Bull Trout Population Assessment in the Upper Oldman River Drainage, 2009
Data Report

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1.0 INTRODUCTION

Historically, Bull Trout (Salvelinus confluentus) were the only native 'char' species to occupy all East Slope drainages in Alberta (Post and Johnston 2002). Since the early 1900's, the abundance and distribution of this species has declined and has been restricted to the headwater drainages throughout the upper Peace, upper Athabasca, upper North Saskatchewan, and upper South Saskatchewan River basins. The decline is attributed to the effects associated with anthropogenic impacts, including angling pressure, habitat fragmentation and degradation, migratory barriers and introduction of non-native fish stocks (Post and Johnston 2002). These disturbances have led to a significant decline in Bull Trout populations and have resulted in threatened designations and extirpation throughout the Bull Trout native range (Rieman et al. 1997, Nelson et al. 2002). The General Status of Wild Species (2000) has ranked Alberta's Bull Trout as a 'sensitive' species. In addition, Bull Trout are listed as a "threatened" species in the United States (lower 48 states) under the United States Endangered Species Act (1999).

Bull Trout inhabit cold-water stream, river and lake habitats throughout Alberta's East Slopes which generally have lower productivity and carrying capacity. Reduced growth rates, late maturity and alternate-year spawning of Bull Trout are related to a low production coldwater habitat (Nelson and Paetz 1992). The specific habitat preferences and low reproduction and growth rates of Bull Trout are reflective to the species sensitivity to environmental, biological or anthropogenic effects (Nelson and Paetz 1992, Post and Johnston 2002). Bull Trout prefer diverse habitats with stable flows, low proportions of fine sediments, available cover, suitable water temperatures, and open migratory corridors (Haas 2001, McCart 1997, Watson and Hillman 1997). Bull Trout habitat diversity and connectivity allow for the expression of all types of life history strategies and are responsible for the persistence of Bull Trout (Rieman and Clayton 1997).

Bull Trout exhibit three main life history strategies: resident, fluvial, and adfluvial. Stream-resident Bull Trout permanently reside in small headwater tributaries. Migration is minimal for stream-resident fish, and spawning and overwintering occur within the same stream (Nelson and Paetz 1992). Stream-resident Bull Trout

populations are generally isolated from other Bull Trout populations, typically segregated by fish barriers (McPhail and Baxter 1996). Stream-resident Bull Trout mature earlier and are typically smaller than migratory fish (< 300 mm) because they reside in low production waterbodies (Bellerud et al. 1997 and Earle and McKenzie 2001).

Fluvial and adfluvial Bull Trout are migratory fish that migrate from larger waterbodies and spawn in smaller headwater tributary streams. The difference between the two migratory life history forms is that fluvial Bull Trout inhabit larger mainstem streams and rivers throughout most of their life, whereas adfluvial Bull Trout reside in lakes and reservoirs throughout most of their life (McPhail and Baxter 1996). Migratory Bull Trout grow larger than stream-resident Bull Trout (≥ 400 mm) given that they reside in waterbodies that are much more productive (Allan 1980, Brewin 1994, Clayton 1999, Hvenegaard and Thera 2001, Rhude and Rhem 1995). Bull Trout migration can be quite extensive, as fish have been known to migrate distances of up to 400 km (McPhail and Baxter 1996). Upstream migration occurs early in the summer when water temperatures rise and stream flows subside and typically vary depending on the migration distance (Monnot et al 2008, Mushens 2003, Popowich and Paul 2006, Allan 1980, Bellerud et al. 1997, Burrows et al. 2001, Clayton 1998).

Alternate-year spawning is common in migratory Bull Trout populations, where individuals migrate and spawn in spawning tributaries once every two years (Nelson and Paetz 1992). As adult spawning populations become denser, alternate-year spawning occurs less and non-repetitive spawning (> 2-year spawning cycle) becomes more common, especially in male fish (Johnston and Post 2009). Successive-year spawning is also present in migratory populations and comprises 20% of the spawning population. Successive-year spawning is also density dependent and occurs less frequently as the spawning density increases (Johnston and Post 2009).

Bull Trout contain complex habitat requirements and exist in habitats where life history strategies overlap (Post and Johnston 2002). It is common for stream-resident and migratory Bull Trout to inhabit the same waterbody. Historically, where resident and migratory forms coexist, the migratory form is dominant (Fredenberg et al. 2005).

Whitesel et al. (2004) indicates that as an apex predator species, the migratory life cycle of Bull Trout is a highly successful strategy.

The upper Oldman River (UOM) Bull Trout population historically exhibited two of the three life history strategies, stream-resident and fluvial populations. And since the construction of the Oldman River Dam, an adfluvial Bull Trout population has become established in the Oldman Reservoir (Warnock in press).

Bull Trout distribution within the Oldman watershed has declined to 34% of the watershed's historic range, largely since the 1950s (Fitch 1997). Since this time, human activity has increased in the UOM drainage, as well as other East Slope drainages. Logging, gas exploration and extraction, off-highway vehicle use, random access camping and angling are just a few activities that have been cumulatively impacting Bull Trout and Bull Trout habitat in the UOM drainage. Few assessments have been completed on the UOM Bull Trout population. Therefore, a drainage-wide Bull Trout population assessment is required to update the current status of the species within the UOM drainage.

The Alberta Conservation Association (ACA) is currently conducting a four-year Bull Trout population assessment in the UOM drainage. The study focuses on intercepting and marking migratory post spawn Bull Trout in key spawning tributaries in an effort to estimate the adult migratory Bull Trout population in the UOM drainage. Redd surveys have also been conducted to identify critical Bull Trout spawning habitats throughout the UOM drainage and also to determine the abundance and distribution of spawning activity within these identified spawning habitats. Currently, three consecutive years of fish trapping has been completed in Hidden Creek, since 2007. Similar efforts were completed for two consecutive years in the Livingstone River, Racehorse Creek and Dutch Creek. Redds surveys have been completed throughout the UOM drainage in 2008 and 2009.

2.0 METHODS AND MATERIALS

2.1 Trapping

Fish traps were installed in Hidden Creek, the Livingstone River, Racehorse Creek, and Dutch Creek to intercept post spawn Bull Trout between 24 August and 6 October, 2009, (Figure 1). All four traps were positioned at the same time and location as 2008. Hidden Creek was initially trapped in 2007, which utilized a bidirectional fish trap during the summer and fall to identify the post spawn Bull Trout migration period.

The Hidden Creek fish trap was located approximately 100 m upstream from the confluence of the upper Oldman River. The trap was positioned in a large pool produced by a bedrock outcropping. The Livingstone River fish trap was located approximately 125 m downstream from the mouth of White Creek near the tail end of a large pool. The Racehorse Creek fish trap, located approximately 800 m upstream from the forestry trunk road (Highway 40) bridge crossing, was placed in a run section immediately downstream from a riffle section. The Dutch Creek fish trap was positioned 1750 m upstream from the Highway 940 bridge crossing along a bend in the creek in a run located at the tail end of a pool.

Each fish trap was comprised of aluminium conduit held in place with aluminium frames and steel A-frame support stands. Holding cages were positioned near the middle of the stream and trap wings were attached to each side of the cage that extended at an angle toward adjacent steam banks. Trap wings produced a V-shaped fish barrier that funnelled migrating fish into the holding cage. All holding cages were installed in deep, flowing water that sustained each intercepted fish until the fish were processed. Fish traps were checked daily to reduce fish stress and minimize fish mortality. Upstream migrating fish blocked by the fish trap were captured with a dip net, processed and released upstream from the trap.

Passive Integrated Transponders (PIT) tags were applied to all Bull Trout $\geq$300 mm. PIT tags produce a unique 16 digit numeric marker specific to the individual and in the event of a recapture, fish movements can be tracked in relation to their initial

capture or consecutive captures. Prior to processing, captured fish were scanned with a PIT tag scanner to identify recaptured fish. Newly captured fish were immersed in a clove oil solution bath (10 drops clove oil/10 mL of pure 100% ethanol/10 L water) which was used as an anaesthetic to reduce fish stress and ease fish handling prior to tag insertion.

Tag application occurred by injecting a sterilized 12-gauge needle, loaded with a markers tag, into the musculature of the fish. Tags were applied at the base, near the posterior end of the dorsal fin. Prior to injection, sterilized marker tags were scanned and recorded, and following tag injection, a secondary scan was applied to ensure the tag was retained and to confirm the marker number previously recorded matched the scanned fish. Following fish processing, all Bull Trout were revived and released back in the initial direction the individual was migrating away from the fish trap.

Fork length (mm), total length (mm) and weight (g) was measured and recorded for each captured fish. Fish sex was determined by gently stripping the fish's abdomen and observing the extracted reproductive material (milt or eggs). If no reproductive material was observed, secondary characteristics, such as the presence of a kype (hooked lower mandible) or orange colouration of the abdomen (both male characteristics) were used to identify the sex of the individual.

