FINAL
DATA REPORT

2006 FISH TISSUE SAMPLING AND CHEMICAL ANALYSIS IN THE LOWER DUWAMISH WATERWAY

Prepared by

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1 INTRODUCTION

This data report contains the results of the field collection effort and analytical chemistry results for the September 2006 fish tissue collection and chemical analysis in the Lower Duwamish Waterway (LDW). Shiner surfperch (*Cymatogaster aggregate*) and English sole (*Pleuronectes vetulus*) whole body fish samples were collected from the downstream portion of the LDW for tissue analysis of polychlorinated biphenyls (PCBs) as Aroclors, six phthalate organic compounds, and lipid and moisture content. Shiner surfperch and English sole tissues were analyzed as composite samples. A subset of English sole was also analyzed as individual whole body samples. Other fish species and invertebrates caught during the target fish collection effort were documented for the purpose of gathering information on the current biological communities.

The methods and analyses used in this study were consistent with previous work conducted by Windward Environmental L.L.C. (Windward), on behalf of the Lower Duwamish Waterway Group (LDWG)[1] and approved by the U.S. Environmental Protection Agency (USEPA) and Washington Department of Ecology (Ecology), and these data can be compared to data collected in the same area in past collection and analysis efforts. Detailed methods are provided in the Quality Assurance Project Plan (Anchor and King County 2006; QAPP). The fish tissue data collected provide information on the time-dependant response of tissue to dredging at the Duwamish/Diagonal Combined Sewer Overflow/Storm Drain (CSO/SD) cleanup site and on the effectiveness of the thin-layer placement in 2005 to reduce exposures to fish from PCB residuals (see Figure 1). The data are also suitable to track changes in PCB concentrations in sediment and tissue over time in the vicinity of the Duwamish/Diagonal CSO/SD cleanup site. The fish tissue data collected as part of this study will also complement 2006 sediment data collected as part of the monitoring of the Duwamish/Diagonal CSO/SD cleanup. The area sampled corresponds to Area T1 and its subareas, as shown in Figure 2.

The remainder of this report contains the following sections:

- Section 2 – Sample Methods Overview
- Section 3 – Laboratory Methods Overview
- Section 4 – Results
- Section 5 – Data Validation Summary

[1] The LDWG includes King County, the City of Seattle, the Port of Seattle, and the Boeing Company.

In addition, the report text is augmented with the following appendices:

- Appendix A – Field Forms and Field Notes
- Appendix B – Location Control Data
- Appendix C – Chain-of Custody and Sample Processing Forms
- Appendix D – Laboratory Data Report
- Appendix E – Data Validation Report

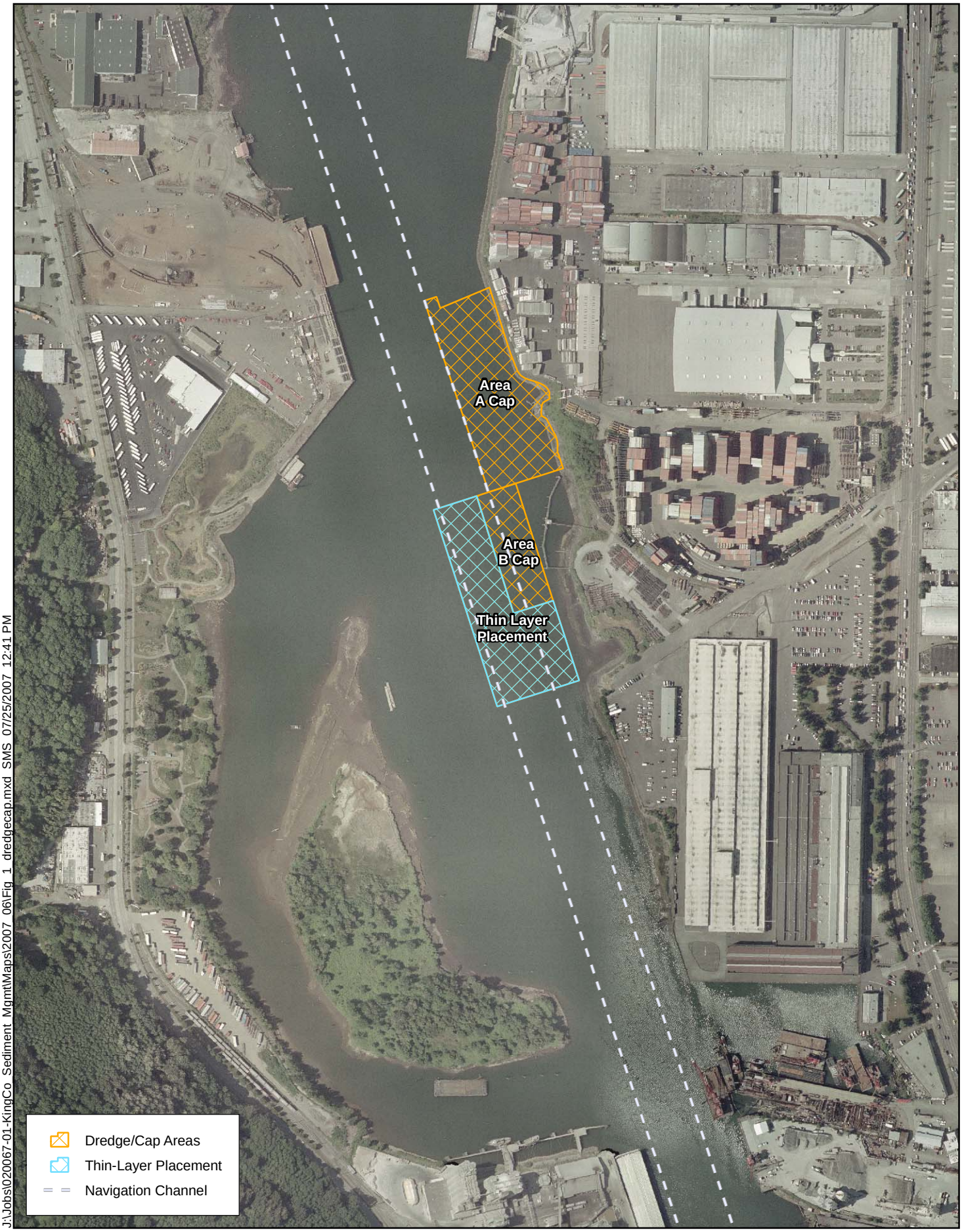

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Figure 1
2004 and 2005 Remedial Actions at the Dredging and Capping Areas of the Duwamish/Diagonal Combined Sewer Overflow/Storm Drain Cleanup Site

