Monitor and Protect Wigwam River Bull Trout for Koocanusa Reservoir

Wigwam River Juvenile Bull Trout and Fish Habitat Monitoring Program

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BONNEVILLE POWER ADMINISTRATION

Wigwam River Juvenile Bull Trout and Fish Habitat Monitoring Program: 2002 Data Report

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Executive Summary

The Wigwam River juvenile bull trout (*Salvelinus confluentus*) and fish habitat-monitoring program is a co-operative initiative of the British Columbia Ministry of Water, Land, and Air Protection and Bonneville Power Administration. This project was commissioned in planning for fish habitat protection and forest development within the upper Wigwam River valley. The broad intent is to develop a better understanding of juvenile bull trout and Westslope cutthroat trout recruitment and the ongoing hydrologic and morphologic processes in the Wigwam River, especially as they relate to spawning and rearing habitat quality. The 2002 project year represents the third and final year of a long-term bull trout-monitoring program with current studies focused on collecting baseline information. This report provides a summary of results obtained to date.

The Wigwam River has been characterized as the single most important bull trout spawning stream in the Kootenay Region. Forest development within the Canadian portion of the upper Wigwam River commenced in August 1997 (road development) and the first cut-blocks were harvested in the winter of 2000/2001. To date, 601.8 ha or 134,900 m^3 of harvest volume representing 81.8% of the allowable cut has been harvested. The remaining volume is scheduled for harvesting in 2003.

The five permanent sampling sites established in summer 2000 in the upper Wigwam River drainage were sampled annually from 2000-2002. In 2002, a sixth permanent sampling site was established in the lower Wigwam River (Reach 2). This site was included to represent habitat outside the “preferred” or high density bull trout spawning and rearing habitat. These six sites were also sampled in 1997 as a sub-set of the preliminary study.

Bull trout represented 96.3%, 92.4%, 95.1% and 97.8% of the catch from 1997, 2000 to 2002, respectively. Fry dominated the catch and this was a direct result of juvenile bull trout ecology and habitat partitioning among life history stages. Site selection was biased towards electrofishing sample sites which favored high bull trout fry capture success.

In 2002, the mean density of juvenile bull trout was estimated to be 12.7 fish/100m^2. This represents the lowest estimated mean density for the enumeration program, even though enumeration of bull trout redds in 2001 was the highest on record. The low 2002 mean densities were a result of lower fry densities within the upper Wigwam River index sites. Lower Wigwam River index sites were at their highest recorded levels in 2002 however, sampling effort for this program was concentrated within the preferred bull trout reaches in the upper Wigwam

River valley. The lower density estimate most likely represents a shift in distribution from upstream concentrations to a more ubiquitous distribution, rather than a decrease in juvenile abundance.

The hypothesized mechanism that resulted in a juvenile distribution shift was a drought-induced shift to the hydrograph that began in 2000 and became particularly significant in the fall of 2001. The two-year drought conditions were due to lower than normal precipitation and in particular, snow pack levels that were approximately 50 to 53% of normal on a region wide scale. During the fall 2001 spawning season, water levels within the upper Wigwam River were extremely low and surficial flow was absent in much of reach 7. Low water depths and limited accessibility caused a distribution shift to increased spawning at lower river locations (reaches two and five in particular). Trends in juvenile abundance are related to proximity to spawning areas and the shift in redd distribution was subsequently reflected in the 2002 juvenile sampling program.

The high water quality of the Wigwam River was reflected in the low maximum summer water temperatures and ubiquitous juvenile bull trout distribution. During the three years of this study, mean weekly maximum water temperatures have not exceeded the provincial guideline of 15^{o}C for streams with bull trout.

Annual channel profile and cross-sectional survey data encompass a range of morphological stream types from the depositional (aggrading) to degrading and sensitive to resilient spectrum and vary from very low to very high bedload sediment yields. Some minor shifting of braids and down-cutting has occurred since 2000 but no major change in geo-morphology or bed material size class has occurred during the baseline survey period. As a result, all sites within the Wigwam River were considered to be in equilibrium and relatively stable. Annual habitat survey data demonstrates the importance of LWD to stream structure, sediment storage, habitat diversity, and stability.

When compared to other bull trout systems, the large spawning escapement and high juvenile densities provide a strong case that the Wigwam River may be the most prolific bull trout population in the species distributional range. At the very least, it can be concluded that the population of Wigwam River bull trout represent a large and stable population. Bull trout populations have been shown to be extremely susceptible to habitat degradation and over harvest and are ecologically important as an indicator of watershed health. As such, the upper Wigwam River watershed remains relatively pristine, and maintains high water quality, high habitat capability and, conservative angling regulations have been successful in preventing over-exploitation.

Acknowledgements

The Wigwam River bull trout (*Salvelinus confluentus*) and fish habitat monitoring program is a trans-boundary initiative implemented by the British Columbia Ministry of Water, Land, and Air Protection (MWLAP), in cooperation with Bonneville Power Administration (BPA). Funding was provided by the Bonneville Power Administration (BPA) under the umbrella project "Monitor and Protect Bull Trout for Koocanusa Reservoir"; BPA project Number 2000-004-00. The contribution and on-going monitoring results provided by Herb Tepper and Bill Westover (MWLAP) are acknowledged and greatly appreciated.

Water Quantity and Water Quality Data was supplemented with data provided by the “Wigwam River Water Quality and Quantity Monitoring Program”. This project was funded by Tembec Industries Inc. (forest licensee) and jointly administered by Tembec Industries Inc. and the British Columbia Ministry of Sustainable Resources.

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1 Introduction

The Wigwam River bull trout (*Salvelinus confluentus*) and fish habitat monitoring program is a trans-boundary initiative implemented by the British Columbia Ministry of Water, Land, and Air Protection (MWLAP), in cooperation with Bonneville Power Administration (BPA). The Wigwam River is an important fisheries stream located in southeastern British Columbia that supports healthy populations of both bull trout and Westslope cutthroat trout (Figure 1). This river has been characterized as the single most important bull trout spawning stream in the Kootenay Region (Baxter and Westover 2000, Cope 1998). In addition, the Wigwam River supports some of the largest Westslope cutthroat trout (*Oncorhynchus clarki lewisi*) in the Kootenay Region. These fish are highly sought after by anglers (Westover 1999a, 1999b).

Bull trout populations have declined in many areas of their range within Montana and throughout the northwest including British Columbia. Bull trout were blue listed as vulnerable in British Columbia by the B.C. Conservation Data Center (Cannings 1993) and although there are many healthy populations of bull trout in the East Kootenay they remain a species of special concern. Bull trout in the United States portion of the Columbia River were listed as threatened in 1998 under the Endangered Species Act by the U.S. Fish and Wildlife Service. The upper Kootenay River is within the Kootenai sub-basin of the Mountain Columbia Province, one of the eleven Eco-provinces that make up the Columbia River Basin. MWLAP applied for and received funding from BPA to assess and monitor the status of wild, native stocks of bull trout in tributaries to Lake Koocanusa (Libby Reservoir) and the upper Kootenay River. This task is one of many that were undertaken to "Monitor and Protect Bull Trout for Koocanusa Reservoir" (BPA Project Number 2000-04-00).

1.1 Objectives

Five permanent sampling sites were established in the Wigwam River drainage in August 2000 (one site on Bighorn Creek and four sites on the mainstem Wigwam River; Appendix A). In 2002, a sixth site was added on the Wigwam River to represent the lower river outside the bounds of the “preferred” bull trout spawning and rearing reaches (Appendix A). At each site, juvenile fish densities and stream habitat conditions have been measured annually. The broad intent of this project was to develop a better understanding of inter-annual variation in juvenile bull trout and Westslope cutthroat trout recruitment and the ongoing hydrologic and morphologic processes in the Wigwam River, especially as

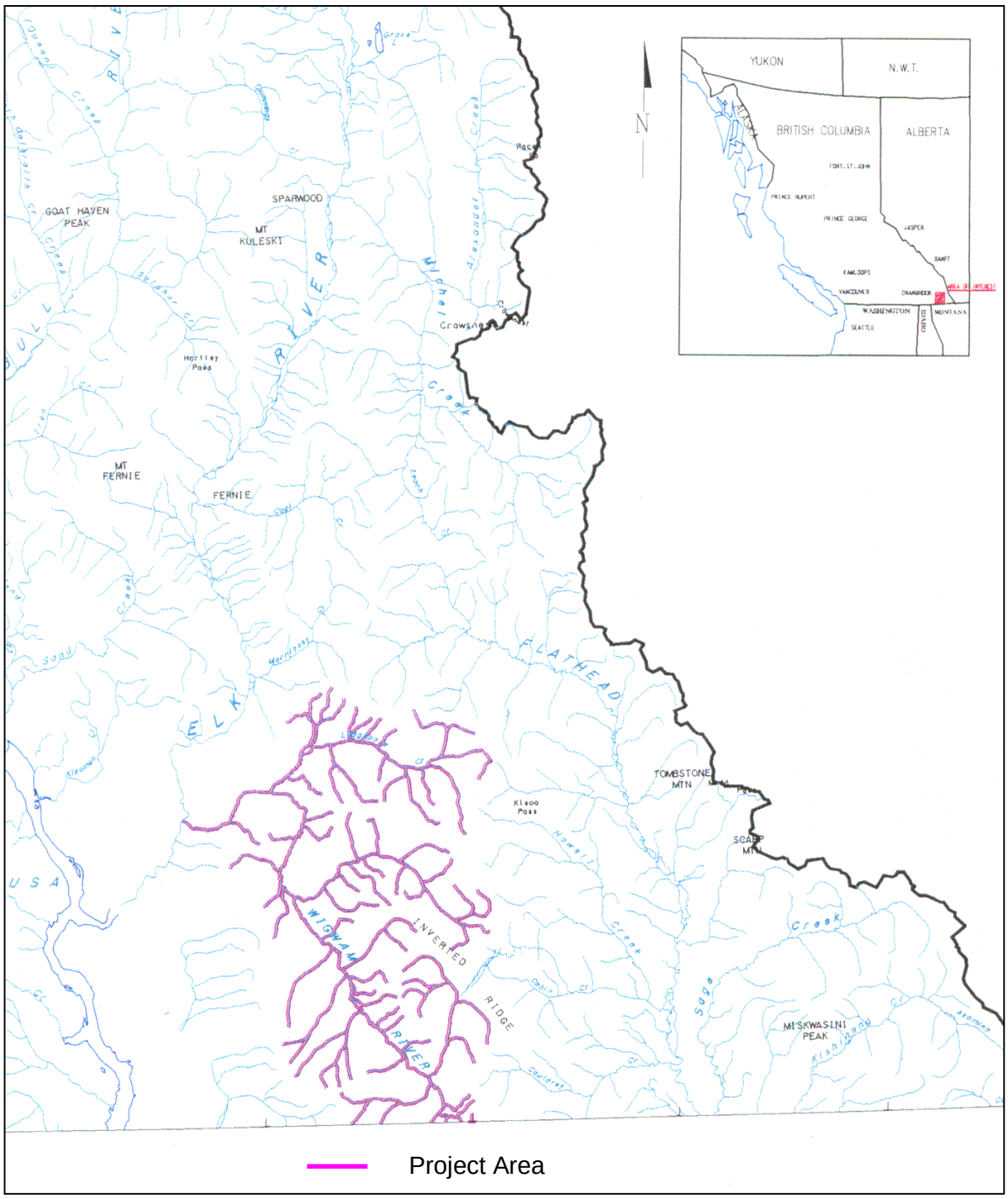

Figure 1. Location of the Wigwam River study area

they relate to spawning and rearing habitat quality and timber harvest development. The 2002 sampling program was the third consequetive year of the study and represents the final year of the proposed monitoring program. These six sites were also sampled in 1997 as a subset of the preliminary study (Cope 1998).

1.2 Study Area

The Wigwam River originates in the Rocky Mountains within the state of Montana and flows northwest between the Galton and MacDonald ranges in British Columbia for approximately 47 km until it empties into the Elk River, a tributary to Lake Koocanusa (Figure 1). The headwaters of the Wigwam drainage originate at an elevation of 2,135 m and declines to 763 m. The Wigwam River valley is characterized by four biogeoclimatic zone variants; Kootenay dry mild interior Douglas-fir, dry cool montane spruce, Kootenay moist cool interior cedar hemlock, and dry cool Engelmann spruce sub-alpine fir (Braumandl and Curran 1992).

The flow regime of the Wigwam River is comparable to most interior systems with high annual run-off reaching it's peak in May (peak mean daily discharge 74 m^3/s on 24 May 2000) and expected low flows in late fall and winter (2.1 m^3/s; Prince and Cope 2001). Freeze up generally occurs in mid to late November; however, areas of groundwater infiltration remain open in most years. The temperature signature recorded in the mainstem Wigwam River in the vicinity of the spawning grounds was indicative of groundwater and daily maximum temperatures within the upper Wigwam River do not exceed 14.5 ^oC (Prince and Morris 2003, 2002, Prince and Cope 2001, 2000).

The upper reaches of the Wigwam River occupy a glacial outwash channel that is bounded by glacial till terraces and silt seams. The occurrence of lacustrine silt deposits overlain by highly permeable glacial till within adjacent terraces has contributed to a predominance of sub-surface flow that reaches the mainstem as groundwater. The influence of groundwater has been a large factor in the maintenance of cool stream temperatures and annual low flows (Prince and Cope 2000, 2001). A number of natural disturbance events over time appear to have contributed a substantial volume of coarse sediment to the river including: wildfires in the 1930's, a slide in 1993, and the 1995 flood event thought to occur every 100 to 200 years (Oliver and Cope 1999). Sediment aggradation throughout a broad, alluvial floodplain is associated with channel-confining bedrock outcrops. The combination of frequent lateral migration and erosion of adjacent terraces and coarse sediment delivery to the mainstem river has created a braided channel comprised of sorted gravels and cobbles

that provide prime spawning habitat for bull trout (Oliver and Cope 1999). The provision of suitably sized bed materials (<70 mm) in a low gradient, low water velocity location with associated groundwater have been identified as repeating patterns of preferred bull trout spawning habitat (McPhail and Baxter 1996).

1.2.1 Forest Development Status

Forest harvesting and accompanying road development in the Wigwam basin have, to date, been undertaken primarily in Montana, where approximately 20% of the watershed was logged (with extensive road network) in the 1950's and 1960's with subsequent 'green-up' ongoing to the present day (Anon. 1999). In the Canadian portion of the watershed, logging has been limited to the Rabbit Creek sub-basin (< 100 ha), with some helicopter logging in the 1990's near the confluence of the Wigwam River with the Elk River. Conventional logging occurred approximately 20 years ago in the vicinity of the confluence with the Elk River, and in the Bighorn Creek sub-basin. British Columbia Watershed Restoration Program (WRP) activities have been on going within the Bighorn Creek watershed since 1995 (Cope 2000).

The original Forest Development Plan (FDP) has gone through several iterations in response to stakeholder concerns. The current plan (commonly referred to as amendment 5) calls for logging a total of 657.3 ha (0.89% of the entire watershed) or 163,816 m^3 of harvest volume, over a three to four year period after which no further harvesting is planned for 20 years. On May 20 to May 22, 2002 a large rainstorm saturated the forest soils. On the morning of May 22, the rain turned to snow resulting in heavily loaded trees in saturated soils. Subsequently, increased wind resulted in a major blow-down or "snow-down" event in the upper Wigwam River valley. This natural event resulted in an additional 78.5 ha of salvage logging that was subsequently approved by the British Columbia Ministry of Forests and the licensee FDP was amended to reflect this. As a result, the total area and volume of forest approved for harvesting within the upper Wigwam River is currently 735.8 ha or 170,612 $m^{3.}$ Lodgepole pine is the predominant species being harvested. All cutblocks are on glacial till terraces in the valley bottom and are to be clear-cut.

Forest development activities for the 2000 works windows included the construction of approximately 30 km of mainline Forest Service Road, spur roads, and the installation of five bridges; including one full span crossing of the upper Wigwam River. Harvesting commenced in December 2000, and in 2000/2001 a total of 231.5 ha or 56,660 m^3 (31.5%

of the planned harvest volume) was harvested. During 2001/2002 an additional 370.3 ha or 78,240 m^3 (50% of the planned harvest volume) was harvested. There remains 134 ha or 35,712 m^3 of harvest volume representing the final 18% of the scheduled harvest.

Forest development plans for the Wigwam River watershed have come under considerable scrutiny because of potential impacts to bull trout habitat. The issues have largely centered on block size, water temperature, increased sediment yield, and base flow levels in the mainstem river. The creation of extensive openings in a largely even-aged, lodgepole pine forest are intended to mimic a natural stand initiating event consistent with the valley's wildfire history. The size of the proposed clear-cuts however, are perceived to alter basin hydrology, affect the annual flow regime (both peak and base flows) and encourage surface erosion that could lead to fine sediment delivery.

1.2.2 Fisheries Resource Status

When compared to other bull trout systems, it can be argued that the Wigwam River may be the most prolific bull trout population in the species distribution range. Juvenile densities are some of the highest densities reported within the literature (Cope 1998) and spawning escapements consistently exceed 1,000 fish (Baxter and Westover 2000). Baxter and Westover (2000) provide a thorough review of the biology, population status, and scientific studies to date for this population. The principle concerns for the Wigwam River population center around the potential impacts of forest harvesting. Bull trout are adapted to cold water temperatures and thrive in waters that are too cold, unproductive or too steep in gradient for other fish. Bull trout are not found in streams where maximum monthly water temperatures exceed 18^oC and are most abundant where water temperatures are 12^oC or less (Goetz 1989, Ford *et. al.* 1995, McPhail and Baxter 1996, Buchanan and Gregory 1997). This preference for cooler water manifests in the frequent association of bull trout with cold perennial springs (Oliver 1979, Goetz 1989, McPhail and Baxter 1996, Buchanan and Gregory 1997). In general, the species does not occur in high densities, a tendency that is partly due to the life-history strategy and the environment in which they live. Low population densities, slow growth, delayed maturation and high quality habitat requirements (water temperatures < 14^oC, spawning gravel with low % fines) make bull trout sensitive to habitat degradation and over-harvesting (Goetz 1989, Fraley and Shepard 1989, Ratliff *et. al.* 1996, Ford *et. al.* 1995, McPhail and Baxter 1996).

Westslope cutthroat trout are also typical of cold, nutrient poor streams (Liknes and Graham 1988). The Wigwam River population of Westslope cutthroat trout contains

appreciable numbers of large individuals with adults attaining 450 mm fork length (Westover and Conroy 1997). Although the distribution and abundance of Westslope cutthroat trout have drastically declined from its historic range during the last 100 years, the abundance and size of the current Wigwam River population may be attributed to the combination of special regulations designed to limit harvest and high quality available habitat.

2 Methods

Five permanent sampling sites were established in the Wigwam River drainage in August 2000 (reaches 5, 6, 7, and 9 of the Wigwam River, and reach 1 of Bighorn Creek, Appendix A, 1:50,000 TRIM map). A sixth permanent sampling site was established in the lower Wigwam River drainage in August 2002 (reach 2, Appendix A 1:50,000 TRIM map). This site was included in order to represent habitat outside the "preferred" or high density bull trout spawning and rearing habitat. The objective of including this site was to better evaluate the potential for range expansion with increasing bull trout spawning escapements. Sampling sites were a minimum of 20 channel widths in length or a distance equal to two stream meander wavelengths. At each site the following reference points were permanently established, geo-referenced and marked with a combination of metal tree tag, tree blaze, fluorescent tree paint, and flagging tape:

- Upstream and downstream elevation benchmarks. Elevation benchmarks were also represented by a lag bolt imbedded in the base of a large, stable, riparian tree,
- Upstream and downstream limits of the longitudinal survey,
- Riffle and pool cross-sectional reference points, and
- Electrofishing habitat units.

The following methods outline the specific assessments completed at each of the six permanently established sites.

2.1 Juvenile Enumeration

Estimates of juvenile fish density (number of fish/100 m^2) were determined using closed, maximum-likelihood removal estimates (Riley and Fausch 1992). For each site, three habitat units (riffle, pool and run) were individually sampled for fish densities over a minimum of 100 lineal meters and/or 500 m^2. This methodology allows for habitat unit comparisons as well as reach comparisons through pooling of habitat units to obtain a

mean. A Smith-Root Mark 12POW backpack electroshocker was used for successive depletions within each closed sample unit. Although bull trout are the main focus of this project, densities of all fish captured were reported. All sampling was conducted at the permanent stations established in 2000 and 2002. The project biologist and lead technician have conducted the enumeration and habitat assessment all three years of study thus ensuring consistency and minimization of sampler bias. These crew members were also members of the preliminary study conducted in 1997 (Cope 1998).

Catch results from individual habitat units were summed, by pass, at each representative reach location. These results were then used to estimate the number of fry (0^+ age class) and juveniles (1^+ and 2^+ age classes) within the composite enclosure area. Population estimates were calculated using the "Microfish" software package (Van Deventer and Platts 1990). Population estimates and their 95% confidence interval were then reported as a standard numerical density (number fish/100 m^2) for each site, by year.

2.2 Fish Habitat Assessment

A standard suite of habitat parameters were collected using the Resource Inventory Committee (RIC) approved Fish Habitat Assessment Procedures (FHAP), Level 1, Form 4 - Habitat Survey Data Form (Johnston and Slaney 1996). The level 1 FHAP is a purposive field survey of current habitat conditions for the target species in select reaches. This form has been developed for interpretation of habitat sensitivity and capability for fish production and includes prominent physical features such as pool and riffle ratios, residual pool depths, channel stability, flood indicators, cover components, abundance of large woody debris (LWD), and riparian vegetation. Habitat parameters were collected annually from 2000 through 2002.

Following methods described in Rosgen (1996) the following measurement of channel bed, channel bank and fish habitat parameters were also completed annually from 2000 through 2002:

- A longitudinal Profile (minimum of 20 channel widths in length or a distance equal to two stream meander wavelengths) of the stream bed following the thalweg of the stream channel and water surface (slope);
- Stream cross-sections on both a riffle and pool segment;
- Modified Wolman pebble count, and

- Stream discharge and bank full width.

Geomorphic surveys were completed using an auto level (Topcon AT-G7 Auto Level) and standard differential hydrometric survey techniques (Anon. 1998). Benchmarks permanently established in 2000 were used. A differential loop was used to accurately determine benchmark elevations. In the 2000 sampling year, a laser level (Laser plane 220 leveling station and target rod) was used for the survey. In 2001, the laser level was replaced with the auto level, as the laser level may not be as accurate as the Auto level over long distances and inclement weather conditions.

The UTM coordinates were overlain on the digital NAD 83 Forest Cover TRIM Sheet and the elevation data corrected to this datum. At 10m intervals, following the thalweg of the stream channel, the elevation of the streambed and the water surface was surveyed over the length of the study area. All stream and habitat unit gradients were calculated from differences in water surface elevation. Cross sectional profiles were surveyed at 1 m intervals and extended 5m beyond the bankfull width. The elevation of the bankfull channel was also noted at each cross section location. All survey loops were closed and error levels expressed to ensure quality control.

Channel bed material characterization employed the modified Wolman method outlined in Rosgen (1996). Briefly, this procedure uses a stratified, systematic sampling method based on the frequency of riffle/pools and step/pools occurring within a channel reach that is approximately 20-30 bankfull channel widths in length (or two meander wavelengths). The modified method adjusts the material sampling locations so that various bed features are sampled on a proportional basis along a given stream reach. In total, 10 transects are established and ten substrate particles are selected at systematic intervals across the bankfull channel width, for a total sample size of 100. The intermediate axis of the particle was measured such that the particle size selected would be retained or pass a standard sieve of fixed opening. The composite particle distribution was used to represent the site. To avoid potential bias, the actual particle was selected on the first blind touch, rather than visually selected.

Stream discharge was estimated at each location using a Price 1210AA velocity meter and wading rod calibrated bi-annually by the National Calibration Service of the National Water research Institute. All methods meet national and provincial standards and have demonstrated precision levels of less than +/- 5% (Prince and Cope 2000, 2001).

3 Results

The sampling schedule for the 2000 to 2002 fish and fish habitat monitoring program was summarized in Table 1. The upper and lower geo-reference points (uncorrected) for each sample site are summarized in Table 2. For the corrected UTM coordinates see the attached 1:50,000 TRIM map (Appendix A). The corresponding site numbers of the preliminary sampling program (Cope 1998) and MWLAP Environmental Monitoring System (EMS) sites (Prince and Morris 2003) were also included for reference between these complimentary monitoring programs. Those years for which both fish density and habitat assessment data were collected are provided for each site for reference.

Additional background data of varying levels of applicability and accuracy (*i.e*. previous streambed and cross-sectional surveys, pebble counts, water quantity and quality data) can be accessed through the EMS data storage initiative (MWLAP, Nelson, B.C.) and the British Columbia WRP program (MWLAP, Cranbrook, B.C.).

Table 1. Schedule of program field components for the Wigwam River bull trout and fish habitat monitoring program, 2000-2002.

Program Component	**Date**		
	Year 1 (2000) [a]	Year 2 (2001) [b]	Year 3 (2002)
Establishment of Permanent Sample Sites	August 9 – 14		August 11
Juvenile Fish Density Sampling	August 9 – 14	August 3-9	August 6-11
Level 1 FHAP Form 4 Measurements and Channel Surveys	September 20 – October 4	September 14 – October 5	August 26 – September 19
Aerial Reconnaissance Survey (Channel Dewatering, Groundwater Influence, Forest Development)	January 22		

[a] – Cope and Morris. 2001.
[b] – Cope *et. al.* 2002

Table 2. Summary of permanently established bull trout and fish habitat sample sites within the Wigwam River study area and associated site designations for on-going and previous surveys conducted in the immediate vicinity.

Sample Site	UTM (Zone.Easting.Northing)	1997 Site No.[1]	EMS No.[2]	Additional Habitat Data[3]	Sample Years [4]
Wigwam R. Reach 2 Site 6	11.646027.5458842 11.645187.5458995	1			1997, 2002
Wigwam R. Reach 5 Site 1	11.648335.5449685 11.648110.5449910	2	E238242[a]		1997, 2000, 2001, 2002
Wigwam R. Reach 6 Site 2	11.653886.5441349 11.653802.5441896	4 & 5[b]		CS1	1997, 2000, 2001, 2002
Wigwam R. Reach 7 Site 3	11.655471.5438625 11.654977.5439074	6 & 7	E238246		1997, 2000, 2001, 2002
Wigwam R. Reach 9 Site 4	11.661031.5432738 11.660942.5432911	10	E238250	CS2	2000, 2001, 2002
Bighorn Cr. Reach 1 Site 1	11.648335.5449685 11.649089.5449439	13[C]		WRP1	1997, 2000, 2001, 2002

[1] – Site numbers from preliminary bull trout and fish habitat monitoring program (Cope 1998). Data includes juvenile enumeration, RIC inventory site card, pebble count and discharge estimation.

[2] – MWLAP EMS site numbers from ongoing upper Wigwam River water quantity and quality inventory project (Prince and Cope 2000, 2001, Prince and Morris 2002, 2003). Data includes water quantity and quality monitoring data.

[3] – CS1 and CS2 site numbers from upper Wigwam River water quantity and quality inventory project (Prince and Cope 2000). Data includes FHAP Form 4, longitudinal and cross-sectional profiles, pebble counts and discharge estimation. WRP1 represents Watershed Restoration Program level II FHAP longitudinal (900 lineal meters) and cross-sectional profiles (n=11) (Cope and Prince 2000).

[4] – Previous study reports; Cope 1998, Cope and Morris 2001, Cope *et. al.* 2002.

[a] – Hydrometric and automated water quality grab station located 1 km upstream.

[b] – Site 4 was 200 m downstream (dewatered due to down-cutting) and Site 5 was 400 m upstream.

[C] – Site 13 was 300 m upstream.

3.1 Juvenile Fish Sampling

3.1.1 Species Composition and Distribution

In total, 17 habitat units were sampled across six reaches (49,507 seconds of backpack electrofishing effort over 3,081.75 m^2; Appendix B). Permanently established index sites were sampled annually from 2000 through 2002. Table 3 illustrates sample effort and total catch across years, including comparative data from the preliminary survey conducted in 1997. In 2002, while effort was relatively consistent, catch was substantially lower than previous study years and was more consistent with 1997 juvenile fish abundance levels.

Table 3. Total effort (seconds of backpack electrofishing and area) and catch (no. of fry and juvenile bull trout and Westlsope cutthroat trout combined) for the five Wigwam River bull trout index sites, 1997 and 2000-2002. Note that the lower Wigwam River site sampled in 1997 and 2002 has been included in the totals denoted by brackets.

Year	Electrofishing Effort (seconds)	Sample Area (m^2)	Total Catch (No. Fish)
1997[a]	36,227 (41,008)	2,632 (2,946)	324 (333)
2000	41,454	2,599	419
2001	36,450	2,502	470
2002	41,849 (49,507)	2,590 (3,082)	315 (364)

[a] - Wigwam River reach 7 sites 6 and 7 were combined to form the current index site. Reach 10 was relocated to reach 9. Bighorn Creek reach 1 was relocated slightly downstream.

A total of 364 juvenile bull trout and Westslope cutthroat trout were captured within the Wigwam River and Bighorn Creek during the sample period 6 – 11 August 2002. Bull trout were the dominant species encountered, representing 97.8% (n = 356) of the total catch. The remaining 2.2% of the total catch was represented by Westslope cutthroat trout (n = 8). Bull trout and Westslope cutthroat trout juveniles comprised the total catch across all years without exception (Table 4). Bull trout fry were the target species and life stage and as such, the catch composition reflects bias associated with site selection for this capture target.

Table 4. Catch composition for the Wigwam River juvenile bull trout monitoring program. Note that the 1997 totals include only those preliminary index sites that were re-sampled in the current monitoring program. Totals in brackets include the lower Wigwam River site sampled in 1997 and 2002.

	BT Fry	BT Juv.	WCT Fry	Wct Juv.	Total
1997	237 (242)	72 (75)	0 (0)	15 (16)	324 (333)
2000	382	4	23	10	419
2001	425	22	17	6	470
2002	286 (329)	25 (27)	0 (3)	4 (5)	315 (364)
Totals	1,330 (1,378)	123 (128)	40 (43)	35 (37)	1,528 (1,586)

3.1.2 Bull Trout

Bull trout fry and juveniles were captured in all sample sites. In total, 356 bull trout were captured and sampled for life history information (Table 5). All captured bull trout were fry or juveniles and ranged in fork length from 31 mm to 121 mm and the modal class, in 10 mm intervals, was 50-59 mm (Figure 2). This size class represents the young-of-the-year cohort (fry, 0^+). The relative proportions of age classes comprising the total bull trout catch were 92.4% fry (0^+) and 7.6% juveniles (1^+). Mean fork lengths of each age class (estimate) were 52.3 (0^+) and 101.5 (1^+) mm. The corresponding mean weights for bull trout age classes were 1.5 and 11.3 g respectively (Table 5). The growth rate of juvenile bull trout in the Wigwam River study area was described by the equation:

$$Log_{10}Weight = -4.8634 + 2.9287\ Log_{10}Length$$ (Figure 3).

Wigwam river Bull trout life history parameters were consistent across sample years (2000 to 2002) as illustrated in the following summary table of descriptive statistics (Table 6). The exception was the capture of two-year old juveniles in the year 2000 sample program, exclusively.

The overall mean density of juvenile bull trout (ages 0^+ and 1^+ combined) was estimated to be 12.7 fish/100 m^2 (95% confidence interval 11.5 – 14.0 fish/100 m^2; Appendix B). The mean density for the 2002 sample period was the lowest on record (Figure 4) even though the 2001 enumeration of bull trout redds was the highest on record (Figure 5).

Table 5. Summary of fork length and weight data, by estimated age cohort, collected from bull trout captured within the Wigwam River drainage, August 2002.

	Age-Group	
	0^+	1^+
Mean Fork Length (mm)	52.3	101.5
Standard Error	0.36	2.29
Range	31-69	79-121
N	330	26
Mean Weight (g)	1.5	11.3
Standard Error	0.03	0.76
Range	0.4-3.6	5.0-18.0
N	329	25

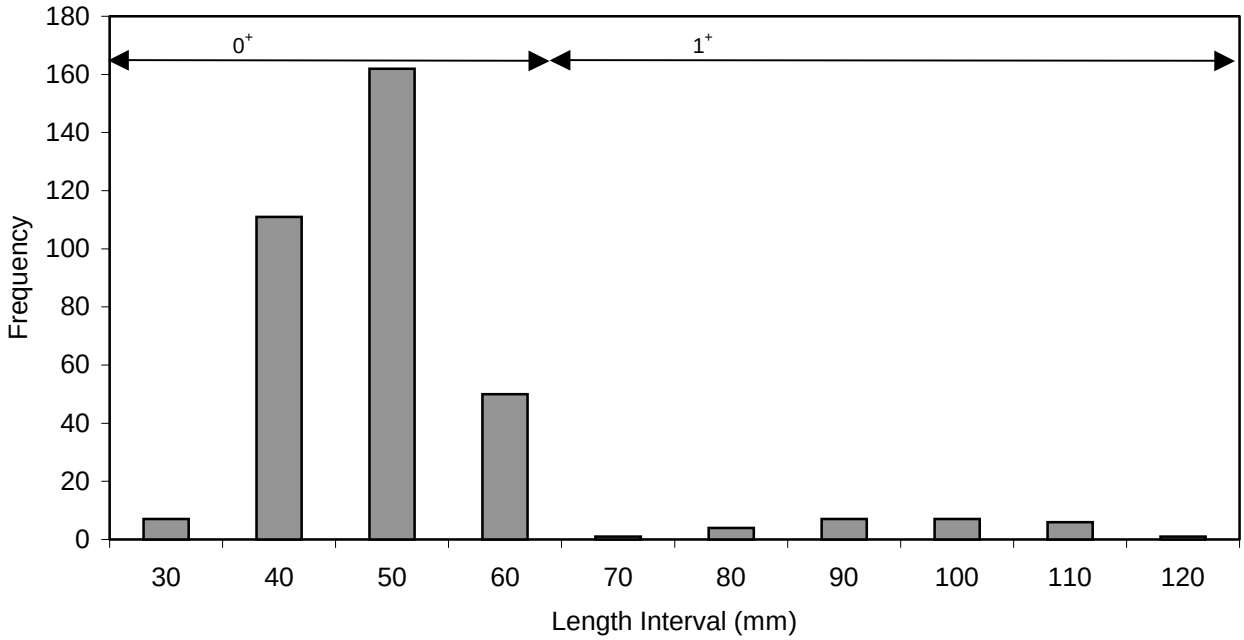

Figure 2. Length frequency distribution and estimated age cohorts for Wigwam River juvenile bull trout.

