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File: M15 Federal Energy Regulatory Commission
Thompson Falls Hydroelectric Project
Docket No. 1869-048 - Montana

October 29, 2008

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Dear Ms. Bose:

This correspondence transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) based on our review of the Federal Energy Regulatory Commission's (FERC) Biological Assessment (BA) for the Thompson Falls Project (FERC No. 1869-048) (Project), owned and operated by PPL Montana, LLC, located in Sanders County, Montana. The attached BO describes the effects of the Project on the threatened bull trout (*Salvelinus confluentus*) and its designated critical habitat. This BO was prepared in accordance with section 7 of the Endangered Species Act (Act or ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Your request for formal consultation was received in the Service's Montana Field Office on May 2, 2008.

This BO is based primarily on PPL Montana's Biological Evaluation (BE) for Bull Trout, dated April 4, 2008 and attachments, which FERC adopted as their BA. A later supplement regarding construction specifics was received on August 22, 2008, completing the BA. A complete administrative record of this consultation is on file at the Montana ES Field Office in Helena, Montana.

The Service acknowledges and appreciates the cooperation of all parties involved in this consultation. If you have questions concerning this BO or your responsibilities under the Endangered Species Act, please contact Tim Bodurtha at the Service Kalispell Office (406) 758-6882 or by e-mail at Tim_Bodurtha@fws.gov.

Sincerely,

R. Mark Wilson

R. Mark Wilson
Field Supervisor

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BIOLOGICAL OPINION

For

Thompson Falls Hydroelectric Project

Bull Trout Consultation

Federal Energy Regulatory Commission
Docket No. 1869-048 – Montana

PPL Montana, LLC, Licensee

Prepared by: U.S. Fish and Wildlife Service
Montana ES Field Office, Helena

Issued by: R. Mark Wilson _________Date: 10/29/08_________________________
R. Mark Wilson, Project Leader
Helena, Montana

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INTRODUCTION

This correspondence transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) based on our review of the Federal Energy Regulatory Commission's (FERC) Biological Assessment (BA) for the Thompson Falls Project (FERC No. 1869-048) (Project), owned and operated by PPL Montana, LLC, located in Sanders County, Montana. The attached BO describes the effects of the Project on the threatened bull trout (*Salvelinus confluentus*) and its designated critical habitat. This BO was prepared in accordance with section 7 of the Endangered Species Act (Act or ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Your request for formal consultation was received in the Service's Montana Field Office on May 2, 2008.

This BO is based primarily on PPL Montana's Biological Evaluation (BE) for Bull Trout, dated April 4, 2008 and attachments, which FERC adopted as their BA (FERC 2008a); with later supplement (FERC 2008b). A complete administrative record of this consultation is on file at the Montana ES Field Office in Helena, Montana.

This BO does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the analysis with respect to critical habitat.

Consultation History

The following chronology documents the consultation process which has culminated in this BO for bull trout in the Thompson Falls Dam project area.

Thompson Falls Dam was built in 1917 on the Clark Fork River near Thompson Falls, Montana. The FERC relicensed Thompson Falls Dam in 1979 and amended the license to include a new powerhouse in 1990. The current FERC license expires December 31, 2025.

Bull trout in the Clark Fork River were listed as a Threatened Species June 10, 1998. Critical Habitat was formally adopted in the vicinity of the Project on September 26, 2005.

On April 12, 2002, the FERC received a letter in which the licensee requested to be designated as the Commission's non-federal representative for the purpose of informally consulting with the Service pursuant to the Endangered Species Act (ESA) for the project. On May 3, 2002 that request was granted.

Because bull trout are present in the Project area, a draft BE was prepared for the Thompson Falls Project by PPL Montana and submitted to the Service and FERC in 2003. The purpose of this BE was to assess the impacts that Thompson Falls Dam and powerhouse may be having on bull trout and to make recommendations about conservation measures to reduce those impacts. The 2003 Draft BE concluded that the Thompson Falls Project was likely to adversely affect bull trout. Issues identified in the draft BE included the lack of upstream adult fish passage, potential for delay or mortality during downstream passage, and potential water quality impacts from increases in total dissolved gases (TDG) during high spill time periods.

The determination that the Project was “likely to adversely affect” bull trout led to the initiation of an informal consultation process to determine conservation measures to reduce “take.” An Interagency Technical Advisory Committee (TAC) was established in 2003, chaired by PPL Montana, with participation by the U.S. Fish and Wildlife Service Montana Field Office (Service); Montana Fish, Wildlife and Parks (MFWP) Missoula and Kalispell Regional Offices; Avista Corporation; Montana Department of Environmental Quality (MDEQ); and the Confederated Salish and Kootenai Tribes (CSKT). PPL Montana has been working cooperatively with the TAC over the last five years to clarify the regulatory issues, plan ongoing research activities, and develop conservation measures appropriate to address bull trout issues at the Thompson Falls Project.

After five years of research and evaluation into fish movement patterns and bull trout status at the dam, PPL Montana proposed to move forward with the development of a full height fishway on the east end (i.e., the upstream terminus) of main Thompson Falls Dam. On April 7, 2008, PPL Montana filed a BE with the FERC pertaining to the listed bull trout. Contained in the licensees April 7, 2008 filing was a January 15, 2008 Memorandum of Understanding (MOU) signed by PPL Montana, Service, MFWP, and CSKT. The MOU provides terms and conditions regarding the collaboration between the licensee and the signators and the implementation of minimization measures for bull trout.

On May 2, 2008, Service received a request from the FERC to initiate formal consultation on the proposed Project and its effects on the bull trout and its critical habitat. The FERC found that based on the analysis and conclusions in the BA (FERC 2008a), the conservation measures described would likely minimize and reduce, but not totally eliminate, impacts of the project. Therefore the FERC concluded the continued operation of the Thompson Falls Project is “likely to adversely affect” the Threatened bull trout.

After a consultation meeting at the site, on August 12, 2008, PPL Montana provided FERC with a supplement to the original BE (filed 8/22/08), further detailing construction plans. This supplement was adopted by the FERC and was incorporated in the BA (FERC 2008b). It is included in the documentation analyzed for this BO.

This Service BO was due to the FERC 135 days after the initiation of consultation, or by September 13, 2008. It was slightly delayed due to the complexity of the information and addition of the supplemental material.

BIOLOGICAL OPINION

1. DESCRIPTION OF THE PROPOSED ACTION

1.1 Project Area and Action Area

The Thompson Falls Project Boundary is defined in the FERC license for the Thompson Falls Hydroelectric Project. It includes the powerhouses, dams, and Thompson Falls Reservoir. We describe this area as the “Project Area.” Bull trout occur throughout the Clark Fork River drainage and its tributaries. The Draft Recovery Plan for bull trout, prepared by the Service in 2001 (Service 2002), identified restoration of connectivity as one of the recovery criteria for the Lower Clark Fork River drainage. For these reasons and because bull trout in the Clark Fork are strongly migratory, the geographic area covered by this review extends to an action area beyond the Thompson Falls Project Area.

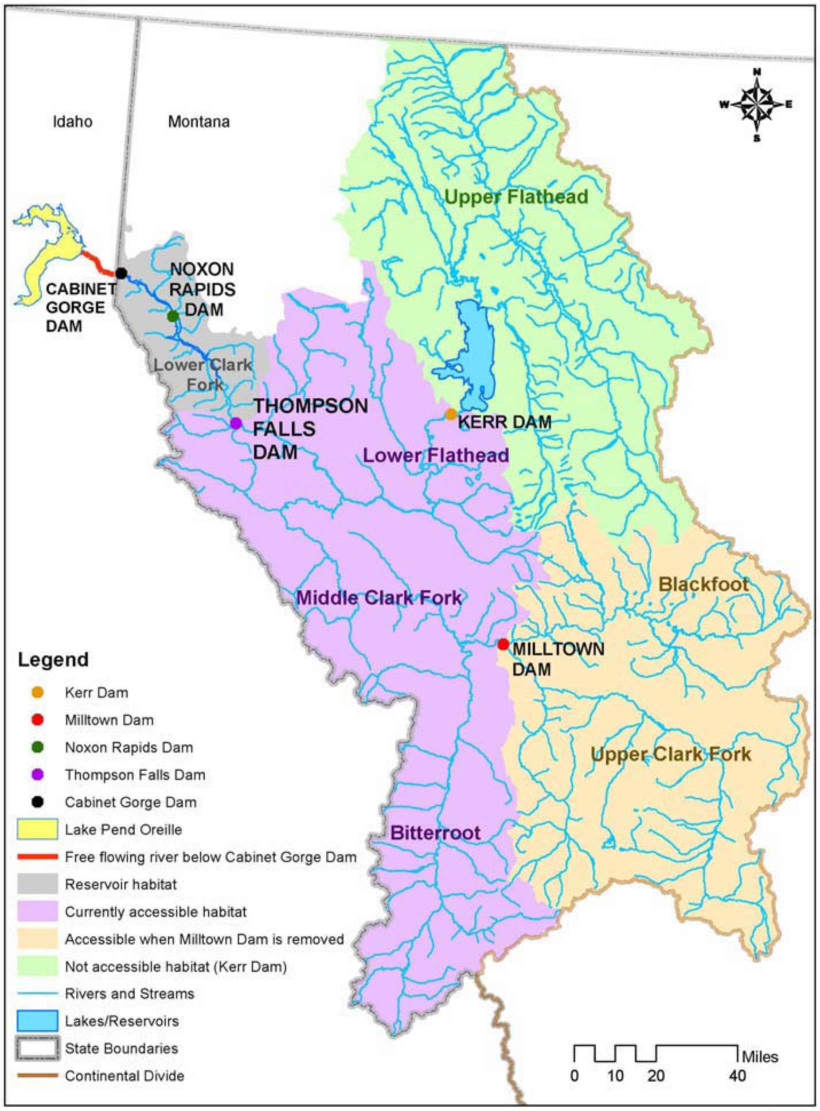
As described below, the action area includes most of the Clark Fork River Basin, including Lake Pend Oreille (upstream of Albeni Falls Dam) and extending to major portions of the Clark Fork River headwaters; encompassing over 600 miles of bull trout foraging, migrating, and overwintering (FMO) habitat in the mainstem Clark Fork River and major tributaries; including major portions of 6 designated bull trout core areas (Lower, Middle and Upper Clark Fork; Bitterroot River, Blackfoot River, and Rock Creek; see Service 2002). These six core areas include at least 59 streams known to support local populations of spawning bull trout and their associated early life history.

Upstream of Thompson Falls Dam there are approximately 283 miles of free-flowing Clark Fork River (Montana DNRC 1984). The only other major fish passage barrier on the Clark Fork River upstream of Thompson Falls was Milltown Dam, located upstream of Missoula and just downstream of the confluence of the Blackfoot River. Milltown Dam, built in 1903, was breached on March 28, 2008, allowing upstream fish passage for the first time in 105 years. Te dam is now being removed as part of a Superfund cleanup project. Fish in the Clark Fork River upstream of the Thompson Falls Project now have free access to the entire 283 miles of the Clark Fork River and, in upstream order: 72 miles of the Flathead River (to Kerr Dam), 39 miles of St. Regis River, 80 miles of the Bitterroot River, 133 miles of the Blackfoot River, 51 miles of Rock Creek, as well as hundreds of miles of their associated tributaries (Figure 1). In total then, over 650 miles of mainstem migratory river corridors and well over a thousand miles of potentially suitable tributary habitat are now open to bull trout that migrate upstream of Thompson Falls Dam.

Immediately downstream of Thompson Falls Dam, beyond the project area but still included in the action area, there are two dams/reservoirs: Noxon Reservoir and Cabinet Gorge Reservoir. Noxon Reservoir is 41 miles long, covers 7,940 acres at full pool, and has an active storage capacity of 230,700 acre feet of water in the top 36 feet of the reservoir (Service 1999a). Minimum operating elevation of the reservoir is 54 feet below full pool. The upstream extent of the Reservoir extends nearly to Thompson Falls Dam.

Cabinet Gorge Reservoir is 17 miles long, covers 3,200 acres at full pool and has an active storage capacity of 42,780 acre feet in the top 15 feet of the reservoir (Service 1999a). At full pool, Cabinet Gorge Reservoir extends nearly to Noxon Rapids Dam.

Downstream of Cabinet Gorge Dam, which is nearly on the Montana / Idaho border just into the state of Idaho, there are approximately 7 miles of free flowing river before the Clark Fork River enters Lake Pend Oreille. Lake Pend Oreille is a large natural lake with lake levels controlled by the Albeni Falls Hydroelectric Dam.



Data Source: NRIS
Datum: North American 1983
December 19, 2006

GEI Consultants

Figure 1.	Map of the Clark Fork River Drainage and location of Thompson Falls Dam.

1.1.1 Project Hydrology

Thompson Falls Dam is located on the Clark Fork River, the largest river in the State of Montana in terms of flow. The annual hydrograph of the Clark Fork River just upstream of Thompson Falls Dam from 1957 to 2004 is described in the BA (FERC 2008a; see Figure 2). The annual hydrograph indicates that the ascending limb of the hydrograph normally begins between mid- and late March, peaks between late May and mid-June, and descends to base flow levels around mid-August. The average annual discharge of the Clark Fork River near Plains, Montana from 1911 to 1998 was 19,773 cubic feet per second (cfs) (USGS 2002). Plant capacity at the Project is approximately 23,000 cfs. River flow in excess of this amount is routed over the spillways. Typically, spill begins in late April, peaks in early June, and ends in mid-July.

1.2 Project Features

In 1912, the Thompson Falls Power Company began construction of the Thompson Falls Project (Figure 2). The original license expired in 1975. The current license was issued to Montana Power Company (now PPL Montana) in 1979 and is scheduled to expire on December 31, 2025. A major order amending the license was issued in 1990 allowing for construction of an additional powerhouse and generating unit, which was completed in 1995.

According to the BA (FERC 2008a), the Thompson Falls Project consists of: (1) a concrete gravity arch Main Dam Spillway, approximately 1,016 feet (ft) long and 54 ft high; 2) a concrete gravity auxiliary dam known as the Dry Channel Dam, approximately 449 ft long and 45 ft high; 3) a 1,446 acre, 12-mile-long reservoir with a usable storage capacity of 15,000 acre-feet (ac-ft); 4) a 450-ft-long, 80-ft-wide intake channel cut through rock; 5) a steel framed and masonry powerhouse containing six generating units with a total capacity of 40 megawatts (Mw); 6) an additional powerhouse, built in 1994, containing one generating unit with a capacity of 52.6 Mw; 7) a 75-ft-wide, 300-ft-long intake channel; 8) a 1,000-ft-long tailrace channel, 9) a 1,000 ft access road; and 10) a 360-ft-long bridge (FERC 1990; FERC 1994). The Project operates at about 62 ft of maximum head with headwater at 2,397 ft above mean sea level (msl) and tailwater at 2,335 ft msl depending on discharge and flashboard/reservoir conditions. More typical operating heads are around 59 ft.

Figure 2. Aerial photo of the Thompson Falls Project, looking upstream. The Main Dam spillway is in upper right and full height fishway will be located on the right abutment of the Main Dam (looking downstream). Photo courtesy of PPL Montana.

1.2.1 Powerhouses and Operations

The old powerhouse is on the right bank, near the bottom of the photo, looking downstream (Figure 2). It is watered by a canal or modified channel along the right bank and discharges roughly perpendicular to the river flow. A wing wall that bilaterally divides the river and separates the flows in the main channel guards the tailrace. The new powerhouse and Dry Channel Spillway section and Main Dam Spillway sections all discharge into this main or center channel section (Figure 2). According to the BA (FERC 2008a), the turbine-generator configuration in the old powerhouse consists of six similar Francis units (Nos. 1-6) each with about 6.5 Mw capacity and hydraulic capacities up to 1,850 cfs, for an aggregate capacity of 40 Mw and powerhouse discharge of 10,800 cfs. Units 1 and 3 have been upgraded to new runners in 2000 and 2002, respectively, and these units average about 1 Mw more capacity than the old units (Bonnes, PPL Montana, personal communication, 2002). The Francis runners are 11 ft in diameter and have 13 buckets. Unit 7 in the new powerhouse is an adjustable blade Kaplan runner 28 ft in diameter. It has a hydraulic capacity of 13,000 cfs or about 57 percent of the total plant capacity of the Project. New governors exist on the newest units (Nos. 1, 3, and 7) and these units are automated to maintain constant reservoir elevation during normal run-of-river operations. During peaking operations, the plant is operated at full gate for the number of hours that will enable refill within a 24-hour period and stay within the restricted headwater elevations of 2,393 to 2,397 ft msl. The old powerhouse intakes are about 16 ft square and the invert is about 35 ft below forebay surface elevation. The top of the intake is about 20 ft below the surface. The intakes are guarded by a steel trash rack with openings of 2-5/8 inch between the bars in the old powerhouse and 5-1/2 inch spacing in the new powerhouse.

According to the BA (FERC 2008a), when discharge is less than 13,000 cfs the new powerhouse is preferentially operated to maximize peak efficiency of the Project. Two units, typically Nos. 1 and 3, are operated as auxiliary power to No. 7 to maintain heat in the old powerhouse and to exercise these other units during low flows. Units 2, 4, 5, and 6 are operated at high flows, as they are the least efficient and the smallest units at the Project.

1.2.2 Reservoir and Operation

Thompson Falls Reservoir covers approximately 1,500 surface acres and extends upstream to 12 linear miles of river at a normal pool elevation of 2,396 ft msl. Drawdown is limited to 4 feet. The reservoir has a total storage capacity of 15,019 ac-ft at normal pool, and has a maximum depth of 45 ft. The Project is capable of discharging its total storage pool of 15,000 ac-ft in slightly less than 8 hours minus the inflows (FERC 1990). The Project operates on average as a run-of-the-river plant for about eight months of the year, with peaking restricted to the late summer and early fall months.

1.2.3 Spillways and Operations

According to information supplied in the BA (FERC 2008a), when river discharge exceeds the combined hydraulic capacity of both powerhouses (23,000 cfs), two tainter gates enable automatic spill operations up to 10,000 cfs each. The tainter gates have openings of 41 ft wide and 14 ft high when fully open. As the runoff proceeds, 4 ft by 8 ft spillway panels on the Main Dam Spillway are removed for additional spill capacity. As flows increase, more panels are removed to balance flows across the length of the Main Dam Spillway spill section until all 228 panels have been removed. In most years, when the peak flood discharge is less than 70,000 cfs, spill is restricted to the Main Dam Spillway section. If flows exceed 70,000 cfs, there are 72 Dry Channel Dam spill panels (each 4 ft by 8 ft) available to increase spill capacity. Operation of the Dry Channel Spillway occurs infrequently (approximately every 10 years), according to dam operators.

1.3 Elements of the Proposed Action

1.3.1 Upstream Passage

The Draft Recovery Plan for bull trout (Service 2002), identified restoration of connectivity as one of several proposed recovery criteria for the Lower Clark Fork River drainage. Since that time, several actions have been taken to restore connectivity in the drainage, including development of a trap and haul fish passage program at Cabinet Gorge and Noxon Rapids Dams downstream of Thompson Falls, and the 2008 removal of Milltown Dam. Providing fish passage at Thompson Falls is one more step towards reconnection of the Clark Fork River and subsequent recovery of migratory bull trout.

Upstream fish passage has been blocked at Thompson Falls Dam since 1913. According to statements in the BA (FERC 2008a), local anglers have long reported pooling of trout during the spring season below the spillways of the dam. In 2001, a fish tracking study was conducted by PPL Montana and MFWP. Bull trout, rainbow trout *(Oncorhynchus mykiss)*, and cutthroat trout *(Oncorhynchus clarkii)* were captured, either by angling or in a Denil ladder and trap (Odeh 1999) positioned downstream of the dam, and then radio tagged and transported upstream of the dam. All three species showed significant upstream movements into potential spawning tributaries. In addition, the Denil ladder placed on the left bank of the river just downstream of the Main Dam Spillway consistently collected a wide variety of fish, including occasional bull trout in the early spring, indicating that fish attempt to migrate upstream past Thompson Falls Dam.

The 2003 draft BE concluded that the Thompson Falls Project is having a potential adverse impact on bull trout by blocking the upstream movement of adult fish. As a result, PPL Montana submitted a plan (Thompson Falls Dam Fish Passage Study Plan: Pre-design Phase) to the TAC (GEI 2003) to develop adult upstream fish passage alternatives at Thompson Falls Dam. This plan identified the steps needed to locate and design an upstream adult fishway in the Project tailrace. Data needs identified in this long-term plan were addressed through implementation of annual fish behavior studies that were developed by PPL Montana, with assistance from GEI Consultants, Inc. (GEI), from 2004-2006.

The overall goal of these studies was to identify movement patterns of tagged fish in the Thompson Falls tailrace, through the use of a stationary radio telemetry receiver array. Analysis of fish behavior and movement facilitated the understanding of where the ideal location for a permanent fish passage facility could be constructed. Telemetry data were analyzed to distinguish fish movement and behavior related to the three main areas of the Thompson Falls Project area (Main Dam Spillway, Dry Channel Dam, and the powerhouse tailraces). Telemetry data analyzed from 2004 and 2005 indicated the Main Dam Spillway was the most likely location for a successful fish passage facility to be located. In 2006, the study was fine-tuned to focus primarily on monitored fish behavior and response to manipulating the flashboard operations at the Main Dam Spillway. The Main Dam Spillway was monitored with four antennae (left, center, right, and right abutment). Telemetry data from 2006 further evaluated and defined the optimal location for an entrance to a fish passage facility at the Main Dam Spillway area (GEI 2007c).

The 2006 telemetry results also indicated that releasing a small amount of water at the Main Dam Spillway in the early spring prior to spill attracted fish to the Main Dam Spillway area. In addition, there was some evidence that fish could be preferentially attracted to the right bank by modifying hydraulic conditions at the Main Dam Spillway (GEI 2007c).

In a letter report finalized in June 2006, PPL Montana concluded that the Main Dam Spillway was the optimum location for the new fishway. Once this general location was agreed upon by the members of the TAC, an alternatives evaluation was conducted to assess the risks and benefits of different styles and locations of potential fishways at the Main Dam Spillway location (GEI 2007a).

1.3.1.1 Upstream Passage Conservation Measures

The fish behavior study and upstream passage alternatives evaluations were presented to the TAC, in conjunction with site visits to tour the Project area. The TAC agreed with PPL Montana and GEI Consultants that, based on the results of the fish behavior and engineering alternative studies, the best alternative to provide fish passage at the Thompson Falls Project is a full height fishway at the right (east) bank of the Main Dam Spillway. The construction, operation, and evaluation of the upstream fish passage facility is the primary conservation measure being considered to mitigate upstream fish passage concerns from the Project.

The Preliminary Design Report was completed for the right bank full height fishway in January 2007 (GEI 2007b). This report was submitted to the TAC for comments, which were discussed at subsequent TAC meetings and changes as a result of those discussions were incorporated into the ladder design. At the time the BE was written (March 2008), the fishway design was 90% complete and as this BO is submitted it is now nearing 100% completion (G. Gillin, GEI, personal communication, 2008). Construction drawings for the Thompson Falls Hydroelectric Project upstream fish passage (90% Submittal) are included in Appendix B of the BA (FERC 2008a) and the supplement (FERC 2008b). It is anticipated that permitting and design will be complete for the ladder in 2008, with construction to start in 2009. The tentative schedule is shown in Table 1.

This ladder is designed to provide volitional fish passage at the Main Dam Spillway during nonspill periods. In addition, it will be possible for small numbers of fish to be selectively sampled in the fishway; with a portion removed to a holding tank, and hauled via truck to an upstream location should this be desired in the future.

Table 1. Proposed schedule of developments for Thompson Falls Fish Ladder (from BA Table 10; FERC 2008a).

Activity	Date
Biological evaluation submitted from PPL Montana to Service	March 10, 2008
Comments from Service on BE (conference call)	March 26, 2008
Make final revisions to BE and submit to FERC	April 4, 2008
FERC submits BA to Service (assumed date)	April 25, 2008
Completed plans and specifications	May 16, 2008
Final design report	June 13, 2008
Service Final BO	October 15, 2008
Contractor selected	October 15, 2008
Begin implementation of recommendations that can be implemented without FERC order	October 30, 2008
Apply for USACOE and State permits	October 30, 2008
Receive USACOE and State permits	December 30, 2008
Final FERC Order amending License	January 2009
Start construction	Spring 2009
Complete construction	Fall 2010

1.3.1.2 Sample Facility Components

Functional features of the fish sampling facility at the proposed fishway were agreed upon by the TAC. In general, the TAC agreed that the fish sampling facility should accommodate the following functional needs, and should:

- Be designed for handling by one person;
- Include options for anaesthetizing, sorting, fish recovery, scanning for Passive Integrated Transponder (PIT) tags (by a portable scanner), and returning fish to the ladder so fish can pass to the forebay;
- Include an option for returning fish to the tailrace;
- Be sized to handle a large volume of fish;
- Maintain good access to the fishway pool 46 so that fish can be netted if needed;
- Include a fail-safe provision (diffuser gate at upstream end of pool 49) to ensure that a fish accidentally released into the ladder can be prevented from passing into the forebay; and
- Allow truck-transport of a few fish at a time.

The design includes the following fish sampling facility features in fishway pool 46 and the fish sampling loop:

- Fish trapping mechanism space (compatible with either a vee-trap or finger weir);
- Fish holding pool (adjacent to ladder pool 46);
- Fish crowder;

- Fish lock;
- Fish sorting table;
- Anesthetic tank;
- Recovery tank;
- Return flume to fishway pool 49;
- Fish return pipe to tailwater; and grating at the tunnel outlet that can easily be raised or lowered as a fail-safe measure to prevent accidental escape of a non-intended fish (e.g., invasive species) from reaching the forebay.

While the preliminary design of the sampling facility has been completed, the completion of the detailed design of fish sampling facility will be delayed until later in 2008. However, the current plan is for concurrent construction of the fishway and sampling facility in 2009 and 2010 (Table 1). Drawings in Appendix B of the BA (FERC 2008a) show the sample facility plan view; the design of which was developed to ensure compatibility with the new fishway design.

1.3.1.3 Sample Facility Operations

To operate the sample facility, a detailed set of procedures is described in the BA (FERC 2008a; Section 6.1.2). The sample holding pool is self-contained, with a separate water supply and drain system and will pass 0.5 cfs regardless of whether flow is being discharged into the holding pool through the lock. When trapping fish, the fish work-up cycle is initiated by lowering a closure plate on the holding pool side of the short trapping mechanism channel, then shutting off the holding pool water supply from the fish lock by closing a valve supplying gravity inflow to the fish lock. The fish crowder then concentrates fish into the fish lock. The lock closure gate is closed and water is pumped into the lock (below the floor brail) to raise the lock water level. Fish and pumped flow overtop a lock transition lip elevation and pass onto a sloped flume. A chute floor-screen allows pumped lock water to bleed off while fish slide down the chute onto a sorting table. The floor brail in the lock can be raised and lowered remotely by the operator to control the number of fish passing out of the lock and toward the work-up table, so that all fish do not pass onto the sorting table at once. Since only a few target fish are expected to be present, most fish will be returned from the work-up table directly to fishway pool 49. The work-up table will also have a tailrace return pipe to send invasive (or other non-target) species fish back to the tailrace.

Target fish can be scanned by a portable PIT tag detector and routed from the work-up table into an anesthetic tank. While biologists may decide that target fish will not be anesthetized, fish can be detained in this tank while awaiting transport, tagging, or other sampling activities. A recovery tank is also provided so that anesthetized target fish can be revived before being returned to pool 49 or transported manually in a small portable tank to a utility truck. All fish returned to pool 49 will accumulate until a diffuser panel is opened at the tunnel outlet. The purpose of the diffuser panel is to ensure that fish not allowed in the forebay, such as invasive species, are not accidentally allowed to pass through the tunnel. If an invasive nonnative fish enters pool 49, it can be netted. Once this diffuser panel is opened, target fish can pass through the fishway tunnel, exit pool, and trash rack to enter Thompson Falls Dam Reservoir and proceed upstream.

1.3.2 Downstream Passage

One of the major environmental issues for hydroelectric power plants is fish mortality due to turbine passage. When the dam is spilling, fish can migrate downstream via spillway, outlet works, or through the turbines. During non-spill periods, the primary means of downstream passage is through the turbines. Any form of dam passage poses some quantifiable risk of injury or mortality to migrating fish. According to the BA (FERC 2008a), studies done on anadromous fish have generally indicated that passage via spill poses less risk than via turbine. Mortality is typically zero to two percent for standard spill bays and five to 15 percent for turbine passage at most hydropower plants. However, mortality at a specific facility can vary depending on the specific configuration of the turbines and spillways and type and timing of fish being passed. Therefore, there may be some direct and indirect mortality as a result of fish passage through turbines or over the spillway at the Thompson Falls Project.

In general, at any given time throughout the year, approximately 50 to 70 percent of the Clark Fork River at Thompson Falls flows through the Kaplan unit. Based on an assumed 1:1 ratio of fish to flow, PPL Montana assumed that 50 to 70 percent of the migrants that pass through the turbines at the Project pass through the new Kaplan unit during non-spill time periods. If spillway efficiency is 1:1, the number of migrants passing the dam in spill would be similar in proportion to water being spilled. Based on combined survival estimates for passage through the Francis turbines, the Kaplan turbine, and the spillway, PPL Montana has determined the average downstream passage survival at the Project for trout measuring greater than 100 millimeters (mm) is likely 91 to 94 percent (FERC 2008a). There are no empirical studies to either support or refute these conclusions and the Service accepts these calculations at face value.

Thompson Falls Dam also creates Thompson Falls Reservoir on the Clark Fork River. This reservoir contains slow-moving, backwater-type habitats, suitable for nonnative predators such as northern pike, smallmouth bass, and largemouth bass. PPL Montana asserts in the BA (FERC 2008a) that the reservoir may therefore pose a higher predation risk to downstream migrating salmonids than would be present in a free flowing river environment.

1.3.2.1 Downstream Passage Conservation Measures

Numerous, often costly efforts have been undertaken to address the issue of safe downstream fish passage at hydropower projects. Many of these efforts have not been evaluated for effectiveness, and some are so new that their benefit has yet to be established. According to the BA, most of these projects have been constructed in rivers with anadromous fish, which must migrate downstream in order to complete their life-history and PPL Montana maintains that measures that are warranted for anadromous fish may not be logical or reasonable for rare non-anadromous fish (FERC 2008a).

