PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Mitigation For The Construction And Operation Of Libby Dam

BPA project number: 8346700
Contract renewal date (mm/yyyy): 11/2000 ☒ **Multiple actions?**

Business name of agency, institution or organization requesting funding
Montana Department of Fish, Wildlife and Parks

Business acronym (if appropriate) MFWP

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NPPC Program Measure Number(s) which this project addresses
Program Measures10.1B, 10.1C.1, 10.3B, 10.3B.2, 10.3B.3, 10.3B.5, 10.3B.6, 10.3B.7, 10.3B.10 and 10.3B.11.

FWS/NMFS Biological Opinion Number(s) which this project addresses
Kootenai River White Sturgeon Biological Opinion (59 FR 45989)
NMFS Hydrosystem Operations for Salmon Recovery (56 FR 58619; 57 FR 14653)
Bull Trout Listing (62 FR 31647)
Westslope Cutthroat Trout proposed listing (63 FR 31691)

Other planning document references

Fisheries Mitigation and Implementation Plan for Losses Attributable to the Construction and Operation of Libby Dam (MFWP,CSKT and KTOI 1998).

Kootenai Watershed Programmatic Habitat and Physical Parameter Review (Bibliography)Open File Report – MFWP-Libby, MT

Bull trout and westslope cutthroat trout recovery plans and actions (Montana Bull Trout Restoration Team 1997; Montana Bull Trout Scientific Group 1995; MFWP and CSKT 1991, 1993; Montana Westslope Cutthroat Trout Recovery Team, in prep.)

Fisheries Losses Attributable to Reservoir Drawdown In Excess of Limits Stated in the Columbia Basin Fish and Wildlife Program: Hungry Horse and Libby Dams 1987-1991 (Marotz and DosSantos 1993); Fisheries Losses Attributable to Reservoir Drawdown In Excess of Limits in the Columbia Basin Fish and Wildlife Program: Hungry Horse and Libby Dams 1991-1993 (MFWP and CSKT 1997).

Short description
Research, design, execute and monitor watershed / habitat enhancement projects that mitigate for native fish losses caused by hydropower construction and operation.

Target species
Westslope cutthroat trout, Kootenai River white sturgeon, bull trout, burbot, inland rainbow trout.

Section 2. Sorting and evaluation

Subbasin
Kootenai Subbasin, Upper Columbia

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more caucus	If your project fits either of these processes, mark one or both	Mark one or more categories
☐ Anadromous fish ☒ Resident fish ☐ Wildlife	☒ Multi-year (milestone-based evaluation) ☒ Watershed project evaluation	☐ Watershed councils/model watersheds ☐ Information dissemination ☒ Operation & maintenance ☐ New construction ☒ Research & monitoring ☒ Implementation & management ☐ Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description
20517	Libby Fisheries Mitigation Program

9401000	MFWP- Libby Reservoir Excessive Drawdown
8346500	Libby and Hungry Horse Modeling Technical Analysis - Libby Component
20028	Purchase Conservation Easement from Plum Creek Timber Company Fisher River.

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
8806500	IDFG-Kootenai River Fisheries Investigations	White Sturgeon Recovery
8806400	KTOI – White Sturgeon Experimental Aquaculture	White Sturgeon Recovery
9404900	Kootenai River Ecosystem Improvement Study	Ecosystem Function
9401001	MFWP - Libby Reservoir Excessive Drawdown	Habitat Enhancement
8346500	MFWP - Libby and Hungry Horse Technical Analysis	Reservoir and River Modeling
9608702	MFWP - Focus Watershed Coordination	Watershed Coordination

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
1995	Developed a tiered (variable volume) approach for white sturgeon spawning flows balanced with reservoir IRCs and Snake River salmon biological opinion	Strategy unanimously supported by the White Sturgeon Recovery Team.
1998	Rehabilitated approximately 200' of Pipe Creek frontage to prevent further loss of habitat for bull trout and rainbow trout.	Yes. Pipe Creek was once a primary spawning and rearing tributary for bull trout. Recently redds were located for the first time in nearly a decade.
1998	Developed on-site isolation facility for eventual brooding of inland rainbow trout.	The work has not been fully completed, but the objectives of the various phases of this project are being met.
1989	The LRMOD and preliminary IRCs (called Biological Rule Curves) were first published in 1989 (Fraley et al. 1989), then refined in 1996 (Marotz et al. 1996).	Integrated Rule Curves (IRCs) were adopted by NPPC in 1994, but have not yet been implemented.

	A long-term database was established for monitoring populations of kokanee, bull trout, westslope cutthroat trout, rainbow trout and burbot and other native fish species, as well as zooplankton and trophic relations.	Ongoing data collection since inception of project.
1997	The effects of dam operation on benthic macroinvertebrates in the Kootenai River was assessed (Hauer et al. 1997) for comparison with conditions measured in the past (Perry and Huston 1983).	Quantified shifts in community structure and loss due to substrate exposure in the varial zone.
1996	A model was calibrated to estimate the entrainment of fish and zooplankton through Libby Dam as related to hydro-operations and use of the selective withdrawal structure.	Allows seasonal estimation of quantity and species relative abundance of entrained fish under varying discharge configurations.
1998	Chemically rehabilitated Carpenter Lake in northern Lincoln County to remove illegally introduced and stunted bluegill, largemouth bass, yellow perch, and northern pike populations.	Lake will be stocked with cutthroat trout and rainbow trout in the spring of 1999 (no natural reproduction possible).
1997	Chemically rehabilitated Bootjack, Topless, and Cibid Lakes in eastern Lincoln Country to remove illegally introduced pumpkinseed and yellow perch.	Lakes were restocked with rainbow trout in the spring of 1998 (no natural reproduction possible).

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Monitor spawning and rearing use of mainstem Kootenai River by fluviat burbot and rainbow, cutthroat, and bull trout.	a	Continue hoopnetting operations during December and February to monitor burbot spawning activity in the stilling basin below Libby Dam.
		b	Monitor tributary use of fluvial bull trout in the Montana portion of the Kootenai River, and the Wigwam River in B.C. Redd counts have been the principal bull trout monitoring tool since 1983 (Dalbey et al. 1998).

		c	Describe the magnitude of the spawning run of trout into O'Brien and Callahan Creeks and the recruitment of fry from these spawning events back into the Kootenai River.
		d	Continue counting rainbow redds below Libby Dam from river locations 4-20 through 5-31 between Alexander Creek and the Fisher River.
2	Document entrainment of fish through Libby Dam during flow events greater than 20,000 cfs.	a	Monitor entrainment of fish through Libby Dam via high velocity netting in the outlet tubes.
		b	Measure draft tube velocity distributions and correlate with discharge volume and reservoir elevation (head differential).
		c	Incorporate >20 kcfs entrainment data into the existing entrainment model (Skaar et al. 1996).
		d	Investigate feasibility of development and installation of kokanee salmon deterrent structure on the face of Libby Dam.
3	Monitor zooplankton and gamefish populations in Koocanusa Reservoir.	a	Monitor seasonal and annual changes in fish abundance in near shore zones with seasonal gillnetting.
		b	Conduct annual estimates of population numbers of each age class of kokanee (hydroacoustics).
		c	Monitor burbot movement in Libby Reservoir via telemetry and tag returns.
		d	Monitor zooplankton populations in the reservoir.
		e	Extend the existing food habits data to include information about winter and summer diets.
4	Develop isolation habitat at the Libby Field Station for native interior redband trout to be used as the initial source of eggs for species recovery actions.	a	Survey and redesign the stream channel on the Libby Field Station Spring Creek using Rosgen standards.

		b	Obtain 124, 3A and 404 permits for channel construction, and contract for stream restoration.
		c	Line the excavated creek bed and place rearing and spawning habitat structures in the channel.
		d	Monitor reconstructed creek for water quality and make adjustments as needed to provide maximum rearing habitat. Monitor for benthic invertebrate population establishment.
		e	Conduct population estimates for interior redband trout in the Basin Creek and the East Fork Yaak River drainages and determine how many individual fish might be taken from this population without affecting viability.
		f	Given favorable indications from Tasks "d" and "e", capture interior redband from Basin Creek and transport to the Libby Field Station isolation habitat.
5	Assess the seasonal movement and habitat use of native burbot and bull trout in the Kootenai River between Libby Dam and Idaho.	a	Surgically implant radio and sonic transmitters into captured bull trout.
		b	Monitor movements of radio-tagged fish through several seasons to identify seasonal movements, habitat use and likely spawning concentrations.
		c	Determine habitat preference by use of established IFIM methods, radio telemetry, temperature recorders, and SCUBA transects and snorkeling.
6	Implement the Libby Mitigation Plan (MFWP, CSKT and KTOI 1998) to enhance native species in the Kootenai Basin.	a	Implement habitat enhancement, fish passage improvements, off-site mitigation and monitoring as established in the Libby Fisheries Mitigation and Implementation Plan.

