

Chum Salmon Spawning Habitat Report
for the Clatskanie River and Scappoose Creek Populations

Oregon Department of Fish and Wildlife

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Introduction

Historically, Chum Salmon represented a significant portion of the annual returns of salmon and steelhead to the lower Columbia River. It is thought that 10–15 million salmon and steelhead returned annually (Gresh et al. 2000), of which Chum Salmon may have comprised 7–10% of the return (NPPC 1986). The earliest estimate of abundance of Chum Salmon comes from commercial catch data; in 1928, over 700,000 Chum Salmon were captured (Smith 1979), which may have represented a population of over a million Chum Salmon (NPPC 1986). Beginning in the early 1800s, settlement along the lower Columbia River (LCR) and tributaries resulted in changes to land use and harvest of Chum Salmon that ultimately led to the extirpation of 90% of Chum Salmon populations in the LCR. By the 1950s, returns to the lower Columbia River numbered in the thousands.

In response to these dramatic declines, all populations of Columbia River Chum Salmon were listed as “threatened” under the Endangered Species Act in 1999 (USFWS 1999) as a single evolutionary significant unit (ESU). At the time of listing, 17 historic populations were recognized (Myers et al. 2003, USFWS 1999) and all but two of them (the Grays River and lower gorge populations) were considered extirpated (Kostow 1995). Following listing, Oregon developed the Chum Recovery Strategy (ODFW 2010), which outlined the overall approach towards restoring Chum Salmon populations. In preparing that recovery strategy, it was determined that very little historical data existed on Chum Salmon distribution and abundance within the lower Columbia River. Moreover, it was unclear which specific limiting factors existed within each historical population and whether those limiting factors had been addressed. To address these critical uncertainties, Oregon created a Chum Salmon Reintroduction Project in 2012.

The goals of the Chum Salmon Reintroduction Project are to identify and address factors that limit the abundance of Chum Salmon, restore habitat to promote natural recolonization, and reintroduce Chum Salmon into locations where they do not currently exist. As such, baseline habitat surveys were completed in all populations within the coastal stratum (Youngs Bay, Big

Creek, Clatskanie River, and Scappoose Creek). This report summarizes data collected during these surveys.

Methods

In designing the Chum-centric surveys, spatial extent was determined based on high intrinsic potential habitat (Hale et al. 1985). Primarily, this relates to stream gradient (targeting contiguous locations with a gradient < 1%), proximity to tidal extent (beginning as close to tidal extent as feasible), and is limited by the maximum gradient in corridors between spawning habitat (gradient < 5%). Specific survey parameters were selected to capture habitat attributes relevant to Chum Salmon spawning, including quantity and quality of appropriate substrate size (0.7–7.6 cm, Duker 1977; 2–3 cm but sometimes larger, Scott and Crossman 1973; Morrow 1980), low percent fines (< 20%; Rukhlov 1969), presence of cold water patches during summer surveys, which might imply upwelling groundwater (Tautz and Groot 1975), and lack of barriers.

For all surveyed streams, previous habitat data were collected by the Aquatic Inventories Project (AQI). AQI surveys provide detailed information about channel morphology, valley form, land use, riparian zones, large woody debris, and substrate. AQI surveys also include data on potential barriers and habitat conditions upstream and downstream of the reaches surveyed for the Chum Reintroduction Project. Both AQI and Chum survey data were collected in a spatially explicit manner such that they could be aggregated into a single, complete database.

For the purposes of these surveys, suitable spawning gravel is defined as: patches (1) with an area $\geq 1 \text{ m}^2$, (2) comprised of substrate size from small gravel to small cobble (4–128 mm, diameter), and (3) with < 20% fine sediment interspersed in the patch. The following substrate size classes were derived from the literature and were used to describe chum spawning habitat:

Fines/Sand	< 4 mm
Small Gravel	4–11 mm
Large Gravel	12– 45 mm
Small Cobble	46–128 mm
Large Cobble	129–300 mm
Boulder	> 300 mm

Cold water patches were defined as a patch of any size with a temperature difference from the surrounding area of at least 1° C. These patches could be produced by upwelling groundwater or by seeps or springs entering the active channel. Microhabitat data (substrate, channel unit type) were recorded at each patch site in order to differentiate between cold water that could indicate upwelling groundwater and cold water resulting from stream shading or deep pools.

Defining Chum Salmon barriers is difficult because there is no accepted standard of what vertical height or gradient can be ascended by adults. We designed our barrier criteria to be highly conservative by encompassing conditions that are likely not barriers. This will allow further refinement of our barrier data based on improved definitions of what Chum Salmon can surmount. We recorded potential barriers using the following criteria:

A potential barrier was defined as any natural or man-made structure at least 1 meter high and extending across the width of the watered channel. Culverts were recorded as potential barriers even if there was no drop to the stream (because they could be velocity barriers).

CC = Circular Culvert

SC = Semicircular Culvert

DL = Dam with fish Ladder

D = Dam without fish ladder

ID = Irrigation Ditch

W = Waterfall (> 1 m drop height)

G = Gradient/ Rapids (> 5 %)

LWD = Large Woody Debris blocking channel

TG = Tide Gate

DK = Dike

O = Other

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Scappoose Creek Population

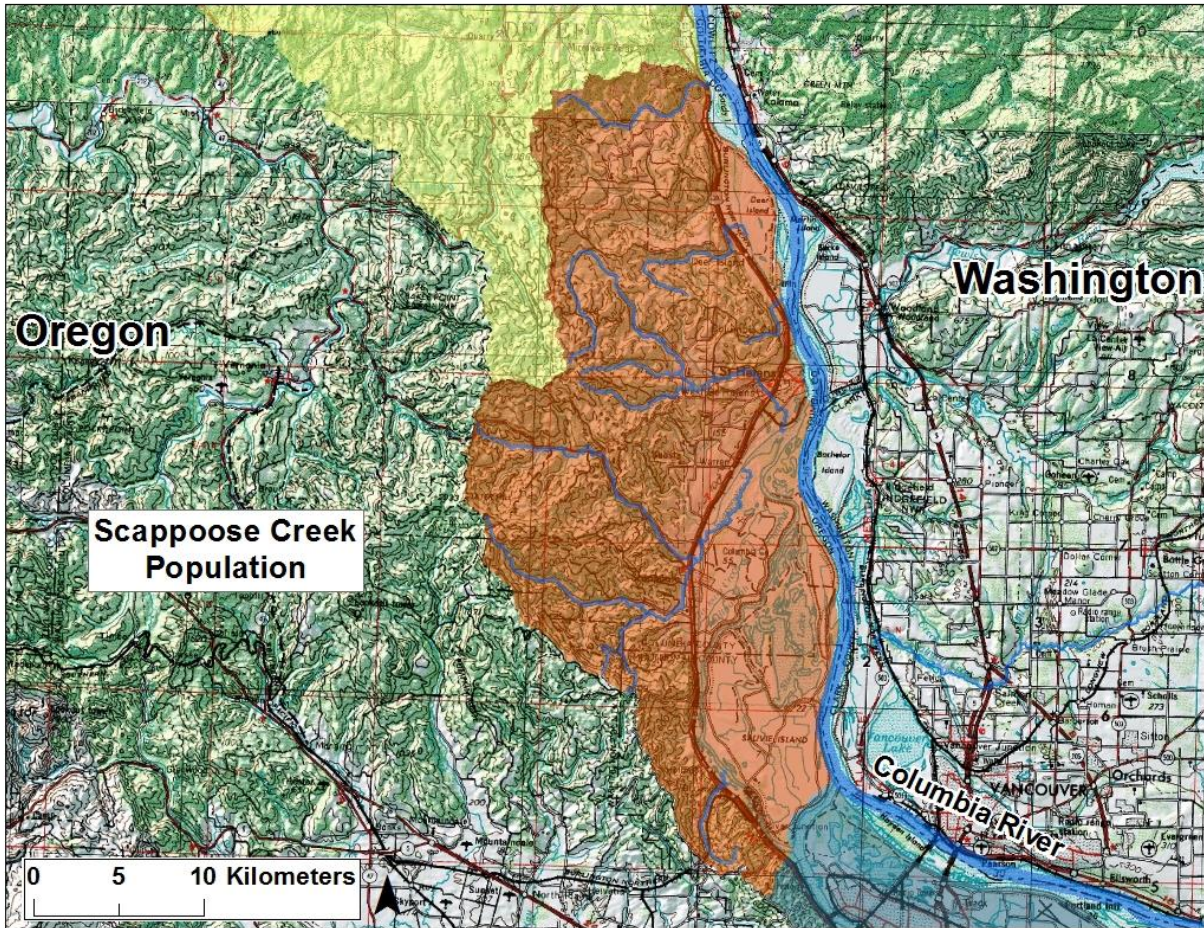


Figure 1. Map of Scappoose Creek Chum Salmon *Oncorhynchus keta* population (orange).

Cox Creek

SURVEY DATES: August 1, August 22, and August 28, 2012

SURVEY CREW: Brian Alfonse, Kris Homel, and Lorana McCalester

GENERAL DESCRIPTION:

The Cox Creek habitat survey (Township: 4N Range: 2W Section: 100) started at the confluence with Milton Creek and continued upstream 4 km to an unnamed tributary near Dowd Road. Surveys on Cox Creek were delineated into three reaches (Figure 2) based on physical features, landowner access, and overall distance. Approximately 630 m of this section was not surveyed due to landowner denials in reach 1.2.

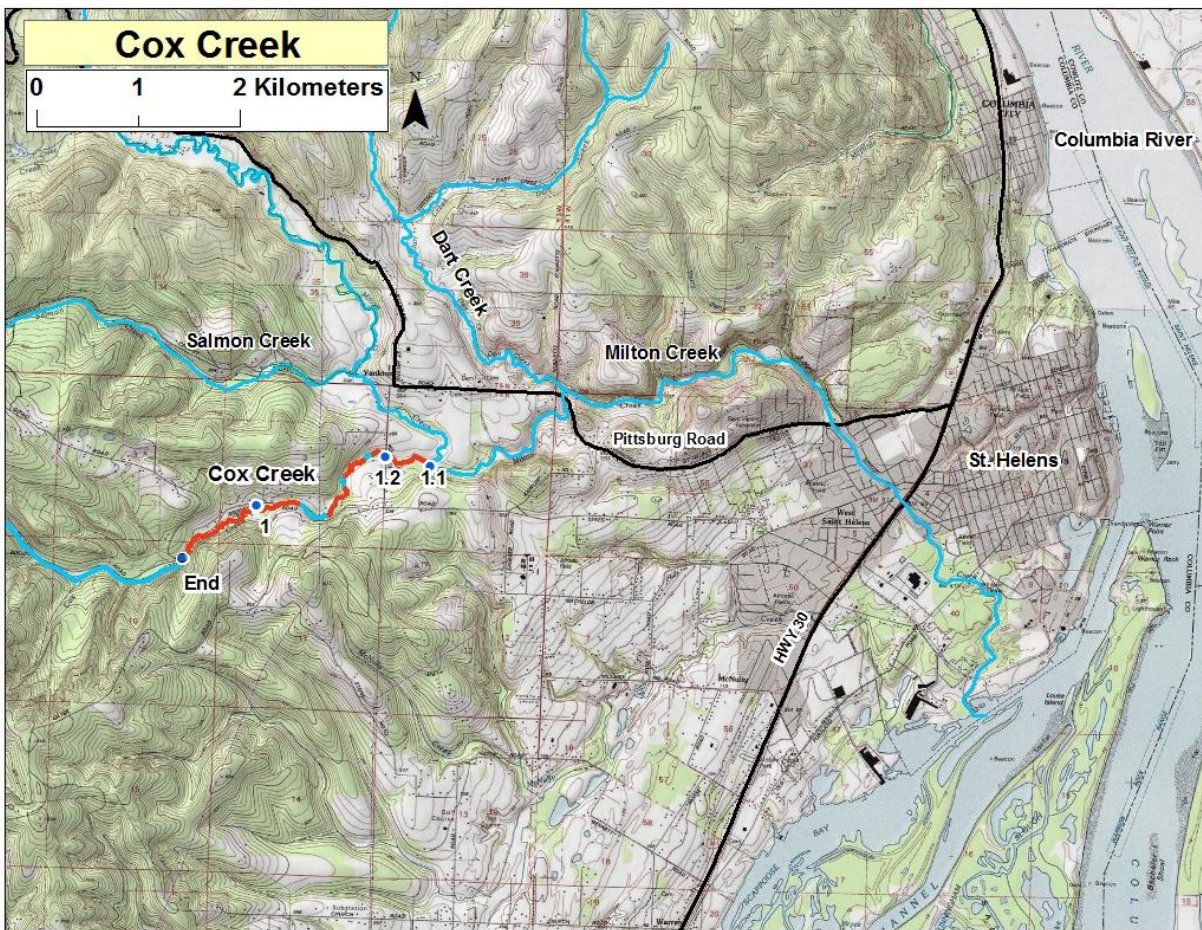


Figure 2. Map of reaches (red line) on Cox Creek, located west of St. Helens, OR. Reach break labels correspond to the downstream end of each reach.

REACH 1.1

REACH DESCRIPTION:

Reach 1.1 started at the confluence of Cox Creek and Milton Creek (Lat: 45.859296, Long: -122.882552; Figure 4, panel A) and continued upstream to Kappler Road bridge (Lat: 45.860071, Long: -122.887924; Figure 3; Figure 4, panel B). The mainstem thalweg length of the reach was 581 m, there were no side channels, and the channel meandered. The riparian zone included alders, maples, cedars, and grasses. Land use was a mix of young timber and rural residential.

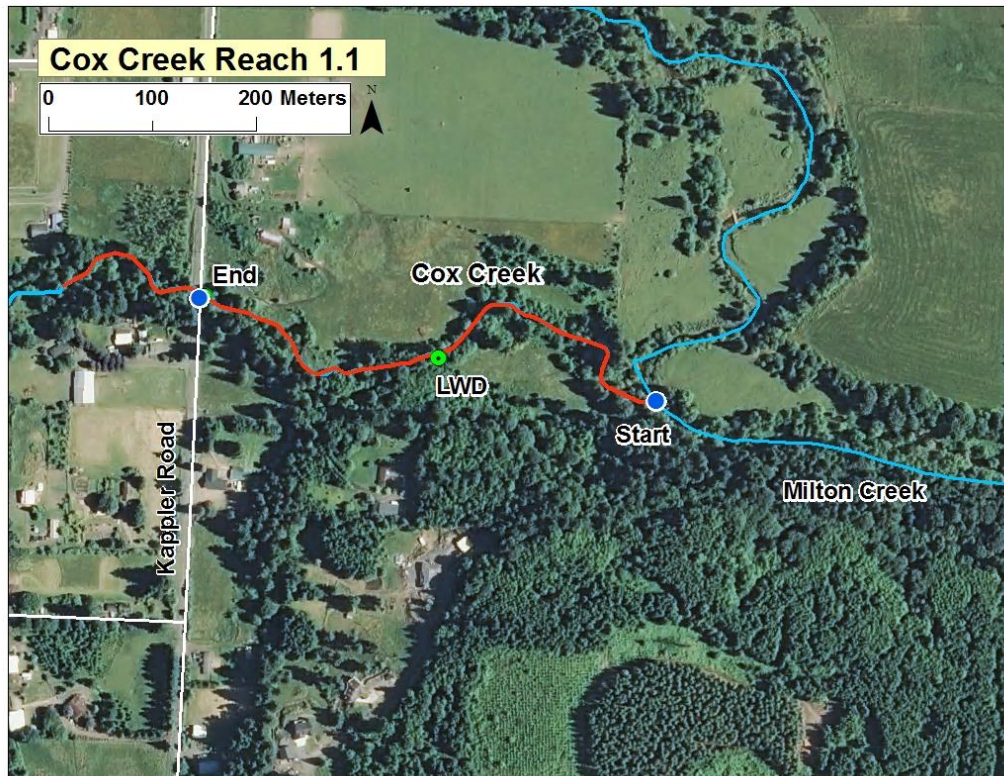


Figure 3. Map of reach 1.1 (red line) on Cox Creek, including start and end points (blue dots) and a channel-spanning log jam (LWD).



Figure 4. Survey pictures of Cox Creek reach 1.1 showing evidence of grazing at the confluence of Cox and Milton Creeks (panel A), the Kappler Road bridge at the upstream end of the reach (panel B), and a channel-spanning log jam barrier (panel C).

RESULTS:

There were no gravel patches that met the established criteria. One cold-water patch was identified near the upstream end of the reach (0.9 m²); temperature in the patch was 13.1° C and temperature adjacent to the patch was 14.4° C. The dominant substrate type within this cold-water patch was fine sediment (< 4 mm diameter). There was one potential barrier to Chum Salmon *Oncorhynchus keta* migration, classified as a channel-spanning log jam (Figure 3; Table 1; Figure 4, panel C).

Table 1. Barrier type, drop (from flowing water to substrate), width (across stream), length (upstream and downstream), and max pool depth downstream in reach 1.1 of Cox Creek, near St. Helens, OR, in August 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Large woody debris	1.6	5	2	0.7

REACH 1.2

REACH DESCRIPTION:

Reach 1.2 started at the Kappler Road bridge (Lat: 45.860111, Long: -122.887987) and continued upstream to a point 230 m west of where the creek crossed Brooks Road (Lat: 45.855452, Long: -122.904866; Figure 5). A total of 1,580 m of the mainstem thalweg were surveyed. Within the upstream and downstream boundaries of this reach, one side channel and three main channel sections (total thalweg length of 530 m) were not surveyed due to landowner denials (Figure 5). Channel form was primarily confined, with multiple meanders. The riparian zone was comprised of maintained yards and some large trees (Figure 6, panels A and B), and land use was rural residential and timber harvest. Active logging was observed throughout the habitat survey. In the upper section of the reach along Brooks Road, the stream banks were riprapped and there were several beaver dams. Only one of these beaver dams was large enough to be considered a potential barrier to migration (Figure 6, panel E).

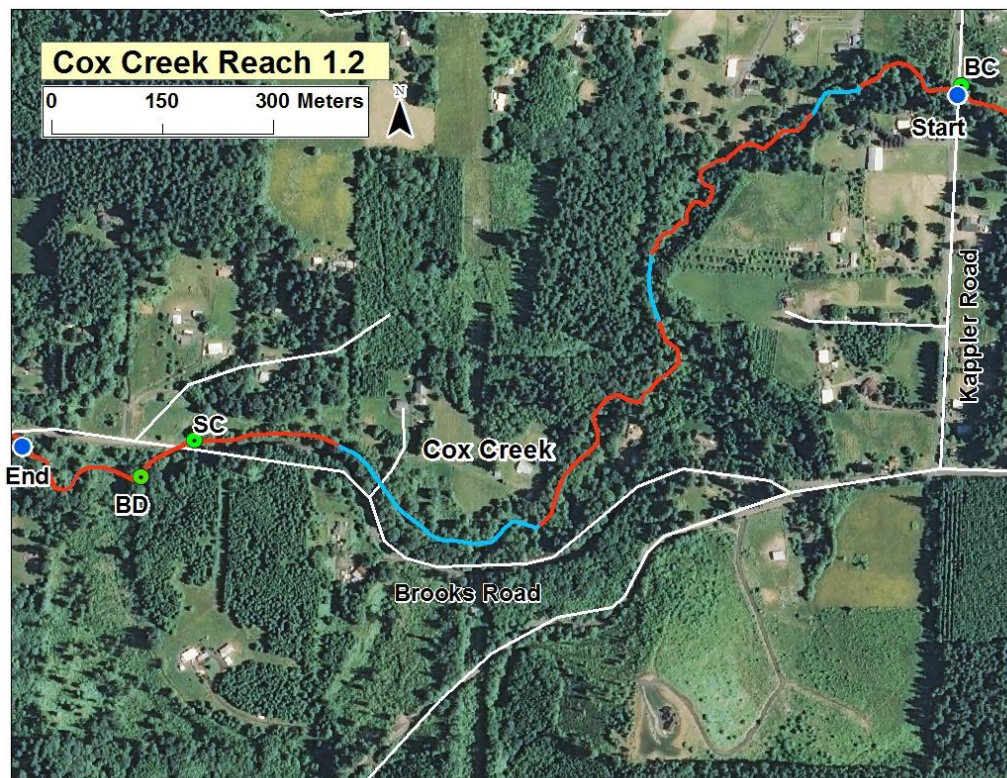


Figure 5. Map of reach 1.2 (red line) on Cox Creek, including start and end points (blue dots), a semicircular culvert (SC), a beaver dam (BD), and a box culvert (BC).



Figure 6. Survey pictures of Cox Creek reach 1.2 showing a mowed lawn in the riparian zone (panel A), a section of the riparian zone with cedar trees (panel B), the downstream end of the Kappler road bridge (panel C), a culvert bridge at Brooks Road near the upper end of the reach (panel D), and a beaver dam (panel E).

RESULTS:

Five patches of suitable spawning substrate that met established criteria were found in Cox Creek reach 1.2 (Table 2; Figure 6), measuring a total of 9 m². All patches were designated

“low” quality because of excess fine sediment (11–20% of patch area), but substrate consisted of large gravel and small cobble (Table 2). One cold-water patch was identified, measuring 0.5 m² (Figure 6); temperature in this patch was 13.9° C and temperature adjacent to the patch was 14.9° C. The dominant substrate within this cold-water patch was fine sediment (<4 mm diameter). There were three potential barriers to Chum Salmon migration in this reach (Figure 5). The first was a box culvert under Kappler Road, located at the downstream end of the reach (Figure 6, panel C; Table 3). The second was a semicircular culvert under Brooks Road (Figure 6, panel D; Table 3) and the third was a beaver dam located near the upstream end of the reach (Figure 6, panel E; Table 3).

Table 2. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 1.2 of Cox Creek, near St. Helens, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	4	7
low	11-20	0	50	50	0	0
low	11-20	0	25	75	1	2
low	11-20	0	0	100	0	0

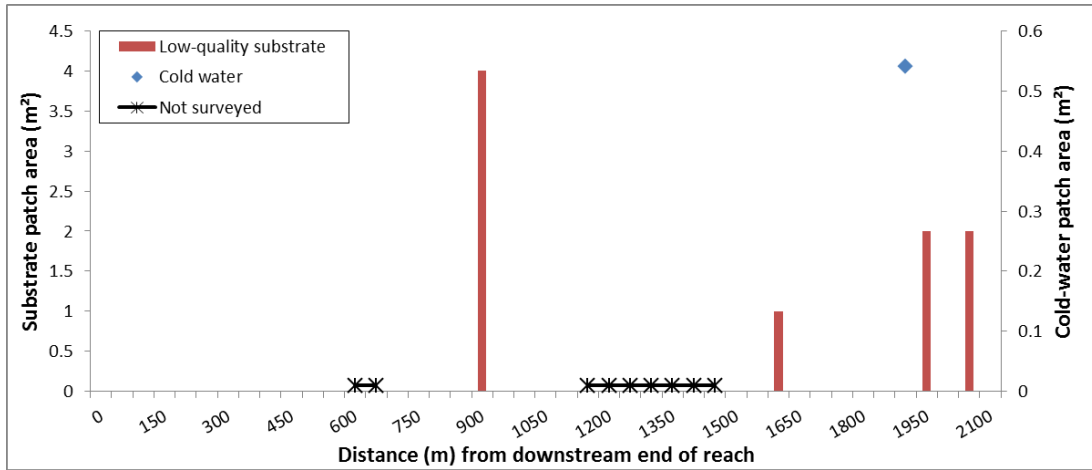


Figure 7. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 1.2 of Cox Creek, OR, in August 2012. For cold water and substrate quality, patch area was summed into 50 m units. Cold-water patches were at least 1.0° C colder than the temperature in the main channel.

Table 3. List of barriers, types, drops (from flowing water to substrate), widths (across stream), lengths (upstream and downstream), and max pool depths downstream for reach 1.2 in Cox Creek, near St. Helens, OR, in August 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Box culvert	0	3.2	7	0.3
2	Semicircular culvert	0	5.5	19.5	0.1
3	Beaver dam	1.2	0.6	1.2	0.1

REACH 1

REACH DESCRIPTION:

Reach 1 started on a private access road (Lat: 45.855470, Long: -122.90177) and continued upstream to a small tributary near the intersection of Dowd Road and Brooks Road (Lat: 45.850519, Long: -122.913352; Figure 8). The mainstem thalweg length of this reach was 1,199 m, and there were no side channels. Channel form was primarily confined, with multiple meanders throughout. The lower half of the reach was characterized as low gradient with limited vegetation and a riparian zone dominated by grass (Figure 9, panel A). Gradient increased in the upper half of the reach (although it was still <1 %) and the riparian zone was primarily large alders, cedars, and firs. Land use was a mix of timber harvest and mature timber.

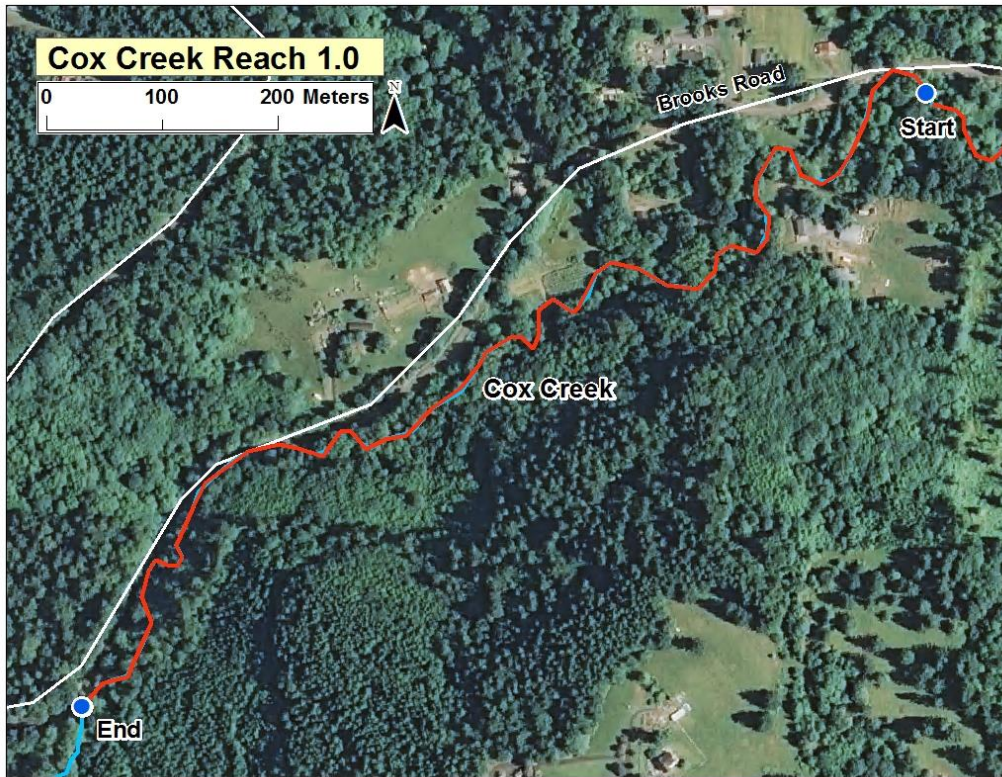


Figure 8. Map of reach 1 (red line) on Cox Creek, including start and end points (blue dots).



Figure 9. Survey pictures of reach 1.0 on Cox Creek showing a riparian zone dominated by grass near the downstream end of the reach (panel A), and a large gravel bar (panel B).

RESULTS:

Forty-three patches of suitable spawning substrate that met established criteria were found in Cox Creek reach 1.0 (Table 4; Figure 10), measuring a total of 249 m². None were categorized as “high” quality, seven patches were of “moderate” quality, and 33 patches were of “low” quality (Table 4; Figure 10). All but two patches consisted of large gravel and small cobble (Table 4; Figure 9, panel B). One cold-water patch was identified (18.0 m²; Figure 10);

temperature in this patch was 14.3° C and temperature adjacent to the patch was 15.1° C. The dominant substrate type within this cold-water patch was fine sediment (< 4 mm diameter). There were no potential barriers to Chum Salmon migration in this reach.

Table 4. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 1 of Cox Creek, near St. Helens, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	1	2
moderate	11-20	25	75	0	1	8
moderate	11-20	0	100	0	5	24
low	11-20	0	75	25	25	155
low	11-20	0	50	50	5	35
low	11-20	0	25	75	3	12
low	11-20	0	0	100	0	0

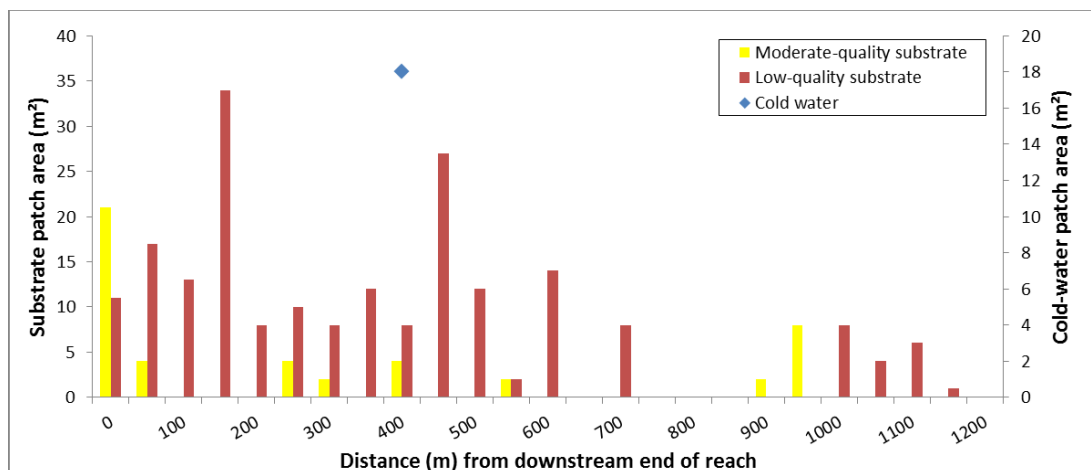


Figure 10. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 1 of Cox Creek, near St. Helens, OR, in August 2012. For cold water and for each category of substrate quality, patch area was summed into 50 m units. Cold-water patches were at least 1.0° C colder than the temperature in the main channel.

Goble Creek

SURVEY DATE: September 4, 2012

SURVEY CREW: Brian Alfonse and Lorana McCalester

GENERAL DESCRIPTION:

The Goble Creek habitat survey (Township: 6N Range: 2W Section: 1200) started 600 m upstream from the mouth of the creek (Lat: 46.020163, Long: -122.881748; Figure 11, Figure 12, panel A) and continued upstream to a large waterfall with a fish ladder. (Lat: 46.018061, Long: -122.892323; Figure 11). The survey consisted of one reach with a mainstem thalweg length of 1,117 m, as well as one side channel with a thalweg length of 34 m. Channel form was confined with multiple meanders. The riparian zone was dominated by a mix of alders, firs, and cedars (Figure 12, panel B), and land use was primarily mature timber. There was one gradient barrier in the upstream portion of this survey, followed by a large waterfall with a functioning fish ladder at the survey end.

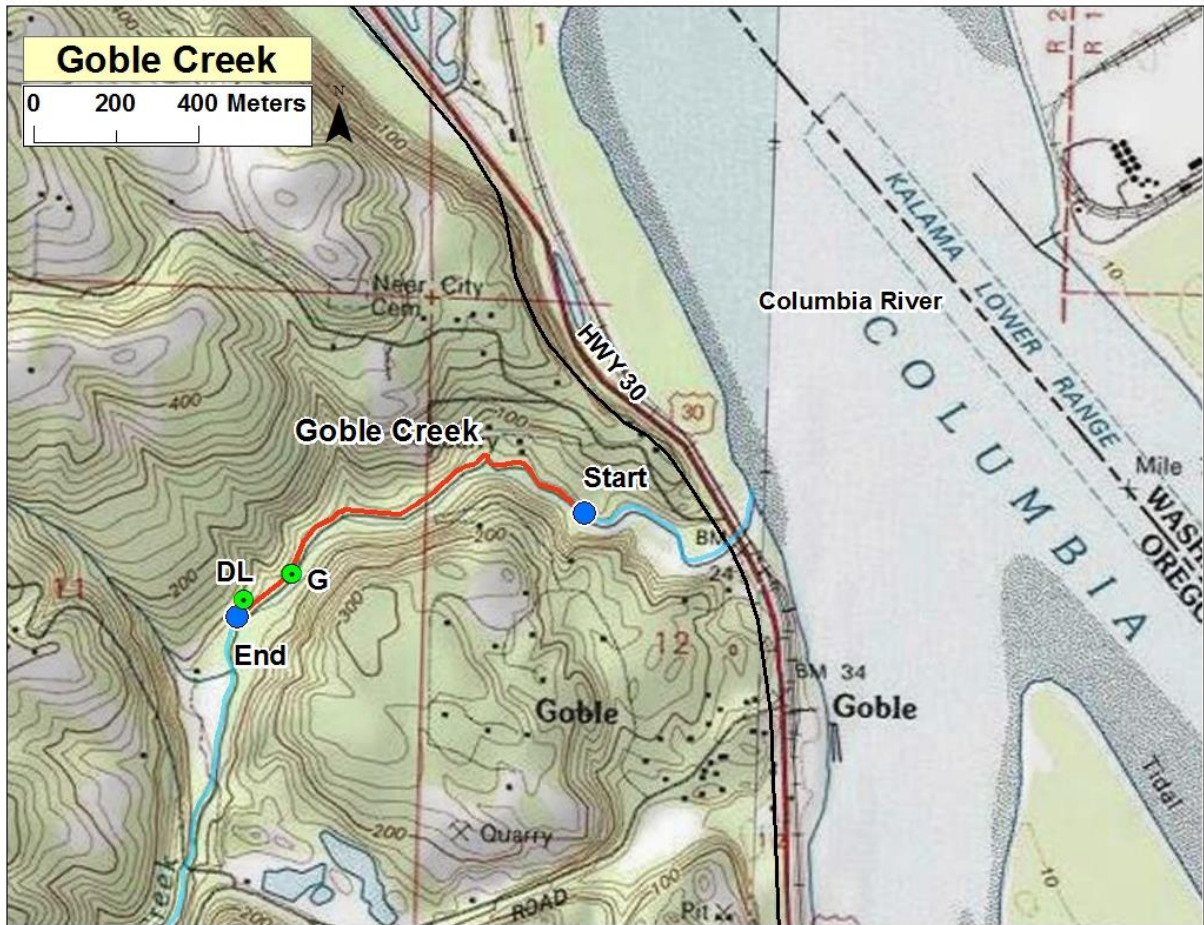


Figure 11. Map of reach (red line) surveyed on Goble Creek, located near Goble, OR, including start and end points (blue dots), a gradient barrier (G), and one waterfall with a ladder (DL).



Figure 12. Survey pictures of Goble Creek showing a tidal area under Highway 30 (panel A), dense riparian vegetation (panel B), a gradient barrier (panel C), and a waterfall with a fish ladder, located at the upstream end of the reach (panel D).

RESULTS:

Small substrate was present at the downstream end of the reach, however because fine sediment levels were > 20%, little suitable spawning habitat was identified. Substrate size increased in the upstream direction, and several areas of bedrock were present throughout the reach. Two patches of suitable spawning substrate that met established criteria were found in Goble Creek (Figure 13), measuring a total of 2 m². Both patches were designated as “low” quality because of elevated levels of fine sediment (11–20% of patch area); one patch was entirely comprised of small cobble and the other was comprised of 25% large gravel and 75% small cobble. There were three cold-water patches observed, measuring a total of 10.8 m² (Figure 12); average temperature in these patches was 13.3° C and average temperature adjacent to these patches was 14.7° C. The dominant substrate types within these cold-water patches were fine sediment (n = 1) and bedrock (n = 2). There were two potential barriers to Chum Salmon migration in this reach (Figure 11; Table 5): one was a high gradient bedrock cascade with a calculated slope of 29%, and the other was a waterfall with a fish ladder, both located at the upstream end of the survey (Table 5; Figure 11; Figure 13, panels C and D).

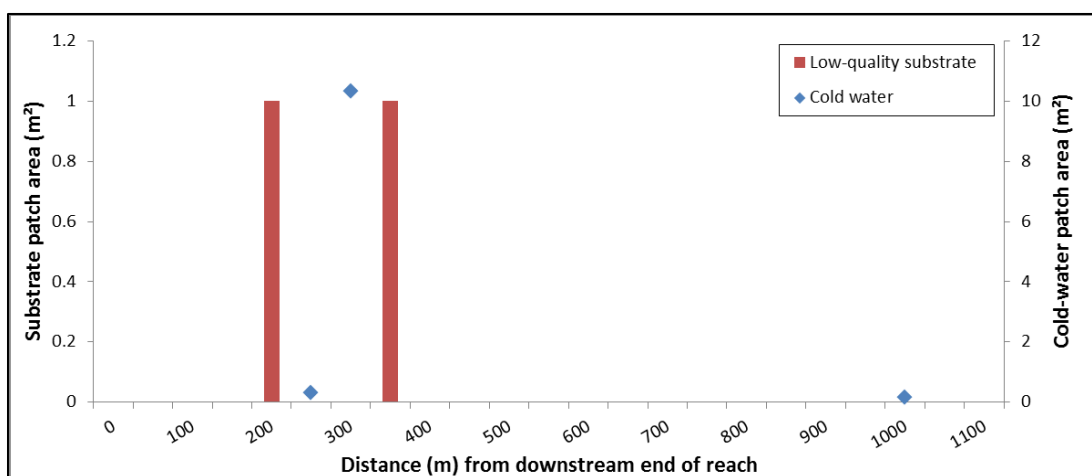


Figure 13. Location of substrate and cold-water patches measured as distance from downstream end of survey in Goble Creek, near Goble, OR, in September 2012. Cold water and substrate patch areas were summed into 50 m units. Cold-water patches were at least 1.0° C colder than the temperature in the main channel.

Table 5. List of barriers, types, drops (from flowing water to substrate), widths (across stream), lengths (upstream and downstream), and max pool depths downstream in Goble Creek, near Goble, OR, in September 2012. ** indicates data not collected

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Gradient	1	10	3.4	0.8
2	Waterfall with ladder	9	18	**	**

McBride Creek

SURVEY DATES: August 13 and December 12, 2012

SURVEY CREW: Brian Alfonse, Kris Homel, Lorana McCalester, and Brad Benson

GENERAL DESCRIPTION:

The McBride Creek habitat survey (Township: 5N Range: 1W Section: 2100) started 250 m upstream from the mouth of McBride Creek and continued upstream for 2.4 km, to a point approximately 200 m downstream of the Smith Road bridge at a perched double culvert. Surveys on McBride Creek were delineated into two reaches (Figure 14) based on physical features, landowner access, and overall distance. Approximately 500 m of this section was not surveyed due to a landowner denial.

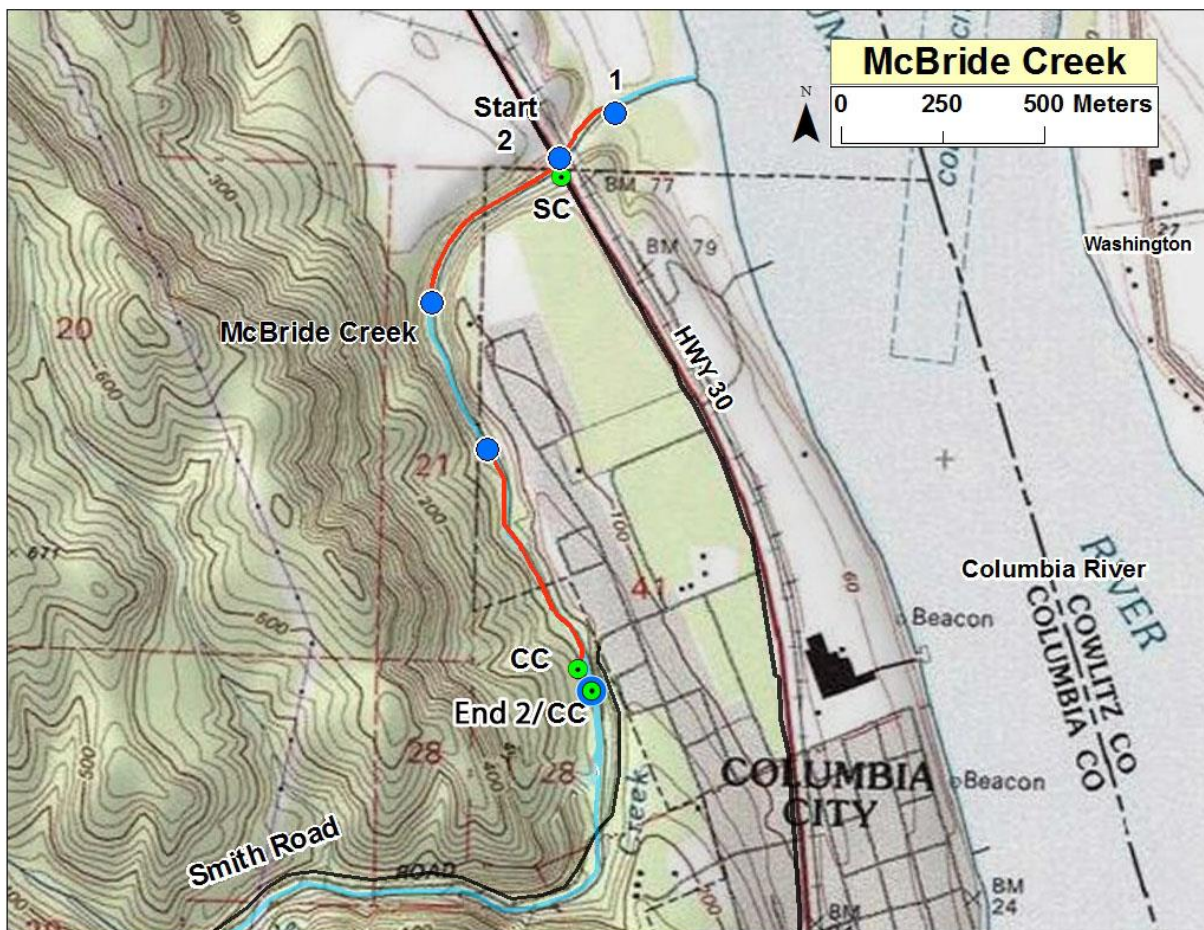


Figure 14. Map of reaches (red line) surveyed on McBride Creek, located west of Columbia City, OR, including start and end points (blue dots), one semicircular culvert (SC), and two circular culverts (CC), and 500 m not surveyed due to landowner denial (blue line interior to reach 2).

REACH 1

REACH DESCRIPTION:

Reach 1 started approximately 250 m upstream from the mouth of McBride Creek, (Lat: 45.907007, Long: -122.818202) and continued upstream to where Highway 30 crosses the creek (Lat: 45.90656, Long: -122.818803; Figure 14; Figure 15). The mainstem thalweg length of this reach was 186 m and there were no side channels. Riparian vegetation was limited, and land use was rural residential. The stream in this reach was deeply channelized with few meanders and there were several tidally-influenced pools.



Figure 15. A semicircular culvert located under Highway 30 at the upstream end of reach 1 of McBride Creek, near Columbia City, OR, in December 2012.

RESULTS:

Substrate sizes within the range suitable for Chum Salmon (4 mm–128 mm) were observed in this reach of McBride Creek; however, fine sediment exceeded 20%. There were no gravel patches or cold-water patches that met minimum established criteria. There was one potential barrier to Chum Salmon migration in this reach, a semicircular culvert located under Highway 30 (Figure 14; Table 6; Figure 15).

Table 6. Barrier type, drop (from flowing water to substrate), width (across stream), length (upstream and downstream), and max pool depth downstream in reach 1 of McBride Creek, near Columbia City, OR, in December 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Semicircular culvert	0	1.7	40	0.8

REACH 2

REACH DESCRIPTION:

Reach 2 started at the Highway 30 bridge (Lat: 45.905787, Long: -122.819971) and continued upstream to a perched, double circular culvert 200 m downstream from the Smith Road bridge (Lat: 45.892545, Long: -122.818288; Figure 14). The mainstem thalweg length of this reach was 1,732 m, and there were no side channels. A section in the middle of this reach with a thalweg length of 500m was not surveyed due to a landowner denial. The lower half of this reach was constrained by a deep canyon with a sparsely vegetated riparian zone of large leaf maples. The gradient of the stream was < 1% throughout most of this reach except for one small hardpan shelf with a short drop in the downstream portion of the reach. Primary land use was rural residential, with some mature timber. The survey ended at a perched, double culvert.



Figure 16. Survey pictures on reach 2 of McBride Creek showing a small footbridge (panel A), the lower culvert (panel B), and the downstream end of the double culvert at the top of the reach (panel C).

RESULTS:

Substrate sizes within the range suitable for Chum Salmon (4–128 mm) were observed in reach 2 of McBride Creek; however, fine sediment levels were typically > 20%, and little substrate was suitable for spawning. Three patches of suitable spawning substrate met established criteria (Table 7; Figure 17), measuring a total of 6 m². All substrate patches were of “low” quality (Table 7) because of excess fine sediment (11–20% of patch area), but substrate consisted of large gravel and small cobble (Table 7). Four cold-water patches totaling 21.7 m² were observed (Figure 17). Average temperature in these patches was 17.4° C and average temperature adjacent to these patches was 19.3° C. The dominant substrate types within these cold-water patches were fine sediment (n = 3) and large gravel (n = 1). There were two potential barriers to Chum Salmon migration in this reach (Figure 14; Table 8). The first barrier was a partially crushed culvert and the second was a set of two perched culverts (Figure 16, panels B and C).

Table 7. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 2 of McBride Creek, near Columbia City, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	1	3
low	11-20	0	50	50	2	3
low	11-20	0	25	75	0	0
low	11-20	0	0	100	0	0

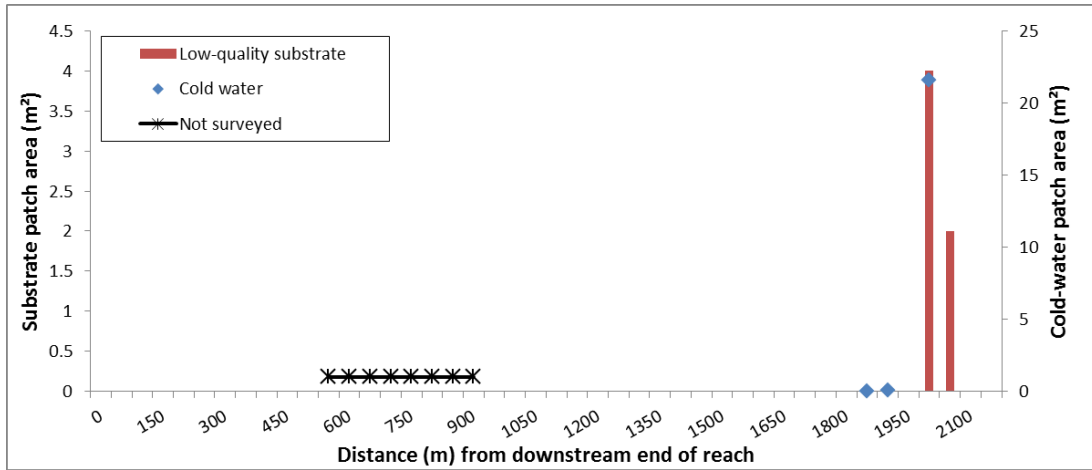


Figure 17. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 2 of McBride Creek, near Columbia City, OR, in August 2012. Cold water and substrate patch areas were summed into 50 m units. Cold-water patches were at least 1.0° C colder than the temperature in the main channel.

Table 8. List of barriers, types, drops (from flowing water to substrate), widths (across stream), lengths (upstream and downstream), and max pool depths downstream in reach 2 of McBride Creek, near Columbia City, OR, in August 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Circular culvert	0.2	2	21	0.4
2a	Double perched culvert	2.7	0.5	12	1.5
2b	Double perched culvert	2.7	1.5	12	1.5

McCarthy Creek

SURVEY DATES: September 20 and September 24, 2012

SURVEY CREW: Brian Alfonse, Lorana McCalester, and Brad Benson

GENERAL DESCRIPTION:

The McCarthy Creek habitat survey (Township: 5N Range: 1W Section: 2100) started at the Highway 30 bridge and continued 1.5 km upstream (Figure 18). Approximately 1 km of this reach could not be surveyed due to a landowner denial. A reach was also delineated downstream of Highway 30 (reach 1), but the stream flowed through a marsh so the reach was not surveyed.

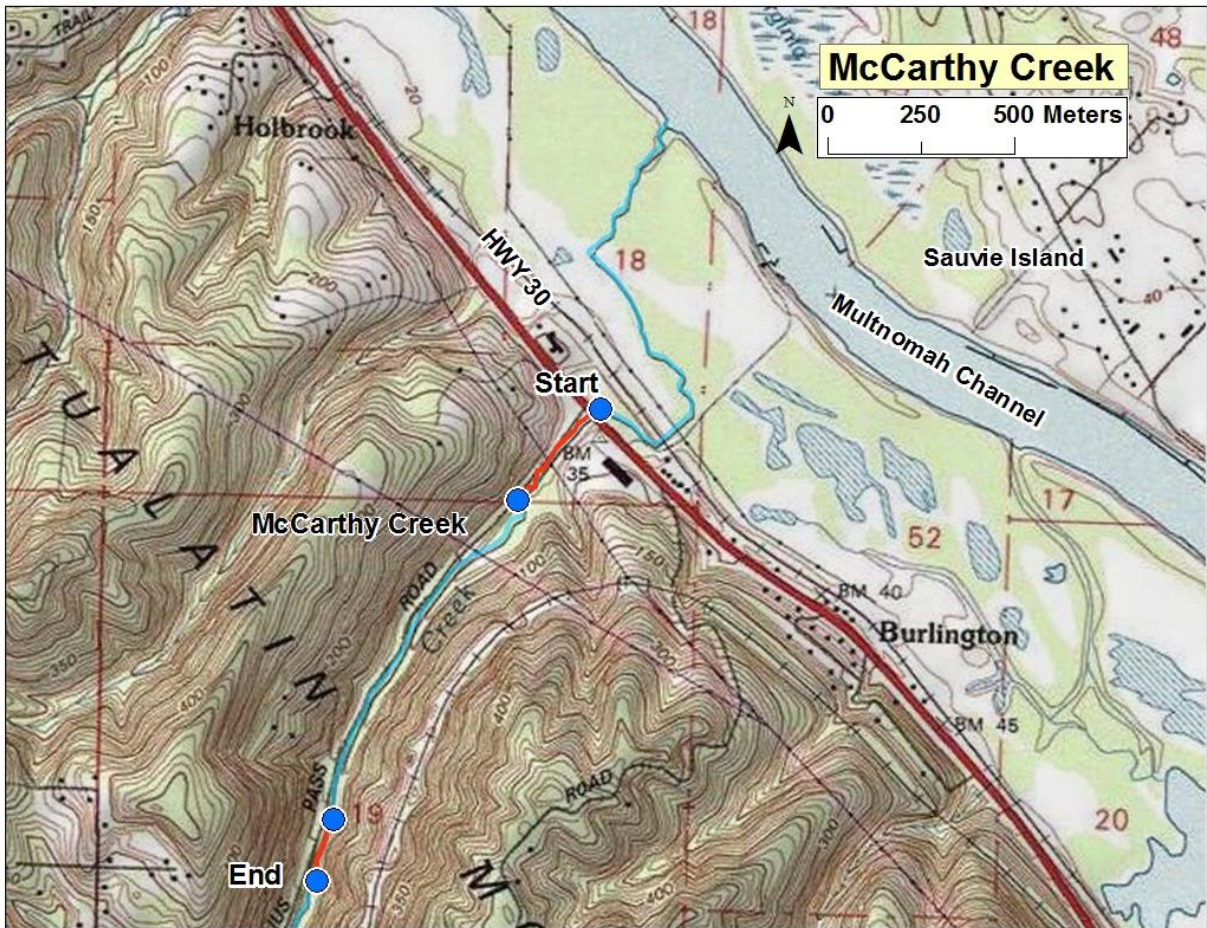


Figure 18. Map of reach (red line) surveyed on McCarthy Creek, located along Cornelius Pass road near Linnton, OR. This includes a portion not surveyed due to landowner denial (blue line).

REACH 2

REACH DESCRIPTION:

Reach 2 started at the Highway 30 bridge (Lat: 45.651157, Long: -122.851415; Figure 19, panel A) and continued upstream to a house with a fence adjacent to the creek (Lat: 45.639951, Long: -122.860161). The mainstem thalweg length of this reach was 506 m and there were no side channels. Through this reach, the creek flowed through a narrow canyon confined by Cornelius Pass Road and a railroad. Signs of beaver activity, including small dams, were observed in the lower half of the reach. The riparian zone was dominated by big leaf maple, with several small clusters of invasive knotweed also observed (Figure 19, panel B). Land use was rural residential.



