Kootenai River Habitat Restoration Project Master Plan

Chapter 1 – Introduction

Kootenai Tribe of Idaho

July 2009

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1 Introduction

This document is the Kootenai Tribe of Idaho's (Kootenai Tribe) Master Plan for the Kootenai River Habitat Restoration Project. This Master Plan was developed by the Kootenai Tribe with funding from the Bonneville Power Administration (BPA) provided through the Northwest Power and Conservation Council's (NPCC) Columbia Basin Fish and Wildlife Program (project # 200200200).

This Master Plan presents a conceptual feasibility analysis and design framework for the Kootenai River Habitat Restoration Project. The Tribe is proposing to implement this ecosystem-based river habitat restoration project in the Idaho portion of the Kootenai River subbasin (Kootenai subbasin).

Chapter 1 provides an introduction to the Kootenai River Habitat Restoration Project and this Master Plan. This chapter describes the purpose of the project and why the project is needed; presents project history and context; and describes the relationship of this project to other fish and wildlife projects in the Kootenai subbasin. This chapter also includes a description of the Tribe's approach to ecosystem restoration, specific project goals and objectives, a description of the project area, and an overview of the Master Plan organization and content.

1.1 Overview

Section 1.1 describes the overarching purpose of the Kootenai River Habitat Restoration Project and the need for the project.

1.1.1 Purpose of the Kootenai River Habitat Restoration Project

The purpose of the Kootenai River Habitat Restoration Project is to:

- Restore and enhance Kootenai River habitat by addressing ecological limiting factors and constraints related to river morphology, riparian vegetation, aquatic habitat and river stewardship. The desired result is a more resilient ecosystem, capable of sustaining diverse native plant and animal populations, and tolerant of natural disturbances.
- Restore and maintain Kootenai River habitat conditions that support all life stages of (i.e., migration, occupancy, spawning, incubation, recruitment and early rearing) endangered Kootenai River white sturgeon (*Acipenser transmontanus*) and other aquatic focal species; and
- Restore the Kootenai River landscape in a way that sustains Tribal and local culture and economy and contributes to the health of the Kootenai subbasin as both an ecological and socio-economic region.

1.1.2 Need for the Kootenai River Habitat Restoration Project

During the last century, the Kootenai subbasin was modified by agriculture, logging, mining, flood control and impoundment in the forms of Libby Dam (Koocanusa Reservoir) upstream and

Corra Linn Dam (Kootenay Lake) downstream. Conversion of more than 50,000 acres of floodplain to agricultural fields has resulted in loss of riparian and wetland plant and animal species, and related functions that normally support a healthy ecosystem. Constructed levees were built on top of natural sand levees for flood control, limiting the hydrologic connection between the Kootenai River and its floodplain.

Libby Dam became operational in 1972 effectively reducing annual peak flows by half disrupting the hydrograph, which had a single spring freshet that provided energy to drive ecosystem processes. These modifications resulted in unnatural flow fluctuations in, the Kootenai River and its floodplain, which no longer provide suitable habitat to support the complete life cycles of some aquatic species, and the ecosystem can no longer support many aspects of the traditional life styles it sustained historically.

Although major habitat alterations such as levee construction and the regulation of the natural flood regime by Libby Dam benefited agriculture, they also reduced the Kootenai Tribe's access to traditional resources previously relied upon for long-term subsistence and cultural uses. Following levee construction and flood regulation by Libby Dam, native fish stocks such as Kootenai River white sturgeon, burbot (*Lota lota*), kokanee (*Oncorhynchus nerka*), redband trout (*Oncorhynchus mykiss garideini*), westslope cutthroat trout (*O. clarki lewisii*) and bull trout (*Salvelinus confluentus*) as well as local wildlife populations began to decline.

1.1.2.1 Kootenai River White Sturgeon

The Kootenai sturgeon is a naturally landlocked, locally adapted population that has been isolated since the last glacial age approximately 10,000 years ago. The Kootenai sturgeon have profound cultural significance to the Kootenai Tribe.

Recognizing the need for immediate protection of Kootenai sturgeon, in 1989 the Kootenai Tribe initiated a conservation aquaculture program as a stopgap measure designed to ensure an adequate demographic and genetic basis for a healthy future Kootenai sturgeon population. The Tribe's conservation aquaculture program currently provides the only significant source of recruitment in the Kootenai River. It is likely that the next Kootenai sturgeon generation will be produced primarily, or entirely, by the conservation aquaculture program while necessary habitat improvement measures are being finalized and implemented.

The Kootenai sturgeon was listed as endangered under the Endangered Species Act (ESA) in 1994. The population has been in decline for at least 50 years and is estimated to consist of between 500 and 1,000 wild adults. There has been no significant recruitment of young sturgeon observed since the early 1970s and consistent annual recruitment has not been seen since the 1950s. The remaining wild population of large old fish is declining by about 9% per year. Put another way, as fish die naturally and are not replaced, every eight years 50% of the population disappears. At this rate, there will be no wild population by about 2030 to 2040, and functional extinction could occur long before that time. Importantly, Kootenai sturgeon numbers have already reached critically low levels where genetic and demographic risks are acute, only their long life span (estimated at 80+ years) has forestalled extinction of this population to this point. The Kootenai Tribe's Tribal Sturgeon Hatchery plays a critical role in preventing extinction of Kootenai sturgeon while measures are taken to implement the habitat restoration actions described in this Master Plan.

The U.S. Fish and Wildlife Service (USFWS) Kootenai River White Sturgeon Recovery Team was convened in 1994 and completed the Recovery Plan for the Kootenai River Population of White Sturgeon in 1999 (USFWS 1999). The recovery plan outlined a four part strategy for recovery including measures to restore natural recruitment, use of conservation aquaculture to prevent extinction, monitoring of survival and recovery, and updates to the recovery plan criteria and objectives as new information becomes available.

Table 1-1 provides a summary of critical benchmarks related to Kootenai sturgeon recovery efforts.

Table 1-1. Summary of critical benchmarks related to Kootenai River white sturgeon recovery efforts.

Date	Benchmarks
1980	▪ Population problems first reported for Kootenai sturgeon (Andrusak 1980)
1983	▪ Recruitment failure reported in Idaho portion of Kootenai River (Partridge 1983) ▪ Estimated adult population size of 8,000-9,000 fish
1984	▪ Idaho sturgeon fishery closed to harvest; catch and release fishery remained open
1987	▪ Comprehensive NPCC Fish and Wildlife Program recommends Kootenai sturgeon measures
1988	▪ Kootenai Tribe Fisheries Department is established
1988	▪ Kootenai Tribe initiates Kootenai sturgeon studies and program planning
1990	▪ First Kootenai sturgeon is spawned in makeshift river-bank hatchery and eggs are flown to College of Southern Idaho to incubate and hatch
1991	▪ Construction of Kootenai Tribe experimental sturgeon hatchery completed ▪ First successful production of progeny from wild Kootenai River broodstock ▪ Recovery of first wild sturgeon eggs
1992	▪ First release of hatchery-produced fish into the Kootenai River
1993	▪ Breeding plan developed for Kootenai River white sturgeon (Kincaid 1993)
1994	▪ Kootenai River white sturgeon listed as federally endangered under ESA ▪ Hatchery production stopped while under federal review ▪ Catch and release sturgeon angling prohibited in the Kootenai River in ID and B.C. ▪ Population abundance estimated at 1,694 fish ▪ USFWS Kootenai River White Sturgeon Recovery Team formed
1995	▪ Hatchery program reinitiated following ESA listing
1996	▪ Draft Sturgeon Recovery Plan mandates use of Kootenai Tribal Sturgeon Hatchery (USFWS 1996) ▪ Adult population abundance estimated at 1,700 fish
1997	▪ 1997 year class lost due to hatchery equipment failure and inadequacy of initial low cost experimental facility design
1998	▪ Funding request approved by NPPC and BPA to bring the hatchery facility and equipment up to standard
1999	▪ Sturgeon Recovery Plan completed and signed by USFWS Regional Director (USFWS 1999; Duke et al. 1999); hatchery upgrades completed ▪ KTOI provides funding and direction for B.C. Kootenay Hatchery program to be developed as failsafe and additional rearing site ▪ Sturgeon tiered flows begin

