

ACA PROJECT REPORT

Distribution and Abundance of Native Trout in the Wildhay River Watershed, 2022–2023

Final Report



#101, 9 Chippewa Road Sherwood Park, Alberta, Canada T8A 6J7

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Distribution and Abundance of Native Trout in the Wildhay River Watershed, 2022–2023

Final Report

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EXECUTIVE SUMMARY

Athabasca rainbow trout (*Oncorhynchus mykiss*) and bull trout (*Salvelinus confluentus*) abundance and distribution have decreased from historical levels in Alberta. These species are listed under the federal *Species at Risk Act*, which identifies many anthropogenic threats to native trout in the province. Alberta's Native Trout Recovery Program is a collaboration of government and non-government organizations tasked with assessing native trout populations and recovering at-risk populations. The Wildhay River watershed was identified through the Native Trout Recovery Program as a priority for inventory to provide current fisheries information on at-risk Athabasca rainbow trout and bull trout populations. The Alberta Fish Sustainability Index (FSI) is a standardized process of assessment that provides the framework within which fishery inventories must occur for greatest relevance to government managers and planners. Our objective was to describe fish distribution, abundance, and habitat in the Wildhay River watershed of Alberta, with emphasis on native Athabasca rainbow trout and bull trout to address data deficiencies for these FSI priority species.

From July 19 to August 7, 2022, and July 25 to August 25, 2023, we sampled fish with backpack electrofishing gear and collected habitat data at 95 sites randomly distributed throughout ten Hydrologic Unit Code (HUC) 10 sub-watersheds: Ice Water Creek, Jarvis Creek, Lower Wildhay River, Middle Wildhay River, Moberly Creek, Mumm Creek, Pinto Creek, Rock Creek, South Wildhay River, and Upper Wildhay River. These HUC 10 sub-watersheds make up the greater Wildhay River HUC 8 watershed.

We captured 383 fish, including 220 rainbow trout ranging in size from 44 to 259 mm fork length (FL). Rainbow trout was the most widely distributed species we captured. We detected them in seven HUC 10 sub-watersheds and at 27 of the 95 sites sampled. The Middle Wildhay River HUC 10 had the highest mean relative abundance (fish per 300 m) of immature (<142 mm FL) and non-immature rainbow trout at 9.0 (Confidence Interval [CI] = 1.9–18.1) and 3.0 (CI = 1.3-4.9), respectively. We captured 57 bull trout (63–255 mm FL) in four of the HUC 10 sub-watersheds and at 11 of the 95 sites. The Ice Water Creek HUC 10 had the highest mean relative abundance (fish per 300 m) of immature (<150 mm FL) bull trout at 3.4 (CI = 0.0-8.2). The Upper Wildhay River HUC 10 had the highest mean relative abundance (fish per 300 m) of non-immature bull trout at 0.7 (CI = 0.0-2.1). Sixty sites had zero fish captures of any species. Zerocatch sites occurred across all HUC 10 sub-watersheds but were concentrated in the upper, more alpine, sub-watersheds of Mumm Creek, Rock Creek, South Wildhay River, and Upper Wildhay River.

Stream substrate composition in the headwaters of the Wildhay River HUC 8 watershed was dominated by gravel and cobble, substrates preferred by rainbow and bull trout for spawning, while lower reaches were characterized by finer sediments. Suitable thermal habitat for bull trout

was found throughout all HUC 10 sub-watersheds, while many headwater sites had temperatures below the preferred range for rainbow trout.

Our study provides current information on stream habitats, and the abundance and distribution of at-risk Athabasca rainbow trout and bull trout, FSI priority species, within the Wildhay River HUC 8 watershed. This information is useful to land managers who must balance the diverse values of the land base and is critical for the conservation of native fish species that are particularly sensitive to habitat degradation.

Key words: Alberta, Wildhay River, FSI, Athabasca rainbow trout, bull trout, distribution, abundance.

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1.0 INTRODUCTION

Native trout species along the Eastern Slopes of the Rocky Mountains have intrinsic economic and ecologic value yet have seen a decrease in population size and distribution compared to historical levels (Sinnatamby et al. 2019). Athabasca River populations of rainbow trout (*Oncorhynchus mykiss*) are listed as *Endangered* under the federal *Species at Risk Act*, while Western Arctic populations of bull trout (*Salvelinus confluentus*) are listed as a species of *Special Concern* (Government of Canada 2023). Provincially, both species are listed as *Threatened* under Alberta's *Wildlife Act* (Alberta King's Printer 2023). Anthropogenic threats are leading causes of the decline of both populations, including habitat alteration and fragmentation, sediment introductions, non-native fish stocking, hybridization, and angling mortality (COSEWIC 2012, 2014; DFO 2020).

The Canadian Nature Fund for Aquatic Species at Risk (CNFASR) is a federal fund targeting atrisk aquatic species by supporting recovery activities that address key threats to the populations. The CNFASR has identified the Eastern Slopes as a priority area for funding recovery initiatives including population assessments and monitoring, habitat rehabilitation, and communication and outreach. The Native Trout Recovery Program (Government of Alberta 2024a), a collaboration between government and non-government organizations, has received funding through the CNFASR to carry out these initiatives with the goal of restoring fish habitat and increasing sustainable native trout populations.

The success of recovery actions is assessed using the Alberta Fish Sustainability Index (FSI). The FSI is a standardized process of assessment that provides a landscape-level overview of fish sustainability within the province and enables broad-scale evaluation of management actions and land-use planning. The FSI evaluates fish species on four groups of metrics: population integrity, population productivity, threats, and data reliability (MacPherson et al. 2014). Fishery inventory data are particularly suited to evaluation of the population integrity (adult and immature density) and productive potential (geographic extent) metrics. When conducting fishery inventories in Alberta, watersheds are managed using a Hydrological Unit Code (HUC) appropriate for the focal fish species, with HUC 2 being the coarsest scale and HUC 10 being the finest.

The Wildhay River watershed was identified through the Native Trout Recovery Program as a priority to provide current population status information on at-risk Athabasca rainbow trout and bull trout. Genetic testing has shown that most rainbow trout populations within the Wildhay River watershed are native Athabasca rainbow trout (COSEWIC 2014). Previous inventory work was completed in 2012 by the Government of Alberta (GOA). Results of our project will provide up-to-date information on population abundance and distribution of native Athabasca rainbow trout and bull trout in the Wildhay River watershed and help GOA assess the effectiveness of recovery actions.

We had two objectives for this study:

- Provide up-to-date information on population abundance and distribution of native Athabasca rainbow trout and bull trout in the Wildhay River watershed.
- Describe fish inventory and stream habitat in the Wildhay River HUC 8 watershed by assessing ten HUC 10 sub-watersheds.

2.0 STUDY AREA

The Wildhay River originates in three protected areas: Jasper National Park, Wilmore Wilderness Park, and Rock Lake-Solomon Creek Wildland, west of Hinton, Alberta. The Wildhay River flows approximately 186 km northeast to its confluence with the Berland River, shortly before it enters the Athabasca River. The Wildhay River HUC 8 watershed is approximately 2,622 km² and major tributaries within the watershed include Ice Water Creek, Jarvis Creek, Moberly Creek, Mumm Creek, Pinto Creek, and Rock Creek. Land-use activities within this watershed include forestry, mining, oil and gas exploration, and recreation. Historical fish stocking in the watershed has included brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), cutthroat trout (*Oncorhynchus clarkii*), lake trout (*Salvelinus namaycush*), nonnative rainbow trout, splake (*S. fontinalis* x *S. namaycush*), and walleye (*Sander vitreus*) (GOA 2024b). Our study area consists of the Wildhay River watershed (HUC 8) and includes the following HUC 10 sub-watersheds: Ice Water Creek, Jarvis Creek, Lower Wildhay River, Middle Wildhay River, Moberly Creek, Mumm Creek, Pinto Creek, Rock Creek, South Wildhay River, and Upper Wildhay River (Figure 1).



