5231

IEc

Portland Harbor Natural Resource Damage Assessment

Phase 2 Allocation Methodology Report

FINAL | JANUARY 2023

prepared for:

Portland Harbor Natural Resource Trustee Council

prepared by:

Industrial Economics, Incorporated

2067 Massachusetts Avenue

Cambridge, MA 02140

TABLE OF CONTENTS

LIST OF EXHIBITS

LIST OF ACRONYMS

ASR	auto shredder waste
AST	above-ground storage tank
Cd	cadmium
CSO	combined sewer overflows
Cu	copper
BEPH	bis(2-ethylhexyl) phthalate
DDx	dichloro-diphenyl-trichloroethane and its breakdown products, dichloro-diphenyl-dichloroethane and dichloro-diphenyl-dichloroethylene
DEQ	Oregon Department of Environmental Quality
DSAY	discounted service acre-year
ECSI	environmental cleanup site information
FST	fuel storage type
GIS	geographic information system
HEA	habitat equivalency analysis
Hg	mercury
LT	landfill type
LWG	Lower Willamette Group
MGP	manufactured gas plant
MP4	four-methyl phenol
MPT	manufacturing/production type
MST	maintenance/service type
NAPL	non-aqueous phase liquids
NRDA	natural resource damage assessment
NSS	non-site specific
PAH	polycyclic aromatic hydrocarbons
Pb	lead

PCB	polychlorinated biphenyls
PRP	potentially responsible party
RI/FS	remedial investigation/feasibility study
SOC	substance of concern
ST	spill type
TBT	tributyltin
UST	underground storage tank

EXECUTIVE SUMMARY

The Portland Harbor Natural Resource Trustee Council (Trustee Council) is conducting a Natural Resource Damage Assessment (NRDA) that encompasses the Willamette River from approximately river mile 12.2 to river mile 1.0 near the confluence with the Columbia River, as well as the upper one mile of Multnomah Channel (Assessment Area; IEc 2018). The NRDA has been implemented in Phases, with Phase 1 assessment planning and field studies beginning in 2007. The NRDA moved into Phase 2 in 2010, which includes a settlement-oriented assessment as well as restoration planning. Through the early settlement process, the Trustee Council engaged potentially responsible parties (PRPs) interested in resolving their liability for natural resource damages (Stratus 2010; IEc 2018). This report summarizes the methodology the Trustee Council developed and applied to determine the basis for Phase 2 early settlements.

To determine an initial estimate of the magnitude of natural resource injuries within the Assessment Area, the Trustee Council evaluated concentrations of 12 substances of concern (SOCs) in surface sediment surface sediment: polycyclic aromatic hydrocarbons, polychlorinated biphenyls, cadmium, copper, lead, mercury, tributyltin, bis(2-ethylhexyl) phthalate, 4-methyl phenol, and dichloro-diphenyl-trichloroethane and its breakdown products, dichloro-diphenyl-dichloroethane and dichloro-diphenyl-dichloroethylene. Areas with sediment concentrations that exceeded thresholds indicative of injury to biological resources were defined as substance of concern "footprints." Ecological losses within those footprints were quantified using habitat equivalency analysis, resulting in 4,130 lost discounted service acre-years (DSAYs).

Based on existing information, the Trustee Council allocated liability for the sediment footprints and associated DSAYs to sites that released the corresponding SOC(s) into the Assessment Area. A site was defined as a tax parcel or group of contiguous tax parcels (i.e., land) associated by ownership and/or related activities. The Trustee Council developed a list of more than 130 activities and associated SOCs to standardize the parameters included in the allocation (see Appendix A). For each site, the Trustee Council posed three threshold questions meant to ensure: (1) a pathway existed to transport site contamination to the Willamette River, (2) an activity was conducted that was a likely source of a specific SOC, and (3) evidence of sediment contamination was located within close proximity to the site or site-related outfall. If all three conditions were satisfied, a site was assigned a relative liability reflective of the proportion of that site's SOC releases compared to other sites contributing the same SOCs based on general activity information, size/quantity and duration of releases, and proximity of the point of release to the

Assessment Area. The Trustee Council applied a relative ranking system for each parameter to ensure a transparent, replicable, and standardized allocation process.

Subsequent to the site allocation, PRPs interested in engaging in the Phase 2 early settlement process shared a suite of technical materials with the Trustee Council to assist the Trustee Council in developing an intra-site (party) allocation specific to that PRP. The process utilized the information and results of the site allocation, subsequently incorporating the location-specific information from each participating PRP to develop a DSAY allocation specific to that entity's ownership and operations at a given site (a relative allocation based on comparison of releases between parties). The allocation accounted for SOC footprints that were not clearly adjacent to or otherwise linked to specific site and SOC contributions from non-site-specific sources. The resulting party allocation was subject to legal and factual review by both the Trustee Council and participating PRP.

Throughout the Phase 2 process, the Trustee Council collected, reviewed, and incorporated additional technical and factual information into the allocation, updating the allocation database and methods as appropriate. Types of updates included adding or updating sites (e.g., revising the physical site boundaries based on updates reported in Multnomah County's tax parcel database), adding or updating activities (e.g., three landfilling activities were combined into a single activity to avoid double counting), and updating the allocation rules (e.g., increased the ranking of coal tar pitch activities to more accurately reflect the high PAH concentrations and low mobility of the pitch after its release into the environment). These updates were applied throughout the Assessment Area to maintain the consistency and equity of the allocation model.

CHAPTER 1 | INTRODUCTION

For decades, the Willamette River near Portland, Oregon, including the Portland Harbor Superfund Site, has been contaminated by oil and hazardous substances. To understand injuries to natural resources resulting from exposure to these contaminants, the Portland Harbor Natural Resource Trustee Council (Trustee Council) is conducting a Natural Resource Damage Assessment (NRDA). The Portland Harbor NRDA assessment area encompasses the Willamette River, including Swan Island Lagoon, from approximately river mile 12.2 to approximately river mile 1.0 near the confluence with the Columbia River, as well as the upper one mile of Multnomah Channel (Exhibit 1-1; IEc 2018). Contaminant levels in assessment area resources are sufficient to cause injury as defined by the U.S. Department of the Interior NRDA regulations (43 CFR Part 11). For example, contaminant concentrations in assessment area sediments exceed thresholds for injury to biological resources, causing a corresponding loss in ecological services. As part of the NRDA Phase 2 injury assessment,[1] the Trustee Council is proceeding with an early settlement process for potentially responsible parties (PRPs) interested in resolving their liability for natural resource damages (see the Portland Harbor Superfund Site Natural Resource Damage Assessment Plan (Stratus 2010) and Assessment Plan Addendum (IEc 2018) for more details).

