can not meet the desired objectives. This approach has two major advantages. First, land management activities that limit natural processes often limit the effectiveness of physical intervention. So, to improve the chances that active restoration measures will succeed, it makes sense to start by changing negative land management practices. Second, changing management usually results in lower overall restoration costs, particularly in situations where the ecosystem retains enough of its original components and processes to recover on its own.

While it is important to distinguish between passive and active restoration, most of the strategies described in Section Three of this document rely on a combination of active and passive approaches. In practice, restoration itself is a process that occurs over time. A holistic restoration program may follow a path that includes changes in land management—for example, eliminating livestock grazing or restoring stream flows (passive)—followed by channel reconstruction or revegetation (active), followed by a period of observation and monitoring (passive), followed in turn by additional active intervention informed by careful analysis of data collected during monitoring. The proportions of passive and active restoration within a particular strategy depend on site-specific circumstances.

Strategies

Channels requiring active restoration are divided into two categories for treatment: (1) those that are still hydrologically connected to the floodplain but lack either proper pattern, dimension, profile, or habitat features and (2) channels that have lost their hydrologic connection to the floodplain because they are incised or isolated from the floodplain by infrastructure.

Strategies for streams falling into the first category vary widely, but include:

- restoring the pattern, dimension and profile— the planform—of the channel system;
- reactivating abandoned meanders;
- eliminating elevated bank sediment sources; and
- stabilizing banks and enhancing aquatic and riparian habitat to meet desired future conditions.

Strategies for streams that have lost their hydrologic connection include:

- reconstructing an appropriate stream type at the original floodplain elevation;
- reconstructing an appropriate stream type and floodplain at the existing channel elevation;
- reconstructing a less desirable stream type at the existing channel elevation; and
- stabilizing the existing channel.

For the most part, strategies designed to restore specific stream types are designed around natural channel evolution pathways. Plant community dynamics, described in Hansen et al. (1995) provide a good model for determining appropriate planting pallets and target plant communities given existing vegetation, hydrology, soils, and knowledge about land use history. HGM cover types provide a useful framework for determining which types of floodplain treatments are appropriate throughout the project area.

Self-design, as described by Middleton (1999) is an approach to ecological restoration that emphasizes the ability of a wetland to organize itself around engineered components. With this approach, the emphasis is on using the minimal amount of intervention necessary to restore a missing process in order to allow the ecosystem to function and change naturally. For example, restoring a channel cross-section (the engineered component in this case) may result in a locally higher water table. The higher water table, in turn, creates conditions where hydrophytic or water-loving vegetation can grow. If the land is minimally disturbed, a seed bank may already exist and weed control may be the only vegetation management necessary to produce a native wetland plant community.

The above scenario contrasts with designing a wetland without providing for self-sustaining hydrology. In the latter case, continued intervention may be necessary to sustain the wetland. Our restoration strategies and techniques emphasize restoring processes first. Once processes are restored, components and structure follow, resulting in positive functional shifts that will serve as measures of overall restoration program success.

Desired Future Condition

The fundamental objective of watershed-scale restoration in the Jocko Drainage is to restore natural physical and biological processes. Essentially this means recreating conditions throughout the floodplain that allow disturbance processes like floods to create, sustain, and enhance habitats and the connections between them. On the lower alluvial sections of the river our fundamental objective or desired future condition is to promote an alluvial channel and floodplain system that maintains a dynamic equilibrium capable of supporting appropriate reach-scale channel features and self-sustaining, diverse riparian and wetland systems. Both objectives at these larger scales are somewhat abstract and difficult to measure, but they form the standard and justification for restoration in the watershed.

Unlike other broad alluvial valleys in western Montana, low population densities and rural land uses in the Jocko Valley afford exceptional opportunities for restoring the historical function of the Jocko River corridor.

At the project-level, or river-reach scale, desired future conditions become more tangible and are measurable. Examples of some of these desired future conditions include:

- restoring the hydrology of the river system through water management operations and conservation;
- restoring the alluvial river attributes, including dynamic equilibrium between water yield and sediment budgets, alluvial gravel bar formation and recurrent inundation and scour, channel and floodplain interconnectivity, and appropriate channel planform and profile;
- restoring native cottonwood , willow, shrub, and other riparian wetland communities;
- managing fish by suppressing non-native populations, increasing connectivity among diverse habitat components, and preserving key meta-populations;
- preserving and enhancing cultural resources by creating opportunities for solitude, for travel along the Jocko River, and for areas to harvest and gather traditional foods.

Restoration Process

Restoring the Jocko River is a complex undertaking that, to succeed, must include the cooperation of Tribal government, local residents, other partner agencies, and a broad technical team. To that end, we have identified a process for selecting restoration sites, developing budgets, protecting resources during projects, acquiring permits, leveraging funding by pursuing additional grant money, and evaluating our success in an ecological and programmatic sense.

Planning Resources

The primary resources utilized to determine restoration opportunities included:

- 1937 aerial photographs, with the channel planform and woody riparian extent outlined as GIS polygons;
- 2002 aerial photographs;
- HGM vegetative cover types, also delineated as GIS polygons;
- Ecological floodplain, as defined in the Vegetation Section, in GIS format;
- Hydric soils map in GIS format;
- NWI maps in GIS format;
- Channel encroachment features in GIS format;
- Channel reference reach data; and
- Fish habitat assessment data.