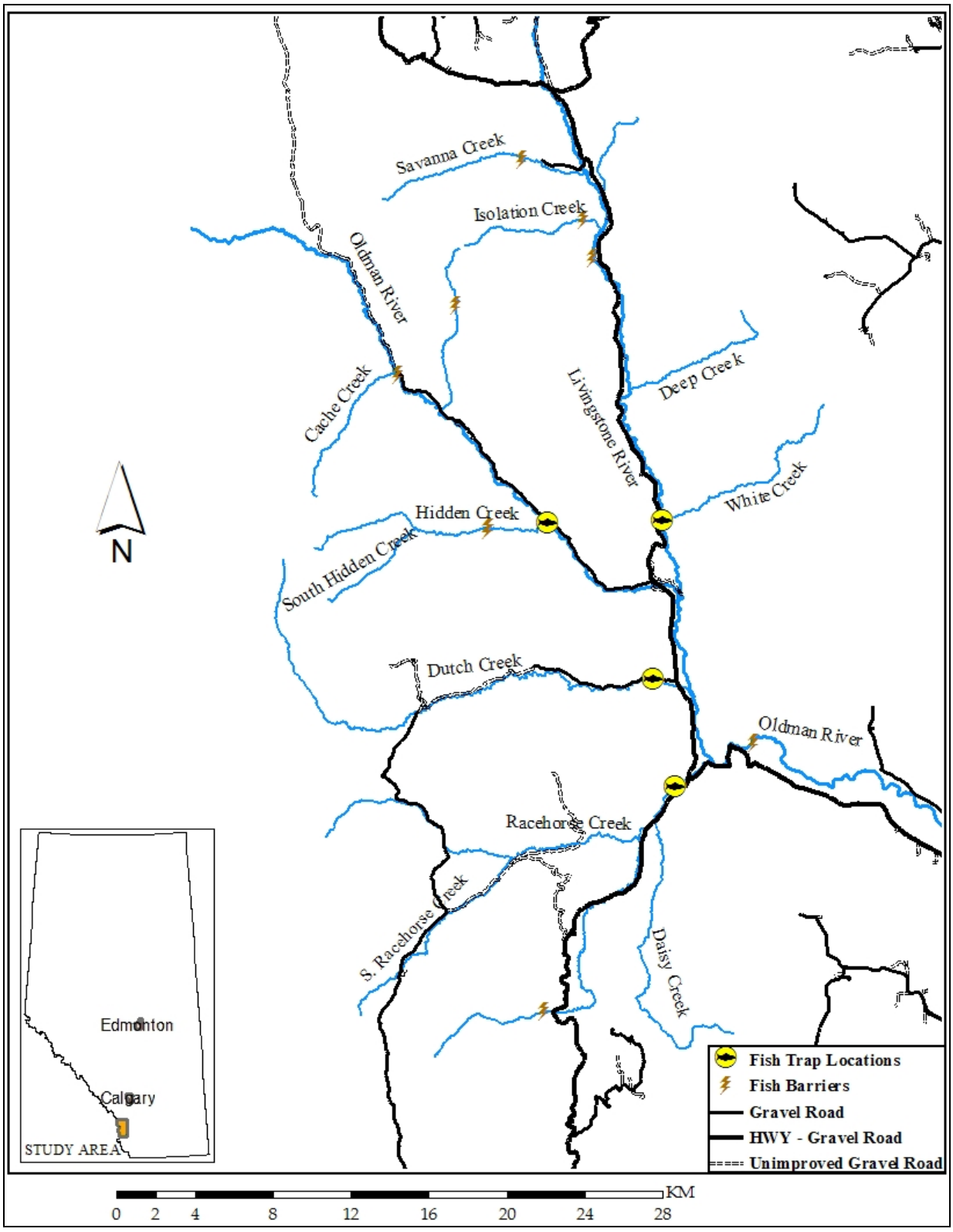

Figure 1. Upper Oldman River drainage Bull Trout fish trap locations, 2009.

2.2 Redd Surveys

Redd surveys were conducted throughout the Bull Trout spawning season. A minimum of three different redd surveys were completed in all historic spawning sections, during the beginning, the middle and the end of spawning season. Final redd surveys were conducted one week prior to the removal of the fish traps to ensure spawning was complete, to account for all fish that remained upstream of the traps, and to enumerate the final number of Bull Trout redds in the stream. Redd surveys were also conducted in other streams in an effort to identify other important Bull Trout spawning habitat in the drainage. These streams were surveyed once during the season and an additional two times if redds were present.

Redd survey methodology was adopted from Gerrand et al. (1995, 1996, 1997 and 1999) and consisted of wading through stream channels to observe Bull Trout redds and/or spawning activity. Redd length (cm), width (cm) and water depth (cm) were measured and recorded for each identified redd. Redd superimposition measurements were obtained by enumerating the total number of pits and by measuring the total length, width and a representative water depth of the entire spawning area. Each redd was identified in a systematic order, flagged and located using a hand held GPS (UTM). Stream type (run, riffle, and pool), stream location (left upstream bank, right upstream bank and mid channel), overhead cover (beneath woody debris, beneath vegetation or no cover) and observations of Bull Trout were additional data collected for analysis.

2.3 Sample Angling

Angling was conducted to capture and tag adult Bull Trout in an effort to identify migration movements from outside of the UOM drainage. Sample angling occurred during late spring when Bull Trout commenced their upstream migration. Sample angling was concentrated at the plunge pools of the GAP falls and Waldron falls, where Bull Trout were observed to be staging prior to their upstream migration. Bull Trout were processed and tagged using the same tagging procedure as fish trap tagging.

2.4 Analysis

Data gathered from all capture events were analyzed using Microsoft Excel and Microsoft Access. Fish data and redd data was assessed using Microsoft Excel and recapture analysis was determined by Microsoft Access. All fish captured downstream between August 25 and October 5 was used as a standard to compare all trapping events (2007 – 2009) which was required to offset the sampling effort variation (August – October and September - October) and difference in trap type (bi-directional vs. directional).

3.0 RESULTS

3.1 Hidden Creek

3.1.1 Fish Trap

The Hidden Creek fish trap captured a total of 59 adult Bull Trout between August 24 and October 6, 2009 (Table 1). Of the 59 intercepted fish, 33 fish were recaptured Bull Trout from the 2007 and 2008 trapping efforts (58% recapture rate). It was observed that 22 of the 33 Bull Trout recaptured during 2009 were alternate-year spawning fish initially captured at Hidden Creek during 2007 (18% alternate year spawning fish, n = 121 [2007]). Eleven of the 33 recaptured fish were identified as successive-year spawning fish which were tagged and/or recaptured between 2007 and 2009 or 2008 and 2009; the remaining fish was originally captured in the Oldman River by electrofishing in 2007.

Table 1. Bull Trout catch summary of fish captured following the removal of the Hidden Creek fish trap, 2007 – 2009 (recaptured fish included).

	Bull Trout intercepted downstream	Bull Trout remaining upstream	Total Bull Trout intercepted
2007+	115	6	121
2008++	70	11	81
2009+++	57	2	59
Total	242	19	261

\+ July 31 – October 5

++ August 25 – October 12

+++ August 24 – October 6

During 2008, a total of 82 Bull Trout were intercepted by the fish trap, 28 of which were recaptured individuals tagged at Hidden Creek during 2007 (34% recapture rate). Of the 28 fish recaptured in 2008, three individual Bull Trout tagged at Hidden Creek during 2007 were recaptured during 2009. Of the 53 Bull Trout intercepted and tagged in Hidden Creek during 2008, eight fish were captured at Hidden Creek in 2009, signifying that these individuals were successive-year spawning fish. A total of 200 fish have been intercepted and tagged in Hidden Creek since 2007 and a total of 29% (n = 57) of these fish have returned to spawn as successive-year or alternate-year spawners; while the remaining 61% (n = 143) of these fish have not returned to spawn in Hidden Creek.

Bull Trout captured at Hidden Creek during 2009 had an average fork length of ($\pm$ SD) 547 + 89.4 mm (fork length) and ranged between 373 to 778 mm (Figure 2). Fish weights ranged from 400 to 4300 g and the average fish weighed 1653 + 818.7 g.

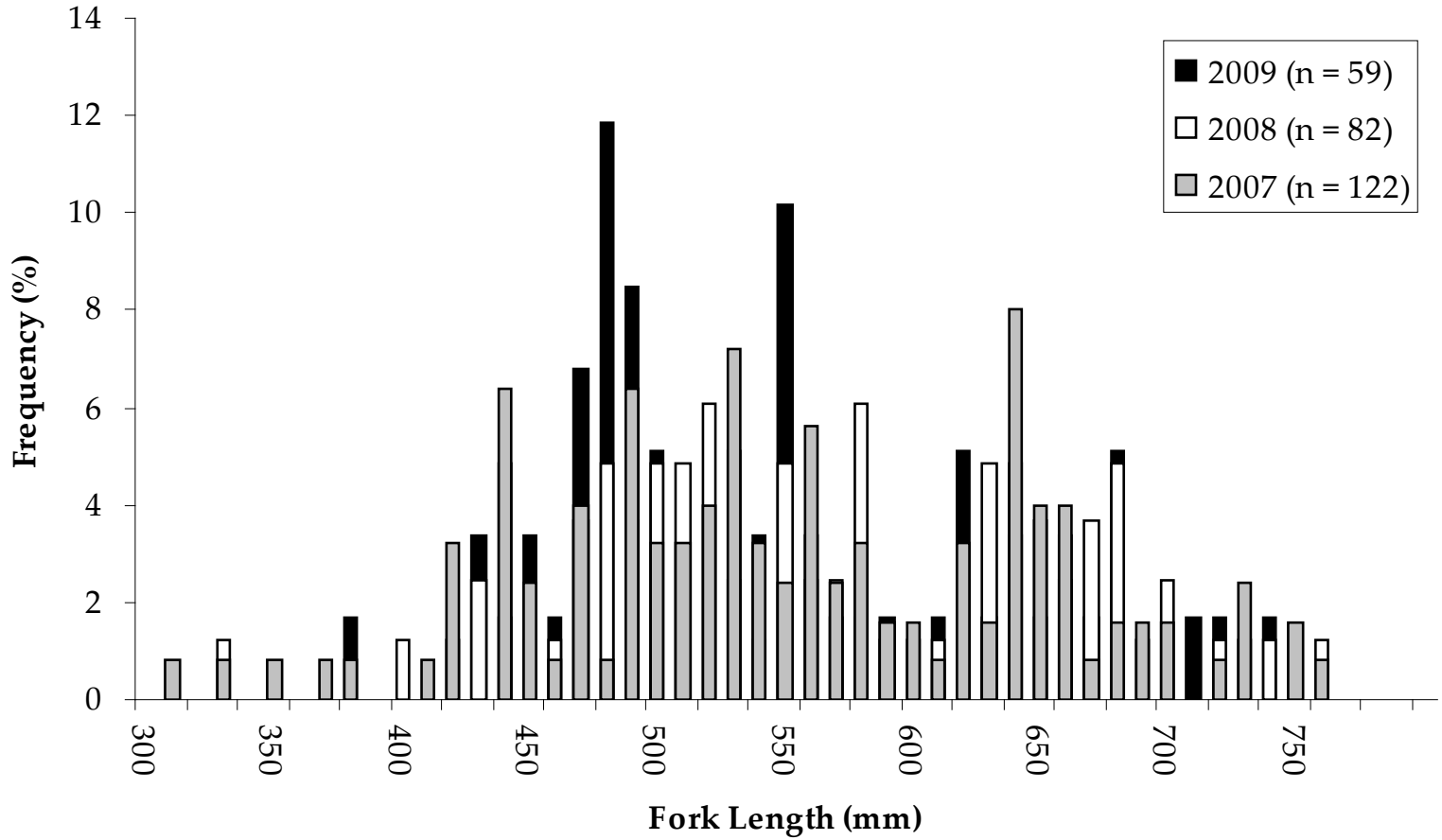

Figure 2. Fork length frequency distribution of Bull Trout intercepted the Hidden Creek fish trap, 2007 – 2009.

Bull Trout captures in the Hidden Creek fish trap was lowest in 2009 and highest in 2007 (Figure 3).