		b	Establish site-specific project designs, budgets and timelines for completion of projects listed in the plan.
		c	Conduct post-treatment data collection for monitoring and reporting purposes.
		d	Identify projects not previously listed in the Mitigation Plan that will enhance native species in the Kootenai River watershed.
7	Further define river operations required to mitigate for losses of macrozoobenthos associated with river regulation.	a	Use model to quantify varial zone area of the Kootenai River affectd by various ramping operations
		b	Quantify seasonal losses of macrozoobenthos in the Kootenai River during ramping periods.
		c	Establish seasonal operational guidelines to minimize effects (refine those already proposed).
8	Link the IFIM model to the existing reservoir model to help evaluate operational tradeoffs between the reservoir and river as per NPPC direction.	a	Expand on information contained in the 1999 IFIM report.
		b	Develop interface between existing reservoir model (LRMOD) and completed riverine model (RHABSIM).
		c	Continue to collect habitat locations for bull trout for incorporation into the model.
9	Quantify and document life cycle requirements and devise recovery actions for burbot in the Kootenai basin (in cooperation with KTOI and IDFG).	a	Enumerate burbot below Libby Dam with SCUBA transects.
		b	Review the feasibility of stocking burbot in closed basin Kootenai basin lakes.
		c	Continue to collect burbot tissue for mitochondrial DNA analysis.

		d	Determine distribution, timing of spawning, and habitat use of all life stages of burbot in the Kootenai River from Libby Dam to the Idaho border.
10	Quantify white sturgeon populations in the Montana portions of the Kootenai River. Investigate habitat requirements of juvenile hatchery sturgeon and determine availability of habitat in Montana.	a	Determine habitat use of juvenile white sturgeon in Montana and Idaho using SCUBA transects, hook and line surveying, gill and trammel nets, and radio telemetry. A graduate student will be funded through this project to accomplish Tasks "a" and "c".
		b	Conduct beam trawling efforts for egg and larval fish collection in the Idaho and British Columbia portions of the Kootenai River. Effort will be coordinated with IDFG, and will consist of a minimum of 20 trawling days during July and August.
		c	Determine habitat requirements of larval, juvenile and adult white sturgeon in Montana portions of the Kootenai River and investigate recovery options.
		d	Continue participation in the white sturgeon recovery team.
11	Continue efforts investigating site-specific limiting factors affecting recruitment of salmonid populations in the lower Kootenai River (Kootenai Falls to Idaho border). Address and implement actions that will enhance this fishery.	a	Install screw trap in O'Brien Creek to determine juvenile outmigrant abundnce druing May through September.
		b	Inventory spawning and rearing habitat in principal tributaries (Callahan, Ruby, Star, O'Brien Creeks and Yaak River) and explore enhancement opportunities.
		c	Conduct electrofishing population estimates in the mainstem Kootenai River and principal tributaries. Determine recruitment to the Kootenai River.

		d	Contract stream rehabilitation projects to meet fisheries enhancement objectives.
		e	Monitor projects to determine cost-effectiveness of various mitigation techniques.

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	10/1994	8/2050			6.00%
2	10/1992	8/2002			7.00%
3	8/1983	8/2050			6.00%
4	7/1997	8/2002			7.00%
5	2/1996	8/2015			10.00%
6	5/1995	5/2055	Objectives will be met if standing stock of target species is increased.		25.00%
7	4/1994	4/2002			6.00%
8	8/1995	8/2002			10.00%
9	10/1994	8/2002			5.00%
10	1/1999	5/2001			8.00%
11	10/1994	8/2015			10.00%
				Total	100.00%

Schedule constraints
We must implement many mitigation actions simultaneously so that as some individual projects are delayed by permitting, contracting or public input, others continue through completion. Our goal is to finalize several site-specific projects annually.

Completion date
2055

Section 5. Budget

FY99 project budget (BPA obligated): $495,000

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel		%30	150,342
Fringe benefits		%11	52,985

Supplies, materials, non-expendable property		%7	34,500
Operations & maintenance		%1	7,000
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		%10	48,000
NEPA costs	Provided by in-house personnel	%0	
Construction-related support		%0	0
PIT tags	# of tags:	%0	0
Travel	Travel and Training	%6	28,000
Indirect costs		%0	
Subcontractor	Contracted services for stream rehabilitation work	%20	100,000
Other	Overhead	%16	79,173
TOTAL BPA FY2000 BUDGET REQUEST			$500,000

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
USFS	Financial and physical support for a proposed westslope cutthroat trout and inland rainbow trout conservation plan in the Yaak River drainage ($25K in FY99; anticipate field support in FY2000 (in kind)).	%0	
Kootenai River Network	Completion of a watershed bibiography for the Kootenai River Basin (in kind).	%0	
		%0	
		%0	
Total project cost (including BPA portion)			$500,000

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	500,000	$505,000	510,000	515,000

Section 6. References

Watershed?	Reference
☐	Anders, P. J. 1993. Natural spawning of white sturgeon in the Kootenai River. Annual Hatchery Report FY1993, Report A. Kootenai Tribe of Idaho for Bonneville Power Administration, Portland, OR.
☐	Anders, P. J. 1994. Kootenai River tributary kokanee spawning ground survey. Annual Hatchery Report FY1994, Report C. Kootenai Tribe of Idaho for Bonneville Power Administration, Portland, OR.
☐	Bovee, K.D. 1978. Probability-of-use criteria for the family Salmonidae. Instream Flow Information Paper 4. United States Fish and Wildlife Service FWS/OBS-78/07. 79pp.
☐	Bovee, K.D. 1982. A guide to stream habitat analysis using the Instream Flow Incremental Methodology. Instream Flow Information Paper 12. United States Fish and Wildlife Service FWS/OBS- 82/26. 248pp.
☐	Bovee, K.D. 1986. Development and evaluation of habitat suitability criteria for use in the Instream Flow Incremental Methodology. In-stream Flow Information Paper 21. United States Fish and Wildlife Service, Biological Report 86(7). 235pp.
☐	Bovee, K.D., and R.T. Milhous. 1978. Hydraulic simulation in instream flow studies: theory and techniques. Instream Flow Information Paper 5. United States Fish and Wildlife Service FWS/OBS-78/33. 129pp.
☐	Chisholm, I.M. and J.J. Fraley. 1986. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Annual report. Prepared for BPA by MFWP, Kalispell, MT. Project 83-467.
☐	Chisholm, I.M., M.E. Hensler, B. Hansen, D. Skaar. 1989. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Methods and Data Summary 1983-1987. Prepared for BPA by MFWP, Kalispell, MT. Project 83-467.
☐	Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management. 5:330-339.
☐	Dalbey, S.R., J. DeShazer, L. Garrow, G. Hoffman, and T. Ostrowski. 1998. Quantification of Libby Reservoir levels needed to enhance reservoir fisheries. Methods and data summary, 1988-1996. MFWP, for BPA. Project 83-467.
☒	Fraley J.J., B. Marotz, J. Decker-Hess, W. Beattie and R. Zubic. 1989. Mitigation, compensation and future protection for fish populations affected by hydropower development in the upper Columbia… Regulated Rivers: Research and Management 3:3-18.
☐	Greenback, J. 1941. Selective poisoning of fish. Transactions of American Fisheries Society. 70:80-86.