Figure 1. The Wildhay River Hydrological Unit Code (HUC) 8 watershed and HUC 10 sub-watersheds. Inset map shows the location of the study area within the province of Alberta.

3.0 MATERIALS AND METHODS

3.1 Fish distribution and abundance

From July 19 to August 7, 2022, and July 25 to August 25, 2023, we sampled 95 randomly distributed sites to describe the distribution and relative abundance of Athabasca rainbow trout, bull trout, and other fish species in the Wildhay River HUC 10 sub-watersheds (Figure 2). We distributed prospective sample sites at 800-m intervals in an upstream progression along the length of second- to fourth-order streams (>400 m; 1:20,000 scale) (Strahler 1952) within each HUC 10 sub-watershed using a geographical information system (ArcGIS version 10.6) and the GOA Resource Management Information Branch hydro line data layer. Sample sites were randomly selected without replacement using a generalized random tessellation stratified (GRTS) design (Stevens and Olsen 2004). We used a conservative target of ten sample sites per HUC 10 sub-watershed based on past evaluations of our power to detect immature bull trout (Rodtka and Judd 2015, Rodtka et al. 2015). Sites were assessed in the order in which they were drawn. To accommodate non-response sites, we drew a total of 15 sites per sample frame. Nonresponse sites (n = 54) included dry sites, inaccessible sites (i.e., sites > 1 km from the nearest access), and sites that could not be safely sampled. Alternate sites were sampled if a nonresponse site was identified (Figure 2). The GRTS sampling design allowed us to adjust our sample size to accommodate non-response sites while maintaining a spatially balanced sample (Stevens and Olsen 2004).

A handheld Global Positioning System was used to locate sample sites. All site sampling commenced at the head of riffle habitat. Our sample protocol for backpack electrofishing required sample sites be 300 m long (measured with a hip chain). Some sites were less than 300 m due to insufficient flow. Sites were sampled using a Smith-Root LR-20B backpack electrofisher with pulsed DC (voltage 100–500 V, frequency 50–60 Hz, and duration 4.2–5.8 ms). Electrofishing effort (seconds) was recorded at 50-m intervals. Fish were identified to species, enumerated, and measured (fork length [FL], mm). Bull trout were visually inspected upon capture for morphological features of hybridization with brook trout based on criteria in Popowich et al. (2011). We report native trout relative abundance by maturity classification to align with FSI convention. Immature bull trout and rainbow trout are defined as having a fork length less than 150 and 142 mm, respectively (Spence et al. 2023).



Figure 2. Electrofishing sites within the HUC 10 sub-watersheds of the Wildhay River watershed in Alberta, 2022–2023.

3.2 Stream habitat measurements

At all sample sites, we measured stream temperature (°C) and ambient stream conductivity (μ S/cm) prior to electrofishing. Ambient stream conductivity was always greater than 50 μ S/cm, below which has been demonstrated to significantly impact detection of immature bull trout using electrofishing gear (Rodtka et al. 2015). We measured stream depth (m), wetted width (m), and rooted width (m) at 50-m intervals. Habitat type and dominant substrate type were assessed between each 50-m interval. We visually estimated the percentage (nearest 5%) of pool habitat (reduced current velocity, little surface turbulence, water deeper than surrounding areas), riffle habitat (swift flow of water over bed materials producing surface turbulence), and run habitat (uniform but swift flow of water without surface waves). Dominant substrate type was scored based on a modified Wentworth (1922) scale: fines (< 2 mm; score 0), small gravel (2–16 mm; score 1), large gravel (17–64 mm; score 2), cobble (65–256 mm; score 3), boulder (>256 mm; score 4), and bedrock (score 5).

All fish and habitat sampling followed the GOA's *Standard for Sampling of Small Streams in Alberta* (AESRD 2013). Information acquired in the field was submitted for inclusion into the GOA Fisheries and Wildlife Management Information System database and to Fisheries and Oceans Canada as a condition of *Species at Risk Act* permit requirements.

4.0 RESULTS

4.1 Fish distribution and abundance

We sampled 95 sites with backpack electrofishing gear resulting in a total sampling effort of 57,602 seconds over 27.6 km of stream. Site-specific location information and effort data are provided in Appendix 1. In total, we captured 383 fish (Table 1). Site-specific catch data are provided in Appendix 2. Our catch included several species in addition to rainbow trout and bull trout: Arctic grayling (*Thymallus arcticus*), brook trout, burbot (*Lota lota*), Iowa darter (*Etheostoma exile*), mountain whitefish (*Prosopium williamsoni*), spoonhead sculpin (*Cottus ricei*), white sucker (*Catostomus commersonii*), and yellow perch (*Perca flavescens*).

Rainbow trout were the most abundant species we captured, composing 57% of our total catch (Table 1). Rainbow trout were also the most widely distributed fish species, detected in seven of the HUC 10 sub-watersheds and at 27 of the 95 sites sampled (Figure 3). The majority (54%) of rainbow trout were captured in the Middle Wildhay River HUC 10 sub-watershed, with 46 (21%) captured at site MWH09 (Appendix 2). No rainbow trout were captured in the Jarvis Creek HUC 10 sub-watershed but were observed in lower sections too deep to wade. Bull trout were less abundant and captured in only four of the HUC 10 sub-watersheds and at 11 of the 95 sites (Table 1, Figure 3). Most (68%) of the bull trout we captured electrofishing were from the

Ice Water Creek HUC 10 sub-watershed, with 19 (33%) captured at site I11 (Table 1, Appendix 2). Brook trout were only captured in the Moberly Creek HUC 10 sub-watershed but were abundant, comprising 21% of the total fish capture (Table 1). We captured mountain whitefish at only four sites located in two of the HUC 10 sub-watersheds (Table 1). Sixty sites, occurring across all sub-watersheds, had zero fish captures (of any species). Zero-catch sites were concentrated in the upper, more alpine, sub-watersheds including all sites sampled in the Mumm Creek HUC 10 sub-watershed (Figure 3).

	Site Detections (n) per HUC 10 Sub-Watershed											
Species ¹	Ice Water Creek	Jarvis Creek	Lower Wildhay River	Middle Wildhay River	Moberly Creek	Mumm Creek	Pinto Creek	Rock Creek	South Wildhay River	Upper Wildhay River	Total Catch (%)	
ARGR	0	0	0	0	1	0	0	0	0	0	1 (<1)	
BKTR	0	0	0	0	5	0	0	0	0	0	82 (21)	
BLTR	5	0	1	2	0	0	0	0	0	3	57 (15)	
BURB	1	0	1	2	0	0	2	1	0	0	10 (3)	
IWDR	0	1	0	0	0	0	0	0	0	0	1 (<1)	
MNWH	2	0	0	0	2	0	0	0	0	0	8 (2)	
RNTR	3	0	3	6	5	0	6	0	1	3	220 (57)	
SPSC	0	0	0	0	0	0	1	0	0	0	2 (<1)	
WHSC	0	1	0	0	0	0	0	0	0	0	1 (<1)	
YLPR	0	1	0	0	0	0	0	0	0	0	1 (<1)	

Table 1.Number of sites where fish were detected and total catch of each fish species using backpack electrofishing gear in ten
HUC 10 sub-watersheds of Alberta, sampled from July 19 to August 7, 2022, and July 25 to August 25, 2023.

