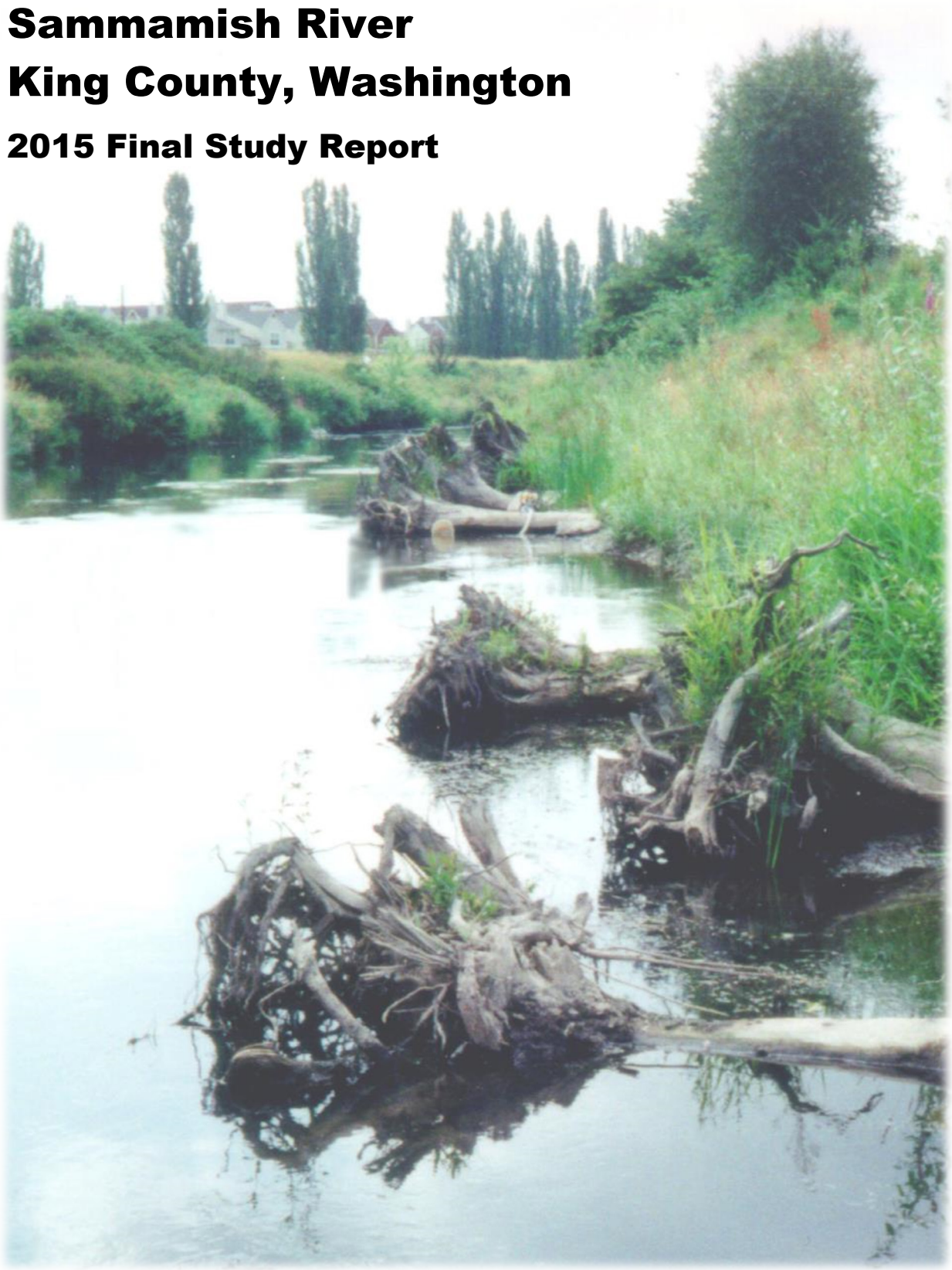
Salmonid Pre-Spawn Mortality Study Sammamish River King County, Washington

2015 Final Study Report



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King County, Washington

2015 Final Study Report

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1. INTRODUCTION

1.1 Study Area

Lake Washington consists of over 22,000 surface acres in the heart of the Puget Sound, in King County, Washington. The Sammamish River basin accounts for approximately 30% of surface water flow into Lake Washington (Pflug and Pauley 1981; Weitkamp et al. 2000). The Sammamish River begins at the outlet of Lake Sammamish (the sixth largest lake in the State of Washington), approximately one mile southeast of the City of Redmond (Figure 1). The river travels for approximately 8.5 miles north, passing through Woodinville, where it turns west for approximately 4.5 miles and enters Lake Washington near Kenmore. The Sammamish River basin was assigned to Water Resource Inventory Area No. 8 (Lake Washington) by Williams et al. (1975). The entire Sammamish River drainage basin encompasses approximately 170 square miles, including mainstem tributaries Big Bear/Cottage Creek, Little Bear, North, and Swamp creeks that originate in both King and Snohomish counties (Ostergaard et al. 1995; King County Online Data). Big Bear Creek enters the Sammamish River downstream of Marymoor Park, near the intersection of the Sammamish River and Highway 520. Big Bear Creek receives water from Cottage Lake and Evans creeks. Little Bear Creek joins the Sammamish River near Woodinville, while North Creek reaches the Sammamish River in Bothell, and Swamp Creek enters between Bothell and Kenmore (Figure 1). The waters and areas adjacent to the Sammamish River create numerous recreational opportunities and provide for the support of several anadromous fish runs in the Lake Washington watershed. The watershed contains a mix of urban, park, agricultural, and forested areas.

The Sammamish River watershed has experienced considerable development pressures in the last thirty years. The Sammamish River has been straightened to convey a 40-year springtime flood event; the riparian vegetation has been removed or altered over most of its course; large woody debris has been removed from within the channel (Warner et al. 1999). Mean daily summer water temperatures in the Sammamish River consistently exceed 16°C, while maximum water temperatures have been recorded as 23-26°C, which exceed Washington Department of Ecology Class AA surface water quality standards (Martz et al. 1999). The Sammamish River also is on the 1996 Washington State 303(d) list for fecal coliform and low dissolved oxygen levels. In addition to water quality and mainstem habitat issues, fish encounter impaired passage to many tributaries entering the Sammamish River and at a flood control weir, located approximately 0.5 miles downstream of Lake Sammamish. This structure was modified in 1998 by the U.S. Army Corps of Engineers and now is conducive to fish passage at most flows (Warner et al. 1999).

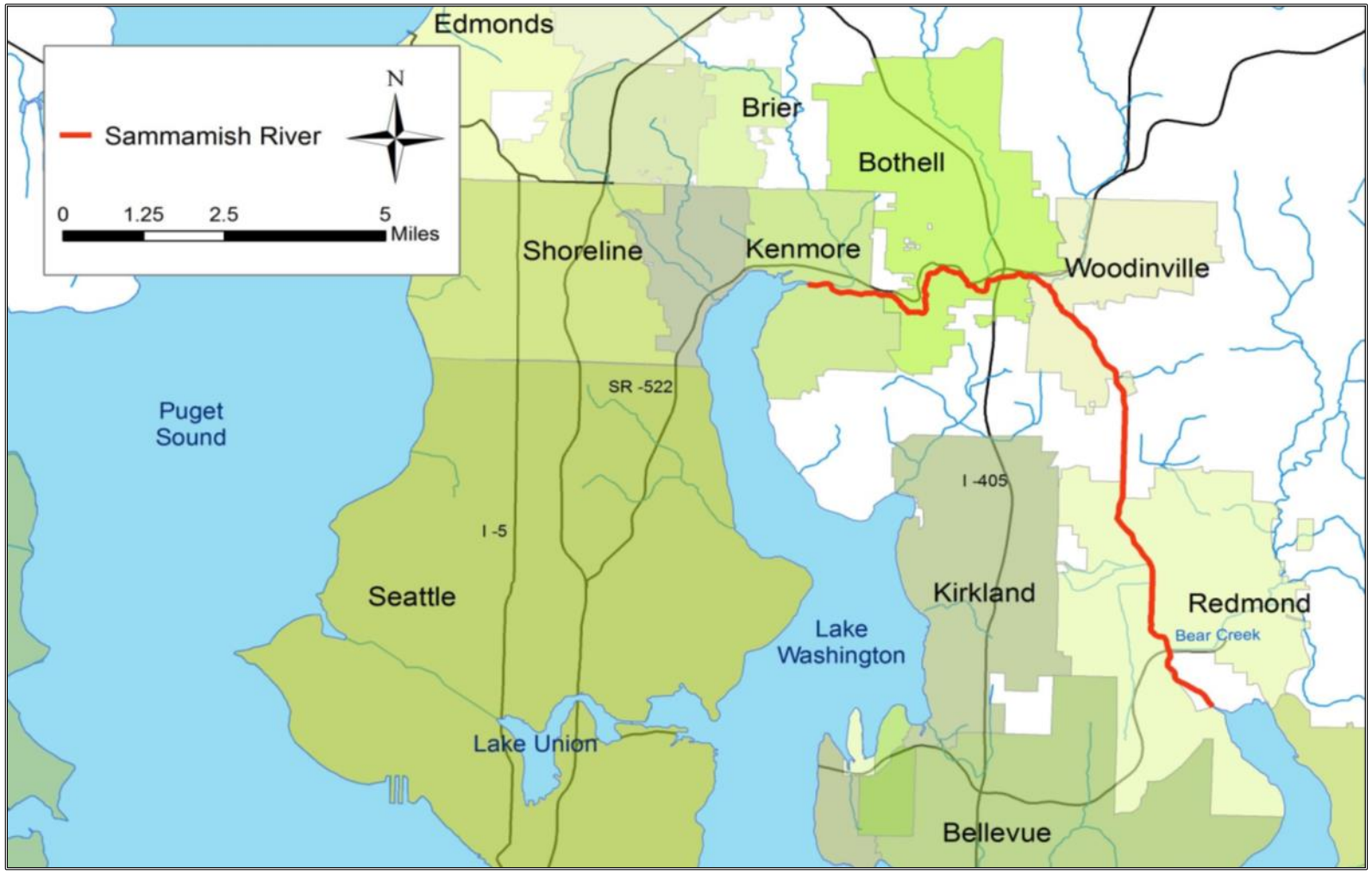

Figure 1. Chinook salmon re-spawn mortality study area, Sammamish River, King County, Washington, 2015.

A baseline habitat survey of the Sammamish River, consisting of the following four modules: reference point cross-section survey; habitat unit survey; vegetation unit survey; and large woody debris survey was conducted following Timber-Fish-Wildlife ambient monitoring program (Schuett-Hames et al. 1994) in 1999 (Jeanes and Hilgert 1999). Results of the survey indicate that the Sammamish River is dominated by glide habitat type, which composed more than 98% of all habitat by area (Table 1). The next most common habitat was riffle (1.4%), followed by pool (0.4%). Mean channel width at ordinary high water mark (OHW) for all transects in the Sammamish River is 78 ft, while mean wetted width is 71 ft. Average water depth for all Sammamish River transects is 3.0 ft, while water velocity averaged 0.25 fps at all transects. Aquatic vegetation, most notably Eurasian water milfoil (*Myriophyllum spicatum*) was encountered at four out of 25 transects. Mean transect coverage by aquatic vegetation in the Sammamish River was 9%, while riparian overhang of the river was lacking in all but a few transects. In general, survey data indicate that the Sammamish River is a wide, slow moving stream that lacks habitat diversity throughout most of its entirety (Jeanes and Hilgert 1999).

1.2 Biological Resources

Despite the lack of habitat diversity in the mainstem Sammamish River, both resident and anadromous salmonids inhabit the Sammamish River basin throughout the year, and because of its geographical setting between two large mesotrophic lakes, the Sammamish River also contains a diverse array of non-salmonid species. Mixed (native and non-native origin) stocks of summer/fall Chinook occur in the Sammamish River basin. Naturally spawning Chinook occur in Issaquah Creek, the largest tributary to Lake Sammamish, and the Bear/Cottage Creek system. The naturally spawning population in Issaquah Creek is located primarily below the hatchery rack and depends on supplementation from the Issaquah Creek Hatchery. This stock is thought to be non-native to the basin, as transfers from the Green River have been released since 1953 (WDFW et al. 1994; Warner et al. 1999). Natural spawning Chinook existing in Bear/Cottage Creek and other tributaries to the Sammamish River are thought to be native; however, these fish may be influenced by strays from the Issaquah Creek Hatchery. Genetic Stock Identification results indicate that Bear Cottage Creek Chinook are similar to Issaquah Creek Chinook. Interannual variation does not rule out the possibility that Chinook from these two streams are independent population, however (Mavros et al. 2000). Escapement estimates for Issaquah Creek averaged 1,993 per year from 1986-1991, while Bear/Cottage Creek Chinook have been below the escapement goal of 350 the same period of record (WDFW et al. 1994). Recent information indicates that Bear/Cottage Creek Chinook exceeded escapement levels during the 1999 spawning season (Mavros et al. 2000). Life histories of Sammamish River Chinook are similar to other Puget Sound Chinook. Adults arrive at the Chittenden locks in mid-June and

enter the river late August and early September. Spawning peaks in the Cedar River in early October and continues through mid-November (Warner et al. 1999).

Table 1. Reference point, reach habitat composition (%), total length of habitat in reach (ft), and mean width of habitat in reach (ft) for mainstem Sammamish River habitat surveys, King County, Washington, 1999 (adapted from Jeanes and Hilgert (1999)).

Reference Point	Glide (%)	Total Length (ft)	Mean Width (ft)	Pool (%)	Total Length (ft)	Mean Width (ft)	Riffle (%)	Total Length (ft)	Mean Width (ft)
L. Samm.									
1	100	1,090	120						
2	71	1,705	100	8	185	78	20	1,060	45
3	91	2,150	43	1	15	50	8	200	48
4	95	700	55	5	35	55			
5	98	1,900	49				2	50	45
6	100	2,100	50						
7	100	2,000	55						
8	98	5,000	59				2	100	52
9	100	950	50						
10	100	2,200	55						
11	100	2,950	55						
12	100	5,500	58						
13	100	1,700	60						
14	100	4,950	67						
15	100	1,500	60						
16	100	2,550	65						
17	94	500	60				6	50	40
18	97	1,675	73				3	100	40
19	100	3,700	64						
20	100	3,500	77						
21	100	2,725	92						
22	100	4,775	90						
23	100	5,950	91						
24	100	1,375	108						
25	100	2,050	143						
L. Wash.	100	1,700	175						
Mean/Total River	***98.2%***	***68,690***	***74***	***0.4%***	***235***	***65***	***1.4%***	***1,560***	***45***

Mixed stocks of coho salmon were consistently planted in the Sammamish River basin beginning in the 1950s and continuing through the early 1970s (WDFW et al. 1994). From 1982 through 1991, hatchery releases of juvenile coho into Issaquah Creek averaged more than three million fish per year. The Lake Washington/Sammamish tributary coho stock was listed as depressed as escapements from 1989 through 1992 were the lowest on record. Adult coho enter the Sammamish River in late September through mid-November, and like other Puget Sound coho, spawn from late October through December.