Figure 19. Survey pictures on reach 2 of McCarthy Creek showing the Highway 30 bridge at the downstream end of the reach (panel A) and invasive knotweed growing along the bank in the upper section of the reach (panel B).

RESULTS:

Three patches of suitable spawning substrate met established criteria in McCarthy Creek reach 2 (Figure 20; Table 9), measuring a total of 16 m² in surface area. All patches were categorized as “moderate” quality (Figure 20; Table 9), and contained both excess levels of fine sediment (11–20% of patch area) and elevated proportions of large gravel (> 50% of patch area). No cold-water patches were observed. There were also no potential barriers to Chum Salmon migration in this reach.

Table 9. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 2 of McCarthy Creek, near Linnton, OR, in September 2012.

Substrate Quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	3	16
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	0	0
low	11-20	0	25	75	0	0
low	11-20	0	0	100	0	0

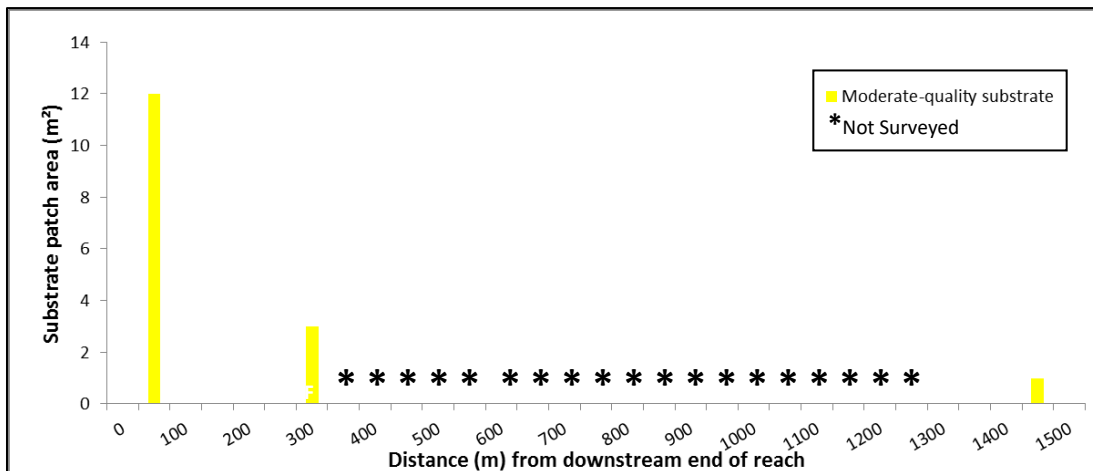


Figure 20. Location of substrate patches measured as distance from downstream end of survey in reach 2 of McCarthy Creek, near Linnton, OR, in September 2012. Substrate patch area was summed into 50 m units.

Merrill Creek

SURVEY DATE: September 5, 2012

SURVEY CREW: Brian Alfonse, Kris Homel, Lorana McCalester, and Brad Benson

GENERAL DESCRIPTION:

The Merrill Creek habitat survey (Township: 5N Range: 1W Section: 700) started at the Canaan Road bridge and continued 2.8 km upstream at a small fence line. The upstream end point was 485 m upstream of the bridge at Hills Haven Road. Two reaches were delineated on Merrill Creek (Figure 21) based on physical features, landowner access, and overall distance. Between reaches 1 and 2, approximately 1.5 km of the stream was not surveyed due to a foul-smelling odor and information from a landowner that raw sewage may have been leaking into the creek. Several small culverts were observed within this section but were not surveyed.

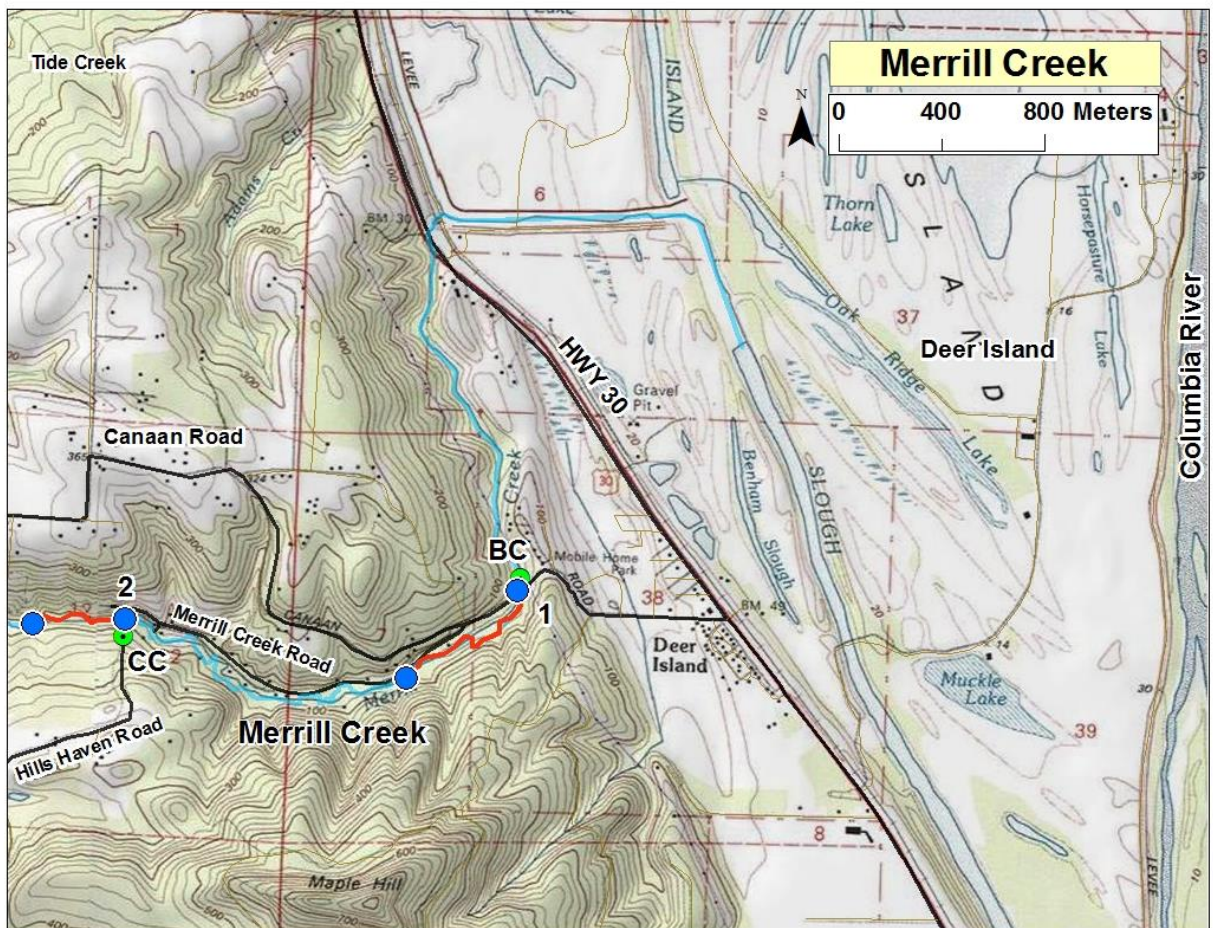


Figure 21. Map of reaches (red line) surveyed on Merrill Creek, located west of Deer Island, OR, including start and end points (blue dots), one box culvert (BC), and one circular culvert (CC). Reach break labels mark the downstream end of each reach.

REACH 1

REACH DESCRIPTION:

Reach 1 started at the Canaan Road bridge (Lat: 45.93269300, Long: -122.85500200; Figure 21; Figure 22, panel A) and continued to a point just upstream of the first house along the creek (Lat: 45.929678, Long: -122.860626; Figure 21). The mainstem thalweg length of this reach was 760 m. There were two side channels with a combined thalweg length of 40 m. The channel meandered through this reach and portions of the banks were actively eroding. The riparian zone was dominated by grass and alders and overall land use was rural residential.



Figure 22. Survey pictures on reach 1 of Merrill Creek showing Canaan Road bridge at the downstream end of the reach (panel A) and gravel substrate interspersed with fine sediment (panel B).

RESULTS:

Substrate suitable for Chum Salmon spawning was observed in this reach (Figure 22, panel B); however, there were elevated levels of fine sediment interspersed within this substrate (> 20% of patch area) and that limited the number of suitable substrate patches. Six patches of suitable spawning substrate that met established criteria were found in Merrill Creek reach 1 (Table 10; Figure 23), measuring a total of 8 m². One patch was designated as “high” quality, no patches were categorized as “moderate” quality, and five patches were of “low” quality (Table 10; Figure 23). One cold-water patch was observed, measuring 0.1 m² (Figure 23); temperature in this patch was 12.8° C and temperature adjacent to this patch was 14.0° C. The dominant substrate type within this cold-water patch was fine sediment (< 4 mm diameter). There was one potential barrier to Chum Salmon migration in this reach, classified as a box culvert located under Canaan Road (Figure 21; Table 11; Figure 22, panel A).

Table 10. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 1 of Merrill Creek, west of Dear Island, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	1	1
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	2	3
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	1	1
low	11-20	0	25	75	2	3
low	11-20	0	0	100	0	0

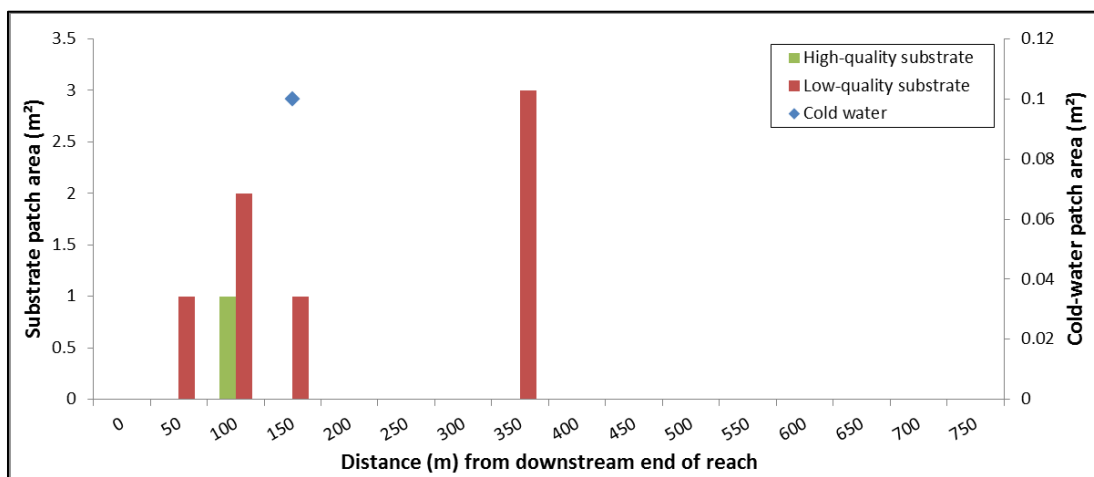


Figure 23. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 1 Merrill Creek, west of Dear Island, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed into 50 m units. Cold-water patches were at least 1.0° C colder than the temperature in the main channel.

Table 11. Barrier type, drop (from flowing water to substrate), width (across stream), length (upstream and downstream), and max pool depth downstream in reach 1 of Merrill Creek, west of Deer Island, OR, in September 2012. ** indicated data not collected

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Box culvert	0	3.7	12	**

REACH 2

REACH DESCRIPTION:

Reach 2 started at the Hills Haven Road bridge (Lat: 45.931451, Long: -122.879359; Figure 21; Figure 24, panel A) and continued upstream to a fence line along the creek (Lat: 45.93119, Long: -122.879359; Figure 24, panel B). The mainstem thalweg length of this reach was 485 m, and there were no side channels. Channel form was confined with meanders observed throughout. Signs of livestock activity (e.g., hoof prints and feces) were observed along the creek, indicating an overall land use of light grazing mixed with rural residential. The riparian zone primarily consisted of alders, maples, cedars and firs.



Figure 24. Survey pictures on reach 2 of Merrill Creek showing a private bridge (panel A), a broken cattle fence near the upstream end of the reach (panel B), and a circular culvert located under Hills Haven Road (panel C).

RESULTS:

Substrate within the range suitable for Chum Salmon (4–128 mm) was observed in reach 2 of Merrill Creek; however, there was excess fine sediment (> 20%) and the substrate was unsuitable for spawning. There were also no cold-water patches that were $\geq 1^\circ$ C colder than the main channel water temperature found. There was one potential barrier to Chum Salmon migration in this reach, classified as a circular culvert located under Hills Haven Road (Figure 21; Table 12; Figure 24, panel C).

Table 12. Barrier type, drop (from flowing water to substrate), width (across stream), length (upstream and downstream), and max pool depth downstream in reach 2 of Merrill Creek, west of Deer Island, OR, in September 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Circular culvert	0	2.2	10	1

Milton Creek

SURVEY DATES: August 30 and September 24, 2012; July 23, July 25, and August 5, 2013

SURVEY CREW: Brian Alfonse, Kris Homel, Lorana McCalester, John Cox, and Brad Benson

GENERAL DESCRIPTION:

The Milton Creek habitat survey (Township: 4N Range: 2W Section: 100) started at the confluence with Salmon Creek and continued 13.9 km upstream to a small logging road bridge located 500 m upstream from the South Canaan Road bridge. Six reaches were delineated (Figure 25) based on physical features, landowner access, and overall distance. Approximately 7.3 km of this section was not surveyed because of landowner denials and dense brush in the stream channel.



Figure 25. Map of reaches (red line) surveyed on Milton Creek, located west of St. Helens, OR. Reach break labels correspond to the downstream end of each reach.

REACH 3.1

REACH DESCRIPTION:

Reach 3.1 started at the confluence of Milton Creek and Salmon Creek (Lat: 45.867313, Long: -122.892378) and continued upstream to a landowner denial at the north end of a holly tree farm (Lat: 45.871548, Long: -122.890267; Figure 26). The mainstem thalweg length of this reach was 673 m, and there were no side channels. The stream was deeply channelized in this reach, and stream banks were > 2 m high in some locations. Most of the reach was comprised of deep pools (too deep to measure; estimated depth = 0.5–1.5 m) dominated by fine sediment, with few meanders. Numerous pieces of large woody debris, dense brush, (Figure 27, panel A) and beaver activity were observed throughout. Overall land use was determined to be rural residential, with a riparian zone dominated by young alders, cedars, and firs.

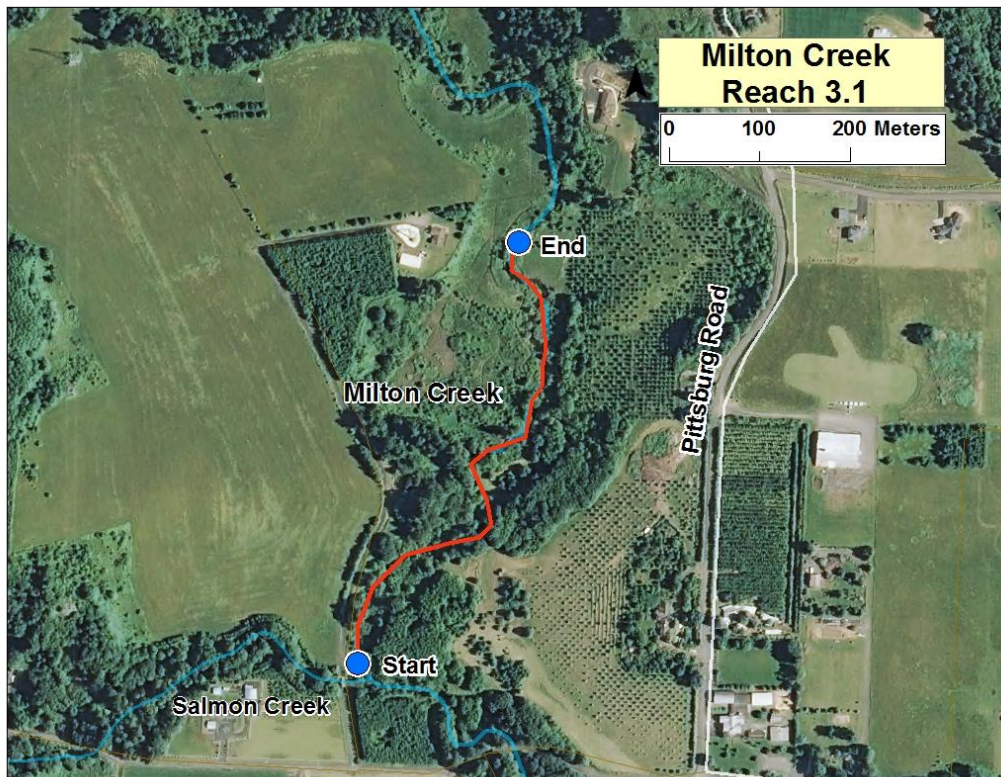


Figure 26. Map of reach 3.1 (red line) on Milton Creek, including start and end points (blue dots).



Figure 27. Survey pictures on reach 3.1 of Milton Creek showing dense brush (panel A) and a stream section with hardpan-clay (panel B).

RESULTS:

The substrate in reach 3.1 of Milton Creek consisted almost entirely of fine sediment (< 4 mm, diameter) or hardpan clay (Figure 27, panel B); large cobble (> 129 mm, diameter) was observed in five locations. There were no gravel patches in this reach that met minimum

established criteria. There were also no cold-water patches and no potential barriers to Chum Salmon migration found within this reach.

REACH 3.4

REACH DESCRIPTION:

Reach 3.4 started at a private bridge near Pittsburg Road (Lat: 45.887456, Long: -122.915310) and continued upstream to a landowner denial next to a house on the creek (Lat: 45.886627, Long: -122.919098; Figure 28). The mainstem thalweg length of this reach was 530 m, and there were no side channels. Channel form was confined, with limited meanders. Stream velocity was slow and the water color had a grey hue. The riparian zone was dominated by grass and included sparse trees (Figure 29, panel A). Land use was a mix of rural residential and light grazing. Throughout the reach, the banks were actively eroding and the stream channel was deeply entrenched (Figure 29, panel B).



Figure 28. Map of reach 3.4 (red line) on Milton Creek, including start and end points (blue dots).

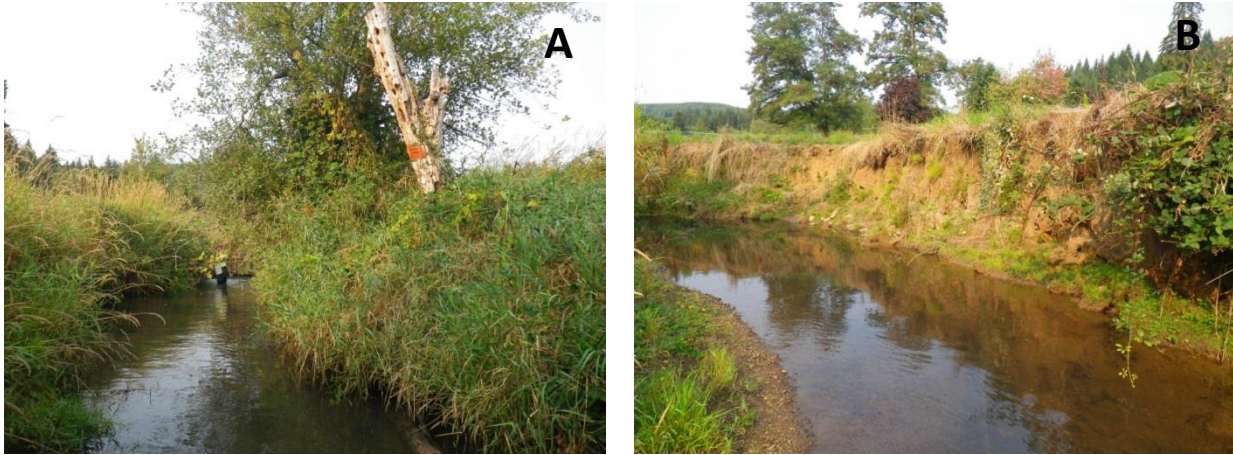


Figure 29. Survey pictures of reach 3.4 of Milton Creek showing a riparian zone dominated by grass near the downstream end of the reach (panel A), and a heavily eroded bank with incised channel (panel B).

RESULTS:

Suitable substrate sizes were observed in reach 3.4 of Milton Creek; however, fine sediment levels exceeded 20%, and the substrate was unsuitable for spawning. No cold-water patches meeting established criteria were found. There were also no potential barriers to Chum Salmon migration within this reach.

REACH 3.5

REACH DESCRIPTION:

Reach 3.5 started at a small footbridge (Lat: 45.88853, Long: -122.922712) and continued upstream to a point adjacent to Pittsburg Road (Lat: 45.889678, Long: -122.922826; Figure 30). The mainstem thalweg length of this reach was 197 m, and there were no side channels. Channel form was confined with few meanders. Beaver activity was observed in this reach, including a newly constructed beaver dam (Figure 31). The riparian zone consisted primarily of grasses and young deciduous timber. Land use was a mix of rural residential and light grazing.



Figure 30. Map of reach 3.5 (red line) on Milton Creek, including start and end points (blue dots).



Figure 31. Survey picture of reach 3.5 on Milton Creek showing a beaver dam and pool.

RESULTS:

In reach 3.5 of Milton Creek abundant substrate in size categories suitable for Chum Salmon (4–128 mm, diameter) was observed, but because of excess levels of fine sediment (> 20% of

patch area), no suitable habitat was identified. No cold-water patches were found. There were also no potential barriers to Chum Salmon migration within this reach.

REACH 4

REACH DESCRIPTION:

Reach 4 started at a log jam 250 m downstream from where Pittsburg Road crosses Milton Creek for the third time (Lat: 45.891675, Long: -122.92763) and continued upstream to a small tributary 300 m downstream from the Pinkney logging road bridge (Lat: 45.903515, Long: -122.929833; Figure 32). The mainstem thalweg length of this reach was 1,664 m. There were nine side channels with a combined thalweg length of 224 m. The channel was entrenched and several seeps and springs were observed. Channel form was confined, with multiple channels and meanders throughout. The riparian zone consisted of alders, cedars, and firs. Land use was a combination of young and mature timber. Beaver activity was observed throughout this reach, and there were several small beaver dams that were < 1 m in height (Figure 33, panel B).



Figure 32. Map of reach 4 (red line) on Milton Creek, including start and end points (blue dots) and one location with increased gradient (not considered a barrier).

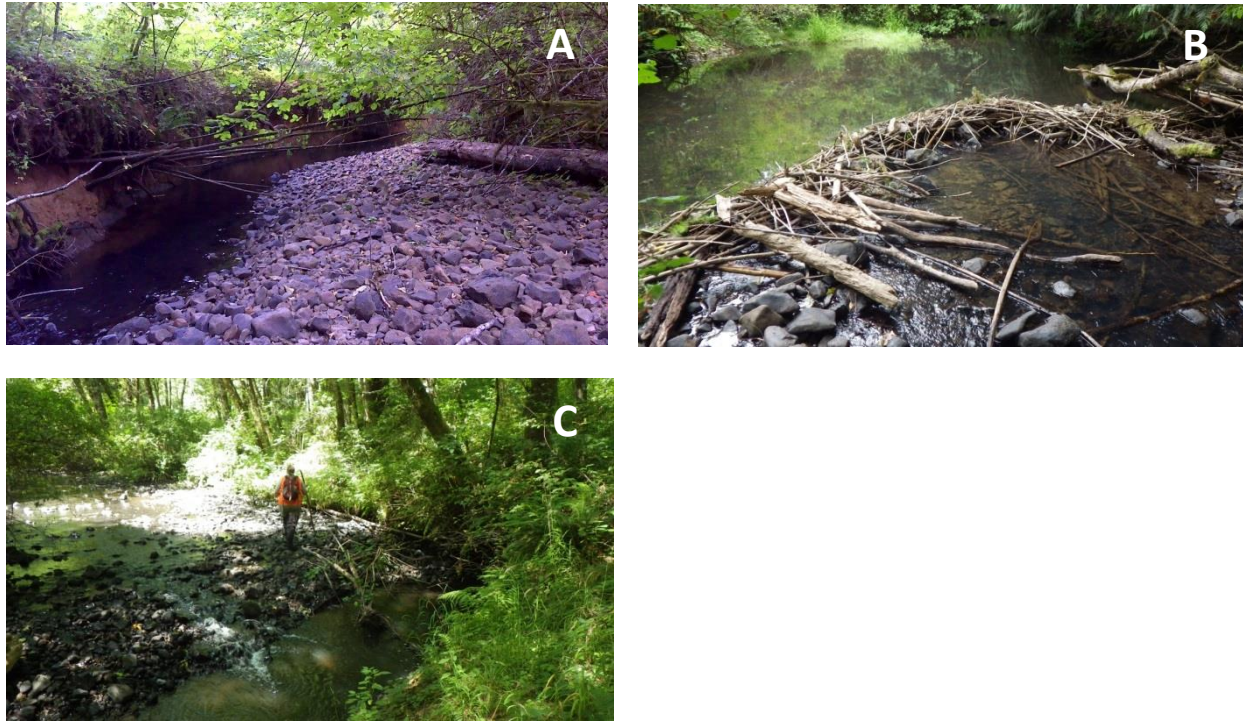


Figure 33. Survey pictures on reach 4 of Milton Creek showing gravel typical of the size observed throughout the reach (panel A), a small beaver dam (panel B), and increased gradient over a gravel bar (panel C).

RESULTS:

Substrate in reach 4 of Milton Creek was primarily large cobble and boulders (> 128 mm, diameter), but a small amount of suitable spawning habitat was observed as well (Figure 33, panel A). Ten patches of suitable spawning substrate met minimum established criteria (Table 13; Figure 34), measuring a total of 37 m² in surface area. All patches were designated “low” quality (Table 13; Figure 34). There were 15 cold-water patches in the reach, with a combined surface area of 122.0 m² (Figure 34); average temperature in these patches was 13.5° C and average temperature adjacent to these patches was 15.8° C. The dominant substrate types within these cold-water patches were fine sediment (n = 9) and small cobble (n = 6). There were also four patches with temperatures between 0.5° C and 0.9° C colder than that of the adjacent stream. There was one location with increased gradient where the stream flowed over a gravel bar, but it was not considered a barrier (Figure 32; Figure 33, panel C).

Table 13. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 4 of Milton Creek, west of St. Helens, OR, in July 2013.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	4	13
low	11-20	0	25	75	5	21
low	11-20	0	0	100	1	3

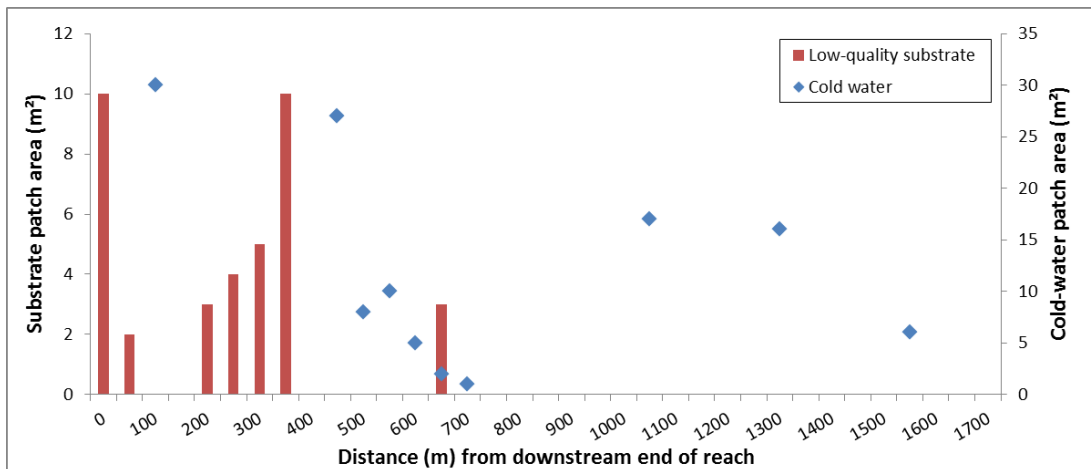


Figure 34. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 4 of Milton Creek, west of St. Helens, OR, in July 2013. Cold water and substrate patch areas were summed into 50 m units. Cold-water patches were at least 1.0° C colder than the temperature in the main channel.

REACH 5.1

REACH DESCRIPTION:

Reach 5.1 started at a point (Figure 36, panel A) west of Pinkney logging road (Lat: 45.913379, Long: -122.941721) and continued to a fence line at the downstream end of a bison ranch (Lat: 45.918578, Long: -122.945288; Figure 35). The mainstem thalweg length of this reach was 1,250 m, and there were no side channels. This channel was wide and meandering, with numerous pools and log jams (Figure 36, panel B). The riparian zone was dominated by shrubs and alders, and land use was young timber. Beaver dams were common throughout this reach, especially in the upper quarter.

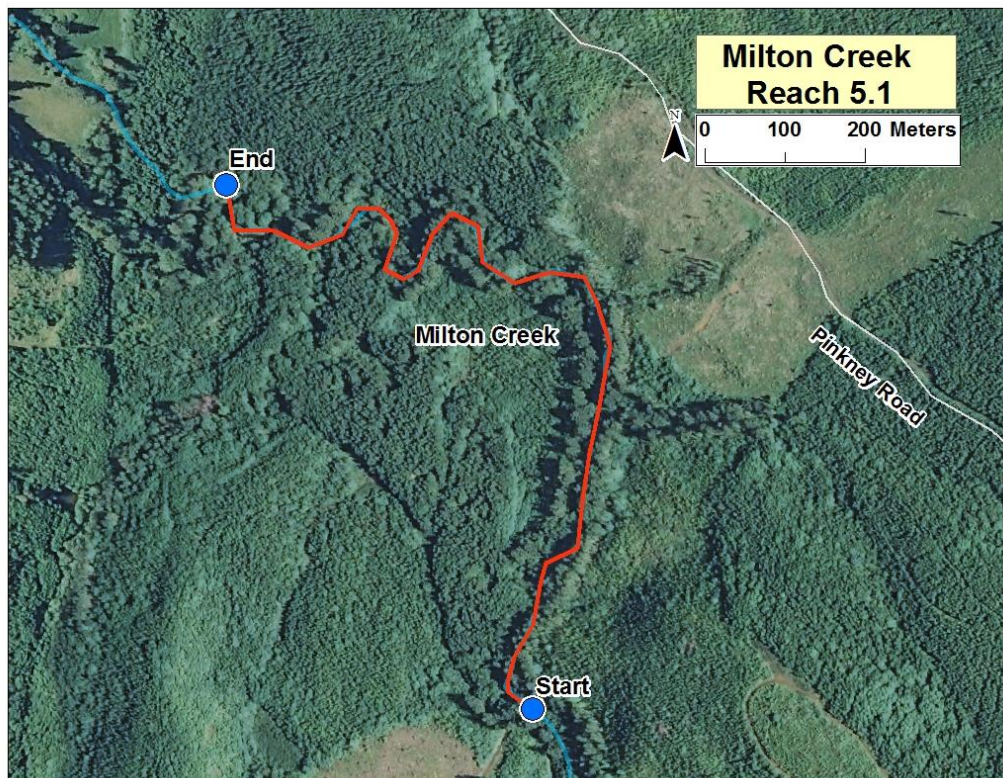


Figure 35. Map of reach 5.1 (red line) on Milton Creek, including start and end points (blue dots).



Figure 36. Survey pictures on reach 5.1 of Milton Creek showing a riffle section with large cobble and boulders (panel A) and a large pool (panel B).

RESULTS:

The substrate in reach 5.1 of Milton Creek was predominantly silt, fine organics, and bedrock, except for one small section (< 100 m, thalweg length) with larger cobble and boulders (Figure 36, panel A). No gravel patches that met minimum criteria were observed. Five cold-water patches totaling 14.6 m² were found (Figure 37). Average temperature in these patches was 15.8° C and average temperature adjacent to these patches was 17.4° C. The dominant substrate types within these cold-water patches were fine sediment (n = 3), small cobble (n = 1), and large cobble (n = 1). There were no potential barriers to Chum Salmon migration.

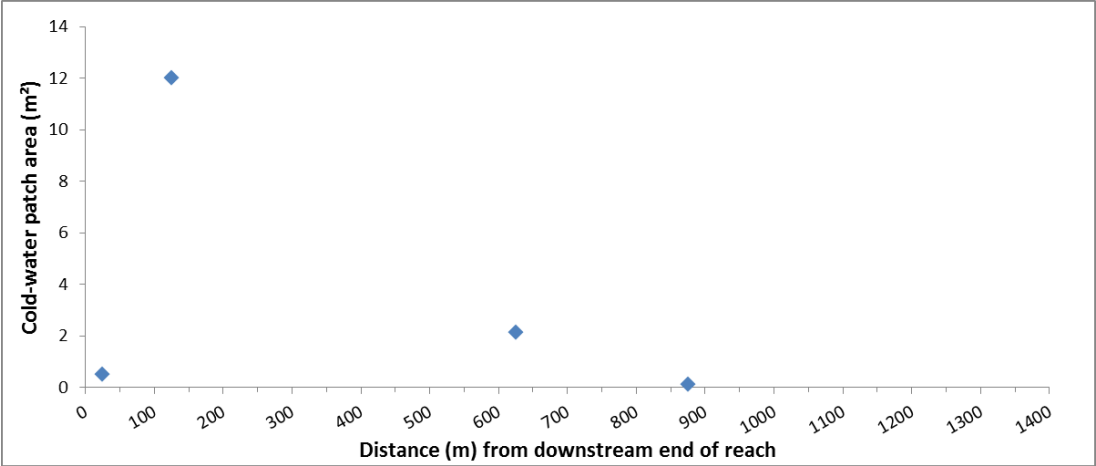


Figure 37. Location of cold-water patches measured as distance from downstream end of survey in reach 5.1 of Milton Creek, west of St. Helens, OR, in August 2013. Cold-water patches were at least 1.0° C colder than the temperature in the main channel and patches were summed into 50 m units

REACH 5.2

REACH DESCRIPTION:

Reach 5.2 started at the Pinkney Road bridge, 125 m downstream of the confluence of Milton Creek and Apilton Creek (Lat: 45.922601, Long: -122.952919), and continued upstream to a small logging road bridge upstream of South Canaan Road (Lat: 45.92957, Long: -122.969963; Figure 38). The mainstem thalweg length of this reach was 2,398 m. There were five side channels with a combined thalweg length of 104 m. Channel form was confined, with multiple channels and meanders. Riparian vegetation was limited in the downstream half of the reach where the creek flowed through a bison ranch. Upstream of the ranch, vegetation was more abundant and was dominated by alders and firs. Land use was a mix of grazing and mature timber. There were several small landslides in this reach that had deposited logs and fine sediment (< 4 mm, diameter) into the stream channel. Beaver activity was also observed in this reach (Figure 39, panel C).

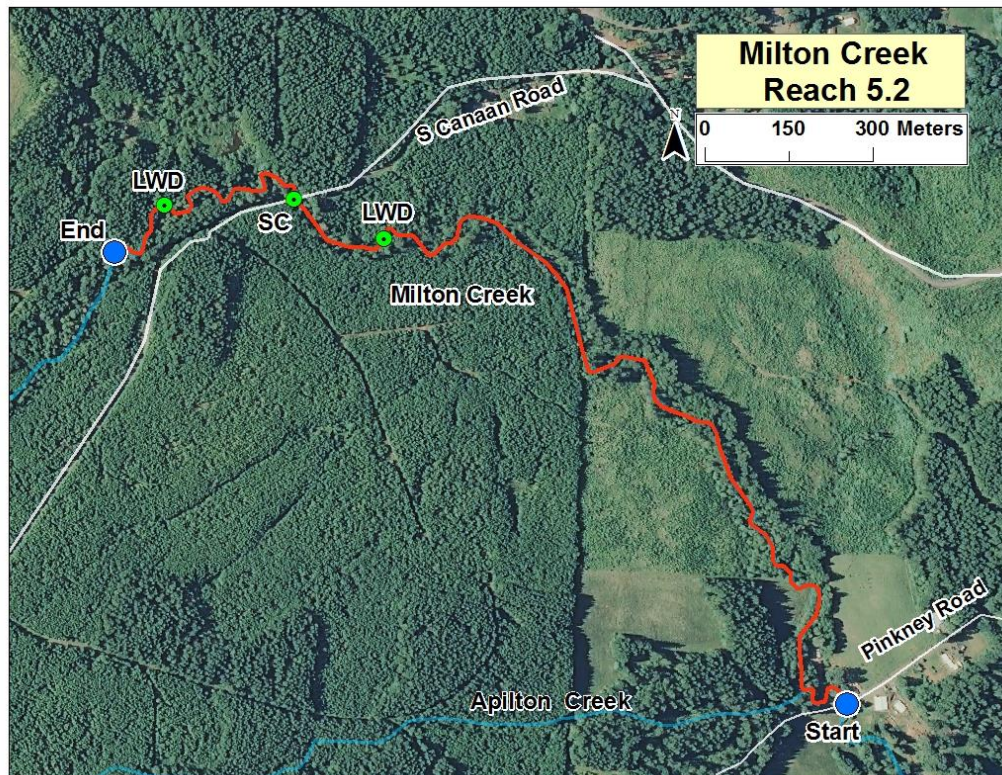


Figure 38. Map of reach 5.2 (red line) on Milton Creek, including start and end points (blue dots), a semicircular culvert (SC) and two log jam barriers (LWD).



Figure 39. Survey pictures on reach 5.2 of Milton Creek showing a suitable gravel patch (panel A), a stream section with boulders and large cobble substrate (panel B), a small beaver dam near the middle of the reach (panel C) a large log jam across the stream (panel D), a culvert under South Canaan road (panel E), and a log jam (panel F).

RESULTS:

Several suitable substrate patches were observed, including some in dry channels (Figure 39, panel A), but most of the substrate was too large (> 128 mm diameter) to be considered suitable for Chum Salmon spawning (Figure 39, panel B). Eight patches of suitable spawning substrate met minimum criteria in Milton Creek reach 5.2 (Table 14; Figure 40), measuring a total of 24 m². All patches were designated “low” quality (Table 14) because of elevated levels

of fine sediment (11–20% of patch area), but substrate consisted of large gravel and small cobble. Seven cold-water patches, totaling 28.4 m² were found (Figure 40); average temperature in these patches was 14.1° C and average temperature adjacent to these patches was 15.9° C. The dominant substrate types within these cold-water patches were fine sediment (n = 5), large gravel (n = 1), and small cobble (n = 1). There were an additional eight cold-water patches with temperatures 0.5–0.9° C colder than that of the adjacent stream. There were three potential barriers to Chum Salmon migration in this reach (Figure 38; Table 15). The first barrier was a channel-spanning log jam that created a plunge pool (Table 15; Figure 39, panel D). The second barrier was a circular culvert under South Canaan Road (Table 15; Figure 39 panel E). The third barrier was a channel-spanning log jam (Table 15; Figure 39, panel F).

Table 14. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 5.2 of Milton Creek, west of St. Helens, OR, in July 2013.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	1	2
low	11-20	0	50	50	4	9
low	11-20	0	25	75	3	13
low	11-20	0	0	100	0	0

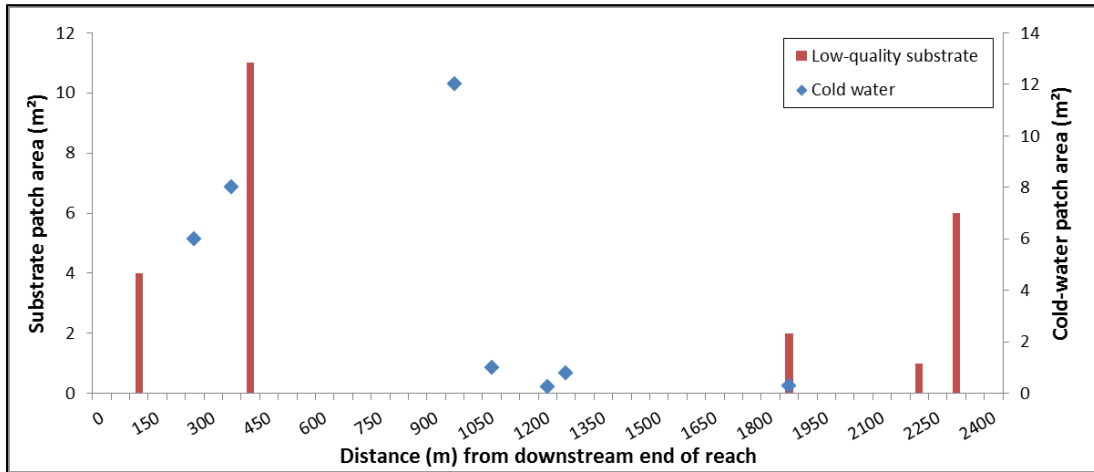


Figure 40. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 5.2 of Milton Creek, west of St. Helens, OR, in July 2013. Cold water and substrate patch areas were summed into 50 m units. Cold-water patches were at least 1.0° C colder than the temperature in the main channel.

Table 15. List of barriers, types, drops (from flowing water to substrate), widths (across stream), lengths (upstream and downstream), and max pool depths downstream for reach 5.2 in Milton Creek, west of St. Helens, OR, in July 2013

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Large woody debris	1	0.5	6	0.7
2	Semicircular culvert	0	2	12	1.1
3	Large woody debris	1.3	8	2	0.3

Raymond Creek

SURVEY DATE: August 27, 2012

SURVEY CREW: Brian Alfonse and Lorana McCalester

GENERAL DESCRIPTION:

The Raymond Creek habitat survey (Township: 3N Range: 2W Section: 1500) started 200 m upstream from the mouth of the creek (Lat: 45.739151, Long: -122.911808) and continued upstream to a green tin shed (Lat: 45.736407, Long: -122.921273; Figure 41). The survey consisted of one reach with a mainstem thalweg length of 928 m. There were two side channels with a combined thalweg length of 40 m. Channel form was primarily confined with multiple meanders. The riparian zone was dominated by manicured lawns, with a few trees at the upstream end of the reach (Figure 42, panel A). Limited riparian vegetation, extensive bank

erosion, and livestock activity along the stream bank were observed throughout the reach. Land use was a mix of heavy grazing and rural residential.

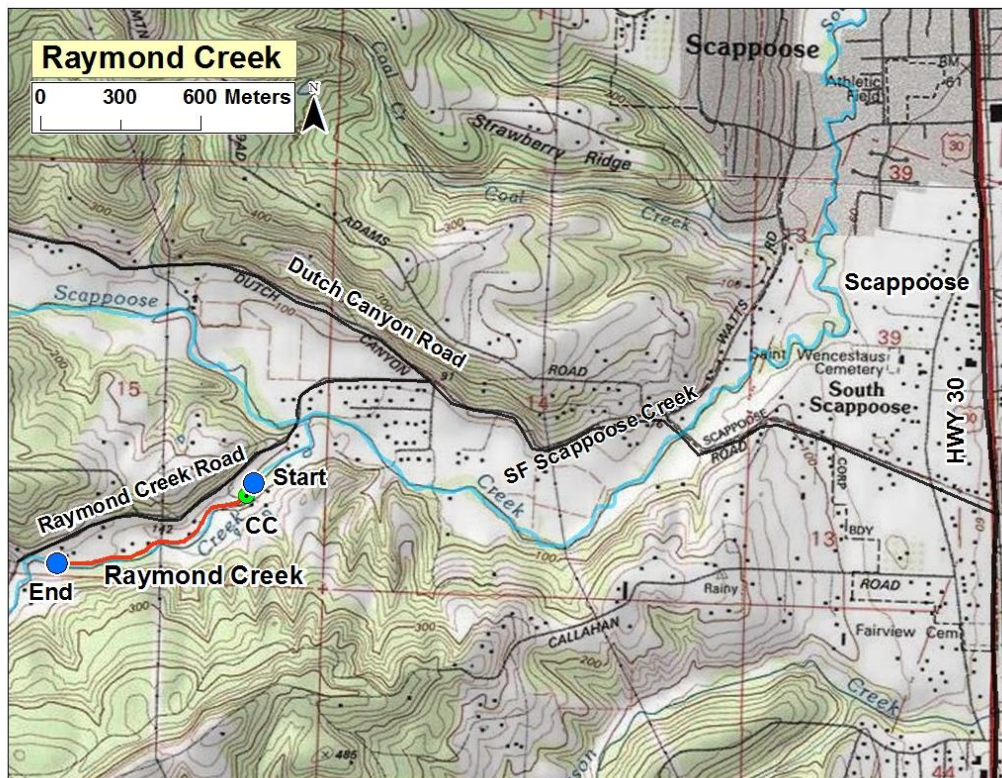


Figure 41. Map of reach (red line) surveyed on Raymond Creek located southwest of Scappoose, OR, including start and end points (blue dots) and a circular culvert (CC).



Figure 42. Survey pictures on Raymond Creek showing a maintained lawn extending to the stream bank (panel A) and a culvert underneath a small bridge (panel B).

RESULTS:

Substrate sizes within the range suitable for Chum Salmon (4–128 mm) were observed in this reach, however because fine sediment levels were > 20%, little suitable spawning habitat was

identified. Twenty-one patches of suitable spawning substrate met minimum criteria in Raymond Creek (Table 16; Figure 43), measuring a total of 70 m². None of these patches were categorized as “high” quality, one patch was of “moderate” quality, and 20 patches were of “low” quality (Table 16; Figure 43). No cold-water patches were observed. There was one potential barrier to Chum Salmon migration in this reach, classified as a circular culvert and located under a small farm road near the downstream end of the reach (Figure 41; Table 17; Figure 42, panel B).

Table 16. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in Raymond Creek, southwest of Scappoose, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	1	2
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	3	6
low	11-20	0	25	75	8	27
low	11-20	0	0	100	9	35

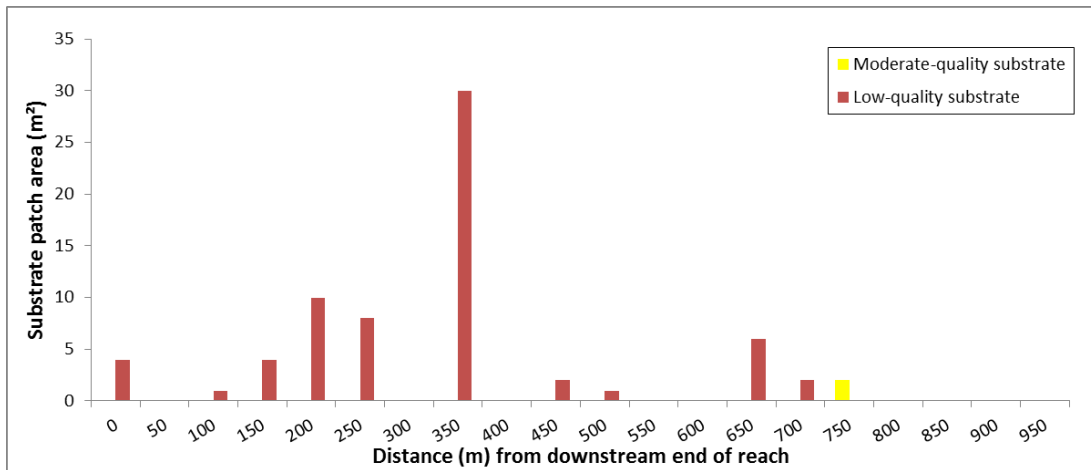


Figure 43. Location of substrate patches measured as distance from downstream end of survey in Raymond Creek, southwest of Scappoose, OR, in August 2012. For each category of substrate quality, patch area was summed and binned into 50 m units.

Table 17. Barrier type, drop (from flowing water to substrate), barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in Raymond Creek, west of Scappoose, OR, in August 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Circular culvert	2.4	2.5	9.7	0.7

Salmon Creek

SURVEY DATE: August 15, 2012

SURVEY CREW: Brian Alfonse and Lorana McCalester

GENERAL DESCRIPTION:

The Salmon Creek habitat survey (Township: 5N Range: 2W Section: 3500) started at a culvert where Brinn Road crosses the creek for the second time (Lat: 45.866663, Long: -122.898423), and continued to a point 150 m upstream of the third Brinn Road bridge (Lat: 45.866483, Long: -122.904644; Figure 44). The survey consisted of one reach with a mainstem thalweg length of 689 m, and one side channel with a thalweg length of 22 m. Channel form was confined with multiple meanders. The riparian zone was well established and was predominantly mature red cedars, firs, alders, and maples (Figure 45, panel A). Land use was mature timber, with some rural residential influence. Several beaver dams were observed within this reach, some of which created large pools.



Figure 44. Map of reach (red line) surveyed on Salmon Creek, located west of St. Helens, OR, including start and end points (blue dots), a circular culvert (CC), a beaver dam (BD), and a semicircular culvert (SC).



Figure 45. Survey pictures on Salmon Creek showing the dense riparian vegetation in the upstream end of the reach (panel A), a circular culvert at the second Brinn Road bridge (panel B), a large beaver dam (panel C), and a semicircular culvert at the third Brinn Road bridge near the upstream end of the reach (panel D).

RESULTS:

In Salmon Creek substrate in size classes suitable for Chum Salmon (4–128 mm, diameter) was present, however fine sediment was > 20%, and no suitable spawning habitat was identified. Five cold-water patches totaling 48.9 m² were found (Figure 46); average temperature in these patches was 14.9° C and average temperature adjacent to these patches was 18.9° C. The dominant substrate type within these cold-water patches was fine sediment (< 4 mm, diameter). There were three potential barriers to Chum Salmon migration in this reach (Figure 44; Table 18): (1) a circular culvert under Brinn Road located at the downstream end of the reach, (2) a large beaver dam with a deep pool upstream, and (3) a semicircular culvert under Brinn Road located in the upstream half of the reach (Table 18; Figure 45 panels B–D).

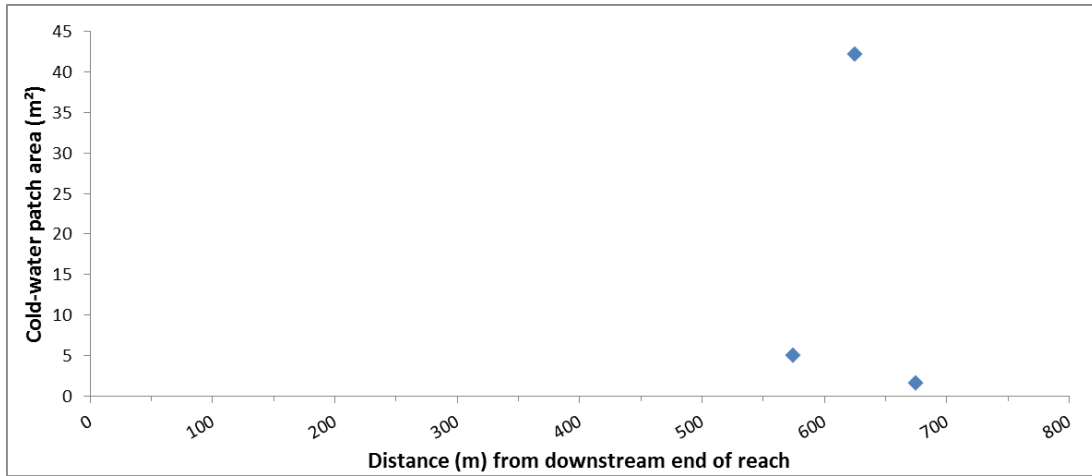


Figure 46. Location of cold-water patches measured as distance from downstream end of survey in Salmon Creek, west of St. Helens, OR, in August 2012. Cold-water patches were $\geq 1.0^{\circ}\text{C}$ colder than the main channel temperature and patch area was summed and binned into 50 m units.

Table 18. List of barriers, types, barrier drops (from flowing water to substrate), barrier widths (across stream), barrier lengths (upstream and downstream), and max pool depths downstream of the barrier in Salmon Creek, west of St. Helens, OR, in August 2012. Note: * indicated data not collected.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Circular culvert	2	2.5	N/A	N/A
2	Beaver dam	1.5	14	2	1.5
3	Semicircular culvert	1.7	5.8	23	N/A

Scappoose Creek Surveys

GENERAL DESCRIPTION:

Scappoose Creek is the largest drainage in this population. North Fork and South Fork Scappoose Creeks converge to form Scappoose Creek 500 m east of Highway 30. Twelve reaches were surveyed within the Scappoose Creek drainage, including: (1) two reaches in Scappoose Creek, (2) three reaches in North Fork Scappoose Creek, and (3) seven reaches in South Fork Scappoose Creek (Figure 47). These surveys were conducted between August 6 and September 20, 2012.