¹ Species codes: ARGR = Arctic grayling, BKTR = brook trout, BLTR = bull trout, BURB = burbot, IWDR = Iowa darter, MNWH = mountain whitefish, RNTR = rainbow trout, SPSC = spoonhead sculpin, WHSC = white sucker, YLPR = yellow perch.



Figure 3. The distribution of trout species captured using backpack electrofishing gear within each HUC 10 sub-watershed of the Wildhay River watershed in Alberta, July 19 to August 7, 2022, and July 25 to August 25, 2023.

Our rainbow trout catch ranged in size from 44 to 259 mm FL and mainly consisted of immature fish (<142 mm FL). Our bull trout catch ranged in size from 63 to 255 mm FL and mainly consisted of immature fish (<150 mm FL) (Tables 2 and 3). Length frequency histograms of our brook trout, bull trout, and rainbow trout catch are presented in Appendix 3.

The mean relative abundance (catch per 300 m) of rainbow trout and bull trout was highest in the Middle Wildhay River and Ice Water Creek HUC 10 sub-watersheds, respectively (Table 3).

				For	k Length (m	m)			
HUC 10 Sub-		BKTR ²			BLTR			RNTR	
Watershed ¹	$\frac{Mean \pm}{SD^3}$	Range	n	Mean ± SD	Range	n	Mean ± SD	Range	n
Ice Water Creek	-	-	-	127 ± 27	91–209	39	110 ± 39	65–206	26
Lower Wildhay River	-	-	-	63 ± 0	-	1	176± 33	146– 214	4
Middle Wildhay River	-	-	-	222 ± 47	188– 255	2	115± 41	44–259	118
Moberly Creek	$\begin{array}{c} 110 \pm \\ 40 \end{array}$	45–210	82	-	-	-	114 ± 39	70–176	12
Pinto Creek	-	-	-	-	-	-	$\frac{138\pm}{28}$	86–209	44
South Wildhay River	-	-	-	-	-	-	125± 37	98–151	2
Upper Wildhay River	-	-	-	149 ± 27	87–200	15	106 ± 59	49–212	14

Table 2. Size distribution of brook trout, bull trout, and rainbow trout captured in HUC 10 sub-watersheds of Alberta's Wildhay River watershed using backpack electrofishing gear, July 19 to August 7, 2022, and July 25 to August 25, 2023.

¹ Sub-watersheds where no trout were captured are not included. ² Species codes: BKTR = brook trout, BLTR = bull trout, and RNTR = rainbow trout.

 $^{3}\pm 1$ standard deviation.

Bootstrapped mean relative abundance (10,000 replicates) of brook trout, bull trout, Table 3. and rainbow trout captured in each HUC 10 sub-watershed of Alberta's Wildhay River watershed using backpack electrofishing gear, July 19 to August 7, 2022, and July 25 to August 25, 2023.

Mean Catch/300 m (95% CI ¹) by Species ² and Maturity									
HUC 10 Sub	BKTR	BL	TR	RN	TR				
Watershed ⁴	All Figh	Immature	Mature	Immature	Mature				
water shed	All FISH	<150mm FL ³	>150mm FL	<142mm FL	>142mm FL				
Ice Water	0	3.4	0.5	2.2	0.4				
Creek	0	(0.0 - 8.2)	(0.0 - 1.0)	(0.0-5.1)	(0.0 - 1.0)				
Lower	0	0.1	0	0	0.4				
Wildhay River	0	(0.0-0.3)	0	0	(0.0-0.9)				
Moharly Crook	$ \begin{array}{c} 10.1 \\ (2.2-19.3) \\ 0 \end{array} $	0	0	1.0	0.3				
Widdenly Creek		0	0	(0.2 - 2.1)	(0.0 - 0.7)				
Middle		0	0.2	9.0	3.0				
Wildhay River	0	0	(0.0-0.5)	(1.9–18.1)	(1.3 - 4.9)				
Pinto Creek	0	0	0	2.2	2.2				
T Into Creek	0	0	0	(0.3 - 5.0)	(0.6 - 4.0)				
South Wildhay	0	0	0	0.1	0.1				
River	0	0	0	(0.0-0.3)	(0.0-0.3)				
Upper	0	0.8	0.7	0.9	0.5				
Wildhay River	0	(0.0 - 2.0)	(0.0-2.1)	(0.0-2.7)	(0.0-1.1)				

 1 CI = confidence intervals.

² Species codes: BKTR = brook trout, BLTR = bull trout, RNTR = rainbow trout. ³ FL = fork length.

⁴ Sub-watersheds where no trout were captured are not included.

4.2 Stream habitat measurements

Overall stream substrate composition across the Wildhay HUC 8 watershed was dominated by gravels (small and large) and cobble (Table 4). Large gravel and cobble substrate are habitat qualities preferred by rainbow and bull trout (COSEWIC 2012, 2014). Within the Middle and Lower Wildhay River HUC 10 sub-watersheds, several sites were dominated by fine sediments (Table 4, Appendix 4).

Preferred temperatures for rainbow trout range from 7 to 18°C, while temperatures from 22 to 24°C are considered life threatening (COSEWIC 2014, Alberta Athabasca Rainbow Trout Recovery Team 2014). Bull trout are found in waters below 18°C, and most commonly below 12°C (COSEWIC 2012). No sample sites had temperature measurements above 18°C (Table 4), with most (87%) below 12°C indicating that summer stream temperatures did not exceed the upper preferences of rainbow and bull trout (Appendix 4). Some sites (29%) had temperature measurements below 7°C making them less suitable for rainbow trout (Appendix 4).

	Stream Temperature (°C)		Ambient Conductivity (µS/cm)		Mean Wetted Width (m)		Mean Rooted Width (m)		Mean Maximum Depth (m)		Modal	Modal Substrate ¹	
HUC 10 Sub- Watershed	$Mean \pm SD^2$	Range	$Mean \pm SD$	Range	Mean ± SD	Range	$Mean \pm SD$	Range	$Mean \pm SD$	Range	Stream Stage	Primary	Secondary
Ice Water Creek	9.2 ± 2.8	4.9–14.4	208 ± 68	118–311	1.9 ± 1.2	0.3–5.5	2.1 ± 1.4	0.6–6.7	0.22 ± 0.12	0.03–0.61	Moderate	С	LG
Jarvis Creek	11.1 ± 3.3	7.2–16.7	332 ± 117	202-638	2.8 ± 1.4	0.8–7.7	3.1 ± 1.5	0.6–7.7	0.26 ± 0.22	0.05-1.20	Moderate	LG	С
Lower Wildhay River	10.0 ± 2.3	5.8–13.2	267 ± 50	171–331	2.2 ± 1.5	0.2–6.1	2.1 ± 1.7	0.2–7.6	0.41 ± 0.26	0.06–1.20	Moderate/Low	F	SG
Middle Wildhay River	9.1 ± 1.5	7.4–11.9	280 ± 71	177–372	2.7 ± 1.8	0.4–7.0	3.0 ± 2.4	0.3–11.6	0.33 ± 0.16	0.10-0.90	Moderate	F	LG
Moberly Creek	8.8 ± 2.7	5.4–13.8	258 ± 75	155–430	3.4 ± 2.9	0.3–14.2	4.2 ± 3.8	0.2–15.9	0.31 ± 0.17	0.09–0.90	Moderate/Low	С	LG
Mumm Creek	6.2 ± 3.5	2.6-10.9	354 ± 24	308–379	5.1 ± 2.7	0.1–10.3	12.0 ± 11.2	1.3-41.9	0.28 ± 0.15	0.01-1.00	Low/ Moderate	С	LG
Pinto Creek	10.6 ± 1.7	7.8–12.8	269 ± 88	121–359	2.3 ± 1.8	0.3–9.6	2.8 ± 2.3	0.3–9.6	0.38 ± 0.36	0.07-1.90	Moderate	LG	SG
Rock Creek	5.6 ± 1.4	3.8–7.6	404 ± 41	349-471	4.2 ± 3.1	0.5–13.7	8.4 ± 11.7	0.6–49.0	0.37 ± 0.19	0.05-1.00	Moderate/High	LG	SG
South Wildhay River	6.6 ± 2.9	3.7–14.0	378 ± 50	241-423	5.0 ± 2.3	0.7–9.5	5.2 ± 2.5	0.7–10.4	0.37 ± 0.19	0.08–1.00	Moderate	LG	С
Upper Wildhay River	7.8 ± 2.9	4.4–13.3	297 ± 104	81–377	6.3 ± 9.2	0.4–43.0	12.6 ± 23.3	1.0–112.0	0.35 ± 0.16	0.05–0.80	Moderate/High	LG	SG

