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2022 Addendum to Quality Assurance Monitoring Plan

The Puget Sound Sediment Monitoring Program

January 2022

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https://apps.ecology.wa.gov/publications/SummaryPages/1803109.html.

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The Puget Sound Sediment Monitoring Program

by Margaret Dutch

January 2022

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Signatures are not available on the Internet version.
EAP: Environmental Assessment Program

1.0 Table of Contents

The numbered headings in this document correspond to the headings used in the original QAMP. Only relevant sections are included. This is why some numbered headings are missing.

2.0 Abstract

This addendum to the 2018 Quality Assurance Monitoring Plan (QAMP) developed for the Puget Sound Sediment Monitoring Program (Sediment Program) provides details about changes to be implemented in 2022 to the Long-Term and Urban Bays elements of the program. Long-Term monitoring will continue to assess sediment and benthic invertebrate condition at up to 50 stations Puget Sound-wide, while Urban Bays monitoring will assess the condition at 30 stations in Commencement Bay. Information about leveraged sampling to be conducted for several regional and national partners is also provided.

Quality assurance elements not mentioned in this addendum remain unchanged for the Sediment Program and are as designated in the 2018 QAMP (Dutch et al., 2018). Safety protocols to protect our sampling crew from COVID-19 transmission while conducting field work are referenced in this addendum. Washington State Department of Ecology (Ecology) protocols for COVID-19 have evolved over time, and our crew will follow requirements in place at the time of sampling.

4.0 Project Description

Puget Sound Sediment Monitoring Program

Monitoring elements of the Sediment Program include:

- **Long-Term monitoring:** Annual characterization and change over time of sediment quality and the condition of benthic invertebrates (benthos) Puget Sound-wide as estimated from samples collected from 50 stations. Samples will be collected in April 2022 and measured for the standard suite of parameters as described in Dutch et al., 2018.
- **Urban Bays monitoring:** Periodic characterization and change over time of sediment quality and benthos condition bay-wide as estimated from samples collected from one of six urban bays sampled on an annual rotational basis. Thirty samples will be collected from the Commencement Bay sampling frame. Samples will be collected in June 2022 and measured for the standard suite of parameters as described in Dutch et al., 2018.

Partnerships with other monitoring programs: Leveraged sampling and data

To gain additional scientific knowledge from our field efforts and collected samples, we have formed partnerships with regional and national scientists to generate data for other sediment and benthos parameters. The additional parameters will help with interpretation of conditions and changes over time in Puget Sound sediment and benthos. For the 2022 Sediment Program, we provide sediment samples to these collaborators who conduct the following projects:

Dead-shell assemblages to reconstruct past benthic conditions

Partners: Dr. Susan Kidwell and Ph.D. candidate Broc Kokesh, University of Chicago (since 2019)

We provide Dr. Kidwell and Mr. Kokesh with the residual sediment remaining from our sieved samples after the "live"[1] benthic invertebrates in the samples have been removed. Dr. Kidwell, Mr. Kokesh, and other students from Dr. Kidwell's lab sort and radiocarbon date the "dead"[2] bivalve shells that were present in these samples. These shells are identified to the lowest possible taxon and counted. Mr. Kokesh will calculate "live-to-dead" ratios and use other evidence from the samples as part of his Ph.D. dissertation work to estimate the assemblage structure of past populations of bivalves in Puget Sound. This information provides evidence of changes in assemblages over time and past ecosystem pressures and stressors that may have influenced these assemblages (Kidwell, 2009).

Microplastics

Partner: Ms. Julie Masura, University of Washington – Tacoma (since 2015)

We provide Ms. Masura and her students with approximately 200 mL of sediment collected from the surface 1 cm at each station sampled. Plastics are recovered from the sediments, counted, measured, and mapped annually.