Sockeye salmon were first introduced into the Lake Washington and Sammamish River basin in 1935 with releases of Baker River sockeye into the Cedar River and Issaquah Creek (WDFW et al. 1994). Prior to this, large numbers of native kokanee (non-anadromous form of sockeye salmon) spawned in several Lake Sammamish tributaries during the early 1900s (Ostergaard et al. 1995; Connor et al. 2000). Three kokanee stocks were distinguishable based mainly on their run timings (Connor et al. 2000). Early run kokanee generally ascended Issaquah Creek, middle run stocks spawned primarily in the Sammamish River and tributaries thereof, while late run stocks primarily spawn in small tributaries to Lake Sammamish. Early run kokanee were thought to be extirpated by the early 2000s (HDR 2009). Young et al. (2004) indicated that Lake Sammamish kokanee are genetically distinct from Lake Whatcom Hatchery transplants and are generally thought to be native to the Lake Sammamish basin. Young et al. (2004) also determined that the middle-run stocks (i.e., Bear and Little Bears creeks, tributaries to the Sammamish River) are genetically similar to sockeye, also native to the Lake Washington watershed. Since available information suggests early/middle-run kokanee are either extinct or genetically introgressed with sockeye, the only remaining native kokanee in the Sammamish River/Lake Sammamish watershed are the late-run stocks that spawn in the upper tributaries of Lake Sammamish (primarily Elbright, Lewis, and Laughing Jacobs creeks). Kokanee generally spawn from August through November; however kokanee from Lake Sammamish often spawn as late as December and early January (Berge and Higgins 2003). Emergent kokanee fry typically move downstream to a nursery lake beginning in April and continue through early June. Kokanee reside in the lake feeding on plankton (primarily daphnia) until they spawn at ages 4-5 (Groot and Margolis 1991).

Coastal cutthroat trout are found throughout the Lake Washington basin in both resident and anadromous life history forms (King County SWMD 1993). Status of cutthroat trout in the Sammamish River basin has not been determined, yet populations appear to have increased in recent years (King County SWMD 1993). Adult cutthroat trout in western Washington tend to follow two run-timings (Johnston 1982). Early returning cutthroat trout typically peak in large

streams in September and October. Late-returning cutthroat trout peak in December and January in small streams draining directly to salt water and lakes for adfluvial populations.

A self-sustaining bull trout (*Salvelinus confluentus*) population occurs in the Lake Washington basin in the upper Cedar River, but populations of bull trout have not been confirmed in the Sammamish River (WDFW 1998; Berge and Mavros 2001). A single observation of native char occurred in Carey Creek, a small tributary of Issaquah Creek (Berge and Mavros 2001). Water temperatures in the Sammamish River in excess of 16°C exceed the thermal tolerance exhibited by bull trout, and probably prevent them from residing in the river for most periods of the year (Goetz 1989). Native char in Puget Sound and coastal streams may express both resident and migratory life history forms (Goetz 1989). Resident bull trout complete their life cycles in native tributaries, while some migratory bull trout adopt an anadromous life cycle. Anadromous fish migrate to sea in the spring and return in late summer and early fall (Wydoski and Whitney 1979). Native char can spend two or even three years in freshwater before migrating to sea. Spawning in most native char populations occurs in September and October, though it may occur in August at elevations above 4,000 feet in the Cascades and as late as November in coastal streams (Goetz 1989; Craig 1997; R. Ladley, Puyallup Tribe, pers. comm).

At least 23 non-native predator/competitor species are present in the Lake Washington basin (Weitkamp et al. 2000). Because of its locale, situated between two large lakes, the Sammamish River also contains a variety of native and introduced non-salmonid fishes. Reproducing populations of smallmouth bass (*Micropterus dolomieui*) and largemouth bass (*M. salmoides*), yellow perch (*Perca flavescens*), northern pikeminnow (*Ptychocheilus oregonensis*), largescale sucker (*Catostomus macrocheilus*), threespine stickleback (*Gaterosteus aculeatus*), and sculpin (*Cottus spp*.) have been documented in sections of the Sammamish River, while other species are likely residents during specific periods of the year.

1.3 Objective

Elevated water temperatures in the Sammamish River during the July-September period have been identified as a significant factor limiting production of Chinook salmon (*Oncorhynchus tshawytscha*) and other anadromous salmonid species during their spawning migration to Issaquah Creek, the Washington Department of Fish and Wildlife (WDFW) Issaquah Creek Hatchery, Bear Creek, and other tributaries downstream (WRIA 8 Steering Committee 2005). Daily maximum temperatures frequently exceed 20°C near the Lake Sammamish outlet during this period and have exceeded 26.6°C (King County online data). A major driver for elevated temperatures is that the river draws its water from the surface layer of Lake Sammamish, which gets very warm during summer months. The resulting elevated water temperatures are

potentially connected with observed pre-spawn mortality that occurs in the system (DeGasperi 2005; Tabor 2002).

Elevated water temperatures may also adversely affect the fitness of adult Chinook salmon, delay their arrival at spawning grounds, or increase their susceptibility to disease/parasites (McCullough et al. 2001). Analyses of tracking data collected collaboratively by Washington Department of Fish and Wildlife (WDFW), the Muckleshoot Indian Tribe Fisheries Division (MITFD), the U.S. Fish and Wildlife Service (USFWS), and King County indicate that adult Chinook delay entry into the Sammamish River until water temperatures become more tolerable, or alternatively enter the river beginning in mid to late August and hold in localized cooler pockets associated with groundwater and at the confluences of cooler tributaries (Fresh et al. 1999). Water temperatures during this period can be within the range of those causing adverse physiological and behavioral effects. Acoustic-telemetered Chinook salmon were found to spend an average of 9 days in the Sammamish River in 1998 and showed a preference for pools with a maximum residence time in a single pool of 24 days. Temperatures during that period were often near lethal levels (Fresh et al. 1999).

The Pacific Northwest suffered from severe drought conditions during the spring and summer of 2015. High daily temperature and low water conditions were hypothesized to cause adult fish kills in numerous basins in the northwest. As a result of long-term water quality issues and the short term drought conditions, R2 Resource Consultants, Inc. (R2) was contracted by King County to perform Chinook salmon pre-spawn mortality surveys in the Sammamish River. Due to the fact that the majority of Sammamish River Chinook salmon spawn in tributary systems, most mortalities observed in the river would be categorized as pre-spawn mortalities. The primary objective was to collect information concerning the survival and of salmonids, including Chinook, in the Sammamish River system. Project objectives are to:

1. Document pre-spawn mortality for the 2015 Bear Creek/Issaquah Fall Chinook salmon that reside in the upstream half of the Sammamish River; and
2. Analyze and report on the quantity and physical characteristics of dead Chinook salmon encountered during the surveys relative to the number of live fish encountered during the survey period.

2. METHODS

2.1 Field Surveys

Chinook salmon pre-spawn mortality surveys were conducted by biologists from R2 on the Sammamish River beginning in late August and continuing September through October 2015. Two biologists floated the Sammamish River three times per week via inflatable kayak; each survey event was at least one day apart (ideally Monday, Wednesday and Friday). The survey began at the Sammamish River weir in Marymoor Park and continued downstream to the take-out location at 145th Ave NE, entailing a distance of approximately six river miles (Figure 2). A pair of biologists moved downstream together downstream looking for live and dead salmon throughout the survey area. Survey personnel utilized polarized sun glasses to observe live and dead fish under the water.

Unique identification numbers were assigned to each Chinook carcass that was observed. In addition to identification number, the following data was recorded for carcass: latitude/longitude, species, fork length, gender, fin clips (adipose/ventral) and the presence of external tags. Secondary sexual characteristics were categorized as fully developed (brown vs. silver skin color or well-developed kype in males) as well as the age of the carcass (gill color, eye clarity, and flesh firmness). Any evidence of disease (i.e., eroded gills, lesions, fungus) or predation were also included during the carcass interrogation as well as information pertaining to the physical condition (i.e., predation and/or decomposition) of the carcass. The physical condition of Chinook carcasses were placed into the following categories:

1. Eyes missing, belly decayed, fins eroded, scales absorbed, gills and carcass covered in fungus, gills decaying, eggs decaying;
2. Eyes intact but glossed covered, belly decayed, fins eroded, scales absorbed, no fungus present on gills and carcass, gills discolored, eggs decaying;
3. Eyes intact but glossed over, belly intact, fins intact, scales intact and body started to get soft, no fungus on gills and carcass, gills partially discolored, eggs discolored; and
4. Eyes intact and bright, belly intact, fins intact, scales intact and body firm, no fungus on gills and carcass, gills bright, eggs fresh.

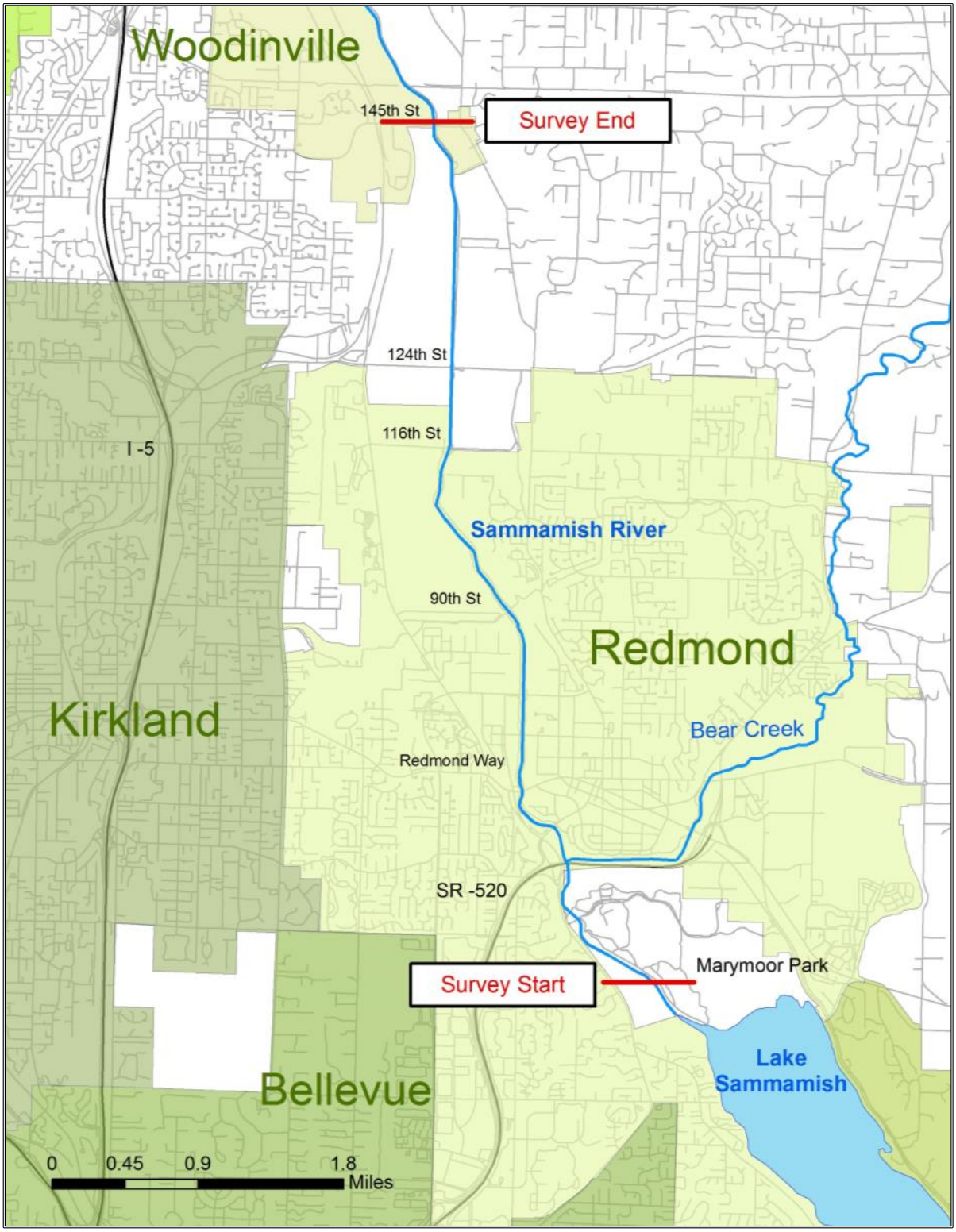

Figure 2. Chinook salmon pre-spawn mortality study site boundaries conducted in the Sammamish River, King County, Washington 2015, King County, Washington, 2015.

Chinook salmon carcasses were incised along the mid-ventral portion of the abdomen to allow for an estimation of egg retention. Egg retention was visually estimated using the following categories: 0- 25%; 25-50%; 50-75%; and 75-100%. Male salmon were not analyzed because milt retention is difficult to quantify and males may spawn more than once. A minimum of six scales were collected from Chinook carcasses at a location just above the lateral line posterior to the dorsal fin and inserted to adhesive scale cards supplied by WDFW. Scale cards were transferred to WDFW for examination at the conclusion of the study (A. Bosworth, WDFW, *pers. comm.*). A minimum of three digital photographs were collected from each Chinook salmon carcass denoting the position of the carcass, the incised belly cavity, and gill cavity. Each carcass was then marked in a manner that it was not confused with new carcasses on subsequent surveys. At least one biologist from R2 was present on every survey so that methodology remained consistent between survey dates. Personnel from WDFW, King County, and WDOE contributed on the majority of survey dates; occasionally, surveys consisted of two R2 personnel (Appendix A; Study plan).

Live salmon counts were recorded utilizing unique physical identification features of the Sammamish River (e.g., tributary outlet or bridges) (Figure 3). Live count data were summed across reaches and analyzed using an in-house MS Excel spreadsheet to calculate Chinook salmon escapement using the area under the curve methodology (English et al. 1992). Due to the timing, escapement was estimated utilizing stream life of 1-, 2-, and 3-days and an observer efficiency adjustment of 95% (A. Bosworth, WDFW, *pers. comm.*). Basin-wide Chinook salmon escapement (i.e., Issaquah Hatchery, lower Issaquah Creek, and Bear/Cottage creeks) and age distribution data was electronically received from WDFW for the 2015 season (A. Bosworth, WDFW, *pers. comm.*).

Water temperature (at water surface) was collected from sites located immediately downstream from Bear Creek and at the 145th Street takeout on each survey date using a calibrated hand-held thermometer. All field survey data were recorded on unique data sheets developed for the Sammamish River pre-spawn mortality study (Appendix A; Study Plan). All data were entered electronically using MS Excel and cross-referenced with original field data forms for QA/QC purposes.

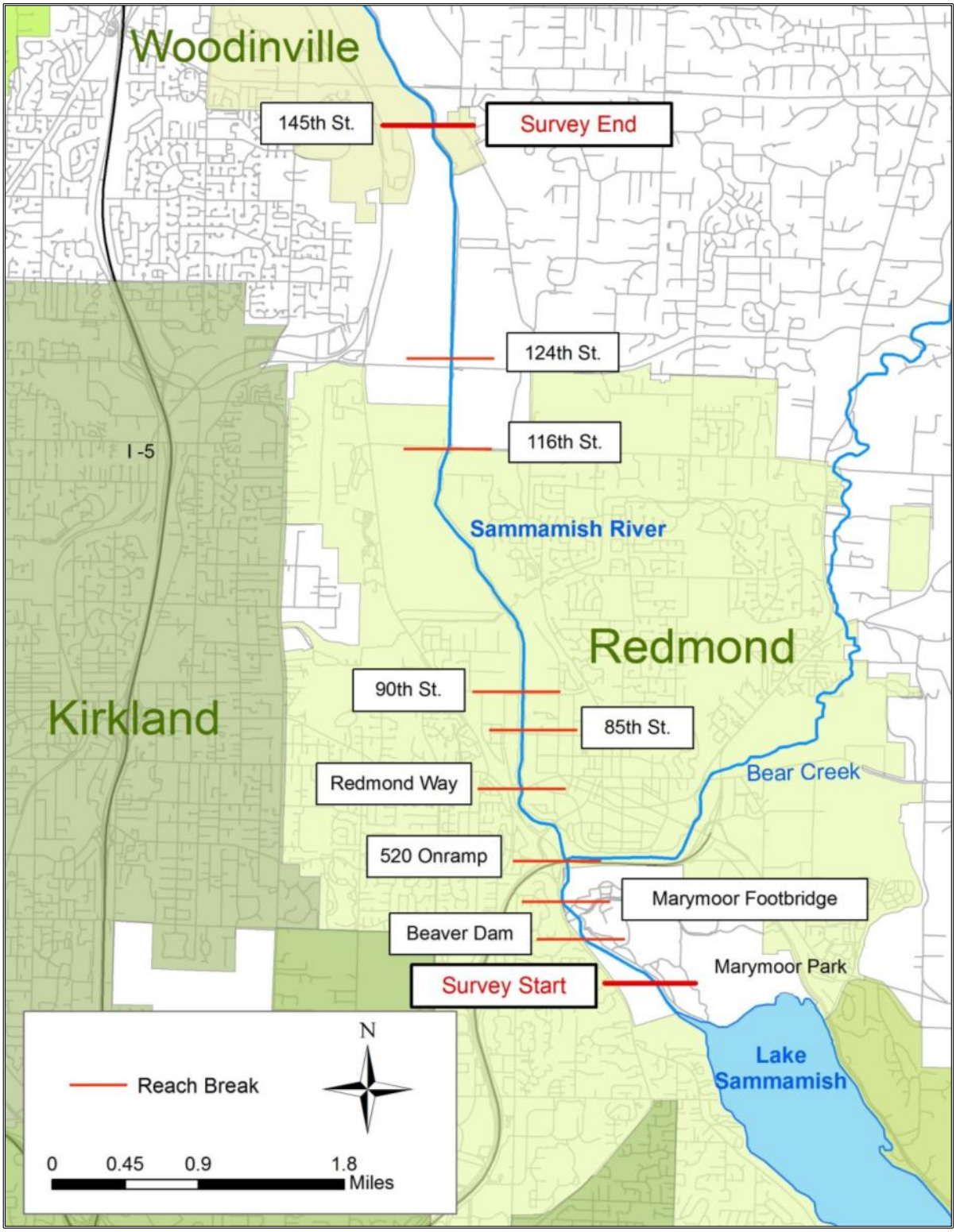

Figure 3. Chinook salmon live-count boundaries during pre-spawn mortality study conducted in the Sammamish River, King County, Washington, 2015.

