Seward Highway
Milepost 75-90
Road & Bridge Rehabilitation

Alaska Department of Transportation & Public Facilities
Seward Highway MP 75-90

DRAFT

2007 Aquatic Habitat Analysis

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INTRODUCTION AND BACKGROUND

The Alaska Department of Transportation and Public Facilities (DOT&PF) are proposing a project to improve sections of the Seward Highway from milepost (MP) 75 near Ingram Creek to MP 90 near Girdwood (Appendix A-Map 1). As part of the Project, DOT&PF has undertaken a program of studies designed to determine the ongoing and potential future effects of the Project on environmental resources.

A study of freshwater resources located along the road corridor was undertaken to determine the distribution of fish and habitat in freshwater water bodies that are completely or partially located within 200 ft of the Seward Highway between MP 75 and 90. The primary objective of this study was to determine the types, distribution, and areas of aquatic habitats located within the Seward Highway MP 75-90 corridor. This study was conducted in conjunction with the Seward Highway Freshwater Fish Assessment (HDR 2007a), results of which are published under a separate report. The results of both studies are being used to describe aquatic habitat values and fish utilization in the Project Area, and will in turn be used in the development and evaluation of project alternatives.

This report documents existing aquatic habitat data collected during the 2007 field season. Appendix B contains photographs of study sites and Appendix C contains field forms used for the Project. Field investigations were conducted from July 25-August 1, 2007 for a total of eight field days. The study was conducted by biologists and biological technicians from HDR Alaska, Inc. and was conducted according to the approach described in the 2007 Seward Highway MP 75-90 Freshwater Fisheries Study Plan (HDR Alaska, 2007b), which was developed in consultation with resource agencies and DOT&PF. Modifications to the study plan required by field conditions are described below in the Methods section.

STUDY AREA

The Seward Highway parallels the coastline of Turnagain Arm and crosses several streams between MP 75 and 90. The study area is known for its mud flats and tides as well as for strong winds and heavy precipitation. The highway is located between the ocean and the mountains, creating a narrow and often winding roadway that offers spectacular views for travelers.

The original construction of the highway and/or adjacent railroad resulted in the creation of numerous wetland areas and ponds on the inland side of the highway. Several streams and ponds also occur naturally within the study area. Surveys were not conducted in larger bridged creeks such as Portage Creek, Placer River and Twentymile because fish resources in these creeks are well-documented and the streams will likely remain bridged at the current bridge locations.

The Alaska Department of Fish and Game (ADF&G) Anadromous Fish Catalog lists several known anadromous water bodies in the project area (ADF&G 2007). Listed water bodies include: Ingram Creek (ADF&G stream 247-60-10190 and 247-60-10190-2005), Placer River (ADF&G stream 247-60-10200 and 247-60-10210), Portage Creek (ADF&G stream 247-60-

10220 and 247-60-10220-2009), Twentymile River (ADF&G stream 247-60-10230), Peterson Creek (ADF&G stream 247-60-10242), Kern Creek (ADF&G stream 247-60-10244), Virgin Creek (ADF&G stream 247-60-10248 and 247-60-10248-2020), Glacier Creek (ADF&G stream 247-60-10250, 247-60-10250-2004, 247-60-10250-2003 and 247-60-10250-2003-3005), and three unnamed water bodies (ADF&G streams 247-60-10235, 247-60-10240, and 247-60-10246; Appendix A-Map 1). According to the list, anadromous species present within the Project area include: Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), chum salmon (*Oncorhynchus keta*), pink salmon (*Oncorhynchus gorbuscha*), sockeye salmon (*Oncorhynchus nerka*), eulachon (*Thaleichthys pacificus*), and Dolly Varden (*Salvelinus malma*) (Table 1).

Table 1. Summary of anadromous fish presence in the Seward Highway 75-90 project area according to the Alaska Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes (ADF&G, 2007)

Seward Hwy MP 75-90 Project Site Name	ADF&G Catalog No.	Anadromous Species																				
		Coho			Pink			Chum			Chinook			Sockeye			Eulachon			Dolly Varden		
		S	R	P	S	R	P	S	R	P	S	R	P	S	R	P	S	R	P	S	R	P
Ingram Creek (MP 75.2)	247-60-10190			X	X					X												X
Ingram Slough (MP 75.3)	247-60-10190-2005						X															
Placer River Overflow	247-60-10210			X			X									X						X
Placer River	247-60-10200			X												X					X	
Portage Creek (Tributary)	247-60-10220-2009	X	X																			
Portage Creek	247-60-10220	X	X				X			X				X	X							
Twentymile River	247-60-10230	X	X					X					X	X	X				X			
MP 81.9	247-60-10235		X																			
Peterson Creek (MP 84.1)	247-60-10242				X																	
Peterson Creek (Tributary)	247-60-10240		X																	X	X	
Kern Creek (MP 86.3)	247-60-10244						X			X												X
MP 88.1	247-60-10246		X																			
Virgin Creek (MP 89.1)	247-60-10248	X	X				X			X												
MP 89.6 (Virgin Slough)	247-60-10248-2020		X																			
Glacier Creek (MP 89.7)	247-60-10250		X	X			X			X		X	X			X						
Glacier Creek (Tributary)	247-60-10250-2004		X																			
Glacier Creek (Tributary)	247-60-10250-2003		X																			
Glacier Creek (Tributary)	247-60-10250-2003-3005		X																			

S = Spawning, R = Rearing, P = Present

METHODS

Stream habitat survey methods for the Project were adapted from the USFS FSH 2090–Aquatic Habitat Management Handbook (R-10 Amendment 2090.21-2001-1), Chapter 20–Fish and Aquatic Stream Habitat Survey. The Habitat Management Handbook establishes standard techniques for fish biologists, hydrologists, and aquatic ecologists conducting fish and aquatic stream habitat surveys in coastal Alaska (USDA Forest Service, 2001). Method protocols are described in detail in this handbook.

Habitat Units

Aquatic habitat is evaluated using a hierarchical system that classifies habitat based on discrete units with measurable criteria. Using this method, a habitat unit such as a pool can be evaluated at different hierarchical levels ranging from macro-units to micro-units. The level of habitat unit analysis (i.e., macro, meso, or micro) is based on a system of three tiers. For example, pools are counted and classified to the macrohabitat unit level in Tiers 1 and 2, whereas pools are counted and classified to the mesohabitat level in Tier 3. Measurement or description categories for each survey level used in this study are shown below in Table 2.

Table 2. Tier Measurement or Description Categories

Tier 2	Tier 3	Tier 4	Categories
X	X	X	Channel Type
X	X	X	Macrohabitat Units
	X	X	Mesohabitat Units
		X	Microhabitat Units*
X	X	X	Main channel vs. Side Channel
X	X	X	Unit Channel Location (Right, Left, Center)
X	X	X	Maximum Pool Depth
X	X	X	Pool Tail Crest Depth
	X	X	Cross-section and Substrate Description
X	X	X	Large Wood
X	X	X	Key Pieces of Wood
	X	X	Large Wood Clusters
	X	X	Zone Three Large Wood
X	X	X	Disturbance
	X	X	Undercut Bank Length
X	X	X	Channel Flow Bed Width

* Tier 4 categories were generally not conducted as part of Tier 3 survey

Tier 3 (mesohabitat) level surveys were conducted within the highway corridor on six streams located between MP 75-90 of the Seward Highway. The only exception to the Tier 3 methods included the occasional classification of stream habitats to the Tier 4 (microhabitat) level. The highway corridor was defined as 200 ft. either side from the highway centerline. Habitat units were separated into a hierarchical system based on hydrology and substrate. Macrohabitat units such as pools and fastwater were identified. Macrohabitat units were broken down into mesohabitat units such as fastwater-glides or fastwater-riffles, and scour pools or backwater pools. Mesohabitat units were further divided into microhabitat units such as fastwater-riffle-cobble or scour-plunge-pools (Table 3). All in-stream macrohabitats (pools and fastwater) were surveyed to the microhabitat level and recorded on the Aquatic Habitat Data Sheet (Appendix C) and geographically represented on Maps 2-7. Photographic examples of dominant habitats are shown in Appendix B. Side channels were surveyed to the same tier level as the adjacent main channel.

Channel Types

Channel types were classified based on the USFS Tongass National Forest Channel Type Field Key (USFS 2001). The field key provided photographs of 38 different channel types, along with criteria (such as gradient or slope, incision depth, and dominant substrate) and a brief narrative. Channel conditions were compared to this key and classified accordingly. Table 4 lists the channel types that were identified during the 2007 study.

Table 3. Stream Habitat Units

Macrohabitat Units	Mesohabitat Units	Microhabitat Units
Pools (PL)	Backwater (PL-Bw)	Backwater Dammed (PL-dm) Backwater Eddy (PL-ed)
	Scour (PL-Sr)	Scour-Plunge (PL-pp) Scour-Lateral (PL-lsc) Scour-Mid Channel (PL-mcs)
	Slough (SL-Sr)	Slough-Slough (SL-sl)
Beaver Pond (BP)	Beaver Pond (BP)	Beaver Pond (BP)
Undercut Bank (U/C Bank)	Undercut Bank (U/C Bank)	Undercut Bank (U/C Bank)
Fastwater (FW)	Glide (GL)	Glide-Glide (GL-gl) Glide-Cobble (GL-cb) Glide-Boulder (GL-bd)
	Riffle (RF)	Riffle-Riffle (RF-rf) Riffle-Cobble (Rf-cb) Riffle-Boulder (RF-bd)
	Cascade (CS)	Cascade-Slip-face (CS-sf) Cascade-Chute (CS-ch) Cascade-Rapids (CS-rp) Cascade-Step-pool (CS-sp) Cascade-Fall (CS-fl)

Note: Not all of the above habitat units were present in the Project Area.

Pool Identification

Pools were identified based on the minimum residual pool depth, which was calculated by subtracting the pool tail crest depth from the maximum pool depth. Slow water habitat qualified as a macro-pool if it equaled or exceeded the minimum residual pool depth.

$$\text{Minimum Residual Pool Depth} = [\text{Average Channel Bed Width} \times 0.01] + 0.15\text{m}$$

Average channel bed width was calculated using a minimum of five bed widths measured at a distance of every one-fifth the total reach length. Reach length was determined by the width of highway corridor and therefore was typically ~ 400 ft for this project.

Undercut Bank

The length of undercut stream bank was measured based on a minimum length greater than or equal to 1.0 m and a depth greater than or equal to 0.3 m.

Table 4. Stream Channel Types Existing within the Project Area

Channel	Physical Characteristics
ES1	Stream Gradient: 0-0.5% Incision Depth: 0-4 m Bankfull Width: < 20 m Dominant Substrate: Silt/clay to sand Channel Pattern: Single, sinuous channel.
ES2	Stream Gradient: ≤ 1% Incision Depth: < 3 m Bankfull Width: < 10 m Dominant Substrate: Sand to gravel Channel Pattern: Single, sinuous channel
ES3	Stream Gradient: 0-3% Incision Depth: < 3 m Bankfull Width: < 10 m Dominant Substrate: Fine gravel to small boulder Channel Pattern: Single, linear channel
ES4	Stream Gradient: ≤ 2% Incision Depth: < 5 m Bankfull Width: > 10 m Dominant Substrate: Gravel to cobble Channel Pattern: Single to multiple channel
MM2	Stream Gradient: 2-6% Incision Depth: ≤ 4 m Bankfull Width: > 10 m Dominant Substrate: Gravel to small boulder Channel Pattern: Single moderately sinuous channel.

Large Wood

Qualifying pieces of large wood located within the bankfull width were counted and described according to the following categories:

- Large Wood Piece (LW): ≥ 0.1 m in diameter and length ≥ 1 m.
- Key Piece of Large Wood (LW-KP): A minimum key piece (of large wood) and stem length dimensions were identified based on the average channel bed width (see Table 5). Key pieces of wood were also tallied as large wood.
- Large Wood Cluster: 5 to 9 Large Wood pieces.
- Large Wood Cluster: ≥ 10 Large Wood pieces.

Table 5. Key Wood Piece Dimensions

Average Channel Bed Width	Key Piece Diameter	Key Piece Stem-Length	Rootwad Diameter
0-4.9 m	0.3 m	> 3 m	> 1 m
5-9.9 m	0.3 m	> 7.6 m	> 3 m
10-19.9 m	0.6 m	> 7.6 m	> 3 m
≥20 m	0.6 m	> 15 m	> 3 m

Source: Murphy and Koski 1989

Side Channels

Side channels were surveyed using the same tier methods as for the adjacent main channel. The presence of a side channel was based on the size of the island between each side channel at bankfull flows. A side channel was denoted if the island between the side channel and the main channel was at least as long as the creek was wide at bankfull flow.