Harmful algal blooms

Partners: Dr. Cheryl Greengrove and Ms. Julie Masura, University of Washington – Tacoma (since 2013)

We provide Dr. Greengrove and Ms. Masura with approximately 200 mL of sediment collected from each station sampled. They and their students examine the abundance and distribution of *Alexandrium* sp. cysts in these sediments. *Alexandrium* sp. is a dinoflagellate that spends part of its life-cycle as a cyst in the sediment before germinating to become a vegetative cell. This species produces a suite of neurotoxins that can accumulate in the tissues of filter-feeding shellfish and can be lethal to humans if ingested. This ongoing study evaluates whether the location or concentration of cysts exhibit patterns that can be associated with shellfish bed closures due to the presence of paralytic shellfish toxins (PSTs) above regulatory limits in shellfish.

Foraminifera monitoring

Partners: Dr. Liz Nesbitt and Dr. Ruth Martin, University of Washington (since 1997)

We provide Dr. Nesbitt and Dr. Martin with approximately 200 mL of sediment collected from each station sampled. They and their students examine the type, abundance, and distribution of foraminifera identified in these samples. Foraminifera, marine protozoans with calcium carbonate or agglutinated sediment particle tests (shells), are an important component of the

[1] "Live" includes those benthos that were alive at the time of sample collection.
[2] "Dead" includes those bivalves that were dead at the time of sample collection.

benthos. Their community structure and physical condition are sensitive indicators of chemical pollution and ocean acidification.

5.0 Organization and Schedule

5.1 Key individuals and their responsibilities

Changes to *Table 2. Organization of project staff and responsibilities*, listed in Dutch et al., 2018, include:

- Removed Angela Eagleston, Taxonomist. She has left this position.
- Replaced Carol Maloy, Unit Supervisor for the Project Manager, with Julianne Ruffner, 360-407-6154, Unit Supervisor.
- Replaced Dale Norton, Section Manager for the Project Manager, with Stacy Polkowske, 360-407-6730, Section Manager.
- Replaced Tom Gries, Acting Ecology Quality Assurance Officer, with Dr. Arati Kaza, 360-407-6964; Ecology Quality Assurance Officer.

5.4 Proposed project schedule

The project schedule for the Long-Term monitoring described in Table 3 of Dutch et al., 2018 is modified to better define the window of time in which the field work will be completed. The original "April/early May" designation is changed to specify that sampling will begin on Monday, April 11, and will conclude by Friday, May 13. The Commencement Bay monitoring schedule will follow the Urban Bays schedule as described in Dutch et al., 2018.

5.5 Budget and funding

The expected budget for the 2022 sampling and analyses is provided in Table 1.

Table 1. Puget Sound Sediment Monitoring Program budget – Sampling Year 2022.

Funding category (parameter)	Long-Term	Urban Bays	Taxonomy Contracts	Grand Total
Lab (MEL)	**$ 32,135.00**	**$ 54,875.00**		**$ 87,010.00**
Nutrients[A]	$ 9,145.00	$ 5,735.00		$ 14,880.00
Grain Size	$ 6,890.00	$ 4,290.00		$ 11,180.00
Metals/Organics	$ 16,100.00	$ 44,850.00		$ 60,950.00
Research vessel	**$ 15,165.00**	**$ 7,077.00**		**$ 22,242.00**
Skookum	$ 15,165.00	$ 7,077.00		$ 22,242.00
Sediment contracts	**$ 12,108.75**	**$ 7,898.68**	**$ 1,200.00**	**$ 21,207.43**
Biogenic Silica, Stable Isotopes of Carbon and Nitrogen	$ 3,210.00	$ 1,998.68		$ 5,208.68
QA Taxonomy	$ 8,898.75	$ 5,900.00		$ 14,798.75
Taxonomic Workshops			$ 1,200.00	$ 1,200.00
Travel	**$ 4,468.00**	**$ 3,940.00**		**$ 8,408.00**
Field travel	$ 4,468.00	$ 3,940.00		$ 8,408.00
Grand Total	**$ 63,876.75**	**$ 73,790.68**	**$ 1,200.00**	**$ 138,867.43**

[A] Total carbon, total organic carbon, total inorganic carbon, total nitrogen, and total sulfides

6.0 Quality Objectives

6.2 Measurement quality objectives

6.2.1 Targets for precision, bias, and sensitivity

6.2.1.3 Sensitivity

The lowest concentration of interest in Table 6 of Dutch et al., 2018 is revised to 0.03% dry weight for total nitrogen (TN), based on review of 2017 through 2019 TN values. For total carbon and total organic carbon, the lowest concentration of interest remains at 0.1% dry weight.