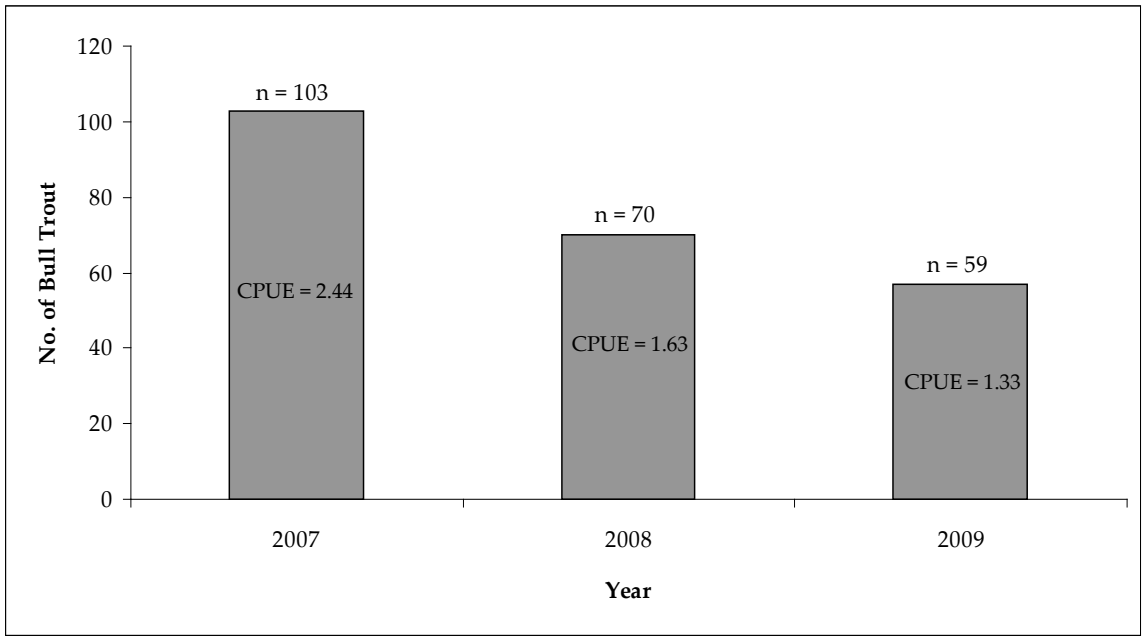

Figure 3. Bull Trout captured by the Hidden Creek fish trap, 2007 – 2009 (Post spawn Bull Trout intercepted between Aug 25 and Oct 5).

3.1.2 Redd Survey

A total of 10.6 km of stream were surveyed from the Hidden Creek confluence upstream to approximately 1 km upstream from the South Hidden Creek confluence (Figure 4). Within the survey reach, a total of 77 Bull Trout redds (including superimposed redds) were observed between August 28 and October 4, 2009. All redds were situated downstream from the Hidden Creek falls, approximately 3.9 km upstream from the Hidden Creek confluence. Fewer redds were observed in Hidden Creek during 2009, than during 2008 (n = 108); a total of 97 of the 108 redds were located downstream of the Hidden Creek falls (2008). Redd densities were lower in 2009 (20 redds per km) than in 2008 (25 redds per km). Fish to redd ratios, however, were similar between 2008 and 2009, respectively 0.76 fish per redd (82 Bull Trout: 108 redds) and 0.77 fish per redd (59 Bull Trout: 77 redds).

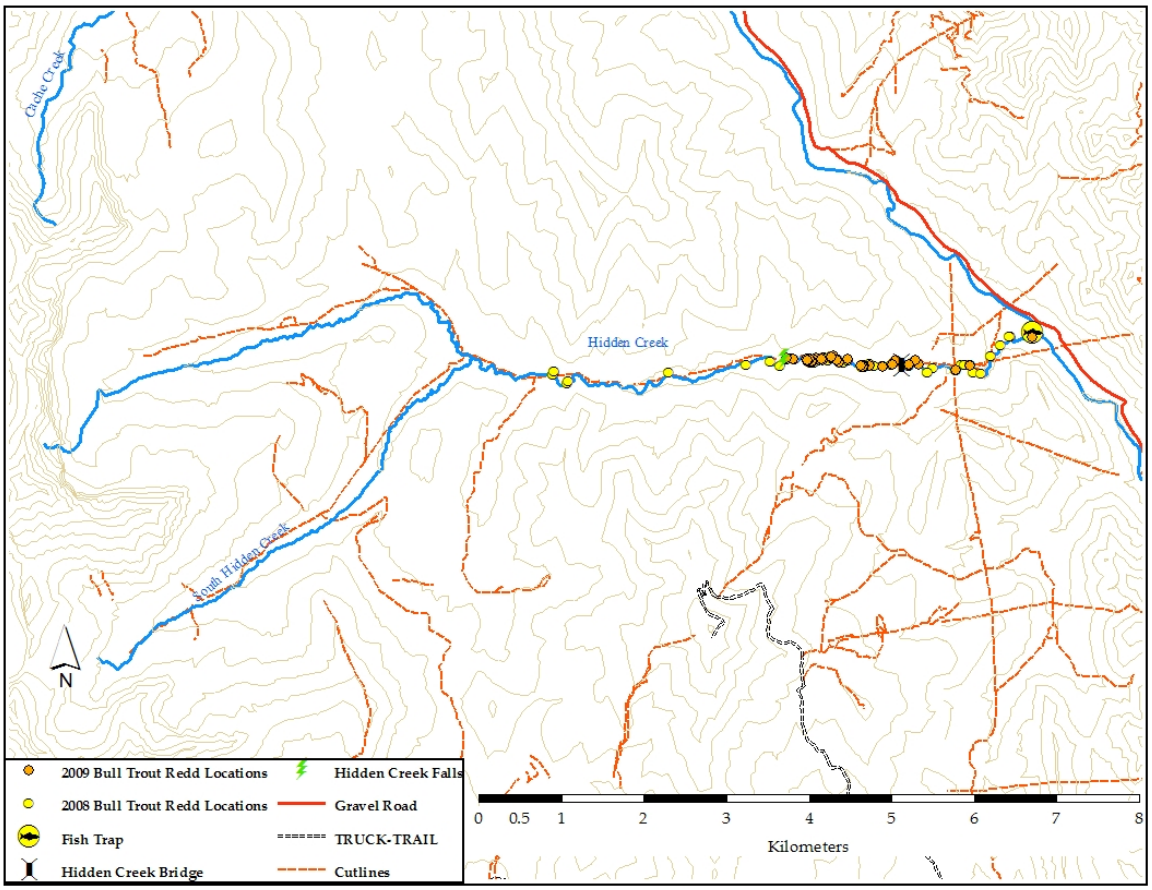

Figure 4. Bull Trout redd locations observed in Hidden Creek during 2008 and 2009.

Redds observed in Hidden Creek during both 2008 and 2009 showed similar dimensions and characteristics with respect to redd size, stream type, stream location, and cover type (Table 2). Redds were observed in 2009, occupied the same spawning habitat as observed during 2008. Most spawning habitat was situated in run sections consisting of marble-sized gravel, overhanging vegetation and/or deadfall and groundwater input; groundwater was observed by the major bank slumping caused by water seepage. The highest density of Bull Trout redds was situated in a 100 m reach of Hidden Creek downstream from the mouth of the middle canyon, located approximately 200 m downstream from the Hidden Creek falls.

Table 2. Redd dimensions obtained from Hidden Creek during 2008 and 2009 (mean ± SD).

		Redd length (cm)	Redd width (cm)	Redd Depth (cm)
2009	Average	127.9 + 34.1	58.8 + 15.8	38.1 + 7.7
	Range	70 - 330	40 - 140	20 - 60
	n	75	75	75
2008	Average	126.9 + 43.1	62.4 + 20.5	32.6 + 12.6
	Range	40 - 300	20 - 120	10 - 80
	n	108	108	108

Redd surveys conducted early in the spawning season revealed a higher rate of spawning activity, when Bull Trout were observed to be on or near redds. During the end of the spawning season, however, spawning activity was not observed even though several Bull Trout remained upstream.

3.2 Livingstone River

3.2.1 Fish Trap

The Livingstone River fish trap intercepted a total of seven adult Bull Trout between August 26 and October 6, 2009 (CPUE = 0.17 Bull Trout per day), which was significantly lower than the 2008 catch (n = 19, CPUE = 0.46). A total of four of the seven Bull Trout were recaptured fish from previous trapping years, three of which were intercepted at the Hidden Creek fish trap; two fish were recaptured earlier at Hidden Creek in 2009, while the third had been previously intercepted during 2008. The fourth recaptured fish was initially captured during 2007 at an electrofishing site from the Oldman River, just downstream from the Livingstone River confluence.

Bull Trout captured from the Livingstone River fish trap ranged in length between 525 and 671 mm (fork length) with a mean (± SD) of 592.1 + 50.5 mm. Fish weights ranged from 1300 - 2600 g and averaged 2071.4 ± 482.1 g.

3.2.2 Redd Survey

Livingstone River redd surveys were conducted between the confluence of Deep Creek, immediately upstream from the Savanna Creek bridge crossing. A total of 41 Bull Trout redds were identified on the upper Livingstone River between the mouth of Isolation Creek and Savanna Creek, covering a total of 5.1 km (Figure 5). No redds were observed upstream of Deep Creek which was the reach where redds were observed during 2008 (n = 26).

Redds discovered in 2009 were commonly established along the margins of the upper Livingstone River where overhanging vegetation and/or deadfall was present. Redds observed in the center of the stream were concealed beneath cover, such as log jams or deep water. Redds were also discovered along the upstream end of an active beaver dam, located approximately 30 m upstream from the Isolation Creek bridge crossing. Redd dimensions for redds discovered throughout the Livingstone River during 2008 and 2009 are listed in Table 3.

Table 3. Redd dimensions obtained from the Livingstone River during 2008 and 2009 (mean $\pm$ SD).

		Redd length (cm)	Redd width (cm)	Redd Depth (cm)
2009	Average	117.0 + 46.0	47.8 + 13.4	42.1 + 11.1
	Range	40 - 280	25 - 80	25 - 70
	n	41	41	41
2008	Average	86.5 + 106.7	48.9 + 106.4	25.3 + 730.5
	Range	55 - 140	30 - 75	11 - 38
	n	26	26	26

A total of seven Bull Trout < 400 mm were observed spawning on or near redds during redd surveys suggesting that these redds were produced by stream-resident Bull Trout. Fish trap data also suggests that these fish are stream-resident fish because no fish of this size class was intercepted by the fish trap during 2009.

