Upper Fording River Westslope Cutthroat Trout Population Monitoring Project: 2019

Study Period: 2012 to 2019
Revision Date April 9, 2020

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Cover Photo: Two snorkel team members enumerating Westslope Cutthroat Trout on Fording River Operations (FRO) property, upper Fording River, September, 2012.

Suggested Citation:

Cope, S. 2020. Upper Fording River Westslope Cutthroat Trout Population Monitoring Project: 2019. Report Prepared for Teck Coal Limited[1], Sparwood, BC. Report Prepared by Westslope Fisheries Ltd., Cranbrook, BC. 48 p. + 2 app.

[1] Data has been archived and is considered confidential. Data requests should be referred to Teck Coal Limited, Mountain View Office, 421 Pine Avenue, Sparwood, BC, V0B 2G0.

Executive Summary

The upper Fording River Westslope Cutthroat Trout Population Monitoring Project: 2019 addresses the recommendation of the Westslope Cutthroat Trout Population Assessment and Telemetry Project Final Report for a long-term population monitoring strategy. The recommendation was made to track trends of Westslope Cutthroat Trout abundance in the upper Fording River to support the long-term objectives of population viability and sustainability. This was considered necessary given the statistical uncertainty in population estimates, population threats identified that may limit population productivity and the habitat offsetting measures under way that are designed to address those population threats and improve population productivity. Note that “population threats” are the term used in this monitoring report based on the Alberta Sustainability Index methodology. Population threats are stressors (*i.e.,* any biological, physical or chemical factor that causes adverse responses in the environment) that are present and can influence population dynamics and abundance. It’s use in this population monitoring report is intended to identify potential population threats or stressors that are present rather than provide a quantitative assessment of causal factors or confirmed population limitations. A causal factor investigation is underway as noted in recommendations below and Teck is working with regulators (Forest Lands Natural Resource Operations and Rural Development (FLNRORD), Department of Fisheries and Oceans Canada (DFO)), First Nations (Ktunaxa Nation Council) and subject matter experts to review potential operational stressors and ways to eliminate or mitigate potential stressors.

The upper Fording River Westslope Cutthroat Trout population monitoring program recognizes catch-per-unit-effort (CPUE) indexing methods are extremely sensitive to methodology deviations that affect catchability. For this reason, trend monitoring included two independent CPUE population metrics to increase confidence in the interpretation of population trends. These included; 1) sub-adult and adult snorkel counts (fish greater than 200 mm) and a Pooled Peterson Model that used previously calibrated observer efficiencies, and 2) fry and juvenile (fish less than 200 mm) three-pass removal-depletion density estimates.

Since the previous snorkel count (2017), the adult count has decreased by 93% from 1,573 counted fish to 104 counted fish. The 2019 count falls well below the range in the previous four survey counts conducted in 2012, 2013, 2014 and 2017, which were 768 – 1,573 fish greater than 200 mm.

The 2019 median model population estimate was 327 fish greater than 200 mm and the three model estimates ranged between 246 to 416 fish greater than 200 mm. The 2019 environmental conditions (visibility and flow) and biological opinion were most consistent with the lowest of the three model estimates for observer efficiencies (25% in 2013) and this would provide weight to the higher model estimate of 416 Westslope Cutthroat Trout greater than 200 mm. Any of the three model estimates represent steep declines of between 88% to 93% since 2017. If accurate, the magnitude of the decline is highly concerning and cause for immediate action.

The resulting density estimates of 8.6 fish/km greater than 200 mm (range of model estimates 5.1 – 8.6 fish/km) and 2.2 fish/km greater than 300 mm (range of estimates 1.3 – 2.2 fish/km) were significantly lower than the last (2017) density estimates of 76.3 fish/km greater than 200 mm and 22.0 fish/km greater than 300 mm. The upper Fording River density of mature fish greater than 200 mm appears to have undergone a steep and unexpected decline between September 2017 and September 2019. The 2019 upper Fording River density estimate of 2.2 fish/km greater than 300 mm represents a population viability

and sustainability concern. These fish represent multiple year classes ranging in age from 4 years to 20 years old.

Density estimates for mature Westslope Cutthroat Trout (fish greater than 200 mm or fish greater than 300 mm) have been collected using similar snorkel methods by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) for a number of priority Westslope Cutthroat Trout streams in the upper Kootenay drainage over a similar time frame (2008 -2019). These estimates have been used to place the upper Fording River estimates in context regionally. These results suggest some feature or condition unique to the upper Fording River, which could include mine influences, are the cause for the population decline between 2017 and 2019; not the broader influence of regional climatic conditions.

In 2019, recruitment and juvenile removal-depletion electrofishing catch (n=185) across 16 locations with 49 meso-habitat enclosures decreased by 74% from the last sample event in 2017 (n=714). Annual density estimates for those locations sampled in all five years (n=10) decreased 74% since 2017. The declines were broad based across all watershed areas or strata (*i.e.,* five primary strata were delineated; the lower, mid (FRO onsite) and upper (headwater) mainstem river segments and both lower and upper tributary) and were attributed to substantial and significant decreases within both mainstem spawning and fry rearing areas and tributary juvenile rearing habitat. Decreases appeared to be associated with subjective assessments of declining habitat quality or perceived impacts. Several concurrent monitoring programs are expected to provide quantitative temporal trends regarding these subjective observations once the 2019 data become available (*i.e.,* Calcite Monitoring Program, Regional and Local Aquatic Effects Monitoring Programs, Operational Environmental Monitoring for Consumptive Water Licences, Effectiveness Monitoring Programs (LCO Phase II and Swift Project) for fish and fish habitat).

The decrease in fry and juvenile densities were consistent with the adult enumeration data suggesting the population decline has occurred across all life stages and age classes. Therefore, there are two concerns that need to be understood and addressed: 1) the steep decline in adult fish between September 2017 and September 2019; and 2) the decrease in fry and juvenile densities suggesting a recruitment issue. The potential causes for these two concerns may be separate and should be evaluated.

Given the concerns regarding the steep decline in Westslope Cutthroat Trout abundance in 2019, immediate actions are being taken in terms of; (1) a precautionary approach (*i.e.,* assuming the decline is accurate), (2) reviewing potential operational stressors through causal investigation and ways to eliminate or mitigate potential stressors, and (3) replication of population monitoring results in 2020 including more rigorous methods to provide confidence in the 2019 and 2020 results.

1. A desktop investigation designed and implemented during the winter of 2019/2020 that compiles and evaluates all available data among the various operational, monitoring and assessment projects within the upper Fording River was recommended. The investigation should proceed using a hypothesis testing methodological approach to identify factors and their likelihood for population level impacts both mine related and natural in terms of both acute and chronic conditions. Note that this recommendation has been accepted by Teck, regulators and Ktunaxa Nation Council (KNC). Consultation and input is proceeding through a technical group of experts from committees that provide input to Teck on existing programs/permits such as the Elk valley Fish and Fish Habitat Committee (EVFFHC) and the Environmental Monitoring Committee (EMC) in developing the scope and terms of the evaluation and actions.

2. Recommendations were also made with the objective of testing, in 2020, the alternative hypothesis of a methodology failure. Replication of the monitoring program including more rigorous methods was recommended to confirm or refute 2019 results and to provide confidence in the results in 2020. Recommendations for the 2020 field season include:

    - The standardized monitoring program with specific control measures to minimize observer variation should be replicated in 2020 rather than wait for the next scheduled monitoring event in 2021. Alternate year sampling was a protective mitigation measure employed in study design to minimize potential handling sensitivities to the fish population; however, given the magnitude of the estimated population decline and the importance of the data to direct management actions, replication is essential to confirm both the population decline and the magnitude of the decline and/or recovery. This includes the three- pass removal-depletion electrofishing and the snorkel survey. Mitigation measures to protect remaining fish from possible electrofishing, handling and PIT tagging sensitivity include; (1) alternate year sampling or every three years for the subsequent 10 year monitoring plan (2021-2030) to be developed in consultation with Teck, management agencies and KNC as a way to mitigate potential effects, (2) only senior staffing with experience in threatened species and populations with specialized handling experience, and (3) elimination of PIT tagging as unwarranted or paused until population recovery if less handling preferred. One minor alteration was recommended; the electrofishing should be completed three weeks later (September 10 – 25) to ensure all fry have emerged and are available for capture. The 2020 report represents the 10 year wrap up of the original study design and will require consultation and input from the monitor, Teck and the EVFFHC or it's equivalent to develop the study design for the next 10 years of population trend monitoring (2021 – 2030).

    - An additional two snorkel surveys were recommended for increased rigour and confidence in the 2019 and 2020 results. These surveys would replicate all control measures to minimize observer variation where possible with the exception of altered timing. The three surveys would include; 1) July 22 – 30, 2020. The objective of this survey is to count Westslope Cutthroat Trout post-spawning when they are in their summer feeding habitats. During this time period fish are more widely distributed resulting in a less “clumped” distribution and there would be less likelihood of missing a large aggregation of fish. 2) September 2 – 10, 2020. The objective of this survey is to replicate the 2019 enumeration survey which represents the standardized methods employed in 2012, 2013, 2014, 2017, and 2019. 3) October 13 – 21, 2020. The objective of this survey is to capture the early over-wintering period during low flows when fish have, for the most part, moved into known over-wintering areas and form aggregations.

    - The replication of the intensive angling effort completed in 2012, 2013, and 2014 was recommended. The objective of this survey is to provide a second independent sub-adult and adult assessment method to confirm relative abundance. Replication of this method will utilize the same staff to maintain consistency in search patterns and effort to support CPUE comparisons among years to validate snorkel survey results. Methods include Passive Integrated Transponder (PIT) tagging to ensure fish captured are unique individuals. Specific fish handling specialists and protocols will be followed during this sampling to minimize impact to captured fish.

- The completion of spawning surveys to count redds and spawning adults was recommended. Repeating the effort and spatial extent of surveys completed in 2014 and 2015 would provide an index of spawning, adult abundance and distribution that would inform both impact hypotheses and population abundance. Provided conditions are conducive to success in terms of flows and water clarity (*i.e.,* visibility), five spawning surveys are recommended over the spawning season (May 15 – July 15).

Acknowledgements

This study is part of a co-operative initiative funded by Teck. While Westslope Fisheries Ltd. has been retained by Teck to undertake the Project, the contribution of study team members from Lotic Environmental Ltd. and Jon Bisset and Associates are gratefully acknowledged. Dr. Carl Schwarz is also gratefully acknowledged for providing statistical guidance.

The upper Fording River Westslope Cutthroat Trout Population Monitoring Project was implemented under the guidance and direction of the Elk Valley Fish and Fish Habitat Committee (EVFFHC). The EVFFHC consists of representatives from Teck, the Ktunaxa Nation Council (KNC), BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), and Department of Fisheries and Oceans Canada (DFO).

Special thanks are extended to Teck as the funding source and for their striving for a standard of excellence that permitted the results of the Project. Special thanks to Lindsay Watson (Teck Project Manager) for support, advice, and assistance. The many employees of Teck Fording River Operations and Greenhills Operations that facilitated the safe and effective completion of field studies are greatly appreciated.

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1 Introduction

Teck Coal Limited ("Teck") operates three surface coal mines within the upper Fording River watershed upstream of Josephine Falls; 1) Fording River Operations (FRO), 2) Greenhills Operations (GHO), and 3) Line Creek Operations (LCO). The current permitted boundaries for the three operations are illustrated in Figure 1.1. The primary product is high-quality, metallurgical coal. The combined annual production capacity of the three mines is approximately 17 million metric tonnes of clean coal (Mtcc).

Production at FRO began in 1971 and the operation (approximately 7,000 ha) lies along the Fording River valley with mining on both the east and west sides of the river. GHO was originally opened in 1981 and the current operational area (approximately 3,100 ha) lies mostly along the height of land between the Fording River and the Elk River to the west. LCO includes activities in the upper Dry Creek watershed, a tributary within the upper Fording River watershed.

In addition to mining, forest harvesting, recreational activities, road, trail, railway, natural gas pipeline, wells and drill pad developments and exploration related disturbances also occur in the upper Fording River watershed. During the Environmental Assessment (EA) review process for the extension of mining development proposals in the area (*i.e.,* FRO Swift, LCO Phase II), concerns were raised by communities of interest about the lack of information regarding the status of the Westslope Cutthroat Trout population in the upper Fording River watershed.

In 2010, the Province of British Columbia closed the upper Fording River to angling due to uncertainty around the population status. In 2012, Teck commissioned the Upper Fording River Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) Population Assessment and Telemetry Project, ("population assessment project") which was a 3.3 year study (August 2012 to November 2015, Cope *et al.* 2016). The population assessment project final report provided supporting data for decision making around land use planning and fisheries management in the upper Fording River watershed upstream of Josephine Falls.

The population assessment project concluded that the upper Fording River population metrics of adult abundance (2,552 to 3,874 fish greater than 200 mm), habitat availability (57.5 km of mainstem river plus 59 km of tributary) and genetic integrity (pure strain) represented a viable Westslope Cutthroat Trout population. However, there remained two key statistical uncertainties that required further population monitoring and four threats to population resilience identified that required mitigation or offsetting to insure long-term population sustainability.

Note that "population threats" are the term used in this monitoring report based on the Alberta Sustainability Index methodology (MacPherson et al. 2014). Population threats are stressors (*i.e.,* any biological, physical or chemical factor that causes adverse responses in the environment) that are present and can influence population dynamics and abundance. It's use in this population monitoring report is intended to identify potential population threats or stressors that are present rather than provide a quantitative assessment of causal factors or confirmed population limitations.

Statistical uncertainty following the population assessment project remained due to; 1) point estimates for sub-adult and adult abundance appeared to be increasing over time (2012, 2013, 2014) but the 95% confidence intervals were wide enough (*i.e.,* overlap among years) that the evidence of an increase in

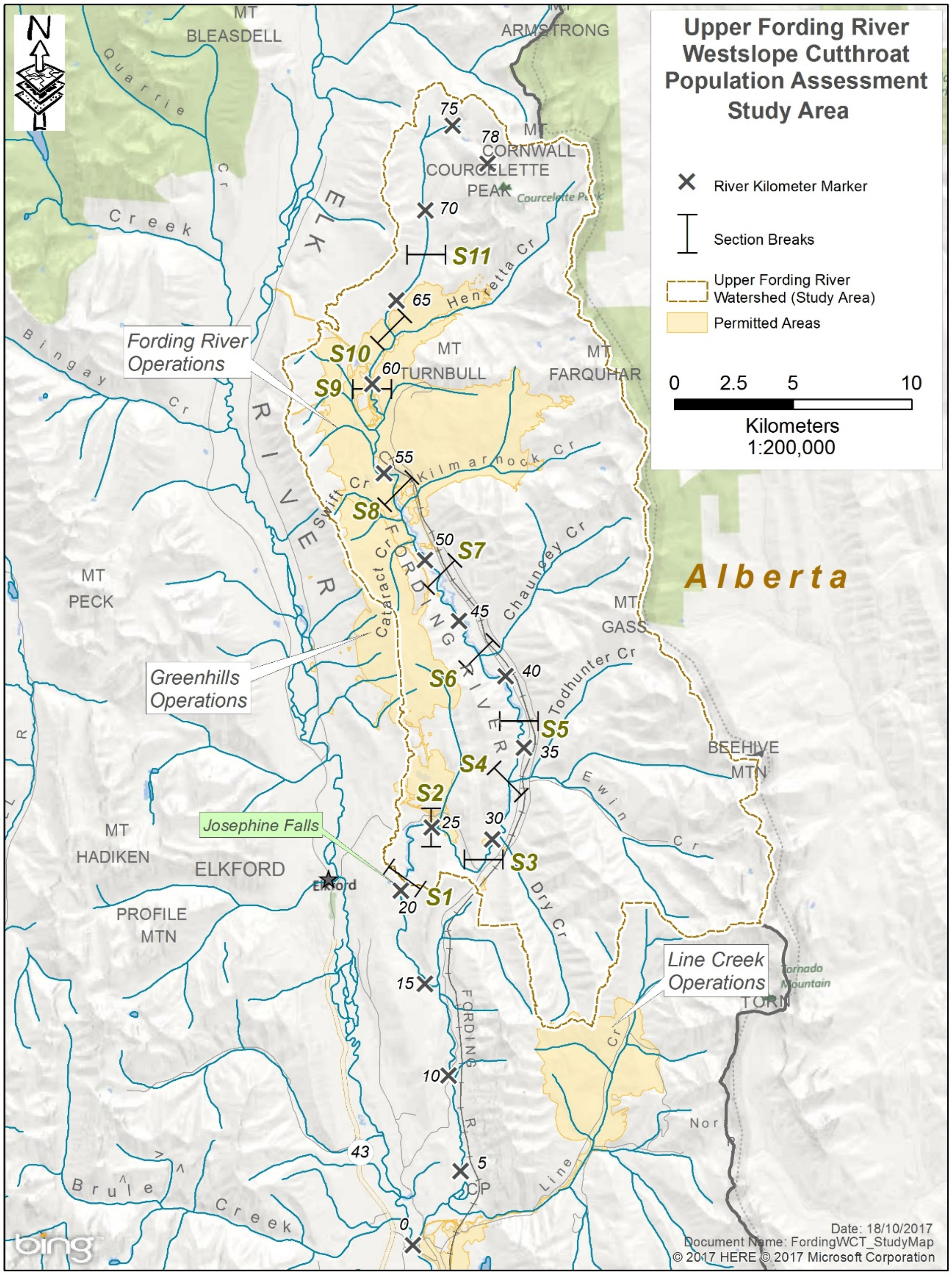


Figure 1.1. Upper Fording River study area illustrating population assessment river segments (S1 to S11) and mine property boundaries. Note that mine boundaries are for illustrative purposes and Teck should be contacted for the current or exact boundaries.

population size among the three years was weak, and 2) differences between the mortality rate estimates of radio tagged Westslope Cutthroat Trout (*i.e.,* 21% to 32% per year) and those used by the model authors to estimate the amount of stream required to maintain a population (*i.e.,*10%, Hilderbrand and Kershner 2000).

The following threats to population sustainability were identified; 1) water quality and quantity concerns, 2) loss of connectivity and resulting tributary habitat fragmentation due to valley infill and constructed fish passage barriers, 3) degraded stream channels, and 4) potential re-introduction of angling. The population assessment project concluded that the long-term sustainability of a healthy, self-sustaining population of Westslope Cutthroat Trout in the upper Fording River should be possible, if not probable, provided the implementation of suitable management strategies (*e.g.,* water quality treatment, water quantity protection, habitat protection, effective habitat offsetting, stream and riparian rehabilitation programs, and continued angling prohibition).

Population threats were identified as opportunities and ongoing initiatives by Teck have already targeted some of the identified threats for habitat offsetting projects focused on specific river segments and limiting factors. In 2016 through 2018, in collaboration with the Elk Valley Fish and Fish Habitat Committee (EVFFHC), habitat offsetting measures were constructed and additional offsetting measures are planned to be constructed over the next several years.

The upper Fording River Westslope Cutthroat Trout Population Monitoring Project ("population monitoring project") addresses the recommendation of the population assessment project for a long-term population monitoring strategy. The recommendation was made to track trends of Westslope Cutthroat Trout abundance in the upper Fording River to support the long-term objectives of population viability and sustainability are being met. The 2019 survey represents the second of three proposed population monitoring surveys scheduled for 2017, 2019 and 2021.

1.1 Background

Westslope Cutthroat Trout are a key fisheries resource in the Fording River watershed and is the only fish species known to occur in the upper Fording River upstream of Josephine Falls. The presence of Josephine Falls prevents upstream movement of fish protecting this population from hybridization with non-native Rainbow Trout (and competition with non-native species in general). As such, the upper Fording River can be considered an isolated upstream refuge where genetically pure Westslope Cutthroat Trout are present (Carscadden and Rogers 2011). Previous studies have identified the upper Fording River Westslope Cutthroat Trout population as one of a limited group to qualify as genetically pure (Rubidge and Taylor 2005, Rubidge *et al.* 2001), thus making them an important population in the context of Westslope Cutthroat Trout conservation.

The Fording River is a tributary to the Elk River located within the Regional District of East Kootenay, in southeastern British Columbia. The Fording River drainage basin is located on the west slope of the Rocky Mountains and encompasses an area of approximately 621 km^2 with a mean annual discharge of 7.93 m^3/s (Water Survey Canada, Stn 08NK018, 1970-2010). The river flows 78 km in a southerly direction from its headwaters immediately west of the British Columbia – Alberta boundary and the continental divide to its confluence with the Elk River near Elkford, B.C. Josephine Falls represents a natural fish barrier in a steep-walled canyon and is located at river kilometer (rkm) 20.51.

The Fording River is a tributary to the Elk River, which is one of seven major streams (Bull, Elk, Skookumchuck, St. Mary, Upper Kootenay, Wigwam and White Rivers) and their tributaries in the upper Kootenay River watershed that were designated as Class II Classified Waters in 2005 (Anon. 2006). The classified waters licensing system was created to preserve the unique fishing opportunities provided by these waters, which contribute substantially to the province's reputation as a world class fishing destination (Heidt 2007).

These seven streams within the upper Kootenay River watershed in the Rocky Mountains of southeast British Columbia are recognized as range-wide strongholds for Westslope Cutthroat Trout and currently support an intensive, high quality recreational fishery. It is generally recognized that this is due to the fact that these watersheds are some of the most pristine and diverse landscapes within the species range (Isaak *et al.* 2012, Muhlfeld *et.al.* 2009). Although there are many healthy populations of Westslope Cutthroat Trout in the East Kootenay, Westslope Cutthroat Trout are a blue-listed species (*i.e.,* species of concern; formerly vulnerable) in British Columbia (Conservation Data Centre (CDC) 2004) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the British Columbia population of Westslope Cutthroat Trout as Special Concern in November 2006 (COSEWIC 2006). Currently, the federal Species at Risk Act (SARA) lists the British Columbia population of Westslope Cutthroat Trout as Special Concern under Schedule 1 of SARA. If a project is subject to an assessment under the Canadian Environmental Assessment Act, measures must be taken to avoid or lessen any adverse effects of the project on the species. Additionally, fisheries protection and pollution prevention provisions of the Fisheries Act provide protection to this species. DFO in cooperation with the British Columbia Ministry of Environment and Climate Change Strategy (ENV) has developed a Management Plan for Westslope Cutthroat Trout (British Columbia population) adopted under Section 69 of SARA (DFO 2017).

1.2 Regulatory Context and Connection to Other Programs

The Environmental Assessment Certificate (EAC) for the Fording River Operations (FRO) Swift Project, a legally binding document for Teck, was issued in September 2015. The Swift Project will develop new operating areas adjacent to existing Fording River operations to provide a mine life extension of 25 years. Condition 12 of the EAC requires Teck to develop and implement a plan to address the final recommendations of the population assessment project. The population monitoring project addresses one of the recommendations.

The population monitoring project also provides supporting information to the following Teck monitoring programs;

1. The various monitoring projects implemented under Permit #107517 issued under the *Environmental Management Act.* These include the Regional Fish Habitat Management Plan, Tributary Management Plan, FRO Local Aquatic Effects Monitoring Program, Regional Aquatic Effects Monitoring Program, and Adaptive Management Plan,

2. The FRO Operating Parameters and Procedures Report and Operational Environmental Monitoring Plan for Consumptive Water Licences C133241, C133242, C133243, and,

3. The effectiveness monitoring programs for the LCO Phase II and Swift Project Fish and Fish Habitat Offsetting and Effectiveness Monitoring Plans.

1.3 Consultation

The 2017 and 2019 population monitoring projects were completed considering input from the EVFFHC. The EVFFHC consists of representatives of the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), the Ktunaxa Nation Council (KNC), Fisheries and Oceans Canada (DFO) and Teck.

An initial kick-off meeting was held with the EVFFHC on October 24, 2016 to review the population recommendations from the population assessment project (Cope *et al.* 2016) and gather input prior to developing the population monitoring project. The population monitoring project was developed based on the study objectives and goals, recommended methodologies and options identified in this meeting. Maintaining consistency in population monitoring provides many benefits including identification of a population trend with sufficient power. Population monitoring data can be used to detect trends (*i.e.,* stable, increasing, decreasing) and as the data set grows, the ability to detect trends improves. This was considered important by the EVFFHC given the relatively low population densities and broad confidence limits currently estimated for this population (Cope *et al.* 2016).

Subsequent meetings were held with the EVFFHC in June 2017 to align the population monitoring project with the data requirements for the habitat offsetting effectiveness monitoring.

Consultation with the EVFFHC has and will continue throughout the implementation of the population monitoring project. Continued consultation includes annual input on the methods, results and recommendations. A draft report will be provided to the EVFFHC by December 15 for review with input requested by January 15 and the final report will be completed by February 15 the year after data collection.

1.4 Scope

The 2019 population monitoring project addresses the recommendation of the population assessment project final report for a long-term population monitoring strategy. The 2019 monitoring project is the second year of a proposed monitoring plan to continue snorkel counts and extend the current sub-adult and adult population trend monitoring data (2012, 2013, 2014) to a 6-year data set (2012, 2013, 2014, 2017, 2019, 2021) over a 10-year period. Similarly, continuation of the fry and juvenile density monitoring program will extend the current trend monitoring data (2013, 2014, 2015) to a 6-year data set (2013, 2014, 2015, 2017, 2019, 2021) over a 9-year period. This was expected to reduce uncertainty regarding the population trend and the long-term viability and sustainability of the upper Fording River Westslope Cutthroat Trout population above Josephine Falls.