PPL Montana has proposed that an alternative approach for the Project be adopted that would have a higher likelihood of benefiting bull trout, and incidentally westslope cutthroat trout, incorporating off-site mitigation. The Thompson Falls Project MOU established a TAC to manage off-site mitigation efforts in the Middle Clark Fork River. The MOU (FERC 2008a) will guide the implementation of conservation measures for bull trout in future years. The MOU includes a management framework for future consultation with the managing agencies, and a funding mechanism to implement conservation measures.

1.3.3 Total Dissolved Gas

Montana Water Quality Standards limit TDG to 110 percent of saturation. This standard is meant to protect aquatic life, which can experience gas bubble trauma (GBT) when water is supersaturated. It has been shown that excessive TDG results in embolisms and the appearance of tiny gas bubbles in fish tissues, resulting in elevated mortality rates. At most dams, spill discharge plunges into a deep armored stilling basin, designed with enough volume to dissipate energy for the maximum design flood discharge. The intent is to confine energy dissipation in the armored zone, so that erosion does not scour and undermine the spillway or other dam features, thereby leading to potential structural failure. As spill plunges into a deep spillway stilling basin, vertical circulation cells often take turbulence aeration to depth, where hydrostatic pressure collapses bubbles, forcing them into solution, and elevating TDG levels (gas absorption). However, spillways at the Thompson Falls Project are built on bedrock, so erosion is not a concern. For this reason, the Thompson Falls Project spillways do not incorporate plunge pools, therefore reducing the amount of TDG added to water spilled by the Project (FERC2008a).

Monitoring of TDG downstream of the Thompson Falls Project indicates that TDG levels can exceed 110 percent during spill. To date at Thompson Falls, symptoms of GBT to fish have not been documented (G. Gillin, GEI Consultants, personal communication, August 2008), though thorough examinations have not occurred. Instead emphasis has been placed on monitoring of gas levels in the water column at varying locations (see BA, section 5.3). Based on these studies, it appears that elevated TDG levels downstream of the Project is, in part, a result of water plunging at Thompson Falls, a natural river feature downstream of the Main Dam Spillway.

PPL Montana maintains that the Project may actually reduce TDG levels at low to moderate spill levels, in comparison to the pre-Project condition, because the Project routes approximately 23,000 cfs through the powerhouse (FERC 2008a). Studies have demonstrated that water passing through the turbines is slightly de-gassed by about two percent, so outflow from the powerhouse has been demonstrated to contain lower levels of TDG than water in the forebay. Prior to Project construction, a portion of the river flow would have passed over Thompson Falls. PPL Montana believes that under natural, historical conditions, increasing flow over the falls would have naturally elevated the TDG levels. The base of the natural Thompson Falls plunge area is now inundated by the pool of Noxon Reservoir, making it impossible to replicate historical conditions or collect actual measurements of the gas status that occurred under the historic condition. There also does not appear to be adequate information available on how much of the natural flow went down each of the three possible channels during various flow conditions. Further, the pool of Noxon Reservoir now prevents natural dissipation of gases that likely occurred in the river downstream of Thompson Falls, during predammed condition. Consequently, the Service neither agrees with nor disagrees with the conclusions reached by PPL Montana on these issues. PPL Montana has determined that at high levels of spill, perhaps above about 50,000 cfs, TDG is likely increased by the Project in comparison to the pre-dam condition.

Montana DEQ agrees with the Service that there is insufficient empirical evidence to conclude that the natural configuration of Thompson Falls was a major contributor to gas entrainment and concurs that the limited data set demonstrates TDG levels increase across the Thompson Falls Project area during spill periods (A. Welch, Montana DEQ, personal communication, September, 2008). MDEQ notes that regardless, TDG levels exceed the Montana water quality standard of 110% and for those reasons the MDEQ states that: “PPL Montana must continue to remain engaged in systemwide efforts to resolve TDG problems, including potential efforts to degas the Clark Fork River downstream of the Project.” (A. Welch, Montana DEQ, personal communication, September, 2008).

1.3.3.1 TDG Conservation Measures

PPL Montana proposes that the TDG monitoring program continue on an annual basis, as determined by the Thompson Falls TAC, using the principle of adaptive management. In addition to continued monitoring of TDG levels in the forebay and tailrace, PPL Montana has proposed including attempts to measure the contribution of the Main Dam Spillway as distinct from Thompson Falls.

As mentioned, GBT has not been routinely observed in fish in the Thompson Falls Project area. During the period from May 19, 2008 to June 23, 2008 a total of 220 fish of 14 different species were collected by electrofishing in the tailrace area and systematically examined for external evidence of GBT (G. Gillin, GEI Consultants, personal communication, August 2008). No symptoms of GBT were evident, despite recording of TDG levels as high as 119.4% (F. Pickett, PPL Montana, personal communication, September 2008).

1.4 Monitoring Plans

PPL Montana’s BA (FERC 2008a) describes numerous fish monitoring and evaluation studies using radio telemetry or other techniques to evaluate upstream and downstream route-specific survival at the Thompson Falls Dam. These actions also include the development and implementation of a bull trout monitoring plan to document occurrence of bull trout in the project area. It is proposed in the BA that all future respective studies, evaluations, and monitoring plans would be discussed and coordinated through the TAC.

PPL Montana will develop the monitoring and evaluation plan at a later date in consultation with the TAC. The goal of the monitoring plan will be to determine the best operational strategy for the ladder and to assess the effectiveness of the ladder in passing bull trout and other migratory species. The design of the ladder provides many opportunities for adjustments to attraction flow and in-ladder conditions. The ladder can be operated with a wide range of attraction flows. Pool to pool passage can be through orifice or weirs. In addition, the spillway panel opening pattern can be adjusted to enhance ladder effectiveness. It is anticipated that the monitoring program will take place over a number of years while experiments are conducted to find the most effective configuration and operational strategy.

According to the BA (FERC 2008a), it is anticipated that implementation of these monitoring plans will involve PPL Montana's request for ESA section 10(a)(1)(A) recovery permits, as appropriate. However, it is Service policy that upon completion of this consultation these activities should be covered under the terms and conditions of this BO, with annual take authorized under Section 7 of the Endangered Species Act. This is because take minimization measures (as proposed in this BO) are separate from recovery related actions that might occur independent of the Project that would be permitted under Section 6 or Section 10 of the Act.

1.4.1 Thompson Falls MOU and the Technical Advisory Group (TAC)

An important conservation measure has already been implemented with the signing of an MOU (provided in Appendix C of the BA; FERC 2008a) effective January 15, 2008. The MOU created a formal Technical Advisory Committee (TAC). The TAC will be responsible for making recommendations on the expenditure of funds that PPL Montana will provide for upstream fish habitat protection and improvement, to provide a measure of downstream fish passage mitigation. PPL Montana will provide $100,000 per year, for an initial period of five years (2009-2013) in an Adaptive Management Funding Account (AMFA), and the TAC will determine the means to use funds to leverage additional funding for project work. Fish habitat protection and improvement work will focus on identified bull trout spawning tributaries in key watersheds upstream of the Project. PPL Montana has provided to the Service a preliminary list of potential types of projects eligible for funding (L.B. Mabbott, PPL Montana, personal communication, September 2008).

The MOU establishes terms and conditions for collaboration amongst the four voting members of the TAC (PPLMT, Service, MFWP, and CSKT) and additional advisory members (USFS, MDEQ, Avista). The TAC is chartered to function as "the means for collaboration on the expenditure of mitigation funds and the implementation of bull trout minimization measures". The MOU establishes terms and operating rules for the TAC.

1.5 FERC License Conditions

The 1990 FERC license amendment allows the Project (No. 1869) to operate as a peaking facility as described above. Peaking is limited by the minimum Project discharge of 6,000 cfs and by a maximum drawdown to 2,393 ft msl (FERC 1990). Other license requirements, which relate to fisheries issues at Thompson Falls Dam, are as follows (FERC 1979; FERC 1990):

Article 15. *The Licensee shall, for the conservation and development of fish and wildlife resources, construct, maintain, operate, or arrange for the construction, maintenance, and operation of such reasonable facilities, and comply with such reasonable* *modifications of the Project structures and operation, as may be ordered by the Commission upon its own motion or upon the recommendation of the Secretary of the Interior or the fish and wildlife agency or agencies of any State in which the Project of part thereof is located, after notice and opportunity for hearing.*

Article 16. *Whenever the United States shall desire, in connection with the Project, to construct fish and wildlife facilities or to improve the existing fish and wildlife facilities at its own expense, the Licensee shall permit the United States or its designated agency to use, free of cost such of the Licensee's lands and interests in lands, reservoirs, waterways, and Project works as may be reasonably required to complete such facilities or such improvements, thereof. In addition, after notice and opportunity for hearing, the Licensee shall modify the Project operation as may be reasonably prescribed by the Commission in order to permit the maintenance and operation of the fish and wildlife facilities constructed or improved by the United States under the provisions of this article. This article shall not be interpreted to place any obligation on the United States to construct or improve fish and wildlife facilities or to relieve the Licensee of any obligation under this license.*

Article 38. *Licensee shall, in consultation with Montana Wildlife, Fish and Parks, U.S. Forest Service, U.S. Fish and Wildlife Service, and any other appropriate state and local agencies, take such actions found necessary for the protection and enhancement of the natural resources and values of the Project. The Commission reserves the right to require any changes in the Project works or operations that may be necessary to Project and enhance those values.*

Article 410. *To take into account, to the fullest extent practicable, the Columbia River Basin Fish and Wildlife Program (developed and amended in accordance with the Pacific Northwest Electric Power Planning and Conservation Act), the Commission, upon its own motion or upon the recommendation of federal, or state fish and wildlife agencies or affected Indian Tribes, reserves the authority to order alternations of Project structures and operations.*

Article 411. *To protect and enhance the aquatic resources of the Clark Fork River, the licensee shall discharge from the Thompson Falls Project a continuous minimum flow of 6,000 cfs or inflow to the Project reservoir, whichever is less. These flows may be temporarily modified if required by operating emergencies beyond the control of the licensee and for short periods on mutual agreement between the licensee and the Montana Wildlife, Fish and Parks.*

2. STATUS OF THE SPECIES

2.1 Listing History

Bull trout *(Salvelinus confluentus)* in the Clark Fork River were listed as threatened under the ESA on June 10, 1998. The coterminous United States population of the bull trout was listed as threatened on November 1, 1999 (64 FR 58910). Bull trout occur in the Klamath River Basin of south-central Oregon and in the Jarbidge River in Nevada, north to various coastal rivers of Washington to the Puget Sound and east throughout major rivers within the Columbia River Basin to the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Cavender 1978, Bond 1992, Brewin and Brewin 1997, Leary and Allendorf 1997).

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation and alterations associated with: dewatering, road construction and maintenance, mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels; and introduced non-native species (64 FR 58910).

The bull trout was initially listed as three separate Distinct Population Segments (DPS) (63 FR 31647, 64 FR 17110). The final listing rule for the United States coterminous population of the bull trout consolidated all population segments into a single listed taxon; bull trout in the coterminous United States (64 FR 58930).

2.2 Current Rangewide Status

Five segments of the coterminous United States population of the bull trout were identified as interim recovery units: (1) Jarbidge River; (2) Klamath River; (3) Columbia River; (4) Coastal-Puget Sound; and (5) St. Mary-Belly River. A summary of the current status and conservation needs of the bull trout within these units is provided below. A comprehensive discussion of these topics is found in the Service's Draft Bull Trout Recovery Plan (Service 2002), the Services Science Team Document (Whitesel et al 2004), the Critical Habitat rule (Service 2005a), the Rock Creek Mine BO (Service 2006a), and the science used in the analysis for the 5 year review (Service 2005b).

Generally, the conservation needs of the bull trout are often expressed as the need to provide the four "C's": cold, clean, complex, and connected habitat. Cold stream temperatures, clean water that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminous to local populations. The recovery planning process for the bull trout (Service 2002) has also identified the following conservation needs for the bull trout: (1) maintain and restore multiple, interconnected populations in diverse habitats across the range of each interim recovery unit; (2) preserve the diversity of life-history strategies; (3) maintain genetic and phenotypic diversity across the range of each interim recovery unit; and (4) establish a positive population trend.

Central to the survival and recovery of the bull trout is the maintenance of viable bull trout core areas (Service 2002). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat, and in some cases in their use of spawning habitat. About 118 core areas are recognized across the United States range of the bull trout (Service 2002, 2005b).

2.2.1 Columbia River

The Columbia River interim recovery unit currently contains about 90 core areas and 500 local populations. About 62 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The condition of the bull trout within these core areas varies from poor to good, but generally all have been subject to the combined effects of habitat degradation, fragmentation, and alterations associated with one or more of the following activities: dewatering; road construction and maintenance; mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species.

The draft Bull Trout Recovery Plan (Service 2002) identifies the following conservation needs for this unit: maintain or expand the current distribution of the bull trout within core areas; maintain stable or increasing trends in bull trout abundance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange.

2.3 Life History

Bull trout have an elongated body, somewhat rounded and slightly compressed laterally, and covered with cycloid scales numbering 190-240 along the lateral line. The mouth is large with the maxilla extending beyond the eye and with well-developed teeth on both jaws and head of the vomer bone (none on the shaft). Bull trout have 11 dorsal fin rays, 9 anal fin rays, and the caudal fin is slightly forked. Although bull trout are often olive green to brown with paler sides, color is variable with locality and habitat. The spotting pattern is easily recognizable, showing pale yellow spots on the back, and pale yellow to orange, pink, or red spots on the sides. Bull trout fins are often tinged with yellow or orange, while the pelvic, pectoral, and anal fins have white leading margins. Bull trout have no black markings on the dorsal fin and no halos around their spots, which is useful in distinguishing them from brook trout (*Salvelinus fontinalis*).

Prior to 1980, bull trout and Dolly Varden were considered a single species, the Dolly Varden. In 1980, the American Fisheries Society recognized bull trout (*Salvelinus confluentus*) and Dolly Varden (*Salvelinus malma*) as distinct species (see Cavender 1978). Bull trout are found mostly inland and Dolly Varden are found primarily in coastal drainages. Though separation of the two species based on phenotypic characteristics may be difficult (i.e., similarity of appearance), in recent years results of genetic analysis have supported the distinctiveness of these species.

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989, Goetz 1989).

Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989, Goetz 1989), or saltwater (anadromous) to rear as subadults or to live as adults (Cavender 1978, McPhail and Baxter 1996). Bull trout normally reach sexual maturity in 4 to 7 years and may routinely live longer than 12 years; being found up to 20 years old in Canada (Goetz 1989). They are iteroparous (they spawn more than once in a lifetime), and both repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982, Fraley and Shepard 1989, Pratt 1992, Rieman and McIntyre 1996). Downs et al. (2006) describes that in the Trestle Creek, in Lake Pend Oreille, a larger number of bull trout spawn annually and that repeat spawners only comprise a portion of that number. Baxter and Westover (1999) describe a 2:1 ratio of annual repeat spawners to alternate year spawners.

Growth varies depending upon life-history strategy. Resident adults range in total length from 6 to 12 inches (14-30cm) total length, and migratory adults commonly reach 24-36 inches (60-90 cm) or even more (Pratt 1985, Goetz 1989). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

Mortality rates of bull trout at various life history stages can be high; however, these rates decrease as the size of the fish increases. Egg survival can decrease with stream temperatures and alterations in habitat conditions (Service 1998, Pratt 1992). Egg to fry survival may vary from 3% to 50%, depending on speed of growth, age at maturity, and fecundity (Rieman and McIntyre 1993). Fecundity may vary from less than 100 eggs in resident forms to greater than 5,000 eggs or more in migratory forms (Rieman and McIntyre 1993, Goetz 1989).

Sizes of bull trout varies widely depending on geography and is likely due to a variety of other factors, although water temperatures and diet are thought to play a large role (Pratt 1992, Goetz 1989, Rieman and McIntyre 1993, Service 1998). General age and size classification of the migratory bull trout life history form are generally defined as: juveniles: 0-3 years old and ranging in size from less than 1 to about 5 inches (2-13cm) in total length; subadults: 3-5 years old and ranging in size from 5 to16 inches (13 to 40cm) in total length; and migratory adults: 5+ years old and typically greater than 16 inches (40cm) in total length (Fraley and Shepard 1989; Goetz 1989; Pratt 1992; Rieman and McIntyre 1993; Kramer 2003; McPhail and Baxter 1996).

The iteroparous reproductive behavior of the bull trout requires year-round, two-way passage, both up and downstream, not only for repeat spawning but for foraging, rearing, and overwintering. Most fishways, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and therefore require only one-way passage upstream). Therefore, even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a safe and effective downstream passage route.

2.4 Habitat Requirements

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), they should not be expected to simultaneously occupy all available habitats (Rieman et al.1997).

Migratory corridors are necessary to link seasonal habitats for bull trout life history forms (Service 1998). The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993; Rieman et al. 1997). Migration facilitates gene flow among local populations when individuals from different local populations interbreed, or stray, to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic composition may vary among populations in close proximity, which may indicate local adaptation within individual populations. This also suggests that rates of straying and recolonization are low and reestablishment of extirpated populations may take a very long time (Spruell et al. 1999, Rieman and McIntyre 1993).

Cold water temperatures play an important role in determining bull trout habitat, as these fish are primarily found rearing in the coldest streams in a watershed (below 59 °F), and spawning habitats are generally characterized by temperatures that drop below 48 °F in the fall (Fraley and Shepard 1989, Pratt 1992, Rieman and McIntyre 1993).

Thermal requirements for the bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs and groundwater infiltration (Pratt 1992, Rieman and McIntyre 1993, Rieman et al. 1997). Optimum incubation temperatures for bull trout eggs range from 35 to 39 °F whereas optimum water temperatures for rearing range from about 46 to 50 °F (McPhail and Murray 1979, Goetz 1989, Buchanan and Gregory 1997).

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman et al. 1997). Factors that can influence bull trout ability to survive in warmer rivers include availability and proximity of cold water refugia at the mouths of cold tributaries (Myrick 2003).

All life history stages of the bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, Goetz 1989, Hoelscher and Bjornn 1989, Sedell and Everest 1991, Pratt 1992, Thomas 1992, Rich 1996, Sexauer and James 1997, Watson and Hillman 1997). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993).

Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and alevins in the gravel from winter through spring (Fraley and Shepard 1989, Pratt 1992, Pratt and Huston 1993).

Increases in fine sediment reduce egg survival and emergence (Shepard et al. 1984, Fraley and Shepard 1989, Pratt 1992). Bull trout are very benthically oriented and typically rest in close proximity to cover.

Bull trout typically spawn from August to November during periods of decreasing water temperatures, but primarily in September in western Montana. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). Redds are often constructed in stream reaches fed by springs or are near other sources of cold groundwater (Goetz 1989, Pratt 1992, Rieman and McIntyre 1996). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992), and after hatching, alevins remain in the substrate. Time from egg deposition to emergence of fry may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992, Ratliff 1992).

Migratory forms of bull trout appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes where foraging opportunities may be enhanced. Multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. The dispersal of bull trout among populations provides a potential mechanism for supporting weaker populations or refounding those that may become extirpated (Rieman and McIntyre 1993). Benefits to migratory bull trout include greater growth in the more productive waters of larger streams and lakes, greater fecundity resulting in increased reproductive potential, and potential dispersal of the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Rieman and McIntyre 1993, MBTSG 1998, Frissell 1999). In the absence of the migratory bull trout life form, isolated populations will not be re-established when disturbance makes local habitats temporarily unsuitable (Rieman and McIntyre 1993).

2.4.1 Food Habits

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. A single optimal foraging strategy is not necessarily a consistent feature in the life of a fish, but this foraging strategy can change from one life stage to another. Fish growth depends on the quantity and quality of food that is eaten; as fish grow their foraging strategy changes as their food changes in quantity, size, or other characteristics.

Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, mysids and small fish (Shepard et al. 1984, Boag 1987, Goetz 1989, Donald and Alger 1993). Bull trout that are 4.3 inches long or longer commonly have fish in their diet (Shepard et al. 1984), and bull trout of all sizes have been found to eat fish half their length (Beauchamp and Van Tassell 2001). Adult migratory bull trout feed mostly on various fish species (Leathe and Graham 1982, Fraley and Shepard 1989, Donald and Alger 1993).

Migratory bull trout begin growing rapidly once they move to waters with abundant forage that includes fish (Shepard et al. 1984, Carl 1985). As bull trout mature they become larger bodied predators and are able to travel greater distances (with greater energy expended) in search of prey species of larger size and in greater abundance (with greater energy acquired). Migration historically allowed bull trout in the Clark Fork River and Lake Pend Oreille to access optimal foraging areas and exploit a wider variety of prey resources. Migratory bull trout are known to move to or with a food source, such as mountain or pygmy whitefish or kokanee salmon.

3. STATUS OF BULL TROUT CRITICAL HABITAT

3.1 Legal Status

The Service published a final critical habitat designation for the coterminous United States population of the bull trout on September 26, 2005 (70 FR 56212); the rule became effective on October 26, 2005. The scope of the designation involved the Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units). Rangewide, the Service designated 143,218 acres of reservoirs or lakes and 4,813 stream or shoreline miles as bull trout critical habitat (Table 2).

Table 2. Stream/shoreline distance and acres of reservoir or lakes designated as bull trout critical habitat by state.

State	Stream/shoreline Miles	Acres
Idaho	294	50,627
Montana	1,058	31,916
Oregon	27,322	27,322
Oregon/Idaho	17	
Washington	1,519	33,353
Washington (marine)	985	

3.2 Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (70 FR 56212). Core areas reflect the metapopulation structure of the coterminous U.S. population of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses (Service 2002). Critical habitat units generally encompass one or more core areas and may include foraging, migration, and overwintering areas, outside of core areas, that are important to the survival and recovery (i.e., conservation) of the bull trout.

Because there were numerous exclusions associated with the final critical habitat designation that reflect land ownership, designated critical habitat map segments often appear fragmented. In reality, the habitat needed to sustain a particular migratory population of the species is typically continuous, incorporating both foraging, migrating and overwintering habitat as well as spawning and rearing habitat. The individual critical habitat map segments are expected to contribute to, but not necessarily encompass the ability of the stream to support viable local and core area populations of the bull trout in each critical habitat unit.

The primary function of individual critical habitat units is to maintain and support viable core areas (70 FR 56212) which (1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993); (2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993; MBTSG 1998); (3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Rieman and McIntyre 1993; Hard 1995; Healey and Prince 1995; MBTSG 1998); and (4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Rieman and McIntyre 1993; Hard 1995; MBTSG 1998; Rieman and Allendorf 2001).

Within designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Note that all except PCE (iii) also apply to foraging, migration, and overwintering habitat identified as critical habitat.

The PCEs of bull trout critical habitat are as follows (70 FR 56212):

1. Water temperatures that support bull trout use. Bull trout have been documented in streams with temperatures from 32 to 72 ºF (0 to 22 ºC) but are found more frequently in temperatures ranging from 36 to 59 ºF (2 to 15 ºC). These temperature ranges may vary depending on bull trout life-history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence. Stream reaches with temperatures that preclude bull trout use are specifically excluded from designation;

2. Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures;

3. Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. This should include a minimal amount of fine substrate less than 0.25 inch (0.63 centimeter) in diameter;

4. A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a BO that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation. This rule finds that reservoirs currently operating under a BO that addresses bull trout provides management for PCEs as currently operated;

5. Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source;

6. Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows;

7. An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish; and

8. Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

In freshwater habitat, critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water mark. In areas where ordinary high-water mark has not been defined, the lateral extent will be defined by the bank full elevation. Bank full elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series. For designated lakes, the lateral extent of critical habitat is defined by the perimeter of the water body as mapped on standard 1:24,000 scale topographic maps.

Adjacent stream, lake, and shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of freshwater habitat along streams, lakes and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat can have major effects on the PCEs of bull trout critical habitat in the marine environment.

3.3 Rangewide Condition of Bull Trout Critical Habitat

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, bull trout occur in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). This condition reflects the condition of bull trout habitat.

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: (1) the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Rieman and McIntyre 1993; Dunham and Rieman 1999); (2) degradation of spawning and rearing habitat and headwater areas, particularly alterations resulting in increased sedimentation rates and water temperatures, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989; MBTSG 1998); (3) the introduction and spread of nonnative species as a result of fish stocking, often facilitated by degraded habitat conditions. Effects are particularly profound for congeneric brook trout and lake trout, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Donald and Alger 1993, Leary et al. 1993); (4) in locations where large migratory bull trout occur, degradation of mainstem river habitat and the degradation and loss of lacustrine foraging and migration habitat, sometimes due to urban and residential development; and (5) degradation of foraging, migration, and overwintering habitat resulting from reduced prey base (e.g., loss of salmon or other native species), roads, agriculture, development, and dams.

4. ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR § 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area on listed species or critical habitat. Also included in the environmental baseline are the anticipated impacts on listed species or critical habitat of all proposed Federal projects in the Action Area that have undergone Section 7 consultation, and the impacts of State and private actions that are contemporaneous with the consultation in progress.

This section analyzes the current condition of the bull trout in the action area, the factors responsible for that condition, and the intended role of the action area in the conservation of the Columbia River interim recovery unit for the bull trout. The action area, at the focus of this discussion, lies within the Columbia River Basin Interim Recovery Unit for the bull trout (Figure 3). This section also analyzes the current condition of bull trout critical habitat in the action area, the factors responsible for that condition, and the intended conservation role of bull trout critical habitat within the action area.

The following assessment of the current status of the bull trout and its critical habitat in the action area is based, in part, on application of the format titled “A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Scale” (Service 1999b). This format includes a decision matrix with pathways and indicators (Matrix) designed to describe the baseline of the population and habitat conditions and effects of the proposed action on these conditions. The Service uses the Matrix, the Service’s Draft Recovery Plan (Service 2002), the final rule for designated Critical Habitat (Service 2005a), and the science associated with the development of information for the Service’s 5 year review (Service 2005b).

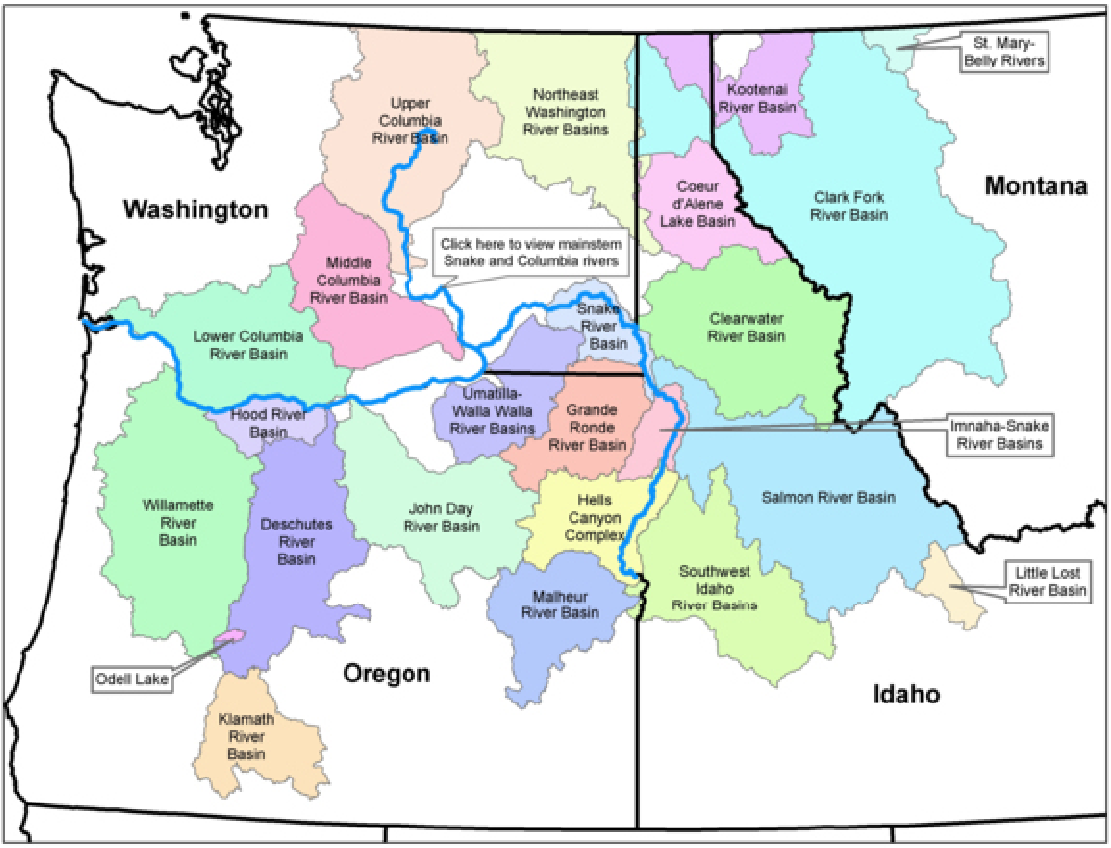


Figure 3. Map of major river basins within the Columbia River drainage containing bull trout (shaded and labeled). The mainstem Columbia and Snake Rivers are indicated by a blue line. Note the Clark Fork River Basin (largest block shown at far right), shaded aqua blue (Service 2002).

4.1 Bull Trout Core Area Terminology and Characteristics

The Draft Bull Trout Recovery Plan (Service 2002) describes an organizational hierarchy for bull trout at nested spatial levels that include *recovery units, core areas, and local populations* (the lowest rung in the hierarchical organizational level). Twenty-seven major watersheds were referred to as recovery units; terminology that has since been revised and the former recovery units are now referred to as management units. The following definitions are from the Draft Bull Trout Recovery Plan (Service 2002):

- Local population: A group of bull trout that spawn within a particular stream or portion of a stream system. Multiple local populations may exist within a core area. A local population is considered to be the smallest group of fish that is known to represent an interacting reproductive unit. In most areas a local population is represented by a single headwater tributary or complex of headwater tributaries where spawning occurs. Gene flow may occur between local populations (*e.g.*, those within a core population), but is assumed to be infrequent compared with that among individuals within a local population.

- Core area: The combination of core habitat (*i.e.*, habitat that could supply all elements for the long-term security of bull trout) and a core population (a group of one or more local bull trout populations that exist within core habitat) constitutes the basic unit on which to gauge recovery. Core areas require both habitat and bull trout to function, and the number (replication) and characteristics of local populations inhabiting a core area provide a relative indication of the core area's likelihood to persist. A core area represents the closest approximation of a biologically functioning unit for bull trout. Local populations within a core area have the potential to interact because of connected aquatic habitat.