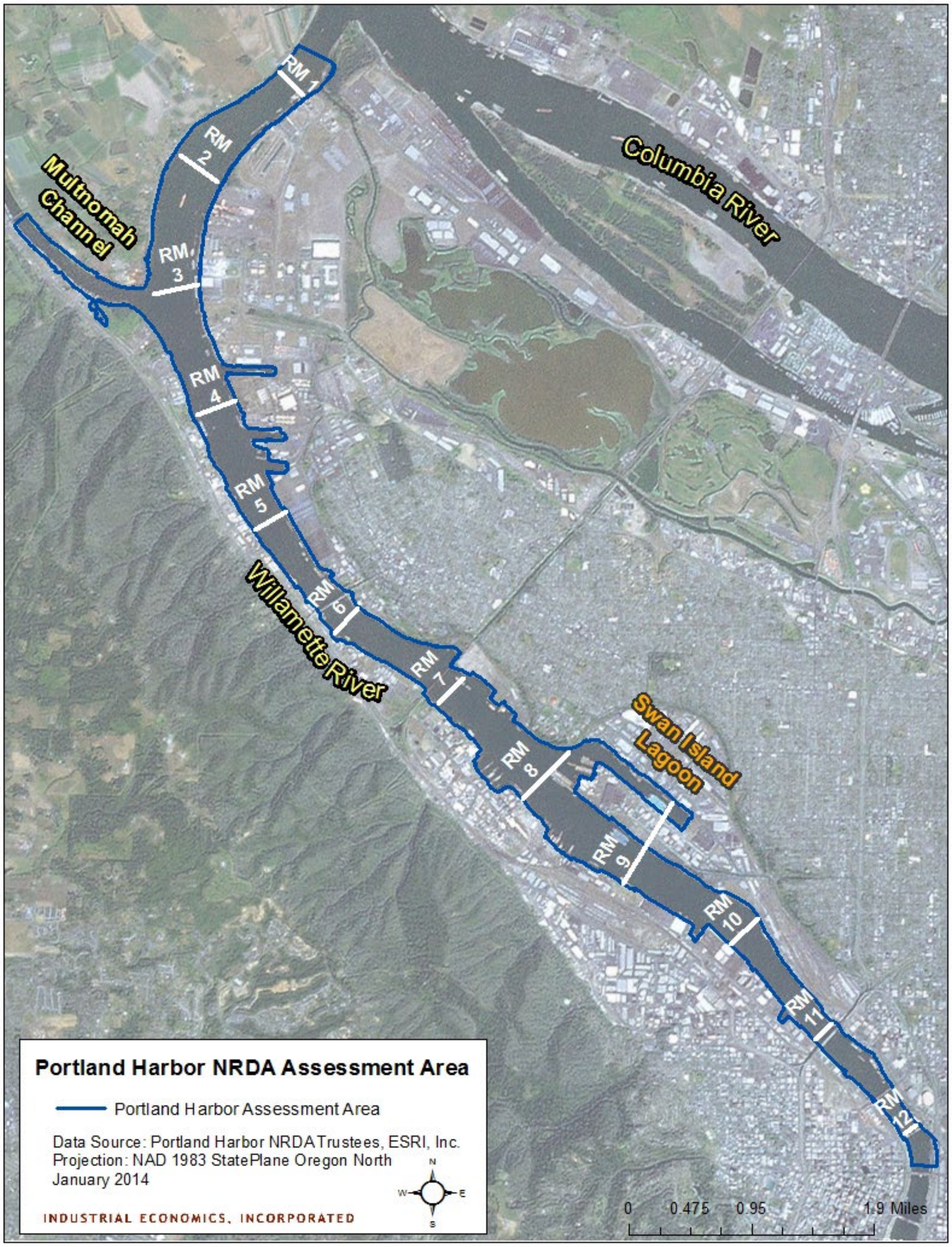
1.1 SCOPE OF THIS REPORT

This report summarizes the methodologies applied to determine the following (intended only to apply to Phase 2 early settlements):

- An initial allocation of liability for sediment-based ecological service losses within the Portland Harbor assessment area to various *sites* (i.e., a tax parcel or group of tax parcels) that contributed to the observed contamination.
- Subsequent *party* allocations of ecological losses (i.e., allocation to an entity associated with one or more sites).
- Updates to the allocation model as more information became available during the Phase 2 process.

[1] The Portland Harbor NRDA is being implemented in Phases. In 2007, Phase 1 began with assessment planning and field studies. Phase 2 began in 2010 with settlement-oriented assessment and restoration planning. In 2018, the Trustees began Phase 3, the full damage assessment process. The related timeline is summarized at the following link: https://www.fws.gov/portlandharbor/sites/portland/files/resources/ProjectTimeline_20210305.pdf. The Phases are described in more detail in the Damage Assessment Plan Addendum (IEc 2018).

EXHIBIT 1-1 ASSESSMENT AREA MAP



1.2 SITE ALLOCATION

To conduct the Portland Harbor site allocation, the Trustee Council relied on an allocation approach similar to that used for the Hylebos waterway NRDA in Washington State (NOAA 2002). Both the Portland Harbor and Hylebos NRDAs involve contamination of sediments, address similar substances of concern (SOCs), sources, and transport pathways, and rely on similar data sets. Briefly, the Trustee Council developed maps of surface sediment contamination in the Portland Harbor Assessment Area from 2000 to 2010 for 12 SOCs, including polycyclic aromatic hydrocarbons (PAHs); polychlorinated biphenyls (PCBs); metals, including cadmium, copper, lead, mercury, and tributyltin; phthalates, including bis(2-ethylhexyl) phthalate (BEPH); phenols, including 4-methyl phenol (MP4); and pesticides, including dichloro-diphenyl-trichloroethane and its breakdown products, dichloro-diphenyl-dichloroethane and dichloro-diphenyl-dichloroethylene (DDx). The SOC concentrations were compared to adverse effects thresholds, that is, concentrations above which injury to biological resources, and therefore a loss in ecological services, is expected to occur. Areas where sediment SOC concentrations exceeded the corresponding SOC threshold were defined as SOC "footprints." Varying degrees of ecological service loss may have been represented within a single SOC footprint, depending on the range of measured chemical concentrations.

The site allocation method allocated a percentage of observed sediment contamination and associated ecological losses to each "site." A site was defined as a tax parcel or a group of contiguous tax parcels (i.e., land) associated by ownership and/or related activities that contributed chemicals responsible for natural resource injuries in the assessment area. The site allocation integrated information across all historical and current owners, tenants, operators, generators, and transporters at a given site for which information was available. The site allocation was based solely on readily available data obtained from the following sources:

- Portland Harbor Remedial Investigation Report (LWG 2009),
- Portland Harbor RI/FS (Remedial Investigation/Feasibility Study) Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report (LWG 2007),
- Portland Harbor Remedial Investigation/Feasibility Study (RI/FS) Conceptual Site Model Update including Site Summaries (LWG 2004-2007),
- Oregon Department of Environmental Quality (DEQ) Environmental Cleanup Site Information (ECSI) Database (DEQ 2013),
- Facility website references, and
- Google Maps.

The allocation process necessarily involved the application of professional judgment, largely to address variability in the amount, type, and quality of data available for each site. To ensure equity in the allocation process, the Trustee Council explicitly identified assumptions in the methodology prior to its implementation and systematically applied standards across all sites considered in this analysis. Sites were allocated responsibility for their relative contribution to ecological losses only if there was a link between the site and contamination found in the assessment area. For each site and SOC, the Trustee Council posed three threshold questions:

1. Is there a pathway for process water, surface water, groundwater, or sediment to travel from the site to the Willamette River?
2. Was an activity conducted at the site that is a likely source of a specific SOC or which resulted in the release of a chemical likely to exacerbate the impact of an SOC?
3. Is there evidence of sediment contamination in an SOC footprint in close proximity (within 100 feet) to the site or site-related outfall?

The site was considered to be a source of the contaminant if, and only if, the answer to all three questions was "yes." The site allocation methods used for those sites passing this threshold test are described in more detail in Chapter 2 of this report.

1.3 PARTY ALLOCATION

Subsequent to the site allocation, PRPs joined the Trustee Council in Phase 2 early settlement discussions (IEc 2018). Each participating PRP prepared a suite of technical materials to enable the Trustee Council to conduct an intra-site (party) allocation specific to that PRP. The process utilized the information and results of the site allocation, subsequently incorporating the location-specific information from each participating PRP to develop an allocation specific to that entity's ownership and operations at a given site. The resulting party allocation was subject to legal and factual review by both the Trustee Council and participating PRP. The allocation methods used to parse the contribution attributed to a participating PRP are described in Chapter 3 of this report.