The 2019 population monitoring project also collects detailed fish distribution, habitat utilization and trend monitoring data for habitat offsetting effectiveness evaluation. In 2016, fish habitat offsetting works began on river sections of the Fording River within the FRO mine boundaries (*i.e.* within FRO River Segments S7, S8, S9 and Henretta Creek). Additional offsetting works are scheduled within these river segments in upcoming years. In 2017 and 2019, these river segments and Henretta Creek were further sub-divided into a total of 23 treatment and control sub-sections and these data are forwarded to the habitat offsetting monitor (*see* Appendix A).

2 Methods

This section describes the study area, sample locations and the study methods used for the population monitoring project. Population monitoring data can be used to detect trends (*i.e.,* decreasing, stable, increasing) and monitor population sustainability (*i.e.,* does not decrease over time). However; assessing a population's sustainability represents a present-day snapshot in time of the current status of a population and should be reassessed if the severity of population threats changes, as new threats appear, or as management actions change.

Telemetric methods used to support the population monitoring project were supported by 24 years of implementation and interpretation by the principle biologists and field crew within British Columbia watersheds on threatened or endangered populations for a variety of species such as Westslope Cutthroat Trout (Cope *et al.* 2016, Cope and Prince 2012, Morris and Prince 2004, Prince and Morris 2003), Mountain Whitefish (*Prosopium williamsoni*) (Cope and Prince 2012), Bull Trout (*Salvelinus confluentus*) (Prince 2010), Rainbow Trout (*Oncorhynchus mykiss*) (Prince *et al.* 2000), Pacific salmon (Sockeye (*Oncorhynchus nerka*), Hinch *et al.* 1996; Coho (*Oncorhynchus kisutch*), Healey and Prince 1998), White Sturgeon (*Acipenser transmontanus*) (Prince 2004, R.L.&L. Environmental Services Ltd. 1996) and Burbot (*Lota lota*) (Kang *et al.* 2015, Cope 2011).

Similarly, juvenile removal-depletion electrofishing methods for a variety of species including Westslope Cutthroat Trout were supported by over 15 years of implementation and interpretation by the principle biologists (Cope *et al.* 2016, Cope 2008, 2007, 2001, Cope and Morris 2006, Bisset and Cope 2002).

2.1 Study Period

The population monitoring program has been designed to encompass a 10-year monitoring period. The 2019 population monitoring project was the second year of a proposed monitoring program to continue snorkel counts and extend the current sub-adult and adult population trend monitoring data (2012, 2013, 2014) to a 6-year data set (2012, 2013, 2014, 2017, 2019, 2021) over a 10-year period. Similarly, continuation of the fry and juvenile density monitoring program will extend the current trend monitoring data (2013, 2014, 2015) to a 6-year data set (2013, 2014, 2015, 2017, 2019, 2021) over a 9-year period.

In 2017 and 2019, field studies were conducted between August 20 and September 30 to be consistent with the sampling period in previous years.

A review of the population monitoring program after the 10-year monitoring period was recommended to insure monitoring was achieving the desired objectives. At that time, based on the current state of knowledge, the population monitoring program could be ended, renewed, modified, or re-designed.

2.2 Study Area

The spatial boundary of the monitoring program was defined as the upper Fording River watershed (including tributaries) above Josephine Falls (Figure 1.1). The upper Fording River mainstem was sub-divided into 11 population assessment river segments of similar character to facilitate sub-adult and adult population monitoring and distribution assessment using snorkel methods (Figure 1.1; Table 2.1). Henretta Creek was also subdivided into three river segments. River "segments" represent "strata"

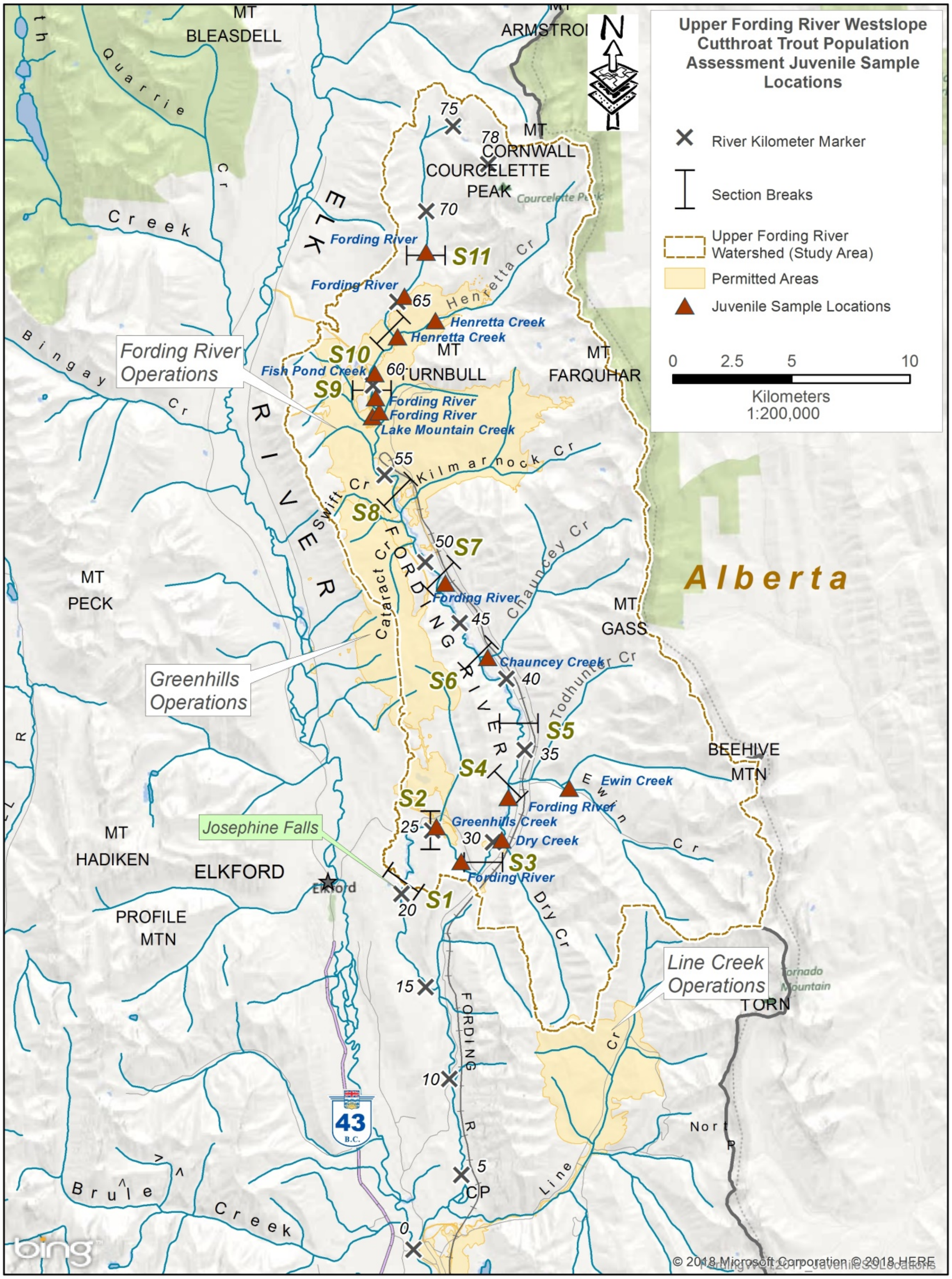


Figure 2.1. Upper Fording River recruitment and juvenile sample locations.

Table 2.1. Upper Fording River segments (*i.e.,* strata) used for population monitoring and distribution assessments (2012, 2013, 2014, 2017 and 2019). River kilometers (rkm) are upstream from the confluence with the Elk River. The study area extends from 20.51 rkm at Josephine Falls to approximately 78.00 rkm (headwaters greater than 20% gradient). Fording River Operations extend from approximately 51 to 65 rkm.

River Segment	River Km	Length (km)	Location
1	20.51–25.00	4.49	Josephine Falls to GHO
2	25.00-29.00	4.00	GHO to above Fording Bridge
3	29.00-33.16	4.16	Above Fording Br. To Ewin Creek
4	33.16-37.59	4.40	Ewin Cr. To S-bends
5	37.56-41.96	4.40	S-bends to Chauncey Creek
6	41.96-48.96	7.00	Chauncey Cr. to F2 side road
7	48.96-54.00	5.04	F2 side road to Diversion Reach
8	54.00-59.75	5.75	Diversion reach to Turnbull Br.
9	59.75-63.40	3.65	Turnbull Br. to above Henretta
10	63.40-67.75	4.35	Above Henretta
11	67.75-78.00	10.25	Headwaters
H1	00.00-1.00	1.00	Henretta Creek Below Henretta Lake
H2	1.00-1.50	0.50	Henretta Pit Lake
H3	1.50-4.00	2.50	Henretta Creek above Henretta Lake
		61.49	N = 14

replicated from the randomly stratified approach used for population assessment (Cope *et al.* 2016). River segments were delineated principally based on the requirement to include enough stream length (lineal river km) to facilitate the recaptures necessary to generate population estimates while restricting the total segment length to a distance that could be snorkeled and traversed on foot within a day. As such, each river segment was not a river "reach" of similar geomorphological characteristics since some segments contain several reaches.

The elevation of the study area ranges from 1,400 m at Josephine Falls to 2,740 m at the headwaters (78.0 rkm). For context, the FRO processing plant and dryer were located at 57.0 rkm and 1,650 m elevation. As Josephine Falls represents a natural barrier, the Westslope Cutthroat Trout population of concern was considered a fluvial, headwater population restricted to the approximately 57.5 km portion of the upper Fording River (plus tributaries) between Josephine Falls at 20.5 rkm and the upstream limit of fish distribution in the headwaters somewhere between 73.0 and 78.0 rkm.

Recruitment is typically the strongest determinant influencing populations (Maceina and Pereira 2007). Recruitment (fry) and juvenile (fish less than 200 mm) population monitoring of the upper Fording River Westslope Cutthroat Trout was examined through density estimates generated using three-pass removal-depletion electrofishing methods. The current monitoring replicates the 2015 representative locations of the previous population assessment sampling (Cope *et al.* 2016). The location of the sampling sites was summarized below in Table 2.2 and illustrated in Figure 2.1.

Table 2.2. Summary of upper Fording River recruitment and juvenile sample locations 2013, 2014, 2015, 2017 and 2019.

Location	Strata	River Segment	River Km	Sample Years
Fording River	Mainstem Headwaters	11	68.0	2013, 2014, 2015, 2017, 2019
Fording River	Mainstem Headwaters	10	65.6	2013, 2014, 2015, 2017, 2019
Fording River	Mid-Mainstem (FRO Onsite)	8b	59.3	2015, 2017, 2019
Fording River	Mid-Mainstem (FRO Onsite)	8a	58.1	2013, 2014, 2015, 2017, 2019
Fording River	Mid-Mainstem (FRO Onsite)	7	52.4	2013, 2014
Fording River	Lower Mainstem	6	48.5	2015, 2017, 2019
Fording River	Lower Mainstem	5	34.4	2013, 2014
Fording River	Lower Mainstem	3	32.5	2015, 2017, 2019
Fording River	Lower Mainstem	2	27.2	2013, 2014, 2015, 2017, 2019
Henretta Creek	Lower Tributary	1	0.2	2013, 2014, 2015, 2017, 2019
Henretta Creek	Upper Tributary	3	2.4	2013, 2014, 2015, 2017, 2019
Fish Pond Creek	Lower Tributary	1	0.4	2013, 2014, 2015, 2017, 2019
Fish Pond Cr. Trib.	Lower Tributary	1	0.3	2019
Lake Mountain Cr.	Lower Tributary	1	0.1	2015, 2017
Chauncey Creek	Lower Tributary	1	0.4	2013, 2014, 2015, 2017, 2019
Chauncey Creek	Upper Tributary	2	1.3	2013, 2014, 2019
Ewin Creek	Lower Tributary	1	0.7	2013, 2014
Ewin Creek	Upper Tributary	2	3.3	2013, 2014, 2015, 2017, 2019
Dry Creek	Lower Tributary	1	0.2	2013, 2014, 2015, 2017, 2019
Greenhills Creek	Lower Tributary	1	0.3	2015, 2017, 2019
Fording River	Mid-Mainstem (UFR 49-2)	8	59.8	2019 Off-setting Monitoring
Fording River	Mid-Mainstem (UFR 47-2)	8	57.1	2019 Off-setting Monitoring
Fording River	Mid-Mainstem (UFR 47-1)	8	56.6	2019 Off-setting Monitoring

2.3 Population Monitoring

The methodology for the population monitoring project employs two independent estimation methods:

- Snorkel count of all Westslope Cutthroat Trout within at least 80% of the available habitat within the upper Fording River mainstem and the lowermost 4.0 km of Henretta Creek. The sub-adult and adult count data (fish greater than 200 mm) was then input into a Pooled Peterson model that addressed the observer efficiency issue (not estimated in 2017 or 2019) by using the range of observer efficiencies estimated through a mark-recapture calculation in previous years (2012, 2013, 2014), and

- Three-pass removal-depletion electrofishing methods to estimate densities within three meso-habitat sites within 16 representative locations (represents a total of 48 meso-habitat unit enclosures). This includes Passive Integrated Transponder (PIT) tagging and scanning of all electrofishing captures for supplemental data on survival, longevity, growth and movement. Depending on how the fish mix with each other across years, the multiple years of data can also be modeled and analysed to generate population estimates for the entire stream from recapture of PIT tagged fish and from the unmarked fish captured during each electrofishing event (year).

Two independent trend-monitoring approaches increase confidence in the interpretation of population trends. This is an important consideration given the selection of relative indices (*i.e.,* snorkel count CPUE data) as the population estimator and their weakness in regards to being a misleading indicator of abundance when not applied properly or meeting underlying assumptions (Hubert and Fabrizio 2007). As such, it was imperative to standardize sample methods and environmental conditions (*i.e.,* timing, flow, visibility conditions, spatial extent and consistency in qualified trained observers) as much as possible amongst all years of data collection. These standardization measures are outlined in the respective sample methods sections below.

As the data set grows (for example, estimates in Years 1, 2, 3, 6, 8 and 10), the ability to detect trends (*i.e.,* stable, increasing, decreasing) improves. Therefore, long term population monitoring using such a study design is possible. Data quality objectives for sub-adult and adult population monitoring were to detect +/-25% change in abundance per year. After completion of the 10 year data set it was hoped this would improve to +/- 10%.

2.3.1 Snorkel Count (Enumeration) Methods

As a general rule, a relative abundance estimator (*i.e.,* snorkel count or CPUE) can be used to track trends in actual population abundance provided underlying assumptions are not seriously violated and sources of variation are minimized to the extent possible (Hubert and Fabrizio 2007). CPUE indexing methods such as snorkel counts are extremely sensitive to methodology deviations that affect catchability (*i.e.,* observer efficiency). Therefore, it was imperative to standardize sampling design (*i.e.,* timing, visibility conditions, spatial extent and consistency in qualified trained observers) as much as possible between sample years to manage consistency in observer efficiency. Consequently, the following practices were standardized to keep snorkel count catchability reasonably constant across years (*i.e.,* +/-25%) and that counts were representative of trends in actual abundance;

1. Spatial extent remain consistent among years (*i.e.,* greater than 48 km or 80% of available mainstem upper Fording River and Henretta Creek Habitat). As replicated from previous years, a crew of four to six experienced snorkel observers enumerated river Segments S1 through S10, Henretta Pit Lake and Henretta Creek above and below Henretta Pit Lake over an eight day period. The counts were summed by river Segment and their number and distribution compared from year to year. This maintains consistency in effort among years and confirms potential changes in the spatial distribution of the population does not go unnoticed or bias results,

2. To manage consistency, the same trained and qualified observers (snorkelers) were used in all years. Although some staff turnover was expected, at least 50% of the snorkel observers (*i.e.,* one individual in each snorkel pair of observers) have participated in all snorkel counts (2012, 2013, 2014, 2017), and

3. Timing (*i.e.,* Aug 25 – September 15) must be consistent and flow and visibility based (*i.e.,* no precipitation in preceding days and no instream works activities). If in the opinion of project

biologists, flow and/or visibility conditions during the timing window are outside the range of previous years, the snorkel survey will be deferred to the next year.

In 2017 and 2019, snorkel counts of Westslope Cutthroat Trout within the 12 river or tributary population index strata or "Segments" established for the population assessment project were replicated (Table 2.1, Figure 1.1). The 12 population segments include 11 mainstem upper Fording River segments plus one tributary segment (Henretta Pit Lake including lower Henretta Creek to the confluence with the upper Fording River). In 2016, fish habitat offsetting works were begun within FRO (River Segments S7, S8, S9 and Henretta Creek). Additional offsetting works are scheduled within these river segments in upcoming years. In 2017 and 2019, these river segments, Henretta Creek (including upper Henretta Creek above the lake) and Fish Pond Creek (and unnamed tributary) were further sub-divided into a total of 23 treatment and control sub-sections to facilitate more detailed fish distribution, habitat utilization and trend monitoring data for offsetting effectiveness evaluation. These data are summarized in Appendix A and were forwarded to the habitat offsetting monitor completing the effectiveness monitoring (Robinson 2020).

The following areas are not snorkelled;

- The uppermost headwater river segment (S11) representing 11 km of headwater stream channel habitat,. This was not snorkeled due to the low water volume, small stream size and high gradients,
- The lowermost 370 m of river Segment S1 above Josephine Falls was not snorkeled due to obvious safety concerns, and
- The remaining potential fish bearing tributaries (*i.e.,* Chauncey, Ewin, Dry Creeks) were not snorkelled due to the low water volume and small stream size. These tributaries are sampled as juvenile rearing tributaries using three-pass removal- depletion electrofishing.

Snorkel surveys were conducted using a team of four observers with the exception of Henretta Pit Lake where four or five observers were employed. Where possible, a snorkeler's lane extends 3-5 metres towards shore, with the offshore observer looking both ways towards the near shore observer. Where the stream width was less than 15 m the snorkel team formed two person teams to cover the distance in a more efficient manner. Frequent stops occur to discuss whether duplication has occurred. Whenever necessary, a habitat unit was re-surveyed if there was uncertainty or obvious discrepancies. Observed Westslope Cutthroat Trout were identified to 100 mm size class (e.g., 0 – 100 mm, 100 – 200 mm, etc.).

If, in the opinion of the senior project biologist in the field, water clarity and/or flows (*e.g.,* due to a significant precipitation event) were not consistent with the previous years for which observer efficiency calibrations were completed (*i.e.,* 2012, 2013, 2014), then the snorkel survey would be cancelled and deferred to the subsequent year. In an effort to support the biologists opinion and document consistency of conditions, horizontal Secchi distance, a measurement of water clarity and an index of visibility, was taken each day. Upper Fording River flows (mean daily discharge, Water Survey Canada Station 08NK018 at the mouth) for the survey period are also summarized for comparison. Spot water temperatures are also taken. Any variations in sample effort (river kilometers surveyed) are documented.

Given suitable watershed conditions, snorkel counts have proven to be a reliable and efficient means of obtaining indices of relative abundance for salmonid populations in British Columbia streams (Korman *et* *al.* 2002, Slaney and Martin 1987, Northcote and Wilkie 1963) and for Cutthroat Trout throughout their range including the East Kootenay (Cope *et al.* 2016, Cope and Prince 2012, Baxter 2006a, 2006b, 2005, 2004, Baxter and Hagen 2003, Oliver 1990, Zubick and Fraley 1988, Slaney and Martin 1987, Schill and Griffith 1984). However, snorkel counts are typically underestimates of true abundance because individuals are routinely missed due to the impacts of visibility, fish behaviour, and stream channel complexity.

In previous years (2012, 2013, 2014), to address the observer efficiency issue, fish were marked (Floy tags and radio tags) within the section of stream for which the estimate was conducted and the population estimate was generated with associated variability through a mark-recapture calculation (Schwartz *et al.* 2013). Previous population estimates applied a “blended” approach to uncertainty and were based on the pooled set of radio tags and Floy tags combined to generate a single mark-recapture population estimate for each year.

In 2017 and 2019, only the count data (*i.e.,* observed fish within each stream segment) was collected. There was no mark-recapture program and hence no estimate of observer efficiency in either year. Instead, an estimate of abundance relied on the previous years (2012, 2013, 2014) calculation of observer efficiency. Using the previous year’s observer efficiencies (Cope *et al.* 2016), a Pooled Peterson model was used to expand the count data into an estimate of abundance. These model estimates for 2017 and 2019 assumes consistency in observability was met (*i.e.,* spatial extent and effort, same seasonal timing, flow, visibility, consistency in snorkel observers and observer search patterns) and that observer efficiency was within the values estimated in the years 2012 (42%), 2013 (25%), and 2014 (32%). This was a reasonable assumption given the measures outlined above that were employed to standardize snorkel methods. The rationale for the change in methods was previously outlined (Cope *et al.* 2016).

The three observer efficiencies for 2012, 2013 and 2014 were applied to the catch data and the median, minimum and maximum values were plotted as a relative index of abundance for comparison with previous population estimates and their 95% confidence interval from 2012 to 2014. Finally, a biological opinion or ranking of previous years observability conditions (flow, visibility) compared to the current year was provided for context on the most likely estimate or range of estimates among the three outcomes of the model.

2.3.2 Removal Depletion Electrofishing Methods

In order to generate fry and juvenile density estimates and to PIT tag juveniles, fry and juvenile Westslope Cutthroat Trout (fish less than 200 mm) were captured using three-pass removal-depletion electrofishing late August through early October 2013, 2014, 2015 and 2017 when water temperatures were greater than 5.0 ^{o}C. Depletion sampling in combination with multiple-pass electrofishing is an important fisheries management tool for wadeable streams and this combination of techniques has been used routinely for several decades as a reliable means to obtain quantitative data on trout populations (Hilborn and Walters 1992, Van De-venter and Platts 1983).

Locations were selected to represent the available river strata or segments (*i.e.,* reach based methods) to facilitate population estimation, although access considerations (light truck and/or ATV) also factored into the selection process. Five primary strata were delineated; the lower, mid (FRO onsite) and upper (headwater) mainstem river segments and both lower and upper tributary. In total, nineteen representative juvenile locations were sampled in 2013, 2014 and 2015. Fourteen locations were sampled in 2013 and 2014; fifteen locations were sampled in 2015 and 2017 and sixteen locations were sampled in 2019 (plus 3 habitat off-setting locations reported elsewhere (Robinson 2020)). In 2013 and 2014 the same 14 locations were replicated; in 2015, 10 locations were replicated and 5 new locations were sampled (Table 2.2). Location changes in 2015 were designed to test fry and juvenile densities within areas of observed high density spawning. The 2015 locations were replicated in 2017. The 2017 locations were replicated in 2019 with two exceptions. Lake Mountain Creek was lost to development in 2017 and in 2019 was replaced by the constructed juvenile rearing habitat of the Fish Pond Creek tributary (*i.e.,* off-setting habitat). In planning for culvert removal and restoration of connectivity within Chauncey Creek, the upper Chauncey Creek location above the culvert was resampled in 2019. Figure 2.1 and Table 2.2 illustrate and summarize the monitoring locations and their distribution within the study area.

Each location was sub-divided into three meso-habitat sites of approximately 100 m^2 each. The one exception was Lake Mountain Creek, which only had one meso-habitat site at that location (Cope *et al.* 2016). Using shore-based or backpack electrofishing, depending on site characteristics, the three meso-habitat units in each sample location were sampled using three-pass removal depletion methods for a total meso-habitat effort of at least 43 sites and 4,200 m^2 habitat. These sampling methods were adapted from Ptolemy *et al.* (2006) and replicated from the 2013 to 2015 assessments (Cope *et al.* 2016); with specific measures designed to insure consistency.

Westslope Cutthroat Trout fry and juveniles were captured using a 3-person crew, a DC backpack electrofishing unit (Smith Root LR24), and three-pass removal depletion methods that requires three successive passes of declining catch for population estimation methods. As described in Ptolemy *et al.* (2006), wadeable meso-habitat units (*i.e.,* <1.5 m deep) within the selected locations were sampled using three sided shore sites. Where possible full span upstream and downstream stop nets were used (*i.e.,* wetted widths < 8.0 m). Upstream and downstream stop nets were placed perpendicular to the shore and the off-shore side of the site (if required) followed depth and velocity contours to enclose the area between the upstream and downstream stop nets. Sites offering natural physical barriers such as mid-channel bars or braids were preferred since upstream-downstream barriers are easier to install thus requiring less site disturbance prior to sampling. Fry are typically bounded by high velocities close to shore; barrier nets extend well beyond their distribution with the bottom net angled with mid-channel position about 4 m upstream of the shore reference point. This was done to maximize capture of drifting animals by shunting and collection of fry and juveniles near shore. Nets were configured into stable position with guy ropes, bipod stays, and anchors to a distance of up to 8.0 m from shore. The lead line was knitted to the bottom contours with boulders placed as weights along the lead line. Stop nets were 4 mm stretch mesh (square).

At each site, electrofishing was initiated at the downstream net, and consists of a thorough surprise/ambush search in an upstream direction, followed by a systematic sweep back towards the downstream net. Each “catch” (c1, c2, c3) effort involves multiple passes and the same search pattern was replicated in “catch 2”. Electrofishing seconds (*i.e.,* time) was monitored and recorded. Each successive depletion or “catch” should utilize similar effort. At three-sided shore sites, electrofishing always proceeds from the fast water forming the offshore boundary towards the shore, to avoid chasing larger juveniles into the outside net where they may find a hole and escape from the site. Both the upstream and downstream nets were monitored for any fish that drifted into the nets that were not captured by the netters.