- Recovery unit / management unit: Management units are the major units for managing recovery efforts; management units were initially described (as recovery units) in separate chapters in the draft recovery plan (Service 2002). Most management units, as proposed, consisted of one or more major river basins. Several factors were considered in our identifying management units, for example, biological and genetic factors, political boundaries, and ongoing conservation efforts. In some instances, management unit boundaries were modified to maximize efficiency of established watershed groups, encompass areas of common threats, or accommodate other logistic concerns. Some proposed management units included portions of mainstem rivers (e.g., Columbia and Snake Rivers) when biological evidence warranted such inclusion.

Within each management unit, there are one or more core areas, which are intended to reflect the metapopulation structure of bull trout. By definition, a core area contains all of the necessary constituent elements for the long-term security of bull trout. Each core area represents the closest approximation of a biologically functioning unit for bull trout (Service 2002).

In summary, until the Draft Bull Trout Recovery Plan is finalized, the Service has adopted the use of *interim recovery unit, management unit, core area,* and *local population* for purposes of consultation and recovery. Table 3 illustrates the language used by the Service for purposes of consultation for bull trout, including this BO, as well as the hierarchal relationships between these geographical units of analysis (see below for further explanation).

Table 3. Hierarchy of Units of Analysis for the Thompson Falls Project.

Name	**Hierarchal Relationship**
Columbia River Interim Recovery Unit	One of 5 interim recovery units in the range of the species within the coterminous United States
Clark Fork River Management Unit	One of 23 management units in the Columbia River Interim Recovery Unit (see Figure 3)
Lower Clark Fork Core Area	One of 35 core areas in the Clark Fork River Management Unit
Local Populations	14 local populations in the Lower Clark Fork Core Area

To further illustrate these levels of hierarchy, Table 4 describes the existing status of described local populations in the Lower Clark Fork Core Area. We include other upstream core areas which retain connectivity and are considered part of the action area because they may receive fish that migrate through the Thompson Falls Project (Appendix A; Figure A2).

Table 4. List of local populations of bull trout, by core area, in the action area.

Core Area	**Local population(s)** (Creeks unless otherwise described**)**
Lower Clark Fork (Cabinet Gorge Dam to Flathead River)	Rock Bull R. Prospect Graves Vermilion R. Fishtrap W. Fk. Thompson R. Post Mission Dry Jocko R. South Fork Jocko R. Middle Fork Jocko R. North Fork Jocko R.
Middle Clark Fork River (Flathead River to Milltown Dam)	Rattlesnake Petty Fish Trout Cedar St. Regis R.

Table 4. Continued

Core Area	**Local population(s)** (Creeks unless otherwise described**)**
Upper Clark Fork River (Upstream of Milltown Dam)	Clark Fork R. Warm Springs Racetrack Little Blackfoot R. Flint Boulder Harvey
Rock Creek	Rock Middle Fork Rock East Fork Rock West Fork Rock Ross Fork Rock Upper Willow Stony Wyman Hogback Cougar Wahlquist Butte Cabin Welcome Ranch Brewster Gilbert
Bitterroot River	West Fk. Bitterroot R. (below dam) East Fork Bitterroot R. Warm Springs Bitterroot R. Sleeping Child Skalkaho Blodgett Fred Burr Burnt Fork
Blackfoot River	Blackfoot R. Landers Fork No. Fork Blackfoot R. Monture Cottonwood Belmont Gold

4.2 Status of Bull Trout in the Action Area

4.2.1 Historic Status

Historically, bull trout were likely present throughout the Clark Fork River drainage with unlimited access from Lake Pend Oreille upstream to the headwaters of the Clark Fork River (Pratt and Huston 1993; MBTSG 1996a). Prior to the development of hydroelectric facilities, there were no natural barriers along the Clark Fork River to inhibit fish movement through the mainstem river. After the construction of Thompson Falls Dam in 1913, over 90 percent of the upstream Clark Fork River drainage was rendered inaccessible to Lake Pend Oreille migratory bull trout (Montana Bull Trout Restoration Team 2000).

Pratt and Huston (1993) noted that newspaper articles from 1895 to 1912 discuss char in excess of 10 pounds during July and August in the Thompson Falls area. Other reports in the area indicate that fishing was a primary activity for Native American settlements along the lower Clark Fork River (Malouf 1952 and 1982). The relative importance of bull trout in the harvest is unclear; however, bull trout were the only large salmonid and the largest fish to inhabit the waters at that time and presumably a logical target species for fishermen.

4.2.2 Current Status

In the coterminous U.S. at least three major genetically differentiated groups of bull trout have been identified. They include coastal, Snake River, and upper Columbia River genetic groupings. The upper Columbia River basin genetic grouping includes the mainstem Columbia River and all tributaries upstream of Chief Joseph Dam in Washington, Idaho, and Montana.

4.2.2.1 Clark Fork River Management Unit

The Clark Fork River Basin (Figure 3) is the largest and one of the most diverse watersheds contributing to the Columbia River basin (Service, 2006a). Due to the fragmentation of habitat caused primarily by the dams, the formerly connected Clark Fork Basin was broken into a series of relatively disconnected core areas. Through modifications and operational changes to some dams, removal of Milltown Dam in 2008, and trap and transport of adult bull trout from Lake Pend Oreille upstream of Cabinet Gorge and Noxon Rapids Dams, the fragmentation is gradually being reduced and the core areas gradually reconnected.

In 2006, the Service found that functional biological connectivity in the Lower Clark Fork has been and continues to be progressing, in part through successful fish passage activities (e.g., Avista trap and transport program). The Service judged that, based on best available science, recovery measures related to connectivity described in the Draft Recovery Plan (Service 2002), were being partially met (Service, 2006b). Successful upstream fish passage has been restored to a significant degree by the. As a result, the Service reorganized bull trout core areas in the Clark Fork River drainage (Service 2006b), consistent with the original intent of the Draft Recovery Plan. This decision resulted in the Lower Clark Fork River, previously described as four separate core areas, now being considered a single core area from Cabinet Gorge Dam up to (and including) the lower Flathead River (Appendix A; Figure A1).

4.2.2.2 Lower Clark Fork Core Area (Thompson River Drainage)

The Thompson River drainage appears to be the primary spawning and rearing habitat for bull trout in the project area (Thompson Falls Reservoir and the Clark Fork River in the vicinity). Migratory bull trout are known to occur in two tributaries of the Thompson River, those being the West Fork Thompson River and Fishtrap Creek (Liermann 2003; Liermann et al. 2003). Surveys conducted from 2001 to 2004 (Liermann et al. 2003; Moran 2005) and telemetry data have identified radio-tagged bull trout, passed upstream from below Thompson Falls Dam, entering both the West Fork Thompson River and Fishtrap Creek watersheds (Gillin and Haddix 2005).

Density estimates of juvenile bull trout have been calculated for Fishtrap Creek and the West Fork Thompson River. Electrofishing surveys conducted from 2000 to 2007 in two reaches within the Fishtrap Creek drainage found bull trout density (juvenile bull trout greater than 75 mm; i.e., age 1 to age 3) varied substantially between years. In Fishtrap Creek in the Basin Draw reach, densities ranged between 3.1 and 28 bull trout per 100 meters, and in the Ten-Mile reach densities ranged between 9.5 and 43 bull trout per 100 meters (Liermann et al. 2003; J. Hanson, MFWP, personal communication, March 2008).

Bull trout density estimates from electrofishing data collected between 2000 and 2007 in the West Fork Thompson River were less variable than those observed in Fishtrap Creek. One of the West Fork Thompson River reaches surveyed spanned 1.1 mile of stream, where densities ranged from 4.5 to 13.6 bull trout per 100 meters. The other reach covered 4.0 miles of the West Fork Thompson River where densities of juvenile bull trout ranged between 33.6 and 71.2 bull trout per 100 meters (Liermann et al. 2003; Liermann 2003, Bernall and Lockard 2008).

4.2.2.3 Lower Clark Fork Core Area (Lower Flathead River Drainage)

The confluence of the lower Flathead River with the Clark Fork (near Paradise, Montana) is located approximately 103 miles (165 km) upstream of Lake Pend Oreille, at the upper bound of the Lower Clark Fork core area. The lower Flathead River system is artificially bounded upstream by Kerr Dam, an impassible barrier to upstream migration located at the outlet of Flathead Lake. Currently, there are two tributary drainages with known bull trout populations in the lower Flathead River (DeHaan et al., *in press*), the Jocko River and Mission Creek drainages.

The construction of dams, irrigation diversions, and canals within the Jocko River and Mission Creek drainages has substantially reduced connectivity and has isolated some local bull trout populations. However, genetic information from fish collected in the lower Flathead River and mainstem Jock River indicate that a migratory bull trout life history persists in the drainage. In addition, genetic information from bull trout captured in the lower Clark Fork River at the mainstem dams suggest individual bull trout from the lower Flathead River drainage are migrating downstream (DeHaan and Ardren *unpublished data* cited in DeHaan et al. *in press*).

Based on a 2007 study by DeHaan et al. (*in press*) four local bull trout populations were identified in the lower Flathead River drainage: the North Fork and South Forks of the Jocko River, Post Creek, and Dry Lake Creek in the Mission Creek drainage. Results from this study indicate low genetic diversity and effective population size for these bull trout populations, with limited migratory connectivity for adults compared to other populations in the Lower Clark Fork River Core Area.

4.2.2.4 Middle Clark Fork River Core Area

As previously described, the middle Clark Fork River Core Area extends from the confluence of the lower Flathead River upstream to the confluence of the Blackfoot River (just upstream of the former site of Milltown Dam). Within this reach of the Clark Fork River (excluding the Bitterroot River drainage), six bull trout local populations have been identified (Table 4). These spawning tributaries include Little Joe Creek (within the St. Regis River drainage), Cedar Creek, Trout Creek, Fish Creek, Petty Creek and Rattlesnake Creek. Albert Creek has also been recently identified as a potentially important bull trout spawning and rearing stream (L. Knotek, MFWP, personal communication, June 2008). These tributaries all maintain relatively cold water temperatures during the summer months, typical of high quality bull trout streams. Peak daytime stream temperatures generally do not exceed 16 °C during the summer months (MFWP, unpublished).

The majority of bull trout spawning tributaries mentioned above are also suspected to support fluvial and resident bull trout. Data from Fish Creek indicate that only fluvial bull trout spawn in this tributary (MFWP, unpublished). Albert Creek is assumed to support mainly resident bull trout and westslope cutthroat trout. This is assumed because of the presence of a fish barrier (perched culvert), intermittency (natural dewatering and irrigation withdrawals), and the small overall size of the drainage compared to others supporting fluvial fish.

Genetic analyses for 266 adult bull trout captured below Cabinet Gorge Dam between 2001 and 2007 and two adult bull trout captured below Noxon Rapids Dam in 2008 assigned a total of 17 bull trout to four tributaries in the Middle Clark Fork River Core Area: Cedar Creek, Fish Creek, Little Joe Creek, and Rattlesnake Creek (see Table 5; S. Bernall, Avista, personal communication, February 2008). The genetic analyses indicate adfluvial bull trout life history may still persist in the middle Clark Fork River drainage. For that reason, we presume that bull trout passing through the Thompson Falls Project, that do not originate in the Lower Clark Fork Core Area, are next most likely to originate in the Middle Clark Fork River Core Area.

4.2.2.5 Spawning Surveys

In 2007, biologists counted 3 bull trout redds in the South Fork Bull River, 9 in the East Fork Bull River, and 4 in Rock Creek, for a total of 16 in Cabinet Gorge Reservoir tributaries (Storaasli and Moran 2008). They also counted 7 bull trout redds in Swamp Creek, 1 in Marten Creek, 24 in Vermilion River, 10 in Graves Creek, and 16 in Prospect Creek, for a total of 58 redds in Noxon Reservoir tributaries in 2007 (Storaasli and Moran

2008). Using a standard of 3.2 adult bull trout per redd as a conversion, this would indicate a minimum 2007 spawning population of approximately 186 adult bull from within Noxon Reservoir (including transported fish from below Cabinet Gorge Dam). In the Thompson River drainage, upstream of Thompson Falls Dam, researchers detected 8 bull trout redds in the West Fork Thompson, 17 in Fishtrap Creek, and 11 in Beatrice Creek for a Thompson River total 36 redds (Storaasli and Moran 2008). In all these cases, redd counts represent minimum numbers as typically only the areas of highest redd concentration are surveyed. Redd counts are not available for the Jocko River drainage. In total, at least 110 bull trout redds were constructed in the Lower Clark Fork core area in 2007, with approximately two-thirds downstream of the Project and one-third upstream of the project. These 110 redds would represent a minimum adult population of 352 adult bull trout (110 X 3.2).

In 2007, researchers also enumerated 62 brown trout redds in the Bull River drainage, 2 in Marten Creek, 43 in Vermilion River, 8 in Prospect Creek, and 36 in the mainstem Thompson River (Storaasli and Moran 2008).

From 2001 to 2005, fish passage programs conducted within the Lower Clark Fork Core Area successfully passed between 29 and 42 adult bull trout annually (Service, 2006b). Due to the fecundity of each adult female bull trout, each fish passed upstream to spawn has the potential to make a substantial genetic contribution (Service 2006a). In addition, data collected between 2001 and 2006 have documented several juvenile bull trout captured from tributaries, tagged and transported downstream of Cabinet Gorge Dam, that were recaptured as adults at the base of dam; indicating that at least some migratory bull trout are now able to complete their normal lifecycle in the Lower Clark Fork Core Area.

4.2.2.6 Genetic Surveys

Avista captured a total of 266 adult bull trout below Cabinet Gorge Dam between 2001 and 2007. Of the 266 bull trout, 83 (or 31% of the total) were identified, through genetic testing, as belonging to tributaries upstream of Thompson Falls Dam, Region 4 (S. Bernall, Avista, personal communication, February 2008). Of the 83 bull trout having natal tributaries upstream of Thompson Falls Dam, over half (59%) originated from the Thompson River and lower Flathead River drainage (Table 5). The remaining bull trout (34 adults) represented local populations from upstream core areas in the Middle Clark Fork, Blackfoot, and Rock Creek drainages.

Table 5. Summary of Rapid Genetic Assessment for Bull Trout Captured below Cabinet Gorge Dam between 2001 and 2007 (S. Bernall, Avista, personal communication, February 2008).

Area	**Drainage**	**Tributary of origin (local population)**	**# of Bull Trout**
Lower Clark Fork	Thompson River	Fishtrap Creek	41
		W.F. Thompson	7
	Lower Flathead	S.F. Jocko River	1
Middle Clark Fork	St. Regis	Little Joe Creek	5
	Middle Clark Fork	Fish Creek	5
		Cedar Creek	1
		Rattlesnake Creek	5
Blackfoot	Blackfoot	Monture Creek	5
		N.F. Blackfoot River	2
Upper Clark Fork	Upper Clark Fork	Rock Creek (Clinton)	11
Total			**83**

In addition, in 2008, two adult bull trout were captured below Noxon Rapids Dam and assigned to tributaries upstream of Thompson Falls Dam (Meadow Creek and Cedar Creek) (S. Bernall, Avista, personal communication, February 2008). These data indicate bull trout movements are not limited to the lower Clark Fork River and that the adfluvial migratory life history of bull trout still exists in the Lower Clark Fork River Core Area. However, to continue to perpetuate the adfluvial life history traits, it's believed necessary to continue bull trout passage over the dams in the lower Clark Fork River, thus allowing adult bull trout to return to their natal streams to spawn (Service 2002).

4.2.2.7 Radio Telemetry Studies

In the lower Clark Fork River drainage, there appears to be a wide migration season, approximately between April and August, when adult bull trout leave Lake Pend Oreille or other portions of the Clark Fork mainstem to begin their upstream migrations (Normandeau Associates 2001). The timing of movement into the tributaries varies as well. For example, timing of bull trout spawning movements into the East Fork Bull River can occur between the middle of July and the middle of October. Radio telemetry data also indicate a relatively wide range of timing during which bull trout move into their eventual spawning areas (Lockard et al. 2002; 2003; 2004).

For many decades, dams in the lower Clark Fork River drainage have limited certain historical bull trout spawning migrations. There are, however, numerous reports documenting long distance travel by adult bull trout to spawning areas that are not impeded by dams. In the upper Clark Fork River drainage, fluvial bull trout can migrate over 62 miles (100 km) (Schmetterling 2003). Adfluvial bull trout have been documented migrating more than 124 miles (200 km) in the Flathead River drainage (Fraley and Shepard 1989). A study conducted in 1998 and 1999 in Rock Creek (a Clark Fork tributary) found a substantial portion of bull trout complete a fluvial migratory life history, staying entirely within the Rock Creek drainage (Carnefix et al. 2002).

The specific timing of bull trout migration in the Thompson Falls Project area has not been well documented. The available data indicate that the upstream migratory season for adult bull trout is roughly between April and July. Based on data collected between 1999 and 2006 (Table 6), April is the month when the majority of bull trout have been collected in the Thompson Falls Dam tailrace (PPL Montana unpublished data). It should be noted that it is impossible to safely sample the tailrace of Thompson Falls Dam during high water, and trapping and electrofishing efforts are stopped when water temperatures are high during the summer (to reduce the risk of injury to bull trout). Therefore, sampling has been limited to early spring and late summer/fall months.

Table 6. Bull Trout Collected in the Tailrace of Thompson Falls Dam, 1999–2006. A = angling, EF = electrofishing, T = trapping.

Date	Length (mm)	Weight (gram)	Sampling Method
5/07/1999	505	1247	A
5/18/1999	395	400	EF
5/03/2000	517	1180	A
4/11/2001	323	264	A
6/01/2001	545	1390	T
7/20/2001	644	2275	T
5/03/2002	414	568	A
8/07/2002	780		T
4/03/2003	274	182	EF
3/29/2004	109	n	EF
4/07/2004	487	1225	T
4/13/2004	523	1483	T
4/19/2004	372	393	EF
4/19/2004	535	1275	EF
4/19/2004	718	3660	EF
5/05/2004	505	1185	T
4/11/2005	118	13	EF
4/11/2005	102	9	EF
4/12/2005	167	30	EF

Date	Length (mm)	Weight (gram)	Sampling Method
4/12/2005	162	31	EF
4/21/2005	730	5021	EF
4/21/2005	300	202	EF
3/09/2006	245	103	EF
4/06/2006	341	560	T
4/13/2006	485	1115	EF
5/03/2006	775	3941	EF

Bull trout have specific spawning requirements and only use a small percentage of the available stream habitat for spawning (MBTSG 1998). Typical bull trout spawning grounds are described as low gradient (less than two percent), gravel/cobble substrate, with water depth ranging from 4 to 24 inches (0.1 to 0.6 meters), and stream velocity between 0.3 and 2.0 feet per second (Montana Bull Trout Restoration Team 2000).

After spawning, migratory adult bull trout emigrate downstream to a river or stream. Studies conducted by Avista in the lower Clark Fork River downstream of Thompson Falls Dam have found some radio-tagged bull trout moved downstream through Cabinet Gorge Dam volitionally. Of the 25 fish detected or recaptured below Cabinet Gorge Dam after having been transported upstream of the dam, 19 either definitely or likely survived passage through or over the dam (Lockard et al. 2004). Although the status of the other fish was unknown, at least one was suspected to have expired in passage through the dam (Lockard et al. 2004).

4.2.2.8 Species Interactions

The Service (2002) concluded that of all the threats to bull trout recovery, the expanding presence of nonnative invasive species may prove to be the most intractable. The principle nonnative species of concern interacting with native salmonids in tributary systems to the Clark Fork River are brown trout (*Salmo trutta*) and brook trout.

Data collected for the BA (FERC 2008a) indicated fish densities in the middle Clark Fork are estimated to be approximately 250-600 rainbow trout per mile, 17-55 westslope cutthroat trout per mile, and 1-2 bull trout per mile (Berg 1999; MFWP unpublished data). Brown trout numbers in the middle Clark Fork River are too low to accurately estimate, but the data indicate approximately 20 catchable brown trout (>7 inches) per mile (Berg 1999). Additionally, hybridization of bull trout with brook trout has not been detected to date through genetic analysis in bull trout collected in the middle Clark Fork River (MFWP unpublished).

Brown trout were introduced in the late 1940s to the lower Clark Fork River drainage. Higher densities of brown trout are most often found in lower reaches of tributaries (WWP 1996; Nelson et al. 2002). Brown trout pose a potential threat to bull trout populations. Brown trout typically spawn in late fall, immediately after bull trout, but use similar spawning habitat that may lead to superimposition on bull trout redds. Superimposition may result in lower bull trout egg survival (Chadwick Ecological

Consultants 2002). Superimposition of brown trout redds on bull trout has been documented in the lower Clark Fork River drainage in Prospect Creek, Vermilion River, and Bull River watersheds (Moran 2003, 2004, and 2005). Brown and bull trout also utilize similar microhabitats as juveniles, but the interactions and effects at this life stage are unknown (Pratt and Huston 1993).

Brook trout were introduced to the lower Clark Fork River drainage in the mid-1930s and are found throughout the system (WWP 1996). Brook trout pose a threat to bull trout populations, but for different reasons than brown trout. Bull trout and brook trout compete and exploit similar food and habitat resources. Compared to bull trout, brook trout have a wider array of suitable habitat conditions, lower age at maturity, higher fecundity, ability to hybridize with bull trout, and tendency to overpopulate a stream; all of which provide brook trout with an advantage over bull trout and greater likelihood of displacing bull trout (Kanda et al., 2002). Kanda et al. (2002) concluded that hybridization wasted more reproductive potential for bull trout because eggs contain more energy than sperm and the majority of hybridization was found between female bull trout and male brook trout. Additionally, female bull trout take longer to reach maturity than do male brook trout, leading to a net loss in reproductive potential for bull trout in comparison to brook trout.

4.3 Factors Affecting Bull Trout Habitat in the Action Area

The draft Bull Trout Recovery Plan (Service 2002) describes general habitat conditions in the Clark Fork River drainage. Human impacts that are identified as affecting bull trout habitat include: dams, forestry management, mining, transportation, urban and rural development, agriculture and grazing, and fisheries management including stocking of nonnative fish species (Service 2002).

4.3.1 Dams

Since the construction of Thompson Falls Dam (1913), numerous dams located both downstream and upstream of the Project have fragmented bull trout habitat and isolated fish populations (Service 1998). This fragmentation has been further compounded by degradation of bull trout habitat. According to the Draft Bull Trout Recovery Plan (Service 2002), dams have been one of the key factors in reducing the bull trout population of the Clark Fork Management Unit. The presence of barriers can isolate bull trout subpopulations, eliminate individuals from populations, reduce or eliminate genetic exchange, and separate spawning areas from overwintering and foraging areas.

The Service (2002) notes that the three dams on the lower Clark Fork River act in concert to significantly reduce the amount of spawning and rearing habitat available to Lake Pend Oreille migratory bull trout. Since dams in the Clark Fork River Management Unit have never had fishways, the adult bull trout populations have undergone nearly a century of increasing fragmentation due to dams as well as other physical and biotic barriers to movement.

With the construction of Thompson Falls Dam in 1913, over 90 percent of the Clark Fork River watershed was rendered inaccessible to Lake Pend Oreille migratory bull trout (Montana Bull Trout Restoration Team 2000). The lower Clark Fork River drainage was further dissected after the construction of Cabinet Gorge and Noxon Rapids dams in 1952 and 1958, respectively. In addition to upstream migratory impacts, hydroelectric turbines cause varying degrees of direct mortality when fish move downstream and pass through the mechanical and hydraulic structures (Bell 1986).

The construction of the three lower Clark Fork River dams has also led to habitat modification of the mainstem lower Clark River, transitioning a riverine environment to a reservoir environment. Reservoirs can provide mixed advantages and disadvantages for bull trout. Some reservoirs can increase growth potential or living space for bull trout due to open water habitat, especially when large forage bases are present and deep coldwater habitat is substantial (Service 1998). However, complications exist where nonnative species have been introduced into reservoirs that either compete or prey on bull trout themselves. Water temperatures in the three mainstem impoundments on the Clark Fork River (Thompson Falls, Noxon Rapids, and Cabinet Gorge Reservoirs) are generally too warm in the summer months to be favorable for bull trout and habitat conditions generally favor cool and warmwater species such as northern pike, bass, and walleye.

4.3.2 Forestry Management

The Service (2002) also notes that forestry management practices have affected bull trout in the lower Clark Fork drainage. The Service states:

> *"For over 100 years, forestry practices have caused major impacts to bull trout habitat throughout the Clark Fork Recovery Unit. And because forestry is the primary landscape activity in the basin, the impacts have been widespread. Primary effects of timber harvest, such as road construction, log skidding, riparian tree harvest, clear cutting, splash dams, and others, have been reduced by the more recent development of more progressive practices. However, the legacy effects of the past century have included lasting impacts to bull trout habitat, including increased sediment in streams, increased peak flows, hydrograph and thermal modifications, loss of instream woody debris and of channel stability, and increased accessibility for anglers and poachers. These impacts will continue and are irreversible in some drainages. In addition, insufficient funding to maintain the existing road system has resulted in maintenance deficiencies, even on some well-designed roads. Consequently, impacts of the existing road system are compounded." (Service 2002)*

Logging roads in the lower Clark Fork River drainage are commonly located in the riparian zone adjacent to streams (Service 2002). For example, upstream of the Project, the Thompson River has a main logging haul road along one side of the stream and a county road along the other side of the stream for nearly its entire length. Silviculture has also been identified as a source of impaired water quality within the lower Clark Fork River drainage in Noxon Reservoir, Beaver, Elk, Fishtrap, Graves, Marten, Pilgrim, Prospect, Snake, and Swamp creeks, and in the Middle Fork Bull, Thompson, and

Vermilion Rivers, to name some but not all affected drainages (MDHES 1994). Bull trout in Prospect Creek, the Vermilion River, and the Bull River have been particularly impacted by past logging activities (Pratt and Huston 1993). Deposited sediment levels in the Bull River and Rock Creek are high enough to significantly reduce bull trout survival to emergence (Huston 1988; Smith 1993).

4.3.3 Agriculture and Grazing

The Service identified agricultural impacts to bull trout habitat to be minor in the lower Clark Fork River drainage (Service 2002). Grazing affects some isolated areas in the lower Clark Fork River, including Thompson River, Elk Creek, Pilgrim Creek, and portions of the Bull River, but overall grazing is not one of the high risk factors (MBTSG 1996a).

4.3.4 Transportation

Transportation systems were a major contributor to the decline of bull trout in the Clark Fork River Management Unit (Service 2002). The mainstem Clark Fork River is a major transportation corridor. Separating the direct effect of the roads and railroads from the development associated with their construction is difficult. Separating the effects of transportation corridors in forested habitat from the legacy effects of forest management is also difficult. Road construction methods during the late 19th and early 20th centuries often included channelization and meander cutoffs. These methods caused major impacts on many tributaries to the lower Clark Fork River that are still being manifested. Such impacts seldom occur with new roads, built to higher standards. However, significant legacy problems remain and include passage barriers, sediment production, unstable slopes, improper maintenance, and high road densities (Service 2002).

4.3.5 Mining

Mining activities began in the Clark Fork River drainage over a century ago. Although many areas have not been materially impacted by mining, environmental impacts related to mining often occur outside the physical boundaries of the mine. In addition, impacts to aquatic ecosystems may continue long after mining activities have ceased. There are areas where contaminated streambeds, streambanks, and floodplains persist from mine tailings. In addition, some reaches of stream remain fishless or with severely depressed fish populations because of mining wastes (Service 2002). The most severely impacted sites occur in the upper Clark Fork River drainage, as a result of mining and smelting activity in the Butte and Anaconda areas. These impacts resulted in designation of the nation’s largest Superfund site with the EPA (Service 2002).

Several tributaries in the middle Clark Fork River have been impacted by placer mining. These tributaries include St. Regis River, Ninemile Creek, Cedar Creek, Trout Creek and Quartz Creek (MBTSG 1996b). Impairment to water quality in other streams, including Cache, Cedar, Crow, Josephine, Kennedy, Little McCormick, and Trout creeks were also linked to mining (Service 2002). Mining effluent has also impaired waters in the headwaters of the Blackfoot River drainage.

Contaminated sediments from the Blackfoot River and upper Clark Fork River were deposited behind Milltown Dam and have created fish kills and a persistent threat to groundwater and to surface waters downstream. The sediment deposits were isolated by a series of dikes and a bypass channel in 2007 and in early 2008 Milltown Dam was breached. Over the next several years, the deposited toxic sediment will be removed and then the river channel will be restored to its original configuration. Until the project is completed, a potential threat of downstream impacts from sediment flushing remains.

Other areas in the Clark Fork River drainage face the challenge of proposed mining operations and their potential future impacts. In 2006, the Service prepared a BO regarding a proposed mining operation in the Rock Creek drainage near Noxon (Service 2006a). The proposed mining operation was for an underground copper/silver mine and mill that could produce 10,000 tons of ore per day (Service 2002). The Service anticipated that certain activities associated with the proposed mining activity would likely result in degradation of bull trout habitat causing some incidental take. Anticipated habitat degradation included: 1) an increase in sediment; 2) degradation in water quality; and 3) alterations in channel and habitat complexity (Service 2006a). These impacts to the habitat were described to have the potential to "*result in a take of egg, larval, and juvenile life history stages by harming or impairing feeding, breeding, and sheltering patterns of adult and juvenile bull trout*" (Service 2006a). The duration of impacts were estimated to last, at a minimum, the life of the mine, with possible long-term effects that could continue indefinitely after the mine closure. The BO is under continuing litigation.

4.3.6 Urban and Rural Development

In the Clark Fork drainage, some areas have experienced increases in residential development. In the 1990s, Lincoln, Sanders, Lake, and Mineral counties grew between 7.8 and 26.0 percent (Service 2002). Growth was particularly common in tributary drainages to the Clark Fork River that were bordered by private lands, such as the Bull and Jocko Rivers, that provide important bull trout habitat (Service 2002). Residential development, which is likely to continue to increase in the future, brings associated risks to bull trout restoration. Development can impact bull trout habitat through activities including, but not limited to, the removal of the riparian corridor, removal of large woody debris, construction of roads resulting in the increase of sediment or bedload to the stream, or alterations to the floodplain (e.g., dredging) (Service 2002).