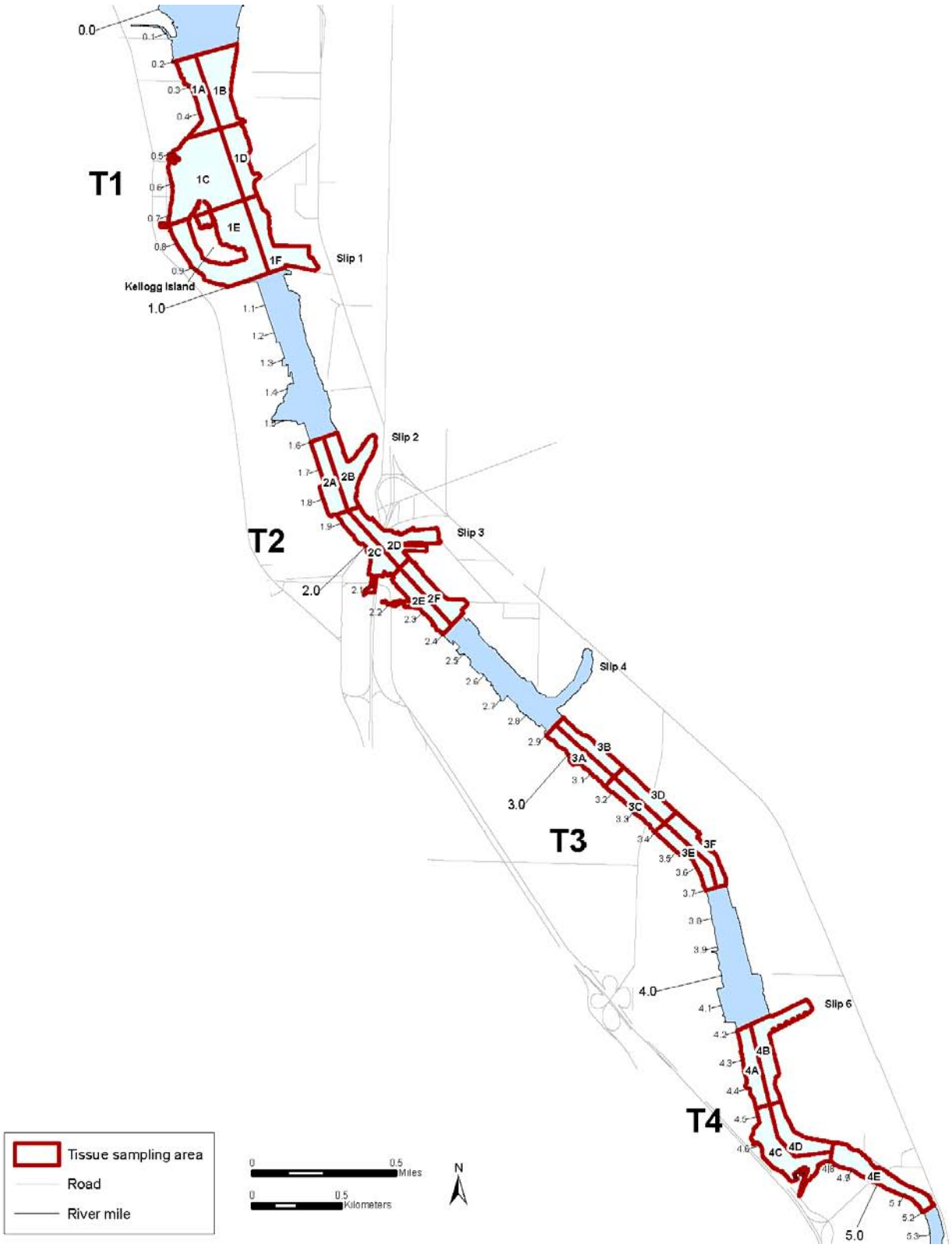

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Figure 2

LDW Phase 2 Remedial Investigation Fish and Crab Tissue Collection Areas

2 SAMPLE METHODS OVERVIEW

This section describes the methods used during the collection and processing of fish tissue samples for chemical analyses. Elements included herein are sampling design, fish sampling methods, and sample handling. Appendix A provides the fish collection field data sheets. Figure 3 depicts the 23 individual trawl transects across the six subareas of tissue collection area T1. Appendix B contains the trawl location summary information including times, tides, coordinates, direction, distance, and trawl wire length.

The sampling effort was performed by Anchor Environmental, L.L.C. (Anchor) and King County in accordance with the QAPP (Anchor and King County 2006). The King County project manager for this work is Jeff Stern. Dan Hennessy is the Anchor project manager, responsible for overall project coordination and providing oversight on planning and coordination, study deliverables, and performance of the administrative tasks needed to ensure timely and successful completion of the study. Paul Schlenger is the Anchor field manager. Mr. Stern, Mr. Hennessy, and Mr. Schlenger all participated in the trawling effort.

A scientific collection permit (#06-402) was obtained from the Washington Department of Fish and Wildlife (WDFW) through Thai Do of Windward Environmental L.L.C. Fishing was conducted under the same U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) permits that were used for in 2004 (numbers TE088853-0 and 1314, respectively), as documented in the original QAPP (Windward 2004a, 2005). In order to utilize the existing permits, Paul Schlenger was added to the existing permits for USFWS and NMFS.