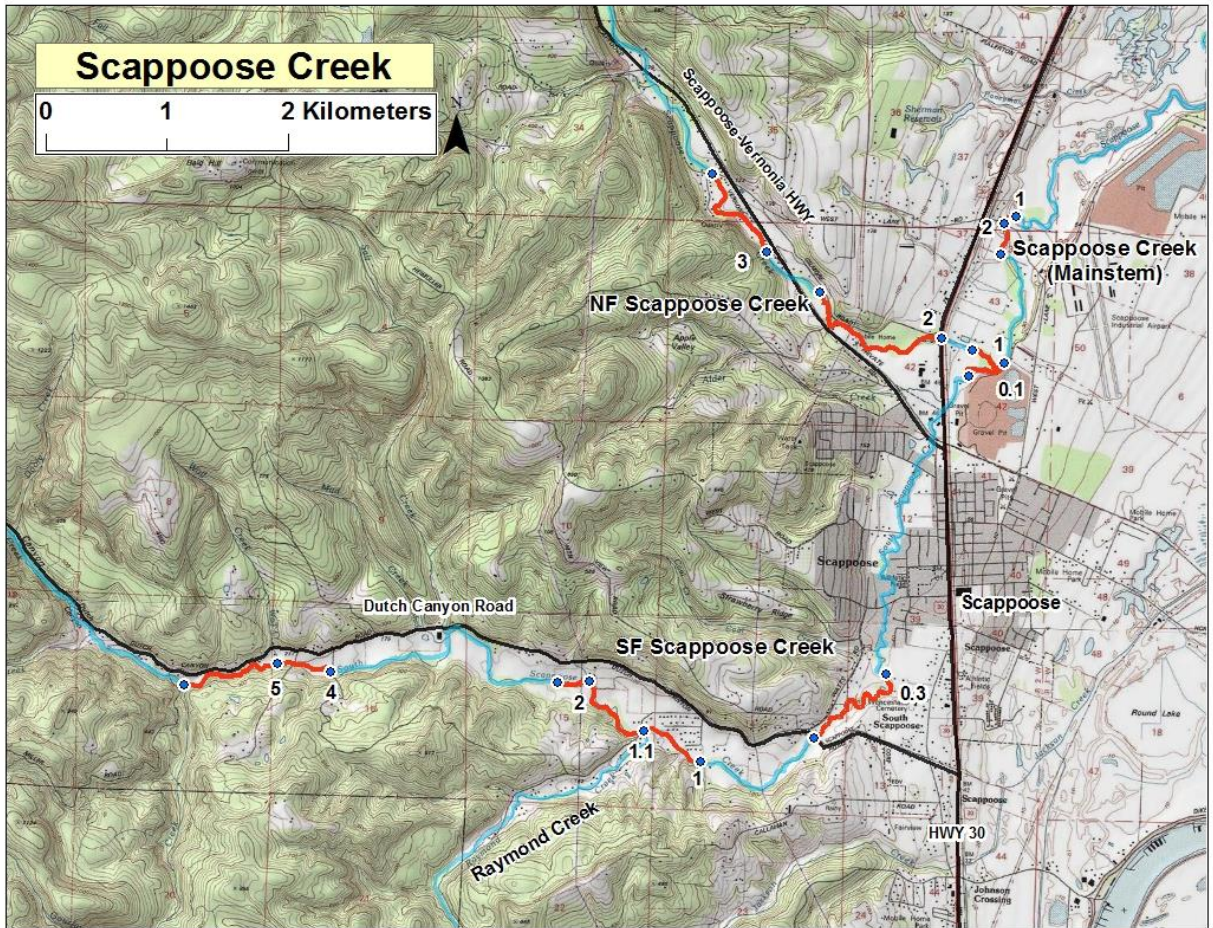


Figure 47. Map of reaches (red line) surveyed on Scappoose Creek, located west of Scappoose, OR. Reach break labels correspond to the downstream end of each reach.

Scappoose Creek

SURVEY DATE: August 6, 2012

SURVEY CREW: Kris Homel

GENERAL DESCRIPTION:

The Scappoose Creek habitat survey (Township: 4N Range: 2W Section: 100) started 200 m downstream from the West Lane Road bridge and continued to a point 450 m upstream. Surveys on Scappoose Creek were delineated into two reaches (Figure 48) based on physical features, landowner access, and overall distance. Temperature data were not collected for either reach.

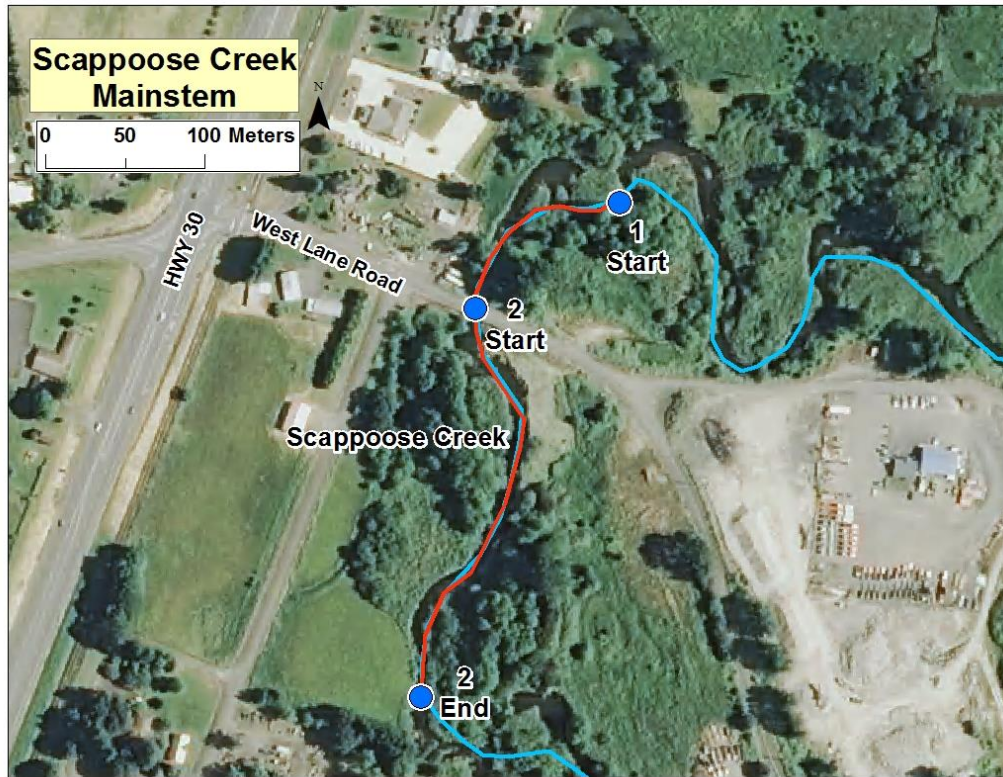


Figure 48. Map of reaches 1 and 2 (red line) on Scappoose Creek, including start and end points (blue dots).

REACH 1

REACH DESCRIPTION:

Reach 1 started 150 m downstream of West Lane Road at a large log jam (Lat: 45.779499, Long: -122.872896) and continued upstream to West Lane Road bridge. The mainstem thalweg length of this reach was 100 m, and there were no side channels. Channel form was confined with multiple meanders. There were several large log jams and deep pools, and the reach was tidally influenced resulting in slow water velocity (Figure 49). Riparian vegetation was dominated by grasses, but some hardwood tree species were also present. Land use was rural residential.



Figure 49. Survey picture in reach 1 of Scappoose Creek showing vegetated banks and deep pools, with limited gravel.

RESULTS:

Nine patches of suitable spawning substrate that met minimum criteria were found in reach 1 of Scappoose Creek (Table 19), measuring a total of 542 m². Two patches were designated “high” quality (64 m²), four were of “moderate” quality (252 m²), and three were of “low” quality (226 m²; Table 19). Large gravel was the most common substrate type within these patches (Table 19). Stream temperature data was not collected in this reach. There were no potential barriers to Chum Salmon migration in this reach.

Table 19. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 1 of Scappoose Creek, north of Scappoose, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	1	48
high	0-10	25	75	0	0	0
high	0-10	0	100	0	1	16
moderate	0-10	0	75	25	1	98
moderate	0-10	0	50	50	1	16
low	0-10	0	25	75	1	160
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	1	48
moderate	11-20	0	100	0	1	90
low	11-20	0	75	25	1	48
low	11-20	0	50	50	0	0
low	11-20	0	25	75	1	18
low	11-20	0	0	100	0	0

REACH 2

REACH DESCRIPTION:

Reach 2 started at the West Lane Road bridge, and continued upstream to the upstream end of the county park property (Lat: 45.777515, Long: -122.873285; Figure 48). The mainstem thalweg length of this reach was 450 m and there were no side channels. Channel form was confined, with few meanders, and active erosion of the stream banks was observed. Riparian vegetation was dominated by grasses, but some hardwood tree species were also present (Figure 50). Primary land use was rural residential.



Figure 50. Survey picture in reach 2 of Scappoose Creek showing vegetated banks and deep pools, with limited gravel.

RESULTS:

Fifteen patches of suitable spawning substrate that met minimum established criteria were found in reach 2 of Scappoose Creek (Table 20), measuring a total of 888 m² in surface area. One patch was designated “high” quality (132 m², area), eight were of “moderate” quality (472 m², area), and six were of “low” quality (284 m², area; Table 20). Large gravel was the most common substrate type within these patches (Table 20). Stream temperature data was not collected to evaluate cold-water patches in this reach. There were no potential barriers to Chum Salmon migration in this reach.

Table 20. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 2 of Scappoose Creek, north of Scappoose, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	1	132
moderate	0-10	0	75	25	2	192
moderate	0-10	0	50	50	4	247
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	2	33
low	11-20	0	75	25	3	128
low	11-20	0	50	50	3	156
low	11-20	0	25	75	0	0
low	11-20	0	0	100	0	0

North Fork Scappoose Creek

SURVEY DATES: August 8, September 5, and September 10, 2012

SURVEY CREW: Brian Alfonse, Kris Homel, Lorana McCalester, and Brad Benson

GENERAL DESCRIPTION:

The North Fork Scappoose Creek habitat survey (Township: 3N Range: 2W Section: 1D0) started at the confluence with South Fork Scappoose Creek and continued 3.3 km upstream to the Sam Blehm Road bridge. Surveys on North Fork Scappoose Creek were delineated into three reaches (Figure 47) based on landowner access and overall distance. Approximately 900 m of stream was not surveyed due to landowner denials.

REACH 1

REACH DESCRIPTION:

Reach 1 started at the confluence of North Fork and South Fork Scappoose Creeks (Lat: 45.769187, Long: -122.872801), and continued upstream to a landowner denial 300 m downstream from where Highway 30 crosses the creek (Lat: 45.770417, Long: -122.875638; Figure 51). A 300 m section of stream between the highway and the end of this reach was not surveyed due to a landowner denial. The mainstem thalweg length of this reach was 306 m, with meanders observed throughout. There was one side channel with a thalweg length of 200 m. This side channel was not surveyed because it was a new restoration site. There was an extensive habitat restoration project on both stream banks in this reach (Figure 52, panel A). Riparian vegetation was sparse and included some young alders. Land use was rural residential. There were also several large log jams associated with pools (Figure 52, panel B).



Figure 51. Map of reach 1 (red line) on North Fork Scappoose Creek, including start and end points (blue dots).

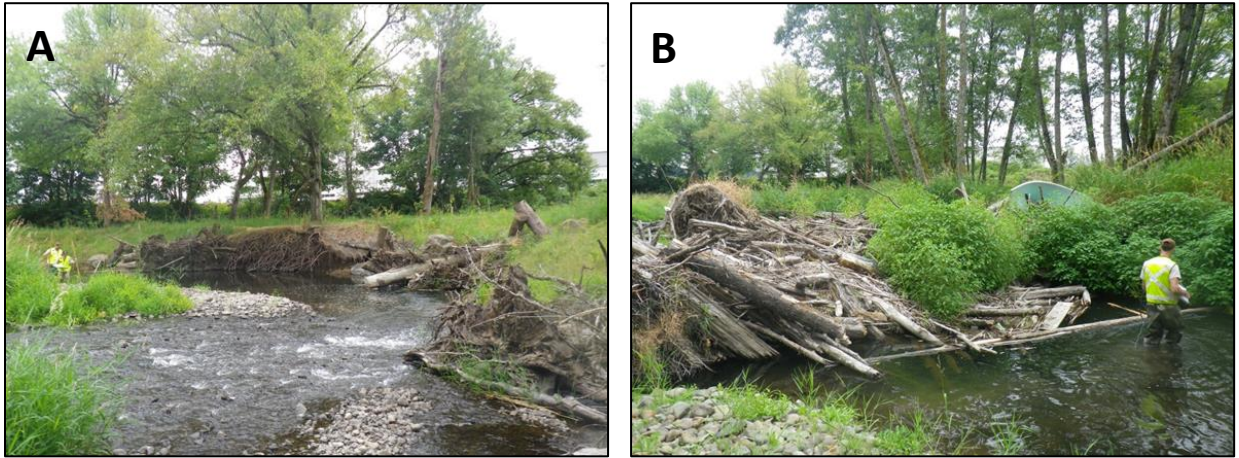


Figure 52. Survey pictures in reach 1 of North Fork Scappoose Creek showing an eroded bank and logs placed as part of a restoration project near the downstream end of the reach (panel A), and a channel-spanning log jam (panel B).

RESULTS:

Eleven patches of suitable spawning substrate met minimum established criteria in reach 1 of North Fork Scappoose Creek (Table 21; Figure 53), measuring a total of 177 m². These patches were designated “low” quality because of either elevated levels of fine sediment (11–20% of patch area), or elevated proportions of small cobble (> 75% of patch area; Table 21). Hardpan clay was also observed in this reach. No cold-water patches were found. There were also no potential barriers to Chum Salmon migration in this reach.

Table 21. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 1 of North Fork Scappoose Creek, northwest of Scappoose, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	5	94
low	0-10	0	0	100	1	6
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	3	52
low	11-20	0	25	75	2	25
low	11-20	0	0	100	0	0

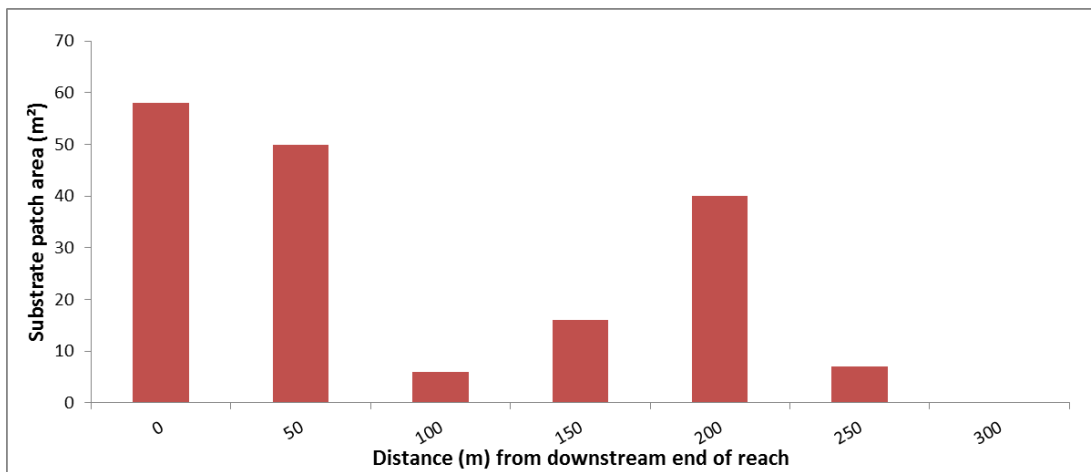


Figure 53. Location of low quality substrate patches (red bars) measured as distance from downstream end of survey in reach 1 of North Fork Scappoose Creek, northwest of Scappoose, OR, in August 2012. Substrate patch area was summed and binned into 50 m units.

REACH 2

REACH DESCRIPTION:

Reach 2 started at the Highway 30 bridge (Lat: 45.771105, Long: -122.879593) and ended 300 m downstream of the Scappoose-Vernonia Highway bridge (Lat: 45.771767, Long: -122.891027; Figure 54). The mainstem thalweg length of this reach was 1,077 m, with meanders observed throughout. There was one side channel with a thalweg length of 84 m. The riparian zone was dominated by reed canary grass and shrubs; however, there were also areas of sparse alders and maples. Land use was rural residential.

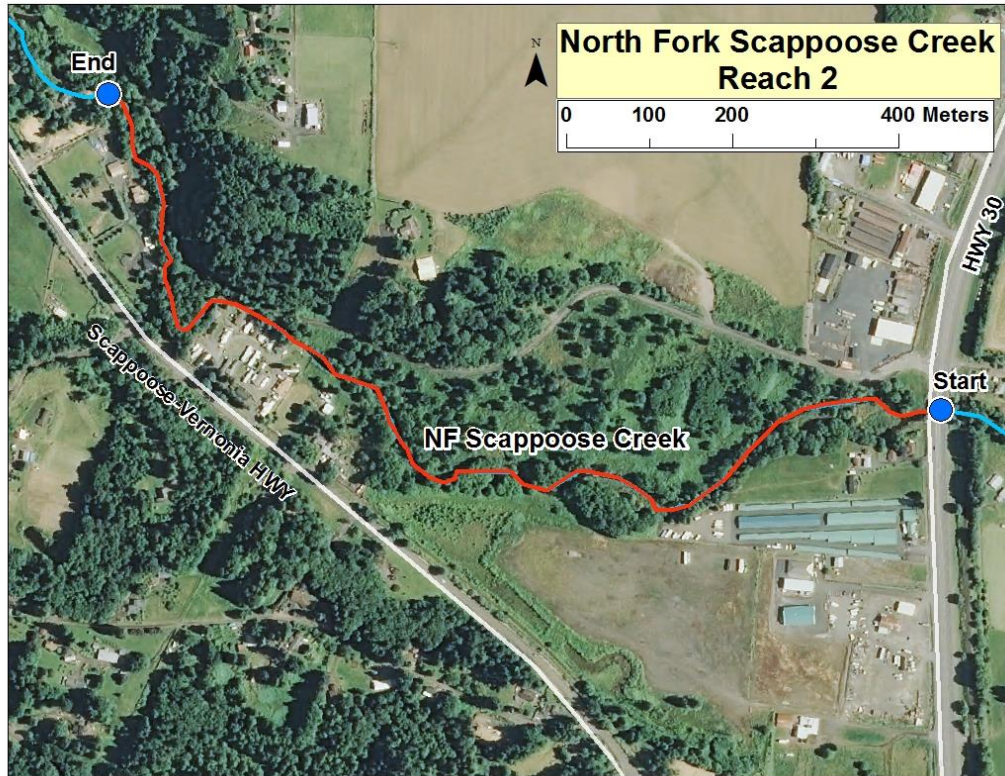


Figure 54. Map of reach 2 (red line) on North Fork Scappoose Creek, including start and end points (blue dots).



Figure 55. Survey pictures in reach 2 of North Fork Scappoose Creek showing a gravel bar near the downstream end of the reach (panel A), and a bedrock shelf and pool near the middle of reach (panel B).

RESULTS:

In reach 2 of North Fork Scappoose Creek suitable substrate for spawning was observed, including several patches on dry gravel bars (Figure 55, panel A) and one large substrate patch adjacent to a deep pool (Figure 55, panel B). Forty-one patches of suitable spawning substrate were found in this reach (Table 22; Figure 56), measuring a total of 278 m². None of these patches were categorized as “high” quality, three were of “moderate” quality, and 38 were of “low” quality (Table 22; Figure 56). Small cobble was the dominant substrate type in all but two of these patches, and 15 patches contained < 10% fine sediment (Table 22). Seven cold-water patches measuring a total of 44.2 m² were observed (Figure 56); average temperature in these patches was 16.6° C and average temperature adjacent to these patches was 18.9° C. The dominant substrate types within these cold-water patches were fine sediment (n = 2) and large gravel (n = 5). There were no potential barriers to Chum Salmon migration in this reach.

Table 22. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 2 of North fork Scappoose Creek, northwest of Scappoose, OR, September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	1	10
low	0-10	0	25	75	7	54
low	0-10	0	0	100	7	60
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	2	3
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	2	11
low	11-20	0	50	50	4	10
low	11-20	0	25	75	12	95
low	11-20	0	0	100	6	35

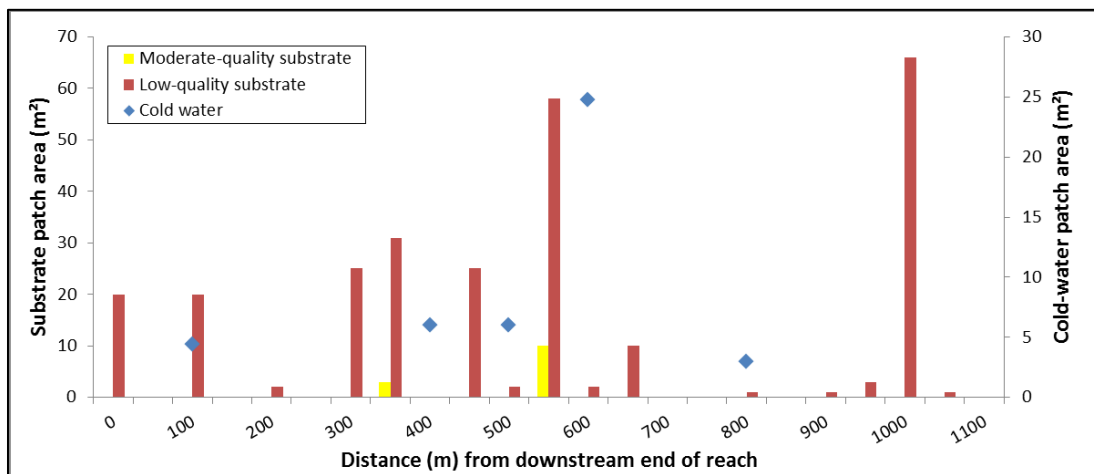


Figure 56. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 2 of North Fork Scappoose Creek, northwest of Scappoose, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 3

REACH DESCRIPTION:

Reach 3 started 300 m upstream of the Scappoose-Vernonia highway bridge (Lat: 45.777106, Long: -122.898033; Figure 58, panel A) and continued upstream to the Sam Blehm Road bridge (Lat: 45.78283, Long: -122.904084; Figure 57). The mainstem thalweg length of this reach was 986 m. There were two side channels with a combined thalweg length of 117 m. Channel form was primarily confined, but there were multiple channels and meanders. The riparian zone in this reach was dense with young timber, but also included maintained yards on residential properties. In several locations, landowners were pumping water out of the stream for irrigation. Primary land use was rural residential, with some agriculture influence as well.

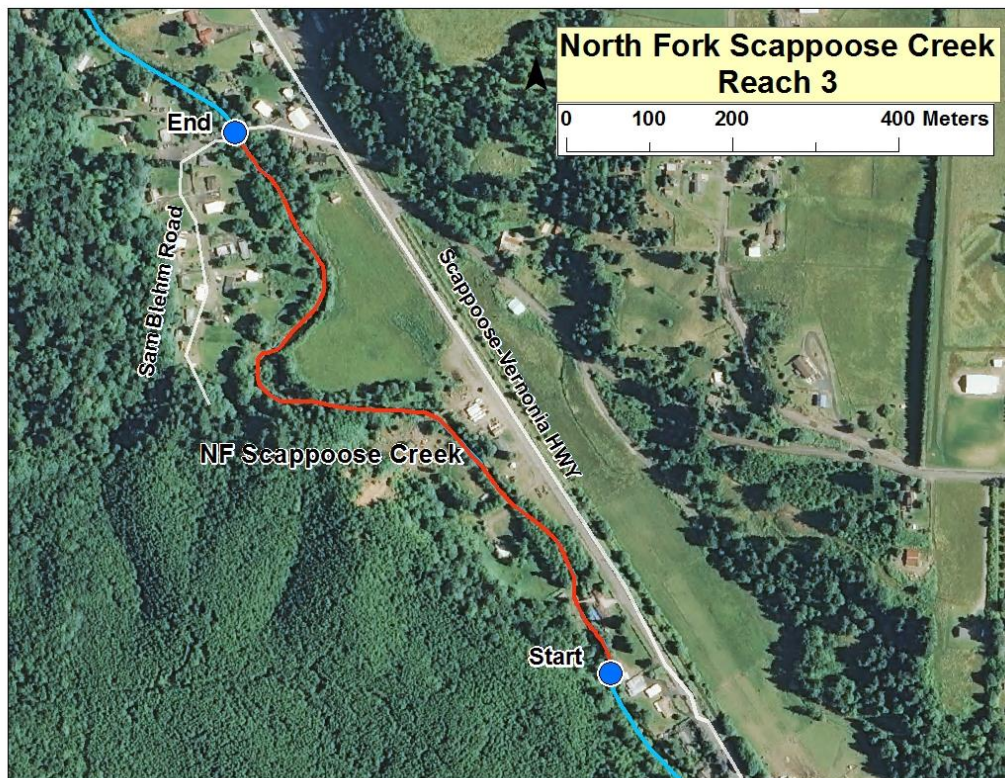


Figure 57. Map of reach 3 (red line) on North Fork Scappoose Creek, including start and end points (blue dots).



Figure 58. Survey pictures in reach 3 of North Fork Scappoose Creek showing an upstream view of Scappoose Creek at the downstream end of the survey (panel A), and a side channel with several cold-water patched (panel B).

RESULTS:

The substrate in reach 3 of North Fork Scappoose Creek was larger in size (> 128 mm, diameter) with some fine sediment as well (< 4 mm, diameter). Six patches of suitable spawning substrate were found in this reach (Table 23; Figure 59), measuring a total of 22 m^2 . All patches were “low” quality (Table 23; Figure 59), because of elevated levels of fine sediment (11–20% of patch area) and also elevated proportions of small cobble ($> 75\%$ of patch area; Table 23). Three cold-water patches with a combined surface area of 82.6 m^2 were observed (Figure 59); average temperature in these patches was 14.0° C and average temperature adjacent to these patches was 15.7° C . The dominant substrate types within these cold-water patches were large gravel ($n = 2$) and bedrock ($n = 1$). Substrate in two of these cold-water patches was suitable for Chum Salmon spawning: dominant substrate sizes between small gravel and small cobble (4–128 mm, diameter), and $< 20\%$ fine sediment (< 4 mm, diameter; Figure 58, panel B). There were no potential barriers to Chum Salmon migration in this reach.

Table 23. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 3 of North fork Scappoose Creek, northwest of Scappoose, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	0	0
low	11-20	0	25	75	5	19
low	11-20	0	0	100	1	3

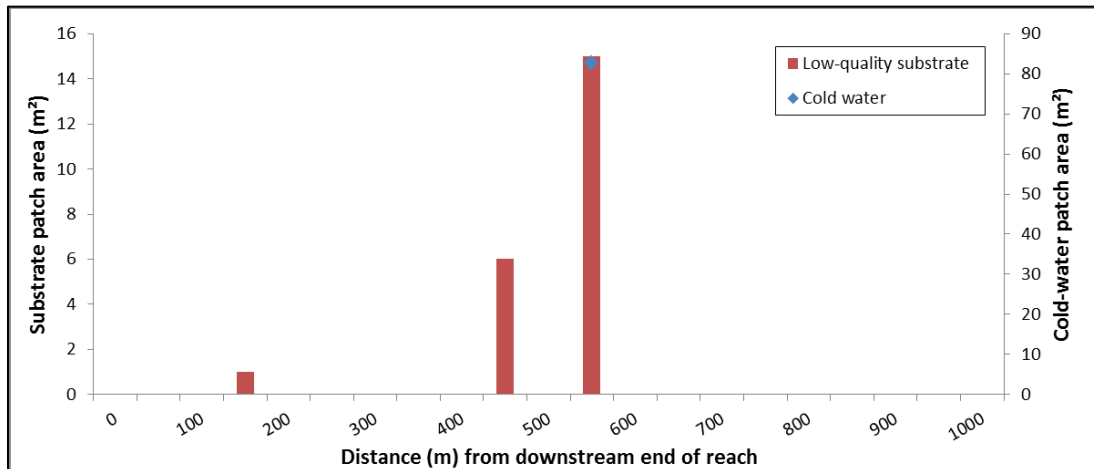


Figure 59. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 3 of North Fork Scappoose Creek, northwest of Scappoose, OR, in September 2012. Cold water and substrate patch areas were summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

South Fork Scappoose Creek

SURVEY DATES: August 8, August 20–21, August 28, and September 17, 2012

SURVEY CREW: Brian Alfonse, Kris Homel, Lorana McCalester, and Brad Benson

GENERAL DESCRIPTION:

The South Fork Scappoose Creek habitat survey (Township: 3N Range: 2W Section: 1D0) started at the confluence with North Fork Scappoose Creek and continued upstream 12.0 km to the confluence with Gourlay Creek. Six reaches were surveyed in the South Fork Scappoose Creek, measuring a total of 4.8 km (Figure 47). Approximately 7.3 km of stream channel between the downstream and upstream end of these surveys were not surveyed due to landowner denials and poor survey conditions. The section of South Fork Scappoose Creek that flows through the town of Scappoose was not surveyed due to poor habitat quality, deep pools, and substrate that consisted entirely of fine sediment (< 4 mm, diameter). Two sections upstream of the city of Scappoose were not surveyed due to landowner denials.

REACH 0.1

REACH DESCRIPTION:

Reach 0.1 started at the confluence of North Fork and South Fork Scappoose Creeks (Lat: 45.769169, Long -122.872769) and continued upstream to a landowner denial 800 m downstream from the Highway 30 bridge (Lat: 45.768559, Long: -122.87632; Figure 60). The mainstem thalweg length of this reach was 362 m, and there were no side channels. This stream channel was deeply entrenched (> 2 m), with few meanders, and consisted primarily of pools and glides (Figure 61). The riparian zone was predominately reed canary grass, but some sparse young trees were associated with a habitat restoration project. Land use was rural residential.

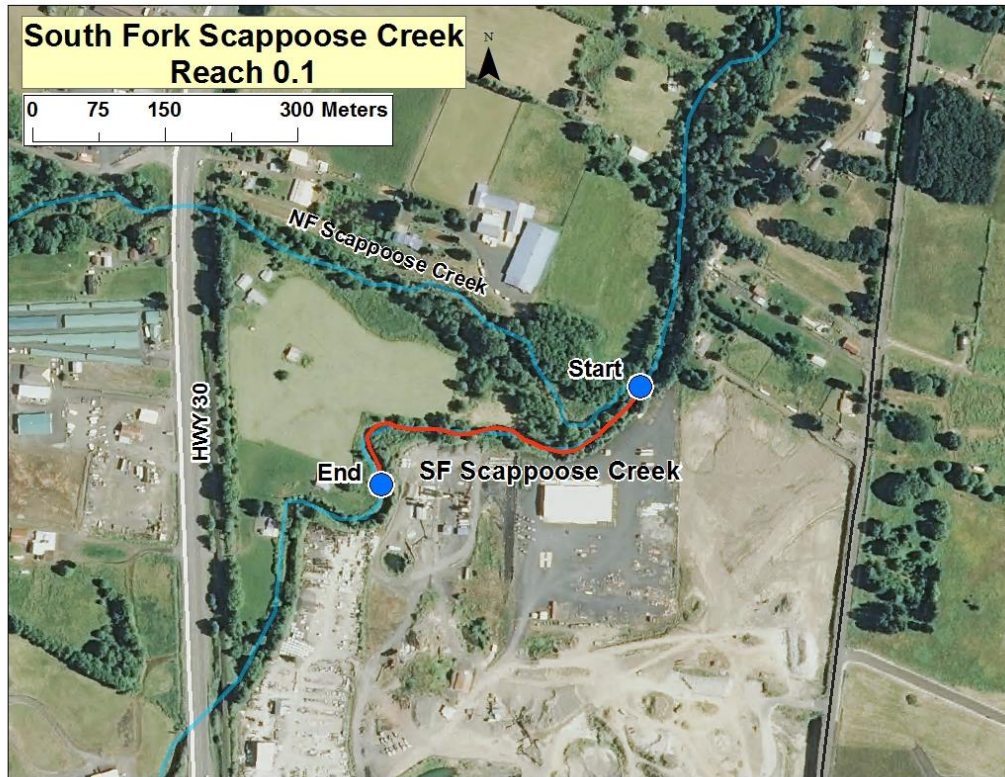


Figure 60. Map of reach 0.1 (red line) on South Fork Scappoose Creek, including start and end points (blue dots).



Figure 61. Survey picture in reach 0.1 of South Fork Scappoose Creek showing a long pool near the upstream end of the reach.

RESULTS:

Six patches of suitable spawning substrate that met minimum established criteria were found in reach 0.1 of South Fork Scappoose Creek (Table 24; Figure 62), measuring a total of 39 m². None of these patches were categorized as “high” quality, four patches were of “moderate” quality, and two patches were of “low” quality (Table 24; Figure 62). The dominant substrate

types within these patches were small cobble and large gravel (Table 24). There were no cold-water patches or potential barriers to Chum Salmon migration in this reach.

Table 24. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 0.1 of South Fork Scappoose Creek, north of Scappoose, OR, in August 2012.

Substrate Quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	1	8
moderate	0-10	0	50	50	2	26
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	1	2
low	11-20	0	75	25	0	0
low	11-20	0	50	50	1	2
low	11-20	0	25	75	1	1
low	11-20	0	0	100	0	0

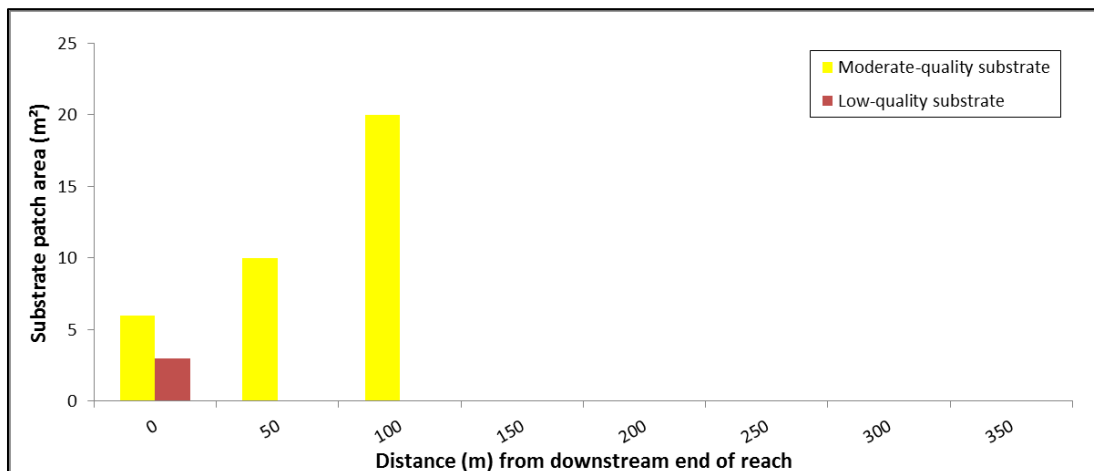


Figure 62. Location of substrate patches measured as distance from downstream end of survey in reach 0.1 of South Fork Scappoose Creek, north of Scappoose, OR, in August 2012. For each category of substrate quality, patch area was summed and binned into 50 m units.

REACH 0.3

REACH DESCRIPTION:

Reach 0.3 started at the downstream end of the property owned by the Creekside Baptist Church (Lat: 45.745922, Long -122.884053) and continued upstream to the Dutch Canyon Road bridge (Lat: 45.741377, Long: -122.89123; Figure 63). The mainstem thalweg length of this reach was 1,229 m, and there were no side channels. The stream channel in this reach was deeply entrenched (> 2 m), with deep pools and glides (Figure 64, panel A), and few meanders. The riparian zone in this reach was dominated by grass, but large firs were also common. Land use was rural residential. Surveyors observed numerous pieces of garbage in the creek including several tires and other large scraps of metal (Figure 64, panel B).

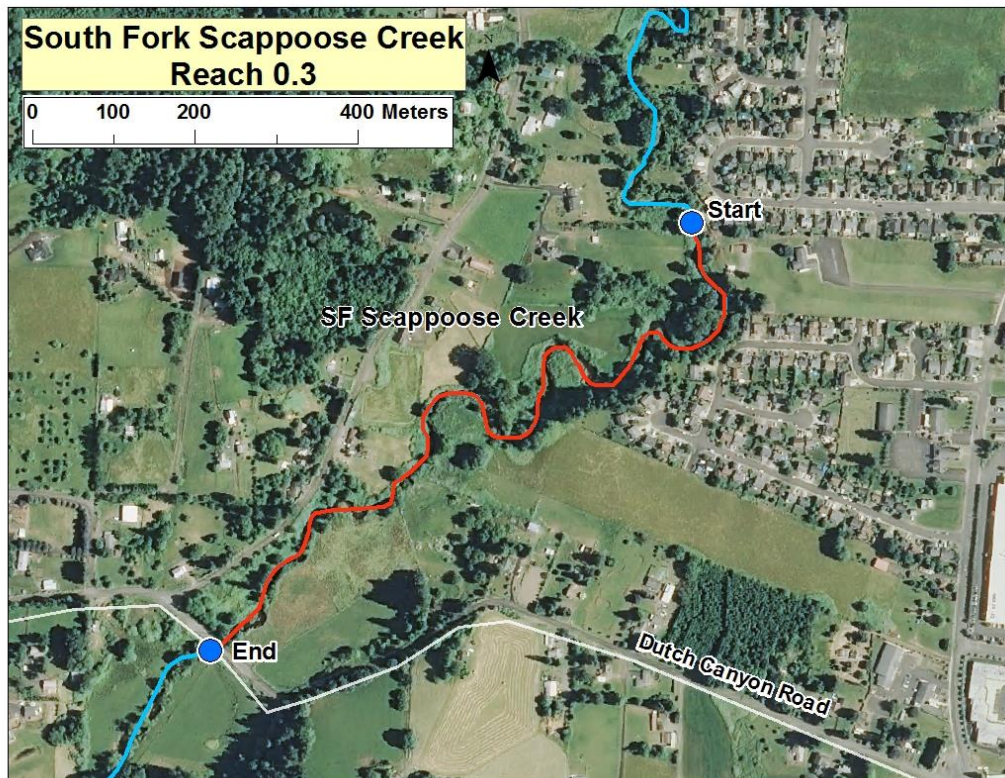


Figure 63. Map of reach 0.3 (red line) on South Fork Scappoose Creek, including start and end points (blue dots).



Figure 64. Survey pictures in reach 0.3 of South fork Scappoose Creek showing a deeply entrenched pool with woody debris (panel A), and section of stream with gravel, excess fine sediment, and garbage (panel B).

RESULTS:

In reach 0.3 of South Fork Scappoose Creek several patches of substrate in the small and large gravel size classes (4–45 mm, diameter) were observed, but fine sediment levels were > 20%, and this substrate was unsuitable for spawning. Three cold-water patches totaling 4.0 m² were found (Figure 65); average temperature in these patches was 12.9° C and average temperature adjacent to these patches was 14.7° C. The dominant substrate type within these cold-water patches was fine sediment (< 4 mm, diameter). There were no potential barriers to Chum Salmon migration in this reach.

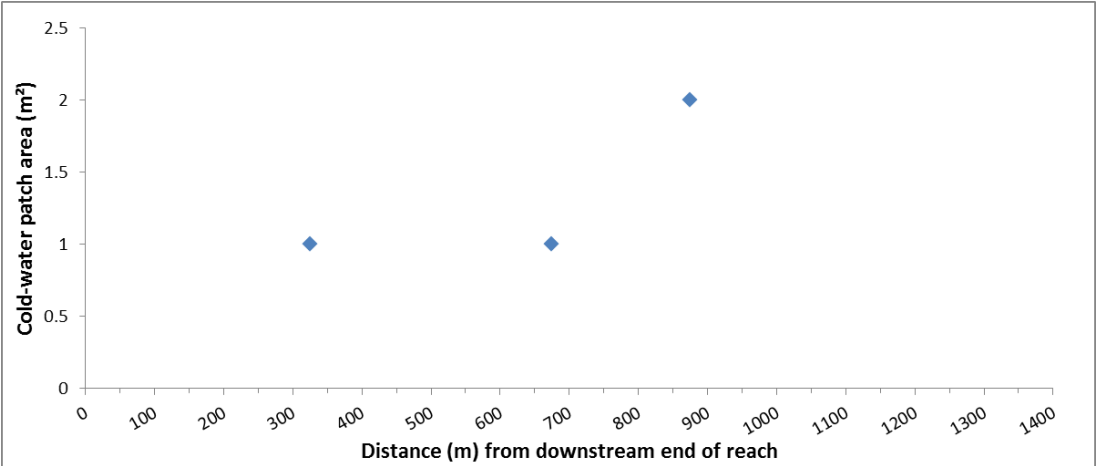


Figure 65. Location of cold-water patches measured as distance from downstream end of survey in reach 0.3 of south Fork Scappoose Creek, near Scappoose, OR, in September 2012. Cold-water patches were ≥ 1.0° C colder than the temperature in the main channel and patch area was summed and binned into 50 m units.

REACH 1.0

REACH DESCRIPTION:

Reach 1.0 started at the lower Branch Drive bridge (Lat: 45.739301, Long -122.903494) and continued upstream to the confluence of South Fork Scappoose and Raymond Creeks (Lat: 45.741377, Long: -122.909607; Figure 66). The mainstem thalweg length of this reach was 643 m, there were no side channels, and multiple meanders were observed. The riparian vegetation in this reach was predominantly small alders, maples, and cedars. There were several residential homes adjacent to the creek with lawns extending to the stream bank. Five residential irrigation pumps in man-made pools were observed in this reach (Figure 67, panel A). There were several areas of active bank erosion (Figure 67, panel B), and there was a large landslide near the downstream end of the reach (Figure 67, panel C). Land use was rural residential.



Figure 66. Map of reach 1 (red line) on South Fork Scappoose Creek, including start and end points (blue dots).



Figure 67. Survey pictures in reach 1 of South Fork Scappoose Creek showing a residential irrigation withdrawal pipe and man-made dam in middle of reach (panel A), bank erosion (panel B), and a large landslide located 30 m upstream from the Branch Drive bridge (panel C).

RESULTS:

Thirteen patches of suitable spawning substrate that met minimum established criteria were found in reach 1 of South Fork Scappoose Creek (Table 25; Figure 68), measuring a total of 44 m². None of these patches were categorized as “high” quality, one was of “moderate” quality, and 12 were of “low” quality (Table 25; Figure 68). Large gravel and small cobble were the dominant substrate types within these patches (Table 25). There was one cold-water patch measuring 3.5 m² (Figure); temperature in this patch was 14.4° C and temperature adjacent to this patch was 16.0° C. The dominant substrate type within this cold-water patch was fine sediment (< 4 mm, diameter). There were no potential barriers to Chum Salmon migration in this reach.

Table 25. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fine sediment (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 1.0 of South Fork Scappoose Creek, west of Scappoose, OR, in August 2012.

Substrate Quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	1	4
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	2	2
low	11-20	0	50	50	4	9
low	11-20	0	25	75	4	25
low	11-20	0	0	100	2	4

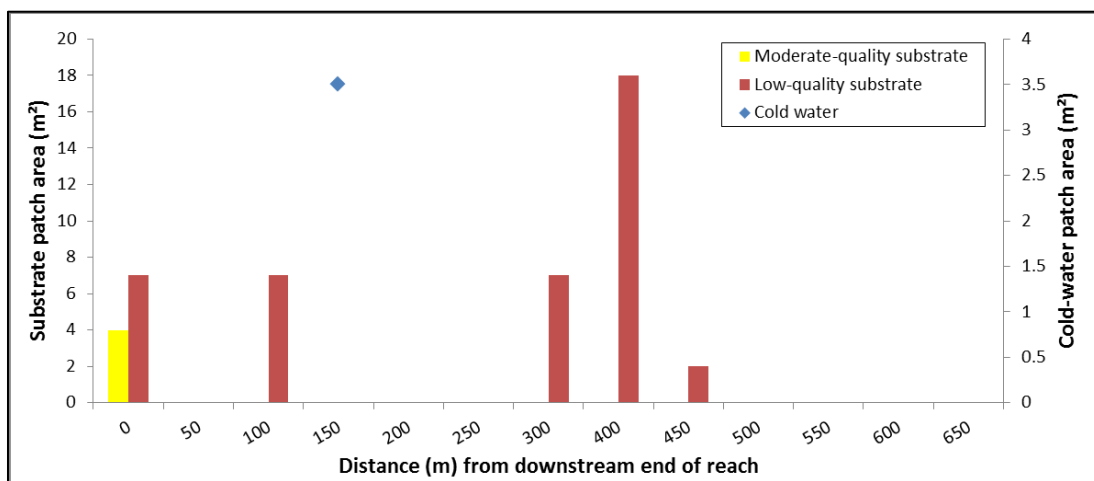


Figure 68. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 1.0 of South Fork Scappoose Creek, west of Scappoose, OR, in August 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 1.1

REACH DESCRIPTION:

Reach 1.1 started at the confluence of South Fork Scappoose Creek and Raymond Creek (Lat: 45.741377, Long -122.909607) and continued upstream to a small unnamed tributary (Lat: 45.744964, Long: -122.915527; Figure 69). The mainstem thalweg length of this reach was 807 m. There were six side channels with a combined thalweg length of 380 m. The channel form was unconfined, with multiple channels and meanders. The riparian zone was densely vegetated with alders, maples, blackberry bushes, and grasses in the downstream half of the reach, but became sparse towards the upstream half of the reach (Figure 70, panels A and B). In the middle of the reach there was a large side-channel complex, characterized by several dry channels and one long wetted channel with a beaver dam in the middle of it. In a large pool upstream of this side-channel complex, survey crews observed numerous Coho Salmon fry. This ancillary data is noted considering the urban environment downstream. Several irrigation pipes were set in the stream, including one (> 5 cm, diameter) that was actively pumping water. Land use was rural residential.

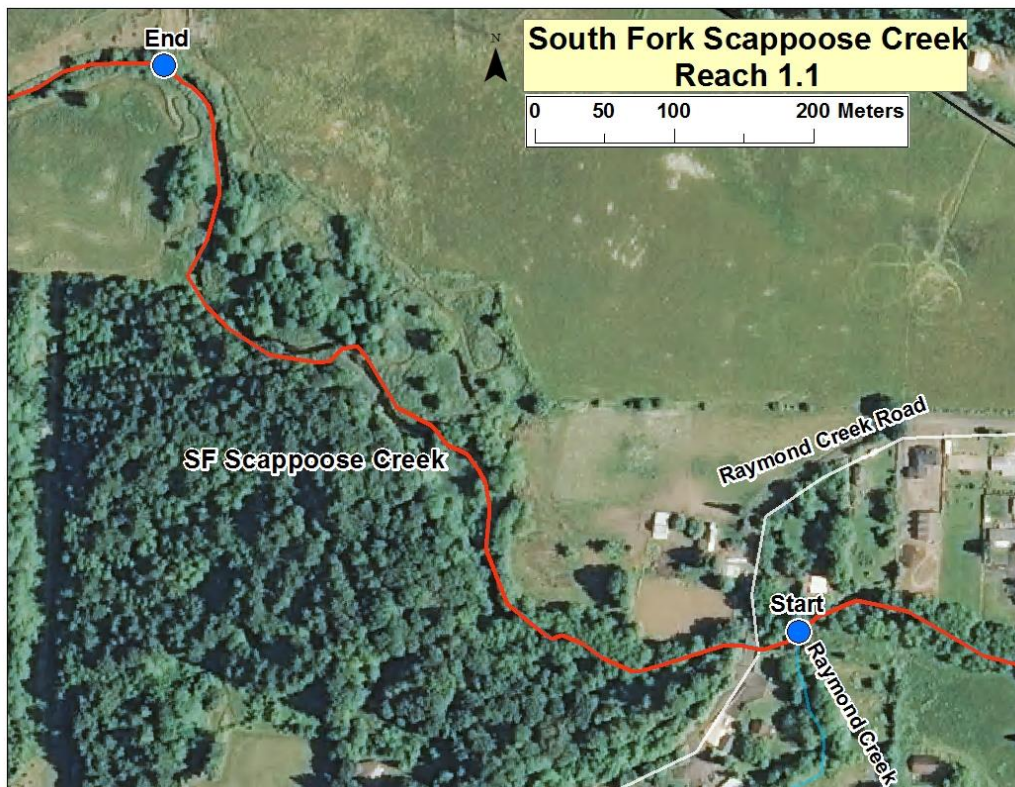


Figure 69. Map of reach 1.1 (red line) on South Fork Scappoose Creek, including start and end points (blue dots).



Figure 70. Survey pictures in reach 1.1 of South Fork Scappoose Creek showing collection of water temperature data in a silty section of channel with a riparian zone dominated by alders (panel A), and a gravel bar near the middle of the reach (panel B).

RESULTS:

Substrate sizes within the range suitable for Chum Salmon (4–128 mm) were common in reach 1.1 of South Fork Scappoose Creek; however, with fine sediment levels > 20%, little of the substrate was suitable for spawning. Seventeen patches of suitable spawning were found in this reach (Table 26; Figure 71), measuring a total of 91 m². None of these patches were categorized as “high” quality, one was of “moderate” quality, and 16 were of “low” quality (Table 26; Figure 71). Small cobble was the dominant substrate in all but two patches (Table 26). There were three cold-water patches totaling 18.5 m² (Figure 71); average temperature in these patches was 15.0° C and average temperature adjacent to these patches was 17.4° C. The dominant substrate type within these cold-water patches was fine sediment (< 4 mm, diameter). There were no potential barriers to Chum Salmon migration in this reach.

Table 26. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 1.1 of South fork Scappoose Creek, west of Scappoose, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	1	18
low	0-10	0	25	75	1	5
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	2	9
low	11-20	0	50	50	2	25
low	11-20	0	25	75	4	10
low	11-20	0	0	100	7	24

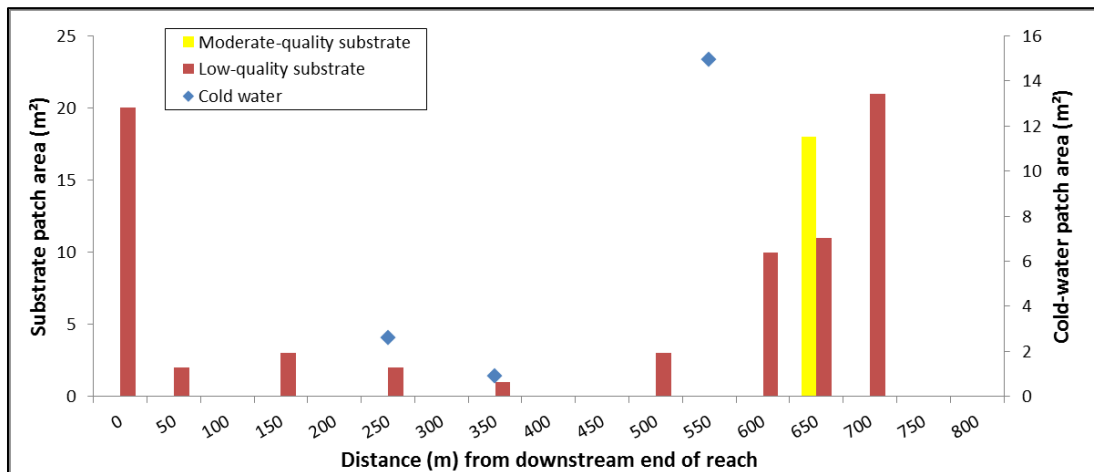


Figure 71. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 1.1 of South Fork Scappoose Creek, west of Scappoose, OR, in August 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 2

REACH DESCRIPTION:

Reach 2 started at a small, unnamed tributary (Lat: 45.741377, Long -122.909607) and continued upstream to a fence line at the end of a large hay field (Lat: 45.744964, Long: -122.915527; Figure 72). The mainstem thalweg length of this reach was 274 m with multiple meanders observed. There were also two side channels with a total length of 84 m. The riparian zone was sparsely vegetated with alders and grass, and the land use was rural residential. There was a farm road bridge near the middle of the reach.

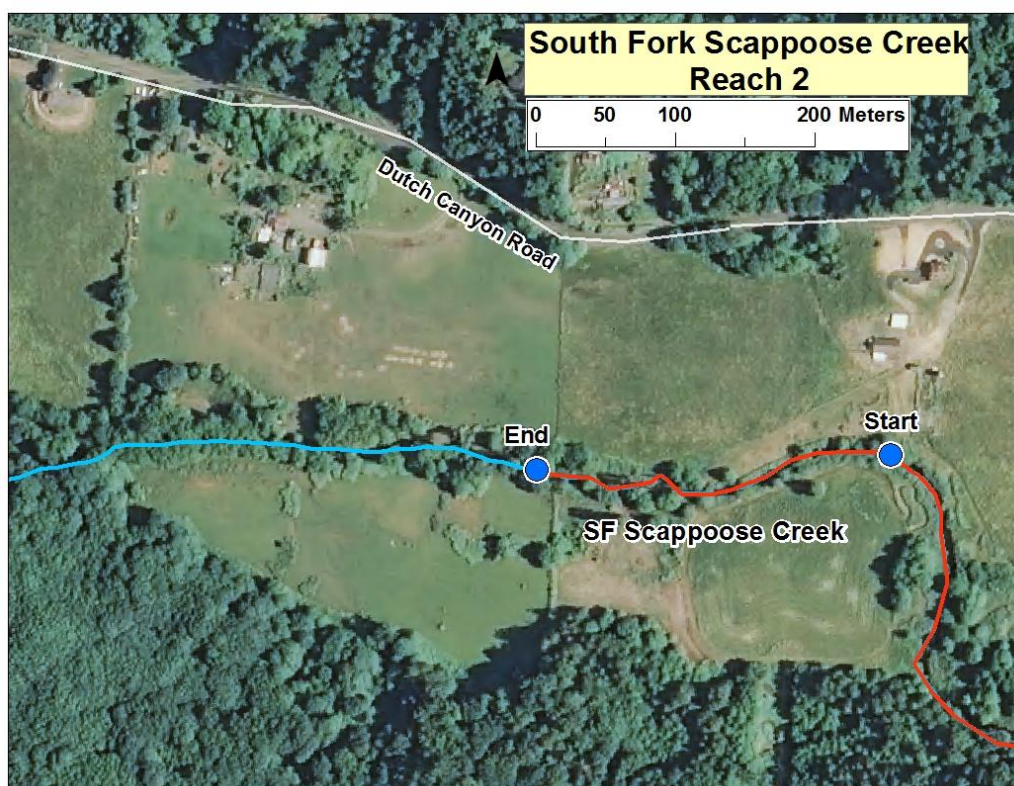


Figure 72. Map of reach 2 (red line) on South Fork Scappoose Creek, including start and end points (blue dots).