Summary of stream habitat measurements in each HUC 10 sub-watershed of Alberta's Wildhay River watershed collected while backpack electrofishing, July 19 to Table 4. August 7, 2022, and July 25 to August 25, 2023.

¹ Substrate codes: B = boulder, C = cobble, F = fines, LG = large gravel, SG = small gravel. $^{2}\pm 1$ standard deviation.

5.0 SUMMARY

Alberta Conservation Association staff sampled 95 sites located throughout ten HUC 10 subwatersheds within the Wildhay River HUC 8 watershed in 2022 and 2023 using backpack electrofishing gear. We detected rainbow trout in seven of the HUC 10 sub-watersheds, with the Middle Wildhay River HUC 10 sub-watershed having the highest relative abundance. Rainbow trout were the most widely distributed fish species we captured and the most abundant species. We detected bull trout in four of the HUC 10 sub-watersheds, with the Ice Water Creek HUC 10 having the highest relative abundance.

Stream substrate composition in the headwaters of the Wildhay River HUC 8 watershed was dominated primarily by gravels and cobble, a habitat quality preferred by both rainbow and bull trout (COSEWIC 2012, 2014). Stream temperature plays an important role in aquatic community processes and has been correlated to fish species distribution and abundance (Rieman et al. 2007, Isaak et al. 2012). Athabasca rainbow trout and bull trout are adapted to living in cold-water habitats, which limits their distribution to cold headwater streams. No sites sampled in the Wildhay River HUC 8 watershed in 2022 and 2023 exceeded suitable temperatures for either species, while some sites were below the preferred range for rainbow trout.

Our study provides current information on stream habitats, and the abundance and distribution of at-risk Athabasca rainbow trout and bull trout, FSI priority species, within the Wildhay River HUC 8 watershed. This information is useful to land managers who must balance the diverse values of the land base upon which they operate, and is critical for the conservation of native fish species that are particularly sensitive to habitat degradation.

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7.0 **APPENDICES**

Site ID ¹	Date (dd/mm/yyyy) –	UTM I NAD 83	Location 3 Zone 11	- Distance (m)	Effort (s)
		Easting	Northing		
I01	05/08/2022	433390	5923895	300	482
I03	06/08/2022	433174	5925791	300	875
I04	07/08/2022	435583	5924644	300	362
I05	06/08/2022	434701	5926177	300	802
I08	04/08/2022	436039	5923184	300	456
I09	05/08/2022	436114	5924144	300	1,073
I11	06/08/2022	433356	5926049	300	1,056
I12	05/08/2022	436380	5922842	300	405
I13	04/08/2022	432043	5924640	300	402
I14	05/08/2022	433036	5924172	300	571
J01	12/08/2023	446263	5928550	300	622
J05	12/08/2023	445326	5925894	300	458
J06	12/08/2023	448631	5923892	300	536
J07	14/08/2023	441312	5922205	300	727
J08	13/08/2023	449452	5922626	300	633
J13	15/08/2023	446895	5928181	300	918
J14	13/08/2023	447466	5925508	300	595
J15	14/08/2023	443692	5920738	300	580
J16	15/08/2023	447382	5922286	300	427
J17	23/08/2023	442984	5926318	300	624
LWH01	25/08/2023	469347	5968816	300	572
LWH02	25/08/2023	469641	5966275	300	499
LWH04	25/08/2023	460929	5968522	300	948
LWH05	24/08/2023	471665	5963019	300	699
LWH06	23/08/2023	468244	5966288	300	1,024
LWH07	22/08/2023	481279	5978411	300	743
LWH09	24/08/2023	466303	5965013	300	894
LWH10	22/08/2023	473884	5971349	300	451
LWH13	22/08/2023	475062	5974360	200	281
LWH15	24/08/2023	472262	5967114	300	885
MO01	20/07/2022	437523	5934801	300	820
MO02	03/08/2022	433611	5933659	300	358
MO05	20/07/2022	432358	5934154	250	274

Appendix 1. Backpack electrofishing sample site locations and effort in the HUC 10 subwatersheds of the Wildhay River in Alberta, 2022 and 2023.

c. D		UTM I NAD 83	Location Zone 11		Effort (a)	
Site ID ²	Date (dd/mm/yyyy) –	Easting	Northing	- Distance (m)	Effort (s)	
MO06	03/08/2022	432501	5934947	150	735	
MO07	07/08/2022	426988	5937237	300	837	
MO08	24/07/2022	420161	5937449	300	433	
MO09	25/07/2022	436630	5935643	300	326	
MO11	24/07/2022	422405	5937126	300	666	
MO13	20/07/2022	431615	5934330	300	757	
MO14	24/07/2022	420465	5936795	300	570	
MU03	23/07/2022	410313	5934825	250	283	
MU05	23/07/2022	415282	5931536	300	394	
MU07	23/07/2022	412536	5934117	300	329	
MU08	23/07/2022	415629	5930525	300	386	
MU12	23/07/2022	419129	5927617	300	366	
MU15	23/07/2022	414370	5932798	300	455	
MWH01	31/07/2023	457944	5954584	300	448	
MWH02	26/07/2023	458112	5960949	300	354	
MWH03	31/07/2023	454301	5944408	250	979	
MWH05	31/07/2023	454149	5948906	300	315	
MWH07	27/07/2023	440329	5928992	300	890	
MWH09	27/07/2023	440781	5934637	300	1,264	
MWH10	01/08/2023	455223	5941386	300	1,231	
MWH12	09/08/2023	452147	5952079	300	769	
MWH13	01/08/2023	456961	5939376	300	1,107	
MWH15	25/07/2023	455845	5958622	300	413	
P01	10/08/2023	427718	5953082	200	412	
P02	25/07/2023	439939	5953941	300	971	
P03	01/08/2023	455195	5967715	100	121	
P05	11/08/2023	437209	5957815	300	448	
P06	25/07/2023	443899	5950492	300	647	
P07	27/07/2023	428490	5939998	300	958	
P09	25/07/2023	437447	5952040	300	857	
P10	11/08/2023	433652	5952669	300	937	
P12	26/07/2023	450009	5961038	300	629	
P13	10/08/2023	430006	5954787	300	416	
R03	21/07/2022	391167	5929520	300	362	
R04	21/07/2022	381769	5930706	300	398	
R05	24/07/2022	410136	5920651	300	643	
R06	21/07/2022	394061	5919724	300	469	
R12	21/07/2022	385647	5929873	300	357	