2.1 Collection Summary

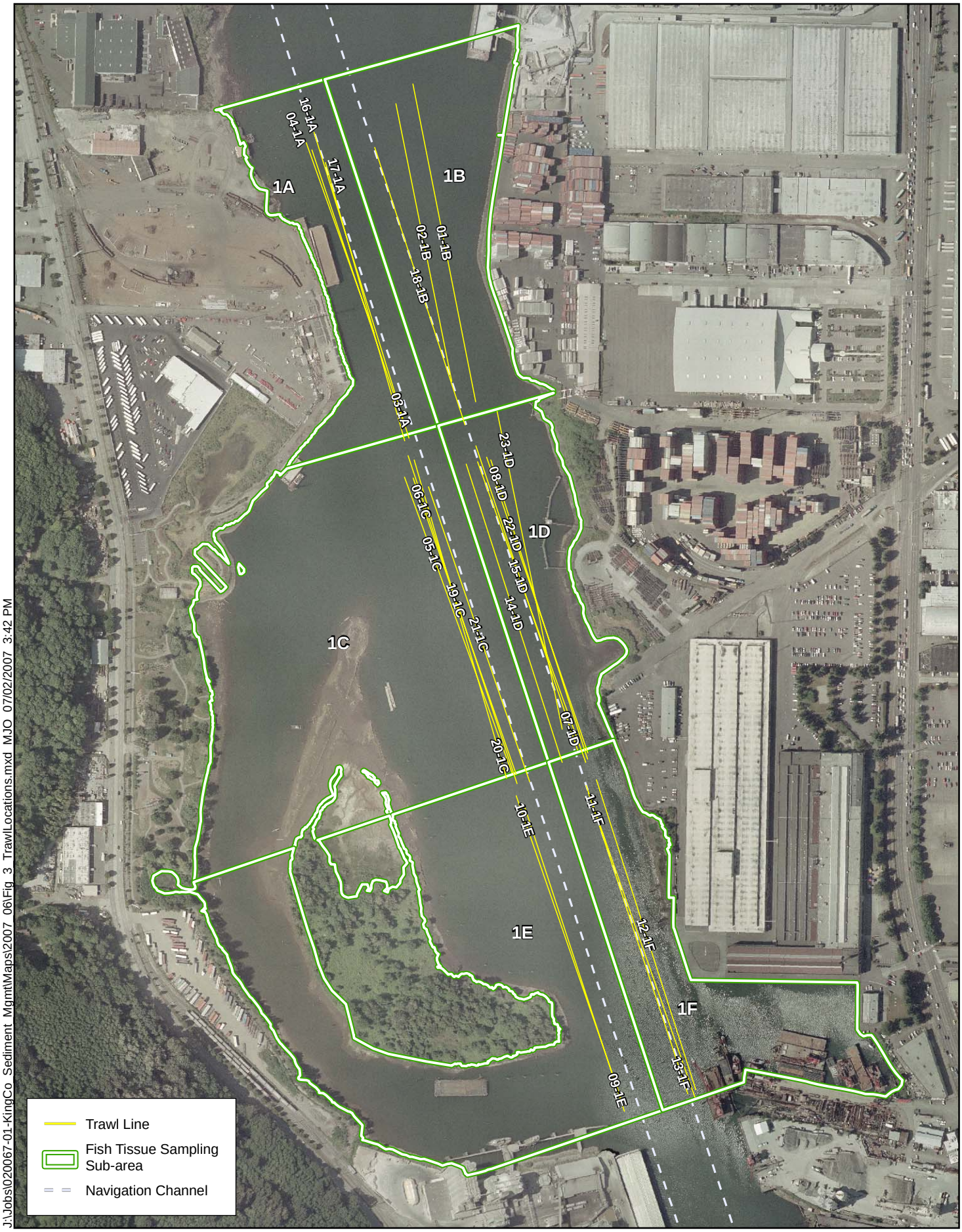
Fish were collected from the LDW using a high-rise otter trawl on September 30, 2006. Trawling was conducted using the vessel *R/V Kittiwake*, captained by Charlie Eaton of Bio-Marine Enterprises and assisted by a deck hand. The trawling methods were based on systematic sampling of the Area T1 and its subareas (Figure 2) as described in the QAPP (Anchor and King County 2006).

Area T1 was divided into six subareas (1A through 1F) as shown in Figure 3. At least one trawl was conducted within each subarea, as described below. Each trawl line was conducted within the bounding coordinates of the sampling subareas. The specific trawl

line and order in which the subareas were sampled was determined by the boat captain based on logistical considerations. Within each subarea, an attempt was made to conduct all trawls outside the navigation channel to capture fish using shallower habitats. Trawling was not conducted in waters shallower than 6 feet deep (at the time of trawling), because the high-rise otter trawl is impractical in shallower areas (Eaton 2004). Subsequent trawls in each subarea followed the first trawl line or a different trawl line at the discretion of the boat captain in consultation with the field manager. The date, time, and location of the trawl was recorded on the Target Fish Tissue Collection Run Sheet (Appendix A) after each trawl was hauled out of the water. Trawl start and end points were recorded using a Trimble NT300D differential global positioning system (DGPS) with 1 to 2 meter accuracy. When the trawl was deployed on the bottom, GPS and clock readings were recorded to mark the starting point of the trawl. Final DGPS and clock readings were recorded when net retrieval began. Whole body samples of shiner surfperch and English sole were collected from each subarea within Area T1 (Figure 3). The number of composite samples and the size of fish were based on generating tissue data comparable to that collected by LDWG in 2004 and 2005 from this same area. The target number of composite samples for each fish type collected from T1 sampling area included:

- Six whole body English sole
- Six whole body shiner surfperch, one from each subarea

Table 1 summarizes the number of shiner surfperch retained or released during the collection effort. Individual shiner surfperch were measured to determine whether they were above the 80 millimeter (mm) target length, but individual fish lengths were not recorded. To obtain 10 shiner surfperch above the target length in a given subarea, fish were collected and retained as they were acquired. Therefore, in some subareas, multiple trawls were necessary to obtain 10 fish. The designated Project Sample Identification number (i.e., sample ID) was based on the first trawl in a given subarea for which fish above the target length were obtained. Where fish from subsequent trawls in the subarea were added to the sample, a note was made on the field form for that trawl.



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0 125 250 500
Scale in Feet

Figure 3
2006 Trawl Locations in the LDW

Table 1
Summary of Shiner Surfperch Composite Samples

Subarea	Sample Number (All Start with LWD-06-T1-)	Number of Fish Retained (>80 mm)	Number of Fish Released
A	A-TR003-SSP-C	10	56
B	B-TR001-SSP-C	10	42
C	C-TR005-SSP-C	10	125
C	C-TR021-SSP-C	10	
D	D-TR015-SSP-C	11*	20
D	D-TR023-SSP-C1	4	
E	E-TR009-SSP-C	10	40
F	F-TR011-SSP-C	10	22

* Fish between 70 and 80 mm

Table 2 summarizes, by subarea, the individual lengths of the 39 English sole retained during the collection effort.

Table 2
Summary of Individual English Sole Samples Retained

Subarea	Sample Number (All Start with LWD-06-T1-)	Total Length (mm)
A	A-TR003-ES-1	210
A	A-TR004-ES-2	195
A	A-TR017-ES-3	264
A	A-TR017-ES-4	263
B	B-TR018-ES-1	215
B	B-TR001-ES-2	166
B	B-TR001-ES-3	158
B	B-TR001-ES-4	152
B	B-TR001-ES-5	160
C	C-TR005-ES-1	275
C	C-TR005-ES-2	307
C	C-TR005-ES-3	294
C	C-TR005-ES-4	240
C	C-TR005-ES-5	234
C	C-TR005-ES-6	264
C	C-TR020-ES-7	207
C	C-TR019-ES-8	202
C	C-TR019-ES-9	221
C	C-TR019-ES-10	207
C	C-TR019-ES-11	257
C	C-TR019-ES-12	373
C	C-TR020-ES-13	212
C	C-TR020-ES-14	213
C	C-TR020-ES-15	241
C	C-TR021-ES-16	265
C	C-TR021-ES-17	209
D	D-TR007-ES-1	209
D	D-TR015-ES-2	273
D	D-TR023-ES-3	189
D	D-TR023-ES-4	242
D	D-TR023-ES-5	345
E	E-TR009-ES-1	253
E	E-TR009-ES-2	255
E	E-TR009-ES-3	272
E	E-TR009-ES-4	182
E	E-TR010-ES-5	238
F	F-TR012-ES-1	275
F	F-TR013-ES-2	205
F	F-TR011-ES-3	190

