APPENDIX F. BCM UPSTREAM DATA

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Acronyms

BCM	bed composition model
cfs	cubic feet per second
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
DF	detection frequency
DL	detection limit
DMMU	dredged material management unit
DOC	dissolved organic carbon
Ecology	Washington State Department of Ecology
FS	feasibility study
ID	identification
LDW	Lower Duwamish Waterway
MDL	method detection limit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEF	potency equivalency factor
RL	reporting limit
RM	river mile
TEF	toxic equivalency factor
TEQ	toxic equivalent
TOC	total organic carbon
TSS	total suspended solids
USACE	US Army Corps of Engineers
USGS	US Geological Survey

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F1 Introduction

This appendix presents the additional information related to the upstream datasets used to derive updated upstream input values for the bed composition model (BCM), which was developed in the Lower Duwamish Waterway (LDW) feasibility study (FS) (AECOM 2012). In the FS, a BCM was developed and used to predict future contaminant of concern (COC) concentrations in surface sediments, and therefore recovery potential following sediment remediation (AECOM 2012). The datasets discussed in this appendix include LDW Turning Basin core data, suspended solids data from Green River and bedded sediment data from upstream of the LDW. Discussions related to these data are in Section 8.2 of the main report.

F2 Sediment Core Data Collected from the Turning Basin (RM 4.3–RM 4.75) by USACE (2008–2017)

The LDW FS included core data from the Turning Basin area (RM 4.3 to 4.75) as a line of evidence for upstream inputs to the LDW. This is because the Turning Basin is designed as a settling basin for upstream solids and is dredged every few years to maintain this function. Thus, the material settling in the Turning Basin typically represents upstream inputs over time scales of 1-4 years.

The US Army Corps of Engineers (USACE) dredge characterization sediment samples collected from LDW river mile (RM) 4.3 through RM 4.75 (the Turning Basin-proper and just downstream) in 2008, 2009, 2011, and 2017 were included in the updated BCM upstream input dataset. The data from 2008 and 2009 were included in the FS (AECOM 2012).The 2011 and 2017 data have been included in the Task 2 existing data compilation (Windward and Integral 2018). Earlier data (e.g., those from the 1990s) from the Turning Basin were excluded from the updated Turning Basin dataset to focus on newer data.

F2.1 Location and Compositing Information

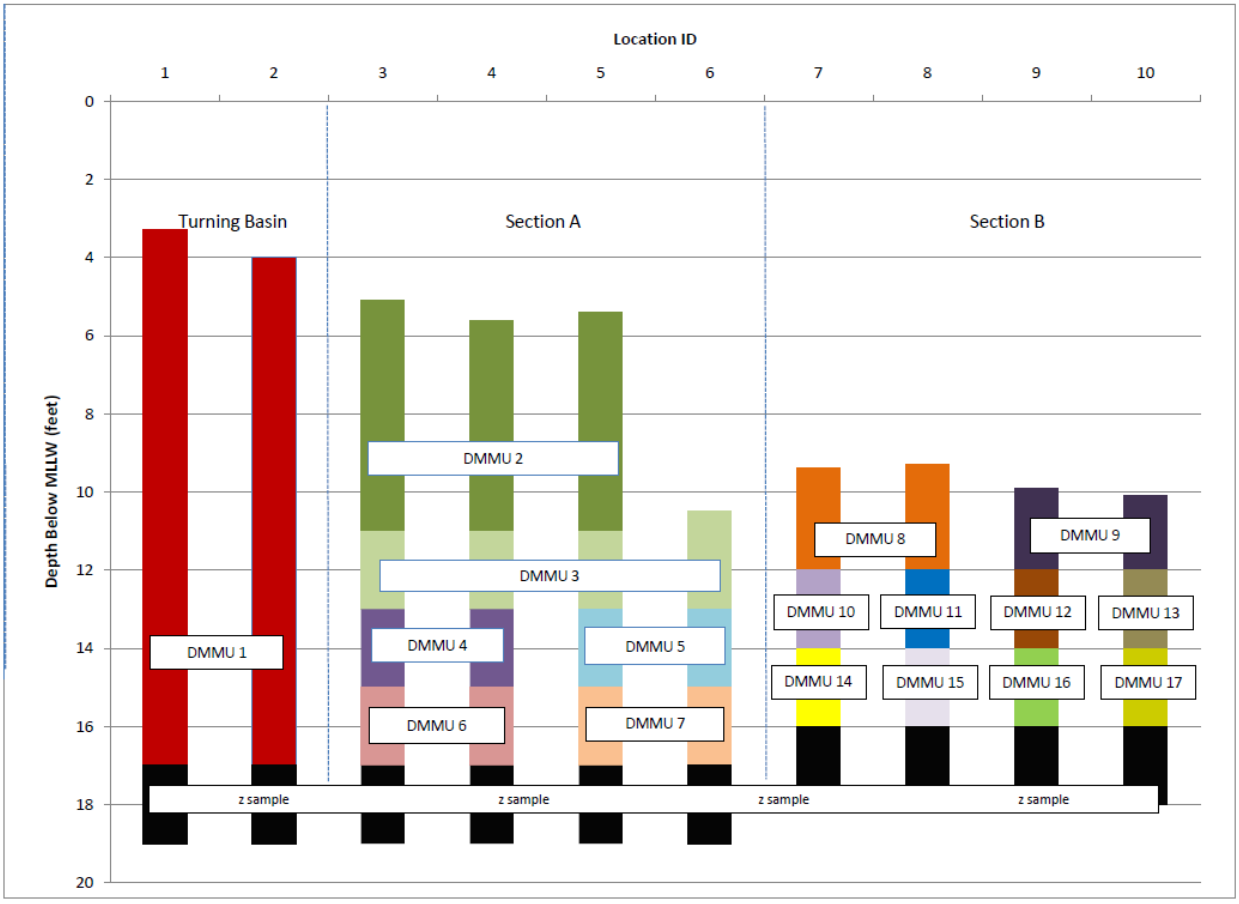
Attachment F1 to this appendix includes maps showing the locations where samples were collected from the Turning Basin. Each of the samples analyzed in this dataset was a composite; Table 2-1 summarizes the location, number of samples in each composite, and sample depths for the 2008, 2009, 2011, and 2017 data. Figure 2-1 (from the 2011 data's suitability determination (USACE 2011)) presents the compositing scheme for the 2011 samples.

Table F2-1. Turning Basin composite sample information

Year	Sample ID	Approximate RM	Number of Samples in Composite	Sample Depth
2008	DR08-A-D01-S	4.6-4.7	4	0-10 cm

Year	Sample ID	Approximate RM	Number of Samples in Composite	Sample Depth
2008	DR08-A-D02-S	4.3-4.6	4	0-10 cm
2009	DR09R-A-D01-C	4.6-4.7	4	0-13 ft
2009	DR09R-A-D02-C	4.3-4.6	4	0-13 ft
2011	DMMU-1	4.6-4.7	2	see Figure 2-1
2011	DMMU-2	4.3-4.6	2	see Figure 2-1
2011	DMMU-3	4.3-4.6	4	see Figure 2-1
2011	DMMU-4	4.4-4.6	2	see Figure 2-1
2011	DMMU-5	4.3-4.4	2	see Figure 2-1
2011	DMMU-6	4.4-4.6	2	see Figure 2-1
2011	DMMU-7	4.3-4.4	2	see Figure 2-1
2017	DUW17-SA-DMMU-01	4.3-4.4	4	range from 0-6 ft to 0-6.6 ft
2017	DUW17-SA-DMMU-02	4.4-4.5	4	range from 0-5.6 to 0-6.2 ft
2017	DUW17-SA-DMMU-03	4.5-4.6	4	range from 0-6.2 to 0-7 ft
2017	DUW17-SB-DMMU-09	4.3	2	0-3.8 ft and 0-4.3 ft
2017	DUW17-TB-DMMU-01	4.6-4.7	6	range between 0-4 ft and 0-11.4 ft

ID - identification
RM – river mile



Source: USACE (2011)

Note: Data from Section B were not considered because Section B is located downstream of RM 4.3.

Figure F2-1. 2011 Turning Basin samples locations, depths, and compositing information

F2.2 RESULTS

Table 2-2 presents a summary of the Turning Basin data for total polychlorinated biphenyls (PCBs), carcinogenic polycyclic aromatic hydrocarbon (cPAH) toxic equivalents (TEQs), dioxin/furan TEQs, and arsenic. Figure 2-2 presents boxplots of the distributions of the Turning Basin data by study year, and Figure 2-3 shows the distribution of the Turning Basin data for all study years combined. Figure 2-4 shows a temporal representation of the data by location (RM 4.3 to RM 4.5 and RM 4.5 to RM 4.75). Figure 2-4 is adapted from the FS and includes the data presented in the FS as well as the data discussed in this section.

Table F2-2. Sample results for Turning Basin samples

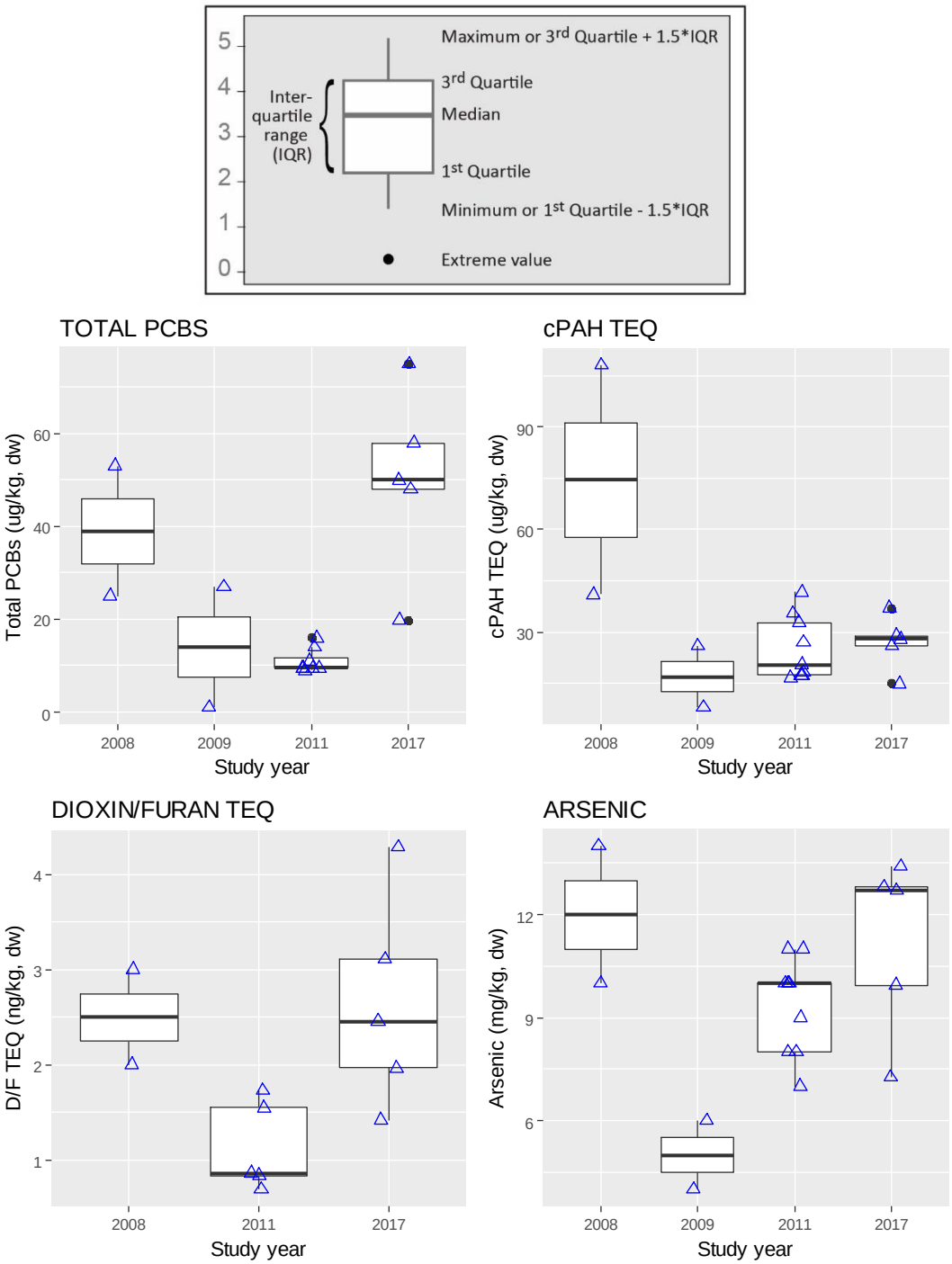
Year	Sample ID	Total PCBs (µg/kg)	cPAH TEQ (½DL) (µg/kg)	Dioxin/Furan TEQ (½ DL) (ng/kg)	Arsenic (mg/kg)
2008	DR08-A-D01-S	25	41	2	10
2008	DR08-A-D02-S	53	108	3	14