3. RESULTS

3.1 Pre-Spawn Mortalities

A preliminary survey was conducted on 18 August 2015 to determine field survey logistics and the number of Chinook salmon present in the Sammamish River. Field surveys began in earnest on 9 September and were conducted continuously through 30 October on 2-3 day intervals (N=23 field surveys). A total of 17 adult Chinook salmon carcasses were observed during the survey period (Table 2). In addition, one pre-spawn coho and 26 post-spawn sockeye carcasses were observed during the study period.

Chinook salmon carcasses were primarily located from Marymoor Park downstream through the City of Redmond to the confluence of the Sammamish River with Peters Creek (Figure 4). The majority (n=16 female, n=1 male; 94%) of the carcasses that were observed in the Sammamish River were female Chinook salmon (Table 2). All but one female Chinook salmon retained 100% of their egg mass, the lone exception was a single spawned-out Chinook observed on the last survey event that occurred on 29 October. The majority (n=13; 76%) of the Chinook carcasses were hatchery origin (Table 2). Peak timing of Chinook salmon pre-spawn mortalities occurred on 16 September (n=4 mortalities) and 21 September (n=3 mortalities). Only two mortalities occurred after 1 October. Due to the frequency of field surveys, most Chinook salmon carcasses were categorized as good condition (Table 2). No external sign of disease or discernible indications of predation were noticeable on any of the Chinook salmon carcasses (Table 2; Appendix B).

3.2 Live Counts

Live adult Chinook salmon were first observed holding in the Sammamish River on 18 August, only three Chinook were observed on the reconnaissance survey. Chinook live counts increased dramatically on 16 September, peaked during that week, and decreased steadily after the first week of October (Table 3; Figure 5). A total of 1,828 Chinook salmon were observed during the study period. The overwhelming majority (40%) of Chinook were observed holding in the first pool located immediately downstream from the Sammamish River Transition Zone (Table 3; Figure 4). Like the carcass counts, live salmon were mainly observed in the upstream portion of the Sammamish River study area beginning at the weir and continuing downstream through Redmond to the confluence of the Sammamish River with Peters Creek (Figure 4). More than 93% of total Chinook live counts were observed in this reach.

The total number of Chinook salmon were estimated in the Sammamish River basin using the area under the curve methodology by WDFW utilizing spawner counts collected in the Bear/Cottage creek system, Issaquah Creek, and hatchery rack counts at the Issaquah Creek Hatchery (Table 3). We also used the lived count data collected during this study and estimated number of Chinook salmon residing in the Sammamish River using the same methodology (Table 4; Figure 6). Both estimates resulted in similar number of Chinook salmon in the Sammamish basin during the 2015 season (Table 4). The summation of the three spawning reaches conducted by WDFW resulted in an estimate of 4,361 Chinook salmon and the data collected from this study resulted in an estimate of 4,836 to Chinook (stream life=1 day). Chinook salmon scale samples collected during this study were submitted to WDFW for aging. Age data collected from the Sammamish River indicate that the majority (90-100%) of Chinook were comprised of age-4, followed by age-5 fish (Table 5). Likewise, age data collected during tributary spawner surveys by WDFW indicated that the majority (64-80%) of Chinook were comprised of age-4, followed by age-3 fish (Table 5). Very few (<1%) of the total number of natural or hatchery origin Chinook were comprised of ag-5+ fish (Table 5).

Visibility was excellent (visibility≥10 ft) throughout the majority of the study period, decreasing slightly downstream from Bear Creek during storm events that occurred during the week of 24 October. Water temperature peaked at 22° C during the reconnaissance survey that was conducted on 18 August and remained above 15° C throughout September and mid-October before decreasing by the end of the survey period. Generally, water temperature was slightly higher (1-2° C) at the take-out location (145th Street) in Woodinville when compared to the confluence of the Sammamish River with Bear Creek in Redmond (Appendix C).

Table 2. Chinook and coho salmon carcass metrics during pre-spawn mortality study conducted in the Sammamish River, King County, Washington, 2015.

Carcass ID	Date	Species	Sex	Fork Length (cm)	Fin Clip(s)	External Tag(s)	Egg Retention	Carcass Condition	Scales	Photo Nos.	Waypoint	
SM 1	11-Sep	Chinook	F	83	Ad Clip	DNA	100	3	Card 1	14-16	47.66386	-122.12659
SM 2	11-Sep	Chinook	F	77	Ad Clip	DNA	100	2	Card 1	18-20	47.66428	-122.12688
SM 3	11-Sep	Chinook	F	91	Ad Clip	DNA	100	3	Card 1	21-23	47.67072	-122.12816
SM 4	11-Sep	Chinook	F	84	Ad Clip	DNA	100	4	Card 1	24-26	47.71207	-122.14278
SM 5	14-Sep	Chinook	F	89	Ad Clip	DNA	100	4	Card 2	27-29	47.67409	-122.13256
SM 6	14-Sep	Chinook	F	83	No Clip	DNA	100	4	Card 2	30-32	47.67477	-122.13274
SM 7	16-Sep	Chinook	M	75	Ad Clip	DNA	DNA	1	Card 3	42-44	47.65831	-122.11790
SM 8	16-Sep	Chinook	F	78	No Clip	DNA	100	1	Card 3	45-47	47.65907	-122.12024
SM 9	16-Sep	Chinook	F	72	Ad Clip	DNA	100	1	Card 3	48-50	47.66338	-122.12619
SM 10	16-Sep	Chinook	F	71	Ad Clip	DNA	100	3	Card 3	51-53	47.66608	-122.12588
SM 11	16-Sep	Chinook	F	83	Ad Clip	DNA	100	4	Card 3	54-56	47.66846	-122.12667
SM 12	18-Sep	Chinook	F	95	Ad Clip	DNA	100	4	Card 4	59-62	47.67241	-122.13244
SM 13	21-Sep	Chinook	F	101	No Clip	DNA	100	4	Card 4	64-67	47.66854	-122.12666
SM 14	21-Sep	Coho	M	54	Ad Clip	DNA	DNA	3	Card 4	68-70	47.67432	-122.13261
SM 15	21-Sep	Chinook	F	92	Ad Clip	DNA	100	2	Card 4	71-73	47.68340	-122.13248
SM 16	28-Sep	Chinook	F	78	Ad Clip	DNA	100	3	Card 5	79-81	47.66398	-122.12667
SM 17	7-Oct	Chinook	F	83	Ad Clip	DNA	100	1	Card 6	82-83	47.67880	-122.13223
SM 18	28-Oct	Chinook	F	77	No Clip	DNA	0	1	Card 7	91-93	47.66074	-122.12396

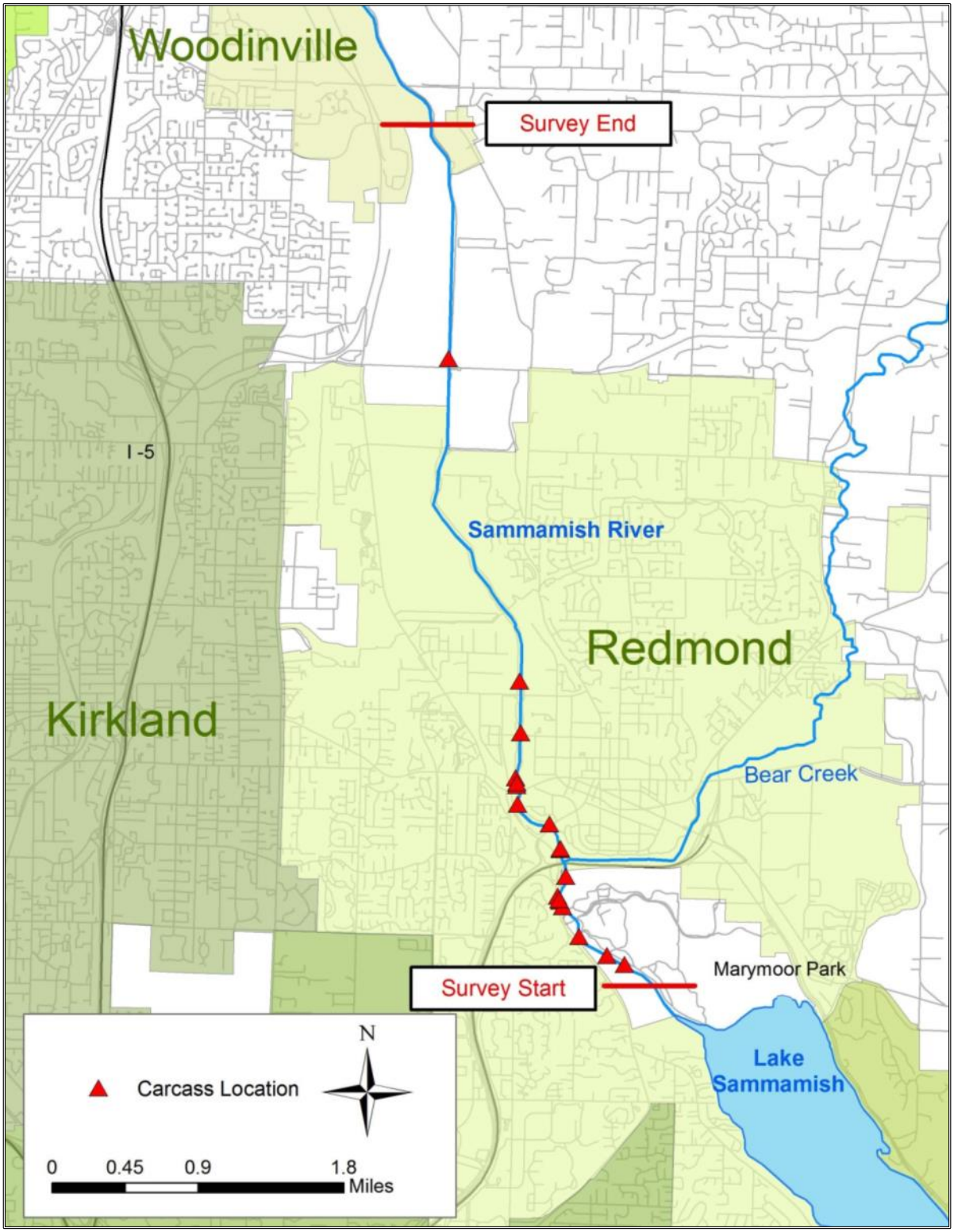

Figure 4. Chinook salmon pre-spawn mortality locations during pre-spawn mortality study conducted in the Sammamish River, King County, Washington, 2015.

Table 3. Chinook salmon live counts by study reach, and total Chinook, sockeye and coho salmon live counts during pre-spawn mortality study conducted in the Sammamish River, King County, Washington, 2015.

Date	Chk Total Number	Chk Beaver Dam	Chk Mary Foot.	Chk 520 Ramp	Chk Redmond Way	Chk 85th St. Bridge	Chk 90th St. Bridge	Chk 116th St. Bridge	Chk 124th St. Bridge	Chk 145th St Bridge	Total Sockeye	Total Coho
18-Aug	3	3	0	0	0	0	0	0	0	0	1	0
9-Sep	23	20	0	0	1	0	0	2	0	0	9	0
11-Sep	76	9	2	13	6	18	15	10	3	0	236	0
14-Sep	89	21	2	30	0	14	16	4	2	0	35	0
16-Sep	222	75	0	1	66	33	33	3	10	1	104	0
18-Sep	261	45	102	58	45	5	5	1	0	0	2	0
21-Sep	102	12	20	39	20	0	0	6	5	0	62	1
23-Sep	83	25	20	20	8	0	0	0	8	2	43	0
25-Sep	112	69	10	5	4	4	10	2	8	0	76	0
28-Sep	130	75	10	5	1	10	5	9	9	6	121	0
30-Sep	134	71	3	6	31	8	4	3	4	4	134	0
2-Oct	99	46	0	1	8	10	10	12	6	6	132	0
5-Oct	109	65	17	2	1	4	2	2	10	6	203	4
7-Oct	107	43	0	4	28	3	0	5	11	13	208	12
9-Oct	51	40	5	5	0	0	0	0	1	0	23	10
12-Oct	79	35	10	24	0	0	0	2	2	6	78	58
14-Oct	43	20	2	4	7	4	0	2	4	0	18	145
16-Oct	19	11	0	0	3	0	2	2	1	0	12	118
19-Oct	28	15	4	4	2	1	0	2	0	0	4	107
21-Oct	2	1	0	1	0	0	0	0	0	0	8	102
23-Oct	10	4	0	0	0	0	0	6	0	0	2	284
26-Oct	24	6	7	0	4	0	0	2	2	3	7	142
28-Oct	11	5	0	0	2	0	0	0	2	2	9	106
30-Oct	11	6	2	0	2	0	1	0	0	0	7	114
Total	1,828	722	216	222	239	114	103	75	88	49	1,534	1,203

