# Portland Harbor
# Injury Assessment
# Juvenile Resident Fish
# Sampling and Analysis

## Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP)

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## Acronyms and Abbreviations

| | |
|---|---|
| ANOVA | Analysis of variance |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| COC | Chain of custody |
| DDT | Dichlorodiphenyltrichloroethane |
| DIVER | Data Integration Visualization Exploration and Reporting |
| EPA | U. S. Environmental Protection Agency |
| FSP | Field sampling plan |
| GC/MS | Gas chromatography/ mass spectrometry |
| LOQ | Limit of quantification |
| NIST | National Institute of Standards and Technology |
| NOAA | National Oceanic and Atmospheric Administration |
| NWFSC | Northwest Fisheries Science Center (NOAA) |
| PAH | Polycyclic aromatic hydrocarbon |
| PCB | Polychlorinated biphenyl |
| RSD | Relative standard deviation |
| QA | Quality assurance |
| QC | Quality control |
| QAPP | Quality assurance project plan |
| SRM | Standard reference material |
| TL | Total length |
| TBT | Tributyl tin |

# 1 Abstract

Resident fishes are an essential component of the aquatic food web. They link benthic invertebrates (e.g. amphipods) and upper trophic level species (e.g. fish-eating birds). Some native resident species are closely tied to river sediment, which is a primary source of contaminants in the Lower Willamette River. As part of the Natural Resource Damage Assessment (NRDA) for Portland Harbor, the Portland Harbor Trustee Council[1] is conducting studies to determine whether fish and other natural resources are injured by exposure to contamination in the river. The purpose of this specific study is to evaluate the growth of juvenile resident fish (starry flounder (*Platichthys stellatus*), largescale sucker (*Catostomus macrocheilus*), peamouth (*Mylochilus caurinus*), or northern pikeminnow (*Ptychocheilus oregonensis*)) in the area of the Lower Willamette River affected by the Portland Harbor Superfund site, compared to upstream reference sites, and to evaluate relationships between growth and concentrations of contaminants such as dichlorodiphenyltrichloroethanes (DDx), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and tributyl tin (TBT). Juvenile (sub-yearling) starry flounder, largescale sucker, peamouth, or northern pikeminnow will be collected using beach seines from select sampling locations within the Lower Willamette River. Whole body fish composites (without livers, stomach contents, and otoliths) of resident fish will be analyzed for DDx, PAHs, PCBs, and TBT. Stomach content composites will be analyzed for DDx, PAHs and PCBs. Additional measurements will include metrics of potential growth impairment in individual fish using microstructural analysis of individual otoliths. Results from this study will support an evaluation of injury to resident fish from contaminant exposures in the Lower Willamette River.

# 2 Background: Rationale for generating or acquiring the data

## 2.1 History of the Study Area

The Willamette River flows through the highly industrialized Portland Harbor prior to its confluence with the lower Columbia River. For more than a century, this harbor has functioned as a commercial shipping port and working waterfront. Over the decades, numerous industries have released potentially toxic chemicals into the river. Common sources of pollution have included permitted and non-permitted end-of-pipe discharges, accidental spills and releases, and stormwater and groundwater transport from upland areas (Trustee Council 2007). Extensive pollution in harbor sediments led the U.S. Environmental Protection Agency (EPA) to add Portland Harbor to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (i.e., designated Superfund site) in December 2000. At present, the Superfund site extends from river mile 2 to 11.

[1] Portland Harbor Trustee Council members include the U.S. Department of Commerce, acting through the National Oceanic and Atmospheric Administration (the Federal agency that serves as the lead administrative Trustee for this site), the U.S. Department of the Interior, the State of Oregon, the Nez Perce Tribe, Confederated Tribes of the Warm Springs Reservation of Oregon, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of Siletz Indians, and the Confederated Tribes of the Grand Ronde Community of Oregon.

## 2.2 Contaminants of Concern

Many hazardous substances have been detected in natural resources in the Assessment Area (IEC 2018). To conduct this NRDA efficiently and at a reasonable cost, the Trustee Council selected a subset of contaminants on which to focus: PCBs, DDT and related metabolites (DDx), and PAHs due to their elevated concentrations, widespread presence in sediments throughout the Assessment Area, and connection to industrial sources (IEC 2018). Samples will also be analyzed for the anti-fouling agent[2] tributyl tin (TBT) due to its elevated concentration in sediments and proximity to industrial sources (EPA 2017).

## 2.3 Results from Previous Studies

Estimates of contaminant exposure in the form of tissue residues were obtained from previous field collections of peamouth, largescale sucker, and northern pikeminnow at sites within the Portland Harbor area of the Lower Willamette River. No prior analysis of contaminants in starry flounder from the river were found. The current NRDA study will measure contaminant concentrations in whole juvenile resident fish (without livers, otoliths, or stomach contents).

In 2002, four individual whole body peamouth between 194 and 269 mm long (total length) were collected from four stations within the Portland Harbor area by the Lower Willamette Group (Integral 2004). Whole body total DDx concentrations ranged from 1.23 to 2.89 μg/g lipid. PCB concentrations ranged from 1.35 to 3.67 μg/g lipid. Lipid values were reported for individual samples. Of these four fish, one whole body peamouth exceeded the PCB concentration (2.4 ug/g lipid) associated with adverse sublethal effects in juvenile salmonids developed by Meador et al. (2002).

The same study (Integral 2004) also analyzed six individual whole body largescale sucker from five stations in the Portland Harbor area. Fish ranged in total length from 397-460 mm. Whole body total PAH concentrations ranged from 26-147 ng/g wet weight (ww). Whole body DDx concentrations ranged from 1.868 to 9.867 μg/g lipid. Whole body total PCB concentrations ranged from 1.173 to 23.218 μg/g lipid. Lipid values were reported for individual samples. Of these six fish, five whole body largescale sucker exceeded the PCB concentration (2.4 ug/g lipid) associated with adverse sublethal effects in juvenile salmonids developed by Meador et al. (2002).

A few historical samples of northern pikeminnow from the Portland Harbor area of the Lower Willamette River were analyzed by the Columbia Basin Contaminant Monitoring Program between 1984 and 1990 (EPA 1994). The concentration of total DDx in one whole body composite (five fish) was 160 ng/g dry weight (dw) in 1984. One composite filet sample (three fish) contained 12 ng/g dw of total DDx (mean length of fish in the composite was 686 mm) in 1988. In 1990, one individual whole body northern pikeminnow contained 18 ng/g dw of total DDx. The same samples contained 300, 15, and 125 ng/g dw of total PCBs, respectively. Lipid and moisture concentrations were not available for these samples to allow comparison to other concentrations in other species and effects thresholds.

[2] An anti-fouling agent prevents the attachment or growth of organisms on the hulls of ships.

### 2.4 Cleanup Actions

In March 2017, the U.S. EPA issued the Record of Decision for clean-up of the site to include active remediation of contaminated sediment and river banks to reduce risks to human health and the environment, which will take an estimated 13 years to complete (EPA 2017).

## 3 Project description

### 3.1 Project purpose and description

The purpose of this NRDA study is to evaluate the growth of juvenile resident fish (starry flounder, largescale sucker, peamouth, or northern pikeminnow) in the Willamette River within the assessment area. Growth metrics will be collected on otoliths from individual fish collected across the Willamette River and an upstream reference area (river mile 14-17). These same fish will be used to create one whole body (minus stomach contents, livers, and otoliths) and one stomach contents composite per sampling unit for chemistry analyses to evaluate the association of tissue contaminant levels with growth (see section 5.1 for an explanation of the sampling design strategy). The concentrations of priority contaminants of concern (PCBs, DDx, PAHs, and TBT) will be measured in whole body composite samples, and stomach content composites will be analyzed for PCBs, DDx, and PAHs (and TBT if tissue is sufficient).

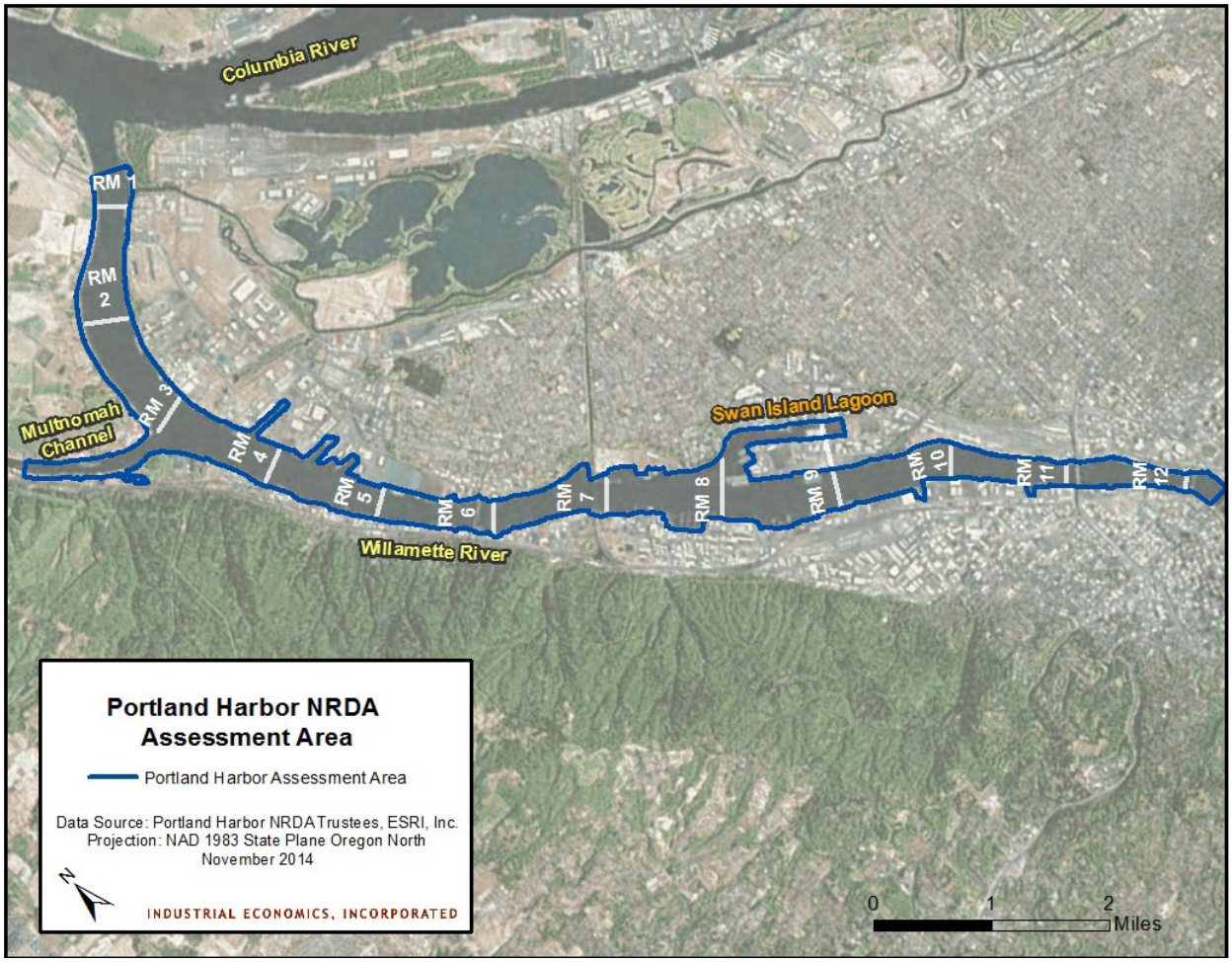
### 3.2 Target population

The target species include subyearling starry flounder, largescale sucker, peamouth, or northern pikeminnow residing in the Willamette River. These species were selected because they are endemic, relatively abundant, and have some association with sediment. Juveniles are the target due to their limited home range (enhanced exposure) and faster growth relative to adult life stages (Sibley et al 2015). Starry flounder less than 110 mm will be assumed to be juveniles (Orcutt 1950). Largescale sucker less than 75 mm will be assumed to be less than 1 year old (Dauble 1986). Peamouth less than 64 mm will be considered to be juveniles (Gray and Dauble 2001). Northern pikeminnow less than 85 mm will be assumed to be juveniles (Moyle 2002). This will be confirmed in the laboratory using the otoliths to confirm the absence of an annulus.

### 3.3 Study and sampling locations

This study will take place in the Assessment Area of the Willamette River (Figure 1). A total of up to 390 resident fish of each of the target species will be collected from locations in the Willamette River and an upstream reference area, according to a stratified sampling design intended to represent injury throughout the sampling area. Detail on the study design can be found in Section 5. Sampling strata and sampling units are described in Section 5.4.

***Figure 1. Portland Harbor NRDA Assessment Area (IEC 2019)***




## 3.4 Tasks required

Tasks involved in this study include:

- Collect up to 390 juvenile resident fish (starry flounder, largescale sucker, peamouth, and/or northern pikeminnow) from 39 sampling units representing five strata, including an upstream reference area. Up to ten fish of each target species will be collected from each sampling unit. If multiple species are collected, the final determination fish to be used for growth evaluation and chemical analysis will occur after the sampling event. Fish will be frozen on site.
- Transfer frozen fish to the NOAA NWFSC for later dissection.
- Extract otoliths, livers, and stomach contents from collected resident fish.
- Swab the inside lining of the stomach tissue (with contents previously removed) for possible genetic analysis of prey species.
- Create composites of remaining whole bodies and stomach contents by sampling units for chemical analyses.

- Store individual liver samples for potential later chemical analysis.
- Submit composite tissue samples to the NOAA NWFSC lab for chemical analysis of PCBs, DDx, and PAHs.
- If tissue is sufficient for TBT analysis, submit to contract lab.
- Submit otoliths to the NOAA NWFSC lab for microstructural analysis.
- Conduct Quality Assurance/Quality Control (QA/QC) review of data.
- Publish documentation on activities and data related to sample collection and laboratory analyses, including providing validated study results in NOAA's Data Integration, Visualization, Exploration and Reporting (DIVER) tool (see Section 12).
- Analyze data, prepare report(s) and peer-reviewed publication(s).

### 3.5 Practical Constraints

The most pertinent practical constraint is the availability of fish, and the resulting amount of sample available for whole body (less livers, stomach contents, and otoliths) and stomach content analyses from juvenile resident fish.

Ten fish of the same species per sampling unit is targeted to evaluate growth differences based on otolith measurements from individual fish. Fish will be combined into a single composite for chemical analysis to ensure sufficient tissue is available to meet data quality objectives. A minimum of 10 g of tissue is required for the TBT analysis, and a minimum of 2 g tissue is required for PAH, DDx, and PCB analysis.

Fish for this study will be collected using beach seining. The use of a beach seine requires shoreline access in addition to suitable water levels, slopes, and a lack of large debris that can snag nets. The navigation channel has been excluded from this study based on depth requirements for seining. Shoreline hardened with sheet pile and areas with overwater structures are also not suitable for beach seining and have been excluded from the study design.

## 4 Organization and Schedule

### 4.1 Key individuals and their responsibilities

***Table 1. Organization of project staff and responsibilities***

| NAME | TITLE | PHONE # | EMAIL | RESPONSIBILITIES |
|---|---|---|---|---|
| **Mary Baker** | Assessment Manager | 206.475.0319 | mary.baker@noaa.gov | Ensuring that the study will meet the broader requirements of NRDA |
| **Cathy Laetz** | Project Manager | 206.321.8760 | Cathy.Laetz@noaa.gov | Study planning and design, field coordinator, sample custodian |
| **Matt Dorsey** | Data Manager | 562.980.3250 | Mathew.Dorsey@noaa.gov | Oversight of data intake and management |

| NAME | TITLE | PHONE # | EMAIL | RESPONSIBILITIES |
|---|---|---|---|---|
| **Irv Schultz** | Laboratory Project Manager | 206.860.3361 | Irvin.schultz@noaa.gov | Environmental Chemistry Program Manager, analytic chemistry lead |
| **Jennie Bolton** | Laboratory QA Officer | 206.860.3359 | jennie.bolton@noaa.gov | Provide quality assurance on chemistry sample data |
| **Savannah Turner** | OR&R Safety Officer | 251.234.4151 | Savannah.Turner@noaa.gov | Provide project safety related guidance |
| **Patrick Pope** | Field Task Leader | 503.801.2728 | Patrick.pope@noaa.gov | Field logistics supervisor with responsibility for directing and overseeing all on-water operations |
| **Rob Neely** | Site NRDA and Health and Safety Representative | 206.617.5443 | Robert.Neely@noaa.gov | On site point of contact for NRDA and safety related issues |

### 4.2 Project schedule: Sampling timeframe and field dates

Juvenile resident fish sampling is planned to occur between June 2021 and August 2021.

***Table 2. Proposed schedule for completing field and laboratory work***

| TASK | DATES | LEAD STAFF (ALL NOAA) |
|---|---|---|
| **Field work** | June 2021-August 2021 | Cathy Laetz<br>Patrick Pope<br>Rob Neely |
| **Laboratory work - chemistry** | October-December 2021 | Irv Schultz |
| **Laboratory work - otoliths** | October-December 2021 | Cathy Laetz<br>Paul Chittaro |
| **Report draft** | February 2022 | Cathy Laetz<br>Rob Neely<br>Mary Baker<br>Others to be determined |
| **Report final** | June 2022 | All |

## 5 Overall study design

Subyearling resident fish (either starry flounder, largescale sucker, peamouth, or northern pikeminnow) from the Willamette River will be targeted for subsequent chemical and growth analysis. Fish will be collected by beach seine (Section 6) from sampling units selected through a probability based sampling design (Section 5.1; Appendix F). Fish will be immediately frozen on dry ice, maintained in a frozen condition during sampling, and transferred to a -80 °C freezer at the NOAA NWFSC at the end of the sampling period (Section 6). Frozen fish will later be dissected over dry ice (section 7). Otoliths will be subjected to microstructural analyses to determine growth rates. Stomach contents will be removed for chemical analyses. Livers will be removed and archived. The whole bodies (minus liver, stomach contents, and otoliths) will be composited for chemical contaminant analysis. Stomach content composites will also be

created for separate chemical contaminant analyses. Stomach linings will be swabbed to evaluate the composition of the diet through genotyping of prey species present (if appropriate). Analytic methods and quality assurance protocols are described in Sections 8 and 9, respectively. Chain of custody will be initiated when fish are collected and maintained throughout the study (Section 10). Data evaluation and interpretation techniques are described in Section 11. Documentation and records management are described in Section 12.

### 5.1 Sampling design: strata, sampling units, and sampling locations

The study will be based on a stratified sampling design with randomized selection of sampling units for fishing intended to represent contaminant exposure and injury throughout the sampling area. There will be five strata in total, three representing a range of exposures assumed to be proportional to surface sediment concentrations of p,p DDE and p,p DDT, PCBs, and/or PAHs (low, medium, and high), Swan Island Lagoon, and an upstream reference area. Swan Island Lagoon was selected as a separate stratum due to its unique geography as an enclosed lagoon, limited available shoreline for sampling, and sediment contamination distribution. Within each stratum, the river shoreline was divided into seinable segments of approximately equal length and the nearshore areas adjacent to these shoreline segments are defined to be the primary sampling units. The collection of 86 study area seinable segments (i.e. the sampling frame) is the population of seinable nearshore areas to which injury estimates and statistical inferences are directly applicable. With appropriate caveats, injury estimates may also be extrapolated to other nearshore areas that are unseinable but where fish species also are likely to reside.

Fish will be collected from 39 randomly selected sampling units from which up to 390 juvenile starry flounder, largescale sucker, peamouth, and/or northern pikeminnow will be collected. Target sampling units were selected at random within each stratum as described in Appendix F.

The target sampling units for each stratum are shown in Figures 2-9 and listed in Appendix F. A set of alternate sampling units were also randomly selected for each stratum in the event that a given unit is logistically infeasible to seine or if fishing at a sampling unit is not successful given the time available for the study. Only 10 sampling units were considered seinable in the High strata, so if High sampling units cannot be sampled, alternate locations will be selected from the Medium strata. If a target sampling unit is unsuitable for any reason (for example, insufficient water depth or the presence of obstructions), the samplers would proceed to the first alternate sampling unit for that stratum and proceed down the list until seining is feasible and 10 fish of one species have been collected from one sampling unit. To maintain the geographic balance (east and west river bank) of the randomly selected sampling units, alternate sampling units will be selected from the same river bank as the target location. Table 3 lists the strata and sampling units for the study. A final determination of which fish to submit for growth evaluation and chemical analysis will be made at the end of the sampling period. Fish from different sampling units will not be combined into one composite. Fish of different species will not be composited together.