All fish captured during electrofishing were anaesthetized, weighed (g), measured (fork length mm), examined externally for any signs of deformity (including the most common deformity, shortened opercula whose frequency of occurrence is tracked) or injury, and all juveniles (fish greater than 60 mm) not previously PIT tagged were implanted with a Passive Integrated Transponder (PIT) tag (Biomark HPT8 134.2 PIT Tag, Biomark, Boise, Idaho). Previously PIT tagged fish had their number recorded. Captured fish were allowed to recover their oxygen deficit (created during capture) in 20 litre capture buckets prior to being anaesthetized and processed. Fish were anaesthetized in a 40 L bath of river water containing 2.0 ml clove oil yielding bath concentrations of 50 ppm. Clove oil is a safe, inexpensive, and effective anaesthetic suitable for invasive procedures in the field (Prince and Powell 2000, Peake 1998, Anderson *et al.* 1997). The lowest effective dose of clove oil is recommended as time to recovery of equilibrium and fear response in salmonids has been shown to increase exponentially with exposure time (Keene *et al.* 1998). Because of its low solubility in water, the clove oil was first dissolved in 10-ml of ethanol (95%) before being added to the river water. The five stages of anaesthesia referred to in this investigation are: level one, partial loss of equilibrium with normal swimming motion; level two, total loss of equilibrium with normal swimming motion; level three, partial loss of swimming motion; level four, total loss of swimming motion and weak opercula motion; level five, no opercula motion (Yoshikawa *et al.* 1988). For PIT tagging procedures level three anaesthesia was all that was required for immobility. To prevent immigration during multiple-pass depletion all fish from successive depletions were allowed to recover within fish sleeves, totes or 20 litre buckets placed downstream. Upon completion of sampling, fish were released back into their respective meso-habitat units.

Capture, effort (area and electrofishing time for each pass), life history data (length, weight, life stage) and individual tag identification are input using the FLNRORD Microsoft Excel tool, “Fish Data Submission (FDS) Spreadsheet Template V2.0”. Physical site attributes were recorded each year during site layout. Repeat habitat inventories at each site include meso-habitat classification (riffle, cascade, glide, run, pool or side-channel), descriptions of depth-velocity profile at 0.25-0.5 m intervals perpendicular to flow with shorter intervals over high velocity gradients (*i.e.,* a representative discharge transect), riparian vegetation, bed material composition, dominant particle size, Dmax, D_{90}, large woody debris content, substrate embeddedness, site length, site wetted width, estimated available cover, and maximum depth. Photographs and UTM coordinates are taken of each site for future reference. These data are captured through the use of three standard data forms plus notes and a site sketch that the surveyor produces. The data forms are; 1) the Fish Data Submission (FDS) Spreadsheet Template V2.0, 2), Level 1 Habitat Survey Data Form, and 3) Hydrometric Survey Data Notes.

The catch data for the three passes (*i.e.,* c1, c2, c3) are input using the “Microfish” software package to calculate population estimates (Van Deventer and Platts 1990). Population estimates and the 95% confidence interval were reported as a standard numerical density (number fish/100 m^2) and biomass (g/100 m^2) by life stage (*i.e.,* fry, juveniles) for each meso-habitat site. Data were then compared to the previous data within the upper Fording River (2013, 2014, 2015, 2017). Recaptures were added to the existing database used to validate growth rates, survival and age classes as data becomes available from recaptures. Recapture data was also examined for movement patterns.

Subsequently, the data were pooled in various ways to explore potential temporal and spatial trends in fry and juvenile densities within the upper Fording River watershed. First, age data was pooled from at least five age classes (0+, 1+, 2+, 3+, 4+) to two life stages (fry and juvenile). Pooling of age classes into two life stages was necessary due to the low densities reported and was consistent with previous sample events (Cope *et al.* 2016) and comparative studies elsewhere (Robinson 2014). The data was then combined (pooled) for each location. The three meso-habitats within each location were combined to provide a composite location density estimate and biomass estimate for fry and juveniles and both life stages combined for the 16 locations within the upper Fording River watershed. The location data was also pooled by watershed area or strata (*i.e.,* lower, mid-, upper mainstem and lower, upper tributary) and finally the location data was pooled by year. Location based data can often be useful in evaluating specific habitat offsetting measures at a later date; despite its lower precision compared to the pooled watershed strata or annual estimate.

2.3.2.1 PIT Tagging

All captures were scanned for PIT tags during electrofishing. Recapture data are examined for movement patterns, growth rates, age classes, survival, and longevity.

A key assumption to PIT tagging is that fish implanted with electronic tags have similar fates and behavior relative to untagged conspecifics. However, fish that survive electrofishing injuries (hemorrhagic trauma, spinal compressions, misalignments and fractures) are more likely to suffer short and long term adverse effects to their behavior, health, growth, or reproduction. In addition to injury, electrofishing can result in a variety of stress related effects that result in physiological and behavioral changes. Panek and Densmore (2011) can be consulted for one of many reviews on the subject. Because of these known impacts to fish, electrofishing (especially multiple pass methods) is the capture method of last resort in the implantation of electronic transmitting devices in fish for behavioral studies. Since it is well known that the capture method (electrofishing), PIT tagging methods, PIT tag placement and the experience of the technician or biologist applying PIT tags influence both tag retention and fish survival (Mamer and Meyer 2016, Cook *et al.* 2014, Panek and Densmore 2011), it is critical to implement best practices. There are trade-offs and rationale to be considered for PIT tagging methods and these are outlined below.

In addition to the above study design concerns influencing tag retention and fish survival, there is an increasing need and desire for scientists to treat organisms with a higher standard of care and respect, rather than just as specimens; this is especially important for listed species (*i.e.,* threatened, endangered or species of special concern) in intensively sampled landscapes. This is something that the EVFFHC takes very seriously; it is also in response to the abundant feedback from Ktunaxa Nation citizens and other citizens.

The experience of the technician or biologist applying PIT tags has been demonstrated to influence tag retention and fish survival; especially when performing a laparotomy to insert tags intraperitoneally (*i.e.,* in the body cavity) in fish as small as 60 mm in length. This will influence the validity of the study results when inferring movement patterns and survival (Mamer and Meyer 2016, Lopes *et al.* 2016, Brown *et al.* 2010, 2011). This will result in trade-offs to be considered in the minimum fish size and the placement of the PIT tag. In smaller fish (typically less than 250 mm, a laparotomy was performed (a needle used) to open the coelomic cavity and place the PIT tag intraperitoneally. In larger fish (*i.e.,* greater than 250 mm), these potential effects were eliminated by injecting PIT tags into the muscle tissue; but still require a detailed knowledge of their application (Cook *et al.* 2014). Muscle tissue placement has the benefit of having higher tag retention rates, especially for mature females. PIT tags applied in the musculature ventral to the dorsal fin report the highest retention rates (94.1% per year) compared to intraperitoneal (59.4% for females and 89.7% for males, Mamer and Meyer 2016). The difference between the sexes is due to females shedding the intraperitoneal tags during spawning. However, PIT tags in musculature have a higher retention (65%) in fillets than body cavity (4%). In some jurisdictions, human consumption concerns may prohibit the use of musculature implantation where angler harvest is possible. Angling is prohibited within the upper Fording River at this time.

To address the above concerns the following considerations were employed:

- An experienced removal depletion electrofishing crew was employed. Principle biologists and senior technicians had a minimum of 10 years' experience and crew leaders have participated in all sample years (2013, 2014, 2015, 2017). Junior team members were employed under the direct supervision of experienced team members.

- Only biologists or technicians with multiple years of experience in specialized handling procedures designed to minimize stress, including anesthesia procedures, sterile techniques and the application of PIT tags were employed for PIT tagging. The Westslope Fisheries Ltd. study team has captured, Floy, PIT and radio tagged over 3,347 Westslope Cutthroat Trout over a 12 year period between 2000 and 2019.

- Single use pre-loaded Biomark HPT8 PIT tags were used to minimize possible infection and handling stress. HPT8 PIT tags were used as they are the smallest tag available and minimize the needle size (coelomic cavity opening) and tag weight; considered important given the application (fish as small as 60 mm) and the 2% rule of biotelemetry (*i.e.,* the weight of the tag not to exceed 2% the weight of the fish in air; Winter 1983). All tools, equipment and surfaces that may come in contact with fish were cleaned with isopropyl alcohol before use. All crew members equipment was disinfected (*i.e.,* 100 mg/l chlorine bleach) before sampling to minimize the risk of disease transmission.

- PIT tags were inserted in the musculature for fish greater than 250 mm (ventral to the dorsal fin) and intraperitoneal for fish less than 250 mm.

- All fish were anesthetized and examined for deformities and injuries. Any deformed or injured fish were documented, concerns identified and released untagged. Captured fish were allowed to recover their oxygen deficit (created during capture) in an instream holding tank prior to being anaesthetized and processed. Processed fish were subsequently allowed to recover for at least 30 minutes in an instream holding tank before being released back into the capture meso-habitat.

3 Results

The results of the sub-adult and adult snorkel count and the juvenile removal-depletion electrofishing are provided in this section. The 2019 results were also used to update the adult population trend monitoring dataset (2012, 2013, 2014, 2017, and 2019) and the juvenile population trend monitoring dataset (2013, 2014, 2015, 2017, and 2019).

3.1 Sub-Adult and Adult Snorkel Survey

The following outlines the rationale for the assertion that the 2019 survey was successful in minimizing the sources of variation and the assumption of equal catchability was met. Table 3.1 summarizes the variables monitored for consistency in potential sources of variation. The snorkel survey timing and effort (spatial extent) were consistent across all years. Similarly, 75% of snorkel observers in 2019 have participated in previous surveys to sustain consistent search patterns and observer efficiency. The 2019 flows were within the range of the previous surveys and within the range for the years in which observer efficiencies were calibrated using Floy tags and radio tags (2012-2014). The 2019 flows were very similar to the 2012 and 2013 flows. In the opinion of project biologists who participated in all five snorkel surveys, visibility was within the range of previous years and was most similar to 2013 which had the lowest observer efficiency. This results in rating the 2017 visibility as moderate to poor and observer efficiency was most consistent with the lower observer efficiencies of 2013 (25%). The reason for the lower visibility was not precipitation or water turbidity in the water column but rather the high fine sediment load that coated the substrate, boulders, LWD, and stream banks. Any turbulence created by snorkel observers re-suspended the fine silt and moderate to excellent visibility quickly became moderate to poor. Poor visibility was 3 m or less; moderate visibility 3 m to 6 m, and excellent visibility was greater than 6 m. In 2013, a similar fine silt effect was noted due to the extreme flood event (*i.e.,* 1 in 100 year event) that preceded the snorkel survey. So turbidity conditions are highly variable and determined by site disturbance caused by the snorkelers themselves which illustrates the importance of snorkel methods that minimize disturbance and replicate search patterns each year.

Table 3.1. Summary of snorkel survey timing and environmental conditions for the five years of population monitoring in the upper Fording River.

	2012	2013	2014	2017	2019
Snorkel Survey	Sept 16 – 22	Sept 4 – 9	Sept 2 - 8	Sept 5 - 12	Sept 4 – 11
Snorkel Kilometers (% mainstem)	47.62 (83%)	48.37 (84%)	46.62 (81%)	48.37 (84%)	48.37 (84%)
Mean Daily Water Temperature (^{o}C)	7.0 – 7.8	9.4 – 10.2	7.0 – 7.9	6.5 – 8.5[a]	7.2 – 11.2[a]
Mean Daily Discharge (m^3/s)[b]	3.9 – 4.3	5.2 – 6.0	5.6 – 10.0	3.5 – 3.7	4.3 – 4.8
Visibility	Excellent	Mod. to Poor	Moderate	Mod. to Excellent	Mod. to Poor
Observer Efficiency[c]	42%	25%	32%	-	-

[a] – spot temperature not mean daily.

[b] – Water Survey of Canada Station 08NK018 at the mouth of the Fording River.

[c] – Floy and Radio tags combined (Cope *et al.* 2016).

Table 3.2 summarizes the snorkel count data for mainstem upper Fording River segments S1 through S10, Henretta Creek (reach 1) and Henretta Pit Lake for 2012, 2013, 2014, 2017 and 2019. Note that 84% of available habitat was snorkelled and excluded habitat was represented by headwaters segment 11 and tributary habitat too small and shallow to be snorkelled (with the exception of 400 m immediately above Josephine Falls excluded for obvious safety reasons). Table 3.2 data has been summarized to represent juvenile age classes (0-200 mm) and sub-adult and adult age classes (200-500 mm). Subsequent population modelling applies only to the 200 – 500 mm size classes (*i.e.,* sub-adult and adult fish). Juvenile age classes were included in Table 3.2 at the request of the EVFFHC to track counts for interest sake and to ensure the data was not lost, however; it is important to note that observer efficiencies are only valid for fish sizes greater than 200 mm and are not calibrated to represent fish less than 200 mm. Observer efficiency calibrations for the upper Fording River and in the method literature clearly demonstrate declining observer efficiency with declining fish size (Cope *et al*. 2016) and as such are not valid for juvenile size classes (0-200 mm). Appendix A also provides a breakdown by sub-sections used in off-setting habitat effectiveness monitoring reported elsewhere (*see* Robinson 2020).

The 2019 snorkel program enumerated 167 Westslope Cutthroat Trout (Table 3.2). This represents less than 5% of the 3,672 fish enumerated in the previous survey count in 2017. Since the previous snorkel count (2017), the adult count has decreased by 93% (1,469 fish) and the 104 adults enumerated fall well below the range enumerated in the previous four survey counts conducted in 2012, 2013, 2014 and 2017 (768 – 1,573 WCT greater than 200 mm).

Given the unexpected decline, a second snorkel count was conducted October 22-25, 2019 (Table 3.2). The purpose was to repeat the snorkel count in select over-wintering river segments and habitats where Westslope Cutthroat Trout aggregations representing 80% of the population have been reported in previous years (Henretta Pit Lake, Clode Flats, Fish Pond Creek ponds, Segment S7, Segment S6 Oxbow pool reach and Segment S2 Greenhills pools; Cope *et al.* 2016). October sub-sampling confirmed results with some variation (Table 3.2).

Table 3.3 summarizes the data used in the pooled Peterson model for the estimation of population abundance using the previous years' mark – recovery calculation and observer efficiency estimates (2012, 2013, 2014). These three observer efficiency estimates were then applied to the 2019 count data and the resulting three 2019 abundance estimates output from the model were summarized (Table 3.3). Note that while all three model estimates are presented, these estimates are not a range or 95% confidence interval but represent a measure of sensitivity to CPUE (catchability or observer efficiency) depending on which of the three previous years observer efficiencies are input into the 2019 pooled Peterson model. This was done to extrapolate the 2019 count data into a relative index of population abundance for context in trend monitoring and for comparison of regional data and reference populations (*i.e.,* FLNRORD data).

The 2019 median model estimate was 327 fish greater than 200 mm and the three model estimates ranged between 246 to 416 fish greater than 200 mm. The median and range of model estimates in Table 3.3 most likely under-estimate the 2019 population abundance based on the flow and visibility conditions in 2019. The 2019 environmental conditions (visibility and flow) were most consistent with the lowest of the three model estimates for observer efficiencies (25% in 2013) and this would provide weight to the higher model estimate of 416 Westslope Cutthroat Trout greater than 200 mm. This was consistent with the professional judgement of the biologists who were snorkel observers in all five surveys who indicated

Table 3.2. Snorkel count data summary for mainstem upper Fording River segments S1 through S10, Henretta Creek (reach 1) and Henretta Pit Lake. Data has been summarized to represent juvenile age classes (0-200 mm) and sub-adult/adult age classes (200-500 mm). Population modelling applies to the 200 – 500 mm size classes only. For a full breakdown by 100 mm size classes see Appendix A.

	Snorkel Count								September		October	
River	2012		2013		2014		2017		2019		2019	
Segment	0-200	200-500	0-200	200-500	0-200	200-500	0-200	200-500	0-200	200-500	0-200	200-500
1	0	46	0	29	0	22	1	25	1	12		
2	81	329	4	51	32	186	12	36	2	45	1	0
3	1	37	1	12	0	51	4	11	0	1		
4	20	68	75	126	17	143	5	77	0	5		
5	5	34	0	1	0	41	9	36	0	0		
6	33	160	10	45	4	121	24	140	1	0	1	52
7	4	18	148	154	16	39	1002	458	0	0	7	0
8	1	33	146	167	89	192	487	195	2	4	1	4
9	39	82	29	44	101	143	275	309	1	0	0	0
10	14	24	15	26	126	77	273	256	56	24		
H1[a]	7	165	1	12	14	19	7	5	0	0		
H2[b]	0	0	38	101	15	42	0	25	0	13	0	0
Total	205	996	467	768	414	1076	2099	1573	63	104	10	56
	1201		1235		1490		3672		167		66	

[a] – Henretta Creek below Henretta Pit Lake.

[b] – Henretta Pit Lake.

Table 3.3. Summary of data used for population model estimates.

	2012	2013	2014	2017	2019
Radio Tags	59	57	58	-	-
Floy Tags	151	164	178	-	-
Combined Tags	210	221	236	-	-
Observed Radio Tags	35	22	23	-	-
Observed Floy Tags	54	33	52	-	-
Combined Observed Tags	89	55	75	-	-
% Recovery	42.38	24.89	31.78	25 – 42	25 -42
Unmarked Count > 200 mm	996	768	1076	1573	104
Unmarked Count > 300 mm	489	283	366	461	26
Previous Years Marks Observed	-	13	23	-	-
Population Estimate (>200 mm)	2,546	3,318	3,664	$3,690_{(2012)}$ [a] $4,908_{(2014)}$ [a] $6,240_{(2013)}$ [a]	$246_{(2012)}$ [a] $327_{(2014)}$ [a] $416_{(2013)}$ [a]

[a] - subscript year refers to the mark – recovery data for that year utilized in combination with the 2019 count data to generate the Pooled Peterson estimate.

the expected value should be consistent with the 2013 conditions. Recall that in 2017 the opposite was true and the higher observer efficiency of 2012 was selected as most appropriate which corresponded with the lower of the three model estimates that year (3,690 WCT > 200 mm; Table 3.3).

Therefore, given the above rationale (flow and visibility and their effect on observer efficiency), the estimate of 416 Westslope Cutthroat Trout greater than 200 mm was used for further trend and regional comparisons. Notwithstanding this decision, any of the three model estimates represent precipitous declines of between 88% to 93%. If accurate, the magnitude of the decline is highly concerning and cause for immediate action. Given the concern immediate actions are being taken in terms of; (1) a precautionary approach (*i.e.,* assuming the decline is accurate), (2) reviewing potential operational stressors through causal investigation and ways to eliminate or mitigate potential stressors, and (3) replication of population monitoring results in 2020.

Figure 3.1 illustrates the adult Westslope Cutthroat Trout count data (*i.e.,* fish greater than 200 mm) for the five years (2012, 2013, 2014, 2017 and 2019) as well as the model estimates for the Pooled Peterson population estimates. The 2019 estimate of 416 fish greater than 200 mm (*i.e.,* sub-adult and adult population) represents an unexpected and precipitous decline. Recall that the 2017 and 2019 data points represent a relative index of count data input into the Pooled Peterson model using the 2012, 2013 and 2014 mark-recapture observer efficiency calculations. The resulting three estimates of the 2017 and 2019 Pooled Peterson Model were plotted in Figure 3.1 as the range representing model variation in estimates in lieu of confidence intervals for these two years (note that 2012, 2013 and 2014 are 95% confidence intervals).

The metric most often used for population estimation and comparison within the literature was fish per lineal river kilometer. Using the 2019 model estimate of 416 Westslope Cutthroat Trout greater than 200 mm over the snorkel distance of 48.37 km yields a density estimate of 8.6 fish/km greater than 200 mm (range of model estimates 5.1 – 8.6 fish/km) and 2.2 fish/km greater than 300 mm (range of estimates 1.3

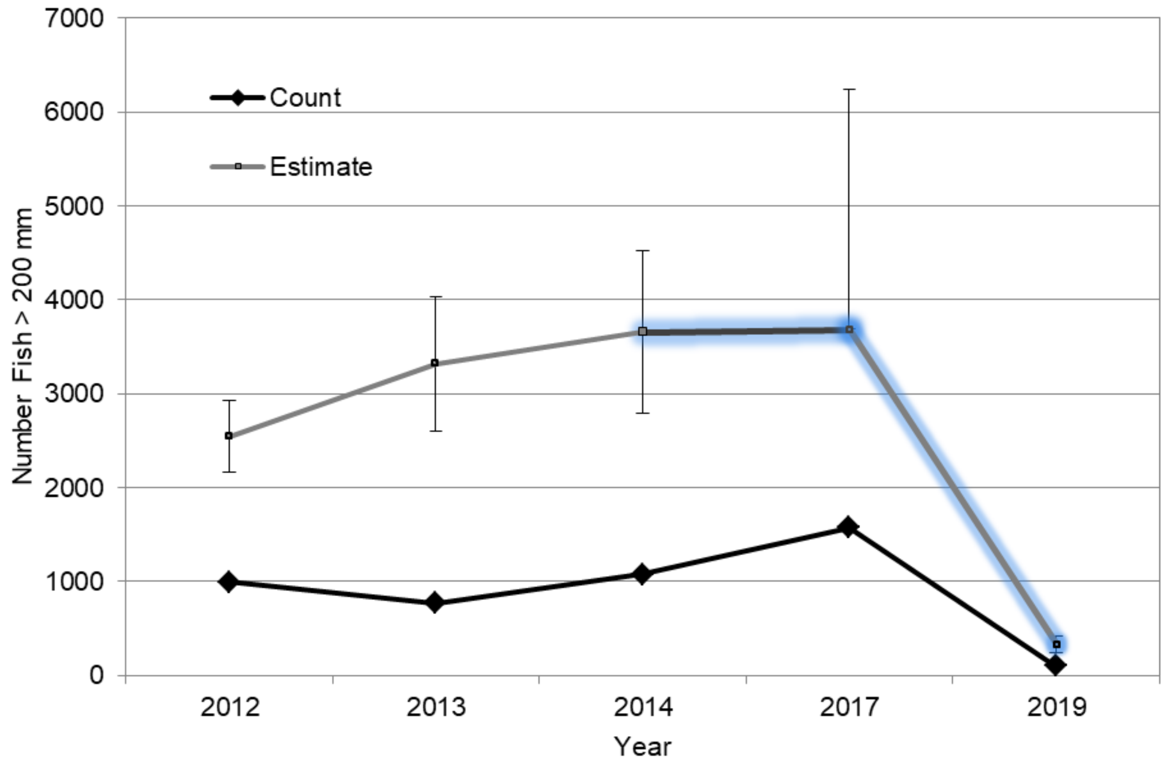


Figure 3.1. Adult Westslope Cutthroat Trout snorkel counts and associated population estimates for the upper Fording River, 2012, 2013, 2014, 2017 and 2019. Error bars in 2012, 2013, and 2014 represent 95% confidence intervals for the estimated number of fish. Error bars in 2017 and 2019 represent model variation (due to the different estimates of observer efficiency in 2012, 2013 and 2014 applied to the 2017 or 2019 count data).

– 2.2 fish/km). These densities were significantly lower than the last (2017) density estimates (76.3 fish greater than 200 mm and 22.0 fish greater than 300 mm). The upper Fording River density of Westslope Cutthroat Trout greater than 200 mm appears to have undergone a significant decline between September 2017 and September 2019. These fish represent multiple year classes ranging in age from 4 years to over 20 years old (*See* Section 3.3 Mark – Recapture and Growth Update).

Density estimates for mature Westslope Cutthroat Trout (fish greater than 200 mm or fish greater than 300 mm) have been collected using similar snorkel methods by FLNRORD for a number of priority Westslope Cutthroat Trout streams in the upper Kootenay drainage. These estimates are summarized in Table 3.4 and have been used to place upper Fording River estimates in context regionally. Figure 3.2 illustrates the upper Fording River population trend in relation to the regional streams monitored by FLNRORD and summarized in Table 3.4. There were six populations (upper Bull River, Upper St. Mary River, Wigwam River, Skookumchuck Creek, Middlefork White River and Northfork White River) with more than one annual estimate encompassing the period 2012 to 2019. Four of the six populations were stable or increasing. The Middlefork White River decline was much less precipitous and reflects impacts of wildfire followed by a 1 in 200 year flood event. The upper Bull River decline was also not as substantial and was similar to the 2008 density. This watershed also supports Rocky Mountain Whitefish and an intensive catch and release Westslope Cutthroat Trout fishery. These results suggest some

Table 3.4. Summary of recent density estimates (snorkel methods) for Westslope Cutthroat Trout greater than 300 mm in Classified Waters from the upper Kootenay River watershed. Note that Heidt 2019 data is preliminary and draft and will be updated during the report review period.