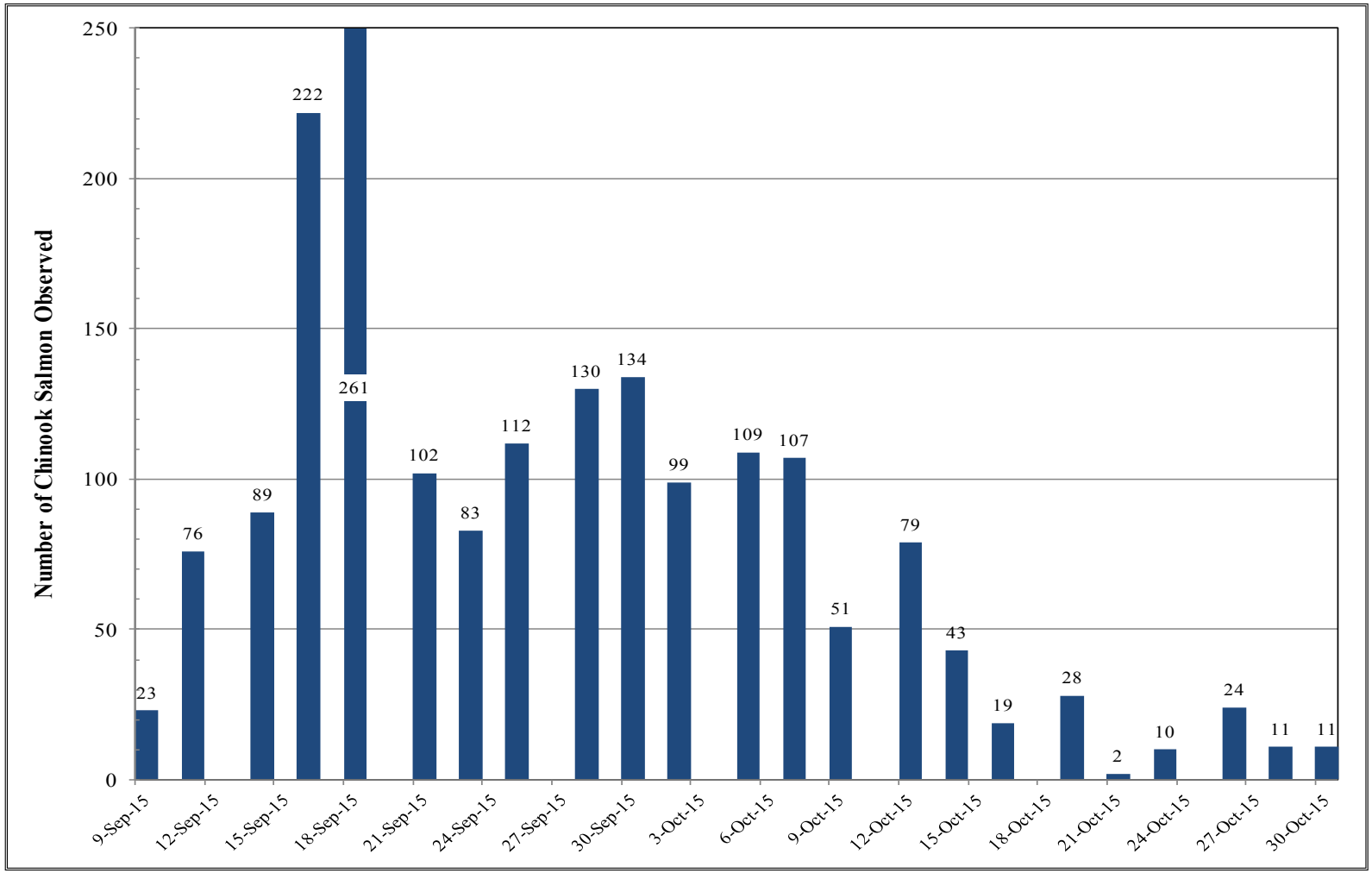

Figure 5. Adult salmon live counts during pre-spawn mortality study conducted in the Sammamish River, King County, Washington, 2015.

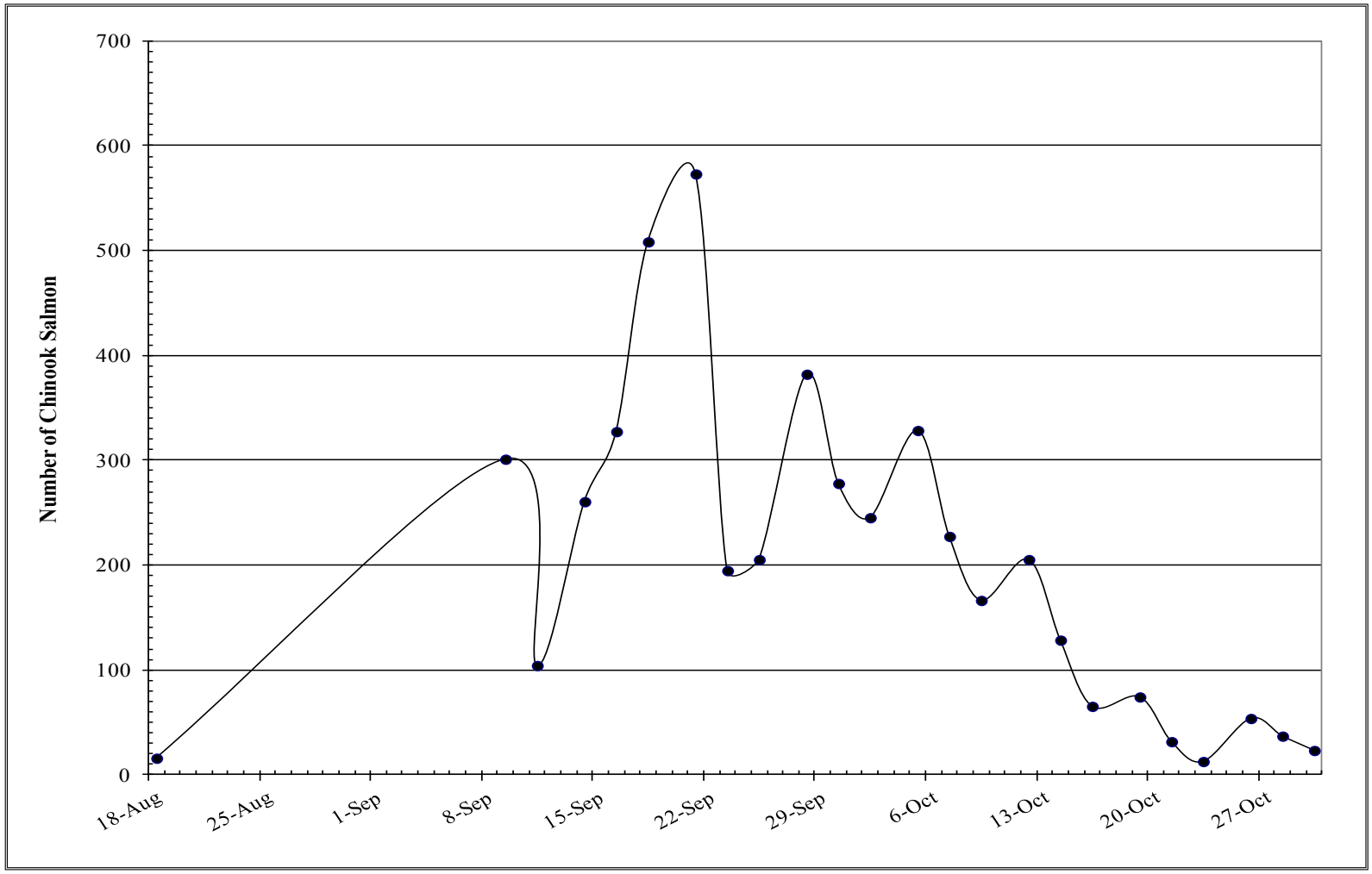

Figure 6. Chinook salmon escapement estimate (area under curve=4,836) collected during pre-spawn mortality study in the Sammamish River, King County, Washington, 2015.

Table 4. Chinook salmon escapement estimate (source of data in parenthesis) for hatchery origin (HOR) and natural origin (NOR) fish during the pre-spawn mortality study in the Sammamish River basin, King County, Washington, 2015.

Chinook Salmon Escapement Estimate (source)	**Total Number**	**HOR (Number)**	**NOR (Number)**
Issaquah Hatchery[a]	3,373	3,223	150
L Issaquah Creek[a]	717	686	31
Bear/Cottage Creek[a]	271	210	61
Total	4,361		
Sammamish River	4,836	-	-

[a] Data provided by WDFW, Region 4, Mill Creek, Washington.

Table 5. Chinook salmon age distribution for hatchery origin (HOR) and natural origin (NOR) fish during the pre-spawn mortality study in the Sammamish River basin, King County, Washington, 2015.

Chinook Salmon Age Distribution (percent of total number)	**HOR (% of Total)**	**NOR (% of Total)**
Sammamish River	0.0%	0.0%
Age-2	0.0%	0.0%
Age-3	0.0%	0.0%
Age-4	90.9%	100.0%
Age-5	9.1%	0.0%
Age-6	0.0%	0.0%
Issaquah Creek [a]		
Age-2	9.0%	7.0%
Age-3	27.0%	22.0%
Age-4	64.0%	70.0%
Age-5	0.0%	1.0%
Age-6	0.0%	0.0%
Bear/Cottage creeks [a]		
Age-2	0.0%	0.0%
Age-3	25.0%	20.0%
Age-4	75.0%	79.0%
Age-5	0.0%	1.0%
Age-6	0.0%	0.0%

[a] Data provided by WDFW, Region 4, Mill Creek, Washington

4. DISCUSSION

The spring and summer months of 2015 were unusually warm and dry creating elevated stream temperatures throughout the Pacific Northwest. Warm temperatures combined with low snowfall were hypothesized to cause pre-spawn mortalities of spring Chinook in the Willamette River near Portland, Oregon (ODFW, online data). In Puget Sound, coho salmon were traditionally the focus of studies dealing with pre-spawn mortalities (Scholz et al. 2011). Numerous researchers indicate high (>50%) pre-spawn mortalities in small streams entering Puget Sound (Spromberg et al. 2015; Baldwin et al. 2014; Scholz et al. 2011; McCarthy 2007). Many of these studies have attributed the high levels of coho mortality to stormwater run-off that is laden with metals and petroleum hydrocarbons.

In the Sammamish River, elevated water temperatures have been identified as a significant factor limiting production of Chinook salmon (*O. tshawytscha*) and other anadromous salmonid species during their spawning migration to Issaquah Creek, the Washington Department of Fish and Wildlife (WDFW) Issaquah Creek Hatchery, Bear Creek, and other tributaries downstream (WRIA 8 Steering Committee 2005). Augmentation of cool water via tributary input was identified as a potential alternative approach to designing and building structural measures to increase thermal refuge habitat availability in the Sammamish River during warm summer months. The study determined that thermal stratification of pools in the Sammamish River was generally found to be negligible upstream of North Creek. There was some stratification evident between North Creek and Horse Creek that may reflect a stronger groundwater influence than elsewhere in the river. However, the maximum difference between surface and bottom temperatures measured in this reach during the longitudinal profile survey was 0.25°C, which does not appear to be large enough to feasibly increase thermal refuge habitat availability to Chinook salmon during their migration to upstream spawning areas (R2 2010). Invasive weeds, notably Brazilian elodea (*Egeria densa*) have also been identified as threats to water quality in the Sammamish River (King County DNR 2013). Dense mats of submerged vegetation when combined with elevated water temperature could pose serious risks to upstream migrating Chinook salmon through decreased dissolved oxygen levels.

This study determined a low incidence of Chinook salmon pre-spawn mortality in the Sammamish River during the 2015 fall migration period. Weekly field surveys found only 16 female Chinook carcasses in the upstream reaches (upstream of 124th Street) of the Sammamish River, equating to approximately 0.33-0.37% of the total Chinook escapement to the Sammamish River during the 2015 season, the majority of which occurred in the areas of high Chinook density (i.e., Marymoor Park). Chinook salmon may be less able to deal with other

stressors when exposed to elevated stream water temperatures, however. Strange (2007) and Materna (2001) found that elevated water temperature often increases the infection rate or virulence of fish pathogens and decreases the ability to withstand disease. Mortality resulting from numerous stressors could be exhibited on the spawning grounds or in Lake Sammamish. The similarity of the escapement estimates (Sammamish River and spawning ground) likely indicate that this did not occur during the 2015 season; however the difference (n=475 Chinook) could be represented by delayed mortality occurring upstream from the mainstem Sammamish River. We did not observe water temperatures exceeding 22°C during this study. Water temperatures approaching those elevated levels have been observed to cause blockages or delays in upstream migration (Strange 2007; Alabaster 1988), likely attributing to the large number of Chinook salmon that were regularly observed in the last pool before reaching the transition zone. Strange (2007) found that slow movement and extended holding of fall Chinook migrants in the lower Klamath River appears to be part of their normal migration strategy and was not necessarily caused by complete physical blockages resulting from high water temperature or decreased discharge.

Puget Sound summer/fall Chinook salmon were listed as threatened in 1999 under the ESA (Federal Register 1999). In turn, federal, state, local, and tribal governments and citizens have engaged in salmon recovery planning to develop watershed specific recovery strategies for Chinook within Puget Sound and the Sammamish River. The goals of these efforts are to implement plans that will result in the recovery (de-listing) of Chinook salmon stocks within the 23 independent populations of Puget Sound (PSTRT 2003). Restoration projects in the form of large woody debris placement, culvert removal, and streamside vegetation plantings are often monitored utilizing post-project spawner surveys. Pre-spawn mortality could have an adverse effect on the conclusions drawn from effectiveness monitoring for Chinook salmon restoration projects. While the rate of pre-spawn mortality in the Sammamish River during the 2015 season did not appear to drastically impede Chinook salmon, the potential exists due to high concentrations of Chinook salmon in several reaches of the river.

5. REFERENCES

Alabaster, J.S. 1988. The dissolved oxygen requirements of upstream migrant Chinook salmon, *Oncorhynchus tshawytscha*, in the lower Willamette River, Oregon. Journal of Fish Biology 32:635-636.

Baldwin, J. Spromberg, J. Davis, S. Damm, and J. McIntyre. 2014. Symptoms of adult coho salmon pre-spawn mortality are not produced by exposures to artificial mixtures of metals and PAHs. Salish Sea Ecosystem Conference. Paper 118. Seattle, Washington.

Berge, H.B., and K. Higgins. 2003. The current status of kokanee in the greater Lake Washington Watershed. King County Department of Natural Resources and Parks, Water and Land Resources Division. Seattle, WA. 50 pp.

Berge, H.B., and B.V. Mavros. 2001. King County bull trout program: 2000 bull trout surveys. Prepared for King County Department of Natural Resources. Seattle, Washington. 42 p.

Connor, E., B. Kvam, and L. Mighetto. 2000. Historic and current status of kokanee in the Lake Washington Basin. Prepared by R2 Resource Consultants, Inc. for King County Department of Natural Resources. Seattle, WA.

Craig, S.D. 1997. Habitat conditions affecting bull trout, Salvelinus confluentus, spawning areas within the Yakima River Basin, Washington. Master's thesis. Central Washington University, Ellensburg, Washington. 74 p.

DeGasperi, C. 2005. Sammamish River Diel pH and Dissolved Oxygen Study. Department of Natural Resources and Parks Water and Land Resources Division. Seattle WA. March.

English, K.K., R.C. Bocking, and J.R. Irvine. 1992. A robust procedure for estimating salmon escapement. Canadian Journal of Fisheries and Aquatic Sciences 49:1982-1989.

Fresh, K.L., E. Warner, R, Tabor, and D. Houck. 1999. Migratory behavior of adult Chinook salmon spawning in the Lake Washington Watershed in 1998 as determined with ultrasonic telemetry. Unpublished draft progress report. October 1999.

Goetz, F. 1989. Biology of the bull trout (*Salvelinus confluentus*): literature review. Prepared for the Willamette National Forest, Eugene, Oregon. 53 p.

Groot, C., and L. Margolis. 1991. Pacific Salmon life histories. University of British Columbia Press. Vancouver, B.C. 564 pp.

HDR Engineering, Inc. (HDR). 2009. Lake Sammamish late run kokanee synthesis report. Prepared for the Lake Sammamish Kokanee Work Group. Seattle, WA. 38 p.

Jeanes, E.D., and P.J. Hilgert. 1999. Habitat survey, Sammamish River, King County, Washington. 1999 Data Report. Prepared for the U.S. Army Corps of Engineers, Seattle District by R2 Resource Consultants, Inc. December 1999. 75 p.

Johnston, J.M. 1982. Life histories of anadromous cutthroat trout with emphasis on migratory behavior. Pages 123-127 in E.L. Brannon and E.O. Salo, editors. Salmon and trout migratory behavior symposium. University of Washington School of Fisheries. Seattle,

King County Department of Natural Resources and Parks. 2013. Integrated aquatic vegetation management plan Sammamish River King County, Washington. Prepared by King County Department of Natural Resources and Parks Noxious weed control program. Seattle, Washington 224 pp.