Project Prioritization

Unlike other broad alluvial valleys in western Montana, low population densities and rural land uses in the Jocko Valley afford land managers exceptional opportunities for restoring the historical function of the Jocko River corridor. Restoration opportunities and priorities will vary according to current land management and ownership, channel and floodplain alterations, institutional support, and acquisition opportunities. Often areas of large sediment inputs will receive priority. But some sites might be selected earlier simply because one parcel can be acquired or shifted into the ARCO program sooner than another. Passive restoration projects will have a high priority because they often have lower implementation costs and less rigorous design requirements, and because correcting damaging land management practices improves the chances that active restoration measures will succeed. The prioritization of active restoration projects is also strongly influenced by costs.

In each case, the Restoration Team will assess existing channel morphology trends; historical channel and floodplain characteristics and existing conditions; and project feasibility and probability of success. Restoration alternatives will be developed through an iterative process that considers cost-benefits, constraints, likelihood of success and other factors.

Those alternatives could include measures such as engineered channel designs, instream control and habitat structures, floodplain restoration activities, and passive measures where appropriate. Several restoration actions are appropriate in every reach along the Jocko River project area. Examples include:

- Adjusting channel cross-sections and alignments based on a natural reach-succession scenario. Lower main-stem Jocko River reaches should be returned to either alternating pool and riffle or steeper and straighter pool and riffle or step and pool (C or B Rosgen stream types), while most Spring Creeks within the project area should be restored to sinuous, low width to depth channels (E Rosgen stream types).
- Recommending stream flows that mimic a natural hydrograph so that ecological processes are supported.
- Eliminating or improving management of livestock grazing to allow for natural recovery. Methods can include changing stocking rates, carefully planning season and duration of use, developing off-stream water sources and herding cattle out of riparian areas.
- Implementing riparian fencing to protect existing and newly planted riparian vegetation.
- Controlling noxious weeds and invasive species to increase native plant species diversity in both wetland and upland areas within the floodplain matrix.
- Building setback levees to protect structures that remain in or near the floodplain.
- Removing constructed levees immediately adjacent to the stream channel throughout the floodplain wherever feasible.

- Restoring microtopography in areas that have been graded, tilled, or drained by restoring spring-related channels, river side-channels, or oxbow features. In addition, microtopography can be increased by adding large woody debris on the surface. In drained areas, filling drainage ditches can raise the water table.
- Converting many agricultural and developed lands (HGM cover types 10 and 11 respectively) to native plant communities through either passive or active revegetation methods.
- Maintaining or enhancing native plant community cover types (Cover Types 1 through 6).

Project Permitting

Once a project design is complete, information from the design is compiled into a permit-support document. Required permits may include Section 404 Clean Water Act permit from the Army Corps of Engineers, Aquatic Lands Conservation Ordinance from the Tribal Shoreline Protection Department, Water Quality (Clean Water Act Section 401) certification through the Tribal Water Quality Department in cooperation with the U.S. Environmental Protection Agency, Endangered Species Act (ESA) Section 10 or Section 7 permits, and Cultural Clearance permits.

Best Management Practices

Best Management Practices (BMPs) are designed to reduce the near-term effects of restoration activities by limiting the disturbance caused by active restoration practices that rely on mechanized equipment. Examples of construction-related disturbance that are minimized by implementing BMPs include:

- hydraulic fluid and other petroleum-based fluid spills and leaks;
- invasive weed species infestations;
- turbidity control;
- vegetation disturbance; and
- soil compaction.

Monitoring

Monitoring is addressed at several levels. Broad-scale monitoring protocols that are better at addressing ecological processes are being developed and implemented under the Restoration Plan and reported on in the annual reporting process. Although there is some overlap, the monitoring protocols articulated here are more specific to individual restoration sites. We have identified three types of monitoring:

1. Baseline monitoring

Used to assess, in a quantified manner, the existing condition prior to restoration project implementation and as a benchmark against which to compare changes after project implementation.

2. Implementation monitoring

Conducted to determine if the restoration project was completed as designed and to establish "as-built" project conditions. Implementation-monitoring data are the foundation for future, post-project effectiveness monitoring data comparisons.

3. Effectiveness monitoring

Used to evaluate whether an implemented restoration project has achieved the desired goals established for the project. Effectiveness monitoring will include variables that focus on indicators to document if desired future conditions were achieved as a result of restoration actions. These indicators need to be sensitive enough to show change. To be effective, they must be measurable, detectable and statistically valid. Data from effectiveness monitoring will be the most important tool for adaptive management. Adaptive management means that later restoration phases are modified based on information gained through the monitoring of earlier phases.

Summary

This document includes the best available scientific information about the lower main-stem Jocko River, and describes a comprehensive, interdisciplinary restoration planning approach. Restoration goals include reestablishing natural linkages between the terrestrial, riparian, and aquatic parts of the ecosystem. However, the focus of restoration will be on the protection and restoration of riparian and wetland areas because they have the greatest influence over the health of the watershed.

The document is organized into five sections. Section 1 describes the scope and purpose of the document, goals and objectives, desired future conditions, descriptions of technical systems and concepts used throughout the document and descriptions of reaches delineated in the lower main stem. Section 2 includes descriptions of historical and existing conditions by reaches described in Section 1. Section 3 describes the restoration process including planning, design and strategies. Section 4 describes monitoring needs and techniques as well as adaptive management strategies. Appendix A describes specific restoration techniques that will be used to restore the Jocko River. Appendix B describes "Best Management Practices" used during the restoration process. Appendix C includes an example monitoring plan. Appendix D includes plan-view figures of the lower main stem. Appendix E describes plant pallets by HGM Cover Type, Hydrologic Zone and Scour Zone. Appendix F describes Reach Succession Scenarios.

While this Executive Summary provides the reader with a working knowledge of the Jocko River restoration program, readers are encouraged to review the full document to become more familiar with the complex Jocko River ecosystem and activities related to its restoration.

Literature Cited

For references to this section, go to the Literature Cited Section.