Population Group	Year	Fish/km (> 200 mm)	Fish/km (> 300 mm)	Reference
Upper Fording River	2019	8.6	2.2	
Upper Fording River	2017	76.3	22.0	Cope *et al.* 2017
Upper Fording River	2014	78.6	28.0	Cope *et al.* 2016
Upper Fording River	2013	53.4	23.0	Cope *et al.* 2016
Upper Fording River	2012	68.6	27.0	Cope *et al.* 2016
Upper St. Mary River	2019		23.5	Heidt 2019, *pers. comm.*
Upper St. Mary River	2014		20.6	Heidt 2019, *pers. comm.*
Upper St. Mary River	2011		19	Heidt 2013, *pers. comm.*
Upper St. Mary River	2008		14	Hagen and Baxter 2009
Skookumchuck Creek	2019		28.2	Heidt 2019, *pers. comm.*
Skookumchuck Creek	2014		21.9	Heidt 2019, *pers. comm.*
Upper Bull River	2019		*In prep.*	Heidt 2019, *pers. comm.*
Upper Bull River	2010	108	55	Cope and Prince 2012
Upper Bull River	2005		40	Baxter 2006a
Middle Fork White R.	2018		27.9	Heidt 2019, *pers. comm.*
Middle Fork White R.	2014		36.5	Heidt 2019, *pers. comm.*
Middle Fork White R.	2011		37.5	Heidt 2013, *pers. comm.*
Wigwam River	2018		21.4	Heidt 2019, *pers. comm.*
Wigwam River	2008		12-24	Hagen and Baxter 2009
North Fork White River	2018		12.0	Heidt 2019, *pers. comm.*
North Fork White River	2014		12.3	Heidt 2019, *pers. comm.*
North Fork White River	2011		9.7	Heidt 2013, *pers. comm.*
Lussier River	2019		10.1	Heidt 2019, *pers. comm.*
East Fork White River	2012		3.7	Heidt 2013, *pers. comm.*
Michel Creek	2008		46	Hagen and Baxter 2009
Lower St. Mary River	2008		44	Hagen and Baxter 2009
Elk River	2008		39	Hagen and Baxter 2009

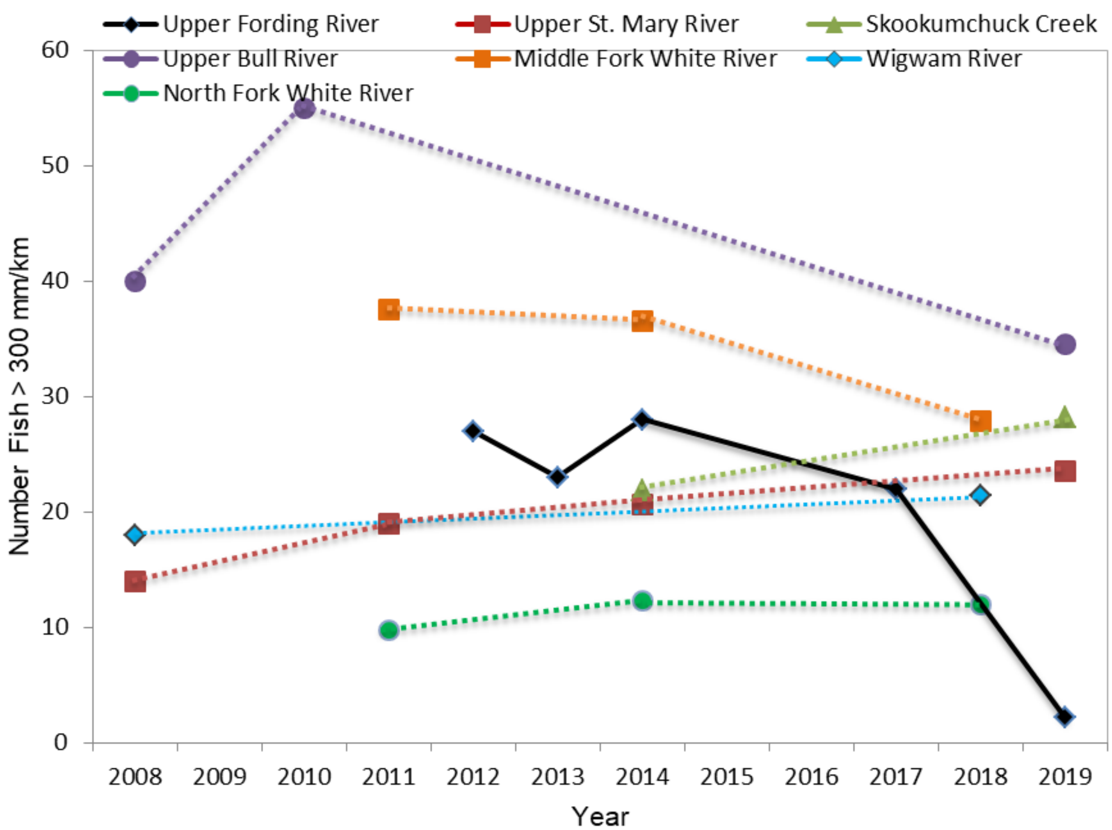


Figure 3.2. Westslope Cutthroat Trout density estimates (snorkel methods) and population trends (number fish > 300 mm/km) within the upper Kootenay River watershed.

feature or condition unique to the upper Fording River, which could include mine influences, are the cause for the population decline between 2017 and 2019; not the broader influence of regional climatic conditions.

In the previous monitoring report (Cope *et al.* 2017), it was noted that regional Westslope Cutthroat Trout densities within reference populations (*i.e.,* upper Bull River, Michael Creek, upper St. Mary River) suggested the upper Fording River Westslope Cutthroat Trout population has not been achieving its full productive potential in the recent past (2012 – 2017).

The 2019 results suggest that between September 2017 and September 2019 some feature or impact unique to the upper Fording River resulted in a population collapse from 76.3 to 8.6 fish/km for fish greater than 200 mm or from 22.0 to 2.2 fish/km for fish greater than 300 mm.

It has been suggested that 45 fish greater than 300 mm/km from systems that are almost entirely catch and release may represent an approximation of the unfished equilibrium abundance ($N_{equilibrium}$) for large productive systems (DFO 2017). The 2019 upper Fording River density estimate of 2.2 fish/km greater than 300 mm represents a population viability and sustainability concern.

There was concern that the timing of fish salvage events and the timing of snorkel surveys from this years and previous years snorkel surveys may have influenced the annual population estimates (*i.e.,* fish salvaged, relocated and present in the surveyed area). This concern regarding fish salvage influences on snorkel survey population estimates for mature fish (*i.e.,* fish greater than 200 mm fork length) was not validated by data review. Firstly, a review of the timing of salvage events in 2017 and 2019 confirmed they were conducted after the snorkel survey was completed. Secondly, salvage operations almost exclusively recover juveniles less than 200 mm fork length and even if there was timing overlap would not influence the estimation of the mature population and it would be inconceivable that it could influence estimates to the degree noted in 2019 (*i.e.,* decrease of mature fish greater than 200 mm of 93%). For example, in 2019 salvage summaries (Nupqu 2020) there were 700 Westslope Cutthroat Trout salvaged from Smith Creek and 156 fish were measured. Only four fish (0.57%) were within the mature category (greater than 200 mm). There were 995 Westslope Cutthroat Trout salvaged from Swift Creek and 110 fish were measured. Zero fish (0.00%) were within the mature category (greater than 200 mm). The causal factor investigation has been tasked with a detailed review of electrofishing impacts including fish salvage, fish relocation, fish handling and tagging and their potential impact as a stressor and cumulative impact to population productivity.

3.2 Recruitment and Juvenile Density Estimates

In 2019, a total of 60 individual meso-habitat enclosures of approximately 100 m^2 each within 19 representative locations were sampled using removal – depletion electrofishing between August 19 and 27, 2019. A total of 214 Westslope Cutthroat Trout were captured. The 19 locations included four new and unique locations added in 2019 for off-setting habitat effectiveness monitoring. One site was the unnamed tributary to Fish Pond Creek that was developed into over-wintering ponds and juvenile rearing habitat. The Fish Pond Creek tributary location was also selected to replace the Lake Mountain Creek location that was lost to development in 2017; therefore, this location and it's catch were included in the 16 monitoring locations for the comparison of population densities across years.

The remaining three locations (UFR47-1, UFR47-2, UFR49-2) were included in the sampling for consistency in methodology and comparisons; however, although these three locations are illustrated in the location estimates for reference (*e.g.,* Figure 3.3) their catch (n=29) were unique to 2019 and not included in further analyses or trend monitoring and are reported elsewhere (Robinson 2020).

Within the 16 population monitoring locations there were a total of 49 meso-habitat units and 185 Westslope Cutthroat Trout were captured. This represents a decrease of 74% from the last sample event in 2017 (n=714 Westslope Cutthroat). Shortened opercula (gill cover defects) are tracked and there was no evidence of an increase in 2019 (0/185 or 0.0%). Previous years (2013, 2014, 2015, 2017) ranged between 0.4% - 2.5%.

Juvenile Density Estimate

Annual density estimates of both life stages combined (fry and juvenile) for all representative locations sampled in all five years (n=10) have demonstrated a significant decrease of approximately 74% in 2019 (Figure 3.3). This decrease in juvenile densities was consistent with the adult enumeration data suggesting the population decline has occurred across all life stages and age classes.

In 2019, of the 10 locations sampled in all five years, two locations had increased juvenile densities and eight locations had decreased juvenile densities (Table 3.5). Dry Creek was the only location that had significant increased fry and juvenile densities and was within the range of previous years. Decreases appeared to be associated with declines in subjective assessments of declining habitat quality. Anecdotal observations were noted of increased calcite distribution and intensity (*i.e.,* concretion), increased fine sediments resulting in silt covering submerged large woody debris/substrate and increased substrate embeddedness and compaction, increased algae and macrophyte's, increased mine development (*i.e.,* Swift extension of mining project) and instream channel works (*i.e.,* off-setting habitat construction and geomorphic channel re-alignment). These anecdotal observations were summarized by location in the following section that examines all 16 locations sampled in 2019. Several concurrent monitoring programs are expected to provide quantitative temporal trends regarding these subjective observations once the 2019 data become available (*i.e.,* Calcite Monitoring Program, Regional and Local Aquatic Effects Monitoring Programs, Water Quality Monitoring Programs, Operational Environmental Monitoring for Consumptive Water Licences, Effectiveness Monitoring Programs for fish and fish habitat).

Location Estimates

The three meso-habitats within each location were pooled to provide a composite location and Figure 3.4 illustrates the density estimates (fry and juveniles combined) for all locations sampled within the upper

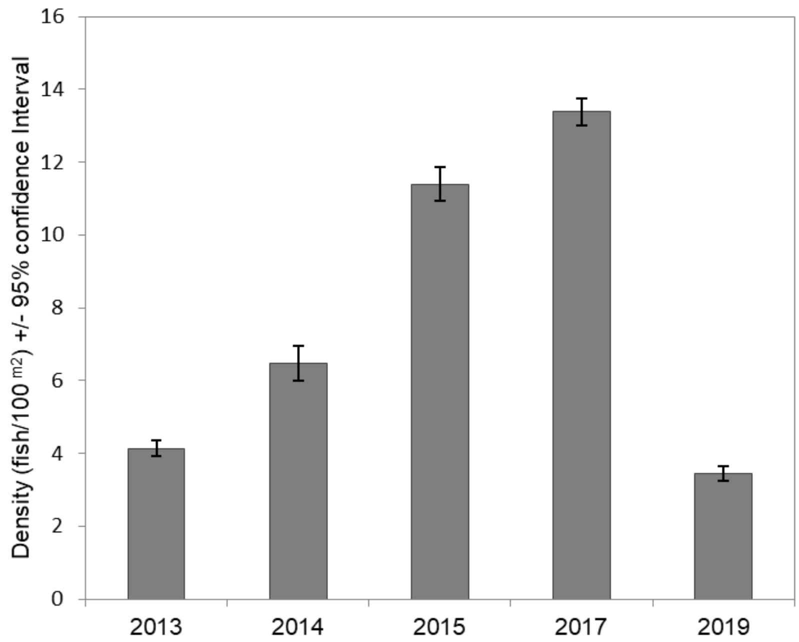


Figure 3.3. Average density estimates (fish/100 m^2) for both fry and juvenile life stages combined within sites sampled in all four years (n=10), upper Fording River, 2013, 2014, 2015, 2017 and 2019.

Table 3.5. Summary of density estimates for locations (n=10) sampled in all five years.

	Density (Fish/100 m^2)				
Site	2013	2014	2015	2017	2019
Henretta-1	0.80	3.96	33.73	26.91	3.46
Henretta-3	0.00	0.25	0.88	5.62	0.00
Fish Pond-1	11.40	42.25	19.76	27.47	16.03
Chauncey-1	4.90	5.77	7.46	30.39	3.09
Ewin-2	0.30	1.62	2.90	2.93	1.26
Dry-1	2.50	2.25	16.50	3.82	6.13
Fording-2	2.90	3.00	3.60	0.42	0.79
Fording-8a	5.30	1.76	11.73	6.30	2.57
Fording-10	11.10	10.10	13.64	7.14	0.95
Fording-11	0.50	6.30	15.18	27.48	4.36

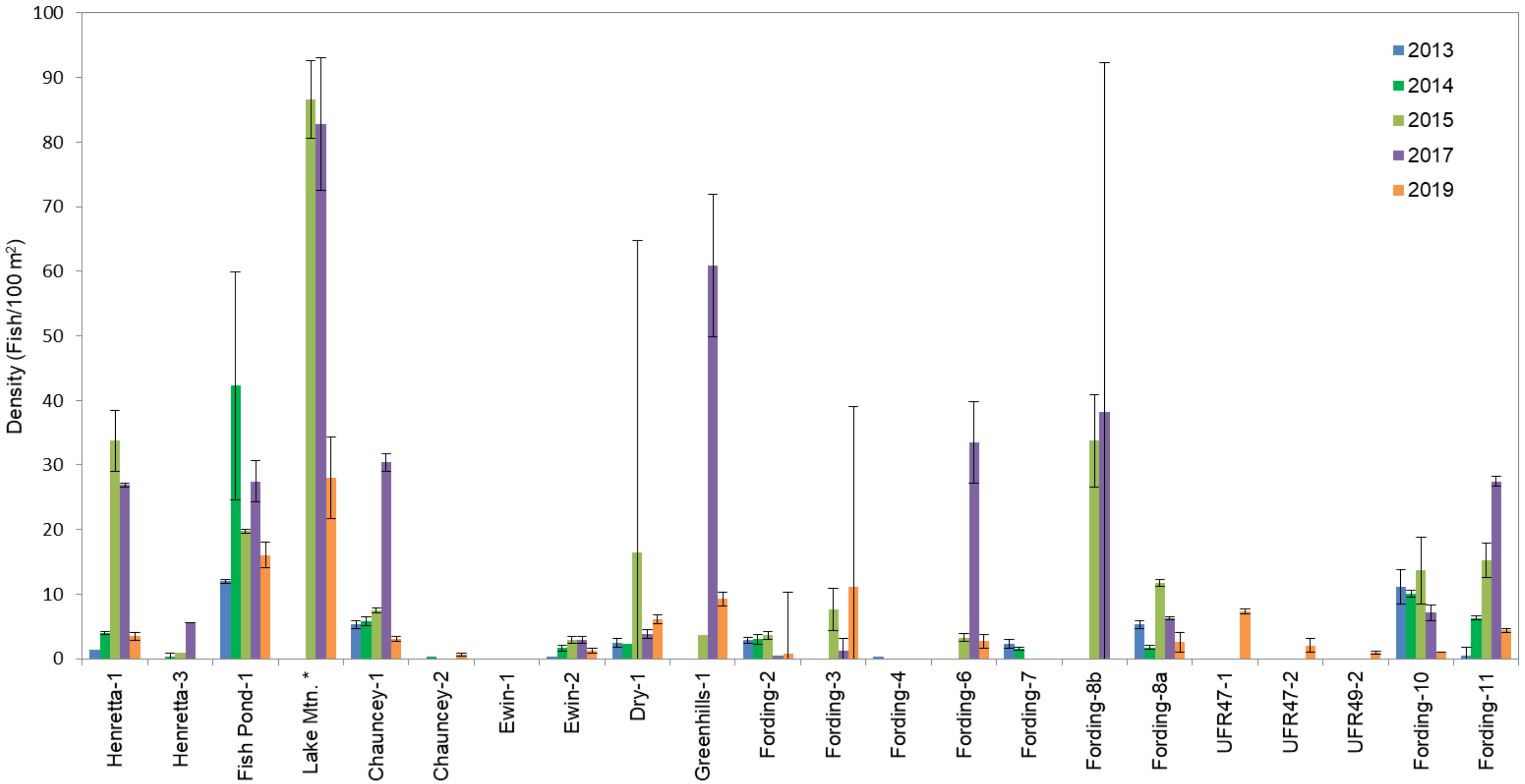


Figure 3.4. Density estimates (fry and juvenile life stages combined) for the locations within the upper Fording River watershed sampled in 2013, 2014, 2015, 2017 and 2019. * Note that in 2017 Lake Mountain Creek was developed for coal production and in 2019 the off-setting habitat represented by the Fish Pond Creek tributary was sampled in it's stead. In 2019 locations UFR47-1, UFR47-2 and UFR49-2 were added to represent off-setting habitat for effectiveness evaluation reported elsewhere (Robinson 2020).

Fording River watershed in 2013, 2014, 2015, 2017 and 2019. Location results illustrate the 2019 decrease in fry and juvenile densities was attributed to substantial and significant decreases within both a) mainstem spawning and fry rearing areas, and b) tributary juvenile rearing habitats. Decreases occurred within both mine influenced reaches and reference reaches (*i.e.,* Fording River upstream headwaters, lower Chauncey Creek). Table 3.6 summarizes the density and biomass results by location for fry and juveniles illustrating trends for these two life stages across all sites and years.

Significant and substantial decreases have occurred within the following locations previously identified as preferred juvenile rearing tributaries with high juvenile densities; lower Henretta Creek (Henretta-1), Fish Pond Creek (Fish Pond-1), the Fish Pond Tributary (Lake Mountain Creek replacement location, Lake Mtn*), lower Chauncey Creek (Chauncey-1), Greenhill Creek (Greenhills-1) and the Fording River headwaters (Fording-10, Fording-11). Note that there was no or at best extremely limited spawning habitat within lower Chauncey Creek and Lake Mountain Creek. These lower tributary habitats adjoin documented high density mainstem spawning habitats (Cope *et al.* 2016). The juvenile densities in these locations reflect movement patterns and habitat preferences of juvenile Westslope Cutthroat Trout for tributary habitat with clean coarse substrate, gradients of 1 to 3% and abundant overhead cover in the form of coarse substrate interstices and large woody debris.

Significant and substantial decreases have occurred within the following locations previously identified as high density spawning and fry rearing habitat and preferred juvenile rearing (*i.e.,* high density) habitat with high fry and juvenile densities; Fording River Oxbow Segment S6 (Fording-6), the historic Clode Flats area (Fording-8a, Fording-8b), Greenhills area (Fording-3, Fording-2) and mine influenced tributaries (Greenhills-1, Dry-1, Henretta-1, Henretta-3, Fish Pond-1, Fish Pond Tributary). Decreases appeared to be associated with subjective assessments of declining habitat quality or perceived impacts. The following anecdotal observations were noted;

- Increased calcite distribution and intensity (*i.e.,* concretion) were noted within locations;
- Increased fine sediments resulting in silt covering submerged large woody debris/substrate and increased substrate embeddedness and compaction were noted within locations;
- Increased algae and macrophyte’s resulting in capture of fine sediments and silt were noted within locations;
- Evidence of heavy equipment activity and instream channel works (*i.e.,* off-setting habitat construction and geomorphic channel re-alignment) were noted at; Fish Pond-1, Fish Pond Tributary, Lake Mountain Creek (habitat removed) and Fording-8b.

It is interesting to note that both Chauncey Creek (Chauncey-1) and the Fording River Headwaters (Fording-11, Fording-10) also underwent significant and substantial decreases in juvenile densities. None of the above habitat impacts or changes were noted for these sites. These sites represent reference conditions and are not mine influenced in either water quality, water quantity or habitat impacts; apart from the migratory nature of the population and their propensity to use tributary habitat for juvenile rearing (Cope *et al.* 2016). Both sites are known to be migratory use. For example, there is no spawning habitat in Chauncey Creek below the highway culvert barrier and these juvenile fish move in from Segment S6 (upper Fording River) as 0+, 1+ or even 2+ age classes. So if the adjacent Fording River population were

Table 3.6. Summary of fry and juvenile density and biomass estimates by composite location, upper Fording River, 2013-2015, 2017 and 2019.

Year	Stream	Segment	Area (m^2)	Density (Fish/100 m^2) Fry	Juv	Comb.	Biomass (g/100 m^2) Fry	Juv	Comb.
2013	Henretta	1	370.8	0.00	1.35	1.35	0.00	35.27	20.90
2014	Henretta	1	505.0	0.00	3.96	3.96	0.00	136.20	136.20
2015	Henretta	1	293.6	1.02	33.38	33.73	0.77	691.97	692.74
2017	Henretta	1	293.5	0.00	26.91	26.91	0.00	2179.87	2179.87
2019	Henretta	1	346.9	0.00	3.46	3.46	0.00	100.12	100.12
2013	Henretta	3	307.4	0.00	0.00	0.00	0.00	0.00	0.00
2014	Henretta	3	810.0	0.00	0.25	0.25	0.00	33.48	33.48
2015	Henretta	3	342.8	0.00	0.88	0.88	0.00	24.12	24.12
2017	Henretta	3	352.9	0.00	5.62	5.62	0.00	305.96	305.96
2019	Henretta	3	402.7	0.00	0.00	0.00	0.00	0.00	0.00
2013	Fish Pond	1	375.5	0.50	11.48	11.98	0.20	296.37	296.57
2014	Fish Pond	1	374.0	3.74	37.17	42.25	0.85	911.23	1035.79
2015	Fish Pond	1	359.4	0.83	18.92	19.76	0.63	326.01	326.64
2017	Fish Pond	1	382.3	4.19	23.28	27.47	3.35	824.80	828.16
2019	Fish Pond	1	199.6	0.00	16.03	16.03	0.00	463.91	463.91
2015	Lake Mtn.	1	100.5	26.87	59.70	86.57	20.15	966.39	986.54
2017	Lake Mtn.	1	107.5	38.14	43.72	82.79	38.14	1505.31	1535.82
2019	Fish Pond Trib	1	239.2	0.00	28.01	28.01	0.00	810.58	810.58
2013	Chauncey	1	319.7	0.00	5.32	5.32	0.00	137.34	137.34
2014	Chauncey	1	277.3	0.00	5.77	5.77	0.00	282.77	282.77
2015	Chauncey	1	281.4	0.00	7.46	7.46	0.00	98.67	98.67
2017	Chauncey	1	286.2	0.00	30.39	30.39	0.00	641.31	641.31
2019	Chauncey	1	259.0	0.00	3.09	3.09	0.00	89.41	89.41
2013	Chauncey	2	300.4	0.00	0.00	0.00	0.00	0.00	0.00
2014	Chauncey	2	320.9	0.00	0.31	0.31	0.00	40.95	40.95
2019	Chauncey	2	459.1	0.22	0.44	0.65	0.39	12.61	13.00
2013	Ewin	1	334.5	0.00	0.00	0.00	0.00	0.00	0.00
2014	Ewin	1	283.4	0.00	0.00	0.00	0.00	0.00	0.00
2013	Ewin	2	325.5	0.00	0.31	0.31	0.00	8.10	8.10
2014	Ewin	2	247.5	0.81	0.80	1.62	0.08	22.26	22.35
2015	Ewin	2	413.3	0.00	2.90	2.90	0.00	63.96	63.96
2017	Ewin	2	341.8	0.59	2.34	2.93	0.47	29.26	29.73
2019	Ewin	2	238.2	0.00	1.26	1.26	0.00	36.45	36.45
2013	Dry	1	294.9	0.00	2.71	2.71	0.00	70.79	70.79
2014	Dry	1	266.5	0.00	2.25	2.25	0.00	71.14	71.14
2015	Dry	1	163.6	6.11	3.06	16.50	4.58	22.89	27.47
2017	Dry	1	287.8	0.00	3.82	3.82	0.00	66.00	66.00
2019	Dry	1	293.8	1.70	4.77	6.13	3.06	137.90	140.97
2015	Greenhills	1	187.6	0.53	3.20	3.73	0.40	23.96	24.36
2017	Greenhills	1	208.4	38.87	21.11	60.94	31.09	296.43	327.52
2019	Greenhills	1	194.9	0.51	8.72	9.24	0.92	252.43	253.35

continued

Table 3.6. Continued.