Site ID ¹	Date (dd/mm/www) -	UTM I NAD 83	Location 3 Zone 11	- Distance (m)	Effort (s)
	Date (dd/min/yyyy)	Easting	Northing		Lifert (5)
R13	22/07/2022	414540	5916271	300	590
R14	21/07/2022	388067	5921591	300	469
R15	21/07/2022	384681	5927777	300	371
SWH01	28/07/2023	423061	5914373	300	348
SWH02	29/07/2023	424031	5919456	300	601
SWH03	29/07/2023	423942	5920769	300	527
SWH04	30/07/2023	426871	5928670	300	788
SWH05	29/07/2023	424047	5922809	300	559
SWH06	28/07/2023	423625	5921846	300	612
SWH07	29/07/2023	422747	5915222	150	156
SWH09	28/07/2023	423433	5914633	300	281
SWH10	29/07/2023	422605	5915591	300	601
SWH11	28/07/2023	423141	5916996	250	646
SWH17	28/07/2023	422919	5916937	300	493
UWH01	19/07/2022	417045	5926230	300	1,230
UWH02	19/07/2022	424027	5933298	300	794
UWH03	22/07/2022	396939	5931725	300	561
UWH04	22/07/2022	409004	5930305	300	567
UWH06	19/07/2022	429678	5930530	300	1,043
UWH07	22/07/2022	394759	5933193	300	362
UWH09	03/08/2022	431393	5928396	300	528
UWH10	03/08/2022	428764	5931538	250	359
UWH11	22/07/2022	400849	5933217	300	415
UWH15	22/07/2022	405348	5928718	300	717

¹ I = Ice Water Creek, J = Jarvis Creek, LWH = Lower Wildhay River, MO = Moberly Creek, MU = Mumm Creek, MWH = Middle Wildhay River, P = Pinto Creek, R = Rock Creek, SWH = South Wildhay River, and UWH = Upper Wildhay River.

		Species ²										
Site ID	ARGR	BKTR	BLTR	BURB	IWDR	MNWH	RNTR	SPSC	WHSC	YLPR		
I01	0	0	0	0	0	0	0	0	0	0		
I03	0	0	16	0	0	1	1	0	0	0		
I04	0	0	0	0	0	0	0	0	0	0		
I05	0	0	1	0	0	0	13	0	0	0		
I08	0	0	0	0	0	0	0	0	0	0		
I09	0	0	1	2	0	0	12	0	0	0		
I11	0	0	19	0	0	4	0	0	0	0		
I12	0	0	0	0	0	0	0	0	0	0		
I13	0	0	0	0	0	0	0	0	0	0		
I14	0	0	2	0	0	0	0	0	0	0		
J01	0	0	0	0	0	0	0	0	0	0		
J05	0	0	0	0	0	0	0	0	0	0		
J06	0	0	0	0	0	0	0	0	0	0		
J07	0	0	0	0	0	0	0	0	0	0		
J08	0	0	0	0	0	0	0	0	1	0		
J13	0	0	0	0	1	0	0	0	0	0		
J14	0	0	0	0	0	0	0	0	0	1		
J15	0	0	0	0	0	0	0	0	0	0		
J16	0	0	0	0	0	0	0	0	0	0		
J17	0	0	0	0	0	0	0	0	0	0		
LWH01	0	0	0	0	0	0	0	0	0	0		
LWH02	0	0	0	0	0	0	0	0	0	0		
LWH04	0	0	0	0	0	0	0	0	0	0		
LWH05	0	0	0	0	0	0	1	0	0	0		
LWH06	0	0	1	3	0	0	1	0	0	0		
LWH07	0	0	0	0	0	0	0	0	0	0		
LWH09	0	0	0	0	0	0	0	0	0	0		
LWH10	0	0	0	0	0	0	0	0	0	0		
LWH13	0	0	0	0	0	0	0	0	0	0		
LWH15	0	0	0	0	0	0	2	0	0	0		
MO01	1	8	0	0	0	2	7	0	0	0		
MO02	0	0	0	0	0	0	0	0	0	0		
MO05	0	0	0	0	0	0	0	0	0	0		
MO06	0	19	0	0	0	0	1	0	0	0		
MO07	0	25	0	0	0	1	2	0	0	0		
MO08	0	0	0	0	0	0	1	0	0	0		

Appendix 2. Backpack electrofishing fish catch in the HUC 10 sub-watersheds of the Wildhay River in Alberta, 2022 and 2023.

Site ID	Species ²										
Sile ID	ARGR	BKTR	BLTR	BURB	IWDR	MNWH	RNTR	SPSC	WHSC	YLPR	
MO09	0	0	0	0	0	0	0	0	0	0	
MO11	0	28	0	0	0	0	1	0	0	0	
MO13	0	0	0	0	0	0	0	0	0	0	
MO14	0	2	0	0	0	0	0	0	0	0	
MU03	0	0	0	0	0	0	0	0	0	0	
MU05	0	0	0	0	0	0	0	0	0	0	
MU07	0	0	0	0	0	0	0	0	0	0	
MU08	0	0	0	0	0	0	0	0	0	0	
MU12	0	0	0	0	0	0	0	0	0	0	
MU15	0	0	0	0	0	0	0	0	0	0	
MWH01	0	0	0	0	0	0	0	0	0	0	
MWH02	0	0	0	0	0	0	0	0	0	0	
MWH03	0	0	0	0	0	0	10	0	0	0	
MWH05	0	0	0	0	0	0	0	0	0	0	
MWH07	0	0	0	0	0	0	28	0	0	0	
MWH09	0	0	0	0	0	0	46	0	0	0	
MWH10	0	0	1	1	0	0	10	0	0	0	
MWH12	0	0	0	0	0	0	18	0	0	0	
MWH13	0	0	1	1	0	0	6	0	0	0	
MWH15	0	0	0	0	0	0	0	0	0	0	
P01	0	0	0	0	0	0	0	0	0	0	
P02	0	0	0	1	0	0	10	0	0	0	
P03	0	0	0	0	0	0	0	0	0	0	
P05	0	0	0	0	0	0	0	0	0	0	
P06	0	0	0	0	0	0	0	0	0	0	
P07	0	0	0	0	0	0	21	0	0	0	
P09	0	0	0	1	0	0	6	0	0	0	
P10	0	0	0	0	0	0	3	2	0	0	
P12	0	0	0	0	0	0	3	0	0	0	
P13	0	0	0	0	0	0	1	0	0	0	
R03	0	0	0	0	0	0	0	0	0	0	
R04	0	0	0	0	0	0	0	0	0	0	
R05	0	0	0	1	0	0	0	0	0	0	
R06	0	0	0	0	0	0	0	0	0	0	
R12	0	0	0	0	0	0	0	0	0	0	
R13	0	0	0	0	0	0	0	0	0	0	
R14	0	0	0	0	0	0	0	0	0	0	
R15	0	0	0	0	0	0	0	0	0	0	
SWH01	0	0	0	0	0	0	0	0	0	0	
SWH02	0	0	0	0	0	0	0	0	0	0	

Site ID ¹	Species ²									
	ARGR	BKTR	BLTR	BURB	IWDR	MNWH	RNTR	SPSC	WHSC	YLPR
SWH03	0	0	0	0	0	0	0	0	0	0
SWH04	0	0	0	0	0	0	2	0	0	0
SWH05	0	0	0	0	0	0	0	0	0	0
SWH06	0	0	0	0	0	0	0	0	0	0
SWH07	0	0	0	0	0	0	0	0	0	0
SWH09	0	0	0	0	0	0	0	0	0	0
SWH10	0	0	0	0	0	0	0	0	0	0
SWH11	0	0	0	0	0	0	0	0	0	0
SWH17	0	0	0	0	0	0	0	0	0	0
UWH01	0	0	1	0	0	0	1	0	0	0
UWH02	0	0	0	0	0	0	0	0	0	0
UWH03	0	0	0	0	0	0	0	0	0	0
UWH04	0	0	0	0	0	0	0	0	0	0
UWH06	0	0	1	0	0	0	11	0	0	0
UWH07	0	0	0	0	0	0	0	0	0	0
UWH09	0	0	0	0	0	0	0	0	0	0
UWH10	0	0	0	0	0	0	2	0	0	0
UWH11	0	0	0	0	0	0	0	0	0	0
UWH15	0	0	13	0	0	0	0	0	0	0

¹ I = Ice Water Creek, J = Jarvis Creek, LWH = Lower Wildhay River, MO = Moberly Creek, MU = Mumm Creek, MWH = Middle Wildhay River, P = Pinto Creek, R = Rock Creek, SWH = South Wildhay River, and UWH = Upper Wildhay River.