Beaver Ponds

The area of beaver ponds was estimated (length × width) and the location of beaver ponds identified as left bank, right bank, or main channel.

Channel Morphology

Stream channel morphology data were recorded on a Habitat Survey Stream Morphology Data Card (Appendix C). Channel measurements were completed within a straight reach for each typical channel section (USFS, 2001). Stream channel characteristics measured included the following:

- Stream Location
- Stream Gradient (percent slope)
- Stream Depth and Velocity
- Stream Channel Cross Section
- Stream Discharge
- Left and Right Bankfull Width
- Left and Right Bottom of Bank
- Left and Right Top of Bank
- Riparian Vegetation
- Noticeable Irregularities
- Stream Substrate

Stream locations were taken from known stream crossings along MP 75-90 and confirmed with a GPS during the field investigations.

Stream gradient (percent slope) was measured by determining the difference in stream water surface elevation from a distance above the cross section to a distance below the cross section. This was done using a standard optical survey level and level rod.

Cross sectional measurements of the stream channel were recorded using methods described by Buchanon and Somers (1976). This generally included delineating a cross section across the stream, perpendicular to flow, with a fiberglass field tape and gathering water depth and water velocity data at distances across the active stream channel. Depth and velocity data were measured using a Marsh-McBirney Flowmate 2000 digital flowmeter and an incrementally marked wading rod. Other stream and channel features recorded when observed were top of bank, bottom of bank, and edge of water.

Instantaneous stream discharge (IQ) was calculated using water depth, velocity and distance measurements collected at each cross section according to standard USGS methods (Buchanon, and Somers 1976).

Bankfull widths were not recorded at all locations. This was primarily due to stream conditions; e.g. bankfull width at Glacier Creek exceeded our field equipment, and marine tidal flats below Peterson Creek created a wide braded drainage pattern that was too irregular to measure.

Substrate was characterized at each cross section using a pebble count (Wolman 1954, USFS 2001). Selection bias for substrate measurements was minimized as much as possible by conducting a "boot tip" survey, in which the observer selected the first particle encountered at the tip of his boot. The pebble counts consisted of 5 transects, spaced at increments of 5 meters, with 20 samples selected and measured per transect. One transect was located at the cross section and two transects were located upstream and downstream, respectively. Substrate was measured and categorized according to USFS methods (Table 6; USFS 2001).

Table 6. Substrate Size Classes and Codes

Substrate	Code	Size Class
Organic	ORG	Organic
Sand/Silt	SS	< 2.0 mm
Very Fine Gravel	VFG	2.0 - 3.9 mm
Fine Gravel	FGR	4.0 - 7.9 mm
Medium Gravel	MGR	8.0 - 15.9 mm
Coarse Gravel	CGR	16.0 - 31.9 mm
Very Coarse Gravel	VCG	32.0 - 63.9 mm
Small Cobble	SC	64 - 127.9 mm
Large Cobble	LC	128 - 255.9 mm
Small Boulder	SB	256 – 512 mm
Large/Medium Boulder	LMB	>512 mm
Bedrock	BR	Bedrock

Adult Fish Migration Barriers

Possible adult fish migration barriers were assessed using the criteria shown in Table 7, and the following information was recorded:

- Barrier type
- Hip chain location
- Temporal nature (ephemeral or permanent)
- Maximum height of falls or biggest single step if cascading
- Maximum depth of falls plunge pool
- Gradient and length (chutes and cascades only)

Steam gradient for migration barriers was determined by using a handheld Suunto optical reading clinometer (PM-5/360 PC). Distance was recorded using a 50 m fiberglass field tape measure or laser range finder.

Table 7. Adult Salmonid Migration Blockage Table

	Salmonid Species					
Criterion	**Coho**	**Steelhead**	**Sockeye**	**Chinook**	**Pink/Chum**	**Dolly Varden**
Maximum Fall height A blockage may be presumed if fall height exceeds:	11 ft (3.35m)	13 ft (3.96m)	10 ft (3.05 m)	11 ft (3.35 m)	a) 4 ft (1.22 m) with deep plunge pools not flooded at high tide. b) 3 ft (0.91m) without pools.	6 ft (1.83m)
Steep channel A blockage may be presumed if channel steepness is greater than the following without resting places for fish:	>225 ft (68.6m) @ 12% gradient >100 ft (30.5m) @ 16% gradient > 50 ft (15.2m) @ 20% gradient				>100 ft (30.5m) @ 9% gradient	>50 ft (15.2m) @ 30% gradient
Pool depth A blockage may be presumed if pool depth is less than the following, and the pool is unobstructed by boulders or bedrock:	1.25 x jump height, except that there is no minimum pool depth for falls: (a)<4 ft (1.2m) in the case of coho and steelhead; and (b)<2 ft (0.6m) in the case of other anadromous fish species.					

Source: USFS FSH 2090–Aquatic Habitat Management Handbook (R-10 Amendment 2090.21-2001-1) Chapter 20–Fish and Aquatic Stream Habitat Survey.

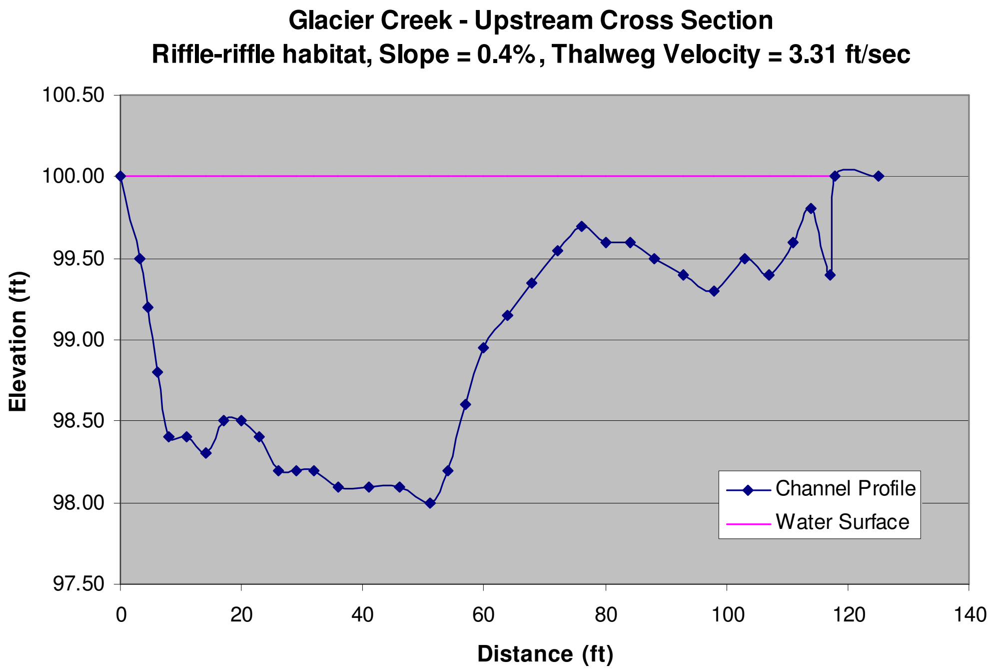
NOTE: To determine waterfall height, measure the additive height of falls only if there is no resting pool between them.

RESULTS

For the purposes of examining aquatic habitat distribution, each stream was divided into two reaches with one reach located upstream and another reach located downstream of the highway centerline. All streams surveyed for this study have been documented by ADF&G as containing anadromous fish (Table 1). Habitat types and their locations relative to the Seward Highway MP 75-90 corridor are shown in Appendix A Maps 2-8.

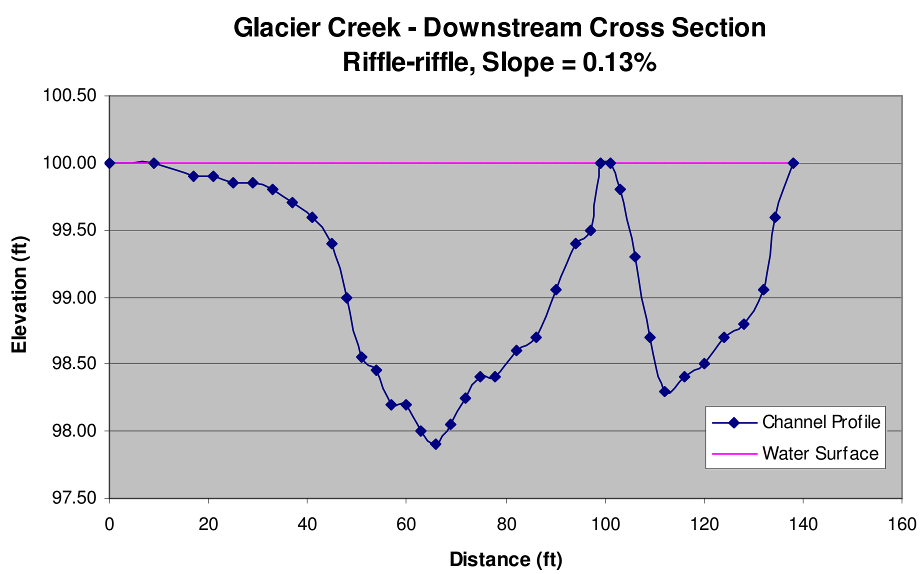
Glacier Creek (MP 89.7), Map 2

The upstream and downstream study reaches for Glacier Creek each extend 200 ft either side of the centerline of the Glacier Creek Bridge. The upstream reach extends from the Glacier Creek Bridge upstream approximately halfway to the railroad bridge located upstream of the highway. Both reaches are tidally influenced and are bordered predominantly by willow and alder riparian vegetation. The right (northwest) bank of the upstream reach is bordered by a gravel road and steep bank while the gradient on the left (southeast) bank is less severe. Cross section photos are available in Appendix B.



Note: Elevation is relative to a randomly selected datum.

Figure 1. Cross Section of Glacier Creek at upstream reach



Note: Elevation is relative to a randomly selected datum.

Figure 2. Downstream Cross Section of Glacier Creek

The channel gradient ranges from 0.4% at the upstream reach to 0.13% at the downstream reach and both reaches are dominated by fastwater habitat. The Glacier Creek reaches are both Large Estuarine (ES4) channels (Table 4). Upstream and downstream cross sections are located in Riffle-riffle habitat and are presented in Figures 1 and 2, respectively.

Flow velocities and substrate were measured in the upstream cross section. Substrate at the downstream cross section was comparable to the upstream cross section and therefore was not collected. In the upstream reach, average flow velocity was 2.1 ft/sec and discharge was 351.1 cfs. The dominant substrate for the upstream cross-section area was very coarse gravel (32 to 63.9 mm, Figure 3). Stream geomorphology characteristics for study cross sections in Glacier Creek are summarized in Table 8.