2.2 Fish Handling and Processing

This section summarizes how fish were handled in the field, including how individual samples were processed, labeled, tracked, stored, and transported to the laboratory for processing and analysis. Trawling was conducted using a live sampling technique, which minimized the number of non-target species mortalities through species sorting and processing prioritization. All species captured were placed in decontaminated bins filled with LDW water. Target fish of similar size were preferentially selected and sorted. Specimens of target species that did not meet size requirements were counted, lengths approximated, and returned to the LDW (Table 3). As required by WDFW, specimens of non-target species were identified to the lowest practical taxon and their numbers estimated. Special care was taken to ensure that non-target organisms were returned to the LDW quickly, with minimal handling.

Table 3
Summary of Non-Target Species Caught and Released

Trawl Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Subarea	**1B**	**1B**	**1A**	**1A**	**1C**	**1C**	**1D**	**1D**	**1E**	**1E**	**1F**	**1F**	**1F**	**1D**	**1D**	**1A**	**1A**	**1B**	**1C**	**1C**	**1C**	**1D**	**1D**	
Species																								**Total**
Snake Prickleback (*Lumpenus sagitta*)	6	2	7	4	24	37	7	3	56	43	5	3	6	2	6	3	4	3	18	8	16	2	9	274
Tubesnout (*Aulorhynchus flavidus*)	3		71	1		14	2	13	30	91	1		10				1	11	5				1	254
Pile Perch (*Damalichthys vacca*)					1	10		4		7	3		4		2	6	13	3	1	3	11	2	3	73
Rock Sole (*Pleuronectes bilineata*)	2		1	2	9	7	1		11	4	1		2	2	1	1	1	3	7	1	2	2	2	62
Pacific Staghorn Sculpin (*Leptocottus armatus*)	1	1		3	6	3	1	2	4	7	3			3			5	1		6			2	48
Roughback Sculpin (*Chitonotus pugetensis*)	1				2	3	1	2	9	7	2		1				2			3	2		1	36
Bay Goby (*Lepidogobius lepidus*)	1		1		5				9	2	1		3				5			1			1	29
Pacific Tomcod (*Microgadus proximus*)						1					2		2	2	1	4	4				2		1	19
Speckled Sanddab (*Citharichthys stigmaeus*)	5		1			1				1								3	3				1	15
Longfin Smelt (*Spirinchus thaleichthys*)			1		1											1	4				1			8

Table 3
Summary of Non-Target Species Caught and Released

Trawl Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Subarea	**1B**	**1B**	**1A**	**1A**	**1C**	**1C**	**1D**	**1D**	**1E**	**1E**	**1F**	**1F**	**1F**	**1D**	**1D**	**1A**	**1A**	**1B**	**1C**	**1C**	**1C**	**1D**	**1D**	
Species																								**Total**
Pacific Herring (*Clupea pallasi*)						1										3				2	2			8
Northern Spearnose Poacher (*Agonopsis vulsa*)	2						1					1												4
Whitespotted Greenling (*Hexagrammus stelleri*)						1		1								1		1						4
Sand Sole (*Psettichthys melanostictus*)						1												1			1			3
Starry Flounder (*Platichthys stellatus*)						1													1					2
Padded Sculpin (*Artedius fenestralis*)							2																	2
Spotfin Sculpin (*Icelinus tenuis*)		1		1																				2
Crescent Gunnel (*Pholis laeta*)															2									2
Threespine Stickleback (*Gasterosteus aculeatus*)	2																							2
Buffalo Sculpin (*Enophrys bison*)								1																1
Brown Rockfish (*Sebastes auriculatus*)																						1		1

Table 3
Summary of Non-Target Species Caught and Released

Trawl Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Subarea	**1B**	**1B**	**1A**	**1A**	**1C**	**1C**	**1D**	**1D**	**1E**	**1E**	**1F**	**1F**	**1F**	**1D**	**1D**	**1A**	**1A**	**1B**	**1C**	**1C**	**1C**	**1D**	**1D**	
Species																								**Total**
Striped Perch (*Embiotoca lateralis*)							1																	1
Coonstripe Shrimp (*Pandalus hypsinotus*)					1		8	105			1		3		1	1	2		2	11	2	53	4	194
Graceful Crab (*Cancer gracilis*)	2		1	3	1	3	3		1		2	1	4	4	6		2	5	1	1	3	4	3	50
Crangon Shrimp (*Crangon* spp.)	1	2		1	7				5	1	1	1	2				1	2	2			1	3	30
Short Spined Sea Star (*Pisaster brevispinus*)			1				2	1			1				2	2		1				1	2	13
Sunflower Star (*Pycnopodia helianthoides*)							2		1							2		1				2		8
False Ochre Star (*Evasterias troschelii*)							1	4														2		7
Kelp crab (*Pugettia producta*)													1				1						3	5
Plumose Anenome (*Metridium senile*)					1				1				2		1									5
Unidentified Sea Star				1	2										1									4
Decorator crab (*Oregonia gracilis*)											2				1									3
Kelp crab (*Pugettia richii*)																							1	1
Red Rock Crab (*Cancer productus*)					1																			1
Black-clawed Crab (*Lophopanopeus bellus*)					1																			1

Table 3
Summary of Non-Target Species Caught and Released

Trawl Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Subarea	**1B**	**1B**	**1A**	**1A**	**1C**	**1C**	**1D**	**1D**	**1E**	**1E**	**1F**	**1F**	**1F**	**1D**	**1D**	**1A**	**1A**	**1B**	**1C**	**1C**	**1C**	**1D**	**1D**	
Species																								**Total**
Crab, unidentified (0.5 inch across carapace)																	1							1
Tunicate																	1							1
Pygmy Rock Crab (*Cancer oregonensis)*																						1		1

The QAPP required that sample custody and handling must be traceable from the time of sample collection, through receipt at Analytical Laboratories, Inc. (ARI), the analytical laboratory for this project, and sample analysis by the laboratory. The combined fish from a given trawl were kept separate from those collected in prior or subsequent trawls and processed one at a time to ensure that each individual specimen was tracked properly. Each English sole was measured for length, and those fish above the target length were individually wrapped in heavy duty aluminum foil (shiny side out), enclosed in individual resealable plastic bags with an identification label (also enclosed in the resealable bag), and immediately stored in coolers with wet ice. English sole weights were measured by the laboratory. Each shiner surfperch was measured to determine if it was greater than the target length of 80 mm. For shiner surfperch that were collected, they were placed together in a foil pouch inserted into a plastic bag with an identification label (also enclosed in the resealable bag), and placed in a cooler on wet ice. As necessary to complete a subarea sample, additional shiner surfperch individuals from additional trawls from within the same subarea were added to the pouch and placed back on ice. Upon collection of all target species, the samples were delivered to the analytical laboratory.