² Species codes: ARGR = Arctic grayling, BKTR = brook trout, BLTR = bull trout, BURB = burbot, IWDR = Iowa darter, MNWH = mountain whitefish, RNTR = rainbow trout, SPSC = spoonhead sculpin, WHSC = white sucker, YLPR = yellow perch.

Appendix 3. Length frequency histograms of brook trout, bull trout, and rainbow trout, captured using backpack electrofishing gear in the Wildhay River HUC 8 watershed, 2022 and 2023.



Species code: BKTR = brook trout.

Appendix 3 continued:



Species code: BLTR = bull trout.

Appendix 3 continued:



Species code: RNTR = rainbow trout.

Site ID ¹	Temp (°C)	Ambient Cond. (µS/cm)	Mean Wetted Width (m) (min–max)	Mean Rooted Width (m) (min–max)	Mean Depth (m) (min–max)	Dominant/ Secondary Substrate ²	Mean % Pool (min–max)	Mean % Riffle (min–max)	Mean % Run (min–max)
									100 (100–
I01	8.1	234	0.9 (0.7–1.0)	1.1 (0.8–1.3)	0.35 (0.21–0.61)	F/C	0 (0-0)	0 (0-0)	100)
I03	10.2	266	2.3 (1.6–4.9)	2.4 (1.2–5.6)	0.28 (0.16–0.38)	C/B	15 (10–20)	10 (10–10)	75 (70–80)
I04	7.3	118	0.9 (0.3–1.2)	1.1 (0.7–1.4)	0.08 (0.03–0.15)	B/LG	5 (5–5)	75 (75–75)	20 (20–20)
105	12.0	166	3.7 (1.6–4.8)	4.3 (1.8–6.7)	0.20 (0.14–0.27)	C/LG	20 (15-30)	26 (10-60)	54 (20–70)
108	8.1	188	1.3 (0.7–1.7)	1.1 (0.6–1.5)	0.13 (0.06–0.22)	C/LG	3 (0–5)	33 (30–35)	64 (60–70)
I09	14.4	147	2.8 (1.7–5.5)	3.1 (2.0-6.6)	0.28 (0.14-0.61)	C/LG	13 (0–30)	19 (10–30)	68 (60-80)
I11	4.9	311	3.0 (1.8–5.2)	3.1 (2.1–5.3)	0.31 (0.26–0.43)	C/B	18 (5-40)	21 (10-40)	61 (40–70)
I12	11.3	163	1.1 (0.6–2.0)	1.3 (0.6–2.2)	0.14 (0.10-0.23)	C/SG, LG	3 (0–5)	81 (60–100)	16 (0-30)
I13	9.1	181	1.3 (0.9–1.5)	1.3 (1.0–1.6)	0.16 (0.08-0.21)	SG/F	11 (5–15)	20 (15-25)	69 (60-80)
I14	6.9	309	2.0 (1.2–3.4)	2.1 (1.1–3.3)	0.22 (0.11-0.45)	LG/C, SG	5 (5–5)	17 (10–20)	78 (75–85)
J01	8.7	303	2.9 (2.1–4.1)	3.0 (2.1-4.1)	0.16 (0.11-0.23)	LG/C	4 (0–10)	49 (35–60)	47 (35–60)
J05	7.2	364	2.1 (0.8–3.3)	3.1 (1.3-4.6)	0.17 (0.09–0.25)	LG/C	4 (0–5)	52 (30-70)	44 (30–70)
J06	11.2	354	2.3 (1.8–3.1)	3.0 (2.1-4.5)	0.22 (0.16-0.26)	LG/C	3 (0-5)	54 (35–90)	43 (10-60)
J07	8.5	202	1.6 (1.1–2.6)	1.5 (0.9–2.4)	0.19 (0.09–0.33)	F/SG	5 (0-10)	12 (5-20)	83 (75–95)
J08	13.2	258	3.4 (2.8–4.4)	3.4 (2.8–4.4)	0.19 (0.09–0.37)	C/B	4 (0–10)	93 (85–100)	3 (0-5)
J13	16.0	323	5.0 (3.1-7.7)	5.8 (4.3-6.7)	0.47 (0.26–0.77)	SG/LG	14 (5-20)	29 (5-45)	57 (50-75)
J14	16.7	298	4.5 (3.6–5.9)	4.5 (3.6–5.9)	0.73 (0.49–1.22)	F/-	13 (10–20)	0 (0-0)	87 (80–90)
J15	11.0	297	3.0 (2.1–4.9)	4.0 (3.2–5.2)	0.13 (0.05–0.28)	LG/C	3 (0-10)	59 (50-65)	38 (35-40)
J16	10.5	638	1.7 (1.3–2.2)	2.0 (1.4–2.9)	0.15 (0.06–0.29)	LG/SG, F	6 (5–10)	56 (30-70)	43 (25–70)
J17	8.4	285	1.3 (0.9–1.7)	1.1 (0.6–2.1)	0.15 (0.12–0.18)	C/LG	2 (0-5)	65 (50-80)	33 (20-45)
LWH01	13.2	274	1.0 (0.9–1.2)	0.9 (0.7–1.1)	0.43 (0.30-0.57)	F/SG	3 (0-5)	3 (0-5)	94 (90–100)
LWH02	5.8	331	0.5 (0.2–0.7)	0.4 (0.2–0.7)	0.14 (0.09–0.18)	F/SG	7 (5–15)	82 (70–90)	12 (5–25)
LWH04	9.4	232	1.5 (1.0–2.6)	1.4 (0.7–2.5)	0.41 (0.18–0.56)	C, F/LG	18 (5–30)	28 (5-60)	55 (20–90)

Appendix 4. Habitat measurements at electrofishing sites in HUC 10 sub-watersheds of the Wildhay River in Alberta, 2022 and 2023.