☐	Hauer, R. and J.A. Stanford 1997. Kootenai river zoobenthos investigation. Kootenai River Fisheries Investigations - Montana. Montana Department of Fish, Wildlife and Parks Region 1 (Open File Report). Annual Report to Bonneville Power Administration.
☐	Huston, J. E., P. Hamlin and B. May. 1984 Lake Koocanusa Investigations – Final Report 1972-1983. Montana Department of Fish, Wildlife and Parks – Region 1 in cooperation with Seattle District ACOE.
☐	ISAB. 1997. The Normative River. Independent Scientific Advisory Board report to the Northwest Power Planning Council and National Marine Fisheries Service. Portland, OR.
☐	ISAB. 1997b. Ecological impacts of the flow provisions of the Biological Opinion for endangered Snake River salmon on resident fishes in the Hungry Horse, and Libby systems in Montana, Idaho, and British Columbia. Report 97-3.
☐	ISG. 1996. Prepublication Copy. Return to the River: Restoration of salmonid fishes in the Columbia River ecosystem. Development of an alternative conceptual foundation and review and synthesis of science underlying the FWP. Document 96-6.
☐	Leathe, S.A. and P.J. Graham. 1982. Flathead Lake fish food habits study. Final Report. Prepared for the Environmental Protection Agency by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana.
☒	Marotz, B.L., B. Hansen, and S. Tralles. 1988. Instream flows needed for successful migration, spawning and rearing of rainbow and westslope cutthroat trout in selected tributaries of the Kootenai River. MFWP. Prepared for BPA. Project 85-6.
☒	Marotz, B.L., D. Gustafson, C. Althen and B. Lonen. 1996. Model development to establish integrated operational rule curves for Hungry Horse and Libby Reservoirs - Montana. MFWP - Region 1. Prepared for BPA. Project 83-467.
☐	Milhous, R.T., M.A. Updike, and D.M. Schneider. 1989. Reference manual for the Physical Habitat Simulation system (PHABSIM) - Version II. Instream Flow Information Paper 26. United States Fish and Wildlife Service Biological Report 89.
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☐	Montana Bull Trout Scientific Group. 1996. Upper Kootenai River drainage bull trout status report. Prepared for the Montana Bull Trout Restoration Team. 30 pp.
☐	Montana Bull Trout Scientific Group. 1996. Middle Kootenai River drainage bull trout status report. Prepared for the Montana Bull Trout Restoration Team. 36 pp.

☒	MFWP, CSKT and KTOI. 1998. Fisheries Mitigation and Implementation Plan for losses attributable to the construction and operation of Libby Dam. Montana Fish, Wildlife & Parks, Confederated Salish and Kootenai Tribes, Kootenai Tribe of Idaho. 50 pp.
☐	Montana Westslope Cutthroat Trout Recovery Team. In preparation. Montana westslope cutthroat trout recovery plan. Prepared for Montana Fish, Wildlife and Parks, Helena, Montana.
☐	Paragamian, V. L. 1994. Kootenai River fisheries investigations: stock status of Burbot and Rainbow Trout, and fisheries inventory. 1994 annual work plan, draft. IDFG, Coeur d'Alene, ID.
☐	Partridge, F. 1983. Sub project IV: River and stream investigations, Study IV: Kootenai River fisheries investigations. Idaho Department of Fish and Game, Boise, Idaho.
☐	Payne, T.R. 1992. Stratified random selection process for the placement of Physical Habitat Simulation (PHABSIM) transects. Paper presented at AFS Western Division Meeting, July 13-16, 1992, Fort Collins, Colorado.
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☐	Perry, S.A. 1984. Comparative ecology of benthic communities in natural and regulated areas of the Flathead and Kootenai Rivers, Montana. North Texas State University. Denton, Texas.
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☐	Snyder, E. B. and G. W. Minshal. 1996. Ecosystem metabolism and nutrient dynamics in the Kootenai River in relation to impoundment and flow enhancement for…Stream Ecology Center, Department of Biological Sciences, Idaho State University, Pocatello, ID.
☐	Trihey, E.W., and D.L. Wegner. 1981. Field data collection for use with the physical habitat simulation system of the instream flow group. United States Fish and Wildlife Service Draft Report. 151pp.
☒	USDA Forest Service. September, 1987. Kootenai National Forest, Forest Plan.
☐	Wesche, T.A. and P.A. Rechard. 1980. A summary of instream flow methods for fisheries and related research needs. Eisenower Consortium Bulletin 9.

☐	Woods, P. F. and C. M. Falter. 1982. Limnological investigations: Lake Koocanusa, Montana Part 4: factors controlling primary productivity [special report 82-15]. Prepared for: USACE, Seattle, WA.
☐	Wright, A. 1996. Review of Columbia River operating criteria. Facilitators Report to National Marine Fisheries Service and Bonneville Power Administration. Al Wright Consulting, Portland, OR. 15 pp. (plus 17 pp. appendices)

PART II - NARRATIVE

Section 7. Abstract

Completion of Libby Dam in 1972 on the second largest Columbia River tributary created the 109-mile Libby Reservoir. Congress authorized Libby Dam for power (91.5%), flood control (8.3%) and other uses (0.2%). Between 1974 and 1996, reservoir drawdowns averaged 112.44 feet, ranging as deep as 152 feet. Drawdown effects all biological trophic levels and influences the probability of subsequent refill during spring runoff. Refill failures are especially harmful to biological production during the productive warm months. Annual drawdowns impede revegetation of the reservoir varial zone, resulting in a littoral zone of nondescript cobble/mud/sand bottom with limited habitat structure. Inundation eliminated 109 miles of the mainstem Kootenai River and 40 miles of critical, low-gradient tributary habitat when Libby Reservoir filled. Power operations cause rapid flow fluctuations (as great as 400% change in daily discharge), which are inconsistent with the normative river concept. Flow fluctuation widens the riverine varial zone, which becomes biologically unproductive. Libby Dam and other anthropogenic factors have caused reductions in native fish populations. Kootenai River white sturgeon are now endangered and bull trout are listed threatened under the Endangered Species Act. Westslope cutthroat trout have been proposed for listing. This project mitigates fisheries losses attributed to Libby Dam using watershed-based habitat enhancement, fish passage improvements and off-site measures; and integrates computer models into a watershed framework to design economical operational changes to recover native species. A loss statement, site-specific mitigation actions and monitoring strategies were established in the Libby Mitigation and Implementation Plan (MFWP, CSKT and KTOI. 1998).

Section 8. Project description

a. Technical and/or scientific background

Libby Dam caused profound biological and physicochemical changes in the Kootenai Subbasin (Woods 1982; Chisholm et al. 1989; Skaar et al. 1996; Snyder and Minshall 1996). Libby dam terminated upstream fish migrations and caused a discontinuity between fish communities above and below the dam. Inundation eliminated 109 miles of the mainstem Kootenai River and 40 miles of highly productive, low gradient tributary stream

habitat when Libby Dam filled (MFWP, CSKT and KTOI 1997). Annual reservoir operations resulted in extreme fluctuations in reservoir surface area and volume and river stage, effecting all biological trophic levels in the impoundment and river downstream (Marotz et al. 1996). Reservoir fluctuations impede revegetation of the reservoir varial zone resulting in a littoral zone of nondescript cobble/mud/sand bottom with limited available structure. River operations for power cause rapid flow fluctuations (as much as 400% change in daily discharge) which are inconsistant with the normative river concept (ISAB 1997) and create a wide varial zone that is biologially unproductive (Perry and Huston 1983; Cushman 1985; Hauer and Stanford 1997).

Fish populations throughout the Kootenai River Drainage have demonstrated responses indicitive of ecosystem collapse (Partridge 1983; Anders 1993; Anders 1994; Paragamian 1994; Williams 1961). Libby Dam converted a large segment of the Kootenai River from a lotic to lentic environment. Changes in the aquatic community reflect this manipulation. Westslope cutthroat and rainbow trout captured during annual gillnetting on Libby Reservoir have declined significantly from early post-impoundment levels of 10% and 14% to current levels 0.2% and 0.3% of the total catch. Conversely, non-game species such as northern squawfish and peamouth chub (not abundant prior to impoundment) have increased significantly in gill net catches to comprise up to 87 percent of the total catch (Chisholm et al. 1989; Dalbey et al. 1997).