4.4 Consulted-on and Other Effects

4.4.1 Rangewide

Previous consulted-on projects occur throughout the range of bull trout that could affect the status of bull trout. Because of a recent court decision for the Rock Creek Mine, ESA Section 7 consultations across the range of bull trout have been summarized. In order to assess the effects of previous actions/projects on bull trout for the Thompson Falls BO, we incorporate by reference the Service's BO for the Rock Creek Mine (Service 2006a).

In the Status of the Species section of the Rock Creek Mine opinion the Service reviewed 137 Biological Opinions written by the Service from the time of listing in June 1998, until August 2003. In summary, 124 of the 137 BO's (91%) applied to activities affecting bull trout in the Columbia River. The geographic scope varied from individual actions (e.g., construction of a bridge or pipeline) within one basin, to multiple-project actions, occurring across several basins.

There were 24 different activity types analyzed in those 137 opinions (e.g., grazing, road maintenance, habitat restoration, timber sales, hydropower, etc.). Twenty actions involved multiple projects, including some of which are restorative actions for bull trout. Within each river basin, the number of actions, type of actions, and a brief description of the action was provided. Furthermore, each individual action was identified as to the cause of the effect and the anticipated effect on a spawning stream and/or migratory corridor if known (in most cases this effect was known). An attempt was made to further define the anticipated effect by duration (e.g., “short-term effects” varied from hours to several months) and a determination was made, when possible, to identify those projects with long-term benefits. Actions whose effects were “unquantifiable” numbered 55 in migratory corridors and 55 in spawning streams.

Since that 2003 analysis, to July 2006, the Service issued another 198 BO’s within the range of bull trout (D. Brewer, Service, 2006, personal communication). These BO’s were all no-jeopardy determinations and they concluded that the continued long-term survival and existence of the species had not been appreciably reduced range-wide. The Rock Creek Mine BO also concluded that out of the 198 BO’s prepared from 2003 to July 2006, those issued that affect the Lower Clark Fork Core Area, considered either singly or cumulatively, will not appreciably reduce the likelihood of survival and recovery of the bull trout or result in the loss of any subpopulation and that many of the proposed actions considered in the BO’s will benefit bull trout.

A database for tracking bull trout effects and incidental has been constructed take so that new and ongoing projects can be more efficiently analyzed. The database is currently being populated by personnel in the Services’ Region 1 and 6 regional offices. Available information also indicates implementation of section 6 and/or section 10(a)(1)(A) permits in the basin have resulted in direct effects to bull trout due to capture and handling and indirect mortality. The Avista native fish restoration project has involves intensive hands-on trapping and electrofishing as well as invasive research activities and there has been a limited level of mortality. However, the Service ascribes net beneficial effects to the project, such as restoring the opportunity for adult bull trout to home to natal streams.

It is unknown how many non-Federal actions have occurred in the mainstem FMO habitat since the listing of bull trout. Activities such as emergency flood control, development, and infrastructure maintenance are conducted on a regular basis and have the potential to impact riparian and instream habitat. Streambank Protection Permits issued by the State of Montana under the “310” and “124” laws also affect bull trout and their habitat. In a few locations, recent land-use changes from agriculture to urban development along the riparian areas may also affect bull trout and their habitat. Construction of homes in floodplains and riparian areas have also increased.

Restoration programs, often commenced by the Forest Service and other land managers, include riparian restoration, restoration of fish passage at barriers, and habitat improvement projects authorized in the Lower Clark Fork and adjacent core areas. Under the Clark Fork Superfund cleanup program, the State of Montana, CSKT, and other watershed groups have coordinated to complete stream habitat work along portions of the mainstem. The Federal Columbia River Power System BO also provides for bull trout monitoring and associated restoration projects that will benefit bull trout.

The FERC settlement agreement for Avista relicensing of Noxon Rapids and Cabinet Gorge Dams requires bull trout monitoring and associated funding is providing restoration of salmonid habitats. The Avista Settlement Agreement provides over $1.25 million dollars per year for 45 years to restore and improve habitat and fish passage under the Native Salmonid Restoration Plan (Kleinschmidt et al. 1998). Funding for portions of that plan are leveraged by matching dollars from State and Federal agencies.

Natural events such as fire and flooding also cause changes in the environment. These may lead to extreme hydrologic fluctuations, with large quantities of high velocity water spilling over flood gates and through turbines. This may, in turn, cause degradation of habitat and a loss of woody debris that contributes to habitat complexity.

Global climate change is also believed to already be contributing to warmer stream temperatures in the mainstem of the Clark Fork River and its tributaries. Warmer air temperatures and increasing frequency of rain on snow events due to winter rainstorms will continue to contribute to changes in habitat conditions for bull trout. Warmer water in the FMO habitat makes it more difficult for bull trout to migrate and feed. Increasingly, bull trout migrate from one cold water refugia to another and angler access points at some of these concentration areas (typically at the mouths of cold water tributaries) leave bull trout increasingly vulnerable to overfishing or illegal fishing activities. Increased severity of hydrologic events may lead to a higher frequency of disruptions and less stability in habitat conditions (i.e. streambed features, pools, and other habitat may contain more sediment or may be altered more frequently to develop complex spawning or rearing habitat, etc).

4.4.2 Rock Creek Mine BO

The analysis described in the Rock Creek Mine BO (see 4.4.1, above) occurred at the Clark Fork Management Unit level and was then stepped down to the Lower Clark Fork core area scale. The original Rock Creek Mine BO included an evaluation of the entire Clark Fork Management Unit from the time of listing (June, 1998) to August 2003, where 37 actions occurred during this period. The majority (35) involved habitat disturbance with unquantifiable effects. Sixteen actions were considered ongoing and 21 actions were completed with effects no longer considered to be occurring.

At the time of preparation of the second (revised) Rock Creek Mine BO (October 11, 2006), no BO's within the range of bull trout had reached a jeopardy determination. The actions summarized in the revised Rock Creek Opinion (Service 2006a) did not adversely affect bull trout populations to the extent or loss of subpopulations and the Service concluded that the continued long-term survival and existence of the species had not been appreciably reduced range-wide.

The comprehensive assessment of all of the BO's across the range of bull trout from the time of listing until July 2006 (335 BO's), described in the Rock Creek Mine BO (Service 2006a), confirmed that no actions that have undergone section 7 consultation, considered either singly or cumulatively, will appreciably reduce the likelihood of survival and recovery of the bull trout or result in the loss of any local populations.

4.5 Environmental Baseline of Designated Critical Habitat

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the Action Area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress.

This environmental baseline analysis is based on information provided in the proposed and final critical habitat rules. Critical habitat contains eight Primary Constituent Elements. In summary, PCE #1 is stream temperature, PCE #2 relates to complex stream channels, PCE #3 relates to spawning substrate, PCE #4 protects natural hydrographs, PCE #5 relates to springs, seeps, and groundwater, PCE #6 is for protection of migratory corridors, PCE #7 describes the food base, and PCE #8 is related to streamflow. These are described in greater detail in the Critical Habitat Rule (Service 2005a) and in section 3.2 of this BO, above.

Within the Action Area, the extent of designated critical habitat is within streams and rivers within six core areas (Table 4) of the Clark Fork River basin, Critical Habitat Unit 2 (Appendix A; Figure A3). Reaches of stream and river which are designated as critical habitat for bull trout are interspersed with sections of non-designated reaches. Interspersed, excluded stream segments are not consistently identifiable on this map due to limitations related to scale and land ownership information. Therefore, this map should be considered a coarse approximation of final critical habitat locations.

In the Clark Fork River Basin, most of the designated critical habitat segments (1,136 miles or 1,828 km of stream; 49,755 acres or 20,135 hectares of lake habitat) are located along mainstem foraging, migrating, and overwintering (FMO) corridors adjacent to private lands (Figure A3). This occurs because the most important spawning and rearing (SR) habitat is typically in the headwaters, which are mostly located on Forest Service or Plum Creek Timber Company lands, both of which were excluded from the critical habitat designation (Service 2005a).

4.5.1 Condition of Critical Habitat in the Clark Fork: Unit 2

In the Clark Fork Critical Habitat Unit bull trout typically occupy at least portions of all major drainages where they were historically distributed. Remaining populations are often fragmented and sometimes isolated, due to a variety of factors described in 4.3, above. Most of the designated critical habitat is already in degraded condition due to isolation by dams, agricultural practices, and associated water withdrawals that have affected stream temperatures, passage, sediment, and flows. Historically, dams in the system lacked fish passage and precluded free movement between local populations (SR or spawning and rearing habitat) and FMO habitat, particularly for fish that undertook full migrations downstream to Lake Pend Oreille. Additional activities affecting critical habitat in the basin include forestry practices, grazing, roads, mining, non-native species, contaminants, and residential development. In addition, drought conditions have increased the potential for fire impacts within most forested areas.

Common to all the critical habitat units are past logging operations and the infrastructure necessary to carry out these activities. Federal management on national forest lands has incorporated the Inland Native Fish (INFISH) aquatic conservation strategy since 1995. These INFISH management strategies have improved management on national forest lands in western Montana and reduced the impact of forest management, which has resulted in a reduced rate of degradation within the Action Area. Legacy effects from past logging and road building on Federal and non-Federal lands will likely continue for decades or longer. Plum Creek Timber Company lands are subject to the standards of the Plum Creek Native Fish Habitat Conservation Plan (Service et al. 2000). Conditions needed for bull trout recovery will require additional habitat restoration and threat abatement from land- and water-management practices affecting freshwater habitats. The condition of designated critical habitat within the action area is described, below. Within the Middle Columbia Critical Habitat Unit, all PCEs (particularly 1, 2, 4, 5, 6, 7, and 8) have experienced some degree of degradation since listing.

4.5.2 Conservation Role of Critical Habitat for the Clark Fork: Unit 2

The conservation role of bull trout critical habitat is to support viable core area populations (70 FR 56212). Individual critical habitat segments are expected to contribute to the ability of the stream or river to support viable local and core area populations of the bull trout in each critical habitat unit.

Critical habitat in the Clark Fork River basin, in concert with major areas of proposed critical habitat on the National Forests that were excluded due to the current application of INFISH and portions of Plum Creek lands excluded due to the presence of an HCP (Service et al. 2000), should ensure the persistence of bull trout in the core areas within the basin. Collectively, these areas need to contain the habitat necessary to sustain the fish; provide for persistence, redundancy, and resilience of strong local populations; and provide habitat for migratory fish. The function of these habitats should be to assist in ensuring connectivity and migration between populations so that bull trout are distributed throughout the historic range, in order to preserve both genetic and phenotypic diversity within not only the Clark Fork Basin, but across the range of bull trout. See the list of PCEs in the Status section (3.2, above) describing the conditions necessary for the critical habitat to support local populations and core areas of bull trout.

4.6 Ongoing Conservation Measures within the Action Area

Currently, timber management on U.S. Forest Service lands is guided by several Forest Management Plans, implementing and incorporating the Decision Notice for the INFISH Strategies for Managing Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada (USDA 1995). INFISH strategies are expected to be overlain with revised on-site forest management plans that, when implemented, are designed to reduce impacts to aquatic species, riparian areas, and listed fish. Road and riparian restoration work has been on-going in forests of the Clark Fork Basin and in the Confederated Salish and Kootenai Reservation watersheds. Fish passage at culverts, irrigation and diversion dams; and riparian restoration projects have been the focus of restoration efforts in the Basin.

Under the Avista Native Fish Restoration Program, the Plum Creek Native Fish HCP (Service et al. 2000), and with additional sources of tributary funds projects are focused on strategies to restore passage at forest roads, reduce sedimentation, monitor bull trout, reduce impacts to instream flows, and improve fish passage.

Within the Action Area, all legal angling for bull trout was halted in the early 1990’s, and spawning or staging areas of some streams are closed or listed under restrictive angling regulations. Additional restrictions are currently proposed for 2009. Nonetheless, illegal take of bull trout is still problematic in certain areas.

4.7 Conservation Needs of Bull Trout in the Action Area

The following characterization is based on information presented in the Service’s Draft Bull Trout Recovery Plan (Service 2002) and information derived from applying the Matrix to bull trout populations within the action area.

Viable populations of the bull trout in the action area are essential to the conservation of species within each of the core areas, the Columbia River interim recovery unit, and the coterminous listing (Service 1998, Service 2002). To maintain or restore the likelihood of long-term persistence of self-sustaining, complex, interacting groups of bull trout within the action area, the Service has identified the following needs: 1) maintain the current distribution of bull trout and restore distribution in previously occupied areas; 2) maintain stable or increasing trends in abundance of bull trout; 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies; and 4) conserve genetic diversity and provide opportunities for genetic exchange.

The Clark Fork River and mainstem reservoirs serve as migration corridors, as well as providing foraging habitat and overwintering areas for bull trout. Bull trout spend up to 10 months or more in the mainstem FMO habitat before migrating to spawn in their natal streams (if accessible). Although currently fragmented by dams, the mainstem provides habitat that maintains interactions between local populations of bull trout in the tributaries within each of the six core areas in the action area. Connectivity in the mainstem provides for genetic diversity and population characteristics necessary for recovery including: distribution, stable or increasing trends, and suitable habitat condition for all bull trout life history stages (Rieman and McIntyre 1993, Service 2002).

Several components in the mainstem Clark Fork River are necessary for bull trout, based on studies on their habitat requirements and population biology. Furthermore, these essential components have been documented by some of the primary constituent elements for bull trout habitat (see 3.2, above; Service 2005a). In migratory habitat, bull trout need at least the following habitat conditions:

Water temperatures ranging from -2 C to 22 C, depending on life history stage and form, geography, elevation, diurnal and seasonal variation, and local groundwater influence (PCE 1).

A natural hydrograph including peak, high, low, and base flows within historic ranges or if regulated according to a BO, that supports bull trout populations by minimizing daily and day-to-day fluctuations, etc (PCE 4).

Migratory corridors free of physical, biological or chemical barriers between spawning, rearing, overwintering, and foraging habitats (PCE 6).

An abundant food base including prey items such as: macroinvertebrates and forage fish (PCE 7).

Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival, are not inhibited (PCE 8).

Central to the survival and recovery of the bull trout is the maintenance of viable local populations and core areas (Service 2002, 2005a, and 2005b). Core areas are thought to represent the scale necessary for maintaining a functioning metapopulation of bull trout because they contain the habitat qualities necessary for them to spawn, rear, forage, overwinter, and migrate and the contiguous habitat necessary to survive catastrophic events. A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat, and in some cases in their use of spawning habitat. There are unique characteristics of each of the core areas within the Action Area. According to Service bull trout recovery teams and the Service's Draft Recovery Plan (Service 2002), maintenance and connectivity of the FMO habitat is important to the function of all core areas in the action area.

In summary, using site specific information from radio telemetry, genetics, and other information, there are likely several hundred individuals from six core areas (Table 4) using the mainstem Clark Fork River for FMO habitat during major parts of their life cycle.

5. EFFECTS OF THE ACTION

"Effects of the action" refers to the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that will be added to the environmental baseline. Direct effects are considered as immediate effects of the project on the species or its habitat. Indirect effects are those caused by the proposed action and are later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consultation. Both interrelated and interdependent activities are assessed by applying the “but-for test” which asks whether any action and its resulting impact would occur “but-for” the proposed Federal action.

“Insignificant effects” relate to the size of the impact and should never reach the scale where take occurs. “Discountable effects” are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

One important aspect of the analysis of project effects is the term of the proposed action. This BO authorizes incidental take for the remaining term of the existing Thompson Falls Project FERC license, which runs through December 31, 2025, or for approximately another 17 years. Multi-year impacts, aggregated over a long period of time, can be substantial. However, the implementation of the Reasonable and Prudent Measures and Terms and Conditions of this BO (see Incidental Take Statement) will substantially mitigate the historical loss of connectivity for bull trout due to the Project

5.1 Hydrograph Variation

Because there is a minimal amount of upstream storage capacity, the Clark Fork River at Thompson Falls is subject to a relatively predictable and recurring hydrograph pattern. As described in 1.1.1 (above) the annual hydrograph of the Clark Fork River normally ascends beginning between mid- and late March, peaks between late May and mid-June, and descends to base flow levels around mid-August. Plant capacity at the Project is approximately 23,000 cfs. River flow in excess of this amount is routed over the spillways. Typically, spill begins in late April, peaks in early June, and ends in mid-July. At this time, project operations do not consider bull trout and accompanying critical habitat

5.2 Upstream Passage

Dams built in the early and mid-1900s in the lower Clark Fork River prevented upstream migration of bull trout for nearly 100 years. Only recently have operators of hydroelectric facilities attempted to move fish upstream of these barriers.

According to the BA (FERC 2008a), at the Thompson Falls Project, local anglers have long reported trout concentrations during spring, below the dam. These reports prompted PPL Montana to install a small Denil ladder and fish trap at the left bank of the Project (looking downstream) of the Main Dam Spillway in 1999. This fish trap has collected a wide variety of fish, including an occasional bull trout, in the early spring, indicating that fish are attempting to migrate upstream past the Thompson Falls Project.

In 2001, a fish tracking study was conducted by PPL Montana and MFWP. Bull, rainbow, and cutthroat trout were captured by angling or in a fish trap downstream of the Main Dam Spillway, then radio tagged and transported upstream of Thompson Falls Dam. All three species showed significant upstream movements into potential spawning tributaries (Table 7). Bull trout (n=2) moved an average of 16.5 miles (26.5 km) upstream of the dam. Cutthroat trout (n=13) moved an average of 30.3 miles (48.8 km) upstream of the dam, and rainbow trout (n=6) moved an average of 36.3 miles (58.4 km).

The two bull trout radio tagged in 2001 ascended the Thompson River. Total upstream movement averaged 16.5 miles (26.5 km). One bull trout was transported above the Thompson Falls Dam on April 11 and the other on June 1. Both bull trout moved upstream at an average rate of 0.19 miles (0.3 km) per day. It took between 86 and 92 days for the bull trout to reach their upstream-most location.

In addition to data collected by PPL Montana, a radio telemetry study was conducted by the CSKT in 1999. CSKT documented one bull trout, initially captured in the lower Flathead River downstream of Mission Creek in April 1999, moving downstream into Thompson Falls Reservoir in May 1999 (C. Barfoot, CSKT, personal communication, May 2002). Cutthroat trout that were radio tagged in the Flathead River were also documented moving downstream into the Clark Fork River near Quinn’s Hot Springs (upstream of the Project) over the winter (C. Barfoot, CSKT, personal communication, May 2002). These movements indicate the wide range trout utilize when barriers are not present.

All of these bull trout studies have shown how the presence of a barrier without passage can impair the ability of adult bull trout to reach natal streams and spawn. Based on these data, it has been concluded by PPL Montana in their BA (FERC 2008a) that the Thompson Falls Project has an adverse effect on bull trout by blocking the upstream movement of adult fish.

Table 7. Upstream movements of bull trout transported above Thompson Falls Dam, 2001. (Source: PPL Montana and MFWP unpublished file data)

Date captured	**Date last located**	**Days tracked**	**Date most upstream**	**Days to move upstream**	**Miles moved upstream**	**Rate moved upstream (km/day)**	**Tributary Selected**
11-Apr	3-Aug	114	6-Jul	86	15.8	0.3	Thompson R
1-Jun	5-Oct	127	31-Aug	92	17.1	0.3	Thompson R

5.2.1 Fishway

PPL Montana proposes to design, build, operate and maintain an adult fishway at the dam (FERC 2008a). After examining a number of alternatives, the proposed fishway design that was chosen is a full height pool and weir type fishway located on the right abutment of the main dam (FERC 2008a). The design incorporates a series of 48 pools, each 6-ft long x 5-ft wide x 4-ft deep (GEI Consultants 2007a). Approximately 6 cfs of flow will pass through a series of 2-ft wide notches, with an option to convert the notches to orifices should that prove beneficial to moving bull trout upstream. The ladder will incorporate an auxiliary water system (AWS) that will add diffused flow into the downstream ladder pools, creating a total discharge of up to 60 cfs at the entrance pool. A second AWS high velocity attraction jet will provide additional assistance in attracting fish to the ladder entrance. The design incorporates a sample loop adjacent to the upper ladder pools, allowing all fish to be either held or selectively passed.

Annual operating plans and investigations of methods for improving hydraulic conditions in the fishway collection channels, junction pools, and entrance pools will be guided by the TAC, under the policies and procedures outlined in the Thompson Falls MOU, the BA (FERC 2008a) and this BO. It is likely that a period of experimental testing and feedback will be required to determine the precise fishway ladder configuration and operational window of the proposed fish passage facility. The following discussion describes some of the complexities of that process.

The adult fishway facilities will be operated primarily during nonspill periods, roughly from about July1 to May 15 each year. Maintenance and dewatering of the adult fishway facilities should occur from December 1 to February 28. This timeframe is typically when bull trout would not be migrating in the mainstem Clark Fork River.

Bull trout generally display more assertive upstream migration behavior from March through the peak of the spring freshet in mid-June. Based on studies performed by PPL Montana (and described in the BA), after the peak of the hydrograph in mid-June, tagged bull trout and other tagged salmonids dropped downstream and generally left the project area. During non-spill operations, the current discharge at the spillway is approximately 100 cfs, due to leakage. Thus, it is proposed that attraction flow to the ladder would be defined as a percentage of the overall discharge at the spillway (100 cfs), as follows:

During non-spill operations in the spring (river flow less than 23,000 cfs), the fishway design entails the flexibility to discharge 6 cfs (ladder flow only, 6 percent of spill leakage flow), 24 cfs (ladder plus one auxiliary water flow pipeline, 24 percent of spill leakage flow), 42 cfs (ladder plus the other auxiliary water flow pipeline, 42 percent of spill leakage flow), 60 cfs (ladder plus both auxiliary water flow pipelines, 60 percent of spill leakage flow), or 80 cfs (high-velocity jet discharge plus 60 cfs attraction flow from ladder entrance, 80 percent of spill leakage flow). During non-spill, the NOAA/Service attraction water ratio of 5-10 percent of total discharge (total spill in this case) can be discharged to attract fish. Field experience will dictate the amount necessary to pass fish during non-spill operations, but there is operational flexibility to exceed guidelines. A high-velocity jet (HVJ) attraction feature (20 cfs and over 20 ft/sec velocity) has been added as a flexibility feature to attract fish that hold in the far-fishway tailwater zone out of the right quadrant of the Main Dam Spillway tailrace during non-spill operations.

During spill operations, the spill schedule will leave the right Main Dam Spillway near-field tailwater zone as the only suitable holding zone near the spillway apron. Fish behavioral studies described in the BA (FERC 2008a) show that upstream migrating fish are attracted to high-velocity discharges even though they may not be able to pass. If the HVJ is near a fishway entrance, experience has shown the fish will be attracted to, enter, and pass the fishway. Once fish detect and approach the HVJ, it is expected that they will move (along the outside of the HVJ perimeter) to the upstream jet discharge point, which is only a few feet from the new fishway high flow and low flow entrances where up to 60 cfs attraction is to be discharged at 8 ft/sec. It is expected that fish from the far-fishway tailwater zone will be more readily attracted to the near fishway tailwater zone by the HVJ (because of the higher velocity energy dissipation in the tailrace) than by the 60 cfs attraction jet at 8 ft/sec. Thus, the HVJ will augment attraction to the new fishway. HVJs are used at numerous fishway locations throughout the Northwest (S. Rainey, GEI Consultants, personal communication, 2008).

During spill operations, the Main Dam Spillway tailrace becomes highly turbulent, and tailwater elevation rises quickly. A spillway gate opening-closing sequence (spillway schedule) was developed to create tailrace hydraulic conditions suitable for fish holding at the upstream terminus and near the right bank Main Dam Spillway abutment, while increasing tailrace turbulence at the left and center Main Dam Spillway. The 2006 telemetry study’s primary objective was to see if tagged fish would enter the right bank near-fishway tailwater holding zone where they could detect, enter, and pass the new fishway. It was determined that fish did enter and hold in the right bank near-fishway tailwater zone (GEI Consultants 2007c). Thus, it was concluded (GEI Consultants 2007c, FERC 2008a) that fish would be able to detect and pass a right fishway that did not pass attraction discharge equaling the full 5-10 percent of spillway discharge.

During spill operations, the current ladder design has multiple attraction flow options that can be deployed: (1) up to 60 cfs discharged through the ladder entrance; (2) a 20 cfs HVJ with over 20 ft/sec discharge velocity, which is located next to the ladder entrances and will discharge parallel to the apron spring-point; and (3) a third attraction feature that does not route flow through the fishway, the adjacent spillway lift gates (233 cfs each). It is emphasized that not all attraction discharge needs to pass through the fishway to attract fish from the far-fishway tailwater zone to the near-fishway tailwater zone. If there is no spill and fish are not otherwise attracted to the right near-fishway area, a partially or fully opened spill gate(s) will certainly attract fish to this zone. Telemetry studies suggest many migrating fish will move around in the entire tailrace seeking an upstream route during the peak few weeks or months of their upstream migration. Therefore, it is expected that the same fish that found and entered the 2 cfs Denil ladder and trap below the Main Dam Spillway apron would also find and enter the new right bank fishway.

If the attraction flow from the fish entrance is assumed to be 60 cfs plus 20 cfs HVJ attraction discharge during spill operations (again, ignoring powerhouse discharge of up to 23,000 cfs, upstream of which fish move to approach the Main Dam Spillway), the percentage of attraction flow during a spill discharge of 10,000 cfs is 0.8 percent. But, as previously expressed, the spill schedule is designed to reduce the footprint of the location of optimum fish holding to the near field of the new right fishway. Therefore, it is not only the total discharge that is expected to attract fish to the new fishway near-tailwater zone, but the optimum tailwater holding zone hydraulic conditions associated with the above-referenced spill schedule. Coupled with aggressive searching forays demonstrated by migrating bull trout and other salmonid species during telemetry studies, it is expected that these fish will readily find the new fishway and pass it. If additional attraction water is required to attract fish into this zone, there is flexibility to open one or more spillway lift gates (233 cfs each) to attract fish into the near-fishway tailwater zone. With two spillway lift gates open (466 cfs) and a total of 80 cfs from the fishway and HVJ, the ratio of total attraction flow to spillway discharge is 546 cfs to 10,000 cfs, or 5.46 percent. With the spill discharge of 25,000 cfs, which is near the high design discharge for operation of the new ladder within criteria, operation of 80 cfs from the new fishway combined with 466 cfs from two opened spillway lift gates gives an attraction ratio of 646 cfs to 25,000 cfs, or 2.6 percent.

5.2.2 Fishway Considerations Specific to Bull Trout

Under the best of conditions operation of the adult fishway is likely to result in delays in upstream movement of adult bull trout, impeded upstream passage of juveniles and sub-adults, and injury or mortality of some fish due to contact with structures within the fishways and fallback. Fishways are also subject to maintenance activities, primarily December through February, and may include power-washing, scrubbing, and the use of detergents to remove aquatic vegetation. During this maintenance period, bull trout will be unable to move upstream to use seasonal habitats. This impairment of normal behavior and movement patterns likely affects foraging opportunities, use of cover, and other key aspects of their life history.

Direct effects to bull trout may include physical injury from contact with fishway structures. A number of indirect effects may stem from temporary fatigue, which may be a function of the length of the ladder and water velocity, including an increased susceptibility to predation, or a decreased ability to compete for cover or forage. In addition, increased susceptibility to infection caused by scale loss or non-lethal wounds incurred during fishway negotiation may also result. The Service will conservatively estimate all fish using adult fishways may incur some sub-lethal injury.

There is considerable uncertainty regarding the timing, efficiency, and effectiveness with which bull trout use of the adult fishway at the Thompson Falls Project will occur. Evidence of bull trout use at other hydropower facilities suggests a delay in migration. BioAnalysts, Inc. (2004) suggested additional time was required for migrating bull trout to pass Rocky Reach Dam. It is not clear, whether these bull trout required more time to find fishway entrances or whether these fish held up to take advantage of potential foraging opportunities in the tailrace. It is not known whether passage delay results in late arrival at spawning locations and subsequently decreased spawning success, higher rates of egg superimposition, or increased adult mortality. Bull trout use of the Thompson Falls fishway is expected to improve over time as more is learned about these variables and ways to improve operational efficiency are explored and implemented.

In 2003, NOAA concluded that small delays for listed steelhead and spring Chinook at Rocky Reach Dam and Rock Island Dam are compensated for by faster travel through the slower flowing reservoirs (NOAA 2003). In addition, NOAA also concluded that any delays that do occur are more likely to affect species that spawn soon after completing their migration (summer/fall-run Chinook salmon or sockeye salmon are more likely to be affected than those that hold in the rivers or streams for considerable periods of time prior to spawning). Lastly, NOAA wrote……. "the effect of delays passing the fishway on Permit Species is likely non-existent to very small. Passage times observed for radio-tagged bull trout are comparable to those found for anadromous salmonids and similar effects for bull trout should be expected (Service 2007).

While the Service considered NOAA's conclusion, it should be noted that the life history of the bull trout is quite different than salmon and steelhead. The frequency, timing and routes of upstream and downstream passage by bull trout are not well understood. This is particularly true of downstream passage. For example, subadult downstream passage may occur at any time, and the routes available are dependent on the time of year (e.g., considering flow, habitat access, temperature, etc.). From results of telemetry studies, adult bull trout are most likely to move downstream after spawning and re-enter the mainstem Clark Fork or downstream reservoirs in mid to late fall (BioAnalysts, Inc. 2004). Because Columbia River migratory bull trout are present in very low densities compared to other fish species, and they have relatively unpredictable migration behavior (especially subadults), effective study methods to evaluate downstream passage have not been developed (BioAnalysts, Inc. 2004).

5.2.3 PIT-tagging and Operation of the Sample Loop

As described in the proposed action (see 1.3.1, above) the upstream fishway will contain a sampling loop that will afford operators the opportunity to systematically evaluate the species, numbers, and condition as well as gather other accessory information on fish that ascend the fishway. All bull trout that are handled will receive passive integrated transponder (PIT) tags and PPL Montana proposes to use state of the art PIT-tag technology or other suitable study methods to obtain dam and project passage survival estimates, in accordance with procedures established and accepted by the TAC. These actions would entail the capture and handling of fish at their facilities.

5.2.4 Fishway Construction Process

Based upon information provided in the BA (FERC 2008a) and supplement (FERC 2008b), the following section highlights some important aspects of the construction process for the upstream fishway. It is anticipated that construction will commence in 2009. Staging and mobilization of materials will occur in the winter and spring of 2009 so that construction can begin immediately once the spring freshet is complete. The contractor will be responsible for developing the detailed construction plan. Construction would target early spring 2010 for completion of in-river work, prior to the beginning on the spring freshet. The entire project is expected to be completed by fall 2010.

PPL Montana provided FERC with a supplement to the original BE (filed 8/22/08), further detailing construction plans. This supplement (FERC 2008b) further details the timing of construction, describing in-river work including about 40 days of rock drilling and blasting) in 2009, with completion of the out-of-water portions of the fishway in 2010.

The ladder construction will require permits from the State of Montana and the U.S. Army Corps of Engineers. The contract will be let once initial permits are in place and the contractor will be responsible for actual construction-related permits. Applications for these permits will be made during 2008 and early 2009. These permits will require plans to control erosion and provide emergency response plans in the event of a fuel spill.

The fishway location is on the right bank of the main dam spillway. This bank is on an island. A bridge provides access to the island; however, load restrictions on the bridge (8,000 lbs/axle) will limit access to heavy equipment. Access to the right bank, across the bridge, is expected to be primarily for light equipment and eventually for fishway operations and maintenance.

Access to the construction site, as currently proposed, is anticipated to require a temporary construction road from the left bank of the main dam across the tailrace area (FERC 2008b). The temporary access road construction would require grading approximately 700 ft of boulders approximately 50 to 100 ft downstream of the main dam. Design criteria for the construction of this access road would require the contractor to utilize excavated native rock blasted from the fish ladder site, supplemented by washed gravel fill with a nominal rock size between 2 and 6 inches and maximum content of 3 percent fines. Approximately 150 to 500 cubic yards of imported fill would be required (FERC 2008b).

Temporary culverts will be required at the deeper sections of the crossing to pass leakage flow through the main dam stop logs and these must be graded so as to continue to allow free movement of fish upstream as well as down. However, it may not be practical to require the contractor to provide a culvert area large enough to pass flow from radial gate operation. Access to the tailwater would require cut and fill near the south abutment in an area that was disturbed during the installation of the 2 radial gates of the main dam. Native material from any excavations in this area would be used for fill of the ramp.

A large downstream portion of the existing log sluiceway will be demolished to provide room for the auxiliary water supply (AWS) stilling basin. Approximately 2100 cubic yards of material will be excavated (FERC 2008b). A detailed blasting plan will specify the types of explosives to be used and this plan will be subject to Service approval. No ammonium nitrate fuel oil mixtures will be permitted, in deference to water quality concerns.

The concrete of the sluiceway will be saw-cut vertically at a distance approximately 53 ft (downstream) from the centerline of the non-overflow section of the dam. Based on existing construction drawings and site observations, limited rebar reinforcing was used in the original construction. However, exposed rebar was observed in the invert of the sluiceway at the base of the structure. All concrete rubble, rebar, soil, fabric, vegetation, and debris will be removed from the tailrace area and disposed of offsite.

Because the access road and all bedding materials will consist of large washed rock and blasted native rock, with minimal contributions from fine material, the Service has determined that this material will not have a negative impact on bull trout or other native fish species and may be left in place to be naturally transported downstream during spring high water. This is discussed in greater detail in the effects section to follow.

A new exterior wall for the stilling basin will be constructed adjacent to the existing spillway apron. The wall will extend to 2,366 ft msl, the estimated tailwater elevation of the 10-year flood, and will be designed for a full unbalanced hydrostatic loading with the stilling basin empty and the forebay at the 10-year flood stage.

The construction of the actual fishway structure will be conducted mostly in the dry. A cofferdam will be constructed to provide a dewatered construction area and prevent sediment from entering the river from the construction site (FERC 2008b).

5.3 Downstream Passage

Much attention has been paid to downstream fish passage in the Columbia River system, which supports anadromous salmon and trout. Bull and cutthroat trout life histories in Montana differ from that of anadromous Pacific salmon in that they do not migrate to the ocean, they do not die after spawning, and both migratory and non-migratory life history patterns are expressed in some systems.

Therefore, the downstream passage issue is different for salmonids in Montana than for anadromous fish in the Columbia River. For anadromous fishes, outmigration of juveniles to the ocean is an obligatory component of the life history. Juveniles must successfully pass downstream through a hydropower system in order to survive to adulthood. Fishes in Montana often migrate, but they can also be non-migratory. In either case, they stay within the freshwater system and may never migrate to a large lake or reservoir. Trout in Montana do not die after spawning and can spawn more than once in a lifetime. Adults may move both upstream and downstream within a river system.

However, it is clear that where large inland lakes are connected to extensive interconnected upstream systems with adequate spawning and rearing habitat (as is the case with Lake Pend Oreille) the migratory life history form predominates. This is summarized in Chapter 3 of the Draft Bull Trout Recovery Plan (Service 2002), as follows:

> "Disruption of migratory corridors probably leads to the loss of the migratory life history form (Nelson 1999), and resident stocks living upstream of barriers are at an increased risk of extinction (Rieman and McIntyre 1993). Restoration of the migratory life history form is needed for the long-term persistence of bull trout in many portions of the upper Clark Fork River drainage.
>
> As dams were built, the migratory corridor for spawning bull trout was blocked. Reservoirs upstream of those dams were filled concurrently with chemical treatments being made for rehabilitation, further compounding the loss of bull trout (MBTSG 1996a). Dam construction isolated migratory fish from Lake Pend Oreille from their natal tributaries and created run-of-the-river reservoir habitats behind Cabinet Gorge, Noxon Rapids, and Thompson Falls Dams. The resulting reservoir habitats are not adequate substitutes for Lake Pend Oreille. Currently, the tributary spawning and rearing habitats still exist (although degraded), but foraging, migrating, and overwintering habitats for migratory adult and subadult fish have changed significantly. Over time, the fish expressing the migratory life history pattern were largely replaced by fish that expressed the resident life form in the tributaries. These changes have occurred over a period dating back nearly a century (Thompson Falls Dam was built in 1913).
>
> The shift from larger, more migratory adfluvial populations to smaller, more isolated migratory and resident populations in the lower Clark Fork River has dramatically increased the likelihood of extirpation for a given stock (MBTSG 1996a). Resident bull trout are typically smaller in body size than their migratory counterparts. Because fecundity is related to size, the migratory strategy can confer an adaptive strategy by increasing reproductive potential. In productive environments, migratory forms should dominate resident forms and should be more resilient and more resistant to environmental variation and stressors (Rieman and McIntyre 1993). In addition, migratory fish are more likely to stray between streams than resident fish, a behavior that provides for genetic exchange and higher chances of refounding locally extinct populations. In their study of demographic requirements for bull trout, Rieman and McIntyre (1993) concluded that maintenance of the migratory life history form is necessary for the long-term survival of the species."

Until recently, there have been limited efforts to provide downstream passage of adult salmonids through the Columbia River hydropower system, and even less effort to provide downstream passage at hydropower projects in Montana.

There are limited data pertaining to the effects of run-of-the-river dams on inland fisheries (Cada and Sale 1993). A comprehensive study regarding adult bull trout movement in the mid-Columbia River hydropower system was conducted from 2001 to 2004. Seventy-nine bull trout were tagged from 2001 to 2002 on the mid-Columbia River to study the operational effects of multiple hydropower projects on adult bull trout (BioAnalysts, Inc. 2004). Of 79 tagged bull trout tracked from 2001 to 2003, eight individuals moved downstream after exiting the fishways at Rocky Reach Dam and Wells Dam. However, 11 total downstream events were documented, thus indicating multiple upstream and downstream passages. For example, the five downstream passage events documented in 2002 at Rocky Reach Dam were undertaken by three individuals. The downstream route was not obtainable for each event, but both spillway and turbine passage were documented. No fish were significantly harmed during their downstream movements (BioAnalysts, Inc. 2004; RRBTMP 2006). Researchers concluded that the operations of the hydropower projects on the mid-Columbia River do not negatively affect adult bull trout survival (BioAnalysts, Inc. 2004).

Avista, owner and operator of the two dams (Cabinet Gorge and Noxon Rapids) on the Clark Fork River downstream of Thompson Falls, is involved in a trap-and-haul fish passage program for bull trout. Adult bull trout are captured downstream of Cabinet Gorge Dam and, depending on the results of genetics testing that is conducted to determine their likely natal stream, the fish are released upstream of either Cabinet Gorge Dam, Noxon Rapids Dam, or Thompson Falls Dam. Many of these fish are radio tagged and their movements tracked. Lockard et al. (2004) report that 15 transported adult bull trout passed back downstream through Cabinet Gorge Dam. While the fate of all 15 of these fish has not been documented, at least eight have been recaptured and, therefore, survived passage through the dam (Lockard et al. 2004).

At this time there are no site-specific data to indicate the degree to which the Thompson Falls Project is an impediment to downstream passage of adult bull trout. Neither of the two bull trout that were passed upstream over Thompson Falls Dam in 2001 as part of the PPL Montana radio telemetry study is known to have returned downstream past the dam. However, it should be noted that fish were tracked for an average of 100 days during the 2001 radio telemetry study. Some radio tagged fish may have moved downstream past the dam after the batteries died in the radios. For example, one of the radio tagged bull trout was last tracked on August 3, 2001, before the start of the bull trout spawning season and well before downstream post-spawning movements would be expected to occur (PPL Montana unpublished data).

No site-specific information on the timing of juvenile bull trout outmigration through Thompson Falls Reservoir is available. In other areas of the lower Clark Fork River drainage, bull trout seem to have a bimodal outmigration pattern. Downstream of the Project in the Bull River, juvenile bull trout outmigrate in the spring (approximately between March and July) and with rain events in the fall (October and November). In Fishtrap Creek and West Fork Thompson River, tributaries to the Thompson River, the spring pattern is unknown, but outmigration in the fall generally occurs with rain events from the end of September through early November (L. Katzman, MFWP, personal communication, July 2002; Liermann 2003).

In 2004, Avista captured 84 juvenile bull trout (less than 300 mm) moving downstream in the East Fork Bull River. Although a few of these fish were collected in the spring (April and May), most were collected between July and October. September had the highest number of outmigrating juvenile bull trout (n=16). Recent studies in Trestle Creek, tributary of Lake Pend Oreille in Idaho, also found two pulses of outmigration for bull trout. The timing of the pulses again was spring (April through June) and fall (September through November). The two pulses accounted for 92 to 93 percent of the total outmigrants sampled in the April to November time period (C. Downs, Idaho Department of Fish and Game, personal communication, November 2002).

Further upstream in the middle Clark Fork River, juvenile bull trout have been found to pass downstream through Milltown Reservoir during a relatively short window during high water in May. This migration has been detected through monitoring of the stomach contents of northern pike in the Milltown Reservoir (Schmetterling 2001). Therefore, juvenile bull trout moving downstream through Thompson Falls Reservoir could conceivably be entering Thompson Falls Reservoir before, during, or after the spill season.

Reservoirs often provide good habitat for predators, creating hazards to downstream migrating fishes. Several native and nonnative predacious species are found in Thompson Falls Reservoir. Several of these species, most notably northern pike, are better adapted to slow moving, shallow weedy habitats, such as those found in Thompson Falls Reservoir, than they are to fast moving rivers. Therefore, it can reasonably be assumed that the creation of the reservoir enhanced the habitat for predacious fishes and consequently, increased the risks to migrating bull trout.

In 2005, 2006, and 2007 a total of ten gill nets were set each October by PPL Montana and MFWP to identify the fish species composition in Thompson Falls Reservoir. Over the years, a total of ten species have been observed, including potential nonnative predators in northern pike, largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), yellow perch (*Perca flavescens*), pumpkinseed (*Lepomis gibbosus*), and black bullhead (*Ameiurus melas*). Native northern pikeminnow (*Ptychocheilus oregonensis*), largescale sucker (*Catostomus macrocheilus*), and peamouth (*Mylocheilus caurinus*) also occur, but no salmonids have been detected. Black bullhead and northern pike have dominated the gill net samples representing between 44 and 72 percent, and between 15 and 23 percent of the fish captured from 2005 to 2007, respectively. Overall, species composition has been similar between years, with bullhead and northern pike the predominant species, followed by yellow perch and largescale suckers.

Schmetterling (2001) sampled northern pike stomachs from Milltown Reservoir to determine seasonal food habits. Milltown Reservoir, located 156 miles upstream of Thompson Falls Dam on the Clark Fork River, provided similar spawning and rearing habitat for northern pike to Thompson Falls Reservoir prior to the breaching of the dam, in 2008. During three sampling events in 2000, representing early spring (March 8 – March 24), high water (May 3- May 17), and late fall (October 17 – November 6) Schmetterling collected stomachs from 57, 56, and 84 northern pike, respectively. Bull trout were not found in the early and late samples, but bull trout were the single most abundant species collected from northern pike stomachs in mid-May during high water. Between May 6 and May 15, nine of 24 stomachs (38%) contained bull trout and westslope cutthroat trout were also common. Schmetterling concluded that northern pike were opportunistic fish predators and could have seasonally important impacts on downstream migrating juvenile bull trout and westslope cutthroat trout.

The extent to which pike and other predator fish are feeding on bull trout in Thompson Falls Reservoir is unknown. Because previous sampling has been limited in scope and represents only a single season (fall) it provides an incomplete picture of the distribution, food habits, and abundance of fishes in the reservoir. Therefore the potential impact of the Project on downstream migrating salmonids remains high, but cannot be adequately assessed or quantified at this time.

5.3.1 Downstream Passage through the Powerhouse

Passage of fish through the turbines poses risks of direct (immediate) mortality from mechanically induced injuries such as blade strike or mortality induced from such forces as shear, cavitation, turbulence, or high pressure gradients (Cada 2001; Coutant and Whitney 2000). Indirect (delayed) effects of turbine passage include physiological stress, disorientation, and increased susceptibility to predation (Coutant and Whitney 2000). Indirect injuries may result in damage to the immune system or other protective systems; and subsequent death from these types of injuries is not easily correlated with turbine-passage (Pavlov et al. 2002). There are no studies in the published literature to document turbine impacts on bull trout, specifically, though the above generalities are likely to apply.

Downstream fish passage through spillways is generally considered to be less risky than passage through turbines. There are anecdotal data, though no strictly quantitative studies, that indicate both juvenile and adult bull trout may pass downstream through turbines without suffering mortality (see e.g., Lockard et al. 2004). However, spillway passage can also result in physical injury to fish and indirect mortality. Generic fish mortality is considered to be typically zero to two percent for standard spill bays and five to 15 percent for turbine passage, with Kaplan turbines generally at the lower end of this mortality range and Francis turbines generally greater (Whitney et al. 1997).

5.3.2 Turbine Operations

According to the BA (FERC 2008a), there are no site-specific data on fish survival during downstream passage at Thompson Falls Dam. The turbine/generator configuration in the old powerhouse consists of six similar Francis units (Units 1-6) rated at 5 Mw each, each with hydraulic capacities of 1,700 cfs and a total turbine capacity of 10,200 cfs. The Francis runners are 11 ft (3.4 m) in diameter, have 13 buckets, and rotate at a speed of 100 revolutions per minute (rpm). The wicket gate at the old powerhouse is 4 ft (1.2 m) tall and has a spacing of 14 inches when fully open (Bonnes, PPL Montana, personal communication, November 18, 2002).

The new powerhouse is immediately upstream of the old powerhouse, and has one large 62 Mw Kaplan turbine (Unit 7) with a capacity of approximately 13,000 cfs. Unit 7 is among the most modern design of Kaplan-type turbines with four adjustable blades. The runner is large, 262 inches (28 ft or 8.5 m) in diameter, and it rotates at a speed of 94.7

rpm. The wicket gate at the new powerhouse is 8.5 ft (2.6 m) tall and has a 36-inch spacing when fully open.

Operational scenarios may be altered depending on the time of year and flow rates (W. Beckman, PPL Montana, personal communication, December 2006). When total river discharge is less than 23,000 cfs, the new powerhouse is preferentially operated to maximize peak efficiency of the Project, with between 50 and 70 percent of the river flow typically going through Unit 7. Two Francis units, typically Unit 1 and Unit 3, operate as auxiliary power to Unit 7 to maintain heat in the old powerhouse and to exercise these other units during low flows. Generally, Units 2, 4, 5, and 6 are operated at high flows, as they are the least efficient and smallest units at the Project.

New governors exist on the newest units (Units 1, 3, and 7) and these units are automated to maintain constant reservoir elevation during normal run-of-river operations. During peaking operations, the plant is operated at full gate for the number of hours that will enable the reservoir to refill within a 24-hour period and stay within the restricted headwater elevations of 2,393 to 2,397 ft msl. The powerhouse intakes at the old powerhouse are about 16 ft square and the invert is about 35 ft below the forebay surface elevation. The top of the intake is about 20 ft below the surface. The intakes are guarded by a steel trash rack with openings of 2-5/8 inches between the bars in the old powerhouse and 5-1/2 inch spacing in the new powerhouse.

Kaplan units are significantly safer for fish than Francis-type turbines (Franke et al. 1997). The differences may be related to the fact that Francis units spin faster and have more blades and more confined hydraulic passages compared to Kaplan turbines. Francis-type turbines could be made safer for fish by increasing the clearance between the wicket gate blades and the runner blades (Monten 1985).

Data for downstream fish passage survival through Francis turbines at this Project are not available. However, data collected at six other hydroelectric facilities using Francis-type units similar to the old powerhouse are presented (see Table 6 in BA). The turbine passage survival at these comparable projects varied from 61 percent to 98 percent among the different tests on mostly salmonids ranging in size from 110 to 317 mm. The Thompson Falls Project is most similar to EJ West in configuration, thus, fish passage survival is expected to be in the 65 to 96 percent range.

Fish survival estimates from other projects using similar Kaplan units to the one installed in the new powerhouse at the Thompson Falls Project are presented (see Table 7 of the BA; FERC 2008a). The range of survival found in these studies for salmonids ranged from 86 to 100 percent. The runner speed at Thompson Falls is quite low compared to many other comparable units, but the blade tips travel at comparable speeds due to the large radius. At 61 ft of operating head and with the large diameter, the Thompson Falls Kaplan unit is more similar to projects in the Columbia River Basin like Big Cliff, than to projects in the mid-west or east coast where heads are relatively lower. The large size of the Kaplan unit means much larger hydraulic openings for water and fish. The trash bar openings are 5-1/2 inches compared to the 2-5/8 inch openings of the old powerhouse.

The wicket gates have 3-ft by 8.5-ft-wide openings compared to 14-inch by 4-ft-wide openings in the old powerhouse Francis unit. The Kaplan unit is a modern, high-efficiency unit with adjustable blades and a relatively flat efficiency curve over the entire range of operation discharges. The Kaplan unit can operate from 10 Mw to 50 Mw.

In the past it was generally believed that units with higher efficiencies were more fish friendly than units with lower efficiencies because loss of efficiency is usually accompanied by turbulence and cavitation, factors known to injure fish (Bell 1991). Inefficient turbine operation is a result of a poor blade-to-wicket gate relationship, where efficiency drops due to turbulence that results from the rotating machinery (hub and blades) being misaligned with the hydraulic flow field coming off the stationary but adjustable wicket gates. However, a statistical relationship between turbine efficiency and fish survival has not been observed (Ferguson et al. 2005).

5.3.3 Spillway Operations

Based on information presented in the BA, the Project is operated as a daily peaking power facility about four months of the year and as a run-of-the-river facility during the high flow and winter months. When river discharge exceeds the combined hydraulic capacity of both powerhouses (23,000 cfs), the two tainter gates enable automatic spill operations up to 10,000 cfs each. The tainter gates have openings 41-ft wide and 14-ft high when fully opened. As the runoff proceeds, 4-ft by 8-ft spillway panels on the east side (toward the left bank) of the Main Dam Spillway are removed for additional spill capacity. As flows increase, more panels are removed to balance flows across the length of the Main Dam Spillway spill section until all 228 panels have been removed. In most years, when the peak flood discharge is less than 70,000 cfs, spill is restricted to the Main Dam Spillway section. If flows exceed 70,000 cfs, there are 72 Dry Channel Dam spill panels (each 4-ft by 8-ft) available to increase spill capacity. Operation of the Dry Channel Spillway occurs infrequently according to PPL Montana dam operators.

Thompson Falls Dam is an intermediate-high head dam (61 ft) that should have relatively high survival for fish passing the dam via spill. However, observations by GEI of spill at Thompson Falls during the 2002 runoff suggest hydraulically violent conditions exist at some locations more than others, at least during high flow events (Figure 4). Spill over the Dry Channel Dam passes via a complex set of downstream rapids and much of the energy is dissipated against the rocky substrate for a distance of up to 400 ft depending on location of passage. Survival over this spillway is unknown. Bickford and Skalski (2000) noted that the spillways in the Columbia River with survival less than 100 percent contained exposed rebar, pitted concrete, or exposed rocks. The Thompson Falls Project spillway contains exposed steel I-beams and large boulders. Thus, it would be reasonable to assume that survival could be less than 100 percent.

Currently, juvenile salmonids must pass Thompson Falls Dam either through either turbines or the spillway. There are currently no juvenile passage facilities operating at Thompson Falls Dam and no water is passed specifically to enhance downstream salmonid passage. However, because the Thompson Falls Project is a complicated site, it may be important to better understand whether downstream migrating juvenile bull trout preferentially pass through the project on the right bank (through the powerhouse) or the left bank (through spill) and how those patterns may change at various flows. An evaluation of juvenile bull trout movement patterns could be conducted by releasing marked fish upstream of the dam and tracking their movement through the project.

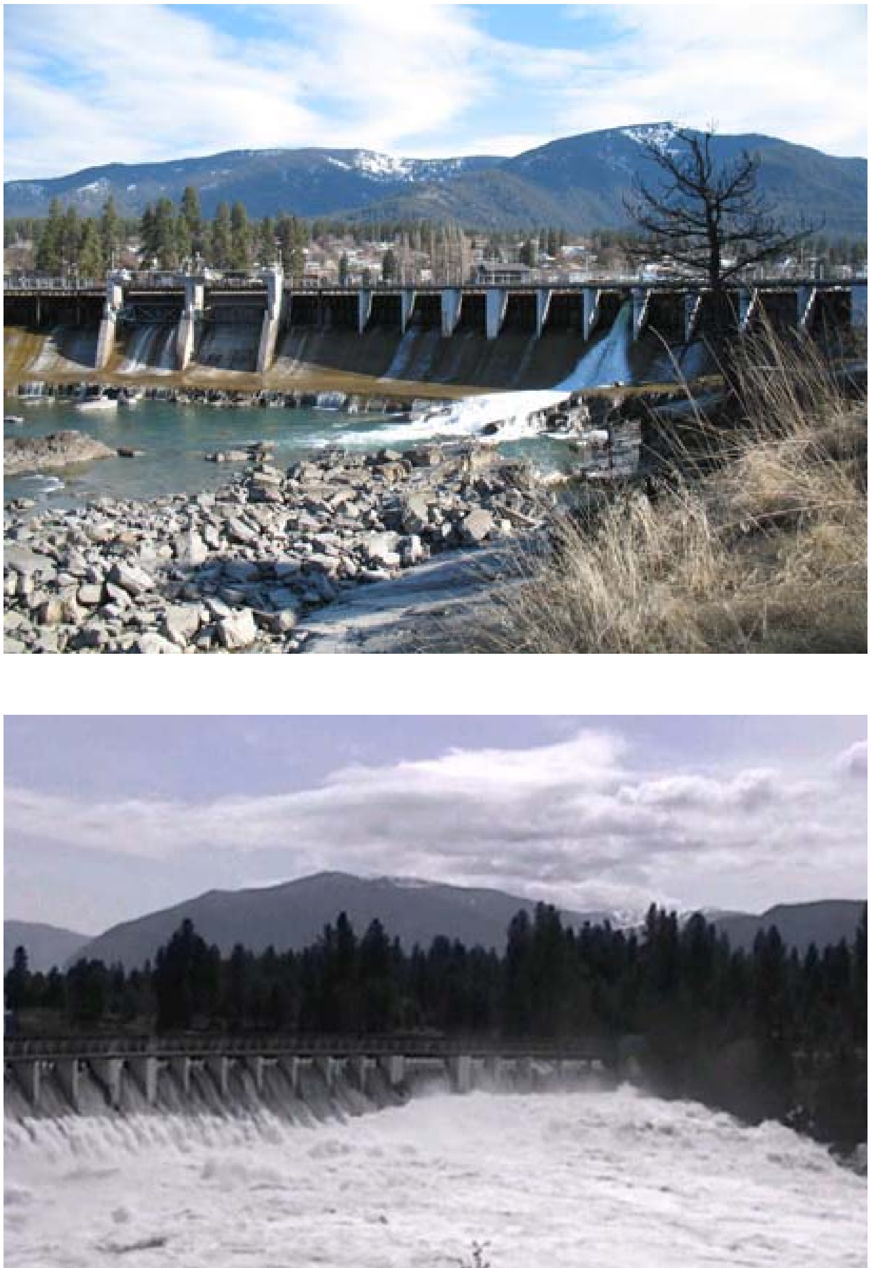


Figure 4. Photos of Main Dam Spillway at Thompson Falls at low flow (upper photo from left bank; March 20, 2006) and high flow (lower photo from right bank; June 10, 2002, total river flow approximately 77,000 cfs).

5.4 Water Quality

5.4.1 Total Dissolved Gas (TDG)

Spill at hydroelectric dams usually increases downstream TDG levels, and occurs when river discharge exceeds turbine hydraulic capacity. Since no additional flow can pass the Project's turbines, it must pass over the spillway. Since the height of the dam typically provides much of the energy head for generation of power, spillway flow transfers much of that potential energy to the spillway tailrace, where turbulence dissipates that excess energy. As spill discharge passes into the spillway tailrace, it typically plunges into a deep armored stilling basin, designed with enough volume to dissipate energy for the maximum design flood discharge. The intent is to confine energy dissipation in the armored zone, so that erosion does not scour and undermine the spillway or other dam features, leading to potential structural failure. As spill plunges into a deep spillway stilling basin, a turbulent energy dissipation zone is created, characterized by unsteady flow and high shear forces. Vertical circulation cells often take turbulence aeration to depth, where hydrostatic pressure collapses bubbles, forcing them into solution and elevating TDG levels (gas absorption).

However, at Thompson Falls Dam there is no formal spillway stilling basin because the spillway is built on bedrock, so erosion and scour are not a concern. This configuration reduces entrainment of TDG, but does not eliminate it.

TDG supersaturation is an unstable condition, and if the river channel downstream of a spillway is sufficiently wide and shallow, and with an enough hydraulic gradient, channel boundary roughness will force flow to "tumble" in a manner where there is increased water surface exposure of ambient air conditions. Where this kind of open-channel flow conditions occur, TDG levels rapidly drop back to near the stable, 100 percent saturation level in less than a mile (distance varies from site to site).

However, if there is a reservoir backed up to near the powerhouse tailrace, as at Thompson Falls, the normal river gradient is reduced and the flow regime becomes more stable. Lower reservoir velocities result in less turbulence, and elevated TDG levels are locked in after entering the impoundment. If there are elevated wind levels, enough shear can be created to induce the vertical circulation necessary to reduce TDG levels in the reservoir. Otherwise, the elevated reservoir TDG levels wane slowly and on the basis of delayed replenishment by lower level TDG inflows.

Montana Water Quality Standards limit TDG to 110 percent of saturation. This standard is meant to protect aquatic life, which can experience GBT when water is supersaturated. It has been shown that excessive TDG results in embolisms and the appearance of tiny gas bubbles in fish tissues, resulting in elevated mortality rates.

The monitoring of TDG at Thompson Falls Dam has been carried out annually since 2003. Table 8 (updated from Table 9 in the BA, per F. Pickett, PPL Montana, personal communication, September 2008) is a summary of the maximum flows and the maximum levels of TDG measured during the years of this monitoring program. Monitoring of TDG downstream of the Thompson Falls Project indicates that TDG levels can exceed 110 percent during spill. Gas bubble trauma (GBT) to fish has not been documented at the Thompson Falls Project, based on observations to date (see 1.3.3.1, above).

Table 8. Thompson Falls Total Dissolved Gas Monitoring Results Summary. (Updated from BA Table 9; FERC 2008a).

PARAMETER	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Daily Average Annual Peak Flow (cfs)	70,130	41,750	69,687	79,013	49,410	79,484
Median Peak Flow (cfs) during 1960-2005	73,200	73,200	73,200	73,200	73,200	73,200
Daily Average Annual Peak Flow (cfs) as % of 1960-2005 Median	96	57	95	108	68	109
Daily Average Annual Peak Spill (cfs)	48,120	18,690	48,539	56,853	23,955	56,292
Spill Period (days)	79	63	69	95	91	74
Above Dam Max Dissolved Gas (TDG %)	106.4	106.1	107.6	107.2	105.8	106.6
200m Below Dam - Max Dissolved Gas - TDG% (Above Natural Falls)		111.5				
At Bottom of Dam Log Chute - Max Dissolved Gas - TDG% (Above Natural Falls)						119.4
High Bridge Max Dissolved Gas (TDG%)		113.8	120.5	123.6	118.5	
Birdland Bay Bridge Max Dissolved Gas (TDG%)	114.1	108.5	115.1	117.0	112.2	118.1

With reference to the State of Montana water quality standards, Thompson Falls Dam is regulated under water quality regulations for water impoundments operating prior to July 1971, as follows (2006 Administrative Rules of Montana, Sub Chapter 6, Water Quality Standards):

> 17.30.602 DEFINITIONS
>
> (19) "Naturally occurring" means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been applied. Conditions resulting from the reasonable operation of dams in existence as of July 1, 1971, are natural.
>
> 17.30.636 GENERAL OPERATION STANDARDS

> (1) Owners and operators of water impoundments that cause conditions harmful to prescribed beneficial uses of state water shall demonstrate to the satisfaction of the department that continued operations will be done in the best practicable manner to minimize harmful effects.

According to the BA (FERC 2008a), these data may indicate that elevated TDG levels downstream of the Project are, in part, a result of water plunging at Thompson Falls, a natural river feature downstream of the Main Dam Spillway. PPL Montana has consistently maintained that the Project may actually reduce TDG levels at low to moderate spill levels, in comparison to the pre-Project condition. This is because the Project routes approximately 23,000 cfs through both powerhouses. Water passing through the turbines is slightly de-gassed by about two percent, so outflow from the powerhouse has lower levels of TDG than water in the forebay. Prior to Project construction, this water would have passed over Thompson Falls, increasing flow over the falls and TDG levels if the natural falls are indeed a source of gas entrainment. At high levels of spill, perhaps above about 50,000 cfs, TDG is likely increased by the Project in comparison to the pre-Project condition. A more detailed explanation of these conclusions, and the rationale for them, is provided in Appendix A of the BA (FERC 2008a).

The Service neither accepts nor refutes these conclusions. To our knowledge, there is not sufficient empirical data regarding the effects of TDG on bull trout, specifically at other locations, to draw appropriate inferences to this Project. However, we do conclude there is insufficient empirical evidence to prove that the natural configuration of Thompson Falls was a major contributor to gas entrainment. Further, it is not clear how much of the flow of the Clark Fork River passed down the left channel and over the main falls and what proportion took other paths at various streamflow levels (see Figure 2). For those reasons, and due to the critical level of uncertainty, we believe PPL Montana must continue to remain engaged to solve TDG problems caused by the Thompson Falls project, including potential efforts to degas the Clark Fork River downstream of the Project, if determined necessary by Montana DEQ and other regulatory entities.

There is concern that modifying spillway operation to enhance fish passage may slightly increase TDG at higher levels of spill. Only two years of data documenting TDG under the modified spillway operation are available, so there is some uncertainty about this conclusion. Further experimentation may be warranted to minimize TDG levels while attempting to maximize fish passage efficiency.

5.4.2 Water Temperature

As Thompson Falls Dam is essentially a low-head facility and thermal stratification is not known to occur upstream of the dam, the stream temperatures downstream of the dam are about the same as upstream (see section 5.3.2 in the BA). Thermograph data collected from March through November 2007 illustrate stream temperatures increasing into the summer months with peak temperatures (greater than 75°F) occurring in July (BA Figure 8; FERC 2008a). There was less than 1 degree of variation between temperatures recorded below and above the Thompson Falls Dam (BA Figure 9; FERC 2008a). The largest deviation in stream temperatures (approximately ±0.80 degrees) occurred in July when maximum stream and air temperatures were the warmest. Throughout the season monitored (March through November), stream temperatures at the two thermograph sites provided similar trends (BA Figure 8; FERC 2008a).

Peak river temperatures at the project coincided with peak air temperatures measured in Thompson Falls, Montana (BA Figure 10; FERC 2008a). July 2007 was the warmest month of the summer with maximum air temperatures ranging from 84 °F to 105°F. During this same period, daytime stream temperatures ranged from approximately 70 °F to 77°F.

As previously described, daily maximum stream temperatures in excess of 15° C (59° F) typically limit distribution of juvenile bull trout in tributary streams. Selong et al. (2001) found juvenile bull trout survival in a laboratory setting was limited by prolonged exposure to water temperatures above 20° C (68° F) and they predicted an ultimate upper incipient lethal temperature (where prolonged exposure leads to death) for juvenile bull trout of 20.9° C. They stated that temperatures above 15-16° C (59-61° F) were unlikely to be suitable for long-term survival. It would appear, based on the 2007 data set, that the Clark Fork River upstream and downstream of the Project exceeds about 60° F for a period of about 3 months (mid-June to mid-September) and may exceed the upper incipient lethal temperature of 21° C (70° F) during much of July and August. Under such conditions, bull trout will typically move sporadically, often during cooler periods, and "hole up" in areas of coldwater thermal refugia during periods of peak temperature. Such coldwater thermal refugia in the mainstem typically occur at the confluence of groundwater fed tributaries. This behavior has been observed in radio tagged adult bull trout in the mainstem Clark Fork (L. Knotek, MFWP, personal communication, June 2008). Less is known about the behavior of juvenile bull trout during such periods.

The Service is not aware that the temperature profile of Thompson Falls Reservoir has been adequately investigated. We believe it's important to better understand the consequences of potential coldwater refugia (e.g., Fishtrap Creek, Prospect Creek) and the thermal profile and patterns in the reservoir as it relates to potential migratory movements of bull trout, both juvenile and adult.

5.5 Effects of the Proposed Action, by Project Element

Both adverse and beneficial effects to the bull trout are anticipated with implementation of the proposed action. Short-term and minor adverse impacts will result from the fishway construction process. Long-term beneficial effects to bull trout within the Lower Clark Fork Core Area and extending upstream to the Middle and Upper Clark Fork, Bitterroot River, Blackfoot River, and Rock Creek core areas are expected in conjunction with the implementation of fish passage and to a lesser degree with upstream habitat restoration actions (mitigation for downstream passage) funded by Project funds.

This section will characterize the effects of the action by Project element, focusing on population-based effects. The Matrix analysis will focus on the habitat-based effects. In order to quantify the effects of the action, we estimated the population likely to be affected in the mainstem Clark Fork, the location where most of the Project effects are anticipated to occur (see the Environmental Baseline). In addition, we have estimated, to the degree possible, where bull trout likely to pass the Project may have originated. This estimate was derived primarily from limited radio-telemetry information and genetic relationships between populations suggesting varying degrees of relatedness. This provides important context for the significance of the effects of the action to bull trout. Effects to a large, resilient population are less severe than effects to a small population that is not resilient when evaluating the Project impacts in terms of the reproduction, numbers, or distribution of bull trout. This is especially true when considering the remaining 17-year term of the FERC license for this Project, which may have a large influence on the survival and recovery of the species in the Clark Fork Basin.

Some potential adverse effects from the Thompson Falls Project, primarily to adult or juvenile bull trout using the mainstem Clark Fork River as a migratory corridor, are expected to continue; these effects include:

1. **Delayed or Deferred Spawning** by bull trout that are not able to access and ascend the ladder in a timely and efficient manner or fall back and resort to spawning in nonnatal waters.

2. **Turbine Entrainment and Spillway Operations** that lead to injury or death of juveniles or adults passing through the Project.

3. **Gas Supersaturation** at the Project or exacerbated by the Project and passed downstream that may cause lethal or sublethal impacts to staging bull trout or their prey; either at the Project or at downstream locations, especially during periods of spill.

4. **Predation Effects** including those caused by injury to bull trout from the Project (e.g., 1-3, above) that may weakens their ability to escape predation as well as effects of the Project that lead to increased predator populations as a result of changes to habitat.

5. **Effects of Fishway Construction** include short-term impacts to water quality (sediment) and temporary disruption of free movement of bull trout immediately downstream of the dam due to construction and maintenance of the haul road.

6. **Reduced Access to Thermal Refugia** as a result of the Project limiting easy upstream or downstream access to cold water refugia during periods of summer heat stress.

7. **Migratory Delay or Interruption** as a result of the Project creating slower water in Thompson Falls Reservoir which may delay expedient downstream

migration of juvenile bull trout from Thompson River and other upstream locations.

8. **Sampling and Monitoring** of the Fishway and associated Project activities.

All of these potential adverse impacts may have a variety of effects to individuals of numerous bull trout local populations (see Table 4). In addition, each of these local populations has different levels of resiliency to endure these effects and thus have differential risks regarding their persistence.

5.5.1 Method of Calculation For Quantifying Downstream Impacts

In order to estimate overall survival for downstream trout passage through the Project, the following assumptions were made:

- Spillway effectiveness (proportion of fish passing the project via spill compared to the proportion of water spilled) is 1:1, so fish will pass the Project in numbers proportional to flow. That is, if 50 percent of the flow is through the spillway, then 50 percent of the fish will pass over the spillway. This assumption may be in error if bull trout, especially from the Thompson River, preferentially migrate along the right bank where the natural flow of Thompson River outflow likely passes. In addition, bull trout are substrate-oriented fish and may be less likely than anadromous smolts to pass the Project via spill, according to the BA.

- Fish will also pass the two powerhouses in proportion to flow.

- Survival estimates are assumed: Kaplan 94 percent, Francis 85 percent, and Spillway 98 percent.

The Spillway survival estimate of 98 percent was based on Ferguson et al. (2005), who noted that fish survival through spillways can be very high (near 1.00) and is often higher than turbine or bypass system survival when spill passage conditions are optimal. However, as noted previously, survival through spillways with deflectors or shallow basins or exposed rocks and rebar can be considerably less (Bickford and Skalski 2000).

Based on the comparison between fish survival at similar projects with Francis-type turbines in (BA Table 6; FERC 2008a) the survival estimate of 85 percent was selected to represent survival through the Francis turbines at Thompson Falls Project. The 94 percent survival estimates for the Project’s Kaplan unit in the new powerhouse was also based on the comparison of projects with similar Kaplan turbines. Overall survival by month was calculated and based on the bulleted assumptions above (Table 9). Downstream fish passage survival at Thompson Falls Project is estimated to be approximately 91 to 94 percent.

Table 9. Immediate Downstream Fish Passage Survival Estimates at Thompson Falls Dam Project (from BA).

Month	Monthly mean Flow *(cfs)	% Flow Kaplan	% Flow Francis	% Flow Spillway	Estimated % Survival
January	12,155	70.0	30.0	0.0	91.3
February	12,043	70.0	30.0	0.0	91.3
March	12,201	70.0	30.0	0.0	91.3
April	20,026	70.0	30.0	0.0	91.3
May	45,406	28.6	22.0	49.3	94.0
June	55,403	23.5	18.0	58.5	94.7
July	25,987	50.0	38.5	11.5	91.0
August	11,239	70.0	30.0	0.0	91.3
September	9,811	70.0	30.0	0.0	91.3
October	10,696	70.0	30.0	0.0	91.3
November	11,647	70.0	30.0	0.0	91.3
December	12,264	70.0	30.0	0.0	91.3

5.5.2 Rationale for Estimating Numbers of Juvenile and Adult Bull Trout Passing Annually Through the Project

Juvenile or subadult bull trout entering the Thompson Falls Project Boundary may originate from populations in the action area upstream of Thompson Falls Dam, which includes most of the Clark Fork River Basin in western Montana incorporating major portions of 5 bull trout core areas that form the interconnected upper Clark Fork basin (Middle and Upper Clark Fork; Bitterroot River, Blackfoot River, and Rock Creek). Fish from these core areas have the potential to move of their own volition downstream of the dam and would be unable to return for spawning purposes. For purposes of this analysis we have considered that bull trout originating from the West Fork Bitterroot River core area upstream of Painted Rocks Dam (see map in Appendix, Fig A-2), from the Clearwater River and Lakes core area, and from local populations associated with McDonald Lake, Mission Reservoir, and St. Marys Reservoir (Post, Mission, and Dry Creek local populations in the headwaters of Mission Creek) are not considered in this analysis as bull trout from those locations would be considered unlikely or unable to migrate downstream beyond the confines of core area waters which provide adfluvial habitat. Consequently, these areas are not included in the action area.

For bull trout originating from the action area upstream of the Lower Clark Fork Core Area (Upper Clark Fork, Middle Clark Fork, Bitterroot River, Blackfoot River, and Rock Creek core areas), the location of spawning habitat and suitability of fluvial habitat downstream of the spawning habitat may be one of the biggest factors in determining the likelihood of migration downstream through Thompson Falls Dam.

The five connected core areas upstream of Thompson Falls Dam include at least 54 streams known to support local populations of spawning and rearing bull trout (see Table

4). Bull trout redds are routinely counted in portions of about 30 of those stream systems, representing a significant portion, but not all of the known spawning. In 2005-2007, an average of 361 migratory bull trout spawning redds (range 343-387) were counted in portions of the five upstream core areas in the action area, partitioned as follows: Upper Clark Fork (8-29), Middle Clark Fork (61-70), Bitterroot River (35-58), Blackfoot River (117-135), and Rock Creek (60-123). In arriving at an estimate of impacts from the project, we make a series of assumptions. Brunson (1952), examined fecundity of 28 mature female bull trout collected at the mouth of Prospect Creek and the Bull River in August 1950. He found a strong relationship between female size and fecundity amongst 28 females, with fecundity ranging from 1,337 eggs in the smallest (17.9 inch female) to 8,845 eggs in the largest (29.1 inch female), and an average of 4,927 eggs per female; an average of 962 (+/-114) eggs per pound of female. Based on this, we have assumed that each redd contained a round average of about 4,000 eggs (approximate for a 5 pound female, given that not all eggs are typically expelled and not all that are expelled are successfully buried in the redd). Shepard et al. (1984) found that egg survival is strongly dependent on sediment levels, and it is also known to be influenced by substrate stability, water temperature, and groundwater inflow. We assumed, rather conservatively based on these multiple variables that 30% of the eggs survived to hatching (4,000 X .3 = 1,200). Juvenile survival rates and age at emigration can also be highly variable (see e.g., Pratt 1992, Downs et al. 2006). We assumed that 5% of the hatching fry survived to migrate downstream as age 1,2, 3, or 4 juvenile fish (1,200 X .05 = 60). Historically, most of the bull trout in the Clark Fork River system were known to be migratory, with the majority of juveniles likely emigrating to Lake Pend Oreille (Pratt and Huston 1993). We assumed that 1-5 % of the juvenile bull trout produced from redds in the upstream systems (Upper Clark Fork Middle Clark Fork, Bitterroot, Blackfoot, and Rock Creek) would potentially pass downstream of Thompson Falls Dam (60 X .01-.05 = 0.6-3.0). Compiling all of those assumed parameters, and acknowledging a great deal of uncertainty but also employing a rather conservative approach to this analysis, 361 bull trout redds in portions of the five upstream core areas in the action area could account for (361 X 0.6-3.0) = 217- 1,083 juvenile bull trout migrating from upstream core areas through Thompson Falls Dam. We reiterate that we believe these values to be conservative. In addition, upstream redd counts probably represent only half or less of total spawning. For example, no redd counts occur in nearly half of the identified local populations and those local populations where counts do occur are typically not fully enumerated.

For the portion of the Lower Clark Fork Core Area, which the Project occurs in and including local populations most directly upstream of Thompson Falls Dam, the number of redds counted in the recent past (2005-2007) were 36-42 annually in the Thompson River system and unknown numbers in the Jocko River system. In this system, due to the nature of the substrate, past efforts to count redds have not proven successful (C. Barfoot, CSKT, personal communication, August 2008). Given the proximity of the Thompson River and Jocko River local populations to the Project, we conservatively estimate that at least 10 % and perhaps 25 % or more of the juvenile bull trout from those systems would naturally migrate downstream through Thompson Falls Dam. Applying similar formulas as above to the fish from these two local populations, we extrapolate that an average of 39 redds in the Thompson River would produce approximately 234 (4,000 X .3 X.05 X

.10 X 39) to 585 (4,000 X .3 X .05 X .25 X 39) juvenile bull trout from the Thompson River to migrate downstream through Thompson Falls Dam. The number coming from the Jocko River system is likely lower, but not readily calculable without redd counts. For purposes of this exercise we will assume that the ratio of adult bull trout captured downstream of Cabinet Gorge Dam and assigned to Thompson River (n = 48) and the Jocko River (n = 1) is an indicator of the relative proportions of migrants from the two systems. Dividing the Thompson River estimate by 48, we conclude that only 5 to 12 juvenile bull trout from the Jocko River emigrate through the project annually.

5.5.2.1 Juvenile Abundance

Juvenile bull trout abundance estimates for the Thompson and Jocko River systems provide additional support for these determinations. In 2004-2006, the CSKT (C. Barfoot, CSKT, personal communication, August 2008) evaluated fish distribution and relative abundance in the upper Jocko River drainage (North, Middle and South Forks) by conducting systematic electrofishing surveys in 33 unique and spatially diverse 152 m (500 foot) sampling reaches. Densities of juvenile bull were generally too low to obtain valid estimates, but bull trout were detected at 7/11 sampling stations in the North Fork Jocko River, and 14/15 sampling stations in the South Fork Jocko River. No bull trout were detected at the seven stations sampled in the Middle Fork Jocko River. Bull trout captured were largely juveniles or small residents, except for a 538 mm TL fish captured in the North Fork Jocko River during 2004 that was likely a fluvial migrant.

Assuming a relatively high capture efficiency of 35 percent (e.g., Peterson et al. 2004) from one-pass electrofishing, CSKT estimated that there were on average about 17 bull trout in each 500 foot (152 meter) sample section over the 10 mile (16 km) length of habitat occupied by bull trout in the South Fork Jocko River and 13 bull trout in each 500 foot sample section over the 4.3 mile (7 km) length of habitat occupied by bull trout in the North Fork Jocko River. Expansion of these estimates is somewhat speculative, but would indicate there were roughly 2,000 or more bull trout residing in the Jocko River headwaters. With improved connectivity and habitat conditions in the Jocko drainage, which the CSKT is systematically providing through mitigation funding, it is not unreasonable to suggest several hundred juvenile bull trout migrants from this system could eventually pass downstream into the Clark Fork, with an unknown portion of those migrating through the Thompson Falls Project and some fish going as far as Lake Pend Oreille.

Similarly, expansion of juvenile bull trout population estimates conducted in the West Fork Thompson River and Fishtrap Creek (including Jungle Creek) led to the conclusion that the Thompson River drainage currently supports about 2,800 juvenile (age 1 and older) bull trout (Jon Hanson, MFWP, personal communication, August 2008). Expansion was based on extrapolating average density over 2006-2007, from two 328-foot (100m) sites in each of those streams to the known extent of available habitat. This would infer that approximately 10 to 20 percent of the juvenile bull trout found in the Thompson River drainage (our estimate based on redd counts, earlier in 5.5.2 was 234 to 585 fish) migrate downstream through Thompson Falls Dam annually, which seems like a reasonable assumption.

5.5.2.2 Summary

In summary then, developing a conservative estimate based on the above rationale, we estimate approximately 217 to 1,083 juvenile bull trout from the five upper Clark Fork core areas, and 239 to 597 bull trout from the Thompson and Jocko Rivers could pass the project annually in downstream migration. In rough numbers, we add these and use an estimate of approximately 456 to 1,680 juvenile bull trout annually, passing through the Project on downstream migration, as the basis for estimating the impacts of the Project.

Compared to major bull trout tributaries located downstream of Thompson Falls Dam (Cabinet Gorge Reservoir tributaries), where the Avista project has conducted intensive annual outmigrant trapping and population abundance studies, the estimated number of outmigrant bull trout potentially passing Thompson Falls Dam from upstream sources appears reasonable. In 2005-2007, estimated total numbers of outmigrant juvenile bull trout from local spawning tributaries were generally in the range of a few hundred (e.g., 300 to 800) for each of four major tributaries (E. Fork Bull River, Rock Creek, Vermilion River, and Graves Creek) and totaled roughly 1,000 to 2,000 outmigrants combined for each of those years (Bernall and Lockard 2008)

Genetic assignment testing of 83 adult bull trout captured downstream of Cabinet Gorge Dam (Table 5) that were assigned to local populations upstream of Thompson Falls Dam indicated approximately 59% originated in the Thompson and Jocko (Lower Clark Fork core area) and the other 41% originated form upstream core areas. This is close to the proportions we have calculated at the lower end of our estimate, with 239/456 fish (52%) from the Thompson and Jocko and the remaining 217/456 (48%) from upriver.

Juvenile bull trout that migrate downstream from core areas within the Clark Fork watershed will most likely take up residence to mature in one of the four downstream bodies of water, Thompson Falls Reservoir, Noxon Reservoir, Cabinet Gorge Reservoir, or Lake Pend Oreille. Unquantifiable, but varying rates of survival would be expected in those reservoirs due to suitability of the habitat. The portion the emigrating fish that go to Lake Pend Oreille are subject to additional mortality from passage through all three dams. Genetic sampling of bull trout captured below Cabinet Gorge, Noxon Rapids, and Thompson Falls Dams has been used to establish a high likelihood that some of these fish are more closely related to numerous upstream Clark Fork River tributary stocks than to stocks present in Lake Pend Oreille, Cabinet Gorge, or Noxon Reservoir tributaries. The sample from downstream of Cabinet Gorge is large enough to draw inferences about relative upstream contributions at this time (see below). We do not have quantitative estimates of the number of fish currently returning to the base of either Cabinet Gorge or Noxon Rapids Dam, though the Avista project is working to refine their techniques in order to potentially produce such estimates in the future (L. Lockard, Service, personal communication, August 2008). Pratt and Huston (1993) estimated the historic bull trout migration up the Clark Fork River from Lake Pend Oreille was roughly 2,000 fish past the site of Cabinet Gorge Dam.

Bernall and Lockard (2008) reported that genetic assignments have been conducted on 20 adult bull trout captured in 2001 through 2007, during migration in tributary streams to Cabinet Gorge Reservoir. These are fish that apparently lived and matured in the reservoir (not transported from downstream). Of the 20 samples, 65% (13 fish) assigned back to Cabinet Gorge Reservoir tributaries, 20% (4 fish) assigned to tributaries from Noxon Reservoir immediately upstream and thus were apparently washed through or over Noxon Rapids Dam and were unable to return. The remaining 15% (three fish) assigned to tributaries upstream of Thompson Falls Dam and thus would be fish likely to pass through a Thompson Falls fishway.

Additionally, Bernall and Lockard (2008) reported 41 adult bull trout samples were collected from tributaries to Noxon Reservoir. Genetic assignment indicated 59% (24 fish) originated from tributaries to Noxon Reservoir and the other 41% (17 fish) were from tributaries upstream of Thompson Falls Dam. Again, the fish in this latter category would have been likely candidates to pass through a Thompson Falls fishway. In either case, the samples probably underestimate the proportion of upstream migrants that are actually present in the reservoirs because they do not include fish that would be likely to congregate at the base of the dam and failing passage may abort spawning efforts.

We acknowledge there is a great deal of uncertainty in these estimates. What is certain is that historically, prior to the construction of Milltown Dam (1906-1907) and Thompson Falls Dam (1913) on the mainstem Clark Fork River substantial numbers of adult bull trout from Lake Pend Oreille migrated through the project area bound for upstream spawning locations and likely thousands or tens of thousands of juvenile bull trout migrated downstream past the Project to the lower Clark Fork River and Lake Pend Oreille. The importance of treating this system for bull trout as a single interconnected entity and not a sum of disconnected individual parts cannot be overstated. Ultimately, timely and efficient passage upstream and downstream from Lake Pend Oreille to the connected core areas of the upper Clark Fork river drainage holds the strongest promise for bull trout recovery. Since the development of the four mainstem projects (Milltown, Thompson Falls, Noxon Rapids, and Cabinet Gorge) there has been nearly a century of selection against these upriver spawning stocks, and yet they persist against fairly long odds. By systematically restoring this migratory connectivity, a substantial but yet-to-be determined migratory component is expected to be restored.

Estimation of adult numbers of bull trout in the Project and Action Areas is equally, if not more challenging. The Avista project has captured an average of 38 adult bull trout per year at the base of Cabinet Gorge Dam since 2001 (S. Bernall, Avista, personal communication, February 2008). Based on percentages from genetic assignment testing, approximately 12 of those adult bull trout (31% of the total), on average, were upriver fish headed to local populations upstream of Thompson Falls Dam. An unknown numbers of bull trout from Lake Pend Oreille could not be captured, due to inefficiency of the capture methods.

We previously noted (see section 4.2.2, spawning surveys) that 2007 redd counts in tributaries to Cabinet Gorge Reservoir (n = 16) and Noxon Reservoir (n = 58) expanded by a standard factor of 3.2 adults per redd would indicate a minimum adult population of 51 bull trout in Cabinet Gorge Reservoir and 186 adults in Noxon Reservoir. If even 10% of the adult populations are comprised of upriver stocks (an estimate we believe could be conservative), then free and open passage may provide 5 adult migrants from Cabinet Gorge and 19 adult migrants from Noxon Reservoir passing through the Thompson Falls Project annually. At minimum then, we estimate a total of 36 adult bull trout (12 fish from Lake Pend Oreille, 5 from Cabinet Gorge Reservoir, and 19 from Noxon Reservoir) are currently stopped by the three dams from migrating through the Thompson Falls project boundary.

In the reach of the Clark Fork River upstream of Thompson Falls Dam (Lower and Middle Clark Fork core areas) densities of adult fluvial bull trout have averaged approximately 2 fish per mile in recent years (L. Knotek, MFWP, personal communication, July 2008). There are approximately 57 miles of the Clark Fork impounded by Cabinet Gorge and Noxon Rapids Dams. At an average of 2 adult bull trout per mile, the fluvial component alone could include approximately 114 adult bull trout, not accounting for adfluvial fish from Lake Pend Oreille, which historically was believed to account for the majority of migratory fish in the system and may have numbered in the thousands. It should be noted that current numbers are a reflection of the already seriously reduced status of the migratory run of bull trout in the Clark Fork. Recovered numbers could be several times greater than what we are currently projecting.

5.6 Significance of the Effects of the Action on Bull Trout

The findings presented below are based, in part, on applying “A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Scale” (Service 1999b). Under this approach, the effects of the proposed action have been evaluated in the context of considering the existing condition of affected bull trout populations (and critical habitat) in the action area with respect to the following Matrix pathways: population characteristics; water quality; habitat access; habitat elements; channel conditions and dynamics; flow/hydrology; and watershed conditions. The final Matrix pathway is integration, designed to aggregate the effects of the proposed action by Project element and informing the section 7(a)(2) analysis. The proximity, distribution, timing (duration, frequency), type, intensity, and severity of effects caused by the proposed action are also considered in determining the degree of effect resulting from implementation of the proposed Federal action (Service and NMFS 1998).

The analysis of Project effects on the bull trout using the Matrix is presented and summarized in Table 10. Note that the Matrix was developed before the draft *Bull Trout Recovery Plan*, and so the Matrix uses the term “subpopulation.” For the purpose of using the Matrix in this consultation, the Service considers the term “subpopulation” to be analogous with “local population”.

As summarized in Table 10, some Matrix pathways are impacted to a greater degree than others by the Project elements. In particular, the population characteristics pathway (e.g., population size, growth and survival, life history diversity and isolation, and persistence and genetic integrity) are impacted by all project elements and the water quality pathway (e.g., temperature, sediment, and chemical contaminants and nutrients) are impacted by nearly all project elements. The habitat access pathway (e.g., physical barriers) is moderately impacted, with some Project elements affecting fish passage to some degree. The hydrographic variation project element is one of the few Project elements that affects all Matrix pathways, and all but one risk ranking is high. The following summarizes the effects of action grouped by Matrix pathways.

5.6.1 Population Characteristics

The following summarizes the population-based effects described in section 5.1.2. Overall, the effects of the action are anticipated to kill and injure both adult and juvenile or sub-adult bull trout. These fish are anticipated to originate from the Lower Clark Fork core area as well as 5 upstream core areas (Middle and Upper Clark Fork; Bitterroot River, Blackfoot River, and Rock Creek), and the significance of these effects depends in part on the resiliency of the local population(s) impacted annually and over the remaining 17-year term of the Project. Given the current status of bull trout in the action area, any losses to bull trout are of concern. In most of the affected core areas, the current status and trend of bull trout suggests either a decreasing population, or at best stability at low abundance. Beneficial effects of adult passage (in combination with passage at Milltown Dam and the Avista trap and transport program) are likely to contribute a net positive effect to the status and trend of bull trout. Although the proposed action is anticipated to affect relatively few fish, the potential benefit of passing a few large spawners is high.

Table 10. Overall Risk[1] of Thompson Falls Project Effects to Bull Trout by Selected Pathways of the Matrix.

Project Element	**Matrix Pathways**						
	Subpopulation Characteristics	Water Quality	Habitat Access	Habitat Elements	Channel Condition/ Dynamics	Flow/ Hydrology	Watershed Conditions
Turbine Operations	M	L					
Fishway Construction	L	L	L		L		
Adult Fishway Operation	BH		BH				
Spillway Operations	M	H					
Hydrograph Variation	L	L	L	L	L	L	M
Predation	M						
Project Habitat Fund[2]	L	L	L	M	L	L	L
Monitoring Plan[2]	L		L				

[1] – Risk of Project effects are qualitative estimates (high, moderate, and low) by the Service based on the proximity, distribution, timing (duration, frequency), type, intensity, and severity of effects caused by the proposed action. Beneficial Project Effects are preceded by a “B”.

[2] - Based on the information provided, there is insufficient information to evaluate the site-specific nature and magnitude of the potential effects of some Project elements. In these cases, the Service relied on best professional judgment and experience from past and current federal actions that are similar in nature to qualitatively estimate the degree of effect.

5.6.2 Water Quality

The primary mechanism of the effects to the water quality pathway are related to temperature increases due to impounding water and reducing velocity and gas supersaturation due to spillway operations. These impacts were analyzed in detail in section 5.1.2 as they relate to population effects. Other water quality degradation may occur due to mitigation activities proposed under the Project habitat fund. These future efforts may require individual State or Corps permits, so impacts can be assessed and minimized at that time. In addition, some temporary introduction of sediment will occur during construction of the fishway, but the nature of the riverine habitat downstream of Thompson Falls Dam precludes spawning at that location and the impacts to rearing and migration of bull trout will be minimal due to the timing, limited scope and location of sediment introduction.

The overall effect of the action is to likely maintain existing degraded water quality in the mainstem Clark Fork. In the tributaries, the overall effect of the action (i.e., monitoring and habitat fund Project elements) is the potential for low to moderate short-term degradation of water quality at the project scale if actions such as streambank stabilization or channel restoration occur, but in most cases providing long-term habitat improvement.

5.6.3 Habitat Access

The primary effect of the proposed action, following construction of a fishway, is a major beneficial effect on habitat access by allowing volitional movement of bull trout upstream past the Project. Seasonal closure of the fishway can temporarily isolate upstream habitat, returning the system to the current condition. Juvenile and sub-adult bull trout are also expected to be beneficially impacted, although it's unknown how often and how successfully nonadult bull trout will use the ladder. The effects of reducing the existing isolation of bull trout by providing fishway operations were previously described in section 5.1.2. Degraded water quality, especially high summer water temperatures and supersaturated gases during spill may create temporary thermal or chemical barriers, reducing effectiveness of the ladder and access to the mainstem Clark Fork River. The overall effect of the action is to maintain an improved, but still degraded condition for habitat access. In the tributaries, the overall effect of the action (i.e., habitat fund Project elements) is likely to maintain degraded habitat access. However, some habitat fund activities may improve habitat access at a localized scale.

5.6.4 Habitat Elements

A number of habitat elements are impacted by hydrographic variation and the impoundment of the Clark Fork River. Large woody debris has been decreased due to the fluctuations in river levels and removal at the dams for Project maintenance. Riparian vegetation composition, vigor, and mortality has been reduced along reservoirs, compared to natural channels. Pool frequency and quality, especially primary pools, have also been inundated by the Project and maintained by hydrographic variation. Off-channel habitat has also been reduced in quality and access due to fluctuating river levels and overall channel simplification. Coldwater refugia have likely been altered or even eliminated at the mouths of certain tributaries due to impoundment. The impoundments have generally not provided sufficient amounts of deep, cold water and other attributes to replace lost access to habitat in Lake Pend Oreille. Future habitat fund projects and monitoring may also affect habitat elements, potentially to net benefit, but little information was provided to assess these effects.

5.6.5 Channel Condition/Dynamics

Hydrographic variation has likely resulted in an overall change in wetted width/maximum depth ratio, increasing this ratio and overall water depth (especially in the mainstem Clark Fork impoundments) and altered channel dynamics at the confluence and lower portions of tributaries. While increased water depth is generally beneficial to bull trout, it is accompanied with slower water, warmer temperatures, simplified habitat conditions, and other habitat degradation. Streambank condition is also impacted, primarily by the fluctuations in pool/river level. Effects can stem from direct bank erosion, but also impacts to the condition and extent of riparian vegetation, which, if degraded, can lead to additional stream bank instability. Floodplain connectivity is also impacted by hydrographic variation, reducing hydrologic connectivity between off-channel habitat, wetlands, and riparian areas. In addition, the extent of wetlands has likely been reduced and riparian vegetation and succession have been altered significantly. However, some habitat fund activities may improve channel conditions and dynamics to some degree at a localized scale.

5.6.6 Flow/Hydrology

As a run of the river Project, hydrographic variation at the Thompson Falls Project has resulted in only a minor amount of hydrographic change from hydropower generation. The overall effect of the action is to likely maintain degraded flow and hydrology conditions in the mainstem Clark Fork.

5.6.7 Watershed Conditions

Hydrographic variation has resulted in substantial effects to the condition of the watershed condition. The disturbance history in the action area has been altered by substantial changes to the hydrograph due to impoundment, hydropower generation, degraded riparian areas, and nearly a century of fire suppression. This has contributed to the impairment of a number of ecosystem processes that support habitats used by bull trout. The natural disturbance regime in terms of floods and fires has departed substantially from its historic properly functioning condition. This likely contributes to an overall watershed condition of poor quality, little resiliency, and limitations to habitat for migratory bull trout in the long term.

5.6.8 Integration

The last step of the Matrix analysis is integration, which is a summary of the effects of the action. Overall, bull trout are anticipated to originate from the Lower Clark Fork Core Area where the Project is located as well as five upstream core areas and all will be exposed to the effects of one or more Project elements. The significance of the population effects depends in part on the resiliency of the local populations within the four core areas impacted annually and the overall beneficial effects of gradually restored connectivity occurring throughout the Clark Fork system over the 17-year term remaining for the Project FERC license. Negative Project effects are likely to contribute to maintaining the core areas in depressed condition, which may result in an increased risk of extirpation due to stochastic events. There will be limited and short-term negative impacts to juvenile bull trout as a result of fishway construction. However, the potential benefit of providing upstream fish passage will significantly offset any limited negative effects. Although the proposed action is anticipated to affect relatively few fish, the potential benefit of restoring upstream access for even a few spawners is significant.

Habitat effects in the mainstem Columbia FMO are anticipated to maintain a degraded condition, with the most severe effects expected to occur to water quality, habitat access, and to a lesser extent multiple habitat indicators associated with hydrographic variation (Table 10). In the tributaries, the overall effect of the action (i.e., monitoring, and habitat fund Project elements) is the potential for low to moderate improvement in the conditions of some indicators at a localized scale, but are unlikely to change the overall ranking of a pathway at the core area scale.

5.7 Effects of the Action on Bull Trout Critical Habitat

Since the Project itself is not located in critical habitat, minimal impacts to critical habitat are associated with the ongoing operation of the Project. However, the lower reaches of Prospect Creek are designated as critical habitat. The confluence of Prospect Creek with the Clark Fork River is immediately downstream of the Project's spillways.

Construction of the fishway, proposed as a conservation measure for the Project's impact to upstream fish passage, may add a minimal level of fine sediment to the Clark Fork River during the construction period. Most of the sediment that will enter the Clark Fork River as a result of fishway construction will be deposited immediately downstream, in the upper reaches of Noxon Reservoir. However, some portion of this sediment may be temporarily deposited at the mouth of Prospect Creek. It is anticipated that this sediment deposition would be flushed during the next high river flow. Any impacts would be limited to a very small area, at the mouth of Prospect Creek, and a short time period (primarily during placement or removal) and would not affect any of the PCEs associated with spawning and rearing habitat further upstream in Prospect Creek.

It should be noted that the PCE for bull trout critical habitat that is related to sediment calls for substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. This should include a minimal amount of fine substrate less than 0.25 inch (0.63 centimeter) in diameter. The mouth of Prospect Creek is not a bull trout spawning area. Bull trout migrate up Prospect Creek to spawn, rather than using the area near the mouth. Therefore, sediment deposition at the mouth of the stream is unlikely to have any impact on egg and embryo survival, overwinter survival, fry emergence, or young-of-the-year and juvenile survival.

Other important bull trout Critical Habitat in the lower Clark Fork Core Area within the Action Area occurs in the lower reaches of the Thompson River and upper reaches of the

Jocko River, upstream of the Project. Since the proposed action will not materially modify the hydrograph or operational regime of Thompson Falls Reservoir, no effect on the PCEs in the Thompson River or Jocko River is anticipated.

The benefits of constructing the fishway (providing volitional upstream adult fish passage) would be long-term and would potentially benefit populations of bull trout throughout the Clark Fork River drainage, including those in Prospect Creek, the Thompson River, and the Jocko River.

Implementation of future actions conducted under the Project habitat fund and monitoring Project elements proposed have the potential to adversely affect all eight PCEs. Effects are likely to be site-specific, with the potential to affect PCE 1 (temperature), 2 (stream channel complexity), 3 (substrate), 4 (hydrograph), and 6 (migratory corridor). It is anticipated that both minor adverse and beneficial effects will result from these activities, although adverse effects in both the short- and long-term may potentially occur before the beneficial effects are realized. At the critical habitat unit scale, the effects of the action to the habitat conditions or PCEs are anticipated to be quite low since most of the bull trout migratory corridors and important local populations in the upper Clark Fork are not designated critical habitat.

Habitat restoration projects are expected to benefit the bull trout in the long-term, in spite of any short-term adverse effects that occur. Although many of these actions are ongoing and are reasonably certain to continue, they may in rare instances result in the injury or death of bull trout. There is insufficient information at present to evaluate the site-specific nature, timing, duration, frequency, and magnitude of potential effects, let alone which core areas or local populations of bull trout may be affected.

The Service will continue to actively participate in the TAC, overseeing fish monitoring and habitat restoration activities. Some methodologies can be substantial in their impact, involving gill nets or physical features that may temporarily impair or preclude fish passage. Monitoring can vary in the effects to bull trout, ranging from negligible to severe impacts depending on the activity. Based on the information provided to the Service in this consultation, there is insufficient information to evaluate the site-specific nature, timing, duration, frequency, and magnitude of the potential effects from implementation of monitoring plans, including which core areas or local populations of bull trout may be affected.

6. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

As the human population in western Montana continues to grow, residential growth and demand for dispersed and developed recreation is likely to occur. This trend is likely to result in increasing habitat degradation from road construction, bank stabilization, and development on private lands. Since most of the private lands in the Clark Fork basin are concentrated in valley bottoms and along stream corridors, these problems are exacerbated. These activities tend to remove riparian vegetation, deplete stream flow, disrupt fish migration, disconnect rivers from their floodplains, interrupt groundwater-surface water interactions, reduce stream shade (and increase stream temperature), reduce off-channel rearing habitat, and reduce the opportunity for large woody debris recruitment. Each subsequent action by itself may have only a small incremental effect, but taken together they may have a substantive effect that would further degrade the watershed's condition and resiliency, and undermine efforts to improve the habitat conditions necessary for listed species to survive and recover.

Watershed assessments and other education programs may reduce these adverse effects by continuing to raise public awareness about the potentially detrimental effects of residential development and recreation on salmonid habitats and by presenting ways in which a growing human population and healthy fish populations can co-exist. For this description of cumulative effects, the Service assumes that future non-Federal activities in the area of the proposed action will continue into the immediate future at present or increased intensities. Accordingly, these actions will contribute to maintenance of at risk and non-functioning habitat indicators in the action area.

Cumulative effects from a variety of activities are likely to adversely affect the bull trout and the PCEs of bull trout critical habitat. These actions include, but are not limited to, industrial and residential development, road construction and maintenance, mining, forest activities, agriculture and grazing, and fire management. Impacts from these activities have the potential to degrade PCEs 1, 2, 3, 4, 5, 6, and 7 within the Action Area. Water storage facilities and future dams for irrigation are likely to adversely affect PCE 8.

7. CONCLUSION

Conservation measures described in the BA (FERC 2008a) will reduce, but not totally eliminate, impacts of the Project. The Thompson Falls Project is currently adversely affecting bull trout. Conservation measures to be implemented through collaboration between PPL Montana and the Service, MFWP, and the CSKT, are described in the BA (FERC 2008a) and a signed Thompson Falls Project MOU (FERC 2008a).

7.1 Bull Trout

After reviewing the current status of the bull trout, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's Biological Opinion that the action, as proposed, is not likely to jeopardize the continued existence of the bull trout. We reached this conclusion for the following reasons:

1. The environmental baseline for the action area indicates that although bull trout are widely distributed, abundance is generally low and productivity highly variable. The overall status and trend in the Lower Clark Fork core area may show a slight improvement in population size, largely due to concentrated efforts of the Avista Program and CSKT to restore habitat and connectivity. However, the core area status remains at some level of elevated risk. Habitat conditions are highly variable across the action area, but generally increase in quality when moving upstream into tributaries, particularly in the Blackfoot River. The mainstem Clark Fork River is highly altered and summer water temperatures are perilously high to support bull trout, yet the river does provide key FMO habitat and remains functional due to the presence of functioning bull trout habitat at the mouths of numerous coldwater tributaries.

2. The effect of the action is likely to result in the injury and death of adult and juvenile or sub-adult bull trout, most of which originate from the Lower Clark Fork Core Area, but with contributions of migratory fish potentially originating from five additional upstream core areas as well. This includes direct mortality from turbine and spillway operations, delays in migratory behavior, and a variety of habitat-based effects related to hydrologic variation. Construction of a fishway will have short-term low-impact adverse effects during the construction period. Beneficial effects, however, include operation of the new fishway and partial funding of an offsite habitat restoration program. Overall, the proposed action provides unproven but potentially important connectivity between core areas, the key conservation role of the mainstem Clark Fork River, where the Project is located.

3. Cumulative effects are anticipated to maintain degraded conditions across the action area. Key issues include floodplain development and function, water quality and quantity, fish passage (connectivity), and habitat fragmentation.

4. Overall, the operation and maintenance of the Thompson Falls Project, per the FERC license, will not diminish the numbers, distribution, or reproduction of bull trout to a degree that will appreciably reduce the likelihood of survival and recovery of bull trout in the Columbia River interim recovery unit.

Incidental take of bull trout is reasonably certain to continue to occur, given that bull trout are known to occupy the action area. Incidental take may occur as a result of construction of the fishway, delayed or deferred passage, turbine operations, downstream passage, fishway passage, spillway operations, migratory interruption, hydrographic variation, and predator enhancement.

Based on the information provided, there was insufficient information to evaluate the site-specific nature and magnitude of the potential effects of offsite Project habitat restoration. So, while these Project elements were considered in this section 7(a)(2) analysis, the Service cannot issue incidental take for those Project elements at this time.

Future unrelated actions at this Project that may impact the threatened bull trout will potentially invoke additional section 7 consultation under the Act between the Service and PPL Montana, FERC's non-Federal designee. For those future actions that would enhance the propagation and survival of bull trout, PPL Montana may apply for a section 10(a)(1)(A) permit under the Act. Such actions should be identified in annual work plans.

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7.2 Bull Trout Critical Habitat

After reviewing the current status of bull trout critical habitat, the environmental baseline for the action area, the effects of the proposed relicensing action, and the cumulative effects, it is the Service's BO that the action, as proposed, is not likely to destroy or adversely modify bull trout critical habitat. We reached this conclusion for the following reasons:

1. The status of critical habitat is relatively unchanged since it was designated. Approximately 4,813 miles of critical habitat was designated in Oregon, Washington, Idaho, and Montana.

2. The environmental baseline for the PCEs of critical habitat in the Clark Fork River Basin (unit 2) is relatively unchanged since it was designated, with few significant consulted-upon effects. Although degraded, this critical habitat unit continues to function in the manner for which it was designated.

3. The effects of the action on bull trout critical habitat will be restricted to minor portions of designated habitat in the Clark Fork basin, and are anticipated to be affected primarily by habitat enhancement or restoration projects. Because these actions are designed to restore habitat conditions and ecosystem processes, only short-term degradation of the PCEs of designated critical habitat are anticipated. Long-term benefits and improvement of the habitat baseline may result due to enhancement of habitat PCEs.

4. Overall, the sum of the effects of the Thompson Falls Project will not appreciably diminish the value and function of designated critical habitat for the bull trout.

8. INCIDENTAL TAKE STATEMENT

Section 9 of the Act, and Federal regulations pursuant to section 4(d) of the Act, prohibit the take of endangered and threatened species, respectively without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by FERC so that they become binding conditions of any license(s) issued to the applicant for the exemption in section 7(o)(2) to apply. The FERC has a continuing duty to regulate the activity covered by this incidental take statement. If the FERC (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the FERC license, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FERC must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement.

8.1 Amount or Extent of Take

The Service expects that authorizing the issuance of a permit to PPL Montana for continuing operations of the Thompson Falls hydroelectric project in accordance with the proposed action, in compliance with the Endangered Species Act, is likely to result in incidental take of bull trout in the form of harm and harassment, including mortality. Because the Thompson Falls project is one of a series of projects on the mainstem Clark Fork River between its headwaters in Montana and the lower end of Lake Pend Oreille in Idaho (including, in downstream order Milltown Dam (recently removed), Thompson Falls Dam, Noxon Rapids Dam, Cabinet Gorge Dam, and Albeni Falls Dam) the effects of this proposed action and implications associated with incidental take of bull trout from the other projects are interrelated and not easily dissociated. For the Thompson Falls Project, the extent of each action that is anticipated to incidentally take bull trout, by Project Element, is estimated, as follows:

Anticipated Incidental Take of Upstream Migrant Adults through Delayed or Deferred Spawning. The Service concludes that blockage of spawning migrations by Thompson Falls Dam incidentally takes an estimated minimum of 19 adult bull trout per year (all originating from Noxon Reservoir; see 5.5.2, above) through disruption of normal breeding patterns, resulting in physical injury from failed migration attempts (e.g. jumping against the dam) and physiological stress caused by gonad resorption caused by prevention of spawning. If the 19 bull trout spawn below Thompson Falls Dam (e.g., nearest option is Prospect Creek), then incidental take of approximately 40,000 bull trout eggs (approximated as 4,000 eggs per female for each of 10 females if the sex ratio is 1:1) and unknown numbers of resulting juvenile bull trout will likely occur as a result of the fish being forced to attempt reproduction in non-natal tributaries not known to be capable of supporting additional juvenile bull trout rearing and survival.

Rationale: Bull trout are known for their strong fidelity to natal spawning streams, which means blocked migration routes to natal tributaries upstream of the dams likely result in failed reproduction through either uncompleted spawning attempts or forced spawning in nearby suboptimal habitat where egg or juvenile survival is likely to be low. If the alternative habitat is already fully seeded (e.g., Prospect Creek is the nearest option), then the addition of spawning fish diverted into these systems from blocked habitat upstream is essentially wasted and may also cause harm by disrupting the genetic structure of the natural population in the nonnatal receiving tributary.

The Avista researchers have captured a total of 266 adult sized bull trout below Cabinet Gorge Dam between 2001 and 2007. Of the 266 bull trout, 83 were identified, through genetic testing, as belonging to tributaries upstream of Thompson Falls Dam (aka Region 4; S. Bernall, Avista, personal communication, February 2008). Of the 83 bull trout assigned to natal tributaries upstream of Thompson Falls Dam, over half (59%) originated from the Thompson River and lower Flathead River drainage (see Table 5). The remaining bull trout (34 adults) represented local populations from upstream core areas in the Middle Clark Fork River drainage, Blackfoot River drainage, or Rock Creek (Table 5). Based on these data, 31% of the adult bull trout Avista captured downstream of Cabinet Gorge Dam would have volitionally passed upstream of Thompson Falls Dam, given the opportunity. However, since there is no fish passage facility at Cabinet Gorge or Noxon Rapids Dams a portion of these fish are currently being captured by various means and transported by vehicle above Thompson Falls Dam. Thus, their natural migratory pattern is not currently relevant to the Thompson Falls Project, except when they either (1) fall back over Thompson Falls Dam and are precluded from returning, or (2) spawn upstream and then drop over Thompson Falls Dam and take up residence in Noxon Reservoir, where they may be precluded from carrying out future spawning migrations to upstream natal tributaries. If volitional fish passage is eventually incorporated into Cabinet Gorge and Noxon Rapids Dams, the number of bull trout using the Thompson Falls fishway may increase dramatically.

In the meantime, adult bull trout that would benefit from the Thompson Falls fishway will be those adults from upstream local populations (Thompson and Jocko Rivers or other upstream core areas) that have matured in Noxon Reservoir. In 2008, two adult bull trout captured below Noxon Rapids Dam were genetically assigned to tributaries upstream of Thompson Falls Dam (Meadow Creek and Cedar Creek) (S. Bernall, Avista, personal communication, February 2008). We have assumed that a minimum of 10% of adult bull trout in Noxon Reservoir are from upstream populations.

After the fishway is constructed, a portion of the adult bull trout currently being adversely impacted in this fashion will be expected to use the ladder, experiencing much reduced adverse effects.

Anticipated Incidental Take of Downstream Migrant Juveniles or Adults through Physical Injury. The Service anticipates that 6 to 9 percent of the downstream migrants, or a total of about 27 to 151 juvenile bull trout, will be incidentally taken each year through physiological stress, physical injury, and death as a result of passing through turbines or spillway structures at Thompson Falls Dam.

Rationale: We concluded that roughly 456 to 1,680 juvenile bull trout originating from upstream local populations pass through the Thompson Falls project annually (see 5.5.2, above). Based on combined survival estimates for passage through the Francis turbines, the Kaplan turbine, and the spillway, PPL Montana calculated the average downstream passage survival at the Project for trout measuring greater than about 4 inches (100 mm) is likely 91 to 94 percent. Applying these percentages to the minimum and maximum number of migrants, we reach the conclusion that between 27 (456 X .06) to 151 (1,680 X .09) juvenile bull trout are adversely affected by physical injury due to passage. Some portion of downstream migrants destined for Lake Pend Oreille may pass through as many as three dams and for those fish the incidental take would be cumulative. If survival rates are similar at all three projects (unknown), then survival of fish passing from upriver local populations to Lake Pend Oreille would be approximately 75 to 83 percent.

For the purposes of this exercise, the Service assumes a 5 percent survival rate to adulthood for juvenile fish entering Noxon Reservoir, Cabinet Gorge Reservoir, or Lake Pend Oreille. Thus, in a typical year, about 456 to 1,680 juvenile bull trout from upstream may pass one or more dams with about 75 to 94 percent surviving the passage through one or more structures, leaving approximately 342 (456 X .75) to 1,579 (1,680 X .94) to grow and mature. If 5 percent of those survive to adulthood, the total potential number of migratory adults staging below the three dams would calculate to between 17 and 79 adults. Based on current observations, this appears to be a reasonable, but perhaps conservative number. It is noted in the BA (FERC 2008a) that the spillway conditions at Thompson Falls Dam (direct impact on angular rock) may be more damaging to fish than standard conditions at most dams, where typically only 0 to 2 percent of fish passing spillways are injured. We have no independent verification, but generally agree with the observation that violent conditions occur during spill at the Project spillway.

Anticipated Incidental Take of Downstream Migrant or Resident Juveniles Due To Gas Supersaturation. The Service anticipates that in most years when periods of spill occur (flows exceeding 23,000 cfs at Thompson Falls Dam), approximately 43 - 158 juvenile bull trout will be adversely affected through exposure to gas supersaturation conditions resulting in some level of gas bubble disease symptoms in those fish. The Service acknowledges that this form of incidental take has not been demonstrated at the Thompson Falls Project by the field observations gathered to date (see e.g., G. Gillin, GEI Consultants, personal communication, August 2008). However, we also maintain that there is reasonable scientific uncertainty and a likelihood, based on review of the published literature and observations at downstream facilities, that total dissolved gas levels as high as those measured at the Project (see for example Table 8, above) are likely to produce chronic and perhaps subacute levels of gas bubble disease in fish downstream of the Project. Gas bubble disease in fish can affect migration behavior, increase susceptibility to predation, and can cause physical injury and death. Additional incidental take of bull trout is anticipated downstream throughout Noxon and Cabinet Gorge reservoirs and river segments as well as in Lake Pend Oreille, with the most severe impacts in riverine reaches downstream of Cabinet Gorge Dam. Largest impacts will be on fish originating from the Thompson and Flathead River drainage local populations as these are the fish most likely to pass through the Project. Incidental take due to gas bubble trauma will be highly variable year to year, predicated largely on streamflow conditions and amount and timing of the spill.

Rationale: When river discharge exceeds the combined hydraulic capacity of both powerhouses (approximately 23,000 cfs), two tainter gates enable automatic spill operations up to 10,000 cfs each (FERC 2008a). As the runoff proceeds, 4 ft by 8 ft spillway panels on the Main Dam Spillway are removed for additional spill capacity. In most years, when the peak flood discharge is less than 70,000 cfs, spill is restricted to the Main Dam Spillway section. If flows exceed 70,000 cfs, Dry Channel Dam spill panels are available to increase spill capacity. Operation of the Dry Channel Spillway occurs infrequently (approximately every 10 years).

Adult or sub-adult bull trout present downstream of Thompson Falls Dam or exposed to gas supersaturated waters in Noxon Reservoir, Cabinet Gorge Reservoir, or Lake Pend Oreille may not be adversely affected to the point of being incidentally taken by gas supersaturation because of their natural preference for deep water and ability to move into waters deep enough (greater than 3 meters) to avoid deleterious effects of gas bubble disease. However, juvenile bull trout migrating downstream through the Clark Fork River mainstem or residing in shallow water habitats along the margins of the three reservoirs are likely to be exposed to gas supersaturation and may manifest some level of gas bubble disease. Based on the seasonal peak of juvenile bull trout migrations coinciding with spring high flow periods, it is estimated that up to 10 percent of the juvenile bull trout that successfully pass downstream of Thompson Falls Dam will be so affected in years of average or above spill intensity and duration. Bull trout lethally injured in passage cannot be re-taken, thus, of the 429 to 1,579 juvenile bull trout that survive passage over the spillway or through the turbines of the Thompson Falls Project (accounting for minimum 6% mortality to the 456 to 1,680 passing downstream), we estimate 10%, or roughly 43 to 158, may suffer some (typically sublethal) effects from gas bubble trauma. Again, we note this form of incidental take has not been documented at the Thompson Falls Project, but we also point out that direct observations of juvenile bull trout to date are quite limited. The effects of gas can be both chronic and cumulative, so fish that pass further downstream through Noxon Rapids and Cabinet Gorge projects would be expected to suffer the most harm from this condition.

Anticipated Incidental Take of Downstream Migrant or Resident Juveniles Due to Predation Caused By Predation Bottlenecks. The Service anticipates that approximately 46 to 420 (i.e., 10 to 25 percent of 456 to 1,680 that pass downstream from upriver local populations) juvenile bull trout will be subjected to incidental take annually, as a result of increased susceptibility to predation caused by the creation of cool and warmwater fish habitat created by the Project in Thompson Falls Reservoir as well as the potential for the Project to pass injured or disoriented bull trout into a potential predator trap downstream of the Project. This incidental take occurs primarily as an indirect consequence of water level management in Thompson Falls Reservoir which favors survival of other fish species which prey on or compete with bull trout. Nearly all take of this nature is lethal.

Rationale: Thompson Falls Reservoir covers 1,500 surface acres at maximum elevation and partially impounds 12 linear miles of river at a normal pool elevation of 2,396 ft msl, backing water upstream further than the confluence of the Thompson River (6.6 miles upstream of the Project). The creation of shallow, weedy, slow-moving lentic habitat instead of a free flowing river in much of the impounded portion of Thompson Falls Reservoir has created suitable habitat for a variety of predatory cool and warmwater fish species, dominated by black bullhead and northern pike (FERC 2008a). At present, there is no effort in place to suppress these species and while the angling regulations are protective of bull trout (i.e., illegal to fish for them) the regulations do not place any special emphasis on removal of nonnative predators. The northern pike limit in the three reservoirs is the fairly liberal standard Western Fishing District limit of 15 fish.

Without benefit of supporting scientific documentation from onsite studies, the Service estimates that at least 10 percent and as many as 25 percent (or possibly more) of the 456 to 1,680 juvenile bull trout passing from upstream local populations through this reservoir are likely to become prey for nonnative fish predators. In a similar situation at Milltown Dam, predation on bull trout by northern pike was shown to be seasonally significant (Schmetterling 2001). The juvenile bull trout successfully passing downstream of Thompson Falls Dam are also subject to additional predation, in part because of potential injury or disorientation as well as the potential for a second predatory bottleneck that exists at the upstream end of Noxon Reservoir. Telemetry studies have also indicated that the upstream portion of Noxon Reservoir is a gathering area for recently established populations of large predatory walleye during the spring, coinciding with the peak migration period for juvenile bull trout. Northern pike and largemouth and smallmouth bass as well as brown trout are also common to abundant and have the potential to prey on juvenile bull trout in Noxon Rapids and Cabinet Gorge Reservoirs. While most of the take of bull trout in those systems is not attributable to the Thompson Falls Project (exception being fish injured or disoriented by passage through the Project), the physical nature of all three reservoirs (shallow and warm) and current and proposed water level management regimes of the reservoirs accommodate continuing reproduction and survival of bull trout predators and competitors. Low juvenile survival, due to substandard habitat and predation, is likely a key limiting factor for bull trout populations in Thompson Falls, Noxon Rapids, and Cabinet Gorge Reservoirs.

Anticipated Incidental Take of Upstream Migrant Adults and Downstream Migrant or Resident Juveniles Due to Blockage of Access to Thermal Refugia. The Service anticipates that a number of adult and juvenile bull trout will be incidentally taken annually (likely in the form of sublethal impacts) as a result of an indirect effect of blocking migratory access to thermal refugia or altering its historic use. Lacking adequate information from onsite studies, we conservatively estimate this number as 10 adults and 100 to 200 juvenile/subadults.

Rationale: MFWP radio telemetry studies (L. Knotek, MFWP, personal communication, July 2008) conducted in 2002 through 2005 in the mainstem Clark Fork River upstream of the Thompson River have shown the strong thermal preference exhibited by bull trout, which consistently congregate at the mouths of the coldest tributaries. By inundating many of these coldwater refugia under the series of reservoirs, thereby reducing the quantity of such habitat, the migratory patterns of the fish may be affected in unknown and indeterminate ways. In addition, the placement of the Thompson Falls Project has predictable impacts on the nearest local populations in the Thompson River (6.6 miles upstream of the project) and Prospect Creek (0.5 miles downstream). In the former case, the Thompson River discharges immediately into a shallow, warm, slow-moving impoundment. There is likely a coldwater plume that extends downstream some distance from this source, which probably traces the primary migratory corridor used by juvenile bull trout in their downstream movement through Thompson Falls Reservoir. In the case of Prospect Creek, the confluence of this stream has become a defacto coldwater sanctuary near the base of the Project for fish blocked from upstream movement. There is anecdotal data that both adult and juvenile bull trout, as well as other coldwater species, congregate in the hole at the confluence of Prospect Creek creating unknown levels of competition and predation with uncertain impacts on bull trout. Evidence of poaching has also been noted at this “fishing hole”, including retrieval of lost snagging hooks and disappearance of several radio tagged fish, last detected at this location (L. Lockard, Service, personal communication, August 2008).

Anticipated Incidental Take of Adults and Downstream Migrant or Resident Juveniles Due to Interrupted Migration. The Service anticipates that a small number of adult and juvenile bull trout (conservatively estimated as 10 adults and 100 to 200 juvenile/subadults) will be sublethally taken annually as a result of modified or interrupted migration patterns resulting from reduced water velocities and suboptimal adfluvial habitat created in the reservoirs caused by dam operations. As a result of the creation of these habitats, which function as partial surrogates for Lake Pend Oreille, bull trout take up temporary or permanent residence and may carry out portions of their natural migratory life history, but are unable to fully complete a natural migratory cycle. An indication of this take is the low population levels of these adult migratory bull trout in the reservoirs. Insufficient scientific information is available to predict the effect of juvenile loss (to the Lake Pend Oreille population) or juvenile predation in the reservoirs on resulting adult populations, but lacking more detailed information, we conservatively estimate this number as 10 adults and 100 to 200 juvenile/subadults.

Rationale: Proposed reservoir operations can affect downstream migrating juvenile bull trout entering the reservoirs from the tributaries, by causing disorientation as the small fish enter a relatively large and slow moving water body (compared to the former Clark Fork River). These juvenile migrants, which occur in undetectably low densities (given current sampling efforts) in Thompson Falls Reservoir and at higher densities in Noxon and Cabinet Gorge Reservoirs, would have been historically destined for Lake Pend Oreille. They may eventually complete that migration, but can be delayed by the slow moving current and are thus exposed to predation (take) in the reservoirs for a longer time period than if the reservoirs were operated differently. In addition, because the physical nature of at least portions of the reservoirs are at least seasonally somewhat similar to Lake Pend Oreille (large, deep water bodies compared to the tributaries), juvenile fish may “think” they have arrived at their destination (Lake Pend Oreille) and discontinue their migration. These fish, residing in the reservoirs until adulthood, will be subjected to the enhanced predation and competition pressures (incidental take) caused by project operations, described above.

Anticipated Incidental Take of Migrant or Resident Juveniles or Adults Due to Construction of the Fishway. The Service anticipates that during 2009 and 2010 the construction of the fishway will have minor and short-term negative impacts to bull trout. Based on existing knowledge of limited use by bull trout of this habitat, we estimate incidental take as 2 adults and 10 to 20 juvenile/subadults. The proposed construction elements include 40 days of drilling and blasting to excavate the fishway footprint, construction of a haul road from the left bank to cross the river downstream of the dam (which will necessitate adding 150-500 cubic yards of fill and temporary culverts), demolition of the existing log sluiceway, and the actual construction of the fishway structure. The Service anticipates that limited incidental take of bull trout may occur during this process, but that all such impacts will be nonlethal and consist largely of minor levels of displacement from preferred habitat, considered harassment under the ESA. As previously noted (see 4.2.2.7, above), the specific timing of bull trout migration in the Thompson Falls Project area has not been well documented. The available data indicate that the upstream migratory season for adult bull trout is roughly between April and July and downstream migration of juveniles typically occurs with spring high water and fall freshets. As a result, numbers of bull trout in the project area are likely to be low during most of the summer construction window.

Rationale: Blasting and excavating of the rock wall will result in noise and shock wave disturbances and may introduce “shot rock” into the waterway. Blasting materials will be chosen to incorporate only materials that are nonlethal to aquatic organisms and the concussions from the blasting or sloughing of materials are not expected to lethally affect bull trout, which are unlikely to remain in the work zone during this period of time anyway. Some fish may be temporarily displaced during the activity. Construction of the haul road will necessitate regrading of approximately 700 lineal feet of boulders in the streambed (mostly above the stream level at the time of construction), and deposit of both native and nonnative fill must occur to create the roadbed. The installation of one or more temporary culverts to pass the river flow will also be required. These activities will cause some temporary downstream sediment plumes, but are not expected to cause significant or long-term sedimentation due to the coarse nature of the native materials and fill that will be used. Ultimately, the fill material will be left in place and the 2010 or later high flows will redistribute these materials downstream. Since juvenile bull trout are benthically oriented and utilize coarse substrate for cover, the addition of coarse materials has the potential to create bull trout habitat in the interstices, not reduce it. The temporary culverts will be installed at grade and positioned to allow continuing fish passage during low flow. Finally, the construction site will be coffer dammed off. Destruction of the existing log sluiceway, sawing and removal of concrete from the dam, and actual fishway construction will occur within the coffer dammed area, with all concrete waste materials hauled away and deposited offsite. No adverse impacts to bull trout from these activities are anticipated.

Anticipated Incidental Take of Migrant or Resident Juveniles or Adults Due to Sampling and Monitoring Protocols. The Service anticipates and acknowledges that incidental take of bull trout will occur on an annual basis related to implementation and operations associated with proposed fish passage, sampling, and monitoring activities. The extent and/or specific amount of this incidental take will vary from year to year, but is not expected to exceed 10 adults or 100 juveniles. With rare exceptions, this take is expected to be sublethal in the form of harm and harassment.

Rationale: The fish passage and habitat protection program, with details to be developed through implementation of the Thompson Falls Project MOU under the guidance of an interagency Technical Advisory Committee (TAC) is designed in part to minimize incidental take of bull trout and to otherwise minimize or eliminate the adverse impacts to the native fishery resources caused by the dams' fish passage obstructions. In order to successfully implement the program, and to conserve and recover bull trout, the TAC will require that individual bull trout be incidentally taken by a variety of means. Examples of incidental take under the program or its associated monitoring include: genetic sampling, disease testing, trapping, electrofishing, netting, surgical implanting of transmitters, transport via fish tanks on trucks, snorkel surveys, etc. Further examples of unintentional incidental take include: injury or death due to adult bull trout turbine passage following transport upstream of dams; injury or death in the fishway, fishway sampling loop, or due to fallback; predation following release of captured fish; complications (e.g. infections) following surgery or bio-sampling; etc. When intentional take is described as part of a proposed project in order to minimize anticipated incidental take, the BO and incidental take statement issued on the proposed project serve as the authority for that take (Service and NMFS, March 1998). The terms and conditions of this incidental take statement require that an annual report be prepared and submitted to the Service to ensure that the level of intentional take, as well as incidental take, remains within the levels authorized by this BO.

Summary. Summarizing, the total quantifiable amount of incidental take related to the proposed action (Table 11) is sublethal harm and harassment of approximately 51 adult, 353 to 678 juvenile bull trout, and 40,000 bull trout eggs each year for the remaining 17 years of the license period through 2025. In addition, it is estimated that lethal take of 73 to 571 juvenile bull trout may be occurring annually at the project. Some juvenile bull trout could be "taken" (harmed or harassed) again after passing the dam into the tailrace and upper end of Noxon Reservoir. Thus, these numbers include juvenile bull trout anticipated to be taken by effects of gas bubble disease and increased vulnerability to predation caused by operations upstream and downstream of Thompson Falls Dam.

Table 11. Summary of Thompson Falls Hydroelectric Project elements assigned annual "take" in this BO.

Project Element	Type of Take	Lethal Take		Non-lethal Take	
		Adult	Juvenile/ Sub-adult	Adult	Juvenile/ Sub-adult
Delayed/Deferred Spawning	Harm or Harass			19	40,000 eggs
Turbine and Spillway Ops.	Injury & Death		27 - 151		
Gas Supersaturation	Harm or Harass				43 - 158
Predation Effects	Harm or Harass		46 - 420		
Access to Thermal Refugia	Harm or Harass			10	100 - 200
Migratory Delay or Interruption	Harm or Harass			10	100 - 200
Fishway Construction	Harm or Harass			2	10-20
Sampling and Monitoring	Harm or Harass			10	100
	TOTAL		**73 - 571**	**51**	**40,000 eggs plus 353–678 fish**

8.2 Effect of the Take

In this BO, the Service has determined that this level of anticipated incidental take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

8.3 Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize take:

1. **PROVIDE SAFE AND EFFECTIVE UPSTREAM FISH PASSAGE**: Identify adult bull trout attempting to travel upstream of Thompson Falls Dam from Lake Pend Oreille, Cabinet Gorge Reservoir, or Noxon Reservoir and in a timely manner, agreed to by the Service and coordinated with the Avista projects, facilitate upstream fish passage, operated in accordance with an approved Operational Plan, to enhance spawning migrations. Successful upstream passage will reduce or eliminate incidental take from blockage of

migrants by the dam, including delayed/deferred spawning, restriction of access to thermal refugia, and migratory delay or interruption.

2. **PROVIDE SAFE AND EFFECTIVE DOWNSTREAM FISH PASSAGE**: Identify juvenile bull trout attempting to travel downstream from Thompson River, Flathead River, and upstream core areas and provide safe, timely and efficient downstream fish passage to facilitate bull trout migration to Noxon Rapids and Cabinet Gorge Reservoirs or Lake Pend Oreille. Successful downstream passage will reduce or minimize incidental take related to dam effects on juvenile fish, including intermittent effects from any gas supersaturation and chronic effects from blocked access to thermal refugia and migratory delay or interruption.

3. **REDUCE EFFECTS OF GAS SUPERSATURATION ON BULL TROUT IN PROJECT AREA**: Further evaluate the mechanism and impacts of dissolved gas supersaturation on bull trout at Thompson Falls Dam; first establishing the degree to which the Thompson Falls Project contributes to the systemic problem and secondly with an objective of participating in control, mitigation, and monitoring programs to reduce incidental take of bull trout by effects of gas bubble disease at the Thompson Falls Project.

4. **DEVELOP IMPLEMENTATION STRATEGIES FOR THE MOU AND TAC**: Implement provisions of the Thompson Falls Project MOU under the guidance of an interagency Technical Advisory Committee (TAC) that call for enhancing, acquiring or protecting sensitive upstream habitat that is used by migratory bull trout for spawning or rearing.

5. **REDUCE OR MITIGATE ADVERSE EFFECTS TO BULL TROUT FROM OPERATIONS OF THOMPSON FALLS RESERVOIR**: Initiate a comprehensive evaluation of bull trout use of Thompson Falls Reservoir and determine the primary migratory pathway through the reservoir and interaction of bull trout with predatory and competing nonnative species in Thompson Falls Reservoir. These investigations should be carried out over a 10-year period as a prelude to further evaluation of downstream passage concerns associated with future relicensing discussions.

6. **PROVIDE PERIODIC MONITORING AND EVALUATION ACROSS THE CORE AREA**: Contribute to coordinated genetic assessment and monitoring of bull trout populations in the Lower Clark Fork Core Area and, to a lesser extent, connected upstream core areas as related to impacts of Thompson Falls Dam.

7. **REPORTING**: Implement reporting and consultation requirements as outlined in the terms and conditions in order to minimize take of bull trout related to implementation of the Plan and other fisheries monitoring activities.

8.4 Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the FERC must comply with the following terms and conditions which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

It is the intent of Service and the FERC, as agreed to with the licensee, that implementation of fish passage at Thompson Falls will occur in systematic phased steps:

Phase 1 – Fishway Preconstruction and Construction Phase; (through 2010) includes the planned development and construction of a full-height fishway.

Phase 2 – Fishway Post-Construction Monitoring and Evaluation; (mid-2010 through 2020) includes a comprehensive assessment and iterative enhancement of the safe, timely and efficient passage of bull trout (and other species) both upstream and downstream through the facility as well as examination of other bull trout limiting factors in the Project action area.

Phase 3 - Pre-Licensing and Ongoing Fishway Operations; (2021 and beyond) is currently not described, but will involve optimal operation of the fishway and become preparatory to FERC relicensing of the Thompson Falls Dam, scheduled to be in process up to five years before the license expires at the end of 2025.

TC1. The following terms and conditions are established to implement reasonable and prudent measure #1. UPSTREAM PASSAGE:

a. During 2009 and 2010, PPL Montana will construct a fish passage facility (permanent fishway) to provide timely and efficient upstream passage at the right abutment of the main dam, as agreed to by the Service and through oversight of the TAC (as provided for in the interagency Thompson Falls MOU).

b. During construction and cleanup, PPL Montana will follow permit procedures as required by the Service, the State of Montana, and U.S. Army Corps of Engineers so that minimal impacts to downstream aquatic resources occur during construction.

c. PPL Montana will determine operational procedures for the passage facility and develop a written operation and procedure manual (SOP) by the end of 2010, with input from the TAC and approval by the Service, updated as needed.

d. For the remaining term of the license (expiring December 31, 2025), PPL Montana will ensure that operation of the fish passage facility is adequately funded and conducted in compliance with the approved SOP; including activities such as biological studies, transport of bull trout (as needed), and assessment of ladder efficiency.

e. During the Phase 2 evaluation period (2010 through 2020), PPL Montana will provide adequate funding for genetic testing to determine the likely natal tributary of origin of all adult bull trout which ascend the fishway and enter the sample loop, as well as those otherwise captured at the base of Thompson Falls Dam. In order to positively identify natal origin of bull trout at the project, PPL Montana will institute a permanent fish tagging system for all bull trout handled during monitoring and for other fisheries investigation activities in the Project area.

f. During the Phase 2 evaluation period (2010 through 2020), PPL Montana will make a fish transport vehicle available, and provide staff to transport any adult bull trout that is captured at Thompson Falls Dam and determined by the SOP to require transport to upstream waters.

g. In consultation with the TAC, PPL Montana will prepare by January 1, 2011, for Service approval, an action plan for Phase 2 of the evaluation period (2010 through 2020) to evaluate efficiency of the upstream passage facility. The goal will be to assess how effective the ladder is at passing bull trout, the potential length of any delay, the amount of fallback, and the optimal operational procedures to achieve the highest efficiency. During this Phase 2 evaluation period (2010 through 2020) a routine feedback loop will be established and used, as agreed to by the Service, to fine tune operations and will be combined with a variety of experimental and evaluative studies. It may be necessary to conduct research on surrogate species (e.g., rainbow trout) at the discretion of the TAC, in order to facilitate certain of these evaluations. At a minimum, for the remaining term of the license (through 2025), PPL Montana will support a sampling method to annually estimate the total numbers of all species passing through the ladder and adequately characterize the timing of such movements.

h. During the entire Phase 2 evaluation period (2010-2020), the TAC, subject to approval of the Service and with PPL Montana support, will provide adequate oversight of scientific aspects, surveys, studies, and protocols associated with the fish passage aspects of the Project. At the end of the Phase 2 evaluation period (2010-2020), and upon completion and adequate distribution and consideration of a comprehensive ten-year report (due December 31, 2020), PPL Montana will convene a structured scientific review of the project, guided by the TAC. This scientific review will be completed by April 1, 2021 and will develop a set of recommendations to be submitted to the Service for evaluation, modification, and approval; including specific conclusions as to whether the fishway is functioning as intended and whether major operational or structural modifications of the fishway are needed. The review process will culminate, by December 31, 2021, in a revised operating plan for the fishway during the remainder of the existing term of the FERC license (2022 through 2025).

TC2. The following terms and conditions are established to implement reasonable and prudent measure #2. DOWNSTREAM PASSAGE:

a. PPL Montana will provide annual funding to the TAC, as approved by the Service and specified in the Thompson Falls MOU, to conduct offsite habitat restoration or acquisition in important upstream bull trout spawning and rearing tributaries. The purpose is to boost recruitment of juvenile bull trout. This funding is provided to partially mitigate for incidental take of bull trout caused by downstream passage through the turbines and spillways. The annual $100,000 contribution specified for the first term of the MOU (2009-2013) is subject to renegotiation during succeeding terms of the MOU to run from 2014-2020.

TC3. The following terms and conditions are established to implement reasonable and prudent measure #3. GAS SUPERSATURATION:

a. For the remainder of the license (through 2025), in consultation with the TAC and subject to Service approval, PPL Montana will develop and implement operational procedures to reduce or minimize the total dissolved gas production at Thompson Falls Dams during periods of spill. Future modifications to prescribed operations may be determined from ongoing evaluations, as necessary and determined appropriate by Montana Department of Environmental Quality.

b. For the remainder of the license (through 2025), in consultation with the TAC and subject to Service approval, PPL Montana will continue to collaborate with MDEQ, Avista, MFWP, and other entities toward reducing the overall systemic gas supersaturation levels in the Clark Fork River, occurring from a point downstream of Thompson Falls Dam to below Albeni Falls Dam.

c. For the remainder of the license (through 2025), all bull trout detained through the sampling loop at the Thompson Falls Fish Ladder will routinely be examined for signs of gas bubble trauma; with results of such observations permanently recorded. Should GBT symptoms be discovered, then PPL Montana will consult the TAC on the need for immediate corrective actions and subsequently implement any new studies or potential operational changes (to the ladder or the dam) which may be required by the Service and DEQ, in order to mitigate GBT concerns.

TC4. The following term and condition is established to implement reasonable and prudent measure #4. MOU and TAC:

a. Upon completion of construction of the Thompson Falls Fish Ladder (currently scheduled for 2010) and concurrent with the Phase 2 review period (mid-2010 through 2020), PPL Montana will review the Thompson Falls MOU and collaborate with the signatory agencies as to the need to revise and restructure the MOU after it expires on December 31, 2013. Any such revision may include appropriate changes to the TAC and its operation. Subsequent revision may occur again in 2021, or as needed based on adaptive principles and subject to approval of the Service and PPL Montana.

TC5. The following terms and conditions are established to implement reasonable and prudent measure #5. THOMPSON FALLS RESERVOIR:

a. During the first five years of the Phase 2 evaluation (2011 through 2015) PPL Montana, with TAC involvement and Service approval, will conduct a prioritized 5-year evaluation of factors contributing to the potential loss or enhancement of migratory bull trout passage through Thompson Falls Reservoir. Goals and objectives for this assessment and scientifically-based methodology will be developed through the TAC and approved by the Service no later than the end of 2010 and will focus at a minimum on better understanding temperature and water current gradients through the reservoir; travel time, residence time, and pathways that juvenile and subadult bull trout select in moving through the reservoir; and an assessment of potential impacts of predatory nonnative fish species on juvenile and subadult bull trout residing in or passing through the reservoir. The initial findings will be summarized and supported with scientifically based conclusions, no later than the end of 2015. Initial implementation of the most efficacious of those recommendations for adaptively improving survival of juvenile bull trout in Thompson Falls Reservoir as they pass downstream or reside in the system will occur during 2016-2020. A second, more comprehensive summary of conclusions and recommendations regarding reservoir impacts will be submitted as part of the scientific review package by the end of 2020 (see TC1h), with any final recommendations to be approved by the Service.

TC6. The following terms and conditions are established to implement reasonable and prudent measure #6 SYSTEMWIDE MONITORING:

a. For the remainder of the license (through 2025), PPL Montana will ensure that actions at the Thompson Falls Fish Ladder, including tagging, transport, and any tracking of fish movement, are adequately funded and fully coordinated with the Avista project and the management agencies MFWP, CSKT, and the Service. This coordination will include routine communications through the TAC and may require participation in special meetings or discussions to ensure that there is a single seamless fish passage effort for the lower Clark Fork projects.

b. For the remainder of the license (through 2025) PPL Montana will contribute a proportional amount of funding to ensure that fish sampled at the Thompson Falls Fish Passage Facility are processed, analyzed, and integrated into annual updates of the systemwide Clark Fork River genetic database.

c. In consultation with the TAC and with approval of the Service, for the remainder of the license (through 2025), PPL Montana will fund the technology required to track transmittered fish that pass the project as they move through the system. This may include an integrated PIT-Tag scanner at the fishway, mobile PIT-Tag scanning capabilities (wand(s) for use in the field), and radio implantation and tracking of bull trout that move through the sample loop in the ladder. Obligations for tracking transmittered fish by PPL Montana will include at a minimum the portions of the Lower Clark Fork Core Area upstream of Thompson Falls Dam (i.e., mainstem Clark Fork River from Thompson Falls Dam to the confluence of the Flathead River, including tributaries such as the Thompson River) Note: in the lower Flathead River, Jocko River, and other Flathead Reservation waters primary responsibility for tracking is assumed by the CSKT, but close coordination with the Tribes will be maintained by PPL Montana. Broader tracking needs upstream will be determined through cooperation with other entities in the basin (as in TC6a., above).

TC7. The following terms and conditions are established to implement reasonable and prudent measure #7 REPORTING:

a. Annually, by April 1 of each year for the remainder of the license (expires 2025), PPL Montana will prepare and submit to the Service for approval a report of the previous years activities, fish passage totals, and next year's proposed activities and other fisheries monitoring that may result in intentional as well as incidental take of bull trout. The report will quantify the number of bull trout proposed to be incidentally taken by each activity and summarize the cumulative extent of incidental take from all previous year activities.

b. By December 31, 2015, after the first five years of the Phase 2 evaluation period (as described per TC1g., above), PPL Montana will present to the TAC and the Service a comprehensive written assessment of the first five years of fishway operation. This report is partially for the purpose of assessing the need for major mid-Phase 2 modifications to the facility and its operations as well as for consideration of the need for supporting additional bull trout passage or transport above the dam.

c. Annually, by April 1 of each year beginning in 2010 and for the remainder of the license (expires 2025), PPL Montana will archive electronic versions of all biological progress reports (described in TC 1 through TC 7 and dating back to 2005) generated through the Thompson Falls Project. PPL Montana will provide to TAC agencies at no cost, upon request, updated CDs or web-based access to those reports

d. For the remainder of the license (expires 2025), upon locating dead, injured, or sick bull trout, or upon observing destruction of redds, notification must be made within 24 hours to the Service's Division of Law Enforcement Special Agent (Richard Branzell, P.O. Box 7488, Missoula, MT, 59807-7488; (406)

329-3000). Instructions for proper handling and disposition of such specimens will be issued by the Division of Law Enforcement. Dead, injured, or sick bull trout should also be reported to the Service's Kalispell Field Office (406-758-6882).

e. For the remainder of the license (expires 2025), during project implementation the FERC or applicant shall promptly notify the Service of any emergency or unanticipated situations arising that may be detrimental for bull trout relative to the proposed activity.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize incidental take that might otherwise result from the proposed action. With implementation of these measures the Service believes that the likelihood of incidental take will be minimized. If, during the course of the action, the level of incidental take is exceeded, such incidental take represents new information requiring review of the reasonable and prudent measures provided. The FERC must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

For convenience, these Terms and Conditions are summarized in Table 12. Refer to the wording of the Terms and Conditions (above) for more specificity and fuller guidance.

Table 12. Terms and Conditions for Implementing the Reasonable and Prudent Measures Described in the Bull Trout Consultation for the Thompson Falls Hydroelectric Project.

T&C	**Phase 1** **2008 - 2010** **Fishway Preconstruction and Construction**	**Phase 2** **Late 2010 - 2020** **Fishway Post-Construction Monitoring & Eval.**	**Phase 3** **2021 - 2025** **Pre-Licensing and Ongoing Fishway Operations**
1a	Construct Fishway		
1b	Comply with Construction Permits		
1c		Develop Fishway Operations Manual (SOP) by 12/31/10	
1d		Oversee and Fund Fishway Operations	Oversee and Fund Fishway Operations
1e		Conduct Bull Trout Genetic Testing and Permanent Tagging	
1f		Transport Tank, Staff As Needed	

Table 12. Continued

T&C	**Phase 1 2008 - 2010 Fishway Preconstruction and Construction**	**Phase 2 Late 2010 - 2020 Fishway Post-Construction Monitoring & Eval.**	**Phase 3 2021 - 2025 Pre-Licensing and Ongoing Fishway Operations**
1g	Plan Efficiency Studies	Passage Efficiency Action Plan by 1/1/11; Implement Action Plan and Generate Annual Passage Estimates	Implement Action Plan and Generate Annual Passage Estimates
1h		Support Scientific Oversight by TAC; Comprehensive Phase 2 Scientific Report by end of 2020; Begin Development of Revised 5-year Fishway Operations Plan;	Conduct Scientific Review by 4/1/2021; Adopt and Implement Revised 5-Year Fishway Operations Plan 2021-2025;
2a	Implement and Fund Adaptive Management Funding Account (AMFA)	Continue Annual AMFA and Conduct Upstream Offsite Mitigation thru 2013; Renegotiate MOU and Renew AMFA for 2014-2020	
3a	Implement TDG Minimization Measures	Implement TDG Minimization Measures	Implement TDG Minimization Measures
3b	Collaborate With Systemwide Gas Abatement Effort	Collaborate With Systemwide Gas Abatement Effort	Collaborate With Systemwide Gas Abatement Effort
3c.		Systematic GBT Exam; Corrective Measures as Required	Systematic GBT Exam; Corrective Measures as Required
4a.		Revise MOU and TAC, as Needed (current version expires at end of 2013)	Revise MOU and TAC, as Needed (2021)

Table 12. Continued

T&C	Phase 1 2008 - 2010 Fishway Preconstruction and Construction	Phase 2 Late 2010 - 2020 Fishway Post-Construction Monitoring & Eval.	Phase 3 2021 - 2025 Pre-Licensing and Ongoing Fishway Operations
5a.	Develop goals, objectives, and methodology for T Falls Reservoir Assessment by end of 2010.	Conduct T Falls Reservoir Assessment 201102015 and Submit Interim Report by end of 2015; Implement Interim Measures in 2016-2020; Submit Final T Falls Reservoir Assessment for TC1h Science Review at the end of 2020	
6a.	Participate in Seamless Systemwide Fish Passage Coordination	Participate in Seamless Systemwide Fish Passage Coordination	Participate in Seamless Systemwide Fish Passage Coordination
6b.	Contribute Proportionally to Genetic Database	Contribute Proportionally to Genetic Database	Contribute Proportionally to Genetic Database
6c.	Support Tracking of Transmittered Bull Trout Through Lower Clark Fork Core Area	Support Tracking of Transmittered Bull Trout Through Lower Clark Fork Core Area	Support Tracking of Transmittered Bull Trout Through Lower Clark Fork Core Area
7a.	Annual Activity, Fish Passage and Take Report by March 1.	Annual Activity, Fish Passage and Take Report by March 1.	Annual Activity, Fish Passage and Take Report by March 1.
7b.		5-year ladder assessment report due 12/31/2015	
7c.		Annually, by April 1, Update Archived Reports	Annually, by April 1, Update Archived Reports
7d.	Report Dead or Injured Bull Trout	Report Dead or Injured Bull Trout	Report Dead or Injured Bull Trout
7e.	Notification of Emergencies	Notification of Emergencies	Notification of Emergencies

9. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

Continue to cooperate with MFWP, CSKT, Avista and other entities to promote recovery of bull trout, and to survey and monitor bull trout populations and habitat in the lower Clark Fork River core area and the greater Clark Fork basin.

During the fishway construction, retrieve and remove all loose steel beams and other “junk” from the stilling basin that can be reasonably accessed from the construction roadway.

10. REINITIATION NOTICE

This concludes formal consultation on the Commission’s proposed relicensing of the PPL Montana hydropower project. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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APPENDIX A: MAPS

Figure A1. Lower subbasin of the Clark Fork Management Unit, showing associated core areas. Note that the Cabinet Gorge, Noxon, Clark Fork River Section 3, and Lower Flathead core areas displayed in the 2002 map were combined, in 2006, into a single unified Lower Clark Fork Core Area. From the Draft Bull Trout Recovery Plan (Service 2002).

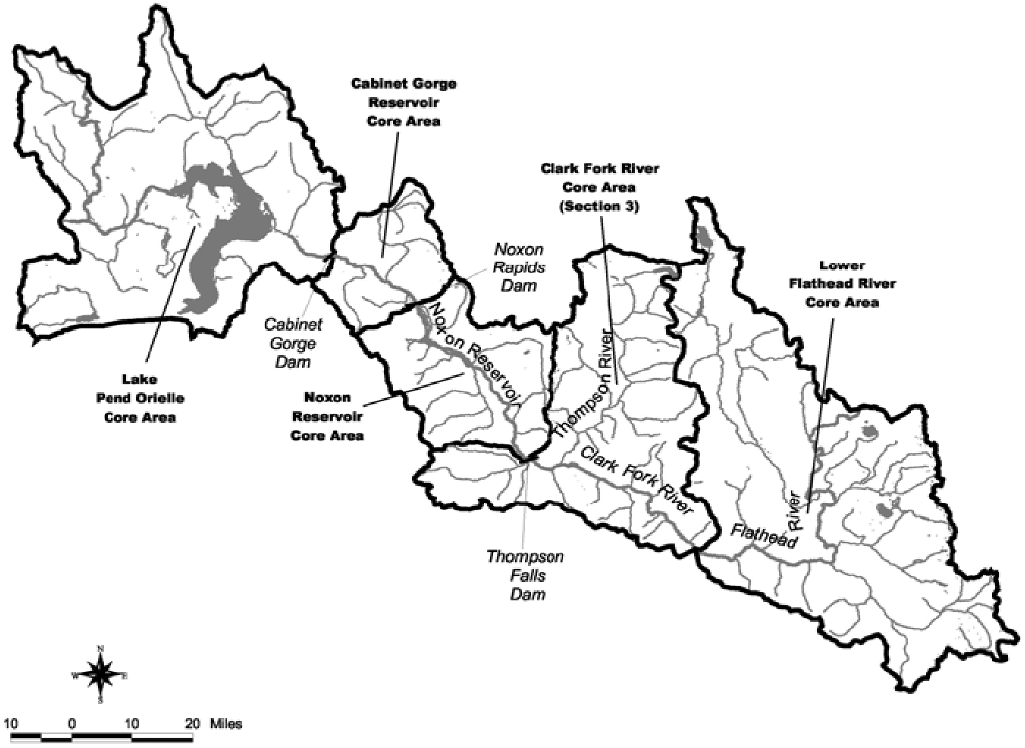

Figure A2. Upper subbasin of the Clark Fork Management Unit, showing associated core areas.
From the Draft Bull Trout Recovery Plan (Service 2002).

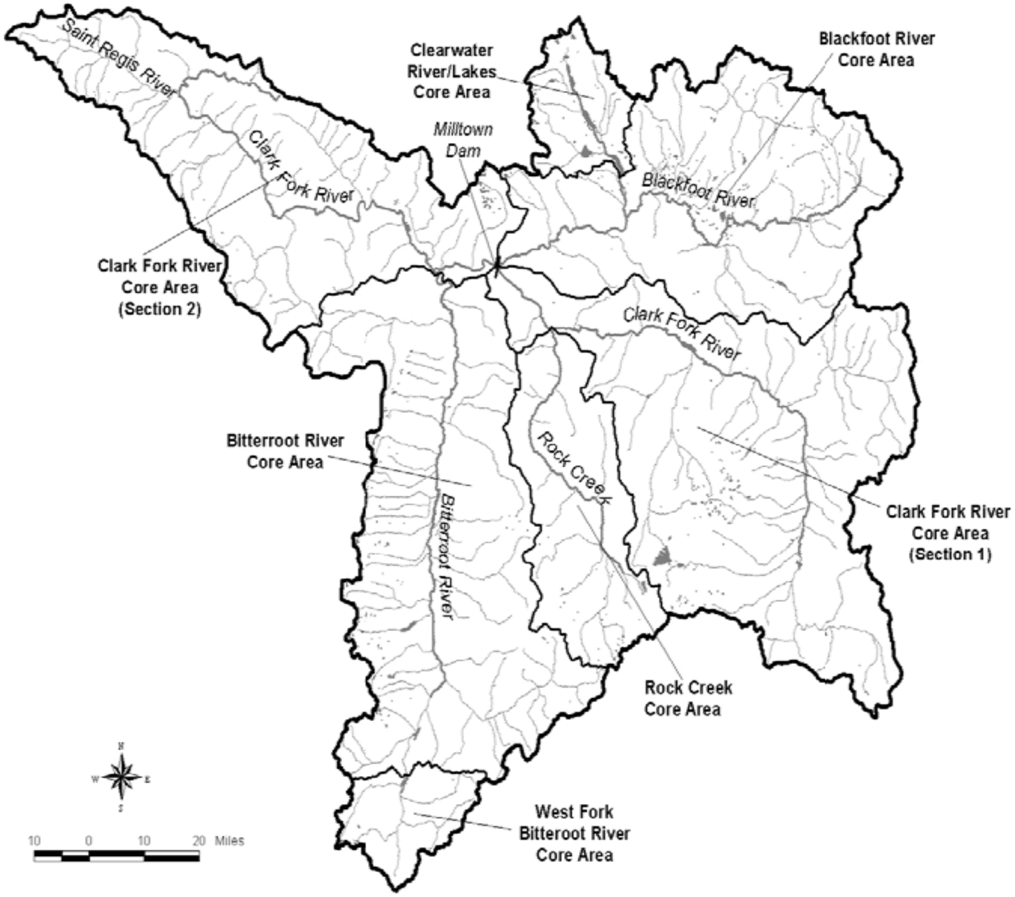

Figure A3. Map of Bull Trout Critical Habitat (segments shown in bold) in the Clark Fork Management Unit: Unit 2 (Service 2005).