7.0 Study Design

7.2 Field data collection

7.2.1 Sampling locations and frequency

Long-Term monitoring stations

The Long-Term monitoring element includes a set of 50 sampling stations. Due to field conditions, some of the target and alternate station locations presented in Table 9 of Dutch et al., 2018 have been relocated following protocols outlined in this QAMP. Table 2 provides the latitude and longitude for these revised station locations.

Table 2. Revised coordinates for target and alternate station locations.
Latitude and longitude are reported in NAD 83, decimal degrees.

Station	Location	Latitude	Longitude	Station Type
40025	West Sound	48.62446	-122.96331	Target, randomly selected
40034	Port Townsend, mouth of Kilisut Harbor	48.09354	-122.73316	Target, randomly selected
40039	Gedney (or Hat) Island	48.02425	-122.31831	Alternate, randomly selected
40043	So. Possession Sound	47.83918	-122.39813	Alternate, randomly selected

Urban Bays monitoring stations

The Urban Bays monitoring element includes a set of 30 to 36 sampling stations in each of six urban bays. One bay is sampled each year, rotating through all six over a six-year period. In 2022, 30 samples will be collected from the Commencement Bay sampling frame and measured for the standard suite of parameters as described in Dutch et al., 2018.

The list, and sampling priority order, of alternate stations found in Figure 11 and Table 16 of Dutch et al., 2018, has been modified to more accurately adhere to the original sampling design developed for Commencement Bay (Long et al., 2002). The new station locations are depicted in Figure 1. Location coordinates and replacement priority order for five alternate stations in each of eight original strata are provided in Table 3.

An updated six-year rotational sampling schedule for the Sediment Program is provided in Table 4.