Table 1-1. Summary of critical benchmarks related to Kootenai River white sturgeon recovery efforts.	
Date	Benchmarks
2000	▪ Large-scale annual releases of sturgeon begin ▪ Data collection and river modeling for habitat restoration project begins ▪ Kootenai Hatchery Genetic Management Plan completed ▪ Initial genetic analyses (mtDNA) of wild and broodstock groups completed
2002	▪ Adult population abundance estimated at 620 fish
2003	▪ Mark-recapture studies reveal high wild survival rates of hatchery fish ▪ VARQ flood control adopted by USACE
2004	▪ Updated demographic study puts extinction without intervention on the calendar (Paragamian et al. 2005) ▪ Program goals revised to maximize broodstock numbers and releases from dwindling wild population (KTOI 2004) ▪ Initial microsatellite genetic analysis completed (> 94% of wild alleles represented by broodstock to date; Rodzen et al. 2004) ▪ Comprehensive Adaptive Conservation Aquaculture Plan completed by Kootenai Tribe and subcontractors ▪ Kootenai Tribal Sturgeon Hatchery program incorporated into Kootenai Subbasin Plan.
2005	▪ Adult population abundance estimated at approximately 500 fish
2006	▪ Release size (age) increases after monitoring identified poor survival of earlier life stages ▪ Kootenai Tribe Project Proposal for Kootenai River Habitat Restoration Project, Restore Natural Recruitment, Kootenai River White Sturgeon, submitted to Northwest Power and Planning Council (NPCC) and Bonneville Power Administration (BPA) in January ▪ Biological Opinion regarding the Effects of Libby Dam Operations on the Kootenai River White Sturgeon and Bull Trout released by the USFWS in February (clarified in 2008)
2007	▪ Stocking goals are best met with larger fish (age 1+) at release to provide favorable survival rates ▪ Experiments are implemented with fertilized egg and larval fish releases in high-quality habitat upstream from existing spawning sites
2008	▪ Planning begins for new Twin River Hatchery at the confluence of the Moyie and Kootenai Rivers that will provide additional production capacity for sturgeon and burbot help address critical uncertainty regarding imprinting; as well as upgrades and expansion of the existing Tribal Sturgeon Hatchery
2009	▪ Kootenai River Habitat Restoration Master Plan completed ▪ Kootenai River Native Fish Conservation Aquaculture Programs Master Plan completed

Although the purpose of this project is to restore habitat in the Kootenai River ecosystem, the status of the endangered Kootenai sturgeon population imposes an urgent timeline. The next 5 to 20 years are critical to the recovery of this population. There may still be an adequate number of reproductive white sturgeon in the Kootenai River population to take advantage of suitable spawning and rearing conditions if appropriate habitat is quickly identified and restored. However, if timely action is not taken, the wild population will continue to decline and mature fish will find it increasingly difficult to find mates. At some point, the few remaining fish will no longer be adequate to affect recovery and critical components of the native diversity will be lost. Without intervention, functional extinction will occur well before the last wild fish dies.

1.1.3 Project location

The Kootenai River Habitat Restoration Project will be implemented in the Idaho portion of the Kootenai subbasin. The project area consists of a 55-mile reach of the Kootenai River that

extends from the confluence of the Moyie and Kootenai rivers, downstream to the international border.

For the purposes of this Master Plan, the project area is divided into three major river reaches based on their unique geomorphic properties: the Braided Reaches, Straight Reach and Meander Reaches. The Braided and Meander reaches are each further delineated into two sub-reaches. Reaches are described below in reference to river miles (RM). The river miles presented below represent defined locations along the river that were identified at a point in time. Because the river has shifted over time, actual lengths of reaches are usually slightly different than the calculated difference between two river mile designations (for example, the Straight Reach is 1.1 miles long if measured along the thalweg, but it extends from RM 152.7 to 151.7).

Figure 1.1 shows the project area in the context of the Kootenai subbasin.

Braided Reaches 1 and 2

Braided Reach 1 extends nearly 4 river miles (RM 160.9 to RM 156.2 from the Moyie River confluence downstream to the upstream extent of the backwater influence from Kootenay Lake. Braided Reach 2 extends approximately 2.2 river miles (RM 156.2 to RM 152.7) from the upstream extent of the backwater, downstream to the U.S. Highway 95 Bridge.

Straight Reach

The Straight Reach extends 1.1 river miles (RM 152.7 to RM 151.7) from the U.S. Highway 95 Bridge downstream to Ambush Rock.

Meander Reaches

The combined Meander Reaches extend from the downstream end of Ambush Rock to Kootenay Lake. Meander Reach 1 begins at Ambush Rock and extends 9.7 river miles (RM 151.7 to RM 141.8) downstream to slightly below Shorty's Island. Meander Reach 2 spans 35.5 miles (RM 141.8 to RM 105.9) from the end of Meander Reach 1 to the international border.

The federally designated Kootenai River white sturgeon critical habitat is included in the project area and spans 18.3 river miles from upstream of Bonners Ferry (RM 159.7) to downstream to below Shorty's Island (RM 141.4) (USFWS 2008). The critical habitat reach spans a portion of the Braided Reaches, the entirety of the Straight Reach, and the upstream portion of the Meander Reaches.

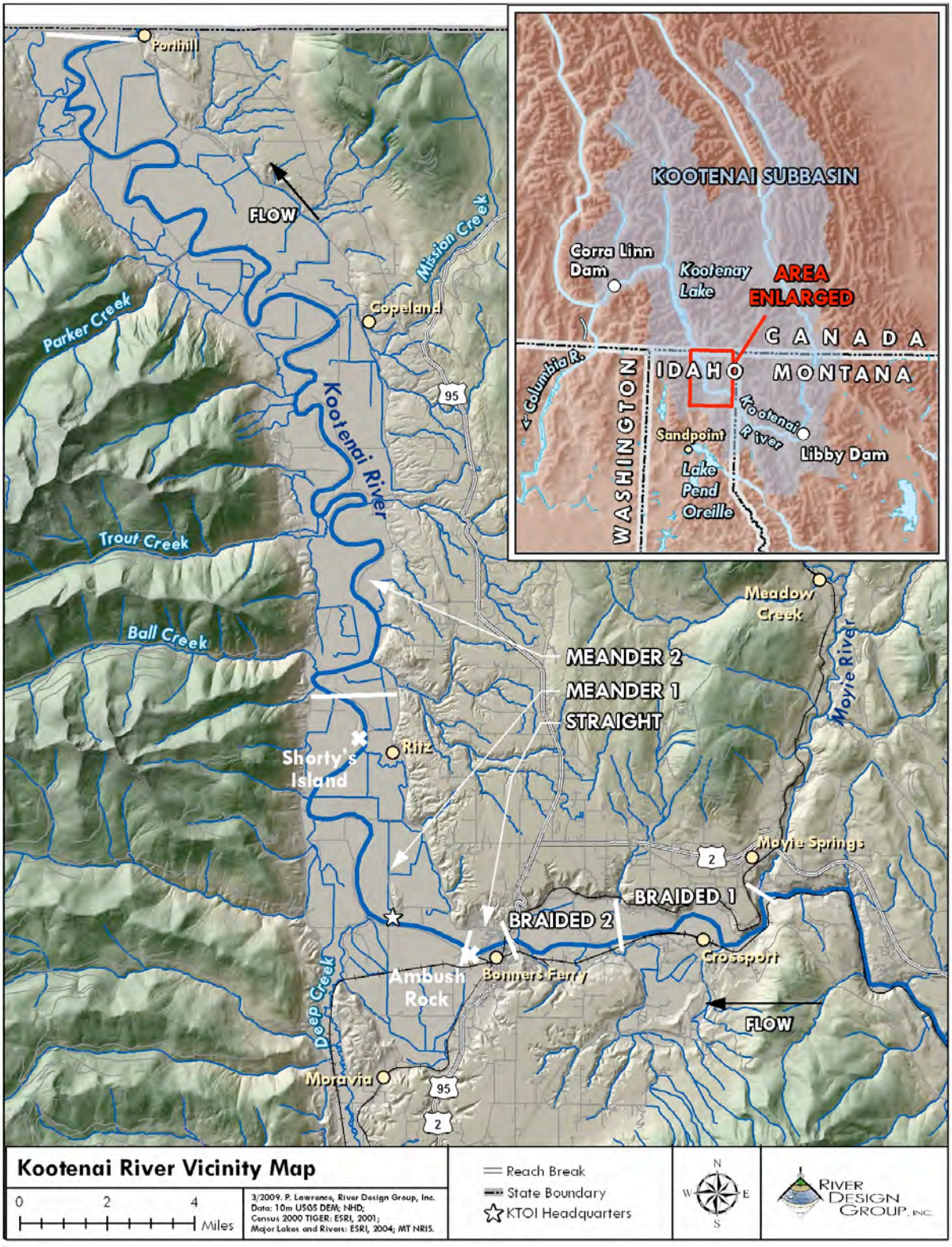

Figure 1-1. Project location within Kootenai Subbasin.