Similar impacts have been observed in the tailwater below Libby Dam. Barriers have been deposited in critical spawning tributaries to the Kootenai River through the annual deposition of bedload materials (sand, gravel, and boulders) at their confluence with the river (Marotz et al. 1988). Prior to impoundment, the Kootenai River contained sufficient hydraulic energy to annually remove these deltas. Since the dam was installed, peak flows have been limited to maximum turbine capacity (roughly 27 kcfs) and hydraulic energy is insufficient to remove deltaic deposits. Reversal of the Kootenai River hydrograph and alteration of the thermograph have caused impacts typical of tailwaters. Native fish populations that have been reduced due to impoundment include burbot, which are now estimated at 10% of pre-impoundment levels based on current hoopnet catches of 0.002-0.168-fish/hoopnet hour. Westslope cutthroat trout populations have declined based on 24 years of population estimates (Huston et al. 1984; Dalbey et al. 1997). In 1973, 44 percent of trout captured were westslope with angler catch rates recorded at 0.5 fish/hour, ranking the Kootenai River among other blue ribbon trout streams in Montana. Estimates in 1994 document significant population reductions with less than five percent of the trout captured being westslope cutthroat trout (MFWP data files). White Sturgeon populations are endangered in the Kootenai River with very little juvenile recruitment since 1974; less than 2000 individuals remain (U.S. Federal Register Vol 59, No. 171).

b. Rationale and significance to Regional Programs

Hydropower-related effects on the Kootenai Watershed are documented in the Libby Dam Fisheries Mitigation and Implementation Plan for Losses Attributed to the Construction

and Operation of Libby Dam and previous project reports. This document was developed as a collaborative programmatic assessment with the Confederated Salish and Kootenai Tribes (CSKT) and the Kootenai Tribe of Idaho (KTOI). The Mitigation Plan quantifies fish losses and mitigation actions above and below Libby Dam as called for by the FWP. Research and monitoring of the endangered Kootenai River white sturgeon is collaborative effort with Idaho Fish and Game (IDFG), KTOI and the British Columbia, Ministry of Environment (B.C. Ministry); actions are coordinated on an annual basis. White Sturgeon Recovery efforts are consistent with the internationally developed White Sturgeon Recovery Plan (USFWS 1998). The bull trout population below Libby Dam has too few subpopulations to be considered a stable metapopulation. However, the population in the Canadian headwaters of Libby Reservoir is believed to be the strongest metapopulation in existence. Recovery actions are coordinated with the Montana Bull Trout Scientific Team and B.C. Ministry. Westslope cutthroat trout have been petitioned for listing under ESA and may be listed during the next year. This program directly addresses the FWP mandate to enhance hydropower-affected fish stocks in the Kootenai Basin through on-the-ground habitat enhancement efforts that alleviate limiting factors to native species populations. Projects reclaiming critical spawning, rearing, and over-wintering habitats have been completed, or are ongoing, as pilot mitigation projects. These projects are being completed using grassroots watershed workgroups comprised of landowners, agencies, sportsmen's groups and local, state and federal government coalitions.

The IFIM river model will be linked with the existing reservoir model LRMOD to complete the integrated watershed framework. The IFIM research calibrated simulations of hydraulic conditions (stage/discharge and velocities) and fish habitat from Libby Dam to Kootenay Lake, British Columbia, Canada at various discharges from Libby Dam. An optimization program is scheduled for development to allow managers to assess tradeoffs between the requirements of reservoir and riverine biota, when conflicts occur between reservoir operation and river flow limits as per the FWP. This project provides data used to develop and refine operating protocols for Libby Dam (IRCs), including Tiered Flow augmentation for the recovery of the endangered Kootenai River white sturgeon. The IRC concept has been recognized by the ISG as a tool for restoring normative conditions in rivers below storage projects. The IRCs can be applied to other projects given the necessary data. A simplified version of the models was used during the Columbia Basin System Operation Review process on Dworshak, Grand Coulee and Pend Oreille. This screening model produces qualitative results that can be used to direct field sampling efforts, which in time will provide the data for quantitative subroutines to construct a full-scale quantitative evaluation model.

This project complements actions in the subproposal for mitigating fisheries losses caused by excessive reservoir drawdowns for power operations at Libby Dam (exceeding drawdown limits stated in the FWP (measures 903a and 903b, NPPC 1987). Effects of several excessive drawdowns have yet to be mitigated. The Integrated Rule Curve (measures 10.3B.6 and 10.3B.7, NPPC 1995) have not been implemented, so the original drawdown limits are in effect. Changes in dam operation for recovery actions in the lower Columbia affect resident fish in the headwaters (ISAB 1997), and must be balanced to

benefit all native fish species. Actions taken must also be affordable or the public will likely stop the effort. To do this, decision-makers must have tools to assess tradeoffs and make wise choices. Native species aspects of this project are consistent with measure 10.1B, which accords the highest priority to weak, but recoverable, native populations injured by the hydropower system. Measure 10.2B requires that comprehensive management be carried out by the related Kootenai Focus Watershed Project (9608720). Funding for on-the-ground watershed projects is included in this proposal. Mitigation projects are directed by measure 10.3B, (specifically measure 10.3B.8) which instructs BPA to fund the design, construction and maintenance of mitigation projects. Research aspects are directed by measure 10.3B.5, which instructs BPA to continue to fund studies to evaluate the effects of Libby Dam. All of the projects proposed for combination compliment the US Forest Service Forest Plan to enhance native species through habitat restoration projects.

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c. Relationships to other projects

This project is a subproposal of the umbrella project Libby Reservoir Mitigation Program, which addresses operational mitigation (Integrated Rule Curve refinement and assessment: measure 10.3B of the FWP) and non-operational mitigation (habitat and passage improvements). Results complement and extend the Kootenai Focus Watershed Program (Project 9608720) and Excessive Drawdown Mitigation (Project 9401001). This project creates new trout habitat and by restoring degraded habitat to functional condition through stream rehabilitation and fish passage repairs. The subproposals compliment each other in the restoration and maintanence of native trout populations in the Kootenai River System.

The radio-telemetry work of this project will identify migration habits, habitat preferences and spatial distribution of species in the Kootenai system. Much of this information can be utilized by the IFIM project in the Flathead watershed (Projects 9401002 and 9502500).

d. Project history (for ongoing projects)

Work on Libby Reservoir to assess the effects of operation on fish populations and lower trophic levels began in 1982. This project established relationship between reservoir operation and biological productivity, and incorporated the results in the computer model LRMOD. The models and preliminary IRCs (called Biological Rule Curves) were first published in 1989 (Fraley et al. 1989), then refined in 1996 (Marotz et al. 1996). Integrated Rule Curves (IRCs) were adopted by NPPC in 1994, but have not yet been implemented. The project also developed a tiered approach for white sturgeon spawning flows balanced with reservoir IRCs and Snake River salmon biological opinion, a strategy unanimously supported by the White Sturgeon Recovery Team.

A long-term database was established for monitoring populations of kokanee, bull trout, westslope cutthroat trout, rainbow trout and burbot and other native fish species. Long-term monitoring of zooplankton and trophic relationships was similarly established. A model was calibrated to estimate the entrainment of fish and zooplankton through Libby Dam as related to hydro-operations and use of the selective withdrawal structure. Research on the entrainment of fish through the Libby Dam penstocks began in 1990, and results were published in 1996 (Skaar et al. 1996). The effects of dam operation on benthic macroinvertebrates in the Kootenai River was also assessed (Hauer et al. 1997) for comparison with conditions measured in the past (Perry and Huston 1983). The project identified important spawning and rearing tributaries in the U.S. portion of the reservoir and began genetic inventories of species of special concern. Research on the effects of operations on the river fishery using IFIM techniques was initiated in 1992. Assessment of the effects of river fluctuations on Kootenai River burbot fishery was examined in 1994 and 1995. IFIM studies were also completed in Kootenai River below Bonners Ferry, Idaho, to determine spawning area available to sturgeon at various river flows. Microhabitat data collection specific to species and life-stage of rainbow trout and mountain whitefish has been incorporated into suitability curves. River cross-sectional profiles, velocity patterns and other fisheries habitat attributes were completed in 1997. Hydraulic model calibrations and incorporation of suitability curves and modification of the model code will be completed in 1999.

The following is a list of project reports and technical papers generated from the projects. A summary of accomplishments and implementation of adaptive management principals can be found in the abstract of each document.

Chisholm, I.M. and J.J. Fraley. 1986. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Annual report. Prepared for Bonneville Power Administration by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana. Project No. 83-467.

Chisholm, I.M. and P.D. Hamlin. 1987. 1985 Libby Reservoir angler census. Prepared for Bonneville Power Administration, by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana. Project No. 83-467.

Chisholm, I.M., M.E. Hensler, B. Hansen, D. Skaar. 1989. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Methods and Data Summary 1983-1987. Prepared for Bonneville Power Administration by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana. Project No. 83-467.