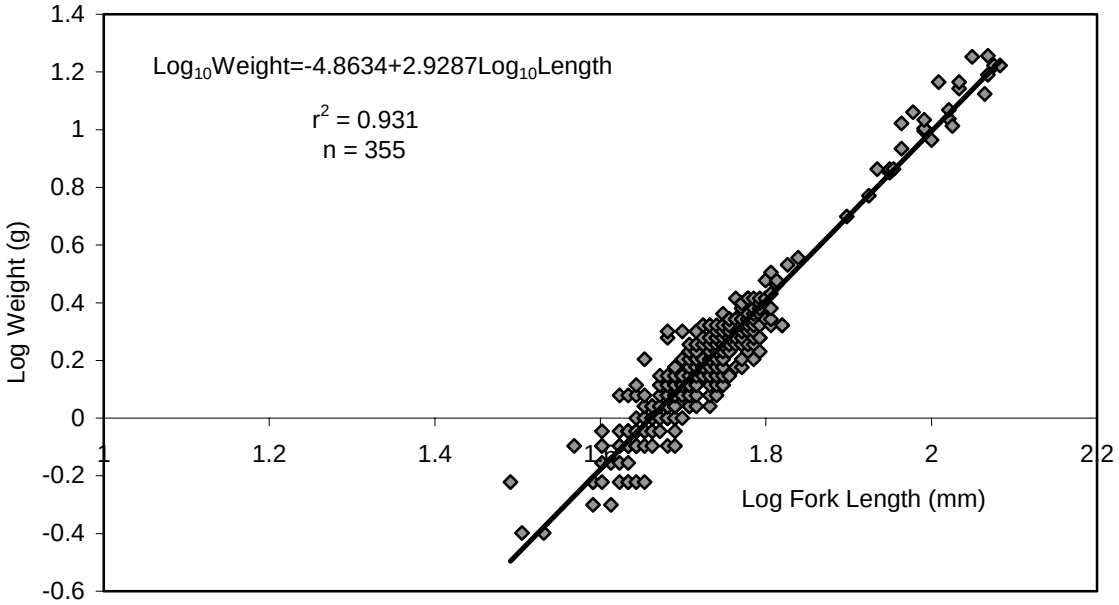

Figure 3. Length-weight regression for bull trout captured within the Wigwam River watershed, August 2002.

Table 6. Summary of descriptive statistics for the sample populations of bull trout fry and juveniles in the Wigwam River, 2000 to 2002.

Life Stage	Year	Proportion Of BT Catch	Mean Fork Length (mm)	Range Fork Length (mm)	Mean Weight (g)	Range Weight (g)	Growth Equation Intercept	Growth Equation Slope
Fry (0^+)	2000	95.6	53.9	24-72	1.7	0.4-3.7	-4.6343	2.7971
	2001	95.1	50.7	35-66	1.5	0.4-4.0	-4.6343	2.7971
	2002	92.4	52.3	31-69	1.5	0.4-3.6	-4.8634	2.9287
Juv. (1^+)	2000	3.9	101.7	82-127	11.7	5.5-24.3	-4.6343	2.7971
	2001	4.9	99.7	79-112	10.7	5.8-16.4	-4.6343	2.7971
	2002	7.6	101.5	79-121	11.3	5.0-18.0	-4.8634	2.9287
Juv. (2^+)	2000	0.5	157	150-164	39.0	34.9-43.0	-4.6343	2.7971
	2001	0.0						
	2002	0.0						

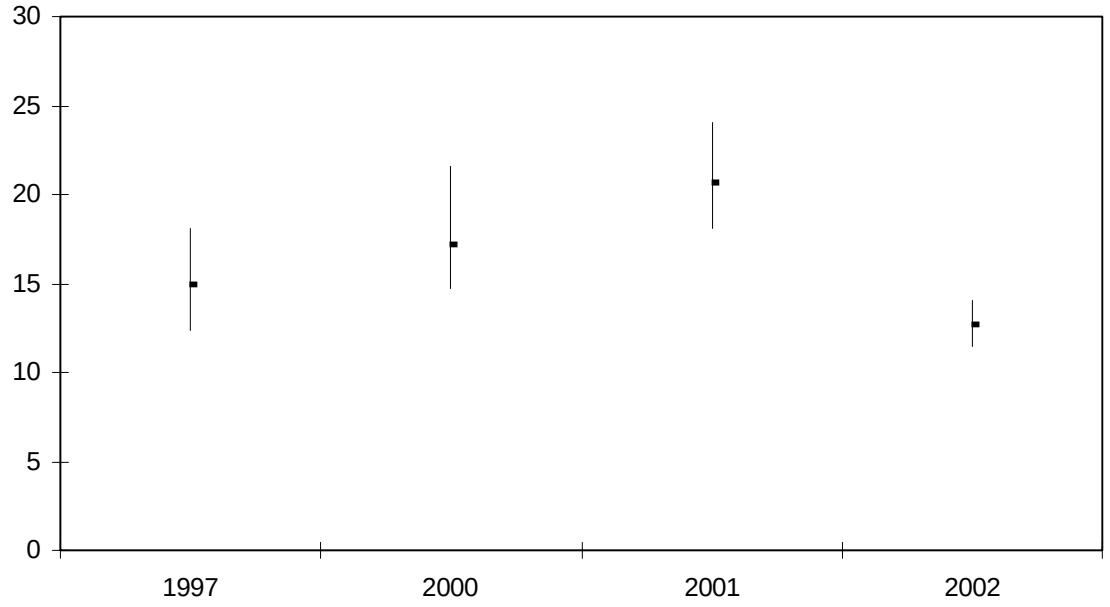

Figure 4. Mean annual density (+/- 95% confidence interval) for bull trout juveniles sampled within the upper Wigwam River sample sites (*i.e.* n=5; reaches 5 through 9), 1997 and 2000 to 2002.

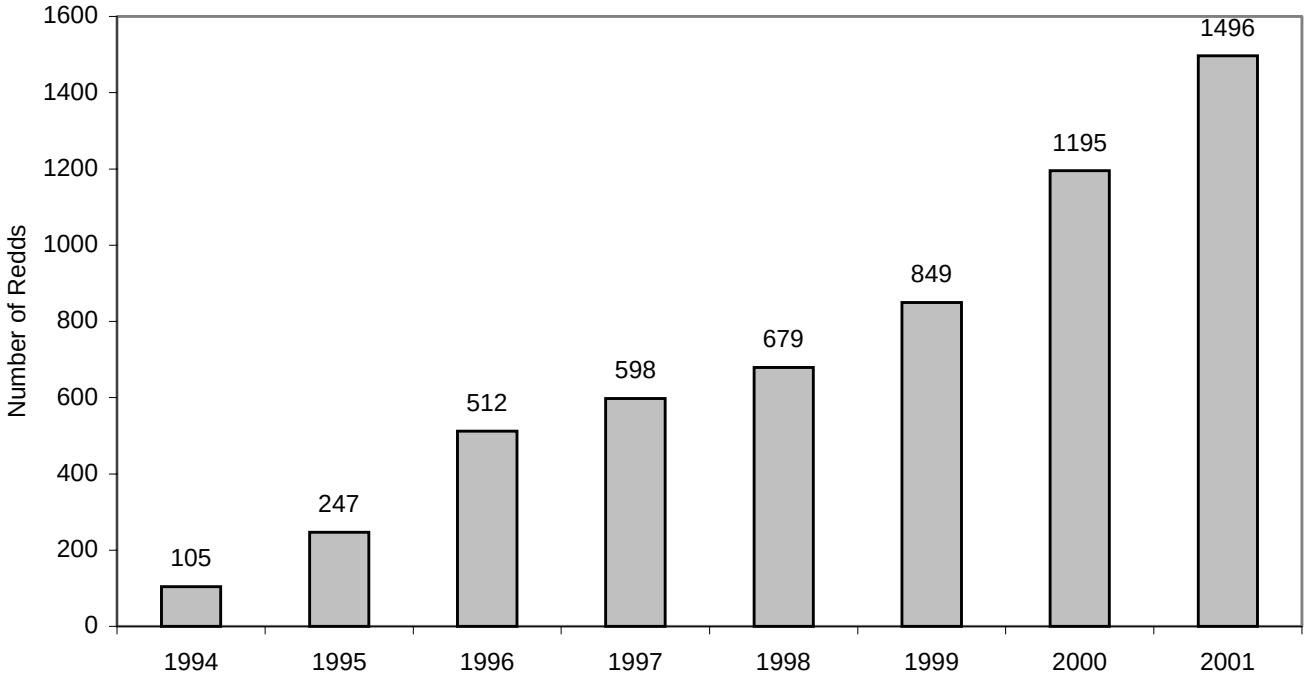

Figure 5. Annual Wigwam River bull trout redd count (Bill Westover, BCMWLAP, Cranbrook, B.C., File Data).

The mean density of juvenile bull trout within individual index sites ranged from 2.3 to 22.1 fish/100 m^2 (Table 7). Inter-annual site comparisons illustrate several notable trends. First, the lower Wigwam River fry and juvenile bull trout densities were significantly higher in 2002 (9.2 fish/100 m^2; 95% confidence interval 8.9 – 9.4) than 1997 (2.6 fish/100 m^2; 95% confidence interval 2.3 – 2.8). In addition, reach five densities were increased. This would suggest increased distribution and densities throughout the lower Wigwam River compensating for the decreased densities at the preferred bull trout spawning areas within the upper Wigwam River. This shift in juvenile distribution pattern reflects adult spawning densities and redds (B. Westover, BCMWLAP, Cranbrook, B.C., *pers. comm*.). The decrease in bull trout juvenile densities for the 2002 sample year was therefore, attributed to upper Wigwam River index sites and total production may not have been impacted as the decrease in densities at the upper index sites may indicate (reaches 6 through 9).

The decrease in juvenile bull trout densities for the upper Wigwam River index sites in 2002 therefore, most likely represents a shift in distribution from upstream concentrations to a more ubiquitous distribution. The mechanism was hypothesized to be a drought-induced shift to the hydrograph in the fall of 2001. During the fall 2001 spawning season, water levels within the upper Wigwam River were extremely low and surficial flow was absent in reach 7 for part of August and September. This limited accessibility caused a distribution shift to increased spawning at lower river locations (reaches two and five in particular). Trends in juvenile abundance are related to proximity to spawning areas and the shift in redd distribution was subsequently reflected in 2002 juvenile density sampling.

3.1.3 Westslope Cutthroat Trout

In total, 8 Westslope cutthroat trout were captured and sampled for life history information. Total captures of cutthroat trout have decreased annually from 2000 to 2002 (Table 4) and the small sample size precludes statistical analyses however, life history summary statistics are presented for inter-annual comparisons (Tables 8 and 9). In 2002, the majority of cutthroat trout captures ranged in age from 0^+ to 1^+ indicating the primary use of sampled habitat was by rearing juveniles. Cutthroat fork lengths ranged from 23 mm to 95 mm (Figure 6). Cutthroat trout fry were only captured in reach two of the Wigwam River and cutthroat trout juveniles were captured in reaches two, five and nine of the Wigwam River. The length-weight regression for Westslope cutthroat trout captured within the Wigwam River was presented (Figure 7).

Table 7. Mean density estimates (+/- 95% confidence interval) for bull trout fry at six permanent sample sites, within the Wigwam River watershed, 1997 and 2000-2002.

Bull trout sample site location	Density Estimate: Number of fry/100m^2 (+/- 95% confidence interval)			
	August 1997 [a]	August 2000[b]	August 2001[c]	August 2002
Wigwam River – Reach 2, Site 6	2.6 (1.6 – 3.5)	N/a	N/a	9.2 (8.9 – 9.4)
Wigwam River – Reach 5, Site 1	19.4 (15.6 – 23.4)	17.1 (14.7 – 19.8)	16.7 (14.6 – 19.3)	22.1 (21.0 – 23.2)
Wigwam River – Reach 6, Site 2	8.5 (7.6 – 9.5)	26.9 (23.3 – 30.4)	25.7 (22.0 – 29.4)	10.4 (8.9 – 11.8)
Wigwam River – Reach 7, Site 3	16.4 (14.4 – 18.4)	16.4 (16.0 – 17.3)	18.6 (15.3 – 23.1)	13.4 (11.2 – 15.7)
Wigwam River – Reach 9, Site 4	21.6 (10.2 – 32.9)	9.2 (8.6 – 10.5)	5.8 (5.4 – 6.9)	2.3 (2.0 – 2.6)
Bighorn Creek – Reach 1, Site 5	8.4 (5.6 – 11.3)	15.6 (10.5 – 24.1)	32.5 (28.6 – 36.4)	15.6 (14.4 – 16.8)

[a] - Cope 1998. Wigwam River reach 7 sites 6 and 7 were combined to form the current index site. The combined mean of these two sites was used for inter-annual comparisons. Reach 10 was relocated to reach 9. Bighorn Creek reach 1 was relocated slightly downstream.
[b] – Cope and Morris 2001.
[C] –Cope *et. al.* 2002.

Table 8. Summary of fork length and weight data, by estimated age cohort, collected from Westslope cutthroat trout captured within the Wigwam River drainage, August 2002.

	Age-Group	
	0^+	1^+
Mean Fork Length (mm)	24.3	75.0
Standard Error	0.67	7.9
Range	23-25	54-95
N	3	5
Mean Weight (g)	0.23	5.8
Standard Error	0.07	1.90
Range	0.1-0.3	1.3-11.5
N	3	5

Table 9. Summary of descriptive statistics for the sample populations of Westlsope cutthroat trout fry and juveniles in the Wigwam River, 2000 to 2002.

Life Stage	Year	Proportion Of WCT Catch	Mean Fork Length (mm)	Range Fork Length (mm)	Mean Weight (g)	Range Weight (g)	Growth Equation Intercept	Growth Equation Slope
Fry (0^+)	2000	68.8	24.6	21-29	0.8	0.7 – 0.9	-2.7142	1.8842
	2001	73.9	24.4	21-32	0.2	0.1-0.4	-2.7142	1.8842
	2002	37.5	24.3	23-25	0.2	0.1-0.3	-4.6892	2.8717
Juv. (1^+)	2000	21.8	76.6	68-98	5.3	3.2-10.1	-2.7142	1.8842
	2001	26.1	79.7	63-92	5.9	2.7-9.1	-2.7142	1.8842
	2002	62.5	75.0	54-95	5.8	1.3-11.5	-4.6892	2.8717
Juv. (2^+)	2000	6.3	136.5	135-138	29.2	28.5-29.8	-2.7142	1.8842
	2001	0						
	2002	0						
Juv. (3^+)	2000	3.1	184.0	184	71.7	71.7	-2.7142	1.8842
	2001	0						
	2002	0						

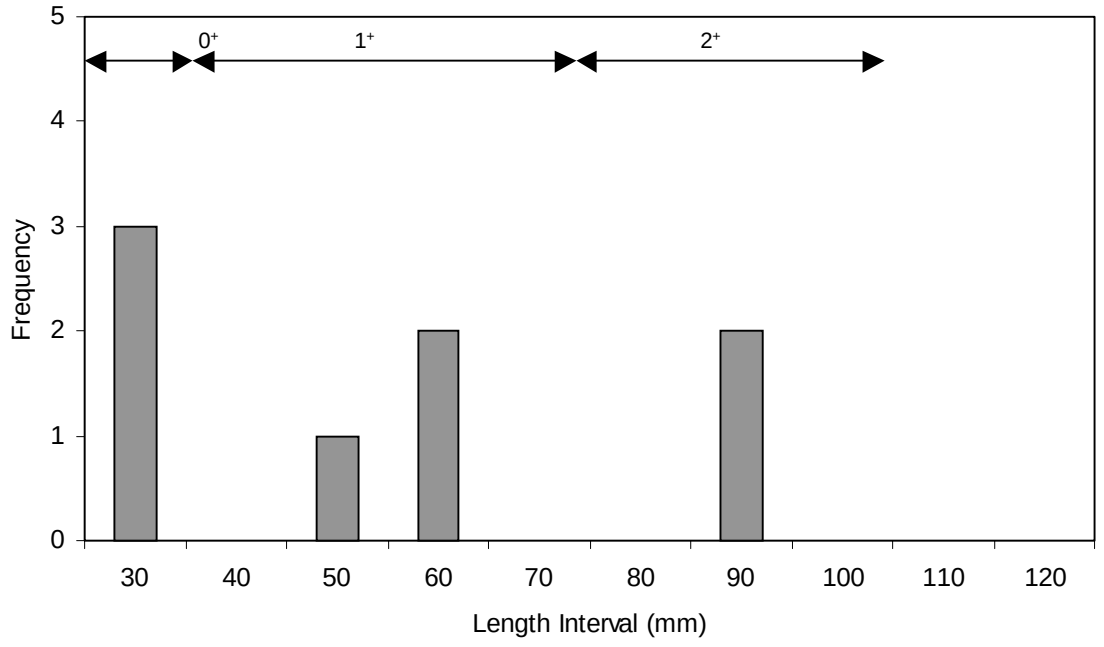

Figure 6. Length frequency distribution and estimated age cohorts for Wigwam River Westslope cutthroat trout juveniles.

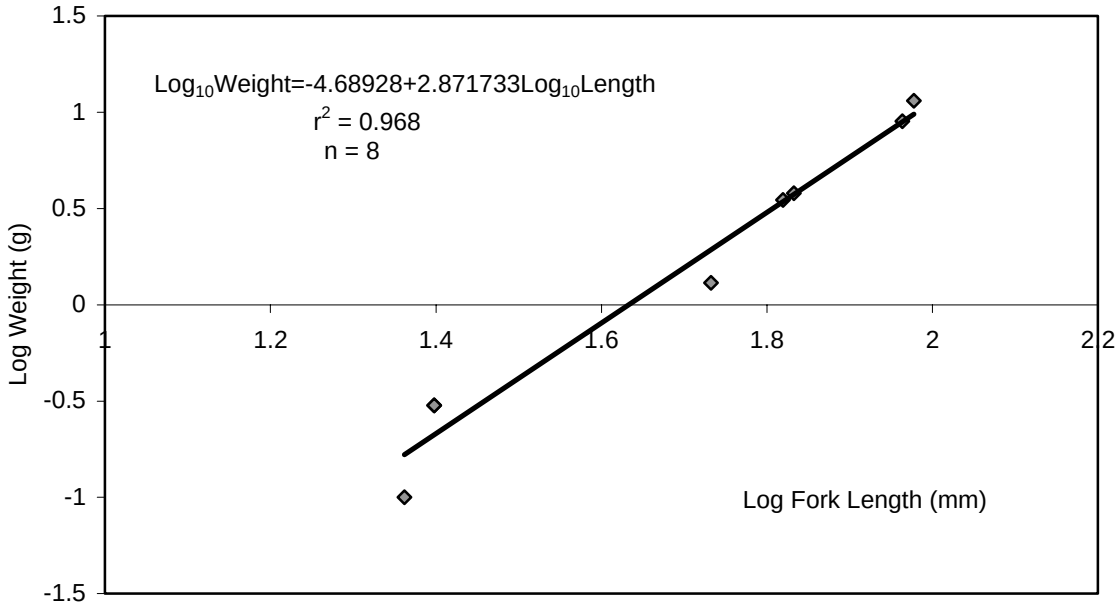

Figure 7. Length-weight regression for Westslope cutthroat trout captured within the Wigwam River watershed, August 2002.

Westslope cutthroat trout were not the target species and captures (n=8) were not sufficient to generate site-specific density estimates. Low densities (mean density = 0.26 fish/100 m^2) resulted in low precision due to either; a non-descending removal pattern, all fish captured in a single pass, or no captures. Maximum likelihood estimation was not possible under these conditions.

3.2 Physical Habitat Monitoring

3.2.1 Water Temperature and Discharge

Discharge estimates within the Wigwam River index sites during habitat sampling ranged from 0.52 to 5.84 m^3/s (Table 10). Excepting Bighorn Creek, discharges were approximately 1 m^3/s higher than the previous two years of the study program. Higher discharges were not entirely due to the earlier discharge estimation timing than previous years as the mean daily discharge recorded at the upper Wigwam River hydrometric station illustrates that the 2002 water yield was the highest recorded for the three years of the juvenile sampling program (Figure 8). Mean daily discharge at the upper Wigwam River hydrometric station (reach five) during electrofishing (3 – 9 August) ranged from 11.26 to 9.58 m^3/s (mean = 10.66 m^3/s), compared with 5.78 to 6.67 m^3/s and 3.95 to 4.47 m^3/s for the 2000 and 2001 electrofishing periods, respectively. While discharge followed a similar

pattern between years, mean daily discharge was significantly lower in 2001 than during the same period in 2000 (Prince and Morris 2002). Flows returned to a more typical level in 2002 (Figure 8). It appears that annual snow pack and groundwater recharge largely determine the hydrograph of the Wigwam River (Prince and Morris 2002).

Table 10. Summary of water temperature, mean velocity, and discharge measurements for the Wigwam River fish habitat monitoring sites.

Site	Date	Discharge (m^3/s)	Mean Velocity (m/s)	Water Temp. (^oC)
Wigwam River Reach 2 Site 6	12/08/1997	4.36[a]	0.59	10.0
	26/08/2002	5.84	0.52	10.0
Wigwam River Reach 5 Site 1	10/08/1997	5.78	0.36	7.0
	20/09/2000	3.13	0.33	8.0
	03/10/2001	3.12	0.35	8.0
	04/09/2002	4.73	0.52	9.0
Wigwam River Reach 6 Site 2	08/08/1997	3.57	0.40	8.0
	04/10/2000	1.80	0.56	5.0
	05/10/2001	1.12	1.12	5.0
	30/08/2002	2.70	0.77	10.0
Wigwam River Reach 7 Site 3	08/08/1997	2.56	0.29	9.0
	29/09/2000	0.15	0.08	7.0
	04/10/2001	0	0	7.0
	04/09/2002	0.63	0.23	12.0
Wigwam River Reach 9 Site 4	11/08/1997[b]	1.57	0.33	7.0
	27/09/2000	0.65	0.22	5.0
	04/10/2001	0.49	0.49	5.0
	16/09/2002	1.16	0.39	8.5
Bighorn Creek Reach 1 Site 5	06/08/1997	1.51	0.67	10.0
	19/09/2000	0.36	0.13	7.0
	14/09/2001	0.57	0.57	7.0
	26/08/2002	0.52	0.42	7.6

[a]– Floating chip method of estimation.
[b] –Reach 10 site was relocated to reach 9 in subsequent years.

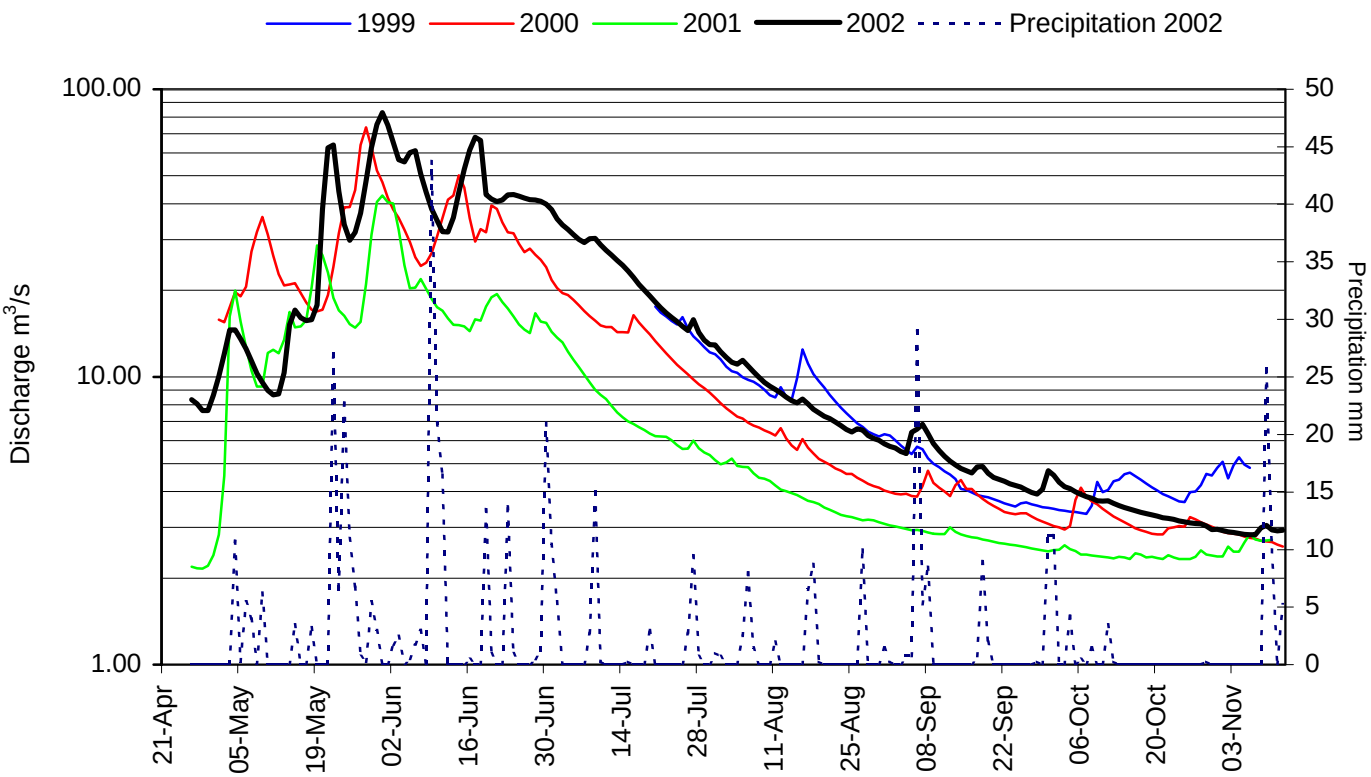

Figure 8. Mean daily discharge and total precipitation for the upper Wigwam River, 1999 - 2002 (Prince and Morris 2003).

Spot temperatures during electrofishing were well within bull trout tolerance limits (<18 ^{o}C) and in general, were indicative of cold perennial springs preferred by bull trout (<12 ^{o}C; Table 10, Figure 9). Peak mean weekly maximum water temperatures for the Wigwam River at the hydrometric station occurred during the week of 22-28 July and reached 12.76^{o}C (Figure 10). Mean weekly maximum water temperatures have not exceeded the provincial guideline of 15^{o}C for streams with bull trout during the three years of this study (Prince and Morris 2003).

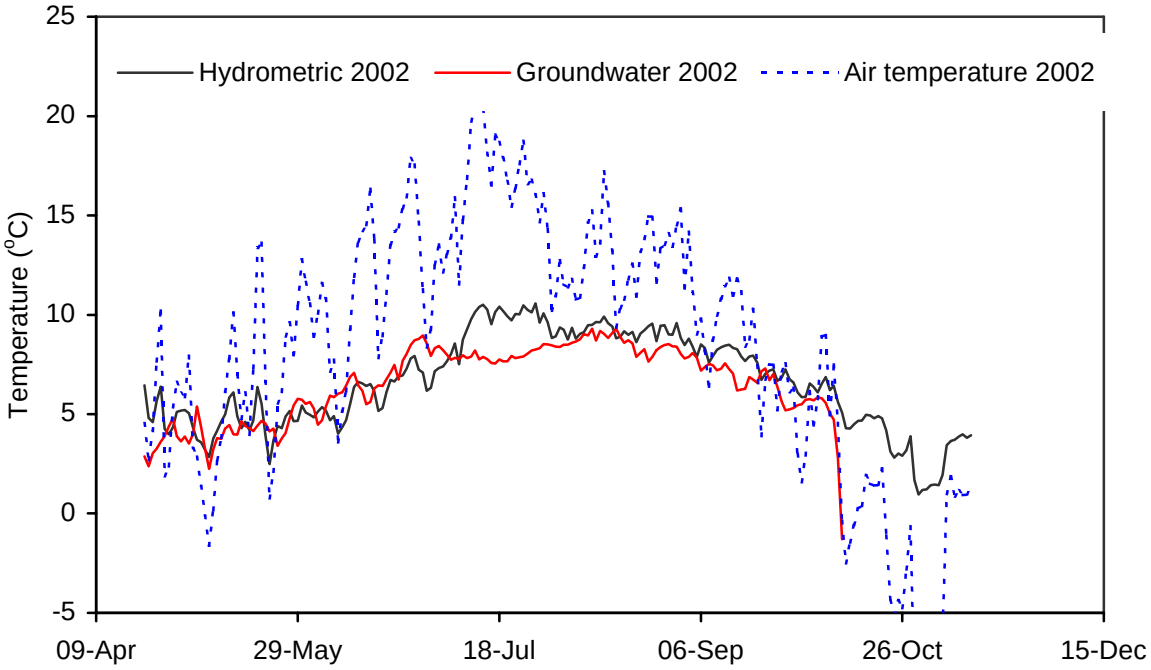

Figure 9. Mean daily water temperatures for the Wigwam River hydrometric and groundwater stations, 2002 (Prince and Morris 2003).

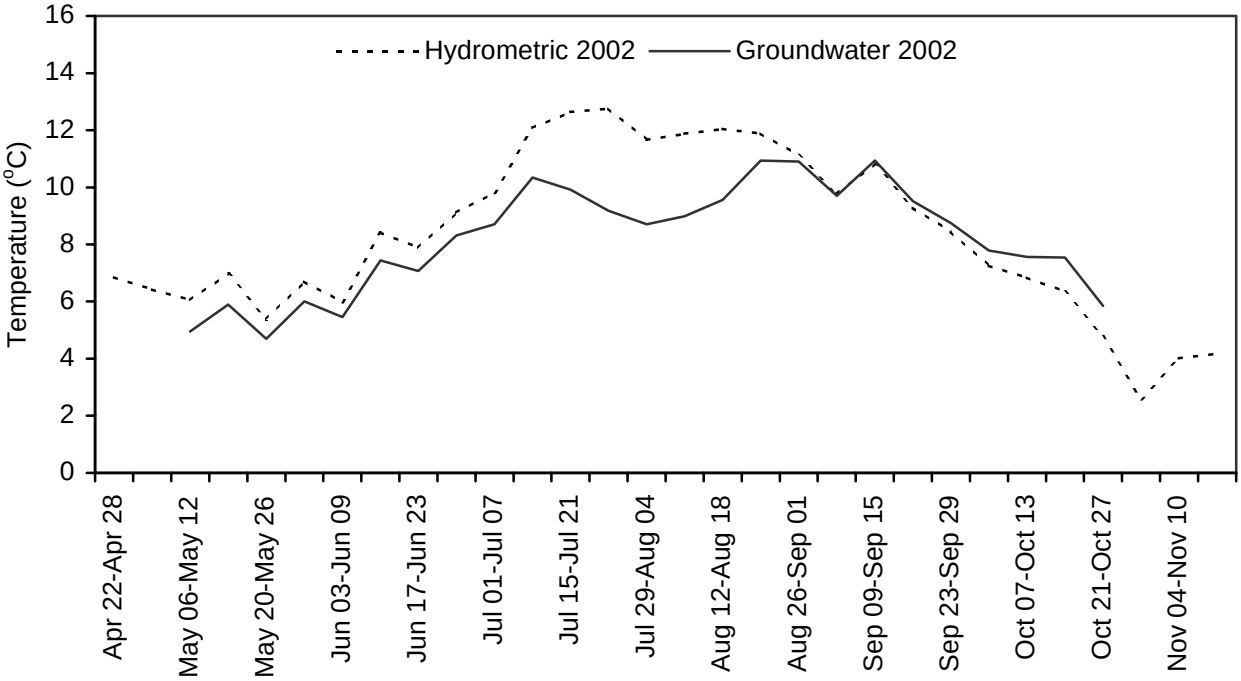

Figure 10. Mean weekly maximum water temperatures for the Wigwam River recorded at the hydrometric and groundwater stations, 2002 (Prince and Morris 2003).

3.2.2 Substrate Pebble Counts

Mean size of sediment particles less than six percent categories (*i.e.* D_{16}, D_{35}, D_{50}, D_{65}, D_{84}, D_{95}) are provided for the 2002 pebble counts and are more appropriate comparative statistics for future studies (Table 11). The preferred spawning reaches (Wigwam River reach five, six and reach one of Bighorn) were dominated by small cobble and large gravel substrate ranging in particle size from 32 mm to 96 mm and D_{50} and D_{90} particle size classes did not vary significantly from the previous years (Table 12). The modal size class had the greatest variability and was probably not an appropriate comparative statistic.

Table 11. Summary of substrate pebble counts for the Wigwam River fish habitat monitoring sites, 2002.

Site	D^{16}(mm)	D^{35}(mm)	D^{50}(mm)	D^{65}(mm)	D^{84}(mm)	D^{95}(mm)
Wigwam River Reach 2 Site 6	12.2	55.6	91.8	146	232	348
Wigwam River Reach 5 Site 1	15.0	48.8	78.1	125	199	273
Wigwam River Reach 6 Site 2	9.4	25.7	45.6	74	116	172
Wigwam River Reach 7 Site 3	23.7	56.1	84.1	119	195	323
Wigwam River Reach 9 Site 4	64.0	144.2	189.3	292	490	827
Bighorn Creek Reach 1 Site 1	5.3	29.8	43.1	60	99	170

Table 12. Summary of substrate pebble counts (mode, D50, D90) for the Wigwam River fish habitat monitoring sites, 1997 to 2002.