1.1.4 Relationship to Other Projects in the Kootenai Subbasin

Because there are many interrelated factors that may be contributing to greater or lesser extents to the Kootenai sturgeon population's decline, and because of the urgent need for action, the Kootenai Tribe in coordination with multiple agency partners has embraced an ecosystem-based adaptive management approach to restoration actions in the Kootenai subbasin. This ecosystem-based approach is also critical to restoring and maintaining all life stages of other aquatic focal species.

In 2004, the Kootenai Tribe participated in a multi-agency adaptive management workshop to develop a long-term adaptive management framework for the Kootenai subbasin. The resulting 20-year adaptive management framework is a work in progress that includes aquatic, riparian, terrestrial and avian components and has helped to guide implementation of coordinated ecosystem restoration projects in the Kootenai subbasin.

A summary of other Kootenai subbasin projects and activities that complement the Kootenai River Habitat Restoration Project described in this Master Plan is provided below. In addition, Table 1-2 shows the relationship of individual projects to the ecosystem component they address, target benefits, amount of time before benefits are realized, potential negative effects, and monitoring requirements. Table 1-1, also provides additional context for the Kootenai Tribe's aquaculture program's critical role the recovery of Kootenai sturgeon.

Native Fish Restoration and Conservation Aquaculture Program

Beginning in 1989 as a small experimental white sturgeon hatchery, this program has evolved to include many aspects of native fish restoration and aquaculture for native white sturgeon, burbot, and kokanee. The release of young Kootenai sturgeon juveniles from the Kootenai Tribal Sturgeon Hatchery has helped to prevent extinction of this important species while habitat restoration activities presented in this Master Plan are planned, evaluated and implemented. The Kootenai Tribe is currently submitting a proposal through the NPCC's Three-Step Review Process to fund critically needed improvements to the Tribal Sturgeon Hatchery at Bonners Ferry, and to construct a new facility at Twin River on Tribally owned lands to support expanded production objectives to allow Kootenai sturgeon to imprint on waters further upstream. The new Twin Rivers hatchery facility will also allow the Tribe to implement a Kootenai River native burbot conservation aquaculture program.

Kootenai River Ecosystem Improvement Project

This project, which was initiated in 1994, involves a comprehensive biomonitoring program designed to document baseline ecological conditions in the Kootenai River. The project includes monitoring of water quality, algal, invertebrate, and fish community conditions. Also, under this project large-scale nutrient restoration experiments are being conducted in the South Arm of Kootenay Lake, and in the Kootenai River, beginning in 2004 and 2005 respectively.

Libby Dam Operational Loss Assessment Project

The Tribe's ancestral lands and the fish and wildlife resources the Tribe relied upon for subsistence are in areas downstream from Libby Dam. The purpose of this project is to quantify and mitigate the ecological losses due to the operation of Libby Dam in such a way that the methodologies and assessment framework are transferable to other areas in the Columbia Basin.

Wildlife Mitigation Project

Through implementation, this project protects, enhances, and mitigates wetland and riparian wildlife habitats as part of ongoing mitigation for construction impacts associated with the Albeni Falls hydroelectric project within the Kootenai Tribe's ancestral lands.

Kootenai River Valley Wetlands and Riparian Conservation Strategy

This strategy contains information about local issues and concerns, wetland/riparian areas, educational opportunities, and provides approaches to coordinate and link together conservation programs, community needs, and economic, social, and natural resources interests. These elements function together to ensure a comprehensive approach that emphasizes community involvement.

Reconnect Kootenai River with the Historical Floodplain

This project involves investigating the feasibility of actions to reconnect the Kootenai River with its historical floodplain based on ecosystem restoration principles. Investigations have specifically targeted the restoration of selected tributaries to their original channel.

Tributary Restoration

The Tribe is applying a model watershed approach to habitat restoration of selected tributaries to the Kootenai River tributaries that includes community driven initiatives, scientific assessment and restoration techniques to reestablish native riparian vegetation, aquatic insects, and native trout and kokanee salmon habitats and populations.

Table 1-2 Relationship among projects funded by BPA in the Kootenai subbasin and the ecosystem adaptive management program component they address.						
BPA Project #	**199404900 198806500**	**199404900 199500400 198806400**	**198806400 198806500**	**200200200 198806500 198806400**	**198806500 199500400 200715200**	**200200800 200201100**
Ecosystem Component:	**Kootenai River nutrient restoration**	**Transboundary nutrient restoration, kokanee introductions, tributary restoration and enhancement**	**White sturgeon and burbot conservation aquaculture**	**Habitat modification to improve sturgeon spawning and recruitment**	**Ecosystem restoration flows - winter low, naturalized spring runoff peaking, summer stable or gradually declining summer flows**	**Flood plain reconnection and Operational Loss Assessments**
Target Benefit	Aquatic, riparian communities, increased growth, survival, and biological. condition	Kokanee, burbot, sturgeon, trout; Aquatic, riparian communities	Addresses stock limitation, genetic conservation, demographic safety net	Increase survival of eggs, larvae. Increase in habitat complexity and resiliency	Sturgeon and burbot recruitment, salmonid recruitment, cottonwood recruitment, natural floodplain processes	Lentic, lotic, riparian and terrestrial communities, all trophic levels
Potential Negative Effects	Stimulation of non-target species.	Stimulation of non-target species.	Overstocking could limit wild production, however no natural recruitement has been observed for decades	Possible unintended hydraulic consequences	Seepage at higher flows, cooler water temperatures inhibit sturgeon spawning, reduced productivity in reservoir (not refilled)	Possible unintended hydrologic consequences
Required Time to See Effect	Periphyton -weeks Inverts-months, Fish = 2-3 yrs,	Kokanee, 1-3 years	Variable depending on life stage and objective	In-season detection of larvae, 2+ yrs to fully recruit to gill nets; 30+ years for population effect for sturgeon	In-season detection of larvae, 2+ yrs to fully recruit to gill nets, 30+years for population effect for sturgeon	Lower trophic levels-responses within summer season, higher trophic level responses across years
Monitoring Requirements	All taxa responses in Kootenay Lake and lower Kootenai River	All taxa responses in tributaries and Kootenay Lake Stream and riparian habitat health and condition estimators and metrics	Survival, growth and biological condition	Recruitment magnitude and frequency. Evaluation of ecological and physical parameters in newly created habitat	Recruitment magnitude and frequency. Ecological condition and biological productivity of post-treatment communities and functions	Nutrient availability and habitat heterogeneity contributions. Ecological condition and biological productivity of post-treatment communities and functions

1.2 Project Background and History

Section 1.2 summarizes project background and history relative to BPA project number 200200200, under which this Master Plan is being funded and developed.

1.2.1 Data Collection and Analysis Prior to Project start

Many individuals and agencies have played a critical role in collecting and analyzing data necessary to understanding the Kootenai River ecosystem. Following is a summary of data collection and analysis that contributed significantly to this project and other projects in the Kootenai subbasin:

- During 1997, the U.S. Geological Survey (USGS) began studying the hydraulic and sediment characteristics of Kootenai sturgeon spawning habitat near Bonners Ferry. An acoustic Doppler current profiling survey was completed during 1997 to characterize the spatial distribution of stream velocities upstream, within, and downstream from the white sturgeon spawning habitat. Results were published in Lipscomb et al. (1997).
- During 1998, USGS and Idaho Department of Fish and Game (IDFG) personnel conducted a seismic-subbottom-profiling reconnaissance of Kootenai River substrate and sediments in the white sturgeon spawning area to define and characterize the lithology of shallow streambed sediments in habitat areas important to sturgeon spawning (Barton 1998).
- During 2000,USGS collected 35 3.5-meter long vibracores and collected seismic subbottom profiles in the USFWS-defined white sturgeon critical habitat reach of the Kootenai River.
- During 2001, USGS analyzed changes in the channel substrate, suspended sediment-transport, and channel geometry in the white sturgeon spawning habitat near Bonners Ferry.