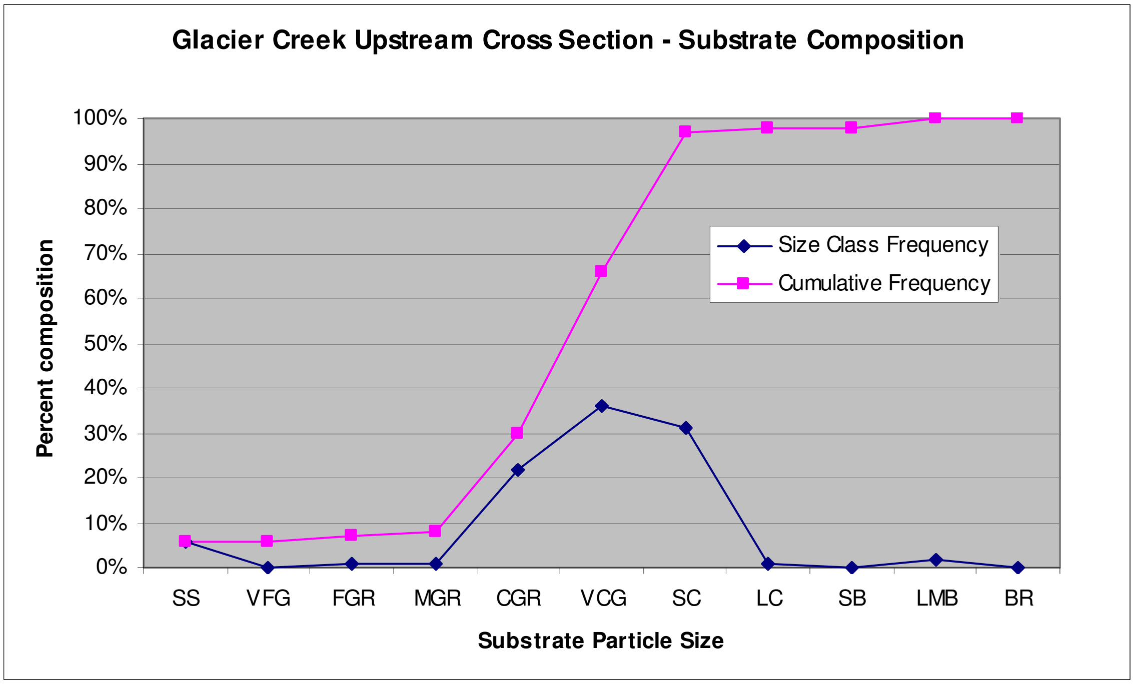


Figure 3. Glacier Creek Upstream Cross Section Substrate Composition

No fish passage barriers are present in the Glacier Creek reaches and both adult Dolly Varden and spawning pink salmon were observed in the study reach during the 2007 survey. Juvenile and adult fish presence is discussed in more detail in the Freshwater Fish Assessment Report for the Project (HDR Alaska, 2007b).

Based on the data collected, the primary channel of the reach is characterized by fastwater habitats consisting of Riffle-riffle habitat and a secondary channel in the downstream reach is characterized by Scour-Pool habitat (Appendix A-Map 2).

Table 8. Stream Geomorphology Summary for Study Cross Sections

Stream Name	Cross Section Location	Gradient (%)	*Dominant Substrate	Wetted Width (ft)	*Depth (ft)	Bankfull Width (ft)	*Velocity (ft/s)	Discharge (cfs)	Dominant Riparian Growth
Glacier	Upstream	0.40	Very Coarse Gravel	114.9	1.1	NR	2.1	351.1	Alder/ Willow
Glacier	Downstream	0.13	Very Coarse Gravel	115.5	NR	NR	NR	NR	Alder/ Willow
Virgin	Upstream	1.02	Very Coarse Gravel	25.0	0.5	NR	1.4	18.8	Estuarine Grasses
Virgin	Downstream	0.32	Sand/Silt	20.6	0.5	52.5	1.7	20.6	Estuarine Grasses
Kern	Upstream	1.26	Very Coarse Gravel / Small Cobble	26.2	0.9	42	2.0	61.9	Willow/ Cottonwood
Peterson	Upstream	2.05	Very Coarse Gravel	22.3	0.5	72	1.9	41.7	Alder/ Willow
Peterson	Downstream	1.63	Very Coarse Gravel	28.3	0.5	NR	2.3	42.1	Alder/ Willow
MP 81.9	Upstream	0.01	Sand/Silt	9.0	2.1	16.9	0.1	1.0	Estuarine Grasses
Ingram	Upstream	0.23	Coarse Gravel	53.1	1.6	73.7	NR	NR	Alder/ Willow
Ingram	Downstream	0.05	Coarse Gravel	92.7	1.1	NR	1.9	206.3	Alder/ Willow

* Represents mean values
NR = not recorded

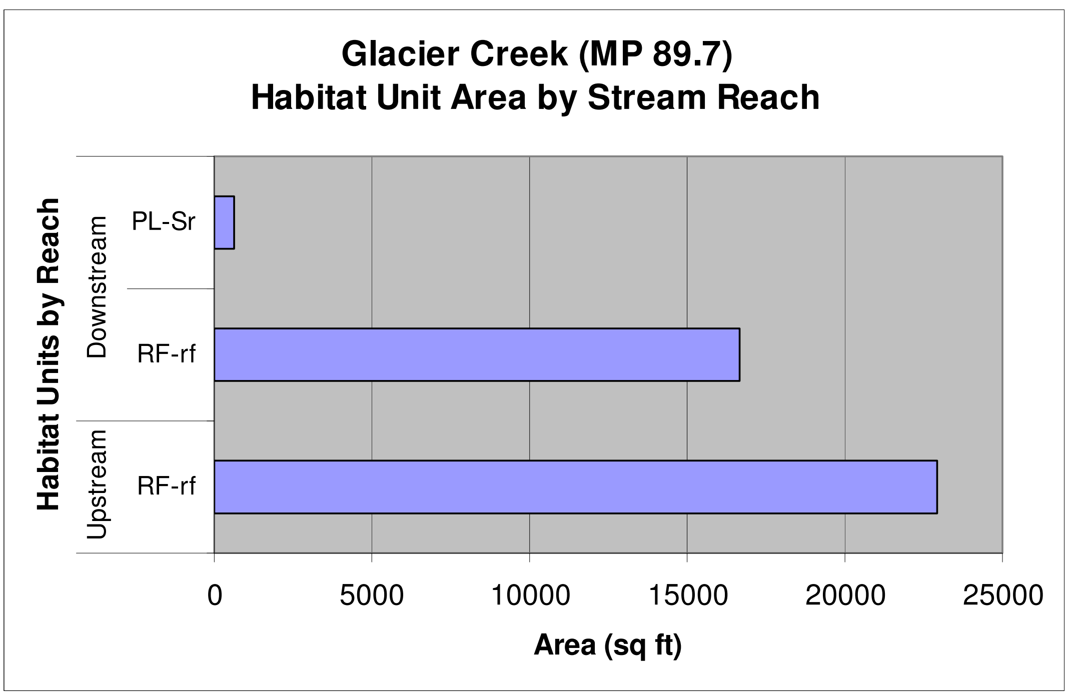


Figure 4. Glacier Creek Habitat by Stream Reach

The upstream reach contained more large wood than the downstream reach (Figure 5). The relatively high amount of large wood in the upstream reach compared to the downstream reach is likely a result of tidal influence terminating within the upstream reach. No undercut banks were observed during the 2007 survey.

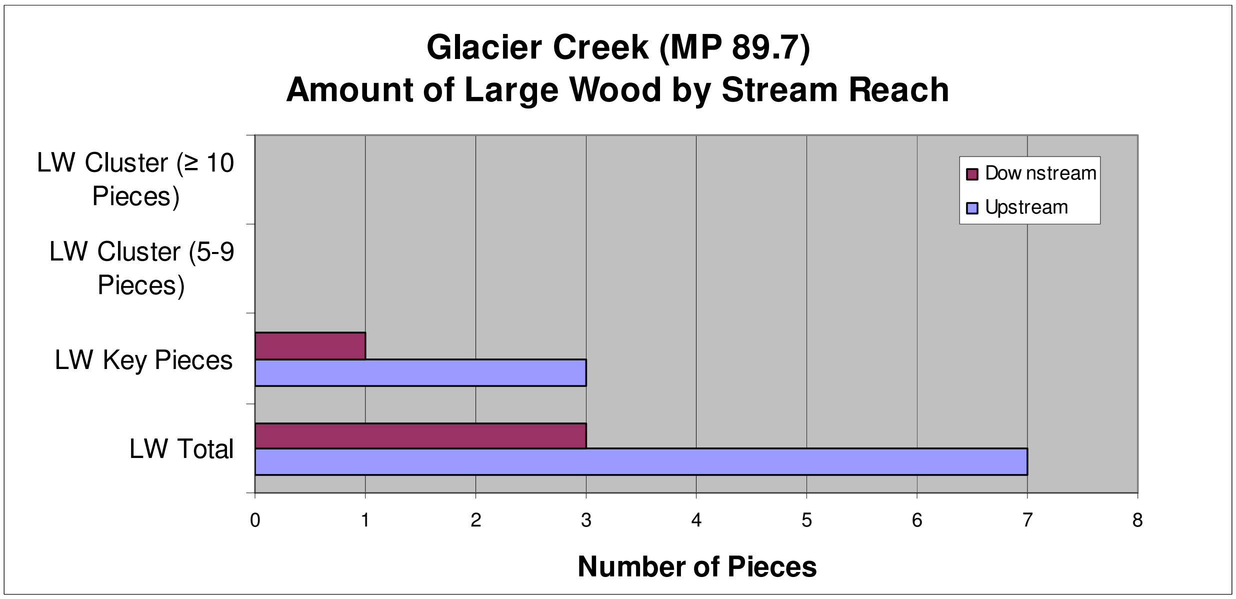


Figure 5. Glacier Creek – Amount of Large Wood by Stream Reach

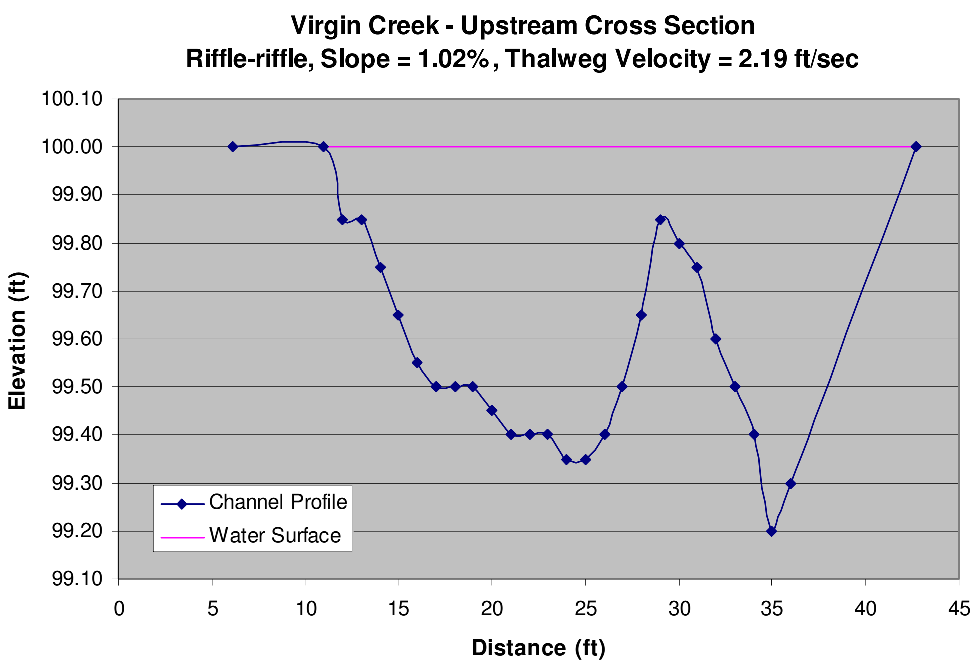
Virgin Creek (MP 89.1), Map 3

The upstream reach of Virgin Creek is 200 ft in length and extends from the centerline of the Virgin Creek highway bridge beyond an old rip-rap dam located approximately 125 ft upstream of the bridge. The downstream reach extends downstream from the centerline of the highway and parallels the highway for 817 ft before bearing southwest and flowing into Turnagain Arm. Both reaches are tidally influenced and are bordered predominantly by estuarine grasses. Bank heights range between 6-8 ft and banks are characterized by sand and silt soils. Cross section photos are available in Appendix B.

The channel gradient ranges from 1.02% at the upstream reach to 0.32% at the downstream reach. The reaches are characterized by a range of habitats. The upstream reach is a Narrow Large Substrate Estuarine (ES3) channel-type while the downstream reach is a Silt Substrate Estuarine Channel or Slough (ES1) channel-type (Table 4). The upstream cross section shown in Figure 6 is located in a Riffle-riffle fastwater habitat approximately 100 ft upstream of the Virgin Creek Bridge. The downstream cross section shown in Figure 7 is located in Glide-glide habitat approximately 100 ft downstream of the Virgin Creek Bridge.

