
**SITE C FISHERIES STUDY
UPPER HALFWAY RIVER WATERSHED
BULL TROUT SPAWNING SURVEY 2008**

*Note: This report has been redacted for protection of the bull trout (*Salvelinus confluentus*).*

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EXECUTIVE SUMMARY

A population of large-bodied, fluvial bull trout (*Salvelinus confluentus*), known as the Peace-Halfway migratory population, resides in the Peace River and makes annual movements to spawning habitat in the upper Halfway River watershed, including the upper Halfway River mainstem, Cypress Creek, the Chowade River, and Needham Creek. The Chowade River spawning sub-population represents the majority of these bull trout. The BC Ministry of Environment (MOE) has monitored indices of abundance for the Chowade sub-population, including snorkel surveys and aerial counts of bull trout redds and mark-resight estimates of adult bull trout in 1994, 1995, 1996, 2002, and 2005. The remaining spawning sub-populations were monitored only in 2007. In 2008, snorkel surveys, ground counts, and aerial surveys of redds were conducted in order to build on the existing database of abundance indices for the four primary Peace-Halfway spawning sub-populations.

On September 9-10, 16-17, and 20, 2008, bull trout and bull trout redds were enumerated using a combination of ground, aerial, and snorkel surveys conducted on the upper Halfway River mainstem, Cypress Creek, the Chowade River, and Needham Creek. In the Chowade River, a two-fold increase in bull trout redd numbers from 2005 was recorded. A total of 425 redds were counted in the Chowade, with 390 located [REDACTED]. The proportion of redds located outside of the Chowade WHA increased from 1.9% to 8.2% between 2005 and 2008. Redd abundance in the remaining tributaries also appears to have increased from 2007 counts with 23, 120, and 76 redds counted in 2008 in the upper Halfway River, Cypress Creek, and Needham Creek, respectively. In addition, the proportion of redds located outside the Upper Cypress and Middle Cypress WHAs appears to have increased significantly.

The results of the work conducted in 2008 suggest a continued increase in abundance of migratory, fluvial bull trout in the Peace-Halfway watershed. This increase is likely partially attributable to the implementation of conservative angling regulations that include a prohibition on angler retention of bull trout and a seasonal prohibition on angling at the Peace-Halfway confluence. Maintenance of the population in the future will also depend on the protection afforded by WHAs in the upper Halfway River, Cypress Creek, Chowade River, and Needham Creek. As industrial and recreational pressures increase, continued monitoring of indices of abundance will be important for the long-term management of the Peace-Halfway bull trout population.

1 INTRODUCTION

1.1 Background

B.C. Hydro is presently considering the Peace River Site C hydroelectric project (Site C) in northeastern British Columbia as one of several resource options being considered to help meet BC's future energy needs. Fisheries studies undertaken between 2005 and 2008 are being used to add to existing Peace River baseline information and to address baseline data gaps that have been identified. Current data that describes critical bull trout spawning areas is an important component of baseline information requirements.

The purpose of the 2008 study was to collect information to compliment existing monitoring data that describes use of the Halfway River system for spawning by the Peace River bull trout population. Diversified Environmental Services (DES) was subcontracted by Mainstream Aquatics to conduct the bull trout spawner survey on behalf of BC Hydro.

Bull trout (*Salvelinus confluentus*) are blue-listed (i.e., a *species of concern*; formerly *vulnerable*) in British Columbia (BC CDC 2009). A population of large, fluvial, migratory bull trout, known as the Peace-Halfway migratory population, resides in the unimpounded portion of the Peace River and adjacent Halfway River mainstem. Adults of this population make annual movements to critical spawning habitat, located in the upper Halfway River watershed. Bull trout in this population appear to be phenotypically unique in that they are among the largest bull trout in the region.

Peace-Halfway migratory bull trout use critical spawning habitat located in large tributaries of the upper Halfway River watershed, including the upper Halfway mainstem, Cypress Creek, the Chowade River, and Needham Creek. Surveys between 1994 and 1999 documented bull trout spawner numbers, redd densities (Baxter 1994a, 1994b, 1995, 1997a, 1997b; R.L. & L. 1994), and migration patterns (Burrows *et al.* 2001, MELP 2000) for the Peace-Halfway population. To date, the emphasis of population monitoring has been on the Chowade River spawning sub-population.