RESULTS:

Seven patches of suitable spawning substrate that met minimum established criteria were found in reach 2 of South Fork Scappoose Creek (Table 27; Figure 73), measuring a total of 73

m². All patches were designated “low” quality (Table 27; Figure 73), and small cobble was the dominant substrate type (Table 27). Two cold-water patches totaling 0.2 m² were observed (Figure 73); average temperature in these patches was 15.8° C and average temperature adjacent to these patches was 16.9° C. The dominant substrate type within these cold-water patches was fine sediment (<4 mm, diameter). There were no potential barriers to Chum Salmon migration in this reach.

Table 27. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 2 of South fork Scappoose Creek, west of Scappoose, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	1	3
low	0-10	0	0	100	1	2
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	1	21
low	11-20	0	25	75	2	11
low	11-20	0	0	100	2	36

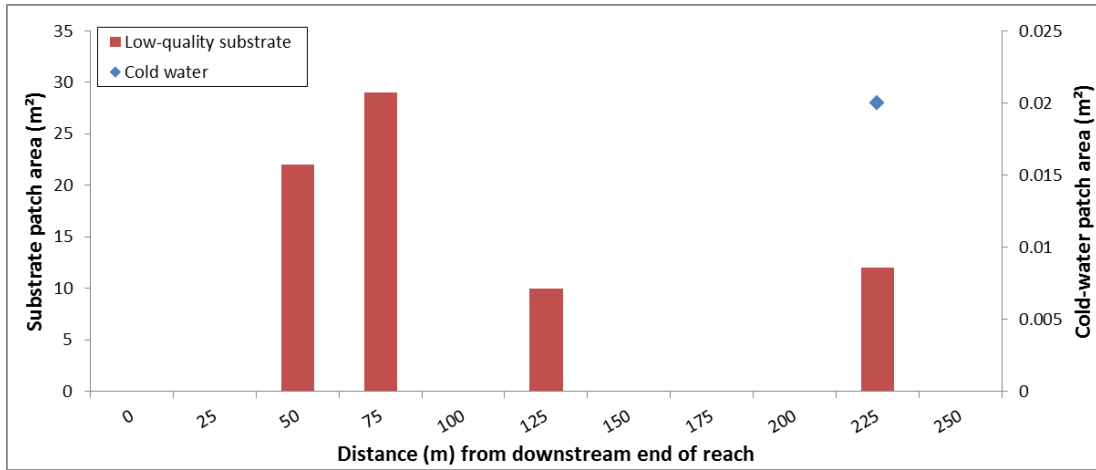


Figure 73. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 2 of South Fork Scappoose Creek, west of Scappoose, OR, in August 2012. Cold water and substrate patch areas were summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 4

REACH DESCRIPTION:

Reach 4 started at a small farm bridge located 350 m downstream from Bankston Road (Lat: 45.745099, Long -122.942913) and continued upstream to the confluence of South Fork Scappoose Creek and Wolf Creek (Lat: 45.745686, Long: -122.948369; Figure 74). The mainstem thalweg length of this reach was 423 m, and there were no side channels. Channel form was unconfined with meanders observed throughout. The riparian vegetation in this reach was sparse, especially on the river-right banks where the vegetation was dominated by grasses. There was a horse pasture on the left bank, but horse access to the stream was restricted to two narrow points by an electric fence. A series of man-made pools were located upstream of the Bankston Road bridge (Figure 75, panel A). Land use for this reach was rural residential.

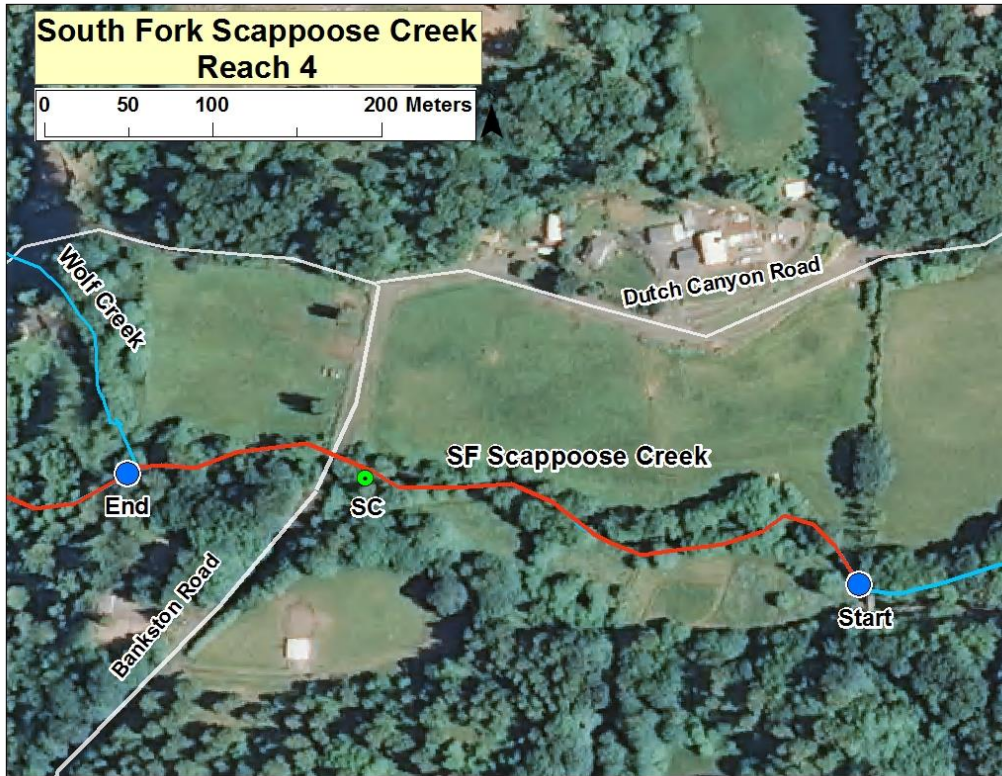


Figure 74. Map of reach 4 (red line) on South Fork Scappoose Creek, including start and end points (blue dots), and one semicircular culvert (SC).



Figure 75. Survey pictures in reach 4 of South Fork Scappoose Creek showing several man-made pools located upstream of Bankston Road (panel A), a streambed with large cobble substrate and limited riparian vegetation (panel B), and a semicircular culvert under Bankston Road (panel C).

RESULTS:

Overall, substrate in reach 4 of South Fork Scappoose Creek was generally larger than the size range suitable for Chum Salmon spawning (Figure 75, panel B). Only nine patches of suitable spawning substrate were found in this reach (Table 28; Figure 76), measuring a total of 19 m². All substrate patches were designated “low” quality (Table 28; Figure 76); small cobble was the dominant substrate type (Table 28). No cold-water patches that were $\geq 1.0^{\circ}$ C colder than the main channel water temperature were observed. There was one potential barrier to Chum Salmon migration in this reach, classified as a semicircular culvert that was located under Bankston Road (Table 29; Figure 74; Figure 75, panel C).

Table 28. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 4 of South Fork Scappoose Creek, west of Scappoose, OR, in August 2012.

Substrate Quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	5	7
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	0	0
low	11-20	0	25	75	1	9
low	11-20	0	0	100	3	3

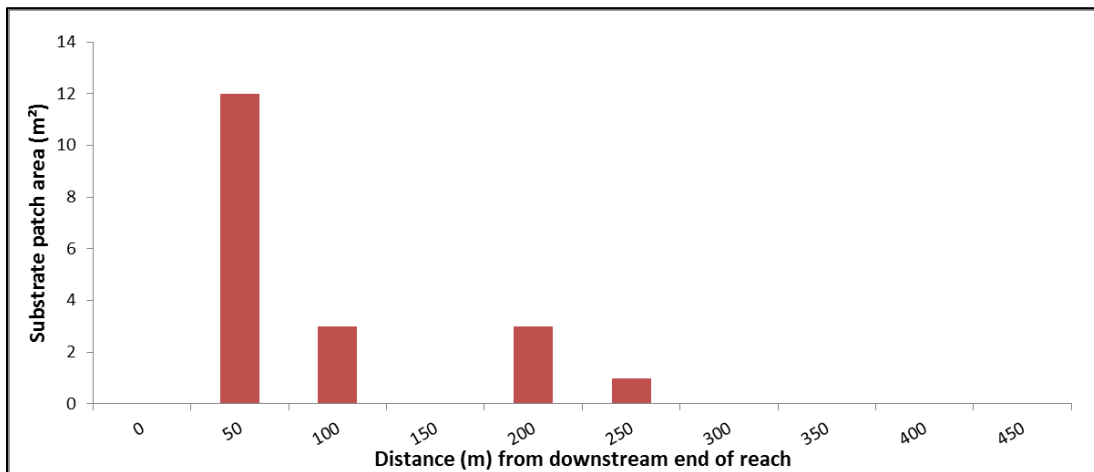


Figure 76. Location of low-quality substrate patches (red bars) measured as distance from downstream end of survey in reach 4 of South Fork Scappoose Creek, west of Scappoose, OR, in August 2012. Substrate area was summed and binned into 50 m units.

Table 29. Barrier type, barrier height, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in reach 4 of South fork Scappoose Creek, near Scappoose, OR, in August 2012. Note: ** indicates data not collected.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Semicircular culvert	4	7	30.5	**

REACH 5

REACH DESCRIPTION:

Reach 5 started at the confluence of South Fork Scappoose Creek and Wolf Creek (Lat: 45.745611, Long -122.948427) and continued upstream to the confluence of South Fork Scappoose Creek and Gourlay Creek (Lat: 45.743837, Long: -122.958392; Figure 77). The mainstem thalweg length of this reach was 934 m. There were four side channels with a total length of 191 m. Channel form was confined, with multiple channels and meanders. The riparian zone in this reach was dominated by with alders, firs, maples, and cedars. Land use was a mix of young and mature timber. Along a hill slope, one portion of the bank had eroded and deposited trees and silt into the channel (Figure 78, panel A). Large woody debris was abundant in this reach (Figure 78, panel B), and several man-made pools were observed as well. Most substrate patches in this reach were located in side channels.

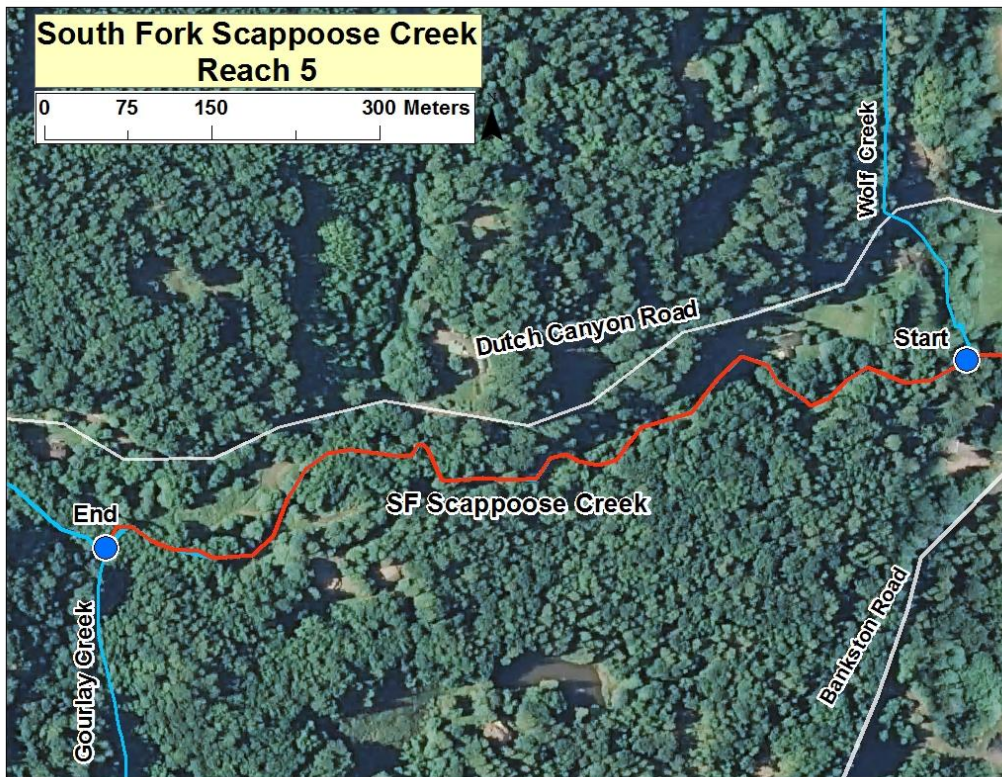


Figure 77. Map of reach 5 (red line) on South Fork Scappoose Creek, including start and end points (blue dots).



Figure 78. Survey pictures in reach 5 of South Fork Scappoose Creek showing a small landslide adjacent to a cold-water seep (panel A), and an accumulation of large woody debris (panel B).

RESULTS:

Seventeen patches of suitable spawning substrate were found in reach 5 of South Fork Scappoose Creek (Table 30, Figure 79), measuring a total of 42 m². None of these patches were categorized as “high” quality, three were of “moderate” quality, and 14 were of “low” quality (Table 30, Figure 79). Most patches included or were dominated by small cobble, but two

patches were comprised of small and large gravel (Table 30). Numerous seeps contained cool water; however, since the water temperature in these seeps was not $> 1^{\circ}\text{C}$ colder than that of the main channel, they were not categorized as cold-water patches. One cold-water patch was observed, measuring 0.5 m^2 (Figure 79); temperature in this patch was 13.2°C and temperature adjacent to this patch was of 14.3°C . The dominant substrate type within this cold-water patch was fine sediment ($< 4\text{ mm}$, diameter). There were no potential barriers to Chum Salmon migration in this reach.

Table 30. Total number and area (m^2) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 5 of South Fork Scappoose Creek, west of Scappoose, OR, in August 2012.

Substrate Quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	1	9
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	1	1
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	2	4
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	3	11
low	11-20	0	25	75	4	10
low	11-20	0	0	100	6	7

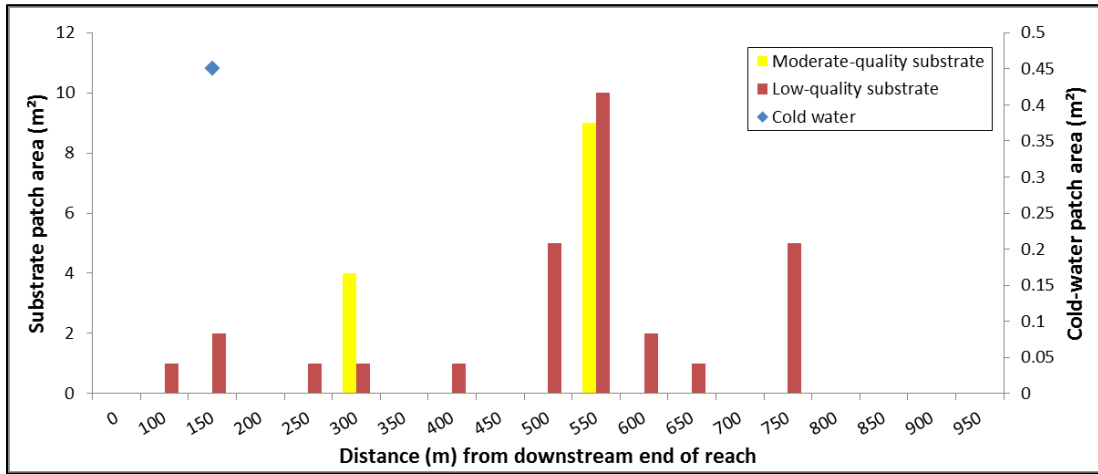


Figure 79. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 5 of South Fork Scappoose Creek, west of Scappoose, OR, in August 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

Clatskanie River Population

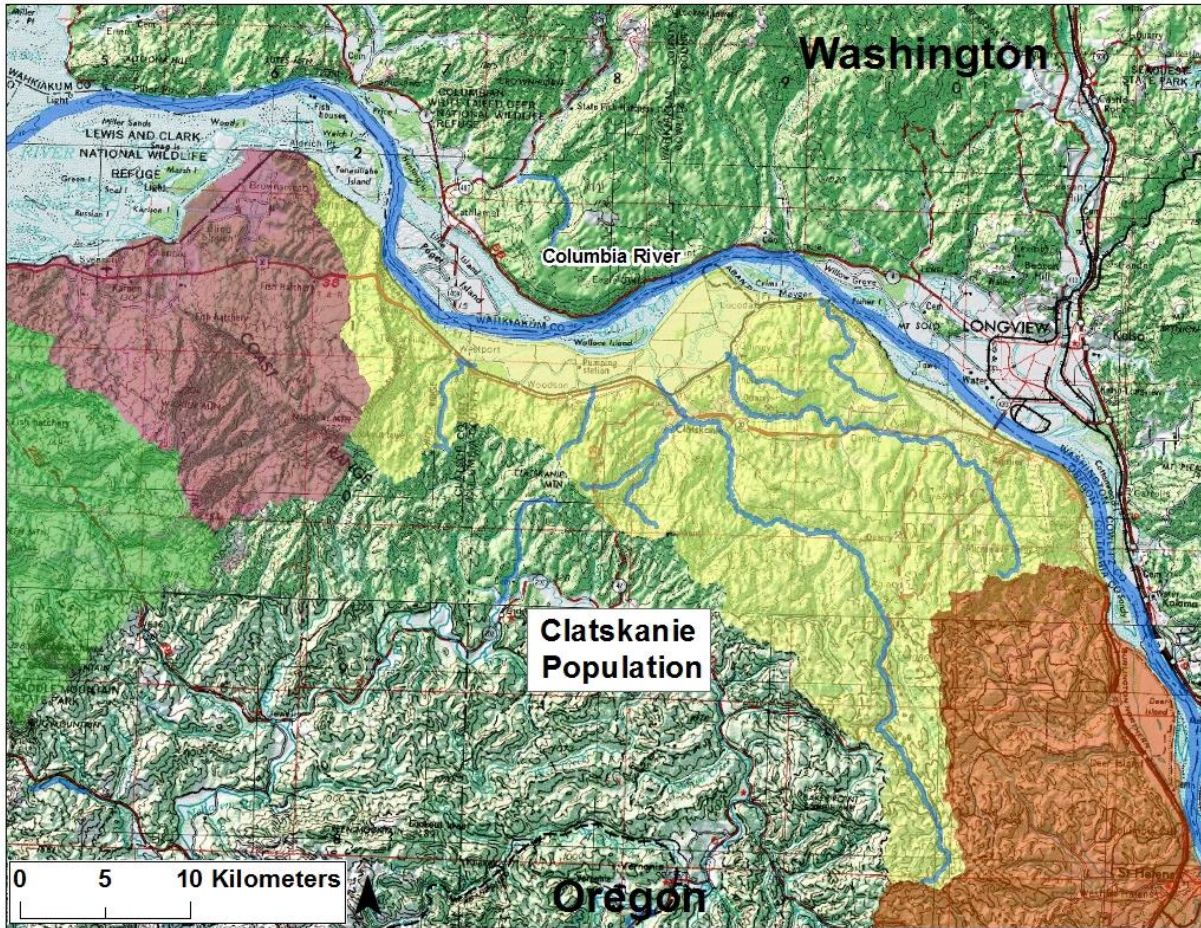


Figure 80. Map of Clatskanie River Chum Salmon population (yellow).

Beaver Creek

SURVEY DATES: July 12, 2012; July 30 and July 31, 2013

SURVEY CREW: Brian Alfonse, Kris Homel, John Cox and Lorana McCalester

GENERAL DESCRIPTION:

The Beaver Creek habitat survey (Township: 7N Range: 4W Section: 300) started at an old farm bridge 0.8 km upstream from the Beaver Falls Road bridge and continued upstream 3.6 km to Beaver Creek Falls. Surveys were delineated into three reaches (Figure 81) based on physical features and overall distance.

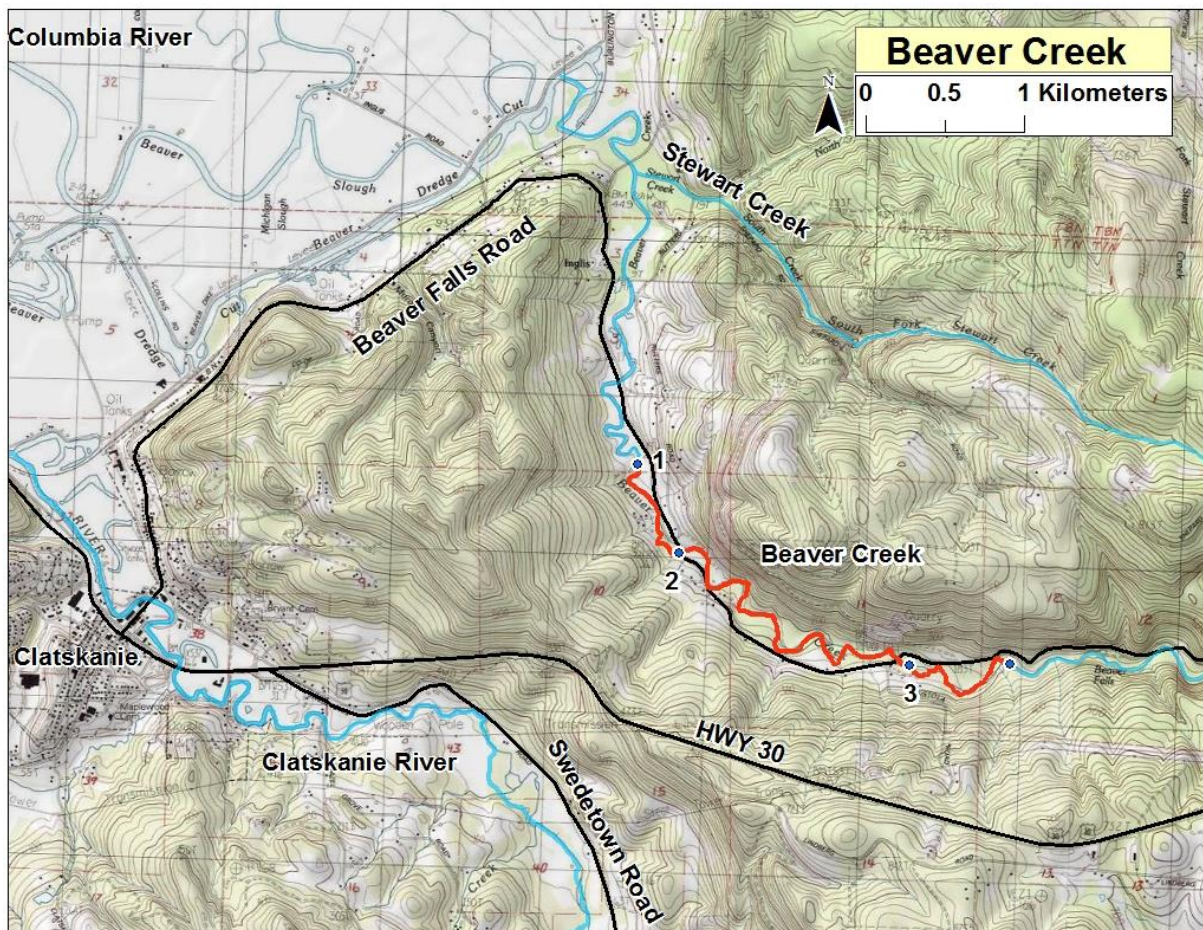


Figure 81. Map of reaches (red line) surveyed on Beaver Creek, located east of Clatskanie, OR. Reach break labels correspond to the downstream end of each reach.

REACH 1

REACH DESCRIPTION:

Reach 1 started at a farm bridge 0.8 km upstream from the Beaver Falls Road bridge (Lat: 46.114443, Long: -123.162421) and continued upstream to the second Beaver Falls Road bridge (Lat: 46.109428, Long: -123.159168; Figure 82). The mainstem thalweg length of this reach was 846 m. There were three side channels with a combined thalweg length of 260 m. The stream channel in the downstream quarter of this reach was tidally influenced with deeply entrenched banks and extensive active erosion. The riparian vegetation was dominated by grasses, alders, and maples. Land use was a mix of rural residential and mature timber. Several large pools were associated with bends in the stream and large bedrock shelves (Figure 83, panel A). Beaver activity was present throughout the reach (Figure 83, panel B).

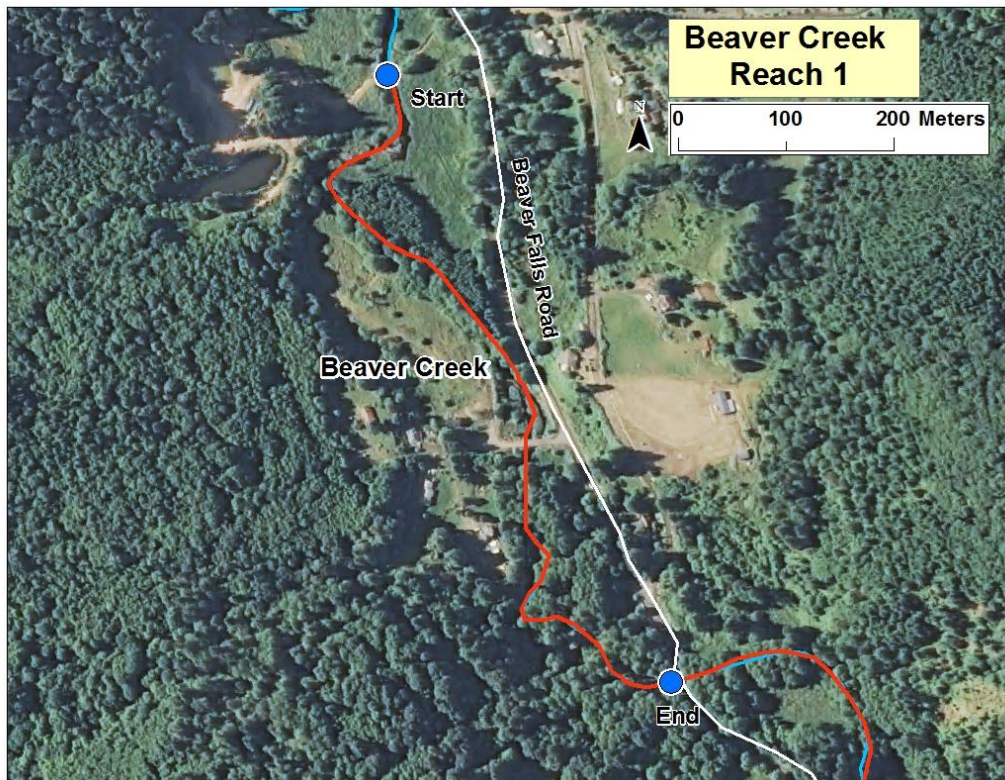


Figure 82. Map of reach 1 (red line) on Beaver Creek, including start and end points (blue dots).



Figure 83. Survey pictures of Beaver Creek reach 1 show a deep pool and adjacent bedrock shelf (panel A), and a pool created by a beaver dam (panel B).

RESULTS:

One hundred and eighteen patches of suitable spawning substrate were found in reach 1 of Beaver Creek (Table 31; Figure 84), measuring a total of 3,064 m². None of these patches were designated “high” quality, 34 were categorized as “moderate” quality, and 84 were of “low” quality (Table 31; Figure 84). All but two of these patches consisted of $\geq 50\%$ small cobble (Table 31). No cold-water patches were observed. There were also no potential barriers to Chum Salmon migration in this reach.

Table 31. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and

25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 1 of Beaver Creek, near Clatskanie, OR, in July 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	1	4
moderate	0-10	0	50	50	33	1561
low	0-10	0	25	75	29	716
low	0-10	0	0	100	27	287
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	1	25
low	11-20	0	50	50	7	93
low	11-20	0	25	75	11	279
low	11-20	0	0	100	9	99

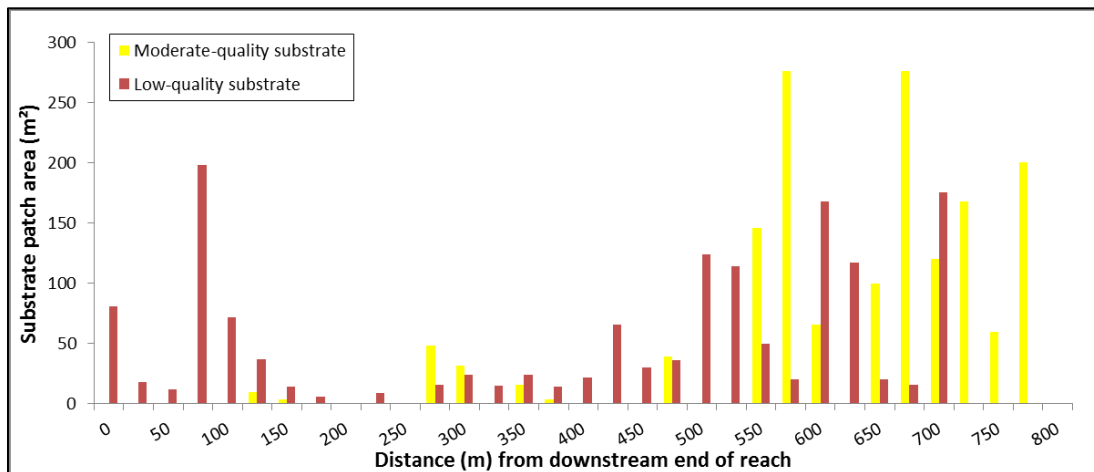


Figure 84. Location of substrate patches measured as distance from downstream end of survey in reach 1 of Beaver Creek, OR, in July 2012. For each category of substrate quality, patch area was summed and binned into 25 m units.

REACH 2

REACH DESCRIPTION:

Reach 2 started at the second Beaver Falls Road bridge (Lat: 46.109428, Long: -123.159168) and continued upstream to a point 200 m upstream of the third Beaver Falls Road bridge (Lat: 46.103546, Long: -123.139701; Figure 85). The mainstem thalweg length of this reach was 2,528 m. There were six side channels with a combined thalweg length of 518 m. The channel was confined by a bedrock canyon (Figure 86, panel A). Several hillsides along the creek were actively eroding into the stream channel (Figure 86, panel B). Substrate was observed in the sections of the stream not associated with the canyon; however, the majority of this substrate was large cobbles and boulders (129–256 mm, diameter; Figure 86, panel C). Land use was a mix of mature timber and rural residential. One irrigation withdrawal pipe was observed in this reach (Figure 86, panel D).

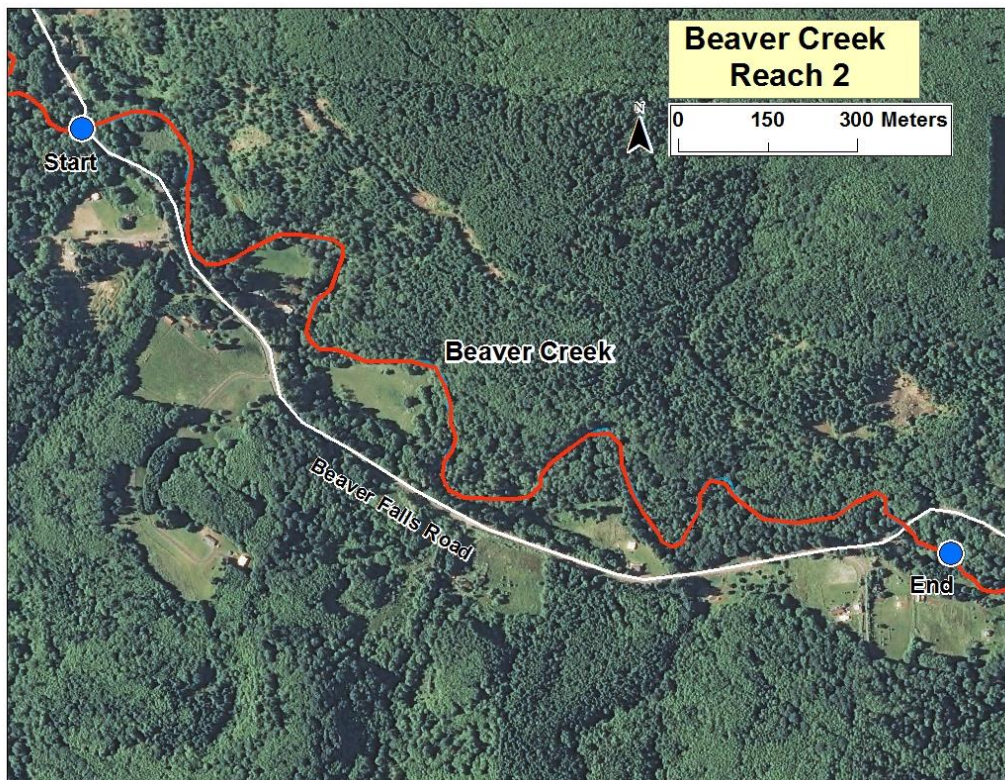


Figure 85. Map of reach 2 (red line) on Beaver Creek, including start and end points (blue dots).

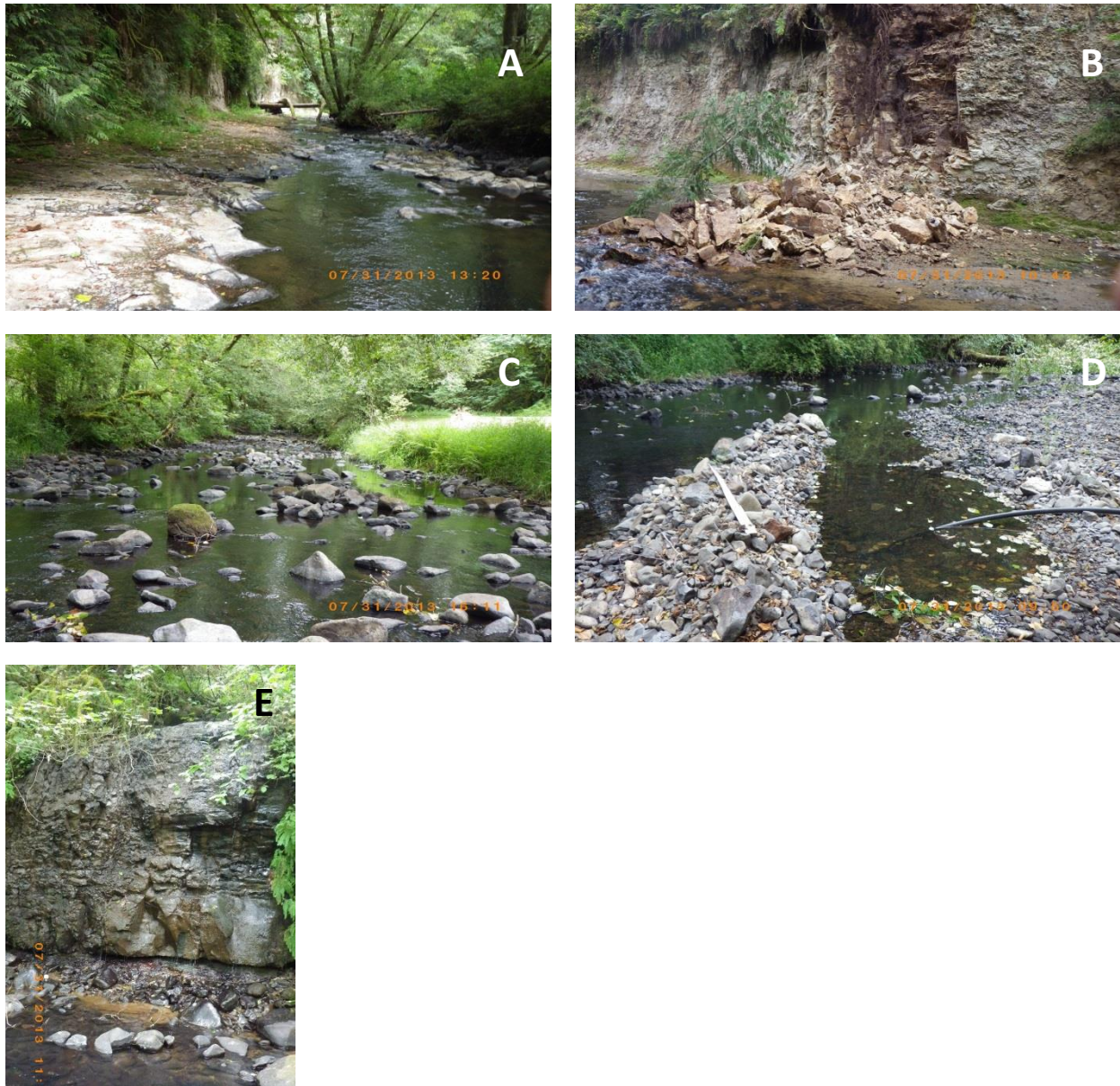


Figure 86. Survey pictures of Beaver Creek reach 2 show a canyon wall with bedrock streambed (panel A), an active rock slide along the creek (panel B), a section of stream with numerous boulders and large cobble substrate (panel C), an irrigation withdrawal pipe (panel D), and a cold-water seep running down a canyon wall (panel E).

RESULTS:

Thirty-seven patches of suitable spawning substrate were found in reach 2 of Beaver Creek (Table 32; Figure 87), measuring a total of 208 m². None of these patches were categorized as “high” quality, four were of “moderate” quality, and 33 were of “low” quality (Table 32; Figure 87). All but one of these patches contained $\geq 50\%$ small cobble (Table 32). Many of the cold-water patches in this reach were seeps originating from canyon walls (Figure 86, panel E). Thirty-two cold-water patches totaling 225.4 m² were observed (Figure 87); average temperature in these patches was 13.8° C and average temperature adjacent to these patches

was 15.7° C. The dominant substrate types within these cold-water patches were fine sediment (n = 7), large gravel (n = 1), small cobble (n = 13), boulder (n = 1), and bedrock (n = 10). There were also 11 patches with temperatures 0.5–0.9° C colder than the adjacent stream, but these did not meet our temperature criteria to be considered “cold-water patches.” There were no potential barriers to Chum Salmon migration in this reach.

Table 32. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 2 of Beaver Creek, east of Clatskanie, OR, in July 2013.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	4	33
low	0-10	0	25	75	4	14
low	0-10	0	0	100	10	33
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	1	2
low	11-20	0	50	50	4	18
low	11-20	0	25	75	11	99
low	11-20	0	0	100	3	9

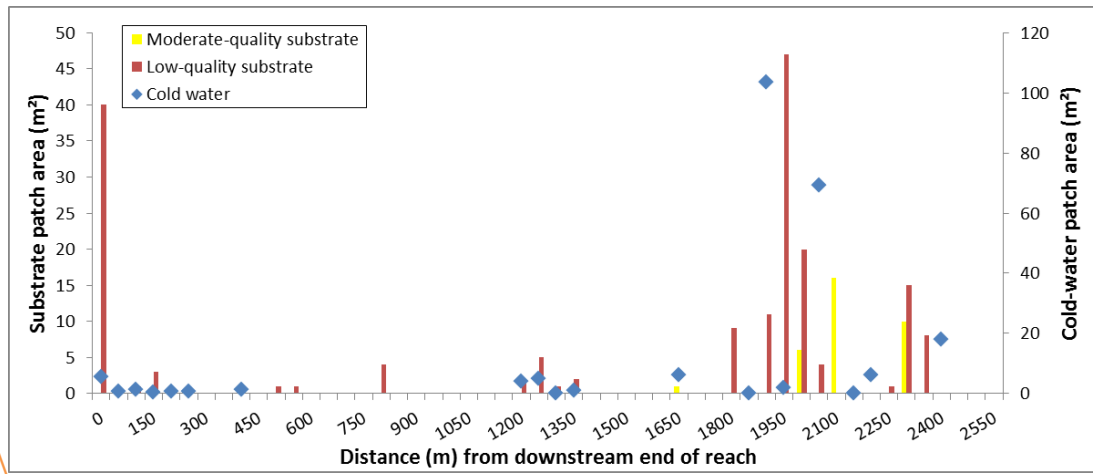


Figure 87. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 2 of Beaver Creek, OR, in July 2013. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 3

REACH DESCRIPTION:

Reach 3 started 200 m upstream of the third Beaver Falls Road bridge (Lat: 46.103546, Long: -123.139701) and continued upstream to Beaver Falls (Lat: 46.103637, Long: -123.131574; Figure 88). The mainstem thalweg length of this reach was 907 m, including one side channel with a thalweg length of 79 m. Channel form was confined, with multiple meanders throughout. The riparian zone was densely vegetated with alders, maples, firs, and cedars (Figure 89, panel A). Land use was dominated by mature timber, with some rural residential. There was one active landslide that was depositing woody debris and large rocks into the stream channel (Figure 89, panel B). One long side channel section (195 m, thalweg length) was predominantly dry (Figure 89, panel C). There was a footbridge near the middle of the reach (Figure 89, panel E).

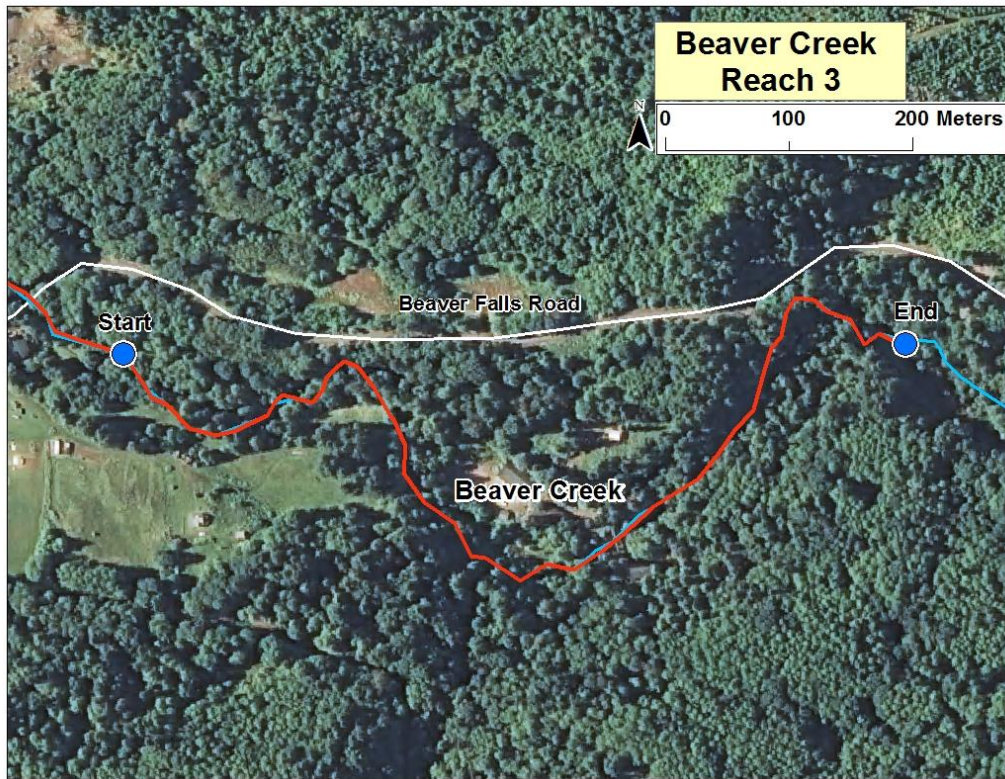


Figure 88. Map of reach 3 (red line) on Beaver Creek, including start and end points (blue dots). Beaver Creek Falls, a fish passage barrier, was located 500 m upstream of reach 3.



Figure 89. Survey pictures of Beaver Creek reach 3, showing a densely-vegetated riparian zone (panel A), a rock slide along the creek (panel B), a dry side channel section (panel C), substrate consisting of large cobble and boulders (panel D), and a footbridge near the middle of the reach (panel E).

RESULTS:

Boulder and large cobble (129–256 mm, diameter) substrate was common throughout reach 3 of Beaver Creek (Figure 89, panel D). Thirteen patches of suitable spawning substrate were found (Table 33; Figure 90), measuring a total of 36 m². None of these patches were categorized as “high” quality, one was of “moderate” quality, and 12 were of “low” quality (Table 33; Figure 90). All but one of these patches contained ≥ 50% small cobble (Table 33). Fourteen cold-water patches totaling 23.9 m² were observed (Figure 90); average temperature in these patches was 13.0° C and average temperature adjacent to these patches was 15.2° C. The dominant substrate types within these cold-water patches were fine sediment (n = 3), small cobble (n = 2), large cobble (n = 1), and bedrock (n = 8). There were also six patches with temperatures 0.5–0.9° C colder than that of the adjacent stream, but these did not meet our temperature criteria to be considered cold-water patches. There were no potential barriers to

Chum Salmon migration in this reach. However, 550 m upstream of the reach top, Beaver Falls (height = 14.6 m, width = 12.1 m) is a complete barrier to Chum Salmon migration.

Table 33. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 3 of Beaver Creek, east of Clatskanie, OR, in July 2013.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	1	1
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	5	7
low	11-20	0	25	75	6	27
low	11-20	0	0	100	1	1

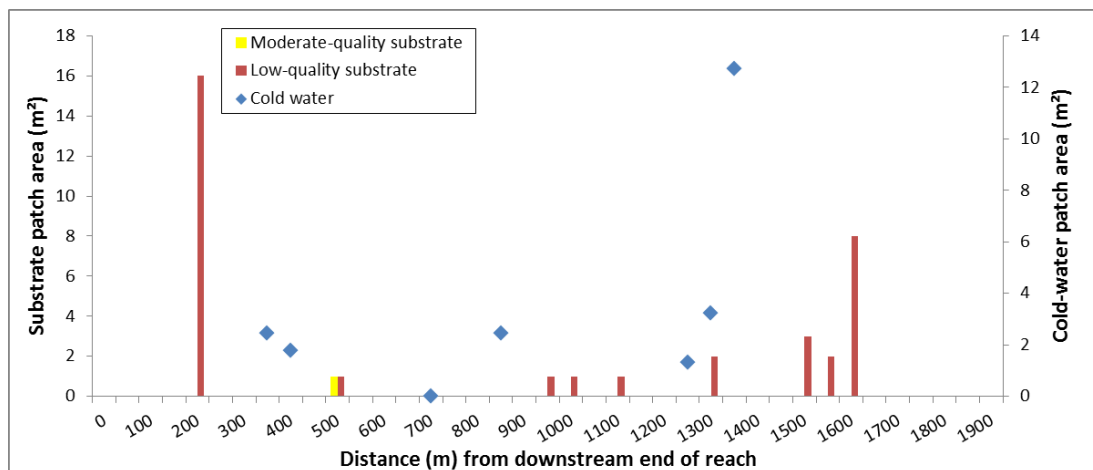


Figure 90. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 3 of Beaver Creek, OR, in July 2013. For cold water and for each category of substrate quality, patch area was summed and binned into 25 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

Clatskanie River

SURVEY DATES: September 11–20, 2012

SURVEY CREW: Brian Alfonse, Kris Homel, Lorana McCalester, and Brad Benson

GENERAL DESCRIPTION:

The Clatskanie River habitat survey (Township: 7N Range: 4W Section: 900) started at tidewater 0.8 km upstream from Olson Road and continued upstream 15.0 km to a small bridge near the confluence with Carcus Creek. Surveys were delineated into 10 reaches (Figure 91) based on physical features, landowner access, and overall distance. Several sections were not surveyed due to landowner denials, including two sections in reach 5, one section in reach 9, and a section (1.7 km) between reach 6 and 7.

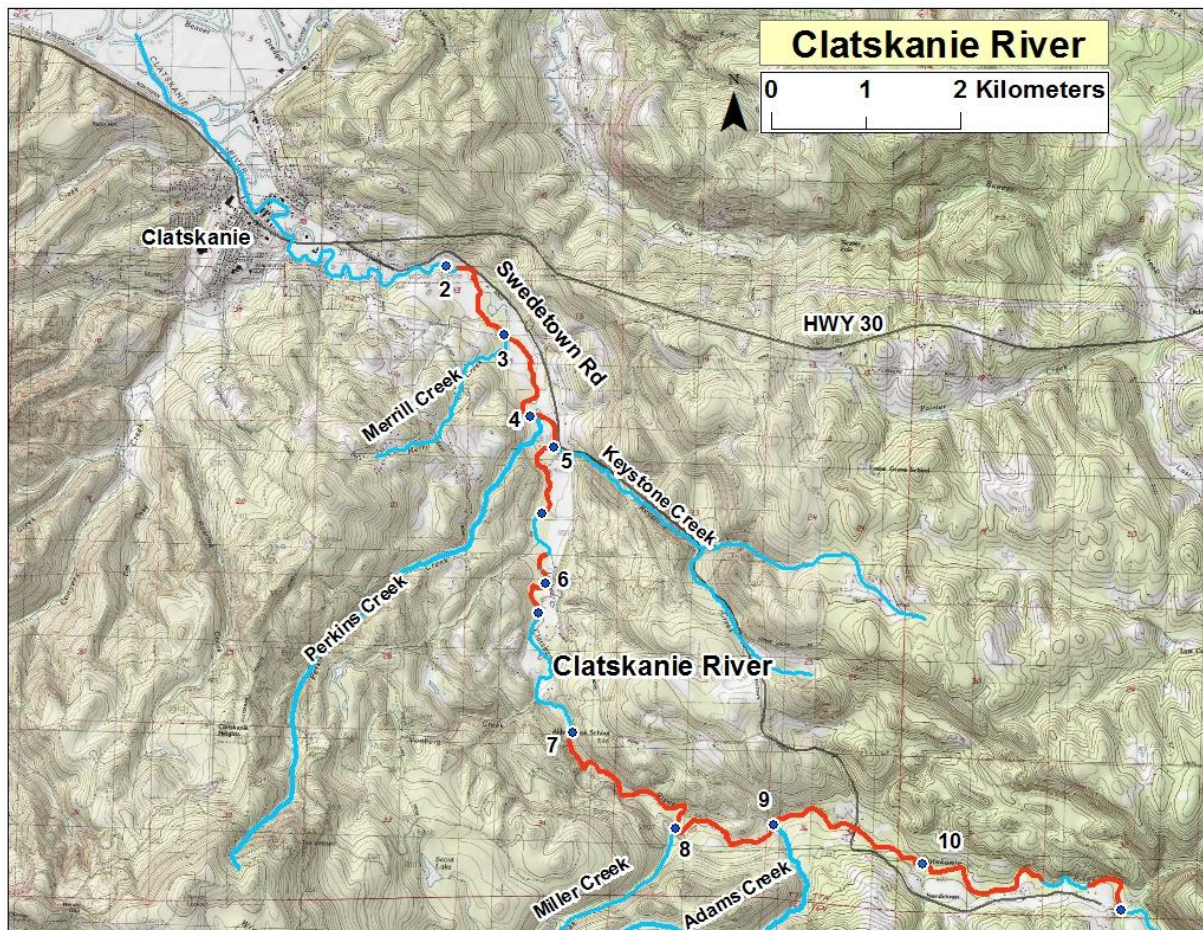


Figure 91. Map of reaches (red line) surveyed on the Clatskanie River, located southeast of Clatskanie, OR. Reach break labels correspond to the downstream end of each reach.

REACH 2

REACH DESCRIPTION:

Reach 2 started at tidewater 0.8 km upstream from Olson Road (Lat: 46.099988, Long: -123.176779) and continued upstream to the confluence with Merrill Creek (Lat: 46.094339, Long: -123.170627; Figure 92). The mainstem thalweg length of this reach was 1,090 m. There were three side channels with a combined thalweg length of 217 m. The channel was unconfined, with multiple side channels and meanders. The riparian vegetation in this reach consisted of grasses and sparse alders. Cattle were observed walking through the stream channel during the survey and signs of heavy grazing were evident throughout the reach (Figure 93, panel A), as such land use was heavy grazing. One side-channel complex was partially surveyed due to dense vegetation and lack of water or spawning substrate in the channel. Active erosion was observed on the river-right stream bank throughout much of this reach (Figure 93, panel B). At the upstream end of the reach there was a channel-spanning log jam (> 10 m long; Figure 93, panel D).