Year	Stream	Segment	Area (m^2)	Density (Fish/100 m^2) Fry	Juv	Comb.	Biomass (g/100 m^2) Fry	Juv	Comb.
2013	Fording	11	373.5	0.00	0.54	0.54	0.00	13.30	13.30
2014	Fording	11	332.5	0.30	6.00	6.32	0.10	304.00	304.00
2015	Fording	11	263.5	0.38	14.42	15.18	0.28	207.55	207.83
2017	Fording	11	272.9	0.00	27.48	27.48	0.00	1122.11	1122.11
2019	Fording	11	320.8	0.00	4.36	4.36	0.00	126.30	126.30
2013	Fording	10	299.0	9.73	0.30	10.03	3.87	8.70	12.57
2014	Fording	10	374.9	6.90	3.20	10.14	2.30	445.20	239.30
2015	Fording	10	308.0	1.30	12.01	13.64	0.97	943.74	944.71
2017	Fording	10	322.1	0.00	7.14	7.14	0.00	584.82	584.82
2019	Fording	10	314.8	0.00	0.95	0.95	0.00	27.58	27.58
2019	UFR49-2	8	423.2	0.00	0.95	0.95	0.00	27.36	27.36
2015	Fording	8b	278.5	27.30	5.75	33.75	20.47	426.15	446.62
2017	Fording	8b	243.7	43.49	2.05	38.16	34.79	89.61	124.00
2019	Fording	8b	444.0	0.00	0.00	0.00	0.00	0.00	0.00
2013	Fording	8a	338.2	0.30	5.02	5.32	0.10	129.40	129.50
2014	Fording	8a	401.1	0.00	1.76	1.75	0.00	62.00	62.00
2015	Fording	8a	400.8	5.74	5.99	11.73	4.30	329.52	333.83
2017	Fording	8a	381.1	0.52	5.77	6.30	0.42	366.15	366.57
2019	Fording	8a	388.6	0.00	2.57	2.57	0.00	74.47	74.47
2019	UFR47-2	8	292.2	0.00	2.05	2.05	0.00	59.42	59.42
2019	UFR47-1	8	259.3	0.00	7.33	7.33	0.00	212.04	212.04
2013	Fording	7	300.0	0.00	2.33	2.33	0.00	60.40	60.40
2014	Fording	7	392.0	0.00	1.53	1.53	0.00	50.82	50.82
2015	Fording	6	336.8	3.27	0.00	3.27	2.45	0.00	2.45
2017	Fording	6	271.6	33.51	0.74	33.51	26.81	6.81	33.62
2019	Fording	6	183.3	0.00	2.73	2.73	0.00	78.93	78.93
2013	Fording	4	366.0	0.00	0.27	0.27	0.00	7.00	7.00
2014	Fording	4	508.8	0.00	0.00	0.00	0.00	0.00	0.00
2015	Fording	3	275.1	7.63	0.00	7.63	5.72	0.00	5.72
2017	Fording	3	257.9	0.78	0.39	1.16	0.62	19.39	20.01
2019	Fording	3	519.5	0.00	0.38	0.38	0.00	11.14	11.14
2013	Fording	2	446.1	2.02	0.00	2.02	0.84	0.00	0.84
2014	Fording	2	268.4	2.98	0.00	2.98	1.79	0.00	1.79
2015	Fording	2	305.7	3.27	0.33	3.60	2.45	2.45	4.90
2017	Fording	2	240.1	0.00	0.42	0.42	0.00	2.92	2.92
2019	Fording	2	253.3	0.00	0.79	0.79	0.00	22.85	22.85

concluded

to decline significantly, Chauncey Creek juvenile densities below the highway would also be expected to decline. There are two additional reference sites (*i.e.,* not mine influenced). The upper Ewin Creek (Ewin-2) and upper Chauncey (Chauncey-2) locations represent reference conditions and are not mine influenced in either water quality, water quantity or habitat impacts. Similar to the above three reference locations (Chauncey-1, Fording-11, Fording-10) none of the above habitat impacts or changes were noted for these sites. However, these locations have consistently demonstrated extremely low densities and does not inform on current trends since other factors dictate fish densities at these locations. Ewin Creek water temperatures are very cold, near minima optima for Westslope Cutthroat Trout (Oliver and Fidler 2001) and upper Chauncey Creek is above the highway culvert representing an upstream fish passage barrier that disrupts population connectivity with the upper Fording River.

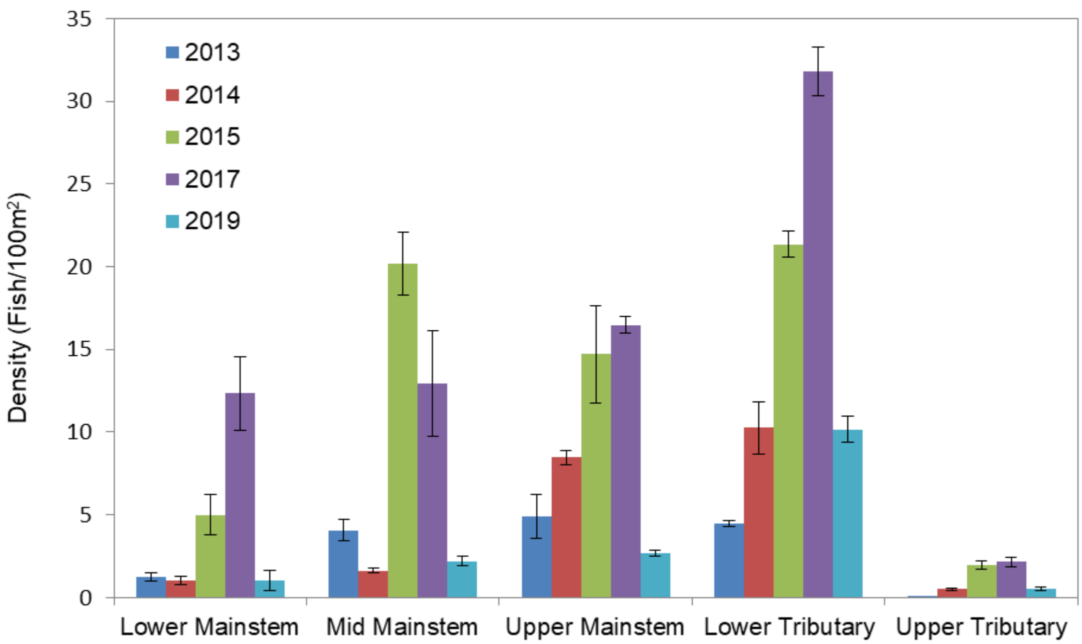
Pooled Segments

Spatial trends were illustrated further through pooling of location estimates into five watershed areas or strata; lower, mid (FRO) and upper (headwaters) Fording River mainstem plus lower and upper tributary (Table 2.2). Figure 3.5 illustrates the decrease in population densities (fry and juveniles combined) have been broad based across all mainstem and tributary habitats. The one exception was the small biomass increase in the lower mainstem strata. This increase was not statistically significant (*i.e.,* 95% confidence intervals overlap) and was due to the increase in fry weight of 0.8 g in 2017 to 1.8 g in 2019. Whether this is a growth effect or a reflection of the extremely small sample size (n=9) remains unclear. Fry are recently emerging during the August sample period and fry weights fluctuate substantially as one progresses downstream from the headwaters to the lower reaches; therefore, changes in fry capture distribution can result in significant changes to mean weight used in biomass extrapolations.

Figure 3.6 illustrates density trends for fry and juveniles separately across watershed strata and the relative importance of these areas to these life stages. Fry have a more ubiquitous distribution suggesting spawning occurs within all strata, whereas juveniles migrate into preferred habitats represented by the headwaters and lower tributaries. The 2019 results illustrate declines were broad based across all watershed areas or strata (*i.e.,* five primary strata were delineated; the lower, mid (FRO onsite) and upper (headwater) mainstem river segments and both lower and upper tributary) and were attributed to substantial and significant decreases within both mainstem spawning and fry rearing areas and tributary juvenile rearing habitat. Calcite, fine sediment and embedded and compacted substrates were noted in many spawning habitats (*i.e.,* declining spawning and incubation habitat quality) and were suggestive of spawning failure in 2019. However, these results may also be explained by the late emergence of fry in headwater watersheds such as the upper Fording River such that in a cooler summer fry may not be emerging from gravels until late August. Recommendations for moving forward include sampling two or three weeks later, during September, to capture fry that have emerged later in the season before characterizing their absence as spawning failure.

The 2019 results illustrate the decline in juvenile densities were broad based across all strata except the lower watershed strata. Note that the lower mainstem strata typically has higher fry densities (*see* fry density Figure 3.6) and low juvenile densities and a small change in juvenile captures (*i.e.,* one or two fish) can appear to have a significant effect. The large decline in juvenile densities within mine influenced river segments (mid-mainstem, lower tributary) represents a concern. The upper mainstem represents headwaters reference stream conditions but is known to be influenced by migratory patterns of both adults and juveniles from lower mine influenced river reaches or segments.

A. Density



B. Biomass

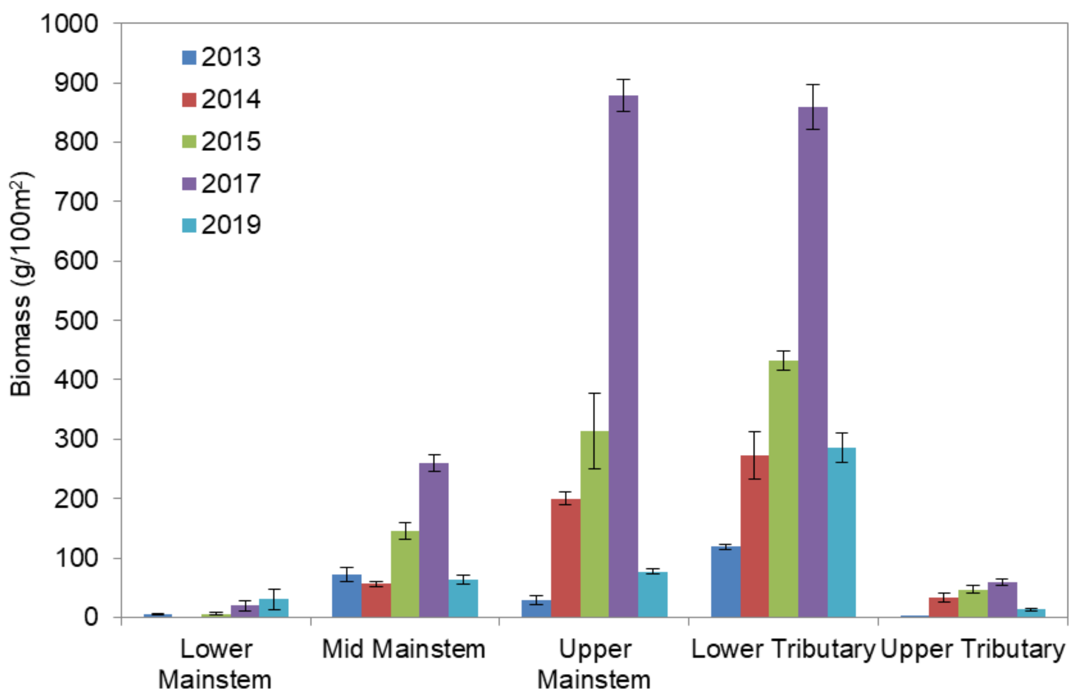
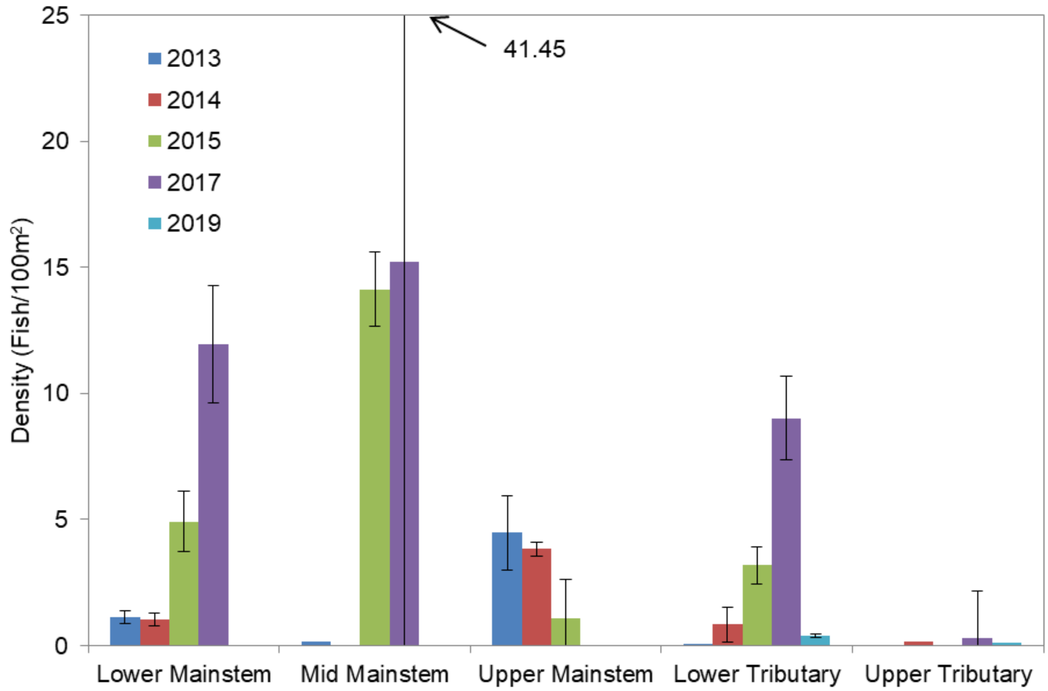


Figure 3.5. Density and biomass estimates for fry and juveniles combined by pooled river segments or watershed area, upper Fording River, 2013, 2014, 2015, 2017 and 2019.

B. Fry



B. Juveniles

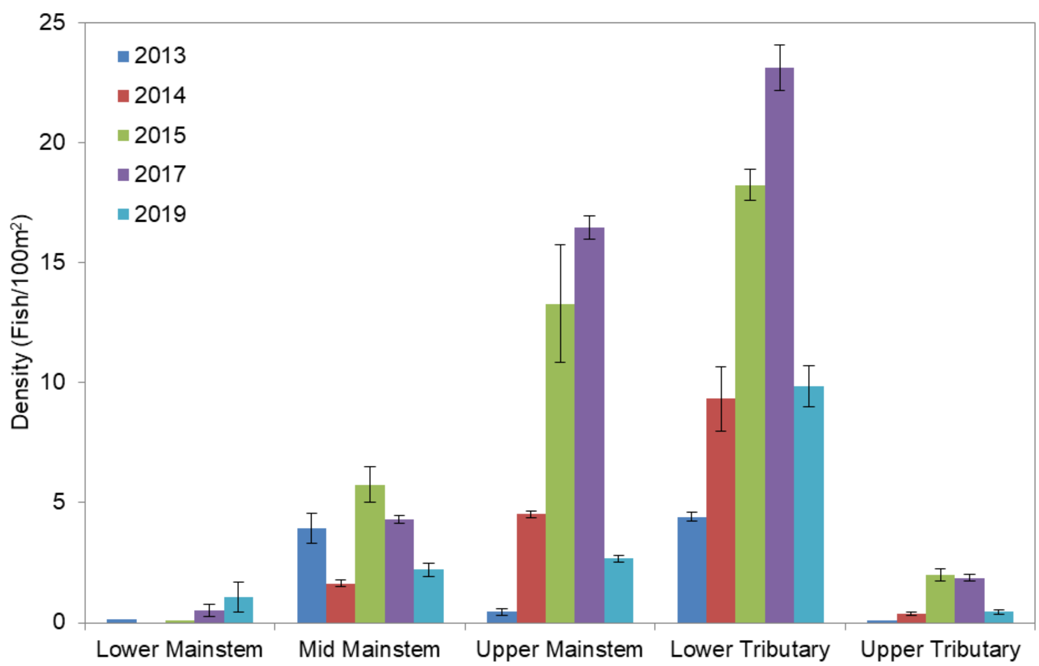


Figure 3.6. Fry and Juvenile density estimates for pooled river segments or watershed area, upper Fording River, 2013, 2014, 2015, 2017 and 2019.

3.3 Mark - Recapture and Growth Update

An additional 119 PIT Tags were applied to the 2019 catch. To date, the assessment (Cope *et al.* 2016) and monitoring programs (Cope *et al.* 2017) have PIT tagged 695 Westslope Cutthroat Trout. There were three recaptures from PIT Tags applied previously; one from the 695 PIT tagged fish (recapture rate of 0.14%) and two from other tagging programs (note that salvage programs and off-setting habitat effectiveness monitoring are also known to PIT Tag but the total numbers at large are unknown to the author at this time). This data is being added to the mark – recapture growth dataset.

Figure 3.7 illustrates the mark – recapture growth dataset collected to date. Growth rates have been used to validate age class estimates and longevity estimates (*i.e.,* 20 years) in the original assessment report (Cope *et al.* 2019). Individual Westslope Cutthroat Trout with a confirmed capture history interval of 7 years confirms at least a 10 or 11 year life span; and this fish was 395 mm in a population with maximum lengths of 485 mm. Recently emerging otolith data suggests Westslope Cutthroat Trout can reach ages of at least 16 years (Janowicz *et al.* 2018, Minnow Environmental Inc. 2011, Wilkinson 2009). Until recently, it was generally accepted that, maximum life span was typically six to eight years (Behnke 2002).

Originally, the study design was also intended to utilize PIT tag recaptures across the multiple years of data to employ a model to generate population estimates for the entire stream from recapture of PIT tagged fish and from the unmarked fish captured during each electrofishing event (year). Unfortunately, the very low recapture sample sizes preclude this estimation method. In both 2017 and 2019 there were only 3 recaptures. In addition, model estimates rely on mortality and tag retention assumptions that are typically variable and could not be field verified. As a result, population estimates using the proposed modeling exercise were not possible and the use of PIT tagging for this objective should be discontinued in light of the population decline and concerns for potential sensitivity of Westslope Cutthroat Trout to tagging. Capture – recapture statistics and assumptions used for calculation of pooled Peterson population estimates for these proposed methods can be reviewed in the Harmer and Grave Creek Westslope Cutthroat Trout Habitat and Population Assessment Project (Cope and Cope 2020). These methods were illustrated under this project with recaptures of n=17 and were deemed to be a failure due to low recapture sample size, violations of underlying model assumptions, and reliance on mortality and tag retention estimates characterized by variation and resulting uncertainty.

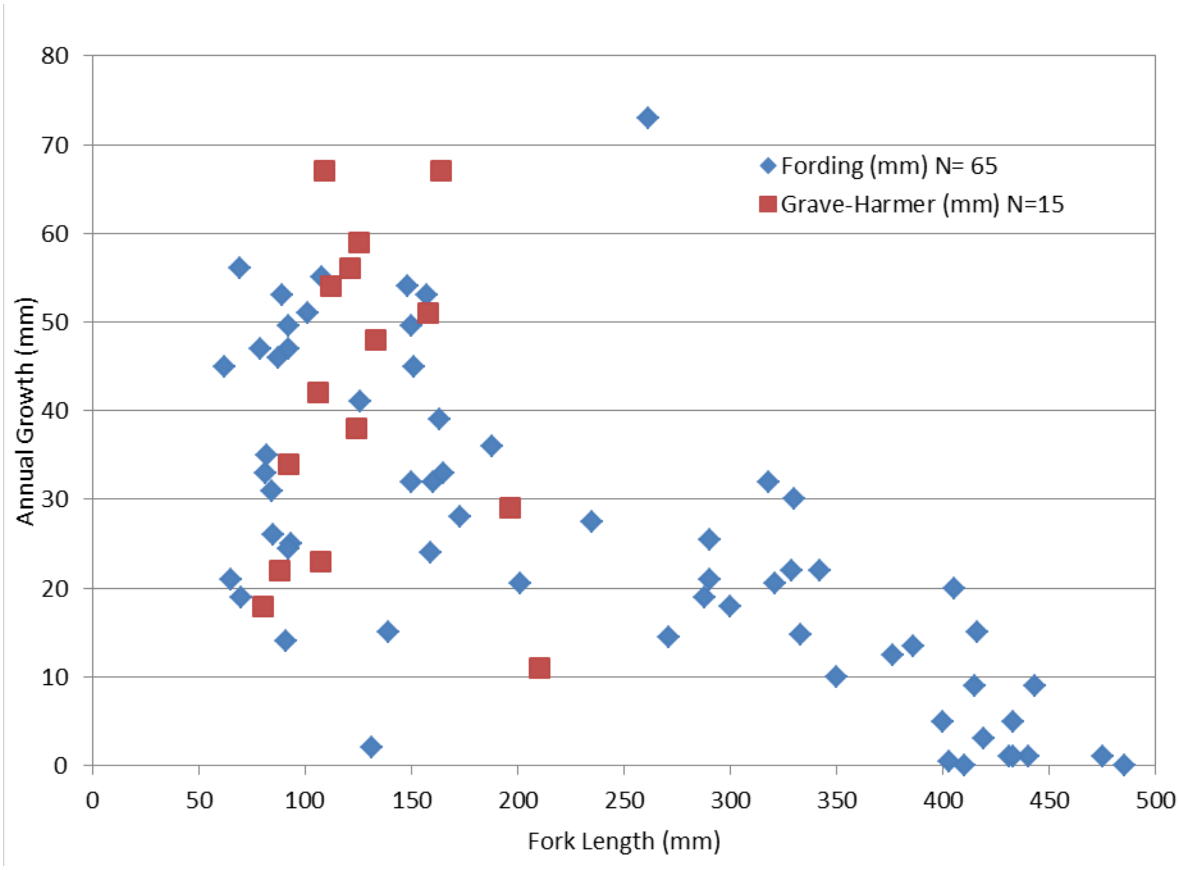


Figure 3.7. Annual growth versus fork length (mm) for Westslope Cutthroat Trout for two isolated, headwater tributaries to the Elk River.

4 Discussion

Since the previous snorkel count (2017), the adult count has decreased by 93% from 1,573 fish to 104 fish counted. The 2019 count falls well below the range in the previous four surveys in 2012, 2013, 2014 and 2017, which was 768 – 1,573 fish greater than 200 mm. The decline appeared widespread across the upper Fording River Westslope Cutthroat Trout distribution.

The 2019 median model population estimate was 327 fish greater than 200 mm and the three model estimates ranged between 246 to 416 fish greater than 200 mm. The 2019 environmental conditions (visibility and flow) and biological opinion were most consistent with the lowest of the three model estimates for observer efficiencies (25% in 2013) and this would provide weight to the higher model estimate of 416 fish greater than 200 mm. Notwithstanding this decision, any of the three model estimates represent declines of between 88% to 93%. If accurate, the magnitude of the decline is highly concerning and cause for immediate action. Given the concern immediate actions are being taken in terms of; (1) a precautionary approach (*i.e.,* assuming the decline is accurate), (2) reviewing potential operational stressors through causal investigation and ways to eliminate or mitigate potential stressors, and (3) replication of population monitoring results in 2020 (*see* Section 5 Recommendations).

Based on the 2019 model estimate of 416 fish greater than 200 mm (*i.e.,* sub-adult and adult population) over the snorkel distance of 48.37 km yields a density estimate of 8.6 fish/km greater than 200 mm (range of model estimates 5.1 – 8.6 fish/km) and 2.2 fish/km greater than 300 mm (range of estimates 1.3 – 2.2 fish/km). Trend monitoring suggests these densities were significantly lower than the last (2017) density estimates of 76.3 fish/km greater than 200 mm and 22.0 fish/km greater than 300 mm. The upper Fording River density of fish greater than 200 mm appears to have undergone a steep and unexpected decline between September 2017 and September 2019. These fish represent multiple year classes ranging in age from 4 years to 20 years old.

Recruitment and juvenile removal-depletion electrofishing was completed within 16 population monitoring locations containing a total of 49 meso-habitat units. In 2019, 185 fish were captured. This represents a decrease of 74% from the last sample event in 2017 (n=714). Annual density estimates for those locations sampled in all five years (n=10) have demonstrated a statistically significant decrease of 74% in 2019.

Decreases in fry and juvenile densities in 2019 illustrate the declines were broad based across all strata (*i.e.,* watershed areas or lower, mid (FRO)-, upper watershed and lower and upper tributary). The decrease in fry and juvenile densities were consistent with the adult enumeration data suggesting the population decline has occurred across all life stages and age classes. The declines in fry and juvenile densities were attributed to substantial and significant decreases within both mainstem spawning and fry rearing areas and juvenile rearing tributary habitats. Decreases were associated with declines in subjective assessments of habitat quality at some locations. Anecdotal observations were noted of increased calcite distribution and intensity (*i.e.,* concretion), increased fine sediments resulting in silt covering submerged large woody debris/substrate and increased substrate embeddedness and compaction, increased algae and macrophytes. There was also anecdotal evidence of increased mining development (*i.e.,* works and related impacts due to mine extension projects (Swift, LCO Phase II)), including logging, stream diversions, construction of water treatment facilities, off-setting instream habitat construction and geomorphic channel re-alignment.

Several concurrent monitoring programs are expected to provide quantitative temporal trends regarding these subjective observations once the 2019 data become available (*i.e.,* Calcite Monitoring Program, Regional and Local Aquatic Effects Monitoring Programs, Operational Environmental Monitoring for Consumptive Water Licences, Effectiveness Monitoring Programs (LCO Phase II and Swift Project) for fish and fish habitat) (*see* Recommendations next section).

The 2019 upper Fording River density estimate of 2.2 fish/km greater than 300 mm represents a population viability and sustainability concern. It has been suggested that 45 fish/km greater than 300 mm from systems that are almost entirely catch and release (Hagen and Baxter 2009) may represent an approximation of the unfished equilibrium abundance ($N_{equilibrium}$) for large productive systems (DFO 2017). Whether or not the upper Fording River, an isolated headwater tributary, represents a large productive system may be debatable. Nevertheless, from 2012 to 2017 the density of fish greater than 300 mm ranged between 22 and 28 fish/km and the assessment project indicated there were habitat impacts and limitations restricting productivity for Westslope Cutthroat Trout. These population threats were identified as opportunities for further population improvements (*i.e.,* increases, Cope et al. 2016). The population data and comparison to regional reference streams would suggest that, on balance, the upper Fording River should be closer to the target of 45 fish/km greater than 300; not densities of 2.2 fish/km greater than 300 mm.