For the total fish length, the length was taken from the anterior-most part of the fish to the tip of the longest caudal fin ray (when the lobes of the caudal are compressed dorsoventrally). Additional observations of fish collected for chemical analysis included general observations of individual specimen health, such as any visible signs of gender, morphological abnormalities, external lesions, parasites, or fin erosion. The final processing was performed by ARI.

The field manager was responsible for reviewing count, length, and external abnormality information of all species, and correcting any improperly recorded information. Following the collection and processing of the last target species, all fish were packed into coolers,with ice and delivered to ARI that evening to be held frozen at -20°C until they were composited and homogenized. Specimen labels were included with each delivery. Homogenization occurred at ARI after the final compositing scheme was developed, which occurred after review of field documents and consultation between King County and Anchor.

All pertinent field information is traceable through the sample ID, which is noted on the field forms (see Appendix B). Sample labels contained the project number, sampling personnel, date, time, sample ID, and comments (see Appendix B). The specimens included in each composite sample were tracked using a Composite Formation Form. The form included the project number, the composite sample ID, the sample ID of each specimen included in the composite sample, and the length and weight of each specimen.

ARI assigned a unique sample identifier to each sample (using a laboratory generated unique number ID). The laboratory maintained a sample tracking record that followed each sample through all stages of laboratory processing. The sample tracking record contained, at a minimum, the name/initials of responsible individuals performing the analyses, dates of sample extraction/preparation and analysis, and the type of analysis being performed. Chain-of-custody procedures were used for all samples throughout the collection, transport, and analytical process, and for all data and data documentation, whether in hard copy or electronic format. Chain-of-custody procedures were initiated during sample collection. A chain-of-custody form accompanied samples to the analytical laboratory.

2.3 Fish Tissue Compositing

A single composite of 10 individual shiner surfperch greater than 80 mm were made for each subarea with two exceptions. In subarea C, a field replicate was collected and therefore there were two composite samples for subarea C (Table 1). Second, the group of shiner surfperch collected for sample LDW-06-T1-D-TR015-SSP-C contained 11 fish between 70 and 80 mm. Therefore, the six largest fish from this sample (LDW-06-T1-D-TR015-SSP-C) were combined with fish from LDW-06-T1-D-TR023-SSP-C1 to make the composite sample for subarea D.

For English sole, a random selection process was employed to equally distribute samples across the distribution of lengths greater than 200 mm, which were 31 of the 39 fish retained. The length of the fish retained ranged from 202 to 373 mm. Fish were first grouped, irrespective of subarea, based on their percentile of the length into five bins: 0 to 19th percentile, 20 to 39th percentile, 40 to 59th percentile, 60 to 79th percentile, and 80 to 100th percentile. From these five percentile bins, fish were randomly selected across the entire T1 sampling area (i.e., composites were not by subareas) to make up the six composite samples.

Table 4 summarizes the English sole whole body compositing scheme. Fish distributions across the subareas were unequal, with subarea C having the greatest number of English sole. Table 4 also presents the subarea counts of the English sole samples.

Table 4
Summary of Whole Body English Sole Composite Samples and Subarea Counts

Composite No.	Length Percentile 80-100%	Length Percentile 60-79%	Length Percentile 40-59%	Length Percentile 20-39%	Length Percentile 0-19%	Subarea					
						A	B	C	D	E	F
1	LDW-06-T1-D-TR023-ES-5	LDW-06-T1-A-TR017-ES-3	LDW-06-T1-C-TR005-ES-4	LDW-06-T1-E-TR010-ES-5	LDW-06-T1-D-TR007-ES-1	1	0	1	2	1	0
2	LDW-06-T1-F-TR012-ES-1	LDW-06-T1-C-TR021-ES-16	LDW-06-T1-C-TR020-ES-15	LDW-06-T1-C-TR019-ES-9	LDW-06-T1-C-TR019-ES-10	0	0	4	0	0	1
3	LDW-06-T1-C-TR005-ES-1	LDW-06-T1-C-TR005-ES-6	LDW-06-T1-E-TR009-ES-2	LDW-06-T1-C-TR005-ES-5	LDW-06-T1-A-TR003-ES-1	1	0	3	0	1	0
4	LDW-06-T1-C-TR005-ES-2	LDW-06-T1-E-TR009-ES-3	LDW-06-T1-D-TR023-ES-4	LDW-06-T1-C-TR020-ES-13	LDW-06-T1-C-TR021-ES-17	0	0	3	1	1	0
5	LDW-06-T1-C-TR019-ES-12	LDW-06-T1-A-TR017-ES-4	LDW-06-T1-C-TR019-ES-11	LDW-06-T1-C-TR020-ES-14	LDW-06-T1-F-TR013-ES-2	1	0	3	0	0	1
6	LDW-06-T1-C-TR005-ES-3	LDW-06-T1-D-TR015-ES-2	LDW-06-T1-E-TR009-ES-1	LDW-06-T1-B-TR018-ES-1	LDW-06-T1-C-TR020-ES-7	0	1	2	1	1	0

2.4 Modifications from QAPP

A modification to the field-collected length and weight data was made because it was not necessary or feasible to collect some data. Specifically:

- Length and weight data were not needed for target and non-target fish that were released
- Weights were not collected on any fish in the field—weight was measured in the laboratory (Appendix C)
- Individual lengths were only collected for English sole
- Shiner perch lengths were only characterized as less than 70 mm, between 70 and 80 mm, and greater than 80 mm
- There were actually seven shiner surfperch composites analyzed rather than six. Two composite samples of 10 fish each were analyzed for subarea C, one representing a field replicate. All other subareas had one composite sample of shiner surfperch.

3 LABORATORY METHODS OVERVIEW

3.1 Methods Overview

Details regarding custody requirements, quality assurance/quality control (QA/QC), instrument/equipment testing protocols and frequency, inspection and maintenance, instrument calibration, supply inspection/acceptance, non-direct measurements, and data management remained the same as documented in *Quality Assurance Project Plan: Fish and Crab Tissue Collection and Chemical Analysis* (Windward 2005) and the QAPP for this sampling effort (Anchor and King County 2006).

