

**Fish Relocation, Willow Creek
Former Unocal/Chevron Edmonds Terminal Site
Edmonds, WA**

On August 13 and 14, 2008 fish were removed and relocated from a 430 foot section of Willow Creek, a small tributary (approximately 10 ft wide) of Puget Sound at the Chevron Edmonds Terminal Site located in Edmonds, Washington. This low-gradient section of stream is being remediated due to the presence of petroleum hydrocarbons in fine-grained sediments (primarily silt and sand) (ARCADIS, 2008). Prior to remedial activities, two coffer dams were constructed at the upstream and downstream ends of the area to minimize flow from the incoming tide and upstream salt marsh (Edmonds Marsh). Pumps were used to route the upstream flow around the remediation area, as well as to pump saltwater from downstream into the salt marsh. Pumps were also used in between the dams to lower the water level to an average of 1 to 2 feet to increase fish removal efficiency. Backpack electrofishing units were initially used, followed by seining techniques to capture live fish and relocate them either upstream or downstream of the dams in Willow Creek. In total, approximately 5,565 live fish were captured and relocated during the removal effort (Table 1). Of these, 5,562 were threespine stickleback (*Gasterosteus aculeatus*; about 1 to 2.5" long), two were prickly sculpin (*Cottus asper*; each about 7" long), and one was a starry flounder (*Platichthys stellatus*; about 3" long). No threatened or endangered (T/E) fish species, including salmonids, were observed. Details of the fish relocation effort are provided below. Photographs of the removal effort are contained in Attachment 1.

Water conductivity was measured prior to fish removal to determine the potential effectiveness of electrofishing. General water quality parameters (temperature, pH, dissolved oxygen, turbidity, ORP) were also measured to determine the comparability of conditions between the remediation area and the relocation release points (Table 2). In general, water quality was similar between the dams and the release areas immediately upstream or downstream of the dams. However, conductivity readings generally indicated salinity was too high for effective electrofishing (i.e., conductivity ranged from 2.9 to 12.5 mS/cm³; backpack electrofishing equipment typically operates in the range of 0.01 to 1.5 mS/cm³). Regardless, one complete pass of the remediation area between the dams was conducted using two backpack electrofishing units following the setting guidelines in NMFS (2000). This was done because: 1) Electrofishing is considered to be one of the most effective sampling techniques for capturing live fish; 2) the Washington Department of Ecology (DOE) requested fishery biologists trained in electrofishing conduct the removal; and 3) initial salinity readings taken during low-tide, when freshwater inputs were greatest from upstream, were close to the operating range of the equipment. The electrofishing effort, however, did not produce any fish. Fish were observed in the vicinity of the equipment, but were not stunned, presumably due to the high conductivity of the water (i.e., the electrical current dissipated at the anodes and did not produce an effective field).

Because electrofishing was not successful, fish were captured and removed from the remediation area using seining techniques. Prior to seining, two 1/4" mesh block nets were set up between the dams to prevent fish movement, effectively dividing the area into thirds. Block nets were also placed at the upstream and downstream coffer dams to keep fish away from the pump and discharge areas. Fish were removed from each of the three sections (upper, middle, and lower) using a 10 ft wide x 4 ft high seine with 1/8" mesh, working from one end to the other, trapping fish against the block nets. At least three, and up to five passes per day of each section were conducted to remove as many fish as possible (Table 1). Special care was taken to look for any potential T/E species, especially salmonids. Once captured, fish were removed from the seine, counted, then placed in a bucket with site water and an aerator, and transported to a suitable release site either upstream or downstream of the coffer dams. Care was taken to minimize

handling of, and stress to the fish. Water in the buckets from the capture location was mixed with water from the release location, and the fish were given time to acclimate prior to release. With the exception of a few sticklebacks that were stunted, all fish captured and released appeared to be in good condition. Very few mortalities (<1 % stickleback) were observed during the relocation.