1.2.2 Project Implementation from 2002 Through 2005

The Kootenai Tribe submitted a proposal in 2001 to the NPCC, and received funding from BPA to implement a project entitled, Assess Surface-Water Flow And Feasibility of Enhancing White Sturgeon Spawning Substrate Habitat, in Kootenai River (project # 200200200). The Tribe sponsored the project, which was developed by the USGS and other entities as a collaborative interagency effort. From 2002 through 2006 USGS continued as lead investigator on behalf of the Tribe and accomplished the following:

- During 2002, the USGS began to construct a suite of hydraulic and sediment-transport models including: 1) a 1-dimensional hydraulic model of the 105-kilometer reach of the Kootenai River in Idaho, 2) a 1-dimensional sediment-transport model encompassing a 24-kilometer reach of the Kootenai River including the 18-kilometer Critical Habitat reach downstream of Bonners Ferry, and 3) a 10-kilometer multi-dimensional flow model encompassing the dominant spawning locations within the Critical Habitat reach. Data collection in support of model construction and validation included: 1) detailed mapping of channel geometry suitable for both 1-dimensional and multi-dimensional models, 2) detailed velocity profiles of 17 cross-sections within the 10-kilometer multi-dimensional

modeling reach, 3) suspended-sediment samples to support development of suspended-sediment rating curves, and 4) select cross-sectional and longitudinal profiles over a range of flows to determine changes in cross-section geometry and dune geometry respectively. One abstract involving project work was published during 2002.

- During 2003, the USGS continued to develop, calibrate and validate the hydraulic models and collected additional channel geometry data in support of model refinement. Stage and velocity were monitored at the Tribal Hatchery gaging site. A report characterizing channel substrate and changes in suspended sediment-transport and channel geometry within the white sturgeon spawning reach in the Kootenai River following the closure of Libby Dam was published during 2003 (http://id.water.usgs.gov/public/reports.html).
- During 2004, the 10-kilometer multi-dimensional hydraulic model calibration and validation was completed and a preliminary analysis of spatial correlations between model-simulated velocity and depth and field collected spawned egg locations was completed. USGS prepared a report on the surveyed cross-sections of the Kootenai River between Libby Dam, Montana, and Kootenay Lake, British Columbia (Barton et al. 2003; http://id.water.usgs.gov/public/reports.html). Two additional abstracts involving this work were published during 2004.
- During 2005, the USGS completed the 105-kilometer 1-dimensional hydraulic model of Kootenai River in Idaho, the 24-kilometer 1-dimensional sediment-transport model, and the 18-kilometer multi-dimensional hydraulic model of the Critical Habitat reach. During this period the extended multi-dimensional model was completed (Barton et al. 2005). As well as providing the spatial distribution of velocity, depth and sediment mobility over a range of flows, the multi-dimensional hydraulic model has been used to gain insight into the hydraulic cues the white sturgeon use to spawn (McDonald et al. 2005). These three hydraulic and sediment-transport models for the Kootenai River are found at: http://id.water.usgs.gov/public/reports.html.

The extensive data collection, analysis and modeling work completed by the USGS on behalf of the Kootenai Tribe laid the groundwork for the transition of the Tribe's project #200200200 to the current habitat restoration focus reflected in this Master Plan. These foundational data collection and analysis activities were critical to the development of this Master Plan, as were contributions of many collaborating agency, private sector, and academic scientists and researchers.

1.2.3 Master Plan Development

In 2005, the Kootenai Tribe submitted a proposal to the NPCC titled, *Restore Natural Recruitment, Kootenai River White Sturgeon* (a continuation of project #200200200). In late 2006, the Tribe received approval and initiated formal project planning to develop this Master Plan. At that time, the Tribe changed the title of the project to the *Kootenai River Habitat Restoration Project* to more accurately reflect this project's ecosystem-based approach.

From 2007 through early 2009 the Kootenai Tribe, in coordination with their consultants, identified and collected additional specific data necessary to develop and confirm the conceptual feasibility of various restoration treatments and designs, conducted additional analysis and modeling associated with conceptual design and feasibility assessments (see appendices A, B, C, and E), and developed the content of the Master Plan.

To facilitate communication, coordination, policy guidance, and technical integration among disciplines, agencies and stakeholders the Tribe established advisory and technical committees early in the project planning stages. These included the following:

- Project management – includes contractors to the Tribe; responsible for project oversight and coordination, procurement and contracting assistance, and project management.
- Design team – includes contractors to the Tribe; responsible for developing the conceptual restoration framework presented in this Master Plan.
- Kootenai Habitat Policy Team – includes appointed policy level representatives from the Kootenai Tribe, Confederated Salish and Kootenai Tribes, federal agencies, British Columbia, and the states of Idaho and Montana; they provide ongoing policy guidance, coordination and help resolve critical issues as they arise.
- Interdisciplinary technical advisory group – participation varied based on need for input or coordination on specific topics. Included participation of various project contractors, and technical representatives from BPA, USACE, USFWS, USGS, IDFG, Montana Fish Wildlife & Parks (MFWP), and British Columbia (B.C.) Ministry of Environment (BCMoE). Their role was to provide technical input and review, assist in development of potential habitat treatments, evaluative tools, and review drafts of the Master Plan.
- Internal "peer" reviewers – includes individuals representing a range of technical disciplines and organizational affiliations. They were invited to participate in technical reviews of two draft versions of the Master Plan.

In late 2008, the Tribe distributed a partially completed draft of the Master Plan for an internal technical "peer," co-manager and agency review. Based on input gathered from this review, the Tribe and their consultants substantially reorganized and revised the Master Plan.

A second revised draft document was distributed for another internal technical review round in May of 2009. The response to the second draft was very positive with most reviewers acknowledging improved document organization, improved clarity of project purpose and improved goals and objectives. In addition to noting the document strengths, several reviewers identified improvements that could still be made to the Master Plan. Many of these suggestions were incorporated into this document; however, others are best deferred to the next phases of the project.

1.2.3.1 Purpose of the Master Plan

This Master Plan provides a conceptual feasibility analysis and design framework for the proposed Kootenai River Habitat Restoration Project. It is intended to:

1. Communicate the project purpose, goals and objectives to a broad range of audiences including Tribal members, state and federal agencies, local governments and communities, non-governmental organizations, local businesses and industry, local landowners, interested stakeholders and members of the public;
2. Identify limiting habitat factors, describe restoration strategies, and identify a toolbox of restoration treatments that will address limiting factors; and
3. Identify how decisions will be made about where restoration projects should be implemented within the project area, how much restoration might cost, how decisions

will be made with respect to project sequencing, and how monitoring information will be used to support the decision-making process and determine treatment effectiveness.

The main focus of this Master Plan is to provide a framework for identifying, refining and implementing restoration actions in a collaborative manner that takes into account related restoration programs and includes a mechanism for incorporating new information into the decision-making process (i.e., adaptive management—see Chapter 6). This Master Plan also identifies specific data gaps that need to be addressed in order to further ascertain feasibility and refine the design of habitat actions (Chapter 9).

Chapter 9 describes planned next steps after completion of the Master Plan including additional targeted data collection, and preliminary and final design activities.

1.3 Project Vision, Goals and Objectives

Section 1.3 describes the Kootenai Tribe's vision, ecosystem restoration philosophy, and project goals and objectives.

1.3.1 Vision

Kootenai Tribe elders pass down the history of the beginning of time, which tells that the Kootenai people were created by Quilxka Nupika, the supreme being, and placed on earth to keep the Creator-Spirit's Covenant – to guard and keep the land forever. The Kootenais have never lost sight of their original purpose as guardians of the land.