King County Surface Water Management Division (King County SWMD). 1993. Sammamish River corridor conditions and enhancement opportunities. December 1993. 83 p.

Martz, M., M. Valentine, and C. Fitzgerald. 1999. Sammamish River temperature study, 1998, results from temperature modeling and literature review of temperature effects on fish. U.S. Army Corps of Engineers, Seattle District. Seattle, Washington. ~25 p + Appendices.

Materna, E. 2001. Issue Paper 4 temperature interaction. Prepared as part of U.S. EPA Region 10 temperature water quality criteria guidance development project. EPA-910-D-01-004.

Mavros, B., S. Foley, K. Burton, and K. Walter. 2000. 1999 chinook spawner survey data technical report for the Lake Washington watershed. Prepared for King County Department of Natural Resources. Seattle, Washington. 30 p.

McCarthy, S. 2007. Impacts of stormwater runoff on coho salmon in restored urban streams. Online Presentation http://your.kingcounty.gov/dnrp/library/water-and-land/science/seminars/October-2007/pre-spawn-mortality-of-coho-salmon-in-restored-urban-streams.pdf.

McCullough, D.A., S. Spalding, D. Sturdevant, and M. Hicks. 2001. Issue Paper 5: Summary of technical literature examining the physiological effects of temperature. Prepared for Region 10 temperature water quality criteria guidance development project. Seattle, WA.

Ostergaard, E., C. Young, and K. Ludwa. 1995. Abundance of spawning kokanee in the Sammamish River basin: 1994 status report. Prepared for King County Surface Water Management Division. Seattle, Washington. 40 p + Appendices.

Pflug, D.E., and G.B. Pauley. 1981. Biology of smallmouth bass (*Micropterus dolomieui*) in Lake Washington. Northwest Science 58(2):118-130.

Puget Sound Technical Review Team (PSTRT). 2003. Final draft: Independent populations of Chinook salmon in Puget Sound. December 8, 2003 Report to NOAA Fisheries, Seattle, Washington. 61 pp.

R2 Resource Consultants (R2). 2010. Assessment of summer temperatures and feasibility and design of improved adult Chinook salmon thermal refuge habitat in the Sammamish River. Prepared for the Muckleshoot Indian Tribe. Auburn, Washington. 106 pp+Appendices.

Scholz, N.L., M.S. Myers, S.G. McCarthy, J.S Labenia, J.K. McIntyre, G.M. Ylitalo, L.D. Rhodes, C.A. Laetz, C.M. Stehr, B.L. French, B. McMillan, D. Wilson, L. Reed, K.D. Lynch, S. Damm, J.W. Davis, and T.K. Collier. 2011. Recurrent die-offs of adult coho salmon returning to spawn in Puget Sound lowland urban streams. Plos One 6(12) e28013.

Schuett-Hames, D., A. Pleus, L. Bullchild, and S. Hall. 1994. Timber-Fish-Wildlife ambient monitoring program manual. Northwest Indian Fisheries Commission TFW-AM9-94-001. ~200 p.

Spromberg, J.A., D.H. Baldwin, S.E. Damm, J.K. McInture, M. Huff, C.A. Sloan, B,F, Anulacion, J.W. Davis, and N.L. Scholz. 2015. Coho salmon spawner mortality in western U.S. urban watersheds: bioinfiltration prevents lethal storm water impacts. Journal of Applied Ecology doi 10.1111/1365-2664.12534.

Strange, J. 2007. Adult Chinook salmon migration in the Klamath River Basin: 2005 sonic telemetry study final report. Prepared by Yurok Tribal Fisheries Program and University of Washington School of Aquatic and Fishery Sciences in collaboration with Hoopa Valley Tribal Fisheries. Seattle, WA. 96 pp.

Tabor, R. 2002. Sammamish River dead Chinook counts, unpublished data. Facsimile memo from to Brian Footen, Muckleshoot Indian Tribe Fisheries Division from U.S. Fish and Wildlife Service June 28, 2002.

United Sates Federal Register (Federal Register). 1999. Endangered and threatened species; threatened status for three Chinook salmon evolutionarily significant units (ESUs) in Washington and Oregon, and endangered status for one Chinook salmon ESU in Washington. Federal Register 64(56):14308-14328.

Warner, E., K. Fresh, H. Coccoli, T. Cropp, S. Foley, P. Hage, K. Hopper, M. Mahovlich, R. Malcom, J. Rector, K. Walter, and J. Zischke. 1999. Lake Washington chinook salmon (*Oncorhynchus tshawytscha*) recovery plan. Draft report Prepared by the Muckleshoot

Indian Tribe Fisheries Department, Washington Department of Fish and Wildlife, and Squamish Indian Tribe Fisheries Department. 25 March 1999. Auburn, Washington. 135 p + Appendices.

Washington Department of Fish and Wildlife (WDFW). 1998. Washington State salmonid stock inventory. Appendix: bull trout and Dolly Varden. Olympia, Washington. 435 p.

Washington Department of Fish and Wildlife (WDFW) and Western Washington Treaty Indian Tribes. 1994. 1992 Washington State salmon and steelhead stock inventory, Appendix 1: Puget Sound stocks. Olympia, Washington. 371 p.

Water Resource Inventory Area (WRIA) 8 Steering Committee. 2005. Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan.

Weitkamp, D.E., G.T. Ruggerone, L. Sacha, J. Howell, and B. Bachen. 2000. Factors affecting chinook populations: Background report. Prepared for City of Seattle. Seattle, Washington. 224 p.

Williams, R.W., R.M. Laramie, and J.J. Ames. 1975. A catalog of Washington streams and salmon utilization: Volume 1, Puget Sound Region. Prepared by Washington Department of Fisheries. November 1975. ~750 p.

Wydoski, R.S., and R.R. Whitney. 1979. Inland fishes of Washington. University of Washington Press. Seattle, Washington.

Young, S.F., M.R. Downen, and J.B. Shaklee. 2004. Microsatellite DNA data indicate distinct native populations of kokanee, *Oncorhynchus nerka*, persist in the Lake Sammamish Basin, Washington. Environmental Biology of Fishes 69:63-79.

Appendix A

Study Plan

Salmonid Pre-Spawn Mortality Study

Sammamish River

King County, Washington

2015 Final Study Plan

Contract: C57105/1112022/E00202-3

Prepared for:

King County

Dept. of Natural Resources and Parks

Seattle, Washington

Prepared by:

R2 Resource Consultants

15250 NE 95th St.

Redmond, Washington 98052

Eric Jeanes

Catherine Morello

8 September 2015

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1. INTRODUCTION

The Sammamish River begins at the outlet of Lake Sammamish (the sixth largest lake in the State of Washington), approximately one mile southeast of the City of Redmond. The river travels for approximately 8.5 miles north, passing through Woodinville, where it turns west for approximately 4.5 miles and enters Lake Washington near Kenmore. The entire Sammamish River drainage basin encompasses approximately 170 square miles, including mainstem tributaries Big Bear/Cottage Creek, Little Bear, North, and Swamp creeks that originate in both King and Snohomish counties (Ostergaard et al. 1995; King County Online Data). The waters and areas adjacent to the Sammamish River create numerous recreational opportunities and provide for the support of several anadromous fish runs in the Lake Washington watershed. The watershed contains a mix of urban, park, agricultural, and forested areas.

The Sammamish River watershed has experienced considerable development pressures in the last thirty years. The Sammamish River has been straightened to convey a 40-year springtime flood event; the riparian vegetation has been removed or altered over most of its course; large woody debris has been removed from within the channel (Warner et al. 1999). Elevated water temperatures in the river during the July-September period have been identified as a significant factor limiting production of Chinook salmon (*Oncorhynchus tshawytscha*) and other anadromous salmonid species during their spawning migration to Issaquah Creek, the Washington Department of Fish and Wildlife (WDFW) Issaquah Creek Hatchery, Bear Creek, and other tributaries downstream (WRIA 8 Steering Committee 2005). Daily maximum temperatures frequently exceed 20°C near the Lake Sammamish outlet during this period and have exceeded 26.6°C (King County data).

Despite the water quality conditions present in the mainstem Sammamish River, both resident and anadromous salmonids inhabit the river basin throughout the year. Of particular interest to local agencies is the presence of fall/summer Chinook salmon runs that are listed as threatened under the Endangered Species Act. R2 Resource Consultants, Inc. (R2) has been contracted by King County to perform pre-spawn salmonid mortality surveys in the Sammamish River. This study is intended to collect information concerning the survival and spawning success of salmonids, including Chinook, in the Sammamish River system. Project objectives are to:

1. Document pre-spawn mortality for the 2015 Issaquah Fall Chinook salmon run in the upstream half of the Sammamish River.
2. Analyze and report on the quantity and characteristics of fish measured in the study.

2. METHODS

2.1 Location and Timing

From early September through October 2015, R2 will float the Sammamish River three times per week by kayak or canoe, with float days at least one day apart (ideally Monday, Wednesday and Friday). The float route starts at the Sammamish River weir in Marymoor Park and ends at 145th Ave NE, just past the JB Turf farm; a distance of approximately six miles (Figure 1).

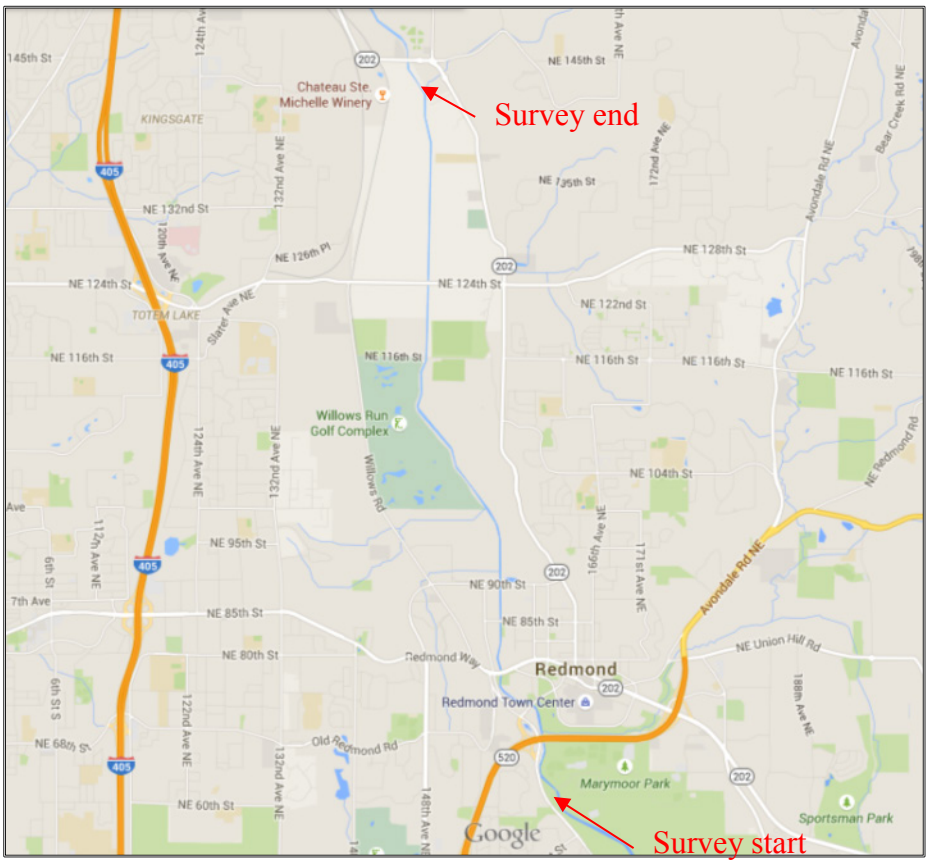

Figure 1. Study site on the Sammamish River between River Mile 7.5 and 13.5. Map produced with Google maps.

2.2 Survey Methodology

Two surveyors will paddle together downstream looking for salmon carcasses in pools, in the weeds and/or on any bars in the river. Polarized sun glasses will assist in viewing into the water. An identifying number will be assigned to each carcass that is found and the following data will be recorded for: latitude/longitude, species, fork length, sex, fin clips (adipose/ventral) and the presence of any external tags. It will be noted whether the secondary sexual characteristics are

fully developed (brown vs. silver skin color or well-developed kype in males) as well as the freshness of the carcass (gill color, eye clarity, and flesh firmness). Any evidence of disease (eroded gills, lesions, fungus) will also be mentioned on the data sheets, including details that may preclude collecting data (predation and/or decomposition). The belly of female Chinook carcasses will be cut open and the estimated percent egg retention (using categories 0- 25%, 25-50%, 50-75%, 75-100%) recorded.

At a minimum, six scales will be collected from just above the lateral line posterior to the dorsal fin and inserted in a paper envelope/baggie labeled with the sample number and date of collection. Photographs will be taken of a subsample of female carcasses (showing the belly cavity and gills if possible) and noting the carcass number. The sampled fish will be marked in such a way (cut belly or tail) that the fish will not be resampled during subsequent surveys as if the carcass was new. If any research tags are found (disc or other type), they will be collected and reported to Eric Warner (253) 876-3125. At the end of the study, the scale samples, photos, and notes will be delivered to the County or Aaron Bosworth at Washington Department of Fish and Wildlife.

3. PROJECT MANAGEMENT AND DELIVERABLES

All data will be entered electronically using MS Excel and cross-referenced with original field data forms for QA/QC purposes. All data analyses shall be conducted using MS Excel and/or Jandel SigmaStat. The management deliverables shall include a final study design plan (this document), data collection sheet, and field staff schedule. The field study deliverables include scanned data sheets. The final deliverable is to include electronic copies of the data, shapefiles of GPS points, a draft and final study reports. The final report will discuss pre-spawn mortality in the context of current climate conditions using flow and temperature data from USGS and King County river gauges. If available water quality data collected for the 2015 Washington Department of Ecology TMDL study will also be included in the discussion. Deliverable(s) will be due as follows:

Deliverable	Date to be Completed
Study Plan and schedules	8 September 2015
Begin Biological Surveys	9 September 2015
End Biological Surveys	Late October 2015
Draft Project Report	November 15 2015
Final Project Report	December 15 2015

4. EMERGENCY PLAN

All activities for this project will occur in the Sammamish River. Emergency telephone numbers and locations of the closest hospitals are provided in the table below (Table 1). Work on this Project can result in exposure to physical and biological hazards. This section describes the most probable hazards that may be encountered while conducting the field activities.

Table 1. Location and description of medical facilities in Redmond, Washington.

Facility Name	Service Type	Phone Number	Location
Overlake Medical Clinic	Urgent Care	425-635-6430	16315 NE 74th Street Redmond Town Center
Evergreen Health Primary and Urgent Care	Urgent Care	425-883-3333	8980 161st Avenue NE Redmond
Evergreen Health Medical Center	Full Hospital	425-899-1000	12040 NE 128th Street Kirkland

4.1 Heat Stress

Working outside during the summer may result in dehydration, sunburn, heat exhaustion, and heat stroke. Loose, lightweight, light-colored clothing, wearing a broad-rim hat, and applying sunscreen will improve comfort levels and reduce exposure during hot conditions. Frequent breaks and adequate daily hydration of at least two liters of water per day during moderately warm conditions and 3+ liters of water per day during hot conditions (>90°F) is recommended. Supplementing water consumption with foods high in electrolytes (e.g., potassium and sodium) and consuming electrolyte replacements such as Gatorade® or Powerade® will help sustain energy levels and improve recovery during extended field campaigns. The most dangerous effects of the heat are heat exhaustion and heat stroke. The signs of heat exhaustion include pale, clammy skin, profuse perspiration, cramps in the limbs and abdominal muscles, and extreme tiredness or weakness. A person suffering from heat exhaustion should be allowed to rest and should be given liquids. Heat stroke is a life-threatening condition. The signs of heat stroke are red or flushed skin, hot, dry skin, high body temperature, dizziness, nausea, headache, rapid pulse, and unconsciousness. A person suffering from heat stroke should be cooled quickly, and medical attention must be obtained as soon as possible. Be aware of the signs of heat exhaustion and heat stroke for yourself and fellow crew members, especially when working in direct sunlight for extended periods of time.