***Figure 2. Locations of sampling units, River Mile 0-2***

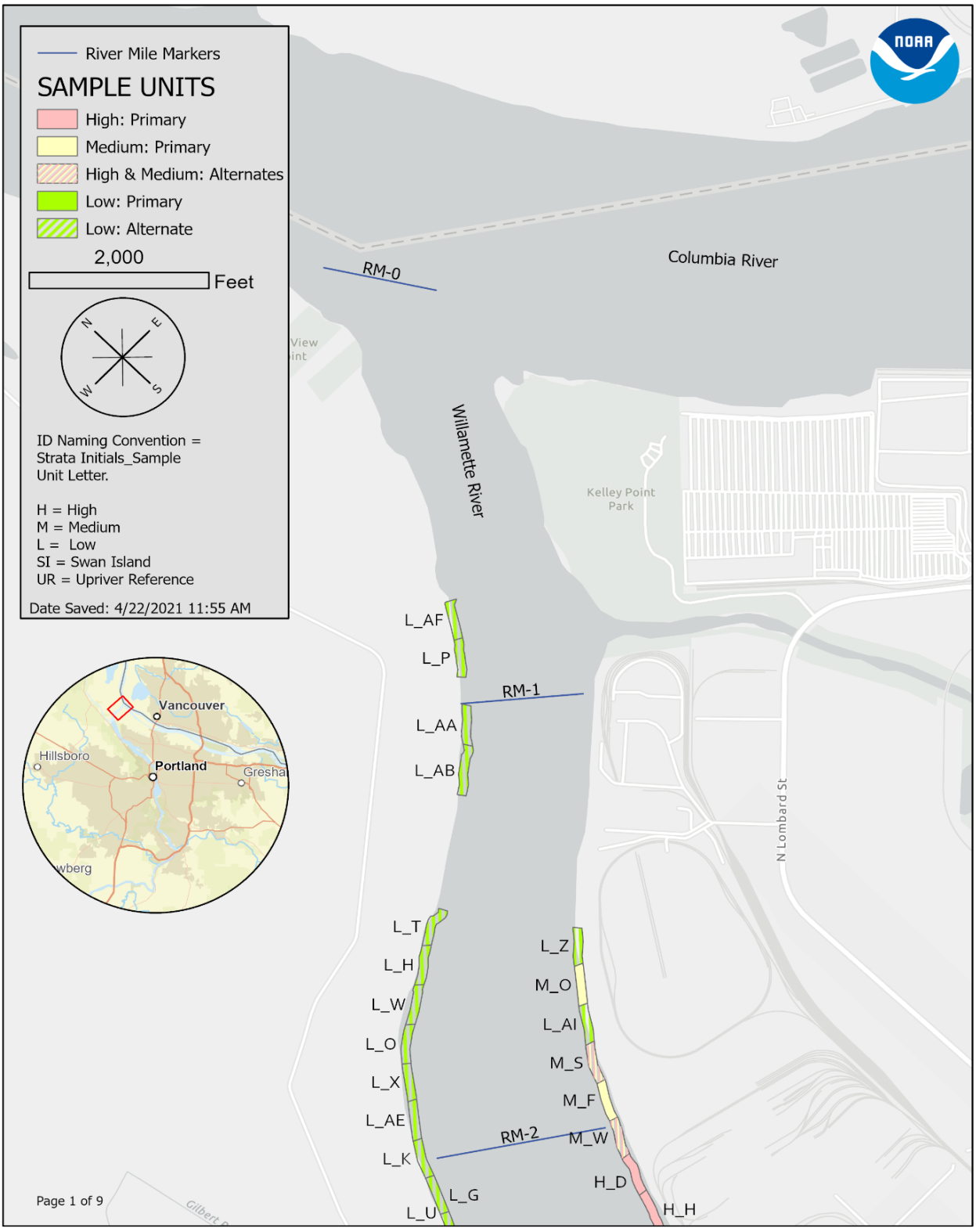


***Figure 3. Locations of sampling units, River Mile 2-4***

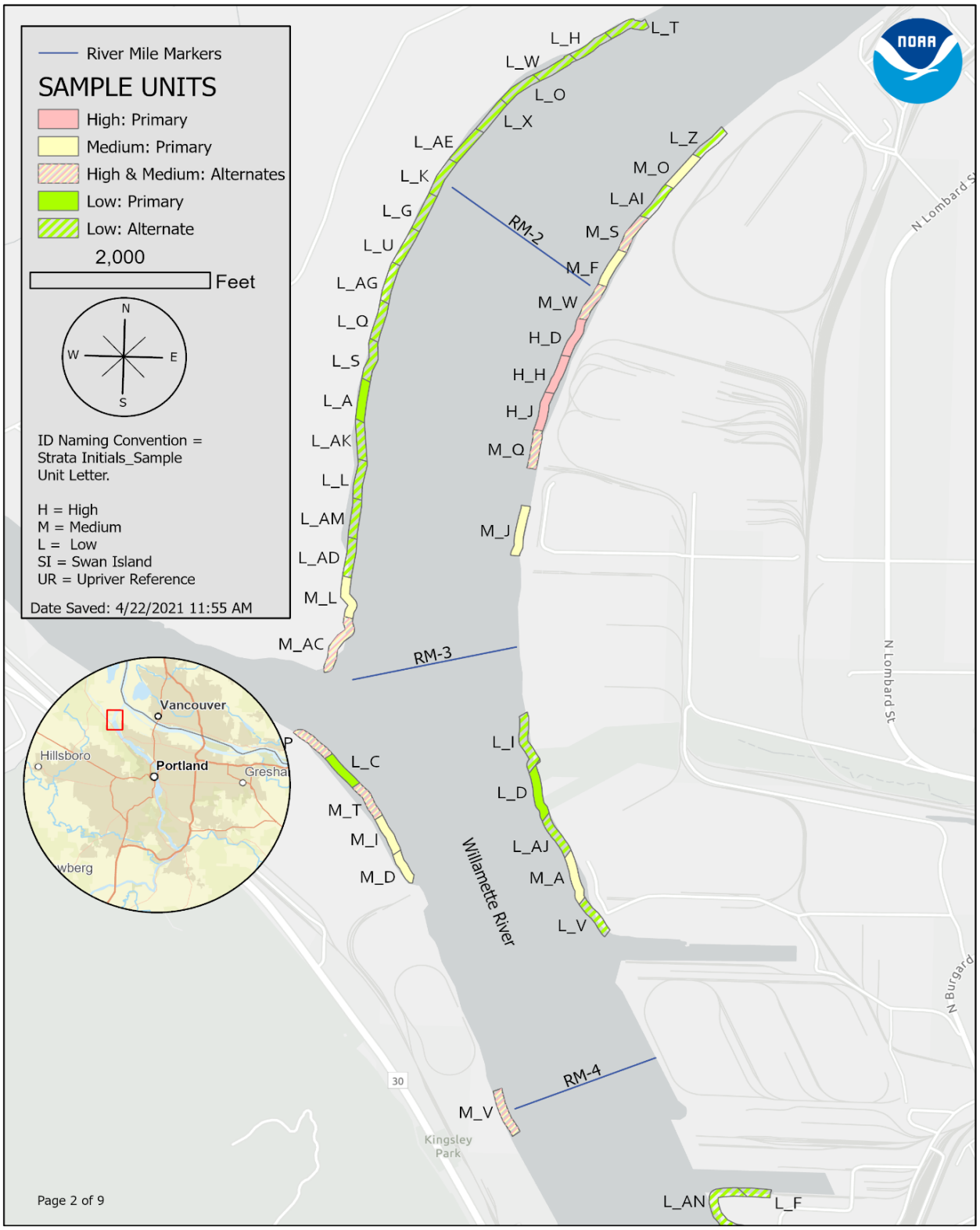


***Figure 4. Locations of sampling units, River Mile 4-6***

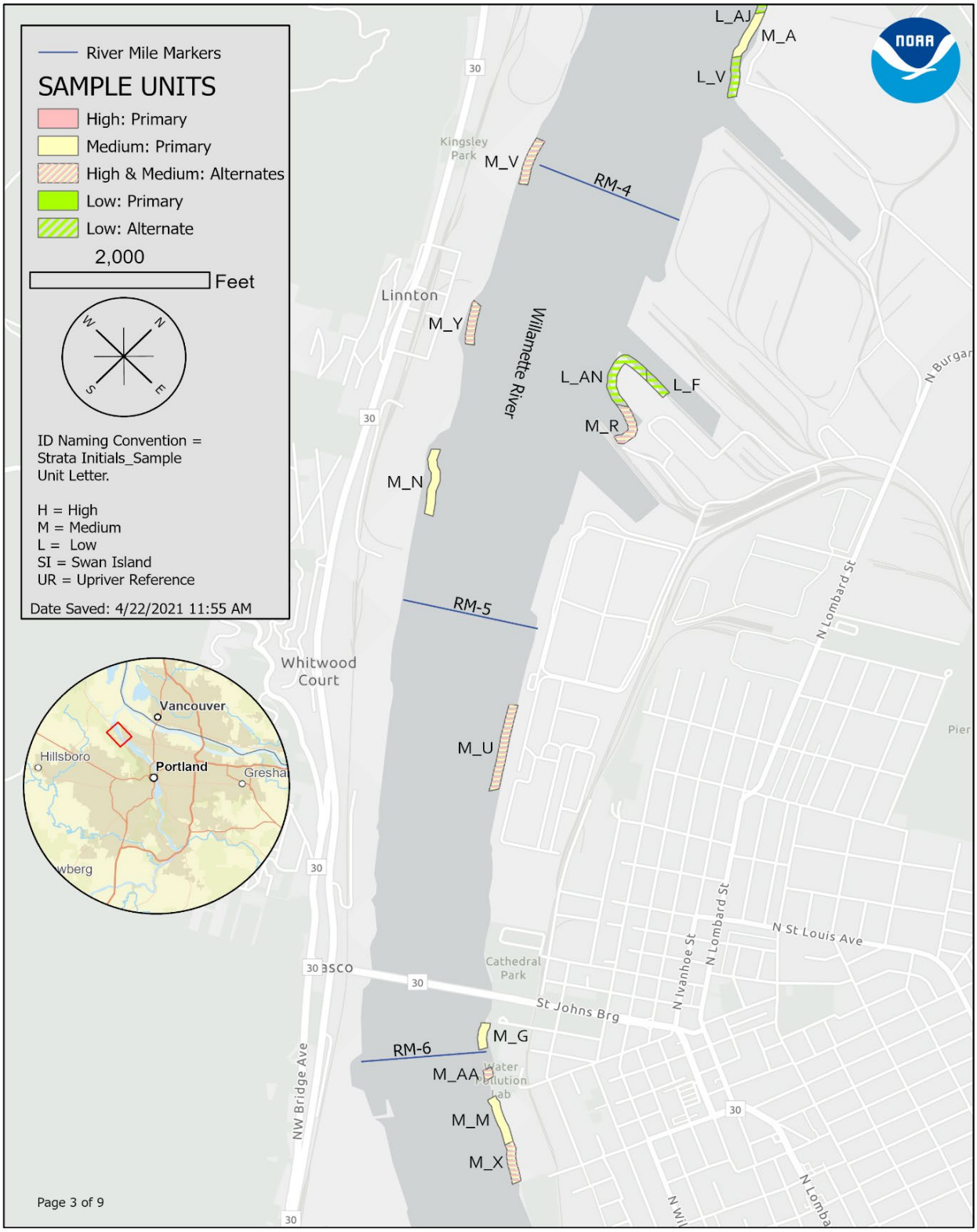


***Figure 5. Locations of sampling units, River Mile 6-8***

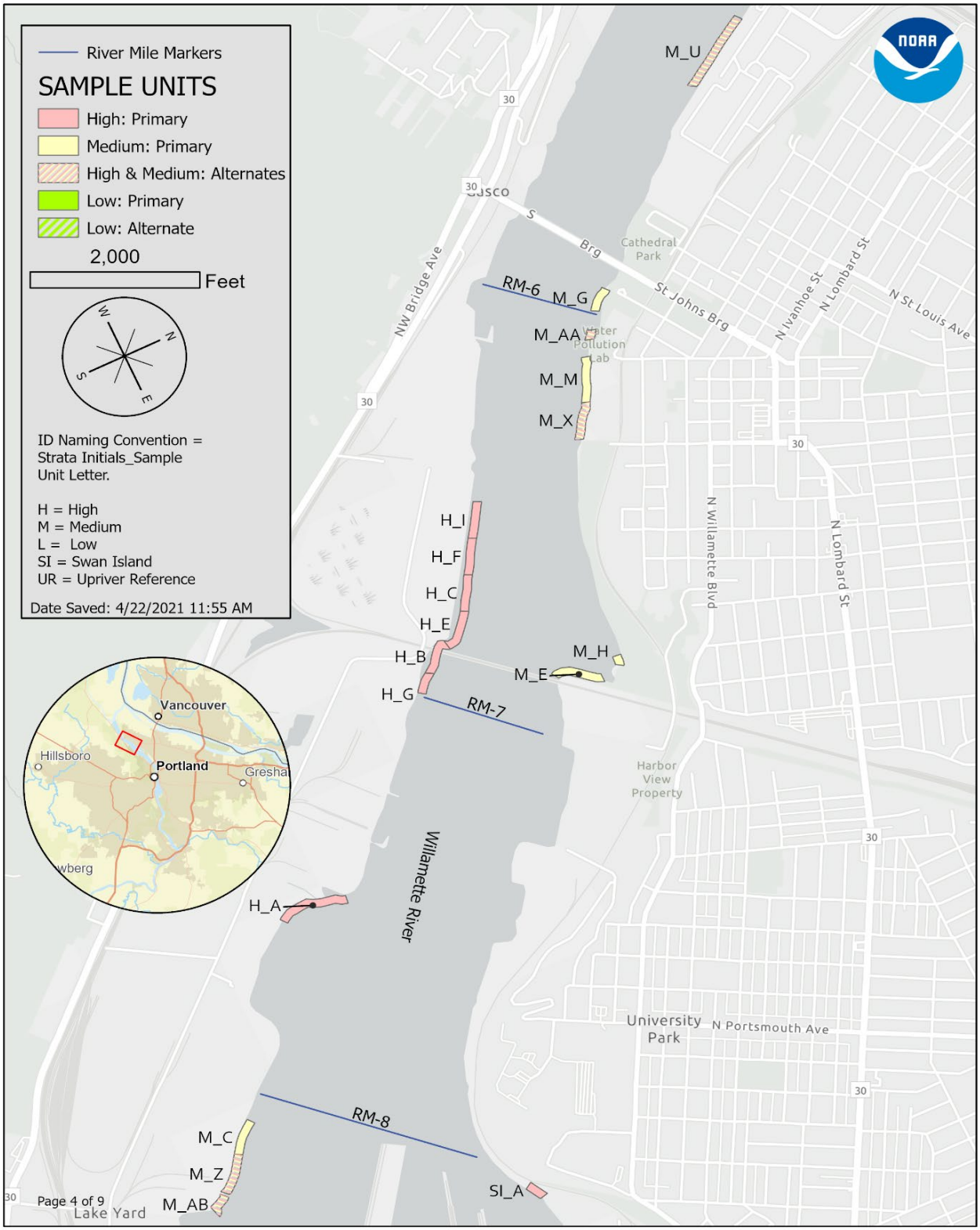


***Figure 6. Locations of sampling units, River Mile 7-9***

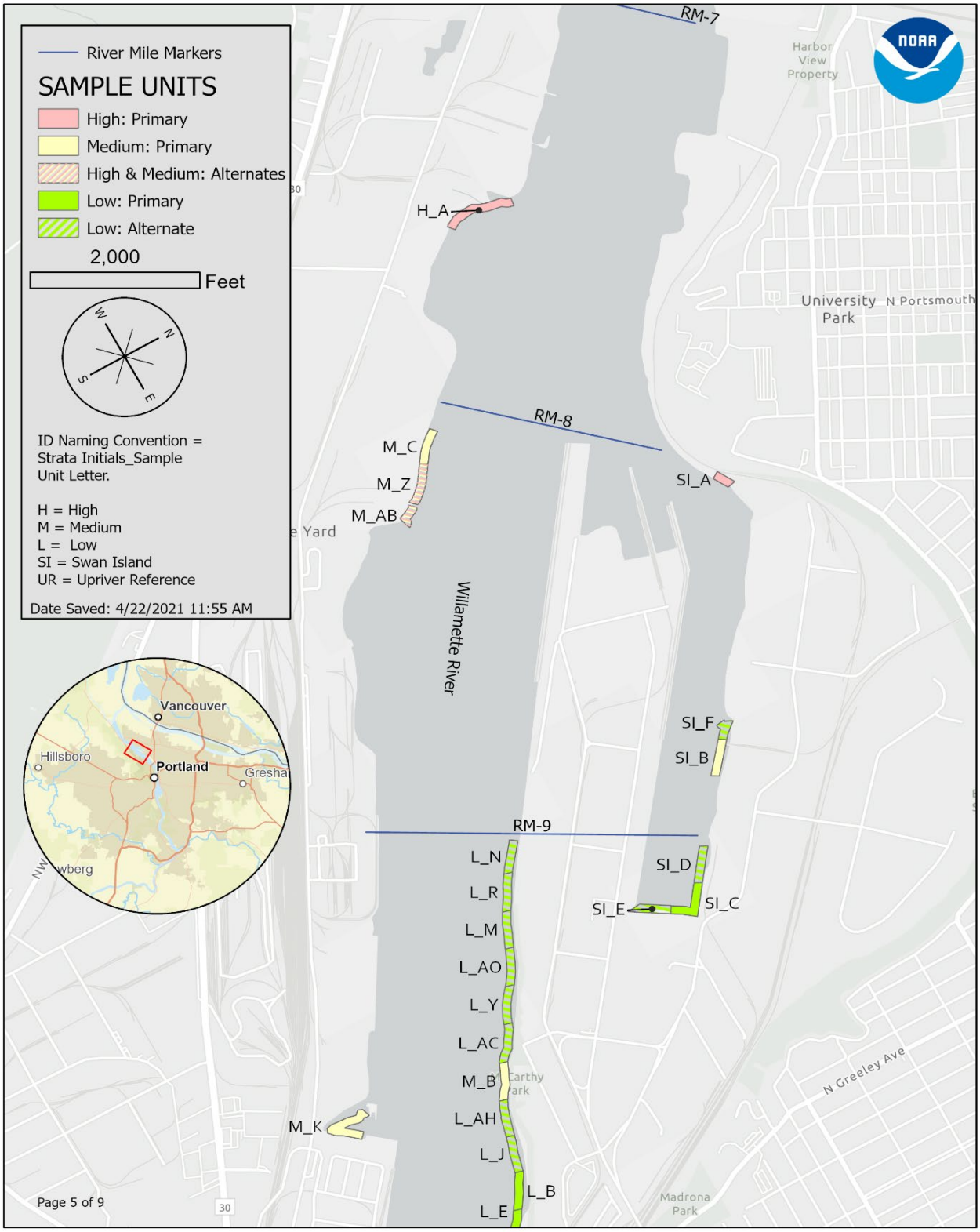


***Figure 7. Locations of sampling units, River Mile 9-11***

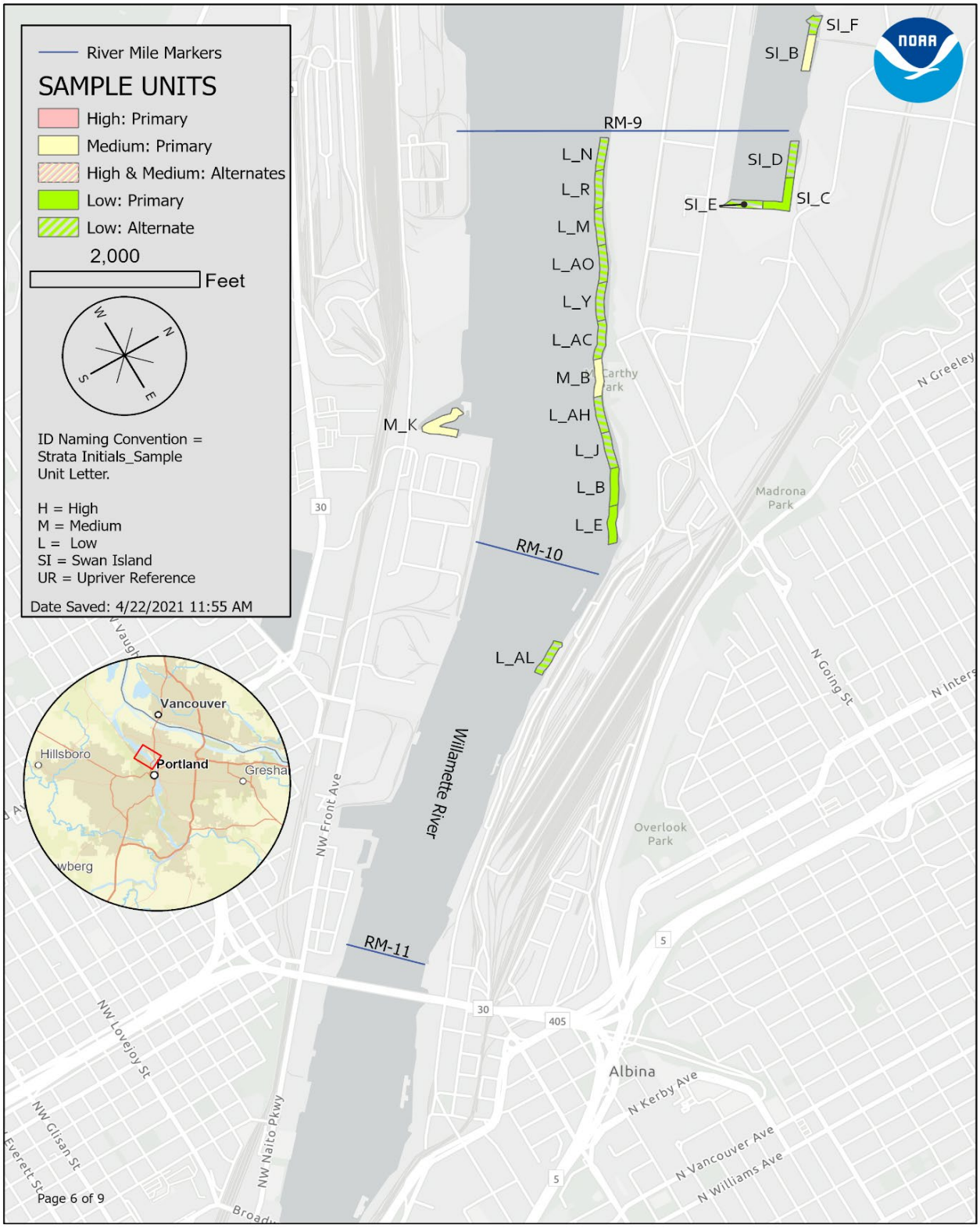


***Figure 8. Locations of sampling units, River Mile 13-15***

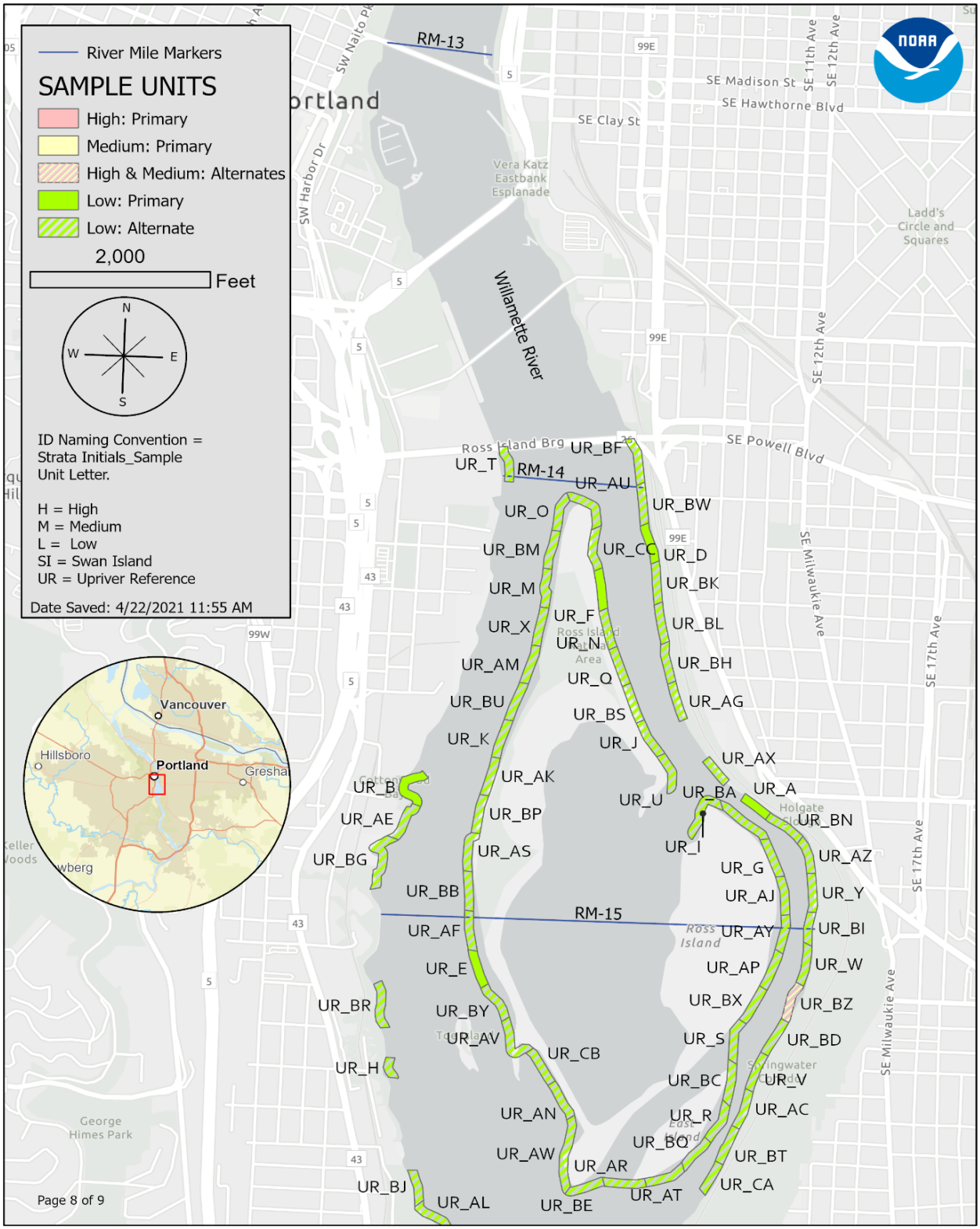


***Figure 9. Locations of sampling units, River Mile 16-17***

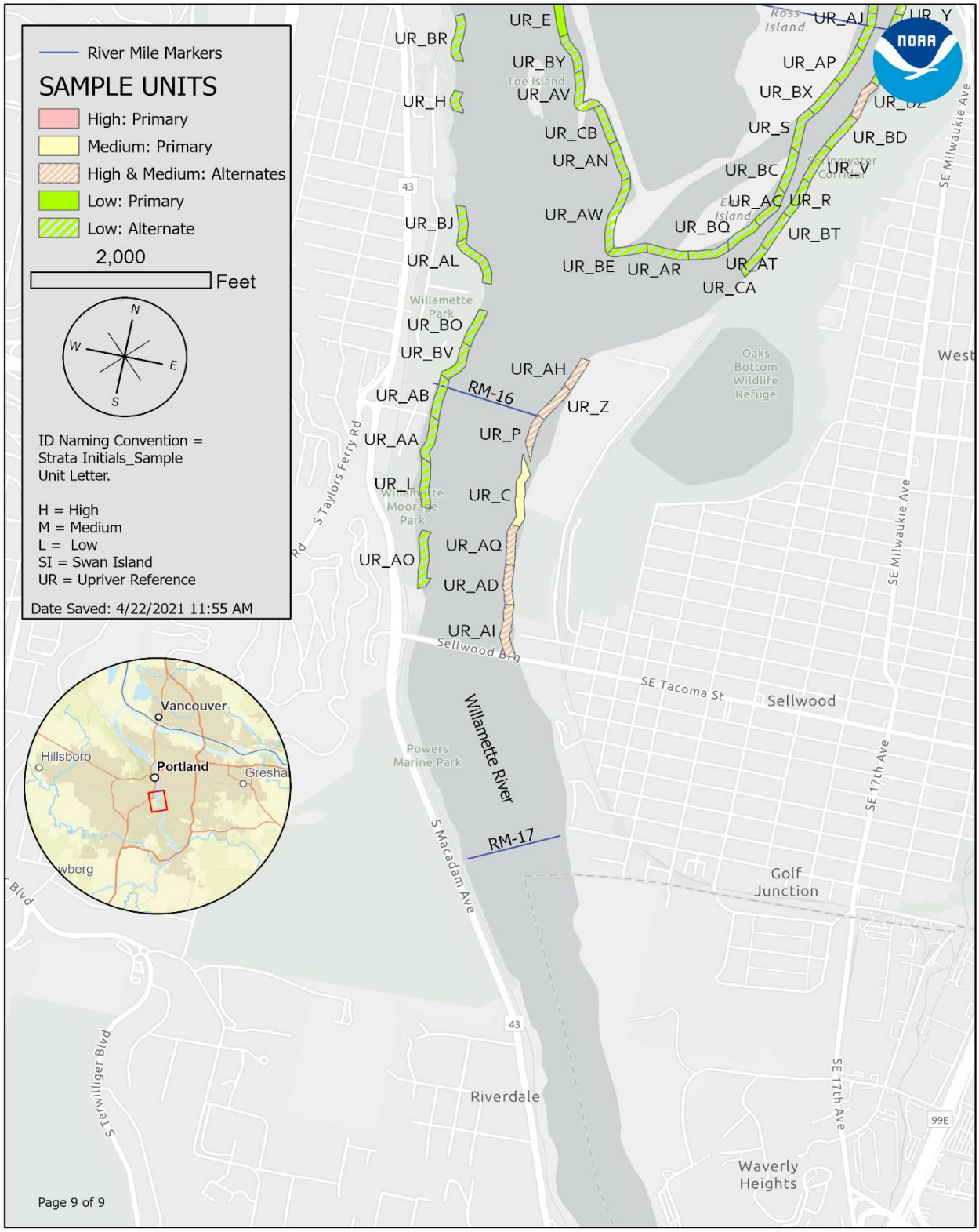


***Table 3. Five strata and 39 sampling units within the Willamette River sampling area (See Appendix F for sampling unit coordinates)***

| STRATA | SAMPLING UNIT |
|---|---|
| High | H-A |
| | H-B |
| | H-C |
| | H-D |
| | H-E |
| | H-F |
| | H-G |
| | H-H |
| | H-I |
| | H-J |
| Medium | M-A |
| | M-B |
| | M-C |
| | M-D |
| | M-E |
| | M-F |
| | M-G |
| | M-H |
| | M-I |
| | M-J |
| | M-K |
| | M-L |
| | M-M |
| | M-N |
| | M-O |
| Low | L-A |
| | L-B |
| | L-C |
| | L-D |
| | L-E |
| Swan Island Lagoon | SI-A |
| | SI-B |
| | SI-C |
| Upriver Reference | UR-A |
| | UR-B |
| | UR-C |
| | UR-D |
| | UR-E |
| | UR-F |

## 5.2 Sampling procedure and target sample size

Our target is to collect ten fish of at least one of the target species meeting the size selection criteria (between 40 and 110 mm for starry flounder, between 40 and 75 mm for largescale sucker, between 40 and 64 mm for peamouth, and between 40 and 85 mm for northern pikeminnow) from each sampling unit. If fewer than ten fish of the same species are collected on the first attempt (which may include multiple seine hauls on one day) at a target sampling

unit, any fish meeting the size selection criteria will be retained and the first alternate sampling unit (seinable polygon) will be sampled at the next opportunity. This will continue until ten fish of the same species meeting the size selection criteria are captured from one sampling unit. The maximum size of fish to be retained may be adjusted depending on catch success. Sampling units may be revisited over multiple days during the sampling period, and all fish of the target size and species will be retained. If ten fish of the same species cannot be captured from a sampling unit by the end of the four-week sampling window, sampling will be discontinued. A final determination of which fish to submit for growth evaluation and chemical analysis will be made at the end of the sampling period.