The Kootenai Tribe envisions the Kootenai River and its floodplain as a healthy ecosystem with clean, connected terrestrial and aquatic habitats, which fully support traditional Tribal uses and other important societal uses. The Tribe recognizes that protection of the environment, including recovery of Kootenai River white sturgeon needs to occur within the context of a sustainable local community and economy. Towards this end the Kootenai Tribe is committed to developing innovative and collaborative approaches to shared guardianship of the land.

In developing and implementing approaches to Kootenai River habitat restoration and related programs aimed at Kootenai sturgeon recovery, the Tribe will continue to emphasize a collaborative approach that takes into consideration the needs and values of our region. The Kootenai Tribe believes that cooperation among all groups with a stake in the region is the only way to ensure the sound and prosperous future of the Kootenai subbasin.

Because the entire ecosystem has been altered for decades, much has been lost. However, the Tribe looks to the future with the hope that native fish and wildlife may once again inhabit the Kootenai drainage in abundance. Much of this hope rides on the rapidly advancing field of ecological restoration and the Tribe recognizes there are a variety of schools of thought among restoration practitioners and researchers. The following section describes the Tribe's philosophy of ecosystem restoration.

1.3.2 Ecosystem Restoration Philosophy

Ecological restoration can be defined as the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed (SER 2004). The Society for Ecological Restoration (2004) defines a restored ecosystem as one containing sufficient biotic (living) and

abiotic (non-living) resources to continue its development without further assistance and that will sustain itself structurally and functionally, demonstrate resilience to normal ranges of disturbance and interact with contiguous ecosystems in terms of biotic and abiotic flows and cultural interactions. This Master Plan is based on a restoration approach that emphasizes a holistic, multidisciplinary approach to evaluating and restoring ecosystem function and structure. The concepts of ecosystem function and structure are closely intertwined and both include abiotic and biotic elements and processes.

This philosophy emphasizes the need for improving or re-establishing both the structural components and the functions of the river ecosystem to restore the conditions necessary to create and maintain habitat benefiting a range of species in dynamic environments. Species are often the most noticeable symptom of ecosystem decline, but the holistic ecosystem approach to restoration focuses on system-wide stressors and interactions that are responsible for those declines. Within this Master Plan, we refer to these system-wide stressors as limiting factors. By identifying combinations of restoration strategies to address multiple limiting factors, we incorporate the idea that an ecosystem is made up of a diverse set of interacting components such that no single restoration action will restore the ecosystem.

This philosophy is consistent with the NPCC's Fish and Wildlife Program's Habitat Strategies, one of which states, 'Restore Ecosystems, Not Just Single Species'. This strategy recognizes that increasing the abundance of single populations may not, by itself, result in long-term recovery and that restoration efforts must focus on restoring habitats and developing ecosystem conditions and functions that will allow for expanding and maintaining diversity within and among species. Taking this approach to restoration will help sustain a system of robust populations in the face of environmental variation (NPCC 2009).

A central premise of an ecosystem-based approach to restoration is that restoration should create conditions that will sustain natural processes and prevent the system's further degradation while simultaneously conserving its native plants and animals. Given that ecosystems are in constant flux and that there is no single correct condition, this philosophy accepts the possibility of a number of responses, trajectories or end points for restoration actions. However, in a restored system, this flux would happen within the bounds of a most probable state (Leopold 2004). This concept, based on observations of unimpeded ecosystem processes, suggests that riverine systems achieve a relatively stable form over time based on a balanced distribution of energy throughout the system. Within the most probable state, constant change would be the norm, driven by natural ecosystem processes such as flows and other stochastic events.

Thus, restoration planning at the ecosystem scale requires integrating a "toolbox" of restoration strategies and techniques within an adaptive framework that allow strategies to shift according to ecosystem response. The techniques and strategies included in this plan include both active and passive approaches to allow natural river processes to create the biotic and abiotic components of habitat. Active techniques involve direct structural modifications to the river, its floodplain or infrastructures (i.e. channel realignment, levee removal, instream habitat structures). Passive techniques rely on the river to do the work (flow augmentation, changes in land use) (Stanford et al. 1996). This type of integrated approach is necessary in altered ecosystems where allowing natural processes alone to create habitat or other desired functions may not be feasible given limiting factors, social and economic factors or necessary timeframes for recovery. For example, when changes in the ecosystem have altered hydrologic inputs and sediment loads it may not be reasonable to expect pre-disturbance channel dimensions and

habitat to be created and maintained by current processes. This approach also recognizes that a failure to account for human interactions within restored systems is both unrealistic and undesirable for their long-term sustainability.

This approach integrates a range of disciplines and schools of thought regarding river restoration, including ecosystem theory applied to restoration (Frissell et al. 1993; Stanford 1996 and Kondolf et al. 2006) and reference or analog approaches through evaluations of historical conditions including use of reference sites and applied models describing geomorphology—flow—sediment-transport relationships (SER 2005; Rosgen 1996). The Tribe does not subscribe solely to any one of these approaches, but recognizes that each has value and that they collectively form a conceptual toolbox that makes it possible to contemplate ecosystem restoration at the scale of the Kootenai River Habitat Restoration Project.

Consistent with this ecosystem restoration philosophy, as noted earlier in this chapter, the purpose of the Kootenai River Habitat Restoration Project is to:

- Restore and enhance Kootenai River habitat by addressing ecological limiting factors and constraints related to river morphology, riparian vegetation, aquatic habitat and river stewardship. The desired result is a more resilient ecosystem, capable of sustaining diverse native plant and animal populations, and tolerant of natural disturbances.
- Restore and maintain Kootenai River habitat conditions that support all life stages (i.e., migration, occupancy, spawning, incubation, recruitment and early rearing) of endangered Kootenai River white sturgeon and other aquatic focal species; and
- Restore the Kootenai River landscape in a way that sustains Tribal and local culture and economy and contributes to the health of the Kootenai subbasin as both an ecological and socio-economic region.

1.3.3 Project Goals and Objectives

The goals for the Kootenai River Habitat Restoration Project address:

- **Morphology.** Restore physical habitat by reducing the negative effects to river and floodplain ecological processes caused by river response to the altered landscape.
- **Riparian vegetation.** Restore native vegetation by establishing stream bank and floodplain conditions that sustain plant community development processes.
- **Aquatic habitat.** Restore aquatic habitat conditions that support all life stages of native fish and promote sustainable populations.
- **River stewardship.** Create opportunities for river and floodplain stewardship in the community.

These goals support several stated objectives in the Kootenai Subbasin Plan that relate to habitat (KTOI and MFWP 2005). Within the Kootenai Subbasin Plan, objectives were organized according to habitat types (mainstem, tributaries, and reservoir), focal species (bull trout, sturgeon, burbot, kokanee, redband and westslope cutthroat trout), and biomes (regulated mainstem, wetland, riparian, grassland/shrub, xeric forest, and mesic forest). For each of these components, several objectives were identified and numbered, for example, Objective M1 is Mainstem Objective 1. Table 1-3 identifies Kootenai Subbasin Plan objectives related to habitat that would be addressed by each project goal. Kootenai Subbasin Plan objectives are repeated verbatim from that document.