1.4 UPDATES TO THE ALLOCATION METHODOLOGY

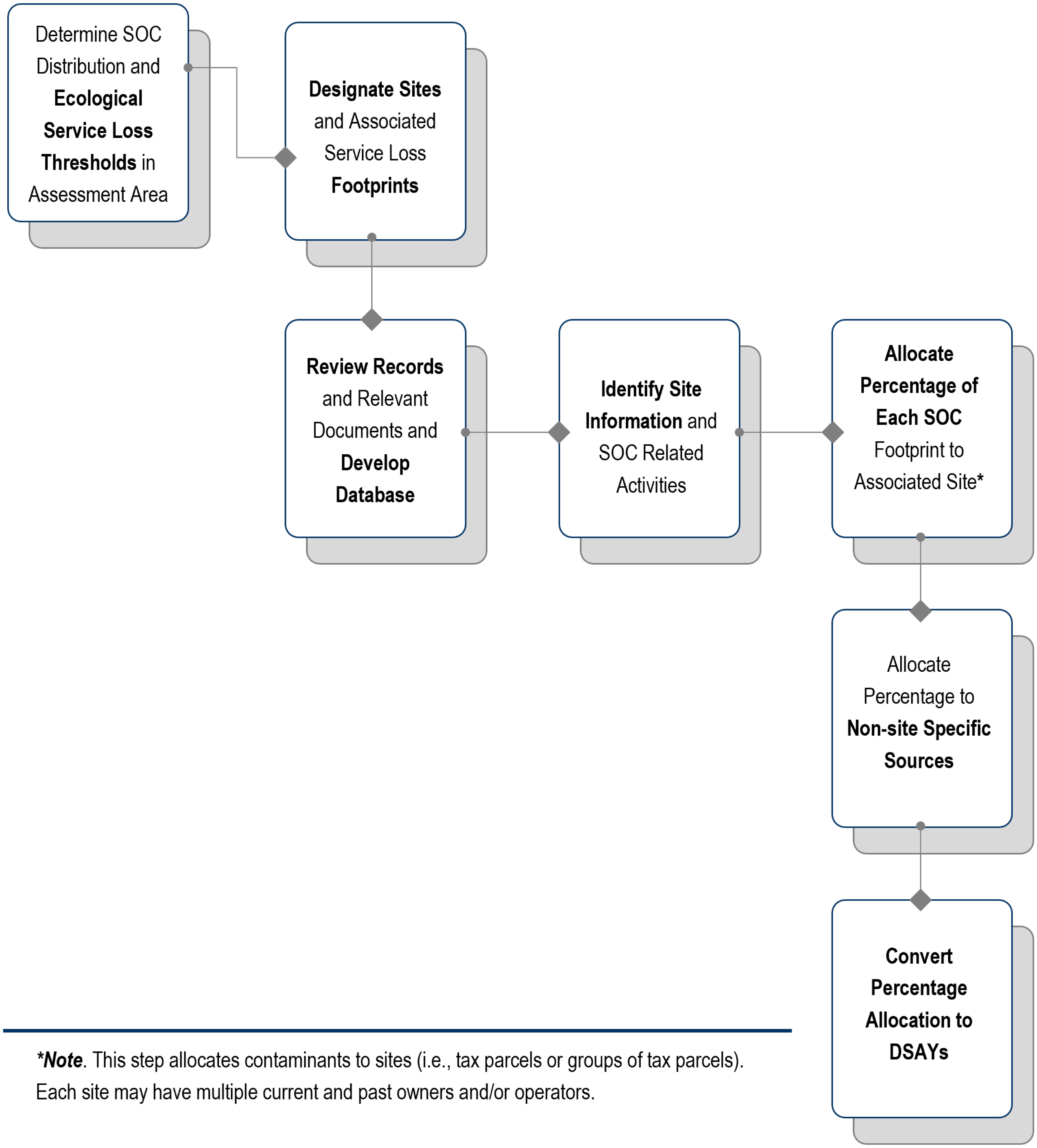
Throughout the Phase 2 process, the Trustee Council collected, reviewed, and incorporated additional technical and factual information into the allocation, updating the methods as appropriate. Information was obtained from participating PRPs as well as public information sources and primary literature on technical topics related to the allocation (e.g., contaminant fate and transport; comparison of products that contain contaminants of concern). The Trustee Council's approach to updating the allocation model is described in more detail, with relevant examples, in Chapter 4 of this report.

CHAPTER 2 | SITE ALLOCATION METHODOLOGY

Chapter 2 describes the methodology the Trustee Council used to conduct the site allocation. A wide variety of allocation approaches have been used in Superfund and NRDA cases. Relevant regulations and legal precedents do not mandate the use of a particular approach, but instead suggest that the approach chosen for a particular case should be equitable, clearly defined, systematically applied, and make reasonable use of available data (EPA 1994). Information about the nature and extent of contamination, the presence of multiple contaminants, relative toxicity, contaminant releases, transport mechanisms, and similar site-specific data may guide the choice of allocation methodology for a particular assessment area.

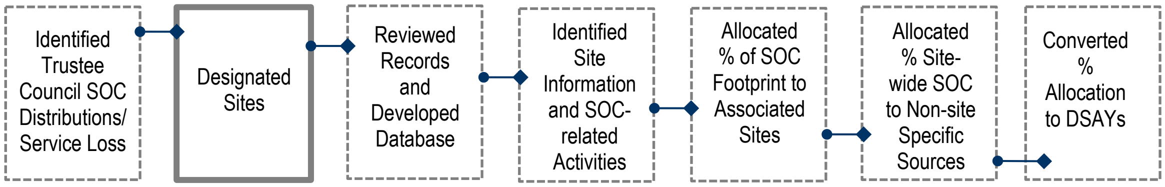
The Trustee Council developed a methodology for allocating responsibility for SOC-related ecological service losses that the Trustee Council then applied to publicly available, site-specific data. The sequential steps and decision junctions included in the site allocation process are shown in Exhibit 2-1 and explained in more detail in the following text. Application of the methodology results in a separate allocation for each of the 12 SOCs.

EXHIBIT 2-1 OVERVIEW OF ALLOCATION STEPS



****Note*. This step allocates contaminants to sites (i.e., tax parcels or groups of tax parcels). Each site may have multiple current and past owners and/or operators.

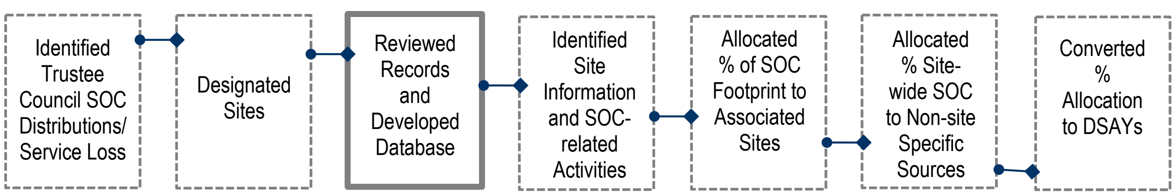
2.1 SELECTION OF POTENTIAL SITES



Having identified Trustee Council SOC distributions and service losses, the first step of the allocation involved identification of sites. The Trustee Council obtained 2008 tax parcel data from Multnomah County. All parcels of land adjacent to the assessment area and upland properties identified in the Lower Willamette Group (LWG) RI Report (LWG 2009) were identified as potential sites. In addition, the Trustee Council searched the DEQ ECSI database using site names and addresses to identify any additional parcels in the assessment area that had been investigated for contaminant releases. Residential parcels, undeveloped parcels, and parks were not included in the allocation analysis, because SOC releases from residential properties are expected to be low and generally captured through evaluation of combined sewer overflows (CSOs) and storm drain contributions.

For allocation purposes, contiguous tax parcels that supported a common set of activities were grouped together and considered a single site.[2] Based on proximity and activities, the combined parcels were assumed to share a consistent SOC discharge profile. Through this grouping process, the Trustee Council identified a preliminary total of 221 sites for purposes of the site allocation. Each site was assigned a unique Site ID number.

2.2 RECORDS REVIEW AND DATABASE DEVELOPMENT



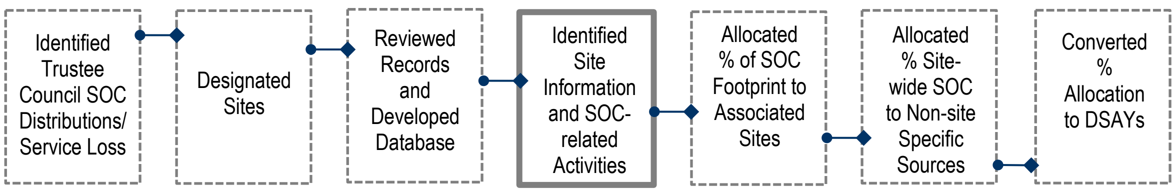
The next step in the allocation process involved the collection and organization of site information and related site-specific data into a database. The database included the following information:

---

2 Tax parcels are split, grouped, and otherwise updated over time by Multnomah County. The tax parcels associated with a site may change due to updates made by the county, or because the Trustee Council revised a site boundary due to shared ownership or operations.

- Portland Harbor NRDA site IDs, tax parcel information, addresses, ECSI numbers, and site locations.
- Current and historical owner and tenant names and years of operation identified in the references.
- Activity descriptions, activity types, and associated SOCs, with references to supporting information.
- Activities that occurred on each site, with references to supporting information.
- All references used to develop the allocation.