The results of the fish removal effort show that approximately 82% of the fish were relocated on the first day (18% on the second day; Table 1). On August 13, 2008 approximately 4,549 fish were captured and moved. Two of these were prickly sculpin (7" long), one was a starry flounder (3" long), and the rest were threespine stickleback (1 to 2.5" long). On the second day, August 14, 2008 approximately 1,016 fish were captured and moved. All were threespine stickleback of similar size. In total approximately 5,565 live fish were relocated (5,562 stickleback, two sculpin, and one flounder). No T/E fish species, including salmonids, or other aquatic organisms, such as mussels, clams, or crustaceans were observed during the removal effort, or during the oversight provided on August 12, 15, and 18, 2008. In comparing the catch rate from the highest first seine pass to the lowest last seine pass in each of the three sections (upper, middle, and lower), the catch rate decreased from 650 to 17 fish in the upper section (2.6%), from 2,306 to 28 fish in the middle section (1.2%), and from 270 to 0 fish in the lower section (0%). This shows that catch rates dropped significantly indicating the majority of fish had been removed during the initial passes. Additionally, due to the high number of fish that were captured, it is unlikely that other fish species were present and went unnoticed during the relocation event. The low number of species observed in this section of Willow Creek may be due to habitat limitations such as little to no structure, channelization, homogenous silt and sand substrates, and low gradient.

References:

ARCADIS. 2008. Draft Project Manual. Chevron Environmental Management Company's Former Unocal Edmonds Bulk Fuel Terminal, Edmonds, WA. February.

NMFS. 2000. Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act. National Marine Fisheries Service. June.

Table 1
Fish Relocation Results, Willow Creek

Former Unocal Edmonds Bulk Fuel Terminal
11720 Unoco Road, Edmonds, WA

Removal Date	Section		Upper					Middle					Lower				
	Seine Pass		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
8/13/2008	Species	Threespine Stickleback	354	74	32	--	--	2306	780	220	--	--	270	390	120	--	--
		Prickly Sculpin											2				
		Starry Flounder											1				
8/14/2008	Species	Threespine Stickleback	650	32	86	28	17	17	49	43	56	28	10	0	0	--	--
		Prickly Sculpin															
		Starry Flounder															

Total Organisms: 5565

Notes:

1. The remediation area in Willow Creek was divided into three sections of similar size (upper, middle, and lower) by placing two block nets inbetween the coffer dams.

-- = no seine pass conducted

Table 2
Water Quality Measures, Willow Creek

Former Unocal Edmonds Bulk Fuel Terminal
11720 Unoco Road, Edmonds, WA

Measure Date	Location		Downstream		Remediation Area		Upstream	
	Tide		High	Low	High	Low	High	Low
8/12/2008	Parameter	Conductivity (mS/cm ³)	11.3	11.3	11.4	12.5	2.87	3.46
		Temperature (°C)	16.7	16.1	20.1	16.2	20.7	16.2
		pH	6.79	6.92	6.85	6.69	7.27	7.05
		Dissolved Oxygen (mg/L)	6.71	4.48	4.89	2.31	7.51	5.18
		Turbidity (NTU)	4.9	11.8	7.8	34.5	3.2	5.1
		ORP	135	127	185	108	218	177

Notes:

1. Water quality measurements were taken with a YSI 6920 multi-parameter water quality meter.
2. Water quality in the remediation area and upstream area was not as influenced by the tide due to the placement of the coffer dams.

mS/cm³ = milliSiemens per centimeter cubed

°C = degree Celsius

mg/L = milligrams per liter

NTU = nephelometric turbidity unit

ORP = oxidation reduction potential

Attachment 1
Fish Relocation Pictures, Willow Creek

Former Unocal/Chevron Edmonds Terminal Site
Edmonds, WA



Remediation Area



Backpack Electrofishing (Insert Picture)



Coffer Dam and Seining



Seining to Block Net



Seine Catch



Threespine Stickleback



Prickly Sculpin



Starry Flounder