If a target sampling unit is infeasible to sample due to logistical considerations (depth, inaccessibility) or safety, the field crew will move to the first randomly selected alternate sampling unit (on the same side of the river as the original target unit) for the stratum and proceed down the list of alternate sampling units until a sampling unit that is feasible is located on the same side of the river as the target sampling unit. As the field crew works down the list of sampling units, documentation of the decision-making process and reason for not selecting the sampling units will be recorded.

Growth metrics will be collected on otoliths from individual fish. These same fish will be used to create one whole body (minus stomach contents, livers, and otoliths) and one stomach content composite for chemical analyses per sampling unit to evaluate the association of tissue contaminant concentrations with growth.

### 5.3 Parameters to be collected

Parameters to be recorded in this study include:

- Field sampling information
    - Date/Time of seine deployment
    - Weather conditions
    - Stratum and sampling unit sampled (latitude, longitude of seine locations)
    - Water depth at time of seine
    - Shoreline habitat type at seine deployment (vegetation, cobble, sand, marsh, mud, riprap, other)
    - Water quality for any location sampled in a given sampling day, measured near the river bottom using a multi-probe instrument. The parameters will include: water depth (feet), dissolved oxygen (%), salinity (ppt), and temperature (°C).
- Biological metrics
    - Fish total length (mm)
    - Fish body weight (g)
    - Liver weight (mg)
    - Stomach contents weight (mg)
    - Body condition (e.g., Fulton's condition factor)
- Tissue chemistry
    - PCBs, DDx, PAHs, TBT, gravimetric % lipids, and lipid class (wax ester and sterol esters, triglycerides, free fatty acids, cholesterol, phospholipids and other polar

lipids) in composites of whole body (minus otoliths, stomach contents, and livers)
    - PCBs, DDx, and PAHs in stomach contents
- Growth
    - Otoliths (microstructure analysis), average daily growth in most recent 7-, 14-, and 21-days

# 6 Field Sampling Plan

The sections below describe the gear and procedures to be employed to capture target fish for this study, handle fish in the field, and document activities.

## 6.1 Field sampling equipment and supplies

- Boat with motor
- Coolers for sample storage and transport
- Dry ice
- Ice packs
- Short-handled dip net for handling live fish
- Beach seine net (see details of net/s below)
- Large tub or buckets
- Measuring boards
- Battery powered aerators for maintaining live fish
- Waterproof pens, waterproof labels, markers
- Nitrile exam gloves – talc-free (S,M,L,XL)
- Sorbent pads
- Field Sample Forms (Appendix A) (waterproof paper, e.g. Rite-in-the-Rain®)
- Fish identification field guides/charts
- GPS, digital camera (with spare batteries)
- 4 mil low density polyethylene (LDPE) plastic bags
- PPE and COVID supplies (see Appendix C)

## 6.2 Collecting juvenile resident fish

- NOAA staff, and other trained biologists and technicians, will conduct all fish handling and analysis. There will be a NOAA NRDA Representative present each day to ensure data management and chain of custody procedures are followed consistently.
- Juvenile starry flounder, largescale sucker, peamouth, or northern pikeminnow will be collected from the Lower Willamette River using beach seine nets deployed using a 17 ft. (5.2 m) Boston Whaler. The net deployed will be a 37 m × 2.4 m (10 mm mesh size) beach seine. The seine will be handled by two crew members who will deploy it parallel to the shoreline with the distance from the shoreline to be determined by water depth (approximately 1 m).
- The field day will begin with a staff briefing to review safety procedures and sampling objectives, and to ensure that all necessary gear is prepared and stowed properly. The

boat operator will transport the field crew to the target sampling location. Before and after the boat is used for sampling in the Lower Willamette River, it will be washed and inspected to ensure that aquatic invasive species are not imported to or exported from the river.

- One water quality measurement will be taken at each seine location before the first seine haul, regardless of the number of seine hauls conducted at the location on that day. If the location is revisited on a different day, a new water quality measurement will be collected before the first seine haul that day. Water quality measurements will be recorded on the Seine Log Form.
- The total number of individuals of each fish species captured will be counted and recorded (See Appendix A; Seine Log Form). Fish will be maintained in site water until released or euthanized.
- The target fish will be juvenile starry flounder (target size 40-110 mm total length), largescale sucker (40-75 mm TL), peamouth (40- 64 mm TL), and northern pikeminnow (40- 85 mm TL). Ten fish of the same species will be required from each sampling unit. Target fish will be kept in site water in a clean container while measuring. The maximum size of fish to be retained may be adjusted depending on catch success.
- Target fishes (confirmed for species identity by qualified field staff) of the proper length range will be placed in a 4 mil low density polyethylene (LDPE) plastic bag, labelled with the SampleID (See Section 6.3), and humanely euthanized by being immediately surrounded by dry ice to be frozen. The fish will remain on dry ice for the entirety of the field sampling day. The SampleID assigned to each fish will be immediately recorded on the Seine Log form.
- Other species caught will be identified, counted (See Appendix A; Seine Log), and released at the point of capture.
- Field staff will wear nitrile gloves where feasible to minimize potential contamination of fish samples and protect staff.
- At end of each sampling day, all samples will be kept frozen in a cooler of dry ice until they are transferred to the NOAA NWFSC (Seattle, WA) and placed in a locked -80 °C freezer.

### 6.3 Documentation

The NRDA representative for each day in the field will maintain detailed documentation for each day's activities. Form entries will be made with indelible ink. Any corrections will be made with strike-through and the recorder's initials.

### 6.4 Fish Field Data Sheet – SEINE LOG

- See Appendix A for sheet
- There will be one form completed for each seine haul
- The form will record the following information:
    - Study unit (sampling location) designator
    - Sampling time and GPS location (latitude and longitude; minimum of 5 decimal points)

- Water quality data measured near the river bottom at the beginning of a trawl, or for the first seine haul at each sampling location per day (if a sampling location is revisited on a subsequent day, a new water quality measurement will be taken)
- Total number of fish of every species captured per trawl/seine deployed at the sampling location
- Total target fish kept (juvenile starry flounder 40-110 mm total length, largescale sucker 40-75 mm, peamouth 40-64 mm, and northern pikeminnow 40-85 mm). Ten fish of the same species will be required from each sampling unit.
- Unusual circumstances that may affect interpretation of results

- Any deviations from the field sampling plan will be recorded, along with the reason for the changes

### *6.4.1 Fish identification Number (Sample ID)*

- All fish kept will be assigned a unique sample number (SampleID). The number will consist of a three-character species identifier (SFL for starry flounder, LSS for Largescale sucker, PMC for Peamouth, and NPM Northern Pikeminnow), plus a two-digit year (21) and three-digit sequential sample number (1-999) (NO dashes, periods, etc). For example, SFL21001, SFL21002, LSS21001, LSS21002, PMC21001, PMC21002, NPM21001, NPM21002. Fish will be assigned sequential three digit numbers by species in the order they are collected, regardless of their sampling location or date.

### *6.4.2 NRDA Sample Collection Form – Daily Log*

- See Appendix A for sheet.
- This form summarizes all fish caught each day by location and serves as an inventory and assistance in completing Chain of Custody forms and Fish Collection (Tally) Sheets.

### *6.4.3 Fish Collection Tally Sheet (cumulative) See Appendix A for sheet.*

- There will be one recording sheet for each strata over the entirety of the sampling effort (data to be recorded cumulatively).
- Success at each sampling unit will be recorded daily, including date sampled/notes of why not sampled, number of fish of each target species collected, total fish for sampling unit (cumulative sum for each species), and initials of recorder.
- This will serve as a quick reference sheet to determine the need to revisit a sampling unit on subsequent sampling days.

### *6.4.4 Photographs – PHOTOLOGGER FORM*

- See Appendix E for Photologger Form and supporting information.
- The Photologger Form will be filled out at the end of each sampling day to document all photographs that were taken. Descriptions and keywords will be included for the photographs. The photograph number (ex: IMG_2345 or DSC_7890) will be recorded on the form.

- Photographs will be taken of each location on a given sampling day at the time of seine deployment. Photographs will be taken at the time of retrieval to document changed circumstances that may affect the interpretation of results.
- The number of photographs should not be excessive (enough to capture the setting at a given location on a given day).
- All photos will be taken on a digital camera. The associated memory card will be retained by Data Management following the sampling effort.
- Photographs will be loaded into DIVER File Collections and will be available after sampling is completed.

### 6.5 Field equipment cleaning procedure and decontamination

All dip nets, buckets, measuring boards, and coolers used to retrieve and store fish will be thoroughly rinsed using river water when arriving at new sampling location. Any large debris or sediment retained in the seine will be removed prior to leaving a location to reduce cross-contamination between locations.

### 6.6 Health and Safety

See Appendix C.

## 7 Sample processing procedures

The following sections describe the gear and procedures to be employed for dissection of collected fish in preparation for chemical analyses, and collection of tissue for other metrics.

### 7.1 Fish Processing and Handling

Fish to be analyzed for growth and contaminant exposure will be weighed, measured, and dissected at the NWFSC after all field efforts and fish collections are complete. Staff will record the weight and length of the fish, extract the otoliths, and remove and weigh stomach contents and liver as described below.

#### *7.1.1 Equipment, reagents and supplies*

- Dry ice
- Liquid nitrogen
- PTFE (polytetrafluoroethylene) cutting boards or boards covered with clean aluminum foil
- Metric measuring board
- Electronic balance accurate to 0.001 g, calibrated annually, for fish wet weight, liver weight, and stomach contents weight
- Weigh boats
- Paper towels
- Kimwipes™
- Dissection kit with stainless steel scalpel, scissors, and forceps, plus additional scalpel blades (enough to change between each sampling unit) for collection of liver samples

- Magnifying glass on stand, with light
- Tap water
- Deionized water
- Isopropyl alcohol
- Ethanol
- Aluminum foil – heavy duty
- Squeeze bottles
- 4 mil LDPE Ziploc® bags
- Micro brand soap for cleaning lab surfaces and instruments
- Thin tip black permanent markers
- Sample labels
- Lab tape, different colors
- Nitrile exam gloves – talc-free (S,M,L,XL)
- Chain of custody forms
- Sample Processing Form (printed on waterproof paper)
- Sample Processing Notes form (printed on waterproof paper)
- Sampling jars – 20 mL jars, I-CHEM Certified 200-0250 series, Type III glass (solvent rinsed) with Teflon-lined polypropylene lids
- Solvent rinsed aluminum foil [for whole bodies]
- 1.5 mL polypropylene Snap-Top tubes
- Synthetic swabs with plastic stem

### *7.1.2 Length and weight*

- **Protocol/procedures**
    - Fish will be weighed (to the nearest 0.01 g).
    - Total length will be measured by placing fish flat on a measuring board.
        - The measurement will be from the tip of the snout to the posterior end of the longer lobe of the caudal fin (to the nearest mm).
    - Both measurements will be recorded on the Sample Processing Form.

### *7.1.3 Fish dissection/necropsy overview*

Dissection of fish will be conducted by or under the supervision of experienced NWFSC personnel. Fish will be processed on a "clean" work surface with "clean" instruments as described in Section 7.3. Separate tools (scissors and forceps) will be designated for use on outer tissue ("outside") and use on internal tissue ("inside") to minimize cross-contamination.

Fish will be placed on dry ice with a paper towel below the ice to label with the sample number. All dissections will be performed on dry ice to keep fish mostly frozen during the dissection process Following the completion of the dissection, all fish will be placed in a cooler with dry ice until being transferred back to a locked -80 °C freezer.

**Collection of otoliths**

- **Protocol/procedures**

- Make a dorsal to ventral cut from top of operculum, about half way down the length of the body.
- Extend head forward to expose tissue.
- Extract both of the otoliths (sagittae) from each fish using forceps.
- Place both otoliths in the same tube (just 1 sagittal otolith will be used in the analysis, but in the event it is cracked the other sagittal otolith will be available).
- Record on the Sample Processing Form.
- Store otolith samples at room temperature.

**Access to internal organs**

- **Protocol/procedures**
  - Internal organs will be accessed by opening the fish with a pair of dissection scissors.
  - Use "outside" scissors to make incision just anterior to anus and cut straight towards gills.
  - Using the "outside" scissors and "outside" forceps, cut out a "window" in the flesh by cutting an arch dorsally beginning and ending at the edges of the incision – try to keep the tissue attached for ease in transferring to the sample container for chemistry analysis.
  - Gently remove internal organs and place them on a clean cutting board using "inside" scissors and "inside" forceps.

**Collection of liver for archival**

- **Protocol/procedures**
  - Isolate liver with cleaned "inside" forceps and remove from other internal organs with scissors or scalpel blade.
  - If the gall bladder can be identified, do not include it with the liver sample, place it with the rest of the body sample (less liver, stomach contents and otoliths).
  - Tare the 1.5 mL Snap-Top tube.
  - Place the liver in the 1.5 mL Snap-Top tube, no solvent or preservative necessary
  - Weigh the liver to the nearest 0.001 g in a tared Snap-Top tube.
  - Close tube securely (confirm audible snap).
  - Place tube containing liver in liquid nitrogen.
  - Record on the Sample Processing Form.
  - Transfer samples to a -80 °C freezer.

**Collection of stomach contents for chemical analysis; Swab of stomach lining for genetic analysis of prey species**

- **Protocol/procedures**
  - The stomach will be gently separated from the other organs.
  - The stomach will be lifted using designated "inside" forceps.
  - Using a second "inside" forceps, the slightly thawed contents will be expelled into a tared labeled vial.

- The stomach contents will be weighed to the nearest 0.001 g.
- Stomach content sample vials will be placed on dry ice until being stored in a -80 °C freezer.
- The inner lining of the stomach will be swabbed for genetic analysis of prey species using a synthetic swab.
- The plastic stem of the swab will be snapped off and the swab will be placed in a labeled 1.5 mL polypropylene tube.
- The emptied stomachs will be returned into the body cavity and included with the rest of the fish whole-body sample.
- Stomach swab tubes will be placed on dry ice until being transferred to a -80 °C freezer.

**Remaining whole bodies minus stomach contents, livers, and otoliths returned to labelled bag**

- **Protocol/procedures**
  - Remaining whole bodies, including stomach tissue minus the stomach contents, will be individually wrapped in a clean piece of aluminum foil (i.e., previously rinsed with methylene chloride) and returned to the labelled bag from field collections, with the second label that indicates SampleID number with "WH" (e.g., SFL21001WH, LSS21002WH, etc.)
  - Samples will be placed in a cooler of dry ice until being transferred to a -80 °C freezer.

## 7.2 Documentation

When fish are dissected to remove otoliths, stomach contents, and livers, fish dissection information must be documented on a Sample Processing Form, and individual component Chain of Custody (COC) forms. Weights and lengths of individual fish will be recorded on the Sample Processing Form. Entries will be made with indelible ink. Any corrections will be made with strike-through and the recorder's initials. Forms are provided in Appendix A and B.

### *7.2.1 Sample identification labels*

To facilitate identification of sample containers (stomach composites), and micro-tubes (liver samples) corresponding labels will be attached to both the lid and the side of the container. Whole bodies, minus otoliths, stomach contents, and liver, will be returned to the labelled bag from field collection, with the addition of the new label on the bag. All labels will be cryogenic, laser printer ready labels that are written using permanent marker or preprinted. The side label will have the species identifier "SFL", "LSS" "PMC", or "NPM", SampleID (year and fish number), and letters qualifying the type of tissue printed on it. The lid will have the SampleID only.

- A sequential numbering system will be used to uniquely identify each fish. SampleIDs will consist of a three character species identifier followed by a two-digit year and a 3-digit sequential number (i.e., LSS20001, … SFL21360, …). The sample number will be followed by letters qualifying the type of tissue (WH: whole body minus otoliths,

stomach contents, and liver; OT: otoliths; SC: stomach contents; LI: liver). All sample IDs will have the same number of digits.

- Capitalization (or non-capitalization) must be maintained when recording SampleIDs on field/sample data sheets
    - Whole body label example: SFL21001WH
    - Otolith label example: SFL21001OT
    - Stomach content label example: SFL21001ST
    - Liver label example: SFL21001LI

#### *7.2.1 Sample Processing Form*

The Sample Processing Form will contain detailed information (e.g., length, weight) on the individual fish. See Appendix A for form.

The forms are printed on waterproof paper to facilitate use in the field/lab environment. The following information is captured in the Sample Processing/Dissection Form:

- Survey information
    - SampleID
    - Processor Name
- Sample information
    - Whole body weight
    - Total length (mm)
    - Otoliths (how many)
    - Liver- whole, weight
    - Stomach contents, y/n and weight, and description
- Other observations

#### *7.2.2 Sampling Processing Notes Form*

The NRDA Representative for each day will maintain the Sample Processing Notes. The notes form should be printed on waterproof paper, clearly state the date, and should be completed using indelible ink. Each page of the notes should be initialed by the recorder at the end of the day.

The Sample Processing Notes Form will have entries as follows:

- Date
- Sample dissection team names
- Description of activity and method
- Time of beginning and end of activity
- Sample identification numbers for fish processed that day
- Fish physical examination comments (general comments only, specific comments will be on sample processing forms)
- Fish dissection comments (general comments only, specific comments will be on sample processing forms)

- Any deviations from the fish processing will be recorded, along with the reason for the changes
- Unusual circumstances that may affect interpretation of results.

### 7.3 Lab equipment cleaning and decontamination procedure

When processing specimens for contaminant analysis, anything (work-surfaces, instruments) that may contact those portions of a specimen that are subject to contaminant analysis must be cleaned according to the sequence below before processing fish from a new sampling unit.

**Between sampling units:**

A "clean" work-surface (lab counter, cutting board, sorting tray, etc.) and "clean" instruments (stainless steel dissection tools) means they have been:

- wiped with a Kimwipe™ and cleared of any tissue or residue
- thoroughly rinsed three times under running tap water
- rinsed with de-ionized water
- solvent rinsed using either isopropyl alcohol or ethanol (held in a Teflon squeeze bottle)

Lab personnel must change nitrile gloves before processing fish from a new sampling unit**.**

**Between fish from the same sampling unit:**

The work surface is wiped of any tissue or residue and rinsed with water. Tools should be wiped with a Kimwipe™ to remove any tissue. Tools used for extraction of liver tissue should be rinsed thoroughly with ethanol and de-ionized water. All other tools should be rinsed thoroughly with de-ionized water, and dried with a clean Kimwipe™.

**Gloves:** Gloves will be worn whenever handling fish. Lab personnel must change nitrile gloves between sampling units, or more often as needed. Gloves will be talc- or dust-free nitrile.

**Quality assurance/control.** Rinsate blanks should be collected if there is a risk of cross contamination from reuse of sampling equipment. After cleaning the equipment in accordance with the procedures described in this method, rinse the clean equipment with solvent or cleaning solution and collect the rinsate in a sample jar (20 mL jars, I-CHEM Certified 200-250 series). Note on the field sample form when and how rinsate blanks were collected. Rinsate samples, if collected, will be archived for potential chemical analysis.

### 7.4 Sample handling and storage procedures

- **Whole fish tissue and stomach contents.** Fish will be kept frozen during processing, and placed back on dry ice immediately following processing. All tissues will be maintained on dry ice during this time, and placed in a locked -80 °C freezer at the end of the day.
- **Swabs of stomach tissue.** Swabs will be kept on dry ice during processing, and placed in a locked -80 °C freezer at the end of the day.
- **Liver samples.** Liver samples will be maintained in vials on liquid nitrogen until they can be placed in a locked -80 °C freezer at the end of the day.

- **Otoliths**. Otoliths will be placed in dry microtubes and kept at room temperature. At the end of each sample processing day, all otoliths will be placed in a locked cabinet at room temperature until processed.
- **Sample archiving.** All excess sample material remaining after laboratory analysis will be archived. The laboratory will maintain COC procedures and sample integrity for the entire time the samples are in their possession. The laboratory will store the excess samples until otherwise notified by the Assessment Manager (Table 1).

# 8 Analytic methods

The methods used for contaminant analysis of tissues (whole body, stomach contents, and liver) and otolith microstructural analysis are described below.

## 8.1 Chemical analysis, fish tissue and stomach contents

Whole body tissue composites (less stomach contents, otoliths, and livers) will be created from juvenile starry flounder, largescale sucker, peamouth, or northern pikeminnow. The goal is to obtain one whole body composite sample for DDx, PCB, and PAH contaminant analysis from each sampling unit. If sufficient tissue is available, TBT analysis will also be performed.

The mass requested by the NOAA NWFSC analytic lab for DDx, PCB and PAH analysis is a minimum of 4 g of fish in each whole body composite. This mass is to ensure 2 g is available for extraction after potential mass loss following the necropsy and homogenization. All stomach content samples will be composited by sampling unit. If mass is not sufficient, stomach contents will be composited at the level of the stratum.

All measurements of DDx, PCBs, and PAHs in fish tissue composites for this study will be conducted by NWFSC (Seattle, WA) according to Sloan et al. (Sloan et al. 2004, Sloan et al. 2014). In brief, juvenile resident fish bodies with stomach contents, livers, and otoliths removed will be homogenized and extracted with dichloromethane, using an accelerated solvent extractor. The sample extracts will be precleaned on an alumina–silica column, and then further cleaned using size-exclusion liquid chromatography. The sample extracts will be analyzed by gas chromatography-mass spectrometry (GC/MS). Measured concentrations in fish tissue will include 45 PCBs (PCBs 17, 18, 28, 31, 33, 44, 49, 52, 66, 70, 74, 82, 87, 95, 99, 101/90, 105, 110, 118, 128, 138/163/164, 149, 151, 153/132, 156, 158, 170/190, 171, 177, 180, 183, 187, 191, 194, 195, 199, 205, 206, 208, and 209), six DDx compounds (o,p'-DDD; o,p'-DDE; o,p'-DDT; p,p'-DDD; p,p'-DDE; p,p'-DDT), and 24 PAHs [naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, biphenyl, 2,6-dimethylnaphthalene, acenaphthylene, 2,3,5-trimethylnaphthalene, acenaphthene, fluorene, retene, phenanthrene, 1-methylphenanthrene, anthracene, fluoranthene, pyrene, chrysene + triphenylene (coelute), benzo[*a*]pyrene, benzo[*e*]pyrene, perylene, dibenz[*a,c+a,h*]anthracene (coelute), benzo[*b*]fluoranthene, benzo[*j+k*]fluoranthene (coelute), indeno[1,2,3-*cd*]pyrene, benzo[*g,h,i*]perylene]. Percent lipids will be measured gravimetrically following extraction in dichloromethane, and lipid class determinations will be conducted using thin-layer chromatography/flame ionization detection (Iatroscan; wax ester and sterol esters, triglycerides, free fatty acids, cholesterol, phospholipids

and other polar lipids). Stomach content composite samples will be analyzed for PCBs and PAHs using analytical methods as described above for whole bodies.

The TBT analysis requires a minimum of 10 g of tissue. If tissue quantity is sufficient, composites for TBT analysis will be prepared. The analysis will be conducted at ALS Environmental (formerly, Columbia Analytical Services; Kelso, WA). Method details and quality assurance criteria will be reported with findings.

### 8.2 Chemical analysis, liver tissue (archival)

Liver tissue will be removed, handled, and preserved according to Section 7 and may be analyzed at a later date. If analysis is performed, method details and quality assurance criteria will be reported with findings.