Year	Sample ID	Total PCBs (µg/kg)	cPAH TEQ (½DL) (µg/kg)	Dioxin/Furan TEQ (½ DL) (ng/kg)	Arsenic (mg/kg)
2009	DR09R-A-D01-C	2	8	-	4
2009	DR09R-A-D02-C	27	26	-	6
2011	DMMU-1	19 U	16.55	0.86	9
2011	DMMU-1	-	-	1.55	10
2011	DMMU-2	14 J	18.24	0.69	7
2011	DMMU-2	16 J	17.44	-	8
2011	DMMU-2	18 U	-	-	-
2011	DMMU-3	19 U	17.43	-	8
2011	DMMU-3	-	32.85	-	-
2011	DMMU-4	19 U	20.47	0.84	10
2011	DMMU-5	19 U	27.09	-	11
2011	DMMU-6	11 J	41.74	-	10
2011	DMMU-7	93 U[a]	35.45	1.73	11
2017	DUW17-SA-DMMU-01	48 J	29 J	1.97 J	13.4
2017	DUW17-SA-DMMU-02	58 J	28 J	3.11 J	12.8
2017	DUW17-SA-DMMU-03	50 J	26 J	4.29 J	9.94
2017	DUW17-SB-DMMU-09	75 J	37 J	2.46 J	12.7
2017	DUW17-TB-DMMU-01	19.8 J	15 J	1.42 J	7.26

Note: In the 2011 study, there are multiple results for some samples. The samples have the same sample name, date, time, and depth. These data are reported in the table as separate results with the same Sample ID.

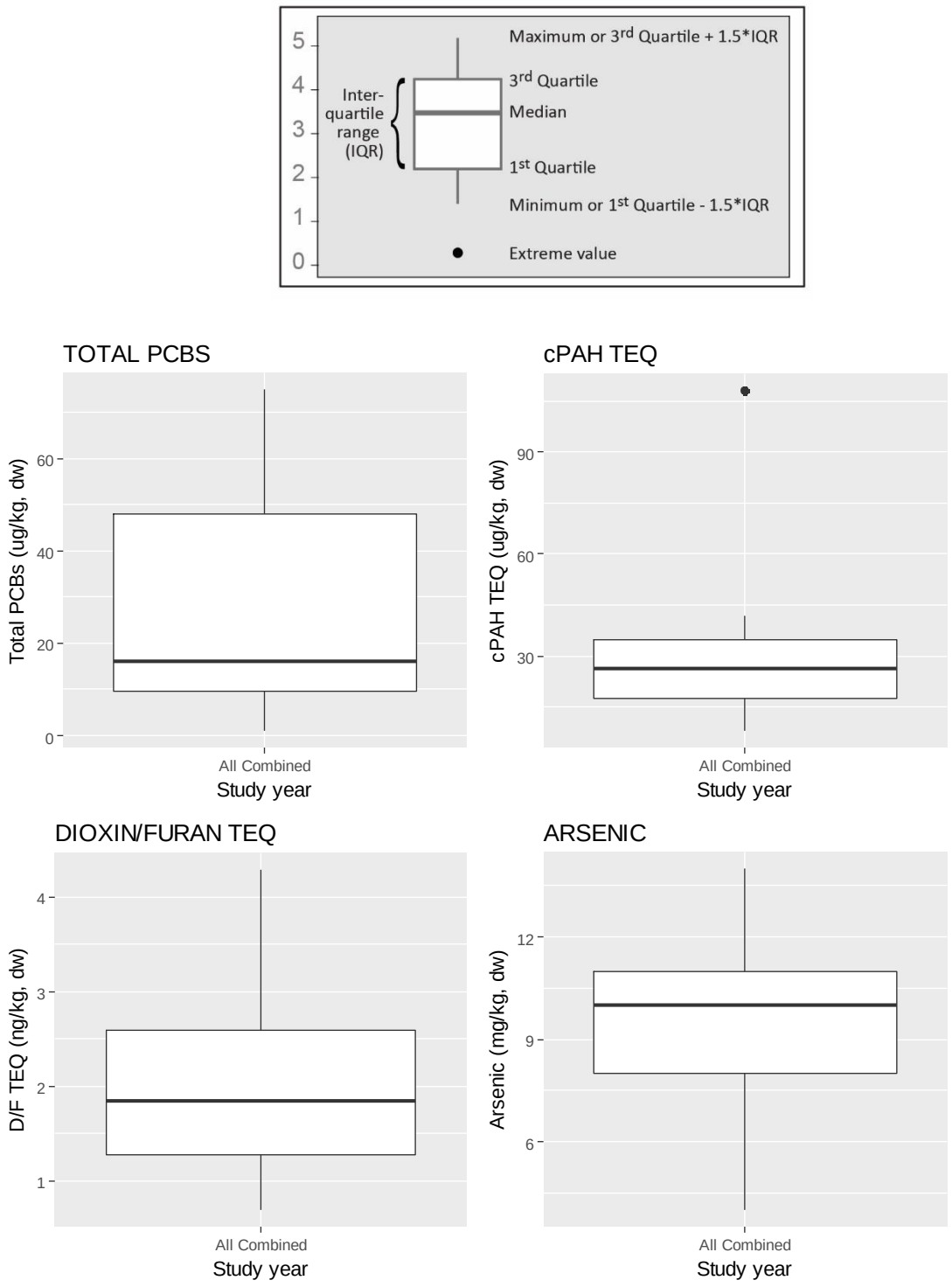
[a] This value was excluded from the analysis because of uncertainty of possible detected PCB concentration below the high RL.

cPAH – carcinogenic polycyclic aromatic hydrocarbon
DL – detection limit
ID – identification
J – estimated concentration
PCB – polychlorinated biphenyl
RL - reporting limit
TEQ – toxic equivalent
U – not detected at given concentration



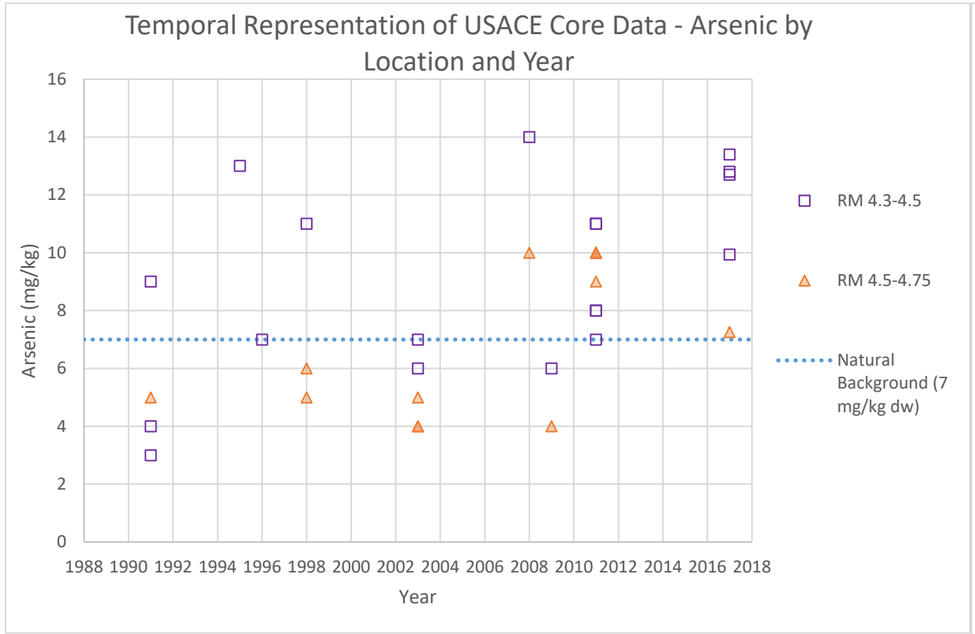
Note: Blue triangles are individual data points that constitute the "distribution;" values are 'jittered' along the horizontal axis to avoid over-plotting when values are the same/similar. PCB values below detection are shown at ½ DL; the high non-detect (93 U) was excluded. TEQs were calculated using ½ RLs for non-detects.