Site	Year	Mode (Particle Class mm)	D_{50} (Particle class mm)	D_{90} (Particle class mm)
Wigwam	1997	64 - 96	96 - 128	256 – 384
Reach 2	2002	180 - 256	90 - 128	256 – 362
Site 6				
Wigwam	1997	32 - 48	32 - 48	192 – 256
Reach 5	2000	64 – 96	64 – 96	256 – 384
Site 1	2001	64 – 96	64 – 96	192 – 256
	2002	180 – 256	64 - 90	180 – 256
Wigwam	1997	64 – 96	64 – 96	96 – 128
Reach 6	2000	64 – 96	48 – 64	128 – 192
Site 2	2001	48 – 64	32 – 48	96 – 128
	2002	64 - 90	45 - 64	128 – 180
Wigwam	1997	64 - 96	48 – 64	128 – 192
Reach 7	2000	128 – 192	64 – 96	192 – 256
Site 3	2001	128 – 192	64 – 96	192 – 256
	2002	90 - 128	64 - 90	180 – 256
Wigwam	1997	192 - 256	128 – 192	384 – 512
Reach 9	2000	256 - 384	192 – 256	512 – 1024
Site 4	2001	256 – 384	128 – 192	512 – 1024
	2002	362 - 512	180 - 256	512 – 1024
Bighorn	1997	64 - 96	64 – 96	128 – 192
Reach 1	2000	32 - 48	32 – 48	64 – 96
Site 5	2001	32 – 48	24 – 32	64 – 96
	2002	45 - 64	32 - 45	90 – 128

3.2.3 Channel Surveys

For a third consequetive year, channel longitudinal and cross sectional profiles were completed for each of the sample stations and were presented in Appendix D. The lower Wigwam River site added in 2002 was surveyed for the first time. While the channel cross-sections and longitudinal sections were not static, the degree of change was minor (*i.e*. localized infilling and/or downcutting due to large-woody debris accumulations). The absence of major channel form alterations was expected given the relatively pristine, stable nature of the study area combined with lower than average flows for the period from 2000 to 2002. The absence of any significant flood event during the 2000 to 2002 sample period suggests that the effect of low return period freshets on channel geo-morphology are minor and localized; and this has resulted in stable channel cross and longitudinal sections. The following summarizes the minor channel changes noted within the profile and sectional data presented in appendix D.

Wigwam River Reach 5 Site 1

This site was noted for its slightly aggrading nature. Pool infilling reported in 2001 has continued and in 2002 transverse bars were forming at 25-50m and 210 – 240m. Site one was located immediately downstream of the Bighorn Creek confluence and the noted high bedload movement through Bighorn Creek was assumed to be the coarse sediment source (gravels and cobbles).

Wigwam River Reach 6 Site 2

This site was noted for its habitat heterogeneity and represented a dynamic channel profile and pattern. In any given year, pools were infilled and new pools were created. Existing large woody debris jams trapped sediment and resulted in localized aggradation while newly recruited large woody debris resulted in scour and localized degradation. Reach six has been noted for its prime bull trout and Westlsope cutthroat trout spawning characteristics (large-woody debris, sediment aggradation, groundwater).

Wigwam River Reach 7 Site 3

This site was characterized by larger substrate particle sizes and a very stable channel profile and pattern. The exception was the infilling of the representative pool utilized for the cross-sectional profile. The large woody debris that scoured the pool has re-orientated parallel to the flow. The rootballs have subsequently trapped coarse sediment causing the pool to infill.

Wigwam River Reach 9 Site 4

This site was noted for its boulder streambed and represents a very stable channel profile and pattern. The minor and very localized sediment accumulation on the inside bend of the representative pool cross-section was the exception due to large woody debris trapping gravels.

Bighorn Creek Reach 1 Site 5

This site was noted for high bedload transport and annual changes to the longitudinal profile illustrate the movement of sediment through this reach. Annually, new depositional and scour features were noted in the longitudinal profile. The cross-sectional profiles illustrate deposition on the inside meander bend and secondary channel, while the outside streambank erodes. Reach one has been noted for its prime bull trout and Westlsope cutthroat trout spawning characteristics (large-woody debris, sediment aggradation, groundwater).

Wigwam River Reach 2 Site 6

This site was surveyed for the first time and was characterized as a wide floodplain with multiple channels. The profile and pattern represent a riffle-pool morphology characterized as aggrading. This was based on the predominance of lateral instability as evidenced by eroding banks, meander scars, vegetative progression, and relic channels. Valley terraces were comprised of clay and were considered unstable as evidenced by several large rotational slumps.

3.2.4 Fish Habitat Survey (FHAP Form 4)

The Level 1 Fish Habitat Assessment Procedure (FHAP) is a purposive field survey of current habitat conditions for the target species in select reaches. In this study, the Level 1 FHAP Form 4 was completed for the representative sample sites (two meander wavelengths) within the selected reaches. The output of the WRP data reporting tool are presented in Appendix C and have been archived for long-term trend monitoring. Generic diagnostic data have been summarized as descriptors of present habitat condition (Table 13).

Note that regional criteria for habitat conditions do not exist and current WRP diagnostic criteria to evaluate habitat condition are exclusive of bull trout and Westslope cutthroat trout data. Notwithstanding these limitations, diagnostic data clearly indicate the high quality

spawning and rearing habitat ratings for reach six of the Wigwam River and reach one of Bighorn Creek. These reaches demonstrate the importance of LWD and it's relationship to habitat diversity and substrate storage and diversity. Reach five pool habitat features were under-represented by site-selection bias for juvenile bull trout and the limitation of two meander wavelengths (400 m) to accurately represent 10.4 km of stream channel. Reaches seven and nine of the Wigwam River were accurately represented as more confined, higher energy reaches with lower habitat diversity. A brief reach and site summary was provided in the preliminary report for year one of the study (Cope and Morris 2001). Photo-documentation was also recorded on standard MWLAP forms and submitted under separate cover.

Comparisons of key annual habitat diagnostics data (2000-2002) for index sites within the upper Wigwam River illustrate the stability of the representative habitat sites across the three years of study (Table 14). Bankfull channel widths were derived from the annual riffle habitat unit cross-sectional survey data. Gradient was derived from the water surface elevation of the longitudinal profile. Inter-annual variation in quantitative variables was due to minor habitat changes noted in section 3.1.3. Reach six was the most dynamic and changes to pool frequency and channel gradient were associated with LWD. Increases in LWD were recorded at all index sites in 2002. LWD recruitment was attributed to the "snow-down" event in spring 2002, combined with a return to more typical discharge levels in May and June 2002.

There was no change to qualitative rearing (*i.e.* ratings for substrate, off-channel habitat) and spawning habitat (*i.e.* ratings for holding pools, gravel quantity and quality) diagnostics across years and therefore, these variables were not presented in tabular format. Both rearing and spawning habitat variables for reach six were rated as excellent across all three years.

Table 13. Diagnostics of salmonid habitat condition at the reach level for 2002 (from Johnston and Slaney 1996). Note that the individual cell format represents value/rating[A, B].

	Habitat Parameter											
	Pool % (by area)	Pool Frequency (mean spacing)	LWD Pieces per Bankfull Channel Width	% Wood Cover in Pools	% Boulder Cover in Riffles	% Overhead Cover	Substrate Rearing Habitat (interstitial rating)	Off-Channel Habitat (< 3% gradient)	Holding Pools (> 1 m deep, good cover)	Spawning Gravel Quantity	Spawning Gravel Quality	Redd Scour Potential
Reach 2 Wigwam R.	21.4 / P	2.7 / F	2.38 / G	0 / P	< 10 / P	<10 / P	Reduced / F	Extensive / G	Adequate / G	Limited / F	High Compaction / F	Extensive / P
Reach 5 Wigwam R.	55 / F	3.1 / F	2.40 / G	2.5 / P	10.7 / F	<10 / P	Clear / G	Some / F	Few / P	Limited / F	Suitable / G	Low / G
Reach 6 Wigwam R.	44.3 / F	1.3 / G	6.00 / G	25.6 / G	<10 / P	< 10 / P	Clear / G	Extensive / G	Adequate / G	Extensive / G	Suitable / G	Low / G
Reach 7 Wigwam R.	10.5 / P	6.3 / P	2.60 / G	16.8 / F	< 10 / P	< 10 / P	Clear / G	Some / F	Few / P	Limited / P	Suitable / G	Fair / F
Reach 9 Wigwam R.	5.2 / P	17.3 / P	2.02 / G	0 / P	20 / F	< 10 / P	Clear / G	Absent / P	Few / P	Absent / P	Absent / P	Extensive / P
Reach 1 Bighorn Cr.	25.9 / P	3.8 / F	4.36 / G	43 / G	< 10 / P	< 10 / P	Clear / G	Some / G	Adequate / G	Extensive / G	Suitable / G	Potential / F

A Note: regional standards are not available and diagnostic ratings (G – good, F – fair, P – poor) are generalized ratings from Johnston and Slaney (1996) for streams with a bankfull channel width of less than 15 m.

B Note: two representative meander lengths were surveyed, not the entire reach.

Table 14. Inter-annual comparison of select salmon habitat condition diagnostics for permanent index sites (from Johnston and Slaney 1996). Note that qualitative ratings for rearing and spawning habitat (see Table 13) were invariable across samples years and are not presented here for brevity.

Site	Year	Mean Gradient (%)	Mean Bankfull Channel Width (m)	Mean Bankfull Depth (m)	Mean Water Depth (m)	No. Pools Within Sample Reach	% Pool Habitat (area)	Pool Freq. (pool Spacing /W_b)	Total LWD Tally	LWD Pieces/ Bankfull Channel Width	% Wood Cover in Pools	% Boulder Cover in Riffles	% Overhead Cover	D_{90}
B1	2000	1.10	31.8	1.19	0.61	3	33.0	2.8	52	1.6	20.0	<10	<10	80
	2001	0.92	32.0	1.19	0.61	3	33.0	2.8	52	1.6	20.0	<10	<10	80
	2002	0.90	33.5	1.00	0.54	3	25.9	2.7	102	3.0	43.0	<10	<10	112
W5	2000	0.67	42.0	1.34	0.55	2	57.0	4.7	71	1.7	2.5	11.7	<10	320
	2001	0.64	43.0	1.34	0.55	2	57.0	4.7	71	1.7	2.5	11.7	<10	224
	2002	0.63	43.0	1.51	0.57	3	55.0	3.1	102	2.4	2.5	10.7	<10	218
W6	2000	0.58	66.6	1.41	0.57	5	29.9	2.0	349	5.2	27.0	<10	<10	160
	2001	0.51	65.1	1.41	0.55	5	29.9	2.1	349	5.4	27.0	<10	<10	112
	2002	0.67	69.0	1.52	0.57	8	44.3	1.3	417	6.0	25.6	<10	<10	154
W7	2000	0.67	33.4	1.28	0.50	2	7.8	9.6	66	2.0	5.0	<10	<10	224
	2001	0.71	33.2	1.28	0.00	2	7.8	9.6	51	1.5	8.3	<10	<10	224
	2002	0.72	34.0	1.19	0.44	3	10.5	6.3	88	2.6	16.8	<10	<10	218
W9	2000	1.93	14.0	1.23	0.39	1	5.2	20.7	31	2.2	3.0	19.0	<10	768
	2001	1.71	13.2	1.11	0.41	1	5.2	22.0	27	2.0	5.0	27.5	<10	768
	2002	1.79	14.0	1.21	0.42	1	5.2	20.7	34	2.4	0.0	23.3	<10	768

4 Discussion

The 2002 project year represents the third and final year of a long-term bull trout monitoring program with current studies focused on collecting baseline information. Forest development within the Canadian portion of the upper Wigwam River commenced in August 1997 (road development) and the first cut-blocks were harvested in the winter of 2000/2001. To date, 601.8 ha or 134,900 m^3 of harvest volume representing 81.8% of the allowable cut has been harvested (Total permitted cut: 735.8 ha or 170,612 m^3; Prince and Morris 2003). The remaining volume is scheduled for harvesting in 2003.

Relative to co-existing species, bull trout densities usually are low, and most broad faunal surveys indicate less than 5% of the total catch is made up of bull trout (McPhail and Baxter 1996, Reiman and McIntyre 1995). However, in the Wigwam River, bull trout represented 96.3%, 92.4%, 95.1% and 97.8% of the catch from 1997, and 2000 to 2002, respectively. Fry dominated the catch and this was a direct result of juvenile bull trout ecology and habitat partitioning among life history stages. Site selection was biased towards electrofishing sample sites which favored high bull trout fry capture success.

The mean density of all juvenile bull trout was estimated to be 12.7 fish/100m^2 and represents the lowest estimated density for the enumeration program, even though enumeration of bull trout redds was the highest on record (Table 15). Inter-annual site comparisons illustrate several notable trends. First, the lower Wigwam River fry and juvenile bull trout densities were significantly higher in 2002 than 1997. In addition, reach five densities were increased. This would suggest increased distribution and densities throughout the lower Wigwam River compensating for the decreased densities at the preferred bull trout spawning areas within the upper Wigwam River. This shift in juvenile distribution pattern reflects adult spawning densities and redds (B. Westover, BCMWLAP, Cranbrook, B.C., *pers. comm*.).

Table 15. Summary of mean annual estimates for bull trout juvenile densities and redd count estimates from the previous year.

Year	Redd Estimate	Year	Juvenile Density Estimate
1996	512	1997	14.9
1999	849	2000	17.2
2000	1195	2001	20.7
2001	1496	2002	12.7

The decrease in juvenile bull trout densities for the upper Wigwam River index sites in 2002 therefore, most likely represents a shift in distribution from upstream concentrations to a more ubiquitous distribution. The mechanism was hypothesized to be a drought-induced shift to the hydrograph that began in 2000 and became particularly significant in the fall of 2001. During the fall 2001 spawning season, water levels within the upper Wigwam River were extremely low and in fact, surficial flow was absent in much of reach 7 for most of August and September. This limited accessibility caused a distribution shift to increased spawning at lower river locations (reaches two and five in particular). Trends in juvenile abundance are related to proximity to spawning areas and the shift in redd distribution was subsequently reflected in 2002 juvenile density sampling. Therefore, total juvenile bull trout production may not have been impacted as the mean density might suggest as the decrease in densities at the upper index sites (reaches 6 through 9) may have been more than compensated for by the increase in densities in the lower reaches (reaches 1 through 5). Lower densities in 2002 were not attributed to the significantly higher discharge during the 2002 sampling period. This was due to the predominant sampling of shallow (5 – 20 cm), low velocity (<0.3 m/s), cobble dominated stream margin habitat.

Maximum summer water temperatures of 14 – 18^{o}C appear to limit bull trout distribution (Baxter and McPhail 1996) and the high water quality of the Wigwam River was reflected in the low maximum summer water temperatures and ubiquitous juvenile bull trout distribution. Mean weekly maximum water temperatures have not exceeded the provincial guideline of 15^{o}C for streams with bull trout during the three years of this study (Prince and Morris 2003). Furthermore, the inverted temperature profile across seasons between upper and lower temperature monitoring locations further demonstrates the influence of groundwater and/or sub-surface streambed flow in maintaining preferred bull trout spawning and incubation temperatures within the upper Wigwam River valley (Prince and Cope 2001).

Trends in abundance appeared to be related to proximity to spawning areas, bed material size, water depth and LWD. The association of bull trout fry with shallow (5 – 20 cm), low velocity (<0.3 m/s), cobble dominated stream margin habitat has been previously documented within the Wigwam River (Cope 1998). The upper Wigwam River is comprised of sorted gravels and small cobbles that provide prime spawning and rearing habitat. Extensive groundwater and sub-surface streambed exfiltration maintains water temperatures and base winter flows.

The range of morphological stream types encompass the depositional (aggrading) to degrading and sensitive to resilient spectrum and vary from very low to very high bedload sediment yields. A number of site-specific disturbance features of note included sediment wedges, extensive unvegetated bars and lateral instability. Aerial photographs (35 mm) within reach six dating to the late 1970's demonstrate remarkable similarity to recent photographs (Cope and Morris 2001). Although reach six appears to be aggrading, these photographs suggest stability. This was in spite of the 1995 rain-on-snow event generally believed to represent a 1 in 150 year flood event. Minor shifting of braids and some downcutting has occurred since 1997 but no major change in geo-morphology or bed material size class has occurred during the baseline survey period. While the reach may appear unstable at first glance, the annual habitat survey data suggest this dynamic, multiple channel stream channel, although a very high sediment storage and bedload yield reach, is currently in equilibrium. This reach contains some of the prime bull trout spawning grounds found in the Wigwam River and should be considered very sensitive. The diagnostics summary table demonstrates the importance of LWD to stream structure and sediment storage, habitat diversity, and stability within this reach.

When compared to other bull trout systems, the large spawning escapement and high juvenile densities provide a strong case that the Wigwam River may be the most prolific bull trout population in the species distributional range. At the very least, it can be concluded that the pre-forest harvesting population of Wigwam River bull trout represent a large and stable population with high juvenile bull trout densities. Bull trout populations have been shown to be extremely susceptible to habitat degradation and over harvest (McPhail and Baxter 1996, Ratliff et al. 1996) and are ecologically important as an indicator of watershed health (Baxter 1997). As such, the upper Wigwam River watershed remains relatively pristine, and maintains high water quality, high habitat capability and, conservative angling regulations have been successful in preventing over-exploitation.

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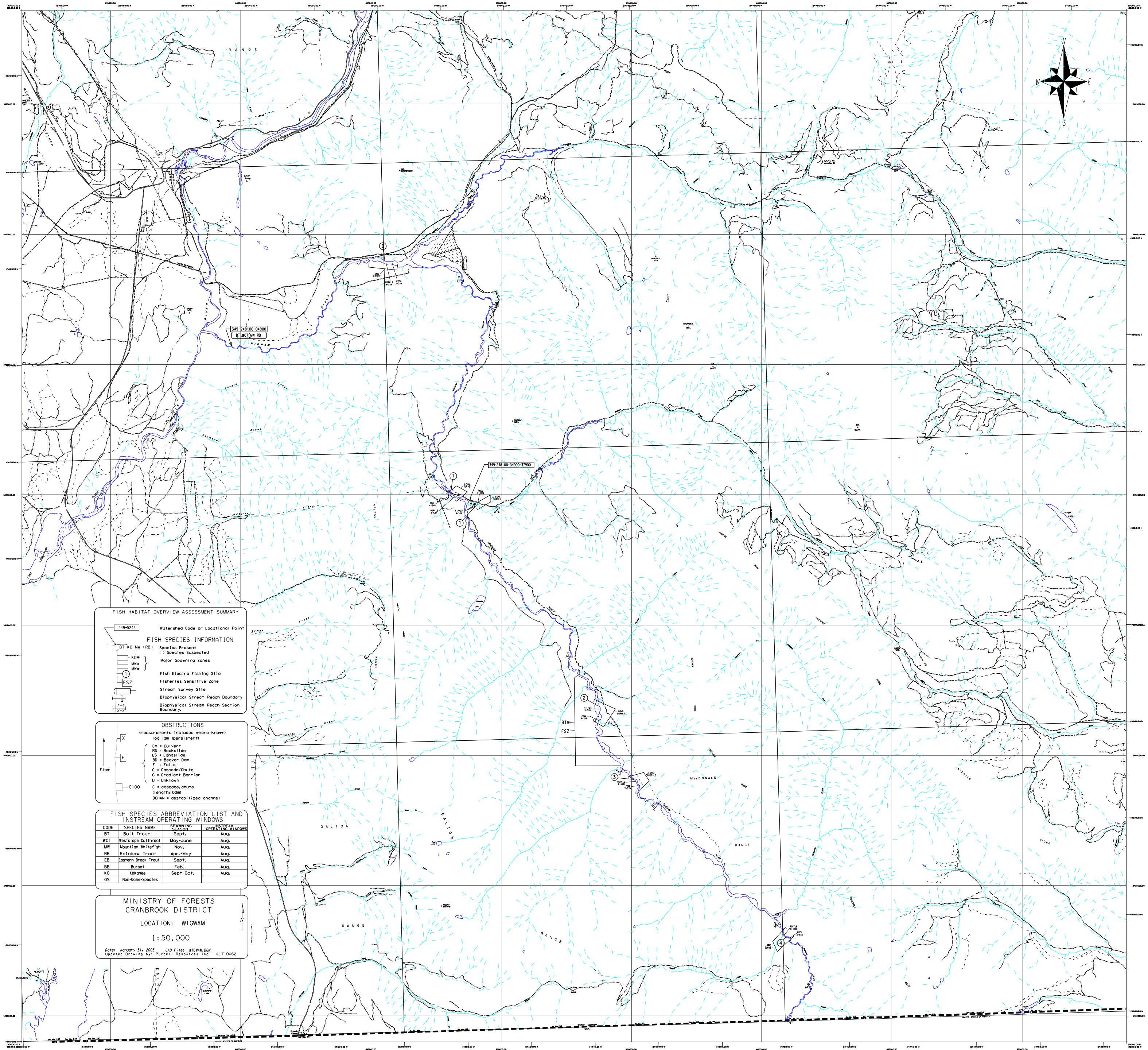
Appendix A

1:50,000 TRIM Map



FISH SPECIES ABBREVIATION LIST AND INSTREAM OPERATING WINDOWS

CODE	SPECIES NAME	SPAWNING SEASON	INSTREAM OPERATING WINDOWS
BT	Bull Trout	Sept.	Aug.
WCT	Westslope Cutthroat	May-June	Aug.
MW	Mountian Whitefish	Nov.	Aug.
RB	Rainbow Trout	Apr.-May	Aug.
EB	Eastern Brook Trout	Sept.	Aug.
BB	Burbot	Feb.	Aug.
KO	Kokanee	Sept-Oct.	Aug.
OS	Non-Game-Species		

MINISTRY OF FORESTS
CRANBROOK DISTRICT

LOCATION: WIGWAM

1:50,000

Date: January 31, 2003 CAD File: WIGWAM.DGN
Updated Drawing by: Purcell Resources Inc - 417-0662

Appendix B

Fish Capture Data

Table B1. Summary of electroshocking sample effort and catch in the Wigwam River and Bighorn Creek, 9 to 14 August 2000.

Reach No.	Site No.	Haul No.	Sample Effort		Catch (number of fish)				Total Catch
			Time (s)	Area m2	BT[1] fry[3]	WCT[2] fry[3]	BT[1] juv.[4]	WCT[2] juv[4]	
1[a]	1	1	1330	254.7	13	1			14
1[a]	1	2	1150	254.7	9	1			10
1[a]	1	3	1230	254.7	6	3			9
1[a]	2	1	678	238.2	10				10
1[a]	2	2	655	238.2	8				8
1[a]	2	3	570	238.2	6				6
SUBTOTAL		1	2008	492.9	23	1	0	0	24
		2	1805	492.9	17	1	0	0	18
		3	1800	492.9	12	3	0	0	15
TOTAL			5613	492.9	52	5	0	0	57
5	1	1	1378	193.93	15			2	17
5	1	2	1072	193.93	12		1	4	17
5	1	3	981	193.93	9				9
5	2	1	1802	265.68	26	2			28
5	2	2	1695	265.68	9	4			13
5	2	3	1083	265.68	4	2			6
5	3	1	1043	138.24	8				8
5	3	2	603	138.24	3				3
5	3	3	593	138.24	2				2
SUBTOTAL		1	4223	597.85	49	2	0	2	53
		2	3370	597.85	24	4	1	4	33
		3	2657	597.85	15	2	0	0	17
TOTAL			10250	597.85	88	8	1	6	103
6	1	1	1328	180	22	1			23
6	1	2	1005	180	14				14
6	1	3	1105	180	13	1			14
6	2	1	1498	180	19	3			22
6	2	2	1093	180	7	1			8
6	2	3	1007	180	5				5
6	3	1	1932	150	27	2	2	1	32
6	3	2	985	150	10	1			11
6	3	3	714	150	2	1	1		4
SUBTOTAL		1	4758	510	68	6	2	1	77
		2	3083	510	31	2	0	0	33
		3	2826	510	20	2	1	0	23
TOTAL			10667	510	119	10	3	1	133

[a] Bighorn Creek

[1] Bull Trout

[2] Westslope Cutthroat Trout

[3] 0+ age group

[4] 1+, 2+, 3+ age groups combined

Cont…

Table B1. Contd.

Reach No.	Site No.	Haul No.	Sample Effort		Catch (number of fish)				Total Catch
			Time (s)	Area m2	BT[1] fry[3]	WCT[2] fry[3]	BT[1] juv.[4]	WCT[2] juv[4]	
7	1	1	1807	203	28				28
7	1	2	1178	203	5				5
7	1	3	1086	203	1				1
7	2	1	909	185.25	11				11
7	2	2	807	185.25	4				4
7	2	3	619	185.25	2				2
7	3	1	819	111	18				18
7	3	2	708	111	7				7
7	3	3	554	111	4				4
SUBTOTAL		1	3535	499.25	57	0	0	0	57
		2	2693	499.25	16	0	0	0	16
		3	2259	499.25	7	0	0	0	7
TOTAL			8487	499.25	80	0	0	0	80
9	1	1	1213	239.44	8			1	9
9	1	2	818	239.44	6				6
9	1	3	776	239.44					0
9	2	1	535	150	2			1	3
9	2	2	450	150	1				1
9	2	3	414	150				1	1
9	3	1	848	109.62	13				13
9	3	2	758	109.62	10				10
9	3	3	625	109.62	3				3
SUBTOTAL		1	2596	499.06	23	0	0	2	25
		2	2026	499.06	17	0	0	0	17
		3	1815	499.06	3	0	0	1	4
TOTAL			4622	499.06	43	0	0	3	46
GRAND TOTAL			**39639**	**2599.06**	**382**	**23**	**4**	**10**	**419**

[a] Bighorn Creek

[1] Bull Trout

[2] Westslope Cutthroat Trout

[3] 0+ age group

[4] 1+, 2+, 3+ age groups combined

Table B2. Summary of site population estimates and density estimates for bull trout (BT) within the Wigwam River study area, 9 to 14 August, 2000. Note that three pass removal-depletion method was used to estimate abundance (see catch summary).

Life Stage	Site Estimate						
	Population Estimate (No. of Fish)	**Low 95% Confidence Interval** (No. of Fish)	**High 95% Confidence Interval** (No. of Fish)	**Density Estimate** (No./100m^2)	**Low 95% Confidence Interval** (No./100m^2)	**High 95% Confidence Interval** (No./100m^2)	**Capture Probability**
Wigwam River, Reach 5, Site 1 (597.85 m^2)							
BT Fry	102	88	118.65	17.1	14.7	19.8	0.478
BT Juv.	0	0	0	0	0	0	0
Wigwam River, Reach 6, Site 2 (510.00 m^2)							
BT Fry	137	119	155.27	26.9	23.3	30.4	0.488
BT Juv.	3	3	6.05	0.6	0.6	6	0.6
Wigwam River, Reach 7, Site 3 (499.25 m^2)							
BT Fry	82	80	86.22	16.4	16	17.3	0.690
BT Juv.	0	0	0	0	0	0	0
Wigwam River, Reach 9, Site 4 (499.06 m^2)							
BT Fry	46	43	52.54	9.2	8.6	10.5	0.573
BT Juv.	0	0	0	0	0	0	0
Bighorn Creek, Reach 1, Site 1 (492.90 m^2)							
BT Fry	77	52	118.64	15.6	10.5	24.1	0.310
BT Juv.	0	0	0	0	0	0	0
Mean Densities							
BT Fry				17.0	14.6	20.4	
BT Juv.				0.1	0.1	1.2	
Combined				17.2	14.7	21.6	

Table B3. Summary of site population estimates and density estimates for Westslope cutthroat trout (WCT) within the Wigwam River study area, 9 to 14 August, 2000. Note that three pass removal-depletion method was used to estimate abundance (see catch summary).

Life Stage	Site Estimate						
	Population Estimate (No. of Fish)	**Low 95% Confidence Interval** (No. of Fish)	**High 95% Confidence Interval** (No. of Fish)	**Density Estimate** (No./100m^2)	**Low 95% Confidence Interval** (No./100m^2)	**High 95% Confidence Interval** (No./100m^2)	**Capture Probability**
Wigwam River, Reach 5, Site 1 (597.85 m^2)							
WCT Fry	13	8	40.28	2.2	1.3	6.74	0.258
WCT Juv.	6	6	8.58	1	1	1.44	0.600
Wigwam River, Reach 6, Site 2 (510.00 m^2)							
WCT Fry	10	10	12.52	2	2	2.45	0.625
WCT Juv.	0	0	0	0	0	0	0
Wigwam River, Reach 7, Site 3 (499.25 m^2)							
WCT Fry	0	0	0	0	0	0	0
WCT Juv.	0	0	0	0	0	0	0
Wigwam River, Reach 9, Site 4 (499.06 m^2)							
WCT Fry	0	0	0	0	0	0	0
WCT Juv.	3	3	6.05	0.6	0.6	1.21	0.600
Bighorn Creek, Reach 1, Site 1 (492.90 m^2)							
WCT Fry	25	5	383.15	5.07	1	77.73	0.069
WCT Juv.	0	0	0	0	0	0	0
Mean Densities							
WCT Fry				1.9	0.9	17.4	
WCT Juv.				0.3	0.3	0.5	
Combined				2.2	1.2	17.9	

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000 2.0 6

WATERBODY

Gazetted Name: WIGWAM RIVER Local: Lodgepole site

Project Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-

WS Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000

Waterbody ID: ILP Map #: ILP #: Reach #: 2 - 6

Project ID: 5861 Lake/Stream: S Lake From Date:

Fish Permit #: 02040845 Date: 2002/08/11 To: 2002/08/11 Agency: C214 Crew: AP/SC/JB Resample: ☑

SITE / METHOD

Site#	NID Map	NID #	UTM:Zone/East/North/Mthd				MTD/NO		Temp	Cond	Turbid	Comment
3		3	11	645276	5459102	GP3	EF	1	12	157	C	glide margin LUB
2		2	11	645117	5458932	GP3	EF	1	10.7	147	C	pool margin main channel
1		1	11	645187	5458995	GP3	EF	1	9.7	113	C	riffle side channel LUB

A. GEAR SETTINGS

Site#	MTD/NO		H/P	Date In	Time In	Date Out	Time Out	Comment
1	EF	1	1	2002/08/11	09:55	2002/08/11	10:30	
1	EF	1	2	2002/08/11	10:32	2002/08/11	11:10	
2	EF	1	1	2002/08/11	11:50	2002/08/11	12:15	
2	EF	1	2	2002/08/11	12:20	2002/08/11	12:41	
2	EF	1	3	2002/08/11	12:42	2002/08/11	13:10	
3	EF	1	1	2002/08/11	14:45	2002/08/11	15:20	
3	EF	1	2	2002/08/11	15:25	2002/08/11	15:50	
3	EF	1	3	2002/08/11	15:51	2002/08/11	16:16	

C. ELECTROFISHER SPECIFICATIONS

Site#	MTD/NO		H/P	Encl	Sec	Length	Width	Voltage	Frequency	Pulse	Make	Model
1	EF	1	1	C	1207	10.5	19.5	300	60	6	SR	12A
1	EF	1	2	C	1128	10.5	19.5	300	60	6	SR	12A
2	EF	1	1	C	958	21.0	7.0	300	60	6	SR	12A
2	EF	1	2	C	888	21.0	7.0	300	60	6	SR	12A
2	EF	1	3	C	769	21.0	7.0	300	60	6	SR	12A
3	EF	1	1	C	976	35.0	4.0	300	60	6	SR	12A
3	EF	1	2	C	815	35.0	4.0	300	60	6	SR	12A
3	EF	1	3	C	917	35.0	4.0	300	60	6	SR	12A

FISH SUMMARY

Site#	MTD/NO		H/P	Species	Stage	Age	Total #	Lgth (Min/Max)		FishAct	Comment
1	EF	1	1	BT	F	0+	10	44	65	R	
1	EF	1	2	NFC			0				zero catch; therefore end of sample
2	EF	1	1	BT	J	1+	1	92	92	R	
2	EF	1	1	BT	F	0+	6	48	57	R	
2	EF	1	1	WCT	F	0+	2	23	25	R	yolk sac visible
2	EF	1	2	BT	J	1+	1	108	108	R	
2	EF	1	2	BT	F	0+	3	49	63	R	
2	EF	1	3	BT	F	0+	1	59	59	R	
3	EF	1	1	BT	F	0+	20	45	60	R	
3	EF	1	1	WCT	J	1+	1	95	95	R	
3	EF	1	2	BT	F	0+	2	57	59	R	
3	EF	1	3	WCT	F	0+	1	25	25	R	
3	EF	1	3	BT	F	0+	1	55	55	R	

INDIVIDUAL FISH DATA

Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
2	EF	1	1	WCT	23	.1	U	U									
2	EF	1	1	BT	56	2.0	U	U									
2	EF	1	1	BT	48	1.2	U	U									
2	EF	1	1	BT	55	1.5	U	U									
2	EF	1	1	BT	50	1.4	U	U									
2	EF	1	1	BT	57	2.1	U	U									
2	EF	1	1	BT	57	1.9	U	U									