### 8.3 Otolith analysis

Otolith microstructure will be analyzed to estimate recent somatic growth using methods described previously (Chittaro et al. 2018; 2020). Sagittal otoliths will be embedded in crystal bond and polished in a sagittal plane using slurries (Buehler©'s 600 grit silicon carbide, 5.0 alumina oxide and 1.0 micropolish) and a grinding wheel with Buehler©'s 1500 micropolishing pads. Polishing will cease when the core of the otolith is exposed and daily increments are visible under a light microscope. Otoliths will be photographed using a digital camera (Leica DFC450) mounted on a compound microscope (Zeiss©). Using Image Pro Plus© (version 7, Mediacybernetics), measurements will be taken from each otolith, including distance from otolith core to edge (i.e., otolith radius at the time of capture) and distance from otolith core to daily increments in from the otolith edge (i.e., otolith radius measured at n days before sacrifice).

### 8.4 Genetic analysis of prey species in stomach

Genetic analysis of stomach swabs from individual fish may be performed to identify composition of the diet through genotyping of prey species DNA present. If this analysis is performed, method details and quality assurance criteria will be reported with findings.

## 9 Quality assurance project plan

This section outlines procedures to ensure that data collected and analyzed will meet project requirements.

### 9.1 Field collection requirements

The following field collection requirements will be used for this study (Table 4).

*Table 4. Quality assurance procedures, field collection requirements*

| TISSUE | REQUIREMENT | CRITERIA | CORRECTIVE ACTION |
|---|---|---|---|
| Juvenile fish | Sampling goal of 10 starry flounder, largescale sucker, peamouth, or northern pikeminnow per sampling unit, to be composited into a single sample. | One composite sample per sampling unit, a total of 39 sampling units from 5 strata are to be sampled. | At a given sampling unit, deploy a beach seine. If target number of fish not caught, repeat seine attempts on at least three days until sampling goal is attained. If sampling unit is not able to be sampled due to depth, safety, intereference, etc., the alternate sampling units on the same river bank as the original will be attempted in consecutive order. |
| Whole body composite | Minimum mass for contaminant analysis, percent lipids, and lipid class analysis. | 2 g per composite, one composite per sampling unit | If minimum composite size is not attained for a sampling unit, compositing may occur at the strata level. |
| Stomach contents composite | Minimum mass for contaminant analysis. | 1 g per composite, number per sampling location will be dictated by amount of mass in fish stomachs. | If minimum composite mass is not attained for a sampling unit, compositing may occur at the strata level. |
| Otolith | Minimum number of otoliths for microstructural analysis. | At least one otolith per fish. Target collection of both otoliths per fish. | If at least one otolith cannot be extracted during necropsy, the fish will be excluded from the growth analysis. |

## 9.2 Field quality assurance

The sampling design incorporates a minimum of three sampling units per stratum. This is a homogenous ecological system; within sampling unit variance is expected to be small so it is not necessary to sample multiple times per sampling unit.

In general, risks of cross-contamination are low due to the decontamination procedures used. If unusual odors or sheens are noticed on fish prior to dissection, extra care will be taken with cleaning and a rinsate blank will be collected as specified in Section 7.3.

## 9.3 Laboratory quality assurance

### *9.3.1 Chemical analysis, fish tissue and stomach contents analytical quality assurance criteria*

Quality assurance criteria for PCBs, DDx, and PAHs analyzed in starry flounder, largescale sucker, peamouth, or northern pikeminnow whole body and stomach contents samples for this study are summarized in Table 5 (taken from Sloan et al. 2019). Details on the quality assurance criteria for TBT analysis in fish whole body composite samples will be reported with findings if tissue is sufficient for analysis.

***Table 5. Minimum analytical quality assurance criteria for DDx, PCBs, and PAHs by gas chromatography/mass spectrometry (from Sloan et al. 2019)***

| QUALITY ASSURANCE ELEMENT | MINIMUM FREQUENCY | ACCEPTANCE CRITERIA |
|---|---|---|
| Instrument calibration | Each calibration standard is analyzed at the start of every batch of samples, or once every two batches in one continuous analytical sequence. | Analyte concentrations must be calculated using point-to-point calibration with at least five concentration levels of calibration standards. Each surrogate standard in the calibrations standards must have a relative standard deviation (RSD) of its response factors (response area divided by the concentration) that is ≤15%. |
| Continuing calibration | One at start and end of every analytical sequence and between every 10 or fewer samples. | The RSD of the analyte responses relative to the internal standard must be ≤15% for the repetitions. This criterion does not apply to Nonachlor III, PBDEs, or PCBs 11, 196, 200, 201, 202, or 207. |
| Reference material: National Institute of Standards and Technology (NIST) standard reference material (SRM) 1946, 1947, 1974c | One appropriate SRM with every batch of 20 or fewer samples. | The concentrations ≥70% of individual analytes, as well as the gravimetric percent lipid, if requested, must be within 30% of either end of the 95% confidence interval range of the certified values. These criteria do not apply to analytes with concentrations below their lower limit of quantification (LOQ) when the lower LOQ is within or greater than the 95% confidence interval, nor to those analytes known to have coeluting compounds. |
| Laboratory method blank | One with every batch of 20 or fewer samples. | No more than 10% of the analytes' concentrations can exceed 2 x lower LOQ. Samples are not corrected for analytes found in the blank. |
| Laboratory sample replicates (i.e., duplicates or triplicates) | One with every 26 or fewer samples. | The RSDs of analyte concentrations must be ≤15% for triplicates, or percent differences must be ≤30% for duplicates, for ≥90% of the analytes that have concentrations > 1 ng/g. |
| Surrogates (internal standards) | At least one internal standard/ surrogate is added to every sample. | The surrogate recoveries must be between 60–130%. |
| Interlaboratory comparison | At least one per year, if available. | In conjunction with NIST or the IAEA, accuracy-based solutions, sample extracts, and representative matrices are analyzed. Acceptance criteria are the same as those for reference material. All results are sent back to NIST or IAEA for comparison across laboratories. |

Measurement quality objectives for accuracy associated with measurement of percent lipids are that each NIST standard reference material (SRM) result should be within its control limits (Sloan et al, 2019):

- Upper control limit = [1.3 × (certified concentration + uncertainty value for 95% confidence)]
- Lower control limit = [0.7 × (certified concentration – uncertainty value for 95% confidence)]

**Precision**

Precision represents the reproducibility of the individual measurements from the same sample. Precision is monitored and controlled within batches using laboratory replicates of field samples and across batches by analyzing SRM of applicable matrix (i.e., tissue) as well as monitoring the performance of internal standards. For this study, a National Institute of Standards and Technology (NIST) mussel SRM 1974c will be used as the reference material for PAH analyses, and a NIST fish tissue SRM 1947 will be used for PCBs analyses[3]. Cross-batch precision is expressed as the relative standard deviation (RSD) for repeated measurements. The RSD of analyte responses relative to the internal standard must be ≤ 15% for the repetitions.

**Accuracy**

Accuracy demonstrates the degree to which the measured value represents the true value. Accuracy of sample results is evaluated by comparing measured SRM values with NIST certified values. Concentrations of ≥70% of individual analytes are to be within 30% of either end of the 95% confidence interval of the reference values. Results of QA analysis will be reviewed by the Laboratory QA Officer.

**Sensitivity**

The limit of quantitation (LOQ) for all organic chemicals in this study is "the concentration that would be calculated if that analyte had a GC/MS response area equal to its area in the lowest level calibration standard used in that calibration. When an analyte is not detected in a sample or it has a response area that is smaller than its area in the lowest level calibration standard used, the concentration of the analyte in that sample is reported to be less than the value of its lower LOQ." (Sloan et al. 2019). Typically LOQ values in 2 g fish whole-body composites range from 0.65 to 1.5 ng/g ww for PAHs and 0.15 to 0.50 ng/g ww for DDx and PCBs.

**Representativeness**

Representativeness is the degree to which data represent a characteristic of an environmental condition. In the field, this is addressed in the sampling design by the selection of sampling units and the sample collection procedures. In the laboratory this is ensured by the proper handling and storage of samples and initiation of analysis within holding times. The sample collection procedures for this study will collect fish at a given sampling unit, with selection of target species only restricted by size. This will ensure representativeness of the contamination across target species collected at a given sampling unit.

[3] SRM 1974b was previously used, but is no longer available from NIST

**Comparability**

Comparability is the similarity among different datasets for use in combining or comparing data. The methods used in this analysis follow similar protocols with previous studies, with comparable or lower limits of detection. One distinction in the protocol described in this study will be chemistry measures on whole bodies minus stomach contents, otoliths, and livers, whereas previous studies have retained the stomach contents, liver, and otoliths in the whole body analyses. Removing liver tissue may underrepresent the contamination profiles of the fish sampled.

### *9.3.2 Chemical analysis, liver tissue analytical quality assurance criteria*

Liver tissue will be removed, handled, and preserved according to Section 7 and may be analyzed at a later date. If analysis is performed, method details and quality assurance criteria will be reported with findings.

### *9.3.3 Otolith analysis*

**Precision**

Precision represents the reproducibility of the individual measurements from the same sample. Precision is monitored and controlled by having the same person perform the measurement procedure for each otolith (see 8.3 Otolith analysis), and by repeating the measurement procedure for a random subset of a minimum of 10% of the otoliths, whereby the same otoliths are evaluated on different days. Once the subset of otoliths has been measured twice, the average increment width across the last seven increments will be determined for each reading. The averages between repeated measurements will be compared using Student's t-test (or non-parametric equivalent). The Student's t-test allows the independent readings of the same otoliths to be compared to confirm whether both provide similar results. If no significant difference is observed between repeated measurements, then the otolith measurements have a high precision and are thus of good quality. If significant differences are detected between repeated measurements, then a three-step process will be followed to improve otolith measurement quality (as outlined in Chittaro et al. 2020). The first step is to identify the otolith(s) in the subset that show the greatest variability between repeated measurements by calculating differences between repeated measurements. Second, for the purpose of identifying where the deviations in increment marks arose between repeated measurements and how to revise the otolith measurement(s), the otolith increment widths and increment markings on the otolith digital images will be compared for those otoliths that have the greatest differences between repeated measurements. Third, the Student's t-test will be repeated on the revised measurements from the subset of otoliths. If this test fails, then Steps 1–3 will be repeated on the same subset of otoliths again. If the test passes, then the above test will be repeated on a new subset of otoliths.

**Accuracy**

Accuracy demonstrates the degree to which the measured value represents the true value. Each otolith will be read without any knowledge of fish sample location. Accuracy of samples

will be maximized through consistency in the measurement protocols, ensuring the increment being measured is in optimum focus, and ensuring the otolith is mounted so that the incremental plane is as close to horizontal as possible.

**Completeness**

Completeness is the ratio of usable data from the otolith analyses. It is fully expected that all otoliths will be processed and read, producing a reliable data point from each fish.

**Representativeness**

Representativeness is the degree to which data represent a characteristic of an environmental condition. In the field, this is addressed in the sampling design by the selection of sampling units and the sample collection procedures. In the laboratory, this is ensured by the proper handling and storage of samples and initiation of analysis within holding times. The sample collection procedures for this study will collect fish at a given sampling unit by beach seine, with selection of target species only restricted by size. This will ensure representativeness of the growth across target species collected at a given sampling unit.

**Comparability**

Comparability is the similarity among different datasets for use in combining or comparing data. To the best of our knowledge, no previous data for average daily growth rates in juvenile starry flounder, largescale sucker, peamouth, or northern pikeminnow are available. However, the methods used in this analysis follow similar protocols used for other fish injury studies for the Portland Harbor NRDA.

## 10 Chain of custody procedures

Chain of custody (COC) procedures are followed to authenticate a sample from the time it is taken until the results are introduced as evidence. For the purposes of litigation, agencies must be able to prove the legal integrity of all samples and data introduced as evidence. This means that it is necessary to have an accurate written record to track possession, handling, and location of samples and data from collection through reporting. Chain of custody facilitates this verification process. Failure to follow COC procedures in this guideline does not necessarily render data unusable. However, the Case Team Lead and Data Manager should be immediately notified of any deviations from the COC guidelines. Assuring that proper COC guidelines are followed is important to assuring the integrity of the samples, and the data generated by the analysis of those samples.

A COC Form will be initiated when fish are collected to track location, disposition, entity responsible for each fish, and, subsequently, individual or composite tissue containers. The COC Form will be completed in indelible ink, scanned, and a copy will accompany the shipment to the laboratory (COC Form, Appendix B). The COC Forms should be printed on waterproof paper and will be enclosed in resealable plastic bags and taped to the inside lip of coolers. The information on this form will be used to track all samples from field collection to receipt at the analytic laboratory, and maintained with the samples during subsequent storage. Upon

delivery and receipt of samples, the COC Forms must be signed and dated by the recipient (analytical laboratory) and the individual (field NOAA staff) that relinquishes the samples.

Samples are considered to be in custody if they are 1) in the custodian's possession or view; 2) in a secured location and in a locked compartment; or 3) in a container that is secured with an official seal(s) such that the samples cannot be reached without breaking the seal(s). The sample custodian will check that all COC Forms are filled out properly and completely, and that the samples are stored in the appropriate conditions.

## 11 Description of the interpretation techniques to be used

*The stratified sampling design described above in Section 5 will give rise to a total of up to 390 starry flounder, largescale sucker, peamouth, or northern pikeminnow from 39 sampling units. We will collect 10 fish of a given species per sampling unit, which will be used to create one whole body (less liver, otolith, and stomach contents) and one stomach contents composite for chemistry analyses. These measurement endpoints will be analyzed as individual dependent variables, and may also be analyzed as a single multivariate vector for testing composite hypotheses. In either case each fish composite will contribute one independent degree of freedom to analyses. Averages of chemical measures in tissue will be obtained for individual strata based on an area weighted average of the measurements within each stratum; these stratum specific averages will be area weighted using standard formulas for stratified sampling designs (Cochran 1977).*

*Growth metrics will be collected on otoliths from individual fish, and analyzed in three ways; 1) averaged over a fixed period of time generating 10 measurements per sampling unit, 2) as repeated observations representing daily changes in growth generating multiple measurements per each of the 10 fish, and 3) as moving averages of the daily growth profiles, also generating multiple measurements per each of the 10 fish. The first of these based on one number per fish will be analyzed by treating each fish as potentially correlated repeated measurements within sampling units. These data will be analyzed statistically using general or generalized linear mixed effects models (GLMM; Littell et al. 1996), or generalized estimating equations (GEE; Halekoh et al. 2006), depending on the specific nature of the data distributions and importance of within sampling unit correlations. For the second and third measurement endpoints, multiple measurements from each otolith will generate growth profiles for each fish resulting in two levels of dependency that also will be accounted for with the mixed effects model framework. The measurement endpoint will be evaluated for association by stratum as well as tissue contamination profile. Other approaches to capturing growth as an endpoint will be explored. Because generalized mixed effects models are mathematically sophisticated, these latter analyses may be presented graphically (with approximate inferential procedures) in cases where mathematical model fitting is unstable (if the models do not converge to parameter estimates). At a minimum, all comparisons of interest will be displayed graphically and supported where appropriate and tractable with statistical inferences.*

*It is also anticipated that measurement endpoints may be associated with other environmental factors that are not related to site contamination. These analyses, in addition to simple one-way treatment structures comparing sampling units and strata, will also be adjusted by*

*incorporating environmental variables as covariates in an analysis of covariance design. Comparisons will be developed first based on simple ANOVA design assumptions, followed by more sophisticated evaluations incorporating covariate adjustments. Results will be interpreted based on each analysis and will also be evaluated by comparing model fit with and without covariate adjustments. These analyses will also incorporate sample weighting proportionally to probability of sample inclusion, i.e. the ratio of sampling unit size to stratum size. Simple estimates of overall averages and their confidence limits will also be calculated based on standard stratified sampling formulas (Cochran 1977).*

It is anticipated that the effects of chemical contamination on the chosen endpoints are likely to act in concert through the complex mixture of contaminants in Portland Harbor. In such situations, it is generally untenable to isolate the independent effects of individual contaminants. We anticipate development of a principal components analysis to summarize groups of contaminants into composite variables (i.e., principal component scores; Harrell 2001) which are by definition mutually independent and therefore appropriate for inclusion in mixed effects multiple regression models. This approach avoids arbitrary scaling and conversion to toxic equivalents and provides a means to associate measured endpoints directly with identified mixtures of co-occurring contaminant mixtures.

## 11.1 Variables for analysis

### *11.1.1 Fish metrics*

- Tissue contaminant values
    - Whole bodies of flounder, sucker, peamouth, or pikeminnow (minus the otoliths, stomach contents, and livers) tested for PCBs, DDx, PAHs, TBT; PCB and DDx values will account for the percent lipid in the sample (1 composite per sampling unit)
    - Stomach contents tested for PCBs, DDx, and PAHs (it is unlikely that sufficient tissue will be available for TBT analysis) (1 composite per sampling unit if mass is sufficient, may composite by strata)
- Lipid class measurements
    - Percent lipids, and lipid classes (wax ester and sterol esters, triglycerides, free fatty acids, cholesterol, phospholipids and other polar lipids) will be measured in whole bodies (1 composite per sampling unit)
- Average daily growth
    - Each of the ten fish collected per sampling unit will be individually analyzed for average daily growth in the most recent 29-days prior to capture using otolith microstructural analysis.

### *11.1.2 Covariates*

- Collection date (categorical and continuous)
- Time of day at fish collection (continuous, categorical [bins to be defined])
- Temperature and salinity at sampling unit on day of sample collection at the time of the first seine haul of the day at the location (continuous for both)

- Habitat at collection location (categorical)
- Water depth at time of sampling (continuous)
- Liver weight (mg) (continuous)
- Stomach contents weight (mg) (continuous)
- Total length of fish (mm)
- Weight of fish (g)
- Body condition (Fulton's condition factor (K)= weight (g)/ length$^3$ (cm); continuous)
- Others to be determined

# 12 Data management

Records will be maintained documenting all activities and data related to sample collection as well as to laboratory analyses. Results of data verification and validation activities will also be documented. Copies of all of these records and data will be stored in NOAA's DIVER (Data Integration Visualization Exploration and Reporting), a NOAA application for the integration and distribution of NRDA-related response, assessment, and restoration data. All publicly available data and documentation will be available through NOAA's DIVER tool (https://www.diver.orr.noaa.gov/). The public can access these data using the DIVER Explorer query tool that allows users to search, filter, and download data. A complete collection of records will be kept in the DIVER Portal, which is the log-in side of DIVER, and requires a username and password to access the information.

## 12.1 Data records available in DIVER

A key objective of DIVER is to accommodate the storing and organizing of data and information. This allows users to query analytical chemistry data along with ancillary information (e.g., continuous-read instruments, photos) and associated data (e.g., field measurements) and helps case team members answer a variety of case related questions. To pursue this objective, DIVER data managers identify the overlapping concepts generally implicit in each data set, defined as the core fields. The core field information makes the related data available for searching and download.

### *12.1.1 Field data and fish dissection documentation*

For field sampling efforts and fish processing (dissections), all data will be stored electronically. Upon the return of the field sampling team each day, data intake and processing will occur for all photos, GPS information, and field forms (including COCs) generated during the field sampling and copies will be uploaded into DIVER. Similarly, after each day of performing fish dissections, fish processing forms and related laboratory notes will be uploaded into DIVER. See Appendix D for details on data intake and processing.

Accurate transcription and review of field and fish processing information is critical for data usability. Data transcription will be reviewed by a second party on at least ten percent of forms to verify accurate transcription. Valid values ranges will be identified for key fields and values outside of those ranges will be flagged for field or processing team review. During the field sampling or lab processing, any changes will be noted on the raw data sheets with a line

through the original, initials of the editor, and the corrected value noted. Validation comments should be noted on the data sheet. Revised sheets will be re-scanned and added to the appropriate DIVER file collection.

### *12.1.2 Chemical analysis data documentation*

The data management team will assemble all of the information reported by the laboratories once the chemical and otolith data have been appropriately validated. The laboratory data and documentation will be included in the project's file collection within DIVER for data archiving, data analyses, and use with GIS. References and/or links to the data set documentation, if available, will include: all quality assurance documentation for the original data set; validation reports; laboratory analytical reports; and final project reports summarizing the data.

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# Appendix A. Sampling and Processing Forms

- Print the form on weather-resistant paper (if available). Make more than enough copies of the form before going into the field.
- Fill out forms with indelible ink. Do not use pencil or erasable ink.
- Make any additional notes that do not fit on the form in a field notes page.
- Fill in blanks with "N/A" if data are not applicable or not available. Avoid leaving blank values on data forms.
- Do not black out erroneous entries on the field data forms. Errors should be corrected by crossing out the entry with a single line and initialing and dating the strike-through.
- The identification label on the fish tissue in the cooler must match the identification number in the forms below.
- Special notes about each attached form:
    - **SEINE LOG**
        - This will keep track of fish counts (collected and released) for our fishing records and permit reporting
        - A new sheet must be filled out for every seine deployed
    - **DAILY LOG**
        - This form summarizes all fish caught each day by location and serves as an inventory and assistance in completing Chain of Custody forms and Fish Collection Tally Sheets.
    - **FISH COLLECTION TALLY SHEET**
        - A cumulative record of what sampling points have been sampled at each sampling unit and total numbers of each target species collected
        - One sheet per strata, only one strata is enclosed as an example – all others follow this same format
    - **SAMPLE PROCESSING FORM**
        - This form will document fish measurements and records from the sample processing (dissections) of the fish
    - **SAMPLE PROCESSING NOTES FORM**
        - This form will document notes from the sample processing (dissection)

# PHa Field Data Sheet- SEINE LOG

Date (mm/dd/2021): ___/ ___/2021 Sampling Unit: eg. (H_A or SI_B)_____

Data recorder / Affiliation: _____

Other team members (initials) / Affiliation: _____

Weather: _____ Photos : (site location before seine)_____

**Tide (circle one): incoming / outgoing / slack**

**Benthic Habitat (circle one):** vegetation / cobble / sand / marsh / mud / riprap / other:_____

| | | |
|---|---|---|
| Water Quality | Dissolved oxygen (%): | |
| | Salinity (ppt): | |
| | Conductivity (µS) | |
| | Temperature (degC): | |
| | Latitude (6 dec) | |
| | Longitude (6 dec) | |

NOTES:

| |
|---|
| |

**Sign Off:**

Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

Date (mm/dd/2021): ___/ ___/2021 Sampling Unit: eg. (H_A or SI_B)_____

SEINE HAUL NUMBER: (H_A_#) _____

**Beach seine (type of net): _____ Maximum Distance from Shore (m): _____**

**Estimated Distance moved along Shore (m): _____**

| | |
|---|---|
| Start Time (24-hr): | |
| Start GPS (lat/long, 6 dec): | |
| * End GPS (lat/long, 6 dec): | |

* If you move along the shoreline, please record End GPS.

| Species *All Fish* | Number Collected | | Retained Sample ID Range |
|---|---|---|---|
| | # Retained | # Released | |
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*Starry Flounder = SF*
*Largescale Sucker = LSS*
*Peamouth = PMC*
*Pikeminnow = NPM*
**(SF-A, SF-B, etc)*

**Sign Off:**

**Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____**

Date (mm/dd/2021): ___/ ___/2021 Sampling Unit: eg. (H_A or SI_B)_____ Seine #_____

| Released Fish *(Fish outside target size range)* | | |
|---|---|---|
| Species | Identification Letter | Total Length (mm) |
| | | |
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*Starry Flounder = SF*
*Largescale Sucker = LSS*
*Peamouth = PMC*
*Pikeminnow = NPM*
**(SF-A, SF-B, etc)*

**Sign Off:**

Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

## PHa Injury Assessment Resident Fish – DAILY LOG

Date: _____ Weather: _____

Form filled out by/ affiliation: _____

Team for the day/ affiliation: _____

Time leave: _____, Time boat in water: _____

Time boat out of water: _____, Time return: _____

Gear used: _____, Number of seines deployed: _____

**Overview of days events: Areas sampled and collected (1 seine per line)**

| Sample Unit ID | No. of SF | No. of PMC | No. of NPM | No. of LSS | Sample IDs | Notes |
|---|---|---|---|---|---|---|
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**Notes about the day**

**Sign Off:**

Federal Representative/Affiliation: _____

Date: _____ Time (24 hr): _____

PHa Resident Fish - Seine Collection Tally Log

Page 1 of ____

| Strata | Sampling Unit | Date(s) Sampled | Number of fish collected | | Initials of recorder | Alternate Sampling Unit Used | Notes - why not sampled |
|---|---|---|---|---|---|---|---|
| **High** | H_A (W) | | Starry Flounder | | | | |
| | | | Largescale Sucker | | | | |
| | | | Peamouth | | | | |
| | | | Pikeminnow | | | | |
| **High** | H_B (W) | | Starry Flounder | | | | |
| | | | Largescale Sucker | | | | |
| | | | Peamouth | | | | |
| | | | Pikeminnow | | | | |
| **High** | H_C (W) | | Starry Flounder | | | | |
| | | | Largescale Sucker | | | | |
| | | | Peamouth | | | | |
| | | | Pikeminnow | | | | |
| **High** | H_D (E) | | Starry Flounder | | | | |
| | | | Largescale Sucker | | | | |
| | | | Peamouth | | | | |
| | | | Pikeminnow | | | | |
| **High** | H_E (W) | | Starry Flounder | | | | |
| | | | Largescale Sucker | | | | |
| | | | Peamouth | | | | |
| | | | Pikeminnow | | | | |
| **High** | H_F (W) | | Starry Flounder | | | | |
| | | | Largescale Sucker | | | | |
| | | | Peamouth | | | | |
| | | | Pikeminnow | | | | |
| **High** | H_G (W) | | Starry Flounder | | | | |
| | | | Largescale Sucker | | | | |
| | | | Peamouth | | | | |
| | | | Pikeminnow | | | | |
| **High** | H_H (E) | | Starry Flounder | | | | |
| | | | Largescale Sucker | | | | |
| | | | Peamouth | | | | |
| | | | Pikeminnow | | | | |

# NRDA Sample Processing Form – FISH DATA

| | | | |
|---|---|---|---|
| Lead Sampler Name/Phone: | Cathy Laetz/ 206-526-6315 | Study Name: | PHa Injury Assessment Resident Fish |
| Lead Sampler Affiliation: | NOAA NMFS NWFSC | **Processing date (mm/dd/yyyy) _____/_____/2021** | |
| NRDA Contact/Phone: | Robert Neely/ 206.617.5443 | | |

| Sample Number | Time Begin Processing | Total Length (mm) | Fish Weight (g to 0.01) | Otoliths (#) | Liver Weight (g to 0.001) | Stomach Contents Weight (g to 0.001) | Stomach Swabs (#) | Sample Notes | Sample Photos |
|---|---|---|---|---|---|---|---|---|---|
| *Sample #* | *(24-hour clock, local time)* | *Total Length of Sample Fish* | *Total Weight of Sample Fish* | *Number of Otoliths Collected* | *Weight of the Liver Collected* | *Weight of the Stomach Contents* | *Number of Stomach Swabs Collected* | *Any documentation regarding a specific fish sample.* | *Photo # for any photo taken of individual fish* |
| PHSF210001 | | | | | | | | | |
| PHSF210002 | | | | | | | | | |
| PHSF210003 | | | | | | | | | |
| PHSF210004 | | | | | | | | | |
| PHSF210005 | | | | | | | | | |
| PHSF210006 | | | | | | | | | |
| PHSF210007 | | | | | | | | | |
| PHSF210008 | | | | | | | | | |
| PHSF210009 | | | | | | | | | |
| PHSF210010 | | | | | | | | | |
| PHSF210011 | | | | | | | | | |
| PHSF210012 | | | | | | | | | |
| PHSF210013 | | | | | | | | | |
| PHSF210014 | | | | | | | | | |
| PHSF210015 | | | | | | | | | |
| PHSF210016 | | | | | | | | | |
| PHSF210017 | | | | | | | | | |
| PHSF210018 | | | | | | | | | |
| PHSF210019 | | | | | | | | | |
| PHSF210020 | | | | | | | | | |
| PHSF210021 | | | | | | | | | |

Form filled out by: _____ Field lab team Initials: _____ Page: _____ of _____

**Sign Off:**

Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

PHa Resident Fish – SAMPLE PROCESSING NOTES

Sample date (mm/dd/yyyy) _____/_____/2021

Data recorder/ affiliation: _____

Other Team members/ affiliation: _____

Time necropsies began (24-hr clock): _____Time necropsies ended (24-hr clock): _____

Notes:

**Sign Off:**

Federal Representative/Affiliation: _____

Date: _____ Time (24 hr): _____

## Appendix B. Chain of Custody Form

Chain of custody forms may be provided by the lab that will receive the sample or the NRDA lead, otherwise, use the attached form.

