Surveys for Presence of ESA-Listed Salmonids on Naval Base Kitsap Property

FINAL report prepared for U.S. Navy by U.S. Fish and Wildlife Service

12/30/2020

Prepared by:

Jeffery R. Johnson

Prepared for U.S. Navy, Contract #'s:

N68742-18-MP-001VX

N68742-19-MP-001VX

N68742-19-MP-002VX

N68742-20-MP-001VX

Table of Contents

Acronym Definitions

ESA: Endangered Species Act

FWS: U. S. Fish and Wildlife Service

NBK: Naval Base Kitsap

HCSC: Hood Canal Summer-Run Chum

NMFS: National Marine Fisheries Service

MLLW: Mean Lower Low Water

Recommended Citation

Johnson, J.R. 2020. Surveys for Presence of ESA-Listed Salmonids on Naval Base Kitsap Property. Western Washington Fish and Wildlife Conservation Office, U.S. Fish and Wildlife Service. Final report to U.S. Navy. 12/30/2020.

Introduction

The United States Navy (Navy) is required to protect Endangered Species Act (ESA) listed species by three legal statutes: 1) The Sikes Act, which requires military installations to provide for the conservation and rehabilitation of natural resources; 2) Section 7(a)(1) of the ESA, which requires federal agencies to use their authority, where feasible, to carry out programs for the conservation of endangered and threatened species; 3) Section 7(a)(2) of the ESA, which requires federal agencies to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any listed species, or result in the destruction or adverse modification of habitat of such species. To meet these requirements, the Navy contracted the U.S. Fish and Wildlife Service (FWS) to survey streams on Naval Base Kitsap (NBK) property to assess presence of ESA-listed salmonids and habitat conditions.

The primary species of concern in this study included Puget Sound steelhead (*Oncorhynchus mykiss*), Hood Canal summer-run chum (*O. keta,* HCSC hereafter), Puget Sound Chinook (*O. tshawytscha*), and bull trout (*Salvelinus confluentus*). To meet the objectives, the FWS completed a series of electrofishing, spawner, dipnet/snorkel, and beach seine surveys over the course of 10 months. The objectives of this work were to: 1) determine if ESA-listed salmonids were present on NBK property and 2) determine if habitat conditions suggested their presence was likely. Many of the streams on NBK property have never been surveyed, or survey data was outdated. These new data would be used to 1) establish baseline information in some of the watersheds, or provide updated information; 2) help prioritize habitat management actions which will benefit ESA-listed salmonids; and 3) provide information that will assist the Navy in conducting ESA section 7(a)(2) consultations with the FWS and National Marine Fisheries Service (NMFS) for future actions which may impact freshwater habitat.

Methods

Study Area

The scope of work identified six different NBK properties with eight streams suitable for surveys (Figures 1, 2, 3 and 4). A sampling strategy was developed for each stream based on the potential for listed species, except for bull trout due to logistic constraints. Habitat assessments were also completed on a subset of streams to take the place of juvenile Chinook surveys that were cancelled due to COVID-19. Because of the potential differences in listed species, sampling varied by stream as described below and in Table 1.

The study streams varied in length from 80 to >1000 meters, with some contained entirely on Navy property, while others contained habitat extending beyond Navy property. Streams contained within Navy property boundaries included: Zelatched, Toandos Stream 2, and the Cattail Basin stream. The following streams extended beyond the Navy property boundaries: Beaver Creek, Toandos Streams 1 and 3, Keyport, and the Naval Hospital stream. All streams entered Puget Sound on Navy property and were therefore sampled from the marine environment upstream to their terminus, the end of suitable habitat, or until we reached the Navy property boundary.

All the streams drained into waters supporting Puget Sound steelhead and Chinook salmon (Figures 1, 2, 3 and 4) and were expected to be sampled for these species. Based on size and gradient, all the streams had the potential for use by Puget Sound steelhead; however, these streams were expected to be too small for spawning by adult Chinook salmon and were only sampled for non-natal use by juvenile Chinook. Due to COVID-19, only one sampling event occurred at every stream for juvenile Chinook. Five streams, including Zelatched, all three Toandos streams, and the Cattail Basin stream drain into Hood Canal six to 20 kilometers from documented HCSC spawning activity and therefore had the potential for use by HCSC (Sands et. al. 2009). Thus, the surveys for HCSC described below were only completed on these streams, with the exception of the Cattail Basin stream because it was a late addition to the project.

Puget Sound Steelhead Survey Methodology

Any *O. mykiss* with access to Puget Sound would be considered an ESA-listed Puget Sound steelhead. Streams without barriers to Puget Sound were sampled for steelhead with single-pass backpack electrofishing (400 v, 30 hz, 15% duty cycle), following Temple and Pearson (2007). Surveys were conducted with a single backpack electrofisher unit (Smith-Root model LR-24) progressing upstream from the lowest point possible considering saltwater influence. A team of two to three netters accompanied the electrofisher and collected all fish encountered. All captured fish were anesthetized with MS-222, identified to species, opportunistically measured for length and weight, and released after recovery at the capture location.

Hood Canal Summer-Run Chum Survey Methodology

Streams entering Hood Canal were surveyed for spawning summer-run chum from August to October 2019 (Haymes 2000; Sands et. al 2009). The streams were approximately 5 to 20 km from the nearest known spawning activity by HCSC, and had not previously been surveyed for HCSC (Sands et. al 2009). Four visual spawner surveys were conducted during the typical spawning window of HCSC (late August through early October). The lowest 100 meters of each stream was surveyed moving upstream looking for evidence of spawning such as redds or carcasses. One stream that enters Hood Canal (Cattail Basin stream) was not surveyed for spawning HCSC because this stream was a late addition to the project.

Puget Sound Chinook Survey Methodology

The original study design was to survey all streams without barriers to Puget Sound for non-natal juvenile Chinook use with nighttime dipnetting from February to May. However, due to COVID-19, only a single sampling event was completed at all streams in late February 2020. Dipnetting was performed at least 30 minutes after sunset and consisted of two samplers walking upstream with artificial lights. If a fish was encountered, it was captured with a dip net, anesthetized with MS-222, identified, and released after recovery at the capture location. When conditions allowed (i.e., enough water), nighttime snorkel surveys in an upstream manner was employed. Additionally, the stream mouth and adjacent shoreline was sampled with a 30-meter beach seine with 4mm mesh (Beamer et al. 2003; 2013). All fish captured in the beach seine were anesthetized with MS-222, identified, and released. The Cattail Basin stream was not surveyed for non-natal use by juvenile Chinook because it was a late addition to the project.

Habitat Assessments

The Northwest Forest Management Plan habitat assessment protocol (USFS 2017) was implemented at a subset of the streams, including Keyport, Beaver Creek, and all three Toandos streams (Figures 2, 3 and 4). Streams were chosen for these surveys based upon time constraints and qualitative ranking of monitoring-need based on site visits during fish surveys (i.e., fish presence). In short, the protocol is a transect-based method where 21 transects (11 major and 10 minor), are evenly spaced over 160 meters of stream. Channel metrics (e.g., bankfull width, wetted width, and depths) were measured at 11 transects, and pebble counts were conducted at all 21 transects. Additionally, large woody debris by area, pool count and area, and percent surface fines on pool tails was recorded along the entirety of the survey length. The protocol was modified slightly to fulfill assessment needs specific to the surveyed streams. Briefly, 1) Survey protocols started at the end of tidal influence at all locations; 2) Large woody debris was defined as greater than 1 meter in length and 0.3 meters in width; 3) Convex densiometer readings were included for each major transect and taken above the thalweg; 4) Entrenchment was not measured; 5) The full 160 meter survey was not completed when the stream was very small (i.e., not fish bearing).

Results

Naval Base Kitsap Bangor

The NBK Bangor main base has an unnamed stream within Cattail Basin (Cattail Basin stream hereafter) that enters the east side of Hood Canal (Figure 2). The Cattail Basin Stream was a late addition to the project and therefore was only sampled with backpack electrofishing on 07/20/2020, to survey for steelhead. Additionally, Trident Lakes on NBK Bangor was sampled on 07/20/2020. Approximately 400 meters of the Cattail Basin Stream was sampled with 865 seconds of backpack electrofishing. Seventy-five coastal cutthroat trout (*O. clarkii clarkii*) between 80 to 150 mm were captured (Table 1 and Appendix A). Also, three spine stickleback (*Gasterosteus aculeatus*), Pacific staghorn sculpin (*Leptocottus armatus*), and a flatfish (family *Pleuronectidae*), were captured in the lowest 100 meters of the stream. The shoreline of Trident Lakes on NBK Bangor was backpack electrofished for 350 seconds and sampled with a single seine haul. Largemouth bass (*Micropterus salmoides*), pumpkinseed sunfish (*Lepomis gibbosus*), and bluegill sunfish (*Lepomis macrochirus*) were captured in Trident lakes.

Naval Hospital Bremerton

The Naval Hospital Bremerton property has a single unnamed stream that enters Puget Sound on the Kitsap Peninsula (Figure 3). The channel on this property was dry on every occasion; therefore, no fish sampling was conducted.

Jackson Park

The Jackson Park property has a single unnamed stream that is connected to Puget Sound via a culvert that is approximately 100 meters in length (Figure 3). The entirety (approximately 100 meters) of the exposed portion of the unnamed stream on the Jackson Park property was sampled with 206 seconds of backpack electrofishing on 09/24/2019. The stream was small (approximately <0.1m average depth and <1.0m wetted width) at the time of sampling and no fish were seen or captured. The mouth of the culvert was sampled on 02/19/2020 with nighttime dipnetting and a single seine haul which captured 28 sculpin (*Cottus spp*.), while no fish were seen upstream of the culvert during any sampling (Table 1 and

Appendix A). The tide stage at Bangor Wharf was approximately 1 meter above Mean Lower Low Water (MLLW) when the beach seine was used (NOAA 2020).

Naval Base Kitsap Keyport

The NBK Keyport property has a single unnamed stream that feeds a lagoon prior to entering Puget Sound on the Kitsap Peninsula (Figures 1 and 2). The entire stream (472.5 meters) on the NBK Keyport property was sampled with 1,049 seconds of backpack electrofishing effort on 09/24/2019. This sampling captured 20 sculpin (*Cottus spp*.), and ten coastal cutthroat trout 154 to 177mm (Table 1 and Appendix A). The stream was sampled with nighttime dipnetting on 02/19/2020, and a single beach seine haul within the lagoon, with no fish seen or captured during that sampling event. The tide stage at Bangor Wharf was approximately 1.5 meters above MLLW when the beach seine was used (NOAA 2020).

Manchester Fuel Department

The Manchester Fuel Department property contains approximately the lowest 400 meters of Beaver Creek, which enters Puget Sound on the Kitsap Peninsula (Figure 3). All of Beaver Creek on the Manchester Fuel Department property was sampled with backpack electrofishing on 09/23/2019 with 2209 seconds of effort (Table 1 and Appendix A). This sampling captured 111 sculpin (*Cottus spp*.), 88 coho salmon (*O. kisutch*) from 41mm to 77mm (number measured; N=33), 144 coastal cutthroat trout from 27mm to 153mm (N=53), and 66 juvenile trout (*Oncorhynchus spp*.) from 18 to 50mm (N=19) that did not show clear diagnostics of species (Figure 5). Additionally, Beaver Creek was sampled via nighttime snorkel and two beach seine hauls at the mouth of the stream on 02/21/2020. During the snorkel survey, eight coastal cutthroat trout from approximately 100 to 400mm were observed. Additionally, 14 coho salmon fry were captured with dipnetting that were observed during the snorkel (30 to 75mm). The beach seine captured one sculpin (*Cottus spp*.). The tide stage at Bangor Wharf was approximately 0 meters above MLLW when the beach seine was used (NOAA 2020).

Toandos Buffer Zone

The Toandos Buffer Zone property has three unnamed streams that enter Hood Canal (Figure 4). All three streams were sampled with backpack electrofishing on 09/26/2019. Approximately the lowest 400 meters of Stream 1 was sampled with 1,143 seconds of backpack electrofishing effort (Table 1 and Appendix A). In Stream 1, 148 coastal cutthroat trout from 50 to 161mm (N=53), 25 sculpin (*Cottus spp*.) from 72 to 92mm (N=3), seven coho salmon from 65 to 105mm (N=7), and 12 juvenile trout (*Oncorhynchus spp*.) less than 50mm that did not show clear diagnostics of species were captured (Figure 4). In Stream 2, all of the habitat available was electrofished, which consisted of a single pool within the tidal zone approximately 10 meters in length, and a couple meters of the very small (approximately <0.5m wetted width, and <0.1m average depth) stream that entered that pool, with 181 seconds of effort (Table 1 and Appendix A). In Stream 2, one coastal cutthroat trout was captured (Table 1 and Appendix A). In Stream 3, the lowest 100 meters of stream was electrofished with 444 seconds of effort (Table 1 and Appendix A). This sampling captured five coastal cutthroat trout from 141 to 181mm, two coho salmon (104 and 112mm), and three sculpin (*Cottus spp*.) from 71 to 86mm.