Comparison of regional Westslope Cutthroat Trout population trends suggest the population decline within the upper Fording River between 2017 and 2019 was due to some feature or condition unique to the upper Fording River, which could include mine influences, not the broader influence of regional climatic conditions. One unique feature to the upper Fording River is the extent of surface mining and associated activity within the watershed. It is recommended that an investigation into all potential impacts and their capability for mortality or emigration of Westslope Cutthroat Trout within the upper Fording River between September 2017 and September 2019 be completed during the winter of 2019/2020. This investigation should include all potential impacts and available monitoring data to provide an assessment of trends, likely stressors, and precautionary measures that could be employed to mitigate or eliminate potential impacts to the remaining Westslope Cutthroat Trout population (*see* 5.0 Recommendations).

Assessment method failure is another alternative hypothesis that could explain the observed decline in Westslope Cutthroat Trout abundance in 2019. It is recommended that this hypothesis be tested in 2020 by replicating the assessment with the addition of more rigorous methods rather than waiting until the next scheduled assessment in 2021 (*see* 5.0 Recommendations).The failure of two independent assessment methods (snorkel survey and three-pass removal-depletion estimates) with controls in place to minimize observer variation was deemed unlikely in the absence of any observed mechanism of failure. On the contrary, there was ample anecdotal evidence of increased mining development (*i.e.,* works and related impacts due to mine extension projects (Swift, LCO Phase II), including logging, construction of water treatment plants, off-setting habitat construction, and geomorphic channel re-alignment. In addition, there have also been reports of water quality non-compliance events, channel dewatering, and fish salvage-relocation-mortality events.

In response to the concerns above, two leading alternative hypotheses were explicitly considered in reviewing the 2019 results and developing recommendations for moving forward in the monitoring program before attributing Westslope Cutthroat Trout population declines to mine influences. The two hypotheses below are presented for their implications in study design moving forward for 2020 planning and are presented as a precursor to the larger causal factor investigation being developed by Teck in consultation with regulatory agencies, KNC and technical experts from committees that provide input to Teck on existing programs/permits such as the Elk Valley Fish and Fish Habitat Committee (EVFFHC) and the Environmental Monitoring Committee (EMC).

One alternative hypothesis to consider is methodology failure. This was considered unlikely for the following reasons; however, it has not been ruled out until implementation of the recommendations in the following section are complete. Recommendations include monitoring replication in 2020 to demonstrate repeatability, including more rigorous methods to support confidence in the 2019 and 2020 results. The reasons this hypothesis was considered unlikely include:

- Control measures were implemented to minimize factors that may affect catchability and were successful in maintaining consistent conditions among surveys across years since 2012 (*i.e.,* timing, flow, visibility conditions, spatial extent and consistency in qualified trained observers).
- Data quality objectives for sub-adult and adult population monitoring were to detect +/-25% change in abundance per year. Declines on the order of 88% to 93% provide some confidence that the results were not statistical artifacts or method failure in detecting change.
- The level of effort (48.37 km) leave few areas for the amount of “missing” fish to be “hiding” and five surveys (2012, 2013, 2014, 2017, 2019) conducted over eight years provide a level of confidence in the methods and results.
- The upper Fording River Westslope Cutthroat Trout population monitoring program recognizes CPUE indexing methods are extremely sensitive to methodology deviations that affect catchability. For this reason, trend monitoring included two independent population metrics to increase confidence in the interpretation of population trends. The recruitment and juvenile density estimates represent a second independent assessment method with a decrease of 74% in 2019.
- Aside from some difficulty in maintaining block nets at some sites due to algae during recruitment and juvenile three-pass removal-depletion, there was no evidence of method failure as decreases were widespread and included sites without the algae issues.
- Decreases appeared to be associated with subjective assessments of declining habitat quality. Anecdotal observations were noted of increased calcite distribution and intensity (*i.e.,* concretion), increased fine sediments resulting in silt covering submerged large woody debris/substrate and increased substrate embeddedness and compaction, increased algae and macrophytes. There was also ample anecdotal evidence of increased mining development (*i.e.,* works and related impacts due to mine extension projects (*i.e.,* Swift), including logging, stream diversions, construction of water treatment facilities, off-setting instream habitat construction and geomorphic channel re-alignment.

The second alternative hypothesis to consider was regional climatic effects and natural variation. This was considered unlikely for the following reason; however, it has not been ruled out until implementation of the recommendations for more rigorous methods in 2020 and a more comprehensive and detailed causal factor investigation to be completed during the winter of 2019/2020 (*see* Recommendations next section). The reason this hypothesis was considered unlikely include:

- Density estimates for mature Westslope Cutthroat Trout (fish greater than 200 mm or fish greater than 300 mm) have been collected using similar snorkel methods by FLNRORD for a number of priority Westslope Cutthroat Trout streams in the upper Kootenay drainage over a similar time frame (*i.e.,* 2008 – 2019). These estimates have been used to place upper Fording River estimates in context regionally. These results seem to confirm some feature unique to the upper Fording River which could include mine influences are the cause for the population decline between 2017 and 2019.

5 Recommendations

If accurate, the magnitude of the decline is highly concerning and cause for immediate action. Given the concern, immediate actions are being taken in terms of; (1) a precautionary approach (*i.e.,* assuming the decline is accurate), (2) reviewing potential operational stressors through causal investigation and ways to eliminate or mitigate potential stressors, and (3) replication of population monitoring results in 2020.

In response to concerns regarding the decline in Westslope Cutthroat Trout abundance in 2019, the following recommendations are provided. These recommendations are provided to improve the study design (*i.e.,* adaptive management) and are a precursor to the larger consultation and input that has been initiated by Teck (*i.e.,* Causal Factor Investigation for the upper Fording River Westslope Cutthroat Trout population). Leading alternative hypotheses were explicitly considered in reviewing the 2019 results and developing recommendations for moving forward in the monitoring program before attributing Westslope Cutthroat Trout population declines to mine influences.

Recommendations are presented primarily to ensure that as monitoring moves forward the alternative hypotheses and specifically the methodology failure hypothesis can be tested and the 2019 results confirmed or refuted through replication (*i.e.,* repeatability) with confidence in 2020. As such, it is essential to move forward in a hypothesis testing manner with the assumption it may be method failure and employ a study design requiring both replication and more rigorous methodology employed in the earlier assessment years (2012, 2013, 2014).

Recommendations include two principle lines of evaluation, 1) A review of available databases to determine possible mechanisms for the observed population decline and as a means to evaluate ways to eliminate or mitigate potential stressors, and 2) Replication of the monitoring program in 2020 including more rigorous methods to support confidence in the 2019 and 2020 results.

1. A desktop investigation should be designed and implemented during the winter of 2019/2020 that compiles and evaluates all available data among the various operational, monitoring and assessment projects within the upper Fording River. The evaluation should proceed using a hypothesis testing methodological approach to identify factors/stressors and their likelihood for population level impacts both mine related and natural variation in terms of both acute and chronic conditions. Note that this recommendation has been accepted by Teck, regulators and KNC. Consultation and input is proceeding through a technical group of experts from committees that provide input to Teck on existing programs/permits such as the EVFFHC and the EMC in developing the scope of investigation. The following hypotheses are presented as preliminary for discussion purposes related to this monitoring project and a more comprehensive list of hypotheses and potential factors for investigation are expected through the consultation and input process; one or more of these hypotheses may require testing depending on results of the evaluation. There are two concerns that need to be understood and addressed: 1) the steep decline in adult fish between September 2017 and September 2019; and 2) the decrease in fry and juvenile densities suggesting a recruitment issue. The potential causes for these two concerns may be separate and should be investigated as such.

   H^{O1} – the decline is not accurate and represents a failure in the methodology through one or more contributing factors that influenced the CPUE indexing methods that are extremely sensitive to methodology deviations that affect catchability.

H^{O2} – the decline is accurate and there has been some acute mortality event between September 2017 and September 2019.

H^{O3} – the decline is accurate and cumulative (multi-factor) effects may be impacting the fish population through a number of mechanisms (*i.e.,* water quality and quantity, calcite, nutrient eutrophication, channel alterations, fish mortality events, fish salvages, fish handling and sampling, predation, poaching, etc.).

H^{O4} – the decline is accurate and a result of regional climatic effects and natural variation. The upper Fording River represents an isolated headwater tributary with natural limitations in productive potential and geographic extent and such populations are identified as susceptible to extreme stochastic events and environmental change (DFO 2017).

2. The following recommendations are made to evaluate hypothesis H^{O1} (the decline is not accurate and represents a failure in the methodology). Testing in 2020 will occur through replication of the monitoring program in 2020 including more rigorous methods to confirm confidence in the 2019 and 2020 results. This requires scheduling early in 2020 so specialized individuals can be available at very specific times to repeat work done in previous years; recognizing the CPUE indexing methods are extremely sensitive to methodology deviations that affect catchability.

    - The standardized monitoring program with specific control measures to minimize observer variation should be replicated in 2020 rather than wait for the next scheduled monitoring event in 2021. Alternate year sampling was a protective mitigation measure employed in study design to minimize potential handling sensitivities to the fish population; however, given the magnitude of the estimated population decline and the importance of the data to direct management actions, replication is essential to confirm both the population decline and the magnitude of the decline and/or recovery. This includes the three- pass removal-depletion electrofishing within the 16 representative locations containing 48 individual meso-habitat enclosures (recruitment and juvenile estimate) and the snorkel survey of the 48.37 km of mainstem Fording River and Henretta Creek (sub-adult and adult count and estimation). Mitigation measures to protect remaining fish from possible electrofishing, handling and PIT tagging sensitivity include; (1) alternate year sampling or every three years for the subsequent 10 year monitoring plan (2021-2030) to be developed in consultation with Teck, management agencies and KNC as a way to mitigate potential effects, (2) only senior staffing with experience in threatened species and populations with specialized handling experience, and (3) elimination of PIT tagging fish captured through electrofishing as unwarranted or paused until population recovery as less handling is preferred. One minor alteration was recommended; the electrofishing should be completed three weeks later (September 10 – 25) to ensure all fry have emerged and are available for capture. The 2020 report represents the 10 year wrap up of the original study design and will require consultation and input from the monitor, Teck and the EVFFHC or it's equivalent to develop the study design for the next 10 years of population trend monitoring (2021 – 2030).

    - An additional two snorkel surveys are recommended for increased rigour and confidence in the results. These surveys would replicate all control measures to minimize observer variation where possible with the exception of altered timing. The three surveys in total would include; 1) July 22 – 30, 2020. The objective of this survey is to enumerate

Westslope Cutthroat Trout post-spawning when they are in their summer feeding habitats. During this time period fish are more widely distributed (Cope *et al.* 2016) resulting in a less “clumped” distribution and there would be less likelihood of missing a large aggregation of fish. The counter point would be that flows will be higher earlier in the season and higher flows typically result in lower observer efficiency. 2) September 2 – 10, 2020. The objective of this survey is to replicate the 2019 survey which represents the standardized methods employed in 2012, 2013, 2014, 2017, and 2019. 3) October 13 – 21, 2020. The objective of this survey is to capture the early over-wintering period during low flows and when fish have, for the most part, moved into over-wintering areas and form aggregations. These dates will be adjusted based on flow and weather conditions in 2020 to complete the surveys during the appropriate targeted period.

- The replication of the angling effort completed in 2012, 2013, and 2014 is recommended. The objective of this survey was to provide a second independent sub-adult and adult assessment method to confirm relative abundance. It is intended to utilize the same two professional anglers and the tagging specialist who completed all three previous surveys. Replication of this method will utilize the same staff to maintain consistency in search patterns and effort so that CPUE can be compared among years to validate snorkel survey results. Methods involve two 10 day passes traversing the stream channel on foot from Josephine falls up to the headwaters (including mainstem Fording River, Henretta, Chauncey, and Ewin Creeks). Fish are PIT tagged during the first pass (August 4 – 13, 2020) to insure fish captured during the second pass (August 18 – 27) are unique individuals. The use of an endangered species tagging specialist with 25 years’ experience will be employed to ensure handling and PIT tagging sensitivities are mitigated. In the past, Floy Tags were used; however, the assessment report noted that Floy Tags likely increased mortality from predators so PIT tagging is recommended. PIT tags will minimize potential mortality sources while still providing confidence in relative abundance estimates. Floy Tags would allow mark – recapture estimation methods for the September and October snorkel surveys but must be balanced by the need to protect fish from all potential sources of mortality as an interim precautionary measure.

- The completion of spawning surveys to enumerate redds and spawning adults was recommended. Repeating the effort and spatial extent of surveys completed in 2014 and 2015 would provide an index of redd and adult abundance and distribution that would inform both impact hypotheses and population abundance. Provided conditions were conducive to success in terms of flows and water clarity (*i.e.,* visibility), five spawning surveys were recommended over the spawning season (May 15 – July 15); for example May 25 – 28, June 9 – 12, June 22 – 25, July 6 – 9, and July 14 – 17. Each survey represents 4 days to traverse the entire watershed. Locations to visit during the spawning survey will include all sites identified in 2015 (*see* Section 3.3.1.6.1 Spawning; Cope *et al.* 2016). These include but are not limited to the following high density spawning areas, 1) Clode Flats and associated tributary habitat, 2) Segment S6 groundwater upwelling area and side-channels, 3) Segment S6 Fording River Oxbow, 4) mid-river log jams, 5) Dry Creek and Segment S3, lower river (Segment S2) log jams, and Greenhills Creek.

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Appendix A

Habitat Off-setting Sub-section Snorkel Data

Appendix A. Snorkel Count Data for individual sub-sections used for habitat off-setting effectiveness evaluation and reaches used for population monitoring (shaded reach totals). *See* Robinson 2020 (*in prep.*) for habitat off-setting effectiveness evaluation.

						Snorkel Count WCT (no Marks)							Tag Observations		
Date	Water Body	Reach	Section	Horizontal Secchi Visibility (m)	Snorkel Length (km)	1-100	100-200	200-300	300-400	400-500	500+	Total > 200	Floy Yellow	Floy Pink	Radio Antenae
Sept 6 2019	Fish Pond Cr	1	FISH1-1T	10		0	0	0	0	0	0	0			
Sept 6 2019	Unnamed Trib to Fish Pond Cr			10		0	1	0	0	0	0	0			
Sept 4 2019	Henretta Cr	3	HEN2-2C	5		0	0	0	0	0	0	0			
Sept 4 2019	Henretta Cr	3	HEN2-1T	5		0	0	0	0	0	0	0			
Sept 4 2019	Henretta Lake	2		7	0.50	0	0	4	6	3	0	13		2	
Sept 4 2019	Henretta Cr	1	HEN1-2T	5		0	0	0	0	0	0	0			
Sept 4 2019	Henretta Cr	1	HEN1-1	7		0	0	0	0	0	0	0			
Sept 4 2019	Henretta Cr	1		6	1.00	0	0	0	0	0	0	0			
Sept 5 2019	Fording River	10	10-1	6		4	50	21	0	0	0	21			
Sept 5 2019	Fording River	10	10-2C	6		0	2	3	0	0	0	3			
Sept 5 2019	Fording River	10	10-1T	6		0	0	0	0	0	0	0			
Sept 5 2019	Fording River	10		6	4.35	4	52	24	0	0	0	24			
Sept 5 2019	Fording River	9	9-6T	5		0	0	0	0	0	0	0			
Sept 5 2019	Fording River	9	9-5	5		0	0	0	0	0	0	0			
Sept 5 2019	Fording River	9	9-4T	5		0	0	0	0	0	0	0			
Sept 5 2019	Fording River	9	9-3C	5		1	0	0	0	0	0	0			
Sept 5 2019	Fording River	9	9-2	5		0	0	0	0	0	0	0			
Sept 5 2019	Fording River	9	9-1T	5		0	0	0	0	0	0	0			
Sept 5 2019	Fording River	9		5	3.65	1	0	0	0	0	0	0			
Sept 6 2019	Fording River	8	8-7T	5		0	0	0	0	0	0	0			
Sept 6 2019	Fording River	8	8-6C	5		0	0	0	0	0	0	0			
Sept 6 2019	Fording River	8	8-5T	7		0	0	0	0	0	0	0			
Sept 6 2019	Fording River	8	8-4T	5		1	0	1	0	0	0	1			
Sept 6 2019	Fording River	8	8-3C	5		0	0	1	0	0	0	1			
Sept 6 2019	Fording River	8	8-2T	5		0	0	0	0	0	0	0			
Sept 6 2019	Fording River	8	8-1C	5		0	1	2	0	0	0	2			
Sept 6 2019	Fording River	8		5	5.75	1	1	4	0	0	0	4			
Sept 7 2019	Fording River	7	7-3T	4		0	0	0	0	0	0	0			
Sept 7 2019	Fording River	7	7-2C	5		0	0	0	0	0	0	0			
Sept 7 2019	Fording River	7	7-1	5		0	0	0	0	0	0	0			
Sept 7 2019	Fording River	7		5	5.04	0	0	0	0	0	0	0			

Appendix A. Concluded.

Date	Water Body	Reach	Section	Horizontal Secchi Visibility (m)	Snorkel Length (km)	Snorkel Count WCT (no Marks) 1-100	100-200	200-300	300-400	400-500	500+	Total > 200	Tag Observations Floy Yellow	Floy Pink	Radio Antenae
Sept 8 2019	Fording River	6	6-Top	4		0	1	0	0	0	0	0			
Sept 8 2019	Fording River	6	6-Bottom	5		0	0	0	0	0	0	0			
Sept 8 2019	Fording River	6		5	7.00	0	1	0	0	0	0	0			
Sept 9 2019	Fording River	5		5	4.40	0	0	0	0	0	0	0			
Sept 9 2019	Fording River	4		5	4.40	0	0	0	5	0	0	5			
Sept 10 2019	Fording River	3		5	4.16	0	0	1	0	0	0	1			
Sept 10 2019	Fording River	2		5	4.00	0	2	33	12	0	0	45			
Sept 11 2019	Fording River	1		5	4.12	0	1	12	0	0	0	12			
Totals					48.37							104			

(Shaded) River Segments used for Population Monitoring (2012, 2013, 2014, 2017). Remaining sub-segments added in 2017 for habitat off-setting effectiveness monitoring (see Lotic Environmental 2017).

Appendix B

Fish Data Summary

Electrofishing Data

Table B1. Reference and Location Information Fish Data Summary.

Reference Number	Gazetted Name Name	Alias (Local Name)	Watershed Code	Reach #	Site #	Survey Date	UTM Zone	UTM Easting	UTM Northing
1	Fording River	Upper Fording river	349-248100-48300	11	1	2019-08-22	11	653058	5569815
2	Fording River	Upper Fording river	349-248100-48300	11	2	2019-08-22	11	653051	5569849
3	Fording River	Upper Fording river	349-248100-48300	11	3	2019-08-22	11	653071	5569897
4	Fording River	Upper Fording river	349-248100-48300	10	1	2019-08-23	11	652167	5567989
5	Fording River	Upper Fording river	349-248100-48300	10	2	2019-08-23	11	652170	5568020
6	Fording River	Upper Fording river	349-248100-48300	10	3	2019-08-23	11	652191	5568087
7	Fording River	Upper Fording river	349-248100-48300	8	1	2019-08-20	11	650932	5563694
8	Fording River	Upper Fording river	349-248100-48300	8	2	2019-08-20	11	650880	5563745
9	Fording River	Upper Fording river	349-248100-48300	8	3	2019-08-20	11	650896	5563811
10	Fording River	Upper Fording river	349-248100-48300	8	4	2019-08-20	11	650930	5563814
11	Fording River	Upper Fording river	349-248100-48300	8	5	2019-08-26	11	651091	5563094
12	Fording River	Upper Fording river	349-248100-48300	8	6	2019-08-26	11	651079	5563121
13	Fording River	Upper Fording river	349-248100-48300	8	7	2019-08-26	11	651070	5563206
14	Fording River	Upper Fording river	349-248100-48300	6	1	2019-08-26	11	653874	5555871
15	Fording River	Upper Fording river	349-248100-48300	6	2	2019-08-26	11	653887	5555877
16	Fording River	Upper Fording river	349-248100-48300	6	3	2019-08-26	11	653882	5555877
17	Fording River	Upper Fording river	349-248100-48300	3	1	2019-08-26	11	656519	5546816
18	Fording River	Upper Fording river	349-248100-48300	3	2	2019-08-26	11	656535	5546828
19	Fording River	Upper Fording river	349-248100-48300	3	3	2019-08-26	11	656554	5546858
20	Fording River	Upper Fording river	349-248100-48300	2	1	2019-08-27	11	654486	5544119
21	Fording River	Upper Fording river	349-248100-48300	2	2	2019-08-27	11	654506	5544154
22	Fording River	Upper Fording river	349-248100-48300	2	3	2019-08-27	11	654460	5544154
23	Henretta Creek	below culvert	349-248100-48300-81900	1	1	2019-08-21	11	651855	5566258
24	Henretta Creek	below culvert	349-248100-48300-81900	1	2	2019-08-21	11	651896	5566269
25	Henretta Creek	below culvert	349-248100-48300-81900	1	3	2019-08-21	11	651985	5566270
26	Henretta Creek	Above Lake	349-248100-48300-81900	3	1	2019-08-21	11	653446	5566925
27	Henretta Creek	Above Lake	349-248100-48300-81900	3	2	2019-08-21	11	653459	5566925
28	Henretta Creek	Above Lake	349-248100-48300-81900	3	3	2019-08-21	11	653498	5566930
29	Fording River	Fish Pond Creek	349-248100-48300	1	1	2019-08-19	11	650928	5564760
30	Fording River	Fish Pond Creek	349-248100-48300	1	2	2019-08-19	11	650950	5564733
31	Fording River	Fish Pond Creek	349-248100-48300	1	3	2019-08-19	11	650930	5564691
32	Fording River	Unnamed Trib to Fish P	349-248100-48300	1	1	2019-08-19	11	650997	5564774
33	Fording River	Unnamed Trib to Fish P	349-248100-48300	1	2	2019-08-19	11	651057	5564854
34	Fording River	Unnamed Trib to Fish P	349-248100-48300	1	3	2019-08-19	11	651078	5564877
35	Chauncey Creek	below culvert	349-248100-48300-53900	1	1	2019-08-24	11	655663	5552732
36	Chauncey Creek	below culvert	349-248100-48300-53900	1	2	2019-08-24	11	655681	5552756
37	Chauncey Creek	below culvert	349-248100-48300-53900	1	3	2019-08-24	11	655683	5552752
38	Chauncey Creek	above culvert	349-248100-48300-53900	2	1	2019-08-24	11	656305	5553128
39	Chauncey Creek	above culvert	349-248100-48300-53900	2	2	2019-08-24	11	656295	5553151
40	Chauncey Creek	above culvert	349-248100-48300-53900	2	3	2019-08-24	11	656311	5553188
41	Ewin Creek		349-248100-48300-42800	3	1	2019-08-25	11	659100	5547221
42	Ewin Creek		349-248100-48300-42800	3	2	2019-08-25	11	659211	5547180
43	Ewin Creek		349-248100-48300-42800	3	3	2019-08-25	11	659252	5547167
44	Dry Creek	below culvert	349-248100-48300-39300	1	1	2019-08-28	11	655973	5544834
45	Dry Creek	below culvert	349-248100-48300-39300	1	2	2019-08-28	11	656271	5545045
46	Dry Creek	below culvert	349-248100-48300-39300	1	3	2019-08-28	11	656306	5544991
47	Greenhills Creek	below culvert	349-248100-48300-32200	1	1	2019-08-28	11	653500	5545599
48	Greenhills Creek	below culvert	349-248100-48300-32200	1	2	2019-08-28	11	653527	5545622
49	Greenhills Creek	below culvert	349-248100-48300-32200	1	3	2019-08-28	11	653540	5545609

Continued

Table B1. Reference and Location Information Fish Data Summary continued.

Reference Number	Gazetted Name Name	Alias (Local Name)	Watershed Code	Reach #	Site #	Survey Date	UTM Zone	UTM Easting	UTM Northing
50	Fording River	UFR 49-2	349-248100-48300	8	1	2019-08-20	11	650780	5563974
51	Fording River	UFR 49-2	349-248100-48300	8	2	2019-08-20	11	650748	5564042
52	Fording River	UFR 49-2	349-248100-48300	8	3	2019-08-20	11	650744	5564074
53	Fording River	UFR 49-2	349-248100-48300	8	4	2019-08-20	11	650711	5564140
54	Fording River	UFR 47-2	349-248100-48300	8	1	2019-08-22	11	651115	5562346
55	Fording River	UFR 47-2	349-248100-48300	8	2	2019-08-22	11	651126	5562370
56	Fording River	UFR 47-2	349-248100-48300	8	3	2019-08-22	11	651116	5562330
57	Fording River	UFR 47-2	349-248100-48300	8	4	2019-08-22	11	651115	5562346
58	Fording River	UFR 47-1	349-248100-48300	8	1	2019-08-23	11	651155	5561751
59	Fording River	UFR 47-1	349-248100-48300	8	2	2019-08-23	11	651167	5561796
60	Fording River	UFR 47-1	349-248100-48300	8	3	2019-08-23	11	651172	5561836

.Concluded

Table B2. Fish Collection Data Fish Data Summary.