- Print the form on weather-resistant paper (if available). Make more than enough copies of the form before going into the field.
- Fill out forms with waterproof pen or permanent marker. Do not use pencil, or biro (erasable) ink.
- Fill in blanks with "N/A" if data are not applicable or not available. Avoid leaving blank values on data forms.
- Do not black out erroneous entries on the field data forms. Errors should be corrected by crossing out the entry with a single line and signing and dating the strike-through.
- Original chain of custody forms should always stay with the samples. Make a copy of the chain of custody form before sending it with the samples.

Attached form: **Chain of Custody Form**

## NRDA Chain of Custody Form



| Sampler Information | | Lead Contact Information | |
|---|---|---|---|
| Contact/Phone/Email: | Cathy Laetz/ 206-526-6315 /Cathy.Laetz@noaa.gov | Contact/Phone/Email: | Robert Neely/ 206.617.5443/Robert.Neely@noaa.gov |
| Affiliation: | NOAA NOS ORR ARD | Affiliation: | NOAA NOS ORR ARD |
| Incident Name: | PHa Injury Assessment Resident Fish | Survey/Project Name | PHa Injury Assessment Resident Fish |

| Special Instructions | Analyses requested | | | | | | | Lab Name: | |
|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | # of containers | Waybill Number: | |
| | | | | | | | | Lab Use Only: Lab Report #: | |
| | | | | | | | | # of Coolers: | |
| Turn Around Time: | | | | | | | | Cooler Temp: | |

| Sample ID | Sample Date | Sample Time | Matrix | ID | Comments |
|---|---|---|---|---|---|
| | *mm/dd/yyyy* | *(24-hr local)* | | *Enter Analyses above, with preservative specified, if needed. Enter x's in boxes below.* | # |
| PHSF210001 | | | | | *1* |
| PHSF210002 | | | | | *2* |
| PHSF210003 | | | | | *3* |
| PHSF210004 | | | | | *4* |
| PHSF210005 | | | | | *5* |
| PHSF210006 | | | | | *6* |
| PHSF210007 | | | | | *7* |
| PHSF210008 | | | | | *8* |
| PHSF210009 | | | | | *9* |
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# Appendix C. Health and Safety Plan

**Portland Harbor**
**Resident Fish SAMPLING AND ANALYSIS**

**QUALITY ASSURANCE PROJECT PLAN (QAPP)**

**Appendix C**
**HEALTH AND SAFETY PLAN**

**April 6th, 2021**

**HEALTH AND SAFETY PLAN APPROVAL**

This appendix to the Portland Harbor Resident Fish Evaluation: Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) (NMFS 2020) has been reviewed and approved for resident fish collection in the area of Portland Harbor, Portland, Oregon. This site health and safety plan (HASP) has been written for the use of NOAA personnel and its subcontractors. NOAA claims no responsibility for its use by others. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions change.

PLAN PREPARED BY: Mary Baker, NOAA

DATE: April 6, 2021

REVIEWED BY:

_____

Katherine Nielsen Date
OR&R Chief of Staff

**HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT**

I have reviewed the site-specific HASP prepared by NOAA, dated April 6, 2021, for the Portland Harbor Resident Fish Evaluation, QAPP and FSP fieldwork. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines while participating in this project.

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**HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT (Continued)**

I have reviewed the site-specific HASP prepared by NOAA, dated April 6, 2021, for the Portland Harbor Resident Fish Evaluation, QAPP and FSP fieldwork. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines while participating in this project.

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**LIST OF ACRONYMS**

| | |
|---|---|
| ACGIH | American Conference of Governmental Industrial Hygienists |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| COVID-19 | Coronavirus disease 2019 |
| EPA | U. S. Environmental Protection Agency |
| FSP | Field Sampling Plan |
| HASP | Health and safety plan |
| HSO | Health and Safety Officer |
| NIOSH | National Institute of Occupational Safety and Health |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NWS | National Weather Service |
| OMAO | Office of Marine and Aviation Operations |
| OSHA | U.S. Occupational Safety and Health Administration |
| PAH | Polycyclic aromatic hydrocarbon |
| PFD | Personal flotation device |
| PPE | Personal protective equipment |
| QAPP | Quality assurance project plan |
| SDS | Safety Data Sheet |
| SHSR | Site Health and Safety Representative |
| STEL | short-term exposure limit |
| TLV | threshold limit value |
| TWA | time-weighted average |
| USCG | U. S. Coast Guard |
| USGS | U. S. Geological Survey |

**HEALTH AND SAFETY PLAN**

**Project Title:** Portland Harbor Resident Fish Evaluation, QAPP and FSP

**Site Name:** Lower Willamette River, Portland, OR

**Dates of Proposed Activities:** June 1, 2021 – October 15, 2021
Additional dates, as needed

## 1. Introduction

This site-specific health and safety plan (HASP) provides the general health and safety provisions to protect workers from potential hazards during field activities associated with the study of juvenile resident fish exposure to contaminants in the Portland Harbor Superfund Site in the Lower Willamette River, Portland, Oregon. The field activities include:

- Capture and transport of juvenile resident fish (starry flounder, largescale sucker, peamouth, and/or northern pikeminnow)

It is the policy of NOAA and all of its line offices to provide a safe and healthful work environment. No aspect of the work is more important than protecting the health and safety of all workers. Given the dynamic and protracted nature of the Coronavirus (COVID-19) pandemic, circumstances may change over time, therefore this plan may be modified as needed in order to comply with COVID-19 related local and state orders or applicable best practices. Consideration for mitigating COVID-19 exposure in the work environment will be made for all project activities.

This plan may also be modified at any time based on the judgment of the Project Manager (PM), Field Task Lead, Site Health and Safety Representative (SHSR) or the OR&R Health and Safety Officer (HSO). Any modification will be presented to the onsite team during a safety briefing prior to field work commencing and will be entered in Form 1 (Attachment 1), which will be placed or posted in a designated area in the field vehicle or on the vessel.

Failure to comply with the requirements of the HASP is grounds for immediate dismissal from the project and future projects.

This HASP has been prepared in accordance with federal safety regulations [U.S. Occupational Safety and Health Administration (OSHA), 29 CFR 1910 and 29 CFR 1926 (OSHA 1994)].

## 2. KEY PERSONNEL

Project personnel have been identified to fill specific roles to include authority, responsibility, and communication pertaining to project health and safety functions (Table 1). The overall organization of project staff and responsibilities are included in the Portland Harbor Resident Fish Sampling and Analysis Quality Assurance Project Plan and Field Sampling Plan.

**Table 1. Names and contact information for project personnel with health and safety roles**

| Name | Title | Phone # | Email | Responsibilities |
|---|---|---|---|---|
| **Savannah Turner** | OR&R Health and Safety Officer (HSO) | 251.544.5021 | Savannah.Turner@noaa.gov | Provide pre-project safety related guidance |
| **Cathy Laetz** | Project Manager (PM) | 206.321.8760 | Cathy.Laetz@noaa.gov | Study planning and design, field coordinator, sample coordinator |
| **Sean Sol** | Field Task Leader (FTL) | 206.909.8198 | sean.sol@noaa.gov | Supervisor of field logistics with responsibility for directing and overseeing all on-water operations |
| **Rob Neely** | Site Health and Safety Representative | 206.617.5443 | robert.neely@noaa.gov | On site point of contact for safety related issues |

## 2.1 Roles and Responsibilties

All personnel and visitors involved with sampling operations must comply with requirements of this HASP. Specific responsibilities and authority of management, safety and health, and other personnel are detailed in the Portland Harbor Resident Fish Sampling and Analysis: Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP).

Site workers are responsible for complying with this HASP, using the proper personal protective equipment (PPE), reporting unsafe acts and conditions, and following the work, safety, and health instructions of the FTL, SHSR, and PM.

**COVID19 Project and Site Worker Personal Responsibility:**

- Personnel must conduct a self-assessment of their health status and COVID19 symptoms as well as consider any potential exposure or close contact before arriving to the field site location (see Attachment 2: Self-Assessment Worksheet).
- Throughout the course of all field activities, all personnel must continue to self-evaluate and communicate any changes in health and degree of comfort with mitigation plans.
- Follow all guidelines and requirements listed in section 3.4 of this plan.

NOAA cannot guarantee the health or safety of any person entering the site or involved in the assessment activities. Because of the potentially hazardous nature of this site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards that may

be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at the site. The health and safety guidelines in this plan were prepared specifically for this site and should not be used on any other site without prior evaluation by trained health and safety personnel.

A copy of this HASP will be maintained in the field vehicles, and in a designated area on the sampling vessels at all times. All individuals performing fieldwork must read, understand, and comply with this plan. Visitors on sampling vessels must also read and comply with the plan. If any part of this HASP is unclear, then the individual should seek clarification from Site Health and Safety Representative, Project Manager, or Field Task Leader prior to commencing fieldwork. Once the information has been read and understood, the individual must sign the Acknowledgment Form provided above, which will then be placed in the project file.

Similarly, all involved subcontractors to NOAA must prepare their own HASPs that are at least as protective as this plan or they may adopt this plan as their own. If a subcontractor to NOAA elects to prepare its own HASP, copies of the plan and a signed acknowledgment similar to NOAA's Acknowledgment Form (see above) must be given to the OR&R Health and Safety Officer (HSO) prior to the subcontractor's involvement in any field activities.

## 3. SAMPLING OPERATIONS

Sampling will be conducted during the summer of 2021 to capture sufficient juvenile resident fish to yield viable samples for chemical analysis and growth/effect evaluations. Information on the sampling plan and procedures as well as a detailed site map can be found in the Portland Harbor Resident Fish Sampling and Analysis: Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP).

Field work will be conducted during daylight hours. The Field Task Leader will evaluate any environmental health and/or safety concerns or issues, such as weather forecasts, COVID-19 local or state requirements and/or relevant updates, site access, condition of first aid kits, PPE, drinking water, and collection supplies, and make a determination about whether to proceed with the planned field work for that day. The Field Task Leader will communicate with the Project Manager the morning of the proposed field work and provide a general schedule of that day's field activities. This will include at which sampling locations the field team will be working, the field team personnel and contact information, and whether any issues are anticipated. The Field Task Leader will conduct a safety briefing each morning, including the location of the nearest hospital, COVID-19 guidelines, and any specific issues related to the planned sampling. Attachment 3 includes some of the important information to be communicated at safety briefings.

### 3.1 Fish Capture and Transport

Fish capture will be conducted using a baby beach seine at designated sampling sites accessed via boat. Seine nets will be deployed from the R/V Stickleback, and hauled to shore by a two-person crew. The baby beach seine measures 7.5 m long with a max depth of 1 m and a mesh size of 3 mm. Personnel performing fish capture using either method will be experienced in these activities.

During sampling operations, the target fish species will be immediately frozen in the field on dry ice, maintained in a frozen state during the sampling event, and transferred to a -80 $^{o}$C freezer at the NOAA Northwest Fisheries Science Center at the end of the sampling period.

## 3.2 Boat Safety

A minimum of three people are required for performing this mission safely relative to the physical requirements, fatigue, and monitoring requirements in an active industrial waterway. The vessel operator (field task leader) will be qualified according to the NOAA Small Boat Program. NOAA vessels and their operations are subject to the NOAA Small Boat Standards and Procedures Manual administered by the NOAA Small Boat Program, part of NOAA's Office of Marine and Aviation Operations (OMAO 2017). The vessel will comply with all U.S. Coast Guard regulations. Safety equipment aboard the vessel includes the following:

- A minimum of one U.S. Coast Guard approved PFD on board for each person;
- A throwable flotation device (e.g., a life ring attached to approximately 90 feet of rope);
- Fire extinguishers;
- Emergency position indicating radio beacon.

The following safety rules will apply during all field operations conducted on the vessel:

- Sampling will not occur between dusk and dawn.
- Consuming food and drink will be limited to periods when sampling is not occurring. Any clothing items that come into contact with food or drink will be cleaned prior to the recommencement of sampling.
- Emergency procedures for fire, person overboard, and capsizing will be reviewed on the first day of operations and any time a change of personnel occurs.
- Additional safety precautions due to COIVD-19 outlined in section 3.4 will be followed.

All personnel must:

- Complete a 24-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course (or 8-hour refresher, depending on training status) prior to the start of operations.
- Review the HASP and sign acknowledgement prior to the start of operations.
- Wear PFD and closed-toed shoes at all times.
- Not bring or consume drugs and/or alcohol on board the vessel.

Boats will be supplied with disinfecting cleaning supplies and hand washing or hand disinfecting supplies. Hand hygiene is a barrier to fomite transmission and has been associated with lower risk of infection.

- First Aid / CPR response inventory must be reviewed to ensure an adequate supply of PPE and biohazard supplies, including hand sanitizer, face masks, and gloves.

## 3.3 Personal Protective Equipment (PPE)

Site safety and health hazards will be eliminated or reduced to the greatest extent possible through engineering controls and work practices. Where hazards are still present, a combination of engineering controls, work practices, and PPE will be used to protect employees.

An initial level of PPE (i.e., Level D) will be assigned to each task to provide an adequate barrier to hazardous exposures and other risks. Initial PPE ensembles are selected based on the anticipated route(s) of entry of chemicals onsite and their suspected concentration, as well as risk from physical hazards. When necessary, multiple layers of protection will be used to accommodate the range of hazards that may be encountered. Final PPE ensembles will be determined by the SHSR after assessment of field conditions. PPE should not be shared between participants. When appropriate, each person shall also be assigned individual PFD's, foul weather gear, and gloves to eliminate common or shared use PPE.

PPE Level D for this project includes:

- PFD (Type I or II, properly fit and in good condition). If a type V inflatable is worn, ensure the service indicator status is green (green means your PFD is armed and ready to inflate).
- Sturdy, closed toe shoes that are non-slip.
- Sun protection (e.g., hat, sunscreen if necessary).
- Insect repellent (if necessary).
- Nitrile gloves when presented with a risk of encountering contaminants or handling fish or chemicals.
- Long pants that cover the ankle.
- Foul weather gear (if necessary)

All disposable sampling equipment, clothing, and PPE must be carefully placed into a sealable plastic bag (e.g., trash bag) for disposal.

Reusable clothing exposed to contamination may be washed with detergent at the end of each day or appropriately disposed of.

All sampling equipment and exposed reusable PPE (e.g., boots, rubber gloves) must be decontaminated as soon as possible. Proper decontamination procedures for reusable PPE and sampling equipment include this sequence of events (with the exception of PFDs):

- Rinse the affected equipment/PPE with a mixture of phosphate-free detergent and distilled/tap water.
- Scrub the affected equipment/PPE with a dedicated decontamination brush.
- Rinse the brushed equipment/PPE with tap water.

For repeated daily use of personal PFDs, the following precautionary COVID guidance is suggested:

- Buckles, zippers, other hardware and hook/loop fasteners (e.g. Velcro®) are hard to clean due to crevasses and metal/plastic construction. Using a 60 – 90% solution of alcohol, spray these components and allow these components to dry before using the PFD again.
- Avoid spraying PFDs with specific disinfectants that are detrimental to the fabric. e.g. bleach-based products.

Once the project is complete, to clean your PFD, hand wash or sponge down in warm, soapy water. If you are cleaning an inflatable PFD, take care not to submerge the inflator. Rinse your PFD with clean water and hang to dry on a plastic coat hanger (see below for details). Do not dry-clean, use chlorine bleach, or apply direct heat. Always store your fully dried PFD in a dry, well ventilated place out of direct sunlight. **DO NOT MACHINE LAUNDER LIFE JACKETS.**

- Life jackets should be hand-washed with gloved hands – in hot water (< 60°C/140°F) to kill the virus. Fabrics are only certifiable up to 60°C.
- Ensuring complete drying is critical, heated air drying is encouraged < 60°C
- Viruses like moisture and can survive in cold – viruses die by drying out and by heat, which some fibers can enhance.
- If hanging to air dry, allow 72 hours (3 days) before reuse.

**DISCLAIMER**: The envelope for SARS-CoV-2, as with other enveloped respiratory viruses, is labile and can degrade quickly upon contact with surfactants contained in cleaning agents and under environmental conditions such as heat and evaporation.

All personnel will thoroughly wash hands with tap water and soap or detergent immediately after handling PPE and prior to consuming food. It is the responsibility of each individual to also thoroughly shower upon their arrival at their point of lodging.
While it is a best practice to launder clothing worn during sampling activities daily; if laundry services are unavailable or this is not feasible, the following recommendations or requirements apply:

- Rotate clothing items between days to allow at least one day of hanging/airing.
- Take care to minimize shaking out already worn clothing, or "hugging" pieces of worn clothing against the body.
- If any articles are damp from use, hang them up in a closet that can close and separate from clean clothes.
- Remove mask/cloth facial covering last. Take care to not dislodge mask when pulling clothing overhead.
- Always wash hands thoroughly with soap and water after undressing and handling clothing and before removing mask or cloth facial covering. Wash hands with soap and water again after removing mask. Masks should be replaced daily or cloth facial coverings shall be laundered before repeated use.
- If clothes are worn while rendering emergency care (First aid, CPR) to another individual, they should be laundered before wearing again.

These recommendations assume that all work is being completed outside, with all individuals masked and maintaining appropriate physical distance, wherever feasible/safe to do so while conducting onwater operations.

Prior to the start of work, all team members that work with or are potentially exposed to hazardous chemicals must attend a daily safety discussion prior to the commencement of planned activities to ensure that all personnel understand site conditions and operating procedures, to ensure that PPE is being used correctly, and to address any worker health and safety concerns.

## 3.4 COVID-19 Prevention Precautions

The SARS-CoV2 virus, which causes COVID-19, is thought to spread mainly from person-to-person, between people who are in close contact with one another (within about 6 feet) through respiratory droplets produced when an infected person coughs, sneezes or talks. These droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs. Additionally, spread can occur through contact with commonly touched surfaces, although available epidemiological data indicates that risk of transmission from fomites is low compared with risks from direct contact, droplet transmission or airborne transmission. Hand hygiene is a barrier to fomite transmission and has been associated with lower risk of infection. COVID19 can be spread by those who do no display

any symptoms, and who are asymptomatic or pre-symptomatic. Therefore it is imperative that all field staff assume that the risk of COVID19 is present and diligently adhere to all available mitigation measures.

To minimize exposure to the novel coronavirus (COVID-19), additional safety measures will be implemented. Staff must:

- Drive to the boat launch site in separate vehicles to maintain social distancing protocols (single occupant).
- Wear a cloth, surgical style mask or face covering. Following CDC guidelines, face masks should 1) have two or more layers of washable, breathable fabric, 2) completely cover your nose and mouth, and 3) fit snugly against the sides of your face without gaps. Masks that have exhalation valves or vents should not be used as they allow viral particles to escape. A gaiter/buff should not be substituted for a facial covering unless the gaiter consists of two or more layers of washable, breathable fabric. In accordance with DOC and NOAA Policy, all personnel must wear face coverings aboard NOAA Small Boats, when in cabin spaces with multiple occupants or on deck anytime six foot distancing cannot be maintained. Masks may be relaxed for eating and drinking, but must be placed somewhere safe to keep the mask clean, such as a paper bag. Make sure to wash or sanitize your hands after removing your mask. After eating, put the mask back on with the same side facing out. Be sure to wash or sanitize your hands again after putting your mask back on.
- Minimize use of shared equipment and PPE unless cleaned and disinfected properly.
- Mask use does not negate the need to maintain at least 6 ft or > distance from others. Maintain physical distancing of at least 6 feet, whenever possible. Be mindful of standing downwind of others for prolonged periods of time (> than 15 minutes, and move away appropriately).
- Follow the CDC guidance for frequent hand washing (with soap and water for at least 20 seconds). Use hand sanitizer (>60% alcohol) when soap and water are not available.
- Practice the CDC guidance for cough and sneeze etiquette. Refrain from touching face (specifically: eyes, mouth, and nose) with unwashed hands.

Staff should also:

- Review the list of co-morbidity factors listed by the CDC and speak with their medical provider for specific medical advice if they fall into any of the high-risk categories before making their personal decision about whether they should participate in the mission or not.

Travel to the Portland Area: Staff traveling to the Portland area to participate in field work must also adhere to all COVID mitigation requirements established by their line office or contracting organization. At a minimum, these will include wearing face coverings or masks when in proximity of others, frequent hand washing or sanitizing, and maintaining physical distancing of at least 6 feet wherever possible. In addition, when staying in hotels, clean high-touch areas frequently and minimize interactions with hotel staff and other guests.

Cloth facial coverings or masks worn should be stored and laundered according to the following guidelines:

- If your mask is wet or dirty from sweat, saliva, make-up, or other liquids or substances, keep it in a sealed plastic bag until you can wash it. Wash wet or dirty masks as soon as possible to prevent them from becoming moldy. Wet masks can be hard to breathe through and are less effective than dry masks.

- Replace your cloth face covering or mask when dirty, or at least daily. If you have a disposable face mask, throw it away after wearing it once.
- Remove your mask correctly and wash your hands after touching a used mask. Keep it in a dry, breathable bag (like a paper or mesh fabric bag) to keep it clean between uses. When reusing your mask, keep the same side facing out.
    - Using a Washing Machine
        - Include your mask with your regular laundry.
        - Use regular laundry detergent and the appropriate settings for the fabric.
    - By Hand
        - Wash your mask with tap water and laundry detergent or soap.
        - Rinse thoroughly with clean water to remove detergent or soap.
    - Drying your mask
        - Dry your mask completely in a warm or hot dryer or,
        - Hang your mask in direct sunlight to dry completely. If you cannot hang it in direct sunlight, hang or lay it flat and let it dry completely.

## 3.5 Job Hazard Analysis

This section describes the health and safety hazards associated with NOAA's efforts to collect and sample fish on the Lower Willamette River, and control measures selected to protect workers. The purpose of the job hazard analysis is to identify and quantify health and safety hazards associated with each site location, task, and operation; and to evaluate the risk to workers. Using this information, appropriate control methods have been selected to eliminate the identified risks if possible, or to effectively control them. Potential hazards and corresponding control methods are provided in this section.