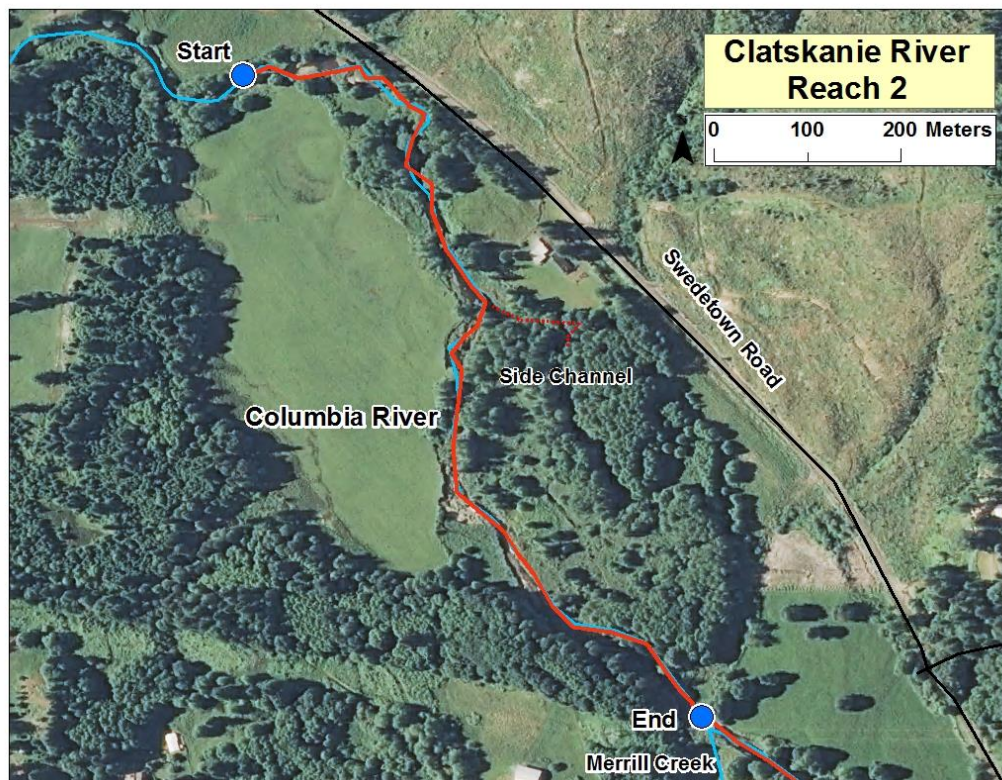


Figure 92. Map of reach 2 (red line) on the Clatskanie River, including start and end points (blue dots).



Figure 93. Survey pictures on reach 2 of the Clatskanie River show cattle crossing the river (panel A), a large, eroded bank on a ranch (panel B), a cliff and large pool near the upstream end of the reach (panel C), and a channel-spanning log jam (panel D).

RESULTS:

Eighty-four patches of suitable spawning substrate were found in reach 2 of the Clatskanie River (Table 34; Figure 94), measuring a total of 3,320 m². Six of these patches were categorized as “high” quality, 22 were of “moderate” quality, and 56 were of “low” quality (Table 34; Figure 94). Seventy-eight patches contained $\geq 50\%$ large gravel (Table 34). Nine cold-water patches totaling 208 m² were observed (Figure 94); average temperature in these patches was 15.1° C and average temperature adjacent to these patches was 17.6° C. The dominant substrate type within these cold-water patches was fine sediment (< 4 mm, diameter). There were no potential barriers to Chum Salmon migration in this reach.

Table 34. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 2 of the Clatskanie River, southeast of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	1	72
high	0-10	0	100	0	5	217
moderate	0-10	0	75	25	4	181
moderate	0-10	0	50	50	2	51
low	0-10	0	25	75	1	35
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	1	4
moderate	11-20	50	50	0	1	24
moderate	11-20	25	75	0	1	50
moderate	11-20	0	100	0	13	388
low	11-20	0	75	25	34	1442
low	11-20	0	50	50	17	827
low	11-20	0	25	75	4	29
low	11-20	0	0	100	0	0

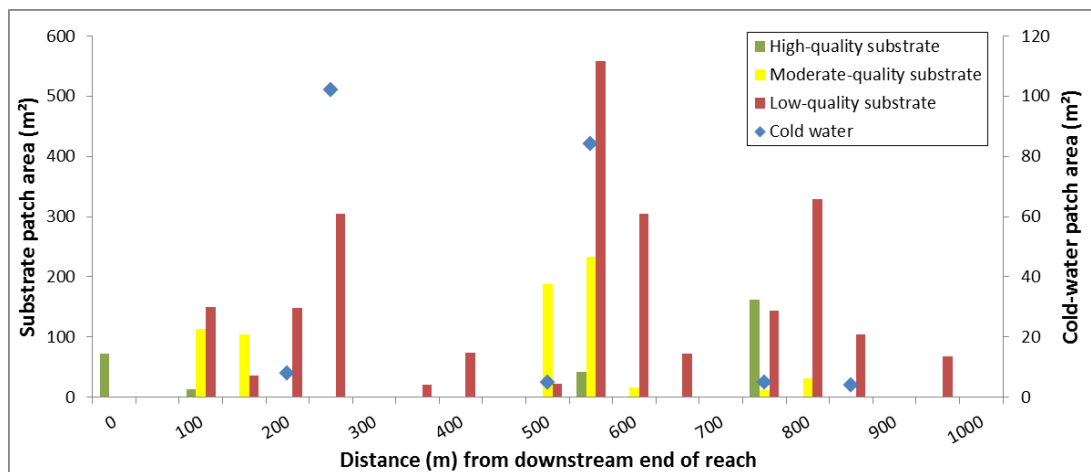


Figure 94. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 2 of the Clatskanie River, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 3

REACH DESCRIPTION:

Reach 3 started at the confluence with Merrill Creek (Lat: 46.093894, Long: -123.170068) and continued upstream to the confluence with Perkins Creek (Lat: 46.086261, Long: -123.166217; Figure 95). The mainstem thalweg length of this reach was 1,174 m. There were three side channels with a combined thalweg length of 474 m. The channel was unconfined, with multiple channels and meanders. The riparian zone consisted of alders and grass, and land use was heavy grazing. Evidence of livestock use within the stream channel was observed throughout this reach including hoof prints in the stream, bank erosion at access points, and feces. Several of the substrate patches in this reach were located outside of the wetted channel, but still within the active channel (Figure 96, panel A). Several instances of major bank erosion were observed within the channel (Figure 96, panel B). In the upstream half of the survey, discharge was evenly split between two channels, one of which occurred below a large log jam (Figure 96, panel C).

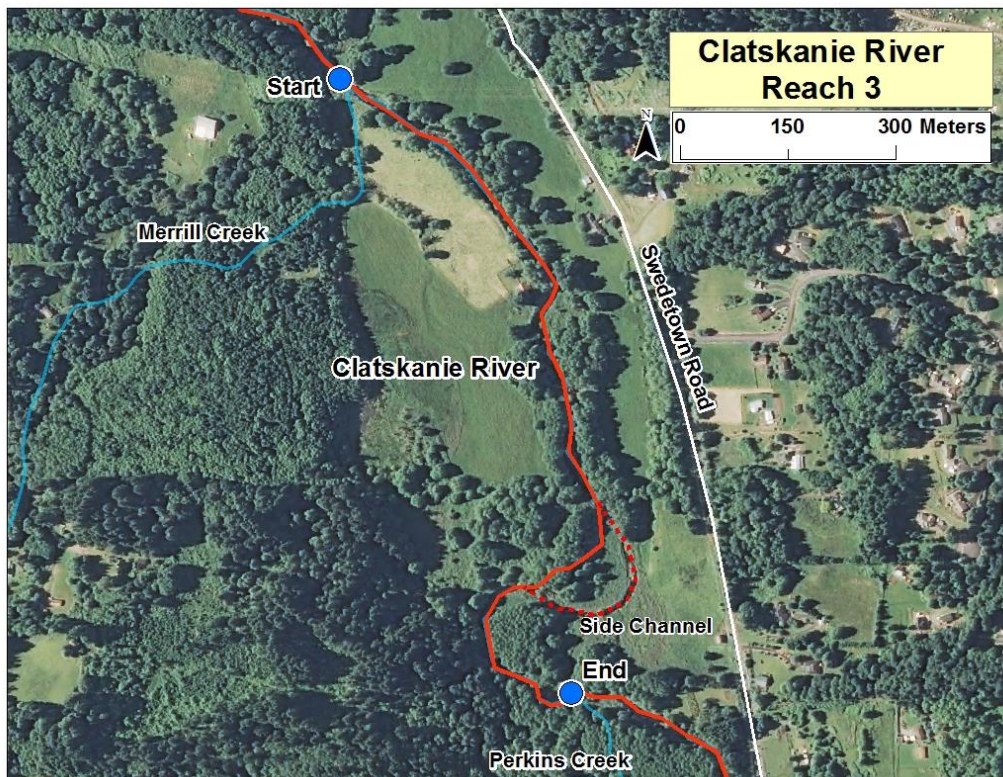


Figure 95. Map of reach 3 (red line) on the Clatskanie River, including start and end points (blue dots).



Figure 96. Survey pictures on reach 3 of the Clatskanie River showing dry gravel within the active channel (panel A), an eroded bank at a sharp river bend (panel B), and a large log jam next to a side channel (panel C).

RESULTS:

Thirty-two patches of suitable spawning substrate were found in reach 3 of the Clatskanie River (Table 35; Figure 97), measuring a total of 396 m². None of these patches were categorized as “high” quality, two were of “moderate” quality, and 30 were of “low” quality (Table 35; Figure 97). Small cobble (46–128 mm) was the dominant or co-dominant substrate in 24 patches (Table 35). Three cold-water patches totaling 18.2 m² were observed (Figure 97); average temperature in these patches was 12.9° C and average temperature adjacent to these patches was 14.0° C. The dominant substrate types within these cold-water patches were fine sediment (n = 2), and small cobble (n = 1). There were no potential barriers to Chum Salmon migration in this reach.

Table 35. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 3 of the Clatskanie River, southeast of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	1	3
moderate	0-10	0	50	50	1	6
low	0-10	0	25	75	4	148
low	0-10	0	0	100	3	37
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	7	58
low	11-20	0	50	50	11	98
low	11-20	0	25	75	5	46
low	11-20	0	0	100	0	0

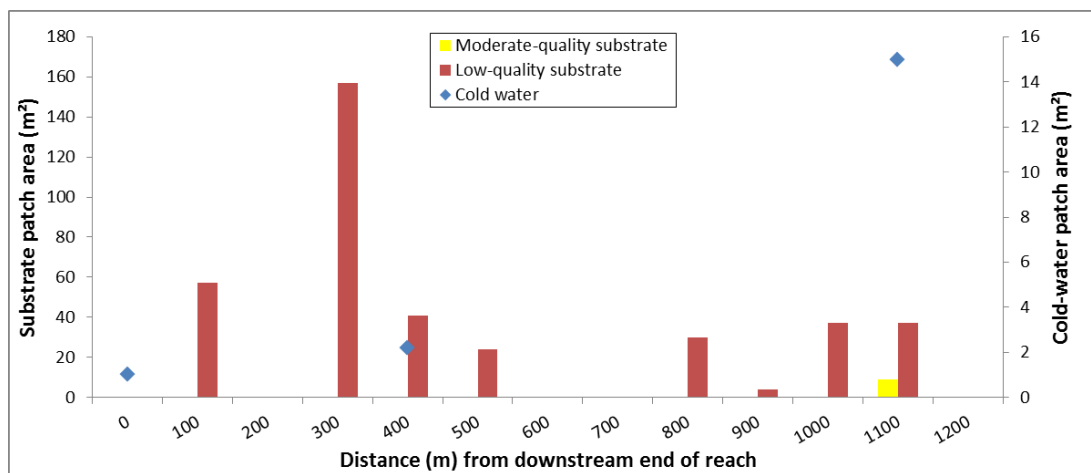


Figure 97. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 3 of the Clatskanie River, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 100 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 4

REACH DESCRIPTION:

Reach 4 started at the confluence with Perkins Creek (Lat: 46.086261, Long: -123.166217) and continued upstream to the confluence with Keystone Creek (Lat: 46.083407, Long: -123.162801; Figure 98). The mainstem thalweg length of this reach was 501 m, and there were no side channels. Channel form was unconfined and braided, with multiple meanders. The riparian zone was dominated by alders and grasses (Figure 99, panel A). No signs of livestock were observed in this reach. Land use was rural residential and young timber. There were several deep pools (depth > 2 m), including one long pool (length > 25 m; Figure 99, panel B) located 100 m downstream from the Perkins Creek Campground bridge (Figure 99, panel C). There was one instance of severe bank erosion, the hillside was actively eroding and cutting under Swedetown Road (Figure 99, panel D).



Figure 98. Map of reach 4 (red line) on the Clatskanie River, including start and end points (blue dots).



Figure 99. Survey pictures on reach 4 of the Clatskanie River showing a long pool near the downstream end of the reach (panel A), a deep pool along a sharp bend in the river (panel B), Perkins Creek Campground bridge (panel C), and an eroded bank near the upstream end of the reach (panel D).

RESULTS:

Ten patches of suitable spawning substrate that met established criteria were found in reach 4 of the Clatskanie River (Table 36; Figure 100), measuring a total of 113 m². None of these patches were categorized as “high” quality, two were of “moderate” quality, and eight were of “low” quality (Table 36; Figure 100). Four cold-water patches totaling 31.8 m² were observed (Figure 100); average temperature in these patches was 9.5° C and average temperature adjacent to these patches was 11.8° C. The dominant substrate types within these cold-water patches were large gravel (n = 1) and small cobble (n = 3). There were no potential barriers to Chum Salmon migration in this reach.

Table 36. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 4 of the Clatskanie River, southeast of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	1	2
moderate	0-10	0	50	50	1	15
low	0-10	0	25	75	1	8
low	0-10	0	0	100	1	2
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	3	15
low	11-20	0	50	50	1	30
low	11-20	0	25	75	1	40
low	11-20	0	0	100	1	1

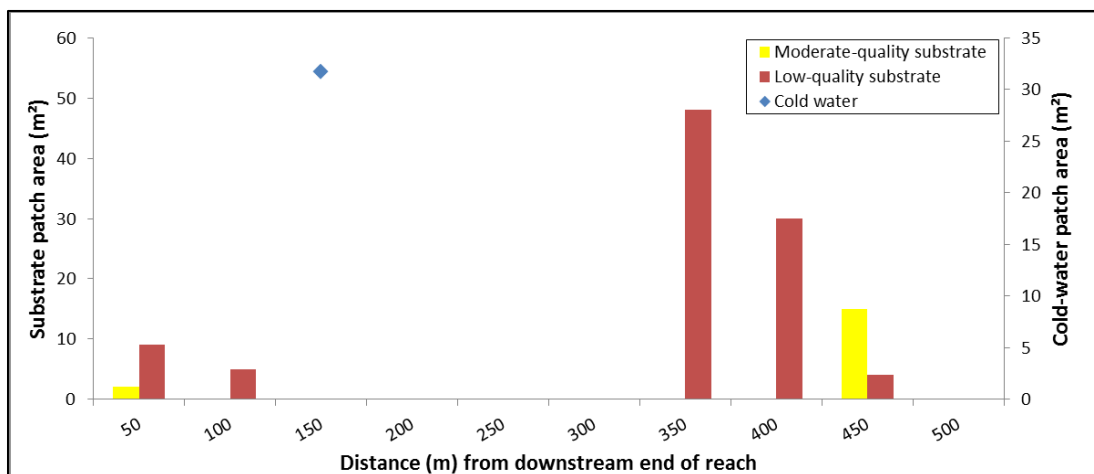


Figure 100. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 4 of the Clatskanie River, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 5

REACH DESCRIPTION:

Reach 5 started at the confluence with Keystone Creek (Lat: 46.083407, Long: -123.162801), and continued upstream to a point adjacent to a house on county tax lot 7N4W2700 302 (Lat: 46.067691, Long: -123.1641; Figure 101). The mainstem thalweg length of this survey was 1,342 m. There were two side channel sections in this reach with a combined thalweg length of 81 m. One side channel and two main channel sections with thalweg lengths of 50 m and 650 m respectively, were not surveyed due to landowner denials. Riparian vegetation was dominated by alders along the river-left bank, and grass along the river-right bank (Figure 102, panel A). In one section of stream there was limited riparian vegetation and the stream temperature increased. Alterations to the stream channel were common throughout this reach and included large holes (depth > 2 m), areas where substrate was removed, and banks that were stabilized by the placement of boulders (Figure 102, panel B). Land use was rural residential and light grazing. Several sandstone cliffs were actively eroding into the stream channel, depositing fine sediment (< 4 mm, diameter), which reduced substrate quality (Figure 102, panel C).

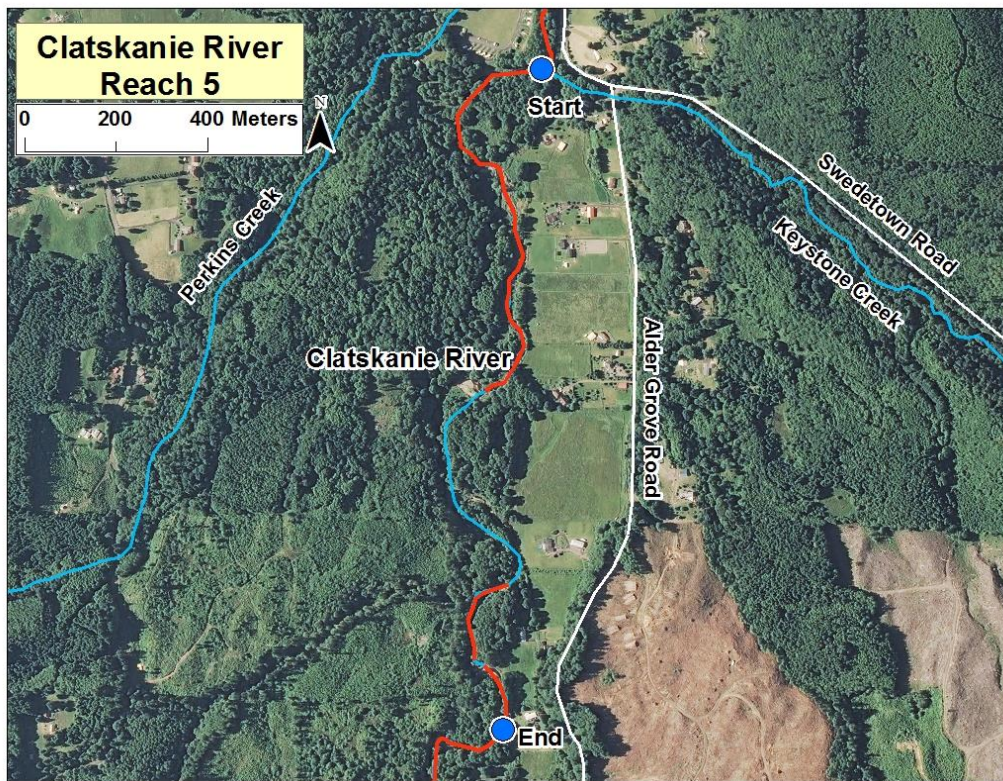


Figure 101. Map of reach 5 (red line) on the Clatskanie River, including start and end points (blue dots).



Figure 102. Survey pictures on reach 5 of the Clatskanie River show alders in the riparian zone near the downstream end of the reach (panel A), boulders stabilizing a bank along residential properties (panel B), an eroded bank (panel C), and large cobble substrate at the upstream end of the reach (panel D).

RESULTS:

Large cobble substrate (129–256 mm, diameter) was common throughout this reach (Figure 102, panel D), but suitable spawning substrate was observed as well. Thirty-one patches of suitable spawning substrate were found in reach 5 of the Clatskanie River (Table 37; Figure 103), measuring a total of 656 m². None of these patches were categorized as “high” quality, six were of “moderate” quality, and twenty-five were of “low” quality (Table 37; Figure 103). Small gravel (4–11 mm, diameter) was present in five of these patches. Nine cold-water patches totaling 57.6 m² were observed (Figure 103); average temperature in these patches was 12.1° C and average temperature adjacent to these patches was 13.7° C. The dominant substrate types within these cold-water patches were fine sediment (n = 5), large gravel (n = 2), and large cobble (n = 2). There were no potential barriers to Chum Salmon migration in this reach.

Table 37. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 5 of the Clatskanie River, southeast of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	3	20
low	0-10	0	25	75	4	78
low	0-10	0	0	100	5	189
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	1	1
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	2	17
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	1	3
low	11-20	0	50	50	4	38
low	11-20	0	25	75	8	200
low	11-20	0	0	100	3	110

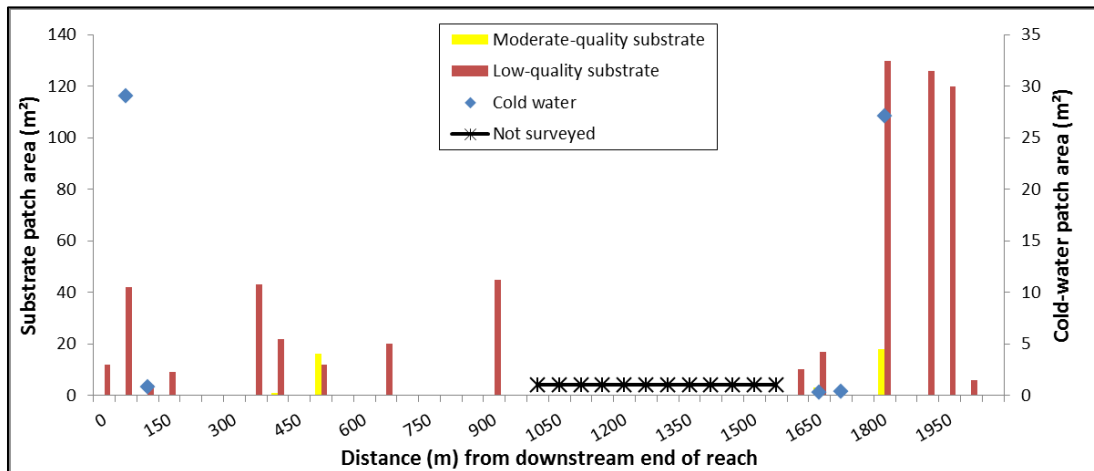


Figure 103. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 5 of the Clatskanie River, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^\circ$ C colder than the temperature in the main channel.

REACH 6

REACH DESCRIPTION:

Reach 6 started adjacent to a house on county tax lot 7N4W2700 302 (Lat: 46.070484, Long: -123.163268) and continued upstream to a small farm at Lat: 46.067691, Long: -123.1641. The mainstem thalweg length of this reach was 508 m. There were two side channels with a combined thalweg length of 93 m. The channel was primarily unconfined, with multiple meanders. A large section of the river measuring 1.7 km, stretching from the upstream end of reach 6 to the downstream end of reach 7, was not surveyed due to several landowner denials. The riparian zone was dominated by trees along both banks, and land use was a mix of mature timber and rural residential. A large sandstone cliff on the river left bank was actively eroding into the stream channel (Figure 105, panel A).

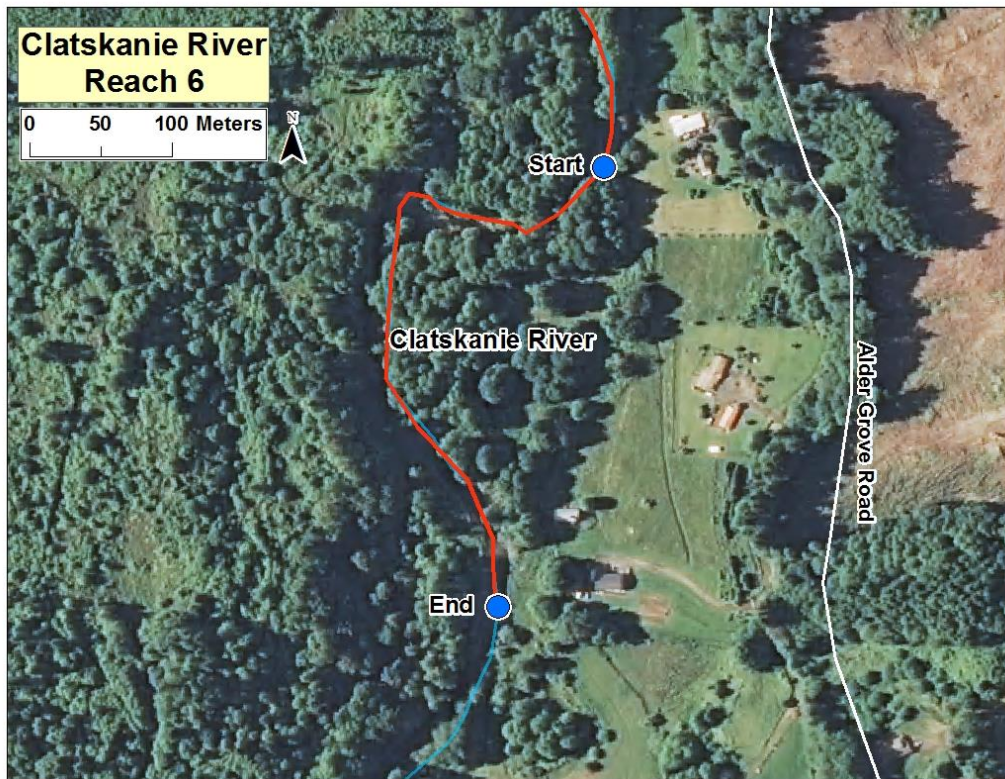


Figure 104. Map of reach 6 (red line) on the Clatskanie River, including start and end points (blue dots).



Figure 105. Survey pictures on reach 6 of the Clatskanie River show a large, eroded, sandstone cliff (panel A), a cold-water patch in an isolated pool (panel B), and sandstone substrate throughout the river (panel C).

RESULTS:

Five patches of suitable spawning substrate were found in reach 6 of the Clatskanie River (Table 38; Figure 106), measuring a total of 44 m². All patches were categorized as “low” quality (Table 38; Figure 106) and they all contained $\geq 75\%$ small cobble (Table 38). Several of the substrate patches in this reach consisted of sandstone rock (4–128 mm, diameter; Figure 105, panel C). One cold-water patch was observed, measuring 13.9 m² (Figure 106). The temperature in this patch was 13.9° C and temperature adjacent to this patch was 15.5° C. The dominant substrate type within this cold-water patch was large cobble (46–128 mm, diameter), and the patch was in an isolated pool in an otherwise dry side channel (Figure 105, panel B). There were no potential barriers to Chum Salmon migration in this reach.

Table 38. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 6 of the Clatskanie River, southeast of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	2	4
low	0-10	0	0	100	3	40
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	0	0
low	11-20	0	25	75	0	0
low	11-20	0	0	100	0	0

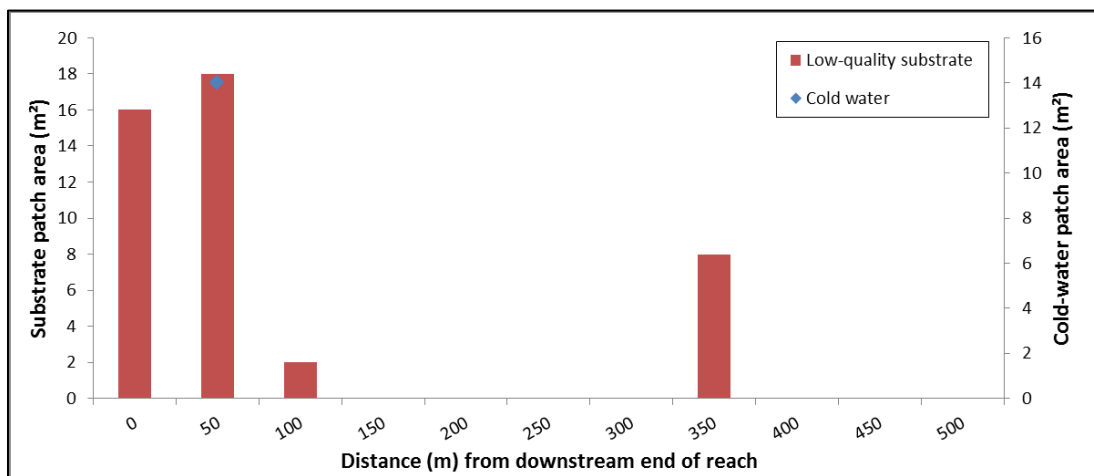


Figure 106. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 6 of the Clatskanie River, OR, in September 2012. For cold water and for low-quality substrate, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 7

REACH DESCRIPTION:

Reach 7 started at a fence line that spanned the channel (located at the Lat: 46.056508, Long: -123.159013; Figure 108, panel A) and continued upstream to the confluence with Miller Creek (Lat: 46.04778, Long: -123.144593; Figure 107; Figure 108, panel B). The mainstem thalweg length of this reach was 2,052 m. There were four side channels with a combined thalweg length of 271 m. The channel was primarily unconfined, with multiple meanders throughout the reach. The riparian zone was densely vegetated with alder, maples, firs, and cedars (Figure 108, panel C). Within this reach, the gradient of the stream channel was increasing, but below 5%. One large side-channel complex included multiple log jams and was located in the upstream half of the reach (Figure 108, panel D). While surveying upstream, the crew encountered increasing turbidity. It appeared the source of the turbidity was the Miller Creek drainage, where active logging was occurring. Land use was mature timber and timber harvest.

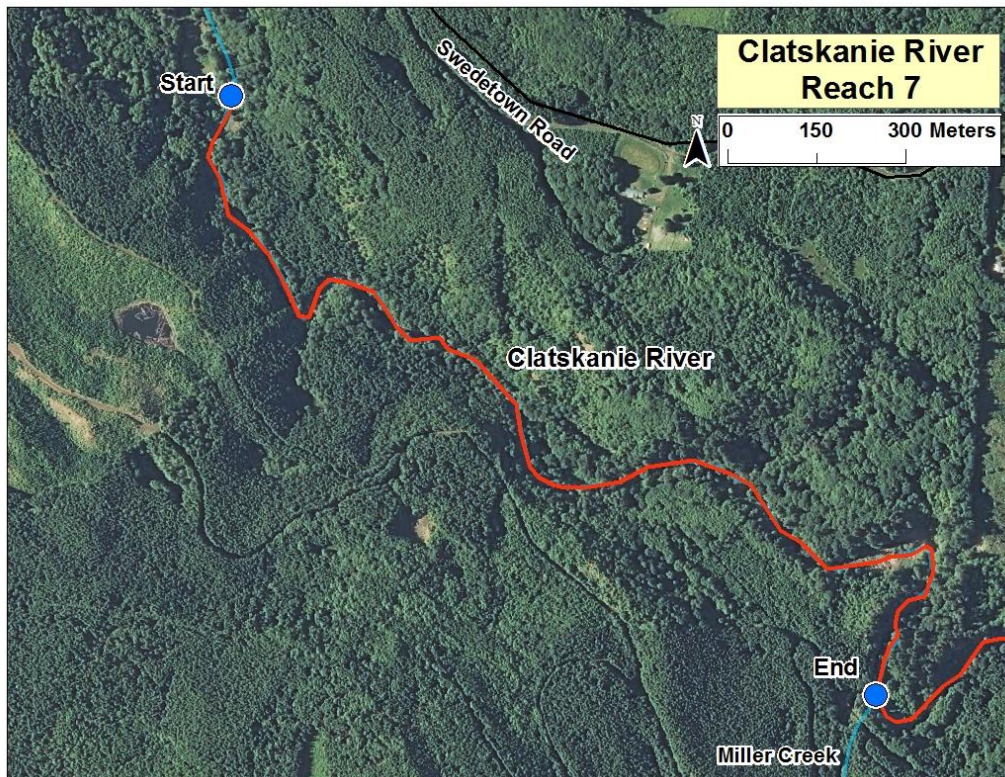


Figure 107. Map of reach 7 (red line) on the Clatskanie River, including start and end points (blue dots).

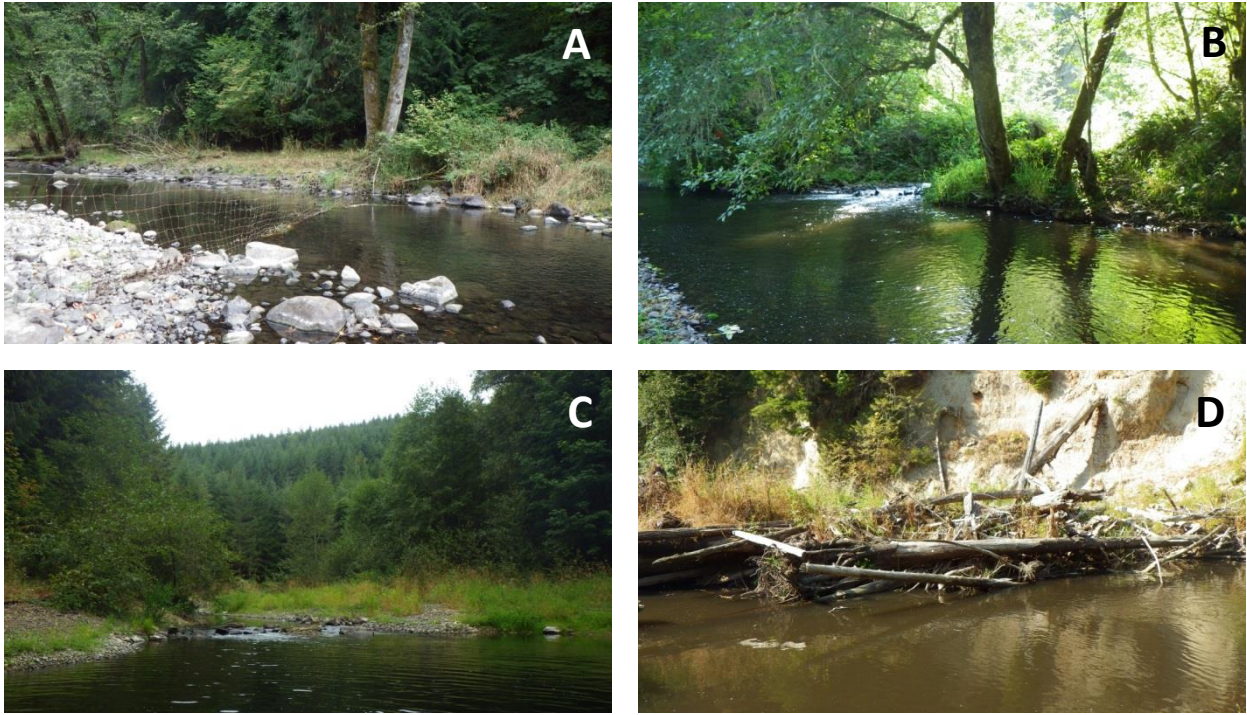


Figure 108. Survey pictures on reach 7 of the Clatskanie River show a channel-spanning wire fence at the downstream end of the reach (panel A), confluence with Miller Creek at the upstream end of the reach (panel B), dense riparian vegetation (panel C), and a channel-spanning log jam adjacent to multiple side channels (panel D).

RESULTS:

The stream channel in this reach consisted of areas of substrate dominated by cobble (45–256 mm, diameter) and boulders. Sixteen patches of suitable spawning substrate were found in reach 7 of the Clatskanie River (Table 39; Figure 109), measuring a total of 239 m². None of these patches were categorized as “high” quality, three were of “moderate” quality, and 13 were of “low” quality (Table 39; Figure 109). Seventeen cold-water patches were observed in this reach, totaling 106.8 m² (Figure 109); average temperature in these patches was 11.0° C and average temperature adjacent to these patches was 13.2° C. The dominant substrate types within these cold-water patches were fine sediment (n = 1), large gravel (n = 3), large cobble (n = 2), and bedrock (n = 11). There were no potential barriers to Chum Salmon migration in this reach.

Table 39. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 7 of the Clatskanie River, southeast of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	2	64
low	0-10	0	25	75	1	8
low	0-10	0	0	100	2	84
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	1	1
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	1	18
low	11-20	0	25	75	3	10
low	11-20	0	0	100	6	54

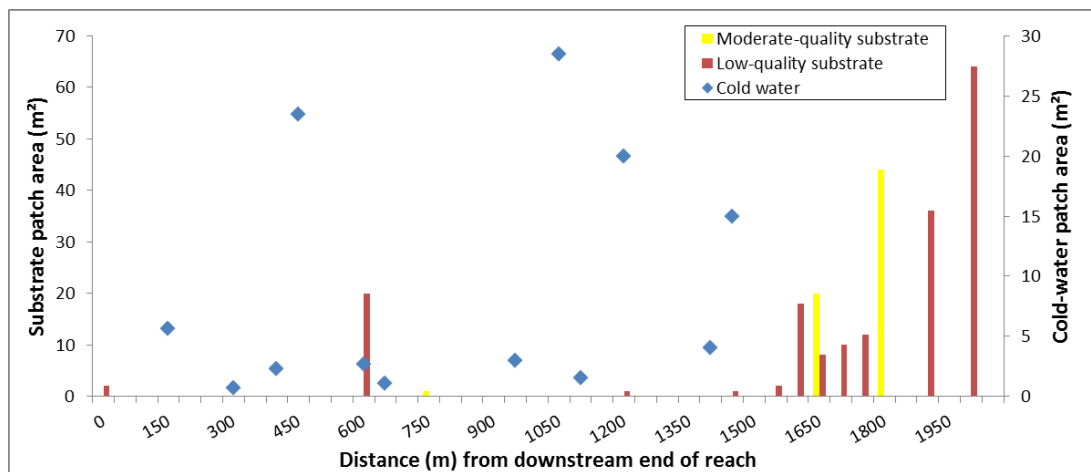


Figure 109. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 7 of the Clatskanie River, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 8

REACH DESCRIPTION:

Reach 8 started at the confluence with Miller Creek (Lat: 46.04778, Long: -123.144593) and continued upstream to the confluence with Adams Creek (Lat: 46.048399, Long: -123.131204; Figure 110). The mainstem thalweg length of this reach was 1,405 m. There was one side channel with a thalweg length of 43 m, and multiple meanders were observed throughout. Channel form was unconfined and braided. The riparian zone was dominated by with grasses, alders, firs, and cedars (Figure 111, panel A), but there were also several sandstone cliffs in the riparian zone (Figure 111, panel B). Land use was primarily mature timber.

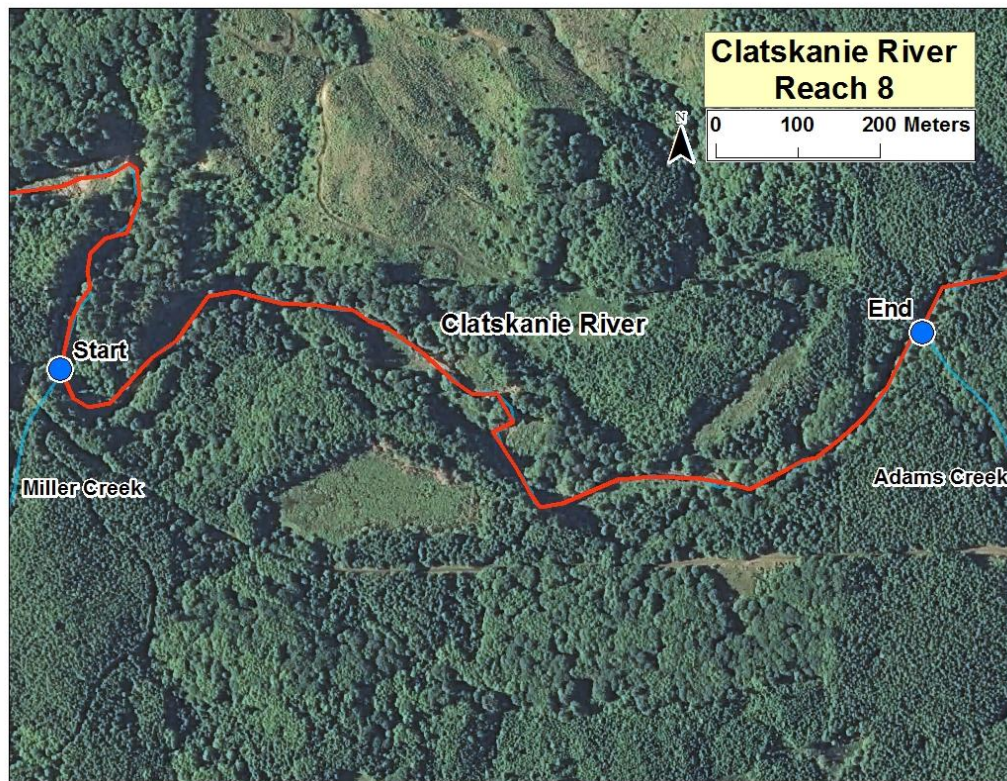


Figure 110. Map of reach 8 (red line) on the Clatskanie River, including start and end points (blue dots).



Figure 111. Survey pictures on reach 8 of the Clatskanie River show a riparian zone with a mix of grass, alder, Western Red Cedar and Douglas Fir (panel A), a large sandstone cliff along the river (panel B), a dry side channel with multiple substrate patches (panel C), and a cold-water seep flowing over a bedrock shelf (panel D).

RESULTS:

Forty-eight patches of suitable spawning substrate were found in reach 8 of the Clatskanie River (Table 40; Figure 112), measuring a total of 2,362 m². Several substrate patches were found in dry side channel sections (Figure 111, panel C). One of these patches was categorized as “high” quality, six patches were of “moderate” quality, and 41 patches were of “low” quality (Table 40; Figure 112). Forty-two of these patches contained $\geq 50\%$ small cobble (Table 40). Four cold-water patches were observed, totaling 30.2 m² (Figure 112); average temperature in these patches was 12.4° C and average temperature adjacent to these patches was 13.9° C. The dominant substrate types within these cold-water patches were fine sediment (n = 1), small gravel (n = 1), small cobble (n = 1), and bedrock (n = 1). One of the cold-water patches was a seep flowing out of a bedrock shelf (Figure 111, panel D). There were no potential barriers to Chum Salmon migration in this reach.

Table 40. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 8 of the Clatskanie River, southeast of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	1	3
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	2	14
moderate	0-10	0	50	50	4	238
low	0-10	0	25	75	13	820
low	0-10	0	0	100	8	622
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	3	19
low	11-20	0	50	50	7	104
low	11-20	0	25	75	9	502
low	11-20	0	0	100	1	40

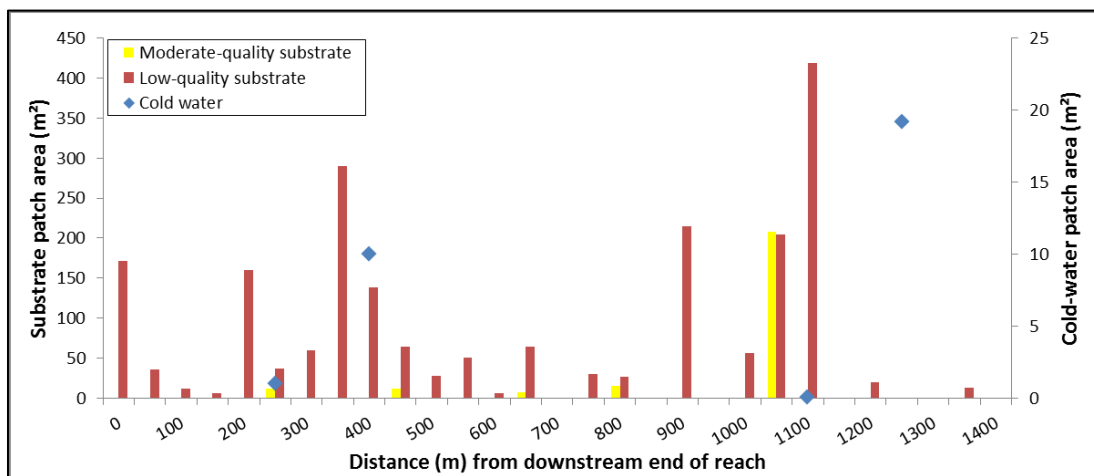


Figure 112. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 8 of the Clatskanie River, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 9

REACH DESCRIPTION:

Reach 9 started at the confluence with Adams Creek (Lat: 46.048399, Long: -123.131204; Figure 114, panel A) and continued upstream to a small unnamed tributary 1 km upstream from the Swedetown Road bridge (Lat: 46.045236, Long: -123.110811; Figure 113). The mainstem thalweg length of this reach was 1,953 m, with no side channels. The channel was unconfined and braided. The riparian zone was dominated by grasses and older alders, firs, and cedars (Figure 114, panels A and B). Land use was a mix of young and mature timber.

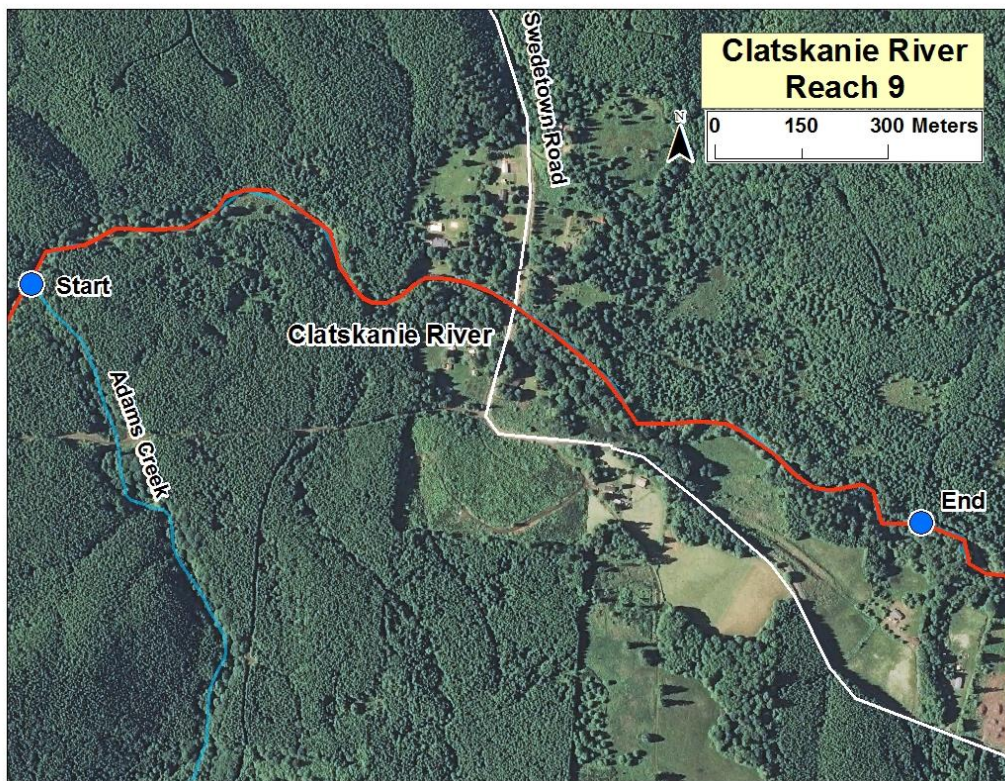


Figure 113. Map of reach 9 (red line) on the Clatskanie River, including start and end points (blue dots).



Figure 114. Survey pictures on reach 9 of the Clatskanie River show the confluence with Adams Creek at the downstream end of the reach (panel A), a grey colored cold-water patch at the base of a tree (panel B), a substrate patch adjacent to a cold-water patch (panel C), and a large substrate patch (panel D).

RESULTS:

Substrate in the size classes suitable for chum spawning (4–128 mm, diameter) was abundant throughout this reach, including several large patches (> 100 m² Figure 114, panel D). Seventy-three patches of suitable spawning substrate were found in reach 9 of the Clatskanie River (Table 41; Figure 115), measuring a total of 2,499 m². None of these patches were categorized as “high” quality, six patches were of “moderate” quality, and 67 patches were of “low” quality (Table 41; Figure 115). Sixty of these patches contained ≥ 75% small cobble (Table 41). Sixteen cold-water patches were observed, totaling 91.5 m² (Figure 115). Several of the cold-water patches were located under the root masses of large, living trees (Figure 114, panel B), and substrate patches were in close proximity to many of these cold-water patches (Figure 114, panel C); average temperature in these patches was 10.4° C and average temperature adjacent to these patches was 12.2° C. The dominant substrate types within these cold-water patches were fine sediment (n = 5), large gravel (n = 3), small cobble (n = 7) and large cobble (n = 1). There were no potential barriers to Chum Salmon migration in this reach.

Table 41. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 9 of the Clatskanie River, southeast of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	2	20
moderate	0-10	0	50	50	4	68
low	0-10	0	25	75	33	1868
low	0-10	0	0	100	11	235
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	7	48
low	11-20	0	25	75	15	228
low	11-20	0	0	100	1	32

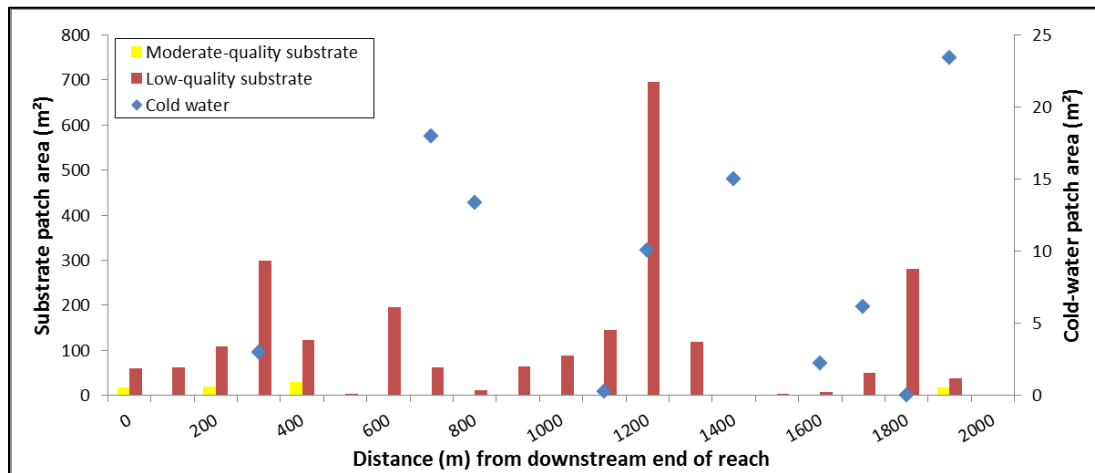


Figure 115. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 9 of the Clatskanie River, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 100 m units. Cold-water patches were $\geq 1.0^\circ\text{C}$ colder than the temperature in the main channel.

REACH 10

REACH DESCRIPTION:

Reach 10 started at a small, unnamed tributary 1 km upstream for the Swedetown Road bridge (Lat: 46.045236, Long: -123.110811) and continued upstream to a small bridge located 50 m downstream from the confluence with Carcus Creek (Lat: 46.041423, Long: -123.083708; Figure 116; Figure 117, panel A). The mainstem thalweg length of this reach was 2,539 m. There were three side channels with a combined thalweg length of 290 m, and multiple meanders were observed throughout. One section in the middle of the reach (thalweg length = 650 m), was not surveyed due to a landowner denial on this property. The riparian vegetation was highly variable in this reach with some areas dominated by young alders (Figure 117, panel B), other sections with only grass (Figure 117, panel C), and some sections with dense vegetation consisting of alders, maples, firs and cedars. Land use was a mix of rural residential and mature timber. Large woody debris was abundant in this reach, including multiple log jams (Figure 117, panel D).