2.3 IDENTIFICATION OF SITE INFORMATION AND SOC-RELATED ACTIVITIES



This phase of the allocation relied on data gathered and organized during the previous step to identify and document which of the sites had the *potential* to have released any of the 12 SOCs. Information about each site was recorded using a consistent process of documentation, and included details regarding the site in general, tax parcel identification, site acreage, current and historical tenant(s), migration pathway(s), SOC footprint(s) associated with the site or site-related outfall, and identification of site activities. SOC footprints were considered associated with a site if the footprint was immediately adjacent or in close proximity to the site or site-related outfall (i.e., within 100 feet based on practical interpretation of the SOC footprint maps). As described in Chapter 1 and shown in Exhibit 2-2, the Trustee Council used a three-step process to determine if a site would be subject to an allocation.

The process of establishing the potential for SOC releases to the assessment area depended on the degree of information available for each site. Site records included information on readily available data obtained from DEQ, LWG, and Google Maps as described in Chapter 1. For the majority of sites, a substantial amount of data was available, and the Trustee Council's evaluation process systematically and objectively used those data.[3] Available documentation did not provide evidence of contamination at eight sites.

[3] Records were incomplete for 3 of 221 sites, and therefore insufficient to establish responses to the factors discussed above. An incomplete site record indicated that data were not available or insufficient to inform an allocation at that time, a contaminant pathway from the site to the Willamette River could not be determined, and/or the documents the Trustee Council reviewed did not present information on activities.

EXHIBIT 2-2 FACTORS CONSIDERED TO TRIGGER ALLOCATION TO A SITE

FACTOR	DESCRIPTION	DETERMINATION[1]
1. Pathway	Is there a pathway for process water, surface water, groundwater, or sediment to travel from the site to the Willamette River?	Yes/No
2. Activity	Was an activity conducted at the site that is a likely source of a specific SOC or which resulted in the release of a chemical likely to exacerbate the impact of an SOC?	Yes/No
3. Evidence of Contamination	Is there evidence of sediment contamination in an SOC footprint in close proximity (within 100 feet) to the site or site-related outfall?	Yes/No

Note:
1. To trigger continuation in the allocation process, the answers to all three factors must be "Yes."

"Activities" were defined as on-site operations that could result in SOC releases to the assessment area (e.g., pesticides manufacturing). Five activity types were used when documenting activity information as described above, including fuel storage type, maintenance/service type, manufacturing/production type, landfill type, and spill type. Exhibit 2-3 lists activities by type as well as the SOCs generally associated with each of the activities. A narrative description of each activity is included in Appendix A.[4] The association of SOCs and activities relies on reference documents obtained from the primary literature.

Sites with a particular activity (or group of activities) falling within any of the five activity types were assumed to have the potential to release associated SOCs into the assessment area. As described above, the presence of an activity was not sufficient to result in an allocation; the methodology also required evidence of nearby sediment contamination from the corresponding SOC(s). Overall, documentation of viable contaminant pathways, activities that could release or exacerbate the release of an SOC, and evidence of on-site SOC contamination provided a compelling rationale for allocating liability to a particular site.

[4] The list of activities was revised throughout the Phase 2 process as the Trustee Council received and reviewed additional technical and factual information. Appendix A presents the most recent list of activities that have been allocated within the Portland Harbor assessment area, including activities that were added over time.

EXHIBIT 2-3 ACTIVITY TYPES, ACTIVITIES, AND ASSOCIATED SOCS

ACTIVITY DESCRIPTION	ACTIVITY TYPE[1]	PAH	PCB	DDX	BEPH	TBT	CD	CU	HG	PB	MP4
adhesives production/use	MPT				X						
adhesives waste disposal	MST				X						
aluminum smelting/nonferrous smelting	MPT	X					X	X	X	X	
application/disposal of pesticides	MST	X		X							
asphalt batch plant/asphalt production	MPT	X									
ASR generation/storage[2]	MPT	X	X		X		X	X	X	X	
ASR used as fill	LT	X	X		X		X	X	X	X	X
AST bilge water[3]	MST	X									
AST bunker c	FST	X									X
AST diesel	FST	X									X
AST gasoline	FST	X									X
AST heating oil	FST	X									
AST hydraulic fluid	FST	X	X								
AST jet fuel/av gas	FST	X								X	X
AST kerosene	FST	X									
AST lubrication oil	FST	X									
AST naphtha solvent	MPT	X									
AST other petroleum/unknown petroleum	FST	X									X
AST waste oil	FST	X	X								X
ballast water storage/treatment	MST	X									
battery breaking/recycling	MST						X			X	
battery manufacturing	MPT						X	X	X	X	
boat moorage or marina operations	MST	X								X	
bulk lead product overwater handling	MST									X	
burning waste, debris	MPT	X							X	X	X
cement manufacturing/cement terminal	MPT	X						X		X	
chromated copper arsenate manufacture	MPT							X			
coal/oil gasification plant/refinery operations	MPT	X							X	X	X
coal tar distillation plant operations	MPT	X							X	X	X

ACTIVITY DESCRIPTION	ACTIVITY TYPE[1]	PAH	PCB	DDX	BEPH	TBT	CD	CU	HG	PB	MP4
coal/coal tar pitch storage/distribution	MST	X							X	X	X
concrete manufacturing/batching	MPT	X					X		X	X	
construction debris transfer station operation	MST	X			X		X	X		X	
contaminant release from sunken ships	ST	X	X			X	X	X	X	X	
copper wire stripping	MST		X		X			X		X	
creosote oil seepage	ST	X									X
creosote treated railroad ties	MST	X									X
creosote treated wood pilings	MST	X						X			X
discharge of machine shop metal shavings	ST							X			
discharge of roadway runoff	ST	X	X		X		X	X		X	
disposal of coal tar distillation wastewater	ST	X							X	X	X
disposal of liquid manufactured gas plant waste	MST	X							X	X	X
disposal of unknown chemical waste	ST	X	X	X	X	X	X	X	X	X	X
electric arc welding	MPT									X	
epoxy resin waste disposal	MST				X						X
extensive vehicle operations or washing facilities	MST	X			X						
extensive vehicle operations – railyard	MST	X									
fuel oil use	MST	X									X
fueling operations	MST	X									X
gas turbine power generation	MST	X								X	
hazardous waste report at Site 125	MST	X			X				X		
hazardous waste report at Site 131	MST						X	X	X	X	
hydraulic fluid use	MST	X	X								
hydraulic oil leakage/spills	ST	X	X								
hydrocarbon based wood preservative use/storage	MST	X		X	X		X	X	X	X	X
ink manufacturing	MPT	X								X	
land application of oily bilge water	ST	X									
landfill of coal tar distillates	LT	X							X	X	X
landfill of construction and demolition debris	LT	X	X		X		X	X		X	
landfill of dredged sediments-Willamette prior to 1980	LT	X	X	X	X	X	X	X	X	X	X
landfill of manufactured gas plant waste	LT	X							X	X	X
landfill of scrap metal	LT						X	X	X	X	
landfill of shredded battery casings	LT									X	

ACTIVITY DESCRIPTION	ACTIVITY TYPE[1]	PAH	PCB	DDX	BEPH	TBT	CD	CU	HG	PB	MP4
landfill of WWII ship debris	LT		X			X	X			X	
landfilling of Doane Lake by surrounding properties	LT	X		X					X	X	
landfilling used sandblast grit	LT	X	X			X	X	X	X	X	
lead smelting	MST						X			X	
locomotive maintenance/manufacturing	MPT	X	X							X	
lubricating oil used in manufacturing	MST	X									
manufacturing abrasives	MPT						X		X	X	
manufacturing of paint products	MPT						X	X	X	X	
manufacturing of resins	MPT	X			X		X	X		X	X
mechanical/electric motor repair and maintenance	MST	X	X		X		X	X	X	X	
mercury spill	ST								X		
metal casting	MPT						X	X	X		
metal plating operations	MST						X	X			
motor vehicle manufacturing	MPT	X			X		X	X	X	X	
municipal landfill operation	LT	X	X	X	X		X		X	X	X
non-magnetic ASR generation/storage	MPT	X	X		X						
oil/petroleum product packaging	MPT	X									X
oil/water separation/filtration use	ST	X									
oil used in machine maintenance	MST	X									
painting boats or marine vessels	MST		X			X		X	X	X	
PCB capacitor use	MST		X								
PCB contaminated oil spill	ST	X	X								
PCB contaminated oil use	MST	X	X								
PCB transformer use/spills/storage	MST		X								
pesticide storage	MST	X		X							
pesticides formulation	MPT			X							
pesticides manufacturing	MPT			X					X		
petroleum leaks from ship maintenance & repairs	ST	X									X
petroleum leaks/spills	ST	X									X
petroleum refining	MPT	X									X
petroleum transporting and storage in leaking containers	ST	X									X
production of creosote	MPT	X									X