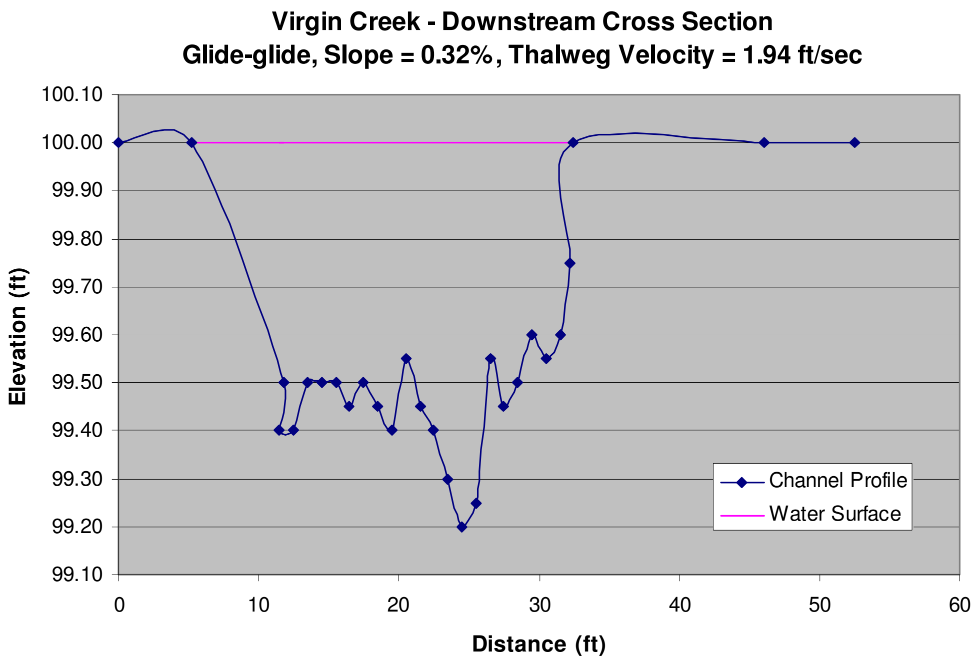
Flow velocities were measured and pebble counts were conducted in both the upstream and downstream cross sections. Upstream velocity averaged 1.40 ft/sec with a discharge of 18.8 cfs. Dominant substrate in this reach was very coarse gravel (32 – 63.9 mm) (Figure 8). At the downstream cross section stream velocity averaged 1.70 ft/sec and discharge was 20.6 cfs. Dominant substrate was sand and silt (0–2 mm, Figure 9). Stream geomorphology characteristics for study cross sections in Virgin Creek are summarized in Table 8.

No fish passage barriers were present in the Virgin Creek reach and both adult pink salmon and Dolly Varden were observed in the study reach during the 2007 survey. Adult fish presence is discussed in more detail in the Freshwater Fish Assessment Report for the Project (HDR Alaska, 2007b).



Note: Elevation is relative to a randomly selected datum.

Figure 6. Upstream Cross Section of Virgin Creek



Note: Elevation is relative to a randomly selected datum.

Figure 7. Downstream Cross Section of Virgin Creek

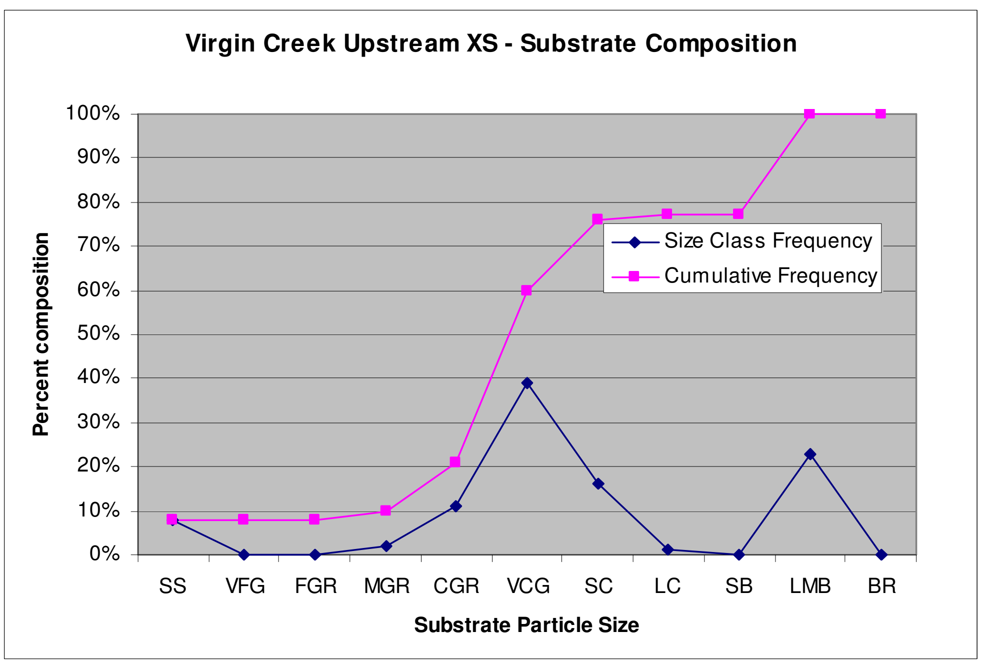


Figure 8. Virgin Creek Upstream Cross Section Substrate Composition

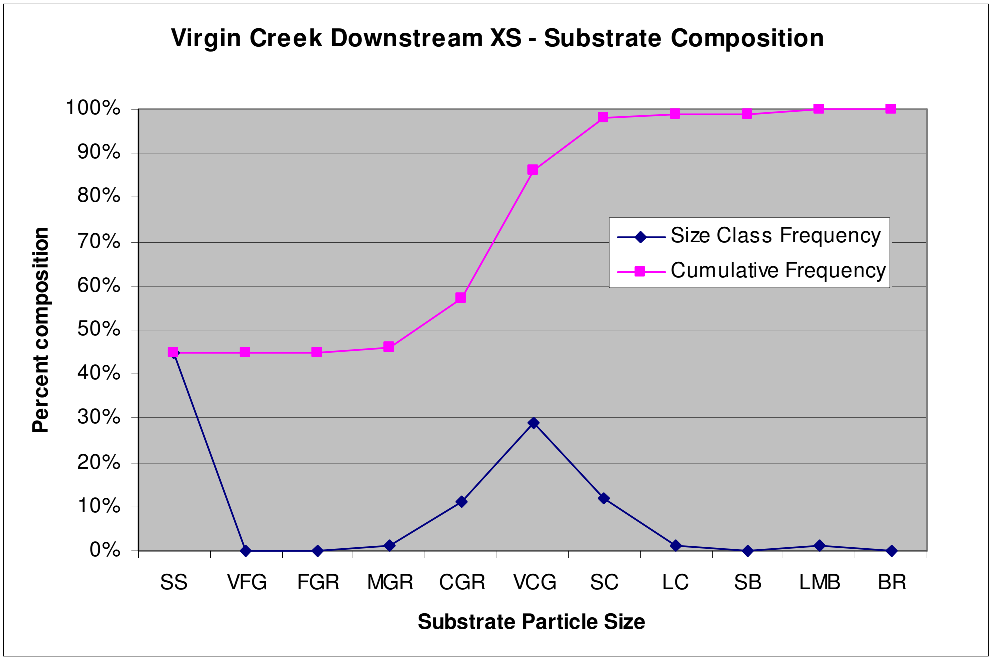


Figure 9. Virgin Creek Downstream Cross Section Substrate Composition

The Virgin Creek reaches are characterized primarily by fastwater habitats including Riffle-riffle and Glide-glide habitats with a small Pool-scour habitat unit (471 ft^2) occurring in the upstream reach immediately below the above-mentioned rip-rap dam (Figure 10; Appendix A-Map 3). Neither reach contained large wood and no undercut banks were observed during the 2007 survey. Wooden posts in the rip rap structure located in the upstream reach were not counted as large wood.

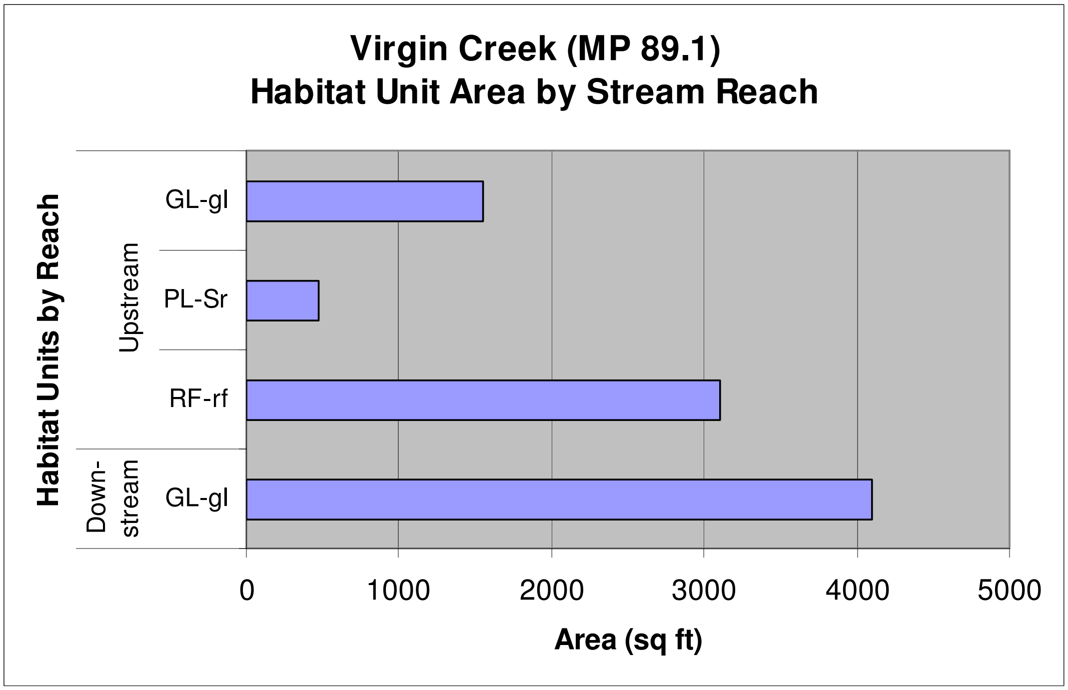
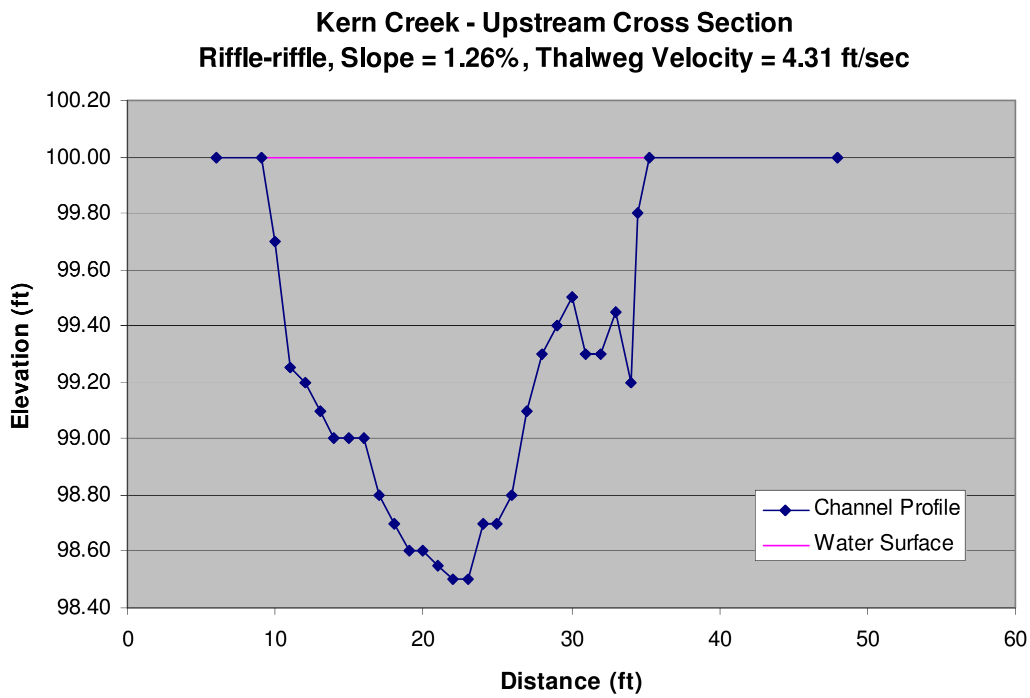


Figure 10. Virgin Creek Habitat by Stream Reach

Kern Creek (MP 86.3), Map 4

The upstream reach of Kern Creek is located immediately upstream of two culverts that run adjacent to each other beneath the Seward Highway and Alaska Railroad. The culverts are each 120 inches in diameter and the bottoms of the culverts are almost completely eroded. The reach extends 200 ft from the upstream end of the two culverts. The reach is tidally influenced and is bordered primarily by willow, cottonwood, and some spruce. Left bank height measured 4.5 ft and right bank height measured 1.5 ft. Cross section photos are available in Appendix B. The downstream end of the highway culverts flow directly into Turnagain Arm; therefore, no downstream reach of Kern Creek was surveyed as part of this study.