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000 2.0 6

INDIVIDUAL FISH DATA

Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
2	EF	1	2	BT	63	3.0	U	U									
2	EF	1	2	BT	57	1.7	U	U									
2	EF	1	2	BT	49	1.3	U	U									
2	EF	1	2	BT	108	13.9	U	U									
2	EF	1	3	BT	59	2.4	U	U									
3	EF	1	1	BT	50	1.3	U	U									
3	EF	1	1	BT	45	1.6	U	U									
3	EF	1	1	BT	55	2.0	U	U									
3	EF	1	1	BT	50	1.6	U	U									
3	EF	1	1	BT	54	2.1	U	U									
3	EF	1	1	BT	56	1.8	U	U									
3	EF	1	1	BT	54	1.9	U	U									
3	EF	1	1	BT	53	2.1	U	U									
3	EF	1	1	BT	60	2.6	U	U									
3	EF	1	1	BT	59	2.5	U	U									
3	EF	1	1	BT	57	2.2	U	U									
3	EF	1	1	BT	51	1.8	U	U									
3	EF	1	1	BT	54	2.1	U	U									
3	EF	1	1	BT	52	2.0	U	U									
3	EF	1	1	CT/RB	95	11.5	U	U									possible hybrid no slashes
3	EF	1	1	BT	56	1.8	U	U									
3	EF	1	1	BT	49	1.1	U	U									
3	EF	1	1	BT	57	2.0	U	U									
3	EF	1	1	BT	55	1.9	U	U									
3	EF	1	1	BT	51	1.7	U	U									
3	EF	1	1	BT	55	1.8	U	U									
3	EF	1	2	BT	57	2.2	U	U									
3	EF	1	2	BT	59	2.2	U	U									
3	EF	1	3	BT	55	1.6	U	U									
3	EF	1	3	WCT	25	.3	U	U									
1	EF	1	1	BT	50	1.2	U	U									
1	EF	1	1	BT	48	1.2	U	U									
1	EF	1	1	BT	49	1.5	U	U									
1	EF	1	1	BT	44	.9	U	U									
1	EF	1	1	BT	52	1.6	U	U									
1	EF	1	1	BT	59	2.5	U	U									
1	EF	1	1	BT	57	2.0	U	U									
1	EF	1	1	BT	65	3.0	U	U									
1	EF	1	1	BT	56	1.9	U	U									
1	EF	1	1	BT	51	1.7	U	U									
2	EF	1	1	WCT	25	.3	U	U									
2	EF	1	1	BT	92	10.5	U	U									

COMMENTS

Section	Comments
WATERBODY	Photos Site 3 (glide margin): 54 - u/s; 55 - x/s; 56 - d/s;
WATERBODY	Photos site 2 (pool side margin): 51-u/s; 52 - x/s; 53 - d/s;
WATERBODY	Photos Site 1 (riffle side channel): 48 - u/s; 49 - x/s; 50-d/s;

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000 5.0 1

WATERBODY

Gazetted Name: WIGWAM RIVER Local: Wigwam River

Project Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-

WS Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000

Waterbody ID: ILP Map #: ILP #: Reach #: 5 - 1

Project ID: 5861 Lake/Stream: S Lake From Date:

Fish Permit #: 02-04-0845 Date: 2002/08/10 To: 2002/08/10 Agency: C214 Crew: SC/JB/AP Resample: ☑

SITE / METHOD

Site#	NID Map	NID #	UTM:Zone/East/North/Mthd				MTD/NO		Temp	Cond	Turbid	Comment
3	82G016	3	11	648102	5450005	GP3	EF	1	11.1	147	C	Riffle margin
2	82G016	2	11	648102	5450005	GP3	EF	1	9.4	109	C	Pool margin
1	82G016	1	11	648102	5450005	GP3	EF	1	8.6	118	C	Glide margin

A. GEAR SETTINGS

Site#	MTD/NO		H/P	Date In	Time In	Date Out	Time Out	Comment
1	EF	1	1	2002/08/10	09:00	2002/08/10	09:40	
1	EF	1	2	2002/08/10	09:47	2002/08/10	10:11	
1	EF	1	3	2002/08/10	10:12	2002/08/10	10:40	
2	EF	1	1	2002/08/10	11:00	2002/08/10	11:44	
2	EF	1	2	2002/08/10	11:45	2002/08/10	12:17	
2	EF	1	3	2002/08/10	12:18	2002/08/10	12:43	
3	EF	1	1	2002/08/10	14:00	2002/08/10	14:55	
3	EF	1	2	2002/08/10	15:00	2002/08/10	15:30	
3	EF	1	3	2002/08/10	15:35	2002/08/10	16:00	

C. ELECTROFISHER SPECIFICATIONS

Site#	MTD/NO		H/P	Encl	Sec	Length	Width	Voltage	Frequency	Pulse	Make	Model
1	EF	1	1	C	1268	15.0	10.0	300	60	6	SR	12A
1	EF	1	2	C	964	15.0	10.0	300	60	6	SR	12A
1	EF	1	3	C	907	15.0	10.0	300	60	6	SR	12A
2	EF	1	1	C	1193	24.0	8.7	300	60	6	SR	12A
2	EF	1	2	C	1170	24.0	8.7	300	60	6	SR	12A
2	EF	1	3	C	839	24.0	8.7	300	60	6	SR	12A
3	EF	1	1	C	1123	36.0	5.0	300	60	6	SR	12A
3	EF	1	2	C	944	36.0	5.0	300	60	6	SR	12A
3	EF	1	3	C	904	36.0	5.0	300	60	6	SR	12A

FISH SUMMARY

Site#	MTD/NO		H/P	Species	Stage	Age	Total #	Lgth (Min/Max)		FishAct	Comment
1	EF	1	1	BT	F	0+	25	39	63	R	
1	EF	1	2	BT	F	0+	11	32	55	R	
1	EF	1	3	BT	F	0+	5	53	55	R	
2	EF	1	1	BT	F	0+	29	37	64	R	
2	EF	1	2	BT	F	0+	7	49	56	R	
2	EF	1	3	BT	F	0+	2	56	67	R	
3	EF	1	1	WCT	J	1+	2	66	92	R	
3	EF	1	1	BT	J	1+	4	89	117	R	
3	EF	1	1	BT	F	0+	22	39	64	R	
3	EF	1	2	BT	F	0+	6	52	60	R	
3	EF	1	3	BT	F	0+	4	46	53	R	
3	EF	1	3	WCT	J	1+	1	68	68	R	

INDIVIDUAL FISH DATA

Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
1	EF	1	1	BT	63	2.5	U	U									
1	EF	1	1	BT	55	1.8	U	U									
1	EF	1	1	BT	52	1.7	U	U									
1	EF	1	1	BT	60	2.1	U	U									
1	EF	1	1	BT	55	1.9	U	U									
1	EF	1	1	BT	51	1.5	U	U									

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000 5.0 1

INDIVIDUAL FISH DATA																		
Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
1	EF	1	1	BT	45	1.1	U	U									
1	EF	1	1	BT	50	1.2	U	U									
1	EF	1	1	BT	48	1.2	U	U									
1	EF	1	1	BT	48	1.3	U	U									
1	EF	1	1	BT	51	1.2	U	U									
1	EF	1	1	BT	45	1.0	U	U									
1	EF	1	1	BT	45	1.1	U	U									
1	EF	1	2	BT	45	1.0	U	U									
1	EF	1	2	BT	42	.7	U	U									
1	EF	1	2	BT	50	1.4	U	U									
1	EF	1	2	BT	43	.9	U	U									
1	EF	1	2	BT	55	1.8	U	U									
1	EF	1	2	BT	54	1.8	U	U									
1	EF	1	2	BT	55	2.0	U	U									
1	EF	1	2	BT	49	1.1	U	U									
1	EF	1	2	BT	46	1.1	U	U									
1	EF	1	2	BT	45	.9	U	U									
1	EF	1	2	BT	32	.4	U	U									
1	EF	1	3	BT	55	2.1	U	U									
1	EF	1	3	BT	54	1.3	U	U									
1	EF	1	3	BT	53	1.8	U	U									
1	EF	1	3	BT	55	1.5	U	U									
1	EF	1	3	BT	53	1.6	U	U									
2	EF	1	1	BT	64	3.2	U	U									
2	EF	1	1	BT	62	2.6	U	U									
2	EF	1	1	BT	48	2.0	U	U									
2	EF	1	1	BT	53	2.1	U	U									
2	EF	1	1	BT	53	1.5	U	U									
2	EF	1	1	BT	46	1.0	U	U									
2	EF	1	1	BT	42	.8	U	U									
2	EF	1	1	BT	53	1.5	U	U									
2	EF	1	1	BT	47	1.0	U	U									
2	EF	1	1	BT	60	2.0	U	U									
2	EF	1	1	BT	57	2.0	U	U									
2	EF	1	1	BT	48	1.1	U	U									
2	EF	1	1	BT	54	1.6	U	U									
2	EF	1	1	BT	50	1.4	U	U									
2	EF	1	1	BT	53	1.5	U	U									
2	EF	1	1	BT	57	1.7	U	U									
2	EF	1	1	BT	60	2.3	U	U									
2	EF	1	1	BT	41	.7	U	U									
2	EF	1	1	BT	51	1.7	U	U									
2	EF	1	1	BT	54	1.7	U	U									
2	EF	1	1	BT	47	1.3	U	U									
2	EF	1	1	BT	40	.8	U	U									
2	EF	1	1	BT	57	2.2	U	U									
2	EF	1	1	BT	45	1.1	U	U									
2	EF	1	1	BT	47	1.4	U	U									
2	EF	1	1	BT	55	1.8	U	U									
2	EF	1	1	BT	37	.8	U	U									
2	EF	1	1	BT	49	1.5	U	U									
2	EF	1	1	BT	42	1.2	U	U									
2	EF	1	2	BT	50	1.4	U	U									
2	EF	1	2	BT	49	1.2	U	U									
2	EF	1	2	BT	55	1.9	U	U									
2	EF	1	2	BT	55	1.9	U	U									
2	EF	1	2	BT	56	1.9	U	U									

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000 5.0 1

INDIVIDUAL FISH DATA																		
Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
2	EF	1	2	BT	56	2.0	U	U									
2	EF	1	2	BT	54	1.7	U	U									
2	EF	1	3	BT	56	2.1	U	U									
2	EF	1	3	BT	67	3.4	U	U									
3	EF	1	1	BT	54	1.7	U	U									
3	EF	1	1	WCT	92	9.0	U	U									
3	EF	1	1	BT	52	2.0	U	U									
3	EF	1	1	WCT	66	3.5	U	U									
3	EF	1	1	BT	117	15.5	U	U									
3	EF	1	1	BT	89	7.1	U	U									
3	EF	1	1	BT	49	1.2	U	U									
3	EF	1	1	BT	98	10.8	U	U									
3	EF	1	1	BT	51	1.6	U	U									
3	EF	1	1	BT	57	2.0	U	U									
3	EF	1	1	BT	47	1.0	U	U									
3	EF	1	1	BT	98	10.1	U	U									
3	EF	1	1	BT	55	1.6	U	U									
3	EF	1	1	BT	54	1.6	U	U									
3	EF	1	1	BT	59	2.0	U	U									
3	EF	1	1	BT	64	2.4	U	U									
3	EF	1	1	BT	58	1.9	U	U									
3	EF	1	1	BT	43	1.2	U	U									
3	EF	1	1	BT	52	1.5	U	U									
3	EF	1	1	BT	52	1.3	U	U									
3	EF	1	1	BT	47	1.1	U	U									
3	EF	1	1	BT	59	2.0	U	U									
3	EF	1	1	BT	48	1.9	U	U									
3	EF	1	1	BT	57	2.0	U	U									
3	EF	1	1	BT	39	.6	U	U									
3	EF	1	1	BT	44	1.3	U	U									
3	EF	1	1	BT	49	1.4	U	U									
3	EF	1	1	BT	49	1.3	U	U									
3	EF	1	2	BT	58	2.2	U	U									
3	EF	1	2	BT	60	2.6	U	U									
3	EF	1	2	BT	54	1.9	U	U									
3	EF	1	2	BT	52	1.8	U	U									
3	EF	1	2	BT	57	2.1	U	U									
3	EF	1	2	BT	55	1.6	U	U									
3	EF	1	3	BT	53	1.8	U	U									
3	EF	1	3	BT	52	1.5	U	U									
3	EF	1	3	BT	46	1.0	U	U									
3	EF	1	3	BT	51	1.4	U	U									
3	EF	1	3	WCT	68	3.8	U	U									
1	EF	1	1	BT	47	1.1	U	U									
1	EF	1	1	BT	47	1.3	U	U									
1	EF	1	1	BT	47	1.2	U	U									
1	EF	1	1	BT	61	2.6	U	U									
1	EF	1	1	BT	52	1.6	U	U									
1	EF	1	1	BT	42	.9	U	U									
1	EF	1	1	BT	39	.6	U	U									
1	EF	1	1	BT	40	.7	U	U									
1	EF	1	1	BT	45	.9	U	U									
1	EF	1	1	BT	54	1.6	U	U									
1	EF	1	1	BT	49	1.3	U	U									
1	EF	1	1	BT	55	1.9	U	U									

COMMENTS

Section	Comments

FDIS Fish Card

		Reach #	ILP Map #	ILP #
Watershed Code:	349-248100-04900-00000-0000-0000-000-000-000-000-000-000	5.0	1	

WATERBODY	Site 3 photos; 46 u/s; 47 x/s; 48 d/s; note we are off by one photo # d/s = 47
WATERBODY	Site 2 photos: 43 u/s; 44 x/s; 45 d/s;
WATERBODY	Site 1 Pictures: 40 - x/s; 41 d/s; 42 u/s;

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000 6.0 2

WATERBODY

Gazetted Name: WIGWAM RIVER Local: Henry's Site

Project Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-

WS Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000

Waterbody ID: ILP Map #: ILP #: Reach #: 6 - 2

Project ID: 5861 Lake/Stream: S Lake From Date:

Fish Permit #: 02-04-0845 Date: 2002/08/08 To: 2002/08/08 Agency: C214 Crew: SC/JB/KM Resample: ☑

SITE / METHOD

Site#	NID Map	NID #	UTM:Zone/East/North/Mthd				MTD/NO		Temp	Cond	Turbid	Comment
3	82G.006	6	11	653433	5441980	GP3	EF	1	10.2	140	C	Side Channel
2	82G.006	5	11	653432	5441979	GP3	EF	1	10.8	140	C	Riffle margin
1	82G.006	4	11	653744	5442243	GP3	EF	1	7.8	140	C	Glide Margin (was Pool)

A. GEAR SETTINGS

Site#	MTD/NO		H/P	Date In	Time In	Date Out	Time Out	Comment
1	EF	1	1	2002/08/08	10:20	2002/08/08	10:48	
1	EF	1	2	2002/08/08	10:56	2002/08/08	11:42	
1	EF	1	3	2002/08/08	11:45	2002/08/08	12:10	
2	EF	1	1	2002/08/08	13:35	2002/08/08	14:10	
2	EF	1	2	2002/08/08	14:15	2002/08/08	14:51	
2	EF	1	3	2002/08/08	14:55	2002/08/08	15:20	
3	EF	1	1	2002/08/08	15:58	2002/08/08	16:35	
3	EF	1	2	2002/08/08	16:37	2002/08/08	17:00	
3	EF	1	3	2002/08/08	17:10	2002/08/08	17:23	

C. ELECTROFISHER SPECIFICATIONS

Site#	MTD/NO		H/P	Encl	Sec	Length	Width	Voltage	Frequency	Pulse	Make	Model
1	EF	1	1	C	1211	26.0	6.0	300	60	6	SR	12A
1	EF	1	2	C	1429	26.0	6.0	300	60	6	SR	12A
1	EF	1	3	C	881	26.0	6.0	300	60	6	SR	12A
2	EF	1	1	C	1182	22.3	9.8	300	60	6	SR	12A
2	EF	1	2	C	998	22.3	9.8	300	60	6	SR	12A
2	EF	1	3	C	961	22.3	9.8	300	60	6	SR	12A
3	EF	1	1	C	910	23.0	5.9	300	60	6	SR	12A
3	EF	1	2	C	856	23.0	5.9	300	60	6	SR	12A
3	EF	1	3	C	639	23.0	5.9	300	60	6	SR	12A

FISH SUMMARY

Site#	MTD/NO		H/P	Species	Stage	Age	Total #	Lgth (Min/Max)		FishAct	Comment
1	EF	1	1	BT	F	0	11	43	60	R	
1	EF	1	2	BT	F	0	4	46	62	R	
1	EF	1	3	BT	F	0	2	44	54	R	
2	EF	1	1	BT	F	0	13	43	59	R	
2	EF	1	2	BT	F	0	6	50	66	R	
2	EF	1	2	BT	J	1	1	106	106	R	
2	EF	1	3	BT	F	0	1	48	48	R	
3	EF	1	1	BT	F	0	5	44	63	R	
3	EF	1	2	BT	F	0	3	43	48	R	
3	EF	1	3	BT	F	0	3	55	59	R	

INDIVIDUAL FISH DATA

Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
1	EF	1	1	BT	59	2.1	U	U									
1	EF	1	1	BT	50	1.3	U	U									
1	EF	1	1	BT	53	1.6	U	U									
1	EF	1	1	BT	59	2.0	U	U									
1	EF	1	1	BT	58	2.2	U	U									
1	EF	1	1	BT	60	2.1	U	U									
1	EF	1	1	BT	44	.8	U	U									
1	EF	1	1	BT	43	.9	U	U									

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000 6.0 2

INDIVIDUAL FISH DATA

Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
1	EF	1	1	BT	45	1.0	U	U									
1	EF	1	1	BT	52	1.7	U	U									
1	EF	1	1	BT	54	1.4	U	U									
1	EF	1	2	BT	46	1.1	U	U									
1	EF	1	2	BT	56	1.5	U	U									
1	EF	1	2	BT	62	2.4	U	U									
1	EF	1	2	BT	50	1.3	U	U									
1	EF	1	3	BT	54	1.7	U	U									
1	EF	1	3	BT	44	.6	U	U									
2	EF	1	1	BT	59	1.8	U	U									
2	EF	1	1	BT	58	2.2	U	U									
2	EF	1	1	BT	51	1.3	U	U									
2	EF	1	1	BT	43	.8	U	U									
2	EF	1	1	BT	52	1.8	U	U									
2	EF	1	1	BT	51	1.3	U	U									
2	EF	1	1	BT	47	.9	U	U									
2	EF	1	1	BT	55	1.4	U	U									
2	EF	1	1	BT	56	1.5	U	U									
2	EF	1	1	BT	53	1.6	U	U									
2	EF	1	1	BT	48	1.1	U	U									
2	EF	1	1	BT	53	1.9	U	U									
2	EF	1	1	BT	57	1.8	U	U									
2	EF	1	2	BT	106	10.3	U	U									
2	EF	1	2	BT	61	1.6	U	U									
2	EF	1	2	BT	62	1.7	U	U									
2	EF	1	2	BT	66	2.1	U	U									
2	EF	1	2	BT	66	2.1	U	U									
2	EF	1	2	BT	50	1.2	U	U									
2	EF	1	2	BT	55	1.4	U	U									
2	EF	1	3	BT	48	1.3	U	U									
3	EF	1	1	BT	50	1.2	U	U									
3	EF	1	1	BT	61	2.4	U	U									
3	EF	1	1	BT	63	2.6	U	U									
3	EF	1	1	BT	57	2.1	U	U									
3	EF	1	1	BT	44	1.2	U	U									
3	EF	1	2	BT	47	1.0	U	U									bite out of caudal fin
3	EF	1	2	BT	48	1.1	U	U									
3	EF	1	2	BT	43	.8	U	U									
3	EF	1	3	BT	59	1.8	U	U									
3	EF	1	3	BT	55	1.7	U	U									
3	EF	1	3	BT	57	1.9	U	U									

COMMENTS

Section	Comments
WATERBODY	Site 3 photos - 27 u/s; 28 x/s; 29 d/s; side channel. Another braid flows into side-channel and as a result there is much more water volume than previous years and spawning BT present.
WATERBODY	Site 2 Photos 24 u/s; 25 x/s; 26 d/s riffle margin
WATERBODY	Photos 20 u/s; 21 x/s; 22 d/s 23 pool (previous site) x/c.
WATERBODY	Site 1: Glide margin, was pool tail out but pool has infilled and most of channel is now riffle, EF site shifted downstream slightly to capture glide habitat similar to pool tail-out of previous years.

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000 7.0 3

WATERBODY

Gazetted Name: WIGWAM RIVER Local:

Project Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-

WS Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000

Waterbody ID: ILP Map #: ILP #: Reach #: 7 - 3

Project ID: 5861 Lake/Stream: S Lake From Date:

Fish Permit #: 02-04-0845 Date: 2002/08/07 To: 2002/08/07 Agency: C214 Crew: SC/JB/KM Resample: ☑

SITE / METHOD

Site#	NID Map	NID #	UTM:Zone/East/North/Mthd				MTD/NO		Temp	Cond	Turbid	Comment
3	82G006	3	11	655098	5439085	GP3	EF	1	12	166	C	Side channel
2	82G006	2	11	655080	5439023	GP3	EF	1	12	166	C	Riffle margin
1	82G006	1	11	655153	5439001	GP3	EF	1	7.8	166	C	Glide margin

A. GEAR SETTINGS

Site#	MTD/NO		H/P	Date In	Time In	Date Out	Time Out	Comment
1	EF	1	1	2002/08/07	10:20	2002/08/07	10:55	
1	EF	1	2	2002/08/07	11:00	2002/08/07	11:36	
1	EF	1	3	2002/08/07	11:41	2002/08/07	12:01	
2	EF	1	1	2002/08/07	13:04	2002/08/07	13:35	
2	EF	1	2	2002/08/07	13:45	2002/08/07	14:10	
2	EF	1	3	2002/08/07	14:12	2002/08/07	14:39	
3	EF	1	1	2002/08/07	15:03	2002/08/07	15:34	
3	EF	1	2	2002/08/07	15:37	2002/08/07	16:03	
3	EF	1	3	2002/08/07	16:05	2002/08/07	16:35	

C. ELECTROFISHER SPECIFICATIONS

Site#	MTD/NO		H/P	Encl	Sec	Length	Width	Voltage	Frequency	Pulse	Make	Model
1	EF	1	1	C	1428	26.5	7.0	300	60	6	SR	12A
1	EF	1	2	C	1280	26.5	7.0	300	60	6	SR	12A
1	EF	1	3	C	1057	26.5	7.0	300	60	6	SR	12A
2	EF	1	1	C	1358	31.0	5.3	300	60	6	SR	12A
2	EF	1	2	C	1076	31.0	5.3	300	60	6	SR	12A
2	EF	1	3	C	706	31.0	5.3	300	60	6	SR	12A
3	EF	1	1	C	1028	22.0	6.1	300	60	6	SR	12A
3	EF	1	2	C	1140	22.0	6.1	300	60	6	SR	12A
3	EF	1	3	C	976	22.0	6.1	300	60	6	SR	12A

FISH SUMMARY

Site#	MTD/NO		H/P	Species	Stage	Age	Total #	Lgth (Min/Max)		FishAct	Comment
1	EF	1	1	BT	F	0+	9	42	49	R	
1	EF	1	2	BT	F	0+	3	43	52	R	
1	EF	1	3	BT	F	0+	2	40	45	R	
2	EF	1	1	BT	F	0+	15	31	52	R	
2	EF	1	1	BT	J	1+	1	89	89	R	
2	EF	1	2	BT	F	0+	5	44	54	R	
2	EF	1	3	BT	F	0+	1	52	52	R	
3	EF	1	1	BT	J	1+	2	110	116	R	
3	EF	1	1	BT	F	0+	6	48	56	R	
3	EF	1	2	BT	F	0+	8	40	49	R	
3	EF	1	3	BT	J	1+	2	100	108	R	
3	EF	1	3	BT	F	0+	4	39	51	R	

INDIVIDUAL FISH DATA

Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
1	EF	1	1	BT	44	.9	U	U									
1	EF	1	1	BT	46	.8	U	U									
1	EF	1	1	BT	42	.8	U	U									
1	EF	1	1	BT	45	.8	U	U									
1	EF	1	1	BT	47	1.1	U	U									
1	EF	1	1	BT	49	1.1	U	U									

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000 7.0 3

INDIVIDUAL FISH DATA																		
Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
1	EF	1	1	BT	44	.8	U	U									
1	EF	1	1	BT	44	.8	U	U									
1	EF	1	1	BT	42	.6	U	U									
1	EF	1	2	BT	52	1.3	U	U									
1	EF	1	2	BT	51	1.1	U	U									
1	EF	1	2	BT	43	.9	U	U									
1	EF	1	3	BT	45	.9	U	U									
1	EF	1	3	BT	40	.8	U	U									
2	EF	1	1	BT	48	1.0	U	U									
2	EF	1	1	BT	89	7.3	U	U									
2	EF	1	1	BT	45	.6	U	U									
2	EF	1	1	BT	49	1.1	U	U									
2	EF	1	1	BT	46	.9	U	U									
2	EF	1	1	BT	48	1.1	U	U									
2	EF	1	1	BT	48	1.0	U	U									
2	EF	1	1	BT	46	.9	U	U									
2	EF	1	1	BT	45	.9	U	U									
2	EF	1	1	BT	52	1.6	U	U									
2	EF	1	1	BT	49	.8	U	U									
2	EF	1	1	BT	49	1.4	U	U									
2	EF	1	1	BT	48	1.0	U	U									
2	EF	1	1	BT	31	.6	U	U									
2	EF	1	1	BT	48	1.0	U	U									
2	EF	1	1	BT	43	.6	U	U									
2	EF	1	2	BT	45	.9	U	U									
2	EF	1	2	BT	54	1.4	U	U									
2	EF	1	2	BT	44	1.0	U	U									
2	EF	1	2	BT	44	.9	U	U									
2	EF	1	2	BT	54	1.2	U	U									
2	EF	1	3	BT	52	1.1	U	U									
3	EF	1	1	BT	48	1.0	U	U									
3	EF	1	1	BT	54	1.2	U	U									
3	EF	1	1	BT	56	1.3	U	U									
3	EF	1	1	BT	49	1.0	U	U									
3	EF	1	1	BT	49	.9	U	U									
3	EF	1	1	BT	52	1.2	U	U									
3	EF	1	1	BT	116	13.3	U	U									
3	EF	1	1	BT	110		U	U									Had in dipnet. Lost and watched swin under blocknet.
3	EF	1	2	BT	43	.7	U	U									
3	EF	1	2	BT	46	1.1	U	U									
3	EF	1	2	BT	44	.8	U	U									
3	EF	1	2	BT	49	1.0	U	U									
3	EF	1	2	BT	46	1.0	U	U									
3	EF	1	2	BT	47	1.0	U	U									
3	EF	1	2	BT	43	.8	U	U									
3	EF	1	2	BT	40	.6	U	U									
3	EF	1	3	BT	45	1.2	U	U									
3	EF	1	3	BT	100	9.2	U	U									
3	EF	1	3	BT	51	1.1	U	U									
3	EF	1	3	BT	49	1.1	U	U									
3	EF	1	3	BT	108	14.6	U	U									
3	EF	1	3	BT	39	.5	U	U									

COMMENTS

Section	Comments

FDIS Fish Card

		Reach #	ILP Map #	ILP #
Watershed Code:	349-248100-04900-00000-0000-0000-000-000-000-000-000-000	7.0	3	

COMMENTS	
Section	Comments
WATERBODY	Site 3 Photos 16, u/s; 17 x/s; 18 d/s;
WATERBODY	Site 2 pass 3 - start 14:12; end 14:37 706 secs
WATERBODY	Site 2: photos 11 u/s, 12 x/s, 13 d/s, 14&15 EF;
WATERBODY	Site 2 end 13:35 pass 1; start pass 2 - 13:45; pass 2 - 1076 sec;
WATERBODY	Water level higher than last year - site went dry in mid - late Aug. Therefore spawning probably did not occur. Shallow margin very sandy
WATERBODY	Site 1 glide - same as previous years; roll dig 1; 8 u/s, 9 d/s, 10-11 x/s;

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000 9.0 4

WATERBODY

Gazetted Name: WIGWAM RIVER Local: Rabbit Creek Site

Project Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-

WS Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-000

Waterbody ID: ILP Map #: ILP #: Reach #: 9 - 4

Project ID: 5861 Lake/Stream: S Lake From Date:

Fish Permit #: 02-04-0845 Date: 2002/08/09 To: 2002/08/09 Agency: C214 Crew: SC/JB/KM Resample: ☑

SITE / METHOD

Site#	NID Map	NID #	UTM:Zone/East/North/Mthd				MTD/NO		Temp	Cond	Turbid	Comment
3	82G.007	12	11	660808	5433115	GP3	EF	1	6.3	187	C	Glide margin
2	82G.007	11	11	660889	5433086	GP3	EF	1	8.5	162	C	Riffle margin
1	82G.007	10	11	660865	5433019	GP3	EF	1	11.3	163	C	Step pool

A. GEAR SETTINGS

Site#	MTD/NO		H/P	Date In	Time In	Date Out	Time Out	Comment
1	EF	1	1	2002/08/09	14:59	2002/08/09	15:32	
1	EF	1	2	2002/08/09	15:37	2002/08/09	16:08	
2	EF	1	1	2002/08/09	11:47	2002/08/09	12:19	
2	EF	1	2	2002/08/09	12:25	2002/08/09	12:58	
2	EF	1	3	2002/08/09	13:03	2002/08/09	13:29	
3	EF	1	1	2002/08/09	09:56	2002/08/09	10:21	
3	EF	1	2	2002/08/09	10:27	2002/08/09	10:49	

C. ELECTROFISHER SPECIFICATIONS

Site#	MTD/NO		H/P	Encl	Sec	Length	Width	Voltage	Frequency	Pulse	Make	Model
1	EF	1	1	C	1145	28.6	8.8	300	60	6	SR	12A
1	EF	1	2	C	958	28.6	8.8	300	60	6	SR	12A
2	EF	1	1	C	1101	28.0	6.1	300	60	6	SR	12A
2	EF	1	2	C	1084	28.0	6.1	300	60	6	SR	12A
2	EF	1	3	C	824	28.0	6.1	300	60	6	SR	12A
3	EF	1	1	C	927	27.0	4.0	300	60	6	SR	12A
3	EF	1	2	C	784	27.0	4.0	300	60	6	SR	12A

FISH SUMMARY

Site#	MTD/NO		H/P	Species	Stage	Age	Total #	Lgth (Min/Max)		FishAct	Comment
1	EF	1	1	WCT	J	1+	1	54	54	R	Caught under LWD
1	EF	1	1	BT	F	0+	2	41	43	R	
1	EF	1	2	NFC			0				
2	EF	1	1	BT	J	1+	4	90	121	R	
2	EF	1	1	BT	F	0+	1	34	34	R	
2	EF	1	2	BT	J	1+	3	69	86	R	
2	EF	1	3	NFC			0				
3	EF	1	1	BT	J	1+	1	79	79	R	
3	EF	1	2	NFC			0				

INDIVIDUAL FISH DATA

Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
2	EF	1	1	BT	121	16.7	U	U									
2	EF	1	1	BT	105	11.7	U	U									
2	EF	1	1	BT	90	7.3	U	U									
2	EF	1	1	BT	105	10.9	U	U									
2	EF	1	1	BT	34	.4	U	U									
2	EF	1	2	BT	84	5.9	U	U									
2	EF	1	2	BT	86	7.3	U	U									
2	EF	1	2	BT	69	3.6	U	U									
1	EF	1	1	WCT	54	1.3	U	U									
1	EF	1	1	BT	41	.5	U	U									
1	EF	1	1	BT	43	.6	U	U									
3	EF	1	1	BT	79	5.0	U	U									

FDIS Fish Card

		Reach #	ILP Map #	ILP #
Watershed Code:	349-248100-04900-00000-0000-0000-000-000-000-000-000-000	9.0	4	

COMMENTS	
Section	Comments
WATERBODY	Site 3 photos; 30 u/s; 31 x/s; 32 d/s; No fish captured on 2nd pass; therefore no 3rd pass
WATERBODY	Site 1: Photos 36 u/s; 37 x/s (rub-lub); 38 d/s;
WATERBODY	Site 2 Photos: 33 u/s; 34 x/s; 35 d/s;

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-37900-0000-0000-000-000-000-000-000-000 1.0 5

WATERBODY

Gazetted Name: BIGHORN CREEK Local: Ram Creek

Project Code: 349-248100-04900-00000-0000-0000-000-000-000-000-000-

WS Code: 349-248100-04900-37900-0000-0000-000-000-000-000-000-000

Waterbody ID: ILP Map #: ILP #: Reach #: 1 - 5

Project ID: 5861 Lake/Stream: S Lake From Date:

Fish Permit #: 02-04-0845 Date: 2002/08/06 To: 2002/08/06 Agency: C214 Crew: SC/JB/KM Resample: ☑

SITE / METHOD

Site#	NID Map	NID #	UTM:Zone/East/North/Mthd				MTD/NO		Temp	Cond	Turbid	Comment
2	82G.016	2	11	649068	5449669	GP3	EF	1	7.8	263	C	Pool/glide
1	82G.016	1	11	164925	5451868	GP3	EF	1	7.6	263	C	New riffle site; old one dry

A. GEAR SETTINGS

Site#	MTD/NO		H/P	Date In	Time In	Date Out	Time Out	Comment
1	EF	1	1	2002/08/06	11:53	2002/08/06	12:58	
1	EF	1	2	2002/08/06	13:04	2002/08/06	13:51	
1	EF	1	3	2002/08/06	13:56	2002/08/06	14:33	
2	EF	1	1	2002/08/06	15:32	2002/08/06	16:14	
2	EF	1	2	2002/08/06	16:20	2002/08/06	16:51	
2	EF	1	3	2002/08/06	17:03	2002/08/06	17:36	

C. ELECTROFISHER SPECIFICATIONS

Site#	MTD/NO		H/P	Encl	Sec	Length	Width	Voltage	Frequency	Pulse	Make	Model
1	EF	1	1	C	1570	35.0	7.5	300	60	6	SR	12A
1	EF	1	2	C	1190	35.0	7.5	300	60	6	SR	12A
1	EF	1	3	C	769	35.0	7.5	300	60	6	SR	12A
2	EF	1	1	C	1115	33.0	8.0	300	60	6	SR	12A
2	EF	1	2	C	1007	33.0	8.0	300	60	6	SR	12A
2	EF	1	3	C	947	33.0	8.0	300	60	6	SR	12A

FISH SUMMARY

Site#	MTD/NO		H/P	Species	Stage	Age	Total #	Lgth (Min/Max)		FishAct	Comment
1	EF	1	1	BT	F	0+	30	40	65	R	
1	EF	1	1	BT	J	1+	1	102	102	R	
1	EF	1	2	BT	F	0+	5	55	62	R	
1	EF	1	3	BT	F	0+	3	60	64	R	
2	EF	1	1	BT	F	0+	19	45	62	R	
2	EF	1	1	BT	J	1+	3	112	117	R	
2	EF	1	2	BT	F	0+	8	50	61	R	
2	EF	1	2	BT	J	1+	2	92	98	R	
2	EF	1	3	BT	F	O+	6	56	62	R	
2	EF	1	3	BT	J	1+	1	98	98	R	