Twenty-two individual fish specimens were homogenized into composite samples according to the compositing scheme presented in Sections 2.1 and 2.3. Data results on individual fish specimens for each composite sample can be found in Appendix D. ARI analyzed the samples for PCB Aroclors according to USEPA method SW846 8082 (GC-ECD); six phthalate compounds were analyzed by USEPA SW846 8270D (GC/MS); percent lipids by the Bligh & Dyer method, and percent moisture by USEPA method 160.3 modified for solids. All results were reported under ARI report IDs KB04 and KK80. A total of six composites of Shiner Perch and six composites of English sole were designated for analysis. Any remaining sample volumes from each of the composites will remain frozen at ARI for one year from the sample receipt date. Additional analyses of individual English sole samples were also conducted as described below under lab deviations.

3.2 Lab Deviations

The laboratory followed the methods and procedures described in the QAPP (Anchor and King County 2006), with the following exceptions:

- The compositing scheme required ARI to make six composite samples of five fish each out of 30 of the individual 39 English sole tissue specimens. The six composites were then analyzed for the above listed analytes. This left nine individual fish samples on hold in the sample archive. The laboratory inadvertently analyzed these remaining archived fish samples as discrete specimens with the exception of one sample LWD-D-TR015-ES-2, which remained archived and unanalyzed. In addition, homogenate from one English sole sample was analyzed both as part of composite as well as by itself (LDWG-06-T1-D-TR023-ES-5).

- The requested reporting limits for phthalates in the QAPP were 50 micrograms per kilogram (μg/kg) or parts per billion (ppb). This reporting limit was only achievable by the laboratory in eight of the samples. The remaining samples contained reporting limits of 200 μg/kg or greater. The raised reporting levels were attributed to matrix interference. The laboratory performed an enhanced silca gel cleanup procedure on several samples in an attempt to reduce the matrix effects and achieve the requested reporting limit. The first attempt did achieve the lower reporting limits of 50 μg/kg for all re-extracts; however, the associated QA/QC was impacted. Due to low remaining sample volumes, the lab re-extracted only two of the samples and applied the enhanced cleanup procedure calibrated for the additional QA spikes. In this case, the results had acceptable QA/QC results; however, the reporting limits were elevated above 200 μg/kg for two of the phthalates: di-n-butylphthalate and bis(2-ethylhexyl) phthalate. Because the re-extracted samples resulted in either poor recoveries for the associated QA/QC or elevated detection limits above the original results, the second and third data analyses associated with these re-extractions and cleanups were not reported in this data report.

4 RESULTS

The results for the chemical analyses of the fish tissue samples collected from the LDW are presented below. The complete laboratory report can be found in Appendix D. Composite tissue samples created from fish collected in the LDW were analyzed for PCBs as Aroclors, phthalates, percent lipids, and percent moisture.

English sole whole body composite samples results are summarized in Table 5. In the English sole whole body composite samples, tissue lipids ranged from 2.46 to 5.06 percent. Total solids ranged from 20.7 to 24.46 percent. Of the PCBs, only Aroclors 1254 and 1260 were detected. Aroclor 1254 ranged from 300 to 700 µg/kg wet weight (ww). Aroclor 1260 ranged from 330 to 770 µg/kg ww. Total PCBs[2] ranged from 630 to 1470 µg/kg ww. The detection limits for the remaining, undetected Aroclors ranged from 40 to 160 µg/kg ww. Only one phthalate, bis(2-ethylhexyl) phthalate, was detected in one sample ES-COMP4 at 170 µg/kg ww. The detection limits for the remaining, undetected phthalates ranged from 50 to 200 µg/kg ww.

Individual English sole samples results are summarized in Table 6. In the individual English sole whole body samples, tissue lipids ranged from 0.67 to 4.67 percent. Total solids ranged from 17.18 to 25.35 percent. Of the PCBs, only Aroclors 1254 and 1260 were detected. Aroclor 1254 ranged from 120 to 620 µg/kg ww. Aroclor 1260 ranged from 120 to 590 µg/kg ww. Total PCBs ranged from 240 to 1210 µg/kg ww. The detection limits for the remaining, undetected Aroclors ranged from 39 to 200 µg/kg ww. No phthalates were detected in the individual fish samples. The detection limits for all undetected phthalates was 200 µg/kg ww.

Shiner surfperch whole body composite samples results are summarized in Table 7. In the shiner surfperch whole body composite samples, tissue lipids ranged from 2.79 to 7.32 percent. Total solids ranged from 23.13 to 27.32 percent. Of the PCBs, only Aroclors 1254 and 1260 were detected. Aroclor 1254 ranged from 120 to 260 µg/kg ww. Aroclor 1260 ranged from 130 to 490 µg/kg ww. Total PCBs ranged from 250 to 730 µg/kg ww. The detection limits for the remaining, undetected Aroclors ranged from 40 to 100 µg/kg ww. No phthalates were detected in the shiner surfperch samples. The detection limits for the undetected phthalates ranged from 50 to 200 µg/kg ww.

[2] Total PCBs are the sum of detected Aroclors.

Table 5
English Sole Whole Body Composite Tissue Chemistry Results

Sample ID	LDWG-06-T1-ES-COMP1	LDWG-06-T1-ES-COMP2	LDWG-06-T1-ES-COMP3	LDWG-06-T1-ES-COMP4	LDWG-06-T1-ES-COMP5	LDWG-06-T1-ES-COMP6
English Sole Composite Results[1]						
Conventionals (%)						
Lipids	**3.29**	**3.68**	**3.27**	**4.23**	**5.06**	**2.46**
Total solids	**23.40**	**23.05**	**20.7**	**23.32**	**24.46**	**21.14**
PCBs (µg/kg wet wt.)						
Aroclor 1016	40 U	40 UJ	40 UJ	40 UJ	59 U	59 U
Aroclor 1221	40 U	40 U	40 U	40 U	59 U	59 U
Aroclor 1232	40 U	40 U	40 U	40 U	59 U	59 U
Aroclor 1242	40 U	40 UJ	40 UJ	40 UJ	59 U	59 U
Aroclor 1248	160 U	120 UJ	79 UJ	120 UJ	120 U	88 U
Aroclor 1254	**480**	**700**	**390**	**390**	**410**	**300**
Aroclor 1260	**470**	**770**	**410**	**430**	**460**	**330**
Total PCBs [2]	**950**	**1470**	**800**	**820**	**870**	**630**
Phthalates (µg/kg wet wt.)						
bis(2-Ethylhexyl)phthalate	58 UJ	62 U	50 UJ	**170 J**	200 UJ	200 U
Butylbenzylphthalate	50 UJ	50 UJ	50 UJ	50 UJ	200 U	200 U
Diethylphthalate	50 U	50 U	50 U	50 U	200 UJ	200 U
Dimethylphthalate	50 U	50 U	50 U	50 U	200 UJ	200 U
Di-n-butylphthalate	50 UJ	50 U	50 U	50 UJ	200 U	200 U
Di-n-octylphthalate	50 UJ	50 U	50 UJ	50 UJ	200 U	200 U

Notes:

1 - Samples collected in September 2006

2 - Total PCBs is based on sum of detected aroclors.

Bold - Results were detected

J - Results are estimated

U - Analyzed for, but not detected at or above the stated reporting limit.

UJ- Analyzed for, but not detected. Reporting limit is estimated.

Table 6
English Sole Individual Whole Body Tissue Chemistry Results

Sample ID	LDW-06-T1-A-TR004-ES-2	LDW-06-T1-B-TR001-ES-2	LDW-06-T1-B-TR001-ES-3	LDW-06-T1-B-TR001-ES-4	LDW-06-T1-B-TR001-ES-5	LDW-06-T1-C-TR019-ES-8	LDW-06-T1-D-TR023-ES-5	LDW-06-T1-E-TR009-ES-4	LDW-06-T1-F-TR011-ES-3
English Sole Individual Composite Results[1]									
Conventionals (%)									
Lipids	**1.90**	**2.46**	**4.20**	**3.49**	**4.17**	**1.21**	**4.67**	**0.669**	**2.47**
Total solids	**21.57**	**23.90**	**21.52**	ISQ	**23.87**	**18.89**	**25.35**	**17.18**	**21.61**
PCBs (µg/kg wet wt.)									
Aroclor 1016	40 UJ	40 UJ	40 UJ	40 UJ	39 UJ	40 UJ	39 UJ	39 UJ	40 UJ
Aroclor 1221	40 U	40 U	40 U	40 U	39 U	40 U	39 U	39 U	40 U
Aroclor 1232	40 U	40 U	40 U	40 U	39 U	40 U	39 U	39 U	40 U
Aroclor 1242	40 UJ	40 UJ	40 UJ	40 UJ	39 UJ	40 UJ	39 UJ	39 UJ	40 UJ
Aroclor 1248	40 UJ	40 UJ	120 UJ	99 UJ	120 UJ	40 UJ	200 UJ	39 UJ	99 UJ
Aroclor 1254	**200**	**190**	**330**	**280**	**240**	**120**	**620**	**250**	**240**
Aroclor 1260	**330**	**240**	**240**	**250**	**180**	**120**	**590**	**260**	**230**
Total PCBs [2]	**530**	**430**	**570**	**530**	**420**	**240**	**1210**	**510**	**470**
Phthalates (µg/kg wet wt.)									
bis(2-Ethylhexyl)phthalate	200 U	200 U	200 U	200 U	200 UJ	200 U	200 U	200 U	200 U
Butylbenzylphthalate	200 U	200 U	200 U	200 U	200 UJ	200 U	200 U	200 U	200 U
Diethylphthalate	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Dimethylphthalate	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Di-n-butylphthalate	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Di-n-octylphthalate	200 U	200 U	200 U	200 U	200 UJ	200 U	200 U	200 U	200 U

Notes:

1 - Samples collected in September 2006

2 - Total PCBs is based on sum of detected aroclors.

Bold - Results were detected

J - Results are estimated

U - Analyzed for, but not detected at or above the stated reporting limit.

UJ- Analyzed for, but not detected. Reporting limit is estimated.

ISQ - insufficient sample quantity for analysis

Table 7
Shiner Surfperch Composite Whole Body Tissue Chemistry Results

Sample ID*	LDW-06-T1-A-TR003-SSP-C	LDW-06-T1-B-TR001-SSP-C	LDW-06-T1-C-TR005-SSP-C	LDW-06-T1-C-TR021-SSP-C	LDW-06-T1-D-TR023-SSP-C1	LDW-06-T1-E-TR009-SSP-C	LDW-06-T1-F-TR011-SSP-C
Shiner Surfperch Results[1]							
Conventionals (%)							
Lipids	**3.80**	**5.27**	**5.27**	**5.86**	**2.79**	**7.32**	**5.86**
Total solids	**23.13**	**24.80**	**25.16**	**27.32**	**25.57**	**25.59**	**24.07**
PCBs (µg/kg wet wt.)							
Aroclor 1016	40 U	40 U	40 U	40 U	40 U	40 U	40 U
Aroclor 1221	40 U	40 U	40 U	40 U	40 U	40 U	40 U
Aroclor 1232	40 U	40 U	40 U	40 U	40 U	40 U	40 U
Aroclor 1242	40 U	40 U	40 U	40 U	40 U	40 U	40 U
Aroclor 1248	40 U	40 U	40 U	40 U	40 U	80 U	100 U
Aroclor 1254	**180**	**240**	**120**	**210**	**140**	**260**	**200**
Aroclor 1260	**270**	**490**	**130**	**300**	**150**	**300**	**210**
Total PCBs (SMS)[2]	**450**	**730**	**250**	**510**	**290**	**560**	**410**
Phthalates (µg/kg wet wt.)							
bis(2-Ethylhexyl)phthalate	200 U	200 U	200 U	50 UJ	50 UJ	50 UJ	50 UJ
Butylbenzylphthalate	200 U	200 U	200 U	50 UJ	50 UJ	50 UJ	50 UJ
Diethylphthalate	200 U	200 U	200 U	50 U	50 UJ	50 U	50 U
Dimethylphthalate	200 U	200 U	200 U	50 U	50 UJ	50 U	50 U
Di-n-butylphthalate	200 U	200 U	200 U	50 U	50 UJ	50 U	50 U
Di-n-octylphthalate	200 U	200 U	200 U	50 UJ	50 UJ	50 UJ	50 UJ

Notes:

1 - Samples collected in September 2006

2 - Total PCBs is based on sum of detected aroclors.

Bold - Results were detected

J - Results are estimated

U - Analyzed for, but not detected at or above the stated reporting limit.

UJ- Analyzed for, but not detected. Reporting limit is estimated.

* The sample ID is based on first trawl but multiple trawls were sometimes needed in a subarea to obtain 10 fish for the composite.

5 DATA VALIDATION SUMMARY

Laboratory Data Consultants (LDC) of Carlsbad, California performed the analytical chemistry quality assurance review of these samples. The validation review was conducted in accordance with QA/QC requirements as described in the QAPP (Windward 2004b); the technical specifications as noted in EPA SW 846, Third Edition, Test methods for Evaluating Solid Waste, update 1, July 1992, update IIA, August 1993, update II September 1994, update IIB, January 1995, update III, December 1996, and update IIIA, April 1998; and USEPA National Functional Guidelines for Organic Data Review (USEPA 1999).

The data review included the evaluation of data completeness, verification of instrument calibration, measurement of laboratory precision (duplicates and spikes), examination of blanks for contamination, assessment of adherence to method specifications and QC limits, and evaluation of method performance. The results of the data validation are discussed below and the full validation report can be found in Appendix E.

Table 8 summarizes the data qualifiers applied to the tissue sample results presented herein. No data were rejected (R qualified) as a result of the data validation process. The following findings were noted during phthalates review and resulted in the data being qualified with the "J" or "UJ" flags to indicate the results reported have been estimated:

- Sample LDW-06-T1-D-TR023-SSP-C1 was qualified due to the percent recovery and relative percent difference (RPD) being outside specified control limits in the matrix spikes. The matrix spike duplicate (MSD) percent recovery (%R) was low for two analytes: dimethylphthalate (5 %R) and diethylphthalate (12.4 %R). However, because the recoveries were within limits for the matrix spike (MS), the resulting RPD exceeded the control limits for these analytes. In addition three analytes had both MS and MSD recoveries within control limits but the resulting RPD exceeded the control limits for di-n-butylphthalate, butylbenzyphthalate, and bis(2-ethylhexyl)phthalate.
- Sample LDW-06-T1-ES-COMP-5 had two analytes outside the %R and three analytes outside the RPD criteria in the MS. The MSD for dimethylphthalate and diethylphthalate had no recoveries; however, because the recoveries were within limits for the MS, the resulting RPD exceeded the control limits. The bis(2-ethylhexyl)phthalate recovery in the MS was within control limits but slightly high

(151 %R) and the MSD recovery was also within criteria (104 %R); however, the resulting RPD was outside control limits.

- Fourteen samples had internal standards outside the method criteria for butylbenzylphthalate, bis(2-ethylhexyl)phthalate, and di-n-octylphthalate.
- Three samples had internal standards outside method criteria din-n-butylphthalate, butylbenzylphthalate, bis(2-ethylhexyl)phthalate, and di-n-octylphthalate.
- Sample LDW-06-T1-ES-COMP2 had the internal standard butylbenzylphthalate outside method criteria.

The following findings were noted during PCB Aroclor review and resulted in the data being qualified with the "J" or "UJ" flags to indicate the results reported have been estimated:

- The continuing calibration analyzed on January 20, 2007 for Aroclor 1016 had a percent difference (%D) above the 15 percent method criteria at a 15.2 %D. This affected Aroclors 1016, 1221, and 1232 quantitation in 12 of the samples' initial analyses. The results associated with these Aroclors have been qualified (Table 8). Six samples were reanalyzed at a dilution, which yielded higher reporting limits for the non-detected Aroclors than those specified in the QAPP. In order to maintain the lowest possible reporting limit, only those values over the linear range of the calibration curve (i.e., detected Aroclors) were reported from the reanalysis runs. The remaining Aroclors were reported from the original analysis (undiluted runs) and qualified as needed.
- Six PCB samples had results reported above the linear range of the calibration curve. These samples were diluted and reanalyzed with acceptable QA/QC results. The data in the original results have been qualified as "J" by LDC to indicate the results are estimated and reported above the quantitation range. However, all final results were reported from the dilution analysis for these detected Aroclors, which was within the linear calibration range and therefore not qualified.

Table 8
Data Qualifiers for English Sole and Shiner Surfperch Tissue Samples

Sample ID	Method/Compound	Flag	Reason
LDW-06-T1-D-TR023-SSP-C1	8270D: Dimethylphthalate Diethylphthalate	UJ (all non-detects)	MS/MSD %R, RPD out
LDW-06-T1-D-TR023-SSP-C1 dilution	8270D: Di-n-butylphthalate Butylbenzylphthalate Bis(2-ethylhexyl)phthalate	UJ (all non-detects)	MS/MSD %R out
LDW-06-T1-ES-COMP5	8270D: Bis(2-ethylhexyl)phthalate Dimethylphthalate Diethylphthalate	UJ (all non-detects)	MS/MSD %R, RPD out
LDW-06-T1-E-TR009-SSP-C LDW-06-T1-F-TR011-SSP-C LDW-06-T1-C-TR021-SSP-C LDW-06-T1-ES-COMP3 LDW-06-T1-B-TR001-ES-5 LDW-06-T1-E-TR009-SSP-CDL LDW-06-T1-F-TR011-SSP-CDL LDW-06-T1-C-TR021-SSP-CDL LDW-06-T1-ES-COMP1DL LDW-06-T1-ES-COMP2DL LDW-06-T1-ES-COMP3DL LDW-06-T1-B-TR001-ES-5DL LDW-06-T1-C-TR023-SSP-C1DL	8270D: Butylbenzylphthalate Bis(2-ethylhexyl)phthalate Di-n-octylphthalate	UJ (all non-detects)	Internal standards (area)
LDW-06-T1-ES-COMP4DL	8270D: Butylbenzylphthalate Bis(2-ethylhexyl)phthalate Di-n-octylphthalate	UJ J UJ	Internal standards (area)
LDW-06-T1-ES-COMP1 LDW-06-T1-C-TR023-SSP-C1DL	8270D: Di-n-butylphthalate Butylbenzylphthalate Bis(2-ethylhexyl)phthalate Di-n-octylphthalate	UJ (all non-detects)	Internal standards (area)
LDW-06-T1-ES-COMP4	8270D: Di-n-butylphthalate Butylbenzylphthalate Bis(2-ethylhexyl)phthalate Di-n-octylphthalate	UJ UJ J UJ	Internal standards (area)
LDW-06-T1-ES-COMP2	8270D: Butylbenzylphthalate	UJ (all non-detects)	Internal standards (area)
LDW-06-T1-ES-COMP2 LDW-06-T1-ES-COMP3 LDW-06-T1-ES-COMP4 LDW-06-T1-A-TR004-ES-2 LDW-06-T1-B-TR001-ES-2 LDW-06-T1-B-TR001-ES-3 LDW-06-T1-B-TR001-ES-4 LDW-06-T1-B-TR001-ES-5 LDW-06-T1-C-TR019-ES-8 LDW-06-T1-D-TR023-ES-5 LDW-06-T1-E-TR009-ES-4 LDW-06-T1-F-TR011-ES-3	Aroclor 1016 Aroclor 1221 Aroclor 1232	UJ (all non-detects)	Continuing calibration %D

6 REFERENCES

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APPENDIX A

FIELD FORMS

APPENDIX B

LOCATION CONTROL DATA

APPENDIX C

CHAIN-OF-CUSTODY AND SAMPLE PROCESSING FORMS

APPENDIX D

LABORATORY DATA REPORT

APPENDIX E

DATA VALIDATION REPORT