The upstream cross section is located in a Riffle-riffle fastwater habitat approximately 75 ft upstream of the previously described culverts (Figure 11). The channel gradient is 1.26% and the reach is predominantly characterized by fastwater habitats with a small pool located immediately above the two culverts. The reach is a Moderate Width Mixed Control (MM2) channel-type (Table 4).



Note: Elevation is relative to a randomly selected datum.

Figure 11. Cross Section of Kern Creek at upstream reach

Flow velocities averaged 2.0 ft/sec and discharge was 61.9 cfs at the upstream cross section. Pebble counts using a boot tip survey were conducted at each cross section site; dominant substrate in this reach is very coarse gravel (32 – 63.9 mm) (Figure 12). Stream geomorphology characteristics for the study cross section in Kern Creek are summarized in Table 8.

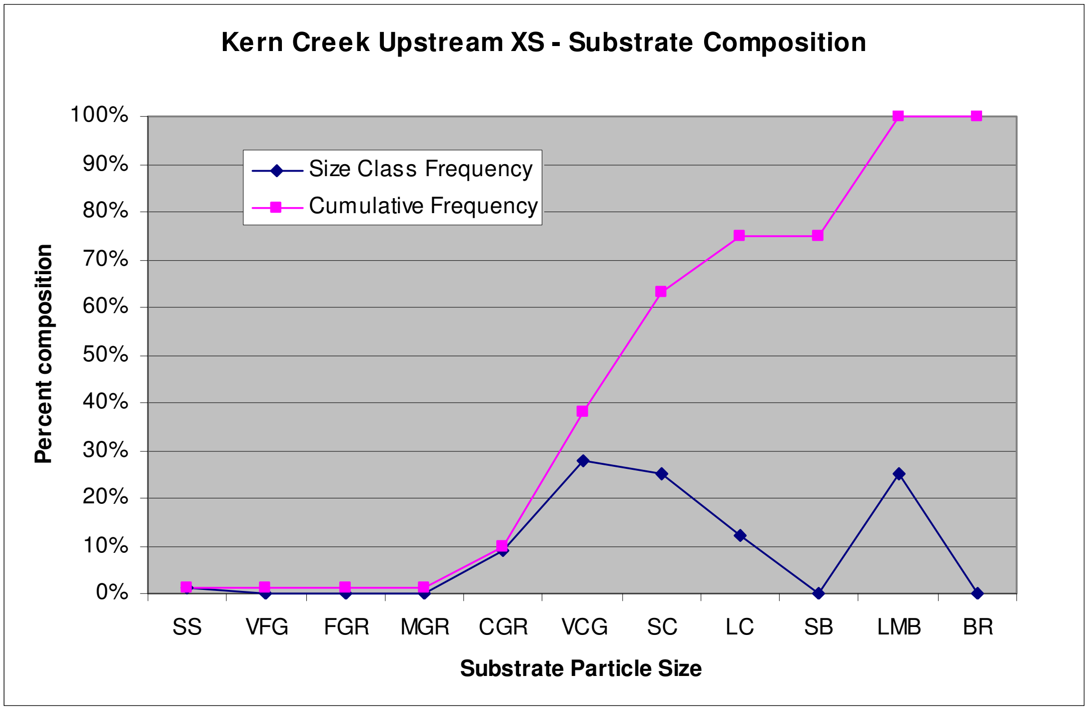


Figure 12. Kern Creek Upstream Cross Section Substrate Composition

Except during very high tide conditions culverts located under the rail road line cause a fish passage barrier in Kern Creek. However, adult Dolly Varden and adult pink salmon were observed in the study reach during 2007 spawning surveys. A series of pools and waterfalls are located a couple hundred yards upstream of the study reach. The stream gradient increases beyond this point and the combination of these factors may serve as a seasonal or permanent fish passage barrier. Juvenile and adult fish presence is discussed in more detail in the Freshwater Fish Assessment Report for the Project (HDR Alaska, 2007b).

Based on the data collected, the Kern Creek reach is characterized primarily by a continuous Riffle-riffle habitat unit with a single Pool-scour unit (293 ft^2) located immediately upstream of the highway and railroad culverts (Figure 13; Appendix A-Map 4).

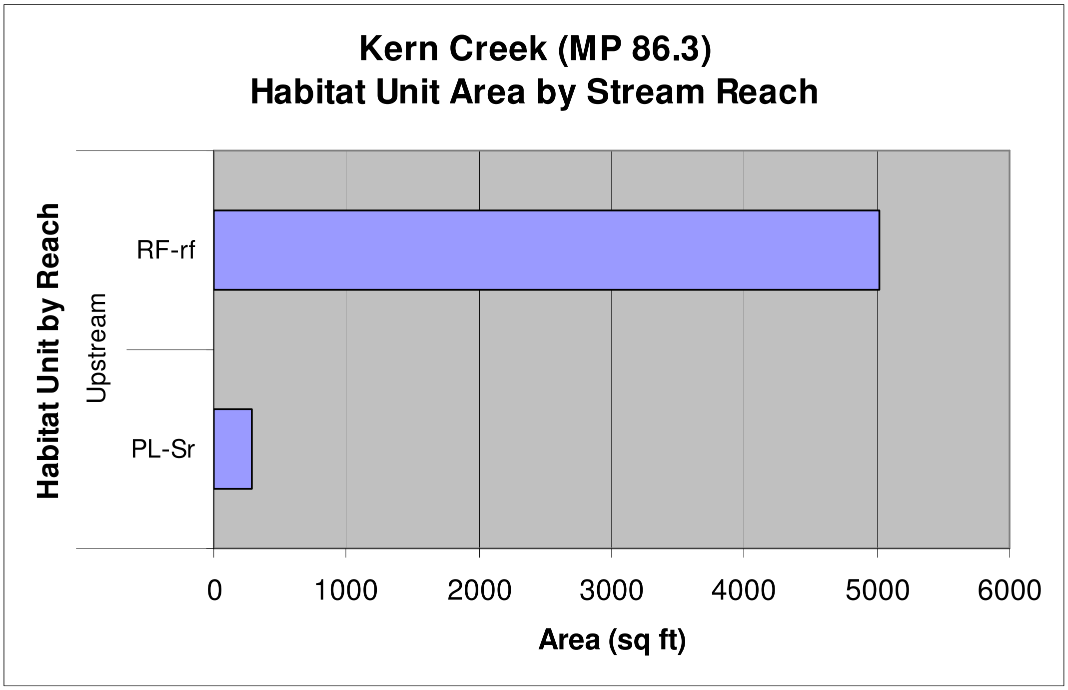


Figure 13. Kern Creek Habitat by Stream Reach

The upstream reach contained a substantial amount of large wood including two large wood clusters each containing 5-9 pieces (Figure 14). The relatively high amount of large wood in the upstream reach is likely a result of tidal influence terminating within the upstream reach as well as the presence of pilings immediately upstream of the railroad/highway culverts. The pilings have contributed to the development of a fairly deep pool (Maximum depth=3.5 ft) upstream of the culverts and the retention of large wood at the head of the pool. No undercut banks were observed during the 2007 survey.

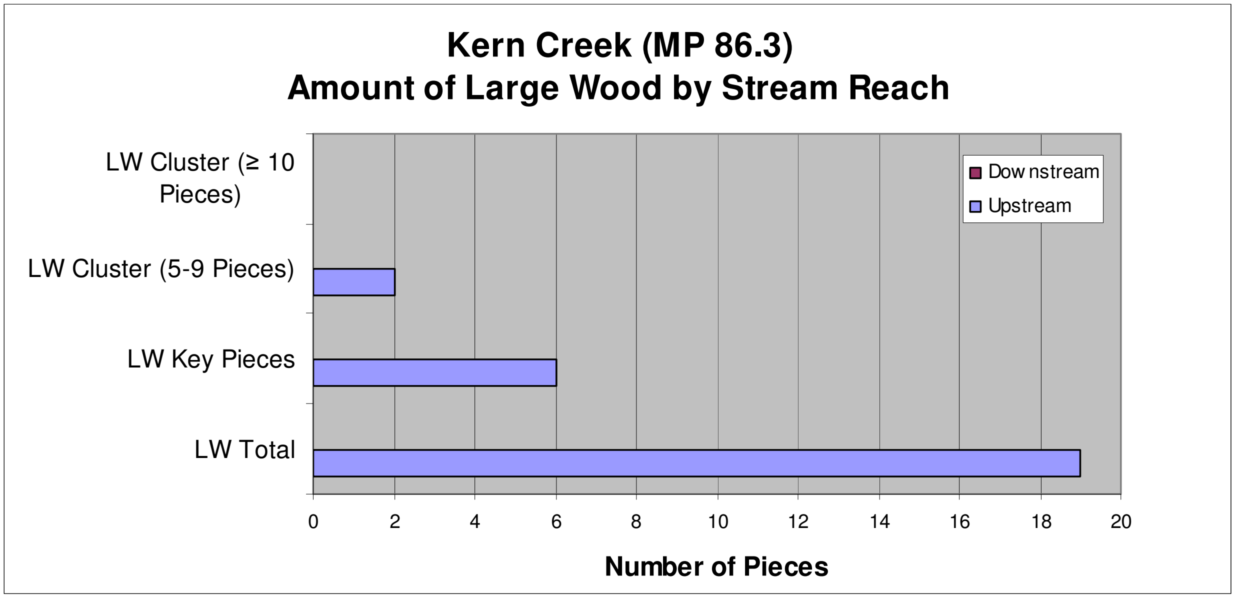


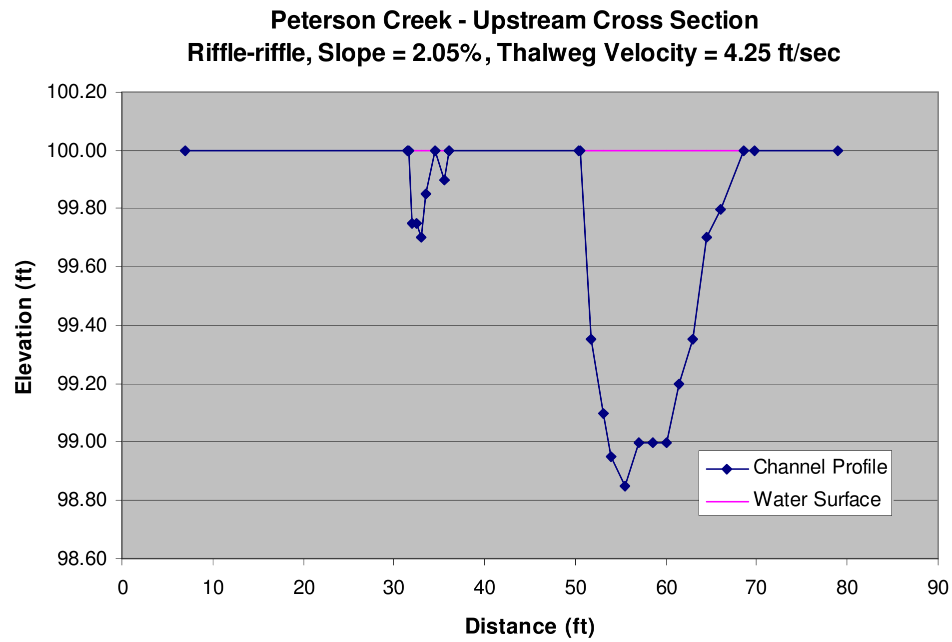
Figure 14. Kern Creek – Amount of Large Wood by Stream Reach

Peterson Creek (MP 84.1), Map 5

The up- and downstream reaches of Peterson Creek each extend 200 ft from the centerline of the Peterson Creek highway bridge. The upstream reach of Peterson Creek extends to the railroad trestle located approximately 200 ft upstream of the Peterson Creek Bridge with riparian vegetation consisting of willows and alders. The downstream reach extends to Turnagain Arm and is bordered by estuarine grasses. Both reaches are tidally influenced and streambank heights are ~1 ft in both the up- and downstream reaches. Cross section photos are available in Appendix B.