INDIVIDUAL FISH DATA

Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
1	EF	1	1	BT	102	14.6	U	U									
1	EF	1	1	BT	56	2.3	U	U									
1	EF	1	1	BT	58	2.6	U	U									
1	EF	1	1	BT	59	2.4	U	U									
1	EF	1	1	BT	65	2.9	U	U									
1	EF	1	1	BT	49	1.3	U	U									
1	EF	1	1	BT	48	1.4	U	U									
1	EF	1	1	BT	40	.9	U	U									
1	EF	1	1	BT	49	1.4	U	U									
1	EF	1	1	BT	60	2.2	U	U									
1	EF	1	1	BT	54	1.9	U	U									
1	EF	1	1	BT	60	2.1	U	U									
1	EF	1	1	BT	51	1.3	U	U									
1	EF	1	1	BT	56	1.8	U	U									
1	EF	1	1	BT	63	2.2	U	U									

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-37900-0000-0000-000-000-000-000-000-000 1.0 5

INDIVIDUAL FISH DATA																		
Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
1	EF	1	1	BT	54	1.1	U	U									
1	EF	1	1	BT	56	1.4	U	U									
1	EF	1	1	BT	59	1.5	U	U									
1	EF	1	1	BT	57	1.4	U	U									
1	EF	1	1	BT	64	2.1	U	U									
1	EF	1	1	BT	56	1.6	U	U									
1	EF	1	1	BT	59	1.8	U	U									
1	EF	1	1	BT	62	1.9	U	U									
1	EF	1	1	BT	60	1.7	U	U									
1	EF	1	1	BT	62	1.9	U	U									
1	EF	1	1	BT	61	1.8	U	U									
1	EF	1	1	BT	50	1.0	U	U									
1	EF	1	1	BT	51	1.1	U	U									
1	EF	1	2	BT	62	2.1	U	U									
1	EF	1	2	BT	56	1.3	U	U									
1	EF	1	2	BT	61	1.9	U	U									
1	EF	1	2	BT	58	1.5	U	U									
1	EF	1	3	BT	64	2.2	U	U									
1	EF	1	3	BT	61	1.9	U	U									
1	EF	1	3	BT	60	1.8	U	U									
2	EF	1	1	BT	59	1.9	U	U									
2	EF	1	1	BT	117	18.0	U	U									
2	EF	1	1	BT	49	1.2	U	U									
2	EF	1	1	BT	48	.8	U	U									
2	EF	1	1	BT	45	.9	U	U									
2	EF	1	1	BT	48	1.0	U	U									
2	EF	1	1	BT	58	1.8	U	U									
2	EF	1	1	BT	50	1.3	U	U									
2	EF	1	1	BT	62	2.3	U	U									
2	EF	1	1	BT	60	2.1	U	U									
2	EF	1	1	BT	60	2.2	U	U									
2	EF	1	1	BT	60	2.2	U	U									
2	EF	1	1	BT	61	2.4	U	U									
2	EF	1	1	BT	112	17.9	U	U									
2	EF	1	1	BT	119	16.7	U	U									
2	EF	1	1	BT	59	2.1	U	U									
2	EF	1	1	BT	56	1.5	U	U									
2	EF	1	1	BT	55	1.3	U	U									
2	EF	1	1	BT	51	1.2	U	U									
2	EF	1	1	BT	55	1.6	U	U									
2	EF	1	1	BT	62	2.5	U	U									
2	EF	1	1	BT	56	1.6	U	U									
2	EF	1	1	BT	54	1.5	U	U									
2	EF	1	2	BT	98	9.9	U	U									
2	EF	1	2	BT	92	8.6	U	U									
2	EF	1	2	BT	56	1.8	U	U									
2	EF	1	2	BT	61	2.3	U	U									
2	EF	1	2	BT	64	2.7	U	U									
2	EF	1	2	BT	50	2.0	U	U									
2	EF	1	2	BT	53	1.4	U	U									
2	EF	1	2	BT	61	2.1	U	U									
2	EF	1	2	BT	52	1.4	U	U									
2	EF	1	2	BT	61	2.2	U	U									
2	EF	1	3	BT	61		U	U									
2	EF	1	3	BT	98	10.1	U	U									
2	EF	1	3	BT	61	2.0	U	U									
2	EF	1	3	BT	59	2.2	U	U									

FDIS Fish Card

Reach # ILP Map # ILP #

Watershed Code: 349-248100-04900-37900-0000-0000-000-000-000-000-000-000 1.0 5

INDIVIDUAL FISH DATA

Site#	MTD/NO		H/P	Species	Length	Weight	Sex	Mat	Age			Vch#	Genetic		Roll #	Frame#	Comment
									Str/Smpl#/Age				Str/Smpl#				
2	EF	1	3	BT	62	2.4	U	U									
2	EF	1	3	BT	57	1.8	U	U									
2	EF	1	3	BT	56	1.7	U	U									
1	EF	1	1	BT	60	1.7	U	U									
1	EF	1	1	BT	59	1.6	U	U									
1	EF	1	2	BT	55	1.2	U	U									

COMMENTS

Section	Comments
WATERBODY	NB; Riffle site was side channel - 99 to 01; s/c aggraded & not flowing at these water levels - moved site to mainstem riffle
WATERBODY	4 u/s; 5 x/s; 6 d/s; Site 2 - pool/glide;
WATERBODY	Photos; Dig 08/06; 1 u/s, 2 x/s, 3 d/s, site 1 - Riffle end net is down;

Appendix C

FHAP Level 1 Form 4 Data

Level 1 - Habitat Summary Diagnosis Report

Form Numb	991
Forest Dist	
Watershed Na	WIGWAM RIVER
Watershed C	349-248100-04900-00000-0000-0000-000-000-000-000-000-000
Survey Da	13/09/2002
Weathe	CLEAR
Survey Cr	SC/KM
Dischar	(CUBIC METERS PER S

Subsampling Fractions:

Riffles	1 IN 1	Pools	1 IN 1	Glides	1 IN 1	Cascade	1 IN 1	Other	1 IN 1

NTS Maps (1:50,00	082G02	BGGS Maps (1:20,0	082G016

Detai No	Sub Basin Name	Reach No	Sectio No	UTM Zoni	UTM Easting	UTM Northin	Distan e (m)	Habitat Un Type	Habitat Un Cat	Lengt (m)	Grad (%)	Mean Depth Bankfu (m)	Mean Depth Wate (m)	Mean Width Bankfu (m)	Mean Width Wette (m)	Pools Only Max Depth	Pools Only Crest (m)	Pools Only Residu	Pools Only Pool Type
1	BIGHORN CR	1	1	11	648335	5449685	0	P	1	10	0.1	1.17	0.84	20.9	11	0.9	0.15	0.75	S

Comments :

NOTE START = 0M = 743 M FROM CONFLUENCE. BANKFULL BARS ARE REVEGETATING/STABILIZING. T

2	BIGHORN CR	1	1	11	649158	5449604	10	R	1	20	0.5	1	0.39	14.9	9.9				

Comments :

3	BIGHORN CR	1	1				30	G	1	50	0.25	0.75	0.45	27.8	12.2				

Comments :

BAR STARTING TO STABILIZE - SPRUCE SEEDLINGS AT 18.5 M = BANKFULL RE-ESTABLISHING?

4	BIGHORN CR	1	1				80	R	1	40	0.5	0.75	0.25	36.8	13.3				

Comments :

SEDIMENT WEDGE CREATED BY X-CHANNEL LOGJAM DOWNSTREAM- BAR STARTING TO REVEGETATE

5	BIGHORN CR	1	1	11	649105	5449620	120	P	1	30	0.1	1.4	1	30.3	9.3	1.26	0.4	0.86	D

Comments :

NEW WOOD - NEW SCOUR - CHANNEL TRYING TO CUT AROUND JAM.

Form Numb
991

Bed Material Type						Total	Functional L			Cover				Offchannel Habit			Disturbance Indicators			Riparian Vegetatio			Barrie
Dom.	Sub-Dom.	D90 (mm)	Compactio	SG Type	SG Amt	LWD Tall	10 - 20cm	20 - 50cm	>50c	Cover Type 1	%	Cover Type 2	%	Type	Acces	Length (m)	1	2	3	Type	Structu	Canopy Closu	
G	S	90	M	R	H	8	4	3	1	LWD	30	DP	10	SC	G	500	WG			M	MF	1	N

*his site has downcut; lts of bedload movement.

G	C	115	M	R	H	1				C	5	OV	5				MB			M	MF	1	N
G	C	95	M	R	H	13	7	3		C	5	OV	5				MB			M	MF	1	N
G	C	105	M	R	H	15	7			OV	15	C	2				MB	WG	MC	M	MF	1	N
S	G	70	M	R	L	48	25	20	3	LWD	90						SC	MC	WG	M	MF	1	N

Level 1 - Habitat Summary Diagnosis Report

6	BIGHORN CR	1	1				150	R	1	20	0.5	1.1	0.45	21.2	6.6			

COMMENTS :

7	BIGHORN CR	1	1	11	649068	5449669	170	P	1	30	0.1	0.95	0.7	12.5	7.5	0.93	0.11	0.82	S

COMMENTS :

POOL X-SECTN INFILLED TO A GLIDE

8	BIGHORN CR	1	1	11	649089	5449439	200	R	1	70	0.5	0.91	0.22	22.8	8			

COMMENTS :

RIFFLE - X-SECTN. LUB S/C HAS INFILLED - BAR VEGETATED AND NO LONGER IN BANKFULL.

G	C	106	M	R	H	4		4		LWD	10						MB	WG	MC	M	MF	1	N

G	S	95	M	R	L	10	10			LWD	10	DP	10	SC	P	250	EB			M	YF	1	N

C	G	115	M	R	L	3	2			SWD	5	OV	5				EB	BC		M	MF	1	N

Level 1 - Habitat Summary Diagnosis Report

Form Nume	992	Forest Dist	
		Watershed Na	WIGWAM RIVER
		Watershed C	349-248100-04900-00000-0000-0000-000-000-000-000-000-000
Survey Da	19/09/2002	Weathe	CLEAR/SUNNY/WINDY
Survey Cr	SC/KM		
Dischar		(CUBIC METERS PER S	

Subsampling Fractions:

Riffles	1 IN 1	Pools	1 IN 1	Glides	1 IN 1	Cascade	1 IN 1	Other	1 IN 1

NTS Maps (1:50,00	082G03	BGGS Maps (1:20,0	082G026

Detai No	Sub Basin Name	Reach No	Sectio No	UTM Zoni	UTM Easting	UTM Northin	Distan e (m)	Habitat Un Type	Habitat Un Cat	Lengt (m)	Grad (%)	Mean Depth Bankfu (m)	Mean Depth Wate (m)	Mean Width Bankfu (m)	Mean Width Wette (m)	Pools Only Max Depth	Pools Only Crest (m)	Pools Only Residu	Pools Only Pool Type
1	WIGWAM RIV	2	2	11	646027	5458842	0	R	1	170	0.5	1.88	0.58	90.3	25				

Comments :

START AT UPSTREAM MARKER @ TOP OF RIFFLE. KOKANEE SPAWNING IN LUB SIDE-CHANNEL. ROTAT

2	WIGWAM RIV	2	2	11	645484	5458824	170	P	1	80	0.1	2.83	1.5	116.5	36.4	1.8	0.5	1.3	S

Comments :

X-SECN POOL. KO SPAWNING IN MAIN AND SIDE-CHANNEL. LWD PARALELL AND UP ON BARS

3	WIGWAM RIV	2	2				250	R	1	110	0.5	1.65	0.6	116.8	32.6				

Comments :

WCT FRY IN SIDE-CHANNEL. KO SPAWNING IN SC (2 S/C'S 100 M EACH). ALL WOOD ON BARS

4	WIGWAM RIV	2	2				350	P	3	25	0.1	2.1	0.8	116.8	32.6	0.95	0.15	0.8	S

Comments :

5	WIGWAM RIV	2	2				360	C	1	20	4	2	0.75	112.6	34.5				

Comments :

INITIAL STAGES OF VEGETATION ON BAR AT 71.6 M. RE-ESTABLISHING BANKFULL AT 71.6 M?

Form Numb
992

Bed Material Type						Total	Functional L			Cover				Offchannel Habit			Disturbance Indicators			Riparian Vegetatio			Barrie
Dom.	Sub-Dom.	D90 (mm)	Compactio	SG Type	SG Amt	LWD Tall	10 - 20cm	20 - 50cm	>50c	Cover Type 1	%	Cover Type 2	%	Type	Acces	Length (m)	1	2	3	Type	Structu	Canopy Closu	
C	G	265	H	R	L	16	10	4		B	2			SC	G	140	DW	EB	MC	D	YF	1	N

tional slump rub bank; LWD on bars

G	C	210	H	R	H	19	14	5		DP	60	OV	2	SC	G	80	EB	DW	PD	D	YF	1	N
C	G	200	H	R	L	17	7	7		LWD	2	SWD	2	SC	G	100	MC	DW	MB	D	YF	1	N
G	C	160	M	R	H	0				DP	50						MB	DW	MC	D	YF	1	N
B	C	420	H	R	N	4	3	1						SC	G	20	DW	PD		D	YF	1	N

Level 1 - Habitat Summary Diagnosis Report

6	WIGWAM RIV	2	2				380	P	1	40	0.2	3	1.5	71.6	30.5	1.9	0.45	1.45	S

COMMENTS :

7	WIGWAM RIV	2	2				420	G	1	50	0.1	1.6	0.7	70	40			

COMMENTS :

8	WIGWAM RIV	2	2	11	645607	5458976	470	R	1	220	0.75	1.36	0.6	83.5	39.2			

COMMENTS :

RIFFLE X-SECTION. SIDE-CHANNELS ARE ACTUALLY BRAIDS OR SECONDARY CHANNELS. SLUMP ON R

9	WIGWAM RIV	2	2	11	645415	5459076	690	C	1	30	3	1.83	0.7	61.3	36.1			

COMMENTS :

BRAIDING

10	WIGWAM RIV	2	2				720	P	1	30	0.1	2.1	1	60.9	36.9	1.4	0.55	0.85	S

COMMENTS :

SMALL RESIDUAL POOL ON OUTSIDE BEND.

11	WIGWAM RIV	2	2				750	R	1	30	0.5	2.08	0.63	43.7	26.1			

COMMENTS :

BEAVER POND/GROUNDWATER AND YOY ON TERRACE RUB. LARGE BOULDER COMPONENT.

12	WIGWAM RIV	2	2	11	645276	5459102	780	G	1	50	0.1	2.1	0.6	45.2	27.4			

COMMENTS :

EF GLIDE SITE. BOULDER RUN/GLIDE. KO SPAWNING IN MARGIN.

13	WIGWAM RIV	2	2				830	R	1	130	0.5	1.72	0.58	65.6	39.1			

COMMENTS :

KO SPAWNING IN MARGIN

14	WIGWAM RIV	2	2	11	645117	5458932	960	P	1	50	0.1	2.17	1.05	52.9	26.7	1.8	0.5	1.3	S

COMMENTS :

WCT ACTIVELY FEEDING. EF SITE. KO SPAWNING.

15	WIGWAM RIV	2	2				1010	G	1	40	0.1	1.92	0.8	45.1	30.4			

COMMENTS :

G	C	215	H	R	H	3		1		DP	80			SC	G	40	DW	PD		D	YF	1	N

C	G	200	H	R	L	3											PD	DW		D	YF	1	N

C	G	200	H	R	L	31	5	3		B	5			SC	G	220	MC	MB	DW	D	YF	1	N

UB.

C	B	310	H	R	L	9				B	2			SC	G	30	MB	MC	DW	D	YF	1	N

C	B	300	H	R	L	6				B	2	DP	20	SC	G	30	MB	MC	DW	D	YF	1	N

C	B	290	H	R	L	6	1			B	2			SC	G	30	EB	MC	MB	D	YF	1	N

C	B	370	H	R	L	28	2	2	1	B	15	LWD	2	SC	G	50	EB	MC	MB	D	YF	1	N

C	B	290	H	R	L	36	3	2		B	10	LWD	2	SC	G	130	MC	DW	PD	D	YF	1	N

C	G	250	H	R	L	4				DP	50	B	2	SC	G	50	MC	DW	MB	D	YF	1	N

C	G	230	H	R	L	1				B	15			SC	G	40	MC	DW	MB	M	YF	1	N

Level 1 - Habitat Summary Diagnosis Report

Form Numb	993
Forest Dist	
Watershed Na	WIGWAM RIVER
Watershed C	349-248100-04900-00000-0000-0000-000-000-000-000-000-000
Survey Da	12/09/2002
Weathe	CLEAR
Survey Cr	SC/KM
Dischar	(CUBIC METERS PER S

Subsampling Fractions:

Riffles	1 IN 1	Pools	1 IN 1	Glides	1 IN 1	Cascade	1 IN 1	Other	1 IN 1

NTS Maps (1:50,00	082G03	BGGS Maps (1:20,0	082G016

Detai No	Sub Basin Name	Reach No	Sectio No	UTM Zoni	UTM Easting	UTM Northin	Distan e (m)	Habitat Un Type	Habitat Un Cat	Lengt (m)	Grad (%)	Mean Depth Bankfu (m)	Mean Depth Wate (m)	Mean Width Bankfu (m)	Mean Width Wette (m)	Pools Only Max Depth	Pools Only Crest (m)	Pools Only Residu	Pools Only Pool Type
1	WIGWAM RIV	5	5	11	648335	5449685	0	R	1	40	0.5	1.15	0.4	41	34.5				

Comments :

Transverse bar very prominent. Side bars re-vegetating. side channels on both sides.

2	WIGWAM RIV	5	5				40	P	1	40	0.1	1.35	0.6	39.2	29.1	0.75	0.5	0.25	S

Comments :

Transverse bar. Pool is residual and depth more a glide. Side channels both banks.

3	WIGWAM RIV	5	5				80	C	1	40	2	1.6	0.5	27	23.2				

Comments :

Transfer bar ends. Tertiary pool developing.

4	WIGWAM RIV	5	5				120	P	1	60	0.1	1.95	0.85	29.2	18.1	1.1	0.42	0.68	S

Comments :

bar stabilizing/reveg. BT holding in glide/pool. Residual depth not quite pool.

5	WIGWAM RIV	5	5	11	648156	5449614	180	R	1	50	0.5	1.63	0.43	30.6	24.6				

Comments :

Previous year categorized bank as EB. There has been no erosion in 3 years so NOT EB.

Form Numb
993

Bed Material Type						Total	Functional L			Cover				Offchannel Habit			Disturbance Indicators			Riparian Vegetatio			Barrie
Dom.	Sub-Dom.	D90 (mm)	Compactio	SG Type	SG Amt	LWD Tall	10 - 20cm	20 - 50cm	>50c	Cover Type 1	%	Cover Type 2	%	Type	Acces	Length (m)	1	2	3	Type	Structu	Canopy Closu	
C	B	350	M	R	N	1		1		B	2	LWD	2	SC	G	40	FP			M	MF	1	N
C	B	350	M	R	N	10	3	7		LWD	5	B	2	SC	P	30	FP			M	MF	1	N
B	C	500	M	R	N	5		1		B	20			SC	P	40	FP			M	MF	1	N
C	G	300	M	R	L	16	11	2		B	10	DP	20	SC	P	60	FP			M	MF	1	N
C	B	250	M	R	N	18	7	5	3	B	10	LWD	5	SC	P	50	DW			M	MF	1	N

Level 1 - Habitat Summary Diagnosis Report

6	WIGWAM RIV	5	5	11	648102	5450005	230	P	1	120	0.1	1.42	0.82	61.2	23.9	1.13	0.39	0.74	S

COMMENTS :

BARS RE-VEGETATING/RE-ESTABLISHING BANKFULL. DW IS DIMINISHING AND BANKFULL MAY BE 39.2

7	WIGWAM RIV	5	5				350	R	1	50	0.5	1.5	0.39	44.1	21.7				

COMMENTS :

RUB SIDE-CHANNEL FULL OF WCT FRY SEASONALLY. LWD SIZE AND NUMBER DECREASING DUE TO U

G	C	200	M	R	H	17	1	2		C	15	SWD	5	SC	P	120	DW			M	MF	1	N

M SEE CROSS-SECTIONAL PROFILE

C	G	470	M	R	L	35	19	6		B	2	LWD	2	SC	G	50				M	MF	1	N

JSE AS FIREWOOD FROM CAMPERS

Level 1 - Habitat Summary Diagnosis Report

Form Numb: 994	Forest Dist:		
	Watershed Na:	WIGWAM RIVER	
	Watershed C:	349-248100-04900-00000-0000-0000-000-000-000-000-000-000	
Survey Da:	18/09/2002	Weathe: mainly cloudy	Survey Cr: sc/km
Dischar:	(cubic meters per s		

Subsampling Fractions:

Riffles:	1 in 1	Pools:	1 in 1	Glides:	1 in 1	Cascade:	1 in 1	Other:	1 in 1

NTS Maps (1:50,00	ENTER 082G03	BGGS Maps (1:20,0	082G006

Detail No	Sub Basin Name	Reach No	Section No	UTM Zone	UTM Easting	UTM Northing	Distance (m)	Habitat Unit Type	Habitat Unit Cat	Length (m)	Grad (%)	Mean Depth Bankfu (m)	Mean Depth Water (m)	Mean Width Bankfu (m)	Mean Width Wette (m)	Pools Only Max Depth	Pools Only Crest (m)	Pools Only Residua	Pools Only Pool Type
1	WIGWAM RIV	6	6	11	653886	5441349	0	R	1	10	0.5	1.07	0.45	29.9	16				
							Comments : DW stabilizing and revegetating-see photos.												
2	WIGWAM RIV	6	6				10	P	1	50	0.1	3.37	2	24.3	14.6	2.74	0.2	2.54	S
							Comments : 20 BT holding/spawning in tailout. WCT in pool. DW stabilizing/reveg.												
3	WIGWAM RIV	6	6				60	R	1	20	0.5	0.85	0.25	41	23.3				
							Comments :												
4	WIGWAM RIV	6	6				80	P	1	30	0.1	1.85	1	48.8	12.2	1.2	0.43	0.77	S
							Comments : New pool formed by 1 large LWD in last 2 years												
5	WIGWAM RIV	6	6				110	R	1	70	0.5	1.15	0.45	34.3	14.4				
							Comments : Fry plus BT/WCT juveniles in off-channel side-channel-groundwater flowwing for 200												

Form Numb
994

Bed Material Type						Tota	Functional L			Cover				Offchannel Habit			Disturbance Indicators			Riparian Vegetati			Barrie
Dom.	Sub-Dom.	D90 (mm)	Compactio	SG Type	SG Amt	LWD Tall	10 - 20cm	20 - 50cm	>50c	Cover Type 1	%	Cover Type 2	%	Type	Acces	Length (m)	1	2	3	Type	Structu	Canopy Closu	
C	G	210	M	R	L	12	5	5		OV	2	LWD	5	SC	P	40	DW			M	MF	1	N
G	S	115	M	R	H	52	26	7		LWD	15	DP	65				DW			M	MF	1	N
G	C	180	M	R	L	11		1		LWD	2	OV	2				DW			M	MF	1	N
G	C	195	M	R	L	18	8	4		LWD	10	DP	30				DW			M	MF	1	N
C	G	200	M	R	L	29	1	1		LWD	2			SC	G	35	DW			M	MF	1	N

M.

Level 1 - Habitat Summary Diagnosis Report

6	WIGWAM RIV	6	6				180	G	1	20	0.1	1.15	0.42	37.5	16			

COMMENTS :

HENRY'S CREEK ENTERS HERE

7	WIGWAM RIV	6	6				200	R	1	50	0.5	1.67	0.3	44.2	19.4			

COMMENTS :

RIFFLE WITH SEDIMENT WEDGE AND TRANSVERSE BAR. TERTIARY POOL/RUN DEVELOPING ON OUTSID

8	WIGWAM RIV	6	6				200	P	3	50	0.1	2.29	0.92	44.2	4	1.2	0.45	0.75	S

COMMENTS :

LARGE SEDIMENT WEDGE FORMED DUE TO CROSS-CHANNEL JAM IN NEXT UNIT.

9	WIGWAM RIV	6	6				250	P	1	50	0.1	2.85	0.85	30	21.9	2	0.4	1.6	S

COMMENTS :

SIDE-CHANNEL TAKES OFF 450M THROUGH FOREST HERE. BT REDDS.

10	WIGWAM RIV	6	6				300	R	1	50	0.5	1.15	0.45	39.5	14.7			

COMMENTS :

2 -SIDE-CHANNELS BOTH RUN THE LENGTH OF THE HABITAT UNIT. 1 BT REDD.

11	WIGWAM RIV	6	6				300	P	3	20	0.1	2.2	1	39.5	3.8	1.5	0.4	1.1	S

COMMENTS :

12	WIGWAM RIV	6	6				350	G	1	30	0.1	1.15	0.45	68	27.1			

COMMENTS :

4 SIDE-CHANNELS, ALL EXCELLENT. THIS IS PRIME TIME SPAWNING/REARING. 5 BT REDDS.

13	WIGWAM RIV	6	6				380	R	1	30	0.5	0.95	0.25	94.9	33.2			

COMMENTS :

4 BRAIDS/CHANNELS. SPAWNING HABITAT.

14	WIGWAM RIV	6	6				410	P	1	60	0.1	2.2	1.1	80.2	26.3	1.5	0.2	1.3	S

COMMENTS :

20 BT - ACTIVE REDD CONSTRUCTION

15	WIGWAM RIV	6	6	11	653432	5441979	470	R	1	70	0.5	0.62	0.3	82.2	43.4			

COMMENTS :

EF SITE. ACTIVE REDDS

C	G	200	M	R	L	16	3			LWD	5	OV	5	SC	G	20	DW	WG	MB	M	MF	1	N

C	G	210	M	R	L	35	7	1		OV	5	C	5	SC	G	50	WG	MB	DW	M	MF	1	N

)E OF WEDGE.

G	C	140	M	R	H	6	6			OV	25	C	15				WG	MB	DW	M	MF	1	N

G	C	140	M	R	H	67	35	18	2	LWD	70			SC	G	40	DW			C	MF	1	N

C	G	125	M	R	L	21	9	6		LWD	5			SC	G	100	DW			C	MF	1	N

S	C	180	M	R	L	16	9	4		LWD	20	DP	30	SC	G	60	DW	MB		C	MF	1	N

G	C	110	M	R	H	12	4	2		LWD	5			SC	G	120	DW	MC	MB	C	MF	1	N

G	C	140	M	R	H	11	4	1		LWD	5	C	5	SC	G	30	MC	DW	MB	M	MF	1	N

G	C	120	M	R	H	64	20	32	3	LWD	60	C	10	SC	G	60	MC	DW	MB	M	MF	1	N

G	C	110	M	R	H	38	18	10	1	LWD	5	C	5	SC	G	70	MC	DW	MB	C	MF	1	N

Level 1 - Habitat Summary Diagnosis Report

16	WIGWAM RIV	6	6				480	P	3	20	0.1	1.23	0.8	82.2	47	0.91	0.3	0.61	S

COMMENTS :

17	WIGWAM RIV	6	6	11	653744	5442243	540	G	1	30	0.1	1.05	0.45	82.2	17.1				

COMMENTS :

EF SITE. SPAWNING BT AND REDDS. SIDE-CHANNEL HAS MUCH MORE FLOW WITH LARGE POOL AND

18	WIGWAM RIV	6	6				570	R	1	20	0.5	1.2	0.6	74.4	15.4				

COMMENTS :

SPAWNING BT AND REDDS IN MAIN AND SIDE-CHANNEL.

19	WIGWAM RIV	6	6				590	P	1	30	0.1	2.3	1.5	62.6	27.9	1.8	0.2	1.6	S

COMMENTS :

SPAWNING BT AND REDDS. BEAVER LODGE. SIDE-CHANNEL HAS BT REDDS.

20	WIGWAM RIV	6	6				620	R	1	80	0.5	1.25	0.4	39.3	10.9				

COMMENTS :

CHANNEL HAS DOWNCUT. SPAWNING BT AND REDDS.

G	C	110	M	R	H	38	18	10	1	LWD	5	C	5	SC	G	70	MC	DW	MB	C	MF	1	N

G	C	100	M	R	H	5	3	1		OV	5	LWD	2	SC	G	30	MC	DW	MB	M	MF	1	N

SPAWNING BT.

G	C	150	M	R	H	5	2			OV	15	C	10	SC	G	20	MC	DW		M	MF	1	N

G	C	110	M	R	H	12	5	5	1	LWD	20	DP	40	SC	G	30	MC	DW		M	MF	1	N

C	G	140	M	R	H	9	3	2	1	LWD	5	C	5	SC	G	80	MC	WG		M	MF	1	N

Level 1 - Habitat Summary Diagnosis Report

Form Numb: 995	Forest Dist:		
	Watershed Na:	WIGWAM RIVER	
	Watershed C:	349-248100-04900-00000-0000-0000-000-000-000-000-000-000	
Survey Da:	17/09/2002	Weathe: Rain	Survey Cr: sc/km
Dischar:		(cubic meters per s	

Subsampling Fractions:

Riffles:	1 in 1	Pools:	1 in 1	Glides:	1 in 1	Cascade:	1 in 1	Other:	1 in 1

NTS Maps (1:50,00	ENTER 082G03	BGGS Maps (1:20,0	082G006

Detai No	Sub Basin Name	Reach No	Sectio No	UTM Zoni	UTM Easting	UTM Northin	Distan e (m)	Habitat Un Type	Habitat Un Cat	Lengt (m)	Grad (%)	Mean Depth Bankfu (m)	Mean Depth Wate (m)	Mean Width Bankfu (m)	Mean Width Wette (m)	Pools Only Max Depth	Pools Only Crest (m)	Pools Only Residu	Pools Only Pool Type
1	WIGWAM RIV	7	7	11	655471	5438625	0	R	1	90	0.5	1	0.3	28.7	11.1				

Comments :

2	WIGWAM RIV	7	7	11			90	G	1	60	0.1	1.3	0.6	37	7.6	0.8	0.2	0.6	S

Comments :

outside bank has scoured a fair bit = EB. Glide = residual pool = EF Pool site.

3	WIGWAM RIV	7	7	11	655098	5439085	150	R	1	50	0.5	0.95	0.3	53	19				

Comments :

Bedload deposition in front of recent LWD filling in pool. Pool=tertiary now.

4	WIGWAM RIV	7	7	11	655250	543884	150	P	3	10	0.1	0.95	0.5	53	19	0.6	0.1	0.5	S

Comments :

Pool x-sectn. = Tertiary pool now due to deposition.