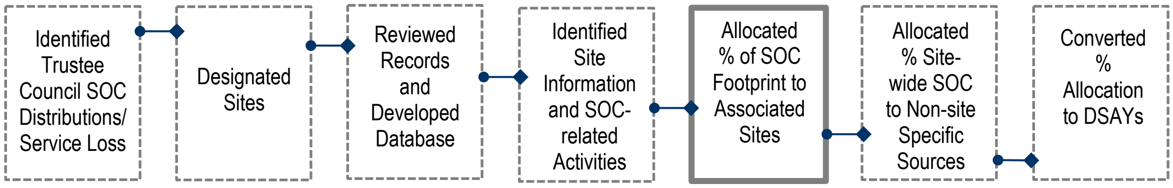
ACTIVITY DESCRIPTION	ACTIVITY TYPE[1]	PAH	PCB	DDX	BEPH	TBT	CD	CU	HG	PB	MP4
production/storage of electric arc furnace dust	MPT						X	X		X	
pulp mill operations	MPT	X	X								
pump manufacturing/refurbishing	MPT	X	X							X	
reconditioning/washing used steel drums	MST	X	X	X	X			X	X	X	
recycling of PCB transformers	MST		X								
sandblasting for other than boats or vessels	MST		X				X	X		X	
sandblasting/pressure washing of painted boat vessels	MST	X	X			X	X	X	X	X	
scrap metal yard operation	MST	X	X				X	X	X	X	
ship berthing	ST					X		X			
ship dismantling	MST	X	X			X		X	X		X
ship/boat maintenance and/or construction	MST	X	X		X	X		X	X	X	
slag storage or landfilling	LT						X	X		X	
steel fabrication	MPT	X						X			
steel manufacturing	MPT						X	X	X		
storage of lead batteries	MST									X	
storage of tires	MST	X					X	X	X	X	
storage or transporting PCB contaminated material	MST	X	X								
storage/disposal of mercury contaminated materials/debris at Site 139	MST								X		
storage/recycling of waste oils containing PCBs	MST	X	X								
uncovered coal/coal tar storage	MST	X									X
unprotected petroleum sump	ST	X									X
unprotected storage of lead-acid batteries	ST								X	X	
unprotected storage of nickel-cadmium batteries	ST						X		X		
unprotected storage of paints/waste disposal/spills	ST				X	X		X	X	X	
unprotected storage of petroleum contaminated soil	ST	X									X
unprotected storage of spent sandblasting grit	MST	X	X			X	X	X	X	X	
UST bunker c[4]	FST	X									X
UST diesel	FST	X									X
UST gasoline	FST	X									X
UST heating oil	FST	X									X
UST hydraulic fluid	FST	X	X								
UST Jet Fuel/Aviation gas	FST	X								X	X

ACTIVITY DESCRIPTION	ACTIVITY TYPE[1]	PAH	PCB	DDX	BEPH	TBT	CD	CU	HG	PB	MP4
UST leaded gasoline	FST	X								X	X
UST lubrication oil	FST	X									
UST other petroleum/unknown petroleum	FST	X									X
UST paint sludge	MPT						X			X	
UST septic tank	MST										X
UST waste oil	FST	X	X								X
vehicle recycling and wrecking	MPT	X	X		X		X	X	X	X	
waste transfer station operation	MST	X	X	X	X		X		X	X	X
wood preservative use	MST	X						X			X

Notes:

1. The five activity types include the following: FST (fuel storage type), MST (maintenance/service type), MPT (manufacturing/production type), LT (landfill type), and ST (spill type).
2. ASR is auto shredder waste.
3. AST is an above-ground storage tank.
4. UST is an underground storage tank.

2.4 ALLOCATION OF SOC FOOTPRINTS TO ASSOCIATED SITES



The purpose of the allocation was to apportion responsibility for each of the SOC footprints to the associated site or sites that contributed to it. As noted above, SOC footprints were considered associated with a site if the footprint was immediately adjacent to or in close proximity to the site or site-related outfall. Due to variation in the distribution of contaminants in the sediment and the quality and quantity of site-specific data, the Trustee Council relied on two methods to perform the site allocation, including Allocation of Unique Footprints and Allocation of Shared Footprints by Relative Index. To provide consistency and transparency in the footprint allocation, the Trustee Council assigned each SOC footprint a unique identification number.

2.4.1 ALLOCATION OF UNIQUE FOOTPRINTS

This approach allocated individual footprints unique to one site. In general, the site allocated responsibility was adjacent to the associated footprint; known to have stored, used, and/or released the footprint's SOC on site; and exhibited a pathway for contamination to reach the river.

In allocating unique footprints to individual sites, the Trustee Council used the following criteria:

- The footprint must be located either within or immediately adjacent to the tax parcel boundary of the associated site and no other site, or at the approximate point of discharge of a site-specific storm drain or CSO and not shared with any other site, and
- The paired site must have an activity that could potentially result in the release of the SOC in question.

Overall, the allocation of unique footprints reflects the reasonable assumption that discrete, elevated concentrations of SOCs found in sediments bordering a single site on which activities took place that used or discharged those SOCs should be attributed to that site. While the Trustee Council cannot rule out the possibility that these footprints received minor contributions from other sources, the likelihood that sources closer to the footprints contributed more significantly to a contaminant footprint justifies the presumption of diminishing impact with distance for other sources when a spatial and causal link between a footprint and a bordering site is clear. The Allocation of Unique Footprints approach was the default allocation methodology used in the analysis. If a particular footprint did not meet the criteria listed above, the Trustee Council applied the Allocation of Shared Footprints by Relative Index approach described below.

2.4.2 ALLOCATION OF SHARED FOOTPRINTS BY RELATIVE INDEX

In some cases, SOC contamination was so widespread and diffuse that contamination footprints blended together and were not readily linked to one unique site. Footprints potentially associated with several sites were allocated using a relative index approach. The relative index of shared footprints allocation is based on establishing a relative contribution of an SOC from each site based on the type, intensity, and duration of an activity and its proximity to the river. While it can be difficult to quantify the amount of an SOC potentially released by different activities, the absolute quantity of a release is less important than the relative quantity compared to other sources of the same SOC. Relative amounts can be estimated from information in the primary literature and by analyzing site-specific information. The fate and transport mechanisms depend on the physical and chemical characteristics of the SOC, location of the site, and pathways by which the SOC could reach the river.

In order to establish the relative contribution of an SOC from each activity at a particular site, activities were evaluated across four categories: General Activity, Size and/or Quantity, Duration, and Proximity, described in more detail below. The allocation model assigned an index value for each ranked category based on the potential for a hazardous substance to be released as a result of a particular activity. Standardized rules were applied to account for uneven or unknown information (e.g., assigning a median rank when the duration of an activity was unknown). The index values were based on the most up-to-date information available to the Trustees and applied consistently throughout the assessment area.

To describe the type and severity of the release associated with an activity, the allocation model assigned a rank based on the general characteristics of the activity (i.e., General Activity category). Each activity was assigned a ranking of low, medium, high, or very high based on the likelihood of an activity to release relevant SOCs on site or to the river. For example, landfilling activities typically had a lower rank than direct discharge into the waterway.

Given the diversity of activities included in the allocation model, several categories were utilized to best describe the relevant size and/or quantity of known or potential releases. Therefore, the Size/Quantity category established the extent of an activity, based on factors such as volume of fuel storage, area of docks, site acreage, number of transformers containing PCBs, length of berthing space, number of ships dismantled, or volume and/or mass of spilled petroleum or oil. The Duration category further emphasized the extent of an activity based on the range of years that an activity was performed on a site. Finally, the Proximity category described the likelihood that a release would reach the Willamette River, based on the activity's distance from the waterway along the most likely pathway (i.e., the distance from the source of the release to the river by the most likely transport route). The Proximity rank was calculated using a Geographic Information System (GIS) Measure Tool and emphasized that activities performed over water or adjacent to the waterway had a higher likelihood of releasing an

SOC to the river compared to activities performed upland. Similar to the General Activity category, the other three categories were scored from low to very high.