The Lower Willamette River flows through Portland, OR and empties into the Columbia River. This is a significant river in the area with flowing current but is generally considered to be protected waters. This section of the waterway is highly developed with significant industrial activity and a variety of vessel traffic. Sample points are located throughout this area of the river and will be accessed by boat. Personnel involved in seine deployment operations at sample points will be operating on or adjacent to the river and will not utilize any upland areas. During on-the-water operations all applicable maritime laws and safety regulations will be followed.

The sampling vessel will be stored in commercial or NOAA parking lots when not in use. Daily travel to and from this location will require operating motor vehicles on private and public roadways.

**Drowning**

Fish capture activities will be conducted while on or very near the water, include flowing river water with significant current present. As such, the potential for drowning will always be present. The risk of drowning is greatest while vessel is in motion or when deploying or retrieving samples. In the event that a crewmember goes overboard, the following procedures should be followed:

- Shout 'man overboard' (MOB) to alert the crew and captain.
- Press the MOB button on the GPS or mark a waypoint.
- Throw a life buoy to the MOB.
- Allocate a crewmember to point at the MOB in the water, don't lose sight of the MOB.

- If assistance is required, send a distress alert and a Mayday.
- Prepare a throwing line.
- The skipper will bring the boat alongside the MOB, with the boat pointing into the wind and the propeller stopped.
- Get a line around the MOB and get them aboard.

*Mitigating Action:* Personnel will wear USCG-approved Type II PFD at all times while aboard the vessel and whenever working adjacent to the water. PFD will fit properly and be in good condition (e.g. no rips or holes, straps and hardware in working order) prior to being on the water. PFDs must be worn when working on docks, ramps, or other water adjacent structures. PFDs will be worn outside of clothing or any other PPE. PFDs will be worn with all straps, zippers, and ties fastened. Loose strap ends should be tucked in to avoid getting snagged while working.

**Vessel Traffic during Sampling**

Collisions between boats are one of the most dangerous and frequent boating accidents. Sampling will likely be conducted in areas used by other vessels. The Lower Willamette River is a navigable river with significant vessel traffic as well as river current. As such, there is risk of collision or accident with either the sampling vessel and/or deployed sampling gear.

*Mitigating Action:* Only knowledgeable and qualified vessel operators will operate the sampling vessel per NOAA Small Boat Policy. Vessel operators will abide by USCG boating right-of-way rules. All personnel onboard should maintain lookout using both sight and hearing, and communicate any hazard to the vessel operator. The vessel will travel at speeds where proper and effective actions can be taken to avoid collisions, given the prevailing circumstances and conditions.

The boat will remain visible at all times while on the water, using running lights at low-light conditions. When deployed, sampling gear should be visible to other vessels. This may require the use of buoys or brightly colored or reflective flagging or markings.

If sampling in active shipping channels or in areas with heavy vessel traffic, gear deployment and retrieval should be conducted in an expedient and deliberate manner. If applicable, port authorities should be notified of proposed sampling times and locations before sampling activities begin. If other vessels are in the area, the sampling vessel will maintain communication with other vessel captains. In accordance with NOAA Small boat Policy a working VHF radio will be available on board for ship to ship and emergency communication if necessary.

**Contact with Biologically-Contaminated Water**

Waterborne, disease-causing organisms (pathogens) are found in nearly all surface water systems. Pathogens enter surface water through untreated sewage discharges and bypasses, stormwater runoff, and direct contact. Pathogens may enter the body when contaminated media are ingested or exposed to open cuts or abrasions.

*Mitigating Action*: Use caution and extra protection when working in or around water with known or suspected contamination. Communicate known or suspected contamination to all personnel who could come into contact with a contaminated sample. Pathogens can enter the body from open wounds and

be transferred from the environment to the mouth by eating, drinking, or smoking after potential exposure. To reduce the risk of infection, use antibacterial soap or hand cleaner throughout the day.

Immune-challenged personnel should notify the HSO or SHSR prior to sampling so that additional health and safety requirements such as additional PPE can be provided. They should also consider COVID-19 prevention precautions provided above.

**Contact with Chemically Contaminated Environmental Media during Project Activities**

The sampling area is in a designated Superfund Site(s) with known higher concentrations of PCB and PAH, and other environmental pollutants, than measured at ambient site conditions.

*Mitigating Action:* All personnel involved in this field effort have completed, at minimum, 24 hour HAZWOPER training and are up to date on any required 8-hour annual refresher training. PPE use at this site is mandatory and strictly enforced to include nitrile gloves and waterproof boots and/or waders. Particular caution will be exercised to minimize disturbance of wet or dry sediments while sampling at this or other sites where contamination is known or suspected to exist.

PPE used at this site will be cleaned of any evident soiling before continuing to other sampling sites. As is practicable, fishing gear will be rinsed using river water between sites or whenever gear appears soiled or to have retained any residue or debris. Personnel will dispose of or decontaminate/wash clothing and PPE with known or suspected exposure to contaminants at the end of each day. Soap and water will be available for hand washing. Personnel will also avoid eating, drinking, or smoking at a sampling site. If personnel have been exposed to site contaminants while sampling, proper sanitary precautions (i.e., hand washing) must occur prior to eating, drinking, or smoking. If an adverse exposure reaction occurs, the affected individual will immediately notify the SHSR, avoid any additional contact with contaminated media, and seek appropriate medical attention.

Personnel will communicate known or suspected contamination to all assessment team members who could come into contact with contamination or be exposed to chemical hazards.

**Cold Stress**

While cold weather conditions are not anticipated, the risk of cold stress may be a factor if personnel are wet from rain or field sampling activities and exposed to wind.

*Mitigating action*: Protect exposed skin surfaces with appropriate clothing (such as face masks, gloves, and footwear) that insulates, stays dry, and blocks wind. Use adequate insulating clothing to maintain a body core temperature above 96.8°F. Have extra insulating clothing onsite. If wind is an issue, shield the work area with windbreaks to reduce the cooling effects of wind.

All field staff should be aware of hypothermia warning signs. These signs include uncontrolled shivering, stiffness of joints, loss of coordination, slurred speech, shallow breathing, and unconsciousness. If any of these warning signs are observed, move the affected person(s) to a warm, dry location as soon as possible. If symptoms remain or progress, seek medical attention.

**Automobile Traffic in Parking Lots and Near Roadways**

Some activities may require operation of automobiles in public and private parking lots and roadways. With these activities there is the risk of being involved in an automobile accident while moving or parked.

*Mitigating action*: All personnel operating or riding in vehicles will wear their seatbelt at all times. Drivers will obey all posted traffic signs, speed limits, and local rules of vehicle operation and avoid traveling on unfamiliar roadways, especially at night. Use of alcohol, prescription/illegal drugs, or a cellular telephone (including both texting and talking, hand-held or hands-free) while operating employer-owned, leased, or rented vehicles or equipment is a direct violation of NOAA policy and is not permitted. Drivers will not operate a motor vehicle if drowsy or sleepy. Always park vehicles in designated parking areas. Off roadway parking with good fore and aft visibility should be considered. If temporarily parked in a loading zone or off a roadway, turn on the vehicle's flashers. Cross roadways in designated crossings or in locations where you are clearly visible to oncoming traffic. Do not assume that as a pedestrian you have the right-of-way.

**Exposure to Chemical Products Used for Sampling Purposes**

Potentially hazardous chemicals may be used for sample processing. Chemical products used for sample preservation include dry ice.

*Mitigating Action*: Only personnel trained and familiar with the use of chemical products will use these products. See Attachment 4 for handling considerations. Appropriate PPE should be worn at all times when working with hazardous or unknown chemical products (including appropriate gloves).

Safety datasheets (SDS) will be available to personnel for each chemical product used during the sampling. The SDS sheets for dry ice can be found in Attachment 4.

Unused or spent chemicals will be appropriately labeled and stored so that the risk of accidental exposure is limited. When used, respective samples should also be labeled so that the contents are readily identified. Both unused and spent chemicals should be stored so that if sample containers break, there is secondary containment of the chemical. Absorbent material such as paper towels should also be used to contain any potential leakage.

Proper decontamination materials should be available to address accidental exposure and spills. Tap or raw water and soap will be available for hand washing. Personnel will take proper sanitary precautions before eating at the site or after leaving the site to avoid unnecessary exposure to site chemicals. If an adverse exposure reaction occurs, the affected individual will immediately notify the SHSR, avoid any additional contact with contaminated media, and seek appropriate medical attention.

**Slip, Trip, and Fall Hazards**

These hazards may be present in all areas at all times; however, there is a particular risk of falling when entering or departing the boat or working on the deck of the boat while out on the water.

*Mitigating Action*: Keep all walkways clear of obstructions. Survey the area for any of these hazards upon entering an area. Clean up liquid spills immediately. Avoid clutter in work areas. Ensure that

footwear is close-toed, sturdy, and slip-resistant and that clothing is properly fitted and in good condition. When on the boat, maintain three points of contact and use handrails if available.

**Cuts, Abrasions, and Pinch Points**

Risk of cuts, abrasions, and pinch points could be present during collection and processing of samples, decontamination of equipment, and other general activities on or around the boat. Sampling equipment may have sharp edges and are a significant hazard.

*Mitigating Action:* Take care when working with sharp equipment to avoid possible puncture and abrasion wounds. Maintain control of doors/hatches; and keep fingers and feet clear of lines/ropes, rigging/blocks, and docks/piers. Wear appropriate PPE. Puncture and abrasion wounds can be painful and are a risk for infection. Keep steady pressure on bleeding wounds until the bleeding stops. Seek emergency medical treatment in the event of a serious wound that requires care beyond basic first aid treatment (see Section 4.1, Evacuation Procedures, for transport procedures in event of medical emergency). A First Aid Kit will be available on board vessel and ashore. Clean minor wounds with soap and clean water, dress with antibacterial ointment, and monitor for infection. Use appropriate hard-sided containers designated for disposal of any sharps or broken glass.

**Exposure to Human Blood and Bodily Fluids (Biological Hazard)**

If an injury results in loss of blood or when needle-stick or sharps-related injuries occur, workers may be exposed to blood borne pathogens. Blood borne pathogens are pathogenic microorganisms that are present in human blood and can cause disease in humans. Pathogens include, but are not limited to, human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV).

*Mitigating Action*: Avoid direct contact with blood or any other bodily fluids. Treat all blood and body fluid spills as if they were infectious. After removing PPE, wash hands or other affected body parts with soap and warm water. Vigorously scrub all areas to remove all potentially infectious contamination. If affected, eyes should be irrigated with clean water and/or saline. If you have an open wound that is exposed, squeeze gently to make it bleed, then wash with soap and warm water. After any exposure to bodily fluids (other than your own), seek emergency medical treatment. Use appropriate hard-sided containers designated for disposal of any sharps or broken glass. Dispose of materials contaminated with blood or bodily fluids in a sealed container.

**Exposure to COVID Virus (Biological Hazard)**

A potential exposure is defined, by the CDC, as having close contact with someone who was within 6 feet of an infected person for a cumulative total of 15 minutes or more over a 24-hour period starting from 2 days before illness onset (or, for asymptomatic patients, 2 days prior to test specimen collection) until the time the patient is isolated. This is considered exposure regardless of whether one or both parties were wearing a mask. Individuals with potential exposure to COVID-19 should follow current CDC guidelines for quarantine and cannot participate in office or field operations related to the Portland Harbor project until the appropriate quarantine period has been completed. Personnel shall also comply with any additional guidance and/or requirements from their local health departments and respective organizations. Proposed field work will require staff to work together in the limited confines of a small boat. The greatest operational challenge is maximizing distancing of personnel, given the space limitations on small boats, confined cabins, and small open-air decks.

*Mitigating Action:* Sampling personnel will participate in a daily safety brief where they will assess the relative personal exposure risks presented by vessel size / configuration, crew size / proximity and mission duration and review appropriate mitigation measures. All mission tasks should be evaluated in the context of maximum separation of personnel. Staff should follow COVID prevention precautions described in section 3.4 and consult the CDC for additional recommendations: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html. If you are feeling sick, notify the project lead by phone and do not report for work. Wear approved face masks, practice social distancing, do not share personal items, wash or sanitize hands frequently, especially before eating or touching face, nose, eyes or mouth and consider personal health risk factors when deciding whether to participate in field work. For example, older adults and people who have underlying conditions like heart or lung disease or diabetes are at increased risk of severe illness from the COVID-19 virus.

**Lifting Heavy Objects**

Proposed field work will require lifting and moving heavy objects such as coolers, nets, and other sampling or laboratory equipment.

*Mitigating Action:* Solicit help when lifting items exceeding 50 pounds. Use proper lifting techniques (https://www.cdc.gov/niosh/docs/2007-131/pdfs/2007-131.pdf). Bend your knees and avoid twisting your body while lifting any object. Use a furniture dolly or hand truck when moving heavy boxes and equipment. Pay particular care if lifting wet or saturated items that may have increased in weight due to water retention.

**Inclement Weather**

During all seasons, weather conditions in the Pacific Northwest can vary greatly. Rain can be frequent and at times heavy. Both wind and rain can arise with little warning. Non-local weather including heavy rainfall or warmer temperatures can have significant impact on river discharge and conditions encountered in the field. Overall weather and river conditions can change quickly throughout the day. In the spring and fall, fog can generate in the evening and become dense along portions of the river. This fog will usually dissipate with a light breeze or as daytime temperatures rise. Small vessels (under 20 meters in length) take on an increased risk of collision in restricted visibility due to difficulty in detecting these vessels with radar.

*Mitigating Action:* The vessel operator (field task leader) and the SHSR will monitor current weather and river discharge as well as forecasts prior to beginning each day's activities and will continue to monitor weather conditions during all field work. Field activities will be halted and appropriate shelter will be sought if weather conditions present a threat to personnel.

**Indigenous Wildlife**

While most field sampling activities will occur on a boat and in an urbanized area, there is still risk of exposure to potentially dangerous or bothersome terrestrial and aquatic wildlife and insects.

*Mitigating action:* All personnel will remain aware of their surroundings and monitor for the presence of wildlife. Contact with wildlife will be avoided if encountered. Gloves will be worn whenever handling

fish. When handling or processing catch, specific care should be taken with those fish species known to have spines or potentially sharp teeth. Personnel being stung or bitten will immediately seek appropriate medical attention, if necessary.

## 4. EMERGENCY PROCEDURES

Prior to departing for on-water operations, the crew will ensure that at least one working cell phone with battery life sufficient to cover duration of planned activities is on board. In the event it is determined that an individual is in need of medical attention call **911**. In the event of serious health issues or mechanical problems, contact the Coast Guard for assistance in addition to **911**. To do so, VHF-FM Channel 16 can be used as a radio channel for hailing or distress calls. To make such a call,

1. Make sure the radio is ON
2. Select VHF **Channel 16**
3. Press and hold the transmit button
4. Clearly say: **MAYDAY, MAYDAY, MAYDAY**
5. Provide vessel name (update) and/or other identifying information
6. Provide your position and/or location
7. Provide nature of emergency (e.g., injury, flooding, sinking, mechanical failure)
8. Provide number of persons impacted
9. Release transmit button
10. Wait 10 seconds; if no response repeat steps 3 through 10.

In case of a weather emergency, stop all ongoing field sampling operations. The Field Task Leader will monitor weather developments throughout the day to enable early decisions about whether to stop field sampling, motor to the nearest boat ramp, and seek shelter on land.

COVID Emergency Procedures:

Review the Red Cross's First Aid/CPR/AED Care during COVID-19 Guidance:
https://www.redcross.org/take-a-class/coronavirus-information/first-aid-cpr-aed-care-during-covid-19

- Non-life-threatening injury:
    - Person requiring care should make every effort to provide self-treatment.
    - If aid is needed, both the injured person and the person rendering aid should don PPE to include: gloves, face shield, and face mask, if available.
    - Personnel not involved in the medical treatment should maintain the appropriate 6 feet of physical distancing.

- Life threatening injury:
    - Every effort should be made to minimize the number of personnel treating the injured person.
    - Emergency Medical Services (EMS) should be notified immediately.
    - The person(s) rendering aid should don all appropriate PPE to include: gloves, face shield, and face mask, if available.
    - A bag valve mask (BVM) should be used as the primary breathing method, if available
    - Mouth-to-mouth CPR should be avoided.

## 4.1 Medical Evacuation Procedures

The nearest emergency room to the Swan Island and Cathedral Park boat ramps is Legacy Emanuel Medical Center.

Emergency room name/address: **Legacy Emanuel Medical Center**
2801 North Gantenbein Avenue
Portland, OR 97227

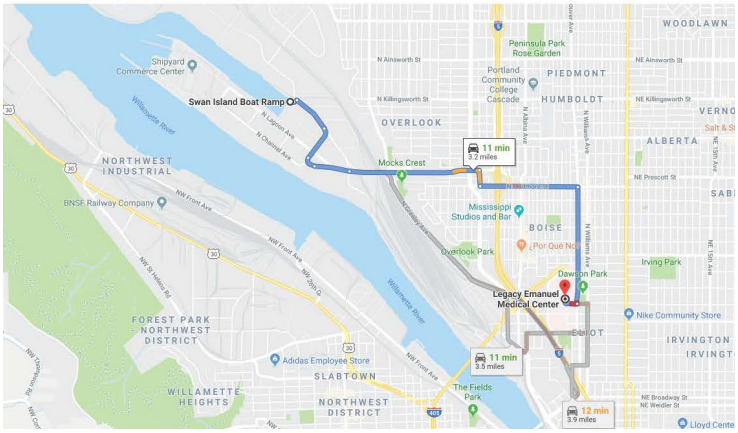
Emergency room telephone number: (503) 413-2200

Ambulance/police/fire emergency: **911**

(Directions from the Swan Island Boat Ramp (on N Basin Ave) to hospital are included below and a map to the hospital is also provided in Figure 1. In an emergency, call 911 for assistance.)

- Driving Directions to Legacy Emanuel Medical Center from the Swan Island Boat Ramp:
    - Take N Basin Ave to N Channel Ave (0.6 miles)
    - Take N Going St, N Skidmore St and N Vancouver Ave to N Stanton St (2.5 miles)
    - Turn right onto N Stanton St (456 feet)
    - Legacy Emanuel Medical Center will be on your right

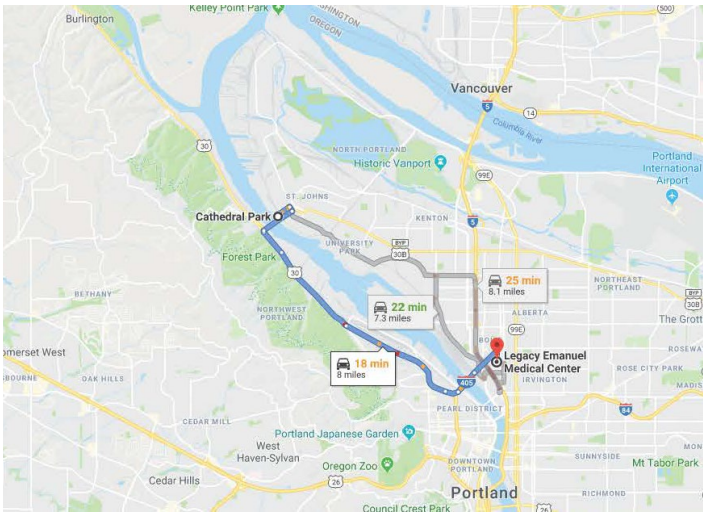
**Figure 1. Map of driving directions to nearest hospital from Swan Island Boat Ramp**




(Directions from Cathedral Park Boat Ramp (on N Bradford St) to the hospital are included below and map to the hospital is also provided in Figure 2. In an emergency, call 911 for assistance.)

- Head northeast toward N Baltimore Ave (270 ft)
- Turn right toward N Baltimore Ave (75 ft)
- Turn left onto N Baltimore Ave (0.3 mi)
- Turn right onto N Syracuse St (0.1 mi)
- Turn right onto N Philadelphia Ave (0.3 mi)
- Continue onto NW St Johns Bridge (0.4 mi)
- Slight left on NW Bridge Ave (0.6 mi)
- Turn right onto NW St Helens Rd (2 mi)
- Continue onto US-30 E/NW Yeon Ave
- Take the Interstate 405 N/US 30 N exit on the left toward Seattle (0.3 mi)
- Merge onto I-405 N/US-30E (0.5 mi)
- Take the Kerby Ave Exit (0.6 mi)
- Keep left at the fork to continue on N Gantenbein Ave (0.2 mi)
- Turn right at N Stanton St (100 ft)
- Legacy Emanuel Medical Center will be on your right

**Figure 2. Map of driving directions to nearest hospital from Cathedral Park Boat Ramp**



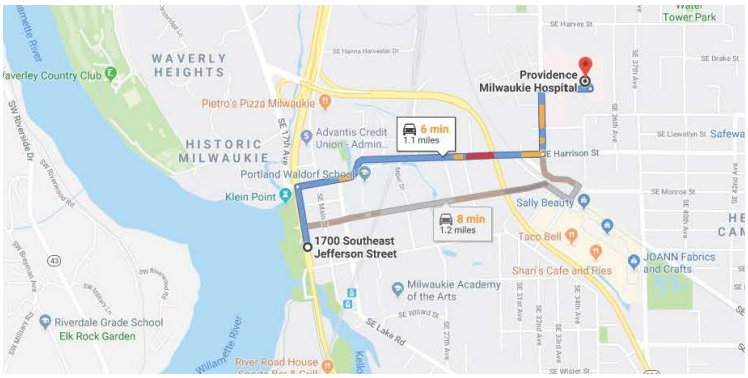

The nearest emergency room to the Milwaukee Bay Park Boat Ramp is Providence Milwaukee Hospital.

Emergency room name/address: **Providence Milwaukee Hospital**
10150 SE 32nd Ave
Milwaukie, OR 97222

Directions from the Milwaukie Bay Park Boat Ramp (on SE Jefferson St) to the hospital are included below and map to the hospital is also provided in Figure 3. In an emergency, call 911 for assistance.)

- Driving Directions to Providence Milwaukie Hospital from Milwaukie Bay Park Boat Ramp:
  - Head north on SE McLoughlin Blvd toward SE Monroe St (0.2 miles)
  - Turn right onto SE Harrison St (0.7 miles)
  - Turn left onto SE 32$^{nd}$ Ave (0.2 miles)
  - Turn right (0.1 mile)
  - Turn left
  - Providence Milwaukie Hospital will be on your right

**Figure 3. Map of driving directions to nearest hospital from Milwaukie Bay Park Boat Ramp**




In the event of an urgent medical emergency during on the water operations, transfer ashore may occur at a location other than the Swan Island boat ramp and an alternative evacuation route may be preferred to expedite arrival at medical facility.

Emergency room telephone number: (503) 413-2200

Ambulance/police/fire emergency: 911

## 5. REFERENCES


EPA. 1992. Standard Operating Safety Guides. United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

OSHA. United States Department of Labor, Occupational Safety and Health Administration. 29 CFR Parts 1910 and 1926. Hazardous Waste Operations and Emergency Response. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9765 (accessed on March 26, 2018)

OMAO. United States Department of Commerce, National Oceanic and Atmospheric Administration, Office of Marine and Aviation Operations, Small Boat Program. 2017. "The NOAA Small Boat Standards and Procedures Manual, 4th Edition."

OMAO. United States Department of Commerce, National Oceanic and Atmospheric Administration, Office of Marine and Aviation Operations, Small Boat Program. 2020. "Guidance and Best Management Practices – COVID-19 Risk Management for Small Boat Operations."

Centers for Disease Control and Prevention (CDC). Coronavirus 2019. https://www.cdc.gov/coronavirus/2019-ncov/index.html

Washington State Coronavirus Guidance: https://coronavirus.wa.gov/

Red Cross: First Aid/CPR/AED Care During COVID-19: https://www.redcross.org/take-a-class/coronavirus-information/first-aid-cpr-aed-care-during-covid-19

**ATTACHMENT 1: Modification to Plan**

**FORM 1**
**MODIFICATION TO HEALTH AND SAFETY PLAN**
**DATE ___ / ___ / _____**

**Project:**

**Modification:**

_____
_____
_____
_____
_____

**Reasons for Modification:**

_____
_____
_____
_____
_____

**Site Personnel Briefed**

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

**Approvals**

Field Task Leader: _____

Principle Investigator: _____

Site Health and Safety Representative: _____

Health and Safety Officer: _____

## ATTACHMENT 2: COVID 19 SELF CHECK QUESTIONNAIRE

**PRIOR TO PLANNED FIELD OPERATIONS, PLEASE CONDUCT A SELF-CHECK TO SCREEN FOR POSSIBLE COVID19 SYMPTOMS.**

**DO YOU CURRENTLY HAVE OR HAD THESE SYMPTOMS IN THE LAST 14 DAYS?**

- **COUGH---------- YES / NO**
- **SHORTNESS OF BREATH OR DIFFICULTY BREATHING---------- YES / NO**
- **FEVER---------- YES / NO**
- **CHILLS---------- YES / NO**
- **MUSCLE PAIN---------- YES / NO**
- **SORE THROAT---------- YES / NO**
- **NEW LOSS OF TASTE OR SMELL ---------- YES / NO**
- **HAVE YOU BEEN IN CONTACT WITH ANYONE BELIEVED TO BE --YES / NO INFECTED WITH COVID-19 (PRESUMPTIVE OR CONFIRMED)?**

**IF YES TO ANY OF THE ABOVE, EVEN IF MILD; <u>DO NOT</u> REPORT TO CONDUCT FIELD OPERATIONS, YOU SHOULD NOTIFY THE FIELD TASK LEADER, YOUR SUPERVISOR, SELF-QUARANTINE, CALL YOUR MEDICAL PROVIDER, AND SEEK COVID-19 TESTING.**

**FURTHER GUIDANCE CAN BE FOUND ON THE NOAA COVID-19 INFORMATION FOR EMPLOYEES / SUPERVISOR RESOURCES WEBPAGE AT:**
**HTTPS://SITES.GOOGLE.COM/A/NOAA.GOV/COVID/SUPERVISOR-RESOURCES**

## ATTACHMENT 3: SAFETY BRIEFING INFORMATION

It is essential that field staff conduct a self-assessment of their health status, to identify potential COVID-19 symptoms, possible exposure & degree of comfort w/mitigation plans prior to proceeding with the planned field work for that day (see Attachment 2: For Self-Assessment Worksheet). At the conclusion of the daily safety briefing, the Field Task Leader should confirm field staff acknowledgment of planned COVID19 mitigations. All personnel are empowered to excuse themselves from participation based upon their level of comfort and personal health concerns.