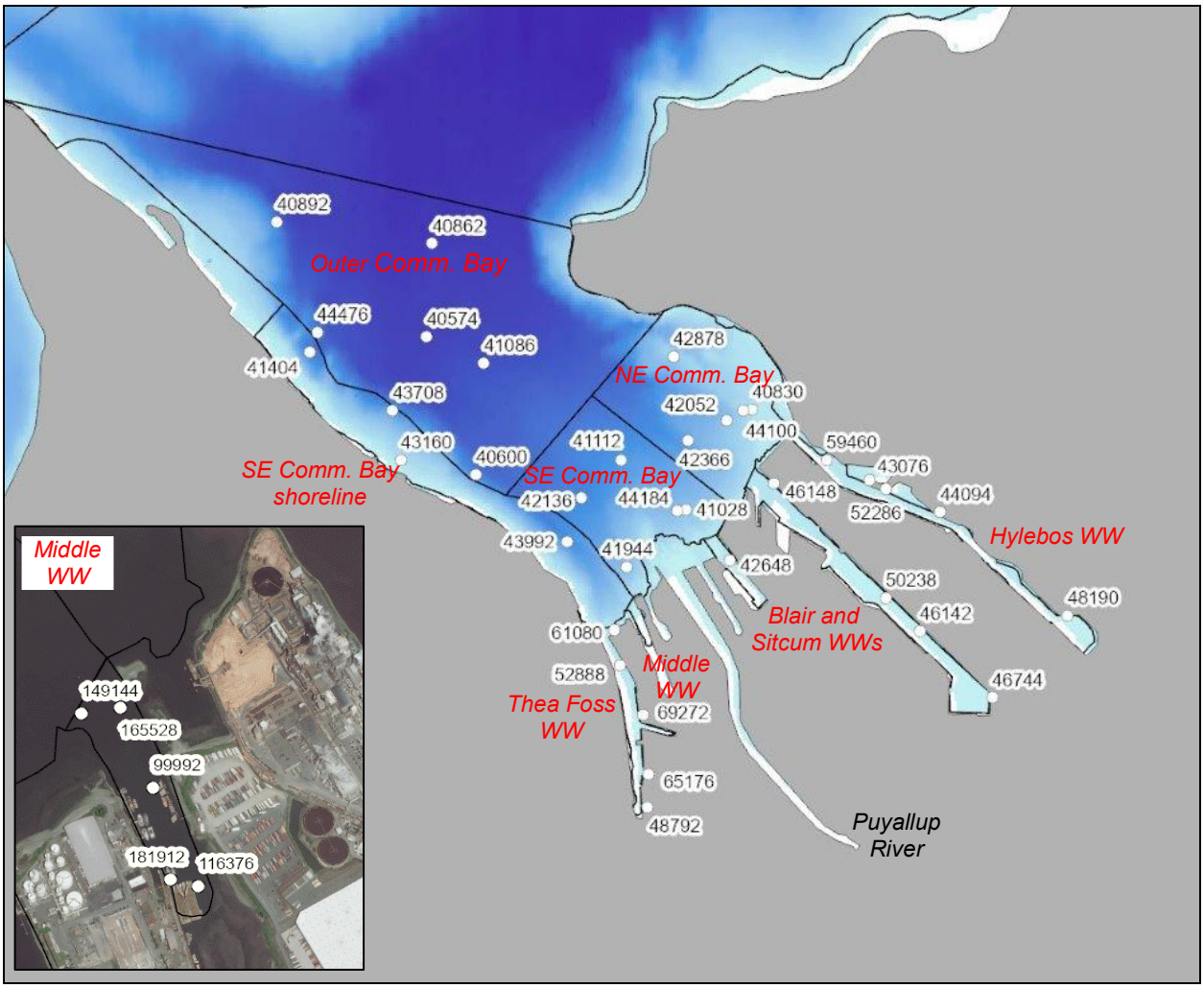

Figure 1. Alternate sampling station locations for the Commencement Bay sampling frame, with five stations in each of eight strata designated in the original program design. (WW=Waterway)

Table 3. Target coordinates for 40 Commencement Bay alternate monitoring stations – Five alternates in each of eight original program design sampling strata.

Location (stratum)	Station	Target (NAD 83, decimal degrees)		Replace-ment Order
		Latitude	Longitude	
Outer Commencement Bay	40574	47.29369	-122.46756	1
	40600	47.27879	-122.45912	2
	40862	47.30381	-122.46706	3
	40892	47.30574	-122.49204	4
	41086	47.29095	-122.45829	5
SE Commencement Bay shoreline	41404	47.29168	-122.48623	1
	43160	47.28017	-122.47122	2
	43708	47.28552	-122.47273	3
	43992	47.27178	-122.44434	4
	44476	47.29388	-122.48513	5
SE Commencement Bay	41028	47.27549	-122.42541	1
	41112	47.28075	-122.43588	2
	41944	47.26913	-122.43457	3
	42136	47.27656	-122.44211	4
	44184	47.27544	-122.42683	5
NE Commencement Bay	40830	47.28659	-122.41513	1
	42052	47.28532	-122.41919	2
	42366	47.28309	-122.42531	3
	42878	47.29220	-122.42797	4
	44100	47.28645	-122.41651	5
Thea Foss Waterway	48792	47.24310	-122.43036	1
	52888	47.25842	-122.43531	2
	61080	47.26230	-122.43628	3
	65176	47.24660	-122.43031	4
	69272	47.25310	-122.43148	5
Middle Waterway	99992	47.26343	-122.43077	1
	116376	47.26142	-122.42940	2
	149144	47.26492	-122.43289	3
	165528	47.26506	-122.43178	4
	181912	47.26154	-122.43020	5
Blair and Sitcum Waterways	42648	47.27008	-122.41820	1
	46142	47.26294	-122.38738	2
	46148	47.27866	-122.41131	3
	46744	47.25590	-122.37558	4
	50238	47.26649	-122.39303	5

Location (stratum)	Station	Target (NAD 83, decimal degrees)		Replace-ment Order
		Latitude	Longitude	
Hylebos Waterway	43076	47.27920	-122.39608	1
	44094	47.27593	-122.38460	2
	48190	47.26504	-122.36382	3
	52286	47.27839	-122.39335	4
	59460	47.28131	-122.40308	5

Table 4. Updated Puget Sound Sediment Monitoring Program six-year sampling rotation.

Monitoring Program	Sampling Year Number of stations					
Sampling Frame	2022	2023	2024	2025	2026	2027
Long-term						
Puget Sound	50	50	50	50	50	50
Urban Bays						
Commencement Bay	30					
Bainbridge Basin		33				
Bellingham Bay			30			
Budd Inlet				30		
East Possession Sound (formerly Port Gardner/Everett Harbor)					30	
Elliott Bay						36

7.2.2 Field parameters and laboratory analytes to be measured

For Long-Term monitoring, chemistry analyses will be conducted on sediments from ten of the 50 stations. A revised version of the five-year, 50-station sampling rotation for sediment chemistry for 2022 through 2026 is presented in Table 5, below.

No tissue samples will be collected or analyzed in 2022.

Table 5. Five-year sampling rotation for sediment chemistry.

Sampling Year Station IDs				
2022	**2023**	**2024**	**2025**	**2026**
19	191	21	40021	3
52	281	34	40022	4
119	40005	40	40025	13
209R	40006	40013	40026	29
222	40007	40015	40027	38
252	40008	40016	40028	44
265	40009	40017	40029	49
305R	40010	40018	40030	40036
BLL009	40011	40019	40032	40037
HCB003	40012	40020	40034	40038

Chemistry analyses will be performed on sediments collected from all 30 stations in Commencement Bay.

All environmental parameters to be measured or analyzed remain unchanged from Table 25 in Dutch et al., 2018.

7.5 Possible challenges and contingencies

7.5.1 Logistical problems

The following amendments are added to section 7.5.1 in Dutch et al., 2018, to underscore logistical problems that may occur during the Long-Term sediment sampling proposed for 2022.

Research vessel, size, condition, sea state, and availability of vessel

During Long-Term sampling, the small size of Ecology's 26' research vessel (R/V) *Skookum* can impact sediment sampling during strong wind and high wave conditions. Under these conditions, the captain and scientific crew will work together to alter the sampling schedule. Contingency days will be chosen to reattempt sampling at missed stations during the sampling window defined in Section 5.4, above. All sampling will be constrained to this window of time to maintain a consistent sampling window for the benthic invertebrate communities which will be compared over time. Limitations on the sampling time window will also minimize (1) the impact on other projects requiring use of the R/V *Skookum*, and (2) the burden placed on the R/V *Skookum* captains, whose time to pilot the vessel is limited.

Station prioritization

While we plan to collect from up to 50 stations during the Long-Term sampling, wind and wave conditions in April may limit sampling to fewer stations. The sampling team will prioritize collection at 22 monitoring stations. These include 20 that are currently co-located with the Marine Monitoring Unit's Marine Waters monitoring stations and two that are part of the set of ten original historical Long-Term sediment monitoring stations sampled since 1989. The 22 stations include:

3	21	38	49	133	222	281	HCB003
4	29	40	52	191	252	305R	
19	34	44	119	209R	265	BBL009	

These 22 stations are located throughout the entire breadth of the Puget Sound sampling frame. The team's sampling itinerary progresses from south to north through the sound, prioritizing collection of samples from the set of 22 co-located stations, with flexible collection of samples from the remaining set of 28 stations as time allows each day.

8.0 Field Procedures

8.3 Containers, preservation methods, holding times

A new laboratory will be selected for 2022 analysis of stable isotopes of carbon and nitrogen. The minimum quantity and container type for these samples will be selected after consultation with the manager of the laboratory.

8.8 Other activities

COVID-19 safety protocols

New Ecology safety protocols were developed in 2020 to protect our staff from COVID-19 exposure while conducting field work. Several agency web pages provide evolving safety protocols for general fieldwork, carpooling, working aboard the R/V *Skookum*, and overnight lodging when working away from home. All protocols are considered "living" documents and are subject to change as pandemic conditions change. Each will be reviewed by all field staff prior to conducting field work. Sampling under these protocols is subject to reevaluation by Environmental Assessment Program (EAP) management based on current or changing pandemic conditions.

The following web pages provide overall agency and EAP guidance:

- *Ecology guidance for fieldwork under Governor's Safe Start Phases* http://awwecology/sites/execi/COVID19/Pages/Fieldwork-Procedures-and-Guidance.aspx
- *Environmental Assessment Program Boat Operations and Safety Guidelines* http://teams/sites/EAP/OperationsCenter/Pages/boats.aspx

All of the safety documents will be read and implemented by those participating in 2022 field work. Updated versions of the COVID-19 protocols will be read and implemented as they are made available.

9.0 Laboratory Procedures

9.1 Lab procedures table

The Reporting Limit (RL) provided in Table 28 (Dutch et al., 2018) for total carbon and total organic carbon is 0.1% dry weight, while the RL for total nitrogen will range from 0.03% to 0.1% dry weight, depending on the mass of sample loaded into the analyzer. A sample size of 10 mg will result in a total nitrogen RL value of 0.1% dry weight, while a larger sample size will result in a correspondingly reduced RL. For example, a 30 mg sample will result in an RL value of 0.03% dry weight (Momohara, 2019; *personal communication*). The mass that can be loaded into the analyzer is sample-dependent and will vary from station to station.

10.0 Quality Control Procedures

10.1 Table of field and laboratory quality control

The quality control sample types and frequency for physical, biogeochemistry, and chemistry parameters in bulk sediments presented in Table 33 in Dutch et al., 2018 is updated in Table 6, below:

Table 6. Quality control sample types and frequency for physical, biogeochemistry, and chemistry parameters – bulk sediments.

Type	Field Replicate	Analytical (Laboratory) Replicate	Laboratory Control Sample (LCS)	Laboratory Control Sample Duplicate (LCSD)	Certified Reference Material (CRM)	Matrix Spike (MS)	Matrix Spike Duplicate (MSD)	Surrogate Spike	Method Blank
Grain size	Duplicate analysis for 5% of samples	Triplicate analysis/batch of 20 samples	1/batch of 20	NA	NA	NA	NA	NA	1/batch of 20
TC/TOC/ TIC/TN	Duplicate analysis for 5% of samples	1/batch of 20 samples	1/batch of 20	NA	1/batch of 20 for TOC only	NA	NA	NA	1/batch of 20
Total Sulfides	Duplicate analysis for 5% of samples	1/batch of 20 samples	1/batch of 20	NA	NA	1/batch of 20	NA	NA	1/batch of 20
Biogenic silica	Duplicate analysis for 5% of samples	Duplicate analysis/batch of 20 samples	1/batch of 20	NA	1/batch of 20	1/batch of 20	1/batch of 20	NA	1/batch of 20
Stable isotopes	Duplicate analysis for 5% of samples	Duplicate analysis/batch of 20 samples	1/batch of 20	NA	1/batch of 20	1/batch of 20	1/batch of 20	NA	1/batch of 20
Metals	Duplicate analysis for 5% of samples	NA	1/batch of 20	1/batch of 20	NA	1/batch of 20	1/batch of 20	NA	1/batch of 20
Organics	Duplicate analysis for 5% of samples	Duplicate analysis/batch of 20 samples	1/batch of 20	1/batch of 20	1/batch of 20	1/batch of 20	1/batch of 20	Every organics sample, blank, and QC sample	1/batch of 20

15.0 References

Dutch, M.E., V.A.ME, VA Partridge, S. Weakland, D. Burgess, and A. Eagleston. 2018. Quality Assurance Monitoring Plan: The Puget Sound Sediment Monitoring Program. Washington State Department of Ecology, Olympia, WA. Publication 18-03-109. 126 pp.

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