Dalbey, S.R., J. DeShazer, L. Garrow, G. Hoffman, and T. Ostrowski. 1998. Quantification of Libby Reservoir levels needed to enhance reservoir fisheries. Methods and data summary, 1988-1996. Montana Department of Fish, Wildlife and Parks - Region 1. Prepared for Bonneville Power Administration. Project No. 83-467.

Hauer, R. 1997. Kootenai river zoobenthos investigation. Kootenai River Fisheries Investigations - Montana. Montana Department of Fish, Wildlife and Parks Region 1. Annual Report to Bonneville Power Administration. Project No. 83-467.

Marotz, B.L. and J.J. Fraley. 1986. Instream flows needed for successful migration, spawning and rearing of rainbow and westslope cutthroat trout in selected tributaries of the Kootenai River. Montana Department of Fish, Wildlife and Parks. Prepared for Bonneville Power Administration. Project Number 85-6.

Marotz, B.L., B. Hansen, and S. Tralles. 1988. Instream flows needed for successful migration, spawning and rearing of rainbow and westslope cutthroat trout in selected tributaries of the Kootenai River. Montana Department of Fish, Wildlife and Parks. Prepared for Bonneville Power Administration. Project Number 85-6.

Marotz, B.L., D. Gustafson, C. Althen and B. Lonen. 1996. Model development to establish integrated operational rule curves for Hungry Horse and Libby Reservoirs - Montana. Montana Department of Fish, Wildlife and Parks - Region 1. Prepared for U.S. Department of Energy - BPA. Project number 83-467

MFWP, CSKT and KTOI. 1997. Fisheries mitigation and implementation plan for losses attributable to the construction and operation of Libby Dam. Montana Department of Fish, Wildlife and Parks, Confederated Salish and Kootenai Tribes and the Kootenai Tribe of Idaho. Prepared for Bonneville Power Administration. Project No. 83-467.

Perry S. and J. Huston. 1983. Kootenai River Investigations Final Report 1972-1982. Section A. Aquatic Insect Study. Montana Fish, Wildlife & Parks in cooperation with the U.S. Army Corps of Engineers. 112p.

Shepard, B.B. 1985. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Annual Report. Prepared for Bonneville Power Administration by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana.

Skaar, D., J. DeShazer, L. Garrow, T. Ostrowski, and B. Thornberg. 1996. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries; investigations of fish entrainment through Libby Dam, 1990-1994. Prepared for Bonneville Power Administration by Montana Department of Fish, Wildlife and Parks. Kalispell, Montana.

Table of annual funding for Project 83-467.

Budget Period	Amt. Funded	Modification
5-83 - 5-84	$156,305	Original
10-83 - 10-84	$371,311	Mod 001000203
9-84 - 4-85	$112,561	4
5-85 - 5-86	$292,106	5
8-85 - 11-87	$231,908	6
9-86 - 3-88	$472,871	7
10-87 - 9-88	$49,696	9
7-88 - 11-88	$72,826	10
11-88 - 12-88	0	11
12-88 - 12-87	$248,844	12
12-89 - 12-90	$270,492	13
12-90 - 12-92	$282,142	14
12-91 - 12-92	$297,262	15
1-93 - 12-93	$275,000	16
1-94 - 12-94	$286,524	17
"	$6,939	18
11-94 - 11-95	$279,715	19
"	$4,500	20
11-95 - 11-96	$298,249	21
11-96 - 11-97	$310,700	22
11-97 – 10-98	$308,004	24

e. Proposal objectives

PROJECT GOAL

Restore, enhance, or protect existing sustainable native fish populations in the Kootenai Basin that have been negatively affected by the construction and operation of Libby Dam.

Objective 1. Monitor use of mainstem Kootenai River and tributaries for spawning and rearing by fluvial burbot and cutthroat and bull trout. Mainstem Kootenai River and principal tributaries will be monitored for spawning and rearing by fluvial burbot and rainbow, cutthroat, and bull trout.

Tasks

A. Continue hoopnetting operations during December and February to monitor burbot spawning activity in the stilling basin below Libby Dam.

B. Monitor tributary use of fluvial bull trout in the Montana portion of the Kootenai River. Bull trout redd counts will be completed in Quartz, W. Fork Quartz, O'Brien, Pipe, E. Fork Pipe, Bear, Keeler, N. Fork Keeler, S. Fork Keeler, Grave, Clarence, Blue Sky and Weasel Creeks, and the Wigwam River (U.S. and Canadian portions). Dates of redd counts will vary from 9-25 through 10-25. Redd counts have been the principal bull trout monitoring tool since 1983 (Dalbey et al. 1998).

C. Describe the magnitude of the spawning run of trout into O'Brien and Callahan Creeks and the recruitment of fry from these spawning events back into the Kootenai River.

D. Continue counting rainbow redds below Libby Dam from 4-20 through 5-31 between Alexander Creek and the Fisher River.

Objective 2. Document entrainment of fish through Libby Dam during flow events greater than 20,000 cfs.

- Kokanee (particularly age 0 fish) are susceptible to entrainment during spring runoff due to high forebay fish densities (Skaar et al. 1996). The extent to which entrainment occurs is related to the magnitude of the runoff and the dam discharge during June and July. Monitoring will be conducted from May to July, with specific sampling dates timed to correspond to dam releases for white sturgeon. Draft tube nets will be deployed accompanied by forebay hydroacoustic enumeration of kokanee during 24-hr periods pre-ramp-up, mid-flow and post-ramp-down. The initial entrainment model was unable to measure entrainment in flows greater than 20,000 cfs. Therefore, the predictive capability of this model is limited during experimental salmon and white sturgeon flows. Data collected in 1999 will allow managers to predict estimated numbers of kokanee salmon entrained through Libby Dam during these experimental flow periods. Furthermore, with the proposed installation of three additional turbines

in Libby Dam for white sturgeon recovery (USFWS), entrainment quantification becomes paramount because the potential release of 44,000 cfs could significantly impact Libby Reservoir kokanee populations. Accurate entrainment model runs can provide baseline data allowing for evaluation of strategies to reduce entrainment through Libby Dam.

Tasks

A. Monitor entrainment of fish through Libby Dam.
B. Measure draft tube velocities and determine relationships to discharge and reservoir elevation.
C. Incorporate >20 kcfs entrainment data into the existing entrainment model (Skaar et al. 1996).
D. Investigate feasibility of installing a device to deter fish entrainment though Libby Dam.

Objective 3. Monitor zooplankton and gamefish populations in Koocanusa Reservoir.

- We have selected kokanee, westslope cutthroat trout, rainbow trout and rainbow X cutthroat hybrids as our target gamefish species for LRMOD. Burbot and bull trout are important gamefish, but are not included in the model. The continued monitoring program of reservoir fisheries will alert managers to significant changes if they occur. Seasonal and annual changes in fish abundance in near-shore areas of the reservoir will be assessed by seasonal horizontal gillnetting based on the following physical characteristics: Spring (28 nets) - Reservoir elevation between 2,350 and 2,375 feet and a surface water temperature near 11^{o}C ($\pm$2^{o}C). Fall (28 nets) - Reservoir elevation between 2,459 (full pool) and 2,449 feet and a surface water temperature near 15^{o}C ($\pm$2^{o}C). Analysis of gillnetting data will be included in annual reports.

  Zooplankton monitoring will involve three vertical tows using a 0.3 meter, 153 micron Wisconsin net completed monthly in randomly selected stations of three reservoir areas (Tenmile, Rexford and Canada). Twenty meter tows are done unless water column depth is less than 20 m, in which case, the entire water column is sampled. Orientation {east, west and middle (>100 m from either shore)} for each site is also chosen randomly. All samples are pulled at a rate of 1 m/sec to minimize backwash (Leathe 1982).

Tasks

A. Monitor seasonal and annual changes in fish abundance in near shore zones with seasonal gillnetting.
B. Conduct annual estimates of population numbers of each age class of kokanee (hydroacoustics).
C. Monitor burbot movement in Libby Reservoir via telemetry and tag returns.

D. Monitor zooplankton populations in the reservoir.
E. Extend the existing food habits data to include information about winter and summer diets.

Objective 4. Develop isolation habitat at the Libby Field Station for native interior redband trout to be used as the initial source of eggs for species recovery actions.