Safety Brief Process:

1. Determine outside area large enough to conduct the safety brief that allows for at least six feet of distance between staff. Maintain physical distance throughout the duration of the meeting.

2. Designate roles and responsibilities during the meeting to clarify the planned evolution. All mission tasks should be evaluated in the context of maximum separation of personnel. Where feasible, procedures should be modified, and engineering implemented so that tasks may be safely completed by a single person.

3. Elements of the established mission risk assessment (GAR) must be expanded to include implications of COVID 19 exposure mitigations

4. Include specific instructions on equipment handling, maintaining physical distancing, PPE, and sanitation protocols with COVID exposure mitigations.

5. Discuss emergency procedures (First Aid and CPR considerations given COVID19 exposure risk). See Section 4: Emergency Procedures within this Plan.

6. Identify the challenges presented by COVID exposure mitigations such as impact on communication, workload, and crew fatigue.

Resolve any raised individual concerns or noted field work plan deficiencies. Verbally confirm that all personnel understand site conditions, operating procedures, and correct use of PPE.

## ATTACHMENT 4: SAFETY DATA SHEET: Dry ice

### 1. PRODUCT AND COMPANY IDENTIFICATION

**1.1 Product identifiers**

| | | |
|---|---|---|
| Product name | : | Dry ice |
| Product Number | : | 93508 |
| CAS-No. | : | 124-38-9 |

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses: Laboratory chemicals, Synthesis of substances

### 2. HAZARDS IDENTIFICATION

**2.1 Classification of the substance or mixture**

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Simple Asphyxiant

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

| | |
|---|---|
| Pictogram | None |
| Signal word | Warning |
| Hazard statement(s) | May displace oxygen and cause rapid suffocation. |
| Precautionary statement(s) | None |

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS**

Contact with liquid or refrigerated gas can cause cold burns and frostbite.

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

**3.1 Substances**

| | | |
|---|---|---|
| Formula | : | $CO_2$ |
| Molecular weight | : | 44.01 g/mol |
| CAS-No. | : | 124-38-9 |

**Hazardous components**

| Component | Classification | Concentration |
|---|---|---|
| Carbon dioxide | | |
| | SA ; | <= 100% |

### 4. FIRST AID MEASURES

**4.1 Description of first aid measures**

**If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration.

**In case of skin contact**
Wash off with soap and plenty of water.

**In case of eye contact**
Flush eyes with water as a precaution.

**If swallowed**
Never give anything by mouth to an unconscious person. Rinse mouth with water.

**4.2 Most important symptoms and effects, both acute and delayed**
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**
No data available

**5. FIREFIGHTING MEASURES**

**5.1 Extinguishing media**

**Suitable extinguishing media**
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**
No data available

**5.3 Advice for firefighters**
Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**
No data available

**6. ACCIDENTAL RELEASE MEASURES**

**6.1 Personal precautions, protective equipment and emergency procedures**
Avoid dust formation. Avoid breathing vapors, mist or gas.
For personal protection see section 8.

**6.2 Environmental precautions**
No special environmental precautions required.

**6.3 Methods and materials for containment and cleaning up**
Sweep up and shovel. Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**
For disposal see section 13.

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Recommended storage temperature -70 °C

Storage class (TRGS 510): Non Combustible Solids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

**Components with workplace control parameters**

| Component | CAS-No. | Value | Control Parameters | Basis |
|---|---|---|---|---|
| Carbon dioxide | 124-38-9 | TWA | 5,000 ppm | USA. ACGIH Threshold Limit Values (TLV) |
| | Remarks | Asphyxia | | |
| | | TWA | 5,000.000000 ppm | USA. ACGIH Threshold Limit Values (TLV) |
| | | Asphyxia | | |
| | | STEL | 30,000 ppm | USA. ACGIH Threshold Limit Values (TLV) |
| | | Asphyxia | | |
| | | STEL | 30,000.000000 ppm | USA. ACGIH Threshold Limit Values (TLV) |
| | | Asphyxia | | |
| | | TWA | 5,000.000000 ppm<br>9,000.000000 mg/m3 | USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants |
| | | The value in mg/m3 is approximate. | | |
| | | TWA | 5,000.000000 ppm<br>9,000.000000 mg/m3 | USA. NIOSH Recommended Exposure Limits |
| | | Normal constituent of air (about 300 ppm) | | |

| Component | CAS-No. | Value | Control Parameters | Basis |
|---|---|---|---|---|
| | | ST | 30,000.000000 ppm 54,000.000000 mg/m3 | USA. NIOSH Recommended Exposure Limits |
| | | Normal constituent of air (about 300 ppm) | | |
| | | TWA | 5,000 ppm 9,000 mg/m3 | USA. NIOSH Recommended Exposure Limits |
| | | Normal constituent of air (about 300 ppm) | | |
| | | ST | 30,000 ppm 54,000 mg/m3 | USA. NIOSH Recommended Exposure Limits |
| | | Normal constituent of air (about 300 ppm) | | |
| | | TWA | 5,000 ppm 9,000 mg/m3 | USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants |
| | | The value in mg/m3 is approximate. | | |
| | | PEL | 5,000 ppm 9,000 mg/m3 | California permissible exposure limits for chemical contaminants (Title 8, Article 107) |
| | | STEL | 30,000 ppm 54,000 mg/m3 | California permissible exposure limits for chemical contaminants (Title 8, Article 107) |

**8.2 Exposure controls**

**Appropriate engineering controls**

General industrial hygiene practice.

**Personal protective equipment**

**Eye/face protection**

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

**Body Protection**

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific workplace, the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and

components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

No special environmental precautions required.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

| | | |
|---|---|---|
| a) | Appearance | Form: solid<br>Color: opaque white |
| b) | Odor | No data available |
| c) | Odor Threshold | No data available |
| d) | pH | 3.7 |
| e) | Melting point/freezing point | -78.49 °C (-109.28 °F) |
| f) | Initial boiling point and boiling range | No data available |
| g) | Flash point | Not applicable |
| h) | Evaporation rate | No data available |
| i) | Flammability (solid, gas) | No data available |
| j) | Upper/lower flammability or explosive limits | No data available |
| k) | Vapor pressure | 57,300 hPa (42,979 mmHg) |
| l) | Vapor density | No data available |
| m) | Relative density | 1.562 g/cm3 |
| n) | Water solubility | No data available |
| o) | Partition coefficient: n-octanol/water | No data available |
| p) | Auto-ignition temperature | No data available |
| q) | Decomposition temperature | No data available |
| r) | Viscosity | No data available |
| s) | Explosive properties | No data available |

t) Oxidizing properties No data available

**9.2 Other safety information**

No data available

**10. STABILITY AND REACTIVITY**

**10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available

**10.4 Conditions to avoid**

No data available

**10.5 Incompatible materials**

Strong oxidizing agents

**10.6 Hazardous decomposition products**

Hazardous decomposition products formed under fire conditions. - Carbon oxides
Other decomposition products - No data available
In the event of fire: see section 5

**11. TOXICOLOGICAL INFORMATION**

**11.1 Information on toxicological effects**

**Acute toxicity**

No data available

Inhalation: No data available
Dermal: No data available

**Skin corrosion/irritation**

Causes skin burns.

**Serious eye damage/eye irritation**

No data available

**Respiratory or skin sensitization**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**
No data available
No data available

**Specific target organ toxicity - single exposure**
No data available

**Specific target organ toxicity - repeated exposure**
No data available

**Aspiration hazard**
No data available

**Additional Information**
RTECS: FF6400000
Difficulty in breathing, Unconsciousness, death

## 12. ECOLOGICAL INFORMATION

**12.1 Toxicity**
No data available

**12.2 Persistence and degradability**
No data available

**12.3 Bioaccumulative potential**
No data available

**12.4 Mobility in soil**
No data available

**12.5 Results of PBT and vPvB assessment**
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

## 13. DISPOSAL CONSIDERATIONS

**13.1 Waste treatment methods**

**Product**

Offer surplus and non-recyclable solutions to a licensed disposal company.

**Contaminated packaging**

Dispose of as unused product.

## 14. TRANSPORT INFORMATION

**DOT (US)**

UN number: 1845 Class: NONE Packing group: III
Proper shipping name: A. W. Dry ice
Reportable Quantity (RQ):
Poison Inhalation Hazard: No

**IMDG**

UN number: 1845 Class: 9 Packing group: III EMS-No: F-C, S-V
Proper shipping name: DRY ICE

**IATA**

UN number: 1845 Class: 9
Proper shipping name: Dry ice

## 15. REGULATORY INFORMATION

**SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**Massachusetts Right To Know Components**

| | CAS-No. | Revision Date |
|---|---|---|
| Carbon dioxide | 124-38-9 | 1993-04-24 |

**Pennsylvania Right To Know Components**

| | CAS-No. | Revision Date |
|---|---|---|
| Carbon dioxide | 124-38-9 | 1993-04-24 |

**New Jersey Right To Know Components**

| | CAS-No. | Revision Date |
|---|---|---|
| Carbon dioxide | 124-38-9 | 1993-04-24 |

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

## 16. OTHER INFORMATION

**Full text of H-Statements referred to under sections 2 and 3.**

May displace oxygen and cause rapid suffocation.
SA Simple Asphyxiant

**HMIS Rating**

| | |
|---|---|
| Health hazard: | 0 |
| Chronic Health Hazard: | |
| Flammability: | 0 |
| Physical Hazard | 0 |

**NFPA Rating**

| | |
|---|---|
| Health hazard: | 0 |
| Fire Hazard: | 0 |
| Reactivity Hazard: | 0 |

# Appendix D. Data management

This document contains supplemental material for the data management aspect of the field study and lab processing of samples.

- Data intake and processing protocol outline to organize the return of the field sampling team for all cameras, GPS units, and field forms used during the field sampling
- The NOAA OR&R field data electronic folder structure and example file names of folders and files used to process and store field collected data and information

### *Data intake and processing*

Upon the return of the field sampling team, data intake and processing will occur for all cameras, GPS, and forms used during the field sampling. This involves scanning all field forms and notebooks and uploading to DIVER File Collections. Field crews and lab crews should remain available to the Data Management Team in order to answer any questions or address any issues that are discovered during processing.

During the course of fish processing, data intake will occur for the all lab notebooks and forms used during the study. This involves scanning all relevant lab notebooks, lab forms, and chain of custody forms and uploading to DIVER File Collections. Photos, chemical analyses, and other results will also be transferred into DIVER.

**Post-field data intake protocols**

☐ Preparation
  - Obtain all devices and forms from the field teams. A team member must be present during the data intake process to answer any questions that may come up.
  - If multiple camera and GPS units are used by a single team, make sure that they are paired correctly.

☐ Review the Photologger Form & Sign COC
  - Photo and GPS Metadata
    Ensure the photographer filled out all fields and provided key photos, descriptions, and keywords
  - Chain of Custody
    Ensure the photographer signs the COC when releasing the data to you. Once the steps below are completed and the data are in DIVER, sign the final paragraph on the Photologger Form.

☐ Download Photos to Computer in appropriate folders
  - See the appendix below for complete data intake folder structure
  - Download the photos directly to the Original_Image_Files folder. These will serve as the original copies taken from the camera and need to be preserved. They should not be

opened, edited, or deleted. Create a zip file that will be uploaded to DIVER as the archive.
    - Copy these original photos to the Photologger_Photos folder.
- ☐ Extract Tracks and Waypoints from GPS Unit
    - Connect GPS unit to computer (remember your cables)
    - Start Garmin MapSource
        1) Click on the "Receive from Device" icon.
        2) Click Find Device (the name of your GPS unit will appear)
        3) Under "What to Receive" > Click only Waypoints and Tracks
        4) Click "Receive" (you will now see the tracks/waypoints for that day)
    - Save .gdb and .gpx files and .txt, then zip all 3 files into one zip file.
- ☐ Scan Field Forms
    - Retain all field form originals. Make sure all information is filled out. The note taker's name and date should be on every page.
    - Scan all field forms for each team into separate PDFs.
- ☐ Samples and COC
    - Check SampleIDs on the Field Sample Form and confirm they are an exact match to the sample COC and Sample Labels. The original COC form remains with the samples.
- ☐ Upload Photos, GPS Files, and Photologger Form and other docs (field forms, notebooks, and COCs) to DIVER
    - In the DIVER Workspace, upload all field files to a new DIVER File Collection for the specific day.

***NOAA OR&R field data electronic folder structure and example file names of folders and files***

- Incident or Case Name
  - Spatial_Data *(working GIS data, projects)*
  - Documents *(general reports, maps, weather, etc., not part of field data collection)*
    - Contact List
    - Daily Reports
    - IAP
    - Trajectories
      - YYYY_MMDD
    - Weather
  - Photologger_Photos *(processing space for Photologger and GeoJot, output files)*
    - PhotologgerDatabase.mdb *(master MDB at root level)*
    - Working
      - YYYY_MMDD
        - LastName_FirstName
          - IMG_001.jpg
    - Output_Photologger *(auto-generated by APL for ERMA)*
      - 20151008_12345_SmithM
        - ERMAPhotoUpload_20151008.zip (Uploads to ERMA)
    - ResponseLink *(auto-generated by APL for ResponseLink)*
      - RLinkUpload_20151008_1234.zip (Uploads to ResponseLink)
  - Field_Data_Files *(files to be uploaded to DIVER)*
    - TWG Name *(ex. Sea_Turtle, SCAT)*
      - YYYY_MMDD_LastName_FirstName *(Field team lead)* – OR:
      - YYY_MMDD_FieldTeamName *(Designated field team name)*
      - *Ex. 2015_1008_RIA1*
        - COC *(Chain of Custody form)*
          - COC_YYYY_MMDD_TeamName.pdf
          - *Ex. COC_2015_1008_RIA1.pdf*
        - GPS *(GPS track)*
          - GPS_YYYY_MMDD_AssociatedCamera#_TeamName.gpx
          - *Ex. GPS_2015_1008_Cam3_RIA1.gpx*
        - Maps *(Final field observation map)*
          - FieldMap_YYYY_MMDD_TeamName.pdf
          - *Ex. FieldMap_2015_1008_RIA1.pdf*
        - Notes *(Field notes)*
          - Notes_YYYY_MMDD_TeamName.pdf
          - *Ex. Notes_2015_1008_RIA1.pdf*
        - ObservationForms *(Observation form)*

- Observationform_YYYY_MMDD_TeamName.pdf
- *Ex. ObservationForm_2015_1008_RIA1.pdf*

- Original_Image_Files *(Original image files)*
  - Photos_YYYY_MMDD_Camera#_GPS#_TeamName.zip
  - *Ex. Photos_2015_1008_Cam1_GPS2_RIA1.zip*
- PhotoLoggerDocument *(Photologger Form)*
  - PhotologgerForm_YYYY_MMDD_TeamName.pdf
  - *Ex. PhotoForm_2015_1008_RIA1.pdf*
- SampleForms *(Field sample form)*
  - SampleForm_YYYY_MMDD_TeamName.pdf

## Appendix E. Photography and GPS Information and Form

Photography forms may be provided by the NRDA lead, otherwise, use the attached form.

- Print the form on weather-resistant paper (if available). Make more than enough copies of the form before going into the field.
- Fill out forms with waterproof pen or permanent marker. Do not use pencil or biro (erasable) ink.
- Fill in blanks with "N/A" if data are not applicable or not available. Avoid leaving blank values on data forms.
- Do not black out erroneous entries on the field data forms. Errors should be corrected by crossing out the entry with a single line and signing and dating the strike-through.
- Special notes about the Photologger Form:
    - <u>This needs to be filled out at the end of each day</u>, noting the pictures taken on the camera and noting the SiteID, SampleID, or significance of photo

**Attached:**
**- Gear Checklist**
**- Photo and GPS Checklist**
**- PhotoLogger Form**

## Photography and GPS Gear Checklist

**Photography - Complete gear list; F indicates field gear**

| | | |
|---|---|---|
| ☐ | Camera ***F*** | With neck strap |
| ☐ | Camera case ***F*** | Sized to hold all camera gear; plus polypropylene freezer bag, if appropriate |
| ☐ | Memory cards ***F*** | 1-2 extra depending on size – (e.g., 200-300 high resolution photographs, each) |
| ☐ | Camera Rechargeable batteries ***F*** | Camera batteries: 2 is OK, 3 is better. AA's two sets of rechargeable are OK |
| ☐ | Battery charger | Appropriate for each type of rechargeable batteries |
| ☐ | Lens cleaning kit ***F*** | (e.g., soft cloth) |
| ☐ | Card reader | One that accepts many types of cards is preferred |
| ☐ | Cable – Camera to PC | |
| ☐ | Camera manual | Paper and pdf |
| ☐ | Underwater housing/kit ***F*** | Optional - useful in rough weather and small boat ops. |
| ☐ | Photo scale ***F*** | 15 cm waterproof, 15 cm disposable. Avoid white or light colors. Grey is best |
| ☐ | Image viewing software | All PC's and many cameras have software for reviewing photographs |
| ☐ | Image editing software | Optional. Good for processing photographs for presentations etc. |
| ☐ | External hard drives | |
| ☐ | PhotoLogger database | |
| ☐ | GPS-Photo Link software | Garmin BaseCamp, Garmin MapSource, GPS Babel |
| ☐ | DVD-R's – NOT RW's | |
| ☐ | Waterproof bag ***F*** | Dry sack or heavy duty zip-lock bags |
| ☐ | Polarizing lens ***F*** | Optional – reduces glare and reflections |
| ☐ | GPS ***F*** | |
| ☐ | Cable – GPS to PC | |
| ☐ | GPS Rechargeable Batteries F | Extra alkaline or lithium |
| ☐ | Field notebook ***F*** | |

## Photograph and GPS Checklist

The following checklist will help ensure that ALL NRDA photographs and GPS photographs are successfully processed and included in the larger photography database.

**Pre-Field:**

- ☐ GPS/camera must be set to local time (Set to 24-hour Military Time)
  Garmin GPS: Turn GPS Unit ON> Menu > Setup > Time > Time Format = "24 hours"
- ☐ Set GPS to Decimal Degrees
  Garmin GPS: Main Menu > Setup > Time > Time Format = "24 hours"
  OR Garmin GPS: Main Menu > Setup > Units > Position Formation = "hdd.ddddd"

- ☐ Datum = “WGS 84”
  Turn On GPS > Menu > Setup > Units > Map Datum = “WGS 84”
- ☐ Set Track Log to “Wrap When Full”
  Turn On GPS > Menu > Tracks > Track Log (Track Log = “On”) > Setup > Check “Wrap When Full”
- ☐ Set GPS Recording Interval
  Garmin GPS: Main Menu > Tracks > Setup > Interval
  You will need to set how often the GPS records a satellite location depending on your method of field observation. Note that recording more frequently will fill up the device’s memory card quickly.

**In-Field:**

- ☐ Ensure GPS unit has acquired a satellite signal
  The device may momentarily lose its signal if you are traveling quickly, if you have placed it in an obstructed location (backpack, field kit, etc.), or it is not facing upwards in a secure location. Attaching the GPS to the outside of your pack can be helpful
- ☐ Take a photograph of the GPS unit showing the Date and current Time of day (with seconds) – NOT a waypoint time. <u>See examples below</u>
  At the beginning of the day, take a photograph of the GPS unit with the display screen showing the current date and time (with seconds). DO NOT take a photograph showing the time that a waypoint was taken since this is not the real-time GPS time. To display date/time on Garmin units, press the “Menu” button twice. Make sure the screen is clearly visible and then take a photo (double-checking the photo to make sure the information is captured)
- ☐ <u>Do not delete any photographs in the field</u>!
  Cameras typically auto-number photographs – any gaps in the number sequence may suggest that the camera was tampered with, raising legal defensibility concerns
- ☐ Do not open photographs before zipping – may change metadata
  Original photographs MUST NOT be opened at any time (beyond viewing them on the camera’s LCD screen). Only copies may be viewed. Opening the photographs prior to uploading to the NRDA site changes the Date/Time in which the photograph was “modified.” This suggests that the photo collection may have been tampered with, thus potentially rendering the collection indefensible
- ☐ Take informative photographs that tell the story
  Photographs of the GPS unit after the beginning of the trip, compass settings, trip preparation, equipment cleansing, sediment mixing, and other sample preparation procedures are helpful, but do not need to be photographed extensively. If such photographs are taken they do not require photograph-specific comments in the Photologger form
- ☐ DO NOT SAVE your GPS track to the GPS unit
  Saving the GPS track on the device will cause it to do two things to make a smaller file on the device. 1) It will delete the date/time data associated with the recording, which

we need for processing and archiving, and 2) It will use an algorithm to delete GPS points.

- ☐ DO NOT turn the GPS unit off at anytime
  DO NOT turn off the GPS unit at any time during the day, even during rest periods. This causes a break in the track log and leads to difficulties in processing the photographs. Please make sure that you have adequate battery power at the beginning of the day.

**Post-Field:**

- ☐ Extract tracks and waypoints from the GPS unit
  Tracks and Waypoints are stored in the GPS unit.
  These are also requisite inputs for the photo processing software.
- ☐ Connect the GPS unit to a computer (remember your cables)
- ☐ Start Garmin MapSource (or similar)
  1) Click on the "Receive from Device" icon.
  2) Click Find Device (the name of the GPS unit will appear)
  3) Under "What To Receive" > Click only Waypoints and Tracks (and Routes if you've recorded them) should be downloaded to your computer
  4) Click "Receive" (you will now see the tracks/waypoints for that day)
- ☐ Save .gdb and .gpx files. The .gpx file contains your tracking and waypoint information and can be used for GPS PhotoLink and Google Earth. The gbd format makes putting data back on your GPS very easy.
  1) > Save As… > "YYYY_MMDD_LastName_FirstName" (Save as type: .gdb)
  2) File > Save As… > "YYYY_MMDD_LastName_FirstName" (Save as type: .gpx)
- ☐ Upload Waypoints to ERMA
- ☐ Complete the PhotoLogger Form (see below)
- ☐ Identify key photographs
  In the photograph-specific comments section, write the photograph name or number for each key picture and "key photograph" as the comment. Key photographs are those which document the effects of the spill and aid in the NRDA process. These include pictures of: samples, tarballs, oil sheens/slicks, oiled vegetation, oiled wildlife, etc. If several pictures are taken of the same oiling observation, pick the best one and mark it a key photograph. Non-key photographs are those taken of the GPS unit showing the time and date at the beginning of the trip (this should be the 1st photograph in the set), directional photographs (N, E, S, W), and the background landscape (unless it is covered in oil). **Non-key photographs do not require photograph-specific comments**
- ☐ Process photographs using GeoJot, see GeoJot training document
- ☐ Import photographs to desktop Photologger
- ☐ Upload photographs to on-line Photologger
- ☐ Upload photograph to ERMA

NOAA OR&R PhotoLogger Form & Chain of Custody

*This form must be filled out to accompany photos taken in the field, either filled out in the field or upon return to Data Intake.*

**Photographer Name:**
**_____**
**Agency Name: _____ Cell Phone Number:**
**_____**
**Study Name**
_____

**Date of Photos (MM/DD/YYYY): _____ Photo Range:**
**_____**
**Camera Time Zone: AST/ADT PST/PDT MST/MDT CST/CDT EST/EDT Other Time Zone:**
**_____**
**Camera Date (MM/DD/YYYY): _____ Camera Time (HH:MM:SS): _____ Camera Model:**
**_____**
**Camera Time Zone: AST/ADT PST/PDT MST/MDT CST/CDT EST/EDT Other Time Zone:**
**_____**
**GPS Date (MM/DD/YYYY): _____ GPS Time (HH:MM:SS): _____ GPS Model:**
**_____**

**Location and State where photos were taken -** G*eographic area where the field work was completed (ex. Neah Bay, WA)*

**General description of all photos -** *If you have photos from significantly different sites / missions in the same group of photos being submitted, please fill out this form separately for each*

**Keywords that describe ALL photos being submitted -** *Specific keywords that describe ALL the photos this form addresses. If you choose to fill out the next section or review your photos in the PhotoLogger database you can add keywords for unique photos.*

**Enter photo-specific comments here –** *Provide more details to key photos of high value in the Comment section. You may also use this section if you need to identify specific photos of sample locations or photos that are data themselves (e.g. photo plots).*

| Photo Number | Comment *(ex. SiteID, SampleID, significance)* and Photo-Specific |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

**Suggested Keywords** – *These are suggested keywords to describe your key photos. You can add others to the side. Keywords are used when importing the photos to PhotoLogger, where they will be queried by field staff, management, or outreach staff in the days and years to come. Please select keywords that are general enough to represent the photos in future queries (ex. Put species in the Comment field). More specific details can be entered into the above Comment section or later in PhotoLogger.*

| | | | |
|---|---|---|---|
| Barge | Fish Kill | Oil-Sheen/Rainbow | Sediment Core |
| Barrel | GPS Unit | Oil-Dark | Shellfish |
| Barrier Island | Gravel Beach | Oil-Emulsified | Shoreline |
| Beach | Grounding | Oil-Tarball | Small Boat |

| Required Chain of Custody Filled Out Upon Data Intake | |
|---|---|
| **Photos & GPS Data Relinquished By** | **Photos & GPS Data Received By** |
| Name Signature: | Name Signature: |
| | |
| Name Printed: | Name Printed: |
| | |
| Agency Name Printed: | Agency Name Printed: |
| | |
| Date/Time: | Date/Time: |
| | |

I, _____ *[**Data Intake Manager print name**]*, without modification, downloaded the photographs referenced on this form in accordance with the NOAA OR&R Data Intake Protocols and uploaded without modification to DIVER in the File Collection ID number_____ with the following Photo Zip file named _____ and GPS Zip file named _____.