Reference Number	Gazetted Name	Local Name	Reach #	Site #	Temp. (˚C)	Cond. (µS/cm)	Turbidity	Sample Method	Pass #	EF Seconds	EF Length (m)	EF Width (m)	Enclosure	Volt	Freq.	Pulse	Species	Stage	Total #	Min Length (mm)	Max Length (mm)	Comments
1	Fording River	Upper Fording river	11	1	7.2	243	clear	EF	1	284	14.5	5.77	closed	275	60	6	WCT	Juv	3	173	232	Pool Photo 4521,4522,4523
1	Fording River	Upper Fording river	11	1	7.2	243	clear	EF	2	314	14.5	5.77	closed	275	60	6	NFC					
1	Fording River	Upper Fording river	11	1	7.2	243	clear	EF	3	257	14.5	5.77	closed	275	60	6	NFC					
2	Fording River	Upper Fording river	11	2	7.2	243	clear	EF	1	542	31	4.4	Closed	275	60	6	WCT	Juv	8	142	203	Riffle Photo 4524,4525, 4526, 4527
2	Fording River	Upper Fording river	11	2	7.2	243	clear	EF	2	468	31	4.4	Closed	275	60	6	WCT	Juv	1	122		
2	Fording River	Upper Fording river	11	2	7.2	243	clear	EF	3	448	31	4.4	Closed	275	60	6	NFC					
3	Fording River	Upper Fording river	11	3	7.2	243	clear	EF	1	396	20.9	4.82	Closed	275	60	6	WCT	Juv	2	161	233	Glide Photo 4528,4529,4530
3	Fording River	Upper Fording river	11	3	7.2	243	clear	EF	2	376	20.9	4.82	Closed	275	60	6	NFC					
3	Fording River	Upper Fording river	11	3	7.2	243	clear	EF	3	392	20.9	4.82	Closed	275	60	6	NFC					
4	Fording River	Upper Fording river	10	1	7.5	250	clear	EF	1	388	21.1	3.38	Closed	275	60	6	NFC					Side-channel Photo 4531, 4532, 4533
4	Fording River	Upper Fording river	10	1	7.5	250	clear	EF	2	404	21.1	3.38	Closed	275	60	6	NFC					
5	Fording River	Upper Fording river	10	2	7.5	250	clear	EF	1	577	27	4.65	Closed	275	50	6	WCT	Juv	3	150	192	Riffle -Braid Photo 4534,4535, 4536
5	Fording River	Upper Fording river	10	2	7.5	250	clear	EF	2	584	27	4.65	Closed	275	50	6	NFC					
6	Fording River	Upper Fording river	10	3	7.5	250	clear	EF	1	401	22.25	5.3	Closed	275	50	6	NFC					Pool Photo 4537, 4538, 4539
6	Fording River	Upper Fording river	10	3	7.5	250	clear	EF	2	438	22.3	5.3	Closed	275	50	6	NFC					
7	Fording River	Upper Fording river	8	1	8.1	501	clear	EF	1	540	19.4	7.6	Closed	150	50	6	NFC					Pool Photo 1195, 1196
7	Fording River	Upper Fording river	8	1	8.1	501	clear	EF	2	510	19.4	7.6	Closed	150	50	6	NFC					
8	Fording River	Upper Fording river	8	2	12.3	491	clear	EF	1	738	42.5	2.3	Closed	150	50	6	NFC					Side-channel photo 1197, 1198,1199
8	Fording River	Upper Fording river	8	2	12.3	491	clear	EF	2	810	42.5	2.3	Closed	150	50	6	NFC					
9	Fording River	Upper Fording river	8	3	12.3	491	clear	EF	1	649	29	4.2	Closed	150	50	6	NFC					Side-channel photo 1200, 1201, 1202
9	Fording River	Upper Fording river	8	3	12.3	491	clear	EF	2	621	29	4.2	Closed	150	50	6	NFC					
10	Fording River	Upper Fording river	8	4	12.2	489	clear	EF	1	383	22	3.5	Closed	150	50	6	NFC					Riffle - Braid Photo 1203, 1204, 1205
10	Fording River	Upper Fording river	8	4	12.2	489	clear	EF	2	383	22	3.5	Closed	150	50	6	NFC					
11	Fording River	Upper Fording river	8	5	7.5	514	clear	EF	1	288	10.5	10.1	Partial enc	190	50	6	WCT	Juv	1	91		Riffle photo 4559, 4560, 4561
11	Fording River	Upper Fording river	8	5	7.5	514	clear	EF	2	346	10.5	10.1	Partial enc	190	50	6	WCT	Juv	2	84	209	
11	Fording River	Upper Fording river	8	5	7.5	514	clear	EF	3	308	10.5	10.1	Partial enc	190	50	6	WCT	Juv	1	83		
12	Fording River	Upper Fording river	8	6	7.5	514	clear	EF	1	185	18.7	7.7	Partial enc	190	50	6	NFC					Glide Photo 4567,4568, 4569, 4570
12	Fording River	Upper Fording river	8	6	7.5	514	clear	EF	2	218	18.7	7.7	Partial enc	190	50	6	NFC					
12	Fording River	Upper Fording river	8	6	7.5	514	clear	EF	3	218	18.7	7.7	Partial enc	190	50	6	NFC					
13	Fording River	Upper Fording river	8	7	10.7	483	clear	EF	1	762	44.7	3.1	Closed	190	50	6	WCT	Juv	3	68	147	Side Channel Photo 4571, 4572, 4573, 4574
13	Fording River	Upper Fording river	8	7	10.7	483	clear	EF	2	707	44.7	3.1	Closed	190	50	6	WCT	Juv	1	70		
13	Fording River	Upper Fording river	8	7	10.7	483	clear	EF	3	694	44.7	3.1	Closed	190	50	6	WCT	Juv	1	96		
14	Fording River	Upper Fording river	6	1	6.9	852	clear	EF	1	450	13	6	Closed	150	60	8	NFC					Pool Photos 1251, 1252, 1253
14	Fording River	Upper Fording river	6	1	6.9	852	clear	EF	2	445	13	6	Closed	150	60	8	NFC					
15	Fording River	Upper Fording river	6	2	10.1	853	clear	EF	1	474	13.8	3.85	Closed	150	60	8	NFC					Riffle Photos 1254, 1255, 1256
15	Fording River	Upper Fording river	6	2	10.1	853	clear	EF	2	450	13.8	3.9	Closed	150	60	8	WCT	Juv	1			
15	Fording River	Upper Fording river	6	2	10.1	853	clear	EF	3	450	13.8	3.9	Closed	150	60	8	NFC					
16	Fording River	Upper Fording river	6	3	10.1	853	clear	EF	1	646	26.1	2	Closed	150	60	8	WCT	Juv	2			Glide Photo 1257, 1258, 1259, 1260
16	Fording River	Upper Fording river	6	3	10.1	853	clear	EF	2	650	26.1	2	Closed	150	60	8	WCT	Juv	2			
16	Fording River	Upper Fording river	6	3	10.1	853	clear	EF	3	545	26.1	2	Closed	150	60	8	NFC					
17	Fording River	Upper Fording river	3	1	6.8	589	clear	EF	1	316	20.3	5.37	Closed	200	60	8	NFC					Riffle Photos 4550, 4551, 4552
17	Fording River	Upper Fording river	3	1	6.8	589	clear	EF	2	332	20.3	5.37	Closed	200	60	8	NFC					
18	Fording River	Upper Fording river	3	2	6.8	589	clear	EF	1	510	25.2	7.75	Closed	175	40	8	NFC					Pool Photos 4553, 4554, 4555
18	Fording River	Upper Fording river	3	2	6.8	589	clear	EF	2	663	25.2	7.75	Closed	175	40	8	NFC					
19	Fording River	Upper Fording river	3	3	7.3	591	clear	EF	1	506	21.8	9.87	Closed	175	40	8	WCT	Juv	1	86		Glide Photos 4556, 4557, 4558
19	Fording River	Upper Fording river	3	3	7.3	591	clear	EF	2	548	21.8	9.87	Closed	175	40	8	WCT	Juv	1	84		
19	Fording River	Upper Fording river	3	3	7.3	591	clear	EF	3	558	21.8	9.87	Closed	175	40	8	NFC					
20	Fording River	Upper Fording river	2	1	5.9	676	clear	EF	1	724	28.5	3.9	Closed	200	60	6	NFC					Side channel Photos 1261, 1262, 1263

continued

Table B2. Fish Collection Data Fish Data Summary continued.

Reference Number	Gazetted Name	Local Name	Reach #	Site #	Temp. (˚C)	Cond. (µS/cm)	Turbidity	Sample Method	Pass #	EF Seconds	EF Length (m)	EF Width (m)	Enclosure	Volt	Freq.	Pulse	Species	Stage	Total #	Min Length (mm)	Max Length (mm)	Comments
20	Fording River	Upper Fording river	2	1	5.9	676	clear	EF	2	724	28.5	3.9	Closed	200	60	6	WCT	Juv	1	75		
20	Fording River	Upper Fording river	2	1	5.9	676	clear	EF	3	674	28.5	3.9	Closed	200	60	6	WCT	Juv	1	72		
21	Fording River	Upper Fording river	2	2	6.4	672	clear	EF	1	415	13	7.4	Closed	200	60	6	NFC					Glide Photos 1268, 1269, 1270
21	Fording River	Upper Fording river	2	2	6.4	672	clear	EF	2	417	13	7.4	Closed	200	60	6	NFC					
22	Fording River	Upper Fording river	2	3	6.4	672	clear	EF	1	427	10.2	4.5	Closed	200	60	6	NFC					riffle Photos 1265, 1266, 1267
22	Fording River	Upper Fording river	2	3	6.4	672	clear	EF	2	455	10.2	4.5	Closed	200	60	6	NFC					
22	Fording River	Upper Fording river	2	3	6.4	672	clear	EF	3	440	10.2	4.5	Closed	200	60	6	NFC					
23	Henretta Creek	below culvert	1	1	8.1	433	clear	EF	1	595	12.5	9.1	Closed	150	50	8	WCT	Juv	1	152		Side Channel Photos 1106, 1107, 1108
23	Henretta Creek	below culvert	1	1	8.1	433	clear	EF	2	610	12.5	9.1	Closed	150	50	8	WCT	Juv	2	130	172	
23	Henretta Creek	below culvert	1	1	8.1	433	clear	EF	3	605	12.5	9.1	Closed	150	50	8	WCT	Juv	1	100		
23	Henretta Creek	below culvert	1	1	8.1	433	clear	EF	4	622	12.5	9.1	Closed	150	50	8	NFC					
24	Henretta Creek	below culvert	1	2	9.3	419	clear	EF	1	827	20	5	Partial enc	150	50	8	NFC					Glide Photo 1109, 1110, 1111
24	Henretta Creek	below culvert	1	2	9.3	419	clear	EF	2	762	20	5	Partial enc	150	50	8	NFC					
25	Henretta Creek	below culvert	1	3	9.3	419	clear	EF	1	866	11	12.1	Partial enc	150	50	8	WCT	Juv	7	67	210	Riffle Photo 1112, 1113, 1114
25	Henretta Creek	below culvert	1	3	9.3	419	clear	EF	2	800	11	12.1	Partial enc	150	50	8	WCT	Juv	1	137		
25	Henretta Creek	below culvert	1	3	9.3	419	clear	EF	3	677	11	12.1	Partial enc	150	50	8	NFC					
26	Henretta Creek	Above Lake	3	1	6.7	273	clear	EF	1	292	16	8.15	Partial enc	240	60	8	NFC					Riffle Photo 4512, 4513, 4514
27	Henretta Creek	Above Lake	3	2	6.7	273	clear	EF	1	241	15.7	9.92	Partial enc	240	60	8	NFC					Glide Photo 4515, 4516, 4517
27	Henretta Creek	Above Lake	3	2	6.7	273	clear	EF	2	283	15.7	9.92	Partial enc	240	60	8	NFC					
28	Henretta Creek	Above Lake	3	3	8.3	273	clear	EF	1	308	20.1	5.8	Partial enc	240	60	8	NFC					Pool Photo 4518, 4519, 4520
28	Henretta Creek	Above Lake	3	3	8.3	273	clear	EF	2	300	20.1	5.8	Partial enc	240	60	8	NFC					
29	Fording River	Fish Pond Creek	1	1	11.8	393	clear	EF	1	573	14.6	4.65	Closed	175	60	6	WCT	Juv	6	73	174	Riffle Photo 1189, 1190, 1191
29	Fording River	Fish Pond Creek	1	1	11.8	393	clear	EF	2	567	14.6	4.65	Closed	175	60	6	WCT	Juv	4	72	163	
29	Fording River	Fish Pond Creek	1	1	11.8	393	clear	EF	3	575	14.6	4.65	Closed	175	60	6	WCT	Juv	2	86	91	
30	Fording River	Fish Pond Creek	1	2	11	390	clear	EF	1	826	16.6	5	Closed	175	60	6	WCT	Juv	8	74	153	Riffle Photo 1186, 1187, 1188
30	Fording River	Fish Pond Creek	1	2	11	390	clear	EF	2	835	16.6	5	Closed	175	60	6	WCT	Juv	4	67	81	
30	Fording River	Fish Pond Creek	1	2	11	390	clear	EF	3	825	16.6	5	Closed	175	60	6	WCT	Juv	1	74		
31	Fording River	Fish Pond Creek	1	3	11.2	398	clear	EF	1	411	11.8	4.13	Closed	175	60	6	WCT	Juv	6	67	150	Glide - Riffle Photo 1192, 1193, 1194
31	Fording River	Fish Pond Creek	1	3	11.2	398	clear	EF	2	446	11.8	4.13	Closed	175	60	6	NFC					
31	Fording River	Fish Pond Creek	1	3	11.2	398	clear	EF	3	417	11.8	4.13	Closed	175	60	6	NFC					
32	Fording River	Unnamed Trib to Fish	1	1	9.1	315	clear	EF	1	300	23.5	2.6	Closed	200	50	8	WCT	Juv	8	78	211	Riffle Photo 4474, 4475, 4476-78
32	Fording River	Unnamed Trib to Fish	1	1	9.1	315	clear	EF	2	354	23.5	2.6	Closed	200	50	8	WCT	Juv	9	80	153	
32	Fording River	Unnamed Trib to Fish	1	1	9.1	315	clear	EF	3	689	23.5	2.6	Closed	200	50	8	WCT	Juv	7	72	100	
33	Fording River	Unnamed Trib to Fish	1	2	9.1	317	clear	EF	1	335	29.5	2.9	Closed	200	50	8	WCT	Juv	1	89		Glide/Riffle Photo 4479, 4480, 4481-83
33	Fording River	Unnamed Trib to Fish	1	2	9.1	317	clear	EF	2	310	29.5	2.9	Closed	200	50	8	WCT	Juv	1	87		
33	Fording River	Unnamed Trib to Fish	1	2	9.1	317	clear	EF	3	307	29.5	2.9	Closed	200	50	8	NFC					
34	Fording River	Unnamed Trib to Fish	1	3	9.6	316	clear	EF	1	510	35.6	2.6	Closed	200	50	8	WCT	Juv	21	66	162	Glide/Cascade Photo 4484, 4485, 4486
34	Fording River	Unnamed Trib to Fish	1	3	9.6	316	clear	EF	2	635	35.6	2.6	Closed	200	50	8	WCT	Juv	8	73	97	
34	Fording River	Unnamed Trib to Fish	1	3	9.6	316	clear	EF	3	556	35.6	2.6	Closed	200	50	8	WCT	Juv	2	91	150	
35	Chauncey Creek	below culvert	1	1	5	267	clear	EF	1	987	30	4	Closed	250	60	6	WCT	Juv	1	124		Pool Photo 1233, 1234, 1235
35	Chauncey Creek	below culvert	1	1	5	267	clear	EF	2	1012	30	4	Closed	250	60	6	WCT	Juv	1	79		
35	Chauncey Creek	below culvert	1	1	5	267	clear	EF	3	989	30	4	Closed	250	60	6	NFC					
36	Chauncey Creek	below culvert	1	2	6.1	267	clear	EF	1	810	14.3	6.5	Closed	250	60	6	WCT	Juv	4	120	127	Riffle Photo 1236, 1237, 1238
36	Chauncey Creek	below culvert	1	2	6.1	267	clear	EF	2	825	14.3	6.5	Closed	250	60	6	WCT	Juv	1	135		
36	Chauncey Creek	below culvert	1	2	6.1	267	clear	EF	3	625	14.3	6.5	Closed	250	60	6	NFC					
37	Chauncey Creek	below culvert	1	3	6.8	267	clear	EF	1	400	11.5	4	Closed	250	60	6	NFC					Glide Photo 1239, 1240, 1241
37	Chauncey Creek	below culvert	1	3	6.8	267	clear	EF	2	372	11.5	4	Closed	250	60	6	WCT	Juv	1	134		

continued

Table B2. Fish Collection Data Fish Data Summary continued.

Reference Number	Gazetted Name	Local Name	Reach #	Site #	Temp. (˚C)	Cond. (µS/cm)	Turbidity	Sample Method	Pass #	EF Seconds	EF Length (m)	EF Width (m)	Enclosure	Volt	Freq.	Pulse	Species	Stage	Total #	Min Length (mm)	Max Length (mm)	Comments
37	Chauncey Creek	below culvert	1	3	6.8	267	clear	EF	3	802	11.5	4	Closed	250	60	6	NFC					
38	Chauncey Creek	above culvert	2	1	5.7	222	clear	EF	1	397	31	5.43	Partial enc	375	60	8	NFC					Side-Channel Photo 4540, 4541, 4542-43
38	Chauncey Creek	above culvert	2	1	5.7	222	clear	EF	2	446	31	5.43	Partial enc	375	60	8	NFC					
39	Chauncey Creek	above culvert	2	2	5.7	222	clear	EF	1	557	22.3	7.7	Closed	275	60	8	WCT	fry	1	48		Glide Photo 4544, 4545, 4546
39	Chauncey Creek	above culvert	2	2	5.7	222	clear	EF	1	557	22.3	7.7	Closed	275	60	8	WCT	Juv	1	180		
39	Chauncey Creek	above culvert	2	2	5.7	222	clear	EF	2	578	22.3	7.7	Closed	275	60	8	NFC					
39	Chauncey Creek	above culvert	2	2	5.7	222	clear	EF	3	607	22.3	7.7	Closed	275	60	8	NFC					
40	Chauncey Creek	above culvert	2	3	7.3	214	clear	EF	1	469	24.8	4.8	Closed	325	60	8	NFC					Riffle Photo 4547, 4548, 4549
40	Chauncey Creek	above culvert	2	3	7.3	214	clear	EF	2	468	24.8	4.8	Closed	325	60	8	WCT	Juv	1	198		
40	Chauncey Creek	above culvert	2	3	7.3	214	clear	EF	3	452	24.8	4.8	Closed	325	60	8	NFC					
41	Ewin Creek	0	3	1	6	321	clear	EF	1	827	25	4	Closed	250	60	6	NFC					Riffle Photo 1248, 1249, 1250
41	Ewin Creek	0	3	1	6	321	clear	EF	2	780	25	4	Closed	250	60	6	NFC					
42	Ewin Creek	0	3	2	4.4	323	clear	EF	1	823	16.5	4	Closed	250	60	6	WCT	Juv	1	165		Pool Photo 1242, 1243, 1244
42	Ewin Creek	0	3	2	4.4	323	clear	EF	2	610	16.5	4	Closed	250	60	6	WCT	Juv	1	138		
42	Ewin Creek	0	3	2	4.4	323	clear	EF	3	654	16.5	4	Closed	250	60	6	NFC					
43	Ewin Creek	0	3	3	5	322	clear	EF	1	495	19	3.8	Closed	250	60	6	WCT	adult	1	220		Glide Photo 1245, 1246, 1247
43	Ewin Creek	0	3	3	5	322	clear	EF	2	470	19	3.8	Closed	250	60	6	NFC					
43	Ewin Creek	0	3	3	5	322	clear	EF	3	415	19	3.8	Closed	250	60	6	NFC					
44	Dry Creek	below culvert	1	1	4.9	372	clear	EF	1	529	23	2.6	Partial enc	225	60	8	WCT	Juv	4	57	100	Glide Photo 4575, 4576, 4577
44	Dry Creek	below culvert	1	1	4.9	372	clear	EF	2	475	23	2.6	Partial enc	225	60	8	WCT	Juv	2	57	98	
44	Dry Creek	below culvert	1	1	4.9	372	clear	EF	3	502	23	2.6	Partial enc	225	60	8	WCT	Juv	2	64	68	
45	Dry Creek	below culvert	1	2	6.6	371	clear	EF	1	522	32	3	Closed	250	60	8	WCT	Juv	1	111		Pool Photo 4578, 4579, 4580
45	Dry Creek	below culvert	1	2	6.6	371	clear	EF	2	522	32	3	Closed	250	60	8	NFC					
45	Dry Creek	below culvert	1	2	6.6	371	clear	EF	3	415	32	3	Closed	250	60	8	WCT	Juv	1	173		
46	Dry Creek	below culvert	1	3	9.3	368	clear	EF	1	585	30	4.6	Closed	250	60	8	WCT	Juv	7	60	176	Run Photo 4581, 4582, 4583
46	Dry Creek	below culvert	1	3	9.3	368	clear	EF	2	477	30	4.6	Closed	250	60	8	WCT	Juv	1	68		
46	Dry Creek	below culvert	1	3	9.3	368	clear	EF	3	458	30	4.6	Closed	250	60	8	NFC					
47	Greenhills Creek	below culvert	1	1	13.5	1240	clear	EF	1	974	33	2.3	Closed	100	60	8	WCT	Juv	6	57	173	Photo 1271,1272, 1273
47	Greenhills Creek	below culvert	1	1	13.5	1240	clear	EF	2	871	33	2.3	Closed	100	60	8	NFC					
47	Greenhills Creek	below culvert	1	1	13.5	1240	clear	EF	3	728	33	2.3	Closed	100	60	8	NFC					
48	Greenhills Creek	below culvert	1	2	15.6	1350	clear	EF	1	613	25	2	Closed	100	60	8	WCT	Juv	4	84	167	Photo 1274, 1275, 1276
48	Greenhills Creek	below culvert	1	2	15.6	1350	clear	EF	2	630	25	2	Closed	100	60	8	WCT	Juv	1	149		
48	Greenhills Creek	below culvert	1	2	15.6	1350	clear	EF	3	570	25	2	Closed	100	60	8	WCT	Juv	1	132		
49	Greenhills Creek	below culvert	1	3	16.4	1234	clear	EF	1	782	30	2.3	Closed	100	60	8	WCT	Juv	3	81	105	Photo 1277, 1278, 1279
49	Greenhills Creek	below culvert	1	3	16.4	1234	clear	EF	2	642	30	2.3	Closed	100	60	8	WCT	Juv	2	97	119	
49	Greenhills Creek	below culvert	1	3	16.4	1234	clear	EF	3	587	30	2.3	Closed	100	60	8	WCT	Juv	1	94		
50	Fording River	UFR 49-2	8	1	8	392	clear	EF	1	405	25	6	Open	230	40	8	NFC					Pool Main Photo 4491, 4492-93, 4494-95
50	Fording River	UFR 49-2	8	1	8	392	clear	EF	2	455	25	6	Open	230	40	8	NFC					
51	Fording River	UFR 49-2	8	2	10.1	384	clear	EF	1	545	18.65	5.6	Closed	240	60	8	WCT	Juv	1	98		Riffle s/c Photo 4496, 4497, 4498-99
51	Fording River	UFR 49-2	8	2	10.1	384	clear	EF	2	507	18.65	5.6	Closed	240	60	8	NFC					
51	Fording River	UFR 49-2	8	2	10.1	384	clear	EF	3	464	18.65	5.6	Closed	240	60	8	NFC					
52	Fording River	UFR 49-2	8	3	11.3	381	clear	EF	1	431	21.5	5.6	Closed	240	60	8	WCT	Juv	1	78		Glide s/c Photo 4500, 4501, 4502-04
52	Fording River	UFR 49-2	8	3	11.3	381	clear	EF	1	530	21.5	5.6	Closed	240	60	8	NFC					
53	Fording River	UFR 49-2	8	4	11.3	383	clear	EF	1	620	17	3.5	Closed	240	60	8	WCT	Juv	1	85		Glide s/c Photo 4505,4506-09, 4511
53	Fording River	UFR 49-2	8	4	11.3	383	clear	EF	2	693	17	3.5	Closed	240	60	8	WCT	Juv	1	75		
53	Fording River	UFR 49-2	8	4	11.3	383	clear	EF	3	625	17	3.5	Closed	240	60	8	NFC					
54	Fording River	UFR 47-2	8	1	9.3	562	clear	EF	1	657	14.5	4.1	Partial enc	150	60	6	WCT	adult	1	220		Constructed Riffle Photo 1115, 1116, 1117

continued

Table B2. Fish Collection Data Fish Data Summary continued.