Site ID ¹	Temp (°C)	Ambient Cond. (µS/cm)	Mean Wetted Width (m) (min-max)	Mean Rooted Width (m) (min–max)	Mean Depth (m) (min–max)	Dominant/ Secondary Substrate ²	Mean % Pool (min–max)	Mean % Riffle (min–max)	Mean % Run (min–max)
LWH05	10.6	171	2.1 (0.4-4.5)	2.1 (0.4-4.5)	0.54 (0.08–1.15)	F/-	3 (0–10)	3 (0–5)	94 (85–100)
LWH06	12.6	288	4.8 (3.8–6.1)	5.3 (4.5-7.6)	0.49 (0.30-0.70)	SG, F/F	9 (0–15)	4 (0–10)	87 (75–100)
LWH07	11.4	214	1.3 (0.6–2.2)	1.2 (0.5–1.9)	0.21 (0.12-0.32)	SG/F	11 (10–15)	36 (10-60)	53 (30-80)
LWH09	8.2	252	3.4 (2.6-4.3)	3.2 (2.3-4.2)	0.73 (0.65–1.10)	F/SG, F	3 (0–10)	2 (0-5)	96 (85–100)
LWH10	11.7	305	1.4 (1.0–1.8)	1.3 (1.0–1.8)	0.40 (0.23-0.77)	F/-	18 (15–25)	3 (0-5)	78 (75–80)
LWH13	8.6	301	2.2 (0.4–5.0)	2.2 (0.4–5.0)	0.09 (0.06-0.14)	F/-	15 (0-40)	8 (0-20)	78 (40–100)
LWH15	8.3	304	3.4 (2.3-4.2)	3.4 (2.3–5.0)	0.53 (0.34-0.90)	F/F, LG	9 (0–20)	9 (0–20)	82 (60–100)
MO01	13.8	221	8.8 (5.7–14.2)	12.3 (7.8–15.9)	0.56 (0.40-0.90)	C, LG/LG	22 (5-35)	44 (20-85)	34 (10–55)
MO02	8.9	218	1.0 (0.7–1.4)	0.8 (0.5–1.3)	0.15 (0.09–0.25)	SG/C	12 (5-30)	66 (60-75)	23 (10-30)
MO05	7.2	216	0.6 (0.3–0.8)	0.7 (0.2–1.3)	0.20 (0.10-0.32)	F/LG	4 (0–5)	4 (0–5)	92 (90–100)
MO06	11.2	225	4.5 (3.7–5.5)	6.9 (4.7–7.5)	0.42 (0.19–0.61)	LG/SG, C	18 (15–20)	30 (30–30)	52 (50-55)
MO07	11.1	237	6.6 (4.3–7.7)	7.0 (5.9–7.7)	0.37 (0.22–0.53)	C/B, LG	11 (5–15)	43 (20–75)	47 (15–65)
MO08	5.4	299	4.1 (3.0–5.8)	5.3 (3.7-6.5)	0.35 (0.20-0.40)	C/LG	16 (5–20)	33 (15–60)	51 (35–70)
MO09	9.7	430	1.0 (0.5–1.4)	1.0 (0.8–1.1)	0.31 (0.11–0.68)	F/-	2 (0–5)	10 (5–15)	88 (85–95)
MO11	8.5	285	4.2 (2.2–5.4)	5.6 (4.3-6.9)	0.33 (0.26–0.39)	C/LG	7 (0–15)	32 (25–45)	62 (45–70)
MO13	5.6	155	1.6 (1.2–2.2)	1.4 (0.9–2.0)	0.20 (0.15-0.26)	LG, C/SG	9 (5–10)	78 (70–90)	13 (5–20)
MO14	6.6	291	2.0 (1.4-3.0)	2.4 (1.3–4.3)	0.25 (0.15-0.36)	C/LG	6 (0–10)	54 (40–70)	40 (30–50)
MU03	2.6	308	1.1 (0.1–1.6)	2.0 (1.3-2.6)	0.13 (0.01–0.17)	LG/SG	27 (15–40)	53 (30–70)	20 (5-40)
MU05	7.6	366	6.7 (4.2–10.3)	8.7 (6.2–12.0)	0.43 (0.20-0.95)	LG/C	8 (5–10)	73 (60–80)	20 (10-30)
MU07	2.6	354	3.0 (0.5-5.0)	5.3 (3.8–7.1)	0.18 (0.11-0.25)	C, LG/SG, LG	24 (10–35)	39 (15–60)	41 (10–70)
MU08	9.2	358	6.8 (6.1–7.5)	13.8 (8.1–18.1)	0.29 (0.21–0.35)	C/LG	4 (0–5)	71 (55–90)	25 (10-40)
MU12	10.9	379	7.4 (5.5–10.0)	33.8 (22.4–41.9)	0.33 (0.19–0.62)	C, LG/LG	9 (5–15)	65 (35–85)	26 (10-60)
MU15	4.5	360	4.9 (3.6–6.6)	6.0 (4.1–10.4)	0.27 (0.24–0.31)	C/LG	6 (0–15)	38 (25–60)	56 (35–65)
MWH01	10.5	318	0.9 (0.7–1.2)	0.8 (0.6–1.0)	0.35 (0.31-0.42)	F/-	3 (0–5)	0 (0-0)	97 (95–100)
MWH02	7.9	371	1.1 (0.5–2.1)	0.9 (0.6–1.8)	0.33 (0.21–0.51)	F/LG	4 (0–5)	7 (5–10)	89 (85–95)
MWH03	11.9	289	2.5 (1.2–3.2)	2.5 (1.8–2.9)	0.61 (0.30-0.94)	F/-	20 (10-50)	7 (0–20)	73 (50-85)

Site ID ¹	Temp (°C)	Ambient Cond. (µS/cm)	Mean Wetted Width (m) (min–max)	Mean Rooted Width (m) (min–max)	Mean Depth (m) (min–max)	Dominant/ Secondary Substrate ²	Mean % Pool (min-max)	Mean % Riffle (min–max)	Mean % Run (min–max)
MWH05	8.9	355	0.5 (0.4–0.6)	0.5 (0.4–0.6)	0.15 (0.10-0.19)	F/-	0 (0-0)	9 (5–15)	91 (85–95)
MWH07	7.6	177	2.5 (1.6–3.6)	2.4 (1.4–3.3)	0.34 (0.21–0.51)	C/LG	8 (0-30)	47 (10-60)	45 (35-80)
MWH09	10.1	224	4.7 (3.6–5.5)	5.4 (4.3-6.8)	0.35 (0.26-0.56)	C/LG	4 (0–10)	49 (25–75)	47 (15–70)
MWH10	8.3	250	5.4 (3.6-7.0)	5.2 (3.5-7.0)	0.41 (0.21-0.73)	LG/C, SG	18 (10–35)	15 (0-35)	67 (45–90)
MWH12	9.9	219	4.2 (3.7-4.9)	6.4 (4.6–11.6)	0.27 (0.22–0.41)	C/LG	8 (0-20)	48 (30-60)	45 (35-60)
MWH13	8.2	220	4.3 (3.2–5.3)	4.7 (3.3–6.1)	0.33 (0.22–0.53)	C/LG	5 (0-10)	45 (10-80)	50 (20-85)
MWH15	7.4	372	1.1 (0.7–2.1)	1.1 (0.6–2.3)	0.25 (0.13-0.60)	F/-	1 (0–5)	13 (10–15)	82 (80-85)
P01	9.5	305	3.9 (2.6–5.1)	4.0 (3.2–4.6)	1.21 (0.39–1.9)	F/LG	0 (0-0)	10 (0-40)	90 (60–100)
P02	12.8	333	2.5 (1.3-3.7)	2.7 (1.4–3.6)	0.26 (0.20-0.32)	LG/SG	12 (5–15)	27 (15-65)	62 (20-80)
P03	12.8	162	0.7 (0.5–0.8)	0.6 (0.5–0.6)	0.39 (0.32–0.51)	F/-	13 (10–15)	0 (0–0)	88 (85–90)
P05	8.8	359	0.9 (0.6–1.4)	0.9 (0.5–1.4)	0.14 (0.07–0.23)	LG/SG, F	3 (0–5)	16 (0-25)	82 (70–100)
P06	11.2	244	2.7 (1.7-3.5)	6.4 (4.9–7.9)	0.26 (0.15-0.33)	C/B	9 (5–15)	81 (70–90)	10 (5-20)
P07	11.0	169	1.8 (1.0-2.7)	1.7 (1.3–2.7)	0.32 (0.15-0.59)	LG/C	3 (0–10)	5 (0–10)	92 (85–95)
P09	11.9	354	1.3 (0.7–1.8)	1.1 (0.5–1.8)	0.47 (0.37-0.62)	F/SG, F	3 (0–5)	3 (0–10)	93 (85–100)
P10	9.3	320	5.7 (3.1–9.6)	6.5 (4.2–9.6)	0.28 (0.12-0.52)	C/LG	11 (5–15)	37 (30–55)	53 (40-60)
P12	7.8	121	1.9 (1.2–2.7)	1.8 (1.0-2.6)	0.25 (0.14-0.36)	LG/SG	10 (5–15)	78 (75–85)	12 (10–15)
P13	10.4	320	0.8 (0.3–1.1)	0.8 (0.3–1)	0.23 (0.11-0.32)	LG/C	5 (0–10)	11 (5–15)	84 (75–90)
R03	3.8	349	0.9 (0.5–1.2)	2.9 (1.7-3.9)	0.09 (0.05–0.18)	C/LG	6 (0–10)	94 (90–100)	0 (0–0)
R04	4.0	378	1.3 (0.8–1.7)	1.3 (0.6–1.7)	0.17 (0.12-0.25)	LG/SG	2 (0–5)	72 (45–80)	26 (20-45)
R05	7.6	471	10.2 (7.3–13.7)	37.7 (29.2–49.0)	0.47 (0.37-0.60)	C/LG	3 (0–10)	92 (85–100)	5 (0-10)
R06	7.5	434	6.9 (5.2-8.2)	8.4 (6.8–14.1)	0.59 (0.29-0.95)	LG/SG	6 (0–10)	78 (70–90)	17 (5–30)
R12	5.3	412	3.4 (2.2–4.7)	3.4 (2.1–4.8)	0.44 (0.23–0.54)	LG/C	0 (0–0)	88 (85–90)	12 (10–15)
R13	5.3	370	3.7 (2.9–4.7)	4.1 (2.9–5.3)	0.43 (0.37-0.52)	C/LG	6 (0–10)	78 (70-85)	17 (10–20)
R14	5.7	384	3.9 (2.5-6.7)	4.6 (2.5–9.4)	0.47 (0.40-0.56)	LG/SG	5 (5–5)	28 (20-35)	67 (60–75)
R15	5.5	432	3.2 (2.2–5.2)	4.7 (2.2–10.2)	0.27 (0.20-0.37)	C/LG	5 (0-10)	71 (35–90)	24 (5-55)
SWH01	4.9	423	3.0 (2.0-4.0)	3.5 (2.0-5.2)	0.20 (0.08-0.28)	LG/C	3 (0-5)	70 (70–70)	27 (25-30)