The lowest 100 meters of all three of the Toandos Buffer Zone streams were surveyed for evidence of HCSC spawning on four occasions (08/08/2019, 09/05/2019, 09/26/2019 and 10/10/2019) (Table 1 and Appendix A). No evidence of spawning activity from HCSC was observed in any of the streams.

All three streams were sampled with nighttime dipnetting and a beach seine on 02/20/2020 (Table 1 and Appendix A). In the lowest 100 meters of Stream 1, two coastal cutthroat (64 and 93mm) and four chum salmon (38 to 42mm) were captured with dip nets (Figure 6). Additionally, eight chum salmon (38 to 43mm), three pink salmon (*O. gorbuscha*) (35 to 38mm), and four sculpin (*Cottus spp*.) were captured in two beach seine hauls near the mouth of Stream 1. The tide stage at Bangor Wharf was approximately 0 meters above MLLW when the beach seine was used near the mouth of Stream 1 (NOAA 2020). At Stream 2, three chum salmon (35 to 38mm) were captured with dipnetting in the lowest 10 meters of the stream. Additionally, nine chum salmon (33 to 40mm), seven pink salmon (28 to 40mm), and two shiner perch (*Cymatogaster aggregata*) were captured in a single beach seine haul near the mouth of Stream 2. The tide stage at Bangor Wharf was approximately 0.5 meters above MLLW when the beach seine was used near the mouth of Stream 2 (NOAA 2020). At Stream 3, one 65mm coastal cutthroat trout and 16 chum salmon (30 to 44mm) were captured with dipnetting. Additionally, two chum salmon (38 and 42mm), one shiner perch, four sculpin (*Cottus spp*.), and five flatfish (family *Pleuronectidae*) were captured in a single beach seine haul near the mouth of Stream 3. The tide stage at Bangor Wharf was approximately 1 meter above MLLW when the beach seine was used near the mouth of Stream 3 (NOAA 2020).

Zelatched Point

The Zelatched Point property has a single unnamed stream that enters a lagoon that ultimately connects to Hood Canal in Dabob Bay (Figure 4). The channel was dry during the sampling window for steelhead and therefore could not be electrofished. The channel and the edge of the lagoon area were walked to survey for evidence of HCSC spawning on four occasions (08/08/2019, 09/05/2019, 09/26/2019 and 10/09/2019) (Table 1). No evidence of spawning activity from HCSC was observed in the stream or lagoon area. The stream was surveyed on 02/19/2020 with nighttime dipnetting. No fish were seen or captured in the stream. Additionally, three beach seine hauls were employed on the portion of the beach that the Navy owns, and captured no fish. Dipnetting was employed in the channel that connects the lagoons to Dabob Bay, and two chum salmon (39 and 43mm) were captured (Table 1 and Appendix A). Two beach seine hauls were conducted in the lagoon area and captured three chum salmon (35 to 44mm), two pink salmon (34 and 36mm), six three-spine stickleback, and 14 sculpin (*Cottus spp*.). The tide stage at Bangor Wharf was approximately 0.15 meters below MLLW when the beach seine was used (NOAA 2020).

Habitat Assessments

Habitat surveys were conducted at NBK Keyport, Manchester Fuel Department, and all three Toandos Buffer Zone streams. The data for these surveys are presented in Appendix B. Naval Base Kitsap Keyport was surveyed a full protocol length (160 meters) and the remaining stream was walked until the property boundary at 472.5 meters total length to include distances to notable features (Appendix B). Data was collected on bankfull width, wetted width, depth, large woody debris, pools, and in-stream cover. Data was not collected on percent surface fines on pool tails, and pebble counts were not conducted at this site. The stream at Naval Base Kitsap Keyport is generally shallow, narrow, low gradient, with some pools and large woody debris present (Table 2).

At the Manchester Fuel Department, Beaver Creek was surveyed two full protocol lengths (320 meters) and mapped to the property boundary (391 meters total length) (Figure 3). Beaver Creek is the largest stream surveyed, and generally has quality, complex habitat for salmonids (Table 2). Stream 1 at the Toandos Buffer Zone property was surveyed a full protocol length and then mapped to a culvert feature at 472 meters total length. Stream 1 is the second largest stream surveyed, although it is shallow and narrow, it generally has quality, complex habitat for salmonids (Table 2). Stream 2 at the Toandos Buffer Zone property was surveyed for 80 meters only due to lack of flow. Stream 2 is the smallest and highest gradient stream surveyed for habitat, and has an abundance of large woody debris that create wood-step features (Table 2). Stream 3 at the Toandos Buffer Zone property was surveyed one full protocol length. Stream 3 is a low gradient, narrow, and the most shallow stream surveyed for habitat. At the Manchester Fuel Department and all three Toandos Buffer Zone streams, data was collected on bankfull width, wetted width, depth, large woody debris, pools, in-stream cover, percent surface fines on pool tails, and pebble counts.

Conclusions

From all fish surveys in all locations, no evidence of presence of any ESA-listed salmonids was observed on NBK property. Surveys were designed to maximize the probability of encountering ESA-listed salmonids, which suggests there is low or no presence of ESA-listed salmonids in freshwater habitat on NBK properties that were visited. Generally, all of the streams are small and provide limited habitat for ESA-listed species. It is possible that there is intermittent use of these streams by ESA-listed salmonids and the surveys did not coincide with their presence. Furthermore, sampling effort (i.e., limited sampling of streams, a single year of observation), low abundance of species of interest, and potential limitations in sampling methodology may have resulted in low capture probability and missed detections.

No definitive steelhead were observed during any of the sampling activities. It is possible, but unlikely, that the surveys missed steelhead. Single pass backpack electrofishing was used, which generally provides high (>90%) probability of detection in small streams (Rodtka et. al. 2015). During electrofishing surveys at two properties (Manchester Fuel Department and Toandos Buffer Zone), juvenile trout less than 50 mm fork length were encountered (Figure 5). Field diagnostics for steelhead versus cutthroat trout can be ambiguous for individuals less than 50mm. However, given the abundance of coastal cutthroat trout in the locations where juvenile trout were recorded, and the lack of any definitive steelhead in the surveys, it is likely that these ambiguous individuals were coastal cutthroat trout. Additional sampling and genetic analysis could provide more certainty.

No evidence of summer chum spawning activity was observed in any of the surveyed streams. This is likely the result of limited habitat (i.e., low water) in the streams where HCSC may occur. The size of these streams makes it unlikely that spawners were present and missed, which supports the hypothesis of limited habitat availability. Additionally, all of the streams have variable connectivity to Hood Canal that appeared to be strongly influenced by tides and beach condition. Given this, years in which the streams may be utilized by spawning summer-run chum could be subject to high variation. To promote a better understanding of whether or not HCSC use these streams, a multiple year dataset with a sampling regime similar to what was implemented could provide more certainty. However, during the single sampling occasion for juvenile Chinook, chum salmon fry were encountered within all streams at the Toandos Buffer Zone property, and near the stream (i.e., lagoon) at the Zelatched Point property.

Based on their size, these chum salmon fry could be either HCSC or fall chum (WFC 2019). The lack of evidence of HCSC spawning in these streams suggests non-natal use if the chum encountered were summer-run chum. Additional sampling and genetic analysis could provide more certainty.

No juvenile Chinook were encountered during the single sampling occasion in late February in any of the streams. The goal was to sample all streams three additional times (during March, April and May) to cover the range in which the streams may be intermittently used by non-natal juvenile Chinook. Due to the limited sampling effort, strong conclusions regarding the use of these streams by Chinook salmon should not be made. The proposed sampling regime would have provided adequate information about presence, and could be implemented in the future.

Pacific salmonids require different habitat types throughout their life cycle, but generally they need stream habitat that are connected, cool, and complex (Quinn 2005). Intensive habitat surveys were completed at five streams to determine if sufficient habitat existed to support spawning and rearing for ESA-listed species (Appendix B). This data can be used to monitor changes in stream condition in the future, and provide insight on any observed changes in fish use. In general, the habitat data describes conditions of limited habitat availability for ESA-listed salmonids. Chiefly, the streams are narrow and shallow and unlikely to support large-bodied fishes, with the exception of Beaver Creek, the largest stream. Several of the streams were dry when visited, thus limiting their utility to support ESA-listed salmonids. Additionally, connectivity to Puget Sound is poor at all streams but Beaver Creek, and is likely a limiting factor.

Although there was no evidence of presence, or encounters with ESA-listed salmonids in any of the streams on the NBK properties surveyed, it is important to reiterate that this is not concluding absence. Constraints on effort, compromised survey design (i.e., COVID-19), low abundance of species of interest, intermittent use, and imperfect detection could all be responsible for missed detections of ESA-listed salmonids. For example, the surveys for juvenile Chinook salmon were reduced to a single survey event of all streams due to COVID-19. In addition, this work was completed during a single year and many of these streams appear to have intermittent connection to Puget Sound. This suggests that use by ESA-listed fish could be intermittent as well, which would require multiple years of surveys to sufficiently evaluate use. The size of most streams suggests limited use. If feasible, additional monitoring of all streams could promote a better understanding of potential use by ESA-listed salmonids, especially in Beaver Creek, the largest stream.

Suggested Future Actions

1) Full sampling season for juvenile Chinook
2) Genetic analysis of juvenile trout
3) Genetic analysis of chum fry
4) Culvert rehabilitation at Jackson Park
5) Continued monitoring at all sites

References

Beamer, E.M., A. McBride, R. Henderson and K. Wolf. 2003. The importance of non-natal pocket estuaries in Skagit Bay to wild Chinook salmon: an emerging priority for restoration. Skagit River System Cooperative Research Report.

Beamer, E.M., W.T. Zackey, D. Marks, D. Teel, D. Kuligowski, and R. Henderson. 2013. Juvenile Chinook salmon rearing in small non-natal streams draining into the Whidbey Basin. Skagit River System Cooperative, LaConner, WA.

Haymes J. 2000. Summer Chum Salmon Conservation Initiative, An Implementation Plan to Recover Summer Chum in the Hood Canal and Strait of Juan de Fuca Region. Supplemental Report No. 1, Revised Estimates of Escapement for Hood Canal and Straight of Juan de Fuca Natural Spawning Summer Chum Salmon Populations. Washington Department of Fish and Wildlife.

National Oceanic and Atmospheric Administration (NOAA). 2020. Tides and Currents available at: www.tidesandcurrents.noaa.gov

Quinn, TP. 2005. The Behavior and Ecology of Pacific Salmon and Trout. University of Washington Press, Seattle. 378 p.

Rodtka, M.C., C.S. Judd, P.K. Aku, and K.M. Fitzsimmons. 2015. Estimating occupancy and detection probability of juvenile bull trout using backpack electrofishing gear in a west-central Alberta watershed. Canadian Journal of Fisheries and Aquatic Sciences, 72(5), pp.742-750.

Sands, N.J., K. Rawson, K.P. Currens, W.H. Graeber, M.H. Ruckelshaus, R.R. Fuerstenberg, and J.B. Scott. 2009. Determination of independent populations and viability criteria for the Hood Canal summer chum salmon evolutionarily significant unit. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-101, 58 p.

Temple, G. M. and T. N. Pearsons. 2007. Electrofishing: backpack and drift boat. Pages 95-132 *in* D. H. Johnson, B. M. Schrier, J. S. O'Neal, J. A. Knutzen, X. Augerot, T. A. O'Neil, and T. N. Pearsons. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda, MD.

U.S. Forest Service (USFS). 2017. Field Protocol Manual. Aquatic and Riparian Effectiveness Monitoring Program. Regional Interagency Monitoring for The Northwest Forest Plan.

Wild Fish Conservancy (WFC). 2019. 2018 Hood Canal Juvenile Chum Salmon Nearshore Habitat Use Assessment. Report from Wild Fish Conservancy to U.S. Navy.

Tables

Table 1. Salmonid species observed during specific sampling methodologies for nine streams on seven Naval Base Kitsap properties. Species observed are separated by stream and target species for each sampling method. No fish observed is represented by NA, while NS indicates no sampling was conducted. The species listed include those observed in the immediate vicinity of the streams (i.e., stream mouth).

	Method			
Stream	Hood Canal Summer-Run Chum	Puget Sound Chinook	Puget Sound Steelhead	All Methods
Zelatched	NA	CHUM, PINK	NS	CHUM, PINK
Toandos 1	NA	CTT, CHUM, PINK	CTT, COHO, UNKT	CTT, COHO, UNKT, CHUM, PINK
Toandos 2	NA	CHUM, PINK	CTT	CTT, CHUM, PINK
Toandos 3	NA	CTT, CHUM	CTT	CTT, CHUM
Cattail Basin Stream	NS	NS	CTT	CTT
Keyport	NS	NA	CTT	CTT
Navy Hospital	NS	NS	NS	NS
Jackson Park South	NS	NA	NA	NA
Beaver Creek	NS	CTT, COHO	CTT, COHO, UNKT	CTT, COHO, UNKT

CTT: Coastal Cutthroat Trout, COHO: Coho Salmon, CHUM: Fall or Summer-Run Chum Salmon, PINK: Pink Salmon, UNKT: Unidentified Juvenile Trout

Table 2. Summarized habitat data for the five streams where habitat surveys were conducted on Naval Base Kitsap properties using the Northwest Forest Management Plan habitat assessment protocol.