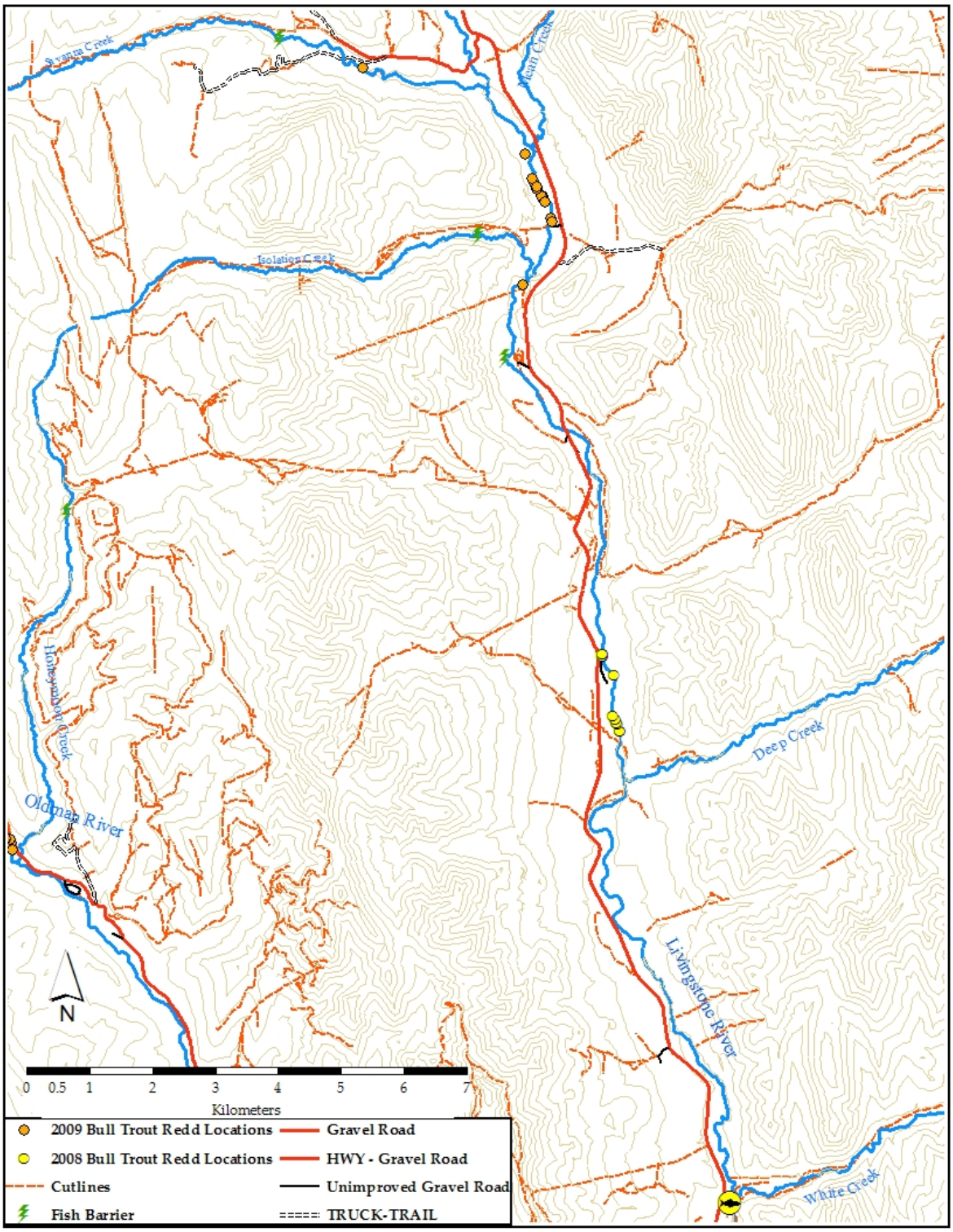

Figure 5. Observed Bull Trout redd locations observed in the Livingstone River during 2008 and 2009.

3.3 Racehorse Creek

3.3.1 Fish Trap

The Racehorse Creek fish trap intercepted a total of eight Bull Trout between August 26 and October 6, 2009. Three of the eight fish were recaptured adult fish marked during 2008. Of the three recaptured fish, a single fish was previously intercepted and tagged at Racehorse Creek during 2008, a second Bull Trout was captured and tagged at Hidden Creek during 2008 and the third fish was also initially captured at Racehorse Creek (2008) and subsequently recaptured a second time in the Livingstone River (2008). Similar to Hidden Creek and the Livingstone River, Racehorse Creek fish catch rates were observed to be significantly lower in 2009 (CPUE = 0.19) than in 2008 (CPUE = 0.37, n = 15).

Bull Trout captured in Racehorse Creek ranged from 490 - 758 mm (fork length) and averaged ($\pm$ SD) 629.3 $\pm$ 80.6 mm. Fish weight ranged between 850 and 4900 g with a mean of 2575 $\pm$ 1183.8 g.

3.3.2 Redd Survey

Redd surveys were conducted on both South and North Racehorse creeks during 2009. The Racehorse Creek mainstem was not surveyed due to the absence of Bull Trout redds during 2008. South Racehorse Creek was surveyed from the forks upstream to the Atlas Road stream crossing where a total of 21 redds were observed in less than 3 km (Figure 6). North Racehorse Creek was surveyed from the confluence of North and South Racehorse creeks, upstream to the headwaters but no Bull Trout redds were observed.

Bull Trout redds observed in South Racehorse Creek were located in two clusters located approximately 4 km downstream from the Atlas Road bridge crossing. This reach of South Racehorse Creek consisted of a relatively narrow channel and marginal stream volume likely unsuitable for larger adult Bull Trout. All 21 redds were located in run sections free from cover and situated in gravel substrate (Table 5).

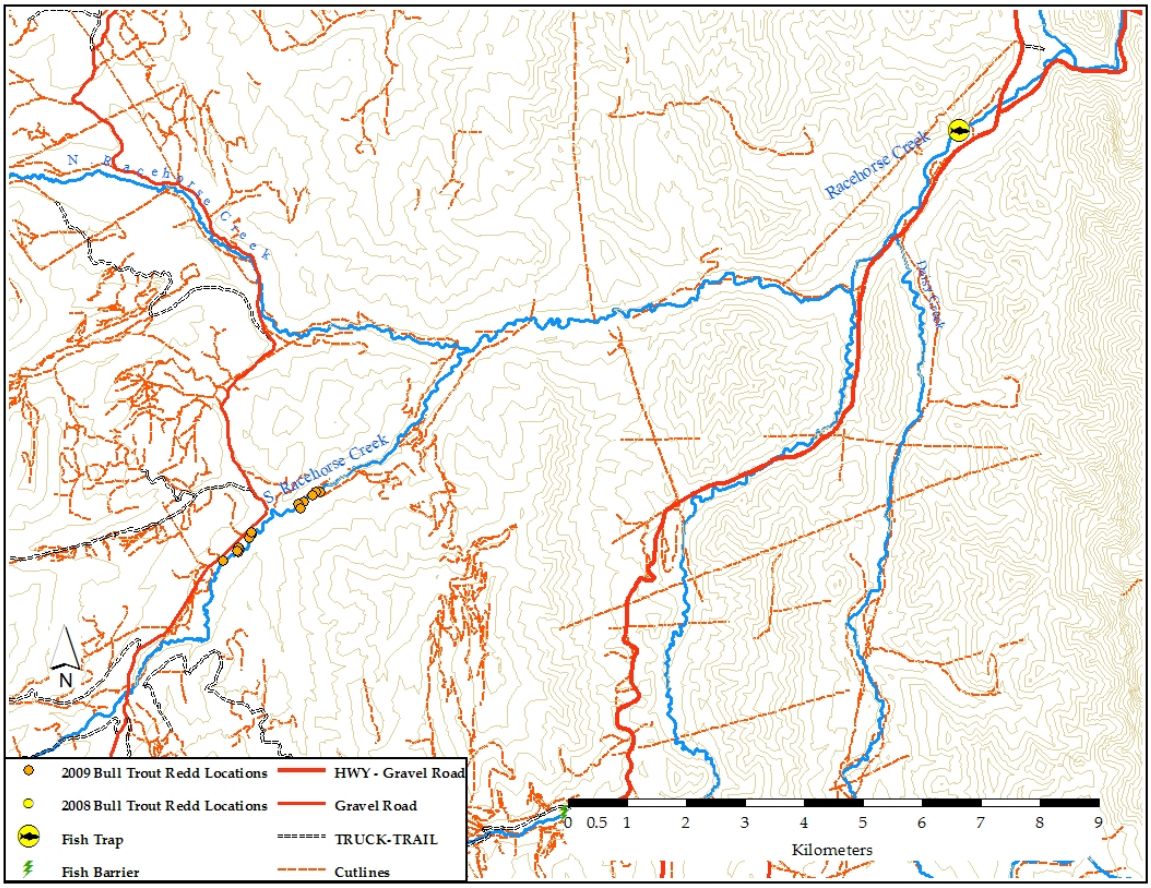

Figure 6. Bull Trout redd locations observed in Racehorse Creek during 2008 and 2009.

Table 5. Redd dimensions obtained from South Racehorse Creek during 2009 (mean ± SD).

		Redd length (cm)	Redd width (cm)	Redd Depth (cm)
2009	Average	127 + 33.6	46.9 + 16.8	28.1 + 9.4
	Range	40 - 180	30 - 90	15 - 50
	n	21	21	21

Bull Trout were not observed during all redd surveys and it was presumed that these redds were produced earlier in the spawning season due to the algae growth and the silt deposition that had accumulated on redds.

3.4 Dutch Creek

3.4.1 Fish Trap

A total of four Bull Trout were captured at the Dutch Creek fish trap, two fish of which were recaptures; one fish initially intercepted by the Dutch Creek fish trap in 2008 and the second fish was initially captured at Hidden Creek in 2007, and subsequently recaptured a second time at Hidden Creek during 2008. The 2009 Dutch Creek fish trap catch rate (CPUE = 0.1) was significantly lower than the catch rate during 2008 (n = 10, CPUE = 0.21).

Bull Trout captured in the Dutch Creek fish trap ranged from 581 - 683 mm (fork length) with a mean of 622.8 $\pm$ 50.1 mm ($\pm$ SD). Fish weights ranged from 1600 - 2850 g and averaged 2250 $\pm$ 558.3 g.

3.4.2 Redd Survey

Redd surveys were conducted from the fish trap upstream 23.5 km to the headwaters, where a total of 69 redds were observed (Figure 7 and Table 6). The highest redd density was located immediately upstream of the Atlas Road bridge crossing. In comparison, only 25 redds were observed in the same reach during 2008. All redds observed in Dutch Creek during 2009 were established in run sections. Groundwater influence was likely the reason for the high density of redds which was identified by the constant flow volume fluctuations throughout this reach. Thirty-eight of the 69 redds were also observed under woody debris and overhanging vegetation or undercut banks.

Table 6. Redd dimensions obtained from Dutch Creek during 2008 and 2009 (mean ± SD).

		Redd length (cm)	Redd width (cm)	Redd Depth (cm)
2009	Average	120.9 + 33.0	47.6 + 15.1	29.0 + 11.6
	Range	50 - 230	30 - 90	10 - 60
	n	69	69	69
2008	Average	96.4 + 19.8	48.9 + 11.3	25.3 + 8.1
	Range	70 - 150	25 - 80	15 - 50
	n	25	25	25

A total of eight adult Bull Trout were observed spawning in the upper reach of Dutch Creek during the initial redd surveys; no fish were observed following the last week of September.