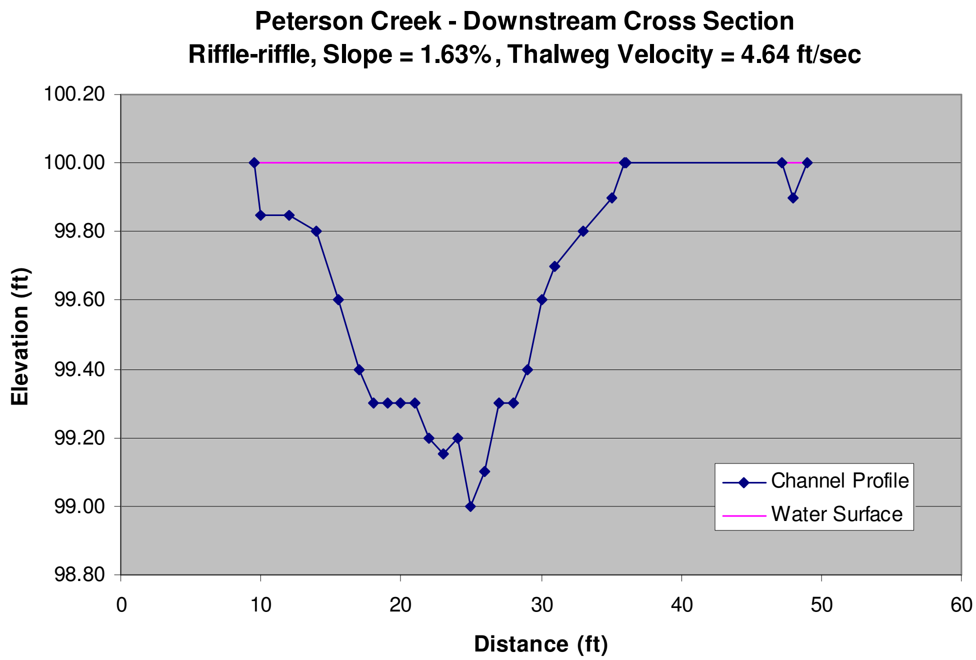
The channel gradient ranges from 2.05% at the upstream reach to 1.63% at the downstream reach. The reaches are characterized by Riffle-riffle habitat. The upstream and downstream reaches are Narrow Small Substrate Estuarine (ES3) channel-types (Table 4). The upstream cross section shown in Figure 15 is located in a Riffle-riffle fastwater habitat approximately 100 ft upstream of the Peterson Creek Bridge. The downstream cross section shown in Figure 16 is located in Riffle-riffle habitat approximately 100 ft downstream of the Peterson Creek Bridge.

Flow velocities and substrate were measured in both the upstream and downstream cross sections. Stream velocity averaged 1.9 ft/sec with a discharge of 41.7 cfs at the upstream cross section. Dominant substrate in this reach was very coarse gravel (32 – 63.9 mm) (Figure 17). Velocity averaged 2.3 ft/sec and discharge was 42.1 cfs at the downstream cross section. Dominant substrate in this reach was coarse gravel (16 – 31.9 mm) (Figure 18). Stream geomorphology characteristics for study cross sections in Peterson Creek are summarized in Table 8.



Note: Elevation is relative to a randomly selected datum.

Figure 15. Cross Section of Peterson Creek at upstream reach



Note: Elevation is relative to a randomly selected datum.

Figure 16. Cross Section of Peterson Creek at downstream reach

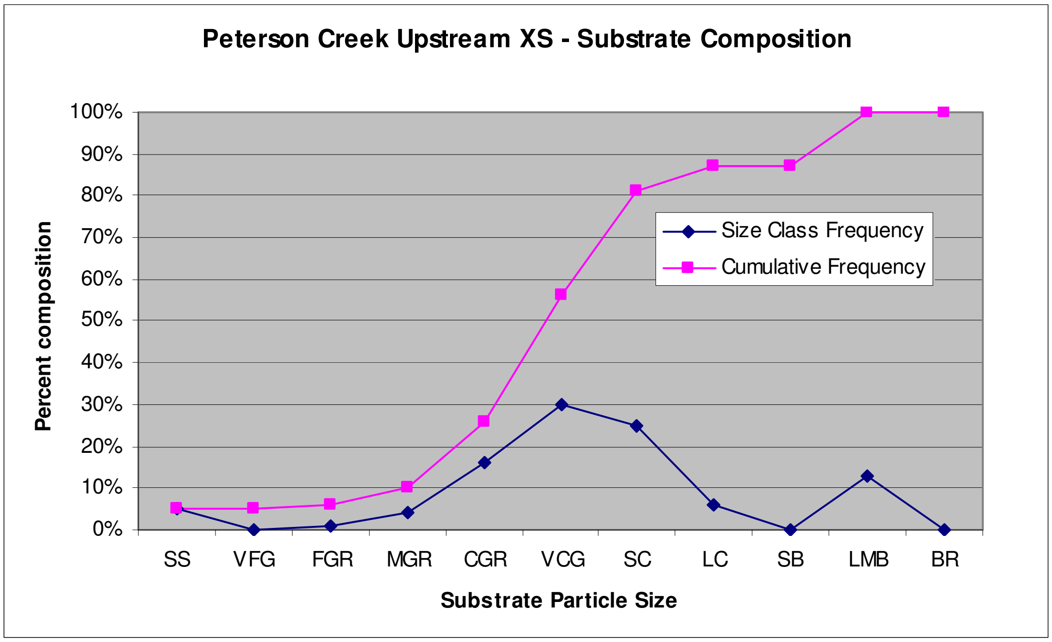


Figure 17. Peterson Creek Upstream Cross Section Substrate Composition

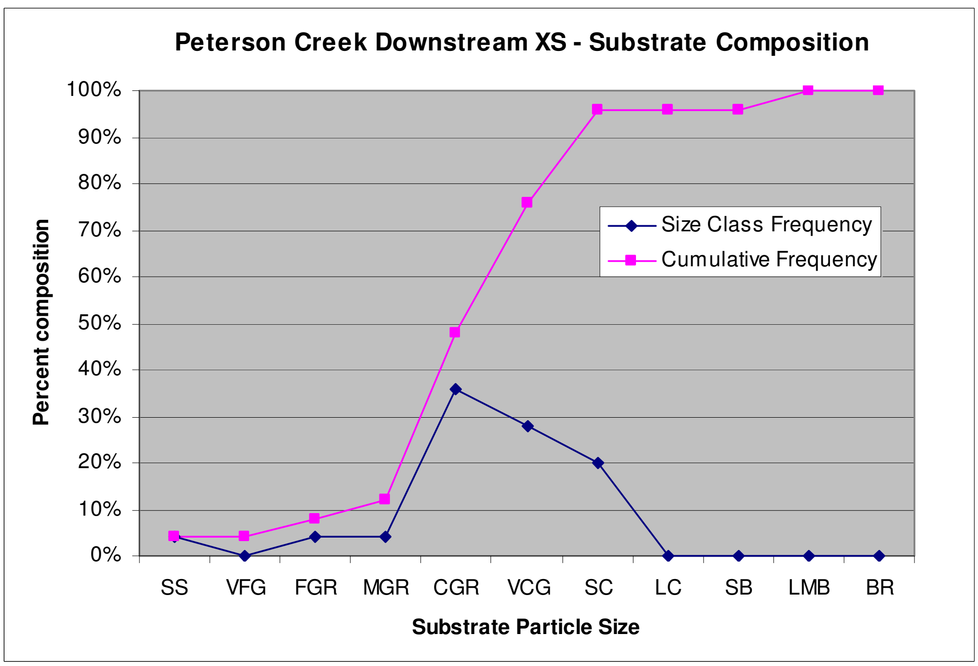


Figure 18. Peterson Creek Downstream Cross Section Substrate Composition

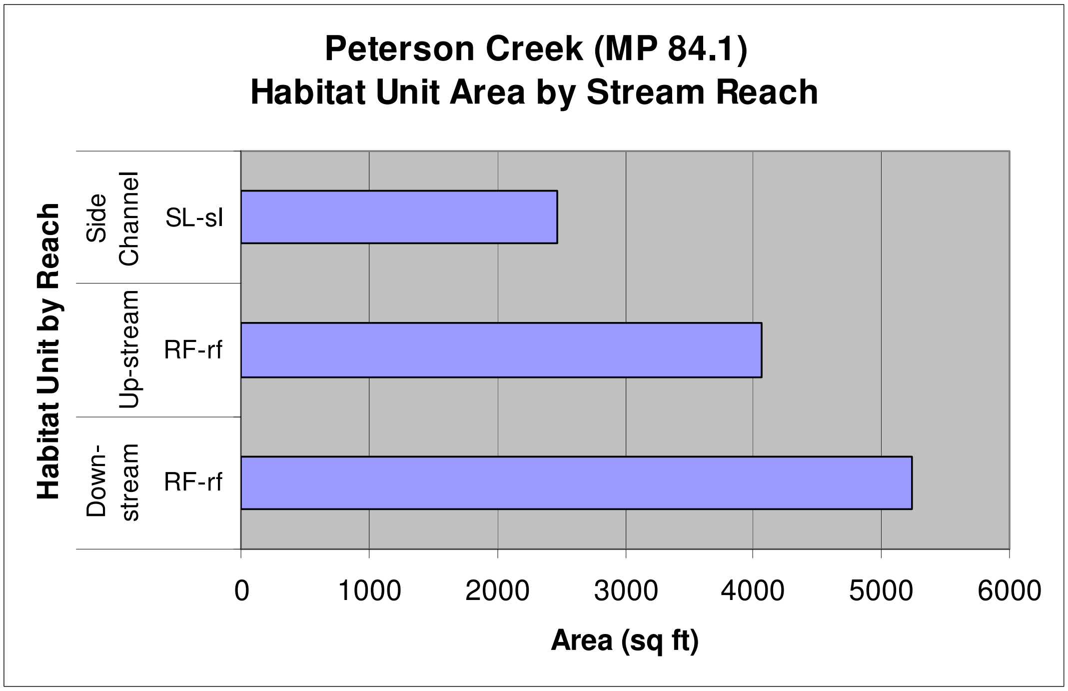


Figure 19. Peterson Creek Habitat by Stream Reach

No fish passage barriers were present in the Peterson Creek reach; however, no salmonid species were observed during the 2007 survey. Juvenile and adult fish presence is discussed in more detail in the Freshwater Fish Assessment Report for the Project (HDR Alaska, 2007b).

Based on the data collected, the Peterson Creek reaches are characterized entirely by Riffle-riffle fastwater habitats. A small tributary flowing into Peterson Creek from the southeast immediately above the Peterson Creek bridge and parallel to the Seward Highway. The tributary provides over 2000 ft^2 of Slough-slough habitat (Figure 19, Appendix A, Map 5). The slough is tidally-influenced and therefore the length of the channel is variable. At the time of the survey, the linear extent of continuous water in the tributary was 616 ft; however, intermittent pools are present throughout the total channel length (>2750 ft) and stickleback were observed in several of these small pools during the survey event. This suggests that the entire channel intermittently contains continuous flow.

The upstream reach contained a greater amount of large wood than the downstream reach (Figure 20). The greater amount of large wood in the upstream reach is likely a result of tidal influence terminating within the upstream reach. No undercut banks were observed during the 2007 survey.