Table 1-3. Kootenai Subbasin Plan objectives that support Habitat Restoration Project goals.	
Project Goal	**Supporting Subbasin Plan Habitat Objective** [1]
1. Morphology. Restore physical habitat by reducing the negative effects to river and floodplain ecological processes caused by river response to the altered landscape.	**M6 (Mainstem Kootenai River).** Improve channel stability to a level equivalent to the QHA-generated, channel stability habitat restoration scores of reference streams, assuming that such levels will support sustainable population levels of focal species that function naturally and may be capable of supporting appropriate forms of human use.
2. Riparian Vegetation. Restore native vegetation by establishing stream bank and floodplain conditions that sustain plant community development processes.	**T2 (Tributary).** Restore riparian habitats to levels equivalent to the QHA-generated riparian condition habitat restoration scores of reference streams.
	RP1 (Riparian). Restore riparian vegetation communities on 10% of the riparian acres in those subunits for which the Floodplain Vegetation Index/Vegetation Distribution Intensity Index in the TBA spreadsheet tool is < a value of 8, consistent with current or future management and mitigation plans.
	RP4. Restore riparian vegetation communities on 10% of the riparian acres in those subunits for which the Floodplain Vegetation Index/Vegetation Distribution Intensity Index in the TBA spreadsheet tool is > a value of 8, consistent with current or future management and mitigation plans.
	Most Grassland/shrub, Xeric Forest and Mesic Forest Objectives in the Subbasin Plan also support this goal.
3. Aquatic Habitat. Restore aquatic habitat conditions that support all life stages of native fish, and promote sustainable populations.	**M2.** Improve riparian function and complexity of mainstem riparian habitat to levels that support or contribute to sustainable population levels of focal species that function naturally and may be capable of supporting appropriate forms of human use.
	M5. Improve habitat diversity to levels equivalent to the QHA-generated habitat diversity habitat restoration scores, and habitat diversity conditions based on ecological primary literature and possible references rivers.
	T1 (Tributary). Protect and maintain prime, functioning tributary habitat (identified as Class 1 in QHA analysis)
	T6a. Protect habitat diversity in Class 1 streams and reaches. **T6b.** Improve habitat diversity to a level equivalent to the QHA-generated habitat diversity scores of reference streams.
	T7b. Determine opportunities for altered hydro operations to remove delta blockages from tributary streams.
	T8. Restore and provide passage to migratory fish by removing potential man-caused barriers, i.e. impassable culverts, hydraulic headcuts, water diversion blockages, landslides, and impassable deltas.
	WST1 (White Sturgeon), BT5 (Bull Trout), and KOK1 (Kokanee). Restore primary, secondary, and tertiary productivity rates and nutrient values downstream from Libby Dam to pre-dam condition (equal to those of inflows into Koocanusa Reservoir, corrected for downstream lateral input).
	KOK1 (Kokanee). Restore primary, secondary, and tertiary productivity rates and values downstream from Libby Dam to pre-dam condition (equal to those of inflows into Koocanusa Reservoir).
4. River Stewardship. Create opportunities for river and floodplain stewardship in the community.	**RP3.** Secure management rights and implement management agreements to conserve, maintain and restore 10% in those subunits for which the Floodplain Vegetation Index in the TBA spreadsheet tool is > a value of 7, consistent with current or future management and mitigation plans.
	RP5. Monitor and treat an average of 10% of acres in those subunits for which the Exotic Vegetation Index in the TBA spreadsheet tool is > a value of 6, consistent with current and future management and mitigation plans.
	Most Grassland/shrub, Xeric Forest and Mesic Forest Objectives support this goal.

[1] Although not specifically identified in this table, it is anticipated that project goals will also help address most Subbasin Plan Biological Objectives for focal species.

Each of the four goals described above (morphology, riparian vegetation, aquatic habitat and river stewardship) represents a logical grouping of the limiting factors identified as part of this Master Plan development process (Tables 1-4 through 1-7). Broad actions aimed at addressing each limiting factor are referred to as strategies, and for each strategy, one or more objectives have been identified as a way to state, in a quantifiable manner, expected outcomes of restoration actions.

These limiting factors are repeated throughout the Master Plan, recurring as a common theme that: 1) explains what problems the habitat project is intended to solve (this Chapter); 2) provides a way to organize the discussion of historical and existing conditions and how each limiting factor was identified (Chapter 2); 3) explains why specific habitat actions were selected in each Reach within the Project Area (Chapter 3); 4) supports criteria used to develop Implementation Scenarios; and 5) provides a way to organize the monitoring and adaptive management program associated with the Habitat Restoration Project (Chapter 5). Figure 1-2 illustrates the relationship among goals, limiting factors, strategies, objectives and other terms used throughout the Master Plan.

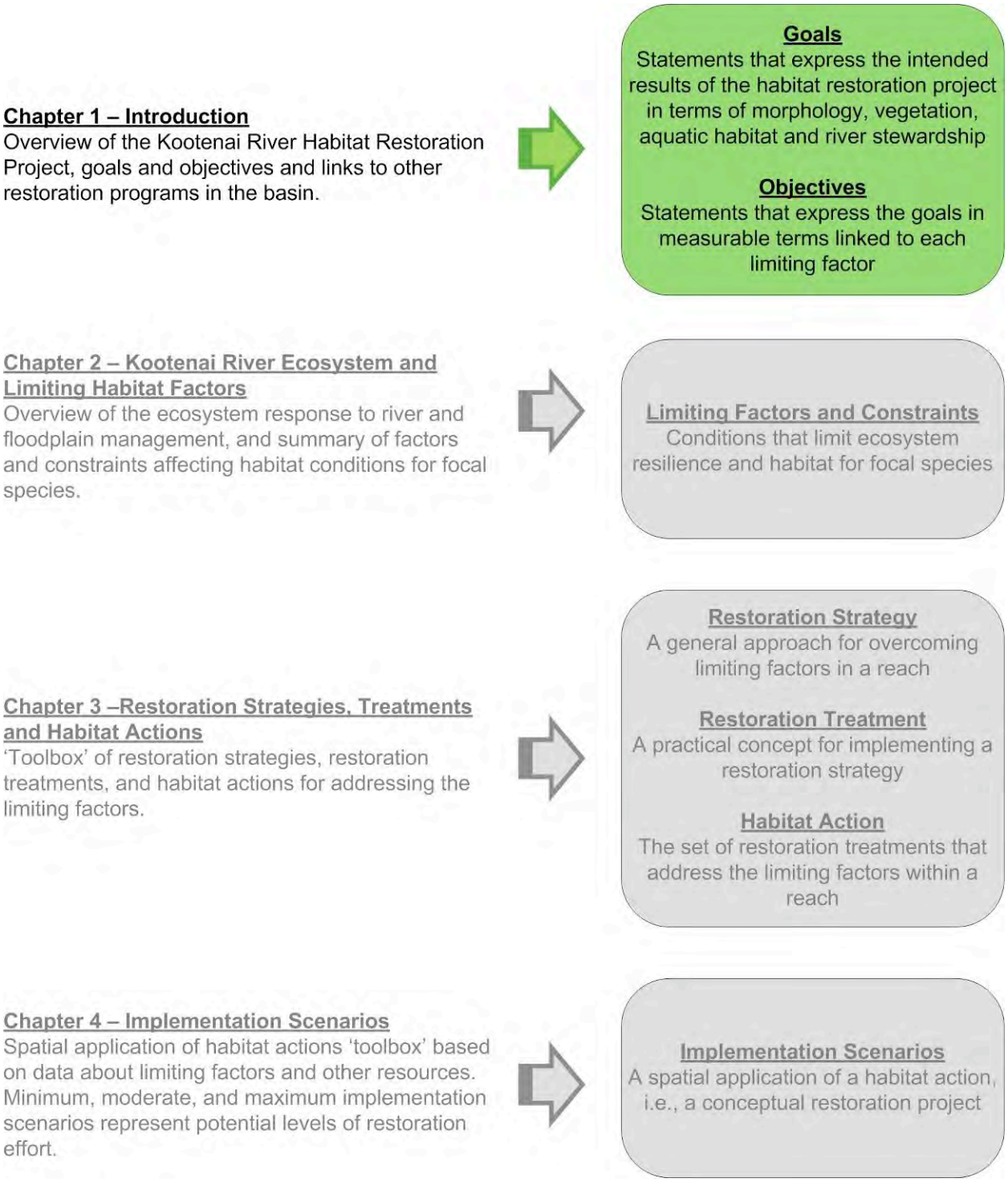

Figure 1-2. Relationship among Master Plan components.

In Tables 1-4, 1-5, 1-6 and 1-7, limiting factors are grouped according the project goals stated above (morphology, riparian vegetation, aquatic habitat and river stewardship). The quantifiable objectives provided for each of these limiting factors are intended to serve as an example of how

progress toward achieving restoration strategies will be measured. These objectives are based on past restoration projects that have addressed goals similar to the Kootenai Rive Habitat Restoration Project goals. Final objectives will be determined during the design phase, and objectives may be modified over time as effectiveness monitoring data is evaluated according to the adaptive management process described in Chapter 5. Because some objectives cannot be fully quantified until the design phase, an "x" is used as a placeholder until appropriate numbers can be developed for these objectives. In addition to additional data collection and analysis associated with design, some objectives will need to be made more specific through a collaborative process that involves stakeholders.