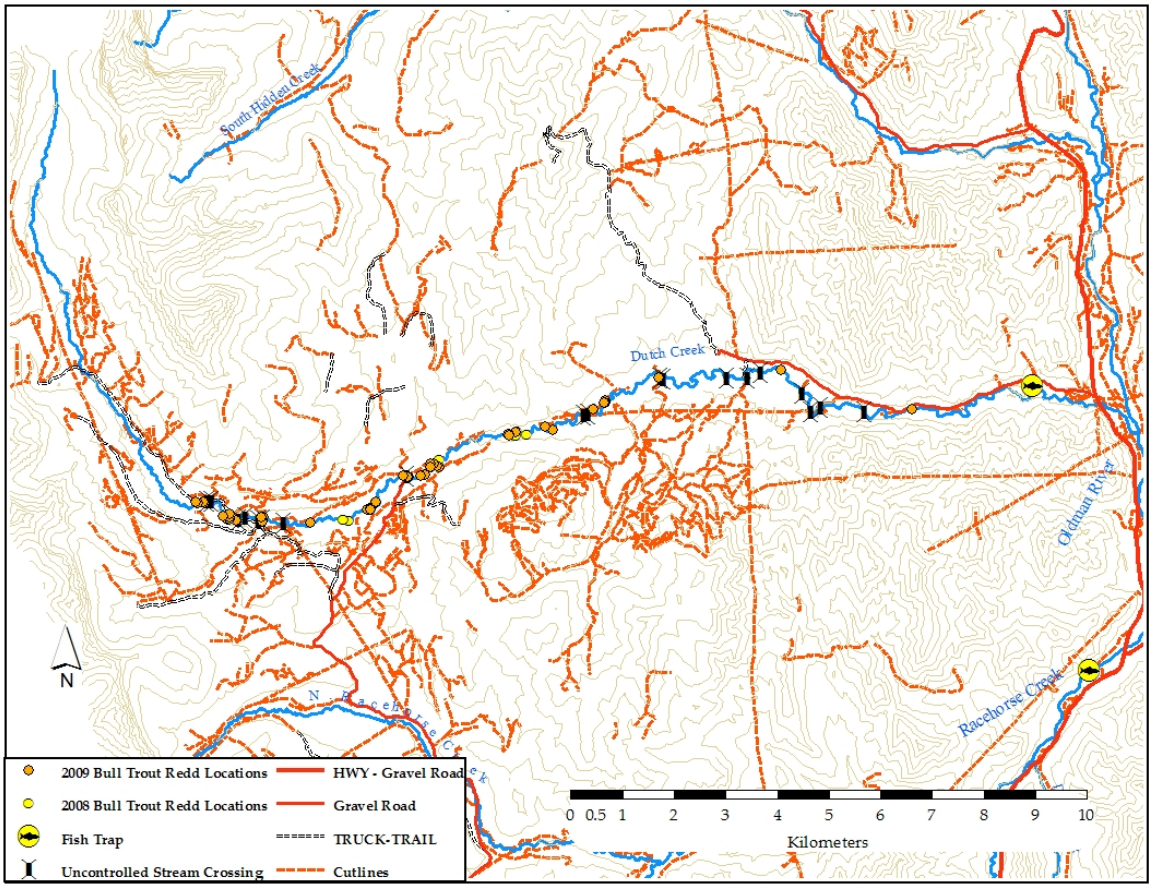

Figure 7. Bull Trout redd locations observed in Dutch Creek during 2008 and 2009.

3.5 Additional Redd Surveys

3.5.1 Upper Oldman River

A total of 21 Bull Trout redds were observed in a 3.5 km reach in the upper Oldman River, from the upper Oldman River falls downstream to the mouth of Honeymoon Creek (Figure 8 and Table 7). Most redds were located along the river's margins, while only seven redds were observed under cover. Redds were common in medium-sized gravel and remained clean from algae growth and silt throughout the fall. Over the course of the spawning season a total of four adult migratory Bull Trout >400 mm were observed to be actively spawning throughout the upper Oldman River.

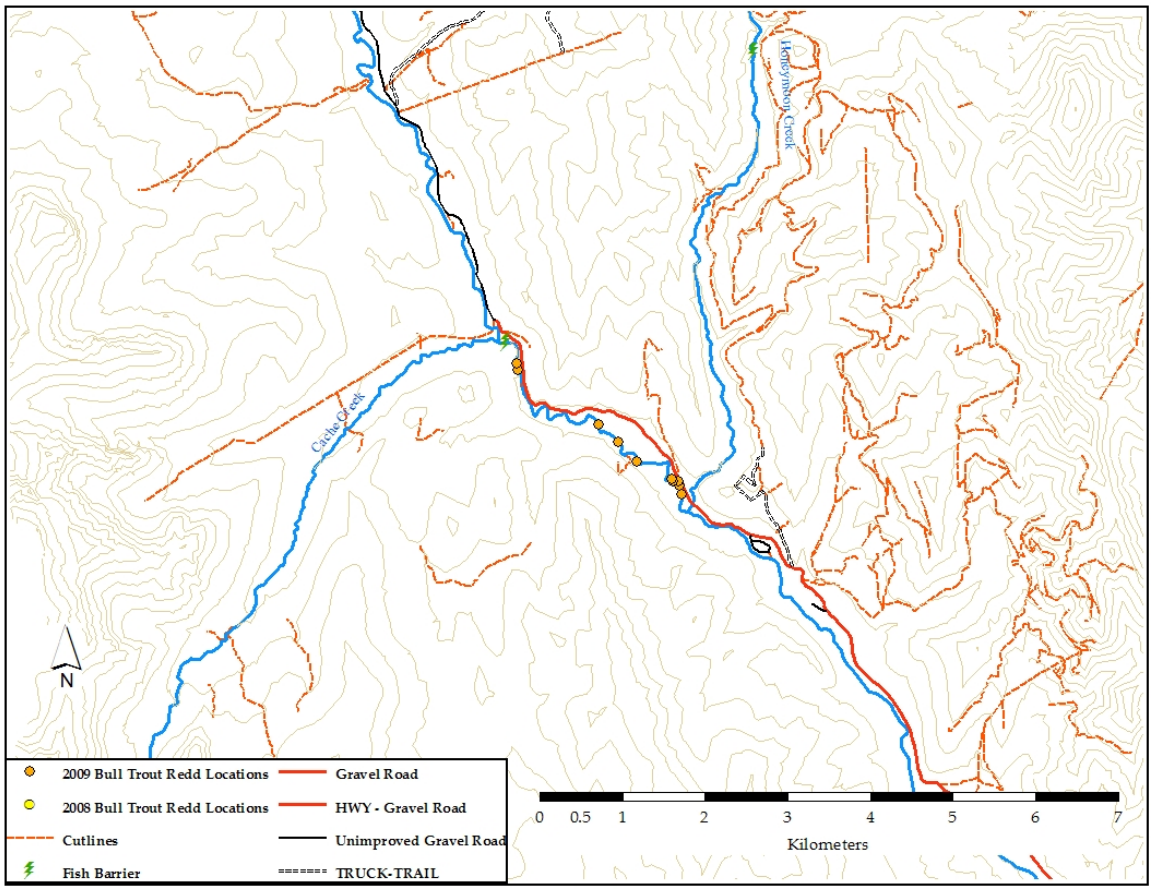

Figure 8. Bull Trout redd locations observed in the upper Oldman River during 2009.

Table 7. Redd dimensions obtained from the upper Oldman River during 2009 (mean ± SD).

		Redd length (cm)	Redd width (cm)	Redd Depth (cm)
2009	Average	112.5 + 21.7	53.8 + 19.0	42.8 + 12.8
	Range	70 - 160	30 - 120	30 - 70
	n	21	21	21

3.5.2 Savanna Creek

One redd was observed approximately 1.5 km downstream from Savanna Creek Falls (Figure 4). During the initial redd survey, seven Bull Trout (~300 mm) were observed in close proximity to the redd and a total of at least three Bull Trout of similar size were observed in the plunge pool below Savanna Creek Falls.

3.5.3 Mean Creek

A 50 m reach of Mean Creek, between the mouth of Mean Creek and the HWY 940 culvert crossing was surveyed, but no redds were observed. The culvert appeared to be an impassable barrier, so therefore, no further redd surveys were completed upstream of the barrier.

3.5.4 Isolation Creek

Isolation Creek was surveyed for but no evidence of spawning was observed, likely due to the undefined stream channel and unsuitable stream flow.

3.5.5 Daisy Creek

A redd survey was conducted in the lower reach of Daisy Creek but no redds were observed however, three large adult Bull Trout were observed in a large pool within the lower canyon. Further investigation is required in order to validate Daisy Creek as a Bull Trout spawning stream because three redds were observed in Daisy Creek by Gerrand and Derosa (1997).

3.6 Fish Tagging Progress

Since 2007, a total of 278 individual adult Bull Trout have been captured and tagged by fish trapping, electrofishing and angling in the UOM drainage. An additional 36 adult Bull Trout were captured by angling and tagged in the Oldman River, downstream from the GAP falls. Overall, a total of 314 adult Bull Trout have been tagged in the Oldman River drainage, upstream of the Oldman Reservoir.

4.0 DISCUSSION

It is evident that Hidden Creek is an important fluvial Bull Trout spawning stream in the UOM drainage. Just over two-thirds (72%) of all Bull Trout captured in the UOM drainage have been intercepted in the Hidden Creek trap since 2007. These fish spawn in Hidden Creek in the fall and migrate downstream to overwinter in various tributaries and mainstem channels throughout the drainage making Hidden Creek vital to the long-term persistence of Bull Trout in the drainage. Catch totals and redd densities signify the importance of Hidden Creek as a Bull Trout spawning stream and it is imperative that this Bull Trout spawning tributary is managed in a manner that will not degrade or compromise the quality of spawning habitat.

The low Bull Trout catches in the Livingstone River fish trap and the lack of redds in the lower portion of the Livingstone River (below the Livingstone Falls) indicates that this reach of the Livingstone River is not suitable migratory Bull Trout spawning habitat and therefore may only be used minimally by migratory Bull Trout. The lower reach of the Livingstone River consists of a high proportion of large deep pools which appears to be more suitable overwintering habitat. Redds observed upstream from the mouth of Deep Creek in 2008 may have been produced by fluvial Bull Trout, however, it is possible that these redds were produced by stream-resident Bull Trout given the size of redds. Redds observed in the upper Livingstone River indicates the presence of a stream-resident Bull Trout population as mentioned by Warnock (in press).