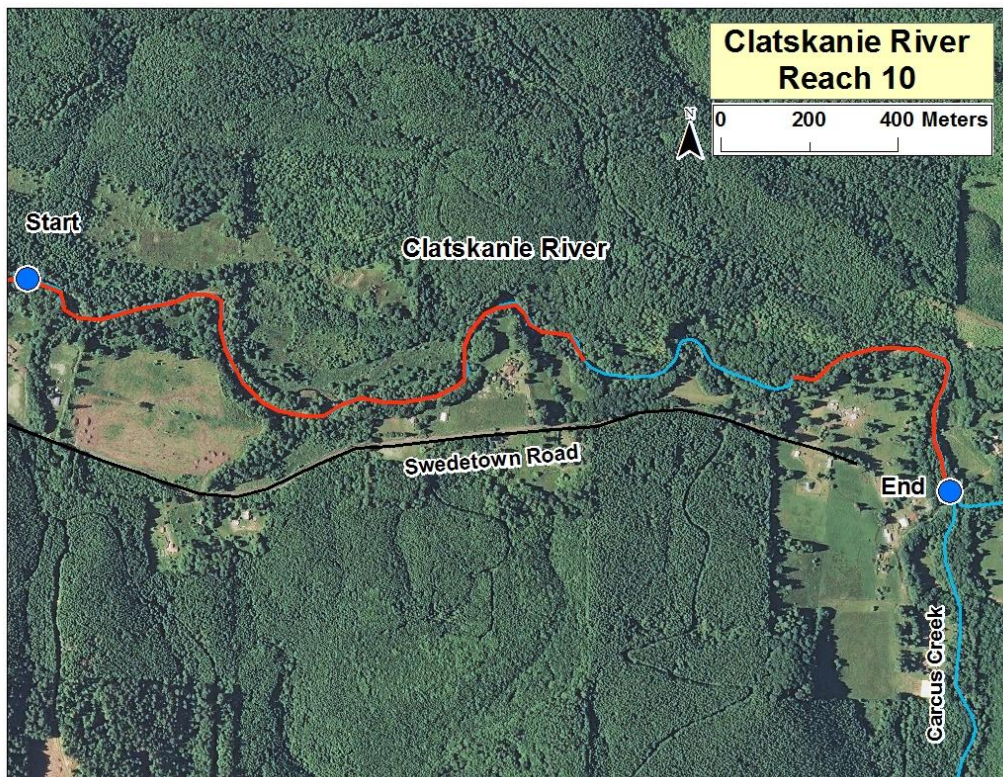


Figure 116. Map of reach 10 (red line) on the Clatskanie River, including start and end points (blue dots).



Figure 117. Survey pictures on reach 10 of the Clatskanie River show a bridge at the upstream end of reach (panel A), an alder-dominated riparian zone near the downstream end of the reach (panel B), a grass-dominated riparian zone at the middle of the reach (panel C), and a log jam in a dry side channel (panel D).

RESULTS:

Eighty-one patches of suitable spawning substrate were found in reach 10 of the Clatskanie River (Table 42; Figure 118), measuring a total of 3,219 m². One of these patches was categorized as “high” quality, four patches were of “moderate” quality, and 76 patches were of “low” quality (Table 42; Figure 118). All but two of these patches contained $\geq 50\%$ small cobble (Table 42). Seven cold-water patches were observed, totaling 24.3 m² (Figure 118); average temperature in these patches was 11.8° C and average temperature adjacent to these patches was 13.3° C. The dominant substrate types within these cold-water patches were fine sediment (n = 2), large gravel (n = 2), small cobble (n = 2), and large cobble (n = 1). There were no potential barriers to Chum Salmon migration in this reach.

Table 42. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 10 of the Clatskanie River, southeast of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	1	1
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	4	32
low	0-10	0	25	75	20	1519
low	0-10	0	0	100	21	819
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	1	21
low	11-20	0	50	50	15	298
low	11-20	0	25	75	11	454
low	11-20	0	0	100	8	75

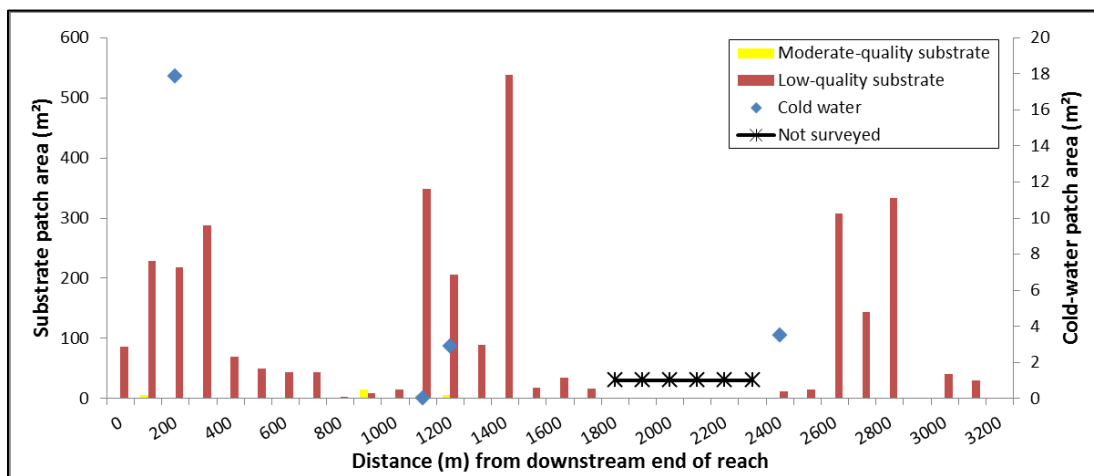


Figure 118. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 10 of the Clatskanie River, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 100 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

Conyers Creek

SURVEY DATES: August 29, September 6, and September 25, 2012; July 22 and July 30, 2013

SURVEY CREW: Brian Alfonse, Kris Homel, John Cox, Brad Benson, and Lorana McCalester

GENERAL DESCRIPTION:

The Conyers Creek habitat survey (Township: 7N Range: 4W Section: 1700) started at the confluence with an unnamed tributary located 50 m downstream from the Clatskanie Heights Road bridge and continued 3.1 km upstream to the confluence with East Creek. Approximately 670 m of this section was not surveyed due to landowner denials between reaches 4 and 5. Surveys on Conyers Creek were delineated into four reaches in the main stem and one reach in a tributary based on physical features, landowner access, and overall distance (Figure 119).

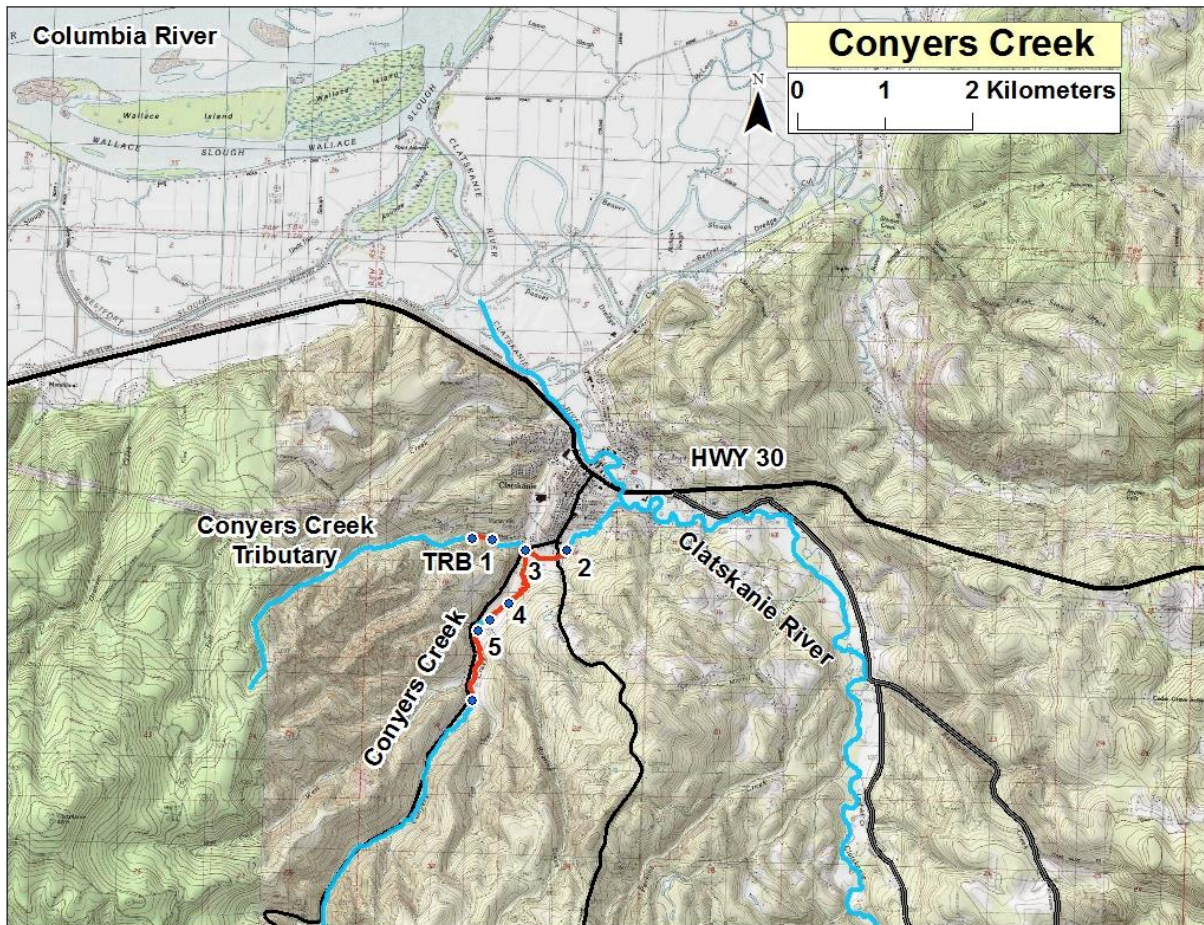


Figure 119. Map of reaches (red line) surveyed on Conyers Creek, located south of Clatskanie, OR. Reach break labels correspond to the downstream end of each reach.

REACH 2

REACH DESCRIPTION:

Reach 2 started at the confluence with an unnamed tributary 50 m downstream from Clatskanie Heights Road bridge (Lat: 46.095718, Long: -123.207487) and continued upstream to the confluence with a small, unnamed tributary adjacent to SW Hall Road (Lat: 46.095485, Long: -123.213418; Figure 120). The mainstem thalweg length of this reach was 628 m, and there was one side channel (thalweg length = 31 m). The channel was confined with multiple meanders. Riparian vegetation was dominated by grasses and alders (Figure 121, panel A). Agricultural fields were also observed, and harvest extended up to the stream bank. Land use was a mix of agriculture, light grazing, and rural residential.

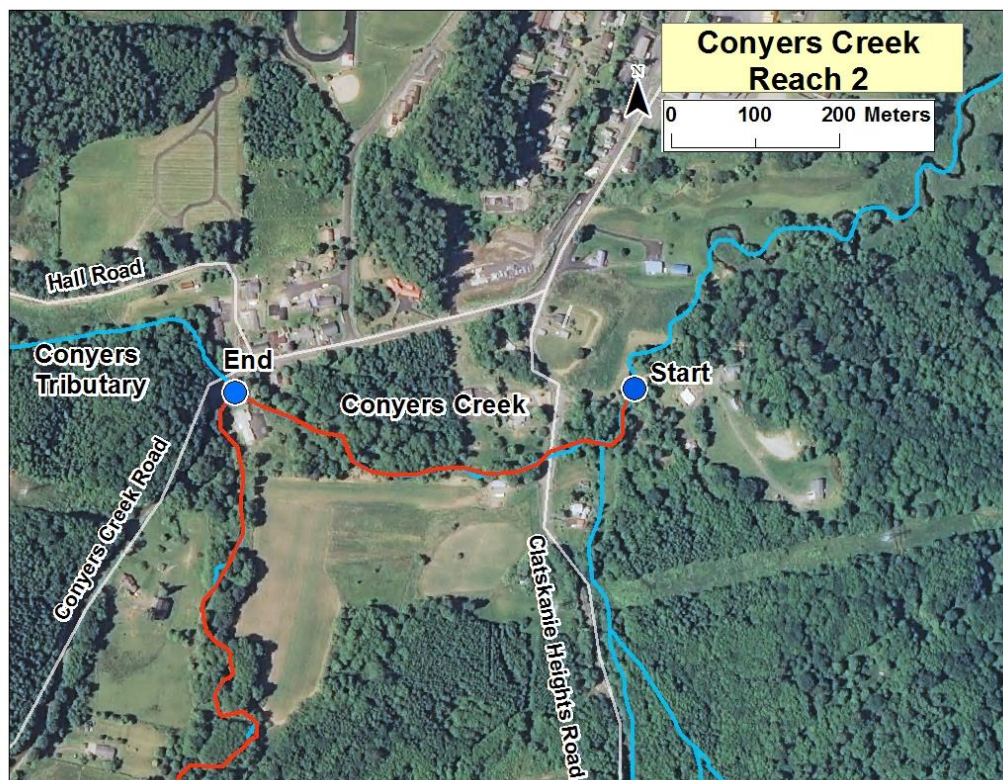


Figure 120. Map of reach 2 (red line) on Conyers Creek, including start and end points (blue dots).



Figure 121. Survey pictures of reach 2 of Conyers Creek show a section of stream with a grass-dominated riparian zone (panel A) and a “low” quality substrate patch with large gravel and elevated levels of fine sediment (panel B).

RESULTS:

Substrate sizes within the range suitable for Chum Salmon (4–128 mm, diameter) were observed in reach 2 of Conyers Creek; however, with fine sediment > 20%, much of this substrate was unsuitable for spawning. Fifty-two patches of suitable spawning substrate were found (Table 43; Figure 122), measuring a total of 639 m². None of these patches were categorized as “high” quality, two were of “moderate” quality, and 50 were of “low” quality (Table 43; Figure 122). All but four patches consisted of both small cobble (46–128 mm, diameter) and large gravel (12–45 mm, diameter) and there were no patches with small gravel (4–12 mm, diameter; Figure 121, panel B; Table 43). No cold-water patches were observed. There were no potential barriers to Chum Salmon migration in this reach.

Table 43. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 2 of Conyers Creek, south of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	2	24
low	11-20	0	75	25	6	35
low	11-20	0	50	50	10	129
low	11-20	0	25	75	32	431
low	11-20	0	0	100	2	20

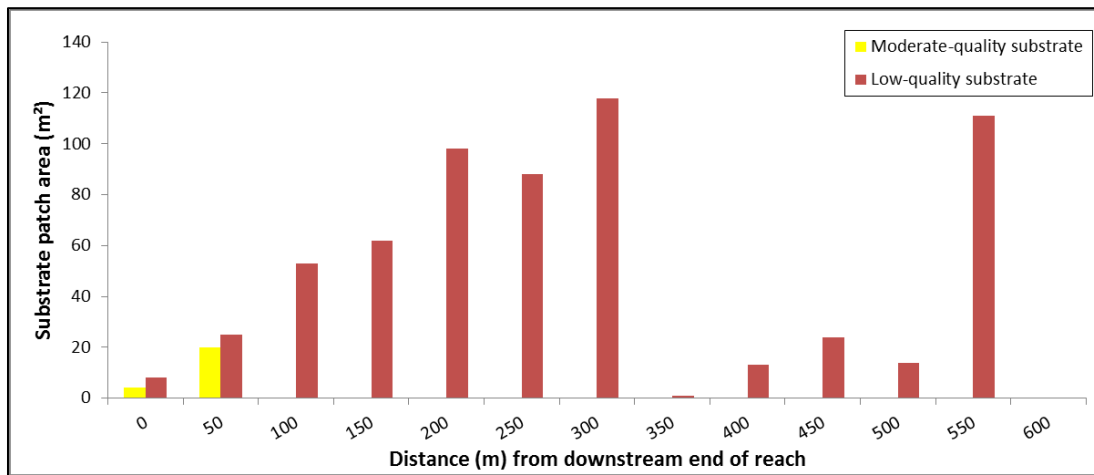


Figure 122. Location of substrate patches measured as distance from downstream end of survey in reach 2 of Conyers Creek, OR, in September 2012. For each category of substrate quality, patch area was summed and binned into 50 m units.

REACH 3

REACH DESCRIPTION:

Reach 3 started at the confluence with a small, unnamed tributary adjacent to SW Hall Road (Lat: 46.095485, Long: -123.213418) and continued upstream to the confluence with another small, unnamed tributary that entered from the river-right bank (Lat: 46.089982, Long: -123.215845; Figure 123). The mainstem thalweg length of this reach was 761 m, there were no side channels, however there were several meanders. Riparian vegetation consisted of young alders and grass (Figure 124, panel A), and land use was rural residential and light grazing. At the downstream end of the survey, a sharp bend in the bank was stabilized with large boulders (Figure 124, panel B). Active erosion of the stream bank occurred in several areas where manicured lawns extended to the stream banks (Figure 124, panel C).

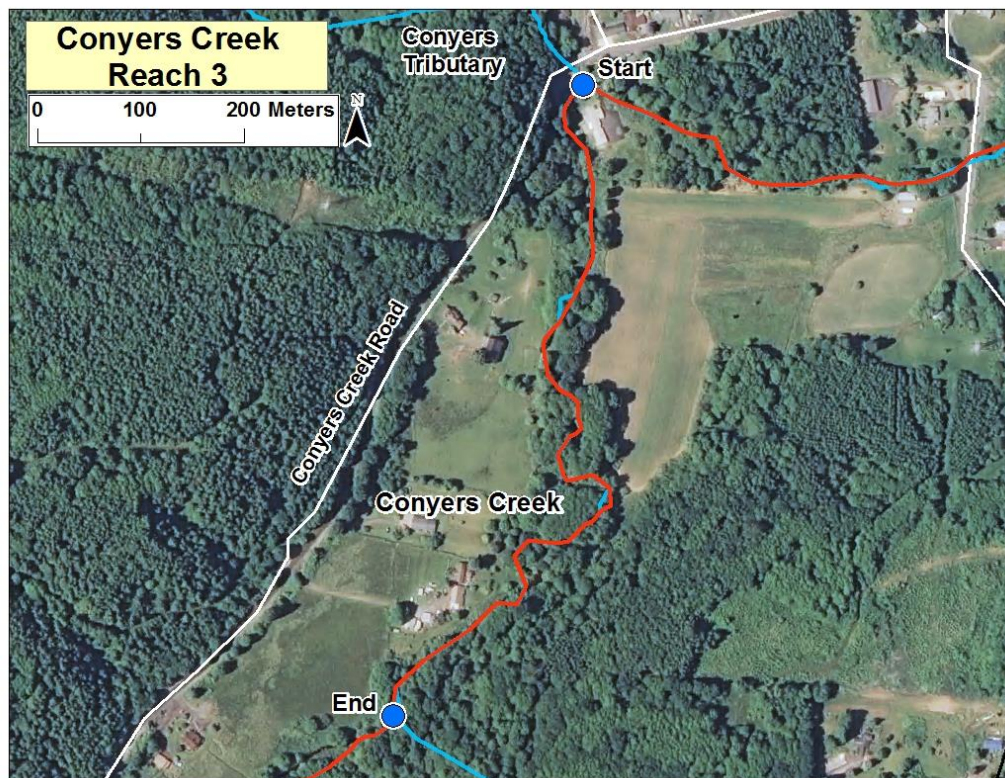


Figure 123. Map of reach 3 (red line) on Conyers Creek, including start and end points (blue dots).

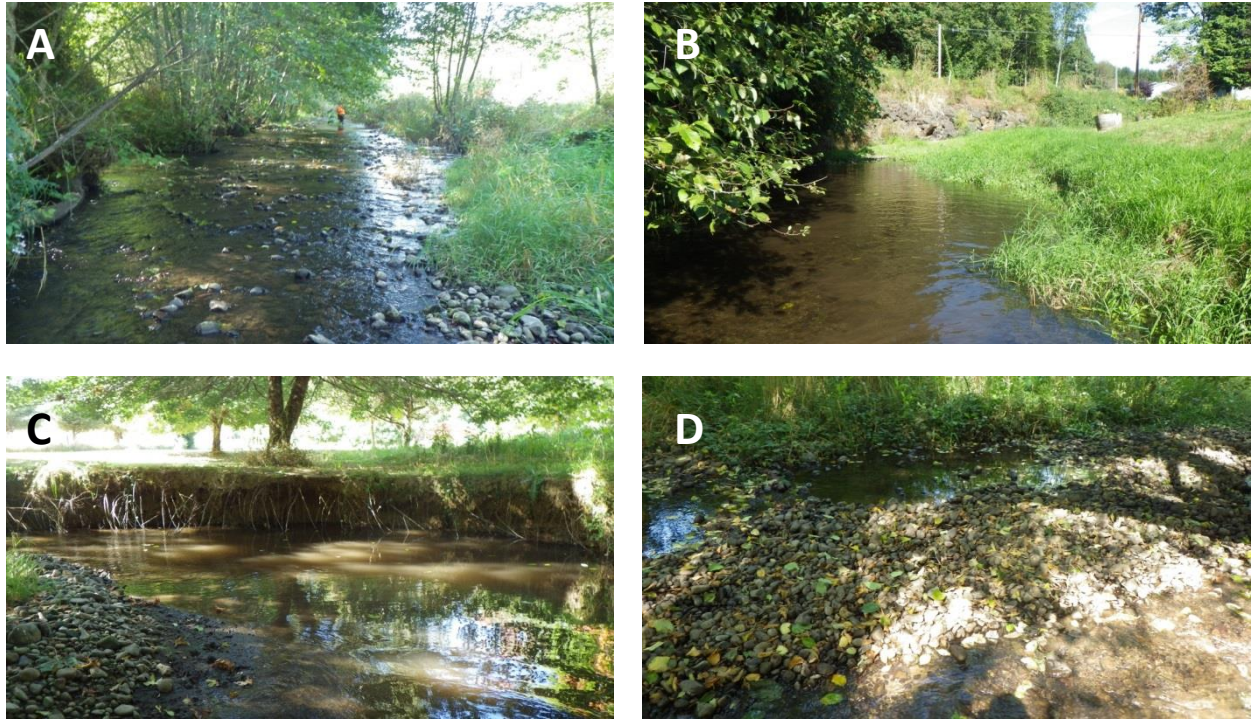


Figure 124. Survey pictures of Conyers Creek reach 3 show a grass and alder-dominated riparian zone (panel A), rip rap along Clatskanie Heights Road (panel B), active bank erosion along a residential property (panel C), and a substrate patch consisting of small cobble (46–128 mm, diameter) and large gravel (12–45 mm, diameter; panel D).

RESULTS:

Twelve patches of suitable spawning substrate were found in reach 3 of Conyers Creek (Table 44; Figure 125), measuring a total of 140 m². None of these patches were categorized as “high” quality, one patch was of “moderate” quality, and eleven patches were of “low” quality (Table 44; Figure 125). Ten of these patches contained $\geq 75\%$ small cobble (46–128 mm, diameter; Table 44). One large patch, measuring 30 m², consisted of 50% small cobble, 50% large gravel (12–45 mm, diameter) and $< 10\%$ fine sediment (< 4 mm, diameter; Figure 124, panel D). No cold-water patches were observed. There were no potential barriers to Chum Salmon migration in this reach.

Table 44. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 3 of Conyers Creek, south of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	1	30
low	0-10	0	25	75	0	0
low	0-10	0	0	100	1	4
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	1	8
low	11-20	0	50	50	0	0
low	11-20	0	25	75	5	73
low	11-20	0	0	100	4	25

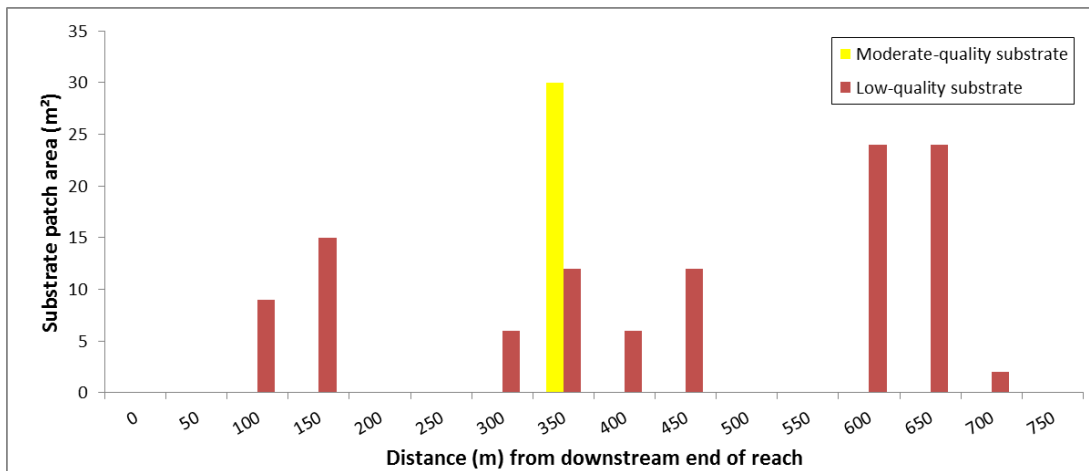


Figure 125. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 3 of Conyers Creek, OR, in September 2012. For each category of substrate quality, patch area was summed and binned into 50 m units.

REACH 4

REACH DESCRIPTION:

Reach 4 started at the confluence with small, unnamed tributary on the river-right bank (Lat: 46.089982, Long: -123.215845) and continued upstream to the confluence of Roaring Creek (Lat: 46.088275, Long: -123.218462; Figure 126). The mainstem thalweg length of this reach was 313 m, and there was one side channel (thalweg length = 30 m). There were several large meanders in this reach. Riparian vegetation consisted of young alders and grass (Figure 127, panel A), and land use was rural residential. Beaver activity was evident throughout the reach, with many downed trees and several beaver dams. These dams created pools, which diverted flow into side channels and produced braids in the stream (Figure 127, panel B).

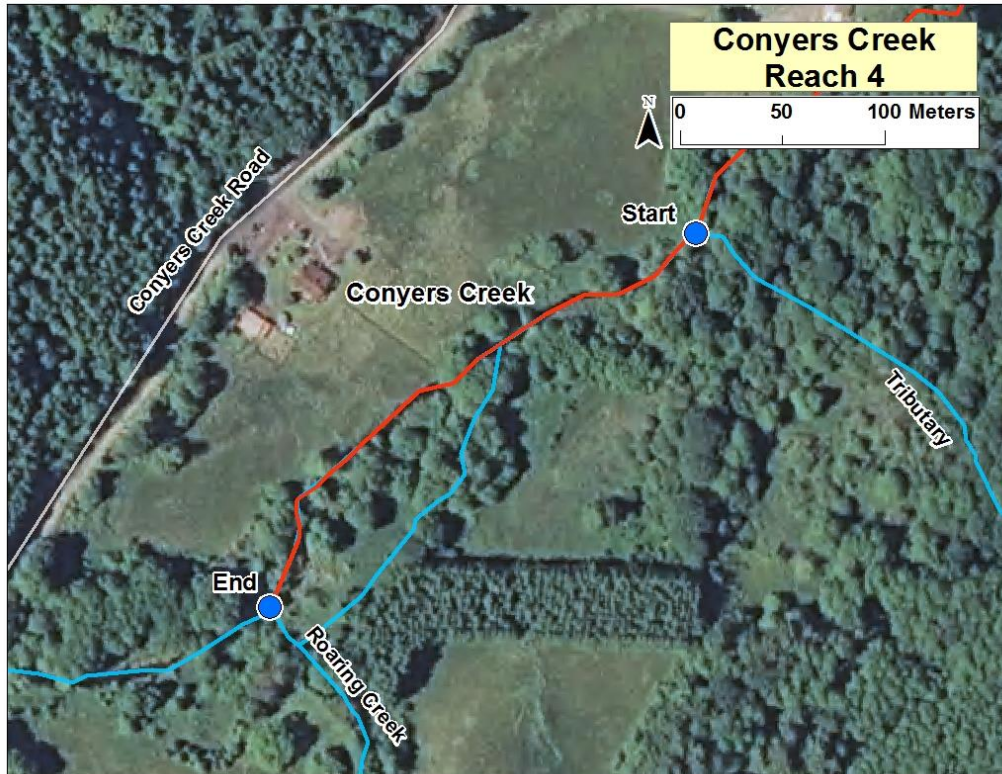


Figure 126. Map of reach 4 (red line) on Conyers Creek, including start and end points (blue dots).



Figure 127. Survey pictures of reach 4 on Conyers Creek show several beaver dams near the downstream end of the reach (panels A and B), and gravel accumulation upstream of a large log jam (panel C).

RESULTS:

Several suitable patches of spawning substrate were located upstream of large log jams (Figure 127, panel C). Seven patches of suitable spawning substrate were found in reach 4 of Conyers Creek (Table 45; Figure 128), measuring a total of 10 m². None of these patches were categorized as “high” quality, two patches were of “moderate” quality, and five patches were of “low” quality (Table 45; Figure 128). No cold-water patches were observed. There were no potential barriers to Chum Salmon migration in this reach.

Table 45. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 4 of Conyers Creek, south of Clatskanie, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	1	1
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	2	3
low	11-20	0	75	25	0	0
low	11-20	0	50	50	0	0
low	11-20	0	25	75	2	4
low	11-20	0	0	100	2	2

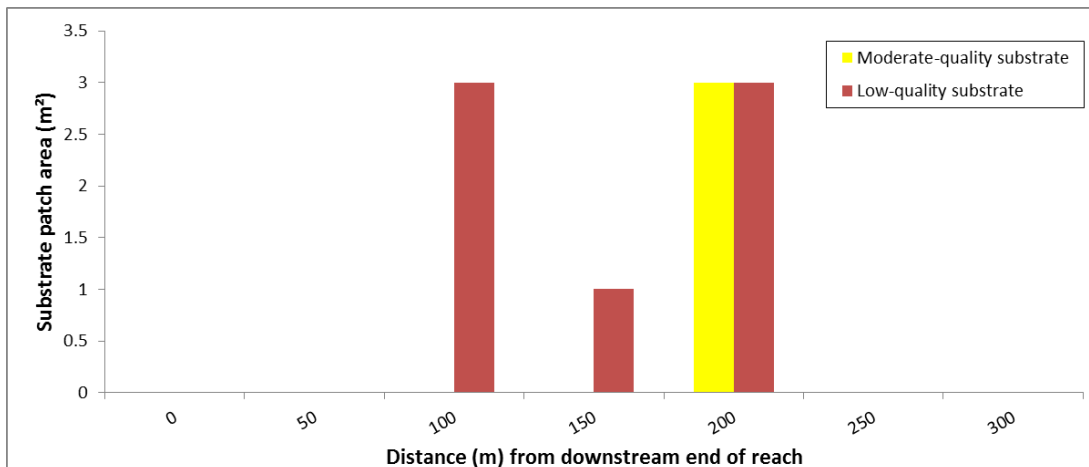


Figure 128. Location of substrate patches measured as distance from downstream end of survey in reach 4 of Conyers Creek, OR, in August 2012. For each category of substrate quality, patch area was summed and binned into 50 m units.

REACH 5

REACH DESCRIPTION:

Reach 5 started on small private property road 250 m upstream from the confluence with Roaring Creek (Lat: 46.088346, Long: -123.218383) and continued upstream to the confluence with East Creek (Lat: 46.079831, Long: -123.220633; Figure 129). The mainstem thalweg length of this reach was 1,436 m. The channel was confined, with multiple channels and meanders throughout. There were 15 side channels with a combined thalweg length of 250 m. Riparian vegetation consisted of young alders and dense grass along the stream banks (Figure 130, panel A). Land use was rural residential and young timber.

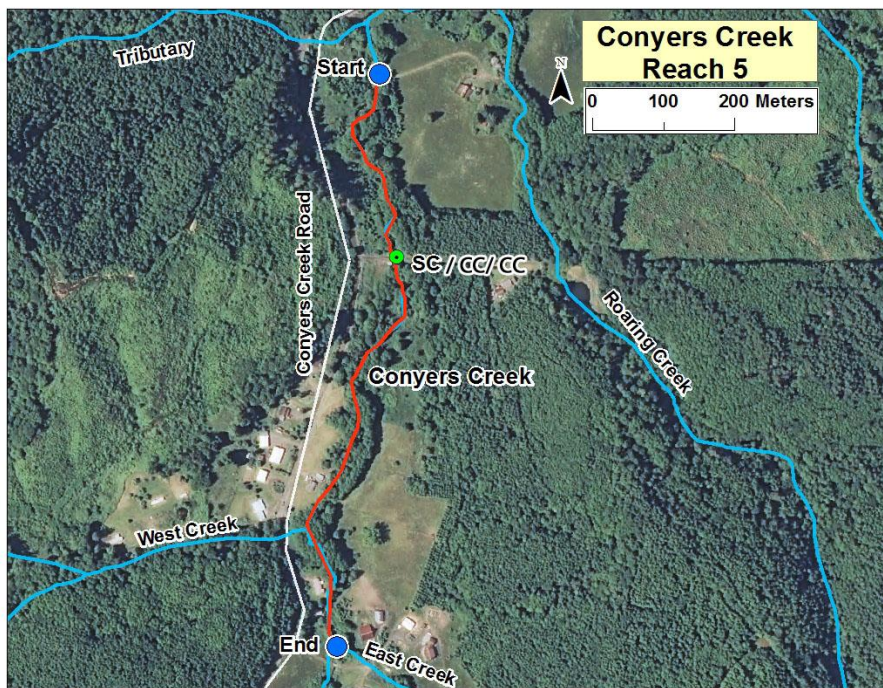


Figure 129. Map of reach 5 (red line) on Conyers Creek, including start and end points (blue dots), a semicircular culvert (SC), and two circular culverts adjacent to the semicircular culvert.

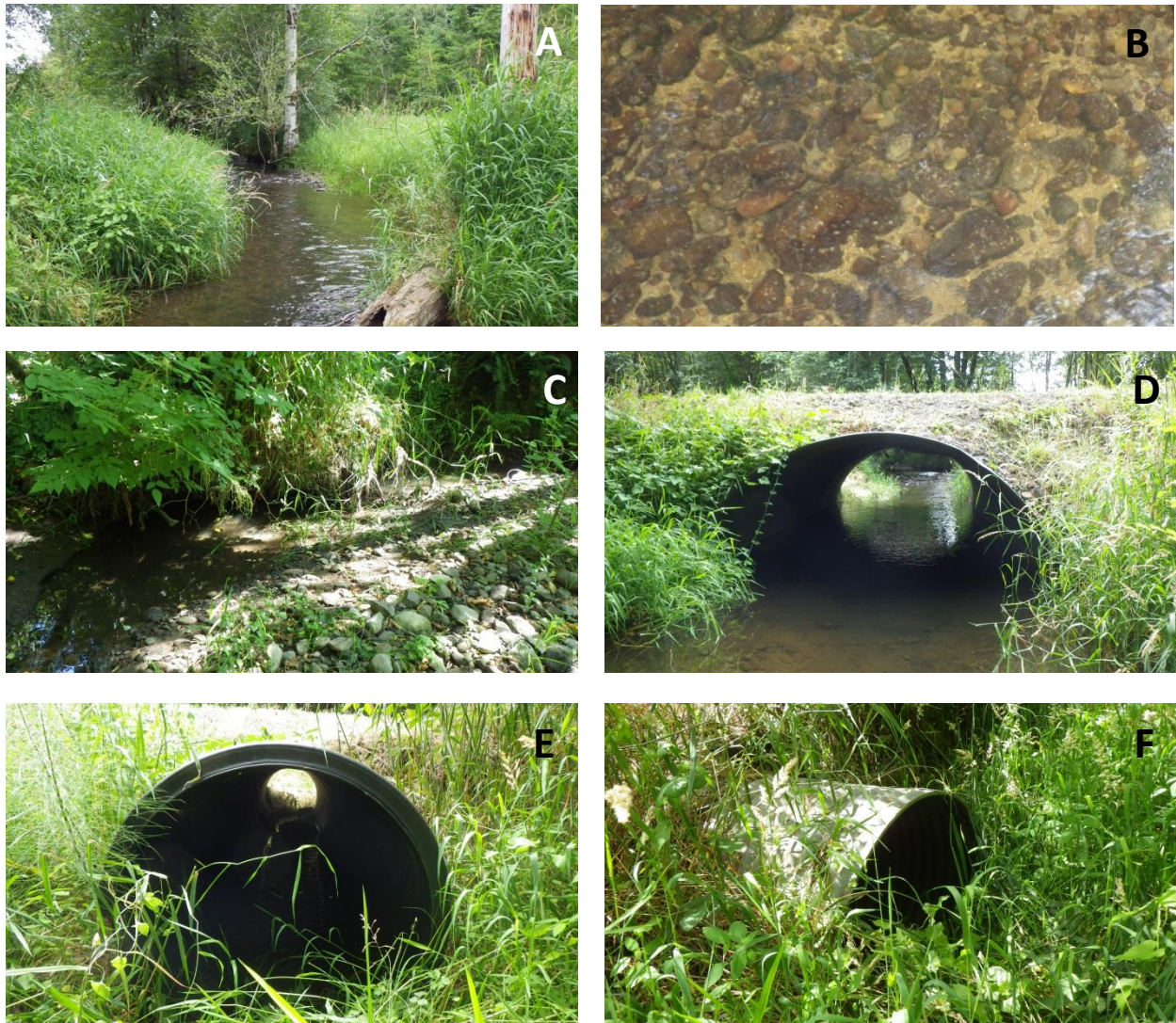


Figure 130. Survey pictures of reach 5 on Conyers Creek show a grass and alder-dominated riparian zone (panel A), gravel with > 20% fine sediment interspersed (panel B), an isolated pool that was a cold-water patch (panel C), a semicircular culvert (panel D) with two adjacent, high flow, circular culverts (panels E and F).

RESULTS:

Substrate within reach 5 of Conyers Creek contained elevated levels (10–20%) of fine sediment (Figure 130, panel B), but suitable patches were identified. Fifty-one patches of suitable spawning substrate were found (Table 46; Figure 131), measuring a total of 604 m². All patches were designated “low” quality because of elevated levels of fine sediment (11–20% of patch area), and 44 patches contained ≥ 50% small cobble (46–128 mm, diameter; Table 46). Five cold-water patches were observed, totaling 28.5 m² (Figure 131); average temperature in these

patches was 12.8° C and average temperature adjacent to these patches was 14.5° C. The dominant substrate type within these cold-water patches was fine sediment (< 4 mm diameter). Several of the cold-water patches were isolated pools located either along the edges of the stream channel or within side channels (Figure 130, panel C). In addition to these five cold-water patches, there were also four patches with temperatures between 0.5° C and 0.9° C colder than that of the adjacent stream; however, these patches did not meet temperature criteria for cold-water patches. There was one potential barrier to Chum Salmon migration: a semicircular culvert with two adjacent perched culverts located at the Himple Road bridge (Figure 130, panel D–F; Table 47).

Table 46. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 5 of Conyers Creek, south of Clatskanie, OR, in July 2013.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	7	53
low	11-20	0	50	50	9	129
low	11-20	0	25	75	22	253
low	11-20	0	0	100	13	169

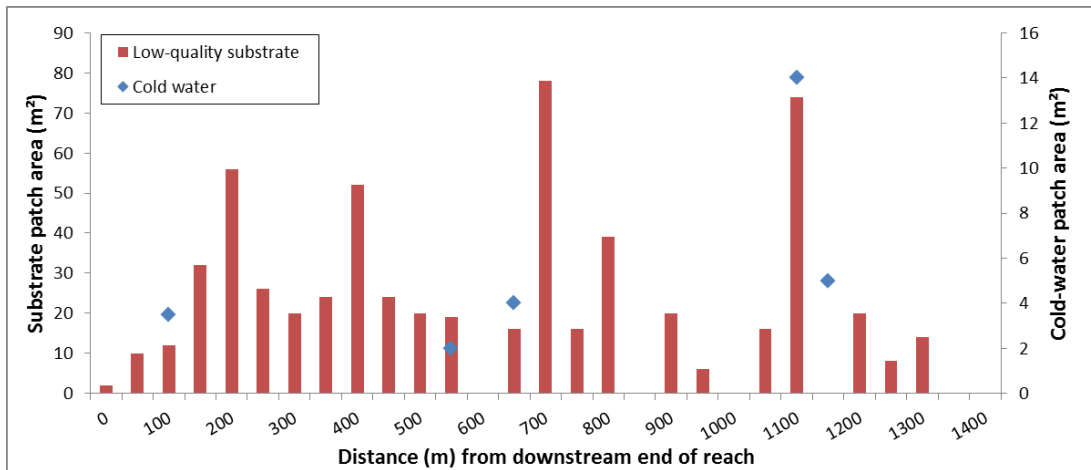


Figure 131. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 5 of Conyers Creek, OR, in July 2013. For cold water and for low-quality substrate, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

Table 47. List of barriers, types, barrier heights, barrier widths (across stream), barrier lengths (upstream and downstream), and max pool depths downstream of the barriers for reach 5 in Conyers Creek, south of Clatskanie, OR, in July 2013.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1a	Semicircular culvert	0	3	10	0.7
1b	Circular culvert	0	1	10	0
1c	Circular culvert	0	1	10	0

Conyers Creek Tributary

REACH 1

REACH DESCRIPTION:

Reach 1 started 450 m upstream from mouth of the creek (Lat: 46.096481, Long: -123.218438) and extended to a point 350 m upstream (Lat: 46.096639, Long: -123.221459). Due to a landowner denial, approximately 450 m between the mouth of the creek and the downstream end of this survey was not surveyed. The mainstem thalweg length of this reach was 350 m. The channel form was single channel with meanders. The riparian zone was densely vegetated

with shrubs and alders (Figure 133, panel A), and land use was rural residential. Gravel was present in the downstream end of this reach; however, bedrock was observed throughout the reach (Figure 133, panel B).

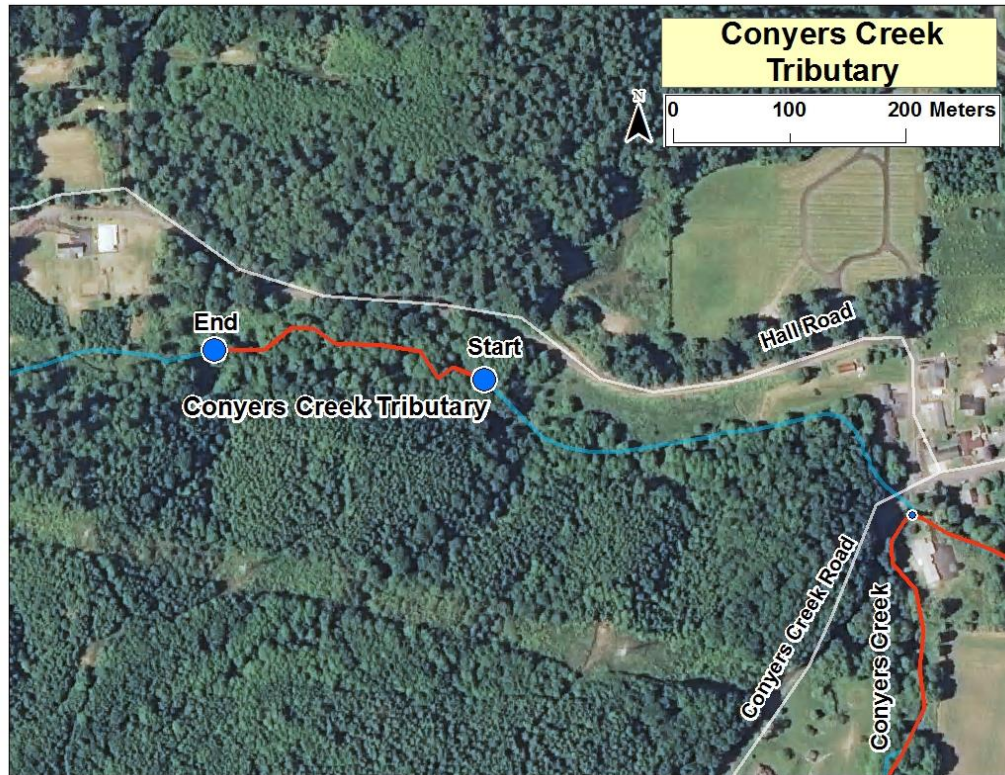


Figure 132. Map of reach 1 (red line) on Conyers Creek tributary, including start and end points (blue dots).



Figure 133. Survey pictures of reach 1 on Conyers Creek tributary show a riparian zone with shrubs and alders (panel A) and the creek flowing over bedrock (panel B).

RESULTS:

There were no suitable gravel patches in reach 1 of the Conyers Creek tributary. No cold-water patches were found and there were no potential barriers to Chum Salmon migration in this reach.

Eilertsen Creek

SURVEY DATE: October 9, 2012

SURVEY CREW: Brad Benson and Lorana McCalester

GENERAL DESCRIPTION:

The Eilertsen Creek habitat survey (Township: 7N Range: 5W Section: 500) started at the Highway 30 bridge (Lat: 46.114867, Long: -123.324377; Figure 135, panel A) and continued upstream 450 m (Lat: 46.111623, Long: -123.326749; Figure 134; Figure 135, panel B). The survey consisted of one reach with a mainstem thalweg length of 434 m. There were two side channels with a combined thalweg length of 35 m. The riparian zone along this reach was dominated by young alders (Figure 135, panel C). The channel was confined, with few meanders throughout the reach. Land use was a mix of rural residential and young timber. Upstream from a temporary bridge (Figure 135, panel D), the stream was confined by a narrow canyon.

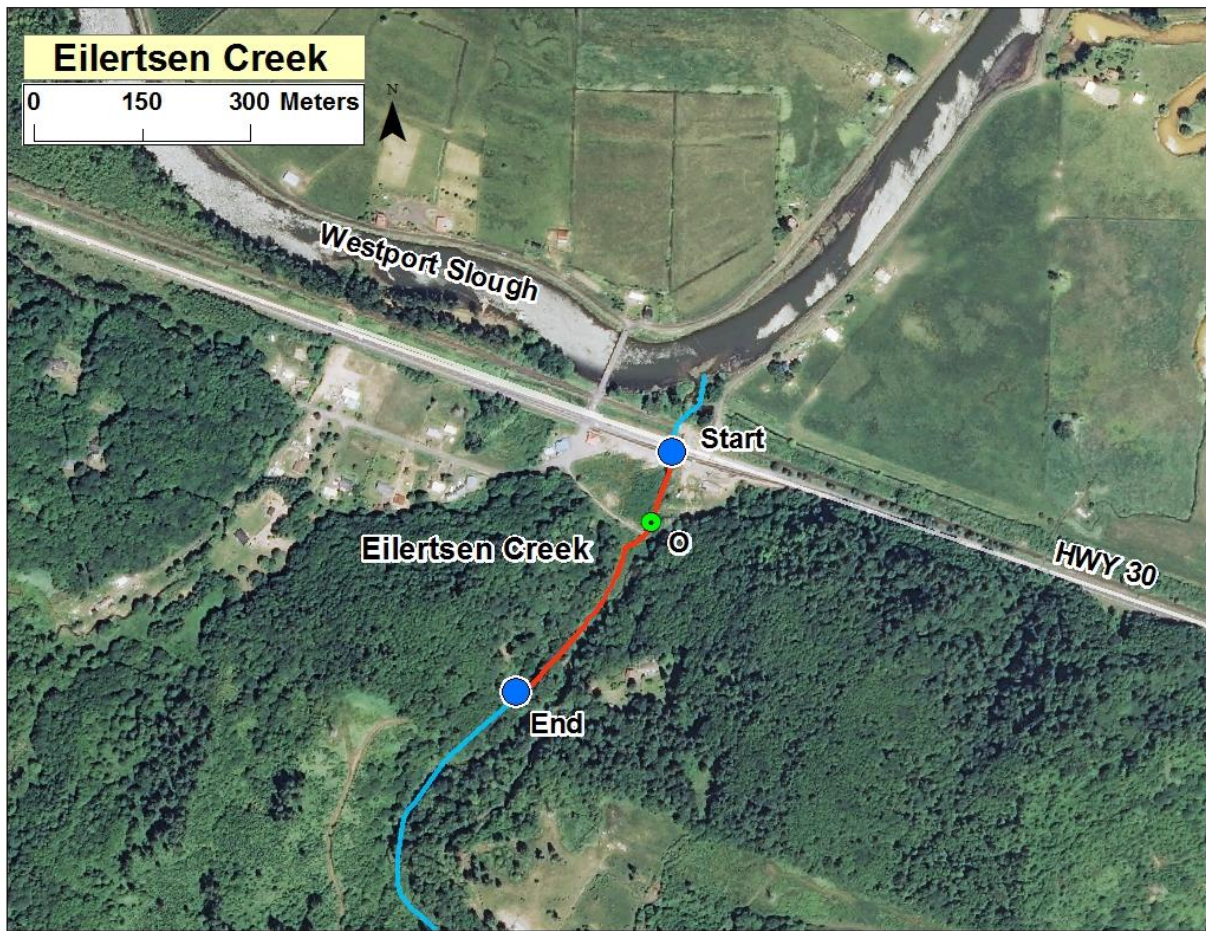


Figure 134. Map of reach (red line) surveyed on Eilertsen Creek, located west of Clatskanie, OR, including start and end points (blue dots) and a temporary bridge (O).



Figure 135. Survey pictures on Eilertsen Creek show the Highway 30 bridge (panel A), large woody debris at the upstream end of the reach (panel B), a section of stream where young alders dominate the riparian zone (panel C), and a temporary bridge (panel D).

RESULTS:

Substrate consisted of substantial quantities of small cobble (45–128 mm, diameter) and gravels, however because fine sediment levels were > 20%, no suitable spawning habitat was identified. No suitable gravel patches were observed. There were also no cold-water patches. There was one potential barrier to Chum Salmon migration in this reach, an old roadbed under a temporary bridge (Figure 134; Table 48; Figure 135, panel D).

Table 48. Barrier type, barrier height above stream, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in Eilertsen Creek, west of Scappoose, OR, in October 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Temporary bridge crossing	1.9	2.4	4.9	.9

Fall Creek

SURVEY DATE: July 9, 2012

SURVEY CREW: Brian Alfonse and Kris Homel

GENERAL DESCRIPTION:

The Fall Creek habitat survey (Township: 7N Range: 4W Section: 8B0) started 20 m upstream from the highway 30 bridge (Lat: 46.109809, Long: -123.210322), and continued upstream to a large waterfall (Lat: 46.108903, Long: -123.211792; Figure 136; Figure 137, panel A). The survey consisted of one reach with a mainstem thalweg length of 193 m, and there were no side channels. The channel was confined to a single channel, with few meanders. The riparian zone was dominated by trees on the river-left bank and grasses on the river-right bank. Access to the downstream end of the culvert under Highway 30 was limited because of deep water and as such no length or max pool depths were recorded. Signs of tidal influence were observed up to the midway point in the reach; upstream from this point, there was an increase in the abundance of gravel (Figure 137, panel B). Land use was a mix of rural residential and young timber.

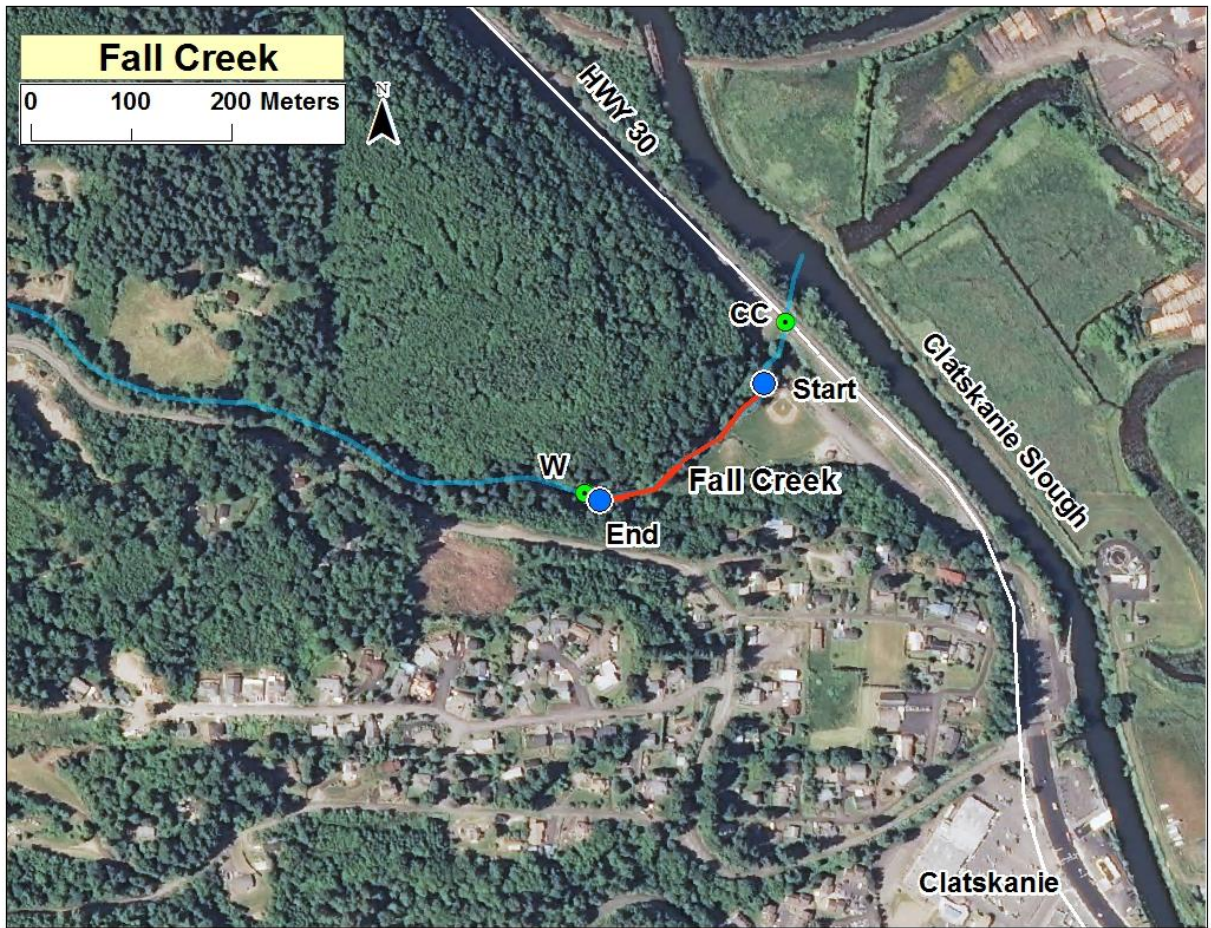


Figure 136. Map of reach (red line) surveyed on Fall Creek, located northwest of Clatskanie, OR, including start and end points (blue dots), a circular culvert (CC), and a waterfall (W).