Reference Number	Gazetted Name	Local Name	Reach #	Site #	Temp. (˚C)	Cond. (µS/cm)	Turbidity	Sample Method	Pass #	EF Seconds	EF Length (m)	EF Width (m)	Enclosure	Volt	Freq.	Pulse	Species	Stage	Total #	Min Length (mm)	Max Length (mm)	Comments
54	Fording River	UFR 47-2	8	1	9.3	562	clear	EF	2	630	14.5	4.1	Partial enc	150	60	6	WCT	Juv	2	150	152	
54	Fording River	UFR 47-2	8	1	9.3	562	clear	EF	3	640	14.5	4.1	Partial enc	150	60	6	WCT	Juv	1	162		
54	Fording River	UFR 47-2	8	1	9.3	562	clear	EF	4	620	14.5	4.1	Partial enc	150	60	6	NFC					
55	Fording River	UFR 47-2	8	2	10.3	564	clear	EF	1	786	18.16	5.55	Partial enc	150	60	6	WCT	Juv	1	92		Constructed riffle Photo 1118, 1119, 1120
55	Fording River	UFR 47-2	8	2	10.3	564	clear	EF	2	740	18.16	5.55	Partial enc	150	60	6	NFC					
55	Fording River	UFR 47-2	8	2	10.3	564	clear	EF	3	720	18.16	5.55	Partial enc	150	60	6	NFC					
56	Fording River	UFR 47-2	8	3	10.7	566	clear	EF	1	655	15	4.8	Partial enc	150	60	6	NFC					Constructed riffle photo 1121, 1122, 1123
56	Fording River	UFR 47-2	8	3	10.7	566	clear	EF	2	727	15	4.8	Partial enc	150	60	6	NFC					
57	Fording River	UFR 47-2	8	4	10.7	566	clear	EF	1	381	14.5	4.1	Open	150	60	6	WCT	Juv	1	142		
58	Fording River	UFR 47-1	8	1	8.8	602	clear	EF	1	730	13	6.5	Partial enc	150	60	6	WCT	Juv	4	72	126	Constructed riffle photo 1224, 1225, 1226
58	Fording River	UFR 47-1	8	1	8.8	602	clear	EF	2	715	13	6.5	Partial enc	150	60	6	NFC					
58	Fording River	UFR 47-1	8	1	8.8	602	clear	EF	3	727	13	6.5	Partial enc	150	60	6	NFC					
59	Fording River	UFR 47-1	8	2	9.6	604	clear	EF	1	741	12.7	6.6	Partial enc	150	60	6	WCT	Juv	2	164	180	Constructed riffle photo 1227, 1228, 1229
59	Fording River	UFR 47-1	8	2	9.6	604	clear	EF	2	712	12.7	6.6	Partial enc	150	60	6	NFC					
59	Fording River	UFR 47-1	8	2	9.6	604	clear	EF	3	705	12.7	6.6	Partial enc	150	60	6	NFC					
60	Fording River	UFR 47-1	8	3	10	601	clear	EF	1	940	18.2	5	Partial enc	150	60	6	WCT	Juv	8	71	189	Glide Photo Constructed riffle 1230, 1231, 1233
60	Fording River	UFR 47-1	8	3	10	601	clear	EF	2	935	18.2	5	Partial enc	150	60	6	WCT	Juv	4	74	149	
60	Fording River	UFR 47-1	8	3	10	601	clear	EF	3	933	18.2	5	Partial enc	150	60	6	WCT	Juv	1	142		

concluded.

Table B3. Individual Fish data Fish Data Summary System.

Reference Number	Gazetted Name	Local Name	Reach #	Site #	Sample Method	Pass #	Species	Length (mm)	Weight (g)	Maturity	Comments
1	Fording River	Upper Fording river	11	1	EF	1	WCT	204	103	Maturing	Pit Tag # 982126054420032
1	Fording River	Upper Fording river	11	1	EF	1	WCT	232	165	Mature	Pit Tag # 982126054420062
1	Fording River	Upper Fording river	11	1	EF	1	WCT	173	67.7	Immature	Pit Tag # 982126054420115
2	Fording River	Upper Fording river	11	2	EF	1	WCT	203	96	Maturing	Pit Tag # 982126054420043
2	Fording River	Upper Fording river	11	2	EF	1	WCT	173	72.2	Immature	Pit Tag # 982126054420075
2	Fording River	Upper Fording river	11	2	EF	1	WCT	189	90	Immature	Pit Tag # 982126054420093
2	Fording River	Upper Fording river	11	2	EF	1	WCT	187	89.5	Immature	Pit Tag # 982126054420088
2	Fording River	Upper Fording river	11	2	EF	1	WCT	160	46.6	Immature	Pit Tag # 982126054420090
2	Fording River	Upper Fording river	11	2	EF	1	WCT	142	35.1	Immature	
2	Fording River	Upper Fording river	11	2	EF	1	WCT	193	97.9	Immature	Pit Tag # 982126054420061
2	Fording River	Upper Fording river	11	2	EF	1	WCT	182	77.3	Immature	Pit Tag # 982126054420101
2	Fording River	Upper Fording river	11	2	EF	2	WCT	122	19.4	Immature	Pit Tag # 982126054420104
3	Fording River	Upper Fording river	11	3	EF	1	WCT	233	178.7	Mature	Pit Tag # 982126054420119
3	Fording River	Upper Fording river	11	3	EF	1	WCT	161	51.4	Immature	Pit Tag # 982126054420081
5	Fording River	Upper Fording river	10	2	EF	1	WCT	163	62	Immature	Pit Tag # 982126054420044
5	Fording River	Upper Fording river	10	2	EF	1	WCT	192	106.4	Immature	Pit Tag # 982126054420048
5	Fording River	Upper Fording river	10	2	EF	1	WCT	150	37.3	Immature	Pit Tag # 982126054420122
11	Fording River	Upper Fording river	8	5	EF	1	WCT	91	6.9	Immature	
11	Fording River	Upper Fording river	8	5	EF	2	WCT	84	5.6	Immature	
11	Fording River	Upper Fording river	8	5	EF	2	WCT	209	119.2	Maturing	RECAP Pit Tag # 982000410690609
11	Fording River	Upper Fording river	8	5	EF	3	WCT	83	5.8	Immature	
13	Fording River	Upper Fording river	8	7	EF	1	WCT	147	34.6	Immature	Pit Tag # 982126054420108
13	Fording River	Upper Fording river	8	7	EF	1	WCT	133	27.5	Immature	Pit Tag # 982126054420117
13	Fording River	Upper Fording river	8	7	EF	1	WCT	68	3.5	Immature	
13	Fording River	Upper Fording river	8	7	EF	2	WCT	70	3.1	Immature	
13	Fording River	Upper Fording river	8	7	EF	3	WCT	96	10.5	Immature	Pit Tag # 982126054420094
15	Fording River	Upper Fording river	6	2	EF	2	WCT	182	69.2	Immature	Pit Tag # 982126054420206
16	Fording River	Upper Fording river	6	3	EF	1	WCT	73	4.9	Immature	
16	Fording River	Upper Fording river	6	3	EF	1	WCT	90	8.4	Immature	
16	Fording River	Upper Fording river	6	3	EF	2	WCT	89	6.8	Immature	
16	Fording River	Upper Fording river	6	3	EF	2	WCT	84	7.4	Immature	
19	Fording River	Upper Fording river	3	3	EF	1	WCT	86	8	Immature	Pit Tag # 982126054420026
19	Fording River	Upper Fording river	3	3	EF	2	WCT	84	6.4	Immature	
20	Fording River	Upper Fording river	2	1	EF	2	WCT	75	5.5	Immature	
20	Fording River	Upper Fording river	2	1	EF	3	WCT	72	5.2	Immature	
23	Henretta Creek	below culvert	1	1	EF	1	WCT	152	44.5	Immature	Pit Tag # 982126054420158
23	Henretta Creek	below culvert	1	1	EF	2	WCT	172	73.2	Immature	Pit Tag # 982126054420130
23	Henretta Creek	below culvert	1	1	EF	2	WCT	130	28.3	Immature	Pit Tag # 982126054420142
23	Henretta Creek	below culvert	1	1	EF	3	WCT	100		Immature	
25	Henretta Creek	below culvert	1	3	EF	1	WCT	67	3	Immature	
25	Henretta Creek	below culvert	1	3	EF	1	WCT	170	59.2	Immature	Pit Tag # 982126054420152
25	Henretta Creek	below culvert	1	3	EF	1	WCT	133	23.9	Immature	Pit Tag # 982126054420185
25	Henretta Creek	below culvert	1	3	EF	1	WCT	142	31.4	Immature	Pit Tag # 982126054420162
25	Henretta Creek	below culvert	1	3	EF	1	WCT	210	113.6	Maturing	Pit Tag # 982126054420150
25	Henretta Creek	below culvert	1	3	EF	1	WCT	147	31.7	Immature	Pit Tag # 982126054420222
25	Henretta Creek	below culvert	1	3	EF	1	WCT	88	7.4	Immature	
25	Henretta Creek	below culvert	1	3	EF	2	WCT	137	28.1	Immature	Pit Tag # 982126054420204
29	Fording River	Fish Pond Creek	1	1	EF	1	WCT	174	67.4	Immature	RECAP Pit Tag # 982000410690616
29	Fording River	Fish Pond Creek	1	1	EF	1	WCT	103	11.4	Immature	Pit Tag # 982126054420187
29	Fording River	Fish Pond Creek	1	1	EF	1	WCT	140	28	Immature	Pit Tag # 982126054420164
29	Fording River	Fish Pond Creek	1	1	EF	1	WCT	75	4.3	Immature	
29	Fording River	Fish Pond Creek	1	1	EF	1	WCT	93	10	Immature	
29	Fording River	Fish Pond Creek	1	1	EF	1	WCT	73	5.7	Immature	

continued

Table B3. Individual Fish data Fish Data Summary System continued.

Reference Number	Gazetted Name	Local Name	Reach #	Site #	Sample Method	Pass #	Species	Length (mm)	Weight (g)	Maturity	Comments
29	Fording River	Fish Pond Creek	1	1	EF	2	WCT	154	47.6	Immature	Pit Tag # 982126054420166
29	Fording River	Fish Pond Creek	1	1	EF	2	WCT	163	43.2	Immature	Pit Tag # 982126054420172
29	Fording River	Fish Pond Creek	1	1	EF	2	WCT	152	41.9	Immature	Pit Tag # 982126054420140
29	Fording River	Fish Pond Creek	1	1	EF	2	WCT	72	5.2	Immature	
29	Fording River	Fish Pond Creek	1	1	EF	3	WCT	86	7.6	Immature	
29	Fording River	Fish Pond Creek	1	1	EF	3	WCT	91	9	Immature	
30	Fording River	Fish Pond Creek	1	2	EF	1	WCT	152	38.2	Immature	Pit Tag # 982126054420209
30	Fording River	Fish Pond Creek	1	2	EF	1	WCT	153	46.5	Immature	Pit Tag # 982126054420124
30	Fording River	Fish Pond Creek	1	2	EF	1	WCT	147	41.8	Immature	Pit Tag # 982126054420182
30	Fording River	Fish Pond Creek	1	2	EF	1	WCT	153	46.5	Immature	Pit Tag # 982126054420161
30	Fording River	Fish Pond Creek	1	2	EF	1	WCT	114	22.4	Immature	Pit Tag # 982126054420213
30	Fording River	Fish Pond Creek	1	2	EF	1	WCT	100	15.6	Immature	Pit Tag # 982126054420205
30	Fording River	Fish Pond Creek	1	2	EF	1	WCT	84	7.3	Immature	
30	Fording River	Fish Pond Creek	1	2	EF	1	WCT	74	4.7	Immature	
30	Fording River	Fish Pond Creek	1	2	EF	2	WCT	81	5.4	Immature	
30	Fording River	Fish Pond Creek	1	2	EF	2	WCT	68	2.8	Immature	
30	Fording River	Fish Pond Creek	1	2	EF	2	WCT	73		Immature	
30	Fording River	Fish Pond Creek	1	2	EF	2	WCT	67	3.9	Immature	
30	Fording River	Fish Pond Creek	1	2	EF	3	WCT	74	4.4	Immature	
31	Fording River	Fish Pond Creek	1	3	EF	1	WCT	150	42.2	Immature	Pit Tag # 982126054420141
31	Fording River	Fish Pond Creek	1	3	EF	1	WCT	69	3.7	Immature	
31	Fording River	Fish Pond Creek	1	3	EF	1	WCT	150	37.8	Immature	Pit Tag # 982126054420223
31	Fording River	Fish Pond Creek	1	3	EF	1	WCT	67	4.2	Immature	
31	Fording River	Fish Pond Creek	1	3	EF	1	WCT	69	4.2	Immature	
31	Fording River	Fish Pond Creek	1	3	EF	1	WCT	127	23.9	Immature	Pit Tag # 982126054420174
32	Fording River	Unnamed Trib to Fis	1	1	EF	1	WCT	211	116	Maturing	Pit Tag # 982126054420105
32	Fording River	Unnamed Trib to Fis	1	1	EF	1	WCT	78	4.2	Immature	
32	Fording River	Unnamed Trib to Fis	1	1	EF	1	WCT	91	7	Immature	Pit Tag # 982126054420040
32	Fording River	Unnamed Trib to Fis	1	1	EF	1	WCT	152	39	Immature	Pit Tag # 982126054420143
32	Fording River	Unnamed Trib to Fis	1	1	EF	1	WCT	201	97.5	Maturing	RECAP Pit Tag # 982126054420123
32	Fording River	Unnamed Trib to Fis	1	1	EF	1	WCT	83	6	Immature	Pit Tag # 982126054420089
32	Fording River	Unnamed Trib to Fis	1	1	EF	1	WCT	171	61.6	Immature	Pit Tag # 982126054420113\
32	Fording River	Unnamed Trib to Fis	1	1	EF	1	WCT	145	36.8	Immature	Pit Tag # 982126054420092
32	Fording River	Unnamed Trib to Fis	1	1	EF	2	WCT	153	38.2	Immature	Pit Tag # 982126054420078
32	Fording River	Unnamed Trib to Fis	1	1	EF	2	WCT	91	8.6	Immature	Pit Tag # 982126054420076
32	Fording River	Unnamed Trib to Fis	1	1	EF	2	WCT	86	7.4	Immature	Pit Tag # 982126054420087
32	Fording River	Unnamed Trib to Fis	1	1	EF	2	WCT	80	6.4	Immature	
32	Fording River	Unnamed Trib to Fis	1	1	EF	2	WCT	134	27.5	Immature	Pit Tag # 982126054420074
32	Fording River	Unnamed Trib to Fis	1	1	EF	2	WCT	147	40.2	Immature	Pit Tag # 982126054420073
32	Fording River	Unnamed Trib to Fis	1	1	EF	2	WCT	90	10	Immature	
32	Fording River	Unnamed Trib to Fis	1	1	EF	2	WCT	93		Immature	
32	Fording River	Unnamed Trib to Fis	1	1	EF	2	WCT	97		Immature	
32	Fording River	Unnamed Trib to Fis	1	1	EF	3	WCT	86	6	Immature	
32	Fording River	Unnamed Trib to Fis	1	1	EF	3	WCT	78	6	Immature	
32	Fording River	Unnamed Trib to Fis	1	1	EF	3	WCT	72	3.3	Immature	
32	Fording River	Unnamed Trib to Fis	1	1	EF	3	WCT	84	7	Immature	
32	Fording River	Unnamed Trib to Fis	1	1	EF	3	WCT	86	8.6	Immature	
32	Fording River	Unnamed Trib to Fis	1	1	EF	3	WCT	100	11.8	Immature	Pit Tag # 982126054420118
32	Fording River	Unnamed Trib to Fis	1	1	EF	3	WCT	78	5.9	Immature	
33	Fording River	Unnamed Trib to Fis	1	2	EF	1	WCT	89	9.1	Immature	Pit Tag # 982126054420097
33	Fording River	Unnamed Trib to Fis	1	2	EF	2	WCT	87	7.6	Immature	Pit Tag # 982126054420049
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	71	3.8	Immature	
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	92	7.5	Immature	Pit Tag # 982126054420071

continued

Table B3. Individual Fish data Fish Data Summary System continued.

Reference Number	Gazetted Name	Local Name	Reach #	Site #	Sample Method	Pass #	Species	Length (mm)	Weight (g)	Maturity	Comments
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	83	6.3	Immature	
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	136	27.6	Immature	Pit Tag # 982126054420085
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	146	31.4	Immature	Pit Tag # 982126054420107
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	91	7.6	Immature	Pit Tag # 982126054420041
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	162	50.4	Immature	Pit Tag # 982126054420056
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	138	30.5	Immature	Pit Tag # 982126054420033
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	147	34.3	Immature	Pit Tag # 982126054420116
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	134	28.3	Immature	Pit Tag # 982126054420030
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	66	4.2	Immature	
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	80	5.4	Immature	
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	73	3.4	Immature	
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	83	5.4	Immature	
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	74	4	Immature	
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	73	3.4	Immature	
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	90	6.9	Immature	Pit Tag # 982126054420070
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	89	7.2	Immature	Pit Tag # 982126054420102
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	73	3.8	Immature	
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	88	6.3	Immature	
34	Fording River	Unnamed Trib to Fis	1	3	EF	1	WCT	83	5.3	Immature	
35	Chauncey Creek	below culvert	1	1	EF	1	WCT	124	22	Immature	Pit Tag # 982126054420193
35	Chauncey Creek	below culvert	1	1	EF	2	WCT	79	4.8	Immature	
36	Chauncey Creek	below culvert	1	2	EF	1	WCT	121	20.5	Immature	Pit Tag # 982126054420175
36	Chauncey Creek	below culvert	1	2	EF	1	WCT	120	18.6	Immature	Pit Tag # 982126054420159
36	Chauncey Creek	below culvert	1	2	EF	1	WCT	127	22.5	Immature	Pit Tag # 982126054420154
36	Chauncey Creek	below culvert	1	2	EF	1	WCT	125	27.8	Immature	Pit Tag # 982126054420126
36	Chauncey Creek	below culvert	1	2	EF	2	WCT	135	32.9	Immature	Pit Tag # 982126054420196
37	Chauncey Creek	below culvert	1	3	EF	2	WCT	134	25.3	Immature	Pit Tag # 982126054420180
39	Chauncey Creek	above culvert	2	2	EF	1	WCT	180	63.3	Immature	Pit Tag # 982126054420035
39	Chauncey Creek	above culvert	2	2	EF	1	WCT	48	0.8	Immature	
40	Chauncey Creek	above culvert	2	3	EF	2	WCT	198	118.6	Immature	Pit Tag # 982126054420024
42	Ewin Creek		3	2	EF	1	WCT	165	53.9	Immature	Pit Tag # 982126054420153
42	Ewin Creek		3	2	EF	2	WCT	138	29.7	Immature	Pit Tag # 982126054420183
43	Ewin Creek		3	3	EF	1	WCT	220	140.2	Maturing	Pit Tag # 982126054420127
44	Dry Creek	below culvert	1	1	EF	1	WCT	87	7.8	Immature	Pit Tag # 982126054420057
44	Dry Creek	below culvert	1	1	EF	1	WCT	100	11.7	Immature	Pit Tag # 982126054420052
44	Dry Creek	below culvert	1	1	EF	1	WCT	58	2.2	Immature	
44	Dry Creek	below culvert	1	1	EF	1	WCT	57	2.3	Immature	
44	Dry Creek	below culvert	1	1	EF	2	WCT	98	11.1	Immature	Pit Tag # 982126054420065
44	Dry Creek	below culvert	1	1	EF	2	WCT	57	2.5	Immature	
44	Dry Creek	below culvert	1	1	EF	3	WCT	64	3	Immature	
44	Dry Creek	below culvert	1	1	EF	3	WCT	68	3.3	Immature	
45	Dry Creek	below culvert	1	2	EF	1	WCT	111	16.6	Immature	Pit Tag # 982126054420051
45	Dry Creek	below culvert	1	2	EF	3	WCT	173	60.4	Immature	Pit Tag # 982126054420045
46	Dry Creek	below culvert	1	3	EF	1	WCT	168	54.8	Immature	Pit Tag # 982126054420084
46	Dry Creek	below culvert	1	3	EF	1	WCT	176	67.7	Immature	Pit Tag # 982126054420066
46	Dry Creek	below culvert	1	3	EF	1	WCT	146	38.9	Immature	Pit Tag # 982126054420114
46	Dry Creek	below culvert	1	3	EF	1	WCT	167	56	Immature	Pit Tag # 982126054420068
46	Dry Creek	below culvert	1	3	EF	1	WCT	128	23.6	Immature	Pit Tag # 982126054420109
46	Dry Creek	below culvert	1	3	EF	1	WCT	60	2.2	Immature	
46	Dry Creek	below culvert	1	3	EF	1	WCT	61	1.8	Immature	
46	Dry Creek	below culvert	1	3	EF	2	WCT	68	3.2	Immature	
47	Greenhills Creek	below culvert	1	1	EF	1	WCT	173	44.3	Immature	Pit Tag # 982126054420134
47	Greenhills Creek	below culvert	1	1	EF	1	WCT	126	15.2	Immature	Pit Tag # 982126054420198

continued

Table B3. Individual Fish data Fish Data Summary System continued.

Reference Number	Gazetted Name	Local Name	Reach #	Site #	Sample Method	Pass #	Species	Length (mm)	Weight (g)	Maturity	Comments
47	Greenhills Creek	below culvert	1	1	EF	1	WCT	118	10.9	Immature	Pit Tag # 982126054420177
47	Greenhills Creek	below culvert	1	1	EF	1	WCT	62	2.1	Immature	
47	Greenhills Creek	below culvert	1	1	EF	1	WCT	61	2	Immature	
47	Greenhills Creek	below culvert	1	1	EF	1	WCT	57	1.2	Immature	
48	Greenhills Creek	below culvert	1	2	EF	1	WCT	167	41.6	Immature	Pit Tag # 982126054420191
48	Greenhills Creek	below culvert	1	2	EF	1	WCT	84	4.9	Immature	
48	Greenhills Creek	below culvert	1	2	EF	1	WCT	157	27.8	Immature	Pit Tag # 982126054420195
48	Greenhills Creek	below culvert	1	2	EF	1	WCT	112	12.3	Immature	Pit Tag # 982126054420186
48	Greenhills Creek	below culvert	1	2	EF	2	WCT	149	24.6	Immature	Pit Tag # 982126054420133
48	Greenhills Creek	below culvert	1	2	EF	3	WCT	132	17.6	Immature	Pit Tag # 982126054420167
49	Greenhills Creek	below culvert	1	3	EF	1	WCT	105	10.5	Immature	Pit Tag # 982126054420214
49	Greenhills Creek	below culvert	1	3	EF	1	WCT	104	9.6	Immature	Pit Tag # 982126054420168
49	Greenhills Creek	below culvert	1	3	EF	1	WCT	81	3.7	Immature	
49	Greenhills Creek	below culvert	1	3	EF	2	WCT	119	12.3	Immature	Pit Tag # 982126054420173
49	Greenhills Creek	below culvert	1	3	EF	2	WCT	97	8.2	Immature	
49	Greenhills Creek	below culvert	1	3	EF	3	WCT	94	6.6	Immature	
51	Fording River	UFR 49-2	8	2	EF	1	WCT	98	10.2	Immature	Pit Tag # 982126054420111
52	Fording River	UFR 49-2	8	3	EF	1	WCT	78	4.6	Immature	
53	Fording River	UFR 49-2	8	4	EF	1	WCT	85	6.8	Immature	Pit Tag # 982126054420050
53	Fording River	UFR 49-2	8	4	EF	2	WCT	75	4.6	Immature	
54	Fording River	UFR 47-2	8	1	EF	1	WCT	220	110.8	Maturing	Pit Tag # 982126054420211
54	Fording River	UFR 47-2	8	1	EF	2	WCT	150	41.1	Immature	Pit Tag # 982126054420184
54	Fording River	UFR 47-2	8	1	EF	2	WCT	152	46.4	Immature	Pit Tag # 982126054420221
54	Fording River	UFR 47-2	8	1	EF	3	WCT	162	51.1	Immature	Pit Tag # 982126054420145
55	Fording River	UFR 47-2	8	2	EF	1	WCT	92	7.7	Immature	
57	Fording River	UFR 47-2	8	4	EF	1	WCT	142	27.1	Immature	Pit Tag # 982126054420146
58	Fording River	UFR 47-1	8	1	EF	1	WCT	72	5.7	Immature	
58	Fording River	UFR 47-1	8	1	EF	1	WCT	126	21.9	Immature	Pit Tag # 982126054420169
58	Fording River	UFR 47-1	8	1	EF	1	WCT	73	4.2	Immature	
58	Fording River	UFR 47-1	8	1	EF	1	WCT	85	6.7	Immature	Pit Tag # 982126054420144
59	Fording River	UFR 47-1	8	2	EF	1	WCT	164	46	Immature	Pit Tag # 982126054420147
59	Fording River	UFR 47-1	8	2	EF	1	WCT	180	76.1	Immature	Pit Tag # 982126054420188
60	Fording River	UFR 47-1	8	3	EF	1	WCT	137	30.1	Immature	Pit Tag # 982126054420190
60	Fording River	UFR 47-1	8	3	EF	1	WCT	189	73.6	Immature	Pit Tag # 982126054420197
60	Fording River	UFR 47-1	8	3	EF	1	WCT	124	19.8	Immature	Pit Tag # 982126054420136
60	Fording River	UFR 47-1	8	3	EF	1	WCT	83	6.5	Immature	
60	Fording River	UFR 47-1	8	3	EF	1	WCT	81	5.7	Immature	
60	Fording River	UFR 47-1	8	3	EF	1	WCT	158	46.5	Immature	Pit Tag # 982126054420202
60	Fording River	UFR 47-1	8	3	EF	1	WCT	75	5	Immature	
60	Fording River	UFR 47-1	8	3	EF	1	WCT	71	4.5	Immature	
60	Fording River	UFR 47-1	8	3	EF	2	WCT	85	7.2	Immature	
60	Fording River	UFR 47-1	8	3	EF	2	WCT	149	39.8	Immature	Pit Tag # 982126054420148
60	Fording River	UFR 47-1	8	3	EF	2	WCT	74	4.8	Immature	
60	Fording River	UFR 47-1	8	3	EF	2	WCT	139	28.5	Immature	Pit Tag # 982126054420132
60	Fording River	UFR 47-1	8	3	EF	3	WCT	142	34.4	Immature	Pit Tag # 982126054420224

concluded.