Similar to the Livingstone River, the low catches of Bull Trout in the Racehorse Creek trap and the lack of redds in Racehorse Creek indicates that Racehorse Creek is not suitable for spawning migratory Bull Trout and may only be used minimally by migratory Bull Trout. It is unclear whether migratory Bull Trout spawn in Racehorse Creek since no redds have been observed in the Racehorse Creek mainstem. The redds observed in South Racehorse Creek were likely produced by stream-resident Bull Trout given the small channel size and low flow volume that would be unsuitable for large migratory Bull Trout. Two spawning Bull Trout from Hidden Creek were captured later in the season migrating upstream in Racehorse Creek, suggesting that these fish could be overwintering in the lower sections of Racehorse Creek.

Dutch Creek may also be used minimally by migratory Bull Trout. Since 2008, fish trap efforts captured few migratory Bull Trout, yet a greater number of redds were observed upstream of the trap. As a result it is likely that the majority of the redds were created by stream-resident Bull Trout. In addition, during redd surveys, a total of eight adult Bull Trout (>400 mm) were observed spawning or near redds. It is uncertain whether these fish are fluvial or resident fish because at least four of these fish were not intercepted by the fish trap suggesting that these larger fish are stream-resident fish.

Redds were situated throughout the entire reach of Dutch Creek, upstream from the fish trap. The greatest density of redds was observed immediately upstream from the Atlas Road bridge crossing where groundwater input and subsurface flow was consistent. Throughout this reach, heavy loads of fine sediment were observed to be accumulating in the stream channel and settling over top of the Bull Trout redds. This sedimentation is a result from the dense network of off-highway vehicle trails that have degraded and eroded the adjacent stream banks, and consequently release the trapped sediments into the stream. A total of eight uncontrolled stream crossings and numerous trail braids in Dutch Creek are responsible for this degradation of stream habitat and are likely a threat to the survival of the Bull Trout eggs.

5.0 CONCLUSION

It is evident that Hidden Creek is an important migratory Bull Trout spawning stream in the UOM drainage. Trapping and redd survey data highlight the importance of Hidden Creek to the migratory Bull Trout population relative to other tributaries within the drainage. It is probable that the Livingstone River, as well as Dutch and Racehorse creeks, once supported a more pronounced spawning migratory populations. But now it is evident that these tributaries support resident populations in the upper portions of the respective drainages with limited use by migratory Bull Trout in the lower portions of the drainages. It is clear that protection of the Hidden Creek drainage from further impacts of human activity is vital to the long term persistence of migratory Bull Trout in the UOM drainage. Any further negative impacts to Bull Trout or their habitat in the Hidden Creek drainage or elsewhere within the UOM drainage could result in further decline in the UOM Bull Trout population. Recreational and industrial activity should be restricted to

reduce the risk of siltation of Bull Trout spawning habitat. These conservation measures will protect the critical spawning habitats and will help maintain viable Bull Trout populations in the UOM drainage. If these critical habitats are not protected, there is considerable risk to the future viability of Bull Trout in the UOM drainage.

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APPENDICES

Appendix 1. Upper Oldman River Bull Trout summary data, 2007 – 2009.

	Total fish captured	Recaptured fish	Average fork length (mm)	Fork length range (mm)	Average weight (g)	Weight range (g)
2007						
Hidden Creek	119	0	549 + 96.3	266 - 760	1738 + 864.2	125 – 4000
Electrofishing	40	1	485 + 129.3	278 - 740	1403 + 104.7	218 - 4075
2008						
Hidden Creek	82	29	559 + 92.6	321 - 751	1830 + 859.1	328 - 3950
Livingstone River	19	7	551 + 106.7	333 - 680	1657 + 730.5	350 - 2800
Racehorse Creek	14	1	559 + 82.7	434 - 693	1663 + 597.5	700 - 2950
Dutch Creek	9	1	601 + 43.4	518 - 670	1970 + 537.6	1200 - 2750
2009						
Hidden Creek	59	34	547 + 89.4	373 - 778	1653 + 818.7	400 - 4300
Livingstone River	7	4	592 + 50.5	525 - 671	2071 + 482.1	1300 - 2600
Racehorse Creek	8	3	629 + 80.6	490 - 758	2575 + 1183.8	850 - 4900
Dutch Creek	4	2	623 + 50.1	581 - 683	2250 + 279.1	1600 - 2850
Combined	**361**	**82**				

Appendix 2. Hidden Creek fish trap data, 2009.

Date	Direction of travel	Waterbody	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Life Stage	Sex	Spawning Maturity	PIT Tag #	Tag applied Captured
25/08/2009	Upstream	Hidden Creek	680446	5539496	1	BLTR	778	805	4500	Adult	M	Mature Ripe	985161000763575	Recapture
26/08/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	778	805	4500	Adult	M	Mature Ripe	985161000763575	Recapture
27/08/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	778	805	4500	Adult	M	Mature Ripe	985161000763575	Recapture
28/08/2009		Hidden Creek	680446	5539496		NO FISH								
29/08/2009		Hidden Creek	680446	5539496		NO FISH								
30/08/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	616	632	1800	Adult	U	Undetermined	985161000783851	Recapture
30/08/2009	Downstream	Hidden Creek	680446	5539496	2	BLTR				U	U			
31/08/2009	Upstream	Hidden Creek	680446	5539496	1	BLTR	555	580	1750	Adult	M	Mature Ripe	985161000784844	Recapture
31/08/2009	Upstream	Hidden Creek	680446	5539496	2	BLTR	671	700	2850	Adult	U	Undetermined	985161000779064	Recapture
31/08/2009	Downstream	Hidden Creek	680446	5539496	3	BLTR	477	499	1150	Adult	M	Mature Ripe	985161000771320	Tag applied
01/09/2009	Upstream	Hidden Creek	680446	5539496	1	BLTR	572	592	2900	Adult	M	Undetermined	985161000763065	Tag applied
02/09/2009		Hidden Creek	680446	5539496		NO FISH								
03/09/2009	Downstream	Hidden Creek	680446	5539496	1	NO FISH	563	583	1700	Adult	U	Undetermined	985161000784132	Recapture
04/09/2009	Upstream	Hidden Creek	680446	5539496	1	BLTR	536	563	1800	Adult	M	Mature Ripe	985161000764560	Recapture
05/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	649	669	2450	Adult	U	Undetermined	985161000766440	Tag applied
06/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	521	538	950	Adult	U	Undetermined	985161000836920	Recapture
06/09/2009	Downstream	Hidden Creek	680446	5539496		NO FISH								
06/09/2009	Downstream	Hidden Creek	680446	5539496	3	MNWH	247	265	180	IMM	U	Undetermined		
07/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	490	514	1300	Adult	U	Undetermined	985161000764605	Tag applied
08/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	636	655	2250	Adult	F	Mature Spent	985161000776492	Tag applied
09/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	676	691	2800	Adult	U	Undetermined	985161000775283	Recapture

Appendix 2. Hidden Creek fish trap data, 2009 ctd.

Date	Direction of travel	Waterbody	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Life Stage	Sex	Spawning Maturity	PIT Tag #	Tag applied Captured
09/09/2009	Downstream	Hidden Creek	680446	5539496	2	BLTR	545	564	1600	Adult	U	Undetermined	985161000768609	Recapture
09/09/2009	Downstream	Hidden Creek	680446	5539496	3	BLTR	494	513	900	Adult	U	Undetermined	985161000764479	Tag applied
09/09/2009	Downstream	Hidden Creek	680446	5539496	4	BLTR	548	566	1550	Adult	U	Undetermined	985161000782792	Recapture
09/09/2009	Downstream	Hidden Creek	680446	5539496	5	BLTR	488	506	1650	Adult	U	Undetermined	985161000782426	Tag applied
09/09/2009	Downstream	Hidden Creek	680446	5539496	6	BLTR	541	562	1700	Adult	M	Mature Spent	985161000763227	Recapture
09/09/2009	Downstream	Hidden Creek	680446	5539496	7	BLTR	496	519	1300	Adult	F	Mature Spent	985161000784659	Tag applied
10/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	535	560		Adult	M	Undetermined	985161000764560	Recapture
10/09/2009	Downstream	Hidden Creek	680446	5539496	2	BLTR	459	483	879	Adult	F	Mature Spent	985161000779528	Tag applied
10/09/2009	Downstream	Hidden Creek	680446	5539496	3	BLTR	604	635	2350	Adult	M	Mature Spent	985161000777710	Recapture
10/09/2009	Downstream	Hidden Creek	680446	5539496	4	BLTR	485	510	1400	Adult	U	Undetermined	985161000943514	Tag applied
10/09/2009	Downstream	Hidden Creek	680446	5539496	5	BLTR	461	485	911	Adult	F	Mature Spent	985161000784941	Tag applied
10/09/2009	Downstream	Hidden Creek	680446	5539496	6	BLTR	424	445	692	Adult	M	Mature Ripe	985161000786090	Tag applied
10/09/2009	Downstream	Hidden Creek	680446	5539496	7	BLTR	543	569	1550	Adult	F	Mature Spent	985161000785118	Tag applied
11/09/2009	Upstream	Hidden Creek	680446	5539496	1	BLTR	541	564		Adult	M	Mature Ripe	985161000764560	Recapture
11/09/2009	Upstream	Hidden Creek	680446	5539496	2	BLTR	553	565	1950	Adult	F	Mature Ripe	985161000785008	Recapture
11/09/2009	Downstream	Hidden Creek	680446	5539496	3	BLTR	675	695	3250	Adult	M	Mature Spent	985161000780684	Tag applied
11/09/2009	Downstream	Hidden Creek	680446	5539496	4	BLTR	588	603	1750	Adult	F	Mature Spent	985161000765836	Recapture
11/09/2009	Downstream	Hidden Creek	680446	5539496	5	BLTR	450	471	950	Adult	U	Undetermined	985161000771314	Recapture
11/09/2009	Downstream	Hidden Creek	680446	5539496	6	BLTR	486	506	700	Adult	M	Mature Spent	985161000777939	Recapture
11/09/2009	Downstream	Hidden Creek	680446	5539496	7	BLTR	469	491	950	Adult	F	Mature Spent	985161000777132	Tag applied
11/09/2009	Downstream	Hidden Creek	680446	5539496	8	CRTR	301	315	301	Adult	U	Undetermined		Tag applied
12/09/2009	Upstream	Hidden Creek	680446	5539496	1	BLTR	550	566	1700	Adult	U	Undetermined	985161000785008	Recapture

Appendix 2. Hidden Creek fish trap data, 2009 ctd.