Goal 1. Morphology

The morphological goal addresses the need to restore physical habitat that forms the foundation for biological habitat including riparian vegetation and the aquatic ecosystem. Components of physical habitat include the flow regime, sediment-transport, river channel morphology and related processes, and floodplain formation processes. Restoration strategies include both management actions and active restoration actions. Objectives are stated in terms of measurable aspects of each physical habitat component.

Table 1-4. Limiting factors, strategies and habitat restoration project objectives related to goal 1 morphology.

Limiting Factors	Strategies	Quantifiable Objectives
River and floodplain response to altered flow regime and altered hydraulics	Establish channel dimensions that are sustainable given the morphological setting and governing flow and sediment regimes	• Construct a meandering gravel-bed channel with side channels in the Braided Reaches • Construct a confined gravel-bed channel in the Straight Reach • Excavate floodplain adjacent to the channel in the Meander Reaches
River and floodplain response to altered sediment supply and sediment-transport conditions	Gradually reduce sediment supply and transport competence in a downstream direction in order to promote deposition of sediment on the floodplain and reduce deposition of sediment on the channel bed in downstream reaches	• Provide floodplain surfaces in the Braided and Straight Reaches that will store X tons of sediment over X years • Provide river and floodplain sediment-transport conditions in the Braided and Straight Reaches that deposit X tons of sediment on the floodplains and less than X tons of sediment in the channel annually
Loss of floodplain connection	Establish channel and floodplain connection at mean annual peak flow where feasible given constraints from river and floodplain management	• In the Braided and Straight Reaches, create x acres of new floodplain surfaces at elevations that correspond to river stage at 30,000 cfs • In the Meander Reaches, connect x acres of floodplain surfaces at elevations that correspond to river stage at 30,000 cfs
Accelerated bank erosion and reduced boundary roughness	Establish bank vegetation Increase channel roughness	• Within identified bank treatment areas, lateral bank migration is 0 ft per year for first five years while vegetation is becoming established • Within identified bank treatment areas, less than 10% of bank length moves laterally more than 5 ft between years 5 and 10 • Within identified bank treatment areas, less than 30% of bank length moves laterally more than 10 ft between years 10 and 20

Goal 2. Riparian vegetation

The riparian vegetation goal addresses the need to restore riparian vegetation that provides floodplain habitat, important components of aquatic habitat such as overhanging bank cover and large woody debris within the river and floodplain, and food web support among other important functions. Riparian vegetation includes cottonwood and conifer forests, shrub complexes and other wetland and upland habitats. Restoration strategies include management actions such as weed control and development of riparian buffers, in addition to active restoration actions such as bioengineering, direct planting and construction of microtopography features. Objectives are stated in terms of measurable aspects of the riparian and floodplain ecosystems that are expected to exhibit variable responses to specific restoration actions.

Table 1-5. Limiting factors, strategies and habitat restoration project objectives related to goal 2, riparian vegetation.

Limiting Factors	Strategies	Quantifiable Objectives
Lack of surfaces that support riparian recruitment	Increase floodplain areas with suitable substrate and elevation relative to the water table that can support riparian vegetation recruitment and establishment	• In Braided Reach 1, create x acres of new floodplain surfaces • In Meander Reach 1, x acres of floodplain is (surface) connected to the river at 30,000 cfs, including x acres with sand/gravel/cobble substrate • In Meander Reach 1, x acres of floodplain has hydrology in the rooting zone sufficient to support hydrophytic vegetation
Lack of outer bank vegetation	Establish bank vegetation	• Within identified bank treatment areas, x live willow and shrub stems per square foot on bank face by year 3 • Within identified bank treatment areas, 80% canopy cover of native shrubs by year 5
Frequent scour/deposition of floodplain surfaces	Increase stability/longevity of floodplain surfaces	• Maximum x% change in footprint of point bars per year over three years (allows some movement, but not complete annual redistribution of point bars)
Altered hydroperiod	Increase floodplain areas with appropriate elevation ranges relative to the water table to support native tree and shrub species	• Link this objective to a design table that represents proportional abundance of elevation patches per unit area
Invasive weeds	Reduce weed cover so weeds do not limit recruitment and establishment of native plant species	• Weed canopy cover is less than 10% by year five within active restoration areas
Lack of native seed sources	Establish nodes of diverse, native vegetation within the Straight Reach and Meander Reaches	• Link this objective to design plant palletes that include a list of species by layer and target density/canopy cover over short, medium and long-term timeframes
Lack of nutrient sources for primary productivity and limited carbon storage (reduced primary productivity)	Increase amount and diversity of native vegetation and wetlands within the Meander Reaches	• Targets would be established for each project design

Goal 3. Aquatic habitat

The aquatic habitat goal addresses the need to restore the aquatic ecosystem that provides habitat for native fish and other aquatic organisms. Aquatic habitat includes physical components such as depth, velocity, substrate, cover, pools and water quality; it also includes ecological components such as the food web, nutrient cycling, and factors that influence interactions among species assemblages. Restoration strategies include management actions related to flow and temperature regulation, in addition to active restoration actions such as constructing specific habitat features and providing fish passage between the river and tributaries. Objectives are stated in terms of measurable aquatic habitat components that are expected to exhibit variable responses to specific restoration actions.

Table 1-6. Limiting factors, strategies and habitat restoration project objectives related to goal 3, aquatic habitat.

Limiting Factors	Strategies	Quantifiable Objectives
Insufficient depth for Kootenai sturgeon migration preference	Provide depth conditions for normal Kootenai sturgeon migration and spawning behavior in Kootenai sturgeon migration reaches	• Provide intermittent depths of 16.5 to 23 ft or greater in 60% of the area of rocky substrate from RM 152 to RM 157 during peak augmentation flows[1]
Insufficient velocity for Kootenai sturgeon spawning preference	Provide velocity conditions for Kootenai sturgeon spawning and embryo/free-embryo incubation and rearing in Kootenai sturgeon spawning reaches	• Provide velocities of 3.3 ft/s and greater in approximately 60% of the area of rocky substrate from RM 152 to RM 157 during post-peak augmentation flows while avoiding harmful fluctuations during critical life stages[1]
Lack of coarse substrate for Kootenai sturgeon egg attachment	Provide substrate conditions for Kootenai sturgeon embryo/free-embryo incubation and rearing in Kootenai sturgeon spawning reaches by placing substrate or create hydraulic or sediment conditions to expose existing coarse substrate	• Create or expose coarse substrate (X mm) in approximately X miles of the Meander Reaches at the locations of known spawning behavior, generally corresponding with pool tailout locations in Meander Reach 1
Lack of cover for juvenile fish	Increase in-stream and bank cover by constructing in-stream structures and establishing bank vegetation	• Create dense vegetation bank cover for approximately X% of the Braided Reaches, X% of the Straight Reach and X% of the Meander Reaches
Lack of pool-riffle complexity	Increase hydraulic habitat complexity by establishing ratios of pool and riffle habitat that are appropriate for the morphological setting	• Establish X% pool/glide habitat and X% riffle/run habitat in all reaches
Simplified food web from lack of nutrients	Increase nutrient availability	• Reference nutrient addition program and reference other goals/objectives aimed at increasing ecosystem productivity
Insufficient pool frequency	Establish pool frequency that is appropriate for the morphological setting	• Establish pool frequency of one pool per unit length corresponding to 5 to 7 bankfull widths
Lack of fish passage into tributaries	Establish fish passage at known barriers on tributaries within the project area	• Remove fish passage barriers on tributaries
Lack of off-channel habitat for rearing	Increase availability of off-channel habitat for native aquatic species	• Create x acres of off-channel habitat that is connected to the mainstem at x cfs. This could be linked to a design table that specifies how habitat should be distributed in terms of wetland systems/classes

Table 1-6. Limiting factors, strategies and habitat restoration project objectives related to goal 3, aquatic habitat.		
Limiting Factors	**Strategies**	**Quantifiable Objectives**
Altered water quality	Identify and reduce point source pollutant inputs into Kootenai River and tributaries	• Identify specific opportunities to reduce pollutant inputs

[1] Objectives follow criteria in the Biological Opinion (BiOp) for Kootenai River White Sturgeon. The clarified 2008 BiOp replaced the intermittent depths of 16.5 to 23 feet with minimum depths of 23 feet.