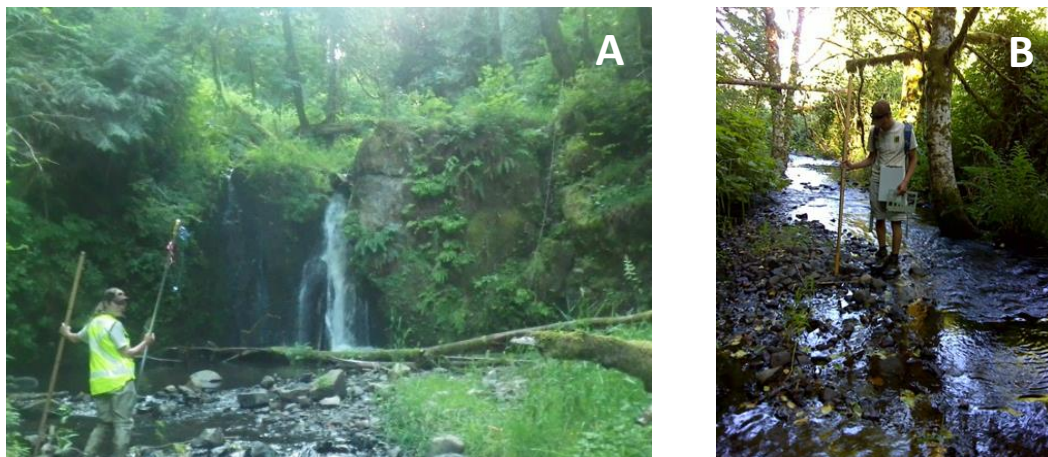


Figure 137. Survey pictures on Fall Creek show the waterfall barrier at the upstream end of the reach (panel A) and a substrate patch (panel B).

RESULTS:

Nine patches of suitable spawning substrate were found in Fall Creek (Table 49; Figure 138), measuring a total of 67 m². All patches were designated “low” quality, and eight of these patches contained ≥ 75% small cobble (46–128 mm, diameter; Table 49). No cold-water patches were observed. There were two potential barriers to Chum Salmon migration in Fall Creek (Figure 136). The first was a circular culvert located 20 m downstream from the reach bottom under Highway 30 (Table 50) and the second barrier was a waterfall at the upstream end of the reach (Table 51; Figure 137, panel A).

Table 49. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in Fall Creek, northwest of Clatskanie, OR, in July 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	5	39
low	0-10	0	0	100	1	14
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	1	4
low	11-20	0	50	50	0	0
low	11-20	0	25	75	2	10
low	11-20	0	0	100	0	0

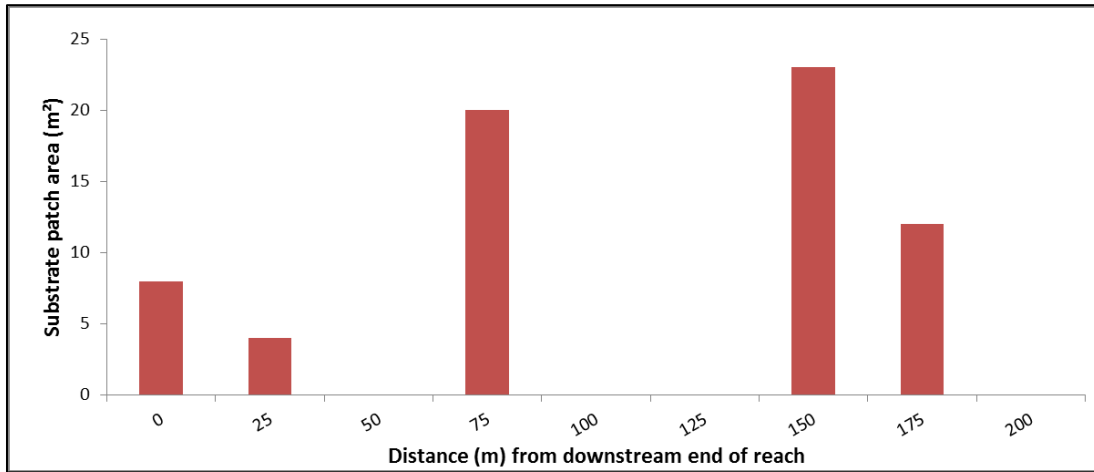


Figure 138. Location of low-quality substrate patches (red bars) measured as distance from downstream end of survey in Fall Creek, northwest of Clatskanie, OR, in July 2012. Substrate patch area was summed and binned into 25 m units.

Table 50. List of barriers, types, barrier heights, barrier widths (across stream), barrier lengths (upstream and downstream), and max pool depths downstream of the barriers in Fall Creek, northwest of Clatskanie, OR, in July 2012. **indicates data not collected

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Circular culvert	0	2	**	**
2	Waterfall	5	10	**	2

Fox Creek

SURVEY DATE: August 9, 2012

SURVEY CREW: Brian Alfonse and Kris Homel

GENERAL DESCRIPTION:

The Fox Creek habitat survey (Township: 7N Range: 2W Section: 16DB) started at the upstream end of a long culvert on C Street in Rainier (Lat: 46.088434, Long: -122.938066), and continued upstream to a logging road located 200 m upstream from where power lines cross the creek (Lat: 46.078228, Long: -122.940315; Figure 139). The survey consisted of one reach with a mainstem thalweg length of 1,378 m, and no side channels. The channel was primarily

confined with multiple meanders. A long culvert, located at the downstream end of the reach, stretched under a full city block. In the downstream quarter of the reach riparian vegetation consisted almost entirely of grasses, and there were several pools associated with beaver dams (Figure 140, panel A). Riparian vegetation in the upstream three quarters of the reach was dense with a mix of mature alders, maples, cedars, and firs (Figure 140, panel B). Land use was primarily mature timber upstream and rural residential in the downstream half. There were numerous sections with large boulders located in the upstream half of the reach (Figure 140, panel C). There was substantial silt deposited upstream of a channel-spanning log jam, located in the upstream quarter of the reach (Figure 140, panel D).

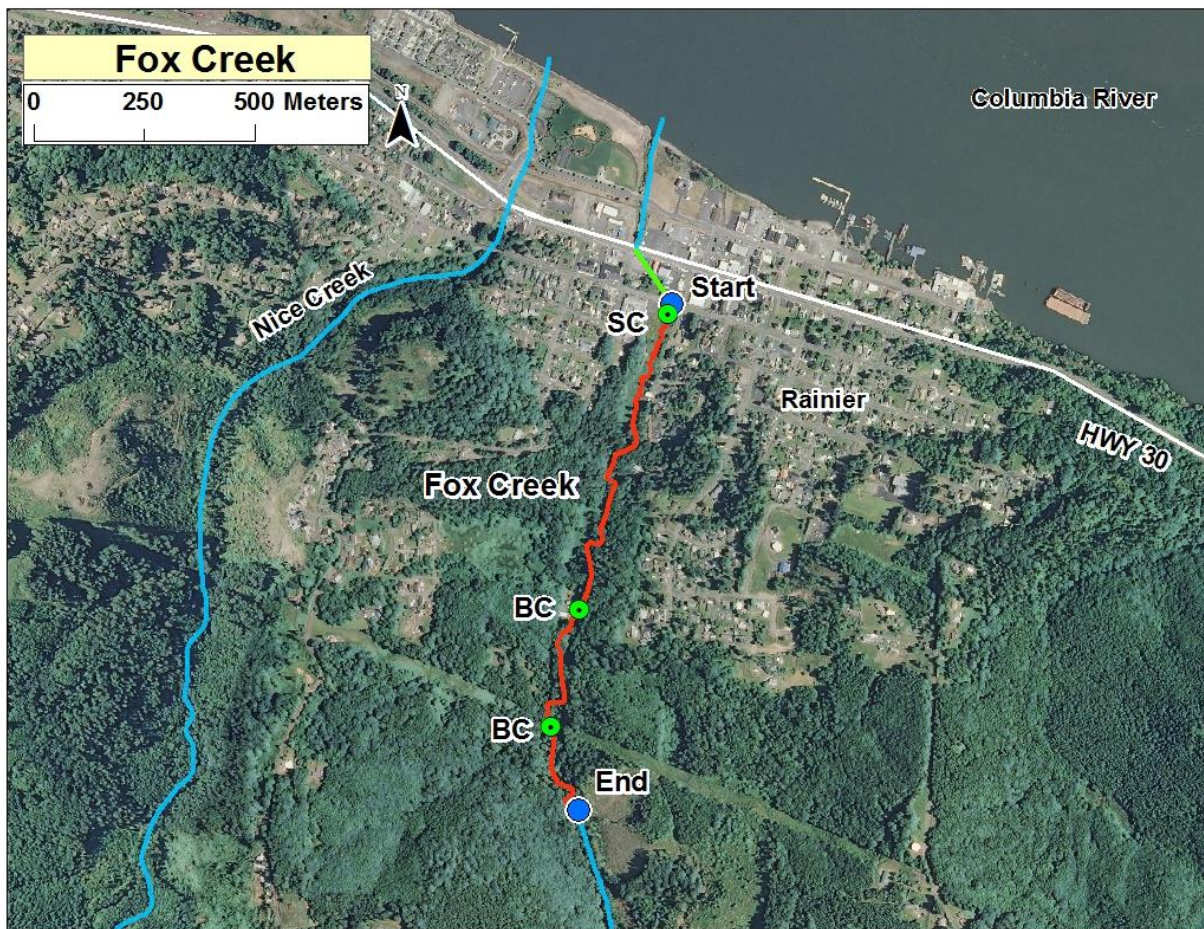


Figure 139. Map of reach (red line) surveyed on Fox Creek, located in Rainier, OR, including start and end points (blue dots), a semicircular culvert (SC), and two box culverts (BC).

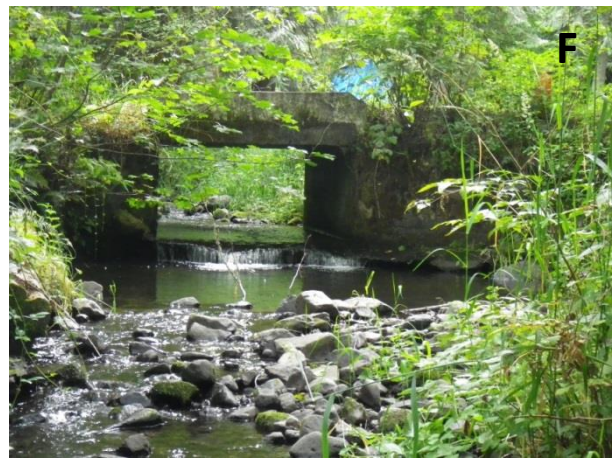


Figure 140. Survey pictures on Fox Creek show a beaver dam and a grass-dominated riparian zone (panel A), dense riparian vegetation near the middle of the reach (panel B), a section of stream with large boulders (panel C), a log jam located in the upstream quarter of the reach (panel D), a semicircular culvert that runs under the town of Rainier (panel E), and one of two box culvert barriers located in the upper half of the reach (panel F).

RESULTS:

Twenty-one patches of suitable spawning substrate were found in Fox Creek (Table 51; Figure 141), measuring a total of 139 m². None of these patches were categorized as “high” quality, but three patches were of “moderate” quality, and 18 patches were of “low” quality (Table 51; Figure 141). Small gravel (4–11 mm, diameter; consisting of ≥ 25% of the patch area), was absent from all patches in this reach (Table 51). One cold-water patch was observed, measuring 1.2 m² (Figure 141); temperature in this patch was 14.2° C and temperature adjacent to this patch was 15.4° C. The dominant substrate type within this cold-water patch was fine sediment (< 4 mm, diameter). There were three potential barriers to Chum Salmon migration in this reach (Figure 139). The first potential barrier was a long culvert (length = 170 m) located at the downstream end of the survey (Table 52; Figure 140, panel E). The next two barriers were both box culverts under small residential roads located in the upstream half of the reach (Table 52; Figure 140, panel F).

Table 51. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in Fox Creek, near Rainier, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	1	8
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	1	6
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	2	15
low	11-20	0	75	25	2	17
low	11-20	0	50	50	9	58
low	11-20	0	25	75	2	20
low	11-20	0	0	100	4	15

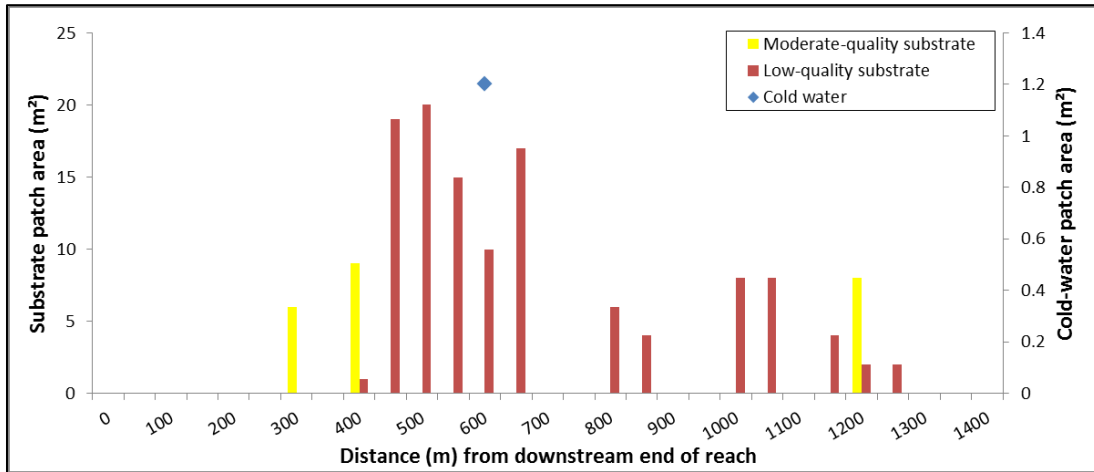


Figure 141. Location of substrate patches measured as distance from downstream end of survey in Fox Creek, near Rainier, OR, in August 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

Table 52. List of barriers, types, barrier heights, barrier widths (across stream), barrier lengths (upstream and downstream), and max pool depths downstream of the barriers in Fox Creek, near Rainier, OR, in August 2012. The length for barrier number 1 (*) was estimated from a map. ** indicates data not collected

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Semicircular culvert	0	2	170*	**
2	Box culvert	1	2	6	0.6
3	Box culvert	0.8	2	6	0.6

Graham Creek

SURVEY DATE: August 2, 2012

SURVEY CREW: Brian Alfonse and Kris Homel

GENERAL DESCRIPTION:

The Graham Creek habitat survey (Township: 7N Range: 5W Section: 200) started at the railroad bridge downstream of Highway 30 (Lat: 46.115517, Long: -123.269838), and continued upstream to a point 300 m upstream of the Colvin Road Bridge (Lat: 46.106864, Long: -123.271994; Figure 142). The survey consisted of one reach with a mainstem thalweg length of 1,127 m, and no side channels. In the section between Highway 30 and Colvin Road the stream channel was straight with meanders only occurring in the upstream 100 m. The channel form

was confined with few meanders. The riparian vegetation in the downstream half of the reach was dominated by grasses and blackberries (Figure 143, panel A). Within the upstream portion of this stream gravel was removed from the streambed and piled on the banks (Figure 143, panel B). Upstream of Colvin Road the stream channel consisted of more meanders and the riparian zone was more densely vegetated with maples (Figure 143, panel C). Land use was a mix of rural residential and young timber.

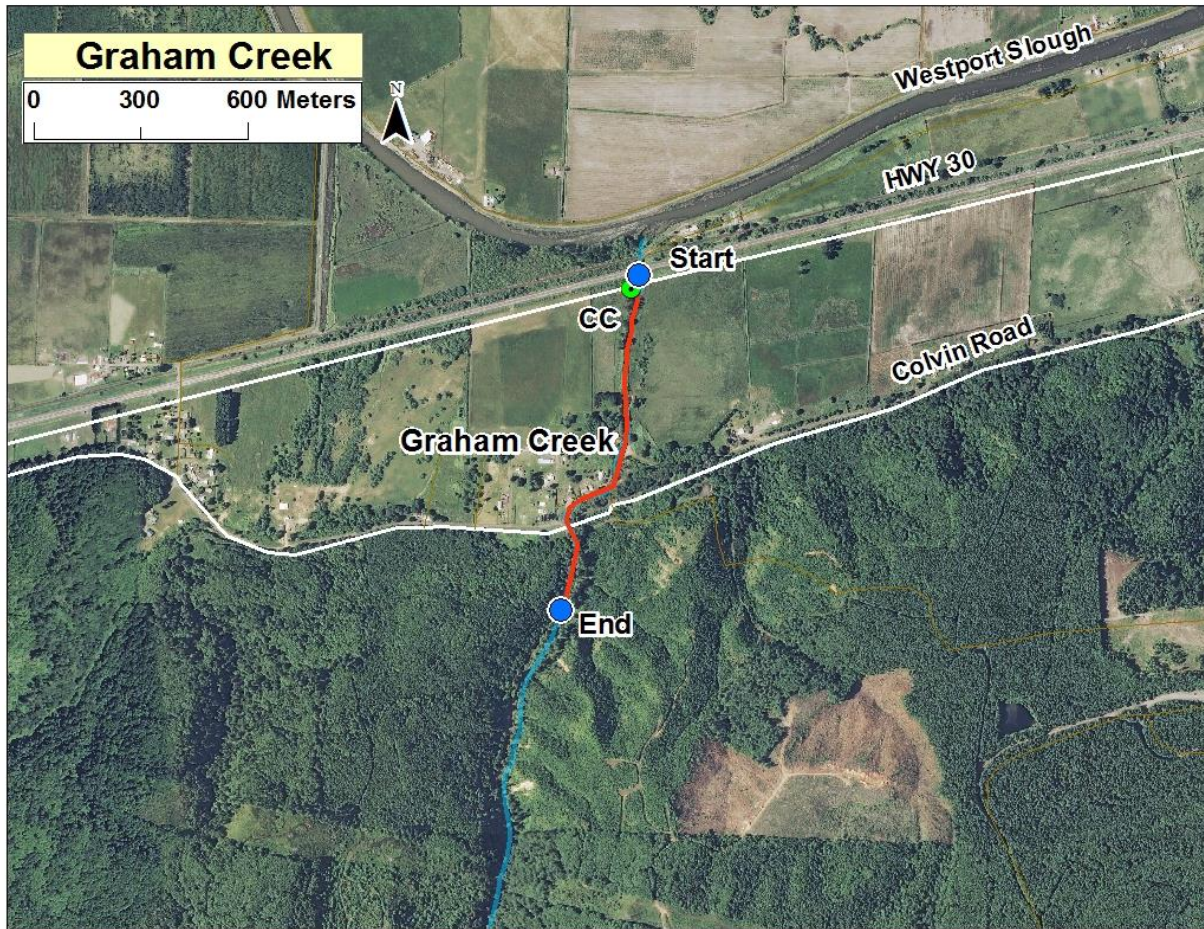


Figure 142. Map of reach (red line) surveyed on Graham Creek, located west of Clatskanie, OR, including start and end points (blue dots) and a circular culvert (CC).



Figure 143. Survey pictures on Graham Creek show a riparian zone dominated by grass and shrub in the lower half of the reach (panel A), an artificially straightened section of stream with piles of substrate on the river-right bank (panel B), a section of stream upstream of Colvin Road (panel C), and two adjacent circular culverts under Highway 30 (panel D).

RESULTS:

Eighty-seven patches of suitable spawning substrate were found in Graham Creek (Table 53; Figure 144), measuring a total of 689 m². None of these patches were categorized as “high” quality, five patches were of “moderate” quality, and 82 patches were of “low” quality (Table 53; Figure 144). Forty-four of these patches contained 100% small cobble (46–128 mm, diameter; Table 53). Two cold-water patches, totaling 4.1 m², were observed (Figure 144). Average temperature in these patches was 13.4° C and average temperature adjacent to these patches was 14.6° C. The dominant substrate types within these cold-water patches were large gravel (n = 1) and small cobble (n = 1). There was one potential barrier to Chum Salmon migration, classified as two adjacent circular culverts located under Highway 30 (Figure 142; Table 54; Figure 143, panel D).

Table 53. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in Graham Creek, west of Clatskanie, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	1	18
moderate	0-10	0	50	50	3	36
low	0-10	0	25	75	12	42
low	0-10	0	0	100	32	60
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	1	1
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	10	220
low	11-20	0	50	50	6	48
low	11-20	0	25	75	10	106
low	11-20	0	0	100	12	158

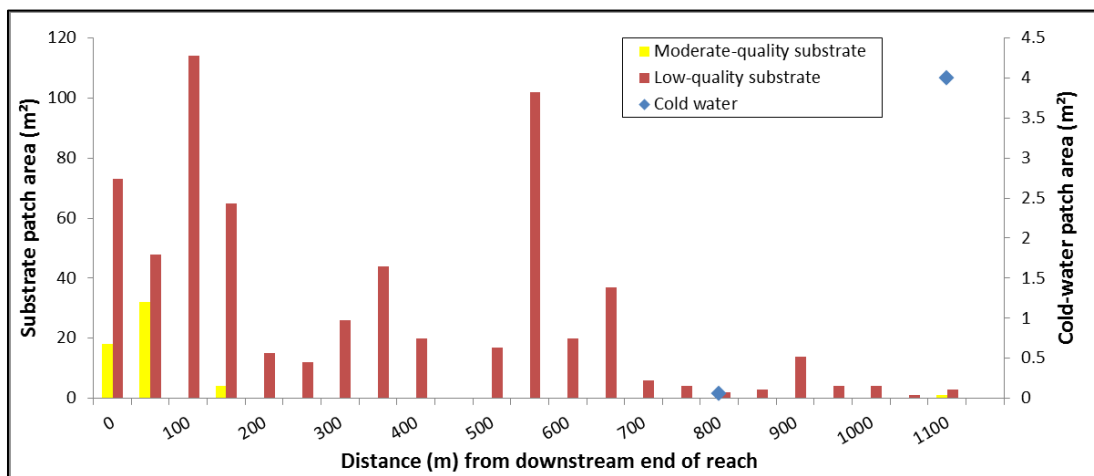


Figure 144. Location of substrate and cold-water patches measured as distance from downstream end of survey in Graham Creek, west of Clatskanie, OR, in August 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

Table 54. Barrier type, barrier height, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in Graham Creek, west of Clatskanie, OR, in August 2012. ** data not recorded.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1a	Circular culvert	0	1.7	28	**
1b	Circular culvert	0	1.7	28	**

Green Creek

SURVEY DATE: August 29, 2012

SURVEY CREW: Brian Alfonse and Lorana McCalester

GENERAL DESCRIPTION:

The Green Creek habitat survey (Township: 8N Range: 3W Section: 19A0) started 300 m upstream from the mouth of the creek (Lat: 46.16463, Long: -123.09952), and continued upstream to a large waterfall (Lat: 46.16344, Long: -123.095058; Figure 145). The survey consisted of one reach with a mainstem thalweg length of 456 m, additionally there was one side channel with a thalweg length of 40 m. The channel form was confined with multiple meanders. The riparian zone in this reach was densely vegetated with large alders, maples, firs, and cedars. Land use was mature timber, but also rural residential in the downstream portion. In the downstream quarter of the reach the stream channel gradient was low, with small gravel substrate (< 128 mm, diameter), and several pools (Figure 146, panel A). Upstream from this lower section, gradient increased as the stream cascaded over larger substrate (> 128 mm, diameter) and boulders (Figure 146, panel B).

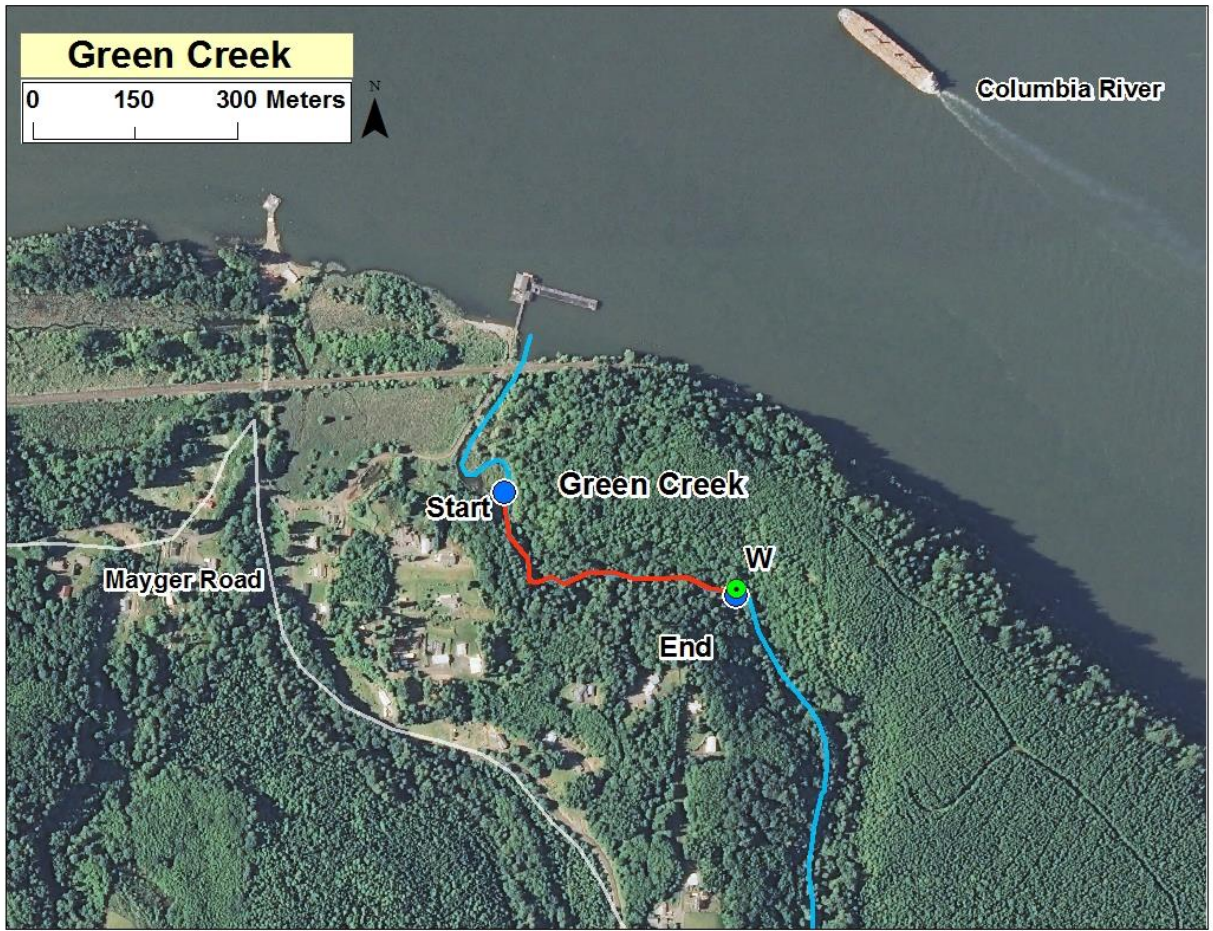


Figure 145. Map of reach (red line) surveyed on Green Creek, located northeast of Clatskanie, OR, including start and end points (blue dots) and a waterfall (W).



Figure 146. Survey pictures on Green Creek show a deep bedrock pool near the downstream end of the reach (panel A), a high gradient section of stream with numerous boulders (panel B), a waterfall at the upstream end of the reach (panel C), and a set of four adjacent circular culverts located under a railroad bridge in tidewater (panel D).

RESULTS:

Seven patches of suitable spawning substrate were found in Green Creek (Table 55; Figure 147), measuring a total of 8 m². None of these patches were categorized as “high” quality, one patch was of “moderate” quality, and six patches were of “low” quality (Table 55; Figure 147). These patches all contained ≥ 50% small cobble (46–128 mm, diameter; Table 55). Three cold-water patches were observed, totaling 14.2 m² (Figure 147); average temperature in these patches was 13.1° C and average temperature adjacent to these patches was 14.2° C. The dominant substrate types within these cold-water patches were large cobble (n = 2) and bedrock (n = 1). There was one potential barrier to Chum Salmon migration, classified as waterfall, and it was located at the upstream end of the reach (Figure 145; Table 56, Figure 146, panel C). In addition to this waterfall barrier, there was also a set of four adjacent circular culverts located under the railroad at the mouth of Green Creek in tidewater (Figure 146, panel D).

Table 55. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in Green Creek, northeast of Clatskanie, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	1	2
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	2	2
low	11-20	0	25	75	1	1
low	11-20	0	0	100	3	3

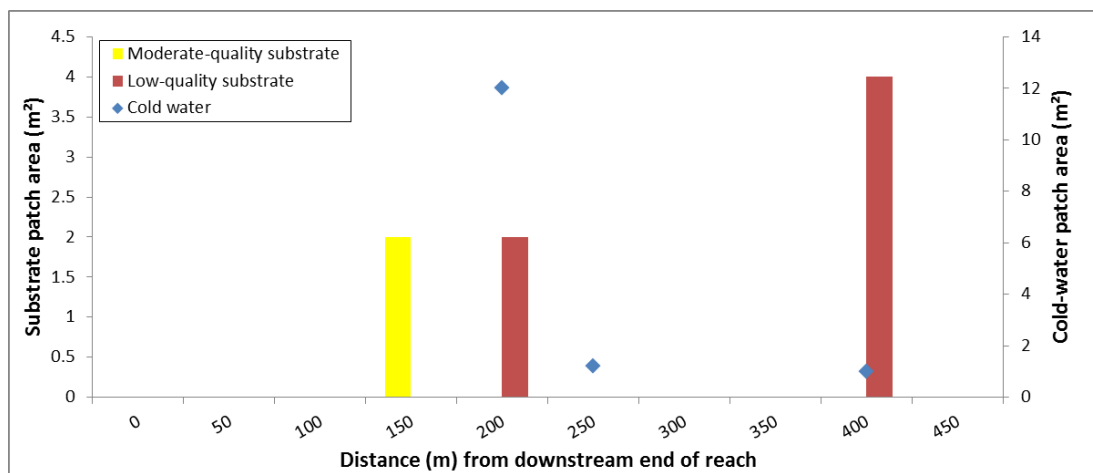


Figure 147. Location of substrate and cold-water patches measured as distance from downstream end of survey in Green, we northeast of Clatskanie, OR, in August 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

Table 56. Barrier type, barrier height, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in Green Creek, northeast of Clatskanie, OR, in August 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Waterfall	3.5	16	4.7	.8

Hunt Creek

SURVEY DATE: September 6, 2012

SURVEY CREW: Brian Alfonse and Lorana McCalester

GENERAL DESCRIPTION:

The Hunt Creek habitat survey (Township: 8N Range: 6W Section: 9B) started 81 m downstream of a waterfall at the first accessible location upstream from tidewater (Lat: 46.195319, Long: -123.442123), and continued upstream to a large waterfall (Lat: 46.194916, Long: -123.442285; Figure 148). The survey consisted of one reach with a thalweg length of 97 m, as well as two side channels (combined thalweg length = 47 m). One of these side channel sections was a channel that did not reconnect with the main-channel but connected with tidewater. This side channel contained several cooler water pools and the only cold-water patch found in the reach (Figure 149, panel A–C). The waterfall at the upstream end of the reach was a complete barrier to Chum Salmon migration and did not have a fish ladder. The riparian zone was densely vegetated with alders, firs, and shrubs, and land use was young and mature timber.

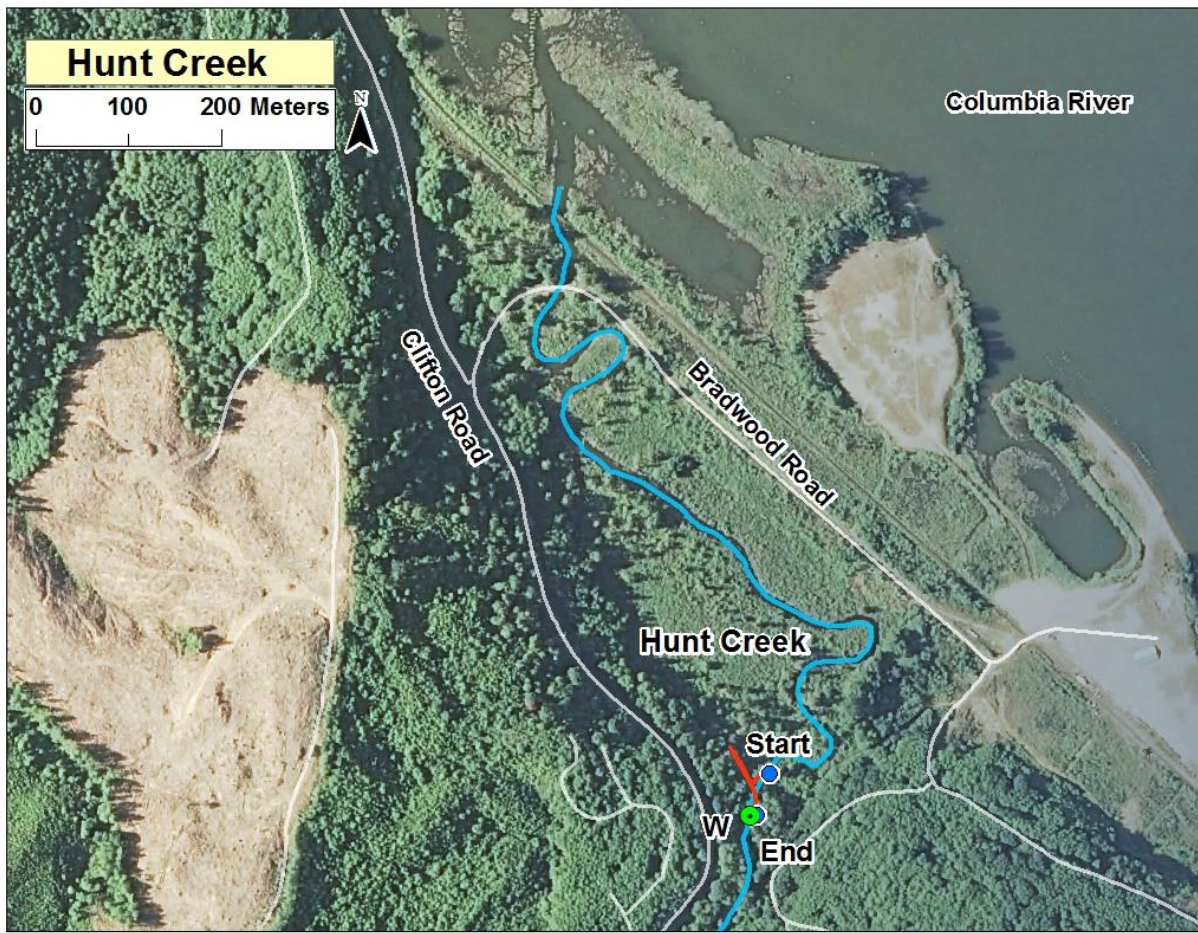


Figure 148. Map of reach (red line) surveyed on Hunt Creek, located northwest of Westport, OR, including start and end points (blue dots) and a waterfall (W).



Figure 149. Survey pictures on Hunt Creek show a log jam separating a dry side channel (left) and the main channel (right; panel A), an isolated cold-water patch located in the otherwise dry side channel (panel B), woody debris and mud in the dry side channel (panel C), and the waterfall at the upstream end of the reach (panel D).

RESULTS:

Five patches of suitable spawning substrate were found in Hunt Creek (Table 57) measuring a total of 15 m². None of these patches were categorized as “high” quality, one patch was of “moderate” quality, and four patches were of “low” quality (Table 57). These patches all contained $\geq 50\%$ small cobble (46–128 mm, diameter; Table 57). One cold-water patch was observed, totaling 11.0 m²; temperature in the patch was 10.7° C, and temperature adjacent to the patch was 14.0° C. The dominant substrate type within this cold-water patch was fine sediment (> 4 mm, diameter). All substrate and cold-water patches were located < 100 m downstream from the waterfall. There was one potential barrier to Chum Salmon migration, this was classified as waterfall and was located at the upstream end of the reach (Figure 148; Table 58, Figure 149, panel D).

Table 57. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in Hunt Creek, northwest of Westport, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	1	4
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	0	0
low	11-20	0	25	75	2	7
low	11-20	0	0	100	2	4

Table 58. Barrier type, barrier height, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in Hunt Creek, northwest of Westport, OR, in September 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Waterfall	14	4	14	20

Keystone Creek

SURVEY DATES: August 23 and September 12, 2012

SURVEY CREW: Brian Alfonse and Lorana McCalester

GENERAL DESCRIPTION:

The Keystone Creek habitat survey (Township: 7N Range: 4W Section: 2200) started 450 m upstream of Alder Grove Road and continued 1.5 km upstream to the Swedetown Road bridge. Surveys on Keystone Creek were delineated into two reaches (Figure 150) based on physical features, landowner access, and overall distance. The section downstream from reach 1, (length = 600 m) was not surveyed due to landowner denials.

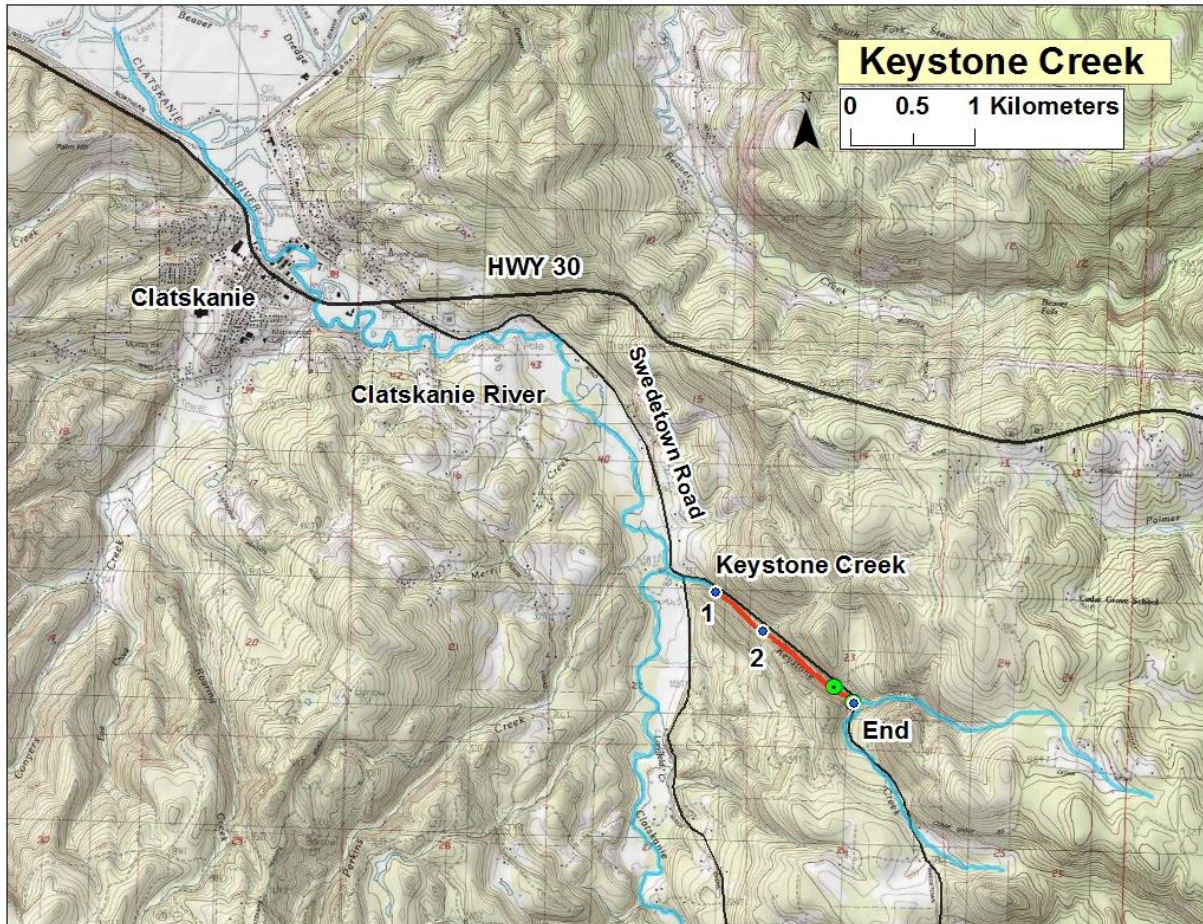


Figure 150. Map of reaches (red line) surveyed on Keystone Creek, located southeast of Clatskanie, OR. Reach break labels correspond to the downstream end of each reach. In reach 2, there was a waterfall (green dot) and a semi-circular culvert (at the upstream end of the reach).

REACH 1

REACH DESCRIPTION:

Reach 1 started 450 m upstream of Alder Grove Road (Lat: 46.081921, Long: -123.157293) and continued 540 m upstream (Lat: 46.079396, Long: -123.152289). The mainstem thalweg length of this reach was 540 m, and there were no side channels. The channel was confined by a canyon adjacent to Swedetown Road and there were a few small meanders. Juvenile Coho

Salmon were incidentally observed in pools throughout this reach. Riparian vegetation was dense with maples, alders, firs, and cedars (Figure 152, panel A), and land use was mature timber. Large cobble substrate (129–256 mm, diameter), bedrock shelves, and plunge pools were all common features found in this reach (Figure 152, panels B–D).

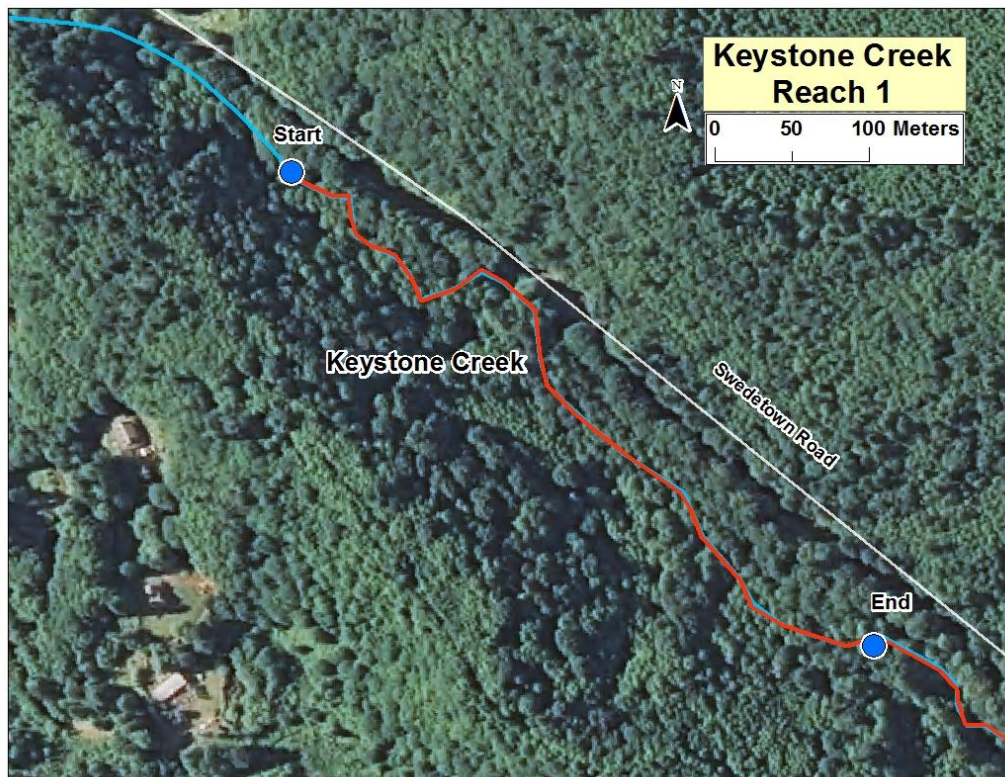


Figure 151. Map of reach 1 (red line) on Keystone Creek, including start and end points (blue dots).



Figure 152. Survey pictures in reach 1 of Keystone Creek show dense riparian vegetation (panel A), a bedrock shelf along the creek (panel B), a section of stream with large cobble substrate (panel C), and a step pool near the upstream end of the reach (panel D).

RESULTS:

Seven patches of suitable spawning substrate were found in reach 1 of Keystone Creek (Table 59; Figure 153), measuring a total of 12 m². One of these patches was categorized as “high” quality, one patch was of “moderate” quality, and five patches were of “low” quality (Table 59; Figure 152). Four of these patches contained 50% large gravel (12–45 mm, diameter) and 50% small cobble (46–128 mm, diameter; Table 59). One cold-water patch was observed, measuring 1.2 m² (Figure 152). Temperature in the patch was 10.9° C and temperature adjacent to the patch was 12.0° C. The dominant substrate type within this cold-water patch was fine sediment (< 4 mm, diameter). There were no potential barriers to Chum Salmon migration in this reach.

Table 59. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 1 of Keystone Creek, southeast of Clatskanie, OR, in September 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	1	1
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	1	1
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	4	9
low	11-20	0	25	75	0	0
low	11-20	0	0	100	1	1

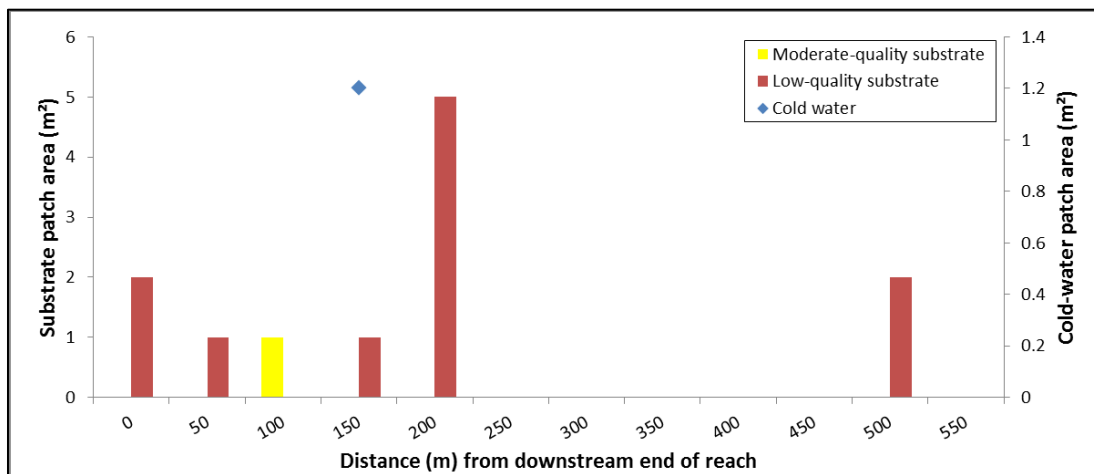


Figure 153. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 1 Keystone Creek, southeast of Clatskanie, OR, in September 2012. For cold water and for each category of substrate quality, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

REACH 2

REACH DESCRIPTION:

Reach 2 started 1 km upstream from Alder Grove Road (Lat: 46.079396, Long: -123.152289) and continued upstream to the Swedetown Road bridge (Lat: 46.074416, Long: -123.142729; Figure 154). The mainstem thalweg length = 983, and there were no side channels. Channel form was confined with limited meanders. The riparian zone was densely vegetated with large maples, cedars, firs, and some alders. Land use was predominantly mature timber, with some timber harvest. Stream gradient in this reach increased towards the upstream end of the reach, and several cascading channels were present (Figure 155, panel D).

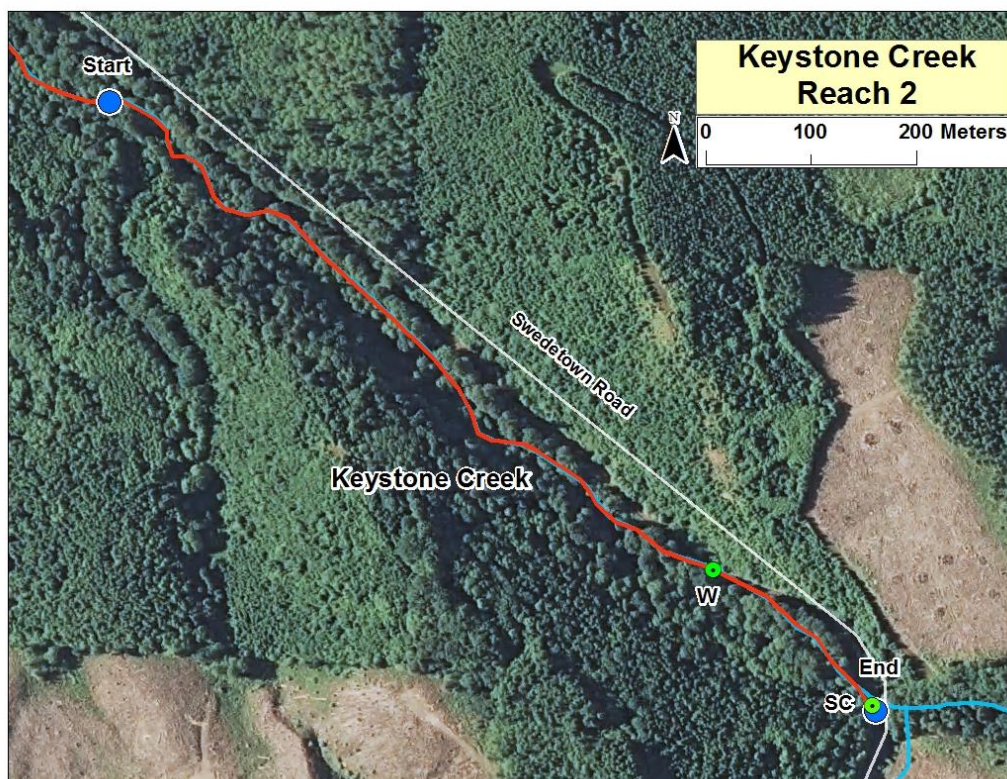


Figure 154. Map of reach 2 (red line) on Keystone Creek, including start and end points (blue dots), a waterfall (W) and a semicircular culvert (SC).

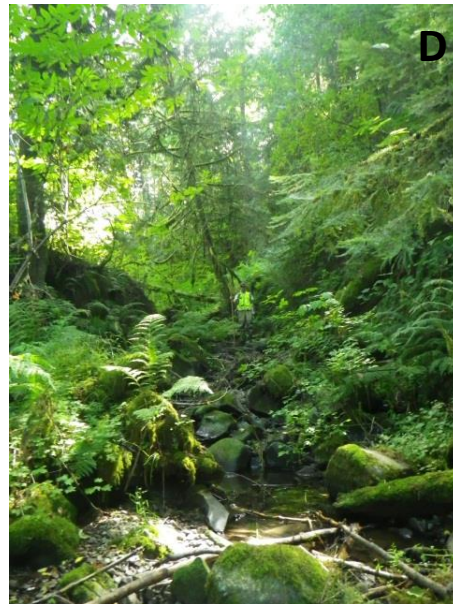
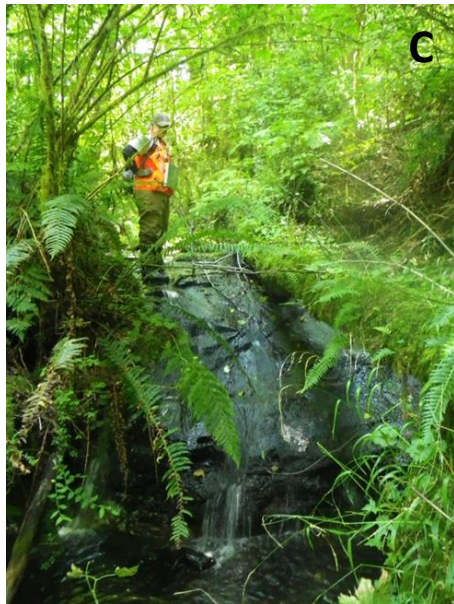


Figure 155. Survey pictures of Keystone Creek reach 2 show the creek flowing over bedrock (panel A), a semicircular culvert located at the upstream end of the reach (panel B), a waterfall barrier over bedrock (panel C), and a cascading section of stream in the upper quarter of the reach (panel D).