4.2 In-Water Work

Some tasks may involve work in relatively deep and weedy water. Traversing rivers may, at times, impose risk and crossing should only be attempted when flow conditions are relatively low and safe for passage. Rivers should not be crossed if depths are too deep or vegetation too thick to allow for safe crossings. The personal protective equipment recommended for use in conducting work in and around water includes water tight waders, wader belts, and individual flotation devices.

4.3 Water Quality

The Sammamish River is TMDL listed for fecal coliform and dead salmon carcasses contain bacteria toxic to humans. All field staff should use extreme caution when handling fish and around the water and use proper decontamination procedures after sampling, particularly before eating. Handwashing water and disinfecting hand gel are highly recommended during this study.

4.4 Safe Work Practices

The following work practices will be followed at all times:

- Visual or hearing contact must be maintained between team members at all times. When field crew members are out of visual contact, a system of periodic checking on others will be used.
- The buddy system will be used implicitly.
- A first aid kit will be carried by each field crew.
- All first aid treatment will be administered by trained personnel.
- First aid kits must be replenished, repaired, or replaced if required prior to each outing to ensure an adequate supply.
- All safety equipment must be inspected prior to each trip to ensure that the appropriate supplies are taken and they are in working order.

5. REFERENCES

Ostergaard, E., C. Young, and K. Ludwa. 1995. Abundance of spawning kokanee in the Sammamish River basin: 1994 status report. Prepared for King County Surface Water Management Division. Seattle, Washington. 40 p + Appendices.

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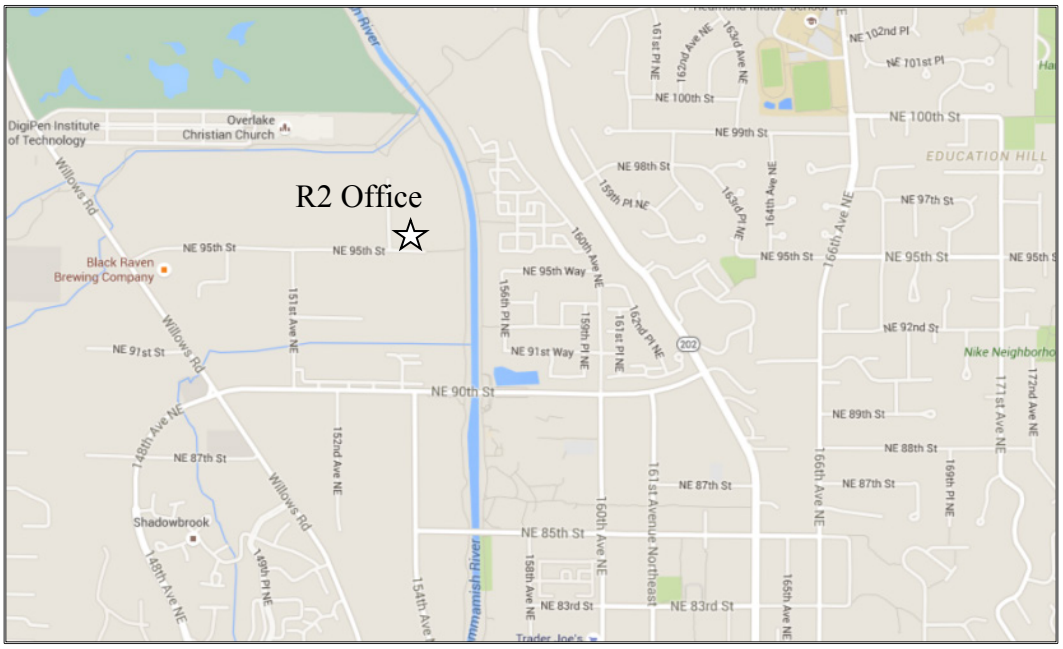
WRIA 8 Steering Committee. 2005. Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon conservation Plan.

Pre-Spawn Study Plan Appendix A

Field Assistant Instructions

All field assistant volunteers will be coordinated by R2 Resource Consultant Biologist Catherine Morello. All questions should be directed to her at: (425) 556-1288 office, (425) 233-0247 cell or cmorello@r2usa.com.

Meeting Location: Field assistants are requested to meet R2 staff at the R2 office at 15250 NE 95th St. Redmond, WA. Meeting time is 8 am, unless other arrangements have been made. Survey length is six miles, and is anticipated to take the greater part of the day depending on the number of fish observed.



Shuttle Vehicle: It will be expected that you will provide a vehicle that can be left at the take out or put in for shuttle purposes. Total equipment that will need to be transported will include two inflatable kayaks (that roll up), paddles, life jackets and other assorted gear. This gear will fit in most cars. If you do not have a vehicle available, please let R2 staff know in advance so that other arrangements can be made.

Personal Requirements: Pre spawn mortality field sampling requires kayaking the Sammamish River in potentially hot or later in the year, rainy field conditions. Field staff should dress for the weather and bring plenty of water, hats, and sunscreen. Chest waders and polarized sunglasses are recommended. Field staff should wear a life jacket (one can be provided) at all times. All field staff will potentially be handling and sampling dead fish. Gloves and disinfecting hand gel will be provided during the study. No previous kayaking experience is necessary, however, this is a full day (six miles) of moderate exercise paddling and participants should be healthy and reasonably fit and have reviewed the safety plan outlined in section 3.0 in this report.

Pre-Spawn Study Plan Appendix B

Field Crew Schedule

Please contact Catherine Morello or Eric Jeanes at R2 Resource Consultants as soon as possible with any schedule changes (425-681-4204 (c)/425-556-1288 (o)/ejeanes@r2usa.com).

September		
9	Wednesday	
11	Friday	R2
14	Monday	R2
16	Wednesday	R2
18	Friday	Aaron Bosworth (WDFW)
21	Monday	R2
23	Wednesday	Aaron Bosworth (WDFW)
25	Friday	Bethany Craig (WDFW)
28	Monday	WDFW
30	Wednesday	Heather Khan (WDOE)
October		
2	Friday	
5	Monday	Bethany Craig (WDFW)
7	Wednesday	Aaron Bosworth (WDFW)
9	Friday	Chris Gregersen (KingCo)
12	Monday	Chris Martin (WDOE)
14	Wednesday	Ben Billick (WDOE)
16	Friday	Chris Gregersen (KingCo)
19	Monday	Bethany Craig (WDFW)
21	Wednesday	Joan Nolan (WDOE)
23	Friday	Chris Gregersen (KingCo)
26	Monday	Bethany Craig (WDFW)
28	Wednesday	Andrew Funk (WDOE)
30	Friday	Chris Gregersen (KingCo)

Pre-Spawn Study Plan Appendix C

Contact Information

R2 Resource Consultants
15250 NE 95th St.
Redmond, WA 98052
Office – 425 556-1288

Catherine Morello
Cell – 425 233-0247
cmorello@r2usa.com

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Cell – 425 681-4204
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King County
Kate Akyuz –Project Manager
Office – 206 477-4607
kate.akyuz@kingcounty.gov

Washington Department of Fish and Wildlife
Aaron Bosworth – District Biologist
Office – 425-775-1311 ex 102
Aaron.Bosworth@dfw.wa.gov

Washington Department of Ecology
Ralph Svrjcek
Office – 425-649-7165
RSVR461@ECY.WA.GOV

Pre-Spawn Study Plan Appendix D

Data Sheets

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: GPS Unit #:

Crew: Start Location:

Camera #: End Location:

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N

Species	Live Adult Tally	Comments
Chinook		
Coho		
Pink		
Sockeye		
Unknown		

add complete carcass description on reverse side

Data Entry: QA / QC:

1- Describe development of secondary sexual characteristics i.e., brown or silver skin, kype development, etc…
2- Note freshness of carcass i.e., gill color, eye clarity, flesh firmness, disease, etc…

Carcass ID SM-###	1 - Reproductive Development	2 - Carcass Condition

Appendix B

Chinook Pre-Spawn Photographs

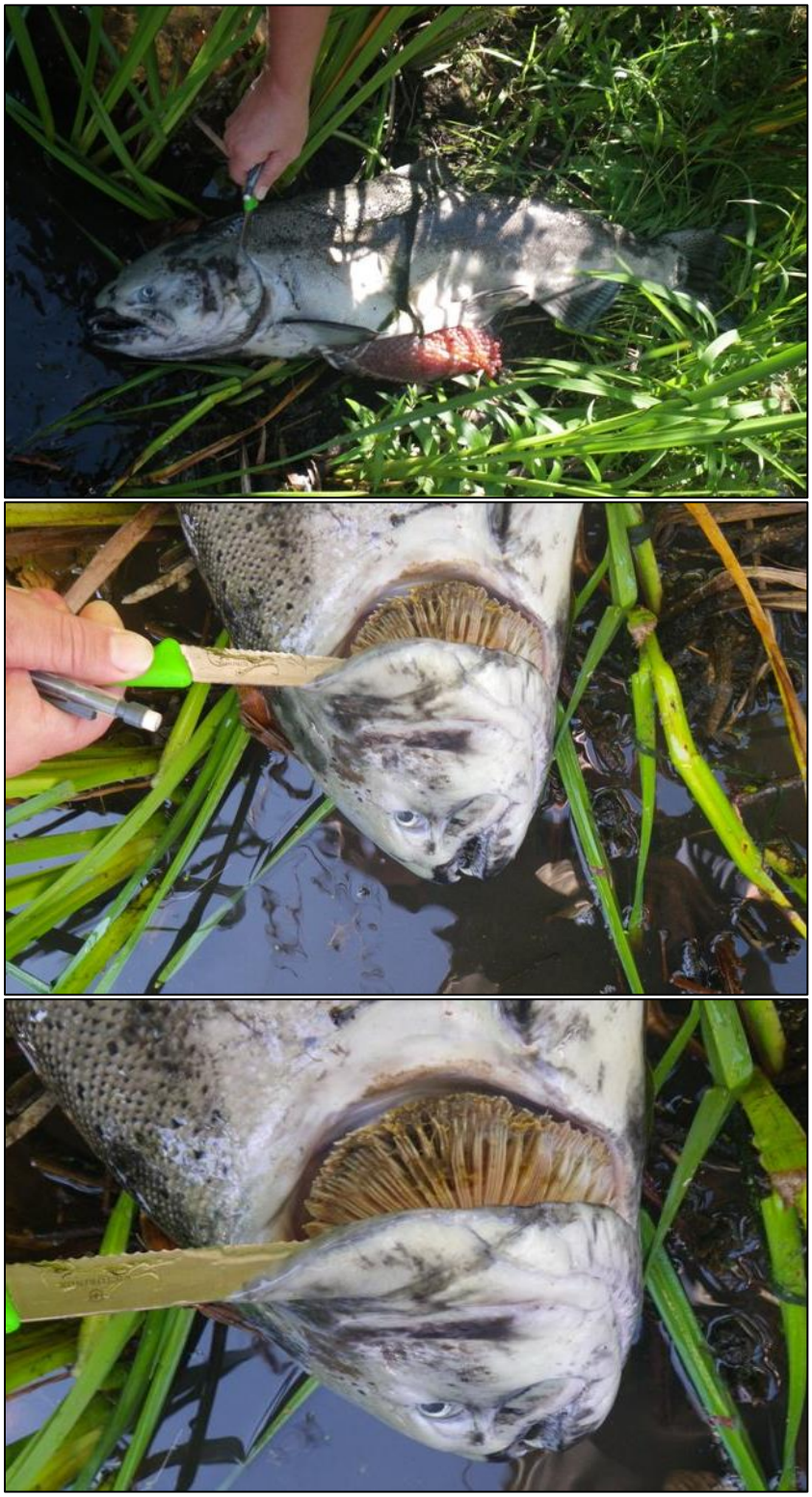

Figure B 1-3. Sammamish River Chinook salmon ID No. SM-1, King County, Washington, 2015.

Figure B 4-6. Sammamish River Chinook salmon ID No. SM-2, King County, Washington, 2015.

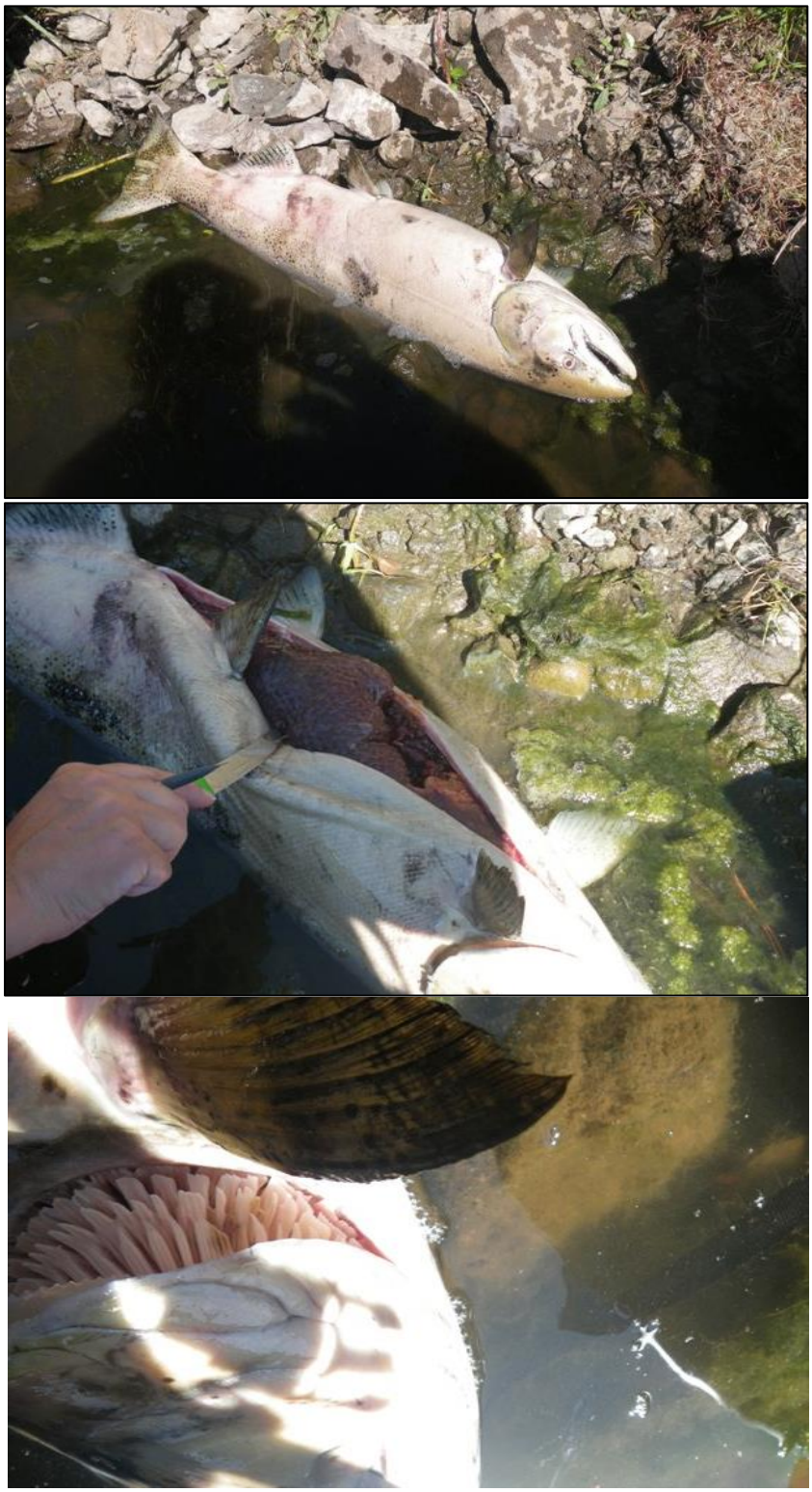

Figure B 7-9. Sammamish River Chinook salmon ID No. SM-3, King County, Washington, 2015.