Individuals of the Peace-Halfway bull trout population migrate up to 280 km from overwintering areas in the lower Halfway River and the Peace River mainstem as far downstream as the Clear River in Alberta (Baxter 1997a, 1997b, Burrows *et al.* 2001, MELP 2000). In the Chowade River, which supports the majority of Peace-Halfway spawning activity, Baxter (1995) found bull trout arrived at the spawning zone as early as August 10, with evidence of redd building reported as early as August 27. Peak spawning activity occurs between September 5 and 12 (Baxter 1995, 1997a). Redd superimposition is common, suggesting that redd site selection is highly site-specific and that the density of spawners in the upper Chowade is substantial. Spawning is typically complete by September 25, by which time bull trout have emigrated from the Chowade River to overwintering sites within the lower Halfway and Peace rivers (Baxter 1995, 1997a, Burrows *et al.* 2001, MELP 2000).

Past estimates of bull trout spawners in the Chowade River have ranged from 185 ±75 (Baxter 1995) to 304 (range 231–431; R.L. & L. 1994); differences in fish numbers observed reflect differences in sampling methodology and intensity. Frequency of repeat spawners, as identified from recaptures of marked fish (fin-clips and spaghetti tags) while snorkeling and angling, has been estimated to be 18 to 25% (Baxter 1995, 1997a).

Preliminary analysis of radio telemetry data also supports evidence of alternate year spawning and spawning site fidelity (Burrows *et al.* 2001, MELP 2000). While densities of bull trout are much lower in the upper Halfway River mainstem, Cypress Creek, and Needham Creek, timing of migration and spawning appear similar (MELP 2000, Euchner 2007).

Concurrent with work completed between 1994 and 1998, as part of the provincial char conservation plan, bull trout retention quotas in the Peace River watershed, downstream of the WAC Bennett Dam, were reduced to zero in 1995. Seasonal closures to angling at the Peace-Halfway confluence and in the upper Chowade River also protect staging and spawning bull trout from harassment and potential hooking mortality. Additional protection for the population is offered by the Identified Wildlife Management Strategy (IWMS) of the Forest Practices Code (currently the *Forest and Range Practices Act*). In 2002, under the IWMS, bull trout Wildlife Habitat Areas (WHAs) were established to encompass critical sections of river habitat where bull trout spawning activity is concentrated or where significant numbers of pre-spawning bull trout migrants are known to stage (Fig. 1).

Specifically, these WHAs are known as [REDACTED] bull trout WHAs.

Long term monitoring of Peace-Halfway migratory bull trout spawning runs serves as an index of the health of the population and is important for the species' conservation and management. Snorkel surveys augmented by aerial redd counts in 2002 and 2005 tracked bull trout spawner abundance and redd distribution and density in the Chowade WHA, as well as portions of the river upstream and downstream of the WHA (Euchner 2002, 2006). Monitoring in 2005 found an apparent two-fold increase in bull trout run size and redd numbers in the Chowade over previous counts in 2002.

With the exception of surveys conducted as part of BC Ministry of Environment's (MOE) effectiveness monitoring of bull trout WHAs in 2007 (Euchner 2007), no previous population trend information for the upper Halfway River, Cypress Creek, and Needham Creek sub-populations was available prior to 2008.

The main objectives of the 2008 monitoring program were to augment long-term population trend data for the Chowade sub-population, confirm the apparent increase in abundance of the Chowade sub-population, and to augment baseline spawning run size and redd distribution and density data for the upper Halfway River, Cypress Creek, and Needham Creek spawning sub-populations.

1.2 Project Area

The Halfway River enters the Peace River approximately 36 km west of Fort St. John, BC (Fig.1). It is a seventh-order tributary of the Peace River, measuring roughly 220 km in length. A 4 m falls located approximately 190 km upstream of the Peace-Halfway confluence limits upstream fish movement. Two circular WHAs, 78.5 ha polygons measuring 1 km in diameter, are situated along the upper Halfway River. [REDACTED] (Euchner 2007).

[Figure 1 - REDACTED]

Cypress Creek is a fifth-order tributary entering the Halfway River approximately 126 km upstream of its confluence with the Peace River (Fig. 1). Two circular WHAs, 78.5 ha polygons measuring 1 km in diameter, are situated along Cypress Creek. [REDACTED] (Euchner 2007).

The Chowade River is a fifth-order tributary of the Halfway River and enters the mainstem approximately 110 km upstream of the confluence with the Peace River (Fig. 1). [REDACTED] (Euchner 2006).

Needham Creek is a fifth-order tributary of the Graham River, which enters the Halfway River approximately 85 km upstream of the confluence with the Peace River (Fig. 1). A 4 m impassable chute precludes fish access beyond the lower 8.0 km of Needham Creek. Needham Creek lies entirely within the Muskwa-Kechika Management Area, with portions also lying within Graham-Laurier Provincial Park. [REDACTED]

2 METHODS

Replicate surveys were conducted between September 9 and 20, in order to account for potential year-to-year variability in timing, and ensure the capture of peak spawning activity and maximum redd density. Bull trout spawning surveys were conducted on September 9-10, 16-17, and 20, 2008. To ensure comparability over time, survey methodology primarily followed that established during previous spawning assessments conducted by DES for MOE. This involved a combination of low-level aerial survey, snorkel survey, and ground-based counts within each spawning zone. The 2008 assessment included the inspection of stream segments both upstream and downstream of previously surveyed stream sections and existing bull trout WHAs in all four spawning streams, in order to document potential spawning zone expansion. Survey methods varied between spawning zones depending on stream-specific conditions including channel width, water clarity, extent of stream bank under-cutting and riparian vegetation encroachment, and the length of the spawning zone. A brief description of the aerial, snorkel, and ground survey methodology follows.

2.1 Aerial Surveys

In stream channels with extensive under-cut banks and an abundance of large woody debris and over-hanging riparian vegetation, such as Cypress Creek and the Chowade River, have shown aerial redd surveys significantly under-estimate redd densities

(Euchner 2006). During the 2008 assessment, low-level aerial surveys were primarily used to determine redd distribution relative to the established WHAs in each drainage and to define the upstream and downstream limits of subsequent ground surveys. Redds were enumerated and georeferenced from the air only in cases where very low densities of redds were found isolated from more intensively used spawning areas.

Aerial surveys were conducted with a three-person observation crew flying upstream at 20-40 m above ground level in a Bell 206 helicopter. GPS coordinates (UTM, NAD 83) were recorded for aerial survey start and end points and for locations of redds or redd clusters.

2.2 Snorkel Surveys

Snorkel surveys were used only in the Chowade River, and were conducted with paired swimmers accompanied by a data recorder walking along the shore. GPS coordinates were collected for each redd or group of redds by the data recorder. The number and location of fish was also recorded. Adult bull trout were identified as male, female, or unclassified. Where high densities of redds with obvious superimposition were encountered, the number of redds was estimated. At locations where very high densities of bull trout and/or redds were encountered, snorkel counts were repeated to ensure accurate estimates. Additional notes regarding snorkel survey start and end points, start and end times, environmental conditions, and miscellaneous observations, such as periphyton re-colonization of disturbed substrate, were also recorded.

2.3 Ground Surveys

Ground surveys were conducted in all surveyed segments except the Chowade River, with paired observers walking at the wetted stream margin along opposite sides of the stream channel. GPS coordinates were collected for each redd or group of redds observed. The number and location of fish was also recorded. Where high densities of redds with obvious superimposition were encountered, the number of redds was estimated. Additional notes regarding the survey start and end points and start and end times were also recorded.

3 RESULTS

On September 9-10, 16-17, and 20, 2008, bull trout spawning surveys were conducted on segments of the upper Halfway River, Cypress Creek, Chowade River, and Needham Creek. Survey dates, locations, and methods appear in Appendix I. Individual redd locations and fish observations appear in Appendix II. A detailed summary of redd and fish counts appears in Appendix III. The distribution and peak densities of bull trout redds observed in the Halfway River, Cypress Creek, Chowade River, and Needham Creek are plotted in Figures 2 to 5, respectively.

3.1 Upper Halfway River

On September 9, 2008, an aerial survey was conducted on segments of the upper Halfway River mainstem [REDACTED] (Fig. 2). Emphasis was placed on searching for redds and fish within each WHA and within the section of river between the WHAs where spawning activities was observed in 2005.

A meandering segment of river in the vicinity of McQue Flats, characterized by large channel morphology and fine substrates, received only a cursory inspection due to low spawning suitability. Six redds and 4 adult bull trout were observed [REDACTED] during the September 9 aerial survey. One adult bull trout was observed [REDACTED] No redds were observed within either WHA.

The September 9 aerial survey was replicated on September 20, 2008, at which time a ground survey was conducted on the section of river containing the redds observed on September 9. A total of 23 redds were enumerated (Fig. 2) and no remaining fish were observed. No additional redds or adult bull trout were observed within the remainder of the aerial search area, which included both WHAs.

3.2 Cypress Creek

On September 9 and 10, 2008, surveys were conducted in the vicinity of the [REDACTED] (Fig. 3). Only one bull trout redd and no fish were observed during a ground survey conducted within [REDACTED], where spawning activity had been concentrated in previous years [REDACTED].

During an aerial inspection extending downstream of the [REDACTED], bull trout redds were observed within a 2 km segment of Cypress Creek [REDACTED]. Redds had not been observed in this section in previous years and a ground survey of the full 2 km segment conducted on September 10 recorded 44 redds and 7 adult bull trout.

September 9-10 surveys in the vicinity of the [REDACTED] included a ground survey of a 2 km segment immediately downstream of the mouth of [REDACTED], encompassing [REDACTED], and aerial surveys of segments of Cypress Creek extending 900 m upstream and 1.6 km downstream of the ground-surveyed section. The lower 3.3 km of [REDACTED] was also assessed during the aerial survey. Eleven redds and 12 adult bull trout were recorded within the 2 km ground-surveyed section [REDACTED]. No redds or fish were observed during the aerial survey immediately upstream and downstream, while 3 redds and 4 adult bull trout were observed during the aerial survey of the lower 3.3 km of [REDACTED].

On September 16, 2008, ground and aerial surveys conducted on September 9 and 10, 2008, were repeated. Ground surveys replicated in the vicinity of [REDACTED] on September 16 recorded 4 redds [REDACTED] and 54 redds in the 2 km segment located 2.5 km downstream (Fig. 3). As during the September 9-10 survey, no redds or fish were observed during the aerial inspection of the 2.5 km between the ground-surveyed sections.

The September 16 ground survey encompassing [REDACTED] recorded 19 redds (13 within the WHA and 6 between the WHA and [REDACTED]). The September 16 aerial survey segment, located upstream of the mouth [REDACTED] was extended 4.7 km beyond the upper limit of the September 9-10 aerial survey. Although no bull trout spawning activity had been noted in this section during previous years, significant spawning activity was recorded during the September 16 survey, upstream of the 900 m section flown on September 9-10.

A total of 40 redds were enumerated in this section using a combination of aerial and ground surveys, during which single redds were counted from the air and redd clusters were counted from the ground. A proportion of these 40 redds were assumed to have been present on September 9-10 but were outside the aerial survey area.

The 3 redds observed during the September 9-10 aerial survey of [REDACTED] were indistinguishable on September 16 due to algae re-growth, and no additional redds were evident.

The minimum total number of bull trout redds present in the Cypress Creek spawning zones in 2008 was 120, including 58 in the vicinity of [REDACTED], 59 in the vicinity of [REDACTED], and 3 in [REDACTED].

3.3 Chowade River

Snorkel surveys were conducted within the existing [REDACTED] WHA on September 10 and 17, 2008. In addition, aerial surveys were conducted for 1.7 km upstream of the WHA boundary and 6.5 km downstream of the WHA boundary.

On September 10, 2008, 198 redds and 245 adult fish (151 males, 89 females, 5 unclassified) were recorded during the snorkel survey within the WHA. Aerial surveys outside the WHA boundaries recorded an additional 6 redds up to 600 m upstream and 21 redds up to 4.5 km downstream of the WHA (Fig. 4).

The replicate snorkel survey conducted on September 17, 2008 recorded 390 redds and 78 adult fish (57 males, 21 females) within the WHA, while a replicate aerial survey upstream of the WHA recorded an additional 14 redds. A replicate aerial survey downstream of the WHA on September 17 could not be completed due to failing daylight, and the September 10 count of 21 redds was used in the total redd estimate for downstream of the [REDACTED].

The minimum total number of redds estimated for the Chowade River spawning zone in 2008 was 425, including 390 within the WHA and 35 outside the WHA boundaries. Adult bull trout densities were highest during the September 10, 2008 survey with 252 bull trout enumerated in the combined snorkel and aerial survey sections. Male bull trout outnumbered females by a ratio of 1.7:1 on September 10.

By September 17, the total number of adult bull trout present had dropped to 78 fish (69% reduction) and the ratio of males to females had increased significantly (2.7:1), indicating that spawning activity was almost complete and emigration was advanced.

3.4 Needham Creek

On September 9, 2008, a ground survey of Needham Creek was conducted from [REDACTED]. A total of 42 redds and 27 adult bull trout were enumerated, including 14 redds within the WHA, 18 redds upstream and 10 downstream. An aerial survey conducted from the site of the lowermost redd, downstream to the mouth of Needham Creek, suggested that no spawning had occurred downstream of the ground-surveyed section.

[Figure 2 – REDACTED]

[Figure 3 - REDACTED]

[Figure 4 - REDACTED]

[Figure 5 - REDACTED]

The Needham Creek ground survey was replicated on September 16, 2008. A total of 76 redds and 5 adult fish were recorded, including 25 redds within the WHA, and 34 and 17 redds upstream and downstream, respectively. A replicate aerial survey conducted upstream from the mouth of Needham Creek recorded no redds or fish downstream of the ground-surveyed section. An aerial survey conducted between [REDACTED] (Fig. 5), revealed the presence of 2 bull trout redds on September 16, [REDACTED].

The minimum total number of redds estimated in Needham Creek for 2008 was 78. For the purpose of comparison with a 2007 MoE aerial redd count in Needham Creek (Euchner 2007), an aerial survey of the Needham Creek spawning zone was also conducted on September 16, resulting in an aerial estimate of 45 redds.

4 DISCUSSION

Surveys conducted in the Halfway River watershed between 1996 and 2001 identified no additional spawning zones used by migratory fluvial bull trout. These surveys included aerial reconnaissance, drift boat surveys, tributary fish and fish habitat inventory, and bull trout telemetry monitoring. Although sporadic spawning activity was observed or suspected in [REDACTED], no consistent year-to-year spawning use was observed in other Halfway River tributaries. Tributaries entering the Halfway River from the east, including the Cameron River, have low suitability for bull trout due to high sediment loads.

Based on bull trout telemetry monitoring (MoE 2000) and previous redd counts (Euchner 2002, Euchner 2006, Euchner 2007), the Chowade River accounts for roughly two-thirds of all migratory bull trout spawning activity in the Halfway River watershed. Aerial surveys and ground activities associated with fish tagging indicate that, although staging and holding occurs in the lower Chowade River, little spawning activity occurred outside the boundaries of the current WHA between 1994 and 2007. The total number of redds and spawning bull trout enumerated in the Chowade River during 2008 was the highest recorded to date (Fig. 6). Between 2005 and 2008, there appears to have been a two-fold increase in redd abundance in the Chowade River (210 to 425), with a corresponding increase in red density within [REDACTED] (206 to 390). This appears to be the continuation of an increasing population trend noted between 2002 and 2005, when the estimated total number of redds increased from 104 to 210 (Euchner 2006). Due to differences in survey extent and methodology, estimates of Chowade River spawning activity recorded between 1994 and 1996 are not directly comparable to the 2002, 2005, and 2008 surveys, but generally suggest lower redd density than that recorded in 2002. Redd numbers estimated in the Chowade River in 1995 and 1996 were 55 and 69, respectively (Baxter 1995, Baxter 1997a).

In 2005, 206 of the 210 identified redds (98.1%) were located [REDACTED] (Euchner 2006). In 2008, 390 of 425 (91.8%) identified redds were located inside the WHA. The increasing proportion of redds located outside the core spawning zone, as defined by the WHA boundaries, is also an indication of increasing spawning run size and higher overall spawner densities. If spawning run size continues to increase, spawning activity may continue to expand outward from preferred spawning sites within the WHA. This is supported by the high degree of redd superimposition encountered within the WHA in 2008.

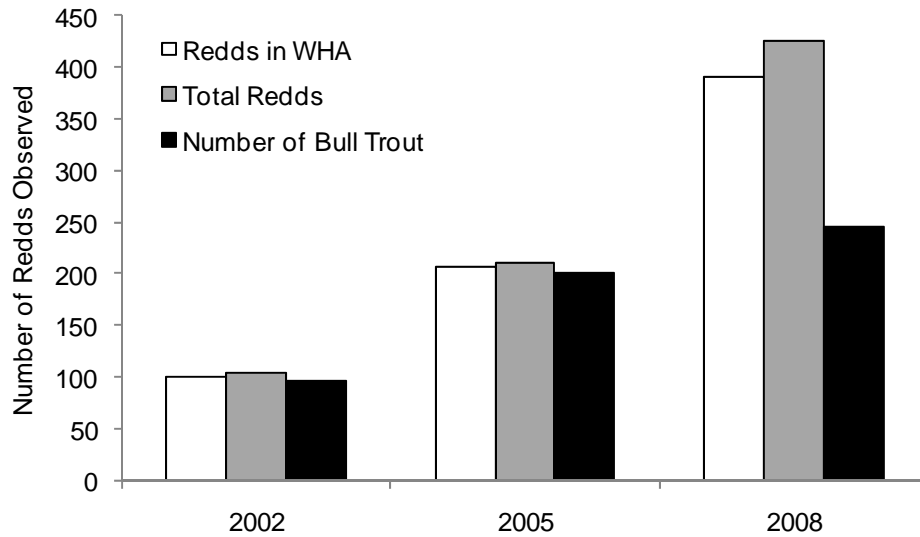


Figure 6. Comparison of counts of bull trout redds and adult spawners in the Chowade River in 2002, 2005 and 2008.

The total number of redds enumerated in the upper Halfway River, Cypress Creek, and Needham Creek spawning zones during 2008 is also higher than that previously observed (Fig. 7). For example, an aerial redd count of [REDACTED] conducted in 2007 (Euchner 2007) recorded 29 redds, while a comparable aerial count conducted on the same [REDACTED] in 2008 recorded 48 redds.

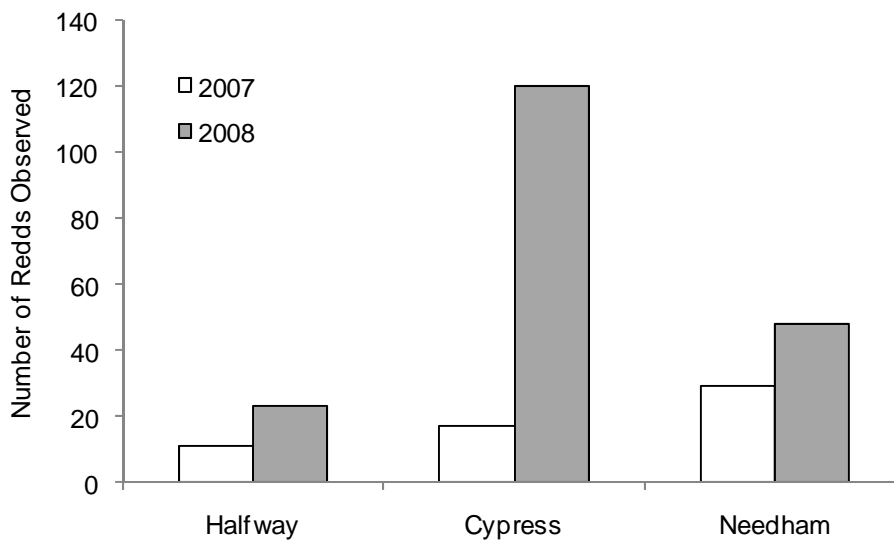


Figure 7. Comparison of the number of bull trout redds observed in upper Halfway River, Cypress Creek and Needham Creek in 2007 and 2008.

Between 2007 and 2008, survey conditions and timing were consistent and there is no indication that factors other than increased spawning run size can account for the increases in bull trout redd counts. It would appear that the apparent increase in abundance occurring in the Chowade sub-population is representative of the other 3 upper Halfway spawning sub-populations, and is assumed to result from a general increase in abundance in the Peace-Halfway migratory bull trout population.

As in 2007 (Euchner 2007), none of the redds identified in the upper Halfway River in 2008 were located [REDACTED]. Furthermore, redds identified in 2008 were located in the same stream section as those in 2007, suggesting a need for modification of the existing WHA boundaries.

The number of redds enumerated in Cypress Creek in 2008 was significantly higher than that observed in 2007 (Fig. 7). In addition to increased redd abundance, 97 of 120 redds (80.8%) were located outside of both existing WHAs. These redds were largely distributed [REDACTED] (54) and [REDACTED] (40). Although there appeared to be a downstream shift in spawning activity from the upper WHA, a proportion of the redds located outside the boundaries of the WHAs is assumed to be a result of increased adult bull trout abundance.

Increased adult bull trout abundance is largely attributed to conservative angling regulations implemented in 1997. A reduction of the legal harvest of bull trout to zero throughout the unimpounded Peace watershed, and the prohibition of angling at the Peace-Halfway confluence during the vulnerable spring staging period, appears to have resulted in increased survival of adult spawners over the last decade.

As industrial development and recreational activity expands, maintenance of the Peace-Halfway migratory fluvial bull trout population will depend on the protection afforded to critical spawning zones in the upper Halfway watershed. The long-term management of this fish population requires continued long-term monitoring of indices of abundance.

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Appendix I
Survey Dates and Location
[REDACTED]

Appendix II

Individual Redd Locations and Fish Observations

[REDACTED]

Appendix III

**Summary of
Redd and Fish Counts
[REDACTED]**