5	WIGWAM RIV	7	7				200	P	1	20	0.1	1.65	0.65	32.65	5.2	0.85	0.3	0.55	S

Comments :

high fraction boulders on LUB

Form Numb
995

Bed Material Type						Tota	Functional L			Cover				Offchannel Habit			Disturbance Indicators			Riparian Vegetatio			Barrie
Dom.	Sub-Dom.	D90 (mm)	Compactio	SG Type	SG Amt	LWD Tall	10 - 20cm	20 - 50cm	>50c	Cover Type 1	%	Cover Type 2	%	Type	Acces	Length (m)	1	2	3	Type	Structu	Canopy Closu	
C	G	190	M	R	N	9				B	2			SC	P	90	DW			M	MF	1	N
G	C	150	M	R	L	11		1		C	5	OV	10	SC	P	60	DW	EB	FP	M	MF	1	N
C	G	200	M	R	L	6	2	4		SWD	2	LWD	15	SC	P	50	DW	PD		M	MF	1	N
G	C	200	M	R	L	6	2	4		LWD	50	SWD	10				DW	PD		M	MF	1	N
C	G	500	M	R	L	1	1			B	30	LWD	2				DW	EB		M	MF	1	N

Level 1 - Habitat Summary Diagnosis Report

6	WIGWAM RIV	7	7	11	655080	5439023	220	G	1	40	0.1	1.4	0.4	24.1	5.7			

COMMENTS :

7	WIGWAM RIV	7	7	11	655186	5438950	260	R	1	90	0.5	0.8	0.25	31.95	15.5			

COMMENTS :

RIFFLE X-SECTION

8	WIGWAM RIV	7	7				350	G	1	30	0.1	1	0.3	16.7	15.6			

COMMENTS :

9	WIGWAM RIV	7	7				350	P	3	7	0.1	1.4	0.7	16.7	15.6	0.86	0.2	0.66	S

COMMENTS :

SWD/JAM POOL

10	WIGWAM RIV	7	7				380	R	1	20	0.5	1.2	0.35	20.5	11.5			

COMMENTS :

11	WIGWAM RIV	7	7				400	G	1	50	0.1	1.2	0.35	20.5	11.5			

COMMENTS :

12	WIGWAM RIV	7	7				450	R	1	40	0.5	1.2	0.35	20.5	11.5			

COMMENTS :

13	WIGWAM RIV	7	7				490	G	1	80	0.1	1	0.54	32.3	19.6			

COMMENTS :

VERY EMBEDDED SUBSTRATE

14	WIGWAM RIV	7	7				570	R	1	20	0.5	1.1	0.15	27.6	24.7			

COMMENTS :

15	WIGWAM RIV	7	7				590	P	1	30	0.1	1.65	0.85	20.4	17.1	0.96	0.15	0.81	S

COMMENTS :

C	G	300	M	R	L	4				B	10						EB	DW		M	MF	1	N
C	B	300	M	R	N	12	2	10		B	15	SWD	2							M	MF	1	N
C	G	200	M	R	N	6	4			LWD	2	DP	2							M	MF	1	N
C	S	150	M	R	N	6	4			LWD	5	DP	10							M	MF	1	N
B	C	400	M	R	N	21	1			B	5						EB			M	MF	1	N
B	C	400	M	R	N					B	5						EB			M	MF	1	N
B	C	400	M	R	N					B	5						EB			M	MF	1	N
G	C	220	H	R	L	11											DW	EB	WG	M	MF	1	N
C	G	250	M	R	N	1		1									DW	WG		M	MF	1	N
G	C	180	H	R	L	6	2	3		C	10	LWD	10				WG	DW		M	MF	1	N

Level 1 - Habitat Summary Diagnosis Report

Form Numb: 996	Forest Dist:		
	Watershed Na:	WIGWAM RIVER	
	Watershed C:	349-248100-04900-00000-0000-0000-000-000-000-000-000-000	
Survey Da:	16/09/2002	Weathe: CLOUDY/SHOWERS	Survey Cr: SC/KM
Dischar:		(CUBIC METERS PER S	

Subsampling Fractions:

Riffles:	1 IN 1	Pools:	1 IN 1	Glides:	1 IN 1	Cascade:	1 IN 1	Other:	1 IN 1

NTS Maps (1:50,00	ENTER 082G03	BGGS Maps (1:20,0	082G007

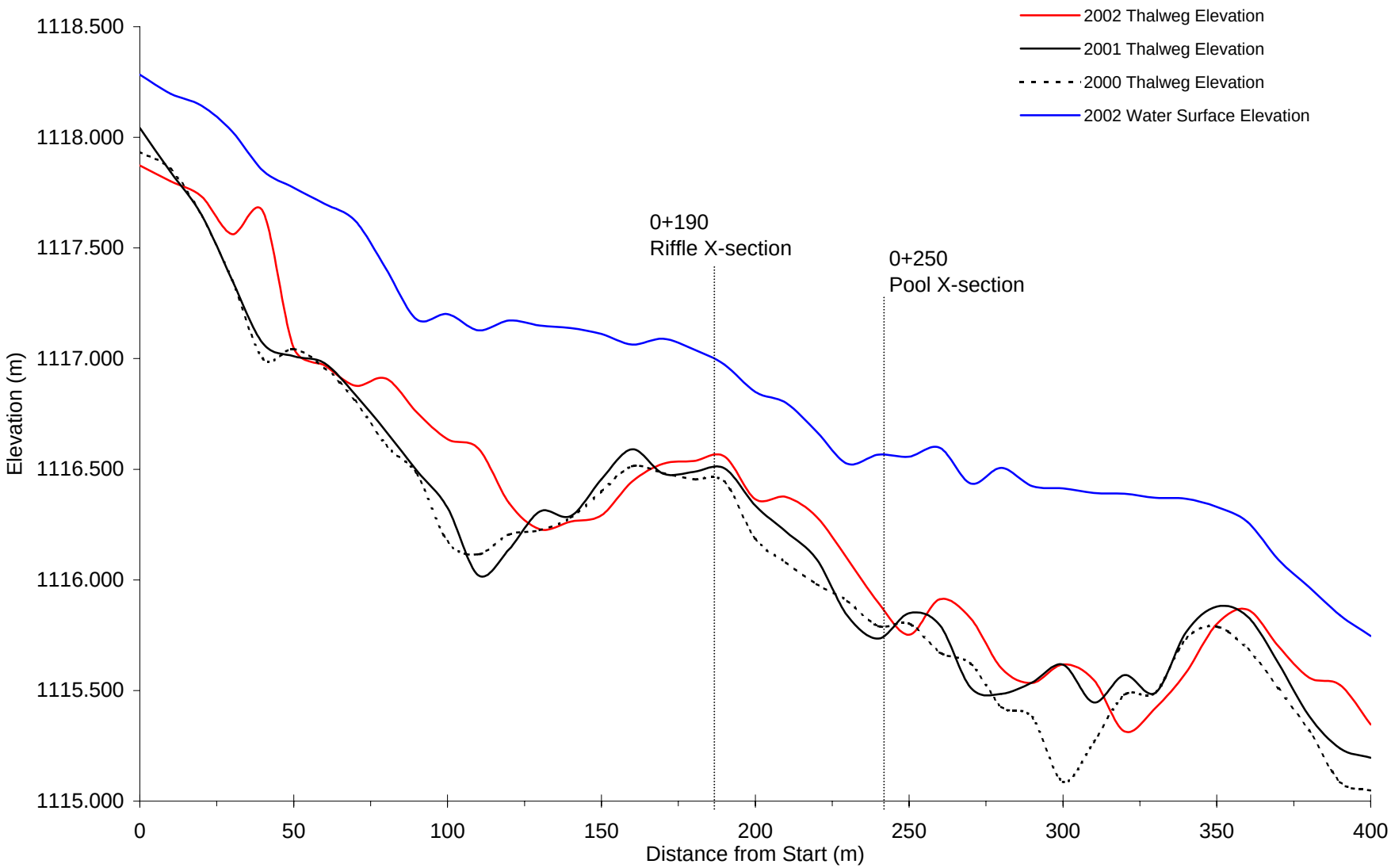
Detail No	Sub Basin Name	Reach No	Section No	UTM Zone	UTM Easting	UTM Northing	Distance (m)	Habitat Unit Type	Habitat Unit Cat	Length (m)	Grad (%)	Mean Depth Bankfu (m)	Mean Depth Water (m)	Mean Width Bankfu (m)	Mean Width Wette (m)	Pools Only Max Depth	Pools Only Crest (m)	Pools Only Residua	Pools Only Pool Type
1	WIGWAM RIV	9	9	11	660830	5433065	0	R	1	25	0.5	1.13	0.5	12.4	9.8				
							Comments : LWD blew out and lost tertiary pool. Some margin deposition.												
2	WIGWAM RIV	9	9				25	C	1	185	3	1.3	0.55	14.8	13.3	0.85	0.4	0.45	S
							Comments :												
3	WIGWAM RIV	9	9	11	660808	5433115	210	P	3	15	0.1	1.2	0.6	14.8	10.3	0.7	0.25	0.45	S
							Comments : Tertiary pool at Rabbit Cr. Confluence												
4	WIGWAM RIV	9	9				210	G	1	70	0.1	1.1	0.4	17	16.2				
							Comments : Called this riffle last year at lower flows.												
5	WIGWAM RIV	9	9				280	C	1	10	4	1.3	0.45	23.1	17.3				
							Comments :												

Form Numb
996

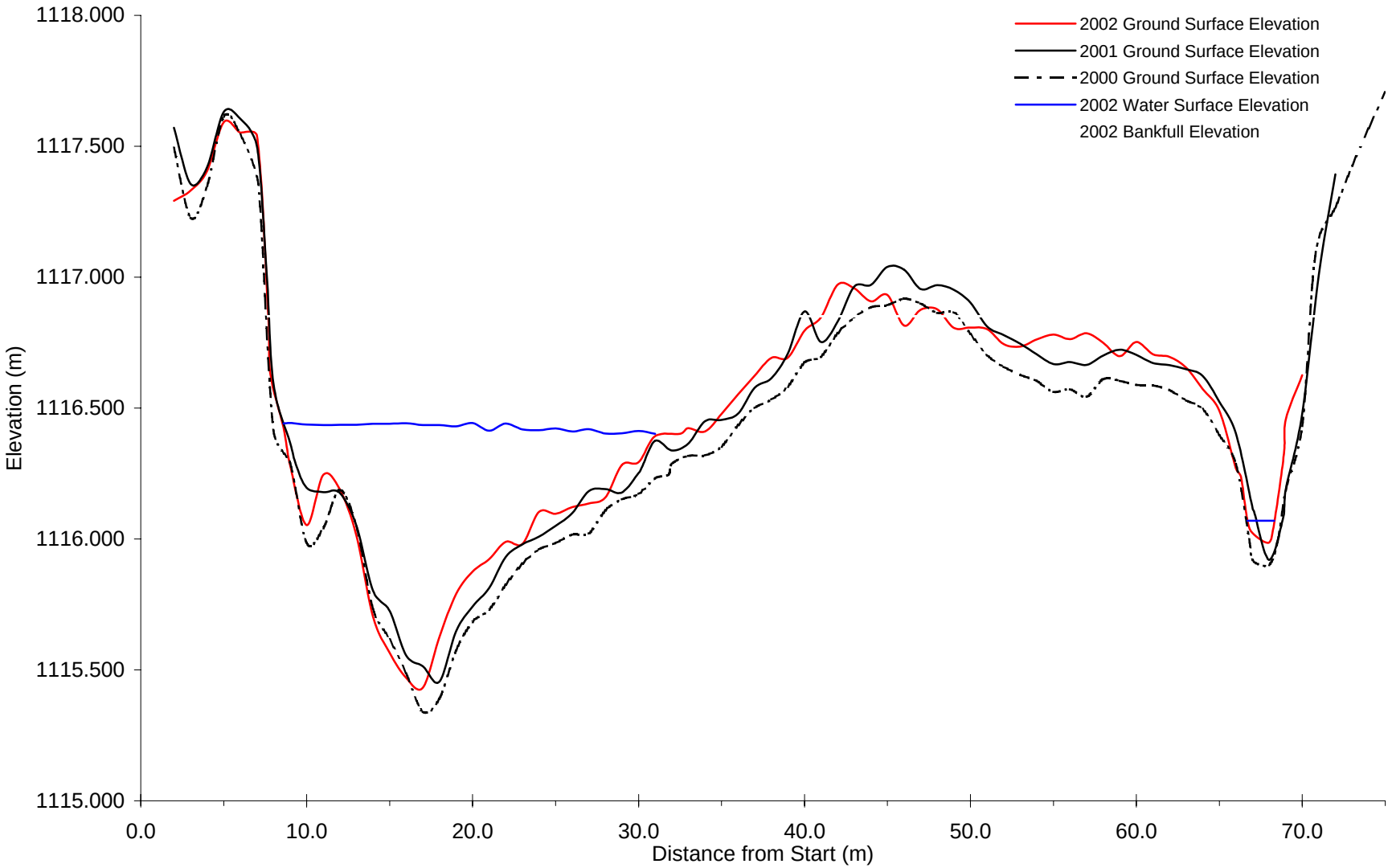
Bed Material Type						Tota	Functional L			Cover				Offchannel Habit			Disturbance Indicators			Riparian Vegetatio			Barrie
Dom.	Sub-Dom.	D90 (mm)	Compactio	SG Type	SG Amt	LWD Tall	10 - 20cm	20 - 50cm	>50c	Cover Type 1	%	Cover Type 2	%	Type	Acces	Length (m)	1	2	3	Type	Structu	Canopy Closu	
B	C	350	M	R	N	13	8	3		B	15	LWD	2							C	MF	1	N
B	C	750	M	R	N	16	9	4		B	50	OV	2							M	MF	1	N
B	C	600	M	R	N					B	30									M	MF	1	N
B	C	500	M	R	N	3	3			B	10	OV	2							M	MF	1	N
B	C	380	M	R	N	2	1			B	5	C	2				MB			C	MF	1	N

Appendix D

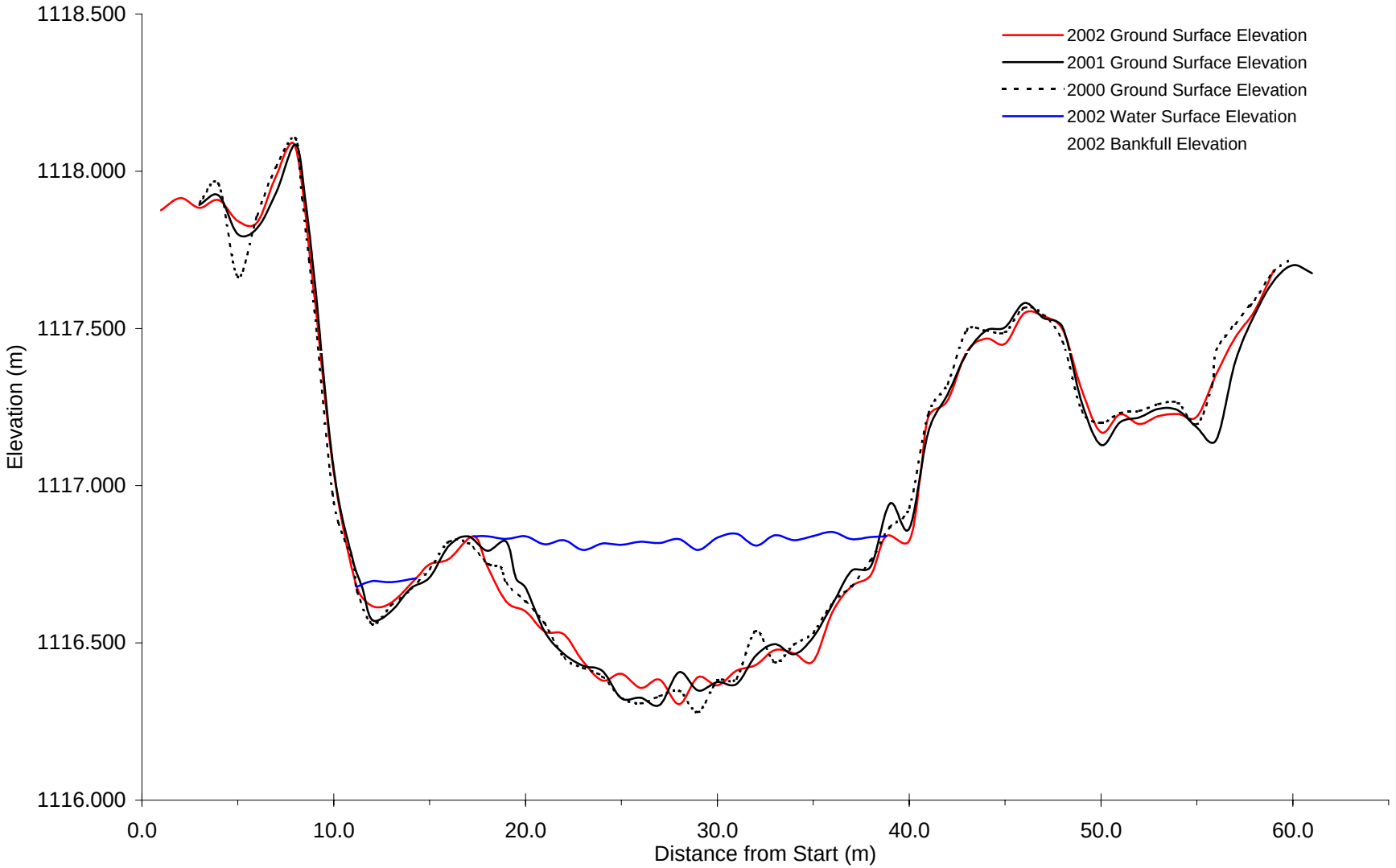
FHAP Channel Survey Data



Longitudinal profile of a representative two meander lengths of the Wigwam River in reach 5, study site 1.



Cross sectional profile of a representative pool habitat unit of the Wigwam River in reach 5, study site 1



Cross sectional profile of a representative riffle habitat unit of the Wigwam River in reach 5, study site 1

R5, S1 Differential Level Loop

Differential Levelling Loop - Reach 5, Site 1 **Date:** 27-Aug-02

Field (Arbitrary) Elevations (m)

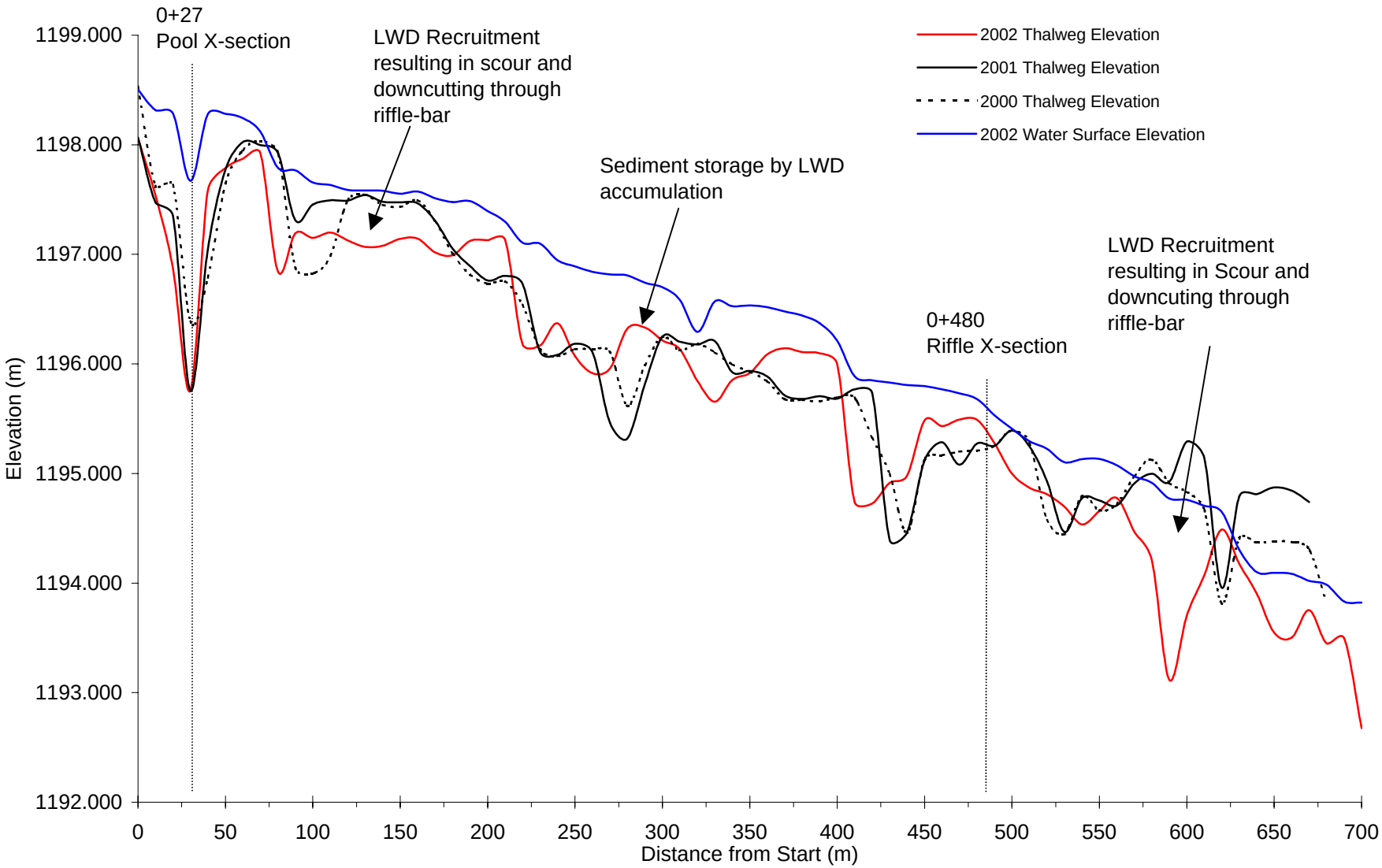
Station	Backsight	Height of Instrument	Foresight	Elevation	Comment
BM1	0.091	5.091		5.000	same
TP1	0.738	3.646	2.183	2.908	new RUB
TP2	0.769	3.299	1.116	2.530	new LUB
BM2		1.951	1.348	1.951	
BM2	1.348	3.299		1.951	
TP2	1.115	3.644	0.77	2.529	
TP1	2.168	5.075	0.737	2.907	
BM1		5.000	0.075	5.000	
		5.000		5.000	

error =0.000

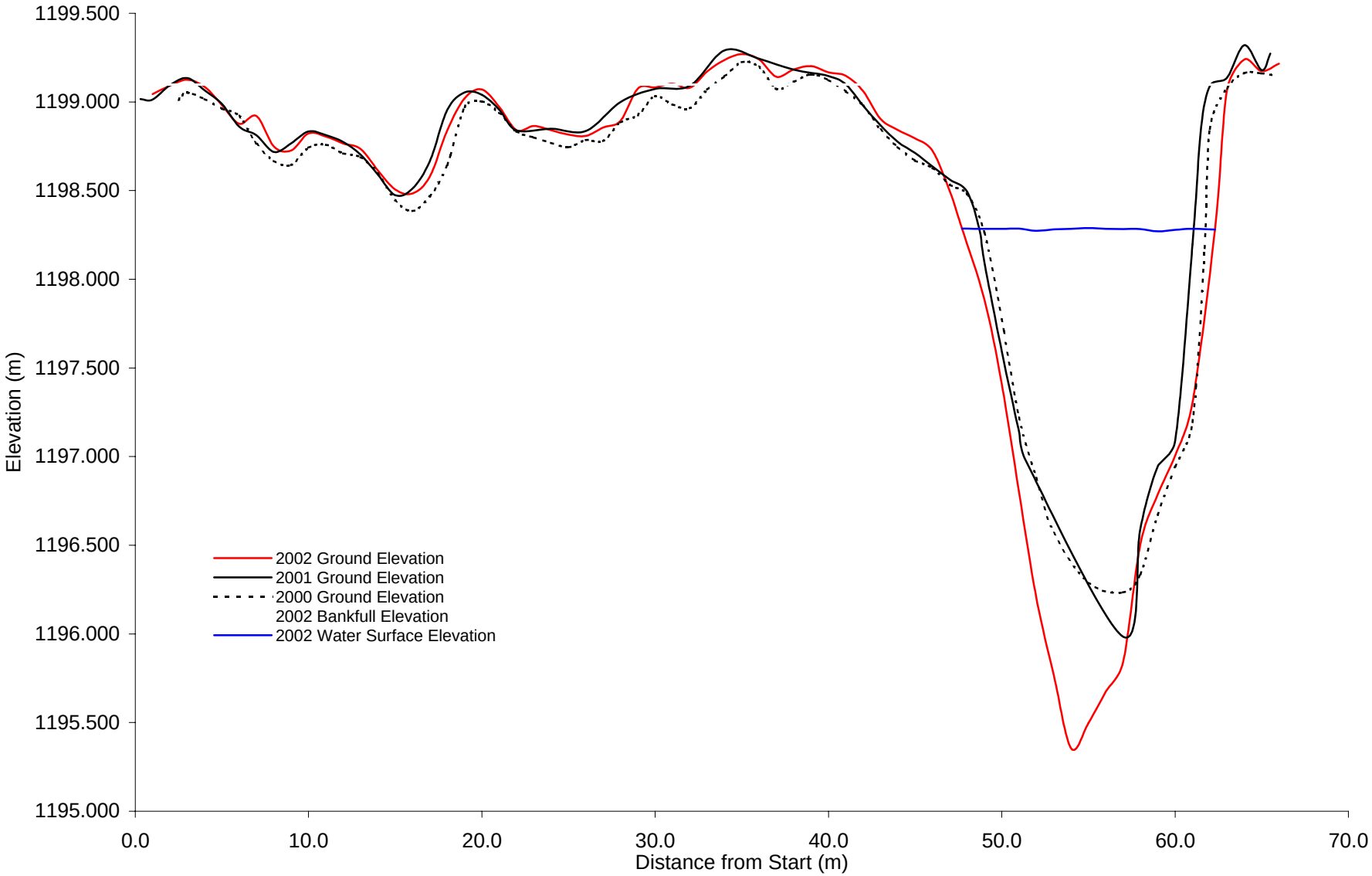
True Elevations (m)

Station	Backsight	Height of Instrument	Foresight	Elevation
BM1	0.091	1120.091		1120.000
TP1	0.738	1118.646	2.183	1117.908
TP2	0.769	1118.299	1.116	1117.530
BM2		1116.951	1.348	1116.951
BM2	1.348	1118.299		1116.951
TP2	1.115	1118.644	0.77	1117.529
TP1	2.168	1120.075	0.737	1117.907
BM1		1120.000	0.075	1120.000
				1120.000
				0.000

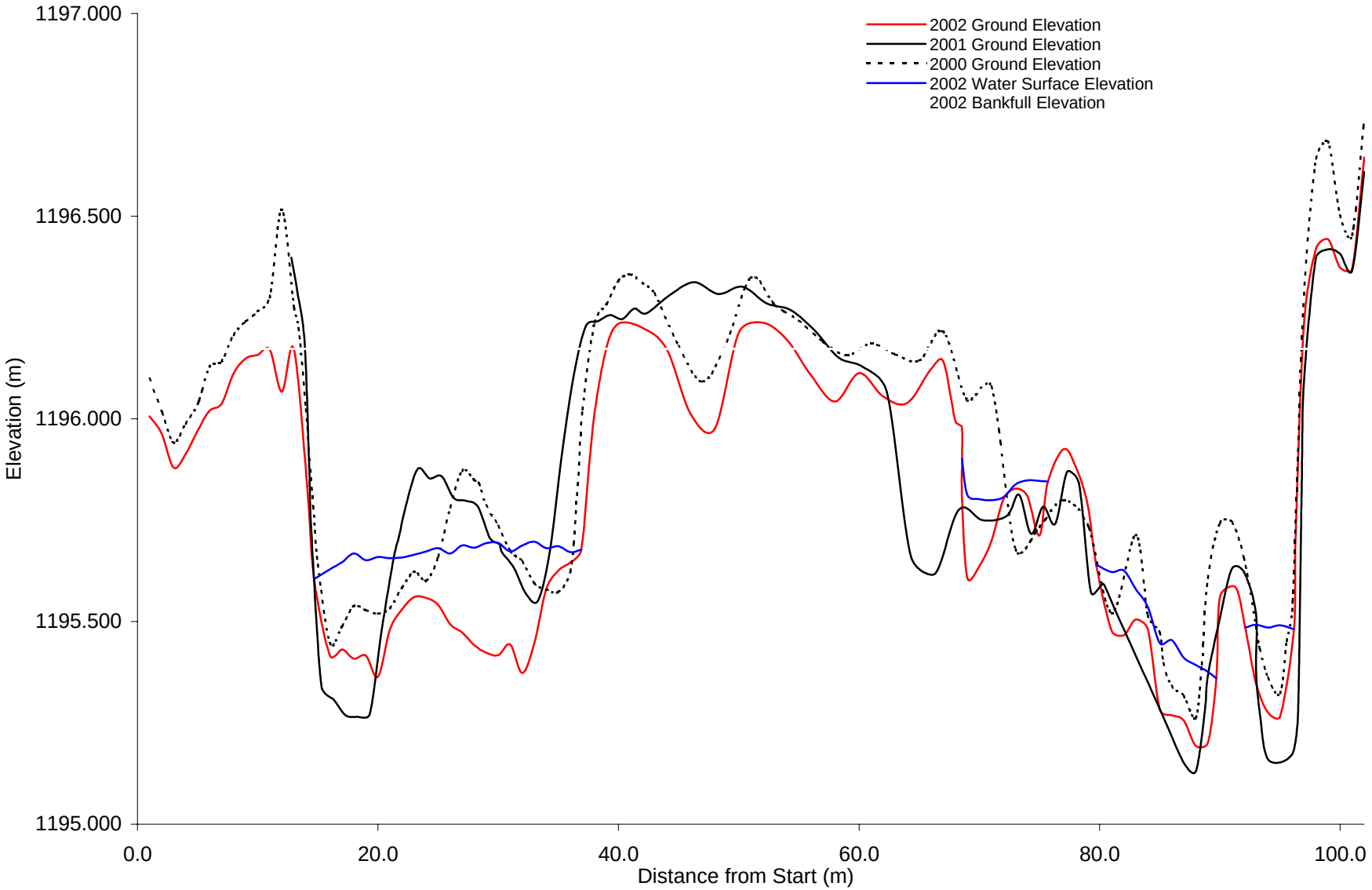
error =0.000



Longitudinal profile of a representative two meander lengths of the Wigwam River in reach 6, study site 2.



Cross sectional profile of a representative pool habitat unit of the Wigwam River in reach 6, study site 2.



Cross sectional profile of a representative riffle habitat unit of the Wigwam River in reach 6, study site 2.

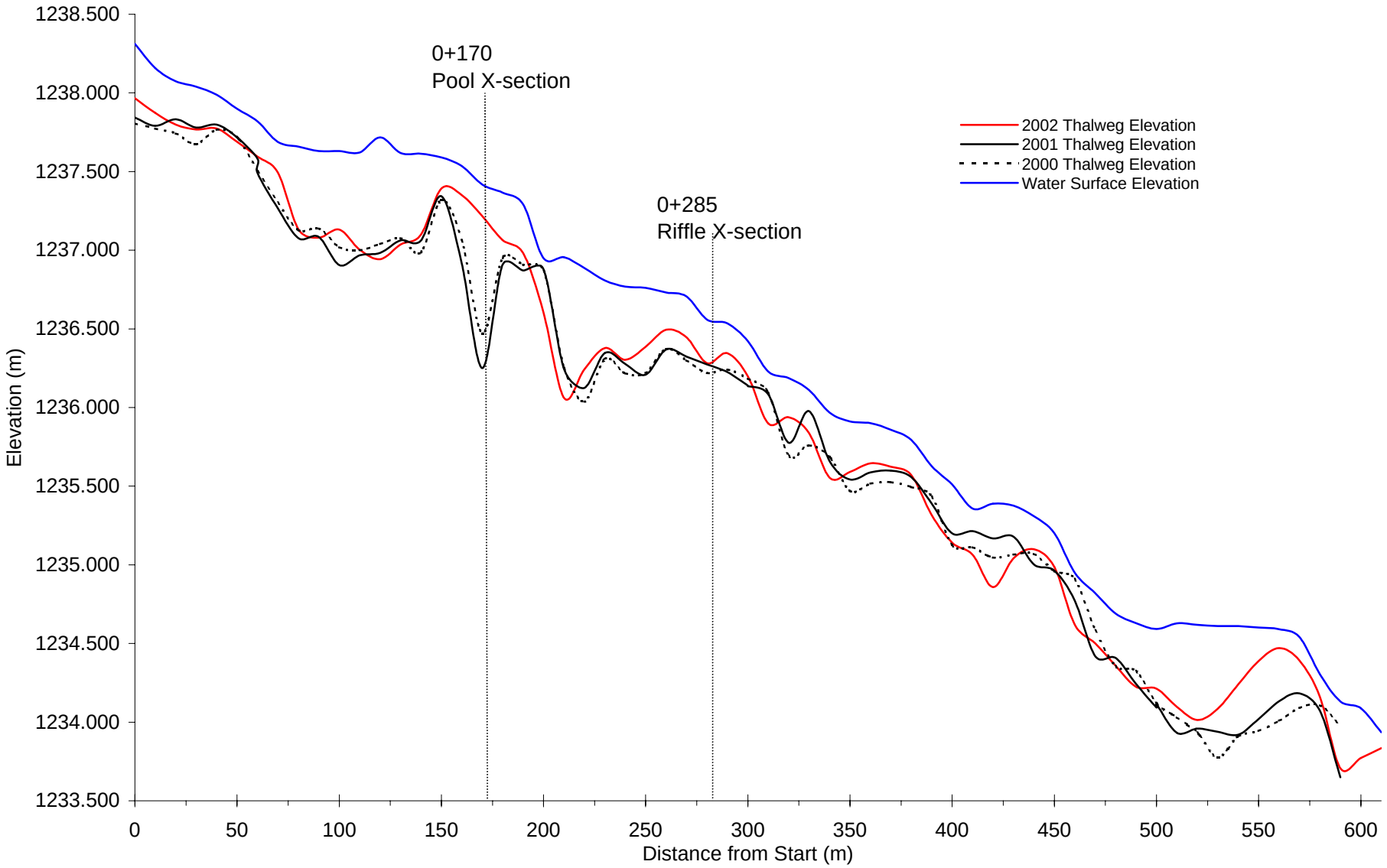
Differential Levelling Loop - Reach 6, Site 2 **Date:** **29-Aug-02**

Field (Arbitrary) Elevations (m)

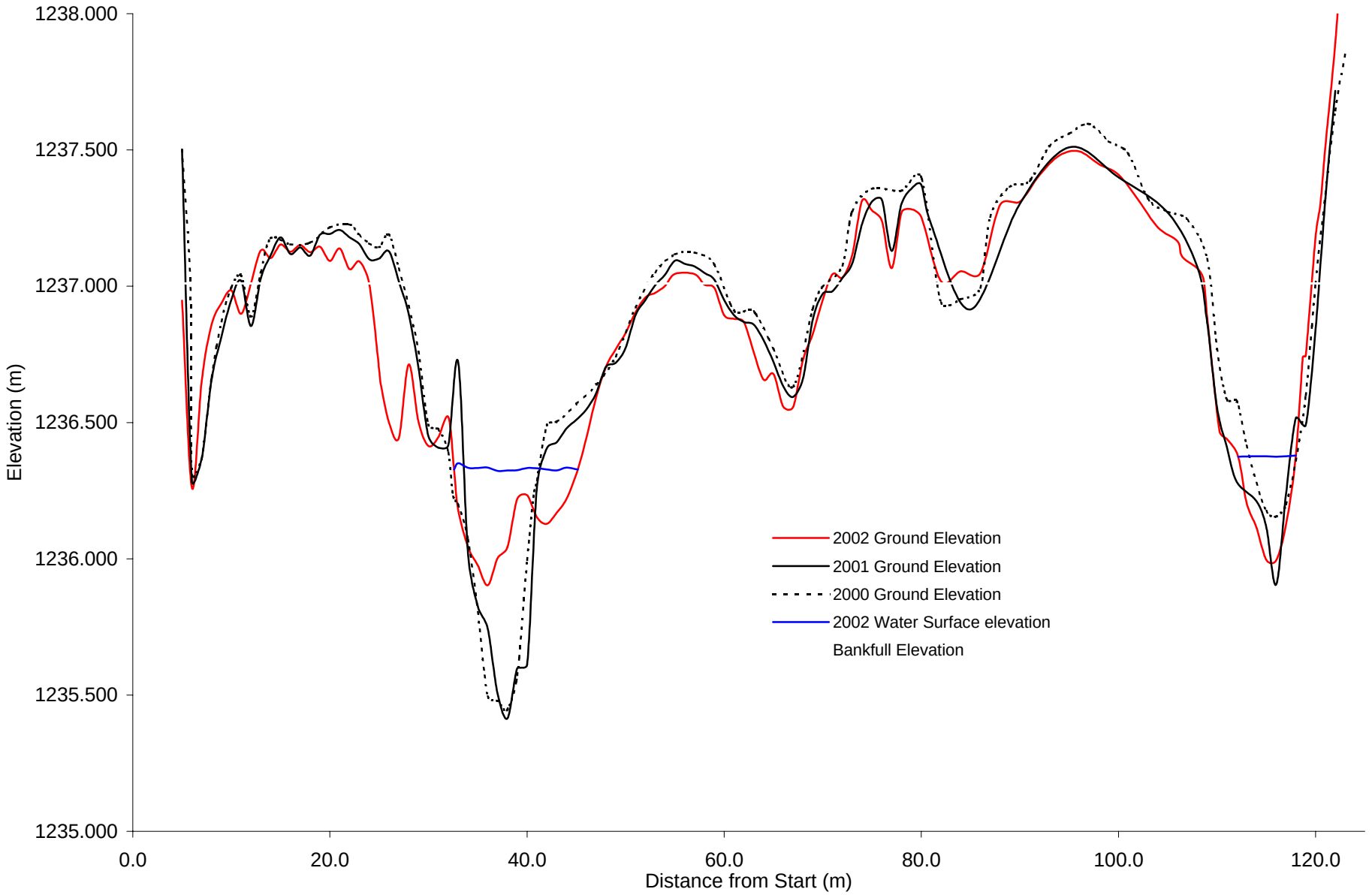
Station	Backsight	Height of Instrument	Foresight	Elevation	Comments
BM1	0.759	5.759		5.000	same
TP1	1.743	4.564	2.938	2.821	rock on LUB
TP2	0.992	3.577	1.979	2.585	
TP3	0.925	2.915	1.587	1.990	
BM3	0.871	2.037	1.749	1.166	
BM2		0.673	1.364	0.673	
BM2	1.364	2.037		0.673	
BM3	1.678	2.844	0.871	1.166	
TP3	1.52	3.511	0.853	1.991	
TP2	1.733	4.318	0.926	2.585	
TP1	2.946	5.763	1.501	2.817	
BM1			0.762	5.001	
				error= +0.001	