Using these four rankings, the estimated relative amount of an SOC released to the assessment area was calculated for each activity at each site, and relative contributions assessed through comparisons of relative index totals (Exhibit 2-4). This allocation method provided a quantitative and equitable basis of establishing the relative contribution of an SOC from each site. This relative index allocation was the basis for apportioning responsibility for a given SOC footprint that was associated with more than one site and/or site-related outfall (i.e., allocation among sites). The fate and transport properties illustrated in Exhibit 2-5 were considered when assigning a ranking factor, particularly when:

- The release was measured at a significant distance from the river.
- The activity took place at some distance from the river.
- Releases involving different pathways (surface water, groundwater, or soil/sediment erosion) were compared.

EXHIBIT 2-4 RELATIVE INDEX ALLOCATION CALCULATIONS

$$\text{Activity Index} = \text{Activity Ranking} \times \text{Size/Quantity Ranking} \times \text{Duration Ranking} \times \text{Proximity Ranking}$$

$$\text{Site Allocation Index} = \text{Sum of all Activity Indices on the Site}$$

$$\text{Allocation to Site A} = \frac{\text{Allocation Index for Site A}}{\sum \text{Allocation Indices for all sites associated with the SOC footprint}}$$

EXHIBIT 2-5 SOC FATE AND TRANSPORT CONSIDERATIONS

PATHWAY	FATE AND TRANSPORT CONSIDERATIONS
Surface Water	Flow path to the river (e.g., distance, velocity)
	Presence of free product
	Chemical concentration
	Potential for volatilization and degradation
	Adsorption to sediments
Groundwater	Flow path to the river (e.g., distance, gradient)
	Transmissivity of aquifer
	Floating or sinking free product
	Chemical concentration
	Potential for adsorption to aquifer soil
	Potential for volatilization and degradation
	Mobilization of SOCs by other chemicals (e.g., presence of organic solvents can mobilize less water soluble compounds)
	Mobilization of natural substances
	Adsorption to sediments
Sediments	Proximity to ditch, swale, or waterway
	Covered or uncovered (e.g., by a tarp)
	Velocity of eroding water over land
	Particle size
	Potential to settle before reaching the river

2.4.3 ALLOCATION OF REMAINING FOOTPRINTS

The Trustee Council was unable to allocate some SOC footprints using the unique footprint or shared footprint methods described above. These SOC footprints fit into one of the following three categories (Exhibit 2-6):

- **Type I**: The SOC footprint was not clearly adjacent to or otherwise linked to specific site(s) (e.g., footprints in the middle of the waterway).
- **Type II**: The SOC footprint was associated with a site, but no SOC-related activities were documented on the site.
- **Type III**: The SOC footprint abutted or was adjacent to a residential area, undeveloped site, or park.

For Types I and II footprints, it was reasonable to assume that nearby sites with relevant activities and viable pathways to the river contributed contamination to those SOC footprints. Lacking more specific information at this stage of the analysis, the Trustee Council assigned losses associated with each Type I and Type II footprint evenly across all sites that were both: 1) assigned an allocation for the corresponding contaminant, and

2) within a half-river mile upstream or downstream of the center of the footprint.[5] This process resulted in a site allocation of Type I and II footprints for PAHs, PCBs, DDx, TBT, mercury, lead, copper, cadmium, phthalate, and MP4. At this stage, Type III footprints remained unallocated because of their connection to non-industrial sites.

EXHIBIT 2-6 SOC FOOTPRINT SUMMARY FOR THE SITE ALLOCATION

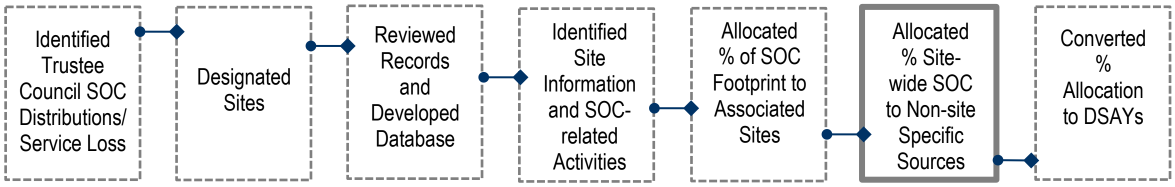
SOC	# OF FOOTPRINTS	UNIQUE TO A SITE	SHARED WITH 2 OR MORE SITES	TYPE I	TYPE II	TYPE III
PAH	59	18	37	1	0	3
PCB	51	18	29	4	1	0
DDT	58	10	47	1	1	0
DDD	30	11	19	0	1	0
DDE	21	3	18	0	0	0
TBT	13	7	6	0	0	0
Mercury	28	19	8	1	0	0
Lead	19	14	5	0	0	0
Copper	29	22	6	1	0	0
Cadmium	13	8	5	0	0	0
BEPH	25	12	12	1	0	0
MP4	76	41	18	16	0	1
Total Number of Footprints[1]	**422**	**247**	**144**	**25**	**5**	**4**

Note.

1. Totals may not sum due to rounding.

[5] In addition to upstream sites, sites downstream of a footprint were allocated a portion of that footprint because of the tidal nature of the Willamette River.

2.5 ALLOCATION OF NON-SITE SPECIFIC SOURCES



SOC concentrations in assessment area sediment may not be attributable solely to site-related activities. The draft RI modeled six indicator chemicals to identify potential sources of non-site specific (NSS) contamination to the Willamette River (LWG 2009). Indicator chemicals included Total PAHs, Total PCBs, Total DDx, copper, TBT and BEPH, all of which are SOCs included in the allocation process. Results indicated that upstream sediment, stormwater, groundwater, and atmospheric deposition are NSS sources of contamination (LWG 2009). Based on the mass of contaminants (kg) contributed by each of these potential sources, the Trustee Council determined that the predominant NSS sources of SOCs to assessment area sediments (as indicated by particulate contributions) were upstream sediment and non-industrial stormwater. Groundwater and atmospheric deposition were not considered significant NSS sources for SOC footprint allocation purposes. Groundwater flow originating from sources removed from the Willamette River was assumed to enter ditches and storm drains discharging to the river and was addressed as part of the discussions regarding stormwater. Groundwater contamination originating at sources subject to this allocation was addressed as part of the Trustee Council's site-specific source evaluation. In terms of atmospheric loading, based on draft RI estimates for PAH, PCBs, DDx, and copper (LWG 2009), the Trustee Council estimated the atmospheric contaminant contribution to corresponding footprints to be negligible.

To determine the contribution of upstream sediment and stormwater to sediment contaminant footprints, the Trustee Council calculated the total mass (in kg) of each SOC in assessment area sediment, determined the total mass (in kg) of each SOC entering the assessment area in upstream sediment and stormwater, and then calculated the percentage of assessment area contamination contributed by upstream sediment and stormwater. The details of the analysis are described in Appendix B.1. The result was a percentage contribution attributable to upstream sediment and stormwater that the Trustee Council subtracted from every allocation to account for upstream contributions of SOCs to the assessment area (Exhibit 2-7).

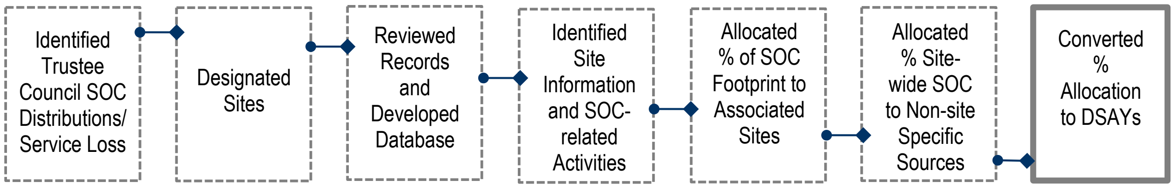
EXHIBIT 2-7 PERCENT CONTRIBUTION OF NSS SOURCES (SUBTRACTED FROM ALLOCATIONS)

SOC	PERCENT CONTRIBUTION OF NSS SOURCES
PAH	1.31%
PCB	1.05%
DDT	4.40%
DDD	4.40%
DDE	4.40%
TBT	9.76%
Mercury	0%
Lead	0%
Copper	12.54%
Cadmium	0%
BEPH	0.81%
MP4	0%

2.5.1 SEDIMENT TRANSPORT CONSIDERATIONS

Overall, the assignment of contaminant footprints to adjacent sites with SOC-associated activities reflected the reasonable assumption that discrete, elevated concentrations of SOCs found in sediments bordering a site on which activities took place that involve those SOCs should be attributed to that site. In addition, the pattern of contaminant concentrations in nearshore environments indicated that adjacent property activities largely overwhelm contributions from potential upstream or downstream sources. In the Trustee Council's view, the likelihood that sources closer to the footprints dominated the contributions to sediment contamination justifies the presumption of diminishing impact with distance from other sources when a spatial and causal link between a footprint and a bordering site is clear. However, as noted above, the Trustee Council could not rule out the possibility that these footprints also received minor contributions via sediment transport from more distant locations in the river (i.e., NSS), and therefore subtracted NSS contributions from site and party allocations.