Stream	Mean Wetted Width (m)	Mean Bankfull Width (m)	Mean Thalweg Depth (m)	Max Depth (m)	Pools / 100 meters	LWD / 100 meters	Mean Gradient (%)
Keyport	1.10	1.49	0.14	0.27	1.88	3.75	2
Beaver Creek	2.11	2.97	0.12	0.60	3.75	7.19	1
Toandos 1	1.45	2.39	0.09	0.40	4.38	5.00	3
Toandos 2	0.71	1.48	0.09	0.50	0.00	28.75	7
Toandos 3	1.19	1.96	0.06	0.13	0.00	3.13	2

Figures

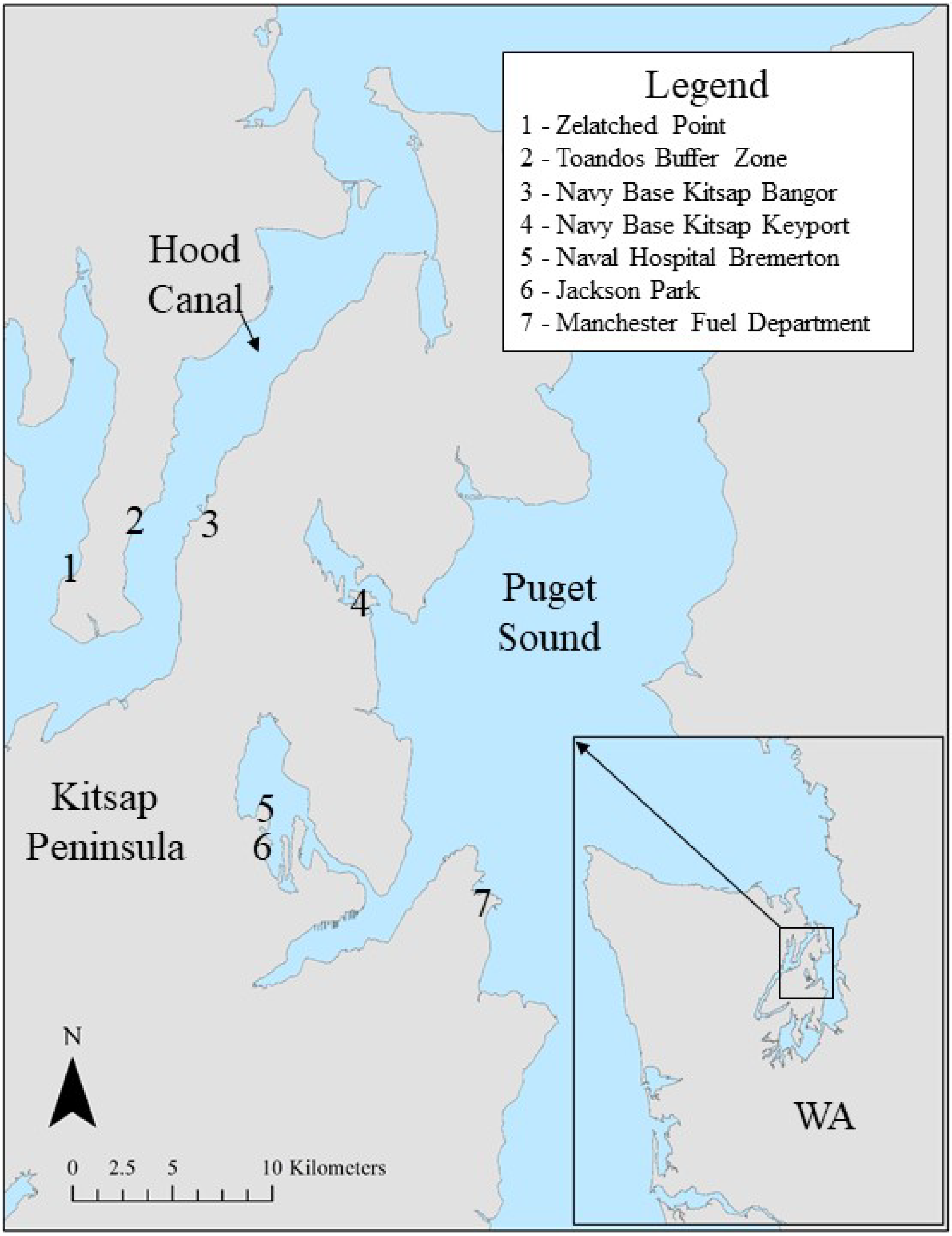

Figure 1. Locations of seven Naval Base Kitsap Properties with streams surveyed for presence of ESA-listed salmonids.

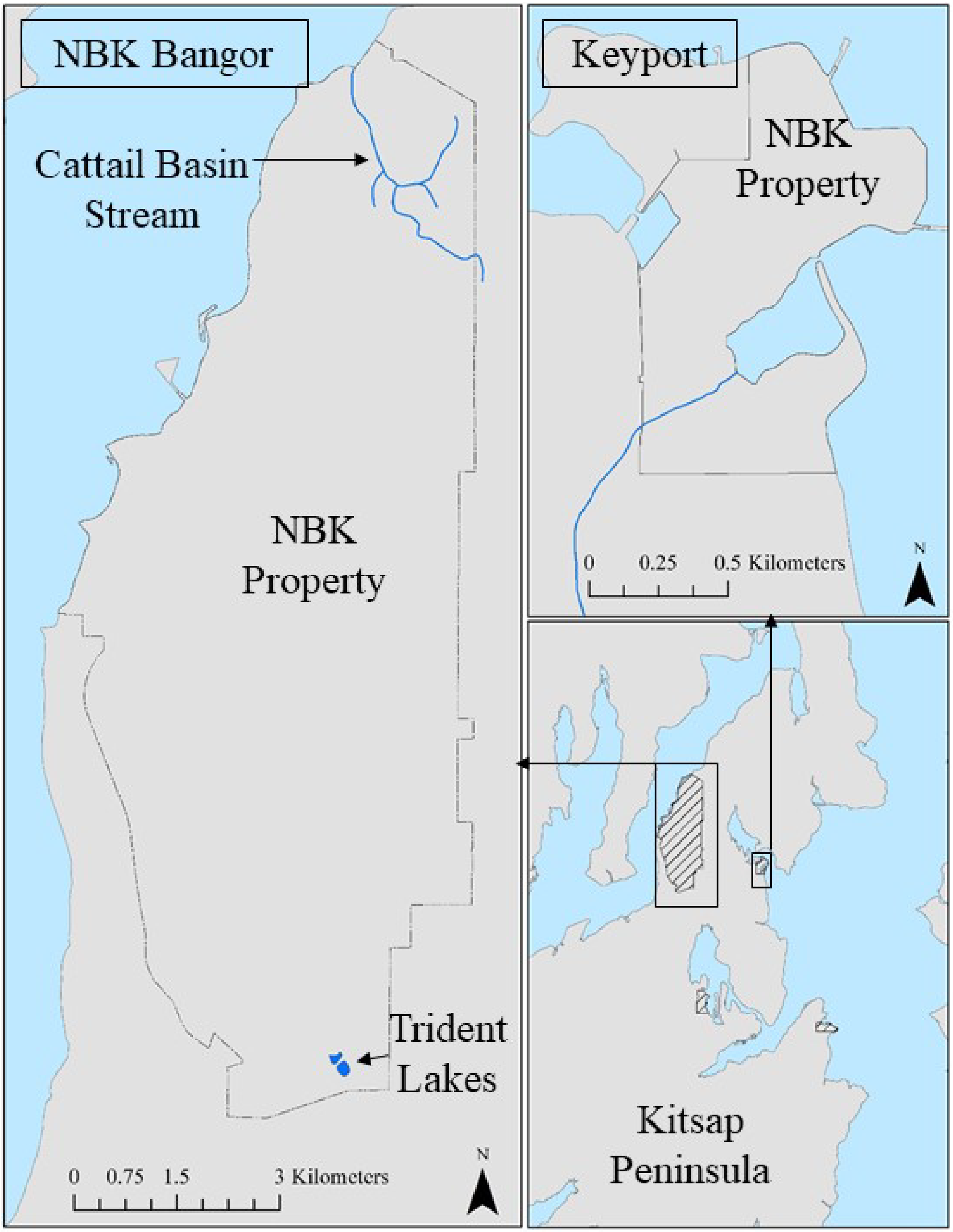

Figure 2. Locations of streams surveyed for ESA-listed salmonids on Naval Base Kitsap Keyport and Naval Base Kitsap Bangor.

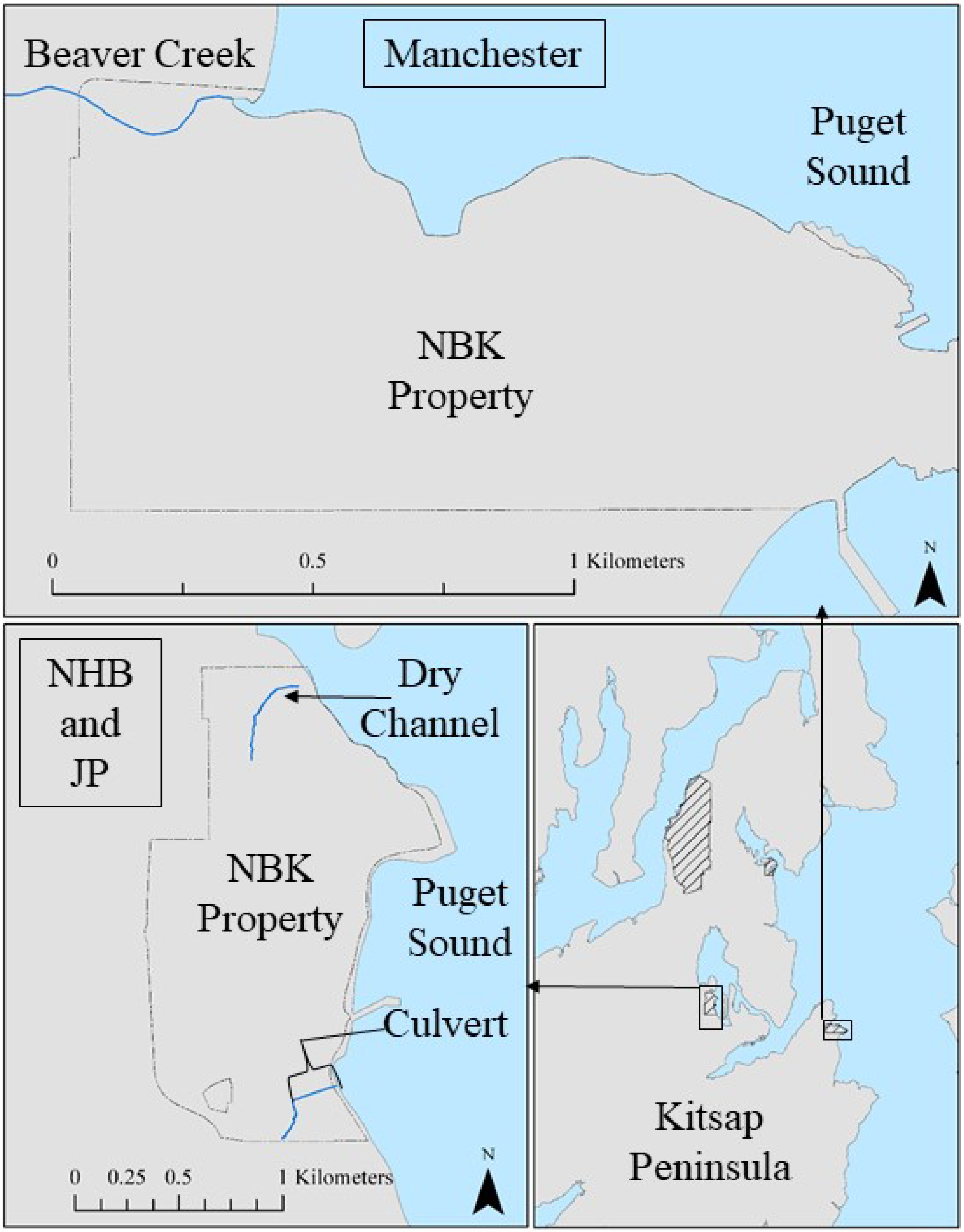

Figure 3. Locations of streams surveyed for ESA-listed salmonids on Naval Hospital Bremerton and Jackson Park (NHB and JP) and Manchester Fuel Department properties owned by Naval Base Kitsap.