Goal 4. River stewardship

The river stewardship goal addresses the need to work directly with community members and stakeholders within the project area. River stewardship includes modifying agricultural practices near streams to protect streambanks and water quality, managing flows and water levels to support ecological processes, limiting risks to infrastructure from restoration actions, and coordinating with landowners and other stakeholders to identify appropriate locations for restoration projects. Restoration strategies include management actions related to flow and land use, in addition to coordinating restoration in such a way that it is compatible with the local economy, community and culture. Objectives are stated in broad terms and focus on making sure the community and stakeholders are involved with all components of the restoration project that might affect them.

Table 1-7. Limiting factors, strategies and habitat restoration project objectives related to project goal 4, river stewardship.		
Limiting Factors	**Strategies**	**Quantifiable Objectives**
Dam controlled flow regime	Develop habitat actions that are compatible with modified flows and work with Libby Dam managers so operations support habitat restoration efforts	▪ Verify that coordination is happening based on outreach as described in Chapter 9
Dam controlled sediment regime	Develop habitat actions that are compatible with modified sediment regime and work with Libby Dam managers so operations support habitat restoration efforts	▪ Verify that coordination is happening based on outreach as described in Chapter 9
Dam controlled thermal regime	Work with Libby Dam managers to manage temperatures in a way that supports habitat needs	▪ Verify that coordination is happening based on outreach as described in Chapter 9 and verify that BiOp conditions are being met
Dam controlled nutrient regime	Coordinate with nutrient addition project	▪ Verify that coordination is happening based on outreach as described in Chapter 9
Floodplain land use	Coordinate with landowners and grazing lessees to explore development of grazing management plans that allow floodplain vegetation to develop	▪ Verify that coordination is happening based on outreach as described in Chapter 9
Bank armoring	Coordinate with appropriate parties to maintain, modify or remove bank armoring to support channel, riparian and floodplain ecological processes according to specific habitat actions	▪ Verify that coordination is happening based on outreach as described in Chapter 9
Levees and diking districts	Coordinate with diking districts and other affected parties to maintain, modify or remove levees to support channel, riparian and floodplain ecological processes according to	▪ Verify that coordination is happening based on outreach as described in Chapter 9

Table 1-7. Limiting factors, strategies and habitat restoration project objectives related to project goal 4, river stewardship.		
Limiting Factors	**Strategies**	**Quantifiable Objectives**
	specific habitat actions	
Transportation corridors	Develop habitat actions that are compatible with existing infrastructure; and work with owners to mitigate for potential impacts to infrastructure from project actions	▪ Verify that coordination is happening based on outreach as described in Chapter 9
Floodplain draining/pumping	Assist diking districts, NRCS, SCD, and landowners as appropriate to identify areas where floodplain draining and pumping can be modified to restore floodplain hydrology	▪ Verify that coordination is happening based on outreach as described in Chapter 9
Floodplain tilling/grading	Work with NRSC, SCD, and landowners as appropriate to identify areas where microtopography and roughness can be restored to floodplain surfaces	▪ Verify that coordination is happening based on outreach as described in Chapter 9
Backwater influence from Kootenay Lake	Work with B.C. and other entities to explore and identify potential modifications to Kootenay Lake level management and design habitat actions that would compliment those modifications	▪ Reduce the backwater influence on X miles of river by lowering backwater elevations by X feet during flows greater than X cfs
Urban development adjacent to river	Design habitat actions that do not place urban infrastructure at risk and create riparian buffers to separate city from river where possible by working with City of Bonners Ferry and landowners	▪ Establish riparian buffers for X feet of river frontage based on results of coordinating with landowners

1.4 Master Plan Organization and Content

This section summarizes the organization and content of the remaining chapters and appendices of the Kootenai River Habitat Restoration Master Plan.

Chapter 2 provides an overview of the historical and existing conditions in the Kootenai subbasin, river and floodplain stewardship implications for the river corridor, the characteristics of the river reaches in the project area, and the factors that limit habitat for focal aquatic species and other species within the project area. This chapter presents background information on the historical condition of the Kootenai River and subbasin and explains how human activities have affected the ecosystem.

Chapter 3 describes restoration strategies and treatments that will be used to address limiting factors identified in Chapter 2. Restoration treatments are presented by project reach, and all treatments for a given reach are combined to form a habitat action. Habitat actions represent the restoration toolbox for a particular reach.

Chapter 4 describes how data on limiting factors and other resources within a reach are applied spatially to identify 1) specific locations where habitat is unsuitable and needs to be restored and 2) areas having the greatest potential for restoration success. The result is a set of criteria for each reach that are used to define minimum, moderate and maximum levels of restoration effort (implementation scenarios). These criteria are applied to each reach to estimate quantities of each restoration treatment for each implementation scenario, and this information is used as a basis for estimating costs in Chapter 7.

Chapter 5 describes the Adaptive Management and Monitoring program for the Kootenai River Habitat Restoration Project. The Adaptive Management and Monitoring program is a long-term decision-making framework that provides a formal way to incorporate effectiveness monitoring data related to specific restoration treatments, monitoring information from other related programs, and other new information that may become available. This chapter describes the monitoring and decision-making components that will be used to support Adaptive Management, and describes links to other restoration and monitoring programs.

Chapter 6 provides an overview of anticipated environmental compliance and consultation requirements related to subsequent phases of the Kootenai River Habitat Restoration Project. In this chapter the applicability to this project of each law, regulation, ordinance, or guideline, is defined.

Chapter 7 presents estimated costs associated with the Kootenai River Habitat Restoration Project conceptual framework presented in this Master Plan. This chapter includes an overview of the Kootenai Tribe's approach to developing cost estimates for this Master Plan, discussion of the cost categories used, identification of assumptions associated with each category and examples of costs by category, discussion of additional cost considerations, and estimated costs and cost considerations for implementation scenarios.

Chapter 8 provides a funding analysis and discusses development of a funding strategy for implementation of the Kootenai River Habitat Ecosystem Restoration Project.

Chapter 9 provides an overview of the planned next steps for the Kootenai River Habitat Restoration Project. This chapter presents a summary of the general tasks scheduled for the upcoming phases of this project including interim planning actions, environmental compliance, work associated with the preliminary and final design phases, funding, and project implementation.

This Master Plan also includes six appendices: Appendix A: Hydrology and Hydraulics Summary, Appendix B: Sediment-transport Analyses, Appendix C: Vegetation Analysis, Appendix D: Prioritized Fish and Physical Habitat Factors, Appendix E: Supplemental Geomorphic Data and Analyses, and Appendix F: Cost Analysis.

Appendix A contains a summary of the hydraulic analyses completed for the Master Plan. This appendix includes a summary of historical hydraulic departure by reach. This appendix also contains a brief discussion of data used, methods, analytical procedures, assumptions and limitations of the analyses.

Appendix B consists of sediment-transport data including: a sampling summary, suspended sediment summary, bedload sediment summary, bed material sediment summary, and a provisional sediment-transport analysis. This appendix also contains a brief discussion of data used, methods, analytical procedures, assumptions and limitations of the analyses.

Appendix C consists of the vegetation assessment and supporting information. This appendix provides supporting information related to plant community distribution and ecological processes driving plant community succession and composition for Kootenai River habitat restoration reaches. This appendix describes the results of field assessments and observations made for areas within the Meander Reach and Braided Reach. The purpose of this appendix is to provide supporting information related to further describe limiting factors associated with

developing riparian and floodplain revegetation restoration strategies related to various habitat actions.

Appendix D provides a summary of prioritized fish and physical habitat factors for each of the six focal species.

Appendix E provides a summary of geomorphic data that was used to support development of morphological limiting factors.

Appendix F provides a detailed breakdown of estimated costs in support the cost estimates presented in Chapter 7.

In addition to the information presented in the Master Plan and associated appendices a variety of key support documents used in the development of this Master Plan are available for download on the Kootenai Tribe's website at: http://www.kootenai.org/fish_resources.html.