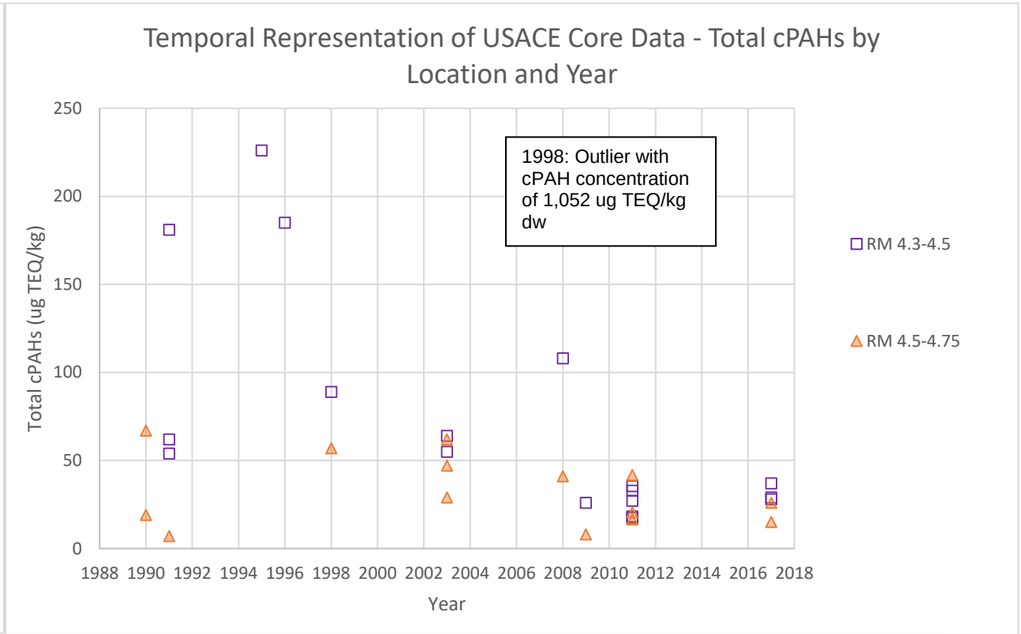
Figure F2-2. Distribution of Turning Basin data by study year

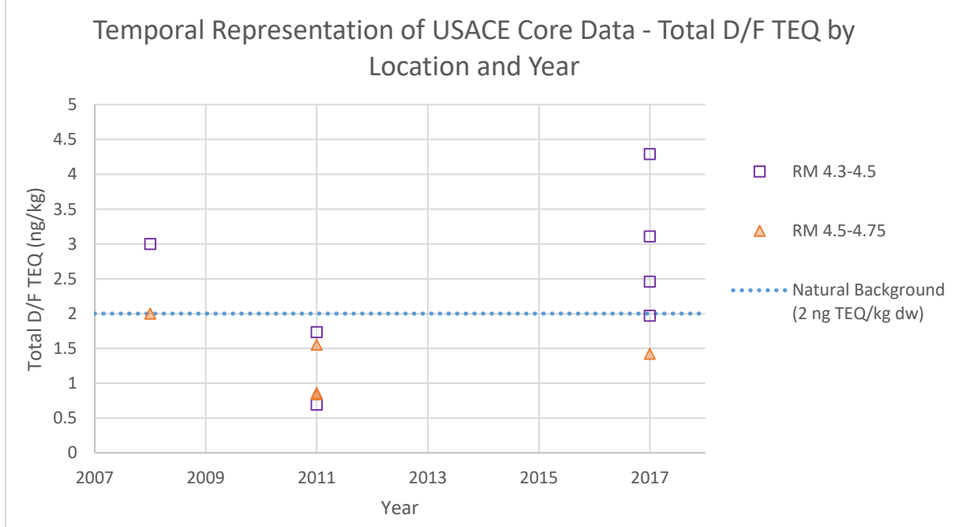


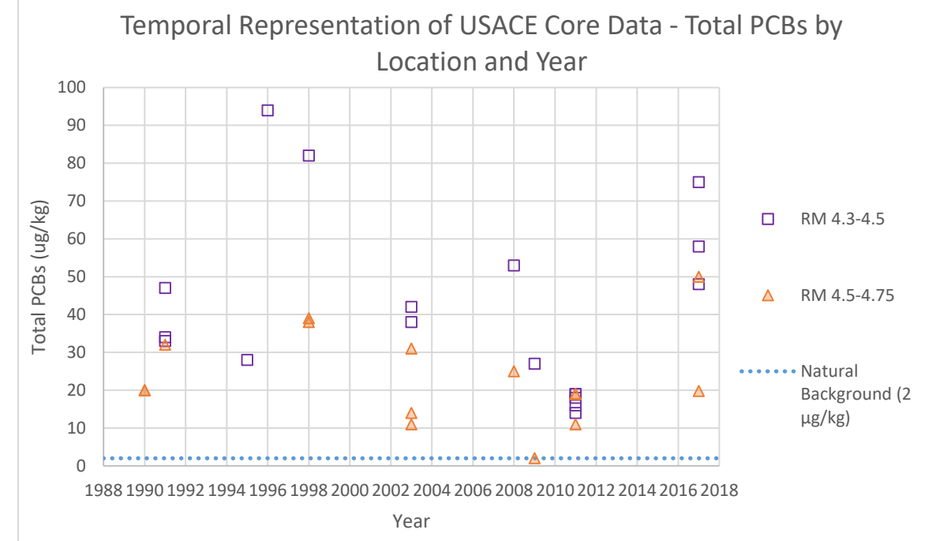
Note: PCB values below detection are shown at ½ DL; the high non-detect (93 U) was excluded. TEQs were calculated using ½ RL for non-detects.

Figure F2-3. Distribution of Turning Basin data, years 2008-2017 combined









Note: Source of natural background concentrations is EPA (2014).

Figure F2-4. Temporal representation of USACE data by location and year

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F2.3 cPAH NON-DETECTED VALUES

In the 2008 and 2009 data, all seven cPAH compounds used to calculate cPAH TEQs were detected. In the 2011 and 2017 data, not all compounds were detected, and in some cases, non-detected results contributed the majority of the cPAH TEQ. Table 2-3 provides a summary of detection frequencies (DFs) and reporting limits (RLs) for the cPAH TEQ data. Figure 2-5 shows the contribution of non-detected results to total cPAH TEQs from the 2008, 2009, 2011, and 2017 data. Due to the contribution of non-detected results in calculating cPAH TEQs, cPAH TEQs are uncertain.

Table F2-3. Summary of detections and RLs for cPAHs

Year	Sample	No. of cPAHs Detected	No. of cPAHs Not Detected	RLs (ug/kg)
2008	DR08-A-D01-S	6	0	na
2008	DR08-A-D02-S	6	0	na
2009	DR09-A-D01-C	6	0	na
2009	DR09-A-D02-C	6	0	na
2011	DMMU-1	2	4	18 (same DL reported for all non-detect components in this sample)
2011	DMMU-2-1	4	2	18 (same DL reported for all non-detect components in this sample)
2011	DMMU-2-2	2	4	19 (same DL reported for all non-detect components in this sample)
2011	DMMU-3-1	2	4	19 (same DL reported for all non-detect components in this sample)
2011	DMMU-3-2	4	2	19 (same DL reported for all non-detect components in this sample)
2011	DMMU-4	4	2	19 (same DL reported for all non-detect components in this sample)
2011	DMMU-5	5	1	19 (same DL reported for all non-detect components in this sample)
2011	DMMU-6	5	1	19 (same DL reported for all non-detect components in this sample)
2011	DMMU-7	5	1	19 (same DL reported for all non-detect components in this sample)
2017	DUW17-SA-DMMU-01	4	2	benzo(a)pyrene = 31 UJ; dibenzo(a,h)anthrancene = 16 UJ
2017	DUW17-SA-DMMU-02	4	2	benzo(a)pyrene = 29UJ; dibenzo(a,h)anthrancene = 17 UJ
2017	DUW17-SA-DMMU-03	5	1	benzo(a)pyrene = 31 UJ
2017	DUW17-SB-DMMU-09	5	1	benzo(a)pyrene = 39 UJ
2017	DUW17-TB-DMMU-01	4	2	benzo(a)pyrene = 18 UJ; dibenzo(a,h)anthrancene = 3.0 UJ

cPAH – carcinogenic polycyclic aromatic hydrocarbon
DL – detection limit
na - not available
RL – reporting limit
TEQ – toxic equivalent
UJ – not detected at given concentration; estimated concentration

Note: Benzo(b) and benzo(k) fluoranthene were reported together, resulting in a count of six cPAHs.

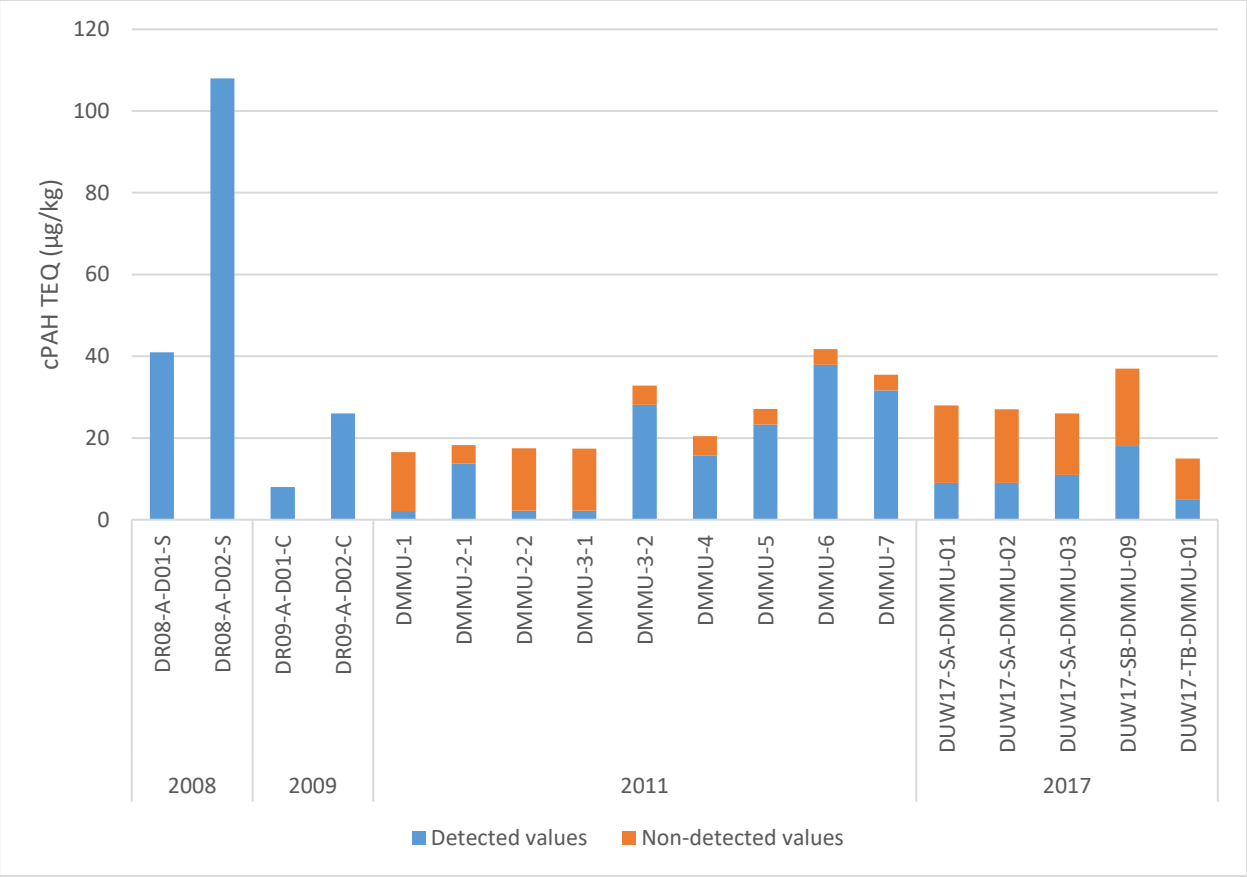


Figure F2-5. Contribution of non-detected values to cPAH TEQs in Turning Basin cores data (ND = ½ RL)

F2.4 DIOXIN/FURAN NON-DETECTED VALUES

The dioxin/furan congeners used to calculate dioxin/furan TEQs were all detected in 1 of the 12 Turning Basin cores samples from 2008, 2011, and 2017. Dioxin/furan TEQ results were not available for 2009. Table 2-4 presents the DF and range of RLs for individual dioxin/furan congeners used to calculate dioxin/furan TEQs in the Turning Basin cores data. Figure 2-6 shows the contributions of non-detected concentrations to dioxin/furan TEQs. Due to the contribution of non-detected concentrations, some dioxin/furan TEQs are uncertain.

Table F2-4. Summary of detections and RLs in dioxin/furan congeners

Study Year	Sample ID	No. of Congeners Detected	No. of Congeners Not Detected	RL Range (ng/kg)
2008	DR08-A-D01-S	13	4	0.107–0.302
2008	DR08-A-D02-S	14	3	0.148–0.396
2011	DMMU-1 1	12	5	0.0878–0.305
2011	DMMU-1 2	17	0	na

Study Year	Sample ID	No. of Congeners Detected	No. of Congeners Not Detected	RL Range (ng/kg)
2011	DMMU-2	10	7	0.0661–0.259
2011	DMMU-4	10	7	0.0775 - 0.182
2011	DMMU-7	13	4	0.176–0.477
2017	DUW17-SA-DMMU-01	8	9	0.250–1.42
2017	DUW17-SA-DMMU-02	12	5	0.372–1.17
2017	DUW17-SA-DMMU-03	11	6	0.269–1.92
2017	DUW17-SB-DMMU-09	8	9	0.327–1.1
2017	DUW17-TB-DMMU-01	9	8	0.133–0.587

ID – identification
na - not available
RL – reporting limit
TEQ – toxic equivalent

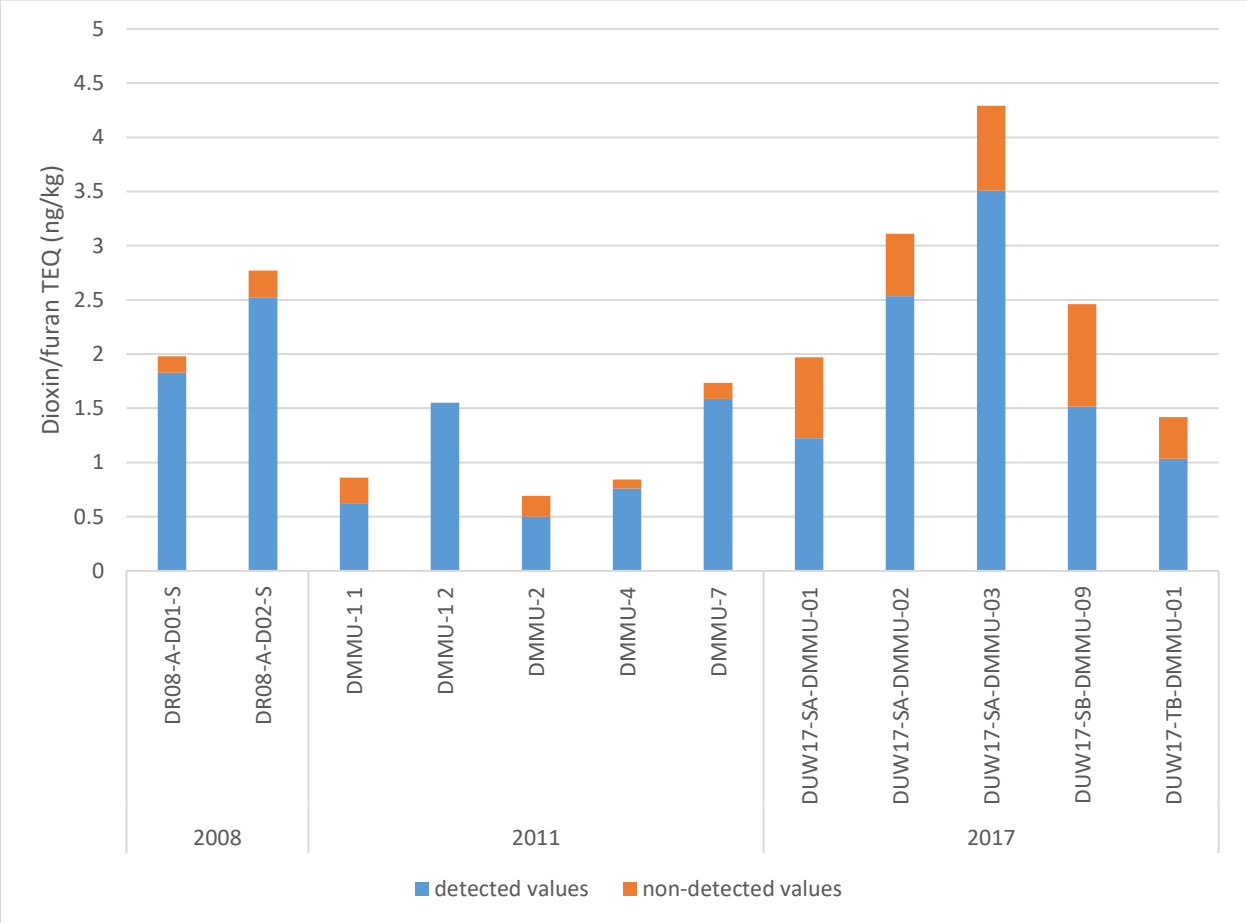


Figure F2-6. Contribution of non-detected values to total dioxin/furan TEQs in Turning Basin cores data (2008, 2011, and 2017) (ND = ½ RL)

F2.5 GRAIN SIZE DISTRIBUTION

Table 2-5 presents total percent fines and total PCB concentrations in each of the Turning Basin samples. Higher total PCB concentrations are sometimes associated with samples with higher percent fines. Sample DR08-A-D02-S and samples collected in 2017 from Section A and Section B (i.e., 2017 sample IDs containing "SA" and "SB" in Table 2-5) have higher PCB concentrations and percent fines. Samples located in the Turning Basin-proper are shaded green. Total fines in the Turning Basin-proper samples were less than 20%.

Table F2-5. Percent fines and total PCB concentrations

Year	Sample ID	Total Fines (%)	Total PCBs (µg/kg)
2008	DR08-A-D01-S	19	25
2008	DR08-A-D02-S	74.1	53
2009	DR09R-A-D01-C	6.1	2
2009	DR09R-A-D02-C	23.3	27
2011	DMMU-1	9.1	19 U
2011	DMMU-2	11.3	14 J
2011	DMMU-2	-	16 J
2011	DMMU-2	-	18 U
2011	DMMU-3	16.6	19 U
2011	DMMU-4	24.8	19 U
2011	DMMU-5	38.9	19 U
2011	DMMU-6	25.1	11 J
2011	DMMU-7	38.1	93 U
2017	DUW17-SA-DMMU-01	54.33	48 J
2017	DUW17-SA-DMMU-02	52.63	58 J
2017	DUW17-SA-DMMU-03	48.36	50 J
2017	DUW17-SB-DMMU-09	71.06	75 J
2017	DUW17-TB-DMMU-01	18.71	19.8 J

Green shaded rows indicate samples from the Turning Basin-proper.
ID – identification
J – estimated concentration
PCB – polychlorinated biphenyl

F3 Suspended Solids

The LDW FS included suspended solids data as a line of evidence for upstream inputs to the LDW. Suspended solids samples were collected in the Green River at the Foster Links Golf Course (Tukwila, Washington) by the US Geological Survey (USGS) and King County, from 2013 to 2017 and 2013 to 2015, respectively. Suspended solids data

from the Washington State Department of Ecology (Ecology) were collected in the Green River at the 119th Street footbridge location near Tukwila (RM 6.7) from 2008 to 2009. The Ecology data were included as reported in the FS (AECOM 2012). Suspended solids collected by Ecology and USGS were centrifuged, while samples collected by King County were filtered or collected in sediment traps. Total water data collected upstream of the LDW were not used in the updated dataset because 1) newer suspended solids data are available, and 2) using the water data by assuming all chemicals were sorbed to solids led to a high bias.

F3.1 US GEOLOGICAL SURVEY CENTRIFUGED SOLIDS

USGS collected data from the Green River at the Foster Links Golf Course in Tukwila (USGS water quality site 12113390 - RM 10.4) during periods of different flow conditions over multiple years (Conn et al. 2018; Conn and Black 2014; Conn et al. 2015). USGS collected samples by filling a Teflon bucket with 700 to 10,000 L (2014 to 2015) or 500 to 5,000 L (2016 to 2017) of whole water samples that included suspected solids pumped from the thalweg at 80% depth. Suspended sediment was collected from the sample by flow-through centrifuging, conducted concurrently with water chemistry sampling. The percentage of fines in the samples ranged from 56 to 95%, depending on season and weather conditions. Samples were collected during three types of events: baseflow, storm, and storm with significant water release from Howard Hanson Dam (2,000 cfs).

The suspended solids were analyzed for 209 PCB congeners, 17 dioxin/furans congeners, cPAHs and arsenic. Dioxin/furan TEQs were calculated according to the World Health Organization 2005 guidelines (Van den Berg et al. 2006). When a dioxin or furan congener was not detected, the value was noted as one-half the detection limit (DL). For total PCBs, only detected congeners were included in the sum. If all congeners were non-detects, the total value was assigned the highest DL or RL. cPAHs were calculated using potency equivalency factor (PEF) values listed in California EPA (2005).[1] If a reported concentration for a polycyclic aromatic hydrocarbon (PAH) included in the calculation of a cPAH TEQ was below detection, one-half the DL was used.

F3.2 KING COUNTY FILTERED SOLIDS AND SEDIMENT TRAPS

King County collected suspended solids samples using sediment traps and as filtered solids from 2013 to 2015 from two Green River locations and four major tributaries (King County 2016); only the samples collected from Green River at Foster Links Golf Course sampling station (RM 10.4) were considered for BCM inputs.

[1] The PEF values listed in California EPA (2005) are the same as the PEFs listed in the Data Management Plan for the LDW (Appendix C of the *Pre-design Studies Work Plan* (Windward and Integral 2017)) except for dibenz(a,h)anthracene, which is listed as 0.1 in California EPA (2005) and 0.4 in the LDW data management plan.

Two types of sediment traps, baffle and jar, were used at the Foster Links location. The targeted sampling period for sediment traps was three months; two dry seasons and three wet seasons were targeted. Baffle sediment traps collected a greater volume of solids and were used for 5 collection periods. Jar sediment traps were deployed at Green River Foster Links during four of the 5 baffle collection periods to allow comparison to the baffle trap samples.

Filtered solids samples were collected with purpose-built devices obtained from Ecology. The devices pump water through 20-inch long, 4-inch diameter 5-micron bag-type polypropylene felt filters to trap suspended solids. Solids from filter bags were removed at the King County laboratory and processed for analyses. Filtered solids samples were collected during three types of events: baseflow, storm, and storm with significant water release from Howard Hanson Dam (2,000 cfs). Storm event samples were collected over a 12 to 24-hour period and baseflow events over 36 to 72-hour period.

The suspended solids were analyzed for 209 PCB congeners[2], 17 dioxin/furans congeners, cPAHs, arsenic and conventional parameters. Dioxin/furan TEQs were calculated according to the World Health Organization 2005 guidelines (Van den Berg et al. 2006). When a dioxin or furan congener was not detected, the TEF was applied to the non-detect values. For total PCBs, only detected congeners were included in the sum. When both Aroclor and congener data were available, total PCBs were based on congener data. At least one congener was detected in all samples. cPAHs were calculated using PEF values. If a reported concentration for a PAH included in the calculation of cPAH TEQ was a non-detect, one-half the method detection limit (MDL) concentration was used.

F3.3 ECOLOGY CENTRIFUGED SOLIDS

Centrifuged solids data were collected by Ecology in late 2008 and early 2009 (Ecology 2009) at the 119th Street footbridge location near Tukwila (RM 6.7). Samples of suspended material were collected on seven occasions at this location under varying flow and rainfall conditions. Sampling was conducted by pumping river water into continuous-flow centrifuges and through stainless steel sieves to collect enough mass of suspended sediment from the water column to analyze risk driver concentrations associated with different size ranges of suspended sediments.[3] Several discrete samples were collected from the water column every 3 hours (to coincide with tidal phases) over 1 to 2 full tidal cycles (24 to 48 hours) and then composited. Water quality parameters, such as total suspended solids (TSS), total organic carbon (TOC), and dissolved organic carbon (DOC) were analyzed, as well as PCB Aroclors, arsenic,

[2] The study first analyzed PCBs as Aroclors but due to low number of detections, PCB congener method was used for the remainder of the study.

[3] Particles collected were those caught by a 250-µm mesh sieve (medium-coarse sands) and a 63-µm mesh sieve (fine-medium sands), as well as other fine particles.

PAHs, and dioxins/furans. These data are presented in Appendix C of the FS (AECOM 2012).

The Ecology samples were generally representative of sediments suspended mid-channel in the Green River that would have entered the LDW. This assertion is based on elements of the study design, choice of field methods, field measurements, and validated analytical results.

F4 Bedded Sediment Data

F4.1 US Geological Survey Upstream Samples

USGS collected seven bed sediment samples in May/June 2013, July/September 2014 and February/March 2015 (Conn and Black 2014; Conn et al. 2015). The top 10 cm of sediment were collected from as many as 10 depositional areas with fine grain particles at locations 1,000 m upstream and downstream from the Green River Foster Links suspended sediment sampling location (RM 10.4). The bed sediment samples were collected and composited with Teflon and glass sampling supplies. All samples were sieved to 2 mm, with metal samples passed through a nylon sieve and organic samples passed through a stainless-steel sieve. Sampling methods were consistent for both the 2013 and 2015 efforts.

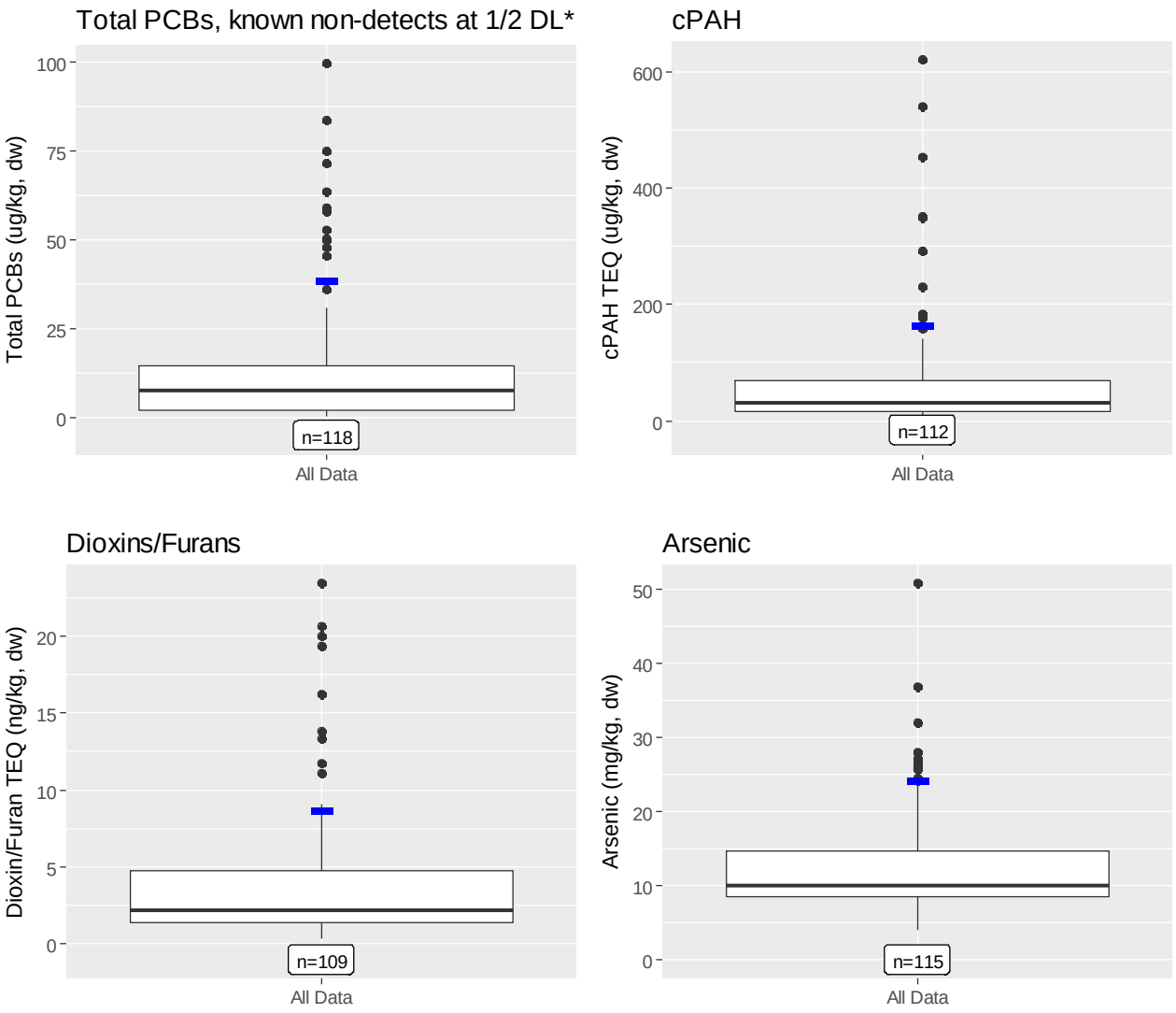
The sieved sediment samples were analyzed for 209 PCB congeners, 17 dioxin/furans congeners, cPAHs and arsenic. Dioxin/furan TEQs were calculated based on the summation of 17 TEF values. When a dioxin or furan congener was not detected, the value was noted as one-half the DL. For total PCBs, only detected congeners were included in the sum. If all congeners were non-detects, the total value was assigned the highest DL or RL. cPAHs were calculated using PEF values. If a reported concentration for a PAH included in the calculation of cPAH TEQ was below detection, one-half the DL was used.

F4.2 Ecology Upstream Samples

This study assessed the potential point sources located in these upstream areas. Seventy-four samples were collected. TOC and fines percentages were lower in the upstream surface sediment than in surface sediment from the upper Turning Basin, and lower contaminant concentrations tended to be associated with lower TOC and fines. To account for the grain size bias in the upstream sediment samples, only samples with > 30% fines (n = 31) were considered in the statistical analysis and in setting the range of upstream input values for the BCM in the FS; the data were treated the same for the updated BCM input value assessment.

F5 All upstream data combined

Solids data discussed above were also combined together in their entirety to indicate over-all central tendencies of the data (Figure 5-1). No upstream input parameters were selected from these plots; instead the data were used as a general supporting line of evidence (Section 8 of the main report).



*The datapoint with high non-detect value (93U) was omitted.

Blue lines indicate 90th percentile. Fine-grained upstream bedded sediments, combined suspended sediments, and Turning Basin cores datasets are included.

Figure F5-1. Distributions of all BCM upstream input value datasets combined

F6 References

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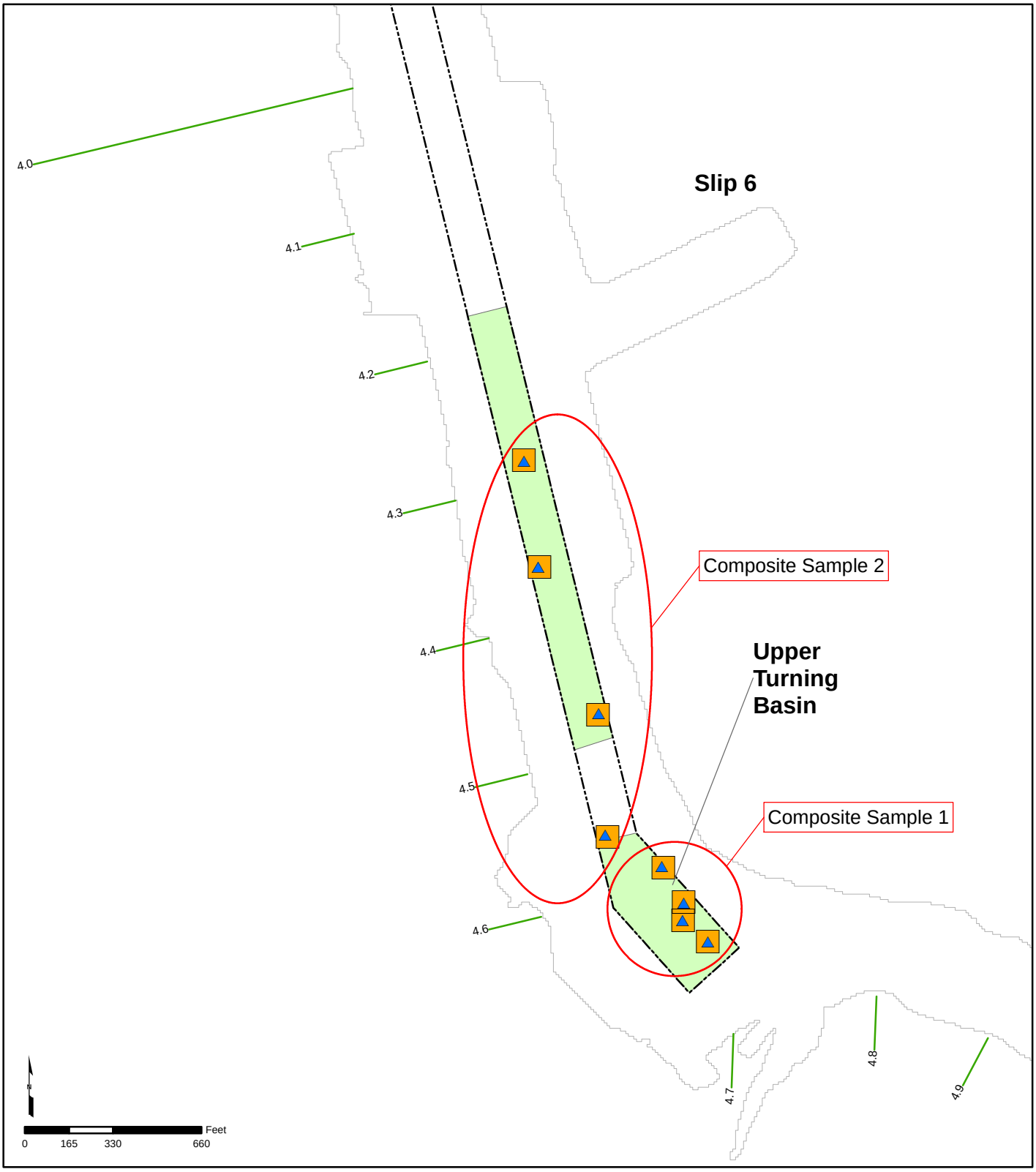
Attachment F1. Maps of USACE Turning Basin Sediment Data

This attachment includes the following maps from the associated sources:

- 2008 and 2009 Maps
  - AECOM (2012)
  - SAIC (2009)
- 2011 Maps
  - USACE (2011)
- 2017 Maps
  - USACE (2018)

2008-2009 Maps



Notes:
1. Sample data provided by SAIC and USACE in September 2009. Final data reports published in October and November 2009.
2. Stations downstream of RM 4.3 not shown.

Legend

- River Mile Marker
- Navigation Channel
- 2008 Surface Sample Location
- 2009 Core Sample Location
- 2010 Dredging Footprint

AECOM Lower Duwamish Waterway Group
Port of Seattle / City of Seattle / King County / The Boeing Company

Lower Duwamish Waterway Final Feasibility Study 60150279-14.46			**2008 & 2009 Pre-Dredging Event Sampling Locations from Upper Reach**	
DATE: 10/15/10	DRWN:MVI/sea	Revision: 0		**FIGURE 5b**

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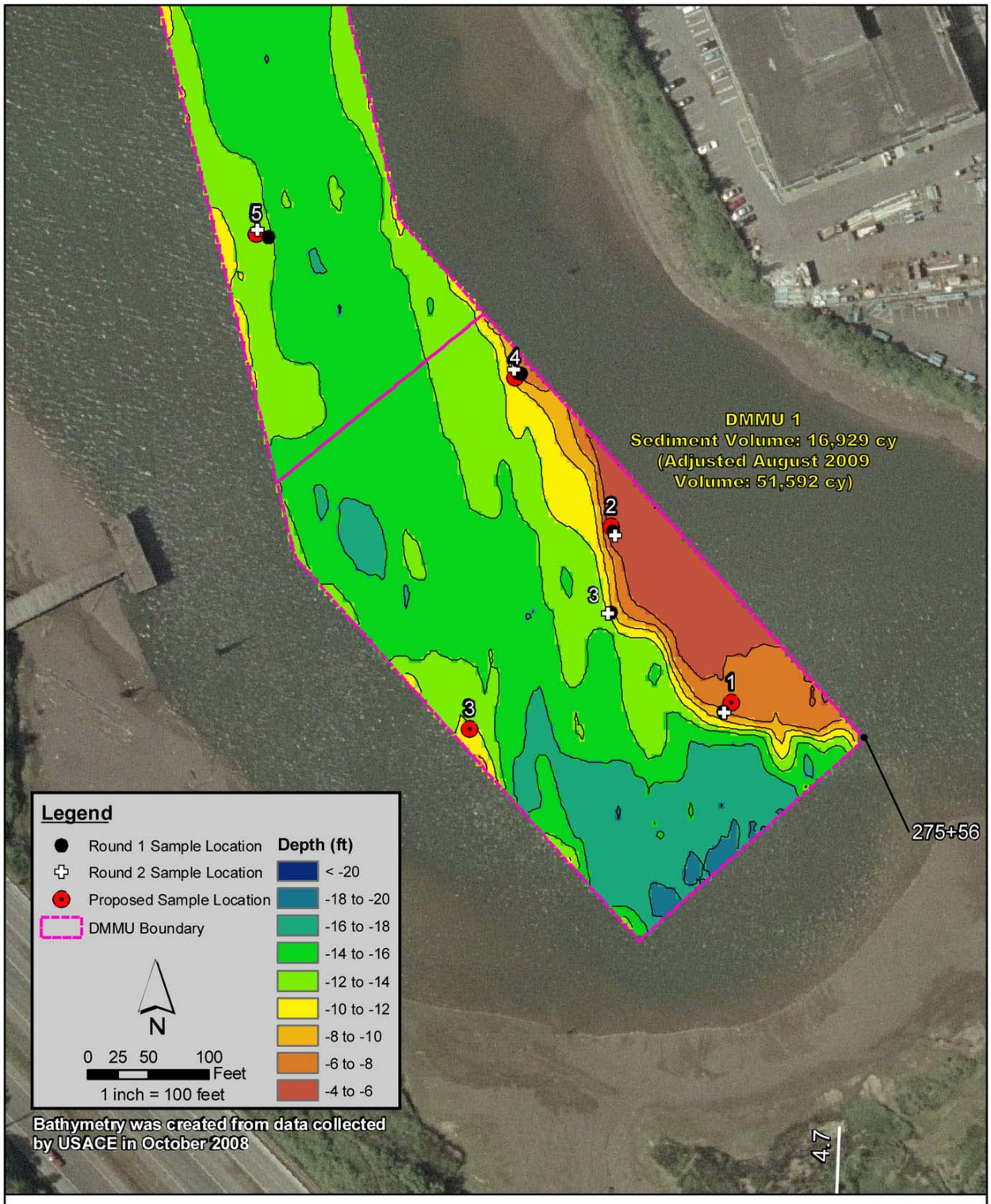

Figure 2–1. Target and Actual Sampling Locations in Section A, DMMU 1

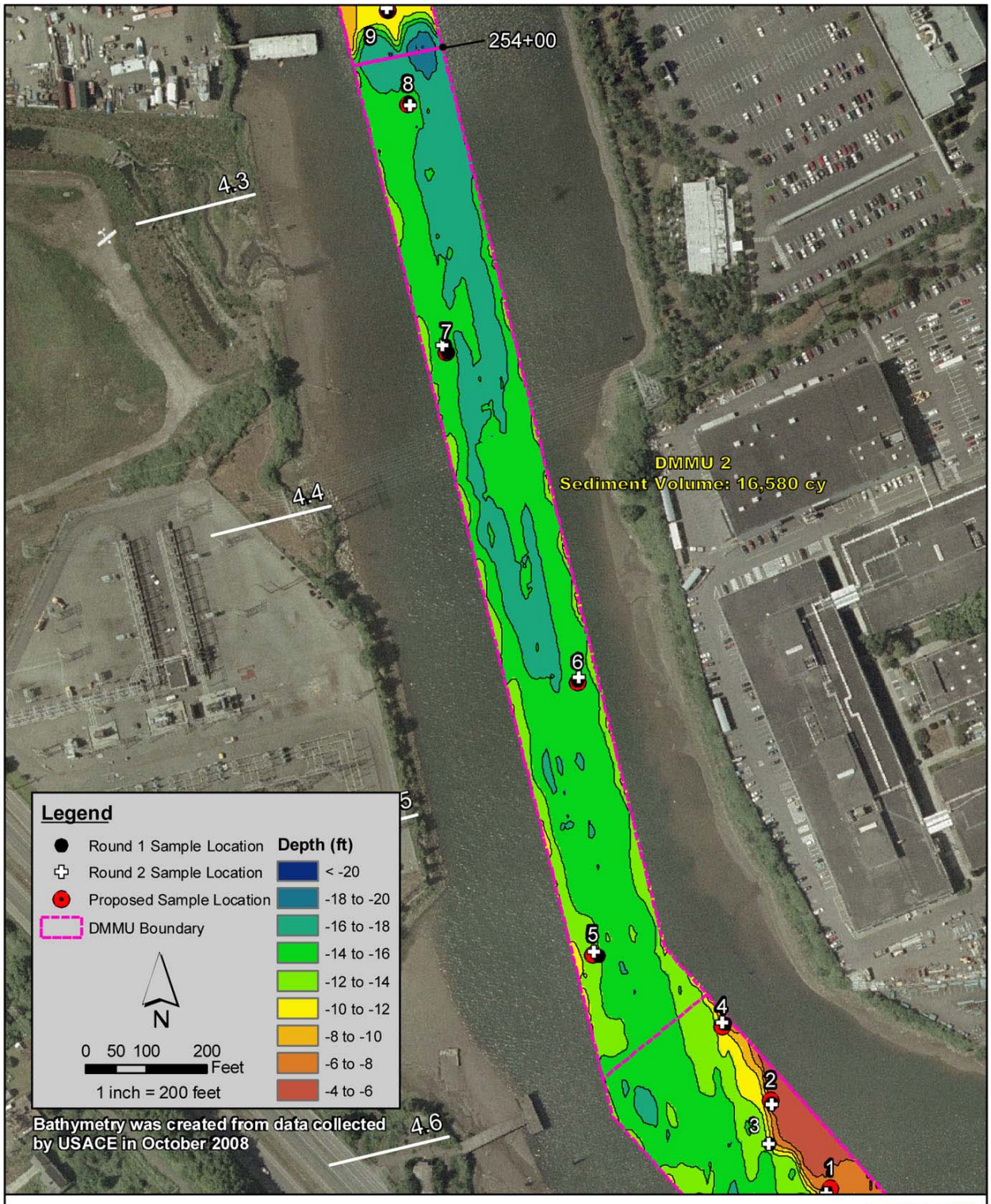

Figure 2–2. Target and Actual Locations in Section A, DMMU 2

SAIC From Science to Solutions

L. Delwiche, 2008

2011 Maps

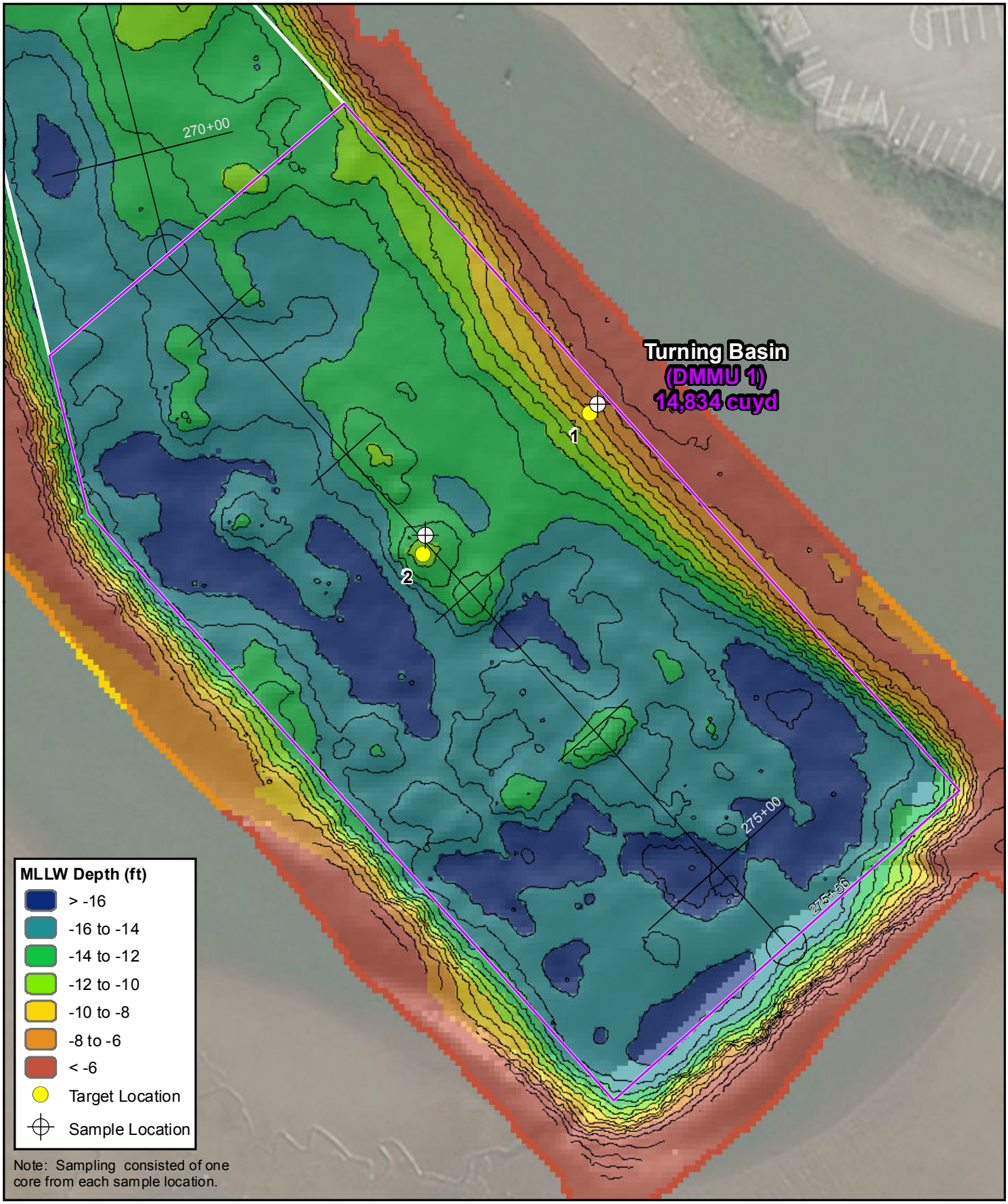

Figure 3. DMMU1 Target and Actual Sampling Locations

N

0 25 50 100 Feet

NEWFIELDS

J. Nuwer, June 2011

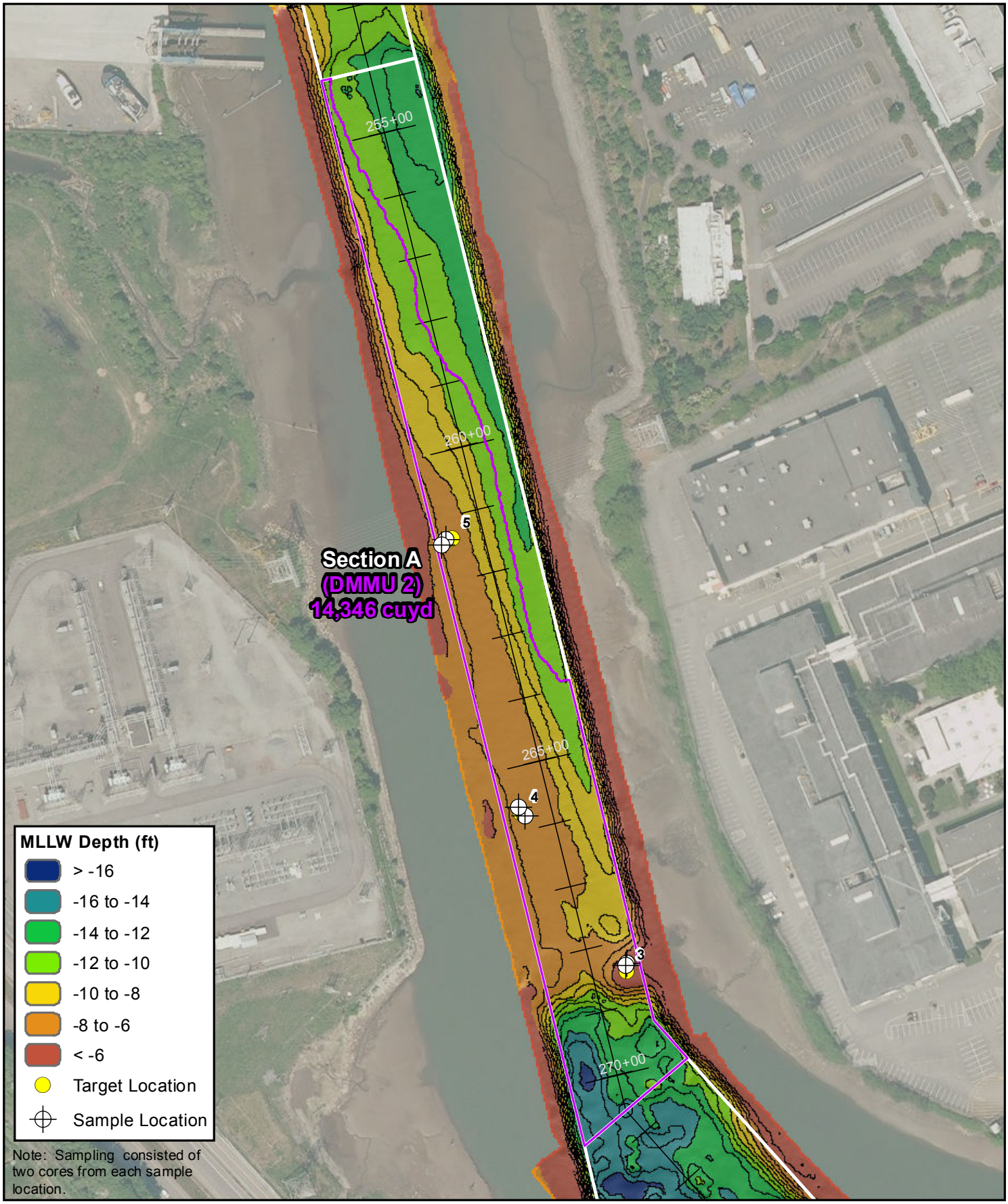

Figure 5. DMMU2 Target and Actual Sampling Locations

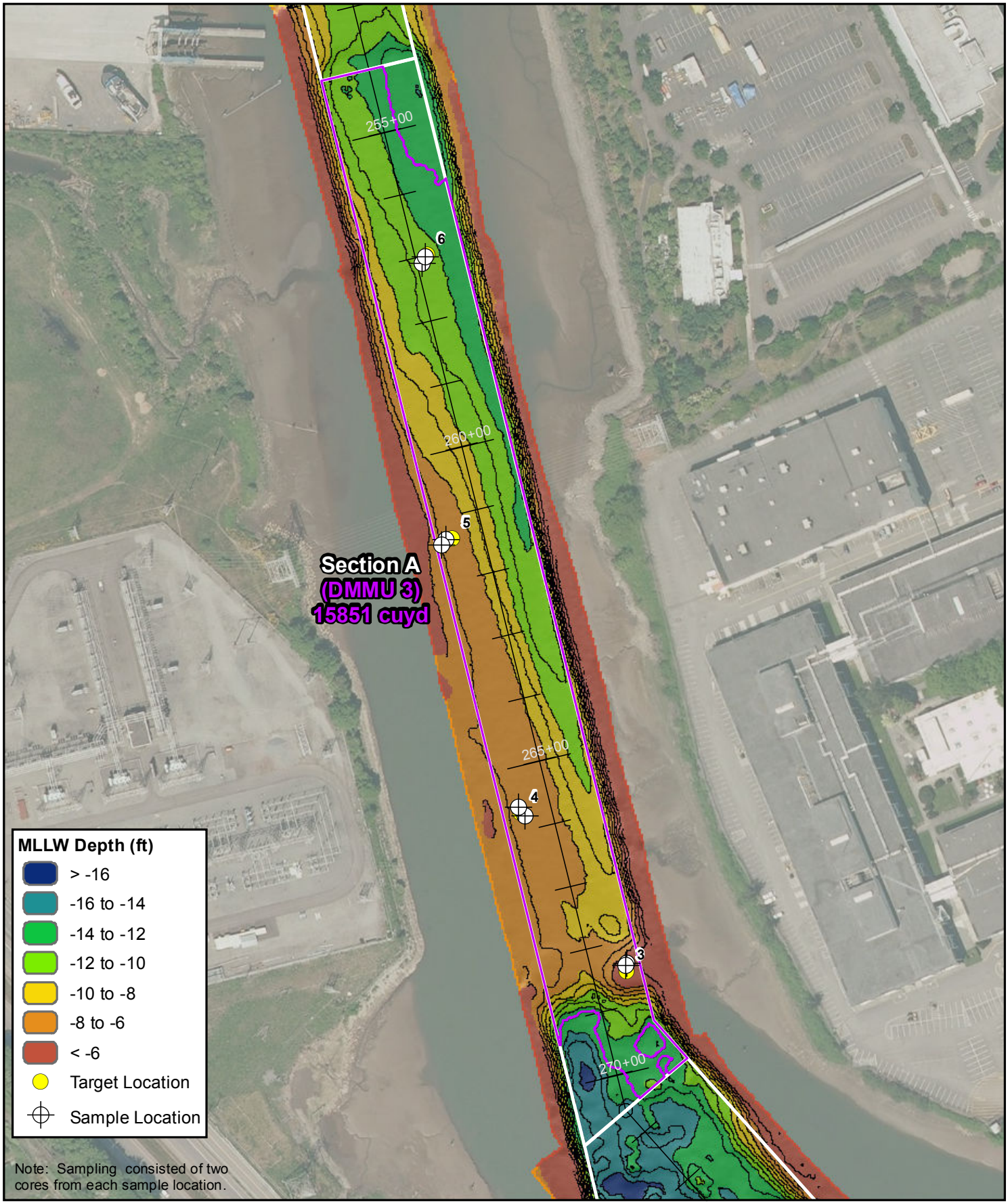

Figure 6. DMMU3 Target and Actual Sampling Locations

N

0 50 100 200 Feet

NEWFIELDS

J. Nuwer, June 2011

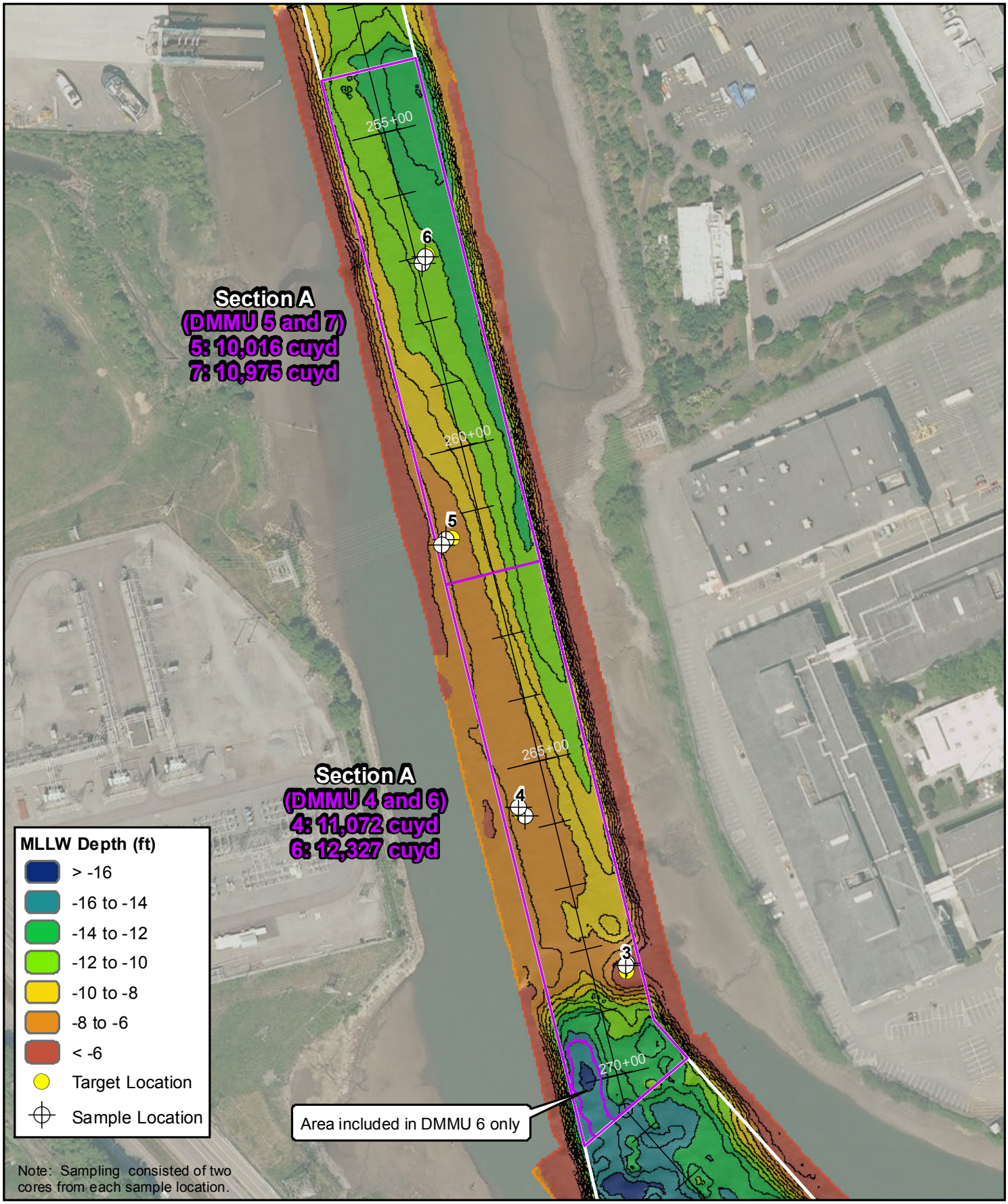

Figure 7. DMMU 4 through 7 Target and Actual Sampling Locations

N

0 50 100 200 Feet

NEWFIELDS

J. Nuwer, June 2011

2017 Maps

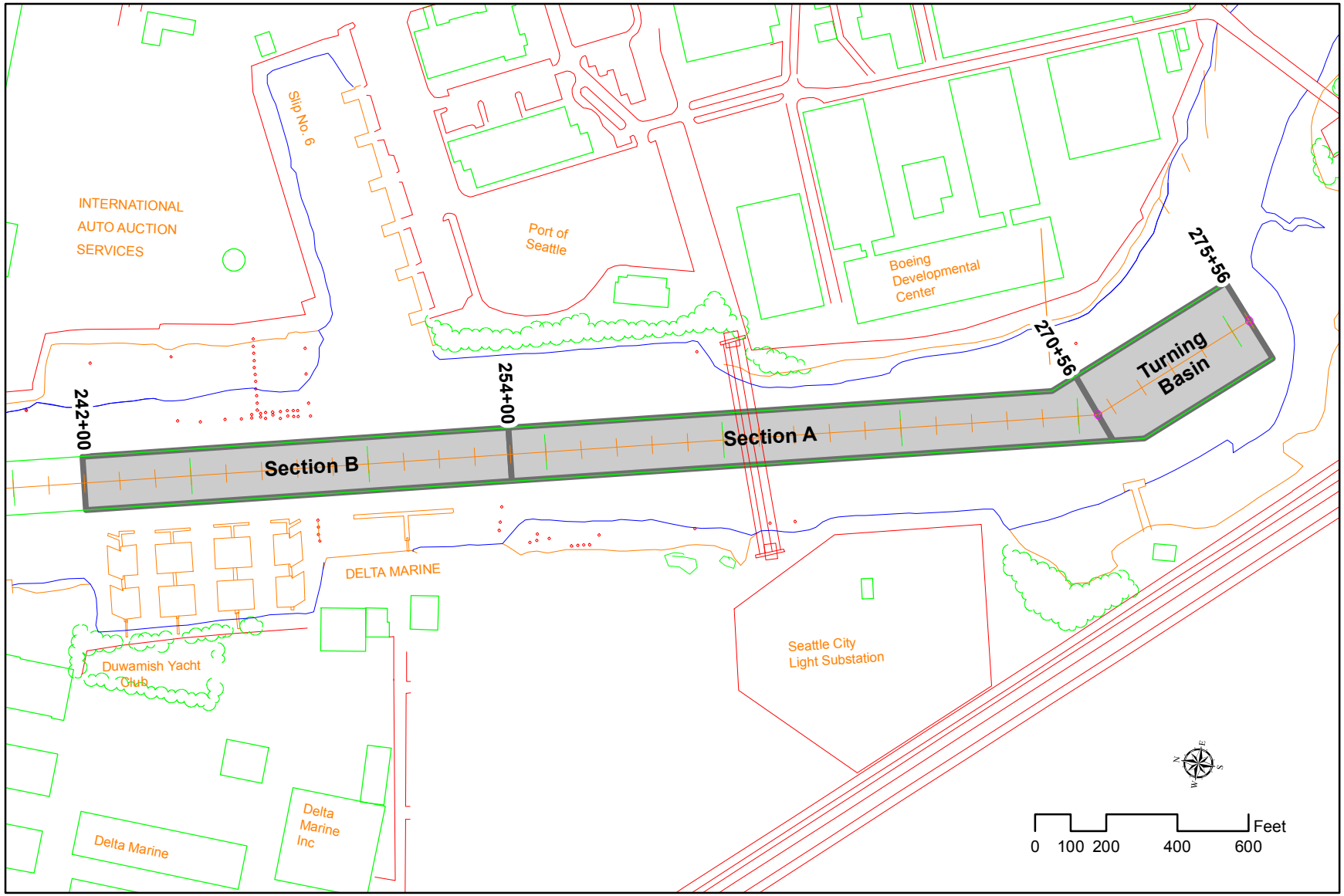

Figure 2. Proposed Dredging Area in the Upper Duwamish Waterway

Figure 3. Section A and Turning Basin Proposed and Actual Station Locations (from Anamar\EcoAnalysts, 2018)

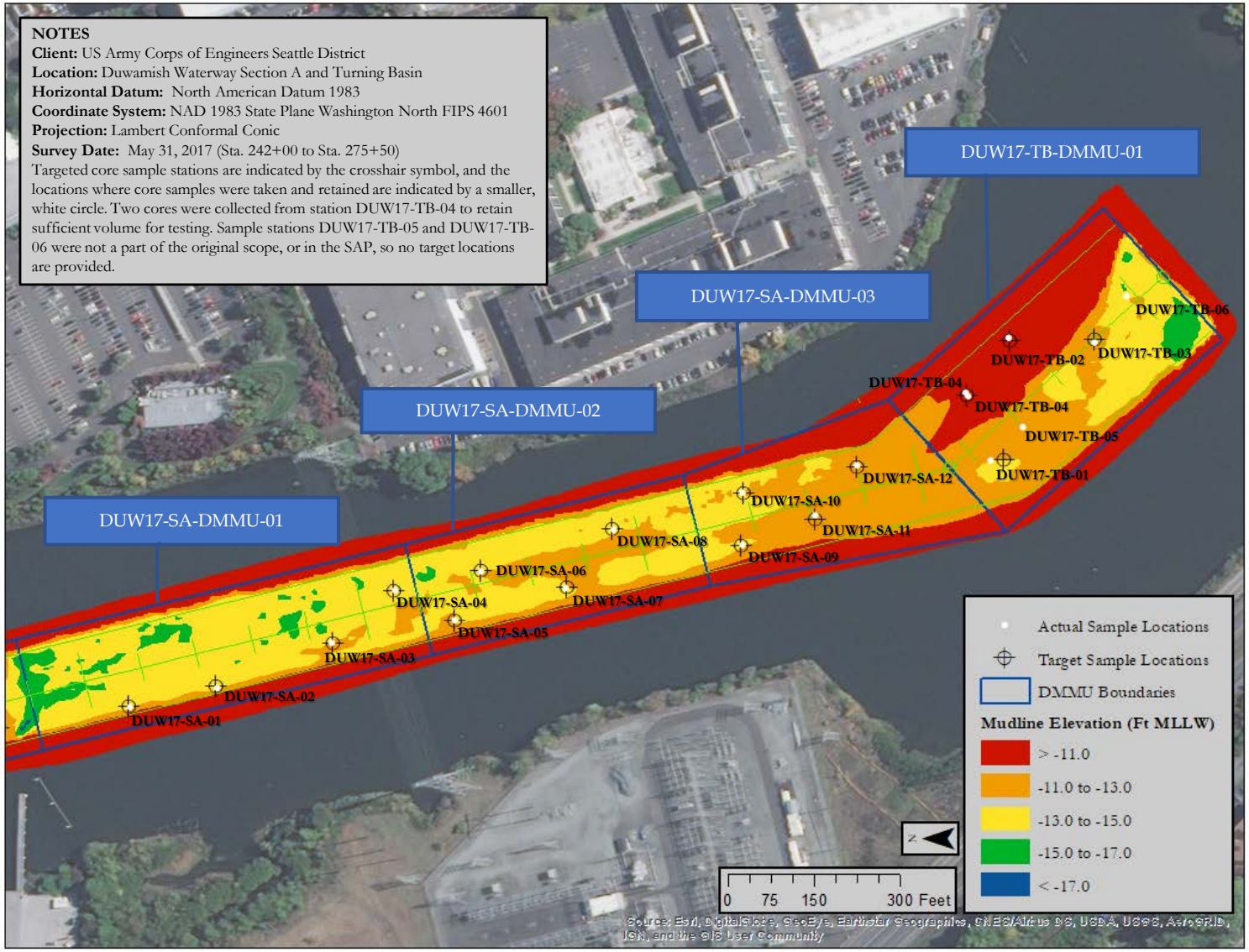

Figure 4. Section B Proposed and Actual Station Locations (from Anamar/EcoAnalysts, 2018)