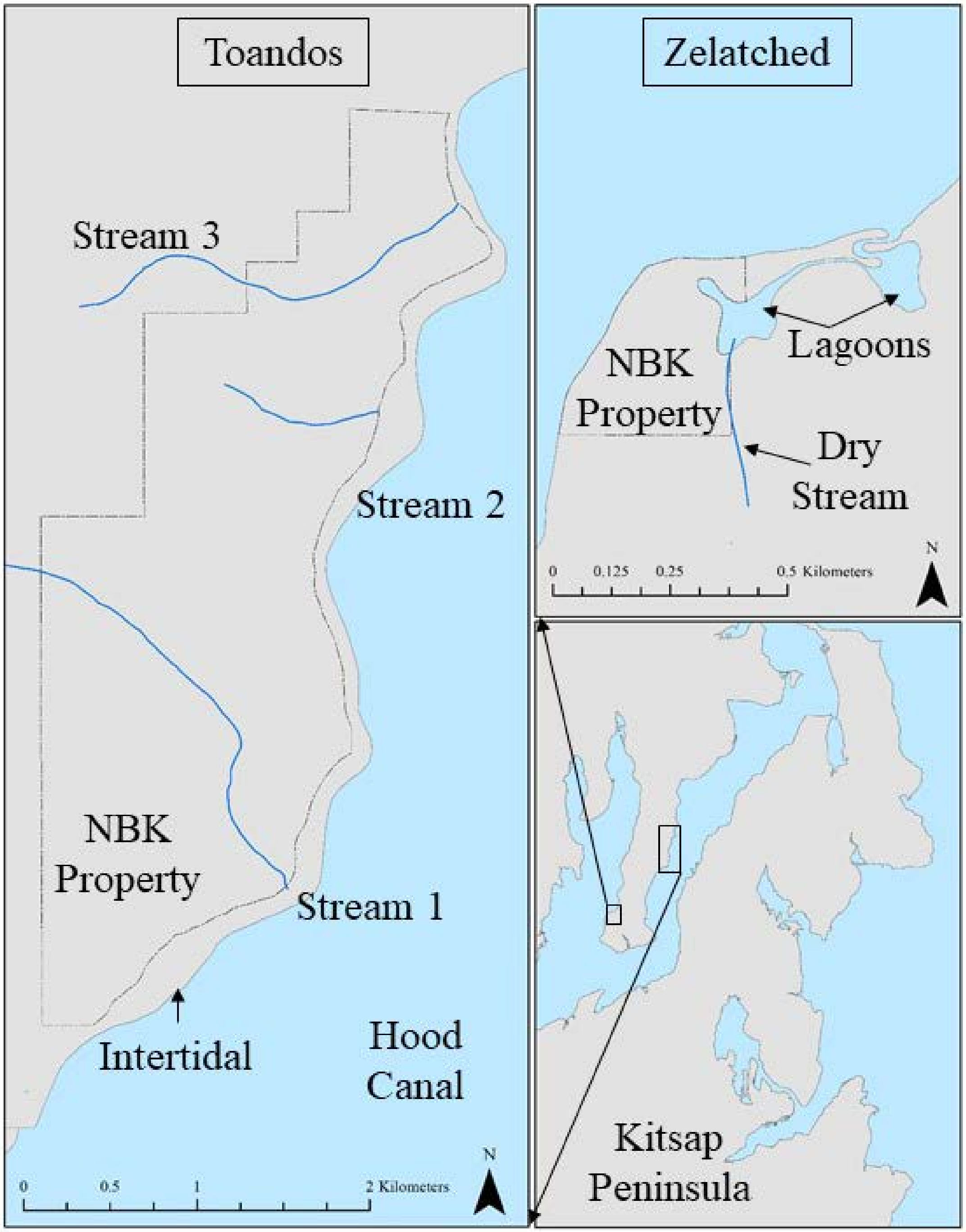

Figure 4. Locations of streams surveyed for ESA-listed salmonids on Zelatched Point and Toandos Buffer Zone properties owned by Naval Base Kitsap.

Figure 5. Image of a juvenile trout (*Oncorhynchus spp*.) captured on Naval Base Kitsap Property.

Figure 6. Image of a chum salmon fry captured on Naval Base Kitsap Property.

Appendix A

Attached pdf with data from all fish sampling.

Appendix A - Fish data

Definitions and Abbreviations

CTT: COASTAL CUTTHROAT

COHO: COHO SALMON

UNKT: UNKNOWN TROUT

COTSP: COTTID SPECIES

LMB: LARGEMOUTH BASS

PMKN: PUMKINSEED SUNFISH

BLG: BLUEGILL SUNFISH

CHUM: CHUM SALMON

PINK: PINK SALMON

~ : APPROXIMATE

All Length in mm

All weight in g

Black bars separate sampling methods, thin lines separate streams

Backpack Electrofishing

date	property	stream	species	length	weight
9/23/2019	Manchester	Beaver	COHO	58	2
9/23/2019	Manchester	Beaver	COHO	70	4.2
9/23/2019	Manchester	Beaver	COHO	72	4.6
9/23/2019	Manchester	Beaver	COHO	61	2.7
9/23/2019	Manchester	Beaver	COHO	61	2.8
9/23/2019	Manchester	Beaver	COHO	65	3.3
9/23/2019	Manchester	Beaver	COHO	77	5.7
9/23/2019	Manchester	Beaver	COHO	64	2.6
9/23/2019	Manchester	Beaver	COHO	60	2.4
9/23/2019	Manchester	Beaver	COHO	68	3.6
9/23/2019	Manchester	Beaver	COHO	67	3.8
9/23/2019	Manchester	Beaver	COHO	73	4.6

9/23/2019	Manchester	Beaver	COHO	62	2.7
9/23/2019	Manchester	Beaver	COHO	57	2.5
9/23/2019	Manchester	Beaver	COHO	60	2.9
9/23/2019	Manchester	Beaver	COHO	63	3.2
9/23/2019	Manchester	Beaver	COHO	63	3.2
9/23/2019	Manchester	Beaver	COHO	75	4.5
9/23/2019	Manchester	Beaver	COHO	70	4.1
9/23/2019	Manchester	Beaver	COHO	60	2.3
9/23/2019	Manchester	Beaver	COHO	73	4.5
9/23/2019	Manchester	Beaver	COHO	67	3.9
9/23/2019	Manchester	Beaver	COHO	68	3.8
9/23/2019	Manchester	Beaver	COHO	58	2.2
9/23/2019	Manchester	Beaver	COHO	68	NA
9/23/2019	Manchester	Beaver	COHO	70	NA
9/23/2019	Manchester	Beaver	COHO	68	NA
9/23/2019	Manchester	Beaver	COHO	75	NA
9/23/2019	Manchester	Beaver	COHO	72	NA
9/23/2019	Manchester	Beaver	COHO	70	NA
9/23/2019	Manchester	Beaver	COHO	66	3.3
9/23/2019	Manchester	Beaver	COTSP	87	7.2
9/23/2019	Manchester	Beaver	COTSP	78	6.3
9/23/2019	Manchester	Beaver	COTSP	79	5.6
9/23/2019	Manchester	Beaver	COTSP	77	5.6
9/23/2019	Manchester	Beaver	COTSP	57	1.9
9/23/2019	Manchester	Beaver	COTSP	83	6
9/23/2019	Manchester	Beaver	COTSP	83	6
9/23/2019	Manchester	Beaver	COTSP	60	2.5
9/23/2019	Manchester	Beaver	COTSP	77	4.7
9/23/2019	Manchester	Beaver	COTSP	58	2.3
9/23/2019	Manchester	Beaver	COTSP	79	3.5

9/23/2019	Manchester	Beaver	COTSP	81	7.4
9/23/2019	Manchester	Beaver	COTSP	69	3.7
9/23/2019	Manchester	Beaver	COTSP	61	NA
9/23/2019	Manchester	Beaver	COTSP	82	NA
9/23/2019	Manchester	Beaver	COTSP	64	NA
9/23/2019	Manchester	Beaver	COTSP	64	NA
9/23/2019	Manchester	Beaver	COTSP	61	NA
9/23/2019	Manchester	Beaver	COTSP	65	NA
9/23/2019	Manchester	Beaver	COTSP	71	NA
9/23/2019	Manchester	Beaver	COTSP	64	NA
9/23/2019	Manchester	Beaver	COTSP	59	NA
9/23/2019	Manchester	Beaver	COTSP	64	NA
9/23/2019	Manchester	Beaver	COTSP	63	NA
9/23/2019	Manchester	Beaver	COTSP	60	NA
9/23/2019	Manchester	Beaver	COTSP	80	NA
9/23/2019	Manchester	Beaver	COTSP	81	NA
9/23/2019	Manchester	Beaver	COTSP	65	NA
9/23/2019	Manchester	Beaver	CTT	69	3.9
9/23/2019	Manchester	Beaver	CTT	87	6.8
9/23/2019	Manchester	Beaver	CTT	97	9.1
9/23/2019	Manchester	Beaver	CTT	94	9.7
9/23/2019	Manchester	Beaver	CTT	103	15.4
9/23/2019	Manchester	Beaver	CTT	54	1.7
9/23/2019	Manchester	Beaver	CTT	120	16.4
9/23/2019	Manchester	Beaver	CTT	132	25.5
9/23/2019	Manchester	Beaver	CTT	140	27.2
9/23/2019	Manchester	Beaver	CTT	56	2.2
9/23/2019	Manchester	Beaver	CTT	93	8.6
9/23/2019	Manchester	Beaver	CTT	112	13.7
9/23/2019	Manchester	Beaver	CTT	63	3.8

9/23/2019	Manchester	Beaver	CTT	60	2.4
9/23/2019	Manchester	Beaver	CTT	64	2.8
9/23/2019	Manchester	Beaver	CTT	96	9.4
9/23/2019	Manchester	Beaver	CTT	73	4.5
9/23/2019	Manchester	Beaver	CTT	110	12.7
9/23/2019	Manchester	Beaver	CTT	56	2.4
9/23/2019	Manchester	Beaver	CTT	97	9.5
9/23/2019	Manchester	Beaver	CTT	80	5.7
9/23/2019	Manchester	Beaver	CTT	57	2.2
9/23/2019	Manchester	Beaver	CTT	53	1.6
9/23/2019	Manchester	Beaver	CTT	114	17.7
9/23/2019	Manchester	Beaver	CTT	62	2.7
9/23/2019	Manchester	Beaver	CTT	66	3.3
9/23/2019	Manchester	Beaver	CTT	54	2.1
9/23/2019	Manchester	Beaver	CTT	144	27.4
9/23/2019	Manchester	Beaver	CTT	66	3.1
9/23/2019	Manchester	Beaver	CTT	54	1.1
9/23/2019	Manchester	Beaver	CTT	130	21
9/23/2019	Manchester	Beaver	CTT	67	2.7
9/23/2019	Manchester	Beaver	CTT	55	0.9
9/23/2019	Manchester	Beaver	CTT	53	1.8
9/23/2019	Manchester	Beaver	CTT	92	7.8
9/23/2019	Manchester	Beaver	CTT	108	10.8
9/23/2019	Manchester	Beaver	CTT	112	16.6
9/23/2019	Manchester	Beaver	CTT	68	3.6
9/23/2019	Manchester	Beaver	CTT	120	16.5
9/23/2019	Manchester	Beaver	CTT	68	3.6
9/23/2019	Manchester	Beaver	CTT	127	21.5
9/23/2019	Manchester	Beaver	CTT	90	6.7
9/23/2019	Manchester	Beaver	CTT	95	8.2

9/23/2019	Manchester	Beaver	CTT	95	NA
9/23/2019	Manchester	Beaver	CTT	70	NA
9/23/2019	Manchester	Beaver	CTT	58	NA
9/23/2019	Manchester	Beaver	CTT	65	NA
9/23/2019	Manchester	Beaver	CTT	61	NA
9/23/2019	Manchester	Beaver	CTT	57	NA
9/23/2019	Manchester	Beaver	CTT	153	NA
9/23/2019	Manchester	Beaver	CTT	55	NA
9/23/2019	Manchester	Beaver	UNKT	45	1.4
9/23/2019	Manchester	Beaver	UNKT	47	1.2
9/23/2019	Manchester	Beaver	UNKT	47	1.2
9/23/2019	Manchester	Beaver	UNKT	38	0.6
9/23/2019	Manchester	Beaver	UNKT	49	1.4
9/23/2019	Manchester	Beaver	UNKT	50	1.6
9/23/2019	Manchester	Beaver	UNKT	34	0.4
9/23/2019	Manchester	Beaver	UNKT	50	NA
9/23/2019	Manchester	Beaver	UNKT	45	0.9
9/23/2019	Manchester	Beaver	UNKT	40	0.8
9/23/2019	Manchester	Beaver	UNKT	44	0.9
9/23/2019	Manchester	Beaver	UNKT	45	NA
9/23/2019	Manchester	Beaver	UNKT	36	NA
9/23/2019	Manchester	Beaver	UNKT	45	NA
9/23/2019	Manchester	Beaver	UNKT	47	NA
9/23/2019	Manchester	Beaver	UNKT	47	NA
9/23/2019	Manchester	Beaver	UNKT	48	NA
Additional fish captured but not weighed below here					
9/23/2019	Manchester	Beaver	CTT	91 ADDITIONAL CAPTURED	
9/23/2019	Manchester	Beaver	COHO	96 ADDITIONAL CAPTURED	
9/23/2019	Manchester	Beaver	UNKT	47 ADDITIONAL CAPTURED	
9/23/2019	Manchester	Beaver	COTSP	45 ADDITIONAL CAPTURED	

Comments: Five samplers, 2209 seconds of e-fishing effort.

date	property	stream	species	length	weight
9/26/2019	Toandos	Stream 1	CTT	114	16.5
9/26/2019	Toandos	Stream 1	CTT	85	5.6
9/26/2019	Toandos	Stream 1	CTT	100	9.8
9/26/2019	Toandos	Stream 1	CTT	134	24.7
9/26/2019	Toandos	Stream 1	CTT	83	6
9/26/2019	Toandos	Stream 1	CTT	62	3.5
9/26/2019	Toandos	Stream 1	CTT	65	3.2
9/26/2019	Toandos	Stream 1	CTT	94	9.2
9/26/2019	Toandos	Stream 1	CTT	61	2
9/26/2019	Toandos	Stream 1	CTT	66	2.8
9/26/2019	Toandos	Stream 1	CTT	129	25.1
9/26/2019	Toandos	Stream 1	CTT	109	13.8
9/26/2019	Toandos	Stream 1	CTT	89	7.8
9/26/2019	Toandos	Stream 1	CTT	67	3.6
9/26/2019	Toandos	Stream 1	CTT	158	46.2
9/26/2019	Toandos	Stream 1	CTT	90	9.3
9/26/2019	Toandos	Stream 1	CTT	63	3.5
9/26/2019	Toandos	Stream 1	CTT	56	2
9/26/2019	Toandos	Stream 1	CTT	130	20
9/26/2019	Toandos	Stream 1	CTT	145	32
9/26/2019	Toandos	Stream 1	CTT	114	16.1
9/26/2019	Toandos	Stream 1	CTT	124	18.6
9/26/2019	Toandos	Stream 1	CTT	100	10.7
9/26/2019	Toandos	Stream 1	CTT	117	16.5
9/26/2019	Toandos	Stream 1	CTT	57	2
9/26/2019	Toandos	Stream 1	CTT	85	5.6
9/26/2019	Toandos	Stream 1	CTT	110	13.8

9/26/2019	Toandos	Stream 1	CTT	124	21
9/26/2019	Toandos	Stream 1	CTT	111	13.9
9/26/2019	Toandos	Stream 1	CTT	138	25.9
9/26/2019	Toandos	Stream 1	CTT	124	21
9/26/2019	Toandos	Stream 1	CTT	127	24
9/26/2019	Toandos	Stream 1	CTT	84	6
9/26/2019	Toandos	Stream 1	CTT	108	12.6
9/26/2019	Toandos	Stream 1	CTT	90	7
9/26/2019	Toandos	Stream 1	CTT	90	8
9/26/2019	Toandos	Stream 1	CTT	64	3.2
9/26/2019	Toandos	Stream 1	CTT	54	1.1
9/26/2019	Toandos	Stream 1	CTT	103	10.7
9/26/2019	Toandos	Stream 1	CTT	97	10.2
9/26/2019	Toandos	Stream 1	CTT	86	7.9
9/26/2019	Toandos	Stream 1	CTT	109	15.8
9/26/2019	Toandos	Stream 1	CTT	50	1
9/26/2019	Toandos	Stream 1	CTT	82	5.1
9/26/2019	Toandos	Stream 1	CTT	120	20
9/26/2019	Toandos	Stream 1	CTT	60	1.5
9/26/2019	Toandos	Stream 1	CTT	62	1.5
9/26/2019	Toandos	Stream 1	CTT	144	33.6
9/26/2019	Toandos	Stream 1	CTT	161	43.7
9/26/2019	Toandos	Stream 1	CTT	129	22.4
9/26/2019	Toandos	Stream 1	CTT	84	6.9
9/26/2019	Toandos	Stream 1	CTT	86	7
9/26/2019	Toandos	Stream 1	CTT	57	2
9/26/2019	Toandos	Stream 1	COTSP	92	9.9
9/26/2019	Toandos	Stream 1	COTSP	72	6
9/26/2019	Toandos	Stream 1	COTSP	85	7.6
9/26/2019	Toandos	Stream 1	COHO	65	3

9/26/2019	Toandos	Stream 1	COHO	86	8.5
9/26/2019	Toandos	Stream 1	COHO	105	10.7
9/26/2019	Toandos	Stream 1	COHO	75	4.1
9/26/2019	Toandos	Stream 1	COHO	74	4.2
9/26/2019	Toandos	Stream 1	COHO	79	4.8
9/26/2019	Toandos	Stream 1	COHO	77	3
9/26/2019	Toandos	Stream 1	UNKT	35	0.5
9/26/2019	Toandos	Stream 1	UNKT	35	0.5
Additional fish captured but not weighed below here					
9/26/2019	Toandos	Stream 1	CTT	95 ADDITIONAL CAPTURED	
9/26/2019	Toandos	Stream 1	UNKT	11 ADDITIONAL CAPTURED	
9/26/2019	Toandos	Stream 1	COTSP	15 ADDITIONAL CAPTURED	

Comments: Five samplers, 1143 seconds of e-fishing effort.

date	property	stream	species	length	weight
9/26/2019	Toandos	Stream 2	CTT	~100	NA

Comments: Five samplers, 181 seconds of e-fishing effort.

date	property	stream	species	length	weight
9/26/2019	Toandos	Stream 3	CTT	163	44.7
9/26/2019	Toandos	Stream 3	CTT	163	51.2
9/26/2019	Toandos	Stream 3	CTT	104	13
9/26/2019	Toandos	Stream 3	CTT	71	4.3
9/26/2019	Toandos	Stream 3	CTT	161	45.9
9/26/2019	Toandos	Stream 3	CTT	181	63.5
9/26/2019	Toandos	Stream 3	CTT	112	17.5
9/26/2019	Toandos	Stream 3	CTT	141	33.5
9/26/2019	Toandos	Stream 3	CTT	86	6.9
9/26/2019	Toandos	Stream 3	CTT	85	7.2

Comments: Five samplers, 444 seconds of e-fishing effort.

date	property	stream	species	length	weight
9/26/2019	NBK Bangor	Cattail Basin	CTT	~80 - 150	NA

Comments: Six samplers, 865 seconds of e-fishing effort. We captured 75 CTT from approximately 80 - 150 mm.

date	property	stream	species	length	weight
9/26/2019	NBK Bangor	Trident Lakes	LMB	<100	NA
9/27/2019	NBK Bangor	Trident Lakes	PMKN	<100	NA
9/28/2019	NBK Bangor	Trident Lakes	BLG	<100	NA

Comments: Six samplers, approximately 200 seconds of e-fishing effort and 1 beach seine haul. The three species identified were numerous.

Snorkel

date	property	stream	species	length	weight
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	COHO	<50	NA
2/21/2020	Manchester	Beaver	CTT	~100	NA

2/21/2020	Manchester	Beaver	CTT	~100	NA
2/21/2020	Manchester	Beaver	CTT	~100	NA
2/21/2020	Manchester	Beaver	CTT	~100	NA
2/21/2020	Manchester	Beaver	CTT	~100	NA
2/21/2020	Manchester	Beaver	CTT	~150	NA
2/21/2020	Manchester	Beaver	CTT	~150	NA
2/21/2020	Manchester	Beaver	CTT	~400	NA

Dipnetting

2/21/2020	Manchester	Beaver	COHO	75	NA
2/21/2020	Manchester	Beaver	COHO	34	NA
2/21/2020	Manchester	Beaver	COHO	33	NA
2/21/2020	Manchester	Beaver	COHO	34	NA
2/21/2020	Manchester	Beaver	COHO	34	NA
2/21/2020	Manchester	Beaver	COHO	32	NA
2/21/2020	Manchester	Beaver	COHO	30	NA
2/21/2020	Manchester	Beaver	COHO	37	NA
2/21/2020	Manchester	Beaver	COHO	34	NA
2/21/2020	Manchester	Beaver	COHO	34	NA
2/21/2020	Manchester	Beaver	COHO	34	NA
2/21/2020	Manchester	Beaver	COHO	32	NA
2/21/2020	Manchester	Beaver	COHO	31	NA
2/21/2020	Manchester	Beaver	COHO	30	NA

date	property	stream	species	length	weight
2/20/2020	Toandos	Stream 1	CTT	93	NA
2/20/2020	Toandos	Stream 1	CTT	64	NA
2/20/2020	Toandos	Stream 1	CHUM	40	NA
2/20/2020	Toandos	Stream 1	CHUM	42	NA
2/20/2020	Toandos	Stream 1	CHUM	41	NA

2/20/2020	Toandos	Stream 1	CHUM	38	NA

date	property	stream	species	length	weight
2/20/2020	Toandos	Stream 2	CHUM	38	NA
2/20/2020	Toandos	Stream 2	CHUM	37	NA
2/20/2020	Toandos	Stream 2	CHUM	35	NA

date	property	stream	species	length	weight
2/20/2020	Toandos	Stream 3	CTT	65	NA
2/20/2020	Toandos	Stream 3	CHUM	38	NA
2/20/2020	Toandos	Stream 3	CHUM	43	NA
2/20/2020	Toandos	Stream 3	CHUM	39	NA
2/20/2020	Toandos	Stream 3	CHUM	38	NA
2/20/2020	Toandos	Stream 3	CHUM	38	NA
2/20/2020	Toandos	Stream 3	CHUM	30	NA
2/20/2020	Toandos	Stream 3	CHUM	37	NA
2/20/2020	Toandos	Stream 3	CHUM	35	NA
2/20/2020	Toandos	Stream 3	CHUM	40	NA
2/20/2020	Toandos	Stream 3	CHUM	38	NA
2/20/2020	Toandos	Stream 3	CHUM	40	NA
2/20/2020	Toandos	Stream 3	CHUM	38	NA
2/20/2020	Toandos	Stream 3	CHUM	44	NA
2/20/2020	Toandos	Stream 3	CHUM	37	NA
2/20/2020	Toandos	Stream 3	CHUM	43	NA
2/20/2020	Toandos	Stream 3	CHUM	35	NA

[redacted]

Beach Seine

date	property	stream	species	length	weight
2/21/2020	Manchester	Beaver	COTSP	NA	NA

Comments: Two seine hauls at mouth of Beaver Creek.

date	property	stream	species	length	weight
2/20/2020	Toandos	Stream 1	CHUM	39	NA
2/20/2020	Toandos	Stream 1	CHUM	40	NA
2/20/2020	Toandos	Stream 1	CHUM	38	NA
2/20/2020	Toandos	Stream 1	CHUM	40	NA
2/20/2020	Toandos	Stream 1	CHUM	41	NA
2/20/2020	Toandos	Stream 1	CHUM	43	NA
2/20/2020	Toandos	Stream 1	CHUM	42	NA
2/20/2020	Toandos	Stream 1	CHUM	39	NA
2/20/2020	Toandos	Stream 1	PINK	37	NA
2/20/2020	Toandos	Stream 1	PINK	35	NA
2/20/2020	Toandos	Stream 1	PINK	38	NA
2/20/2020	Toandos	Stream 1	COTSP	NA	NA
2/20/2020	Toandos	Stream 1	COTSP	NA	NA
2/20/2020	Toandos	Stream 1	COTSP	NA	NA
2/20/2020	Toandos	Stream 1	COTSP	NA	NA

Comments: Two seine hauls at mouth of stream.

date	property	stream	species	length	weight
2/20/2020	Toandos	Stream 2	CHUM	33	NA
2/20/2020	Toandos	Stream 2	CHUM	36	NA
2/20/2020	Toandos	Stream 2	CHUM	38	NA
2/20/2020	Toandos	Stream 2	CHUM	38	NA
2/20/2020	Toandos	Stream 2	CHUM	35	NA
2/20/2020	Toandos	Stream 2	CHUM	37	NA
2/20/2020	Toandos	Stream 2	CHUM	40	NA
2/20/2020	Toandos	Stream 2	CHUM	40	NA
2/20/2020	Toandos	Stream 2	CHUM	37	NA
2/20/2020	Toandos	Stream 2	PINK	36	NA

2/20/2020	Toandos	Stream 2	PINK	28	NA
2/20/2020	Toandos	Stream 2	PINK	33	NA
2/20/2020	Toandos	Stream 2	PINK	40	NA
2/20/2020	Toandos	Stream 2	PINK	31	NA
2/20/2020	Toandos	Stream 2	PINK	33	NA
2/20/2020	Toandos	Stream 2	PINK	30	NA

Comments: One seine haul at mouth of stream.

date	property	stream	species	length	weight
2/20/2020	Toandos	Stream 3	CHUM	42	NA
2/20/2020	Toandos	Stream 3	CHUM	38	NA
2/20/2020	Toandos	Stream 3	COTSP	NA	NA
2/20/2020	Toandos	Stream 3	COTSP	NA	NA
2/20/2020	Toandos	Stream 3	COTSP	NA	NA
2/20/2020	Toandos	Stream 3	COTSP	NA	NA

Comments: One seine haul at mouth of stream.

date	property	stream	species	length	weight
2/20/2020	Zelatched	Lagoon	CHUM	43	NA
2/20/2020	Zelatched	Lagoon	CHUM	39	NA
2/20/2020	Toandos	Lagoon	CHUM	38	NA
2/20/2020	Toandos	Lagoon	CHUM	35	NA
2/20/2020	Toandos	Lagoon	CHUM	44	NA
2/20/2020	Toandos	Lagoon	PINK	34	NA
2/20/2020	Toandos	Lagoon	PINK	36	NA

Comments: Two seine hauls in lagoon and channelized area off NBK Bangor property.

Appendix B

Attached pdf with data from all habitat sampling.

Appendix B - Habitat data

All width and depth measurements in meters
Pebble count measurements in mm
Large woody debris location and measurements in meters
Densiometer: reading from convex densiometer in portion of area (0-96) not occupied by cover
left bf: left bankful
left wet: left wetted
right wet: right wetted
right bf: right bankful
10%, 20%, 30%, 50%, 70%, 90%:
Pool depths, legths and width in meters
Black bars separate complete surveys
X represents missing values, NA indicates no measurement required

Property:	Keyport	Date:	7/23/2020	
Stream:	Keyport			
		Major Transects		
Transect:	A	Densiometer:	4	
Depths		Gradient:	X	
left bf	left wet	thalweg	right wet	right bf
0	0	0.25	0.24	0.24
10%	20%	50%	70%	90%
0.17	0.2	0.21	0.24	0.24
Bankfull Width:		0.86		
Wetted Width:		0.82		
Transect:	B	Densiometer:	1	
Depths		Gradient:	3%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.12	0	0
10%	20%	50%	70%	90%
0.05	0.12	0.12	0.1	0.04
Bankfull Width:		1.7		
Wetted Width:		1.1		
Transect:	C	Densiometer:	7	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0.08	0.1	0.01	0
10%	20%	50%	70%	90%
0.03	0.02	0.03	0.1	0.08
Bankfull Width:		1.3		
Wetted Width:		1.2		
Transect:	D	Densiometer:	4	

Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0.1	0.21	0.02	0
10%	20%	50%	70%	90%
0.12	0.14	0.21	0.21	0.18
Bankfull Width:		1.35		
Wetted Width:		1.1		

Transect:	E	Densiometer:	1	
Depths		Gradient:	X	
left bf	left wet	thalweg	right wet	right bf
0	0.05	0.12	0	0
10%	20%	50%	70%	90%
0.06	0.08	0.12	0.11	0.04
Bankfull Width:		1.7		
Wetted Width:		1.2		

Transect:	F	Densiometer:	29	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0.02	0.2	0	0
10%	20%	50%	70%	90%
0.17	0.15	0.22	0.16	0.11
Bankfull Width:		2		
Wetted Width:		1.8		

Transect:	G	Densiometer:	1	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.05	0	0
10%	20%	50%	70%	90%
0.05	0.05	0.06	0.04	0.05
Bankfull Width:		1.35		
Wetted Width:		1.2		

Transect:	H	Densiometer:	25	
Depths		Gradient:	3%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.18	0.18	0
10%	20%	50%	70%	90%
0.04	0.09	0.13	0.18	0.18
Bankfull Width:		1.3		
Wetted Width:		0.8		

Transect:	I	Densiometer:	0	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf

0	0.02	0.1	0.01	0
10%	20%	50%	70%	90%
0.1	0.08	0.07	0.07	0.08
Bankfull Width:		1.4		
Wetted Width:		0.8		

Transect:	J	Densiometer:	6	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0.02	0.05	0	0
10%	20%	50%	70%	90%
0.04	0.05	0.05	0.06	0.03
Bankfull Width:		1.8		
Wetted Width:		1.2		

Transect:	K	Densiometer:	1	
Depths		Gradient:	NA	
left bf	left wet	thalweg	right wet	right bf
0	0	0.13	0	0
10%	20%	50%	70%	90%
0.04	0.11	0.13	0.1	0.08
Bankfull Width:		1.6		
Wetted Width:		0.9		

Pebble Counts

ID:	X			
10%	25%	50%	75%	90%
X	X	X	X	X

Large Woody Debris

Transect ID	Length	Width	Wood Type	Location
A	0.6	0.2	RN	1.6
H	1.8	0.45	N	7
H	2	0.37	N	15.5
H	1.3	0.45	N	15.5
I	1.4	0.4	N	10
I	2	0.3	N	16

Pools

Transect ID	Full / Partial	Type	length	width
B	Partial	Scour	1.1	0.9

Pool Depths

head crest	tail crest	max
0.04	0.11	0.27

Transect ID	Full / Partial	Type	length	width
F	Full	Scour	1.7	1.2

Pool Depths

head crest	tail crest	max
*in culvert	0.08	0.25

Transect ID	Full / Partial	Type	length	width
E	X	Scour	11.8	0.9

Pool Depths

head crest	tail crest	max
0.04	*in culvert	0.18

Surface Fines on Pool Tail Crest

Transect ID	Full / Partial	Plunge / Scour
X	X	X

Number of intersection fine

25%	50%	75%
X	X	X

Comments: We did not do pebble counts or measure percent surface fines on pool tails for this survey. End of Survey Photos: Upstream 100-0922, Downstream 100-0921, Right Bank 100-919, Left Bank 100-0920.

[redacted]

Property: Toandos Date: 7/23/2020

Stream: Stream 1

Major Transects

Transect: A Densiometer: 6

Depths Gradient: 2%

left bf	left wet	thalweg	right wet	right bf
0.2	0.2	0.15	0	0
10%	20%	50%	70%	90%
0.18	0.19	0.15	0.15	0.07

Bankfull Width: 2.5

Wetted Width: 1.3

Transect: B Densiometer: 8

Depths Gradient: 4%

left bf	left wet	thalweg	right wet	right bf
0	0	0.12	0	0
10%	20%	50%	70%	90%
0.07	0.11	0.12	0.11	0.1

Bankfull Width: 2.7

Wetted Width: 1.4

Transect: C Densiometer: 7

Depths Gradient: 2%

left bf	left wet	thalweg	right wet	right bf
0	0	0.06	0	0

10%	20%	50%	70%	90%
0.05	0.06	0.06	0.07	0.05
Bankfull Width:		2.3		
Wetted Width:		1.2		

Transect:	D	Densiometer:	6	
Depths		Gradient:	3%	
left bf	left wet	thalweg	right wet	right bf
0.08	0.08	0.12	0	0
10%	20%	50%	70%	90%
0.12	0.12	0.11	0.1	0.05
Bankfull Width:		2.1		
Wetted Width:		1.2		

Transect:	E	Densiometer:	17	
Depths		Gradient:	5%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.1	0	0
10%	20%	50%	70%	90%
0.01	0.03	0.1	0.1	0.05
Bankfull Width:		2.5		
Wetted Width:		1.6		

Transect:	F	Densiometer:	7	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.07	0	0
10%	20%	50%	70%	90%
0.05	0.04	0.07	0.06	0.04
Bankfull Width:		2.4		
Wetted Width:		1.8		

Transect:	G	Densiometer:	9	
Depths		Gradient:	3%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.1	0	0
10%	20%	50%	70%	90%
0.04	0.08	0.1	0.06	0.05
Bankfull Width:		2		
Wetted Width:		1.3		

Transect:	H	Densiometer:	5	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0.07	0.07	0.1	0	0
10%	20%	50%	70%	90%
0.1	0.08	0.07	0.05	0.04

Bankfull Width:		1.8		
Wetted Width:		1.5		

Transect:	I	Densiometer:	26	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.08	0	0
10%	20%	50%	70%	90%
0.09	0.08	0.08	0.08	0.06
Bankfull Width:		4		
Wetted Width:		1.3		

Transect:	J	Densiometer:	7	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0.01	0.01	0.07	0	0
10%	20%	50%	70%	90%
0.06	0.06	0.07	0.08	0.07
Bankfull Width:		2.2		
Wetted Width:		1.9		

Transect:	K	Densiometer:	4	
Depths		Gradient:	NA	
left bf	left wet	thalweg	right wet	right bf
0	0	0.07	0	0
10%	20%	50%	70%	90%
0.06	0.08	0.07	0.03	0.02
Bankfull Width:		1.8		
Wetted Width:		1.5		

Pebble Counts

ID:	A2			
10%	25%	50%	75%	90%
5	29	25	3	6
19	20	25	38	19
31	31	25	27	4

ID:	B1			
10%	25%	50%	75%	90%
12	25	7	19	sand
8	22	28	42	10
11	13	45	47	sand

ID:	B2			
10%	25%	50%	75%	90%
7	39	64	5	14
7	45	29	27	7

5	27	7	35	10

ID:	C1			
10%	25%	50%	75%	90%
44	64	29	60	4
62	9	60	25	12
10	17	43	19	14

ID:	C2			
10%	25%	50%	75%	90%
sand	18	73	35	38
11	11	7	18	42
10	10	76	47	12

ID:	D1			
10%	25%	50%	75%	90%
40	75	20	3	6
41	9	8	9	6
44	25	5	22	6

ID:	D2			
10%	25%	50%	75%	90%
32	4	5	16	65
17	20	15	52	32
16	6	18	22	14

ID:	E1			
10%	25%	50%	75%	90%
16	6	18	15	sand
16	43	6	16	sand
18	28	4	8	10

ID:	E2			
10%	25%	50%	75%	90%
sand	sand	sand	8	4
sand	sand	sand	15	11
sand	sand	sand	16	8

ID:	F1			
10%	25%	50%	75%	90%
6	6	19	54	51
8	6	46	30	22
12	21	18	4	15

ID:	F2			
10%	25%	50%	75%	90%
86	35	36	10	12

70	15	13	5	4
13	55	7	10	5
ID:	G1			
10%	25%	50%	75%	90%
7	20	13	23	47
5	14	13	19	14
14	77	10	7	20
ID:	G2			
10%	25%	50%	75%	90%
4	8	17	45	7
4	13	5	38	9
6	6	32	18	silt
ID:	H1			
10%	25%	50%	75%	90%
56	15	19	10	25
86	18	20	8	5
16	34	18	9	21
ID:	H2			
10%	25%	50%	75%	90%
10	10	20	20	46
6	12	20	27	58
8	17	28	27	18
ID:	I1			
10%	25%	50%	75%	90%
15	5	67	32	9
99	44	45	21	9
16	6	41	24	10
ID:	I2			
10%	25%	50%	75%	90%
6	4	19	24	15
46	7	24	24	29
5	6	11	10	34
ID:	J1			
10%	25%	50%	75%	90%
62	63	26	21	37
39	22	10	15	sand
5	23	4	9	31
ID:	J2			
10%	25%	50%	75%	90%

9	27	23	100	35
21	6	6	9	61
7	11	50	6	10

ID:	K1			
10%	25%	50%	75%	90%
15	4	17	15	12
20	17	22	19	9
13	69	10	3	4

Large Woody Debris

Transect ID	Length	Width	Wood Type	Location
B	1.3	0.25	N	5
C	3	0.4	N	9
D	2.5	0.25	N	2.2
E	2.5	0.7	N	1.5
E	2.2	0.25	N	7
E	3	0.4	N	10
G	1.4	0.25	N	11
J	2.3	0.35	N	13.7

Pools

Transect ID	Full / Partial	Type	length	width
C	Partial	Scour	1.6	1.1
Pool Depths				
head crest	tail crest	max		
0.04	0.05	0.23		

Transect ID	Full / Partial	Type	length	width
D	Full	Scour	1.8	1.8
Pool Depths				
head crest	tail crest	max		
0.1	0.05	0.3		

Transect ID	Full / Partial	Type	length	width
E	Full	Scour	2	2.5
Pool Depths				
head crest	tail crest	max		
0.13	0.04	0.4		

Transect ID	Full / Partial	Type	length	width
E	Partial	Plunge	0.7	0.8
Pool Depths				
head crest	tail crest	max		
0.03	0.02	0.2		

Transect ID	Full / Partial	Type	length	width

G	Full	Plunge	1.8	2
Pool Depths				
head crest	tail crest	max		
0.05	0.08	0.27		

Transect ID	Full / Partial	Type	length	width
H	Full	Scour	2.5	2.2
Pool Depths				
head crest	tail crest	max		
0.04	0.06	3.27		

Transect ID	Full / Partial	Type	length	width
J	X	X	1.9	2.9
Pool Depths				
head crest	tail crest	max		
0.05	0.09	0.3		

Surface Fines on Pool Tail Crest

Transect ID	Full / Partial	Plunge / Scour
C	Partial	Scour
Number of intersection fine		
25%	50%	75%
11	3	9

Transect ID	Full / Partial	Plunge / Scour
D	Full	Scour
Number of intersection fine		
25%	50%	75%
11	5	27

Transect ID	Full / Partial	Plunge / Scour
E	Full	Scour
Number of intersection fine		
25%	50%	75%
22	4	7

Transect ID	Full / Partial	Plunge / Scour
E	Patrial	Plunge
Number of intersection fine		
25%	50%	75%
5	3	15

Transect ID	Full / Partial	Plunge / Scour
G	Full	Plunge
Number of intersection fine		
25%	50%	75%
10	22	9

Transect ID	Full / Partial	Plunge / Scour
H	Full	Scour

Number of intersection fine

25%	50%	75%
6	11	11

Transect ID	Full / Partial	Plunge / Scour
J	Full	Plunge

Number of intersection fine

25%	50%	75%
2	3	4

Start of survey photos; upstream 979, left bank 980, downstream 981, right bank 982.
End of survey photos; downstream 986, right bank 987, upstream 988, left bank 989.

[redacted]

Property: Toandos Date: 7/23/2020
Stream: Stream 2

Major Transects

Transect: A Densiometer: 5
Depths Gradient: 8%

left bf	left wet	thalweg	right wet	right bf
0	0	0.01	0.01	0.01
10%	20%	50%	70%	90%
0.01	0.02	0.01	0.01	0.01

Bankfull Width: 2.4
Wetted Width: 1.5

Transect: B Densiometer: 3
Depths Gradient: 8%

left bf	left wet	thalweg	right wet	right bf
0.04	0.04	0.25	0	0
10%	20%	50%	70%	90%
0.16	0.16	0.25	0.18	0.5

Bankfull Width: 2
Wetted Width: 1.2

Transect: C Densiometer: 2
Depths Gradient: 6%

left bf	left wet	thalweg	right wet	right bf
0	0	0.2	0	0
10%	20%	50%	70%	90%
0.2	0.2	0.2	0.2	0.2

Bankfull Width: 0.8
Wetted Width: 0.3

Transect:	D	Densiometer:	4	
Depths		Gradient:	8%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.02	0	0
10%	20%	50%	70%	90%
0.02	0.02	0.02	0.02	0.02
Bankfull Width:		1.7		
Wetted Width:		0.3		

Transect:	E	Densiometer:	4	
Depths		Gradient:	6%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.01	0	0
10%	20%	50%	70%	90%
0.01	0.01	0.01	0.01	0.01
Bankfull Width:		0.8		
Wetted Width:		0.25		

Transect:	F	Densiometer:	7	
Depths		Gradient:	NA	
left bf	left wet	thalweg	right wet	right bf
0	0	0.03	0	0
10%	20%	50%	70%	90%
0.02	0.03	0.03	0.03	0.02
Bankfull Width:		1.2		
Wetted Width:		0.7		

Pebble Counts

ID:	A2			
10%	25%	50%	75%	90%
wood	wood	wood	12	6
wood	wood	wood	22	11
wood	wood	wood	18	15

ID:	B1			
10%	25%	50%	75%	90%
silt	silt	wood	9	9
silt	silt	wood	16	7
silt	wood	wood	8	5

ID:	B2			
10%	25%	50%	75%	90%
4	4	5	5	7
9	4	8	8	8
4	10	6	11	10

ID:	C1			
10%	25%	50%	75%	90%
8	sand	5	sand	4
sand	sand	15	sand	6
sand	sand	8	sand	5

ID:	C2			
10%	25%	50%	75%	90%
silt	silt	3	3	silt
silt	silt	4	4	7
sand	silt	3	6	8

ID:	D1			
10%	25%	50%	75%	90%
silt	4	sand	sand	4
silt	10	sand	11	10
48	10	sand	9	sand

ID:	D2			
10%	25%	50%	75%	90%
5	9	4	10	silt
sand	2	3	silt	16
4	4	2	10	silt

ID:	E1			
10%	25%	50%	75%	90%
sand	sand	sand	sand	8
sand	sand	sand	5	9
sand	sand	sand	7	4

ID:	E2			
10%	25%	50%	75%	90%
13	5	2	7	sand
11	4	sand	sand	sand
5	14	3	sand	3

ID:	F1			
10%	25%	50%	75%	90%
3	14	31	11	4
37	3	24	14	14
17	11	5	55	7

Large Woody Debris

Transect ID	Length	Width	Wood Type	Location
A	6	0.5	N	3
A	1.5	0.5	N	3
A	1.3	0.3	N	3

A	1.2	0.3	N	3
A	0.8	0.8	RN	5.5
A	1.4	0.45	N	9
A	2	0.3	N	9.5
A	2.5	0.5	N	11
A	1	0.3	N	12
B	4	0.3	N	1
B	1.3	0.35	N	3
B	1	0.4	N	3.5
B	5	0.5	N	5
B	NA	NA	N	1
B	NA	NA	N	12
B	NA	NA	N	12
C	NA	NA	N	4
C	2	0.5	N	8
C	NA	NA	N	9
C	NA	NA	N	10
C	NA	NA	N	13
C	NA	NA	N	13
E	1.2	1.2	N	14

Pools

Transect ID	Full / Partial	Type	length	width
NA	NA	NA	NA	NA

Pool Depths

head crest	tail crest	max
NA	NA	NA

Surface Fines on Pool Tail Crest

Transect ID	Full / Partial	Plunge / Scour
NA	NA	NA

Number of intersection fine

25%	50%	75%
NA	NA	NA

Comments: Start of survey photos; downstream 1001, upstream 998, right bank 1000, left bank 999. End of survey photos; right bank 1005, left bank 1004, downstream 1003, upstream 1002

Property:	Toandos	Date:	8/4/2020
Stream:	Stream 3		

Major Transects

Transect:	A	Densiometer:	6
Depths		Gradient:	2%

left bf	left wet	thalweg	right wet	right bf

0	0	0.03	0	0
10%	20%	50%	70%	90%
0.02	0.02	0.03	0.02	0.01
Bankfull Width:		2.4		
Wetted Width:		1.5		

Transect:	B	Densiometer:	2	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.11	0	0
10%	20%	50%	70%	90%
0.04	0.09	0.11	0.11	0.05
Bankfull Width:		1.9		
Wetted Width:		1.2		

Transect:	C	Densiometer:	5	
Depths		Gradient:	3%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.1	0	0
10%	20%	50%	70%	90%
0.07	0.07	0.1	0.09	0.02
Bankfull Width:		1.8		
Wetted Width:		1.4		

Transect:	D	Densiometer:	3	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.08	0	0
10%	20%	50%	70%	90%
0.1	0.12	0.08	0.13	0.05
Bankfull Width:		2.6		
Wetted Width:		2.1		

Transect:	E	Densiometer:	6	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.05	0	0
10%	20%	50%	70%	90%
0.02	0.01	0.05	0.05	0.02
Bankfull Width:		2.5		
Wetted Width:		0.8		

Transect:	F	Densiometer:	2	
Depths		Gradient:	4%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.05	0	0
10%	20%	50%	70%	90%

0.04	0.05	0.05	0.05	0.03
Bankfull Width:		2.1		
Wetted Width:		1.1		

Transect:	G	Densiometer:	11	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.06	0	0
10%	20%	50%	70%	90%
0.02	0.04	0.06	0.05	0.02
Bankfull Width:		2.4		
Wetted Width:		1.3		

Transect:	H	Densiometer:	5	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0.02	0.02	0.08	0	0
10%	20%	50%	70%	90%
0.04	0.08	0.08	0.04	0.02
Bankfull Width:		1.6		
Wetted Width:		1.2		

Transect:	I	Densiometer:	4	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.03	0	0
10%	20%	50%	70%	90%
0.05	0.03	0.02	0.03	0.02
Bankfull Width:		1.6		
Wetted Width:		1		

Transect:	J	Densiometer:	0	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.06	0	0
10%	20%	50%	70%	90%
0.06	0.08	0.06	0.05	0.02
Bankfull Width:		1.4		
Wetted Width:		0.8		

Transect:	K	Densiometer:	2	
Depths		Gradient:	6%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.06	0	0
10%	20%	50%	70%	90%
0.02	0.04	0.06	0.04	0.02
Bankfull Width:		1.3		

Wetted Width: 0.7

Large Woody Debris

Transect ID	Length	Width	Wood Type	Location
A	2.5	0.2	N	13
C	1.5	0.3	N	7
E	1.6	0.25	N	9
H	1.2	0.5	RW	14.3
J	1.3	1	RW	13

Pools

Transect ID	Full / Partial	Type	length	width
NA	NA	NA	NA	NA

Pool Depths

head crest	tail crest	max
NA	NA	NA

Surface Fines on Pool Tail Crest

Transect ID	Full / Partial	Plunge / Scour
NA	NA	NA

Number of intersection fine

25%	50%	75%
NA	NA	NA

Pebble Counts

ID: A2

10%	25%	50%	75%	90%
16	21	49	21	sand
8	20	45	6	56
51	43	19	15	34

ID: B1

10%	25%	50%	75%	90%
24	23	31	22	25
24	23	36	21	6
25	23	20	68	20

ID: B2

10%	25%	50%	75%	90%
27	21	26	5	31
36	18	10	9	14
9	13	11	19	12

ID: C1

10%	25%	50%	75%	90%
sand	28	27	9	6
9	48	8	6	5

7	25	10	5	8

ID:	C2			
10%	25%	50%	75%	90%
35	sand	sand	11	8
65	sand	sand	4	10
23	58	3	4	5

ID:	D1			
10%	25%	50%	75%	90%
12	17	17	5	13
11	13	18	17	17
24	41	14	25	10

ID:	D2			
10%	25%	50%	75%	90%
11	12	33	34	5
28	46	9	10	13
11	11	8	4	20

ID:	E1			
10%	25%	50%	75%	90%
16	44	33	11	10
18	19	11	67	10
17	14	25	23	14

ID:	E2			
10%	25%	50%	75%	90%
15	14	16	55	7
16	16	17	4	31
sand	31	67	4	5

ID:	F1			
10%	25%	50%	75%	90%
12	19	37	9	50
25	28	27	7	9
11	15	96	23	10

ID:	F2			
10%	25%	50%	75%	90%
15	15	40	39	82
10	20	29	14	42
29	20	46	30	18

ID:	G1			
10%	25%	50%	75%	90%
55	41	34	6	13

12	5	26	71	15
5	35	46	80	11

ID:	G2			
10%	25%	50%	75%	90%
26	14	14	6	5
5	11	22	11	18
10	20	13	13	9

ID:	H1			
10%	25%	50%	75%	90%
15	62	25	54	66
11	70	5	12	30
12	33	23	23	22

ID:	H2			
10%	25%	50%	75%	90%
18	50	71	14	30
38	33	6	8	24
18	44	32	14	5

ID:	I1			
10%	25%	50%	75%	90%
12	43	60	41	26
41	83	72	39	33
29	15	15	65	14

ID:	I2			
10%	25%	50%	75%	90%
60	29	73	4	46
12	40	23	4	66
12	29	21	6	32

ID:	J1			
10%	25%	50%	75%	90%
13	16	18	14	21
29	29	28	12	13
9	86	12	6	13

ID:	J2			
10%	25%	50%	75%	90%
42	11	38	11	45
36	8	39	20	12
11	83	27	11	27

ID:	K1			
10%	25%	50%	75%	90%

27	36	28	76	41
29	24	50	46	54
13	27	41	37	37

Start of survey photos: downstream 1016, right bank 1015, left bank 1014, upstream 1013. End of survey photos: upstream 1023, downstream 1021, right bank 1020, left bank 1022.

Property:	Manchester	Date:	7/22/2020	
Stream:	Beaver Creek			

Major Transects

Transect:	A	Densiometer:	26	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.14	0	0
10%	20%	50%	70%	90%
0.08	0.08	0.11	0.14	0.04
Bankfull Width:		3.6		
Wetted Width:		3.1		

Transect:	B	Densiometer:	10	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0.09	0.09	0.05	0	0
10%	20%	50%	70%	90%
0.04	0.04	0.03	0.05	0.03
Bankfull Width:		4.2		
Wetted Width:		3.8		

Transect:	C	Densiometer:	6	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.07	0	0
10%	20%	50%	70%	90%
0.04	0.01	0.03	0.07	0.07
Bankfull Width:		3.7		
Wetted Width:		1.8		

Transect:	D	Densiometer:	2	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0.09	0.09	0.05	0	0
10%	20%	50%	70%	90%
0.1	0.06	0.05	0.05	0.04
Bankfull Width:		2.4		

Wetted Width:		2.2		

Transect:	E	Densiometer:	7	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0.01	0.01	0.15	0	0
10%	20%	50%	70%	90%
0.08	0.12	0.15	0.07	0.08
Bankfull Width:		2.4		
Wetted Width:		2.4		

Transect:	F	Densiometer:	4	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.07	0	0
10%	20%	50%	70%	90%
0.08	0.05	0.07	0.05	0.1
Bankfull Width:		2.5		
Wetted Width:		2		

Transect:	G	Densiometer:	7	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.2	0.26	0.2
10%	20%	50%	70%	90%
0.05	0.13	0.2	0.22	0.22
Bankfull Width:		1.8		
Wetted Width:		1.3		

Transect:	H	Densiometer:	9	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.14	0.15	0.15
10%	20%	50%	70%	90%
0.03	0.05	0.12	0.14	0.14
Bankfull Width:		2.6		
Wetted Width:		1.3		

Transect:	I	Densiometer:	5	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.07	0	0
10%	20%	50%	70%	90%
0.05	0.05	0.07	0.06	0.04
Bankfull Width:		1.9		
Wetted Width:		1.2		

Transect:	J	Densiometer:	6	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.08	0	0
10%	20%	50%	70%	90%
0.03	0.04	0.08	0.08	0.06
Bankfull Width:		2.6		
Wetted Width:		1.8		

Transect:	K	Densiometer:	4	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.1	0	0
10%	20%	50%	70%	90%
0.02	0.05	0.08	0.1	0.08
Bankfull Width:		2.6		
Wetted Width:		1.3		

Large Woody Debris

Transect ID	Length	Width	Wood Type	Location
C	2.7	0.26	N	1
C	2	0.3	N	3
D	2.7	0.5	N	11
E	1.5	0.5	N	9
E	4.5	0.45	N	11.5
G	2.1	0.3	N	9
G	2.4	0.3	N	9.5
I	4	0.4	N	8
I	1.7	1.7	RN	11
I	2.3	0.45	N	13
K	1.3	2	RN	9
K	3	0.3	N	7

Pools

Transect ID	Full / Partial	Type	length	width
D	Full	Scour	10.5	1.7
Pool Depths				
head crest	tail crest	max		
0.08	0.05	0.3		
Transect ID	Full / Partial	Type	length	width
E	Full	Scour	5.5	3
Pool Depths				
head crest	tail crest	max		
0.07	0.03	0.5		
Transect ID	Full / Partial	Type	length	width
F	Full	Scour	5	1.5
Pool Depths				

head crest	tail crest	max			
0.08	0.08	0.4			
Transect ID	Full / Partial	Type	length	width	
G	Full	Scour		7	2.5
Pool Depths					
head crest	tail crest	max			
0.1	0.1	0.5			
Transect ID	Full / Partial	Type	length	width	
H	Full	Scour		8	2
Pool Depths					
head crest	tail crest	max			
0.03	0.1	0.45			
Transect ID	Full / Partial	Type	length	width	
K	Full	Scour		5	3.1
Pool Depths					
head crest	tail crest	max			
0.08	0.05	0.55			

Surface Fines on Pool Tail Crest

Transect ID	Full / Partial	Plunge / Scour
D	Full	Scour
Number of intersection fine		
25%	50%	75%
3	4	7
Transect ID	Full / Partial	Plunge / Scour
E	Full	Scour
Number of intersection fine		
25%	50%	75%
3	9	19
Transect ID	Full / Partial	Plunge / Scour
F	Full	Scour
Number of intersection fine		
25%	50%	75%
2	4	3
Transect ID	Full / Partial	Plunge / Scour
G	Full	Scour
Number of intersection fine		
25%	50%	75%
3	4	7
Transect ID	Full / Partial	Plunge / Scour
H	Full	Scour
Number of intersection fine		
25%	50%	75%
4	5	2
Transect ID	Full / Partial	Plunge / Scour
K	Full	Scour
Number of intersection fine		

25%	50%	75%
8	6	4

Pebble Counts

ID:	A2			
10%	25%	50%	75%	90%
14	14	40	26	13
9	16	39	27	17
14	12	36	50	17

ID:	B1			
10%	25%	50%	75%	90%
18	12	11	18	35
16	18	12	25	29
41	35	38	18	19

ID:	B2			
10%	25%	50%	75%	90%
silt	silt	17	25	10
silt	silt	11	17	12
silt	silt	22	10	16

ID:	C1			
10%	25%	50%	75%	90%
6	51	17	24	21
48	33	19	46	3
21	30	55	33	70

ID:	C2			
10%	25%	50%	75%	90%
silt	36	41	15	29
silt	24	24	16	15
silt	silt	55	9	22

ID:	D1			
10%	25%	50%	75%	90%
20	26	23	25	56
15	13	32	13	35
28	56	12	12	28

ID:	D2			
10%	25%	50%	75%	90%
31	7	26	46	44
6	17	23	42	12
36	18	47	38	26

ID:	E1

10%	25%	50%	75%	90%
42	31	57	12	31
37	56	42	17	20
9	27	15	12	51

ID: E2

10%	25%	50%	75%	90%
18	26	26	42	12
29	39	31	15	19
37	28	17	11	15

ID: F1

10%	25%	50%	75%	90%
5	41	13	12	92
5	5	25	53	7
7	8	10	7	95

ID: F2

10%	25%	50%	75%	90%
10	10	32	sand	4
13	14	40	sand	20
14	4	48	sand	12

ID: G1

10%	25%	50%	75%	90%
21	15	27	14	36
18	10	9	22	30
5	44	16	21	26

ID: G2

10%	25%	50%	75%	90%
31	5	35	47	55
27	27	18	14	18
19	36	45	57	13

ID: H1

10%	25%	50%	75%	90%
13	35	20	19	48
24	21	20	29	27
10	22	17	24	53

ID: H2

10%	25%	50%	75%	90%
25	35	43	42	34
34	44	62	47	silt
20	35	27	38	silt

ID:	I1			
10%	25%	50%	75%	90%
25	45	37	28	13
46	79	54	30	22
41	50	45	18	14

ID:	I2			
10%	25%	50%	75%	90%
18	26	52	42	50
26	24	23	9	51
12	25	41	14	30

ID:	J1			
10%	25%	50%	75%	90%
25	42	52	12	43
58	45	21	24	7
24	22	13	14	46

ID:	J2			
10%	25%	50%	75%	90%
sand	12	36	37	42
sand	13	31	22	62
sand	8	41	44	50

ID:	K1			
10%	25%	50%	75%	90%
19	44	30	11	27
22	13	28	33	35
47	28	50	36	57

Comments: End of survey photos: 938-941

Property:	Manchester	Date:	7/22/2020	
Stream:	Beaver Creek	*second survey		

Major Transects

Transect:	A	Densiometer:	4	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.07	0	0
10%	20%	50%	70%	90%
0.02	0.06	0.08	0.07	0.03
Bankfull Width:		3		
Wetted Width:		2.1		

Transect:	B	Densiometer:	5	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf

0.07	0.07	0.21	0	0
10%	20%	50%	70%	90%
0.07	0.12	0.21	0.19	0.13
Bankfull Width:		3		
Wetted Width:		1.6		

Transect:	C	Densiometer:	6	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.15	0	0
10%	20%	50%	70%	90%
0.11	0.16	0.15	0.13	0.05
Bankfull Width:		3.6		
Wetted Width:		1.9		

Transect:	D	Densiometer:	5	
Depths		Gradient:	3%	
left bf	left wet	thalweg	right wet	right bf
0.05	0.05	0.15	0.15	0.15
10%	20%	50%	70%	90%
0.17	0.15	0.15	0.2	0.17
Bankfull Width:		3		
Wetted Width:		3		

Transect:	E	Densiometer:	3	
Depths		Gradient:	0%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.25	0.08	0.08
10%	20%	50%	70%	90%
0.1	0.13	0.32	0.3	0.25
Bankfull Width:		3		
Wetted Width:		2.5		

Transect:	F	Densiometer:	1	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0.06	0.06	0.18	0	0
10%	20%	50%	70%	90%
0.15	0.19	0.18	0.12	0.05
Bankfull Width:		3.5		
Wetted Width:		1.3		

Transect:	G	Densiometer:	4	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.08	0.02	0.02
10%	20%	50%	70%	90%

0.04	0.08	0.08	0.09	0.08
Bankfull Width:		3.2		
Wetted Width:		1.7		

Transect:	H	Densiometer:	9	
Depths		Gradient:	2%	
left bf	left wet	thalweg	right wet	right bf
0.02	0.02	0.06	0	0
10%	20%	50%	70%	90%
0.05	0.08	0.06	0.05	0.03
Bankfull Width:		2.6		
Wetted Width:		1.5		

Transect:	I	Densiometer:	6	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.12	0	0
10%	20%	50%	70%	90%
0.15	0.1	0.1	0.12	0.1
Bankfull Width:		3.4		
Wetted Width:		2.7		

Transect:	J	Densiometer:	3	
Depths		Gradient:	1%	
left bf	left wet	thalweg	right wet	right bf
0	0	0.1	0	0
10%	20%	50%	70%	90%
0.06	0.1	0.12	0.08	0.04
Bankfull Width:		3.2		
Wetted Width:		2.8		

Transect:	K	Densiometer:	9	
Depths		Gradient:	NA	
left bf	left wet	thalweg	right wet	right bf
0	0	0.07	0.03	0.03
10%	20%	50%	70%	90%
0.04	0.02	0.04	0.03	0.02
Bankfull Width:		3.5		
Wetted Width:		3.1		

Large Woody Debris

Transect ID	Length	Width	Wood Type	Location
B	2	0.55	N	16
C	2.6	0.3	N	16
C	2	0.35	N	16
C	2.4	0.45	N	16
C	2.5	0.3	N	16

F	3.2	0.55	N	4
G	4	0.4	N	6
G	2	0.35	N	6
G	2.3	0.45	N	6
G	1.5	0.8	N	6
H	1.6	0.6	N	8

Pools

Transect ID	Full / Partial	Type	length	width
B	Full	Scour	6	2.3

Pool Depths

head crest	tail crest	max
0.05	0.05	0.6

Transect ID	Full / Partial	Type	length	width
C	Full	Scour	4	2.6

Pool Depths

head crest	tail crest	max
X	0.08	0.3

Transect ID	Full / Partial	Type	length	width
C	Full	Plunge	2.5	3.2

Pool Depths

head crest	tail crest	max
0.03	0.05	0.5

Transect ID	Full / Partial	Type	length	width
F	Full	Plunge	4	3

Pool Depths

head crest	tail crest	max
0.03	0.16	0.55

Transect ID	Full / Partial	Type	length	width
G	Full	Scour	8	3.5

Pool Depths

head crest	tail crest	max
0.05	0.1	0.4

Transect ID	Full / Partial	Type	length	width
H	Full	Scour	5	2

Pool Depths

head crest	tail crest	max
0.08	0.09	0.3

Surface Fines on Pool Tail Crest

Transect ID	Full / Partial	Plunge / Scour
B	Full	Scour

Number of intersection fine

25%	50%	75%
6	4	4

Transect ID	Full / Partial	Plunge / Scour
C	Full	Scour

Number of intersection fine

25%	50%	75%
12	35	3

Transect ID	Full / Partial	Plunge / Scour
C	Full	Plunge

Number of intersection fine

25%	50%	75%
8	3	2

Transect ID	Full / Partial	Plunge / Scour
F	Full	Plunge

Number of intersection fine

25%	50%	75%
12	28	14

Transect ID	Full / Partial	Plunge / Scour
G	Full	Scour

Number of intersection fine

25%	50%	75%
6	8	9

Transect ID	Full / Partial	Plunge / Scour
H	Full	Scour

Number of intersection fine

25%	50%	75%
9	3	7

Pebble Counts

ID: A2

10%	25%	50%	75%	90%
37	7	41	52	17
8	22	25	36	9
51	26	27	28	24

ID: B1

10%	25%	50%	75%	90%
48	14	52	49	38
29	14	38	47	40
30	11	28	25	18

ID: B2

10%	25%	50%	75%	90%
49	29	20	23	33
36	59	22	29	34
51	47	29	27	16

ID: C1

10%	25%	50%	75%	90%
9	23	33	41	7
33	26	71	31	16

16	16	38	59	19
ID:	C2			
10%	25%	50%	75%	90%
21	26	38	66	29
57	39	8	48	17
14	33	22	53	11
ID:	D1			
10%	25%	50%	75%	90%
51	65	13	28	19
sand	29	26	24	8
sand	19	9	19	21
ID:	D2			
10%	25%	50%	75%	90%
7	18	37	83	37
14	20	22	36	16
39	24	47	11	48
ID:	E1			
10%	25%	50%	75%	90%
12	19	15	38	42
8	14	16	32	36
9	12	23	48	11
ID:	E2			
10%	25%	50%	75%	90%
56	29	48	57	13
12	52	41	114	26
27	27	43	24	51
ID:	F1			
10%	25%	50%	75%	90%
41	18	37	16	33
38	54	13	9	28
32	36	24	19	8
ID:	F2			
10%	25%	50%	75%	90%
67	28	18	21	17
48	27	52	19	43
sand	sand	31	39	41
ID:	G1			
10%	25%	50%	75%	90%
22	17	44	8	21

18	41	34	25	12
24	38	9	32	46

ID:	G2			
10%	25%	50%	75%	90%
34	61	33	22	46
19	53	23	19	9
29	61	29	19	8

ID:	H1			
10%	25%	50%	75%	90%
56	26	61	28	32
41	11	39	49	68
14	12	24	13	13

ID:	H2			
10%	25%	50%	75%	90%
11	37	32	44	29
22	38	16	74	9
24	16	28	28	28

ID:	I1			
10%	25%	50%	75%	90%
46	33	19	26	18
27	16	26	34	51
24	21	41	15	26

ID:	I2			
10%	25%	50%	75%	90%
7	36	58	9	43
12	37	92	32	21
31	44	21	52	34

ID:	J1			
10%	25%	50%	75%	90%
silt	8	13	41	17
33	12	18	38	24
52	8	23	54	38

ID:	J2			
10%	25%	50%	75%	90%
12	11	21	43	29
20	14	18	50	25
14	14	16	34	13

ID:	K1			
10%	25%	50%	75%	90%

36	8	22	15	47
32	29	21	27	21
51	9	11	14	14

Comments: Start of survey photos: upstream 945, downstream 943, right bank 942, left bank 944. End of survey photos: upstream 967, downstream 969, right bank 970, left bank 968.