RESULTS:

Long sections (> 2 m) of the streambed in this reach consisted entirely of bedrock (Figure 155, panel A). Large cobble (46–128 mm, diameter) and other smaller substrate were more commonly associated with large woody debris. Ten patches of suitable spawning substrate were found in reach 2 of Keystone Creek (Table 60; Figure 156), measuring a total of 14 m². All patches were designated “low” quality because of elevated levels of fine sediment (11–20% of patch area) or large cobble (46–128 mm, diameter \geq 75% of patch area; Table 60). Two cold-water patches, measuring 14.4 m², were observed (Figure 156). Average temperature in these patches was 10.2° C and average temperature adjacent to these patches was 13.5° C. Both patches consisted of large gravel (12–45 mm) as a dominant substrate type and one patch also contained < 20% fine sediment (< 4 mm, diameter). There were two potential barriers to Chum

Salmon migration in this reach (Figure 154). The first potential barrier encountered was a waterfall (Table 61; Figure 155, panel C). The next barrier was a perched semicircular culvert under Swedetown Road located at the upstream end of the reach (Table 62; Figure 155, panel B).

Table 60. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in reach 2 of Keystone Creek, southeast of Clatskanie, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	3	5
low	11-20	0	25	75	4	6
low	11-20	0	0	100	3	3

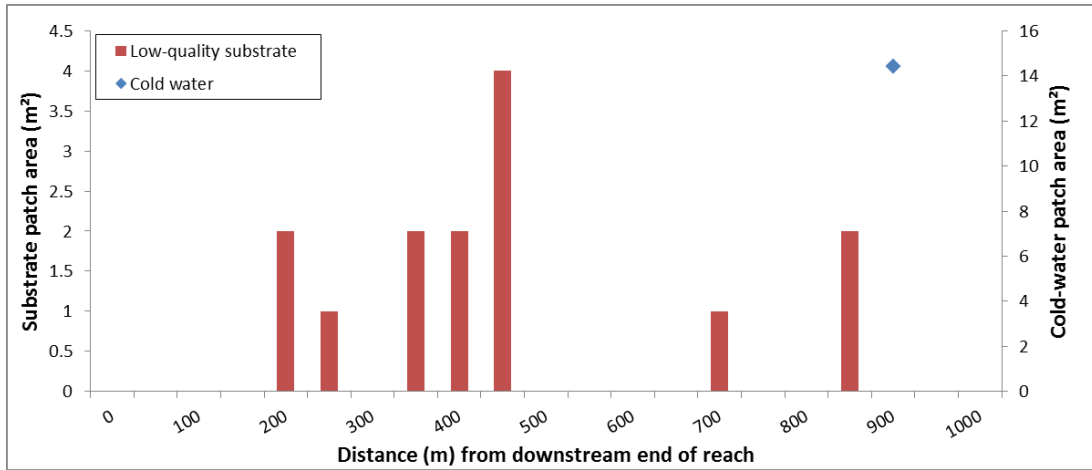


Figure 156. Location of substrate and cold-water patches measured as distance from downstream end of survey in reach 2 of Keystone Creek, southeast of Clatskanie, OR, in August 2012. For cold water and for low-quality substrate, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

Table 61. List of barriers, types, barrier heights, barrier widths (across stream), barrier lengths (upstream and downstream), and max pool depths downstream of the barriers for reach 2 of Keystone Creek, southeast of Clatskanie, OR, in August 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Waterfall	2	12	1.3	0.6
2	Semicircular culvert	1.6	1.8	16	0.8

Nice Creek

SURVEY DATE: August 14, 2012

SURVEY CREW: Brian Alfonse and Lorana McCalester

GENERAL DESCRIPTION:

The Nice Creek habitat survey (Township: 7N Range: 2W Section: 16CA) started at the Highway 30 bridge (Lat: 46.090122, Long: -122.942982) and continued 365 m upstream to a point where the stream cascades over a long bedrock shelf (> 25m; Lat: 46.088841, Long: -122.9465; Figure 157; Figure 158, panel A). The survey consisted of one reach with a mainstem thalweg length of 365 m, and one side channel (thalweg length = 14 m). From Highway 30 to the confluence with the Columbia River, Nice Creek flowed through a long, circular culvert (400 m). The

downstream end of this culvert was perched above the Columbia River water level at the time of the survey, making this a complete migration barrier (Figure 158, panel B). The riparian zone along this reach consisted of grass and blackberry bushes, and the land use was rural residential (Figure 158, panel C).

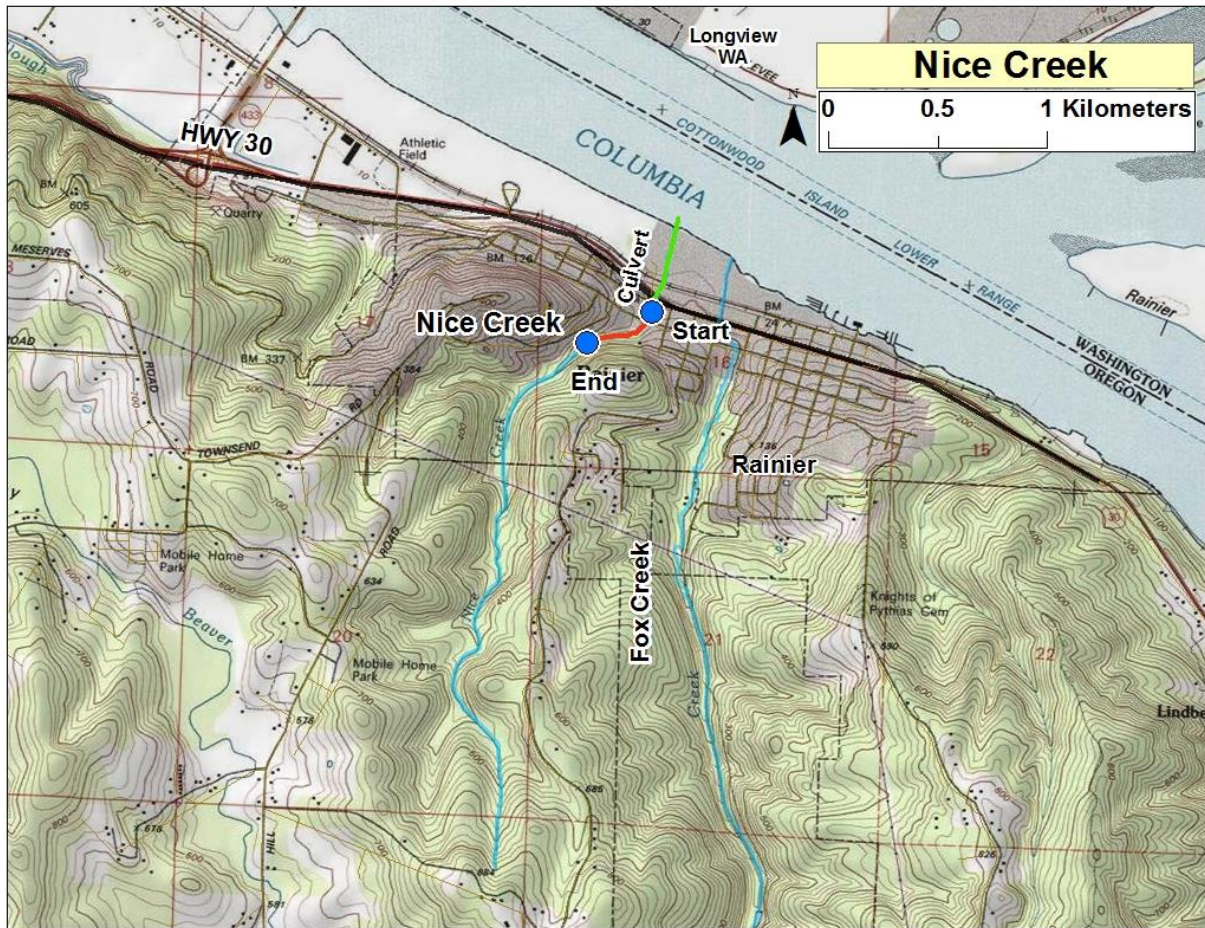


Figure 157. Map of reach (red line) surveyed on Nice Creek, located near Rainier, OR, including start and end points (blue dots) and a circular culvert (green line).



Figure 158. Survey pictures on Nice Creek show a bedrock cascade at the upstream end of the reach (panel A), the downstream end of the culvert where Nice Creek flows into the Columbia River (panel B), a view from the downstream end of the reach showing a riparian zone dominated by grass and blackberry (panel D), and an area of small and large gravel substrate (panel D).

RESULTS:

Substrate consisted of substantial quantities of small and large gravels (4–45 mm, diameter), however because fine sediment levels were > 20%, little suitable spawning habitat was identified (Figure 158, panel D). Seven patches of suitable spawning substrate were found in Nice Creek (Table 62; Figure 159), measuring a total of 12 m². All of these patches were categorized as “low” quality and six patches consisted of ≥ 50% large gravel (12–45 mm, diameter; Table 62; Figure 159). Two cold-water patches were observed, totaling 10.0 m² (Figure 159). Average temperature in these patches was 15.2° C and average temperature adjacent to these patches was 17.3° C. The dominant substrate type within these cold-water patches was fine sediment (< 4 mm, diameter). The culvert under the town of Rainier, OR, was the only barrier in this reach (Table 63).

Table 62. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in Nice Creek, southeast of Clatskanie, OR, in August 2012.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	4	9
low	11-20	0	50	50	2	2
low	11-20	0	25	75	1	1
low	11-20	0	0	100	0	0

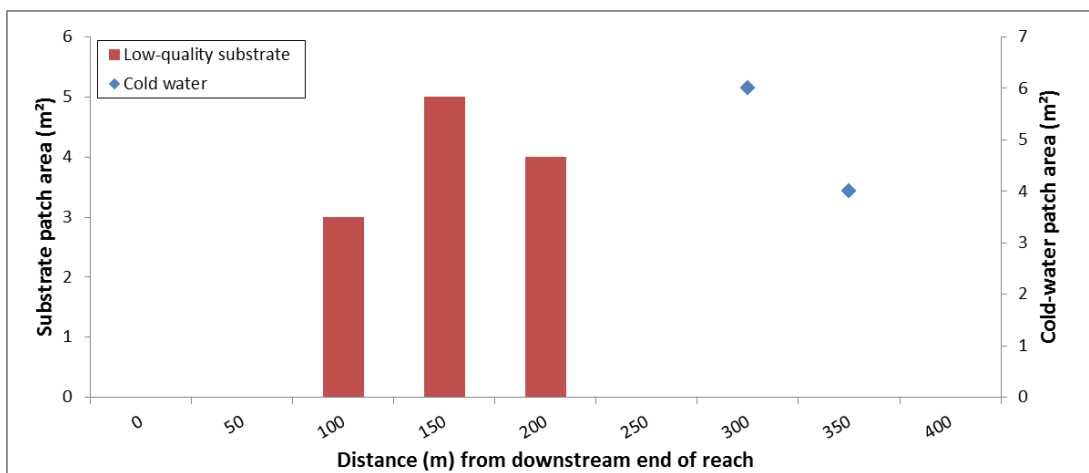


Figure 159. Location of substrate and cold-water patches measured as distance from downstream end of survey in Nice Creek, southeast of Clatskanie, OR, in August 2012. For cold water and for low-quality substrate, patch area was summed and binned into 50 m units. Cold-water patches were $\geq 1.0^{\circ}$ C colder than the temperature in the main channel.

Table 63. Barrier type, barrier height, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier for Nice Cr, Rainier, OR, August 2012. ** indicates data not collected

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Circular culvert	**	**	400	**

OK Creek

SURVEY DATE: August 7, 2012

SURVEY CREW: Kris Homel

GENERAL DESCRIPTION:

The OK Creek habitat survey (Township: 7N Range: 5W Section: 900) started at the Colvin Road bridge (Lat: 46.111077, Long: -123.310694) and continued 325 m upstream (Lat: 46.108792, Long: -123.313082; Figure 160). The survey consisted of one reach with a mainstem thalweg length of 325 m, and there were no side channels. The stream was deeply entrenched with stream banks > 2 m high that were actively eroding and (Figure 161, panel B), and few meanders observed. The riparian zone in this reach was densely vegetated with young alders, and land use was primarily young timber. The gradient of stream channel was high (but < 5%), and most of the stream units were riffles (Figure 161, panel A).

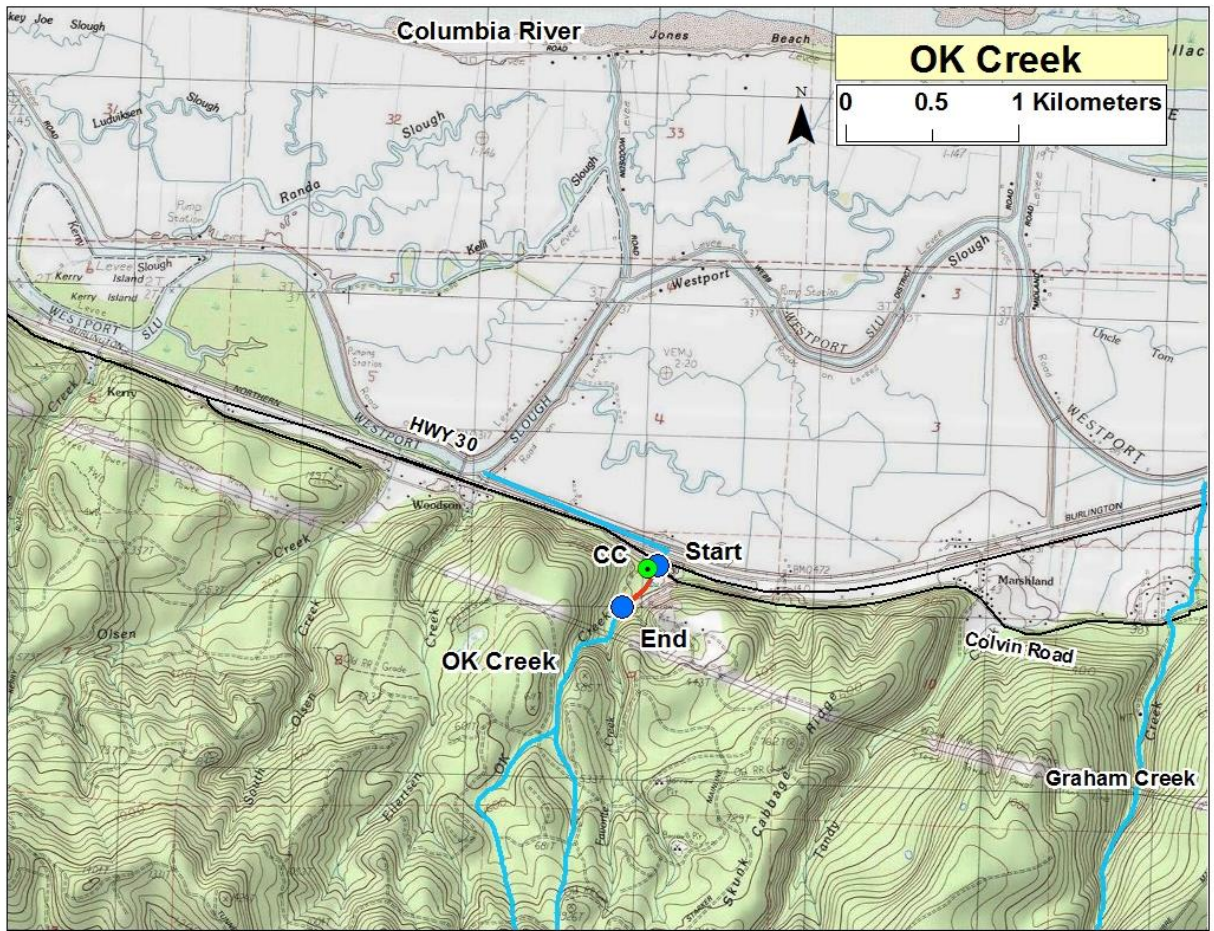


Figure 160. Map of reach (red line) surveyed on OK Creek, located east of Westport, OR, including start and end points (blue dots) and a circular culvert (CC).



Figure 161. Survey pictures on OK Creek show a riffle (panel A), entrenched channel along the stream banks (panel B), substrate section with > 50% fine sediment (panel D), and a circular culvert under Colvin Road (panel D).

RESULTS:

The substrate OK Creek contained a high percentage of fine sediment (< 4 mm diameter, and > 50% of substrate area); (Figure 161, panel C). No gravel patches or cold-water patches were observed. There was one potential barrier to Chum Salmon migration in this reach, a circular culvert under Colvin Road (Figure 169; Table 64; Figure 161, panel D).

Table 64. Barrier type, barrier height, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in OK Creek, east of Westport, OR, in August 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Circular culvert	0	2	8	.3

Perkins Creek

SURVEY DATE: July 17, 2013

SURVEY CREW: Brian Alfonse, John Cox, and Lorana McCalester

GENERAL DESCRIPTION:

The Perkins Creek habitat survey (Township: 7N Range: 4W Section: 1500) started at the confluence the Clatskanie River (Lat: 46.08624, Long: -123.165471) and continued upstream to a point 25 m upstream from a small bridge in Perkins Creek campground (Lat: 46.083788, Long: -123.166781; Figure 162). The survey consisted of one reach with a mainstem thalweg length of 443 m, and there were no side channels. The channel form was confined with multiple meanders. The riparian zone was densely vegetated with young alders (Figure 163, panel C) in the lower half of the reach, and grass-dominated (including some maintained portions) in the upper half (Figure 163, panel B). Land use was a mix of rural residential and young timber.

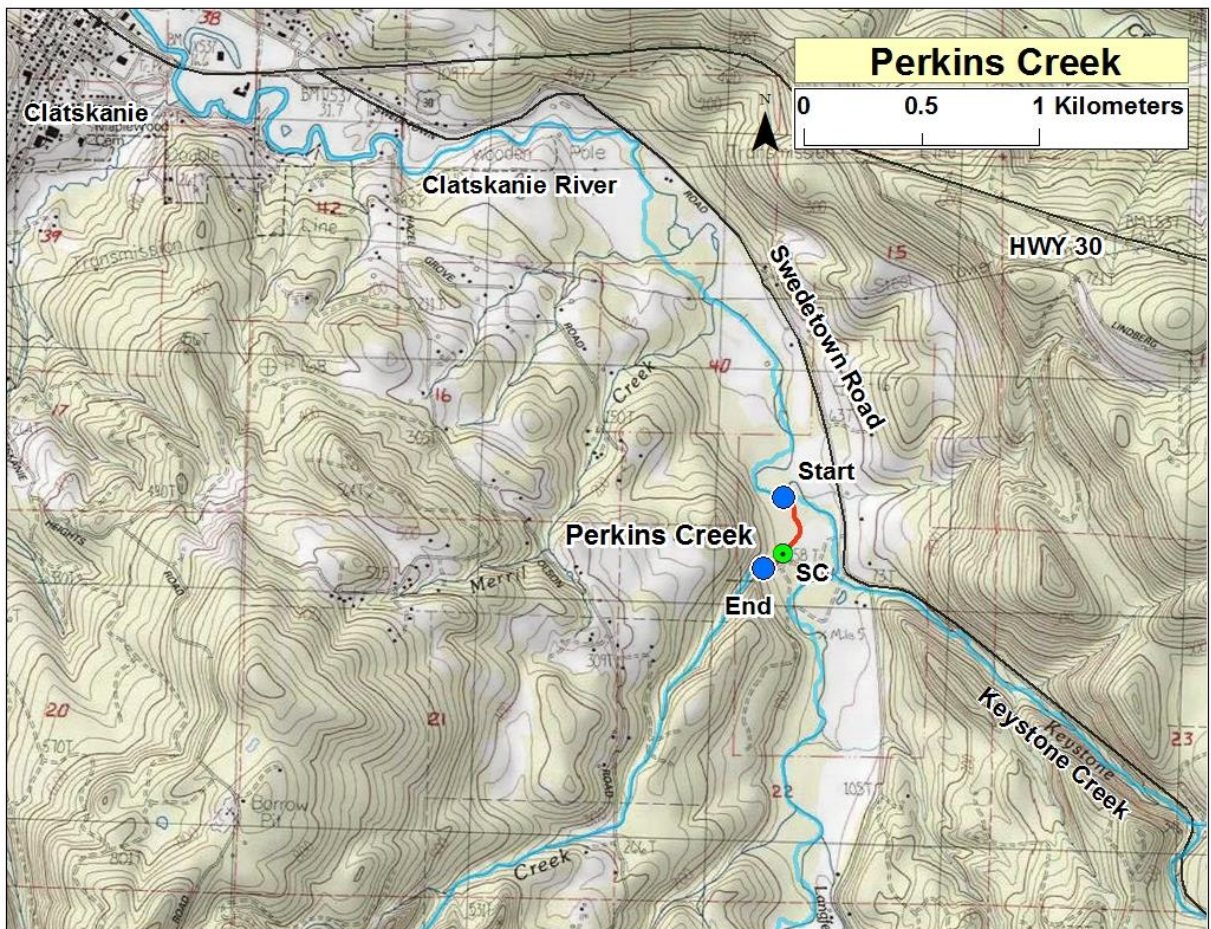


Figure 162. Map of reach (red line) surveyed on Perkins Creek, located south of Clatskanie, OR, including start and end points (blue dots) and a semicircular culvert (CC).



Figure 163. Survey pictures on Perkins Creek show hardpan clay along streambed (panel A), a maintained yard in the riparian zone (panel B), alder-dominated riparian zone in downstream half of the reach (panel C), and a circular culvert under a gravel road (panel D).

RESULTS:

Areas of hardpan clay were abundant along the streambed in this reach of Perkins Creek (Figure 163, panel A), and substrate in this reach was dominated by fine sediment (< 4 mm diameter and > 20% of substrate area). Three patches of suitable spawning substrate were found in (Table 65; Figure 163), measuring a total of 4 m². All patches were designated “low” quality because of elevated levels of fine sediment (11–20% of patch area) and large cobble (46–128 mm, diameter ≥75% of patch area; Table 65). No cold-water patches were observed; however, there was one patch 0.5– 0.9° C colder than the adjacent stream. There was one potential barrier to Chum Salmon migration in this reach: a circular culvert located under a small farm road in Perkins Creek Campground (Figure 162; Table 66; Figure 163, panel D).

Table 65. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in Perkins Creek, south of Clatskanie, OR, in July 2013.

substrate quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	0	0
high	0-10	25	75	0	0	0
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	0	0
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	0	0
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	0	0
low	11-20	0	25	75	2	2
low	11-20	0	0	100	1	2

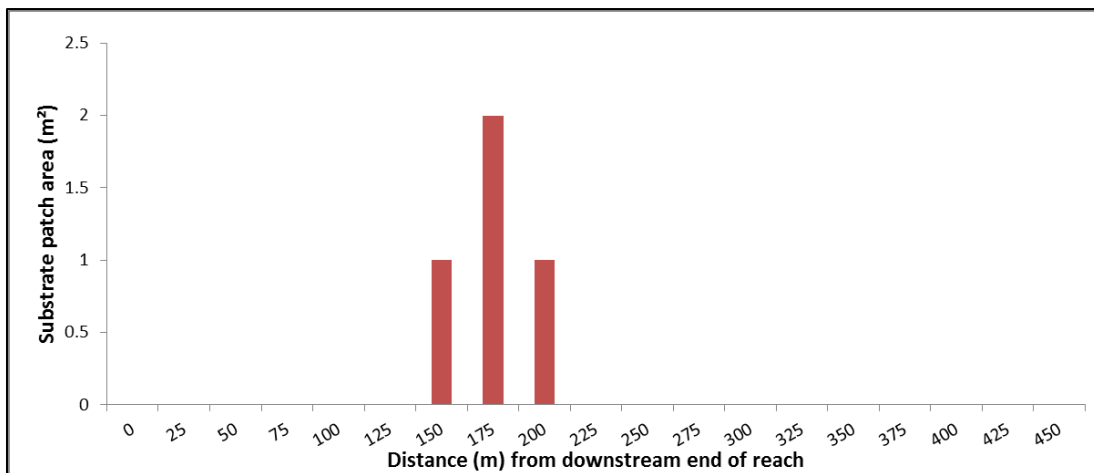


Figure 164. Location of low-quality substrate patches (red bars) measured as distance from downstream end of survey in Perkins Creek, south of Clatskanie, OR, in July 2013. Substrate patch area was summed and binned into 25 m units.

Table 66. Barrier type, barrier height, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in Perkins Creek, south of Clatskanie, OR, in July 2013.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Circular culvert	0	2	8.1	.12

Stewart Creek

SURVEY DATE: July 30, 2012

SURVEY CREW: Brian Alfonse and Kris Homel

GENERAL DESCRIPTION:

The Stewart Creek habitat survey (Township: 8N Range: 4W Section: 34D0) started at the Rutters Road bridge, continued 421 m upstream to a logging road culvert on the North Fork and upstream 283 m to a point on South Fork Stewart Creek. Surveys on Stewart Creek were delineated into three reaches: one in each of the main stem Stewart Creek, North Fork Stewart Creek, and South Fork Stewart Creek (Figure 165).

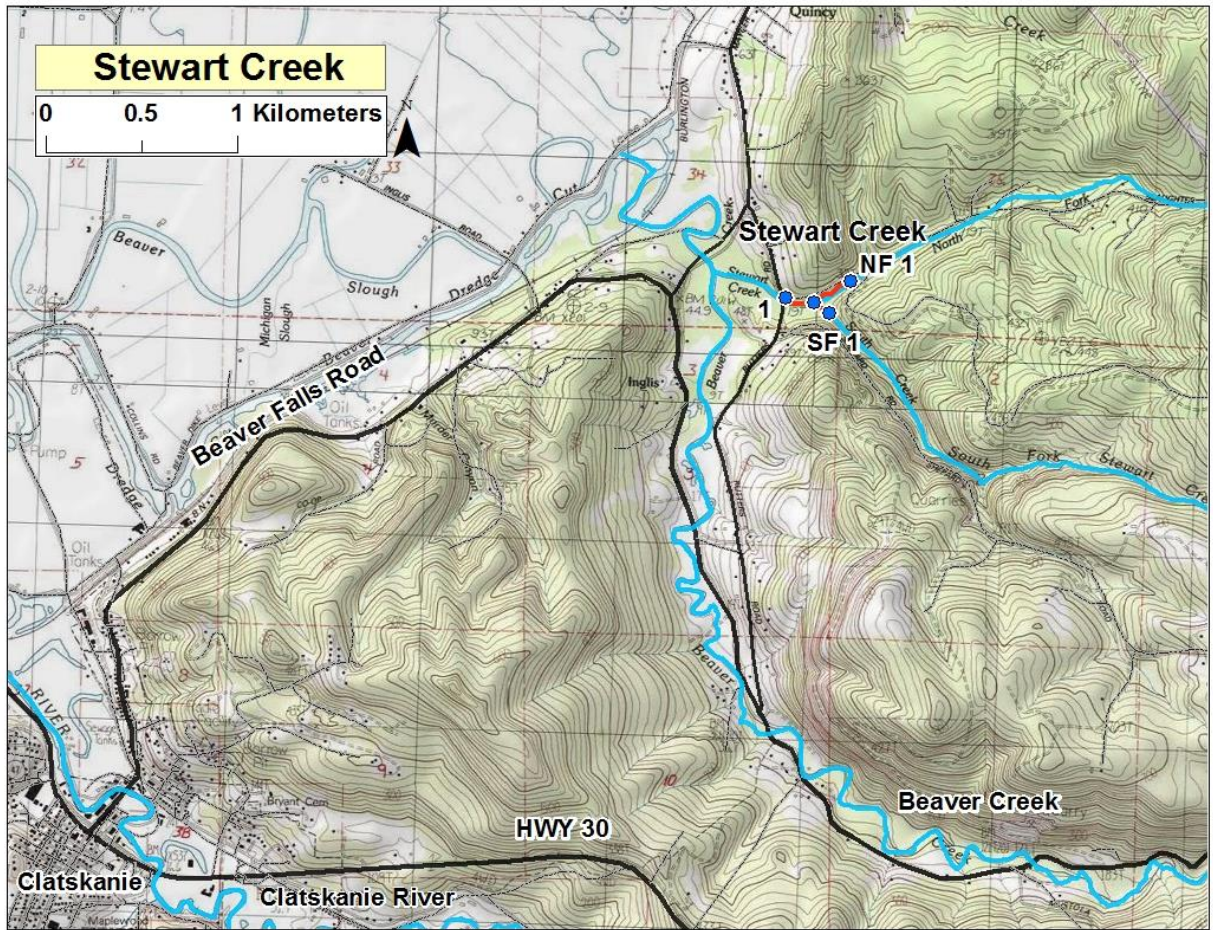


Figure 165. Map of reaches (red line) surveyed on Stewart Creek, located east of Clatskanie, OR. Reach break labels correspond to the downstream end of each reach.

Stewart Creek

REACH DESCRIPTION:

Reach 1 started at a culvert under the Rutters Road bridge (Lat: 46.129733, Long: -123.158595) and continued upstream to the confluence of the north and south forks (Lat: 46.129689, Long: -123.156615; Figure 166). The channel was confined by Stewart Creek Road, and there were few meanders. The mainstem thalweg length of this reach was 176 m, and there were no side channels. Riparian vegetation was dominated by tall grass (Figure 167, panel A). Land use was primarily rural residential.

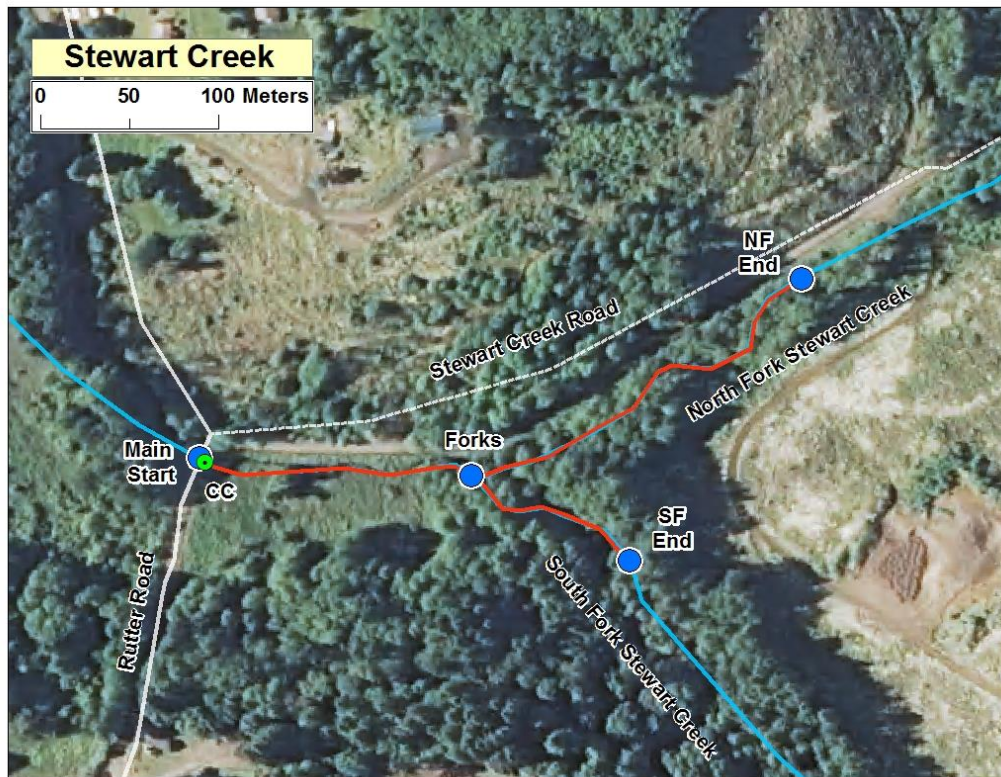


Figure 166. Map of reach (red line) surveyed on Stewart Creek, including start and end points (blue dots) and a triple circular culvert (CC).



Figure 167. Survey pictures of Stewart Creek show a tidal channel downstream from the reach (panel A) and three adjacent circular culverts under Rutter Road (panel B).

RESULTS:

Twenty-one patches of suitable spawning substrate were found in the main stem Stewart Creek (Table 67; Figure 168), measuring a total of 148 m². Seven of these patches were categorized as “high” quality, twelve patches were of “moderate” quality, and two patches were of “low” quality (Table 67; Figure 168). Fifteen of these patches contained $\geq 25\%$ small gravel (4–11 mm, diameter; Table 67). No cold-water patches were observed. There was one potential barrier to Chum Salmon migration in this reach, classified as a set of three adjacent circular culverts located under Rutter Road (Figure 166; Table 68; Figure 167, panel B).

Table 67. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in mainstem Stewart Creek, northeast of Clatskanie, OR, in July 2012.

Substrate Quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	3	19
high	0-10	25	75	0	4	44
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	2	28
moderate	0-10	0	50	50	0	0
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	6	23
moderate	11-20	25	75	0	2	7
moderate	11-20	0	100	0	2	7
low	11-20	0	75	25	2	20
low	11-20	0	50	50	0	0
low	11-20	0	25	75	0	0
low	11-20	0	0	100	0	0

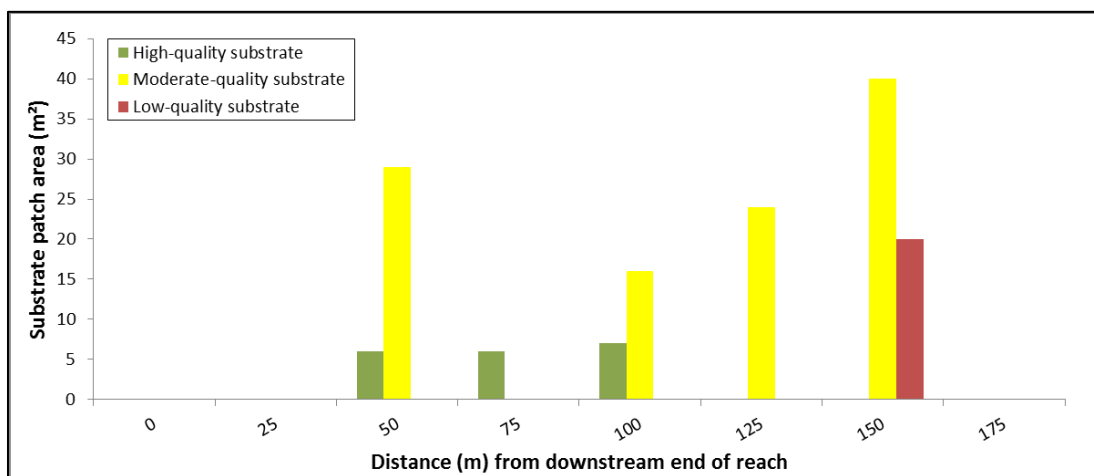


Figure 168. Location of substrate patches measured as distance from downstream end of survey in main stem Stewart Creek, northeast of Clatskanie, OR, in July 2012. For each category of substrate quality, patch area was summed and binned into 25 m units.

Table 68. Barrier type, barrier height, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in Stewart Creek, northeast of Clatskanie, OR, in July 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1a	Circular culvert	0	1	22	0.3
1b	Circular culvert	0	1	22	0.3
1c	Circular culvert	0	1	22	0.3

North Fork Stewart Creek

REACH DESCRIPTION:

Reach 1 started at the confluence of the north and south forks (Lat: 46.129689, Long: -123.156615) and continued upstream to a logging road bridge (Lat: 46.129294, Long: -123.155455; Figure 166). The mainstem thalweg length of this reach was 245 m. There was also one side channel (thalweg length = 9 m). Channel form was unconfined with multiple meanders. The riparian zone was sparsely vegetated with maples, alders, and some firs. Primary land use was rural residential.



Figure 169. A circular culvert, under a logging road, located at the upstream end of the reach on North Fork Stewart Creek (picture taken in the fall 2012).

RESULTS:

Eighteen patches of suitable spawning substrate were found in this reach of North Fork Stewart Creek (Table 69; Figure 170), measuring a total of 195 m². Six of these patches were categorized as “high” quality, eight patches were of “moderate” quality, and four patches were of “low” quality (Table 69; Figure 170). Thirteen of these patches consisted of fine sediment that was ≤ 10% of the patch area (Table 69). No cold-water patches were observed. There was one potential barrier to Chum Salmon migration in this reach, a circular culvert located under a logging road at the upstream end of the reach (Figure 166; Figure 169; Table 70).

Table 69. Total number and area (m²) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in North Fork Stewart Creek, east of Clatskanie, OR, in July 2012.

Substrate Quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	3	20
high	0-10	25	75	0	3	51
high	0-10	0	100	0	0	0
moderate	0-10	0	75	25	6	83
moderate	0-10	0	50	50	1	8
low	0-10	0	25	75	0	0
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	0	0
moderate	11-20	25	75	0	1	8
moderate	11-20	0	100	0	0	0
low	11-20	0	75	25	0	0
low	11-20	0	50	50	0	0
low	11-20	0	25	75	3	23
low	11-20	0	0	100	1	2

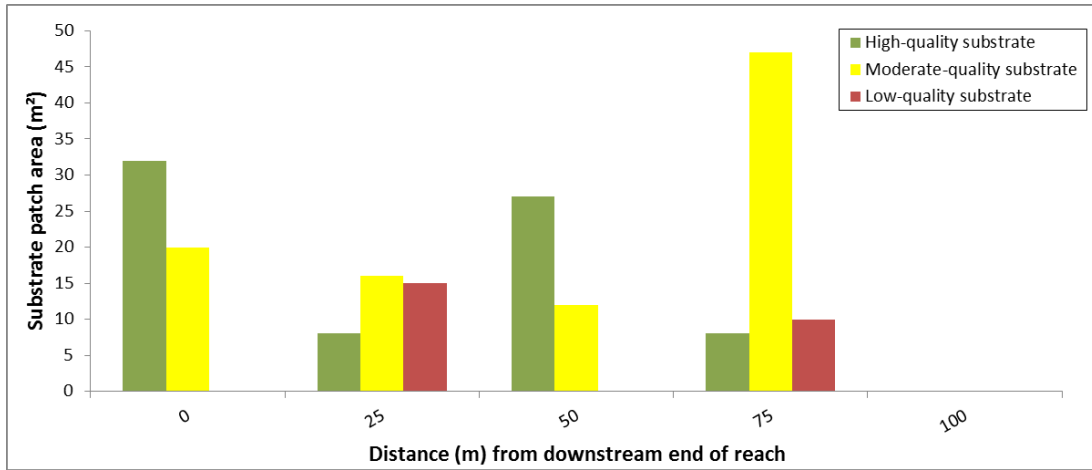


Figure 170. Location of substrate patches measured as distance from downstream end of survey in North Fork Stewart Creek, northeast of Clatskanie, OR, in July 2012. For each category of substrate quality, patch area was summed and binned into 25 m units.

Table 70. Barrier type, barrier height, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in North Fork Stewart Creek, northeast of Clatskanie, OR, in July 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Circular culvert	0	**	**	**

South Fork Stewart Creek

REACH DESCRIPTION:

Reach 1 started at the confluence of the north and south forks (Lat: 46.129689, Long: -123.156615) and continued upstream 107 m from the start (Lat: 46.130699, Long: -123.154406; Figure 166). The mainstem thalweg length of this reach was 107 m, and there were no side channels. The riparian zone in this reach was sparsely vegetated with maples, alders, and fir, land use was rural residential.

RESULTS:

Thirty-one patches of suitable spawning substrate were found in the south fork of Stewart Creek (Table 71; Figure 171), measuring a total of 362 m². Six of these patches were categorized as “high” quality, 16 patches were of “moderate” quality, and nine patches were of “low” quality (Table 71; Figure 171). Nineteen of these patches included low levels of fine

sediment ($\leq 10\%$ of the patch area; Table 71). No cold-water patches were observed. There were no potential barriers to Chum Salmon migration in this reach.

Table 71. Total number and area (m^2) of suitable spawning substrate patches separated into three quality grades (low, medium, and high) classified by the percentage of fines (0–10% and 11–20%) and 25% categories of small gravel (4–11 mm), large gravel (12–45 mm), and small cobble (46–128 mm), observed in South Fork Stewart Creek, east of Clatskanie, OR, in July 2012.

Substrate Quality	Percent of Substrate Type				Number Patches	Patch Area
	Fines	Small Gravel	Large Gravel	Small Cobble		
high	0-10	100	0	0	0	0
high	0-10	75	25	0	0	0
high	0-10	50	50	0	1	4
high	0-10	25	75	0	2	38
high	0-10	0	100	0	3	37
moderate	0-10	0	75	25	9	108
moderate	0-10	0	50	50	3	33
low	0-10	0	25	75	1	4
low	0-10	0	0	100	0	0
moderate	11-20	100	0	0	0	0
moderate	11-20	75	25	0	0	0
moderate	11-20	50	50	0	2	15
moderate	11-20	25	75	0	1	17
moderate	11-20	0	100	0	1	4
low	11-20	0	75	25	3	39
low	11-20	0	50	50	1	24
low	11-20	0	25	75	3	38
low	11-20	0	0	100	1	1

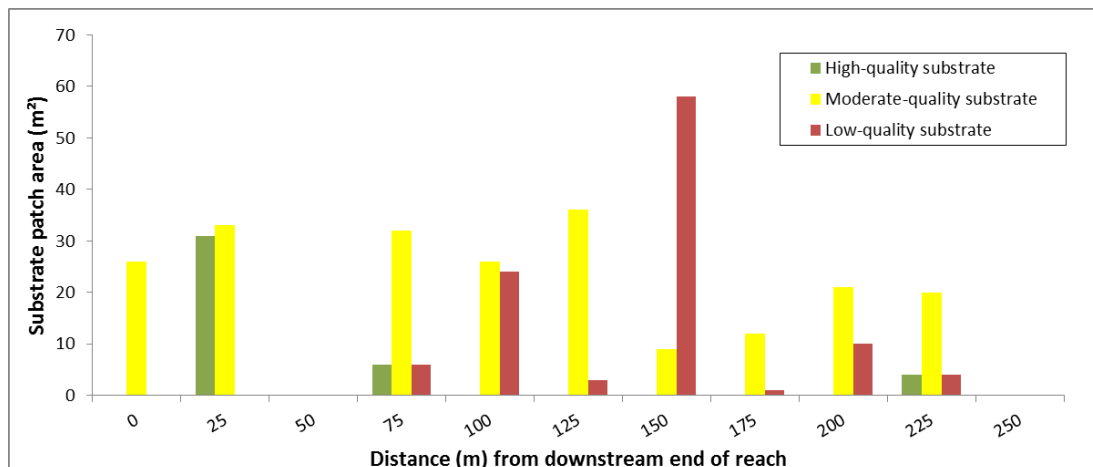


Figure 171. Location of substrate patches measured as distance from downstream end of survey in South Fork Stewart Creek, northeast of Clatskanie, OR, in July 2012. For each category of substrate quality, patch area was summed and binned into 25 m units.

Tandy Creek

SURVEY DATE: July 30, 2012

SURVEY CREW: Brian Alfonse and Kris Homel

GENERAL DESCRIPTION:

Tandy Creek (Township: 7N Range: 5W Section: 1100) was not officially surveyed because it is in very poor condition; instead, a crew walked the channel to look for barriers and to determine the scope of degradation. The crew walked from Colvin Road bridge (Lat: 46.108449, Long: -123.282666; Figure 172) downstream to highway 30. The riparian zone was dominated by grasses and sparse alders in the upstream half of the reach (Figure 173, panel A), and by young alders in the downstream half (Figure 173, panel B). The stream channel in this reach was altered by human activity, with large piles of substrate placed along the creek banks. Land use was urban and with a portion classified as rural residential. A large landslide existed in the canyon upstream of Colvin Road and deposits a tremendous amount of sediment into the creek. This sediment has caused aggradation of the stream bed, resulting in frequent overbank floods. Downstream of Highway 30, the stream channel is tidally influenced (Figure 173, panel C).

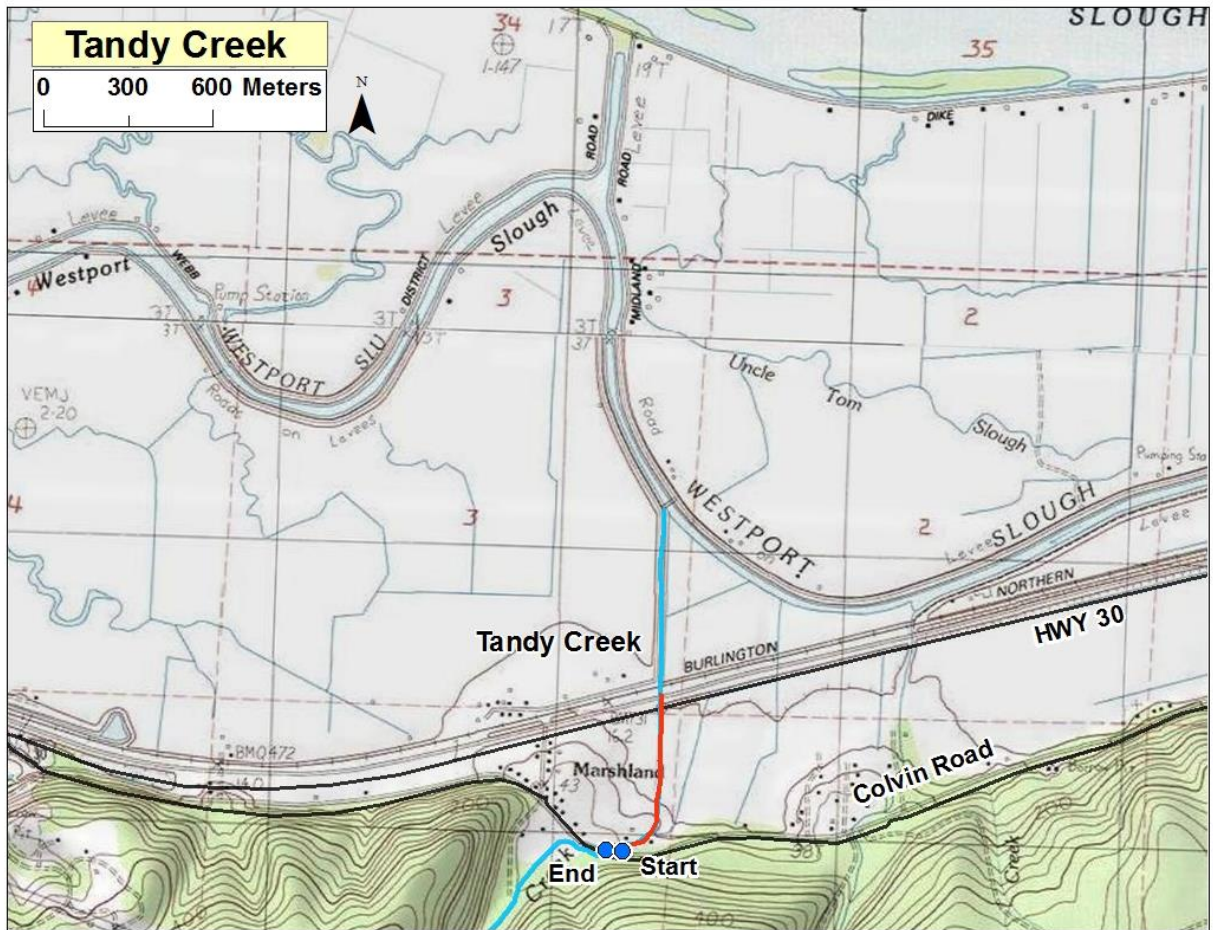


Figure 172. Map of reach (red line) on Tandy Creek, located west of Clatskanie, OR, including start and end points (blue dots).



Figure 173. Survey pictures on Tandy Creek showing the creek immediately downstream of Colvin Road (panel A) and a section of creek upstream (panel B) and downstream (panel C) of Highway 30.

West Creek

SURVEY DATE: September 27, 2012

SURVEY CREW: Brian Alfonse and Lorana McCalester

GENERAL DESCRIPTION:

The West Creek habitat survey (Township: 7N Range: 6W Section: 1A) started at the Burlington Northern railroad bridge adjacent to Highway 30 (Lat: 46.12638, Long: -123.365352; Figure 174), and continued upstream to the first Hungry Hollow Loop bridge (Lat: 46.128403, Long: -123.372035; Figure 175, panel C). The survey consisted of one reach with a mainstem thalweg length of 592 m, few meanders, and no side channels. In the section between the railroad and Highway 30 the stream channel was tidally influenced with several large pools and the riparian vegetation was dominated by grasses (Figure 175, panel A). The section upstream from

Highway 30 was characterized by an increase in riffle habitat and a decrease in pools, as well as a riparian zone that was densely vegetated with alders (Figure 175, panel B). Land use was urban, and a portion was considered rural residential.

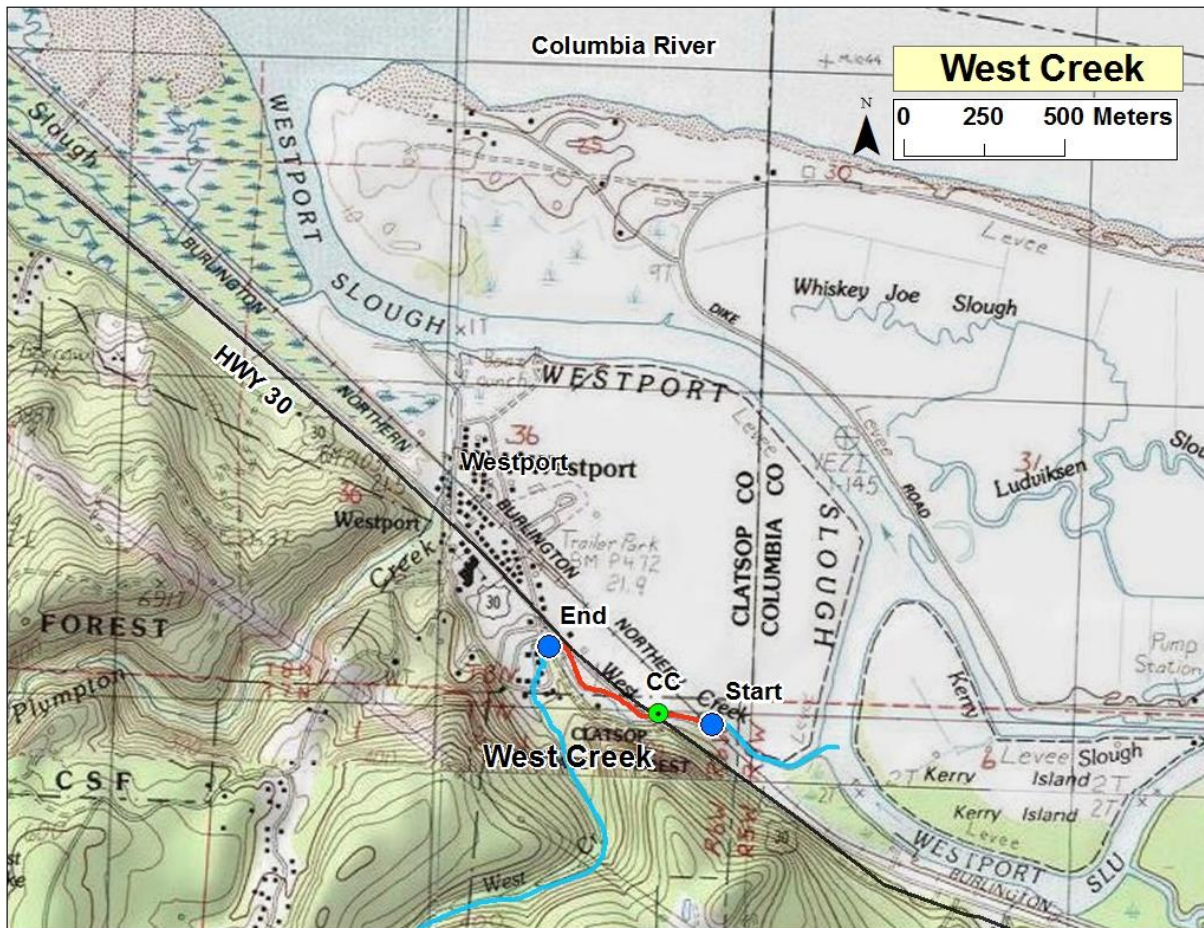


Figure 174. Map of reach (red line) surveyed on West Creek, located east of Westport, OR, including start and end points (blue dots) and a circular culvert (CC).



Figure 175. Survey pictures on West Creek show a tidally-influenced section of stream at the downstream end of the reach (panel A), a riparian zone dominated by young alders and grass (panel B), a bridge on Hungry Hollow Loop at the upstream end of the reach (panel C), and a circular culvert under Highway 30 (panel D).

RESULTS:

Substrate suitable for chum spawning was observed in this reach of West Creek, however because fine sediment levels were > 20%, no suitable spawning habitat was identified. No cold-water patches were found. There was one potential barrier to Chum Salmon migration in this reach, classified as a semicircular culvert located under Highway 30 in the middle of the reach (Figure 174; Table 72; Figure 175, panel D).

Table 72. Barrier type, barrier height, barrier width (across stream), barrier length (upstream and downstream), and max pool depth downstream of the barrier in West Creek, east of Westport, OR, in September 2012.

Barrier number	Barrier type	Drop (m)	Width (m)	Length (m)	Max pool depth (m)
1	Semicircular culvert	0	2.5	35	0.5