Figure B 10-12. Sammamish River Chinook salmon ID No. SM-4, King County, Washington, 2015.

Figure B 13-15. Sammamish River Chinook salmon ID No. SM-5, King County, Washington, 2015.

Figure B 16-18. Sammamish River Chinook salmon ID No. SM-6, King County, Washington, 2015.

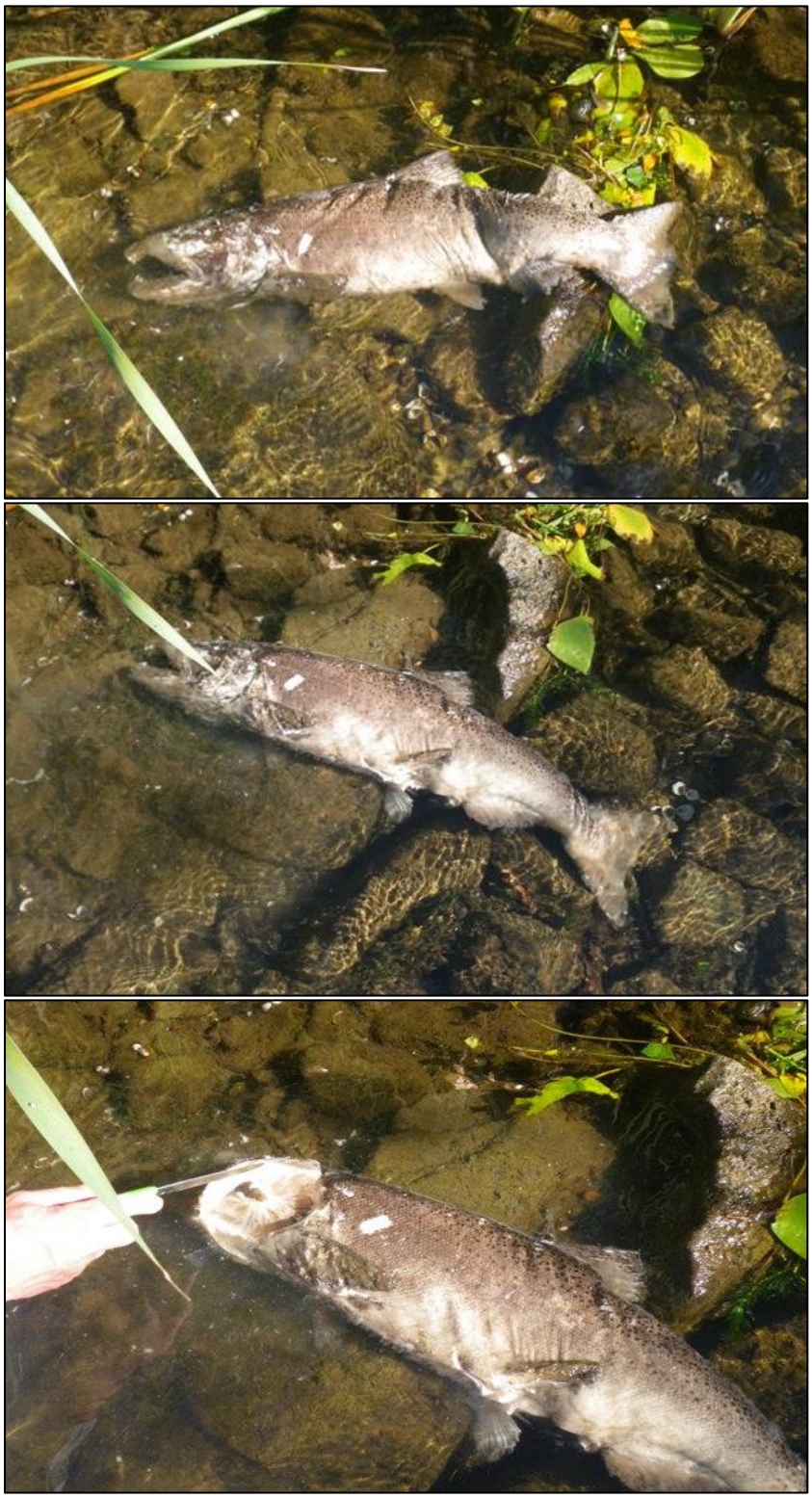

Figure B 19-21. Sammamish River Chinook salmon ID No. SM-7, King County, Washington, 2015.

Figure B 22-24. Sammamish River Chinook salmon ID No. SM-8, King County, Washington, 2015.

Figure B 25-27. Sammamish River Chinook salmon ID No. SM-9, King County, Washington, 2015.

Figure B 28-30. Sammamish River Chinook salmon ID No. SM-10, King County, Washington, 2015.

Figure B 31-33. Sammamish River Chinook salmon ID No. SM-11, King County, Washington, 2015.

Figure B 34-36. Sammamish River Chinook salmon ID No. SM-12, King County, Washington, 2015.

Figure B 37-39. Sammamish River Chinook salmon ID No. SM-13, King County, Washington, 2015.

Figure B 40-42. Sammamish River coho salmon ID No. SM-14, King County, Washington, 2015.

Figure B 43-45. Sammamish River Chinook salmon ID No. SM-15, King County, Washington, 2015.

Figure B 46-48. Sammamish River Chinook salmon ID No. SM-16, King County, Washington, 2015.

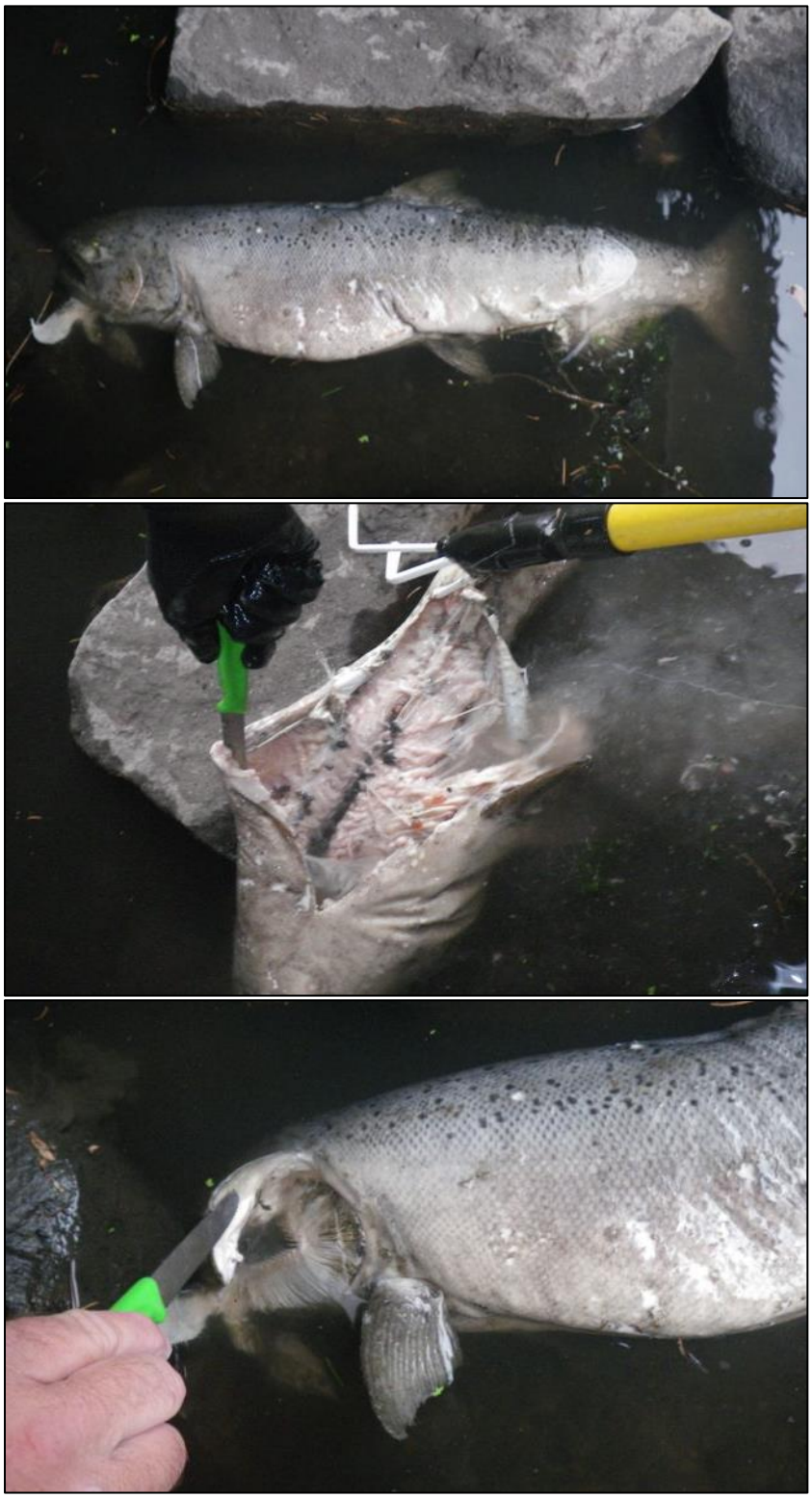

Figure B 49-51. Sammamish River Chinook salmon ID No. SM-17, King County, Washington, 2015.

Figure B 52-54. Sammamish River Chinook salmon ID No. SM-18, King County, Washington, 2015.

Appendix C

Field Study Data Sheets

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 3/18/15
Crew: AW, CM
Camera #: PSOUND #1

GPS Unit #: YELLOW
Start Location: WEIR
End Location: 145TH

→ TEMP: 22°C
0800 HRS @ WOODINVILLE
NO84S STATE

21-22°C INCOMING RIVER

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
			NO	CARCASSES		OBSERVED			

Species	Live Adult Tally	Comments
Chinook	||	HOLDING @ WP 355, GOOD CONDITION
Coho		
Pink		
Sockeye	\	
Unknown		

BEAVER DAM BELOW WEIR

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 9/9/15
Crew: CM, EDJ
Camera #: CM #2

GPS Unit #: BROWN - NEW
Start Location: WEIR
End Location: 145TH

18-19°C THROUGHOUT

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
	NO	CHINOOK	CARC	ASSES	OBSERVED				
			~SOME	REMAINS	@ TAKEOUT				

Species	Live Adult Tally	Comments
Chinook	20+, 1 (RATTLED BEDMOND WAY), 2 (FAMILIAR BEHAVIOR)	WP 784 30 SALMON MOSTLY CHK PRODING
Coho		34 L. BANK BLACKBERRYS - END OF [illegible]
Pink		
Sockeye	~~1~~, 1 2, 1 (UNFLOWER)	JUST ABOVE REDMOND WAY
Unknown	3, 2	UNDER 520 BRIDGE

add complete carcass description on reverse side

UNKNOWN WP 785 CARCASS PHOTO 1979-80

Data Entry:

QA / QC:

4/5 = SPAWNING

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 9/4/15
Crew: EDJ, CM
Camera #: EDJ

GPS Unit #: YELLOW
Start Location: WEIR
End Location:

CAMERA - EDJ @ WEIR PHOTO 12+
TEMP - 20°

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N	CONDITION TALLY 1-OLA
SM-001	CHINOOK	F	83	372	AD CLIP	14-16	NONE	100%	Y	3
SM-002	CHINOOK	F	77	373	AD CLIP	18-20	NONE	100%	Y	2
SM-003	CHINOOK	F	91	374	AD CLIP	21-23	NONE	100	Y	3
SM-004	CHINOOK	F	84	375	AD CLIP	24-26	NONE	100%	Y	4

1ST BROOD 520 TALLY

Species	Live Adult Tally	Comments
Chinook	9 DEAD, 2, 4, 10, 2, 5, 3, 6, 12, 5, 10, 2, 1 11	
Coho		
Pink	1	
Sockeye	20, 6, 30, 4, 6, 2, 2, 12, 15, 15, 1, 3	1 DEAD, 1 DEAD @ 124TH
Unknown		

900 907

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 9/14/15 GPS Unit #: yellow Etrex 18°C @ 10:37 am Ds of Bear Cr.

Crew: E Jeanes, T. Sullivan Start Location: Marymoor weir 17.5°C @ 12:50 pm Ds of R2

Camera #: E DJ camera End Location:

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N	Class 1-5
SM-005	Chinook	F	89	376	Adipose	27,28,29	None	100%	Y	4
SM-006	Chinook	F	83	377	None	30,31,32	None	100%	Y	4

Species	Just Below weir	WP 355 (same as previous day)	520 Bridge	DS of Bear Cr	DS of Leary way	By Exp to R2 377	DS of R2	Comments
	Live Adult Tally							
Chinook	(	~~IIII~~ +15	32 ~~11+30~~		5+1+8	4+9+2+1+2+2	2	
Coho								
Pink								
Sockeye				25+4	X3	2	1	Same sockeye carcass as Friday
Unknown	(							

add complete carcass description on reverse side

Data Entry: QA / QC:

Sock ~~[illegible]~~ ~~[illegible]~~ Sockeye ~~[illegible]~~ ~~[illegible]~~ ~~[illegible]~~ ~~[illegible]~~

1 = POST
3-4 = WHAT WE HAD OP FRI.
5 = FRESH

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 9/16/15
Crew: EDJ/AB
Camera #: EDJ / Yellow GPS

GPS Unit #:
Start Location: WEIR → WINERY
End Location:

1–5

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N	
SM #7	Chin	M	75	47.659831 122.11790	AD	42,43,44	NO	Male	Y	1
SM #8	Chin	F	78	382	Unclipped	45,46,47	NO	Female 100%	Y	1
#9	CHIN	F	72	47.663338 122.12619	AD	48,49,50	NA	Female 100%	Y	1
#10	Chin.	F	71	47.666608 122.12588	AD	51,52,53	NA	Female 100%	Y	3
#11	Chin.	F	83	47.668416 122.120167	AD	54,55,56	NA	Female 100%	Y	4

19°C Downstream of Bear C. confl. @ 12:00

Species	Live Adult Tally	Socks 10,46,48 Comments
Chinook	75 live in Hole downstream from beaver dam	
Coho	1 live Chin + 10 live sockeye @ 520 apartments	
Pink	66 live Chin + 46 live Sockeye @ Bedrock hole	
Sockeye	69 live Chin + 48 live sockeye @ R-2 Bridge	
Unknown	10 live Chin + 0 live Sockeye @ 124th	

1 live chinook + 0 sock D/s → take out

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.