True Elevations (m)

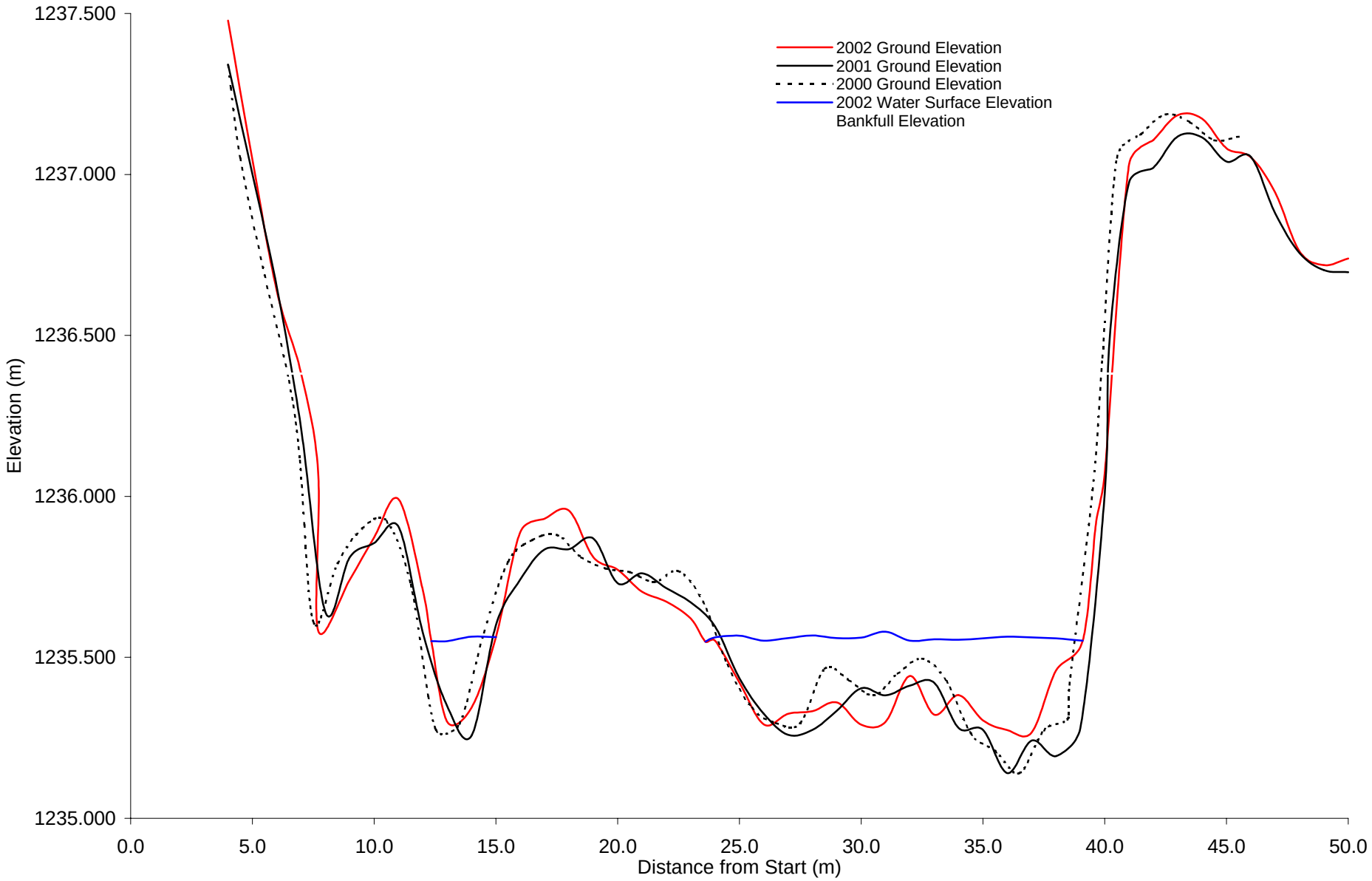
Station	Backsight	Height of Instrument	Foresight	Elevation
BM1	0.759	1200.759		1200.000
TP1	1.743	1199.564	2.938	1197.821
TP2	0.992	1198.577	1.979	1197.585
TP3	0.925	1197.915	1.587	1196.990
BM3	0.871	1197.037	1.749	1196.166
BM2		1195.673	1.364	1195.673
BM2	1.364	1197.037		1195.673
BM3	1.678	1197.844	0.871	1196.166
TP3	1.52	1198.511	0.853	1196.991
TP2	1.733	1199.318	0.926	1197.585
TP1	2.946	1200.763	1.501	1197.817
BM1			0.762	1200.001
				error= +0.001



Longitudinal profile of a representative two meander lengths of the Wigwam River in reach 7, study site 3.
Channel was dry at time of survey



Cross sectional profile of a representative pool habitat unit of the Wigwam River in reach 7, study site 3.



Cross sectional profile of a representative riffle habitat unit of the Wigwam River in reach 7, study site 3.

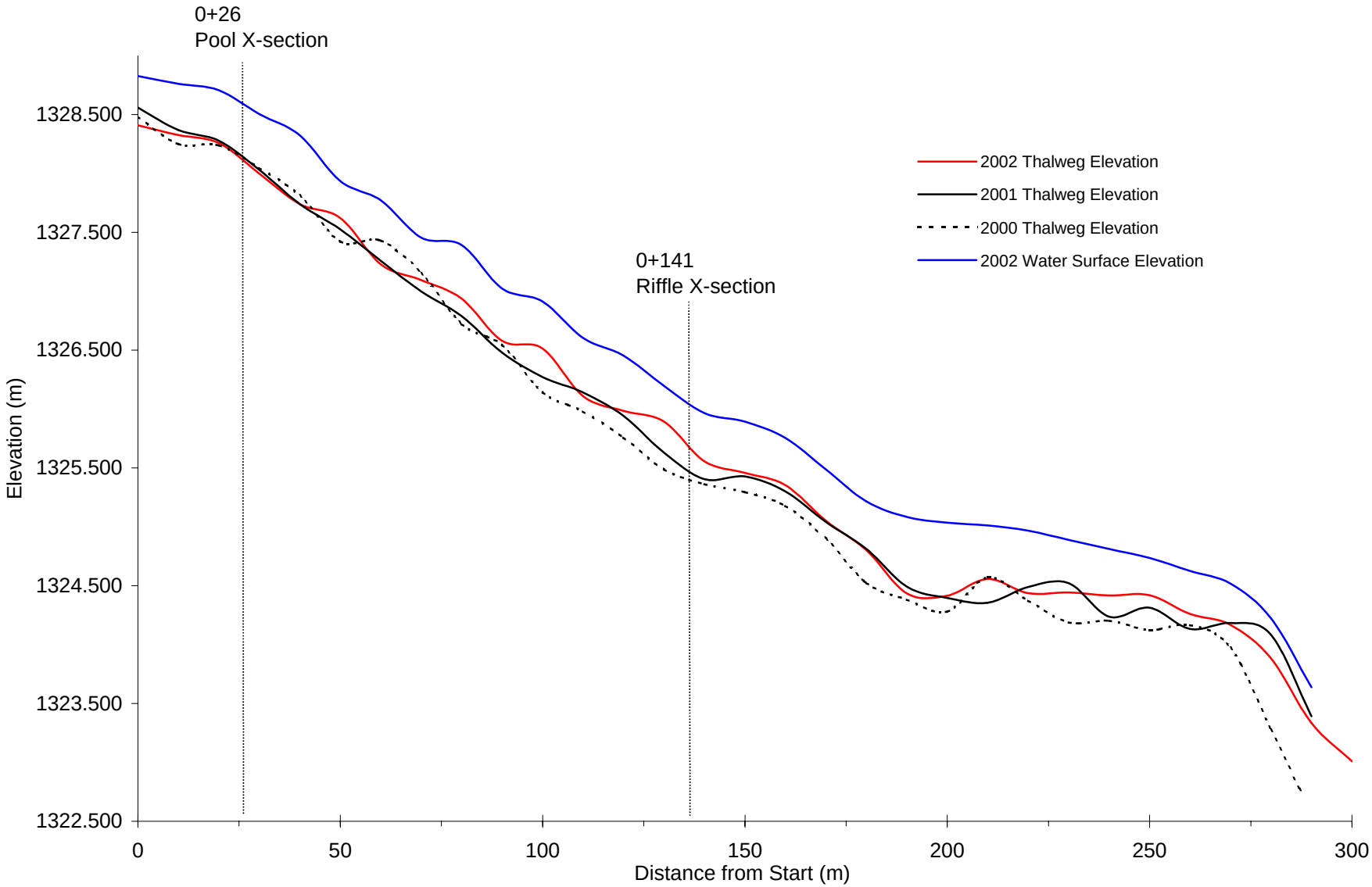
Differential Levelling Loop - Reach 7, Site 3 **Date:03/09/2002**

Field (Arbitrary) Elevations (m)

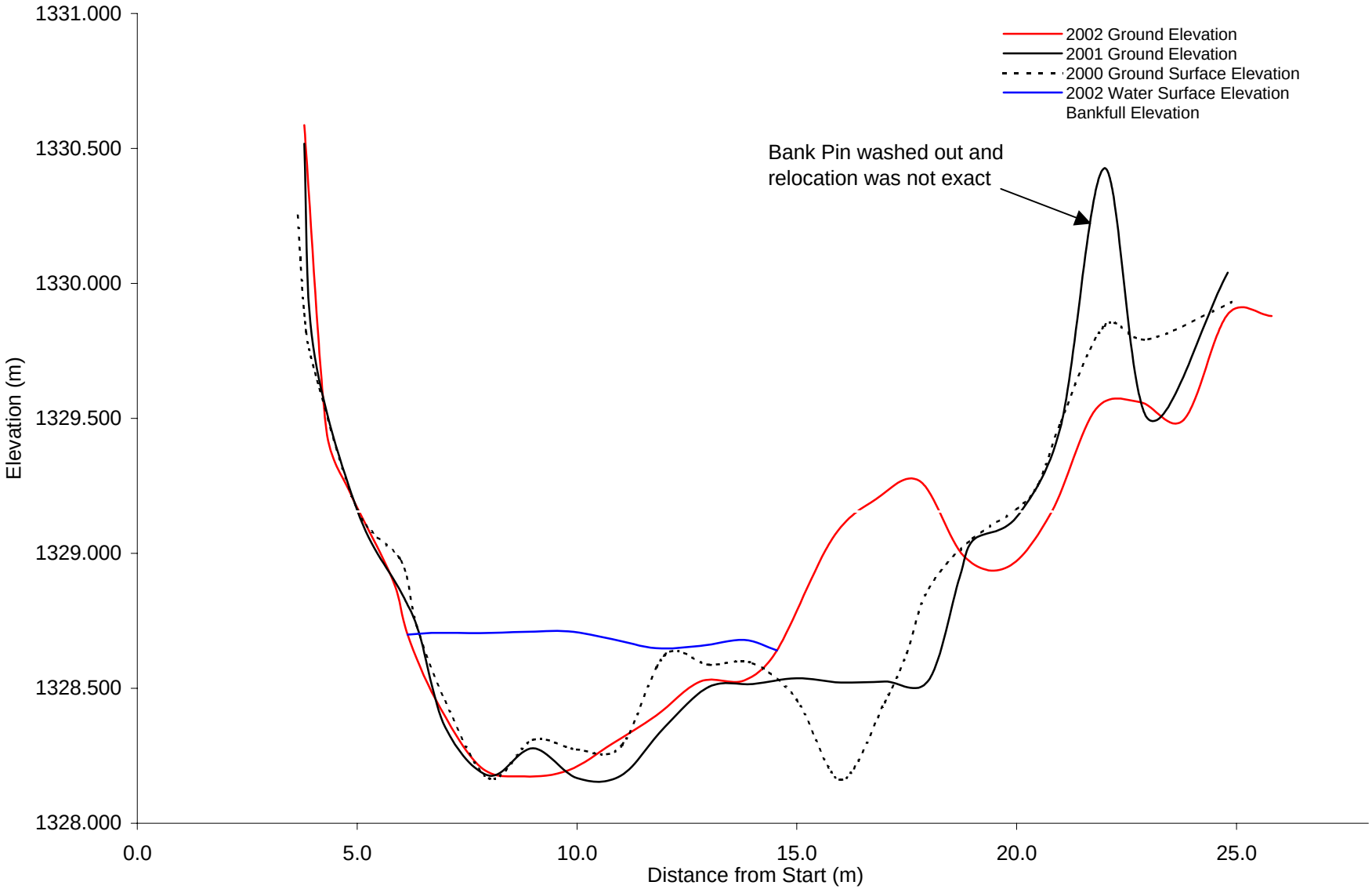
Station	Backsight	Height of Instrument	Foresight	Elevation
BM1	0.546	5.546		5.000
TP1	1.551	4.510	2.587	2.959
TP2	1.923	4.086	2.347	2.163
TP3	0.988	2.234	2.840	1.246
TP4	2.368	2.624	1.978	0.256
BM2			0.832	1.792
BM2	0.832	2.624		1.792
TP4	1.917	2.173	2.368	0.256
TP3	2.414	3.659	0.928	1.245
TP2	2.453	4.615	1.497	2.162
TP1	2.619	5.577	1.657	5.001
BM1			0.576	
				error=-0.001

True Elevations (m)

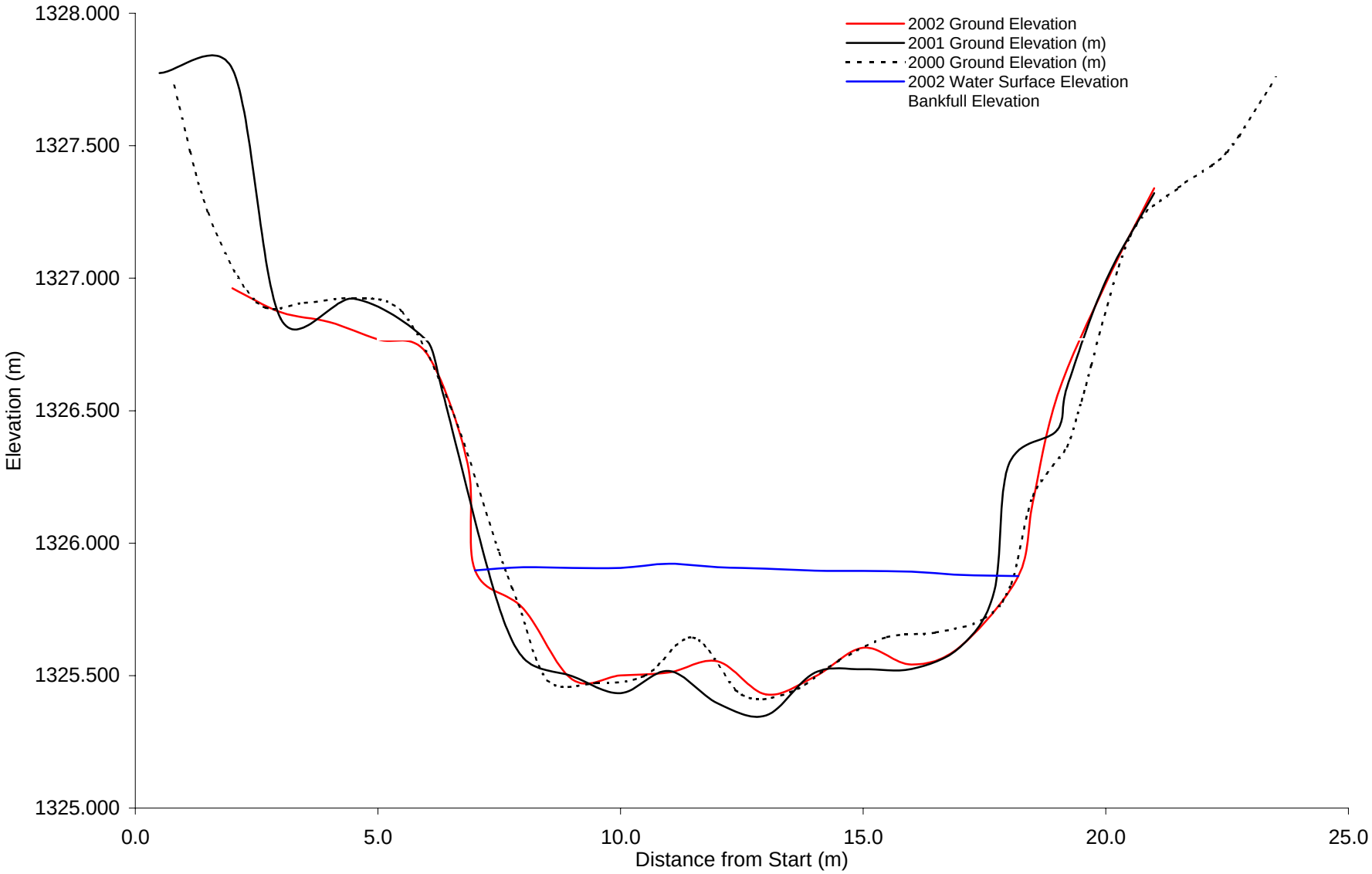
Station	Backsight	Height of Instrument	Foresight	Elevation
BM1	0.546	1240.546		1240.000
TP1	1.551	1239.510	2.587	1237.959
TP2	1.923	1239.086	2.347	1237.163
TP3	0.988	1237.234	2.840	1236.246
TP4	2.368	1237.624	1.978	1235.256
BM2		1236.792	0.832	1236.792
BM2	0.832	1237.624		1236.792
TP4	1.917	1237.173	2.368	1235.256
TP3	2.414	1238.659	0.928	1236.245
TP2	2.453	1239.615	1.497	1237.162
TP1	2.619	1240.577	1.657	1237.958
BM1			0.576	1240.001
				error=-0.001



Longitudinal profile of a representative two meander lengths of the Wigwam River in reach 9, study site 4.



Cross sectional profile of a representative pool habitat unit of the Wigwam River in reach 9, study site 4.



Cross sectional profile of a representative riffle habitat unit of the Wigwam River in reach 9, study site 4.

Differential Levelling Loop - Reach 9, Site 4

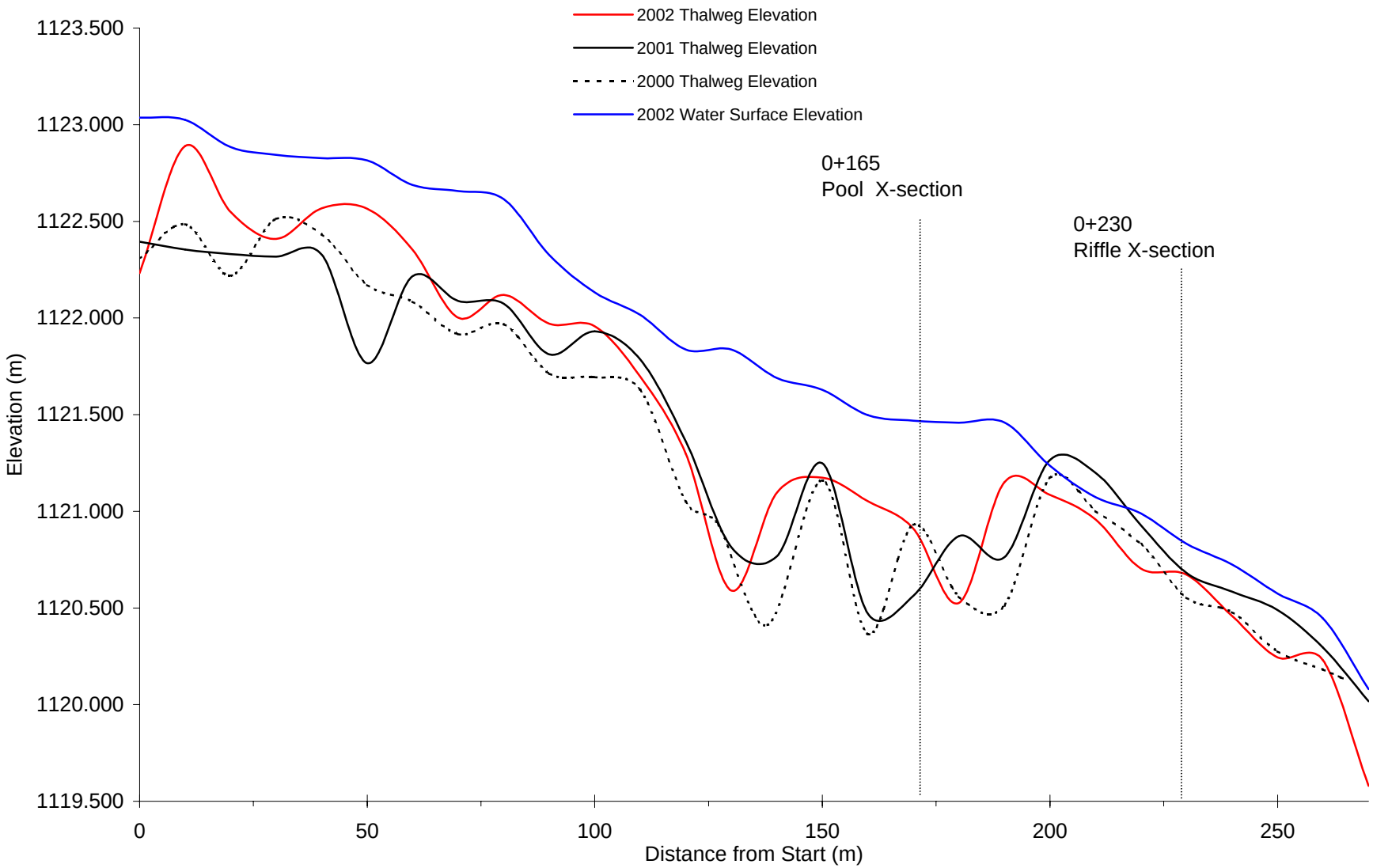
Date: 28/08/2002

Field (Arbitrary) Elevations (m)

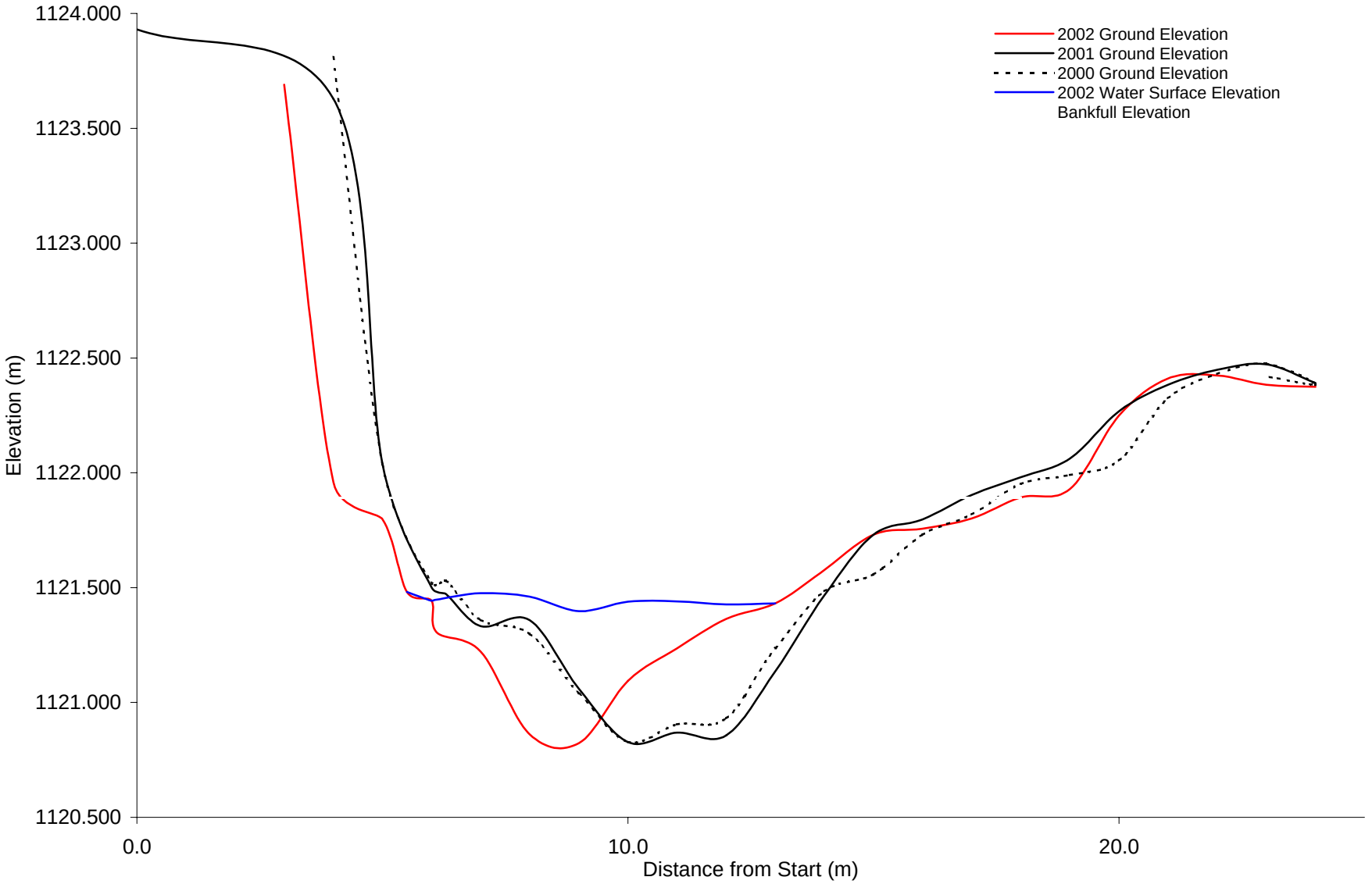
Station	Backsight	Height of Instrument	Foresight	Elevation
BM1	0.101	10.101		10.000
TP1	0.034	8.087	2.248	8.053
TP2	1.055	6.426	2.716	5.371
BM2			1.963	4.463
BM2	1.962	6.425		4.462
TP2	2.679	8.047	1.057	5.368
TP1	2.191	10.242	0	8.051
BM1			0.244	9.998
				error = +0.002

True Elevations (m)

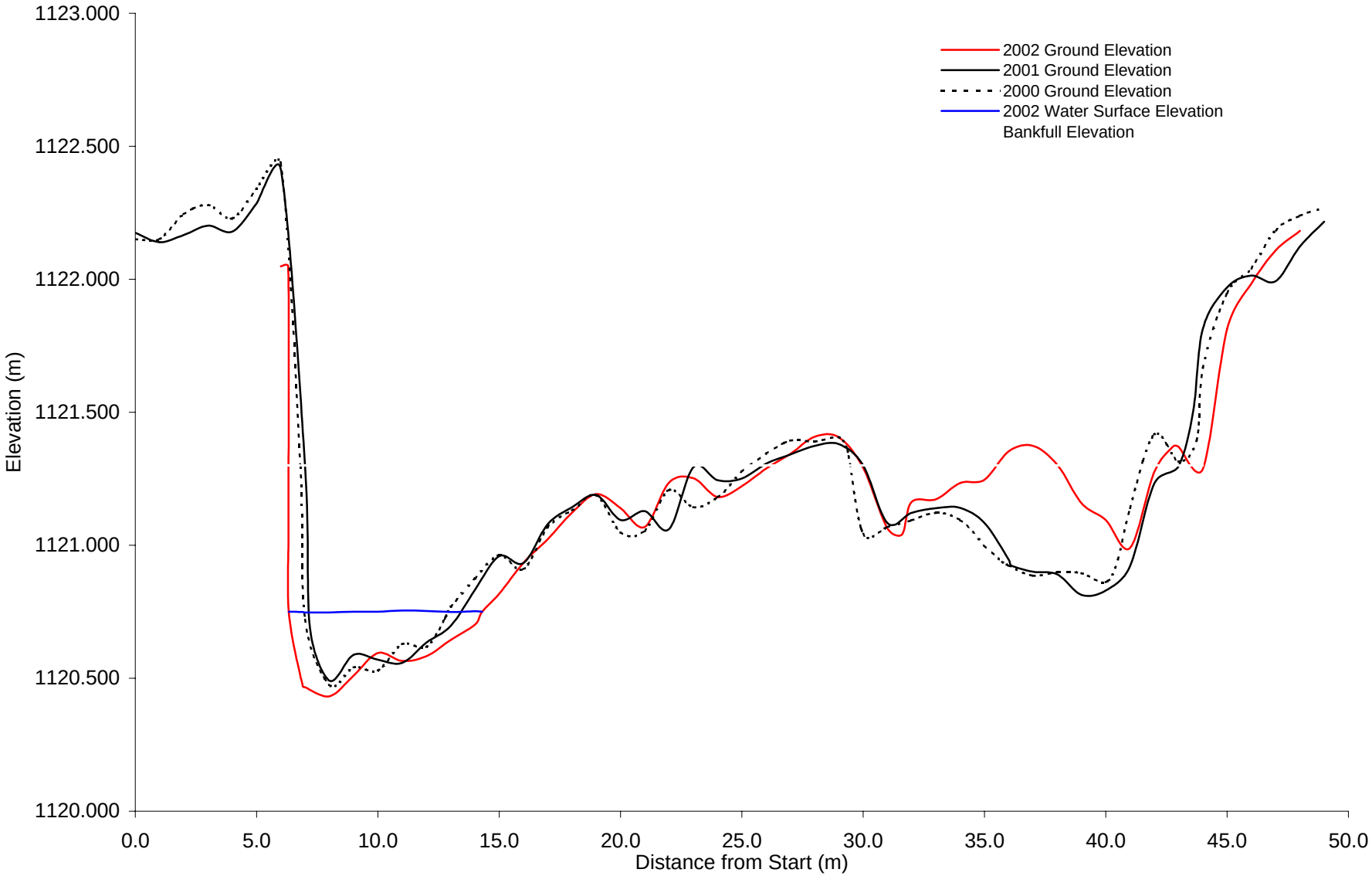
Station	Backsight	Height of Instrument	Foresight	Elevation
BM1	0.101	1330.101		1330.000
TP1	0.034	1327.887	2.248	1327.853
TP2	1.055	1326.226	2.716	1325.171
BM2		1324.263	1.963	1324.263
BM2	1.962	1326.225		1324.263
TP2	2.679	1327.847	1.057	1325.168
TP1	2.191	1330.038	0	1327.847
BM1		132.998	0.244	132.998
				error = +0.002



Longitudinal profile of a representative two meander lengths of Bighorn Creek in reach 1, study site 5.



Cross sectional profile of a representative pool habitat unit of Bighorn Creek in reach 1, study site 5.



Cross sectional profile of a representative riffle habitat unit of the Bighorn Creek in reach 1, study site 5.

Bighorn Creek

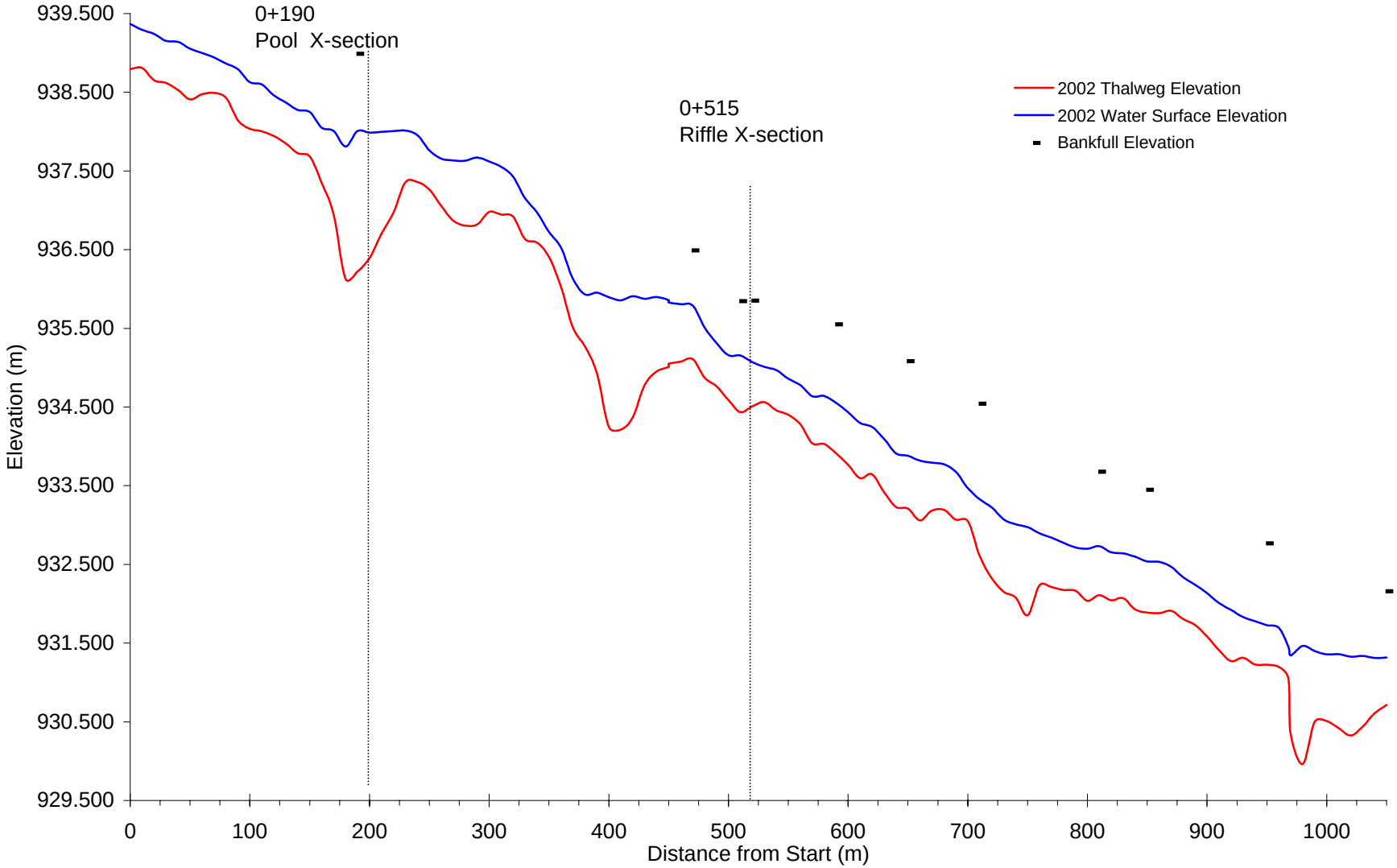
Differential Levelling Loop - Reach 1, Site 5 **Date: 26/08/2002**

Field (Arbitrary) Elevations (m)

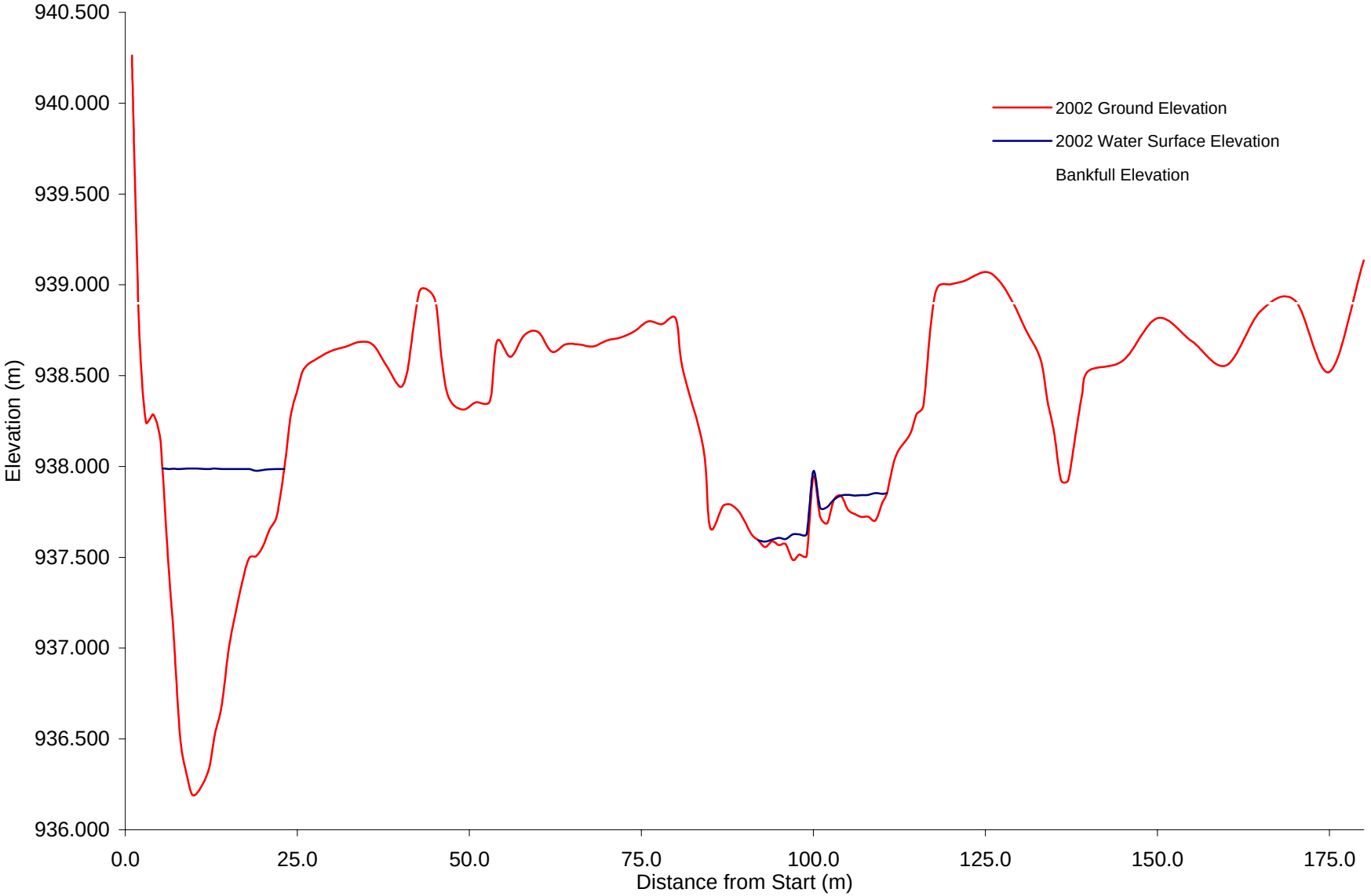
Station	Backsight	Height of Instrument	Foresight	Elevation	Comment
BM2	0.566	5.566		5.000	
TP1	1.706	5.155	2.117	3.449	new rock @ end of bar
TP2	1.261	4.518	1.898	3.257	new log on corner
TP3	1.683	3.463	2.738	1.780	new rock
RP2			2.331	1.132	same lag bolt
RP2	2.331	3.463		1.132	
TP3	2.770	4.551	1.682	1.781	
TP2	1.956	5.214	1.293	3.258	
TP1	2.152	5.601	1.765	3.449	
BM2			0.601	5.000	
				error= +0.000	

True Elevations (m)

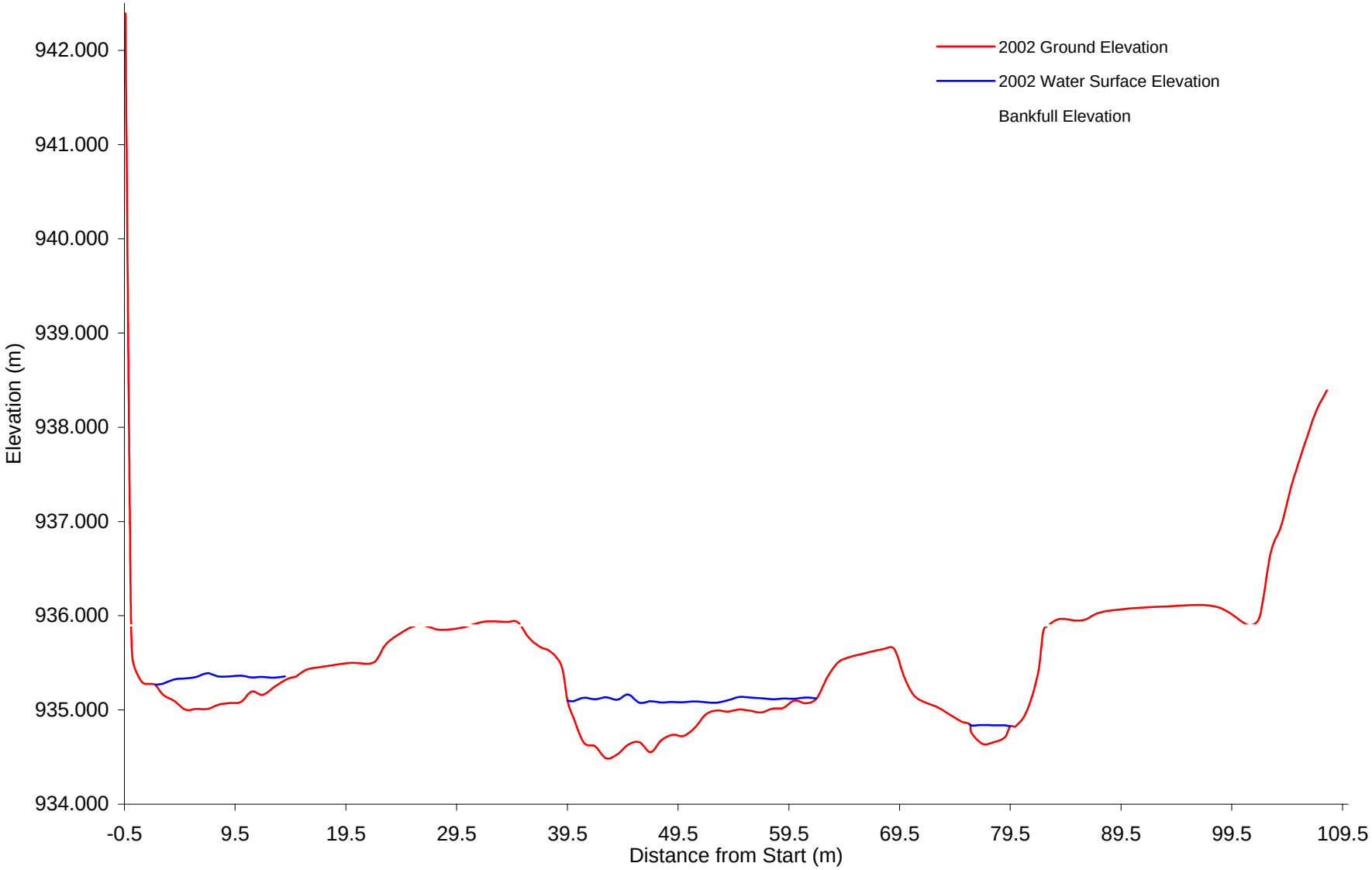
Station	Backsight	Height of Instrument	Foresight	Elevation
BM2	0.566	1125.025		1124.459
TP1	1.706	1124.614	2.117	1122.908
TP2	1.261	1123.977	1.898	1122.716
TP3	1.683	1122.922	2.738	1121.239
RP2			2.331	1120.591
RP2	2.331	1122.926		1120.595
TP3	2.770	1124.014	1.682	1121.244
TP2	1.956	1124.677	1.293	1122.721
TP1	2.152	1125.064	1.765	1122.912
BM2			0.601	1124.463
				error= +0.004



Longitudinal profile of a representative two meander lengths of the Wigwam River in reach 2, study site 6.



Cross sectional profile of a representative pool habitat unit of the Wigwam River in reach 2, study site 6.



Cross sectional profile of a representative riffle habitat unit of the Wigwam River in reach 2, study site 6.

Wigwam River (Lodgepole site)
Differential Levelling Loop - Reach 2, Site 5 **Date: 11-Sep-02**

Field (Arbitrary) Elevations (m)

Station	Backsight	Height of Instrument	Foresight	Elevation	Comment
BM1	0.962	10.962		10.000	
RP1	0.539	not in loop			secondary BM
TP1	1.370	10.199	2.133	8.829	rock near pool
TP2	0.701	8.168	2.732	7.467	rock on end of gravel bar
TP3	1.562	7.433	2.297	5.871	rock on LUB side (near start)
TP4	0.978	5.951	2.460	4.973	rock on LUB side (near start)
TP5	1.824	5.409	2.366	3.585	rock on LUB in corner approx. 0 +720
TP6	2.379	4.830	2.958	2.451	rock in mid @ 0+880
BM2		4.398	0.432	4.398	lag bolt RUB
BM2	0.432	4.830		4.398	
TP6	2.813	5.264	2.379	2.451	
TP5	2.392	5.975	1.681	3.583	
TP4	2.211	7.182	1.004	4.971	
TP3	2.353	8.225	1.310	5.872	
TP2	2.782	10.246	0.761	7.464	
TP1	1.635	10.463	1.418	8.828	
BM1			0.467	9.996	
				error= -0.004	

True Elevations (≈ 940 m

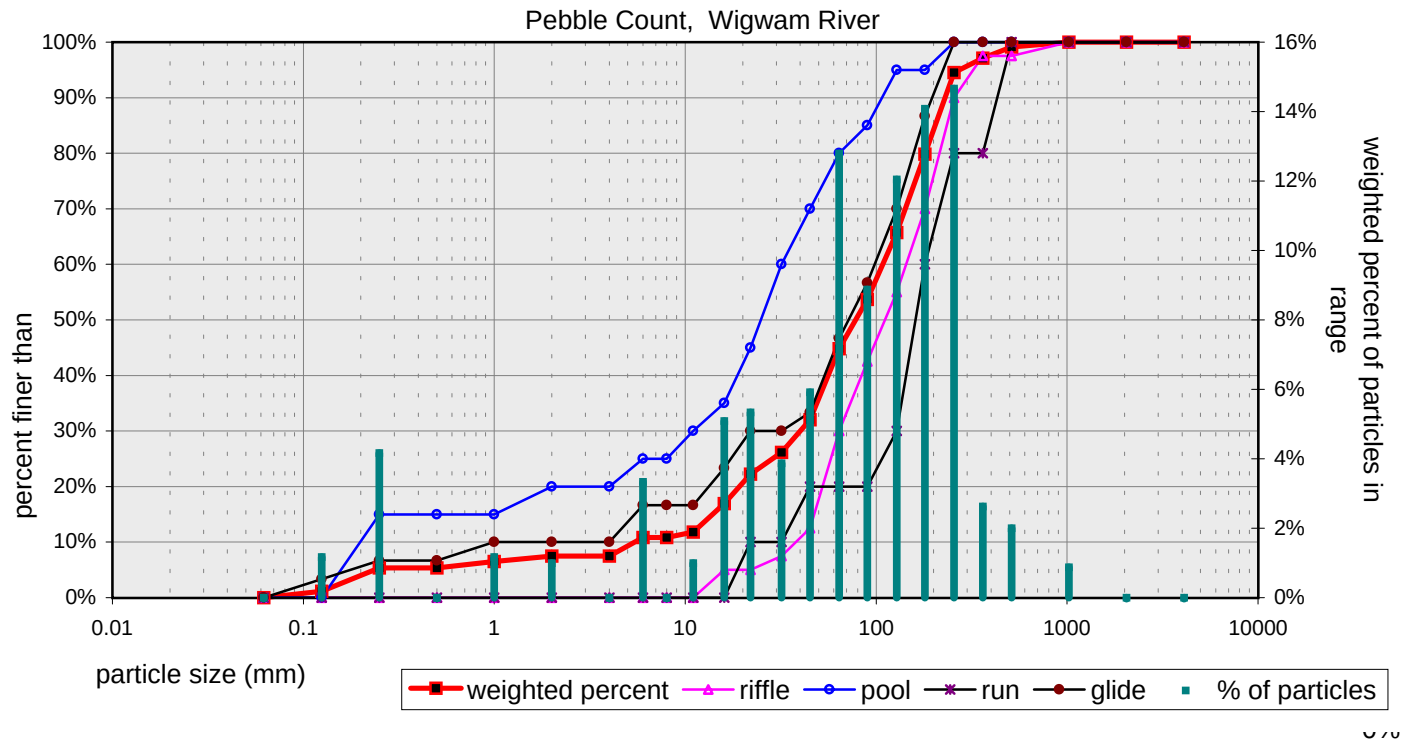
Station	Backsight	Height of Instrument	Foresight	Elevation
BM1	0.962	940.962		940.000
RP1	0.539	not in loop		
TP1	1.370	940.199	2.133	938.829
TP2	0.701	938.168	2.732	937.467
TP3	1.562	937.433	2.297	935.871
TP4	0.978	935.951	2.460	934.973
TP5	1.824	935.409	2.366	933.585
TP6	2.379	934.830	2.958	932.451
BM2		934.398	0.432	934.398
BM2	0.432	934.830		934.398
TP6	2.813	935.264	2.379	932.451
TP5	2.392	935.975	1.681	933.583
TP4	2.211	937.182	1.004	934.971
TP3	2.353	938.225	1.310	935.872
TP2	2.782	940.246	0.761	937.464
TP1	1.635	940.463	1.418	938.828
BM1			0.467	939.996
				error= -0.004

Appendix E

Pebble Count Data

	Wigwam River

Note:	**Wigwam River Reach 5 Site 1** 0%

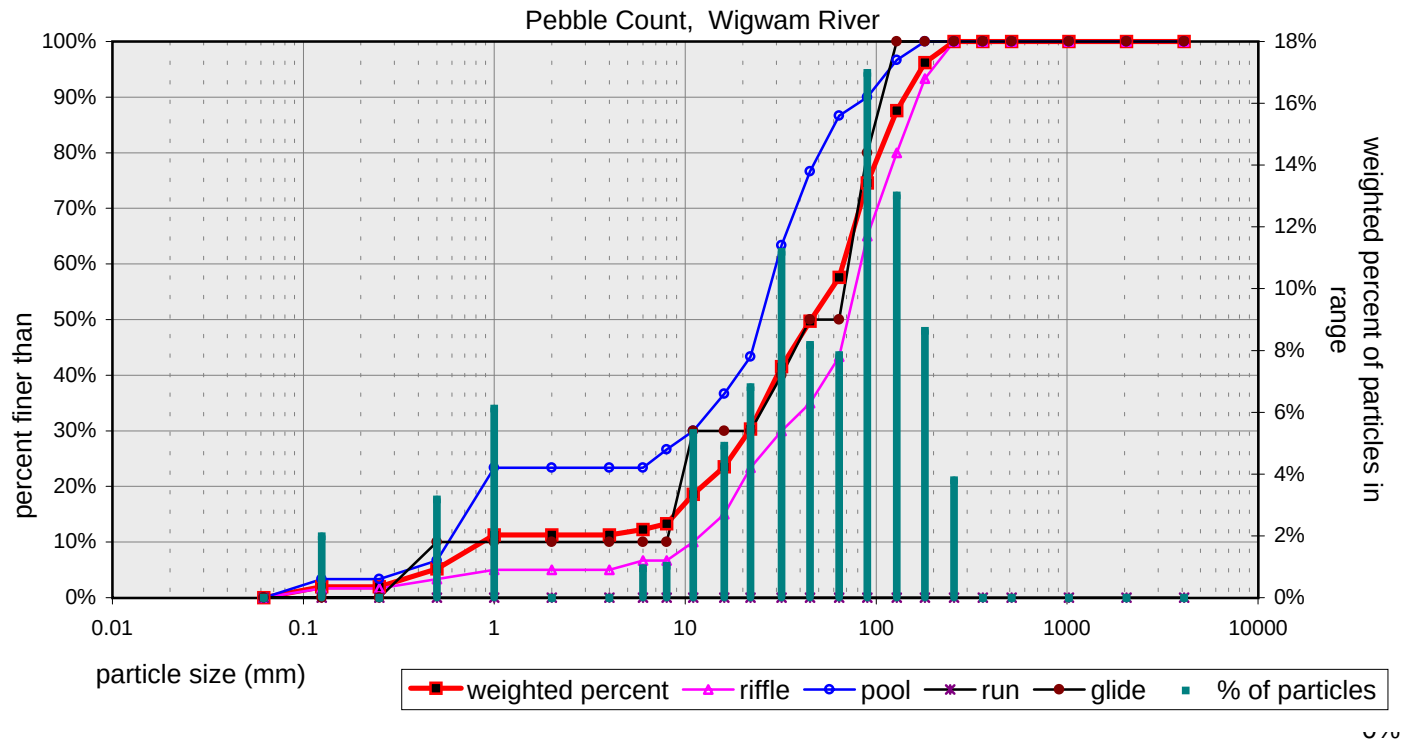


based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	14.955	48.82	78.1	125	199	273	3.9	54.5	3.6

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	8%	37%	50%	6%	0%	0%	0%	0%

	Wigwam River

Note:	**Wigwam River Reach 6 Site 2** 0%

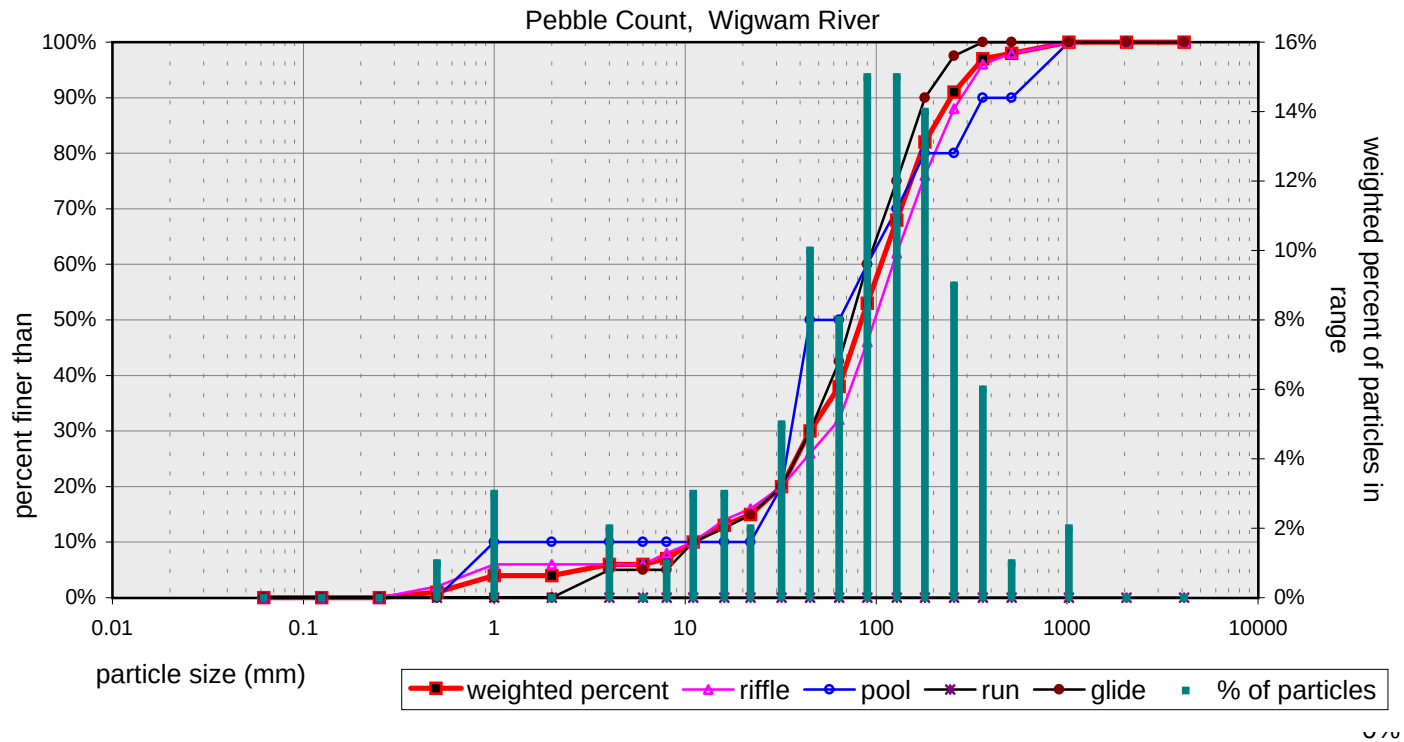


based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	9.418	25.72	45.6	74	116	172	3.7	33.1	3.5

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	11%	46%	42%	0%	0%	0%	0%	0%

	Wigwam River

Note:	**Wigwam River Reach 7 Site 3** 0%

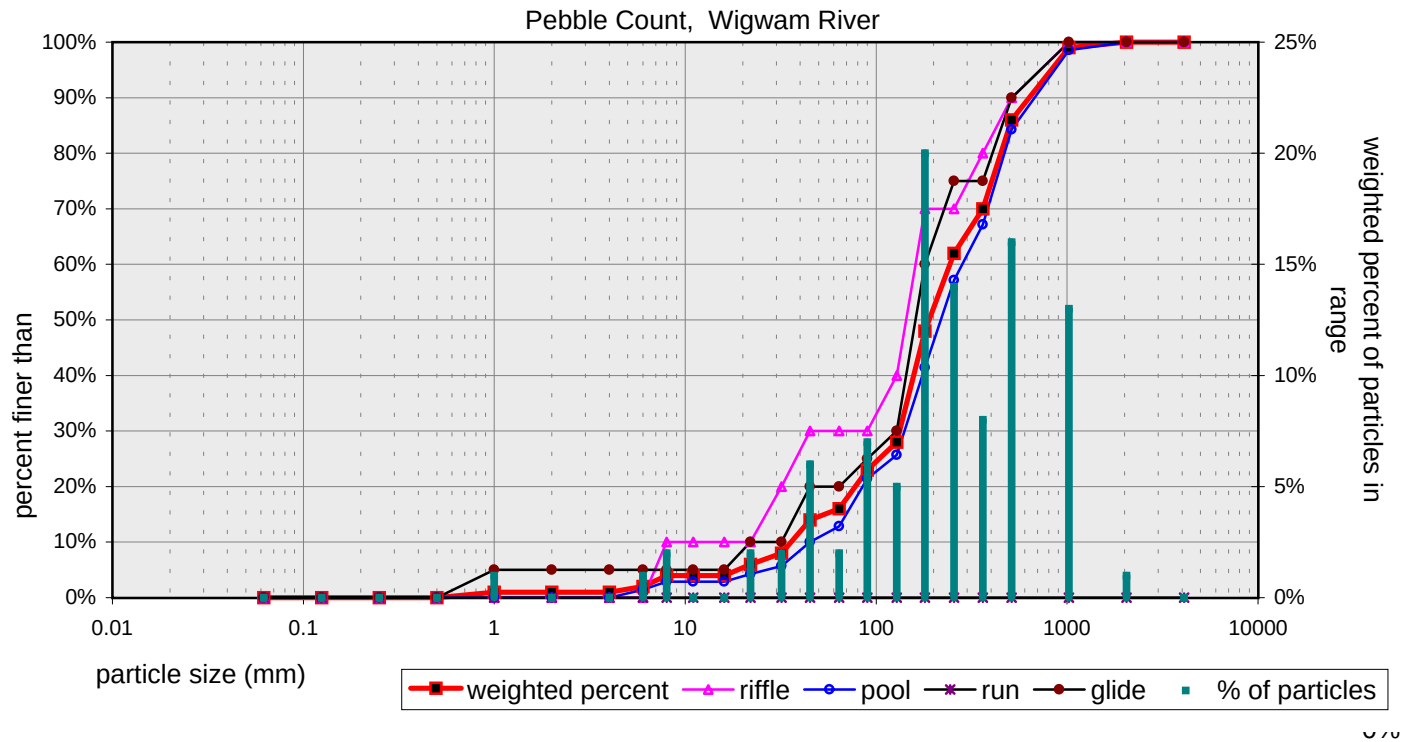


based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	23.712	56.08	84.1	119	195	323	2.9	67.9	2.9

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	4%	34%	53%	9%	0%	0%	0%	0%

	Wigwam River

Note:	**Wigwam River Reach 9 Site 4** 0%

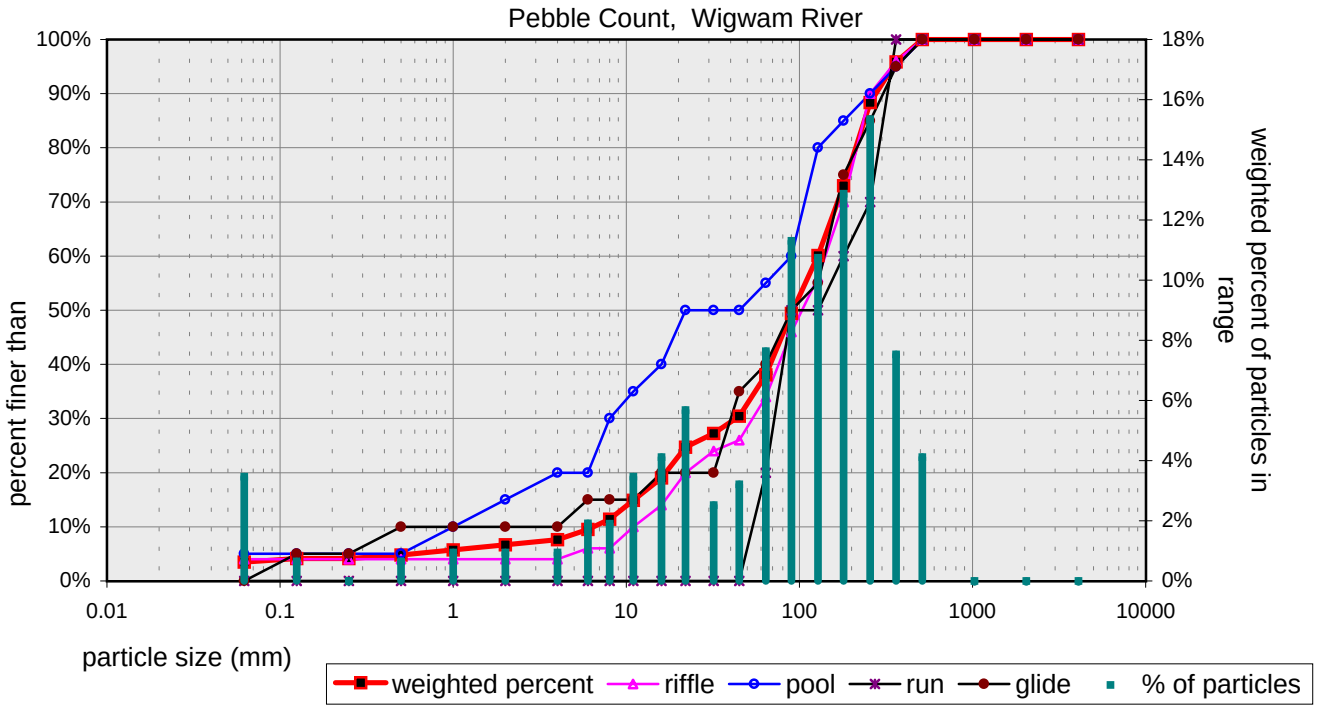


based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	64.000	144.22	189.3	292	490	827	2.8	177.1	2.8

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	1%	15%	46%	38%	0%	0%	0%	0%

	Wigwam River

Note:	**Reach 2 Site 6** 3%

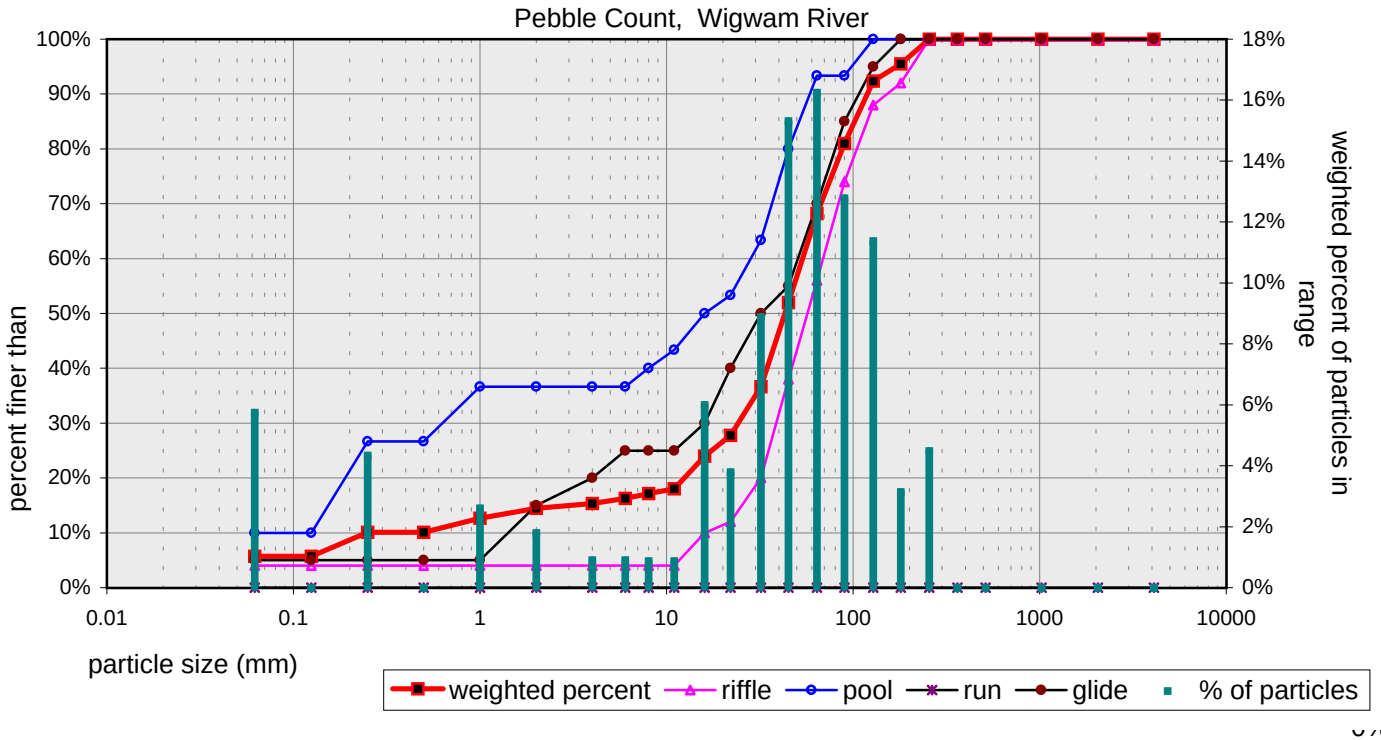


based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	12.157	55.55	91.8	146	232	348	5.0	53.1	4.4

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	3%	3%	31%	50%	12%	0%	0%	0%	0%

	Wigwam River

Note:	**Bighorn Creek Reach 1** 6%



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	5.305	29.83	43.1	60	99	170	5.2	22.9	4.3

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	6%	9%	54%	32%	0%	0%	0%	0%	0%