Tasks

A. Survey and redesign the stream channel on the Libby Field Station Spring Creek using Rosgen standards.
B. Obtain 124, 3A and 404 permits for channel construction, and contract for stream restoration.
C. Line the excavated creek bed and place rearing and spawning habitat structures in the channel.
D. Monitor new creek for water quality and make adjustments as needed to provide maximum rearing habitat. Monitor for benthic invertebrate population establishment.
E. Conduct population estimates for interior redband trout in the Basin Creek and the East Fork Yaak River drainages and determine how many individual fish might be taken from this population without affecting viability.
F. Given favorable indications from Tasks D and E, capture interior redband from Basin Creek and transport to the isolation habitat at the Libby Field Station.

Objective 5. Assess the seasonal movement and habitat use of native burbot and bull trout in the Kootenai River between Libby Dam and Idaho.

Tasks

A. Surgically implant radio and sonic transmitters into captured burbot and bull trout.
B. Monitor movements of radio-tagged fish through several seasons to identify seasonal movements, habitat use and likely spawning concentrations.
C. Determine habitat preference by use of bull trout using established IFIM methods, radio telemetry, temperature recorders, and SCUBA transects and snorkeling.

Objective 6. Implement the Libby Mitigation Plan (MFWP, CSKT and KTOI 1998) to enhance native species in the Kootenai Basin.

Specific projects that were completed in FY1998 include:

- Rehabilitation of Carpenter Lake to remove illegally introduced non-native species that compete and prey on native species. Stock native westslope cutthroat trout during the spring of 1999.

- Pipe Creek – Rehabilitate 780 linear feet of channel to decrease W:D, reduce sediment loading caused by riparian vegitation removal (urban development), revegitation with

native plants to provide soil stabilization and canopy cover, increase instream habitat hetrogeniety (boulders and large woody debris (LWD), provide spawning gravel entrapment conditions, increase juvenile rearing microhabitat. Project completion date = 10/98. Native species benefited = westslope cutthroat and inland rainbow trout.

- Libby Spring Pond reconstruction and reconfiguration. Comprehensive project objective is to provide a wild captive brood stock for inland rainbow trout in the Kootenai Basin. Phase I will involve rehabilitation of small lakes connected to the Libby Field Station Spring Creek on Libby Field Station (MFWP property). Phase II (1999) involves rehabilitating the connected spring creek and removing non-native brook trout. Phase III (1999) will entail gamete collection for conservation aquaculture, followed by outplanting to closed basin lakes and/or genetic swamping of stream populations.

Specific projects that will be completed in FY1999 include:

- Bobtail Creek – Rehabilitate over 2,900 linear feet of channel to decrease width to depth ratio (W:D), reduce sediment loading caused by livestock use (project area will be fenced year-round), revegetation with native plants to provide soil stabilization and canopy cover, increase instream habitat hetrogeniety (boulders and large woody debris (LWD), provide spawning gravel entrapment conditions, increase juvenile rearing microhabitat. Native species benefitted = westslope cutthroat trout.

- O'Brien Creek – Rehabilitate approximately 200 linear feet of channel to decrease W:D, revegetation with native plants to provide soil stabilization and canopy cover, increase instream habitat hetrogeniety, boulders and large woody debris, provide spawning gravel entrapment conditions, increase juvenile rearing microhabitat. Native species benefitted : westslope cutthroat and bull trout, burbot.

- Libby Field Station Spring Creek – Rehabilitate approximately 1,320 linear feet of channel to decrease W:D, reduce sediment loading caused by bank sloughing, increase instream habitat hetrogeniety (boulders and large woody debris), provide spawning gravel entrapment conditions, increase juvenile rearing microhabitat (Phase II). Phase III will entail gamete collection for conservation aquaculture, followed by outplanting to closed basin lakes and/or genetic swamping of stream populations. Native species benefitted : inland rainbow trout.

Specific projects proposed for FY2000 include:

- Kilbrennan Lake – Chemical rehabilitation to remove illegally introduced non-native species that compete and prey on native species. Stock native inland rainbow trout during the spring of 2001. Species benefitted : inland rainbow trout.

- Identify/choose closed basin lake(s) to chemically rehabilitate to remove illegally introduced species. Decisions are based on species composition in relation to the

state's fisheries management policy, age and growth data, public input, and cost effectiveness. Species benefitted : native trout.

- Libby Field Station Spring Creek – Adjust work completed in FY99. Native species benefitted : inland rainbow trout.

- Quartz Creek – Move channel away from large cut-bank (approximately 500 ft) to reduce sedimentation into this important bull trout stream.

- Development of a fishing pond in the town of Libby. Planning began during FY98, and the project, if approved, will be continued through at least FY2000, the anticipated completion date.

  We plan to combine projects with Libby Excessive Drawdown by FY2000, and therefore cost-share our projects and theirs from that point on. We list primarily lake rehabilitation projects here at this time, and stream rehabilitation projects under their proposal.

Tasks

A. Implement habitat enhancement, fish passage improvements, off-site mitigation and monitoring as established in the Libby Fisheries Mitigation and Implementation Plan.
B. Establish site-specific project designs, budgets and timelines for completion of projects listed in the plan.
C. Conduct post-treatment data collection for monitoring and reporting purposes. Pre-treatment survey data (fish density and species assemblage, macroivnertebrate trophic guild composition, water temperature, stream dimension, pattern and profile) will be collected, entered and analyzed to determine cost effectiveness of varous treatment options. Only projects projected to provide measureable improvement in the aforementioned biological indicies will be implemented. Post-treatment evaluations of indicies are established in rigorous data collection protocols followed by evaluation of project success criteria. Habitat enhancement project evaluations will be detailed in progress reports.
D. Identify projects not previously listed in the Mitigation Plan that will enhance native species in the Kootenai River watershed.

Objective 7. Further define river operations required to mitigate losses of Kootenai River macrozoobenthos associated with river regulation. Specific operational guidedlines that incorporate ecologically viable ramping rates and weighted usable area (WUA) for target fish species at various flow regimes will be written as a completion report for 83-467 in 1999. This report will complete the Kootenai River Instream Flow Incremental Methodology (IFIM) study. Specific accomplishments of this report will include Habitat Suitability Indices (HSI) curve establishment for juvenile and adult rainbow trout and mountain whitefish, allowing for habitat quantification of WUA at various Libby Dam discharges. The completed model will provide a template to quantify WUA values by

trophic guild and seasonal life stage for juvenile Kootenai River white sturgeon, bull trout and macrozoobenthos.

Tasks

A. Determine varial zone area of the Kootenai River affected by ramping operations.
B. Quantify seasonal losses of macrozoobenthos in the Kootenai River during ramping periods.
C. Establish seasonal operational guidelines to minimize effects.

Objective 8. Link the IFIM model to the existing reservoir model to help evaluate operational tradeoffs between the reservoir and the river.

Tasks

A. Expand on information contained in the 1999 IFIM report.
B. Develop interface between existing reservoir model (LRMOD) and completed riverine model (RHABSIM).
C. Continue to collect habitat locations for bull trout for incorporation into the model.

Objective 9. Quantify and document life cycle requirements and devise recovery actions for burbot in the Kootenai basin.

Tasks

A. Enumerate burbot below Libby Dam with SCUBA transects.
B. Review the feasibility of stocking burbot in closed basin Kootenai basin lakes.
C. Complete collection of burbot tissue for mitochondrial DNA analysis.
D. Determine distribution, timing of spawning, and habitat use of all life stages of burbot in the Kootenai River from Libby Dam to the Idaho border.

Objective 10. Quantify white sturgeon populations in the Montana portions of the Kootenai River. Investigate habitat requirements of juvenile hatchery sturgeon and determine availability of habitat in Montana.

Tasks

A. Determine habitat use of juvenile Kootenai River white sturgeon in Montana and Idaho using SCUBA transects, hook and line surveying, gill and trammel nets, and radio telemetry. A graduate student will be funded through this project to accomplish portions of this task, and well as portions of Task 18.C.
B. Conduct beam trawling efforts for egg and larval fish collection in the Idaho and British Columbia portions of the Kootenai River. Effort will be coordinated with the Idaho Department of Fish and Game, and will consist of a minimum of 20 trawling days during July and August.

C. Determine habitat requirements of larval, juvenile and adult white sturgeon in Montana portions of the Kootenai River and investigate recovery options.
D. Continue participation in the white sturgeon recovery team.

Objective 11. Continue efforts investigating limiting factors, primarily recruitment, of salmonid populations in the lower Kootenai River (Kootenai Falls to Idaho border). Address and implement actions that will enhance this fishery.