2015 Sammamish River Pre-Spawn Mortality Study

Date: 9/18/15

Crew: CM, TS

Camera #: EDS

GPS Unit #: YELLOW

Start Location: WEIR

End Location: 145 TM

1 - FRESH
5 - FRESH
16°C @ BEAR CREEK
16°C @ 90TM
17°C @ TAKE OUT

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N	CLASS 1 - 5
SM-12	CHINOOK	F	95	385	AD CLIP	59-62	NONE	100%	Y	1

Species	@ WEIR	DOWNSTREAM	D.S. 384	520	U.S. 385	90 TM		Comments
	Live Adult Tally							
Chinook	20	25	102	58	45	9	~~IIII~~ ~~IIII~~ I	
Coho								
Pink								
Sockeye			1				1	1 MORT
Unknown								

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 9/21/15 GPS Unit #: YELLOW

Crew: CM, AB Start Location: VER

Camera #: EDJ End Location: 145M

18°C @ VER
17°C @ 90M

1-DOST
5-FLESH

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N	CLASS 1-5
SM-013	CHINOOK	F	101	388	NONE	64-67	NONE	100%	Y	4
SM-014	COHO	M	54	389	AD CLIP	68-70	NONE	—	Y	3
SM-015	CHINOOK	F	92	390	AD CLIP	71-73	NONE	100%	Y	2

Species	1ST FISH @ CORNER POOL	@ BEAR CREEK → REDMOND LAKE	90TH BRIDGE	@391	124M SE
				Live Adult Tally	
Chinook	12	79	Ø	1	
Coho				+8	
Pink					
Sockeye		38		1	
Unknown					

Species	Comments
Chinook	
Coho	PACK OF LITTLE FISH BY 116TH BRIDGE
Pink	
Sockeye	
Unknown	

add complete carcass description on reverse side

Data Entry: QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 23 Sept 15
Crew: EDJ / BC
Camera #: EDJ

GPS Unit #: YELLOW
Start Location: WEIR
End Location: WINERIES

15.5°C @ takeout 1-OLD 5-FRESH

WATER TEMP = 17°C D/S Bear Cr. @ 1100 HRS

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
SM-16									
			NO	CHINOOK					
				CARCASSES					

CLASS 1-5

Species	Live Adult Tally	Comments
Chinook	25 ⇒ Hole D/S Beaver Dam | ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ |	
~~Coho~~ Chinook	D/S Peters Creek ⇒ | ~~IIII~~ III | 124th ave II | take out	
Pink		
Sockeye	~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ III	1 dead sock @ Bear Creek mouth
Unknown		2 dead @ Redmond way bridge 1 dead @ Gotbridge in near Peters Creek 1 dead @ RB trib through the Hollywood Hills

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 25 Sept 2015
Crew: EDJ/WDFW
Camera #: EDJ

GPS Unit #: Yellow
Start Location: Weir
End Location: Wineries 148th

Water temp D/s Bear Cr = 17.0°C
Water temp @ out = 16.5°C

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N	Class 1-5
SM #16										

NO CHINOOK CARCASSES OBSERVED

Species	Live Adult Tally	Comments
Chinook	69 (HOLE D/S Beaver Dam; Bear Cr; New Bridge; Footbridge; 124th St Bridge; Takeout)	
Coho		
Pink	(Bear Cr; RR bridge)	
Sockeye	44	1 dead sockeye @ Park bridge
~~Unknown~~ Sockeye	4	1 dead sock @ 520 apts.
		1 dead sock u/s footbridge

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 28 Sept 15
Crew: EDJ/WDJE
Camera #: EDJ

GPS Unit #: Yellow
Start Location: WETR
End Location: WINERIES

16°C @ Bear Creek mouth
16°C @ takeout

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N	Class 1-5
SM#16	CHIN	F	78	393	AD	79-81	DNA	100	Y	3

Species	Live Adult Tally	Comments
Chinook	75 (Hole DIS Dam; 85th Street; Redmond Down; R2; 124th Bridge)	
Coho		
Pink	(Marymoor Bridge; Hole DIS Bear Cr; R2; Grasslawn Bridge; Redmond Bridge)	
Sockeye	15 ||+37 |+1+25+5 | 8+3+8+4+1 | 6 | 11 | IIII (85th St; Redmond Down; 124th Bridge)	
Unknown		

1 dead CTK mouth Bear Creek

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 30 Sept 2015
Crew: EDJ/CM
Camera #: EDJ

GPS Unit #: Yellow
Start Location: WEIR
End Location: WINERIES

Water Temp D/S Bear Cr = 15.0°C
Water Temp = 16°C @ Winery

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N	Class 1-5
			CHINOOK							
			NO	CARCASS						

pool d/s beaver dam; City offices 85th St; 90th Bridge; valley bridge; 124th St Bridge

Species	Live Adult Tally										Comments
Chinook	71 |||		4+2		20+5	3+3+2		2+1+1	1+2+	+2+2	2+2+
Coho											
Pink											
Sockeye	4+		20	+2	4+12+	17+		2+	4+2		
Unknown					2+30	10+2+5					6+10+2

marymoor bridge; 520 bridge; Bear Cr; 520 Apts; Redmond Way; RR Bridge; R2 Foot Bridge

add complete carcass description on reverse side

1 dead sock d/s 124th bridge

Data Entry:
11 dead sockeye D/S R2 Foot Bridge

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 2 OCT 2015 | GPS Unit #: Yellow | water temp d/s Bear Cr = 15°C

Crew: EDJ/WDFW | Start Location: WETR | water temp takeout = 15°C

Camera #: EDJ | End Location: WINERIES

1=OLD
5=FRESH

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N	Class 1-5
			NO	CHINOOK						
				CARCASSES						

Species	Pool d/s Bear Dam	Marymoor Park bridge		520 Bridge	520 Apts	Live Adult Tally	R2 BRIDGE	R2 Bridge	R2 FOOT BRIDGE		Valley Bridge	124th BRIDGE	Comments
Chinook	56			1		~~IIII~~ III	~~IIII~~ ~~IIII~~	~~IIII~~ ~~IIII~~	~~IIII~~ I		IIII	II	
Coho							~~IIII~~ ~~IIII~~	II					
Pink													
Sockeye	2	10		5+6		10+12+3+5+	5+10+3+2	5+	4				
Unknown						7+1+20+15	+10						

add complete carcass description on reverse side

Data Entry: Bear Dam

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 5 OCT 2015

Crew: EDS/WDFW CASEY

Camera #: Yellow / EDS

water temp @ d/s Bear Cr = 15°C

water temp @ take out = 16°C

GPS Unit #: Yellow

Start Location: Weir

End Location: Wineries

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
				NO	CHINOOK				
					CARCASSES				

marymoor foot bridge ↓ | 520 bridge ↓ | downtown bridge ↓ | City Redmond bridge ↓ | R2 foot bridge ↓ | valley bridge ↓ | 124th St Bridge ↓

Species													
	Live Adult Tally									Comments			
Chinook	65	~~IIII~~ + 12+	2			1		IIII	III	2+	1+3+	2+1+3+	2+1+2+1
Coho		2									2+		
Pink													
Sockeye		45			35 +	7+3	10+4	24+6+2	4+7				6+
Unknown						25+4+21							

↑ pool d/s beaver dam | marymoor bridge | 520 APts | RR Bridge | 90th bridge (R2) | 1 dead sockeye

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 7 OCT 2015 WATER TEMP = 16°C @ DIS BEAR CR GPS Unit #: Yellow

Crew: EDJ/CG water temp = 16.0°C @ take out Start Location: WEIR

Camera #: EDJ End Location: WINERIES

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
SM17	CHIN	F	825	@399	Ad Clip	82-83, 84	NO	100%	Y under City Hall Bridge

Class 1 - SUPER

Species	Weir	Marymoor Bridge		520 AFT Bridge		RR Bridge	City Hall Bridge	Redmond R2 Bridge		Foot Bridge		124th St
	Live Adult Tally									Comments		
Chinook	42+		2+2	4	4+20+	3			2+3	2+2+1	2+2+2	2+1+4+6
Coho	4									+2+2+2 +2+		
Pink												
Sockeye			20+40	15+3	15	35+10	15		15+4		1+	
Unknown				+25								

520 bridge

Downtown Redmond QFC Bridge

add complete carcass description on reverse side

Data Entry: QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 10/9/15
Crew: CM, CM
Camera #: EDJ

GPS Unit #: YELLOW
Start Location: WEIR
End Location: 145TH

15°C

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
	NO	CHINOOK	CARCASSES						

GOOSS 1-5

Species	1st BRIDGE	51° BELOW B. CREEK	90TH	NO FISH TO 116TH			Comments
	Live Adult Tally						
Chinook	40 ~~+10~~				+1		DARK & MINY
Coho	10						ALL TOGETHER IN ONE PACK, ALL SAME SIZE & COLOR
Pink							
Sockeye	5	6+8	2	1 CARCASS JUST BELOW 124TH ST.		1	ALL OLD FISH - RED
Unknown							

1 DEAD (UEM) YEARLING SALMONID KOKANEE? BELOW BEAR CREEK

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 12 OCT 2015

Crew: EDJ/DOE

Camera #: EDJ

Water Temp d/s Bear Cr = 16°C
water temp @ take-out = 16°C

GPS Unit #: Yellow

Start Location: WEIR

End Location: WINERIES

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
		NO CHINOOK CARCASS							

Beaver Dam Pool | walk bridge | 520 APTS | RR Bridge | City Hall Bridg | R2 BRIDGE | Valley Bridge | take-out

Species					Live Adult Tally							Comments	
Chinook	35+	4+2	4		4+6+28+4					2+	2		2+2+2
Coho	4+2				2+4+6	10+10				10	6+		4+
Pink													
Sockeye	2+6	4+			2+25+		10+		10+	4+2 +5	4+		4+
Unknown													

add complete carcass description on reverse side

Marymoor Park Bridge | 520 bridge | Redmond Main St Bridge | Foot Bridge | 124th Bridge

(1 sock carcass d/s bear cr)

QA / QC: (1 sock carcass u/s 124th @ gage station) (1 sock carcass d/s 124th bridge)

(1 sock carcass @ corner on take-out)

Data Entry:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 14 OCT 2015 Water temp 15°C D/S Bear Creek = [redacted] 15.0°C
water temp @ take-out = 15.0°C

GPS Unit #: Yellow

Crew: EDS / CG

Start Location: WEIR

Camera #: EDS

End Location: WINERIES

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
	NO CHINOOK CARCASS								

Species	D/S Beaver Dam Pool	Marymoor Bridge	Foot Bridge	520 Bridge	520 Apts	Redmond City Bridge	RR Bridge	City Hall Bridge	R2 Bridge	Foot Bridge	Valley bridge	124th Bridge	Comments
	Live Adult Tally												
Chinook	20+		2+	4	1+2+	2+	2+	2+2	2+	2+2+			
Coho	26+7+		4+6+	2+4	6+4+2	4+	4+2	5+4+4	6+	2+6+	2+4+2	6+4+3+1	
Pink	+21+						+2				+4+4		
Sockeye					6+4+			2		4+		2+	
Unknown													

add complete carcass description on reverse side

Data Entry:
(1 sockeye carcass d/s R2 Bridge)

QA / QC:

14th BELOW BEAR CREEK

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 10/16/15

Crew: CM, AB

Camera #: EDJ

PHOTO 88-90

~~400 BAKAPACK~~

GPS Unit #: YELLOW

Start Location: WEIR

End Location: 145TH

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N

NO CARCASS

Species	PARK CREEK	520	85TH	PETERS	7TH AP	116
	Live Adult Tally					Comments
Chinook	11		3	2	2+1	IIII
Coho	1	25	12+4	3+4+3+18	2+1+1+4+9+~~IIII~~ ~~IIII~~ II	~~IIII~~ ~~IIII~~ ~~IIII~~
~~Pink~~ COHO						~~IIII~~ I
Sockeye		1	5+2	4		1 DEAD @ FOOTBRIDGE, 1 DEAD @ 124TH
Unknown						1 DEAD KOKANEE/TROUT ~15" + 1 @ 124TH

NO SCHOOL @ WEIR OR CORNER POOL

add complete carcass description on reverse side

SCHOOL POSSIBLE KOKANEE LIVE 8-10 FISH?

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 19 OCT 2015 Water temp D/S Bear Cr = 15°C temp @ take-out = 16°C

GPS Unit #: Yellow

Crew: EDJ/DOE

Start Location: WEIR

Camera #: EDJ

End Location: WINERIES

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
	NO CHINOOK CARCASSES								

Manyhour Bridge, 520 Bridge, 520 Apts, RR Bridge, R2 Bridge, Valley Bridge, take out

Species					Live Adult Tally								Comments
Chinook	1+5	2+	2	2+2	2+	1		2					
Coho	26+10	5+3	4	6+4	4+2	6+2	2+2+1	2	4+	4+4+2	4+2+	4	
Pink	+10												
Sockeye				2						2			
Unknown													

Foot Bridge, Redmond Way Bridge, City Hall Bridge, Foot Bridge, 124th Bridge

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 10/21/15

Crew: CM, CG

Camera #:

GPS Unit #:

Start Location: WEIR

End Location: 145M

14°C BELOW BEAR CREEK

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
		NO CARCASSES							

Species	520 BADGE LEAD		55M	116M	124
	Live Adult Tally				
Chinook	1	1			
Coho	30+	1	2+2+2+33	12+1+3	+1+4+8+2
Pink					
Sockeye		1	1+1+1	1+1	1
Unknown			1		

Comments: NO FISH IN WEIR POOL

1 DEAD KOKANEE - PREDATION

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 23 OCT 2015
Crew: EDJ / AB
Camera #: EDJ

Water temp = 15.0°C Bear Cr.
water temp @ take-out = 5°C

GPS Unit #: Yellow
Start Location: WEIR
End Location: WINERIES

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
			NO	CHINOOK					
				CARCASSES					

Species	Fookbridge	Maryhill bridge	Redmond Way			City Hall Bridge		Foot Bridge		Valley Bridge		124th Street	Comments
	Live Adult Tally												
Chinook	2+2							2+	2+2				
Coho	17+10	10+2+4	11+10	10+	5	15+2	10	10+	4+2+	2+	4	4+2	6
Pink		+10				+35		10					
Sockeye							2						
Unknown													

52nd Ave bridge
RR Bridge
R2 Bridge

add complete carcass description on reverse side

Data Entry:
QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 26 OCT 2015
Crew: KDJ / DOE
Camera #: EOC

water temp @ 13°C
water temp @ take out = 13°C

GPS Unit #: Yellow
Start Location: WEIR
End Location: WINERIES

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
	NO		CHINOOK						
			CARCASSES						

Species	Marymoor Bridge			520 Bridge		Redmond Way Bridge		City Hall Bridge		Foot Bridge		124th St Bridge
	Live Adult Tally										Comments	
Chinook	4+2	1+2+1		2	2+			2		2+		2+1
Coho	15+4+6	2+4	6+2	8+2+10+	10+10+	2+	8+	6+4	3+	6+4	2+	8+2
Pink		4			12+							
Sockeye				2+2	3+							
Unknown												

	Marymoor Foot Bridge	520 Apt Bridge	RR Bridge	R2 Bridge	Valley Bridge

add complete carcass description on reverse side

Data Entry:

QA / QC:

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 28 OCT 15
Crew: EDJ/CM
Camera #: EDJ

water temp @ bear cr = 13.0°C
water temp @ ~~take-out~~ = 12°C

GPS Unit #: Yellow
Start Location: WEIR
End Location: WINERIES

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N
SM#18	CHK	F	77	4pp	NONE	91-93	DNA	ϕ	Y

CLASS furry slimmy I

Species	Marymoor Bridge		520 Bridge		R2 Bridge		R2 Foot Bridge		124th Bridge	Comments
	Live Adult Tally									
Chinook	4+1			1+1			2+		2+	
Coho	10+4+1	30+15	10+	10+	10+4+	2	4	2	4+	
Pink										
Sockeye				2	2			1	4+	
Unknown										

Foot Bridge | 520 Apts | City Hall Bridge | Valley Bridge

add complete carcass description on reverse side

Data Entry:

QA / QC:
Male sockeye carcass - Redmond Way Park

1 male sock carcass @ R2 Bridge

R2 Resource Consultants, Inc.
2015 Sammamish River Pre-Spawn Mortality Study

Date: 30 OCT 2015
Crew: EDJ / DOE
Camera #: EDJ

Water temp d/s bear cr = 14°C
water temp @ take out = 14°C

GPS Unit #: Yellow
Start Location: WEIR
End Location: WINERIES

Carcass ID SM-###	Species	Sex	Fork Length (cm)	Waypoint	Fin Clip(s)	Photo #	External Tag(s)	Egg Retention 0-25, 25-50, 50-75, 75-100%	Scales Taken Y / N

NO CHINOOK CARCASSES

Species	Marymoor Bridge		Foot Bridge	520 Bridge	520 Bridge		Redmond Way	RR Bridge	City hall bridge	RZ bridge		RZ foot bridge	valley bridge	12th bridge
	Live Adult Tally									Comments				
Chinook	4+2	2+			2+		1+							
Coho	35+6	2+15+	0+	10+8	6+4	4	4+			2	2	4+2		2+
Pink														
Sockeye					2	2					2+1			
Unknown														

add complete carcass description on reverse side

Data Entry:

QA / QC: