CENWS-ODS-ND

MEMORANDUM FOR: RECORD February 8, 2018

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF PROPOSED DREDGED MATERIAL FROM MAINTENANCE OF THE GRAYS HARBOR FEDERAL NAVIGATION CHANNEL, GRAYS HARBOR, WASHINGTON, FOR PLACEMENT AT THE PT. CHEHALIS OR SOUTH JETTY DISPERSIVE OPEN-WATER DISPOSAL SITES OR AT AN APPROVED BENEFICIAL USE LOCATION.

1. INTRODUCTION. This memorandum reflects the consensus determination of the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Environmental Protection Agency, and Washington Departments of Ecology and Natural Resources) regarding the suitability of maintenance dredged material from annual routine operations (Table 1) in the Federal Navigation Channel in Grays Harbor, Washington for unconfined open-water disposal and beneficial use.

2. PROJECT SUMMARY. The U.S. Army Corps of Engineers (USACE) maintains the Grays Harbor navigation channel, dredging about four million cubic yards of accumulated sediment annually. Large ocean-going vessels use the channel to access marine terminal facilities in the towns of Hoquiam, Aberdeen, and Cosmopolis. Proposed disposal of dredged material is at the Point Chehalis and South Jetty open-water dispersive sites; Half Moon Bay (HMB) and South Beach nearshore beneficial use sites, and direct beach nourishment, as needed, appropriate and approved.

The navigation channel has historically been divided into outer harbor reaches (Entrance, Bar, Point Chehalis, and South Reach) and inner harbor reaches (Crossover Reach, North Channel, Hoquiam Channel, Cow Point Reach, Aberdeen Reach, and South Aberdeen Reach) (Figure 1). In-water disposal of the maintenance dredged material from both the inner and outer harbor sections of the navigation channel was most recently approved in a DMMP suitability determination on February 9, 2012 (DMMP 2012).

TABLE 1. PROPOSED DREDGING SYNOPSIS BY CHANNEL REACH

Reach	Annual Volume	Length in Miles	Authorized Depth in ft MLLW*	Dredge Type	Work Scheduled
Bar	333,205	5.4	-46	hopper	April and May
Entrance	239,430	1.9	varies -46 to -40	hopper	April and May
Pt. Chehalis	409,481	1.4	-40	hopper	April and May
South	100,419	4.8	-38	hopper	April and May
Crossover	1,000,689	2.8	-38	Outer Crossover: hopper	April and May
				Inner Crossover: clamshell	1 August - 14 Feb
North Channel	54,445	2.6	-38	clamshell	1 August - 14 Feb
Hoquiam	980,037	3	-38	clamshell	16 July - 14 Feb
Cow Point	813,208	1.5	-38	clamshell	16 July - 14 Feb
Aberdeen	159,276	1.6	-32	clamshell	16 July - 14 Feb
South Aberdeen	194,582	2.5	varies; -32 to -35	clamshell	16 July to 14 Feb

** Actual dredging depth is typically to authorized depth + 2 ft. overdepth + 2 ft. advance maintenance*

TABLE 2. GRAYS HARBOR FEDERAL NAVIGATION CHANNEL SEDIMENT CHARACTERIZATION - PROJECT TRACKING

Initial SAP received	July 6, 2017
Initial SAP comments	July 24, 2017
Final SAP received	July 26, 2017
SAP approved	July 28, 2017
Sampling dates	July 31 – August 8, 2017
Draft Data report received	November 16, 2017
Final Data report received	December 7, 2017
DMMP Tracking number	GRAYS-1-A-F-382
EIM Project number	GRAYS17
Recency Expiration Date – Inner Reaches (Low Rank = 7 years)	August 2024
Recency Expiration Date – Outer Reaches (Very Low Rank = 10 years)	August 2027

3. PROJECT RANKING AND SAMPLING APPROACH. Sediments from the Grays Harbor channel have been characterized many times since 1992. Sediment accumulates rapidly in the Grays Harbor estuary, mostly from the Chehalis River but also from the Hoquiam, Humptulips, Wishkah, Johns, and Elk rivers. Material that settles within the navigation channel is disposed primarily at the mouth of the estuary where it contributes to important coastal sediment transport networks. All of the rapidly accumulating maintenance material has passed chemical and biological evaluations in the past twenty-five years of testing, has been found suitable for open-water disposal, and is ranked “low” by the DMMP. The Grays Harbor channel has been deepened twice in the last three decades, and both times, during associated characterizations, a portion of the bedded sediment (e.g. not recently accumulated) was found unsuitable for open-water and was taken upland for disposal. Particularly, the historical presence of chlor-oxide bleach process pulp mills and wood treatment sites contributed to relatively high levels of dioxins/furans in deeper harbor sediments. Though the active sources no longer exist, remnant levels of dioxins continue to be found in parts of Grays Harbor.

For these two reasons: 1) continued suitability of recently-accumulated sediment over decades and 2) trends in dioxin levels in Grays Harbor sediment, the sampling approach for this project has been modified over time to answer pertinent questions. The most recent suitability determination for this project (DMMP 2012) established a sampling approach independent of the volume criteria typically used by the DMMP to determine the number of DMMUs and samples. For the Inner Reaches (Crossover Reach to South Aberdeen Reach) the number of DMMUs and the number of associated samples are based on a linear scale of river miles; each Inner Reach DMMU is approximately 0.5 miles in length. This approach is meant to facilitate the analysis of historical sediment quality trends (particularly for dioxins/furans) over time. The DMMU boundaries for this characterization effort are the same as those used during the 2012 characterization (DMMP 2012). Regardless of volume in any given DMMU, eight sample locations were placed in each of the Inner Reach DMMUs to provide adequate spatial and volumetric representation.

The outer harbor reaches consist mainly of coarse-grained material in a high-energy environment, geographically removed from sources of contamination and thus meet exclusionary criteria specified in Section 40 CFR 230.60 of the Clean Water Act. They are ranked “very-low” by the DMMP, which means that chemical and biological testing are not necessary if the exclusionary criteria continue to be met. For this characterization, samples were tested for grain-size and total organic carbon (TOC) to confirm that those criteria are met.

4. SAMPLING. Sampling took place on July 31 – August 8, 2017. A 0.2 m^2 power grab sampler was used to collect a total of 253 surface sediment samples (Tables 3a, 3b and 4) per the approved Sampling and Analysis Plan (SAP). Those samples were composited for analysis into nine outer reach DMMUs and 28 inner reach DMMUs. Proposed sample locations were based on relatively recent bathymetric surveys, but due to rapid changes in the channel, the elevation of every sample was verified to be in the dredge prism before samples were taken. If the planned location was deeper than the proposed dredge prism, it was moved to a nearby location with a suitable depth. Samples in one of the Cow Point DMMUs (CP-02) were all moved during the field effort because they overlapped with an ongoing dredge operation. Due to a lack of material above project depth, some samples were taken outside the channel boundaries. Proposed and actual sample locations are shown in Figures 4 - 17.

TABLE 3A. SEDIMENT CHARACTERIZATION SAMPLING PLAN SUMMARY – OUTER REACHES

Reach	Rank	vol/ DMMU (cy)	# of DMMUs	vol/ sample	# of grab samples	Analyses
Bar	VL	300,000	1	100,000	3	grain size/TOC
Entrance	VL	100,000	2	33,000	7	
Pt. Chehalis	VL	100,000	4	33,000	12	
South Reach	VL	100,000	1	33,000	3	
Outer Reach Total			9		26	

TABLE 3B. SEDIMENT CHARACTERIZATION SAMPLING PLAN SUMMARY – INNER REACHES

Reach	Rank	Predicted annual avail. vol (cy)*	# of DMMUs	vol/ sample	# of grab samples	Analyses
Crossover	L	1,000,689	28	n/a	224	full COC list
North Channel	L	54,445				
Hoquiam	L	980,037				
Cow Point	L	813,208				
Aberdeen	L	159,276				
South Aberdeen	L	194,582				
Inner Reach Total		3,202,236	28		224	
Grand Total			37		253	

** Predicted volume is equal to: [A] Previous Years Authorized Depth Volume - [B] The Deepening Material removed during the first deepening window + [C] the Mean of the Shoaling Rate in each reach based on prior 4 years of data.*

5. CONVENTIONAL AND CHEMICAL ANALYSIS. All chemical analyses were conducted by ALS laboratories in Kelso, Washington and Houston, Texas (for dioxin/furans only). The approved sampling and analysis plan was followed and quality control guidelines specified by the PSEP and DMMP programs were met, with only minor quality control deviations (ANAMAR and EcoAnalysts 2017). Outside data validation was conducted by EcoChem, Inc. in Seattle, Washington. The review included EPA Stage 2B review for all chemical data and EPA Stage 4 review for 10% of the dioxin/furan data. Final qualified data were considered sufficient and acceptable for regulatory decision-making under the DMMP program.

a. Sediment Conventionals. Sediment conventional results (Table 5) showed large differences, as expected, between grain sizes in the Outer and Inner Reaches. In the Bar, Entrance, Pt. Chehalis and South Reaches, the sediment was primarily sand. Total fines in the four outer reaches did not exceed 2%. Total organic carbon (TOC) in those reaches was also very low, ranging from 0.05 to 0.12%. Total fines in the Inner Reaches ranged from 2.8% in Aberdeen Reach (AR-03) to 64.3% in Hoquiam

Reach (HR-05). Both the most upstream and most downstream portions of the Inner Reaches had coarser sediment than did the middle reaches. Hoquiam and Cow Point Reaches, as in the past, showed the greatest frequency of fine material.

b. Chemical Analysis. Chemical results indicated no detected or undetected exceedances of DMMP chemicals of concern screening levels (Tables 6 - 10). Most compounds were undetected at low detection limits. The data validation done by EcoChem Inc. included EPA Stage 2B review for all chemical data and EPA stage 4 review for 10% of the dioxin/furan data. Some data were qualified by the laboratory and validators due to data anomalies detailed in the final report (ANAMAR and EcoAnalysts 2017). All data were accepted, as qualified, for use in regulatory decision-making.

c. Dioxins/Furans. Each DMMU composite was analyzed for dioxins at the ALS laboratory in Houston, TX using Method EPA 1613B. Dioxins were detected in all 28 Inner Reach DMMUs, with toxicity equivalents (TEQ, with U = ½ estimated detection limit) ranging from 0.38 to 3.47 ng/kg dry wt. Some detection limits were elevated due to ion ratio outliers and method blank contamination (ANAMAR and EcoAnalysts 2017). External validation indicated that all data, as reported, were acceptable for use. All dioxin results were well below the 15 TEQ suitability level set for Grays Harbor. Levels of 2,3,7,8 TCDD were below the 5 ng/kg suitability level set for this dioxin congener in all DMMUs, with levels ranging from non-detect to 1.06 ng/kg dry wt. Mean TEQs for each reach were compared directly with results from the 2012 characterization. Though long–term trends cannot be determined after only two comparable sampling events, 2017 results showed TEQs lower throughout the channel than were found in 2012 (Figure 3).

6. BIOLOGICAL TESTING. No bioassays or bioaccumulation testing were required to determine the suitability of proposed dredged material, and none were conducted. Reference sediments for potential bioassays were collected along with project test sediments but were not used.

7. SUITABILITY DETERMINATION. This memorandum documents the evaluation of the suitability of sediment proposed for dredging from the Grays Harbor Federal Navigation Channel for open-water disposal and for appropriate in-water and/or upland beneficial use. The approved sampling and analysis plan was generally followed and the data gathered were deemed sufficient and acceptable for regulatory decision-making under the DMMP program.

a. Outer Reaches Exclusion from Testing. The outer reaches, which consist mainly of coarse-grained material in a high-energy environment, are classified as “exclusionary” under Section 40 CFR 230.60 of the Clean Water Act. As such, these reaches are generally not subject to contaminant testing, but do require periodic confirmation of their exclusionary status. Results of grain size and total organic carbon sampling confirmed that the Bar, Entrance, Pt. Chehalis and South Reaches continue to meet the exclusionary criteria of < 20% fines (silt + clay) and < 0.5% TOC. No further testing is required in these reaches, except in the case of a changed condition, for ten years from the date of sampling.

b. Beneficial Uses. Results of chemical analyses were compared to Washington State Sediment Management Standards as an indicator of potential suitability for in-water beneficial use. Based on this analysis, all material within the currently authorized channel is also considered potentially suitable for in-water beneficial use. “Potentially” suitable material means only that the DMMP has tested material for in-water chemical suitability; a given project may require specific grain sizes or other characteristics to be appropriate for a given use. In addition, any proposed beneficial use site must be separately permitted and may have additional material guidelines or requirements. Previously, sandy material from the outer reaches has been used for beach nourishment in Half Moon Bay and off South Beach, and for coastal erosion control and jetty stabilization.

c. Debris Management. The DMMP agencies implemented a debris management requirement in 2015 in order to prevent the disposal of debris (wood or otherwise) greater than 12 inches in any dimension at open-water disposal sites in Puget Sound (DMMP 2015). The Grays Harbor federal navigation channel is dredged annually to maintain navigation; little to no reported debris has been encountered during previous dredging events. The DMMP agencies concur that the dredge project area is of low concern for debris, and a 12" X 12" screening grid or grizzly is not required for this project. However, if any debris larger than 12 inches in any dimension, or man-made debris of any size, is encountered, it must be segregated and disposed of in an upland landfill or other appropriate use. At no time may any debris greater than 12 inches in any dimension or man-made debris of any size, be disposed at an open-water disposal site.

Based on the results of the previously described testing, the DMMP agencies concluded that all material within the currently authorized channel is suitable for open-water disposal at the DMMP South Jetty and Point Chehalis dispersive sites.

8. REFERENCES

ANAMAR and EcoAnalysts 2017. Grays Harbor Navigation Channel Dredged Material Characterization Report, Seattle Washington. Prepared for the US Army Corps of Engineers, Seattle District. December 2017.

DMMP 2012. *Determination on the Suitability of Proposed Federal Operation and Maintenance Dredged Material from Grays Harbor, Washington Evaluated Under Section 404 of the Clean Water Act, for Open-Water Disposal at the South Jetty and Point Chehalis Dispersive Disposal Sites, and at the South Beach and Half Moon Bay Beneficial Use Sites.* Prepared by the USACE for the DMMP Agencies, February 9, 2012.

DMMP 1997. *DMMP Clarification Paper: Beneficial Use of Dredged Material.* Prepared by Justine Barton (EPA Region 10) for the Dredged Material Management Program, May 1997.

DMMP 2016. *Dredged Material Evaluation and Disposal Procedures (User Manual)*. Dredged Material Management Program, updated August 2016.

Ecology 2013. *Sediment Management Standards – Chapter 173-204 WAC*. Washington State Department of Ecology, February 2013.

PSDDA 1988. *Evaluation Procedures Technical Appendix – Phase I – Central Puget Sound*. U.S. Army Corps of Engineers Seattle District, U.S. Environmental Protection Agency Region 10, Washington State Department of Ecology, Washington State of Natural Resources. June 1988.

Word, J.Q., Ward, J.A. and Squires, A.L. 1990. Results of chemical, toxicological, and bioaccumulation evaluations of dioxins, furans, and guaiacols/organic acids in sediments from the Grays Harbor/Chehalis River area. Prepared for the US Department of Energy, September 1990.

Signed copy on file in Dredged Material Management Office, Seattle District Corps of Engineers

9. AGENCY SIGNATURES

SUBJECT: DETERMINATION REGARDING THE SUITABILITY OF PROPOSED DREDGED MATERIAL FROM MAINTENANCE OF THE GRAYS HARBOR FEDERAL NAVIGATION CHANNEL, GRAYS HARBOR, WASHINGTON, FOR PLACEMENT AT THE PT. CHEHALIS OR SOUTH JETTY DISPERSIVE OPEN-WATER DISPOSAL SITES OR AT AN APPROVED BENEFICIAL USE LOCATION.

Concur:

_____ _____
Date Lauran Cole Warner - Seattle District Corps of Engineers

_____ _____
Date Justine Barton - Environmental Protection Agency

_____ _____
Date Laura Inouye, Ph.D. - Washington Department of Ecology

_____ _____
Date Celia Barton - Washington Department of Natural Resources

Copies furnished:

DMMP signatories
Elizabeth Chien, USACE
Paul Berman, ANAMAR
Meg Pinza, EcoAnalysts
Joe Schumacker, Quinault Tribe

TABLE 4. DMMU AND SAMPLE SUMMARY

DMMU/ Composite	Sample ID	Analyses
BR-01	BR-01-01	grain size/TOC
	BR-01-02	
	BR-01-03	
EC-01	EC-01-01	grain size/TOC
	EC-01-02	
	EC-01-03	
EC-02	EC-02-01	grain size/TOC
	EC-02-02	
	EC-02-03	
	EC-02-04	
PC-01	PC-01-01	grain size/TOC
	PC-01-02	
	PC-01-03	
PC-02	PC-02-01	grain size/TOC
	PC-02-02	
	PC-02-03	
PC-03	PC-03-01	grain size/TOC
	PC-03-02	
	PC-03-03	
PC-04	PC-04-01	grain size/TOC
	PC-04-02	
	PC-04-03	
SR-01	SR-01-01	grain size/TOC
	SR-01-02	
	SR-01-03	
CR-01	CR-01-01	Sediment Conventionals, full COC list, dioxin/furans
	CR-01-02	
	CR-01-03	
	CR-01-04	
	CR-01-05	
	CR-01-06	
	CR-01-07	
	CR-01-08	
CR-02	CR-02-01	Sediment Conventionals, full COC list, dioxin/furans
	CR-02-02	
	CR-02-03	
	CR-02-04	
	CR-02-05	
	CR-02-06	
	CR-02-07	
	CR-02-08	
CR-03	CR-03-01	Sediment Conventionals, full COC list, dioxin/furans
	CR-03-02	
	CR-03-03	
	CR-03-04	
	CR-03-05	
	CR-03-06	
	CR-03-07	
	CR-03-08	

TABLE 4. DMMU AND SAMPLE SUMMARY

DMMU/ Composite	Sample ID	Analyses
CR-04	CR-04-01	Sediment Conventionals, full COC list, dioxin/furans
	CR-04-02	
	CR-04-03	
	CR-04-04	
	CR-04-05	
	CR-04-06	
	CR-04-07	
	CR-04-08	
CR-05	CR-05-01	Sediment Conventionals, full COC list, dioxin/furans
	CR-05-02	
	CR-05-03	
	CR-05-04	
	CR-05-05	
	CR-05-06	
	CR-05-07	
	CR-05-08	
CR-06	CR-06-01	Sediment Conventionals, full COC list, dioxin/furans
	CR-06-02	
	CR-06-03	
	CR-06-04	
	CR-06-05	
	CR-06-06	
	CR-06-07	
	CR-06-08	
NC-01	NC-01-01	Sediment Conventionals, full COC list, dioxin/furans
	NC-01-02	
	NC-01-03	
	NC-01-04	
	NC-01-05	
	NC-01-06	
	NC-01-07	
	NC-01-08	
NC-02	NC-02-01	Sediment Conventionals, full COC list, dioxin/furans
	NC-02-02	
	NC-02-03	
	NC-02-04	
	NC-02-05	
	NC-02-06	
	NC-02-07	
	NC-02-08	
NC-03	NC-03-01	Sediment Conventionals, full COC list, dioxin/furans
	NC-03-02	
	NC-03-03	
	NC-03-04	
	NC-03-05	
	NC-03-06	
	NC-03-07	
	NC-03-08	

TABLE 4. DMMU AND SAMPLE SUMMARY

DMMU/ Composite	Sample ID	Analyses
NC-04	NC-04-01	Sediment Conventionals, full COC list, dioxin/furans
	NC-04-02	
	NC-04-03	
	NC-04-04	
	NC-04-05	
	NC-04-06	
	NC-04-07	
	NC-04-08	
NC-05	NC-05-01	Sediment Conventionals, full COC list, dioxin/furans
	NC-05-02	
	NC-05-03	
	NC-05-04	
	NC-05-05	
	NC-05-06	
	NC-05-07	
	NC-05-08	
HR-01	HR-01-01	Sediment Conventionals, full COC list, dioxin/furans
	HR-01-02	
	HR-01-03	
	HR-01-04	
	HR-01-05	
	HR-01-06	
	HR-01-07	
	HR-01-08	
HR-02	HR-02-01	Sediment Conventionals, full COC list, dioxin/furans
	HR-02-02	
	HR-02-03	
	HR-02-04	
	HR-02-05	
	HR-02-06	
	HR-02-07	
	HR-02-08	
HR-03	HR-03-01	Sediment Conventionals, full COC list, dioxin/furans
	HR-03-02	
	HR-03-03	
	HR-03-04	
	HR-03-05	
	HR-03-06	
	HR-03-07	
	HR-03-08	
HR-04	HR-04-01	Sediment Conventionals, full COC list, dioxin/furans
	HR-04-02	
	HR-04-03	
	HR-04-04	
	HR-04-05	
	HR-04-06	
	HR-04-07	
	HR-04-08	

TABLE 4. DMMU AND SAMPLE SUMMARY

DMMU/ Composite	Sample ID	Analyses
HR-05	HR-05-01	Sediment Conventionals, full COC list, dioxin/furans
	HR-05-02	
	HR-05-03	
	HR-05-04	
	HR-05-05	
	HR-05-06	
	HR-05-07	
	HR-05-08	
HR-05-SV	HR-05-07	PAHs
	HR-05-08	
HR-06	HR-06-01	Sediment Conventionals, full COC list, dioxin/furans
	HR-06-02	
	HR-06-03	
	HR-06-04	
	HR-06-05	
	HR-06-06	
	HR-06-07	
	HR-06-08	
CP-01	CP-01-01	Sediment Conventionals, full COC list, dioxin/furans
	CP-01-02	
	CP-01-03	
	CP-01-04	
	CP-01-05	
	CP-01-06	
	CP-01-07	
	CP-01-08	
CP-02R	CP-02-01R	Sediment Conventionals, full COC list, dioxin/furans
	CP-02-02R	
	CP-02-03R	
	CP-02-04R	
	CP-02-05R	
	CP-02-06R	
	CP-02-07R	
	CP-02-08R	
CP-03	CP-03-01	Sediment Conventionals, full COC list, dioxin/furans
	CP-03-02	
	CP-03-03	
	CP-03-04	
	CP-03-05	
	CP-03-06	
	CP-03-07	
	CP-03-08	

TABLE 4. DMMU AND SAMPLE SUMMARY

DMMU/ Composite	Sample ID	Analyses
AR-01	AR-01-01	Sediment Conventionals, full COC list, dioxin/furans
	AR-01-02	
	AR-01-03	
	AR-01-04	
	AR-01-05	
	AR-01-06	
	AR-01-07	
	AR-01-08	
AR-02	AR-02-01	Sediment Conventionals, full COC list, dioxin/furans
	AR-02-02	
	AR-02-03	
	AR-02-04	
	AR-02-05	
	AR-02-06	
	AR-02-07	
	AR-02-08	
AR-03	AR-03-01	Sediment Conventionals, full COC list, dioxin/furans
	AR-03-02	
	AR-03-03	
	AR-03-04	
	AR-03-05	
	AR-03-06	
	AR-03-07	
	AR-03-08	
SA-01	SA-01-01	Sediment Conventionals, full COC list, dioxin/furans
	SA-01-02	
	SA-01-03	
	SA-01-04	
	SA-01-05	
	SA-01-06	
	SA-01-07	
	SA-01-08	

TABLE 4. DMMU AND SAMPLE SUMMARY

DMMU/ Composite	Sample ID	Analyses
SA-02	SA-02-01	Sediment Conventionals, full COC list, dioxin/furans
	SA-02-02	
	SA-02-03	
	SA-02-04	
	SA-02-05	
	SA-02-06	
	SA-02-07	
	SA-02-08	
SA-03	SA-03-01	Sediment Conventionals, full COC list, dioxin/furans
	SA-03-02	
	SA-03-03	
	SA-03-04	
	SA-03-05	
	SA-03-06	
	SA-03-07	
	SA-03-08	
SA-04	SA-04-01	Sediment Conventionals, full COC list, dioxin/furans
	SA-04-02	
	SA-04-03	
	SA-04-04	
	SA-04-05	
	SA-04-06	
	SA-04-07	
	SA-04-08	
SA-05	SA-05-01	Sediment Conventionals, full COC list, dioxin/furans
	SA-05-02	
	SA-05-03	
	SA-05-04	
	SA-05-05	
	SA-05-06	
	SA-05-07	
	SA-05-08	
REF-01	NB13	Sediment Conventionals
REF-02	NB14	Sediment Conventionals
REF-03	NB14.02	Sediment Conventionals

TABLE 5. GRAYS HARBOR FEDERAL NAVIGATION CHANNEL – CONVENTIONAL RESULTS

Reach	Sample ID	Grain Size (%)				Total Solids (%)	(% TVS)	(% TOC)	Total Sulfides (mg/kg)	Ammonia (mg/kg)
		Gravel >2000 µ	Sand 62.5-2000 µ	Silt 3.9-62.5 µ	Clay 0-3.9 µ					
Outer Reaches										
Bar	BR-01	0.03	99.67	0.37	1.22	73.6	NA	0.078	NA	NA
Entrance Channel	EC-01	16.39	84.21	0.17	0.57	80.5	NA	0.055	NA	NA
	EC-02	4	93.4	0.41	0.74	81.9	NA	0.054	NA	NA
Point Chehalis	PC-01	15.26	85.18	0.28	1.05	77.8	NA	0.071	NA	NA
	PC-02	6.51	92.21	0.19	0.88	78.7	NA	0.055	NA	NA
	PC-03	0.59	97.36	0.46	1.51	74.1	NA	0.123	NA	NA
	PC-04	0.93	98.02	0.25	0.66	81.9	NA	0.047 J	NA	NA
South	SR-01	5.61	93.27	0.37	1.42	76.2	NA	0.077	NA	NA
Inner Reaches										
Crossover	CR-01	0.04	89.16	5.76	4.53	69.4	2.1	0.379	3.7 J	6
	CR-02	0.03	93.58	3.41	3.05	71.1	1.8	0.406	2.7 J	3.69
	CR-03	0.03	87.8	8.02	4.09	70.6	2	0.311	9.2 J	3.53
	CR-04	0.08	91.72	4.59	3.57	70.4	2	0.273	2.8 J	3.45
	CR-05	0.14	84	9.76	5.61	63.4	4.4	0.646	3.4	10.2
	CR-06	0.28	75.19	16.13	8.25	64.1	5.9	0.846	37	8.77
North Channel	NC-01	6.21	56.02	27.26	11.3	60.2	6.8	1.41	65	13.3
	NC-02	0.14	64.13	26.68	9.85	61.2	6	0.91	19.1	37
	NC-03	0.37	63.85	25.54	8.61	62.3	5.2	0.97	65	7.88
	NC-04	0.67	48.24	29.2	10.01	60.6	4.8	0.959	18.9	36.8
	NC-05	2.09	54.55	33.7	9.67	56.1	5.2	1.27	65	21.9
Hoquiam	HR-01	0.2	46.11	40.26	11.35	56.1	5.2	1.32	310	14.1
	HR-02	0.36	56.96	31.01	9.14	60.1	4.9	1.6	82	16.6
	HR-03	0.32	46.25	42.42	10.71	50.8	5.7	1.47	49	39.7
	HR-04	0.13	63.73	32.43	9.29	57.2	5.3	1.15	36	20.8
	HR-05	0.32	32.02	50.21	14.13	52.4	6.7	1.44	171 J	47.1
	HR-06	1.04	43.15	42.99	14.57	58.4	6.2	1.08	64 J	34.2
	HR-SV	NA	NA	NA	NA	50.7	NA	NA	NA	NA
Cow Point	CP-01	0.04	39.41	43.59	12.7	50.8	7.1	1.65	133 J	44.1
	CP-02	0.42	35.19	47.97	12.52	48.6	6.6	1.64	17.4	36.4
	CP-03	0.07	43.78	40.93	11.9	49.4	7.1	1.55	11.1 J	34.6
Aberdeen	AR-01	1.16	88.59	6.76	2.79	69.7	4	0.439	6.1	5.25
	AR-02	4.3	98.28	1.83	1.68	66.9	3.8	0.39	0.9 UJ	0.66 J
	AR-03	19.01	80.27	1.5	1.33	76.2	3.7	0.545	0.7 UJ	0.06 U
South Aberdeen	SA-01	16.94	77.88	2.67	1.59	74.5	2.9	0.329	2 J	2.17
	SA-02	34.35	55.06	3.06	1.76	81.9	3	0.35	17.1	1.04
	SA-03	0.54	82.09	11.34	4.3	67.7	3.8	0.601	0.9 U	9.5
	SA-04	0.45	94.17	4.19	2.23	71.5	3.9	0.376	0.9 U	3.53
	SA-05	10.58	87.15	1.7	1.53	76.9	3.1	0.275	0.8 U	1.23
Reference Stations										
North Bay References	NB13	0.03	72.03	20.02	3.24	65.6	4.4	0.812	NA	10
	NB14	0.1	51.48	33.38	15.02	58.2	14	1.15	NA	14
	NB14.02	0.06	18.3	58.51	23.06	46.5	8.1	1.95	NA	48

TABLE 6. RESULTS OF CHEMICAL ANALYSIS FOR CROSSOVER REACH DMMUS

Analyte	SL	BT	ML	Result	Q[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals (mg/kg dry wt.)				CR-01		CR-02		CR-03		CR-04		CR-05		CR-06	
Antimony	150	---	200	0.147	J	0.188	J	0.056	J	0.031	J	0.05	UJ	0.05	UJ
Arsenic	57	507.1	700	6.37		6.37		5.71		4.98		8.1		8.08	
Cadmium	5.1	---	14	0.04		0.048		0.037		0.027		0.072		0.089	
Chromium	260	---	---	17.6		16.8		19.7		17.3		26.2		29.5	
Copper	390	---	1300	11		9.1		14		9.3		18.7		26.6	
Lead	450	975	1200	2.94		2.54		2.91		2.48		4.29		4.55	
Mercury	0.41	1.5	2.3	0.009	J	0.004	J	0.011	J	0.009	J	0.016	J	0.021	J
Selenium	---	3	---	0.1	J	0.1	J	0.12	J	0.09	J	0.2	J	0.3	J
Silver	6.1	---	8.4	0.018	J	0.017	J	0.021		0.013	J	0.031		0.039	
Zinc	410	---	3800	38.8		37.3		41.4		37.2		58.6		64.4	
Pesticides (µg/kg dry wt.)				CR-01		CR-02		CR-03		CR-04		CR-05		CR-06	
gamma-BHC (Lindane)	---	---	---	0.37	U	0.43	U	0.37	U	0.38	U	0.47	U	0.44	U
Heptachlor	1.5	---	270	0.47	U	0.54	U	0.47	U	0.47	U	0.59	U	0.56	U
Aldrin	9.5	---	NA	0.7	U	0.82	U	0.71	U	0.71	U	0.89	U	0.84	U
Dieldrin	1.9	---	1700	0.27	U	0.31	U	0.27	U	0.27	U	0.33	U	0.32	U
4,4'-DDE	16	---	---	0.48	U	0.56	U	0.48	U	0.48	U	0.6	U	0.57	U
4,4'-DDD	9	---	---	0.71	U	0.83	U	0.72	U	0.72	U	0.9	U	0.85	U
4,4'-DDT	12	---	---	0.73	U	0.85	U	0.73	U	0.73	U	0.92	U	0.87	U
Total DDT	---	50	69	0.73	U	0.85	U	0.73	U	0.73	U	0.92	U	0.87	U
trans-Chlordane [2]	2.8	37	---	0.45	U	0.53	U	0.46	U	0.46	U	0.57	U	0.54	U
cis-Chlordane [3]	2.8	37	---	0.49	U	0.57	U	0.49	U	0.5	U	0.62	U	0.58	U
Oxychlordane	2.8	37	---	0.3	UJ	0.35	UJ	0.3	UJ	0.3	UJ	0.38	U	0.36	U
cis-Nonachlor	2.8	37	---	0.35	UJ	0.41	UJ	0.35	UJ	0.35	UJ	0.44	U	0.41	U
trans-Nonachlor	2.8	37	---	0.84	UJ	0.99	UJ	0.85	UJ	0.85	UJ	1.1	U	1.1	U
Total Chlordane	2.8	37	---	0.84	UJ	0.99	UJ	0.85	UJ	0.85	UJ	1.1	U	1.1	U
PCBs (µg/kg dry wt.)				CR-01		CR-02		CR-03		CR-04		CR-05		CR-06	
Aroclor 1016	---	---	---	3.5	U	4.1	U	3.5	U	3.5	U	4.4	U	4.1	U
Aroclor 1221	---	---	---	3.5	U	4.1	U	3.5	U	3.5	U	4.4	U	4.1	U
Aroclor 1232	---	---	---	3.5	U	4.1	U	3.5	U	3.5	U	4.4	U	4.1	U
Aroclor 1242	---	---	---	3.5	U	4.1	U	3.5	U	3.5	U	4.4	U	4.1	U
Aroclor 1248	---	---	---	3.5	U	4.1	U	3.5	U	3.5	U	4.4	U	4.1	U
Aroclor 1254	---	---	---	3.5	U	4.1	U	3.5	U	3.5	U	4.4	U	4.1	U
Aroclor 1260	---	---	---	3.5	U	4.1	U	3.5	U	3.5	U	4.4	U	4.1	U
Total PCBs	130	38[4]	3100	3.5	U	4.1	U	3.5	U	3.5	U	4.4	U	4.1	U
PAHs **(µg/kg dry wt.)**				CR-01		CR-02		CR-03		CR-04		CR-05		CR-06	
2-Methylnaphthalene	670	---	1900	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U
Acenaphthene	500	---	2000	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Acenaphthylene	560	---	1300	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U
Anthracene	960	---	13000	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Fluorene	540	---	3600	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Naphthalene	2100	---	2400	2.9	U	2.9	U	2.9	U	2.9	U	2.9	U	2.9	U
Phenanthrene	1500	---	21000	4.2	J	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Total LMW PAHs	---	---	---	4.2	J	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Benz(a)anthracene	1300	---	5100	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Benzo(a)pyrene	1600	---	3600	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Benzo(b)fluoranthene	3200	---	9900	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U
Benzo(g,h,i)perylene	670	---	3200	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
Benzo(k)fluoranthene	3200	---	9900	4	U	4	U	4	U	4	U	4	U	4	U
Chrysene	1400	---	21000	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U
Dibenz(a,h)anthracene	230	---	1900	3	U	3	U	3	U	3	U	3	U	3	U
Fluoranthene	1700	4600	30000	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U	4	J
Indeno(1,2,3-cd)pyrene	600	---	4400	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Pyrene	2600	11980	16000	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U	4.1	J

TABLE 6. RESULTS OF CHEMICAL ANALYSIS FOR CROSSOVER REACH DMMUS

Analyte	SL	BT	ML	Result	Q[1]	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Total HMW PAHs	---	---	---	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U	8.1	J
Chlorinated Hydrocarbons **(µg/kg dry wt.)**				CR-01		CR-02		CR-03		CR-04		CR-05		CR-06	
1,4-Dichlorobenzene	110	---	120	2.5	U	2.5	U	2.5	U	2.5	U	2.5	U	2.5	U
1,2-Dichlorobenzene	35	---	110	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U
1,2,4-Trichlorobenzene	31	---	64	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U
Hexachlorobenzene	22	168	230	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Phthalates **(µg/kg dry wt.)**				CR-01		CR-02		CR-03		CR-04		CR-05		CR-06	
Dimethyl Phthalate	71	---	1400	4	U	4	U	4	U	4	U	4	U	4	U
Diethyl Phthalate	200	---	1200	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
Di-n-butyl Phthalate	1400	---	5100	7.1	J	6	J	6	J	5.8	J	5.3	J	5	J
Butyl Benzyl Phthalate	63	---	970	3.7	U	3.7	U	3.7	U	3.7	U	4.8	J	3.7	U
Bis(2-ethylhexyl) Phthalate	1300	---	8300	8.9	U	8.9	U	8.9	U	8.9	U	8.9	U	8.9	U
Di-n-octyl Phthalate	6200	---	6200	3.2	U	3.2	U	4.9	J	3.2	U	5.8	J	3.2	U
Phenols **(µg/kg dry wt.)**				CR-01		CR-02		CR-03		CR-04		CR-05		CR-06	
Phenol	420	---	1200	5.2	J	5.1	J	3.1	J	4.9	J	4.2	J	4.6	J
2-Methylphenol	63	---	77	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U
4-Methylphenol	670	---	3600	4.5	U	4.5	U	4.5	U	4.5	U	4.5	U	4.5	U
2,4-Dimethylphenol	29	---	210	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U
Pentachlorophenol	400	540	690	5.3	U	5.3	U	5.3	U	5.3	U	5.3	U	5.3	U
Miscellaneous Extractable **(µg/kg dry wt.)**				CR-01		CR-02		CR-03		CR-04		CR-05		CR-06	
Benzyl Alcohol	57	---	870	4.9	U	4.9	U	4.9	U	4.9	U	4.9	U	4.9	U
Benzoic Acid	650	---	760	96	U	96	U	96	U	96	U	96	U	96	U
Dibenzofuran	540	---	1700	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U
Hexachlorobutadiene	11	---	270	3	U	3	U	3	U	3	U	3	U	3	U
N-Nitrosodiphenylamine	28	---	130	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Dioxins/Furans (TEQ ng/Kg)				CR-01		CR-02		CR-03		CR-04		CR-05		CR-06	
2,3,7,8-TCDD		5		0.167	U	0.119	U	0.048	U	0.089	U	0.272	U	0.145	U
Dioxin/Furan nd EDL *0		15		0.489	U	0.187	U	0.16	U	0.187	U	0.471	U	0.584	U
Dioxin/Furan nd EDL *0.5		15		0.675	U	0.56	U	0.376	U	0.438	U	0.686	U	0.682	U

NOTES FOR TABLES 6 – 10

[1] Validation qualifier used when calculating totals and max detection limits
[2] trans-Chlordane reported by lab as gamma-Chlordane
[3] cis-Chlordane reported by lab as alpha-Chlordane
[4] This value is normalized to TOC, and is expressed in mg/kg C

TABLE 7. RESULTS OF CHEMICAL ANALYSIS FOR NORTH CHANNEL DMMUS

Analyte	SL	BT	ML	Result	Q[1]	Result	Q	Result	Q	Result	Q	Result	Q
Metals (mg/kg dry wt.)				NC-01		NC-02		NC-03		NC-04		NC-05	
Antimony	150	---	200	0.05	UJ	0.06	UJ	0.073	J	0.05	J	0.068	J
Arsenic	57	507.1	700	8.48		6.95		6.79		6.89		8.5	
Cadmium	5.1	---	14	0.108		0.095		0.086		0.094		0.1	
Chromium	260	---	---	29.4		28.5		28.1		28.5		28.8	
Copper	390	---	1300	37.2		31		35		35.7		37.4	
Lead	450	975	1200	4.87		4.43		4.6		4.71		5.17	
Mercury	0.41	1.5	2.3	0.023	J	0.024		0.022	J	0.023	J	0.03	
Selenium	---	3	---	0.3	J	0.3	J	0.3	J	0.3	J	0.33	J
Silver	6.1	---	8.4	0.049		0.04		0.038		0.057		0.05	
Zinc	410	---	3800	64.3		62.9		61.5		61.7		62.8	
Pesticides (µg/kg dry wt.)				NC-01		NC-02		NC-03		NC-04		NC-05	
gamma-BHC (Lindane)	---	---	---	0.81	U	0.5	U	0.46	U	0.51	U	0.55	U
Heptachlor	1.5	---	270	0.65	U	0.63	U	0.57	U	0.65	U	0.69	U
Aldrin	9.5	---	NA	0.98	U	0.95	U	0.86	U	0.97	U	1.1	U
Dieldrin	1.9	---	1700	0.37	U	0.36	U	0.33	U	0.37	U	0.39	U
4,4'-DDE	16	---	---	0.67	U	0.65	U	0.59	U	0.37	U	0.71	U
4,4'-DDD	9	---	---	1	U	0.97	U	0.88	U	0.99	U	1.1	U
4,4'-DDT	12	---	---	1.1	U	0.98	U	0.89	U	1.1	U	1.1	U
Total DDT	---	50	69	1.1	U	0.98	U	0.89	U	1.1	U	1.1	U
trans-Chlordane [2]	2.8	37	---	0.63	U	0.61	U	0.56	U	0.63	U	0.67	U
cis-Chlordane [3]	2.8	37	---	0.68	U	0.66	U	0.6	U	0.68	U	0.73	U
Oxychlordane	2.8	37	---	0.42	U	0.41	U	0.37	UJ	0.42	UJ	0.45	UJ
cis-Nonachlor	2.8	37	---	0.48	U	0.47	U	0.43	UJ	0.48	UJ	0.52	UJ
trans-Nonachlor	2.8	37	---	1.2	U	1.2	U	1.1	UJ	1.2	UJ	1.3	UJ
Total Chlordane	2.8	37	---	1.2	U	1.2	U	1.1	UJ	1.2	UJ	1.3	UJ
PCBs (µg/kg dry wt.)				NC-01		NC-02		NC-03		NC-04		NC-05	
Aroclor 1016	---	---	---	4.8	U	4.7	U	4.3	U	4.8	U	5.2	U
Aroclor 1221	---	---	---	4.8	U	4.7	U	4.3	U	4.8	U	5.2	U
Aroclor 1232	---	---	---	4.8	U	4.7	U	4.3	U	4.8	U	5.2	U
Aroclor 1242	---	---	---	4.8	U	4.7	U	4.3	U	4.8	U	5.2	U
Aroclor 1248	---	---	---	4.8	U	4.7	U	4.3	U	4.8	U	5.2	U
Aroclor 1254	---	---	---	4.8	U	4.7	U	4.3	U	4.8	U	5.2	U
Aroclor 1260	---	---	---	4.8	U	4.7	U	4.3	U	4.8	U	5.2	U
Total PCBs	130	384	3100	4.8	U	4.7	U	4.3	U	4.8	U	5.2	U
PAHs **(µg/kg dry wt.)**				NC-01		NC-02		NC-03		NC-04		NC-05	
2-Methylnaphthalene	670	---	1900	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U
Acenaphthene	500	---	2000	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Acenaphthylene	560	---	1300	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U
Anthracene	960	---	13000	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Fluorene	540	---	3600	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Naphthalene	2100	---	2400	2.9	U	2.9	U	2.9	U	2.9	U	3.1	J
Phenanthrene	1500	---	21000	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Total LMW PAHs	---	---	---	3.6	U	3.6	U	3.6	U	3.6	U	3.1	J
Benz(a)anthracene	1300	---	5100	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Benzo(a)pyrene	1600	---	3600	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Benzo(b)fluoranthene	3200	---	9900	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U
Benzo(g,h,i)perylene	670	---	3200	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
Benzo(k)fluoranthene	3200	---	9900	4	U	4	U	4	U	4	U	4	U
Chrysene	1400	---	21000	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U
Dibenz(a,h)anthracene	230	---	1900	3	U	3	U	3	U	3	U	3	U
Fluoranthene	1700	4600	30000	3.7	U	3.8	J	4.5	J	3.7	U	4.6	J
Indeno(1,2,3-cd)pyrene	600	---	4400	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Pyrene	2600	11980	16000	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U

TABLE 7. RESULTS OF CHEMICAL ANALYSIS FOR NORTH CHANNEL DMMUS

Analyte	SL	BT	ML	Result	Q[1]	Result	Q	Result	Q	Result	Q	Result	Q
Total HMW PAHs	---	---	---	4.1	U	3.8	J	4.5	J	4.1	U	4.6	J
Chlorinated Hydrocarbons (µg/kg dry wt.)				NC-01		NC-02		NC-03		NC-04		NC-05	
1,4-Dichlorobenzene	110	---	120	2.5	U	2.5	U	2.5	U	2.5	U	2.5	U
1,2-Dichlorobenzene	35	---	110	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U
1,2,4-Trichlorobenzene	31	---	64	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U
Hexachlorobenzene	22	168	230	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Phthalates (µg/kg dry wt.)				NC-01		NC-02		NC-03		NC-04		NC-05	
Dimethyl Phthalate	71	---	1400	4	U	4	U	4	U	4	U	4	U
Diethyl Phthalate	200	---	1200	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
Di-n-butyl Phthalate	1400	---	5100	5.6	J	4.8	U	7.5	J	7.5	J	7.2	J
Butyl Benzyl Phthalate	63	---	970	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
Bis(2-ethylhexyl) Phthalate	1300	---	8300	8.9	U	13	J	8.9	U	8.9	U	8.9	U
Di-n-octyl Phthalate	6200	---	6200	3.2	U	3.2	U	5.6	J	3.2	U	6.3	J
Phenols (µg/kg dry wt.)				NC-01		NC-02		NC-03		NC-04		NC-05	
Phenol	420	---	1200	6.5	J	3.7	J	3.7	J	3.8	J	4.1	J
2-Methylphenol	63	---	77	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U
4-Methylphenol	670	---	3600	4.5	U	4.5	U	4.5	U	4.5	U	4.5	U
2,4-Dimethylphenol	29	---	210	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U
Pentachlorophenol	400	540	690	5.3	U	5.3	U	5.3	U	5.3	U	5.3	U
Miscellaneous Extractable (µg/kg dry wt.)				NC-01		NC-02		NC-03		NC-04		NC-05	
Benzyl Alcohol	57	---	870	4.9	U	4.9	U	4.9	U	4.9	U	4.9	U
Benzoic Acid	650	---	760	96	U	96	U	96	U	96	U	96	U
Dibenzofuran	540	---	1700	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U
Hexachlorobutadiene	11	---	270	3	U	3	U	3	U	3	U	3	U
N-Nitrosodiphenylamine	28	---	130	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Dioxins/Furans (TEQ ng/Kg)				NC-01		NC-02		NC-03		NC-04		NC-05	
2,3,7,8-TCDD		5		0.531	J	0.509	U	0.716	J	0.68	J	0.718	J
Dioxin/Furan nd EDL *0		15		1.28	U	1.08	U	2.04	U	2.42	U	1.05	U
Dioxin/Furan nd EDL *0.5		15		1.43	U	1.43	U	2.09	U	2.46	U	1.25	U

TABLE 8. RESULTS OF CHEMICAL ANALYSIS FOR HOQUIAM REACH DMMUS

Analyte	SL	BT	ML	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals (mg/kg dry wt.)				HR-01		HR-02		HR-03		HR-04		HR-05		HR-06		HR-SV	
Antimony	150	---	200	0.067	J	0.076	J	0.083	J	0.069	J	0.053	J	0.048	J	NA	
Arsenic	57	507.1	700	7.86		6.63		6.99		6.63		6.04		6.54		NA	
Cadmium	5.1	---	14	0.128		0.114		0.112		0.094		0.126		0.119		NA	
Chromium	260	---	---	35		30		30.8		28.9		29.9		33.8		NA	
Copper	390	---	1300	54.3		44.1		46.5		39.3		49.3		53.2		NA	
Lead	450	975	1200	6.01		5.09		5.95		4.91		5.83		5.81		NA	
Mercury	0.41	1.5	2.3	0.035		0.03		0.032		0.026	J	0.035		0.031		NA	
Selenium	---	3	---	0.4	J	0.3	J	0.4	J	0.3	J	0.4	J	0.3	J	NA	
Silver	6.1	---	8.4	0.066		0.054		0.061		0.041		0.06		0.065		NA	
Zinc	410	---	3800	74.6		67.7		67.9		65		70		73.2		NA	
Pesticides (µg/kg dry wt.)				HR-01		HR-02		HR-03		HR-04		HR-05		HR-06		HR-SV	
gamma-BHC (Lindane)	---	---	---	0.53	U	0.5	U	0.64	U	0.53	U	0.54	U	0.49	U	NA	
Heptachlor	1.5	---	270	0.67	U	0.62	U	0.7	U	0.66	U	0.67	U	0.61	U	NA	
Aldrin	9.5	---	NA	1.1	U	0.94	U	1.1	U	1	U	1.1	U	0.92	U	NA	
Dieldrin	1.9	---	1700	0.38	U	0.35	U	0.4	U	0.38	U	0.38	U	0.35	U	NA	
4,4'-DDE	16	---	---	0.69	U	0.64	U	0.72	U	0.68	U	0.69	U	0.63	U	NA	
4,4'-DDD	9	---	---	1.1	U	0.95	U	1.1	U	1.1	U	1.1	U	0.94	U	NA	
4,4'-DDT	12	---	---	1.1	U	9.8		1.1	U	1.1	U	1.1	U	0.95	U	NA	
Total DDT	---	50	69	1.1	U	9.8		1.1	U	1.1	U	1.1	U	0.95	U	NA	
trans-Chlordane [2]	2.8	37	---	0.65	U	0.61	U	0.68	U	0.64	U	0.66	U	0.59	U	NA	
cis-Chlordane [3]	2.8	37	---	0.7	U	0.65	U	0.74	U	0.69	U	0.71	U	0.64	U	NA	
Oxychlordane	2.8	37	---	0.43	UJ	0.4	UJ	0.45	UJ	0.43	UJ	0.43	UJ	0.39	UJ	NA	
cis-Nonachlor	2.8	37	---	0.5	UJ	0.72	UJ	0.52	UJ	0.49	UJ	0.5	UJ	0.45	UJ	NA	
trans-Nonachlor	2.8	37	---	1.3	UJ	1.2	UJ	1.3	UJ	1.2	UJ	1.3	UJ	1.2	UJ	NA	
Total Chlordane	2.8	37	---	1.3	UJ	1.2	UJ	1.3	UJ	1.2	UJ	1.3	UJ	1.2	UJ	NA	
PCBs (µg/kg dry wt.)				HR-01		HR-02		HR-03		HR-04		HR-05		HR-06		HR-SV	
Aroclor 1016	---	---	---	5.0	U	4.6	U	5.2	U	4.9	U	5.0	U	4.5	U	NA	
Aroclor 1221	---	---	---	5.0	U	4.6	U	5.2	U	4.9	U	5.0	U	4.5	U	NA	
Aroclor 1232	---	---	---	5.0	U	4.6	U	5.2	U	4.9	U	5.0	U	4.5	U	NA	
Aroclor 1242	---	---	---	5.0	U	4.6	U	5.2	U	4.9	U	5.0	U	4.5	U	NA	
Aroclor 1248	---	---	---	5.0	U	4.6	U	5.2	U	4.9	U	5.0	U	4.5	U	NA	
Aroclor 1254	---	---	---	5.0	U	4.6	U	5.2	U	4.9	U	5.0	U	4.5	U	NA	
Aroclor 1260	---	---	---	5.0	U	4.6	U	5.2	U	4.9	U	5.0	U	4.5	U	NA	
Total PCBs	130	384	3100	5.0	U	4.6	U	5.2	U	4.9	U	5.0	U	4.5	U	NA	
PAH Low Molecular Wt. (µg/kg dry wt.)				HR-01		HR-02		HR-03		HR-04		HR-05		HR-06		HR-SV	
2-Methylnaphthalene	670	---	1900	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U
Acenaphthene	500	---	2000	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Acenaphthylene	560	---	1300	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U
Anthracene	960	---	13000	3.2	U	3.2	U	3.2	U	5.8	J	3.2	U	3.2	U	3.2	U
Fluorene	540	---	3600	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Naphthalene	2100	---	2400	2.9	U	2.9	U	4.2	J	2.9	U	2.9	U	2.9	U	2.9	U
Phenanthrene	1500	---	21000	3.6	U	3.6	U	7.4	J	27		3.6	U	4.2	J	3.6	U
Total LMW PAHs	---	---	---	3.6	U	3.6	U	11.6	J	32.8	J	3.6	U	4.2	J	3.6	U
PAH High Molecular Wt. (µg/kg dry wt.)				HR-01		HR-02		HR-03		HR-04		HR-05		HR-06		HR-SV	
Benz(a)anthracene	1300	---	5100	3.6	U	3.6	U	3.8	J	21		3.6	U	3.6	U	3.6	U
Benzo(a)pyrene	1600	---	3600	3.6	U	3.6	U	3.6	U	13		3.6	U	3.6	U	3.6	U
Benzo(b)fluoranthene	3200	---	9900	3.4	U	3.4	U	5.1	J	32		3.4	U	3.4	U	3.4	U
Benzo(g,h,i)perylene	670	---	3200	3.7	U	3.7	U	3.7	U	7	J	3.7	UJ	3.7	UJ	3.7	UJ
Benzo(k)fluoranthene	3200	---	9900	4	U	4	U	4	U	14		4	U	4	U	4	U
Chrysene	1400	---	21000	4.1	U	4.1	U	4.3	J	610		4.1	U	4.1	U	4.1	U
Dibenz(a,h)anthracene	230	---	1900	3	U	3	U	3	U	3	U	3	U	3	U	3	U
Fluoranthene	1700	4600	30000	4.2	J	3.7	U	12		110		3.8	J	5.8	J	4.5	J
Indeno(1,2,3-cd)pyrene	600	---	4400	3.2	U	3.2	U	3.2	U	8.5	J	3.2	U	3.2	U	3.2	U

TABLE 8. RESULTS OF CHEMICAL ANALYSIS FOR HOQUIAM REACH DMMUS

Analyte	SL	BT	ML	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Pyrene	2600	11980	16000	3.9	J	3.7	U	9.2	J	62		3.7	U	4.4	J	3.7	J
Total HMW PAHs	---	---	---	8.1	J	4.1	U	34.4	J	877.5	J	3.8	J	10.2	J	8.2	J
Chlorinated Hydrocarbons (µg/kg dry wt.)				HR-01		HR-02		HR-03		HR-04		HR-05		HR-06		HR-SV	
1,4-Dichlorobenzene	110	---	120	2.5	U	2.5	U	2.5	U	2.5	U	2.5	U	2.5	U	2.5	U
1,2-Dichlorobenzene	35	---	110	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U
1,2,4-Trichlorobenzene	31	---	64	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U
Hexachlorobenzene	22	168	230	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Phthalates (µg/kg dry wt.)				HR-01		HR-02		HR-03		HR-04		HR-05		HR-06		HR-SV	
Dimethyl Phthalate	71	---	1400	4	U	4	U	4	U	4	U	4	U	4	U	4	U
Diethyl Phthalate	200	---	1200	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
Di-n-butyl Phthalate	1400	---	5100	7.3	J	5.5	J	9.2	J	7.6	J	8.3	U	8.3	U	9.2	U
Butyl Benzyl Phthalate	63	---	970	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
Bis(2-ethylhexyl) Phthalate	1300	---	8300	8.9	U	8.9	U	8.9	U	8.9	U	8.9	U	8.9	U	8.9	U
Di-n-octyl Phthalate	6200	---	6200	3.2	U	6.2	J	3.2	U	7.1	J	3.2	U	3.2	U	3.2	U
Phenols (µg/kg dry wt.)				HR-01		HR-02		HR-03		HR-04		HR-05		HR-06		HR-SV	
Phenol	420	---	1200	4.6	J	3.3	J	4.7	J	4.8	J	6.4	J	3.7	J	5.3	J
2-Methylphenol	63	---	77	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U
4-Methylphenol	670	---	3600	4.5	U	4.5	U	4.5	U	5.2	U	4.9	J	5.9	J	4.5	U
2,4-Dimethylphenol	29	---	210	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U
Pentachlorophenol	400	540	690	5.3	U	5.3	U	5.3	U	5.3	U	5.3	U	5.3	U	5.3	U
Miscellaneous Extractable (µg/kg dry wt.)				HR-01		HR-02		HR-03		HR-04		HR-05		HR-06		HR-SV	
Benzyl Alcohol	57	---	870	4.9	U	4.9	U	4.9	U	4.9	U	4.9	U	4.9	U	4.9	U
Benzoic Acid	650	---	760	96	U	96	U	96	U	96	U	110	J	100	J	110	J
Dibenzofuran	540	---	1700	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U
Hexachlorobutadiene	11	---	270	3	U	3	U	3	U	3	U	3	U	3	U	3	U
N-Nitrosodiphenylamine	28	---	130	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Dioxins/Furans (TEQ ng/Kg)				HR-01		HR-02		HR-03		HR-04		HR-05		HR-06		HR-SV	
2,3,7,8-TCDD		5		1.23	U	1.05		1.01		0.703	U	1.06		0.941		NA	
Dioxin/Furan nd EDL *0		15		2.83	U	1.65	U	1.72	U	1.29	U	1.853	U	3.15	U	NA	
Dioxin/Furan nd EDL *0.5		15		3.54	U	2.28	U	2.31	U	1.74	U	2.764	U	3.16	U	NA	

Table 9. Results of Chemical Analysis for Cow Point and Aberdeen Reach DMMUs

Analyte	SL	BT	ML	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals (mg/kg dry wt.)				CP-01		CP-02		CP-03		AR-01		AR-02		AR-03	
Antimony	150	---	200	0.086	J	0.086	J	0.045	J	0.04	J	0.043	J	0.048	J
Arsenic	57	507.1	700	5.97		7.09		6.65		6.92		5.03		5.25	
Cadmium	5.1	---	14	0.131		0.127		0.101		0.078		0.063		0.059	
Chromium	260	---	---	29.9		31.4		31.8		36.3		32.3		26.8	
Copper	390	---	1300	48.9		45.6		45.6		49.3		42.5		40.7	
Lead	450	975	1200	5.76		6.13		6.14		5.79		4.72		3.59	
Mercury	0.41	1.5	2.3	0.032		0.035		0.035		0.014	J	0.013	J	0.006	J
Selenium	---	3	---	0.3	J	0.4	J	0.3	J	0.1	J	0.1	J	0.14	J
Silver	6.1	---	8.4	0.055		0.062		0.062		0.021	J	0.012	J	0.01	J
Zinc	410	---	3800	69.7		69.2		72.9		82.6		71.9		60.2	
Pesticides (µg/kg dry wt.)				CP-01		CP-02		CP-03		AR-01		AR-02		AR-03	
gamma-BHC (Lindane)	---	---	---	0.6	U	1.2	U	0.52	U	0.39	U	0.42	U	0.35	U
Heptachlor	1.5	---	270	0.76	U	0.73	U	0.66	U	0.5	U	0.53	U	0.44	U
Aldrin	9.5	---	NA	1.2	U	1.1	U	0.99	U	0.75	U	0.8	U	0.67	U
Dieldrin	1.9	---	1700	0.43	U	0.41	U	0.37	U	0.28	U	0.3	U	0.25	U
4,4'-DDE	16	---	---	0.78	U	0.75	U	0.67	U	0.51	U	0.55	U	0.45	U
4,4'-DDD	9	---	---	1.2	U	1.2	U	1.1	U	0.76	U	0.82	U	0.68	U
4,4'-DDT	12	---	---	1.2	U	1.2	U	1.1	U	0.77	U	0.83	U	0.69	U
Total DDT	---	50	69	1.2	U	1.2	U	1.1	U	0.77	U	0.83	U	0.69	U
trans-Chlordane [2]	2.8	37	---	0.74	U	0.71	U	0.64	U	0.48	U	0.52	U	0.43	U
cis-Chlordane [3]	2.8	37	---	0.8	U	0.77	U	0.69	U	0.52	U	0.56	U	0.47	U
Oxychlordane	2.8	37	---	0.49	UJ	0.47	UJ	0.42	UJ	0.32	UJ	0.34	UJ	0.29	UJ
cis-Nonachlor	2.8	37	---	0.56	UJ	0.54	UJ	0.49	UJ	0.37	UJ	0.4	UJ	0.33	UJ
trans-Nonachlor	2.8	37	---	1.4	UJ	1.4	UJ	1.2	UJ	0.9	UJ	0.96	UJ	0.8	UJ
Total Chlordane	2.8	37	---	1.4	UJ	1.4	UJ	1.2	UJ	0.9	UJ	0.96	UJ	0.8	UJ
PCBs (µg/kg dry wt.)				CP-01		CP-02		CP-03		AR-01		AR-02		AR-03	
Aroclor 1016	---	---	---	5.6	U	5.4	U	4.9	U	3.7	U	4	U	3.3	U
Aroclor 1221	---	---	---	5.6	U	5.4	U	4.9	U	3.7	U	4	U	3.3	U
Aroclor 1232	---	---	---	5.6	U	5.4	U	4.9	U	3.7	U	4	U	3.3	U
Aroclor 1242	---	---	---	5.6	U	5.4	U	4.9	U	3.7	U	4	U	3.3	U
Aroclor 1248	---	---	---	5.6	U	5.4	U	4.9	U	3.7	U	4	U	3.3	U
Aroclor 1254	---	---	---	5.6	U	5.4	U	4.9	U	3.7	U	4	U	3.3	U
Aroclor 1260	---	---	---	5.6	U	5.4	U	4.9	U	3.7	U	4	U	3.3	U
Total PCBs	130	384	3100	5.6	U	5.4	U	4.9	U	3.7	U	4	U	3.3	U
PAHs **(µg/kg dry wt.)**				CP-01		CP-02		CP-03		AR-01		AR-02		AR-03	
2-Methylnaphthalene	670	---	1900	3.5	J	3	J	3.4	J	2.8	U	2.8	U	2.8	U
Acenaphthene	500	---	2000	3.2	U	3.3	U	3.3	U	3.2	U	3.2	U	3.2	U
Acenaphthylene	560	---	1300	2.6	U	2.7	U	2.7	U	2.6	U	4.8	J	2.6	U
Anthracene	960	---	13000	4	J	3.4	J	3.3	U	3.2	U	8.9		3.2	U
Fluorene	540	---	3600	3.3	U	3.4	U	3.4	U	3.3	U	3.3	U	3.3	U
Naphthalene	2100	---	2400	6.5	J	5.9	J	7.1	J	2.9	U	2.9	U	2.9	U
Phenanthrene	1500	---	21000	15		9.7	J	11	J	3.6	U	52		6.3	J
Total LMW PAHs	---	---	---	29	J	22	J	21.5	J	3.6	U	65.7	J	6.3	J
Benz(a)anthracene	1300	---	5100	8.2	J	6.9	J	4.7	J	3.6	U	31		36	
Benzo(a)pyrene	1600	---	3600	5.2	J	6.8	J	3.7	U	3.6	U	34		38	
Benzo(b)fluoranthene	3200	---	9900	8.2	J	11	J	4.5	J	3.4	U	76		55	
Benzo(g,h,i)perylene	670	---	3200	3.7	UJ	3.9	U	3.8	UJ	3.7	UJ	35	J	33	J
Benzo(k)fluoranthene	3200	---	9900	4	U	4.2	U	4.1	U	4	U	25		18	
Chrysene	1400	---	21000	7.3	J	10	J	12		4.1	U	75		43	
Dibenz(a,h)anthracene	230	---	1900	3	U	3.1	U	3.1	U	3	U	7.4		8.9	
Fluoranthene	1700	4600	30000	19		11	J	12		3.7	U	260		40	
Indeno(1,2,3-cd)pyrene	600	---	4400	3.5	J	3.8	J	3.3	U	3.2	U	41		36	
Pyrene	2600	11980	16000	14		8.5	J	8.3	J	3.7	U	150		50	

Table 9. Results of Chemical Analysis for Cow Point and Aberdeen Reach DMMUs

Analyte	SL	BT	ML	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Total HMW PAHs	---	---	---	65.4	J	58	J	41.5	J	4.1	U	734.4	J	357.9	J
Chlorinated Hydrocarbons (µg/kg dry wt.)				CP-01		CP-02		CP-03		AR-01		AR-02		AR-03	
1,4-Dichlorobenzene	110	---	120	2.5	U	2.6	U	2.6	U	2.5	U	2.5	U	2.5	U
1,2-Dichlorobenzene	35	---	110	2.4	U	2.5	U	2.5	U	2.4	U	2.4	U	2.4	U
1,2,4-Trichlorobenzene	31	---	64	2.6	U	2.7	U	2.7	U	2.6	U	2.6	U	2.6	U
Hexachlorobenzene	22	168	230	3.3	U	3.4	U	3.4	U	3.3	U	3.3	U	3.3	U
Phthalates **(µg/kg dry wt.)**				CP-01		CP-02		CP-03		AR-01		AR-02		AR-03	
Dimethyl Phthalate	71	---	1400	4	U	4.2	U	4.1	U	4	U	4	U	4	U
Diethyl Phthalate	200	---	1200	3.7	U	3.9	U	3.8	U	3.7	U	3.7	U	3.7	U
Di-n-butyl Phthalate	1400	---	5100	10	U	7.4	J	8.9	U	6.6	U	7.4	U	7	U
Butyl Benzyl Phthalate	63	---	970	3.7	U	7.3	J	3.8	U	7.5		4	J	3.7	U
Bis(2-ethylhexyl) Phthalate	1300	---	8300	8.9	U	9.2	U	9	U	8.9	U	8.9	U	8.9	U
Di-n-octyl Phthalate	6200	---	6200	5.3	J	3.3	U	3.3	U	8.6	J	3.2	U	3.3	J
Phenols (µg/kg dry wt.)				CP-01		CP-02		CP-03		AR-01		AR-02		AR-03	
Phenol	420	---	1200	6.5	J	5.8	J	7.4	J	3.1	U	3.4	J	3.1	U
2-Methylphenol	63	---	77	4.1	U	4.3	U	4.2	U	4.1	U	4.1	U	4.1	U
4-Methylphenol	670	---	3600	4.5	U	4.7	U	4.6	U	4.5	U	4.5	U	4.5	U
2,4-Dimethylphenol	29	---	210	6.3	U	6.5	U	6.4	U	6.3	U	6.3	U	6.3	U
Pentachlorophenol	400	540	690	5.3	U	5.5	U	5.4	U	5.3	U	5.3	U	5.3	U
Miscellaneous Extractable (µg/kg dry wt.)				CP-01		CP-02		CP-03		AR-01		AR-02		AR-03	
Benzyl Alcohol	57	---	870	4.9	U	5.1	U	5	U	4.9	U	4.9	U	4.9	U
Benzoic Acid	650	---	760	130	J	99	U	110	J	96	UJ	96	UJ	96	UJ
Dibenzofuran	540	---	1700	3.4	U	3.5	U	3.5	U	3.4	U	3.4	U	3.4	U
Hexachlorobutadiene	11	---	270	3	U	3.1	U	3.1	U	3	U	3	U	3	U
N-Nitrosodiphenylamine	28	---	130	3.2	U	3.3	U	3.3	U	3.2	U	3.2	U	3.2	U
Dioxins/Furans (TEQ ng/Kg)				CP-01		CP-02		CP-03		AR-01		AR-02		AR-03	
2,3,7,8-TCDD		5		1.03	U	0.392	U	0.317	U	0.401	UJ	0.132	U	0.147	U
Dioxin/Furan nd EDL *0		15		2.93	U	0.709	U	2.26	U	1.21	U	1.11	U	0.269	U
Dioxin/Furan nd EDL *0.5		15		3.47	U	1.71	U	2.49	U	1.59	U	1.26	U	0.504	U

TABLE 10. RESULTS OF CHEMICAL ANALYSIS FOR SOUTH ABERDEEN DMMUS

Analyte	SL	BT	ML	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Metals (mg/kg dry wt.)				SA-01		SA-02		SA-03		SA-04		SA-05	
Antimony	150	---	200	0.033	J	0.034	J	0.068	J	0.172	J	0.022	J
Arsenic	57	507.1	700	4.2		3.99		4.68		4.79		2.8	
Cadmium	5.1	---	14	0.069		0.059		0.086		0.098		0.059	
Chromium	260	---	---	30.1		27		33.8		37.9		25.6	
Copper	390	---	1300	44		39		49.4		51.6		41.2	
Lead	450	975	1200	3.25		3.09		4.2		4.15		2.18	
Mercury	0.41	1.5	2.3	0.012	J	0.01	J	0.016	J	0.012	J	0.007	J
Selenium	---	3	---	0.1	J	0.11	J	0.2	J	0.4	J	0.09	J
Silver	6.1	---	8.4	0.017	J	0.018		0.03		0.039		0.014	J
Zinc	410	---	3800	65.4		60.9		76.7		82.1		59.5	
Pesticides (µg/kg dry wt.)				SA-01		SA-02		SA-03		SA-04		SA-05	
gamma-BHC (Lindane)	---	---	---	0.38	U	0.38	U	0.43	U	0.38	U	0.37	U
Heptachlor	1.5	---	270	0.47	U	0.48	U	0.54	U	0.48	U	0.47	U
Aldrin	9.5	---	NA	0.71	U	0.72	U	0.82	U	0.72	U	0.71	U
Dieldrin	1.9	---	1700	0.27	U	0.27	U	0.31	U	0.27	U	0.27	U
4,4'-DDE	16	---	---	0.48	U	0.49	U	0.56	U	0.49	U	0.48	U
4,4'-DDD	9	---	---	0.72	U	0.73	U	0.83	U	0.73	U	0.72	U
4,4'-DDT	12	---	---	0.74	U	0.74	U	0.85	U	0.74	U	0.73	U
Total DDT	---	50	69	0.74	U	0.74	U	0.85	U	0.74	U	0.73	U
trans-Chlordane [2]	2.8	37	---	0.46	U	0.46	U	0.53	U	0.46	U	0.46	U
cis-Chlordane [3]	2.8	37	---	0.5	U	0.5	U	0.57	U	0.5	U	0.49	U
Oxychlordane	2.8	37	---	0.3	UJ	0.31	UJ	0.35	UJ	0.31	UJ	0.3	UJ
cis-Nonachlor	2.8	37	---	0.35	UJ	0.36	UJ	0.41	UJ	0.36	UJ	0.35	UJ
trans-Nonachlor	2.8	37	---	0.86	UJ	0.86	UJ	0.99	UJ	0.86	UJ	0.85	UJ
Total Chlordane	2.8	37	---	0.86	UJ	0.86	UJ	0.99	UJ	0.86	UJ	0.85	UJ
PCBs (µg/kg dry wt.)				SA-01		SA-02		SA-03		SA-04		SA-05	
Aroclor 1016	---	---	---	3.5	U	3.6	U	4.1	U	3.6	U	3.5	U
Aroclor 1221	---	---	---	3.5	U	3.6	U	4.1	U	3.6	U	3.5	U
Aroclor 1232	---	---	---	3.5	U	3.6	U	4.1	U	3.6	U	3.5	U
Aroclor 1242	---	---	---	3.5	U	3.6	U	4.1	U	3.6	U	3.5	U
Aroclor 1248	---	---	---	3.5	U	3.6	U	4.1	U	3.6	U	3.5	U
Aroclor 1254	---	---	---	3.5	U	3.6	U	4.1	U	3.6	U	3.5	U
Aroclor 1260	---	---	---	3.5	U	3.6	U	4.1	U	3.6	U	3.5	U
Total PCBs	130	384	3100	3.5	U	3.6	U	4.1	U	3.6	U	3.5	U
PAHs **(µg/kg dry wt.)**				SA-01		SA-02		SA-03		SA-04		SA-05	
2-Methylnaphthalene	670	---	1900	2.8	U	2.8	U	2.8	U	2.8	U	2.8	U
Acenaphthene	500	---	2000	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Acenaphthylene	560	---	1300	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U
Anthracene	960	---	13000	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Fluorene	540	---	3600	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Naphthalene	2100	---	2400	2.9	U	2.9	U	4	J	2.9	U	2.9	U
Phenanthrene	1500	---	21000	3.6	U	3.6	U	10		5.5	J	3.6	U
Total LMW PAHs	---	---	---	3.6	U	3.6	U	14	J	5.5	J	3.6	U
Benz(a)anthracene	1300	---	5100	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Benzo(a)pyrene	1600	---	3600	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Benzo(b)fluoranthene	3200	---	9900	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U
Benzo(g,h,i)perylene	670	---	3200	3.7	UJ	3.7	UJ	3.7	UJ	3.7	UJ	3.7	UJ
Benzo(k)fluoranthene	3200	---	9900	4	U	4	U	4	U	4	U	4	U
Chrysene	1400	---	21000	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U
Dibenz(a,h)anthracene	230	---	1900	3	U	3	U	3	U	3	U	3	U
Fluoranthene	1700	4600	30000	3.7	U	3.7	U	9.6		5.2	J	3.7	U
Indeno(1,2,3-cd)pyrene	600	---	4400	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Pyrene	2600	11980	16000	3.7	U	3.7	U	6.4	J	3.7	U	3.7	U

TABLE 10. RESULTS OF CHEMICAL ANALYSIS FOR SOUTH ABERDEEN DMMUS

Analyte	SL	BT	ML	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Total HMW PAHs	---	---	---	4.1	U	4.1	U	16	J	5.2	J	4.1	U
Chlorinated Hydrocarbons (µg/kg dry wt.)				SA-01		SA-02		SA-03		SA-04		SA-05	
1,4-Dichlorobenzene	110	---	120	2.5	U	2.5	U	2.5	U	2.5	U	2.5	U
1,2-Dichlorobenzene	35	---	110	2.4	U	2.4	U	2.4	U	2.4	U	2.4	U
1,2,4-Trichlorobenzene	31	---	64	2.6	U	2.6	U	2.6	U	2.6	U	2.6	U
Hexachlorobenzene	22	168	230	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Phthalates (µg/kg dry wt.)				SA-01		SA-02		SA-03		SA-04		SA-05	
Dimethyl Phthalate	71	---	1400	4	U	4	U	4	U	4	U	4	U
Diethyl Phthalate	200	---	1200	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
Di-n-butyl Phthalate	1400	---	5100	7.4	U	6.6	U	7.2	U	7.1	U	6.8	U
Butyl Benzyl Phthalate	63	---	970	3.7	U	4.3	J	3.7	U	3.7	U	3.7	U
Bis(2-ethylhexyl) Phthalate	1300	---	8300	8.9	U	8.9	U	8.9	U	8.9	U	8.9	U
Di-n-octyl Phthalate	6200	---	6200	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Phenols (µg/kg dry wt.)				SA-01		SA-02		SA-03		SA-04		SA-05	
Phenol	420	---	1200	4.1	J	4.7	J	6	J	4.8	J	4.9	J
2-Methylphenol	63	---	77	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U
4-Methylphenol	670	---	3600	4.5	U	4.5	U	4.5	U	4.5	U	4.5	U
2,4-Dimethylphenol	29	---	210	6.3	U	6.3	U	6.3	U	6.3	U	6.3	U
Pentachlorophenol	400	540	690	5.3	U	5.3	U	26	J	5.3	U	17	J
Miscellaneous Extractable (µg/kg dry wt.)				SA-01		SA-02		SA-03		SA-04		SA-05	
Benzyl Alcohol	57	---	870	4.9	U	4.9	U	4.9	U	4.9	U	4.9	U
Benzoic Acid	650	---	760	96	UJ	96	UJ	96	J	96	UJ	96	UJ
Dibenzofuran	540	---	1700	3.4	U	3.4	U	3.4	U	3.4	U	3.4	U
Hexachlorobutadiene	11	---	270	3	U	3	U	3	U	3	U	3	U
N-Nitrosodiphenylamine	28	---	130	3.2	U	3.2	U	3.2	U	3.2	U	3.2	U
Dioxins/Furans (TEQ ng/Kg)				SA-01		SA-02		SA-03		SA-04		SA-05	
2,3,7,8-TCDD		5		0.416	UJ	0.128	U	0.156	U	0.32	J	0.15	U
Dioxin/Furan nd EDL *0		15		0.706	U	0.685	U	0.934	U	1.37	U	0.808	U
Dioxin/Furan nd EDL *0.5		15		1.01	U	0.875	U	1.15	U	1.4	U	0.909	U

TABLE 11. REPRESENTATIVE CHEMICAL RESULTS COMPARED TO WASHINGTON STATE SMS FOR CROSSOVER REACH

CHEMICAL	UNIT	SQS	CSL	CR-01		CR-02		CR-03		CR-04		CR-05		CR-06	
TOC	%			0.379		0.406		0.311		0.273		0.646		0.846	
Metals															
Arsenic	mg/kg	57	93	6.37		6.37		5.71		4.98		8.1		8.08	
Cadmium	mg/kg	5.1	6.7	0.04		0.048		0.037		0.027		0.072		0.089	
Chromium	mg/kg	260	270	17.6		16.8		19.7		17.3		26.2		29.5	
Copper	mg/kg	390	390	11		9.1		14		9.3		18.7		26.6	
Lead	mg/kg	450	530	2.94		2.54		2.91		2.48		4.29		4.55	
Mercury	mg/kg	0.41	0.59	0.009	J	0.004	J	0.011	J	0.009	J	0.016	J	0.021	J
Silver	mg/kg	6.1	6.1	0.018	J	0.017	J	0.021		0.013	J	0.031		0.039	
Zinc	mg/kg	410	960	38.8		37.3		41.4		37.2		58.6		64.4	
Total PCBs	mg/kg/OC*	12	65	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.005	U
Total LPAHs	mg/kg-OC	370	780	0.01	J	0.01	U	0.01	U	0.01	U	0.006	U	0.004	U
Total HPAHs	mg/kg-OC	960	5300	0.011	U	0.010	U	0.013	U	0.015	U	0.006	U	0.010	J

TABLE 12. REPRESENTATIVE CHEMICAL RESULTS COMPARED TO WASHINGTON STATE SMS FOR NORTH CHANNEL

CHEMICAL	UNIT	SQS	CSL	NC-01		NC-02		NC-03		NC-04		NC-05	
TOC	%			1.41		0.91		0.97		0.959		1.27	
Metals													
Arsenic	mg/kg	57	93	8.48		6.95		6.79		6.89		8.5	
Cadmium	mg/kg	5.1	6.7	0.108		0.095		0.086		0.094		0.1	
Chromium	mg/kg	260	270	29.4		28.5		28.1		28.5		28.8	
Copper	mg/kg	390	390	37.2		31		35		35.7		37.4	
Lead	mg/kg	450	530	4.87		4.43		4.6		4.71		5.17	
Mercury	mg/kg	0.41	0.59	0.023	J	0.024		0.022	J	0.023	J	0.03	
Silver	mg/kg	6.1	6.1	0.049		0.04		0.038		0.057		0.05	
Zinc	mg/kg	410	960	64.3		62.9		61.5		61.7		62.8	
Total PCBs	mg/kg/OC*	12	65	0.003	U	0.01	U	0.004	U	0.01	U	0.004	U
Total LPAHs	mg/kg-OC	370	780	0.003	U	0.004	U	0.004	U	0.004	U	0.002	J
Total HPAHs	mg/kg-OC	960	5300	0.003	U	0.004	J	0.005	J	0.004	U	0.004	J

TABLE 13. REPRESENTATIVE CHEMICAL RESULTS COMPARED TO WASHINGTON STATE SMS FOR HOQUIAM REACH

CHEMICAL	UNIT	SQS	CSL	HR-01		HR-02		HR-03		HR-04		HR-05		HR-06	
TOC	%			1.32		1.6		1.47		1.15		1.44		1.08	
Metals															
Arsenic	mg/kg	57	93	7.86		6.63		6.99		6.63		6.04		6.54	
Cadmium	mg/kg	5.1	6.7	0.128		0.114		0.112		0.094		0.126		0.119	
Chromium	mg/kg	260	270	35		30		30.8		28.9		29.9		33.8	
Copper	mg/kg	390	390	54.3		44.1		46.5		39.3		49.3		53.2	
Lead	mg/kg	450	530	6.01		5.09		5.95		4.91		5.83		5.81	
Mercury	mg/kg	0.41	0.59	0.035		0.03		0.032		0.026	J	0.035		0.031	
Silver	mg/kg	6.1	6.1	0.066		0.054		0.061		0.041		0.06		0.065	
Zinc	mg/kg	410	960	74.6		67.7		67.9		65		70		73.2	
Total PCBs	mg/kg/OC*	12	65	0.004	U	0.003	U	0.004	U	0.0043	U	0.0035	U	0.0042	U
Total LPAHs	mg/kg-OC	370	780	0.003	U	0.002	U	0.008	J	0.029	J	0.003	U	0.004	J
Total HPAHs	mg/kg-OC	960	5300	0.006	J	0.000	U	0.023	J	0.763	J	0.003	J	0.009	J

TABLE 14. REPRESENTATIVE CHEMICAL RESULTS COMPARED TO WASHINGTON STATE SMS FOR COW POINT AND ABERDEEN REACHES

CHEMICAL	UNIT	SQS	CSL	CP-01		CP-02		CP-03		AR-01		AR-02		AR-03	
TOC	%			1.65		1.64		1.55		0.44		0.39		0.55	
Metals															
Arsenic	mg/kg	57	93	5.97		7.09		6.65		6.92		5.03		5.25	
Cadmium	mg/kg	5.1	6.7	0.131		0.127		0.101		0.078		0.063		0.059	
Chromium	mg/kg	260	270	29.9		31.4		31.8		36.3		32.3		26.8	
Copper	mg/kg	390	390	48.9		45.6		45.6		49.3		42.5		40.7	
Lead	mg/kg	450	530	5.76		6.13		6.14		5.79		4.72		3.59	
Mercury	mg/kg	0.41	0.59	0.032		0.035		0.035		0.014	J	0.013	J	0.006	J
Silver	mg/kg	6.1	6.1	0.055		0.062		0.062		0.021	J	0.012	J	0.01	J
Zinc	mg/kg	410	960	69.7		69.2		72.9		82.6		71.9		60.2	
Total PCBs	mg/kg/OC*	12	65	0.0034	U	0.0033	U	0.0032	U	0.0084	U	0.0103	U	0.0061	U
Total LPAHs	mg/kg-OC	370	780	0.018	J	0.013	J	0.014	J	0.008	U	0.168	J	0.012	J
Total HPAHs	mg/kg-OC	960	5300	0.040	J	0.035	J	0.027	J	0.009	U	1.883	J	0.657	J

TABLE 15. REPRESENTATIVE CHEMICAL RESULTS COMPARED TO WASHINGTON STATE SMS FOR SOUTH ABERDEEN REACH

CHEMICAL	UNIT	SQS	CSL	SA-01		SA-02		SA-03		SA-04		SA-05	
TOC	%			0.33		0.35		0.60		0.38		0.28	
Metals													
Arsenic	mg/kg	57	93	4.2		3.99		4.68		4.79		2.8	
Cadmium	mg/kg	5.1	6.7	0.069		0.059		0.086		0.098		0.059	
Chromium	mg/kg	260	270	30.1		27		33.8		37.9		25.6	
Copper	mg/kg	390	390	44		39		49.4		51.6		41.2	
Lead	mg/kg	450	530	3.25		3.09		4.2		4.15		2.18	
Mercury	mg/kg	0.41	0.59	0.012	J	0.01	J	0.016	J	0.012	J	0.007	J
Silver	mg/kg	6.1	6.1	0.017	J	0.018		0.03		0.039		0.014	J
Zinc	mg/kg	410	960	65.4		60.9		76.7		82.1		59.5	
Total PCBs	mg/kg/OC*	12	65	0.0106	U	0.0103	U	0.0068	U	0.0096	U	0.0127	U
Total LPAHs	mg/kg-OC	370	780	0.011	U	0.010	U	0.023	J	0.015	J	0.013	U
Total HPAHs	mg/kg-OC	960	5300	0.012	U	0.012	U	0.027	J	0.014	J	0.015	U

NOTES FOR TABLES 11 – 15

- All SMS chemicals were analyzed as part of this characterization, and all fell below sediment quality standards. Only representative results are presented here.
- TOC = Total Organic Carbon
- SQS = Sediment Quality Standard
- CSL = Cleanup Screening Level
- Organic compounds are normalized to TOC, and expressed in mg/kg OC

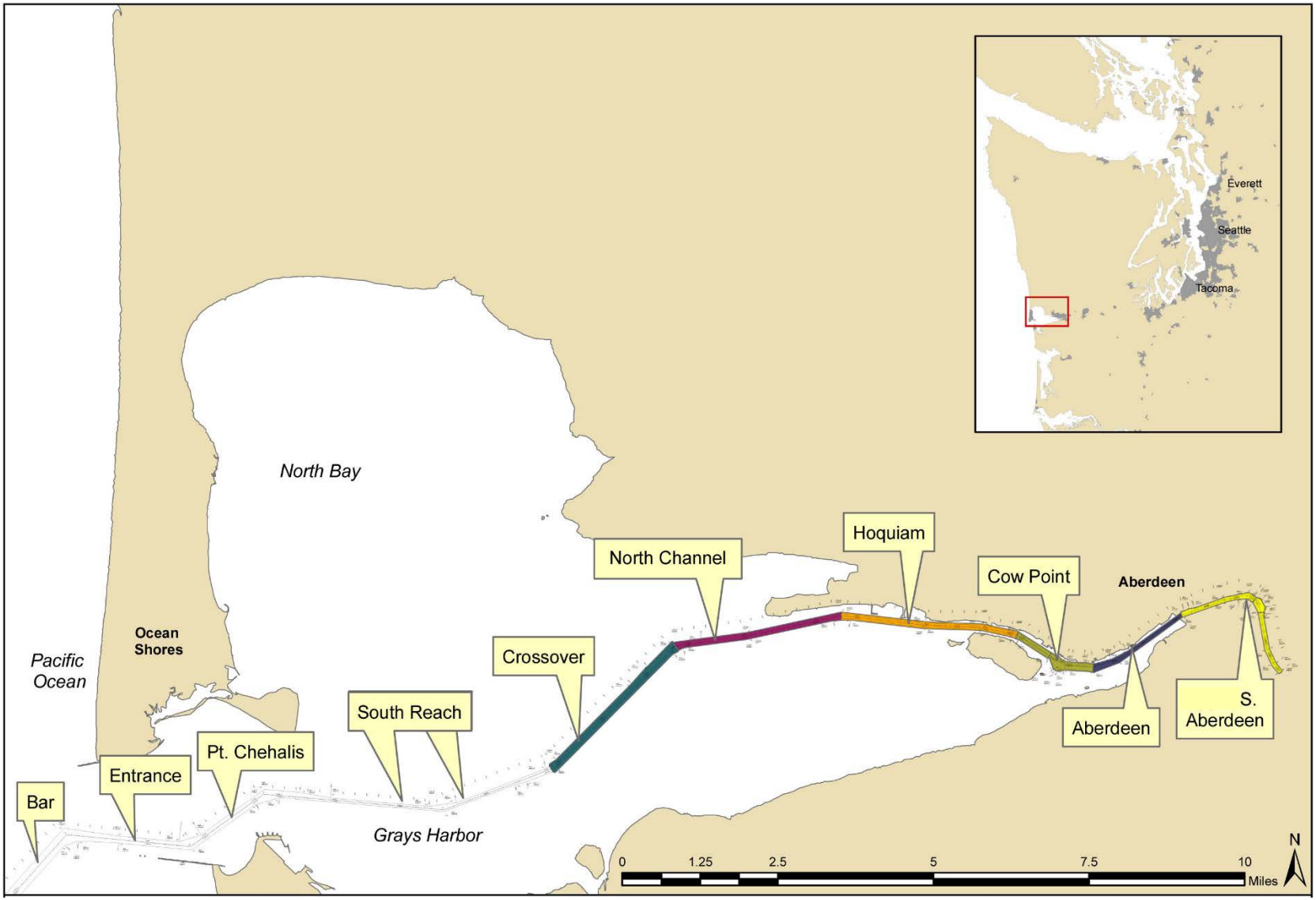


FIGURE 1. GRAYS HARBOR VICINITY AND PROJECT REACHES

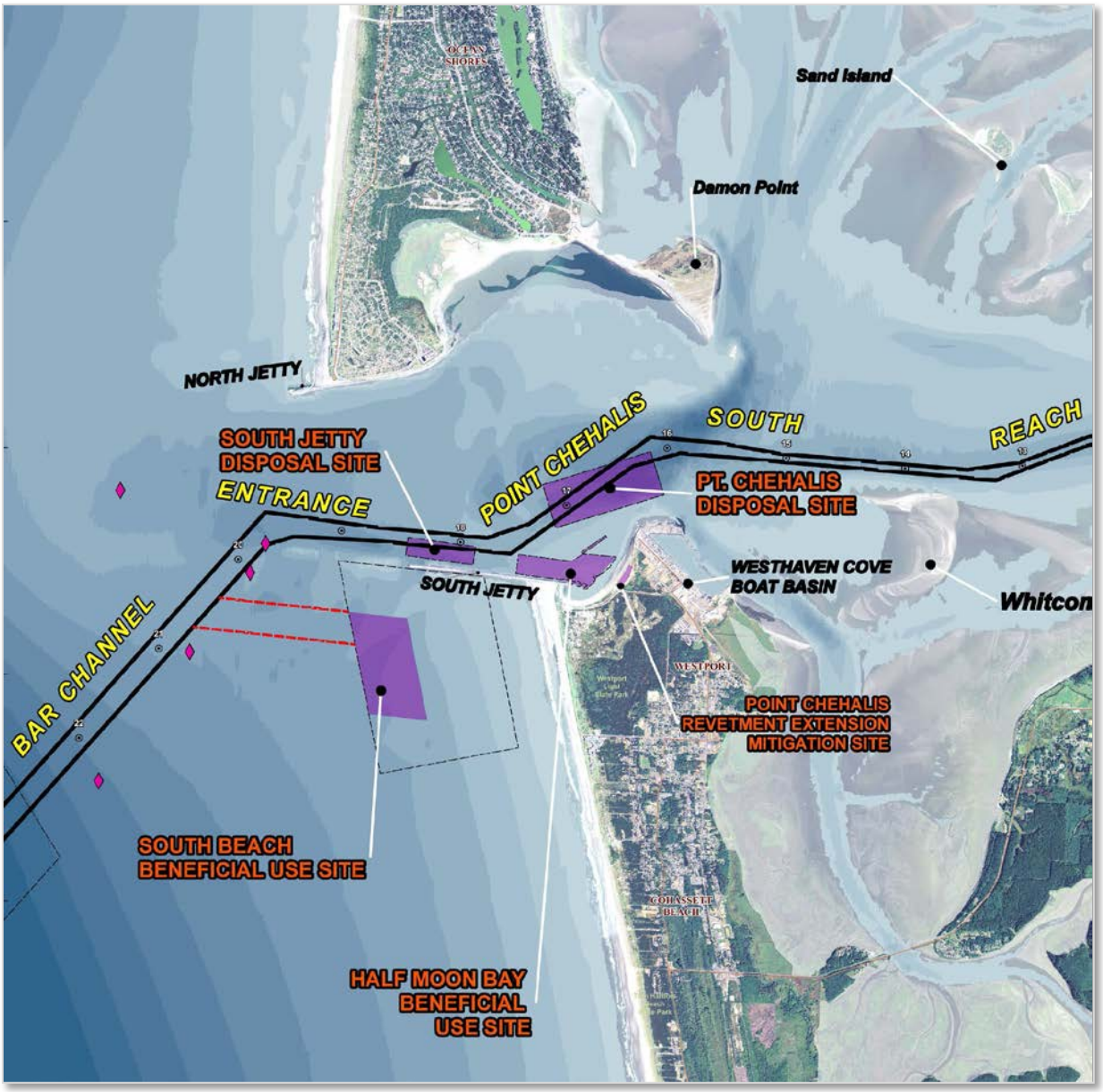


FIGURE 2. OUTER GRAYS HARBOR WITH DISPOSAL SITE LOCATIONS. POINT CHEHALIS AND SOUTH JETTY ARE DMMP DISPERSIVE DISPOSAL SITES. OTHER SITES SHOWN ARE FREQUENTLY-USED BENEFICIAL USE SITES.

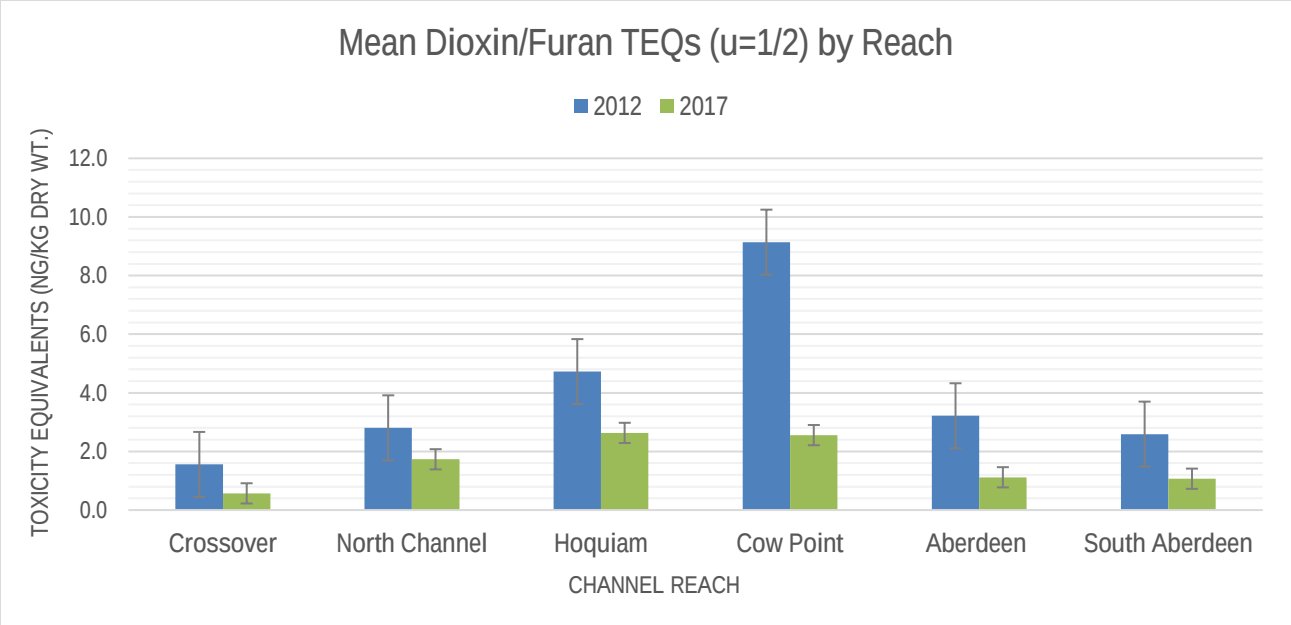
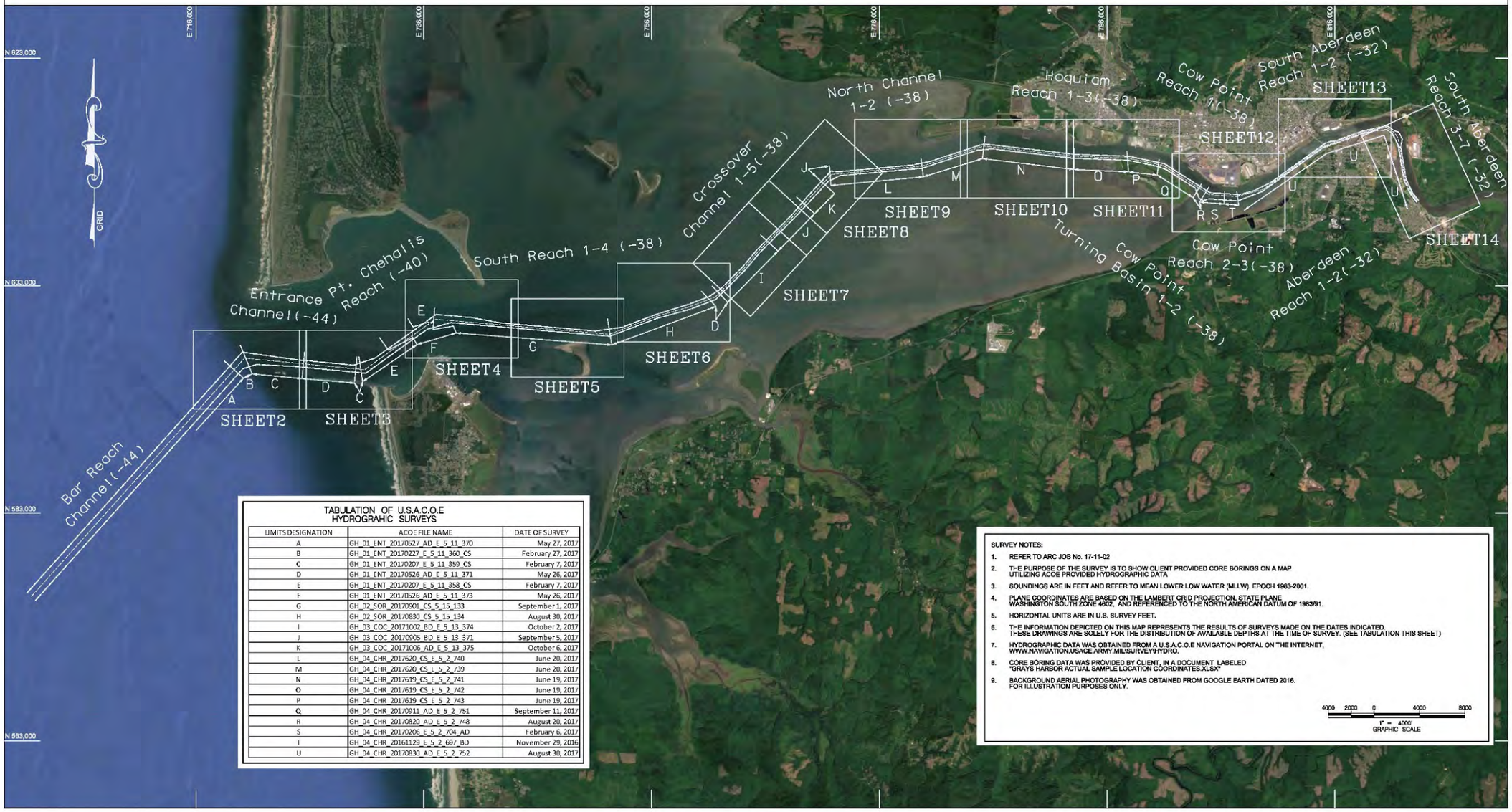


FIGURE 3. DIOXIN/FURAN TEQS - COMPARISON OF 2012 AND 2017 DATA

A MAP SHOWING PROPOSED AND ACTUAL BORING LOCATIONS ALONG A PORTION OF THE GRAYS HARBOR CHANNEL, GRAYS HARBOR COUNTY, WASHINGTON

LOCATION MAP
NOT TO SCALE



TABULATION OF U.S.A.C.O.E HYDROGRAHIC SURVEYS

UMITS DESIGNATION	ACOE FILE NAME	DATE OF SURVEY
A	GH_01_ENT_2017052 7_AD_E_5_11_370	May 27, 2017
B	GH_01_ENT_20170227_E_5_11_360_CS	February 27, 2017
C	GH_01_ENT_2017/0207_E_5_11_359_CS	February 7, 2017
D	GH_01_ENT_20170526_AD_E_5_11_371	May 26, 2017
E	GH_01_ENT_2017/0207_E_5_11_358_CS	February 7, 2017
F	GH_01_ENT_2017/0526_AD_E_5_11_373	May 26, 2017
G	GH_02_SOR_20170901_CS_5_15_133	September 1, 2017
H	GH_02_SOR_2017/0830_CS_5_15_134	August 30, 2017
I	GH_03_COC_20171002_BD_E_5_13_374	October 2, 2017
J	GH_03_COC_2017/0905_BD_E_5_13_371	September 5, 2017
K	GH_03_COC_20171006_AD_E_5_13_375	October 6, 2017
L	GH_04_CHR_2017620_CS_E_5_2_740	June 20, 2017
M	GH_04_CHR_2017/620_CS_E_5_2_739	June 20, 2017
N	GH_04_CHR_2017619_CS_E_5_2_741	June 19, 2017
O	GH_04_CHR_2017/619_CS_E_5_2_742	June 19, 2017
P	GH_04_CHR_2017/619_CS_E_5_2_743	June 19, 2017
Q	GH_04_CHR_2017/0911_AD_E_5_2_751	September 11, 2017
R	GH_04_CHR_2017/0820_AD_E_5_2_748	August 20, 2017
S	GH_04_CHR_2017/0206_E_5_2_704_AD	February 6, 2017
T	GH_04_CHR_20161129_E_5_2_697_BD	November 29, 2016
U	GH_04_CHR_2017/0830_AD_E_5_2_752	August 30, 2017

SURVEY NOTES:

1. REFER TO ARC JOB No. 17-11-02
2. THE PURPOSE OF THE SURVEY IS TO SHOW CLIENT PROVIDED CORE BORINGS ON A MAP UTILIZING ACOE PROVIDED HYDROGRAPHIC DATA
3. SOUNDINGS ARE IN FEET AND REFER TO MEAN LOWER LOW WATER (MLLW). EPOCH 1983-2001.
4. PLANE COORDINATES ARE BASED ON THE LAMBERT GRID PROJECTION, STATE PLANE WASHINGTON SOUTH ZONE 4602, AND REFERENCED TO THE NORTH AMERICAN DATUM OF 1983/91.
5. HORIZONTAL UNITS ARE IN U.S. SURVEY FEET.
6. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED. THESE DRAWINGS ARE SOLELY FOR THE DISTRIBUTION OF AVAILABLE DEPTHS AT THE TIME OF SURVEY. (SEE TABULATION THIS SHEET)
7. HYDROGRAPHIC DATA WAS OBTAINED FROM A U.S.A.C.O.E NAVIGATION PORTAL ON THE INTERNET, WWW.NAVIGATION.USACE.ARMY.MIL\SURVEY\HYDRO.
8. CORE BORING DATA WAS PROVIDED BY CLIENT, IN A DOCUMENT LABELED "GRAYS HARBOR ACTUAL SAMPLE LOCATION COORDINATES.XLSX"
9. BACKGROUND AERIAL PHOTOGRAPHY WAS OBTAINED FROM GOOGLE EARTH DATED 2016. FOR ILLUSTRATION PURPOSES ONLY.

4000 2000 0 4000 8000
1" = 4000'
GRAPHIC SCALE

DATE	DET	REVISION	BY
1/16/17		REVISED CORE BORINGS PER CLIENT	

Project Title: Grays Harbor County, Washington Proposed and Actual Sample Locations

Prepared For: EcoAnalyts, Inc. 4729 NE View Drive Port Gamble, WA 98364

Arc Surveying & Mapping, Inc. Professional Hydrographers • Surveyors • Mappers 5202 San Juan Avenue Jacksonville, Florida 32210 904.384.8377

LB No. 8487
Drawn By: M. SAWYER
Scale: see map
Plot Date: 11/03/17
File Name:
Fld Bk / Pg:
ARC Project No.: 17-11-02
SHEET: 1 OF: 14

Figure 4. Grays Harbor Federal Navigation Channel

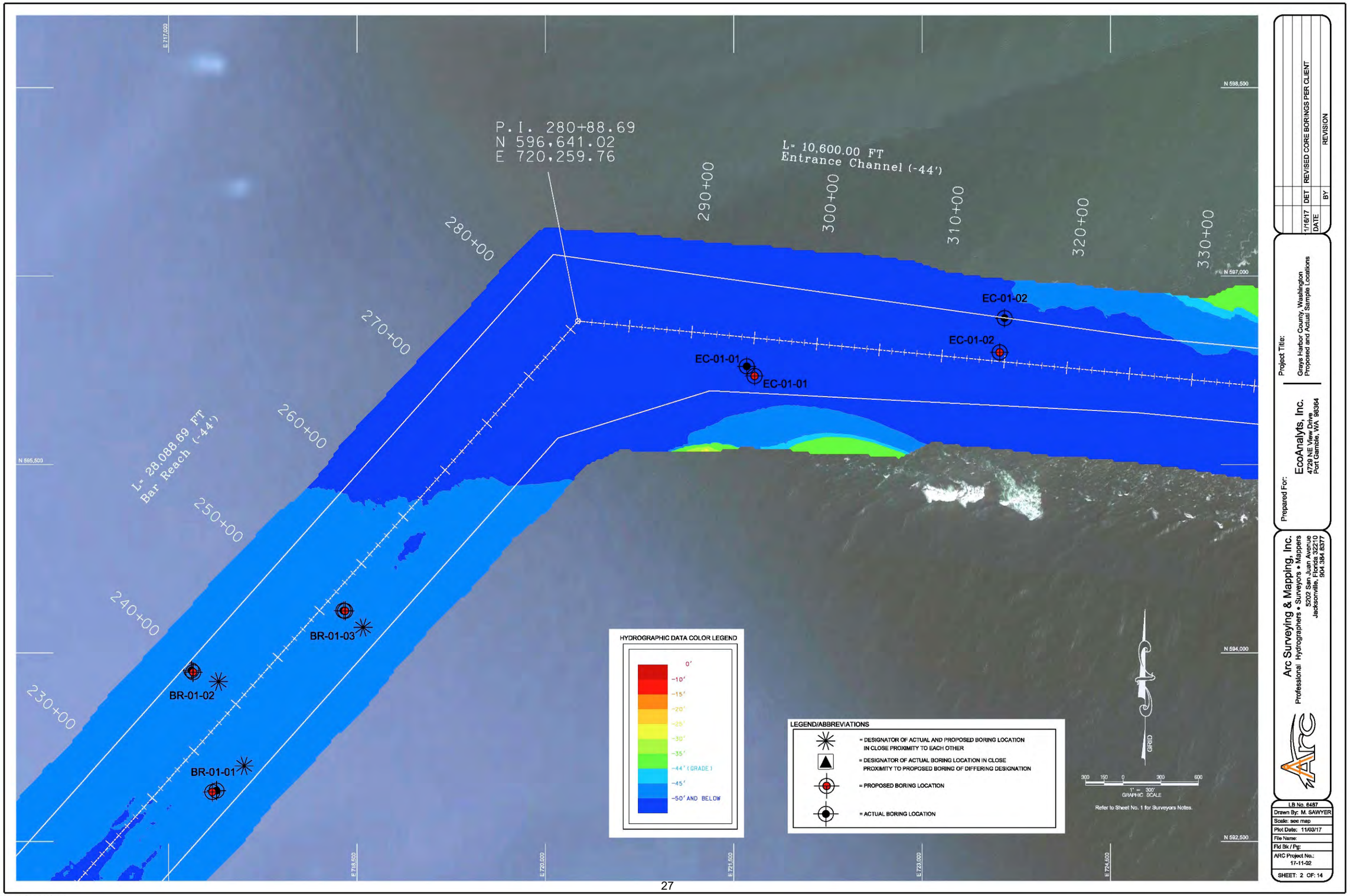


Figure 5. Bar and Entrance Channel Reach Proposed and Actual Station Locations

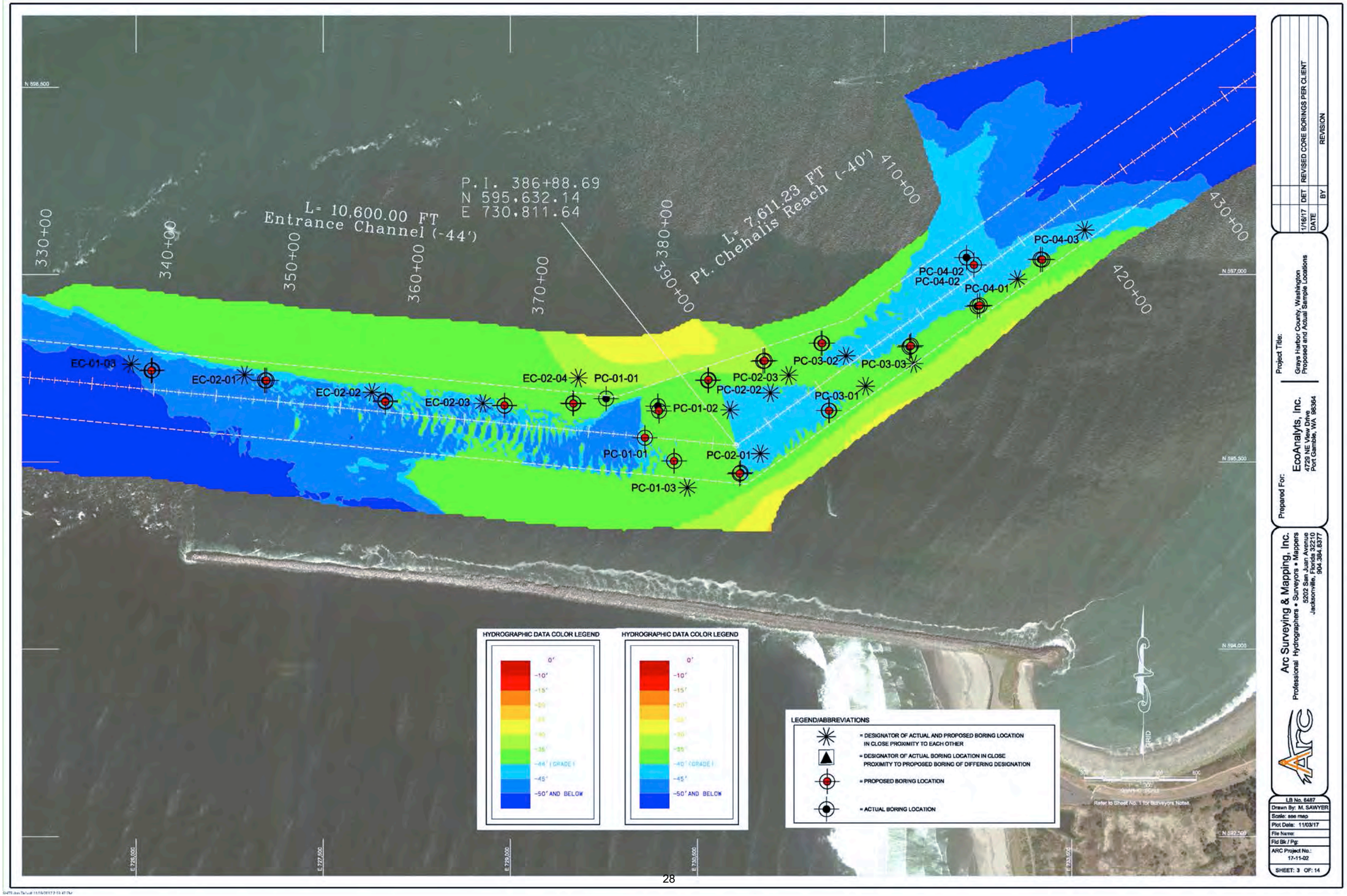


Figure 6. Entrance Channel (cont.) and Point Chehalis Reach Proposed and Actual Station Locations

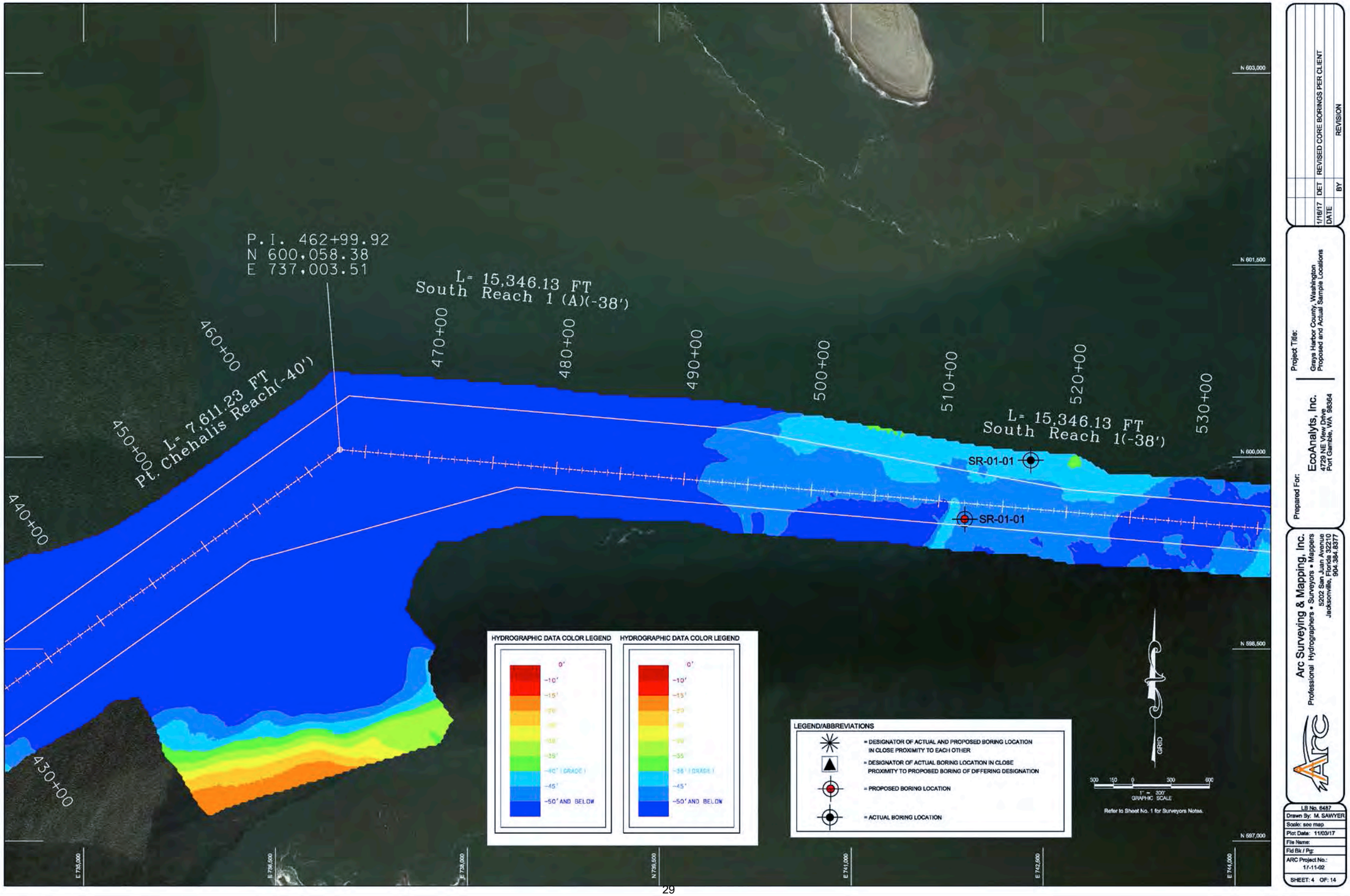


Figure 7. South Reach Proposed and Actual Station Locations

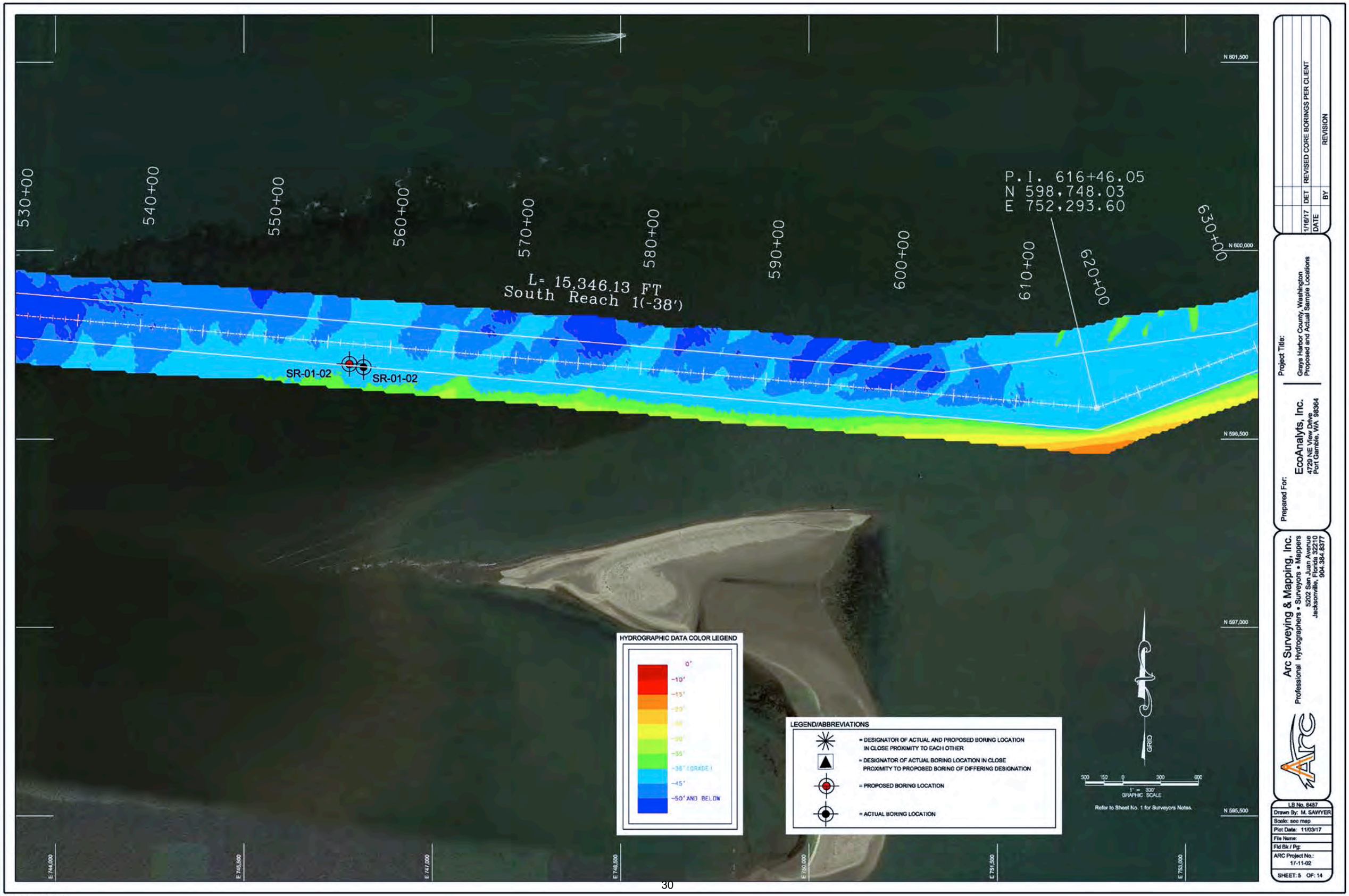


Figure 8. South Reach (cont.) Proposed and Actual Station Locations

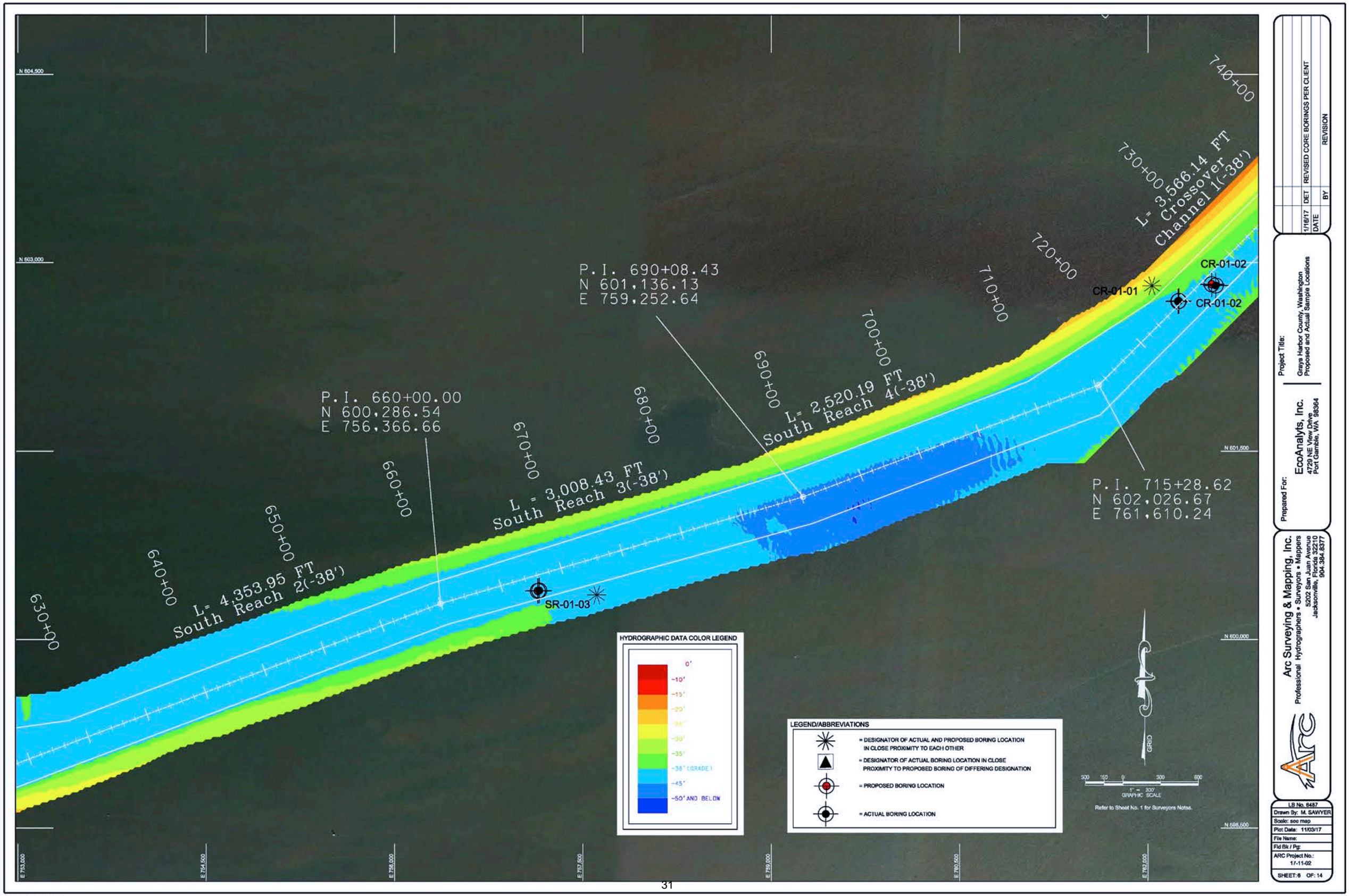


Figure 9. South (cont.) and Crossover Reach Proposed and Actual Station Locations

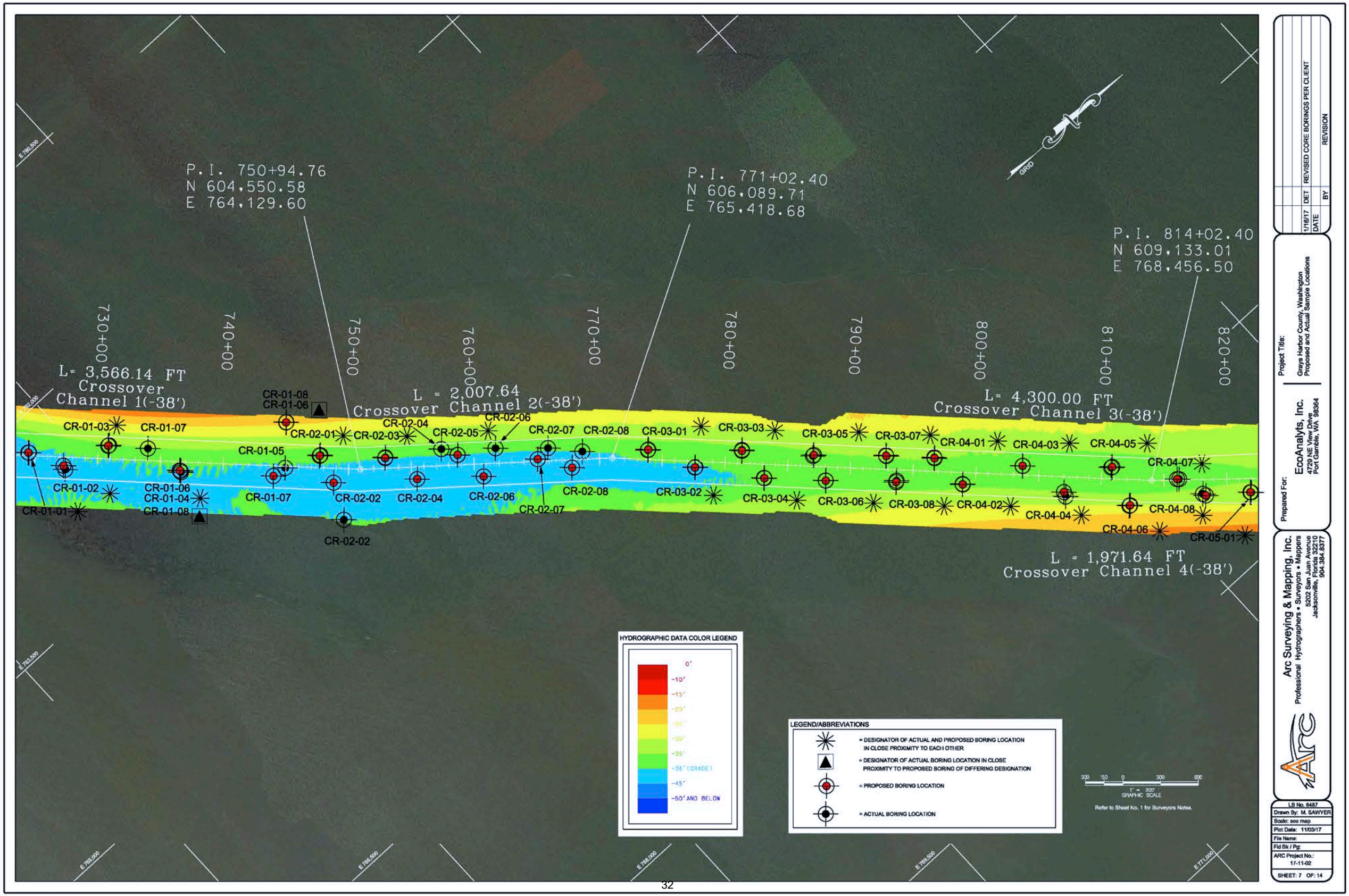


Figure 10. Crossover Reach (cont.) Proposed and Actual Station Locations

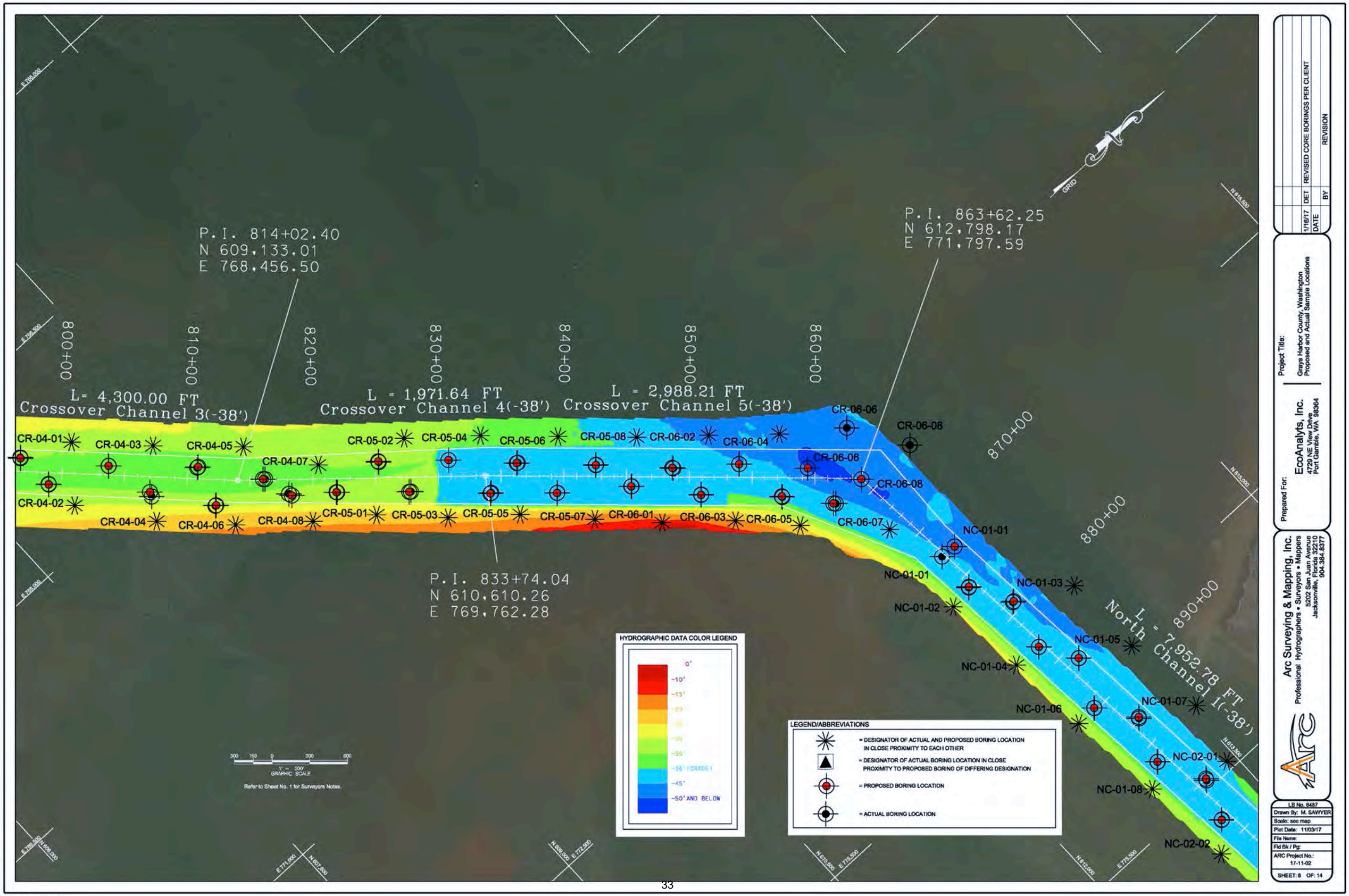


Figure 11. Crossover (cont.) and North Channel Reach Proposed and Actual Station Locations

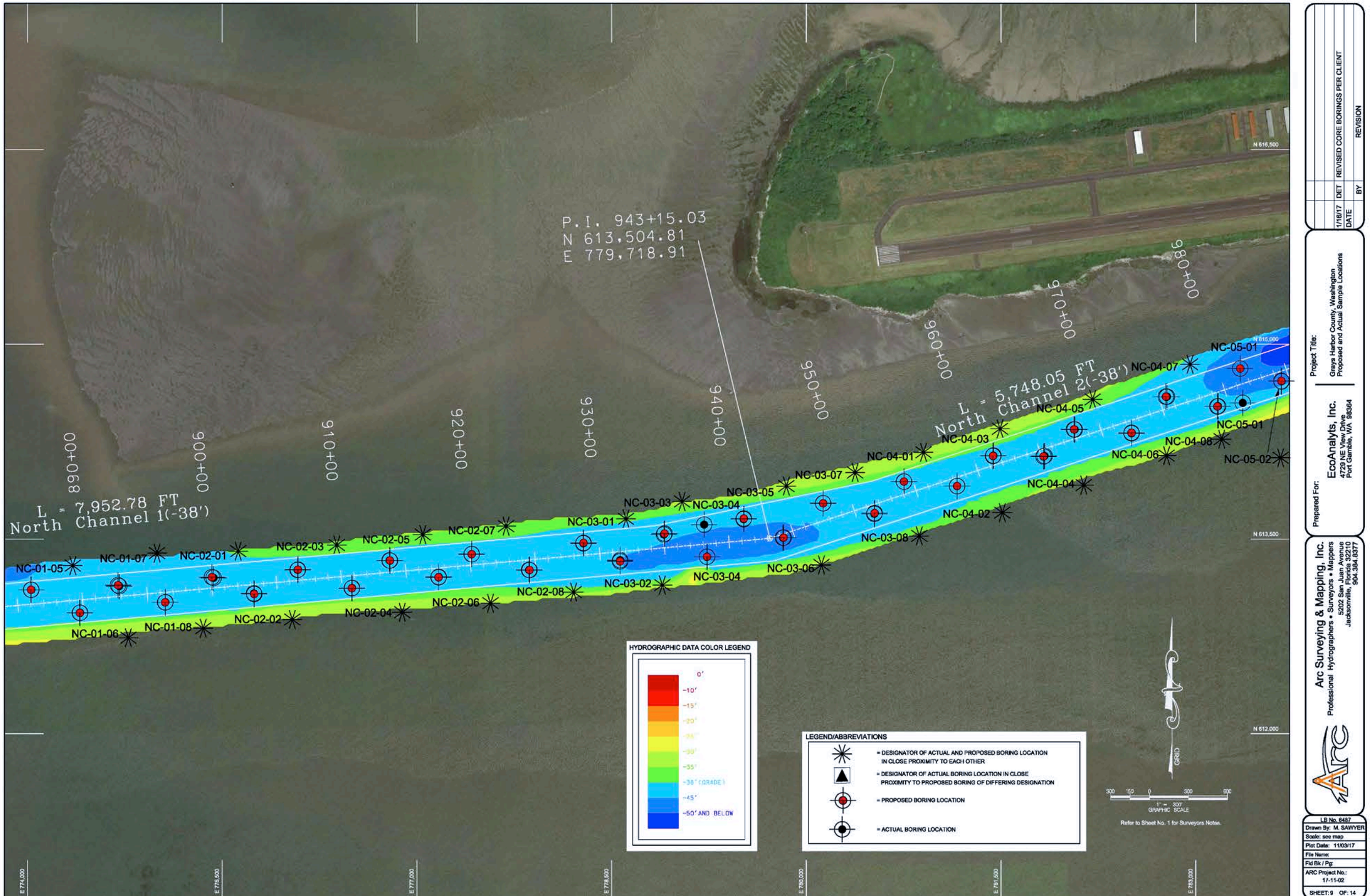


Figure 12. North Channel Reach (cont.) Proposed and Actual Station Locations

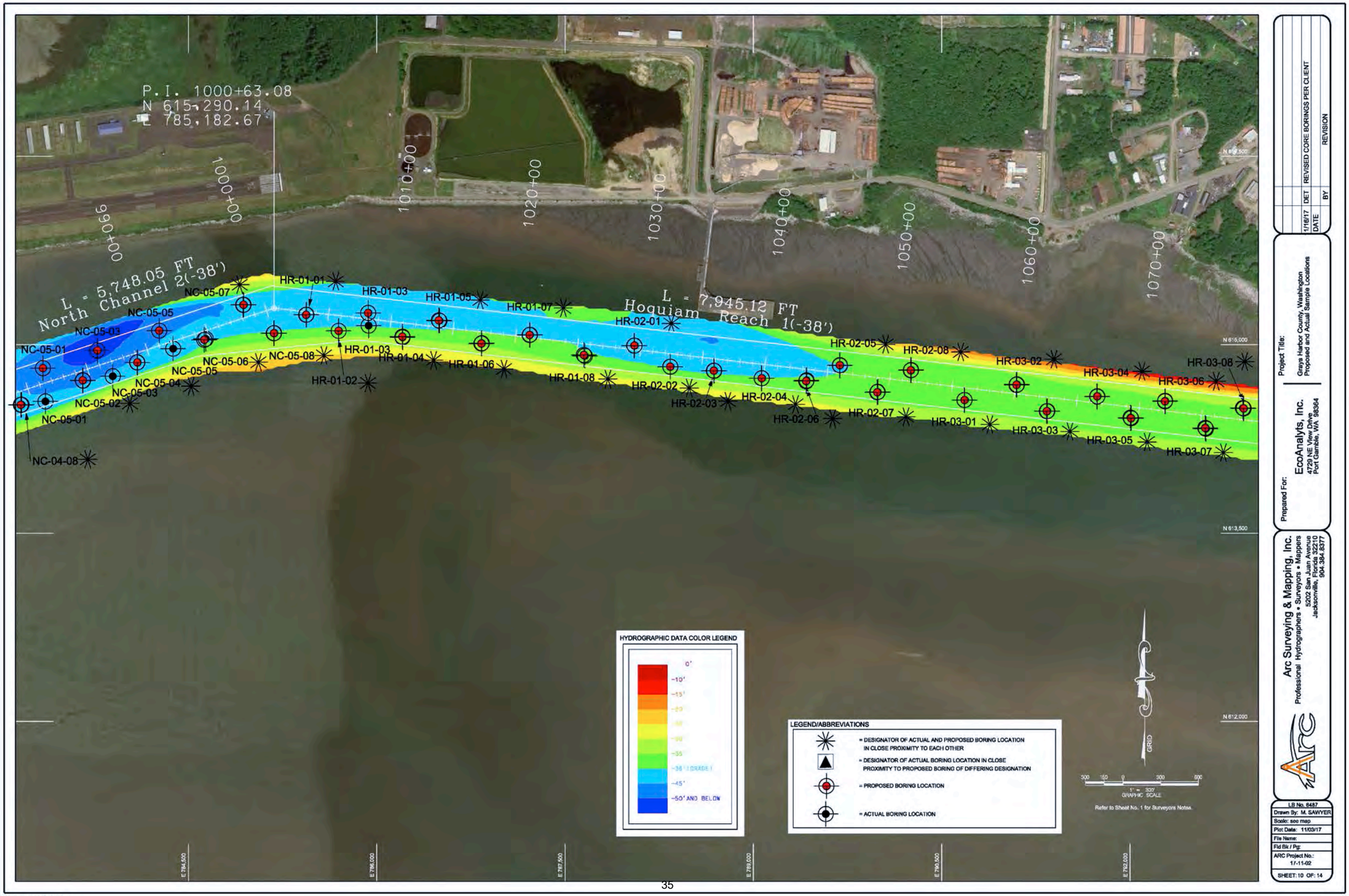


Figure 13. North Channel (cont.) and Hoquiam Reach Proposed and Actual Station Locations

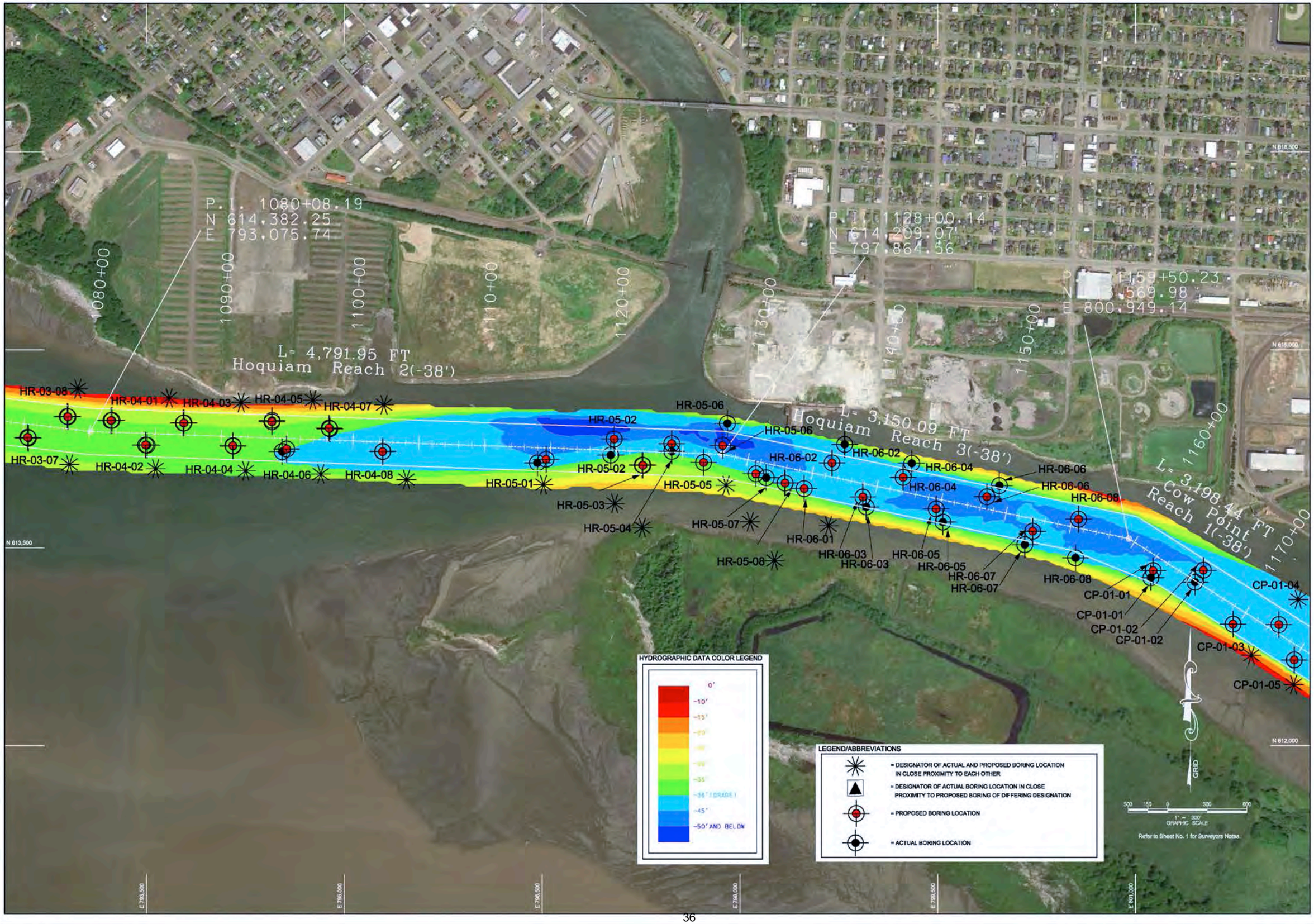


Figure 14. Hoquiam (cont.) and Cow Point Reach Proposed and Actual Station Locations

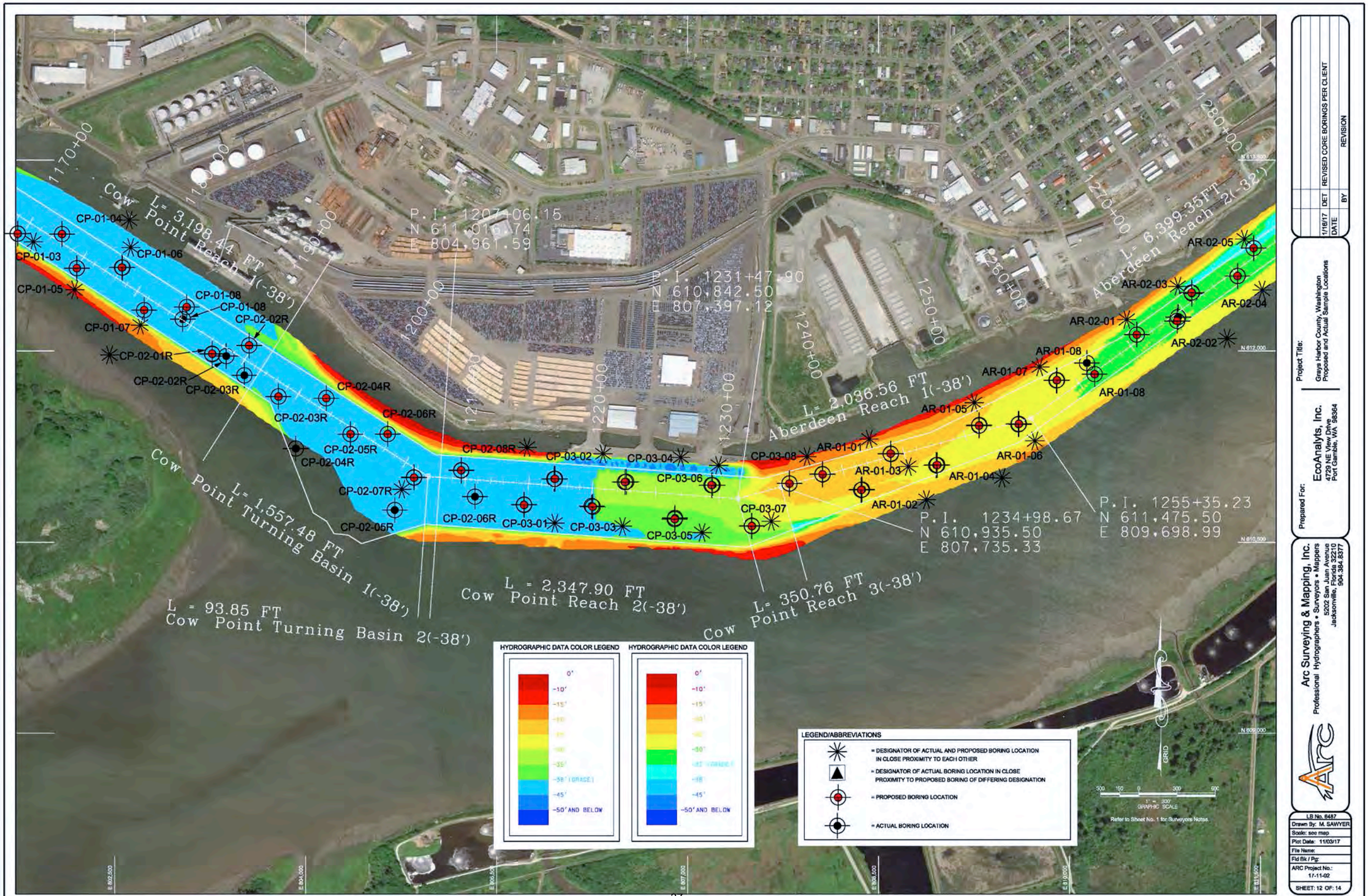


Figure 15. Cow Point (cont.) and Aberdeen Reach Proposed and Actual Station Locations

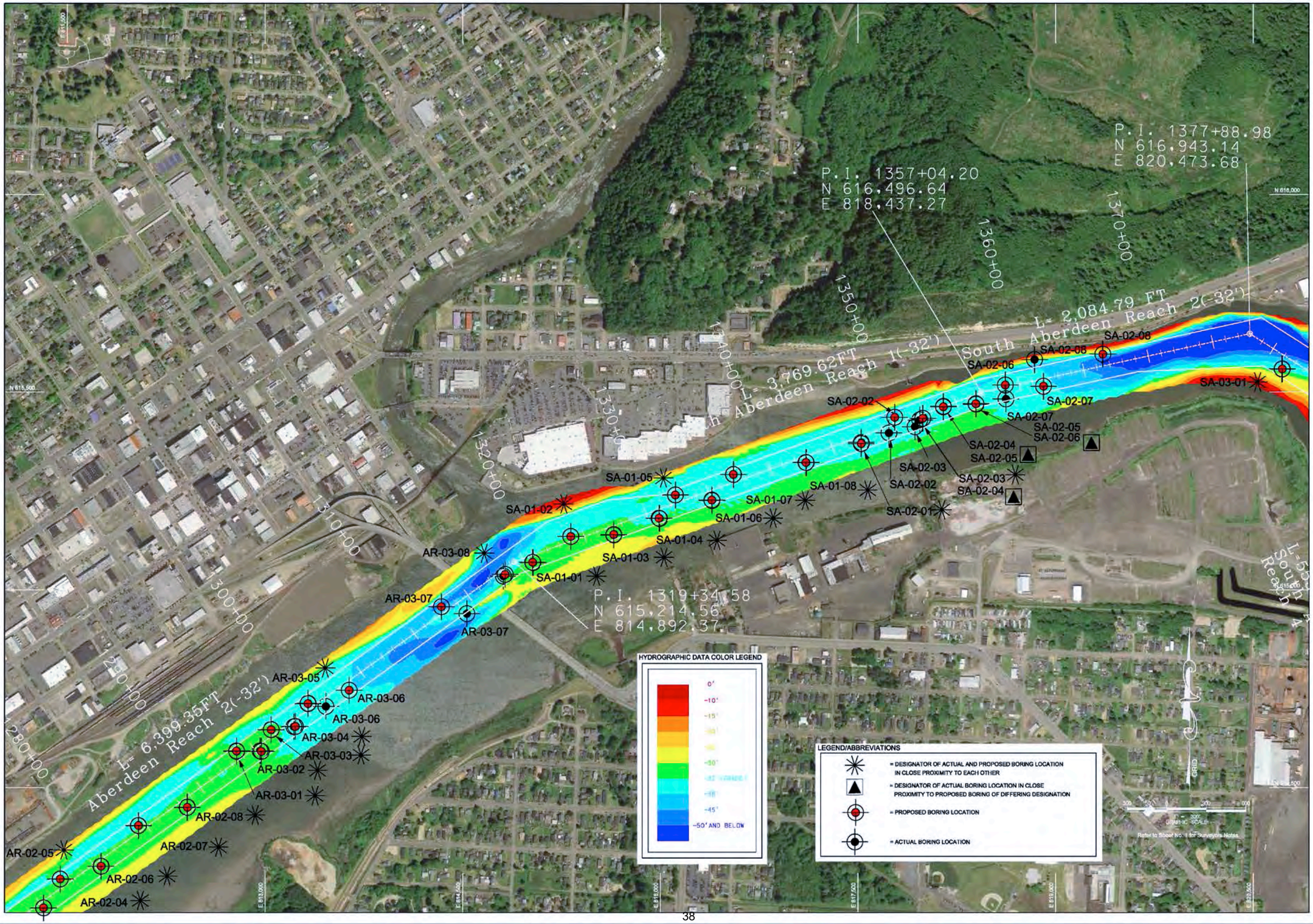


Figure 16. Aberdeen (cont.) and South Aberdeen Reach Proposed and Actual Station Locations

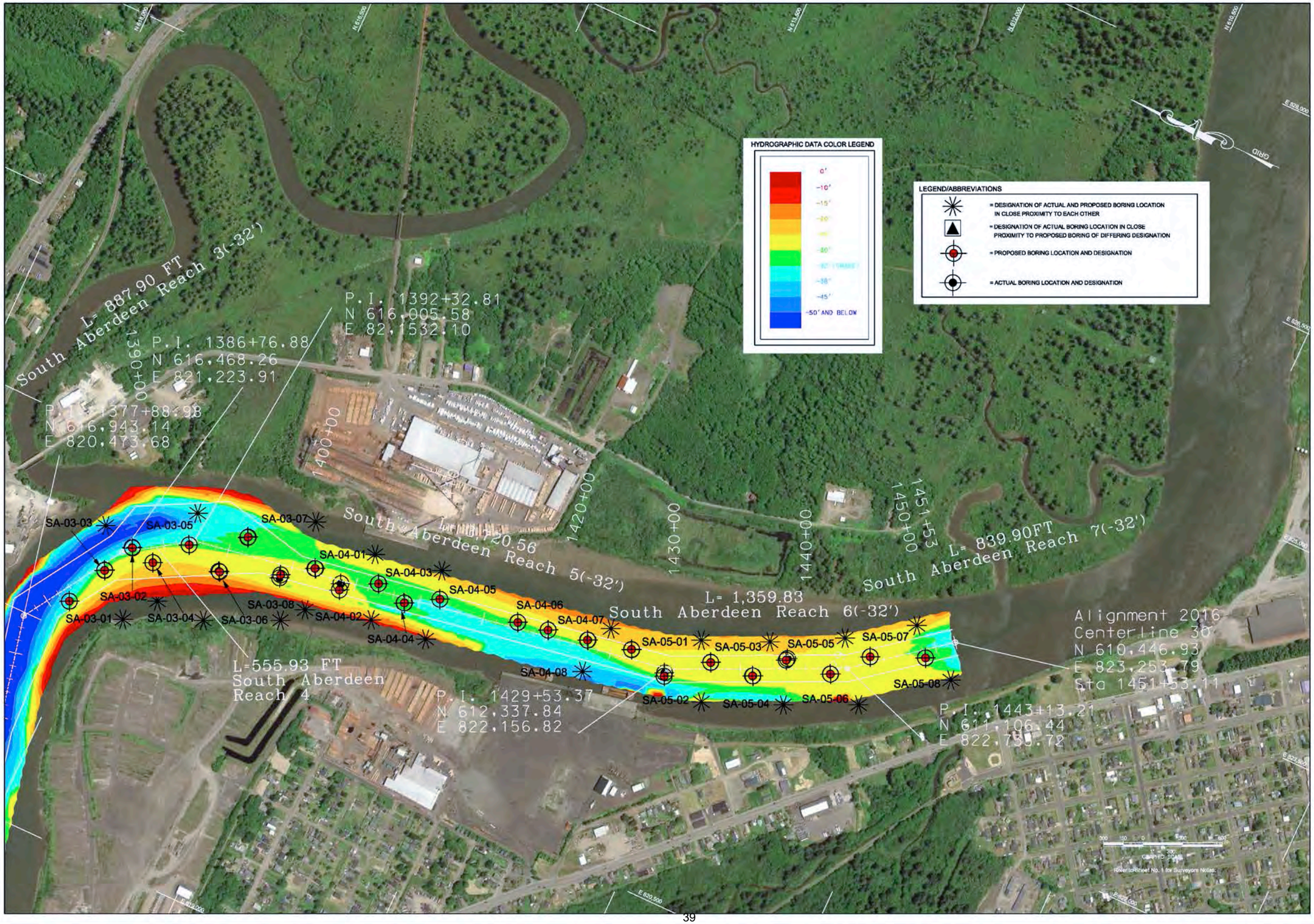


Figure 17. South Aberdeen Reach (cont.) Proposed and Actual Station Locations