Site ID ¹	Temp (°C)	Ambient Cond. (µS/cm)	Mean Wetted Width (m) (min-max)	Mean Rooted Width (m) (min–max)	Mean Depth (m) (min–max)	Dominant/ Secondary Substrate ²	Mean % Pool (min–max)	Mean % Riffle (min–max)	Mean % Run (min–max)
SWH02	6.5	384	6.1 (4.1–7.6)	5.8 (4.1–7.5)	0.50 (0.22-0.85)	C, LG/SG, LG	7 (0–10)	26 (0-50)	67 (40–100)
SWH03	9.2	381	7.5 (6.4-8.4)	7.3 (6.1–8.4)	0.33 (0.22-0.66)	LG/SG, C	7 (0–15)	15 (10–30)	78 (70-85)
SWH04	6.4	421	6.3 (3.5–9.5)	8.8 (7.4–10.4)	0.49 (0.24–0.97)	LG/C	5 (0-10)	29 (5-45)	66 (50–95)
SWH05	3.9	400	4.7 (3.7-6.7)	4.5 (3.5-6.7)	0.43 (0.29–0.72)	LG/SG	10 (5-20)	44 (10–70)	46 (25-70)
SWH06	5.4	380	7.4 (6.4–9.5)	7.4 (6.3–9.5)	0.42 (0.21–0.80)	C/LG	12 (5–25)	46 (10–75)	44 (20–80) 100 (100–
SWH07	3.7	403	1.2 (0.7–1.6)	1.1 (0.7–1.4)	0.29 (0.17-0.36)	F/SG	0 (0-0)	0 (0-0)	100)
SWH09	14.0	241	1.3 (1.1–1.7)	1.3 (1.1–1.5)	0.29 (0.11-0.90)	F/SG, F	1 (0-5)	3 (0-10)	96 (85–100)
SWH10	7.8	378	5.9 (4.6-8.0)	6.2 (4.6-8.5)	0.35 (0.21-0.48)	LG/LG, SG, C	6 (0–10)	78 (70-80)	17 (10–20)
SWH11	5.9	395	5.8 (3.9–7.3)	5.6 (3.7-7.1)	0.43 (0.18–0.55)	C/LG, C	13 (10–20)	22 (10-40)	65 (50-70)
SWH17	5.2	355	3.7 (3.0-4.1)	3.8 (2.8–4.3)	0.27 (0.21–0.33)	C/LG	3 (0–5)	67 (60–75)	30 (25–35)
	0.2	271	29.0 (16.0–	/6.0 (53.0-	0.52(0.24, 0.77)		2(0, 5)	00 (00 100)	11 (0, 15)
	8.3 9.7	3/l 91	43.0)	(112.0)	0.32(0.34-0.77)		2(0-3)	88 (80-100)	11(0-13)
	8./ 5.(81	1.9(1.2-3.0)	2.3(1.0-3.0)	0.30(0.11-0.49)		6(3-10)	24(3-33)	70 (60–90)
UWH03	5.0	3/6	2.6(2.0-3.1)	2.9(2.0-3.4)	0.44(0.39-0.56)	LG/SG	6 (0-20)	/4 (60-80)	20(15-25)
UWH04	6.8	286	4.3 (1.9–9.4)	8.0 (6.4–9.8)	0.18 (0.05–0.25)	C/SG	1/(10-30)	48 (15–60)	35 (20-65)
UWH06	11.5	174	2.7 (1.9–3.4)	3.1 (2.0–4.5)	0.24 (0.14–0.37)	LG/C	4 (0–5)	31 (20–40)	65 (55–75)
UWH07	4.8	377	2.0 (1.8–2.6)	2.0 (1.4–2.6)	0.41 (0.30–0.48)	LG/C	4 (0–5)	48 (40–55)	48 (40–60)
UWH09	6.0	367	3.0 (1.7-4.9)	3.0 (2.1–4.9)	0.25 (0.15-0.56)	LG/C	26 (20-35)	53 (30-60)	21 (5-40)
UWH10	13.3	226	1.2 (0.4–1.7)	1.4 (1.0–1.6)	0.37 (0.24–0.63)	F/C, F	9 (5–10)	10 (10–10)	81 (80–85)
UWH11	4.4	340	1.8 (1.0-2.5)	1.9 (1.2–2.3)	0.29 (0.25-0.34)	C/LG	3 (0–10)	58 (40-65)	38 (30–50)
UWH15	8.4	370	13.3 (6.0–21.0)	23.3 (11.3–29.0)	0.51 (0.30-0.78)	LG/SG	13 (5–20)	62 (30–75)	26 (10-60)

 $^{-1}$ I = Ice Water Creek, J = Jarvis Creek, LWH = Lower Wildhay River, MO = Moberly Creek, MU = Mumm Creek, MWH = Middle Wildhay River, P = Pinto Creek, R = Rock Creek, SWH = South Wildhay River, and UWH = Upper Wildhay River. $^{-2}$ Substrate codes: B = boulder, C = cobble, F = fines, LG = large gravel, SG = small gravel.



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