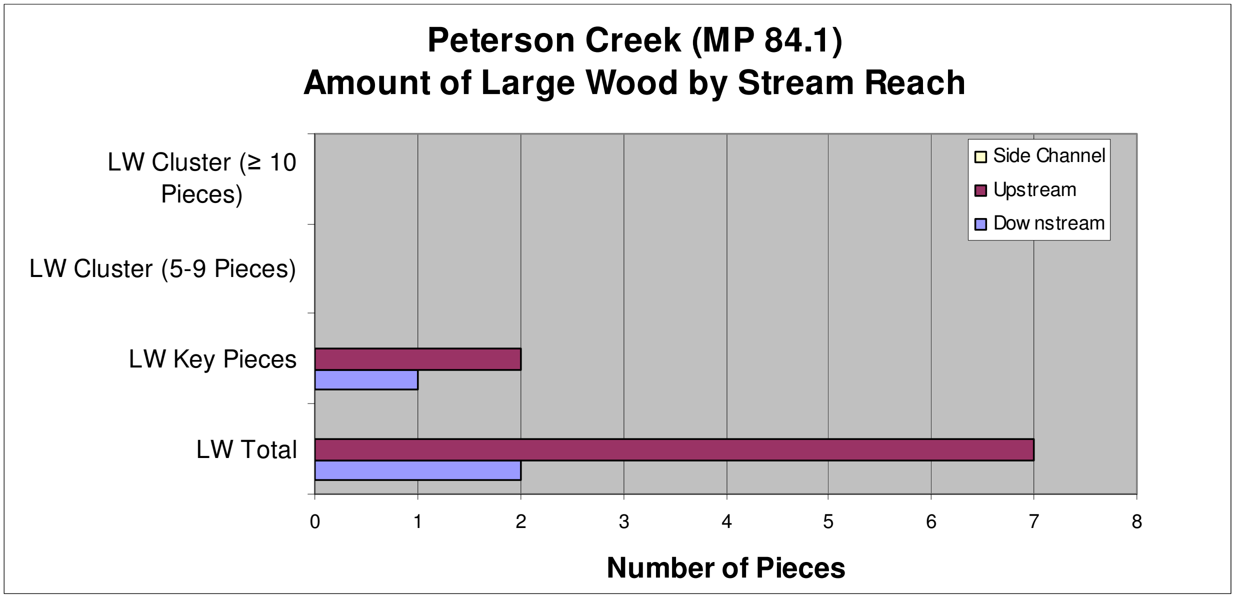


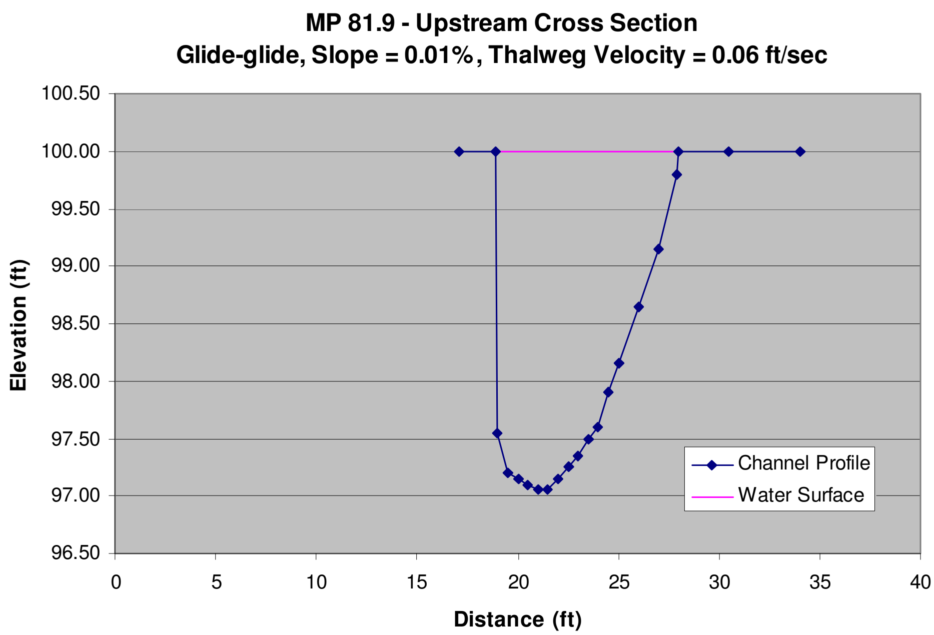
Figure 20. Peterson Creek – Amount of Large Wood by Stream Reach

MP 81.9 (Unnamed Stream), Map 6

The upstream reach of the unnamed stream located at MP 81.9 extends 200 ft from the upstream end of the Seward Highway culvert (diameter=72-inches). The reach is tidally influenced and is bordered primarily by estuarine grasses. The left bank of the cross section measures ~2.5 ft and the right bank measures ~3 ft. Cross section photos are available in Appendix B. The downstream end of the highway culvert flows directly into Turnagain Arm; therefore, no downstream reach of MP 81.9 was surveyed as part of this study.

The upstream reach is characterized by a range of habitats and has a channel gradient of 0.01%. The reach is a Narrow Small Substrate Estuarine (ES2) channel-type (Table 4). The upstream cross section shown in Figure 21 is located in a Glide-glide fastwater habitat approximately 100 ft upstream of the highway culvert. Velocity averaged 0.1 ft/sec and discharge was 1.0 cfs at the upstream cross section. Dominant substrate in this reach was sand and silt (0–2 mm; Figure 22). Stream geomorphology characteristics for the study cross section in the unnamed creek at MP 81.9 are summarized in Table 8.

No fish passage barriers were present in the MP 81.9 reach; however, no adult salmonid species were observed in the study reach during the 2007 survey. Juvenile and adult fish presence is discussed in more detail in the Freshwater Fish Assessment Report for the Project (HDR Alaska, 2007b). Based on the data collected, the MP 81.9 reach is characterized by a variety of habitats with 1655 ft^2 of backwater pool and 1605 ft^2 of glide representing the dominant habitats (Figure 23; Appendix A-Map 6). No large wood or undercut banks were observed during the 2007 survey.



Note: Elevation is relative to a randomly selected datum.

Figure 21. Cross Section of MP 81.9 at upstream reach

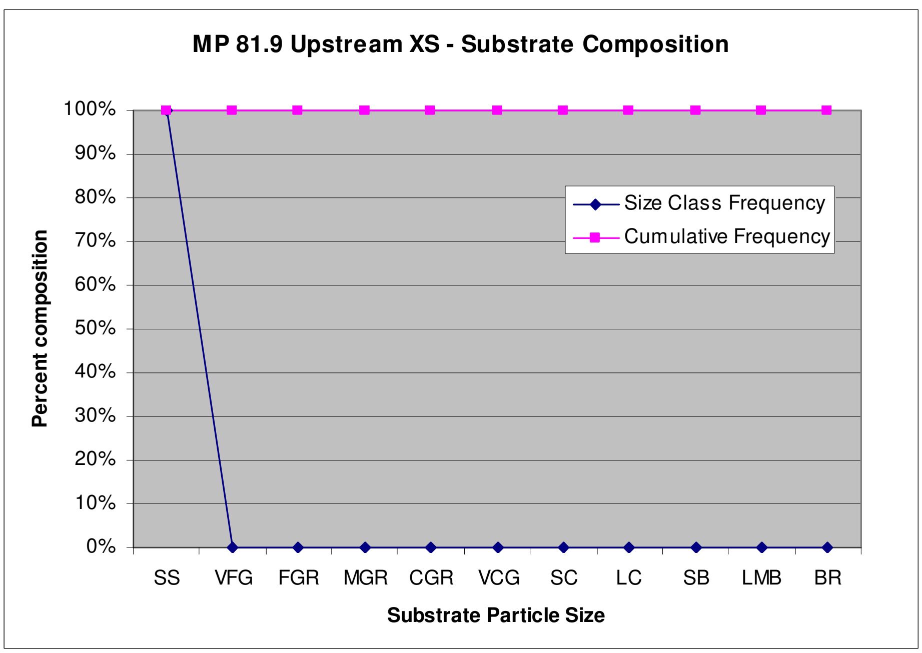


Figure 22. MP 81.9 Upstream Cross Section Substrate Composition

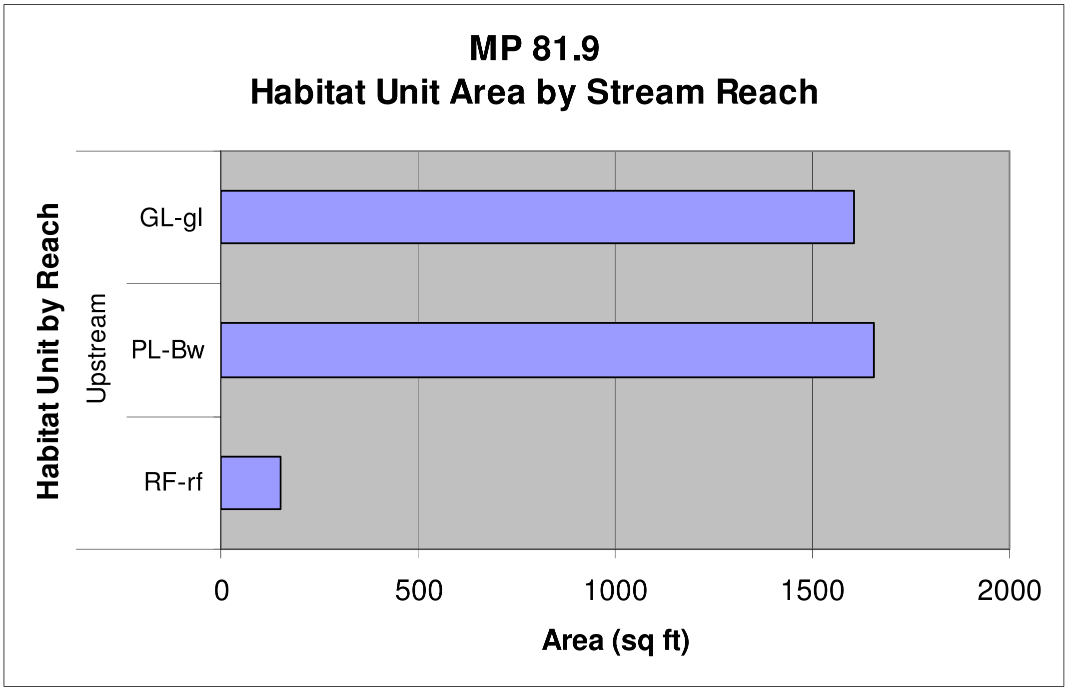


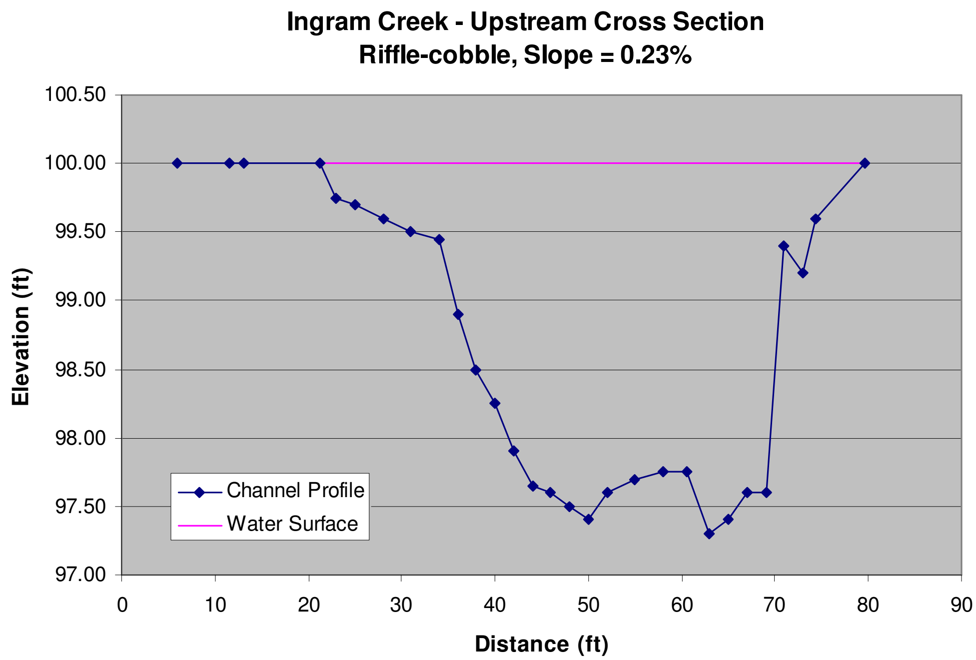
Figure 23. MP 81.9 Habitat by Stream Reach

Ingram Creek (MP 75.2), Map 7

The up- and downstream reaches of Ingram Creek each extend 200 ft from the centerline of the Ingram Creek highway bridge. The upstream reach of Ingram Creek extends beyond an old concrete bridge footing located approximately 140 ft upstream of the Ingram Creek Bridge. Both reaches are tidally influenced and are bordered by willow and alders. Bank heights range between 1-2 ft except in isolated locations along the right bank of the upstream reach where rip-rap materials have been added and bank height exceeds 4 ft. Cross section photos are available in Appendix B.