Date	Direction of travel	Waterbody	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Life Stage	Sex	Spawning Maturity	PIT Tag #	Tag applied Captured
12/09/2009	Upstream	Hidden Creek	680446	5539496	2	BLTR	534	558	1600	Adult	M	Mature Ripe	985161000764560	Recapture
12/09/2009	Downstream	Hidden Creek	680446	5539496	3	BLTR	473	497	1100	Adult	M	Mature Ripe	985161000784291	Recapture
12/09/2009	Downstream	Hidden Creek	680446	5539496	4	BLTR	478	499	1100	Adult	U	Undetermined	985161000785687	Tag applied
12/09/2009	Downstream	Hidden Creek	680446	5539496	5	BLTR	494	516	1000	Adult	F	Mature Ripe	985161000765684	Recapture
12/09/2009	Downstream	Hidden Creek	680446	5539496	6	BLTR	437	461	800	Adult	F	Mature Ripe	985161000778598	Recapture
12/09/2009	Downstream	Hidden Creek	680446	5539496	7	BLTR	445	470	900	Adult	U	Undetermined	985161000780023	Tag applied
12/09/2009	Downstream	Hidden Creek	680446	5539496	8	CTTR	314	331	416	Adult	U	Undetermined		Tag applied
13/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	616	642	2100	Adult	M	Mature Spent	985161000784772	Recapture
14/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	537	557	1200	Adult	U	Undetermined	985161000763771	Tag applied
14/09/2009	Downstream	Hidden Creek	680446	5539496	2	BLTR	373	396	600	Adult	M	Mature Ripe	985161000781101	Recapture
15/09/2009		Hidden Creek	680446	5539496		NO FISH								
16/09/2009	Upstream	Hidden Creek	680446	5539496	1	BLTR	775	808	4700	Adult	M	Undetermined	985161000763575	Recapture
16/09/2009	Upstream	Hidden Creek	680446	5539496	2	BLTR	477	499	1000	Adult	F	Mature Ripe	985161000780825	Tag applied
16/09/2009	Downstream	Hidden Creek	680446	5539496	3	BLTR	527	551	1500	Adult	U	Undetermined	985161000777701	Recapture
16/09/2009	Downstream	Hidden Creek	680446	5539496	4	BLTR	524	550	1500	Adult	F	Mature Ripe	985161000782309	Tag applied
17/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	550	577	1700	Adult	M	Mature Spent	985161000785429	Recapture
17/09/2009	Downstream	Hidden Creek	680446	5539496	2	BLTR	616	638	2100	Adult	F	Mature Spent	985161000782841	Recapture
17/09/2009	Downstream	Hidden Creek	680446	5539496	3	BLTR	478	498	1000	Adult	M	Mature Spent	985161000780890	Recapture
17/09/2009	Downstream	Hidden Creek	680446	5539496	4	BLTR	625	649	2100	Adult	M	Mature Spent	985161000777235	Recapture
17/09/2009	Downstream	Hidden Creek	680446	5539496	5	BLTR	468	493	900	Adult	M	Mature Ripe	985161000781328	Recapture
17/09/2009	Downstream	Hidden Creek	680446	5539496	6	BLTR	471	499	1000	Adult	F	Mature Ripe	985161000768802	Recapture
17/09/2009	Downstream	Hidden Creek	680446	5539496	7	BLTR	477	499	1000	Adult	F	Mature Ripe	985161000780825	Recapture
17/09/2009	Downstream	Hidden Creek	680446	5539496	8	BLTR	426	449	400	Adult	F	Mature Ripe	985161000783740	Tag applied
17/09/2009	Downstream	Hidden Creek	680446	5539496	9	BLTR	775	808	4300	Adult	M	Undetermined	985161000763575	Recapture

Appendix 2. Hidden Creek fish trap data, 2009 ctd.

Date	Direction of travel	Waterbody	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Life Stage	Sex	Spawning Maturity	PIT Tag #	Tag applied Captured
17/09/2009	Downstream	Hidden Creek	680446	5539496	10	BLTR	490	518	850	Adult	U	Undetermined	985161000783858	Tag applied
18/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	461	482	900	Adult	M	Mature Ripe	985161000781343	Recapture
19/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	654	674	2800	Adult	M	Mature Ripe	985161000763983	Tag applied
19/09/2009	Downstream	Hidden Creek	680446	5539496	2	BLTR	663	685	2500	Adult	F	Mature Ripe	985161000766037	Tag applied
20/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	660	678	2400	Adult	F	Mature Spent	985161000781412	Tag applied
21/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	635	661	2500	Adult	M	Mature Ripe	985161000776004	Recapture
22/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	575	595	2000	Adult	M	Mature Spent	985161000763065	Recapture
23/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	710	728	2950	Adult	M	Mature Spent	985161000764702	Recapture
23/09/2009	Downstream	Hidden Creek	680446	5539496	2	BLTR	554	581	1650	Adult	M	Mature Spent	985161000784844	Recapture
24/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	552	575	1625	Adult	U	Undetermined	985161000779076	Tag applied
25/09/2009		Hidden Creek	680446	5539496		NO FISH								
25/09/2009		Hidden Creek	680446	5539496		NO FISH								
27/09/2009	Downstream	Hidden Creek	680446	5539496	1	BLTR	733	756	3200	Adult	M	Mature Spent	985161000784309	Recapture
27/09/2009	Downstream	Hidden Creek	680446	5539496	2	BLTR	717	735	3000	Adult	U	Undetermined	985161000784739	Recapture
27/09/2009	Downstream	Hidden Creek	680446	5539496	3	CRTR	303	314	309	Adult	U	Undetermined		Recapture
28/09/2009		Hidden Creek	680446	5539496		NO FISH								
29/09/2009		Hidden Creek	680446	5539496		NO FISH								
30/09/2009		Hidden Creek	680446	5539496		NO FISH								
01/10/2009		Hidden Creek	680446	5539496		NO FISH								
02/10/2009		Hidden Creek	680446	5539496		NO FISH								
03/10/2009		Hidden Creek	680446	5539496		NO FISH								
04/10/2009		Hidden Creek	680446	5539496		NO FISH								
05/10/2009		Hidden Creek	680446	5539496		NO FISH								
06/10/2009		Hidden Creek	680446	5539496		NO FISH								

Appendix 3. Livingstone River fish trap data, 2009.

Date	Direction of travel	Waterbody	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Life Stage	Sex	Spawning Maturity	PIT Tag #	Tag applied Captured
26/08/2009	Downstream	Livingstone River	686315	5539595	1	BLTR	574	600	2100	Adult	U	Undetermined	985161000780930	Tag applied
26/08/2009	Downstream	Livingstone River	686315	5539595	2	CTTR	332	346	371	Adult	U	Undetermined		
27/08/2009		Livingstone River	686315	5539595		NO FISH								
28/08/2009	Downstream	Livingstone River	686315	5539595	1	MNWH	351	380	584	Adult	U	Undetermined		
28/08/2009	Downstream	Livingstone River	686315	5539595	2	MNWH	250	271	199	U	U			
29/08/2009		Livingstone River	686315	5539595		NO FISH								
30/08/2009		Livingstone River	686315	5539595		NO FISH								
31/08/2009		Livingstone River	686315	5539595		NO FISH								
01/09/2009		Livingstone River	686315	5539595		NO FISH								
02/09/2009	Downstream	Livingstone River	686315	5539595	1	BLTR	590	610	2600	Adult	U	Undetermined	985161000785311	Recapture
02/09/2009	Upstream	Livingstone River	686315	5539595	2	CRTR	269	284	208	U	U	Undetermined		
02/09/2009	Upstream	Livingstone River	686315	5539595		NO FISH								
03/09/2009		Livingstone River	686315	5539595		NO FISH								
04/09/2009	Downstream	Livingstone River	686315	5539595	1	CRTR	275	288	266	U	U	Undetermined		
05/09/2009		Livingstone River	686315	5539595		NO FISH								
06/09/2009		Livingstone River	686315	5539595		NO FISH								
07/09/2009		Livingstone River	686315	5539595		NO FISH								
08/09/2009		Livingstone River	686315	5539595		NO FISH								
09/09/2009		Livingstone River	686315	5539595		NO FISH								
10/09/2009		Livingstone River	686315	5539595		NO FISH								
11/09/2009		Livingstone River	686315	5539595		NO FISH								
12/09/2009		Livingstone River	686315	5539595		NO FISH								
13/09/2009	Upstream	Livingstone River	686315	5539595	1	MNWH	330	354	442	Adult	U	Undetermined		
14/09/2009	Downstream	Livingstone River	686315	5539595	1	MNWH	321	345	439	Adult	U	Undetermined		

Appendix 3. Livingstone River fish trap data, 2009 ctd.

Date	Direction of travel	Waterbody	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Life Stage	Sex	Spawning Maturity	PIT Tag #	Tag applie Captured
15/09/2009	Upstream	Livingstone River	686315	5539595	1	BLTR	618	645	2200	Adult	U	Undetermined	985161000784435	Recapture
15/09/2009	Upstream	Livingstone River	686315	5539595	2	CRTR	240	253	159	U	U			
16/09/2009	Upstream	Livingstone River	686315	5539595	1	BLTR	671	690	2600	Adult	F	Mature Ripe	985161000775283	Recapture
17/09/2009	Upstream	Livingstone River	686315	5539595		NO FISH								
18/09/2009	Downstream	Livingstone River	686315	5539595	1	CRTR	240	253	159	U	U			
19/09/2009		Livingstone River	686315	5539595		NO FISH								
20/09/2009	Upstream	Livingstone River	686315	5539595	1	BLTR	525	552	1300	Adult	M	Mature Spent	985161000779418	Tag applie
21/09/2009		Livingstone River	686315	5539595		NO FISH								
22/09/2009		Livingstone River	686315	5539595		NO FISH								
23/09/2009		Livingstone River	686315	5539595		NO FISH								
24/09/2009		Livingstone River	686315	5539595		NO FISH								
25/09/2009	Upstream	Livingstone River	686315	5539595	1	BLTR	542	563	1600	Adult	U	Undetermined	985161000763227	Recapture
26/09/2009	Upstream	Livingstone River	686315	5539595	1	BLTR	625	646	2100	Adult	U	Undetermined	985161000764469	Tag applie
27/09/2009		Livingstone River	686315	5539595		NO FISH								
28/09/2009		Livingstone River	686315	5539595		NO FISH								
29/09/2009	Upstream	Livingstone River	686315	5539595	1	CTTR	325	346	367	Adult	U	Undetermined		
29/09/2009	Upstream	Livingstone River	686315	5539595		NO FISH								
30/09/2009		Livingstone River	686315	5539595		NO FISH								
01/10/2009		Livingstone River	686315	5539595		NO FISH								
02/10/2009	Upstream	Livingstone River	686315	5539595	1	CTTR	307	323	331	Adult	U	Undetermined		
02/10/2009	Downstream	Livingstone River	686315	5539595	2	CTTR	346	361	336	Adult	U	Undetermined		
02/10/2009	Downstream	Livingstone River	686315	5539595	3	CTTR	345	361	390	Adult	U	Undetermined		
03/10/2009		Livingstone River	686315	5539595		NO FISH								
04/10/2009		Livingstone River	686315	5539595		NO FISH								
05/10/2009		Livingstone River	686315	5539595		NO FISH								

Appendix 4. Racehorse Creek fish trap data, 2009.