Tasks

A. Install a screw trap in the O'Brien Creek to determine juvenile outmigrant abundance during May through September.
B. Inventory spawning and rearing habitat in principal tributaries (Callahan, Ruby, Star, O'Brien, Yaak) and explore enhancement opportunities and options.
C. Conduct electrofishing population estimates in the mainstem Kootenai River and principal tributaries. Determine recruitment to Kootenai River.
D. Contract stream rehabilitation projects that will meet fisheries enhancement objectives.
E. Monitor projects to determine cost-effectiveness of various mitigation techniques.

f. Methods

Completion of the Kootenai River Instream Flow Methodology (IFIM) study involves calibration of the HYDSIM and HABSIM sub-components of the RHABSIM (River HABitat SIMulation) model framework developed under the overall framework of the IFIM and Physical Habitat Simulation (PHABSIM) model. PHABSIM consists of hydraulic simulation (in this case the IFG4 computer model, which uses a single high -flow data set for velocity calibration and two other stage-discharge rating measurements) and habitat simulation with the HABTAT computer model. Calibration of HYDSIM involves utilization of the stream roughness worksheets, velocity graphs and Water Surface Elevation (WSL), with the objectives of reproducing the measured velocities and limiting errors in velocity estimates when extrapolating over a range of simulated flows. Calculation of Weighted Usable Area (WUA) at each simulation flow and species life stage will be accomplished following calibration of Habitat Suitability curves or species criteria curves (stepwise polynomial regression). WUA values for Kootenai River rainbow trout and mountain whitefish (adult and juvenile stages), aquatic macroinvertebrates, and bull trout and white sturgeon under different simulated discharges from Libby Dam will be evaluated seasonally to determine hydropower effects. Dr. Craig Althen will write subroutines from the existing reservoir model (LRMOD) to link the two models, allowing evaluation of tradeoffs and ecological effects of operational schemes on the river and reservoir environments.

Investigations into limiting factors of native, resident, and fluvial populations combine diverse field evaluation techniques. These include mark-recapture estimates in impaired reaches as well as relic reaches of the same or similar stream reach. Assumptions involved

in this approach are that reaches are long enough to include all habitat types, that movement in and out of the reach is extremely limited or nonexistent, and that reaches and associated fish populations are representative of the entire stream (Ricker 1975). Characteristics evaluated include population densities, species assemblages and composition, fish growth and age, condition factors, and biomass estimates. Historic data for the reach or a comparable reach are utilized (if available) and assessment of the reaches carrying capacity or biological potential is evaluated.

Entrainment rates derived from sonar and draft-tube netting were used to estimated the total number of fish entrained throught Libby Dam for various periods of time from December 1990 to June 1994. Fish densities in the forebay wer measured with boat-mounted sonar. Acoustic data were collected along 711 transects. A model (ENTRAIN; Skaar et al. 1996), was developed to predict entrainment of kokanee at various flows. Variability in the model was explained best by discharge, foerbay density at 0-10m above withdrawal depth, and areal density for all transects. Data for discharges above 20 Kcfs are needed to calibrate the model.

Stream habitat restoration projects involve collection of stream survey information to establish accurate dimension, pattern and profile of project reaches. These characteristics include velocity, depth, slope, width, channel materials, discharge and sediment supply. Level III (Rosgen 1996) field evaluation of streams to determine the state, stability, and "health" of the system will be conducted.

Habitat manipulation activities are undertaken following critical evaluation of potential benefits to native species and identification of limiting factors. In general, the following criteria are used to evaluate success or failure of project: changes in standing stock, growth, proportional stock density, relative weight values, catch or harvest rates, angler satisfaction and permanency of improvements. This project offers a unique approach to enhance hydropower-affected fish stocks in the Kootenai Basin through on-the-ground habitat enhancement efforts and pre- and post-treatment data collection. Monitoring strategies have been established to determine long-term success/failure criteria for evaluation of habitat enhancement efforts, and will continue to be refined. Stream restoration and passage improvement are evaluated based on physical and biological changes. Physical characteristics are evaluated using Rosgen stream typing (Rosgen 1996) to determine stream recovery potential and hydraulic heterogeneity of habitat structures, photopoints, and substrate analysis (sediment scoring and coring) in treatment areas. Pre- and post-treatment measurements of fish community structure (standing stock and species relative abundance), age/growth relationships (otoliths and scales) and condition factor (weight/size), and increased spawning utilization (redd/spawner counts) are used to assess fish recovery.

Lake restoration projects follow standard rehabilitation protocols (Greenback 1941). Historic fish and invertebrate data are thoroughly reviewed to determine species assemblage changes that have occurred. Parameters include population densities, species composition, fish growth and age, condition factors, and biomass estimates. Physical

factors (geographic location, water exchange rate, eutrophication, seasonal oxygen and temperature profiles) are used to assess whether the lake has potential to expand the range of native species, create a genetic reserve or provide angling opportunity. Lakes are chemically rehabilitated using rotenone to remove nonnative (often illegally introduced) species that compete or prey on native populations. Following rehabilitation, native species from captive brood stock are stocked back into the lake the spring following rehabilitation.

g. Facilities and equipment

The Libby Field Station of MFWP, located on state property, has two office buildings containing office space, a wet lab, and computer equipment sufficient for project staff. A spring and pond area at the field station provide a water source and diverse habitat for meeting experimental isolation habitat objectives. A workshop and boatshed are situated near the office buildings. State vehicles and work boats are available for project use. Electrofishing equipment (boat-mounted, bank and backpack units), surveying and GPS equipment, SCUBA gear, lake and river sampling devices for sampling/monitoring all trophic levels are available at the site. A Bobcat with apparatus designed for habitat enhancement work is time-shared with the Hungry Horse Mitigation Program. Minor tools and equipment are included in the project budget.

h. Budget

There is an additional $5,000 requested for FY2000 to cover personnel and fringe benefit cost increases. Virtually all of the other compartments are identical to last year.

We anticipate completing 2-3 mitigation projects, and will be using most of the $100K requested for contracted services to cover those expenses. We are developing a cost/linear foot database for stream restoration projects to make this estimate more exact in the future.

We are going to try to cover the cost of NEPA analysis with in-house personnel, which may require one or more of us to attend a training workshop, in turn increasing costs for travel and training.

Travel and training includes funding for personnel to attend Rosgen stream rehabilitation training courese (4).

Section 9. Key personnel

GREGORY C. HOFFMAN
FISHERIES RESEARCH BIOLOGIST
Montana Department of Fish, Wildlife and Parks
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Libby, MT 59923

DEGREES EARNED

University of Wisconsin - Stevens Point; Stevens Point, WI
Master of Science *in* Fisheries, August, 1994

South Dakota State University; Brookings, SD
Bachelor of Science *in* Wildlife and Fisheries Sciences, June, 1990

University of Minnesota - Crookston; Crookston, MN
Associate of Applied Science *in* Natural Resources Conservation, June, 1986

CURRENT RESPONSIBILITIES

Develop and coordinate mitigation projects in the Kootenai River Drainage in northwest Montana, including stream rehabilitation, easement development, and lake reclamation. Supervise 3-5 technicians, write and manage budgets, produce annual and project reports and workplans, and develop and implement monitoring and research program for on-the-ground projects. Maintain and distribute computer simulation models for Koocanusa Reservoir and the Kootenai River, including IFIM and IRC, and coordinate research efforts in Montana for recovery of the endangered Kootenai River white sturgeon.

RECENT EMPLOYMENT

Montana Department of Fish, Wildlife and Parks
Fisheries Research Specialist, 04/97 to 01/98
Fisheries Research Technician, 04/96 to 04/97

Environmental Careers Organization Associate - Fisheries Biologist; E.C.O., Seattle, WA.; 05/94 - 12/95
@ Bureau of Land Management, Challis Resource Area; Salmon, ID; 05/94 to 05/95
@ Bureau of Land Management, Great Divide Resource Area; Rawlins, WY; 05/95 to 12/95

EXPERTISE

- Well-versed in fisheries theories, principles, and methods of research, management, and conservation.
- Fisheries statistics and population dynamics analysis.
- Scientific and technical literature preparation and use.
- Fisheries and other environmental sampling methods and data analysis.
- Stream habitat enhancement.
- Personal computers and application programs, computer habitat simulation models, and GPS/GIS applications.

1994: BLM "Proper Functioning Condition" Workshop - Casper, Wyoming
1995: USFS "R1/R4 Stream Inventory Methodology" - Salmon, Idaho
1995: USFS "R1/R4 FBase Stream Inventory Data Analysis" - Challis, Idaho

1996: AFS Public Outreach Symposium - Bozeman, Montana
1996: SCUBA Certification - Kalispell, Montana
1996: Inter-Fluve, Inc. “Design of Natural Stream Channels” - Bozeman, MT

RECENT PUBLICATIONS (RELEVANT)

Dalbey, S., J. DeShazer, L. Garrow, G. Hoffman, and T. Ostrowski. In press. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Presented to the Bonneville Power Administration, Portland, Oregon.

U.S. Bureau of Land Management. 1995. Colorado River cutthroat trout reintroduction plan decision record and environmental assessment WY-037-05-028. Prepared by U.S. Department of Interior, Bureau of Land Management, G.C. Hoffman. 84pp.

Hoffman, G.C.. 1994. Creel survey and tournament assessment of Lake Winnebago, Wisconsin: 1989 - 1992. Master's thesis. University of Wisconsin, Stevens Point. 1,815 pp.

LARRY F. GARROW
FISHERIES FIELDWORKER III
Montana Department of Fish, Wildlife and Parks
475 Fish Hatchery Road
Libby, MT 59923

DEGREE EARNED

University of Montana - Missoula, MT
B.S. in Wildlife Biology with an emphasis in aquatic and fisheries management, December 1985

CURRENT RESPONSIBILITIES

Act as crew leader on the BPA funded Libby Reservoir Project supervising and scheduling, under the direction of the project biologist, one to three fisheries technicians. Primary duties include assisting project personnel in fisheries research, monitoring and enhancement of fish populations within the Kootenai Basin. Ensure that equipment is properly maintained and organized. Enter, proof and summarize data into statistical and graphical formats for completion of project reports. Locate, document and prioritize potential mitigation sites and prepare site plans, obtain permits and work with landowners and contractors. Following public scoping, implement projects that will provide the greatest benefit to the fisheries. (1.0 FTE)

RECENT EMPLOYMENT

Fisheries Fieldworker III; MFWP; Libby, MT; 02/92 to present

Interim Fisheries Biologist; MFWP; Libby, MT; 09/94 to 01/95

Fisheries Fieldworker II, I; MFWP; Libby, MT; 06/89 to 09/92

Fisheries Fieldworker I; MFWP; Superior, MT; 04/89 to 06/89

Fisheries Laborer I; MFWP; Fort Peck; MT; 04/88 to 07/88

Experimental Biology Aide I; Oregon Department of Fish and Wildlife; Charleston, OR; 10/87 to 01/88

Stream Surveyor; Oregon Department of Fish and Wildlife; Powers, OR; 07/87 to 09/87

EXPERTISE

Field sampling and data collection using backpack, mobile and boom electrofishing methods, gill nets, hoop traps, fyke nets, Idaho weir traps, beam trawls, Schindler traps, Wisconsin nets, setlines, and draft tube nets.

Scheduling and coordinating the logistics of field operations.

Collection and enumeration of reservoir and lake zooplankton samples. Enter, proof and correct the resulting data.

Operation of outboard and I/O jet and prop boats safely and effectively.

Enter, proof and summarize data into statistical and graphical formats for completion of project reports.

RECENT PUBLICATIONS

Dalbey, S., J. DeShazer, L. Garrow, and T. Ostrowski. In Press. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Methods and data summary, 1988-1996. Presented to the Bonneville Power Administration, Portland, Oregon.

Skaar, D., J. DeShazer, L. Garrow, T. Ostrowski and B. Thornburg. 1996. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Investigations of fish entrainment through Libby Dam, 1990-1994. Presented to the Bonneville Power Administration, Portland, Oregon. 80 pp, plus appendices.

JAY A. DE SHAZER
FISHERIES FIELDWORKER II
Montana Fish, Wildlife and Parks
475 Fish Hatchery Road
Libby, MT 59923

DEGREE EARNED

Montana State University; Bozeman, MT
Bachelor of Science *in* Fish and Wildlife Management, June 1989

CURRENT RESPONSIBILITIES

Research, monitor and document the effects on fisheries caused by the construction and operation of Libby Dam. Identify and implement mitigation projects to enhance fisheries within the Kootenai River Basin. Survey, design and coordinate the implementation of habitat enhancement projects.

RECENT EMPLOYMENT

Biological Technician; USFS; Rexford Ranger District; Eureka, MT; 06/89 to 04/91

EXPERTISE

- Well-versed in fisheries theories, principles, and methods of research, management, and conservation.
- Scientific and technical literature preparation and use.
- Fisheries and other environmental sampling methods and data analysis.
- Surveying, mapping and designing stream habitat enhancement.
- Personal computers and application programs, computer habitat simulation models, and GPS/GIS applications.
- Boat maintenance and operation
- Heavy equipment operation

1996: AFS Public Outreach Symposium - Bozeman, Montana
1996: Inter-Fluve, Inc. “Design of Natural Stream Channels” - Bozeman, MT
1995: Physical Habitat Simulation system - Logan, UT
1992: SCUBA Certification - Kalispell, Montana

RECENT PUBLICATIONS (RELEVANT)

Dalbey, S., J. DeShazer, L. Garrow, G. Hoffman, and T. Ostrowski. In press. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Methods and data summary, 1988-1996. Presented to the Bonneville Power Administration, Portland, Oregon.

Skaar, D., J. DeShazer, L. Garrow, T. Ostrowski, B.Thornburg. 1996. Quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries. Investigations of fish entrainment through Libby Dam, 1990-1994. Presented to the Bonneville Power Administration, Portland, Oregon. 80 pp, plus appendices.

WILL T. YOUNG
FISHERIES FIELDWORKER II
Montana Fish, Wildlife and Parks
475 Fish Hatchery Road
Libby, MT 59923

DEGREE EARNED

Montana State University; Bozeman, MT
Bachelors of Science Degree *in* Fish and Wildlife Management, December 1995

CURRENT RESPONSIBILITIES

- Ultrasonic and radio telemetry tag implantation and monitoring in burbot, bull, and rainbow trout.
- Stream surveying, (cross-sections, longitudinal profiles, sinuosity measurements, and pebble counts) for design and monitoring Rosgen type stream rehabilitations
- GIS mapping of radio telemetry locations using ArcView 3.0.
- Stream habitat surveying using modified Hanken and Reeves methodology.
- Assist in McNeil and Ahnell methodology coring and Crouse methodology substrate scoring for juvenile bull trout in area streams.
- Redd counts for bull, and rainbow trout in streams and rivers in Canada and the United States.
-Year round SCUBA transects below Libby dam for burbot trend monitoring.
- Hoop net trapping in Kootenai River and Lake Koocanusa for burbot population trend information.
- Electrofishing (boat and backpack) for population estimates (mark-recapture and multiple removal) in large rivers and small streams.
- Population trend gill netting in area lakes, using experimental horizontal nets.
- Microhabitat location and data collection using snorkeling, and radio telemetry.
- Installation and monitoring of HOBOtm temperature probes in area steams.
- Prepare, mount and age scales, using acetate sheets, heated presses and microfiche readers.
- Prepare, mount and age otoliths using mounting mediums, mechanical, and hand polisher\grinder, and digital video software.

RECENT EMPLOYMENT

Montana Department of Fish, Wildlife and Parks, Libby, MT
Fish and Wildlife Technician I
Summers 1992-1995

EXPERTISE

- Ability to operate, and maintain, boats, both propeller and jet driven in a safe manner in lakes and rivers.
- Ability to communicate with the public in a clear and concise manner.
- Licensed to buy and apply general and restricted use aquatic pesticides.
- Ability to work with several computer programs including: WordPerfect 7.0, Microsoft Word 6.0, Microsoft Excel 5.1, SPSS 7.0, ArcView 3.0, Optimas 6.1, Paint Shop Pro 4.0, and Sigma Plot.
- Ability to use GPS system for location of survey benchmarks, and telemetry locations, etc.
- SCUBA certified.

Section 10. Information/technology transfer

Project results will be published in BPA reports and, where applicable, peer reviewed journal articles. Monthly or quarterly reports to all agency and citizen groups are produced. We also plan on creating and maintaining a web page to keep interested publics informed of pertinent activities.

Congratulations!