2.6 ALLOCATION OF DSAYS



The final step in the site allocation process involved combining the results of the site allocation described above with the results of the Trustee Council's previously developed injury quantification analysis, which was measured in terms of discounted service acre-years (DSAYs)[6] using the Portland Harbor NRDA Habitat Equivalency Analysis (HEA).

2.6.1 METHODOLOGY

The Trustee Council's preliminary Phase 2 injury HEA quantified the harbor-wide service loss as 4,130 DSAYs across all twelve SOCs. In contrast, the site allocation process assigned contamination to sites as a percentage of each contaminant-specific footprint (i.e., reflecting a relative contribution). To determine the number of DSAYs corresponding to those percent allocations, the Trustee Council calculated the number of contaminant-specific DSAYs associated with each SOC footprint. The Trustee Council applied a GIS-based methodology[7] and relied on the following:

- The Trustee Council's GIS output layers from the Phase 2 injury quantification process, including the harbor-wide habitat types, total combined service loss, and service loss (in DSAYs) by contaminant.
- The ArcGIS map algebra tool to calculate the present value discounted service grid years for each contaminant using the same injury HEA equation and HEA inputs (e.g., discount rate, base year, asymptotic curve, K value) as in the Trustee Council's injury HEA model.

The result of this GIS process was twelve contaminant-by-contaminant present value discounted grid year raster GIS grids (i.e., layers). Using the zonal statistics GIS tool[8] and relevant unit conversion factors, the Trustee Council determined the total number of DSAYs per contaminant footprint.[9]

---

[6] A discounted service acre year is the amount of ecological services provided by an acre of habitat over the course of a year, discounted to reflect the fact that the public prefers to have those services now rather than in the future.

[7] Geosyntec, a consultant to several PRPs, provided support in the development of the GIS method.

[8] The zonal statistics tool sums the present value discount grid year values for all of the grid cells within a defined area (e.g., within each individual SOC footprint).

[9] The area of each grid cell is one square meter, and thus the conversion factor (0.00024711) equals (3.28084 ft *3.28084 ft feet)/43560 feet.

To convert the percentage-based site allocation for each SOC footprint to DSAYs, the Trustee Council multiplied the allocation percent per site and footprint by the total footprint DSAYs. For example, assume footprint #500 represented 10 DSAYs, and the site allocation model calculated that Site A is responsible for 90 percent of the injury for the footprint and Site B is responsible for 10 percent. The Trustee Council separately multiplied 90 percent and 10 percent by 10 DSAYs and determined that Site A was allocated 9 DSAYs and Site B was allocated 1 DSAY for footprint #500.

The Trustee Council then adjusted the DSAYs per site to account for Types I and II footprints and non-industrial NSS source contributions. To allocate Type I and II DSAYs, the Trustee Council calculated the number of Type I and II DSAYs per contaminant per corresponding site and added them to the site DSAYs.[10] First, the Trustee Council determined how many sites were within 0.5 miles of a Type I or II footprint, and then divided the Type I or II footprint DSAYs by the number of sites within that distance to determine the number of DSAYs allocated per site. Thus, all sites within 0.5 miles of a Type I or II footprint were assigned an equal potential share of the footprint. To address non-industrial NSS source contributions, the Trustee Council assumed that the percent of assessment area contamination from NSS sources corresponded to the percent of ecological losses incurred from NSS contamination. The Trustee Council then subtracted that percentage of DSAYs from each footprint (i.e., NSS DSAYs are not allocated to sites or parties).

2.6.2 HARBOR-WIDE DSAYS

As noted previously, the Trustee Council's final Phase 2 injury HEA quantified the harbor-wide service loss as 4,130 DSAYs, based upon the total service loss across all contaminants. However, the site allocation methodology allocated DSAYs for each SOC individually. As a result of this method, recombining the DSAYs per SOC resulted in a total of 3,985 DSAYs, or 145 DSAYs (3 percent) fewer than the Trustee Council's Phase 2 calculation. Thus, the Trustee Council subsequently modified the method for calculating individual SOC DSAYs to account for the full 4,130 DSAYs of ecological injury. The steps include the following:

- Treating each SOC individually,[11] calculated the DSAYs per SOC and individual habitat type.

---

[10] Type III footprints were not allocated to industrial sources because the footprints abut or are adjacent to a residential area, undeveloped site, or park.

[11] The Trustee Council's HEA model conditionally sums service losses in a given location to account for the fact that service losses cannot be greater than 100%. That is, service losses for a contaminant are applied to the service losses remaining after accounting for previous contaminants. For example, if at a given point PCB service loss is 50% and PAH service loss is 80%, total service loss would be 90% rather than 130% (e.g., 50% + (80% X (100%-50%)) = 90% service loss).

- Summed the total DSAYs across each SOC and habitat type.[12]
- Scaled the total DSAYs to 4,130. That is, based on the relative proportion of each SOC's DSAYs to total DSAYs (Step 2), adjust the DSAYs per contaminant by a corresponding percentage such that all SOC DSAYs together total 4,130.
- Adjusted individual footprint DSAYs by a standard percentage to account for the revised SOC DSAY calculations.

Every site and party allocation was based on the resulting SOC footprint DSAYs that together across the assessment area totaled 4,130 DSAYs.

[12] This results in greater than 4,130 DSAYs, because in some locations the service losses of multiple SOCs, when added together, exceed 100%.

CHAPTER 3 | PARTY ALLOCATION METHODOLOGY

To facilitate the Phase 2 early settlement process, the Trustee Council invited each participating party to identify the specific SOC footprints for which they may have liability and provide the Trustee Council with additional information related to their activities, releases, and potential party (intra-site) liability. Participating parties submitted to the Trustee Council packages of summarized technical information concerning ownership, leases, and/or uses of a tax parcel; information about each site at which the party may have liability (e.g., size, distance to waterway, discharge outfalls); and activities conducted or authorized by the party at each relevant site. The purpose of those submissions was to provide factual information relevant to the party allocation process.

The site allocation described in Chapter 2, which governs the allocation of Unique Footprints, Shared Footprints by Relative Index, and non-site-specific sources, served as a starting point for subsequent party allocations. To inform the allocation of liability between parties, however, the Trustee Council also considered the context surrounding the release of hazardous substances, the role of the party at a given site (i.e., owner or operator), and the party's relationship to, benefit from, and responsibility for contaminant releases. Three main concepts informed the party allocation methodology, including benefits of ownership, benefits of contamination, and differences in liability between owners and operators. These concepts were applied to several issues relevant to the party allocation methodology, in particular to allocate activities associated with owners and/or operators at a site (as defined in 42 U.S.C. § 9601(20)). The methods the Trustee Council applied to account for a party's roles and responsibilities are described below.

3.1 ALLOCATION BETWEEN OWNERS AND OPERATORS

Property owners derive benefit from their ownership regardless of whether the property contained contamination. Though the level of benefit may differ depending on the relationship between owner and operator, owners are in some part liable for the adverse effects of the contamination. The same concept applies to owners of outfalls.

In addition, contamination often occurs in the context of one of the following scenarios:

- Construction for use of an area wherein contamination may be incidental (e.g., landfilling with contaminated dredge material). In this case, the owner receives a substantial benefit irrespective of the contamination, because land has been created for industrial and/or commercial use which allows entities to generate profit from operations that would otherwise not be possible if the land remained aquatic habitat.

- Deliberate disposal of contaminated waste (e.g., bilge pond). In this case, while the owner receives some benefit, such as fees received for allowing disposal, the operators (i.e., those parties engaged in the disposal) retain substantial liability due to disposal of hazardous substances (as described in 42 U.S.C. § 9607).