_____ _____

_____

*Signature* *Date/Time*

# Appendix F. Design and generation of sampling locations

The initial sampling area was created by buffering the ODFW shoreline characterization shapefile http://ph-public-data.com/) within the study area to include the nearshore zone for sampling. The study area extends from approximately river mile 1 to river mile 12, with the area approximately between river miles 14 and 17 considered as the upriver reference area. The buffer was created by extending the shoreline 50 feet into the water. The buffered area is considered the total potentially seinable zone of the study area. The buffered shoreline was then divided into polygons based on an evaluation as to whether it could be successfully fished using seine nets. The evaluation for "seinability" applied local knowledge of previous fishing success for the target resident fish species as well as a review of aerial imagery for obstructions and barriers that would not be conducive to seining (such as existing overwater structures, debris or the presence of pilings).

Based on the evaluation of seinability, each shoreline area was tagged with a designation of yes or no indicating "yes" the area should be considered for seining or "no" the area could not be successfully seined. The polygons were then further divided into 450 to 600 foot long shoreline areas. Areas that were less than 450 feet long were not subdivided.

To classify seinable polygons by their relative intensities of contaminant exposure, surface sediment chemical concentrations from the following list of studies were used to interpolate concentrations across the study area of the Willamette River.

| Study Name | Study Dates |
|---|---|
| Arkema Draft Removal Action Area 2009 | 2009 |
| Portland Harbor Groundwater Pathway Sed 2005 | 2005 |
| Portland Harbor PAH Forensics 2014-2015 | 2014-2015 |
| Portland Harbor Pre RD Study 2018/2019 | 2018-2019 |
| Portland Harbor Round 2A 2004 | 2004 |
| Portland Harbor Round 2A Beach Sediment 2004 | 2004 |
| Portland Harbor Round 2A Benthic/Lab Bioaccum 2005 | 2005 |
| Portland Harbor Round 2A GW Pathway 2005 | 2005 |
| Portland Harbor Round 2B Cores 2005 | 2005 |
| Portland Harbor Round 3 Co-located Sed 2007 | 2007 |
| Portland Harbor Round 3 Cores 2007-08 | 2007-2008 |
| Portland Harbor Round 3 Sediment Grabs 2007 | 2007 |
| Portland Harbor Round 3 Toxicity Study 2007 | 2007 |

| Study Name | Study Dates |
|---|---|
| Portland Harbor Round 3 Up/downstream Sed 2007 | 2007 |
| Portland Harbor Round 3 Willamette Cove Sed 2007 | 2007 |
| US Govt Moorings RI 2008 | 2008 |
| Downtown Portland Sediment Study 2008 | 2008 |
| DPSC Phase 2 2009-10 | 2009-2010 |
| Lamprey Bioassay Sediment Chemistry 2009-10 | 2009-2010 |

Contaminants of concern for this evaluation included TPAH, PCB Sum, p,p DDE, and p,p DDT. The study data in the list above that was used can be found on DIVER using the following link .

To prepare the data for interpolation, the sample locations (with analysis results shapefile from the studies listed) and the river water boundaries were all projected from the WGS84 coordinate system to the NAD 1983 2011 Oregon Statewide Lambert Feet Intl projection in ArcGIS. Coincident samples were removed and only the highest concentrations at coincident locations were kept. A natural neighbors interpolation with barriers was completed in ArcGIS using the "create tin and the tin to raster" tool. The create tin and the tin to raster tool was used because the natural neighbors interpolation tool in ArcGIS spatial analyst does not offer an option for applying barriers (to exclude the area on land in the interpolation). Once the interpolation was created, the seinable polygons were tagged with mean concentrations using the "zonal statistics as table" tool in ArcGIS. The zonal statistics as table tool overlays the sampling unit area with the interpolated surface to provide the mean of the interpolated concentration values that fall within that area.

Once the mean concentrations were identified for each seinable polygon and each chemical group, sediment quality guidelines for freshwater were used to designate each seinable area as High, Medium or Low contaminant concentrations. The Threshold Effects Concentrations (TEC) and Probable Effects Concentrations (PEC) described in NOAA's sediment Screening Quick Reference Tables (SQuiRTs)[4] were used as the guidelines for assigning concentration labels. If the area weighted mean concentration of any chemical group in a polygon exceeded the PEC, the polygon was designated as High concentration. If the area weighted mean concentration of any chemical group in a polygon exceeded the TEC, but no chemical exceeded the PEC, the polygon was designated as Medium concentration. If the area weighted mean concentration of all chemical groups in a polygon were below the TEC, the polygon was designated as Low concentration.

[4] https://response.restoration.noaa.gov/environmental-restoration/environmental-assessment-tools/squirt-cards.html

Once the High, Medium, Low designations were established, the seinable polygons were classified by area (East Bank Willamette, West Bank Willamette, Swan Island and Upstream Reference). East Bank Willamette and West Bank Willamette were grouped together to represent one area subdivided into three sampling strata by contaminant exposure intensities (Low, Medium, and High). Swan Island Lagoon was selected as a separate strata due to its unique geography as an enclosed lagoon, limited available shoreline for sampling, and sediment contamination distribution. The Upstream Reference area was selected as a fifth strata.

Due to logistical and budgetary constraints, fish from up to 39 sampling units (seinable polygons) can be analyzed. The 39 sampling units were distributed between strata to weight sampling effort more heavily in areas of higher contaminant concentrations. All ten of the High concentration sampling units were selected for sampling from the High strata. Fifteen sampling units were randomly selected from the Medium concentration strata. Five sampling units were randomly selected from the Low concentration strata. Three sampling units were selected from Swan Island Lagoon (prioritizing High and Medium concentration units). Six sampling units were randomly selected from the Upstream Reference strata. In the event that sampling is not successful in the target sampling units, a list of alternate sampling units was created for each strata. If a target sampling unit is infeasible to sample due to logistical considerations (depth, inaccessibility) or safety, the field crew will move to the first randomly selected alternate sampling unit (on the same side of the river as the original target unit) for the stratum and proceed down the list of alternate sampling units until a sampling unit that is feasible is located on the same side of the river as the target sampling unit. As the field crew works down the list of sampling units, documentation of the decision-making process and reason for not selecting the sampling units will be recorded. Since all High concentration sampling units are on the priority target list, the alternate sampling units for this stratum will come from the Medium stratum.

Below is the list of target sampling units grouped by strata determined by the method described above. The sampling unit ID represents the Strata ID (High, Medium, Low, Swan Island, or Upstream Reference) and a letter identifying the priority randomly selected seinable polygons within that strata. To provide guidance for boat operators, the centroid Latitude and Longitude for each sampling unit is provided along with the length of the seinable shoreline upstream and downstream of the centroid location.

| High Strata (10) | | | | | | |
|---|---|---|---|---|---|---|
| **Sample Area** | **Sediment Chemical Strata** | **Sample Letter** | **Sample Unit ID** | **Centroid Latitude** | **Centroid Longitude** | **Shoreline Length from Centroid** |
| West Willamette | High | A | H_A | 45.5681619 | -122.7403434 | 420 |
| West Willamette | High | B | H_B | 45.5753536 | -122.748767 | 224 |
| West Willamette | High | C | H_C | 45.5771336 | -122.7509501 | 226 |
| East Willamette | High | D | H_D | 45.630655 | -122.7855139 | 234 |
| West Willamette | High | E | H_E | 45.5763727 | -122.7494754 | 258 |
| West Willamette | High | F | H_F | 45.5777701 | -122.7524633 | 226 |
| West Willamette | High | G | H_G | 45.5746358 | -122.7478345 | 134 |
| East Willamette | High | H | H_H | 45.6294681 | -122.7861761 | 232 |
| West Willamette | High | I | H_I | 45.5784302 | -122.7539592 | 226 |
| East Willamette | High | J | H_J | 45.6282816 | -122.7867572 | 228 |

| Medium Strata (15) | | | | | | |
|---|---|---|---|---|---|---|
| East Willamette | Medium | A | M_A | 45.6134894 | -122.7847752 | 288 |
| East Willamette | Medium | B | M_B | 45.5545258 | -122.7032978 | 234 |
| West Willamette | Medium | C | M_C | 45.5628103 | -122.7316095 | 220 |
| West Willamette | Medium | D | M_D | 45.613674 | -122.7922294 | 194 |
| East Willamette | Medium | E | M_E | 45.5792535 | -122.7452271 | 298 |
| East Willamette | Medium | F | M_F | 45.6329063 | -122.7839992 | 230 |
| East Willamette | Medium | G | M_G | 45.585227 | -122.7611327 | 152 |
| East Willamette | Medium | H | M_H | 45.5806365 | -122.7450477 | 72 |
| West Willamette | Medium | I | M_I | 45.6146832 | -122.79294 | 228 |
| East Willamette | Medium | J | M_J | 45.6244643 | -122.7876022 | 296 |
| West Willamette | Medium | K | M_K | 45.5493829 | -122.7049324 | 414 |
| West Willamette | Medium | L | M_L | 45.6221866 | -122.7949999 | 255 |

| | | | | | | |
|---|---|---|---|---|---|---|
| East Willamette | Medium | M | M_M | 45.5837044 | -122.7579024 | 281 |
| West Willamette | Medium | N | M_N | 45.5966376 | -122.7803112 | 392 |
| East Willamette | Medium | O | M_O | 45.6360398 | -122.7810215 | 233 |
| Medium Alternates (14) | | | | | | |
| West Willamette | Medium | P | M_P | 45.6175357 | -122.796305 | 226 |
| East Willamette | Medium | Q | M_Q | 45.6270652 | -122.7870744 | 225 |
| East Willamette | Medium | R | M_R | 45.6020807 | -122.7760814 | 287 |
| East Willamette | Medium | S | M_S | 45.6340208 | -122.7831563 | 234 |
| West Willamette | Medium | T | M_T | 45.615748 | -122.793856 | 228 |
| East Willamette | Medium | U | M_U | 45.5921625 | -122.7696739 | 504 |
| West Willamette | Medium | V | M_V | 45.6059571 | -122.7874904 | 278 |
| East Willamette | Medium | W | M_W | 45.6317981 | -122.7848039 | 226 |
| East Willamette | Medium | X | M_X | 45.5829993 | -122.7561803 | 234 |

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|---|---|---|---|---|---|---|
| West Willamette | Medium | Y | M_Y | 45.6010549 | -122.7841227 | 243 |
| West Willamette | Medium | Z | M_Z | 45.5619959 | -122.730184 | 255 |
| East Willamette | Medium | AA | M_AA | 45.58447 | -122.7597644 | 63 |
| West Willamette | Medium | AB | M_AB | 45.5611521 | -122.729144 | 152 |
| West Willamette | Medium | AC | M_AC | 45.6207087 | -122.79534 | 357 |
| Low (5) | | | | | | |
| West Willamette | Low | A | L_A | 45.6284701 | -122.7946302 | 239 |
| East Willamette | Low | B | L_B | 45.5531237 | -122.6983929 | 234 |
| West Willamette | Low | C | L_C | 45.6166713 | -122.7950295 | 227 |
| East Willamette | Low | D | L_D | 45.6161428 | -122.7864722 | 344 |
| East Willamette | Low | E | L_E | 45.5524347 | -122.696854 | 236 |
| Low Alternates (36) | | | | | | |
| East Willamette | Low | F | L_F | 45.6036361 | -122.7764934 | 156 |

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|---|---|---|---|---|---|---|
| West Willamette | Low | G | L_G | 45.6345053 | -122.7922032 | 225 |
| West Willamette | Low | H | L_H | 45.6399182 | -122.7851918 | 234 |
| East Willamette | Low | I | L_I | 45.6177436 | -122.7870309 | 364 |
| East Willamette | Low | J | L_J | 45.5536075 | -122.7000276 | 226 |
| West Willamette | Low | K | L_K | 45.6356307 | -122.7914772 | 226 |
| West Willamette | Low | L | L_L | 45.6259497 | -122.7946554 | 230 |
| East Willamette | Low | M | L_M | 45.5571148 | -122.7095738 | 228 |
| East Willamette | Low | N | L_N | 45.5584052 | -122.712558 | 204 |
| West Willamette | Low | O | L_O | 45.638523 | -122.7882405 | 230 |
| West Willamette | Low | P | L_P | 45.6459362 | -122.7741026 | 224 |
| West Willamette | Low | Q | L_Q | 45.6310044 | -122.7939977 | 231 |
| East Willamette | Low | R | L_R | 45.5577244 | -122.7111519 | 234 |
| West Willamette | Low | S | L_S | 45.6297505 | -122.7943179 | 238 |

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|---|---|---|---|---|---|---|
| West Willamette | Low | T | L_T | 45.6405623 | -122.7836323 | 238 |
| West Willamette | Low | U | L_U | 45.633388 | -122.7929507 | 225 |
| East Willamette | Low | V | L_V | 45.6122508 | -122.7838625 | 236 |
| West Willamette | Low | W | L_W | 45.6392131 | -122.7867133 | 236 |
| West Willamette | Low | X | L_X | 45.6376244 | -122.7894023 | 215 |
| East Willamette | Low | Y | L_Y | 45.5558736 | -122.7064345 | 236 |
| East Willamette | Low | Z | L_Z | 45.6369602 | -122.7798651 | 216 |
| West Willamette | Low | AA | L_AA | 45.6443084 | -122.7760938 | 234 |
| West Willamette | Low | AB | L_AB | 45.6433535 | -122.7776059 | 298 |
| East Willamette | Low | AC | L_AC | 45.5552272 | -122.7048336 | 242 |
| West Willamette | Low | AD | L_AD | 45.6234611 | -122.79496 | 228 |
| West Willamette | Low | AE | L_AE | 45.6366597 | -122.7904703 | 230 |
| West Willamette | Low | AF | L_AF | 45.6469393 | -122.7730676 | 240 |

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|---|---|---|---|---|---|---|
| West Willamette | Low | AG | L_AG | 45.632237 | -122.7936135 | 230 |
| East Willamette | Low | AH | L_AH | 45.5539632 | -122.701709 | 226 |
| East Willamette | Low | AI | L_AI | 45.6350397 | -122.7821109 | 226 |
| East Willamette | Low | AJ | L_AJ | 45.6148042 | -122.7856382 | 260 |
| West Willamette | Low | AK | L_AK | 45.627195 | -122.794645 | 229 |
| East Willamette | Low | AL | L_AL | 45.548395 | -122.6927822 | 240 |
| West Willamette | Low | AM | L_AM | 45.6247042 | -122.7948016 | 228 |
| East Willamette | Low | AN | L_AN | 45.6030847 | -122.7777956 | 484 |
| East Willamette | Low | AO | L_AO | 45.5565818 | -122.7079437 | 232 |
| Swan Island (3) | | | | | | |
| Swan Island | High | A | SI_A | 45.5706251 | -122.7235627 | 120 |
| Swan Island | Medium | B | SI_B | 45.5659097 | -122.7120216 | 226 |
| Swan Island | Low | C | SI_C | 45.5627089 | -122.7065684 | 301 |

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|---|---|---|---|---|---|---|
| Swan Island Alternates (3) | | | | | | |
| Swan Island | Low | D | SI_D | 45.5636445 | -122.7079543 | 228 |
| Swan Island | Low | E | SI_E | 45.5615373 | -122.7071849 | 218 |
| Swan Island | Low | F | SI_F | 45.5665363 | -122.7130788 | 121 |
| Upriver Reference (6) | | | | | | |
| Upstream Reference | Low | A | UR_A | 45.4899358 | -122.6557755 | 178 |
| Upstream Reference | Low | B | UR_B | 45.4901486 | -122.6706829 | 296 |
| Upstream Reference | Medium | C | UR_C | 45.4693868 | -122.6648006 | 402 |
| Upstream Reference | Low | D | UR_D | 45.4981702 | -122.6607952 | 228 |
| Upstream Reference | Low | E | UR_E | 45.4844662 | -122.667513 | 216 |
| Upstream Reference | Low | F | UR_F | 45.4966482 | -122.6628314 | 236 |
| Upriver Reference Alternate (75) | | | | | | |
| Upriver Reference | Low | G | UR_G | 45.4883236 | -122.6549568 | 233 |
| Upriver Reference | Low | H | UR_H | 45.4812007 | -122.6711344 | 124 |

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|---|---|---|---|---|---|---|
| Upriver Reference | Low | I | UR_I | 45.48965 | -122.658054 | 338 |
| Upriver Reference | Low | J | UR_J | 45.4919634 | -122.6604738 | 228 |
| Upriver Reference | Low | K | UR_K | 45.4917936 | -122.6668749 | 229 |
| Upriver Reference | Low | L | UR_L | 45.4691262 | -122.6689567 | 276 |
| Upriver Reference | Low | M | UR_M | 45.4966249 | -122.6652286 | 230 |
| Upriver Reference | Low | N | UR_N | 45.4954011 | -122.6624818 | 229 |
| Upriver Reference | Low | O | UR_O | 45.4990432 | -122.6647453 | 234 |
| Upriver Reference | Medium | P | UR_P | 45.4713413 | -122.6648311 | 242 |
| Upriver Reference | Low | Q | UR_Q | 45.4942248 | -122.6618984 | 226 |
| Upriver Reference | Low | R | UR_R | 45.4798579 | -122.6568124 | 242 |
| Upriver Reference | Low | S | UR_S | 45.482472 | -122.6562644 | 250 |
| Upriver Reference | Low | T | UR_T | 45.5005298 | -122.6671002 | 358 |
| Upriver Reference | Low | U | UR_U | 45.4909065 | -122.6595697 | 245 |

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|---|---|---|---|---|---|---|
| Upriver Reference | Low | V | UR_V | 45.4815041 | -122.6552973 | 227 |
| Upriver Reference | Low | W | UR_W | 45.4849751 | -122.653359 | 237 |
| Upriver Reference | Low | X | UR_X | 45.4954022 | -122.6654059 | 226 |
| Upriver Reference | Low | Y | UR_Y | 45.4872592 | -122.6531719 | 226 |
| Upriver Reference | Medium | Z | UR_Z | 45.4724486 | -122.6642217 | 226 |
| Upriver Reference | Low | AA | UR_AA | 45.4705377 | -122.6691696 | 254 |
| Upriver Reference | Low | AB | UR_AB | 45.4718967 | -122.6691489 | 244 |
| Upriver Reference | Low | AC | UR_AC | 45.4803045 | -122.6557737 | 229 |
| Upriver Reference | Medium | AD | UR_AD | 45.4665062 | -122.6645072 | 232 |
| Upriver Reference | Low | AE | UR_AE | 45.4890577 | -122.6709203 | 243 |
| Upriver Reference | Low | AF | UR_AF | 45.4856582 | -122.6679133 | 232 |
| Upriver Reference | Low | AG | UR_AG | 45.4931824 | -122.6593529 | 227 |
| Upriver Reference | Medium | AH | UR_AH | 45.473485 | -122.6635379 | 192 |

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|---|---|---|---|---|---|---|
| Upriver Reference | Medium | AI | UR_AI | 45.4650622 | -122.6641302 | 312 |
| Upriver Reference | Low | AJ | UR_AJ | 45.4871368 | -122.6543956 | 226 |
| Upriver Reference | Low | AK | UR_AK | 45.490581 | -122.6672958 | 228 |
| Upriver Reference | Low | AL | UR_AL | 45.4763902 | -122.6688088 | 310 |
| Upriver Reference | Low | AM | UR_AM | 45.4941857 | -122.6657528 | 228 |
| Upriver Reference | Low | AN | UR_AN | 45.4803761 | -122.6636618 | 227 |
| Upriver Reference | Low | AO | UR_AO | 45.4667596 | -122.6683373 | 322 |
| Upriver Reference | Low | AP | UR_AP | 45.4847577 | -122.6547917 | 230 |
| Upriver Reference | Medium | AQ | UR_AQ | 45.4677585 | -122.6647495 | 233 |
| Upriver Reference | Low | AR | UR_AR | 45.4778116 | -122.660793 | 234 |
| Upriver Reference | Low | AS | UR_AS | 45.488186 | -122.6680945 | 238 |
| Upriver Reference | Low | AT | UR_AT | 45.4780592 | -122.6590311 | 244 |
| Upriver Reference | Low | AU | UR_AU | 45.4992322 | -122.663538 | 301 |

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|---|---|---|---|---|---|---|
| Upriver Reference | Low | AV | UR_AV | 45.4821983 | -122.6658503 | 316 |
| Upriver Reference | Low | AW | UR_AW | 45.4786718 | -122.6633361 | 458 |
| Upriver Reference | Low | AX | UR_AX | 45.4910112 | -122.6575497 | 177 |
| Upriver Reference | Low | AY | UR_AY | 45.4859346 | -122.6543437 | 217 |
| Upriver Reference | Low | AZ | UR_AZ | 45.4884293 | -122.6534415 | 206 |
| Upriver Reference | Low | BA | UR_BA | 45.4894523 | -122.6562444 | 313 |
| Upriver Reference | Low | BB | UR_BB | 45.4869171 | -122.66804 | 229 |
| Upriver Reference | Low | BC | UR_BC | 45.4811337 | -122.6563908 | 244 |
| Upriver Reference | Low | BD | UR_BD | 45.4826233 | -122.654548 | 226 |
| Upriver Reference | Low | BE | UR_BE | 45.4776367 | -122.6624762 | 223 |
| Upriver Reference | Low | BF | UR_BF | 45.5007847 | -122.6615018 | 348 |
| Upriver Reference | Low | BG | UR_BG | 45.4878116 | -122.6719066 | 377 |
| Upriver Reference | Low | BH | UR_BH | 45.494395 | -122.6598442 | 234 |

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|---|---|---|---|---|---|---|
| Upriver Reference | Low | BI | UR_BI | 45.4861326 | -122.6532586 | 188 |
| Upriver Reference | Low | BJ | UR_BJ | 45.4774609 | -122.6697757 | 200 |
| Upriver Reference | Low | BK | UR_BK | 45.4969226 | -122.6604376 | 238 |
| Upriver Reference | Low | BL | UR_BL | 45.4956469 | -122.6601674 | 232 |
| Upriver Reference | Low | BM | UR_BM | 45.497857 | -122.6650476 | 226 |
| Upriver Reference | Low | BN | UR_BN | 45.489307 | -122.6544779 | 228 |
| Upriver Reference | Low | BO | UR_BO | 45.4743003 | -122.6682904 | 218 |
| Upriver Reference | Low | BP | UR_BP | 45.4893759 | -122.667718 | 226 |
| Upriver Reference | Low | BQ | UR_BQ | 45.4788394 | -122.6577688 | 209 |
| Upriver Reference | Low | BR | UR_BR | 45.4831858 | -122.6716407 | 274 |
| Upriver Reference | Low | BS | UR_BS | 45.4930737 | -122.6612514 | 226 |
| Upriver Reference | Low | BT | UR_BT | 45.4791365 | -122.6564245 | 226 |
| Upriver Reference | Low | BU | UR_BU | 45.4929913 | -122.6663181 | 232 |

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|---|---|---|---|---|---|---|
| Upriver Reference | Low | BV | UR_BV | 45.4730952 | -122.6686803 | 253 |
| Upriver Reference | Low | BW | UR_BW | 45.4994095 | -122.6611792 | 237 |
| Upriver Reference | Low | BX | UR_BX | 45.4836221 | -122.6555255 | 226 |
| Upriver Reference | Low | BY | UR_BY | 45.483421 | -122.6666616 | 230 |
| Upriver Reference | Medium | BZ | UR_BZ | 45.4837712 | -122.6538955 | 230 |
| Upriver Reference | Low | CA | UR_CA | 45.4780918 | -122.6570585 | 193 |
| Upriver Reference | Low | CB | UR_CB | 45.4814261 | -122.6646082 | 226 |
| Upriver Reference | Low | CC | UR_CC | 45.4979346 | -122.6631852 | 250 |