Date	Direction of travel	Waterbody	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Life Stage	Sex	Spawning Maturity	PIT Tag #	Tag applied Captured
27/08/2009	Downstream	Racehorse Creek	686968	5525934	1	CRTR	216	227	112	U	U	Undetermined		
28/08/2009		Racehorse Creek	686968	5525934		NO FISH								
29/08/2009		Racehorse Creek	686968	5525934		NO FISH								
30/08/2009	Upstream	Racehorse Creek	686968	5525934	1	MNWH	442	474	1186	Adult	U	Undetermined		
30/08/2009	Downstream	Racehorse Creek	686968	5525934	2	CTTR				Adult	U			
31/08/2009		Racehorse Creek	686968	5525934		NO FISH								
01/09/2009		Racehorse Creek	686968	5525934		NO FISH								
02/09/2009	Downstream	Racehorse Creek	686968	5525934	1	BLTR	646	672	3100	Adult	U	Undetermined	985161000775789	Recapture
02/09/2009	Downstream	Racehorse Creek	686968	5525934	2	BLTR	758	784	4900	Adult	U	Undetermined	985161000784346	Tag applied
03/09/2009	Downstream	Racehorse Creek	686968	5525934	1	CTTR	328	345	380	U	U	Undetermined		
04/09/2009		Racehorse Creek	686968	5525934		NO FISH								
05/09/2009		Racehorse Creek	686968	5525934		NO FISH								
06/09/2009	Upstream	Racehorse Creek	686968	5525934	1	MNWH	442	474	1186	Adult	M	Undetermined		
07/09/2009	Downstream	Racehorse Creek	686968	5525934	1	BLTR	636	660	2500	Adult	F	Mature Ripe	985161000857067	Recapture
08/09/2009	Downstream	Racehorse Creek	686968	5525934	1	BLTR	575	594	1900	Adult	F	Mature Spent	985161000764476	Tag applied
09/09/2009		Racehorse Creek	686968	5525934		NO FISH								
10/09/2009	Downstream	Racehorse Creek	686968	5525934	1	BLTR	602	618	2050	Adult	F	Mature Spent	985161000942592	Recapture
11/09/2009		Racehorse Creek	686968	5525934		NO FISH								
12/09/2009		Racehorse Creek	686968	5525934		NO FISH								
13/09/2009		Racehorse Creek	686968	5525934		NO FISH								
14/09/2009		Racehorse Creek	686968	5525934		NO FISH								
15/09/2009		Racehorse Creek	686968	5525934		NO FISH								
16/09/2009		Racehorse Creek	686968	5525934		NO FISH								
17/09/2009		Racehorse Creek	686968	5525934		NO FISH								

Appendix 4. Racehorse Creek fish trap data, 2009 ctd.

Date	Direction of travel	Waterbody	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Life Stage	Sex	Spawning Maturity	PIT Tag #	Tag applied Captured
18/09/2009		Racehorse Creek	686968	5525934		NO FISH								
19/09/2009		Racehorse Creek	686968	5525934		NO FISH								
20/09/2009		Racehorse Creek	686968	5525934		NO FISH								
21/09/2009	Downstream	Racehorse Creek	686968	5525934	1	BLTR	624	647	2200	Adult	M	Mature Ripe	985161000786217	Tag applied
22/09/2009	Downstream	Racehorse Creek	686968	5525934	1	BLTR	703	750	3100	Adult	U	Mature Spent	985161000779417	Tag applied
22/09/2009	Downstream	Racehorse Creek	686968	5525934	2	BLTR	490	512	850	Adult	F	Mature Spent	985161000784732	Tag applied
23/09/2009		Racehorse Creek	686968	5525934		NO FISH								
24/09/2009		Racehorse Creek	686968	5525934		NO FISH								
25/09/2009		Racehorse Creek	686968	5525934		NO FISH								
26/09/2009		Racehorse Creek	686968	5525934		NO FISH								
27/09/2009		Racehorse Creek	686968	5525934		NO FISH								
28/09/2009		Racehorse Creek	686968	5525934		NO FISH								
29/09/2009		Racehorse Creek	686968	5525934		NO FISH								
30/09/2009		Racehorse Creek	686968	5525934		NO FISH								
01/10/2009		Racehorse Creek	686968	5525934		NO FISH								
02/10/2009		Racehorse Creek	686968	5525934		NO FISH								
03/10/2009		Racehorse Creek	686968	5525934		NO FISH								
04/10/2009		Racehorse Creek	686968	5525934		NO FISH								
05/10/2009		Racehorse Creek	686968	5525934		NO FISH								

Appendix 5. Dutch Creek fish trap data, 2009.

Date	Direction of travel	Waterbody	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Life Stage	Sex	Spawning Maturity	PIT Tag #	Tag applied Captured
25/08/2009		Dutch Creek	685857	5531461		NO FISH								
26/08/2009		Dutch Creek	685857	5531461		NO FISH								
27/08/2009		Dutch Creek	685857	5531461		NO FISH								
28/08/2009		Dutch Creek	685857	5531461		NO FISH								
29/08/2009	Downstream	Dutch Creek	685857	5531461	1	BLTR	582	603	2000	Adult	U	Undetermined	985161000765227	Recapture
30/08/2009		Dutch Creek	685857	5531461		NO FISH								
31/08/2009		Dutch Creek	685857	5531461		NO FISH								
30/08/2009		Dutch Creek	685857	5531461		NO FISH								
31/08/2009		Dutch Creek	685857	5531461		NO FISH								
01/09/2009		Dutch Creek	685857	5531461		NO FISH								
02/09/2009		Dutch Creek	685857	5531461		NO FISH								
03/09/2009	Downstream	Dutch Creek	685857	5531461	1	MNWH	252	282	228	U	U	Undetermined		
03/09/2009		Dutch Creek	685857	5531461		NO FISH								
04/09/2009		Dutch Creek	685857	5531461		NO FISH								
05/09/2009		Dutch Creek	685857	5531461		NO FISH								
05/09/2009		Dutch Creek	685857	5531461		NO FISH								
06/09/2009	Downstream	Dutch Creek	685857	5531461	1	BLTR	645	665	2550	U	U	Undetermined	985161000775485	Recapture
06/09/2009	Downstream	Dutch Creek	685857	5531461	2	MNWH	275	293	304	U	U	Undetermined		
06/09/2009	Downstream	Dutch Creek	685857	5531461	3	MNWH	275	298	250	U	U	Undetermined		
07/09/2009		Dutch Creek	685857	5531461		NO FISH								
08/09/2009	Downstream	Dutch Creek	685857	5531461	1	MNWH	272	296	248	U	U	Undetermined		
09/09/2009		Dutch Creek	685857	5531461		NO FISH								
10/09/2009		Dutch Creek	685857	5531461		NO FISH								
11/09/2009		Dutch Creek	685857	5531461		NO FISH								

Appendix 5. Dutch Creek fish trap data, 2009 ctd.

Date	Direction of travel	Waterbody	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Life Stage	Sex	Spawning Maturity	PIT Tag #	Tag applied Captured
12/09/2009		Dutch Creek	685857	5531461		NO FISH								
13/09/2009		Dutch Creek	685857	5531461		NO FISH								
14/09/2009		Dutch Creek	685857	5531461		NO FISH								
15/09/2009		Dutch Creek	685857	5531461		NO FISH								
16/09/2009	Downstream	Dutch Creek	685857	5531461	1	BLTR	581	603	1600	Adult	F	Mature Ripe	985161000785859	Tag applied
17/09/2009		Dutch Creek	685857	5531461		NO FISH								
18/09/2009		Dutch Creek	685857	5531461		NO FISH								
19/09/2009		Dutch Creek	685857	5531461		NO FISH								
20/09/2009		Dutch Creek	685857	5531461		NO FISH								
21/09/2009		Dutch Creek	685857	5531461		NO FISH								
22/09/2009		Dutch Creek	685857	5531461		NO FISH								
23/09/2009	Downstream	Dutch Creek	685857	5531461	1	BLTR	683	697	2850	Adult	M	Mature Spent	985161000783789	Tag applied
24/09/2009		Dutch Creek	685857	5531461		NO FISH								
25/09/2009		Dutch Creek	685857	5531461		NO FISH								
26/09/2009		Dutch Creek	685857	5531461		NO FISH								
27/09/2009		Dutch Creek	685857	5531461		NO FISH								
28/09/2009		Dutch Creek	685857	5531461		NO FISH								
29/09/2009		Dutch Creek	685857	5531461		NO FISH								
30/09/2009		Dutch Creek	685857	5531461		NO FISH								
01/10/2009		Dutch Creek	685857	5531461		NO FISH								
02/10/2009		Dutch Creek	685857	5531461		NO FISH								
03/10/2009		Dutch Creek	685857	5531461		NO FISH								
04/10/2009		Dutch Creek	685857	5531461		NO FISH								
05/10/2009		Dutch Creek	685857	5531461		NO FISH								
06/10/2009		Dutch Creek	685857	5531461		NO FISH								

Appendix 6. Angling catch data, 2009.

Location	Location #	Easting	Northing	Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Maturity	PIT Tag Number	Individual Sample Comments
11/06/2009	Oldman River - GAP Falls	690303	5527932	1	BLTR	701	729	3500	Adult	985161000764702	DNA sample obtained - Recapture
11/06/2009	Oldman River - GAP Falls	690303	5527932	2	CRTR	406	431	578	Adult		
11/06/2009	Oldman River - GAP Falls	690303	5527932	3	CTTR	375	394	550	Adult		
11/06/2009	Oldman River - GAP Falls	690303	5527932	4	CRTR	481	505	1200	Adult		
11/06/2009	Oldman River - GAP Falls	690303	5527932	5	CRTR	321	336	373	Adult		
11/06/2009	Oldman River - GAP Falls	690303	5527932	6	CTTR	352	367	474	Adult		
11/06/2009	Oldman River - GAP Falls	690303	5527932	7	CTTR	392	417	604	Adult		
11/06/2009	Oldman River - GAP Falls	690303	5527932	8	CRTR	381	403	719	Adult		
11/06/2009	Oldman River - GAP Falls	690303	5527932	9	RNTR	438	458	960	Adult		
11/06/2009	Oldman River - GAP Falls	690303	5527932	10	CRTR	379	402	590	Adult		
14/06/2009	Oldman River - Waldron Flats	706783	5519736	1	BLTR	544	570	1300	Adult	985161000784468	DNA sample obtained
14/06/2009	Oldman River - Waldron Flats	706783	5519736	2	BLTR	446	471	800	Adult	985161000836228	DNA sample obtained