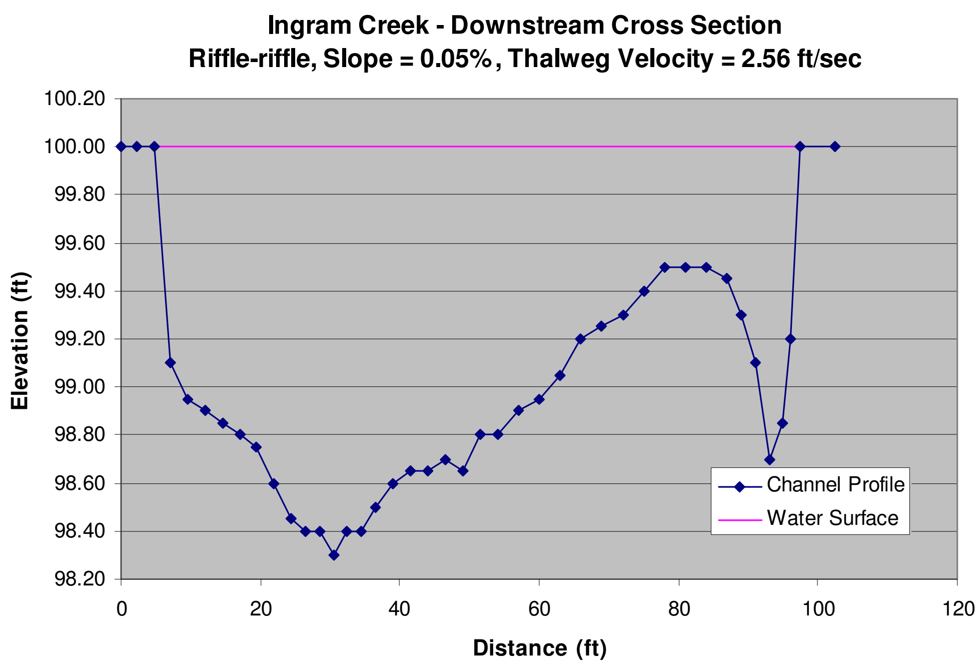
The channel gradient ranges from 0.05% at the downstream reach to 0.23% at the upstream reach. The reaches are characterized by a range of habitats. The upstream reach is a Narrow Large Substrate Estuarine (ES3) channel-type while the downstream reach is a Large Estuarine (ES4) channel-type (Table 4).

The upstream cross section shown in Figure 24 is located in a Riffle-cobble fastwater habitat approximately 75 ft upstream of the Ingram Creek Bridge. The downstream cross section shown in Figure 25 is located in Riffle-riffle habitat approximately 150 ft downstream of the Ingram Creek Bridge.



Note: Elevation is relative to a randomly selected datum.

Figure 24. Cross Section of Ingram Creek at upstream reach



Note: Elevation is relative to a randomly selected datum.

Figure 25. Cross Section of Ingram Creek at upstream reach

Flow velocities and pebble counts were only conducted in the downstream cross section due to unsafe depths and flow in the upstream cross section. Velocity averaged 1.9 ft/sec and discharge was 206.3 cfs at the downstream cross section. Dominant substrate in this reach was coarse gravel (16–31.9 mm) (Figure 26). Stream geomorphology characteristics for study cross sections in Ingram Creek are summarized in Table 8.

No fish passage barriers were present in the Ingram Creek reaches and both adult Dolly Varden and pink salmon were observed in the study reach during the 2007 survey. Juvenile and adult fish presence is discussed in more detail in the Freshwater Fish Assessment Report for the Project (HDR Alaska, 2007b).

Based on the data collected, the Ingram Creek reaches are characterized primarily by fastwater habitats including Riffle-riffle and Riffle-cobble units. One Pool-scour unit (1320 ft^2) does occur in the upstream reach immediately above the above-mentioned old concrete bridge footing and a side channel (commonly referred to as Ingram Slough) that flows into the creek at this location. The side channel is characterized by Pool-backwater habitat (Figure 27; Appendix A-Map 7).

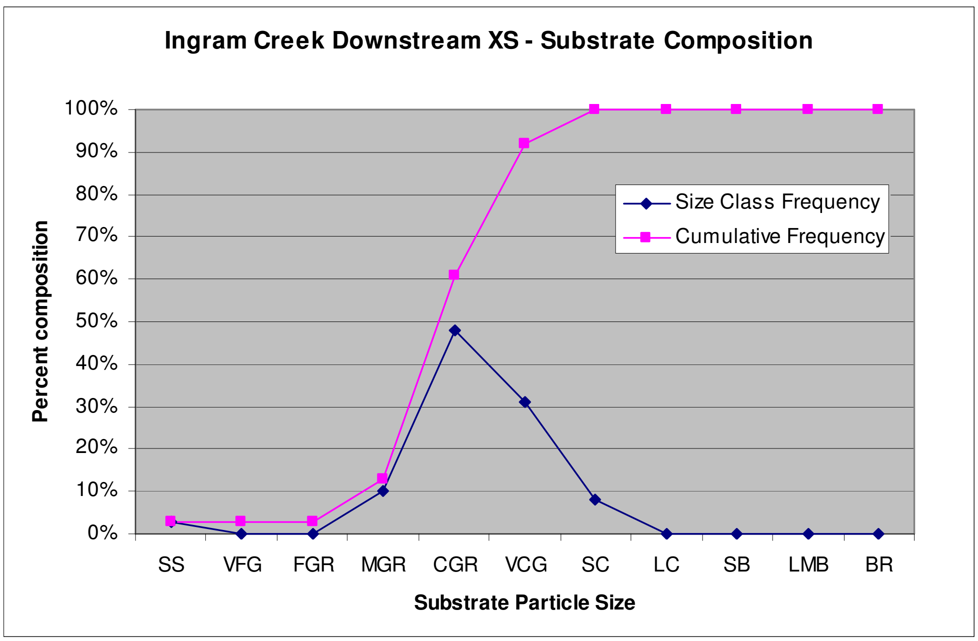


Figure 26. Ingram Creek Downstream Cross Section Substrate Composition

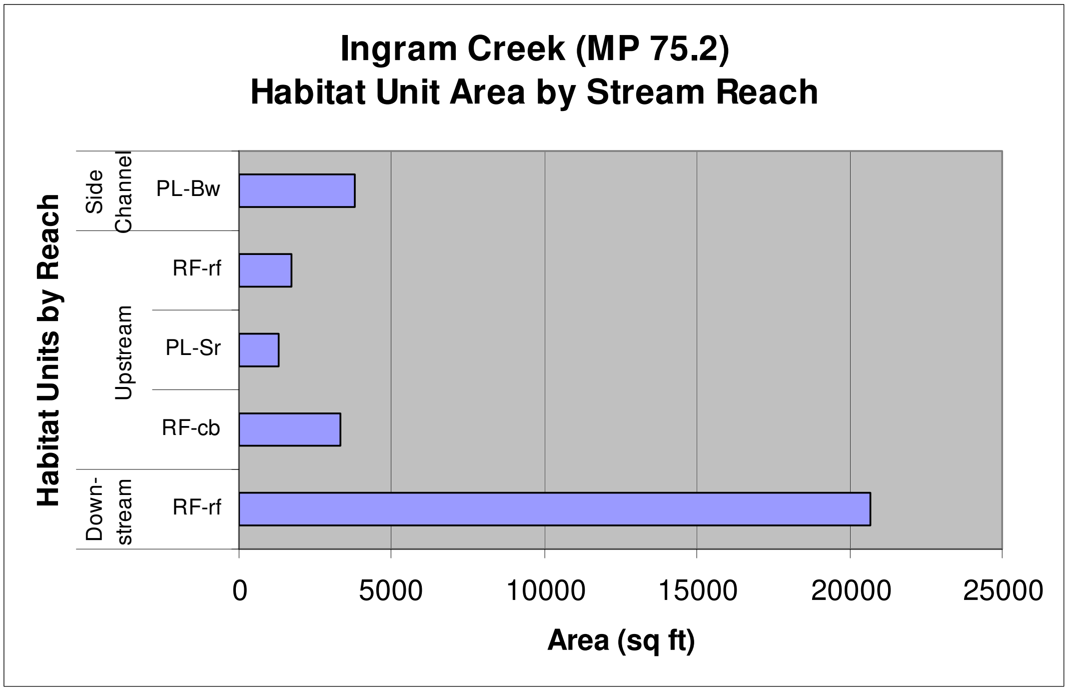


Figure 27. Kern Creek Habitat by Stream Reach

All reaches contained LWD with the majority of LWD occurring in the downstream reach (Figure 28). The higher amount of LWD in the downstream reach is likely a tidal influence terminating within the downstream reach except during the particularly high tides. No undercut banks were observed during the 2007 survey.

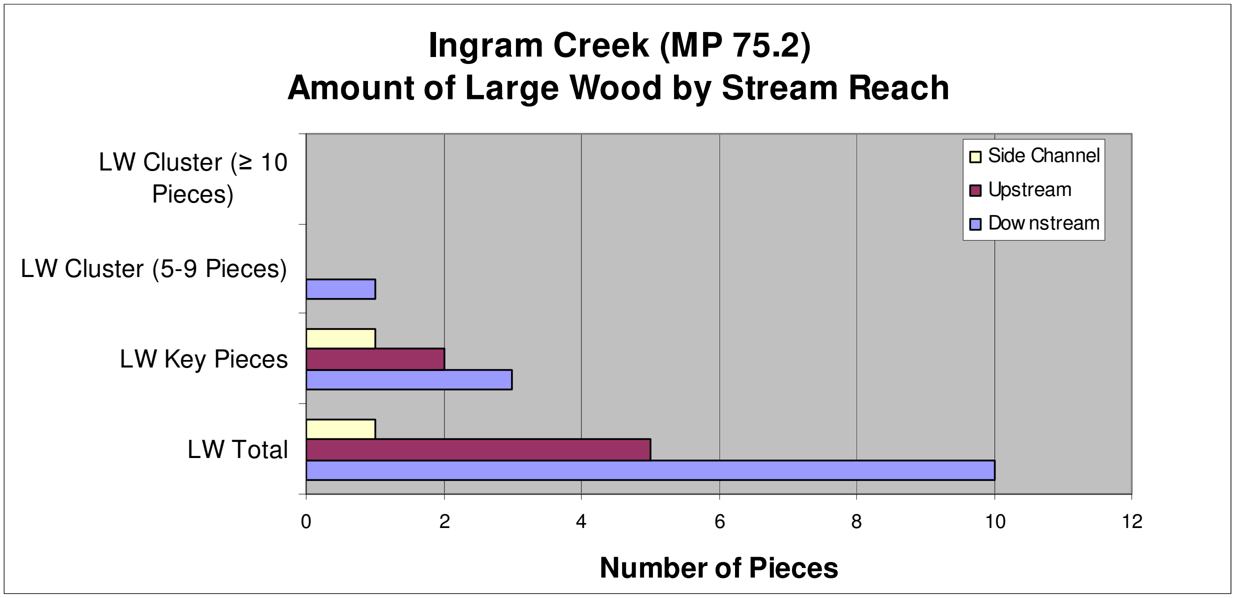


Figure 28. Ingram Creek Large Wood by Stream Reach

RESULTS

Habitat Comparisons

Overall, the six streams that were surveyed as part of this report are dominated by fastwater habitats (e.g., Riffle-cobble and Riffle-riffle) with small, discrete pool habitat units located in several of the streams. Spawning substrate for trout and salmon ideally ranges between 13 and 100 mm (USFS, 2002). With the exception of the downstream reach of Virgin Creek and the upstream reach of MP 81.9, substrate at all reaches fell within this optimal substrate particle size range.

Adult Fish Migration Barrier Assessment

Based on the criteria provided in Table 7, there are no adult fish migration barriers located within the study reaches. Salmonid fish species, including coho, sockeye, Chinook, chum and Dolly Varden, are all present in the Turnagain Arm and, given the right conditions, any of these fish species could migrate up study streams located within the Project Area. Among these fish species, the most stringent fish migration blockage criteria apply to Dolly Varden and it is reasonable to assume that based on the criteria given in Table 7, if a potential blockage is passable to Dolly Varden, then other salmonids will also be able to traverse the potential blockage.

Potential fish blockages do exist immediately upstream of the Kern Creek reach and stream gradients increase above this point. Culverts are also located downstream of the Kern Creek and MP 81.9 reaches. The bottoms of both sets of culverts are eroded with the bottom of the two culverts at Kern Creek being almost completely eroded. The deterioration of the culvert bottoms may serve as an impediment to fish passage.

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APPENDIX A
Maps

APPENDIX B
Study Site Habitat Photos

APPENDIX C
Field Data Forms