The liability of owners versus operators has been explored in other NRDA cases. Consistent with methodologies implemented in other cases, the Trustee Council applied a standard rule to apportion liability among landowners and operators at a site. Specifically, for certain activities, 20 percent of the liability was assigned to the owner(s) and 80 percent of the liability was assigned to the operator(s), consistent with past practice at other CERCLA sites (Exhibit 3-1). Other specific activities were assigned completely to the owner (Exhibit 3-1) or the operator (Appendix A), if either the owner or operator was considered the sole generator of potential contamination and another entity would not receive an economic benefit. For example, activities categorized as ownership-only include land-based activities such as creosote treated wood pilings and railroad ties, landfill of dredged sediment, and PCB transformers. Activities categorized as operational-only provided no economic benefit to the owner and include activities such as application and disposal of pesticides, coal tar pitch storage and distribution, petroleum leaks and spills, and sandblasting of painted boats or vessels.

EXHIBIT 3-1 ALLOCATION BETWEEN OWNERS AND OPERATORS

ALLOCATION RULE[1]	ACTIVITY	RATIONALE
100% Owner	Creosote treated wood pilings	These structures were installed specifically to assist in the development and function of a site. A percentage was allocated to each owner(s) based on ownership.
	Creosote treated railroad ties	
	Landfill of dredged sediment	Placement of fill to create land was implemented specifically to assist with commercial and economic development of the area. A percentage was allocated to each owner(s) based on ownership.
	PCB transformers and capacitors	This equipment was installed to assist in the function of a site. A percentage was allocated to each owner(s) of the transformer-related equipment based on ownership.
20% Owner 80% Operator	Landfill for deliberate disposal of wastes	These landfills, pits, ponds, etc. were developed specifically for disposal of contaminated wastes. Liability was assigned 20 percent to owner(s) and 80 percent to operator(s) when the landfill was active. When the landfill was inactive, the owner was allocated 100% of the liability.
	Ship berthing	Berthing is beneficial to the property owner, but it is likely that the majority of contamination at a berthing site is derived from the activity itself. Therefore, the Trustee Council allocated 20 percent of the liability to the owner(s) and allocated up to 80 percent of the remaining liability to the major participant(s) in ship berthing, based on the relative number of ship-days berthed. Major participants were defined as entities that docked their boats for one year or greater. Liability for minor parties that participated for less than one year was assigned to the owner (in addition to their 20 percent share).
	Ship maintenance/ construction	Ship maintenance/construction is beneficial to the property owner, but it is likely that the majority of contamination is derived from the activity itself. Liability was assigned 20 percent to the owner(s) and 80 percent to the operator(s).
	Underground storage tanks (UST)	USTs were typically installed to store various fuels or products. When the UST was active, 20 percent was allocated to the owner(s) and 80 percent to the operator(s). When the UST was not active, a percentage was allocated to each owner(s) based on ownership.
100% Operator	All other activities (Appendix A)	Liability is assigned 100% to the operator(s) who performed the activity.

Note:

1. The operator at a site may also be the owner.

3.2 ALLOCATION OF LIABILITY AT OUTFALLS

The Trustee Council also developed rules to govern the allocation of contamination received by outfalls that discharged to the Willamette River. Outfalls are owned by either public or private entities. Activities resulting in the discharge of contaminants through privately owned outfalls are allocated based on the allocation rules for that activity. With regard to publicly owned outfalls, owners benefit by having that infrastructure in place (e.g., outfalls provide a mechanism for drainage, which limits flooding) and may gain additional economic benefits from the discharge of contaminants from site-specific activities into the outfall system (e.g., the City of Portland benefits through its rate payers). To allocate liability at publicly owned outfalls, the Trustee Council utilized information on land use characteristics (e.g., heavy and light industrial properties, as defined in the City of Portland's 2004 Industrial Districts Atlas),[13] how much of the industrial-classified land drained to a public outfall, and sediment loading percentages defined as part of the Remedial Investigation (LWG 2009, Table 6.1-5b). The Trustee Council added heavy and light industrial contributions together to calculate the total industrial contribution to sediment contamination per SOC, then multiplied the industrial contribution percentage by the total assessment area DSAYs to determine the DSAYs per SOC associated with industrial discharge through public outfalls. The last step applied a 10 percent ownership factor to allocate liability to the City of Portland. The details of the analysis are described in Appendix B.2.

3.3 PARTY ALLOCATION OF DSAYS

The party allocation of DSAYs utilized the same approach as the site allocation methodology. Each party at a given site was allocated a percentage of a suite of SOC footprints, based on rules outlined in Chapter 2 (e.g., the allocation of Unique Footprints, Shared Footprints by Relative Index, and NSS sources) and above (e.g., allocation to owners and operators based on the type of activity and its benefits, allocation to outfalls). The Trustee Council multiplied the party allocation percentage by the total footprint DSAYs (see Section 2.7.1 for an example). The Trustee Council then adjusted the DSAYs to account for Type I and II footprints and non-industrial NSS source contributions.

- **Step 1.** To allocate Type I and II DSAYs, the Trustee Council started with the results of the site analysis, which divided Type I and II footprints equally among sites within 0.5 miles of the footprint's location.

[13] Heavy and light industrial are defined in the City of Portland's 2004 Industrial Districts Atlas, available at: https://www.portland.gov/sites/default/files/2020-02/industrial_districts_atlas.pdf.

- **Step 2.** For each party at a site that was allocated Type I and II DSAYs, the Trustee Council determined if the party was allocated the SOC at that particular site.
  - If the party was not allocated that SOC, the Trustee Council did not allocate Type I or II DSAYs to the party.
  - If the party was allocated that SOC for one contaminant footprint, the Trustee Council multiplied the site allocation (result of Step 1) by the party allocation percentage for that SOC.
  - If the party was allocated that SOC for multiple contaminant footprints, the Trustee Council multiplied the site allocation (result of Step 1) by the average party allocation percentage for that SOC. For example, if the party liability at Site A for PCB01 was 30% and PCB02 was 40%, and the party was allocated liability for Type I footprint PCB99, the Trustee Council allocated 35% of the maximum PCB99 DSAYs per site (result of Step 1) to the party at Site A.

3.4 SUMMARY

Using the site allocation as a basis, including the allocation of liability for Unique Footprints (Section 2.4.1), Shared Footprints by Relative Index (Section 2.4.2), and NSS sources (Section 2.5), the party methodology incorporated additional factual information to allocate intra-site liability among owners and operators of the site and liability for public outfalls. The result was an allocation for each Phase 2 participating party that accounted for party ownership and/or operations at a given site.

CHAPTER 4 | UPDATES TO THE ALLOCATION MODEL

Throughout the Phase 2 early settlement process, the Trustee Council received and reviewed new factual information from participating parties, publicly available source documentation, and the primary literature. Chapter 4 describes the Trustee Council's approach to updating the allocation model based on the best available scientific and factual information. Specifically, the sections below describe the Trustee Council's approach to adding or updating sites, adding or updating activities, and updating the allocation rules (e.g., activity rankings and SOC-specific adjustments).

4.1 APPROACH TO ADDING OR UPDATING SITES

As part of the site allocation methodology, the Trustee Council defined a site as a tax parcel or a group of contiguous tax parcels (i.e., land) associated by ownership and/or related activities that contributed chemicals responsible for natural resource injuries in the assessment area. As part of the Phase 2 process, participating parties provided information related to their ownership and operations at the sites identified by the Trustee Council. Parties also provided information related to their ownership and operations at other locations throughout the Portland Harbor assessment area, including locations that were not previously defined as sites. The information gathered during this process was utilized to more explicitly define relevant sites, tax parcels, and structures (e.g., bridges and roadways) that were considered in the context of one or more participating party's allocation of liability. As a result, new sites and structures were added to the allocation.

In addition, the physical boundaries of sites were occasionally updated as deemed appropriate, based on information reviewed in Multnomah County's tax parcel database and/or received from participating parties. For example, information about current and historical activities, facilities and structures, or contaminant pathways could have indicated that a tax parcel grouping should be revised to best reflect party allocation considerations.

4.2 APPROACH TO ADDING OR UPDATING ACTIVITIES

The activities listed in Appendix A were identified during the review of factual information conducted to develop the site allocation methodology. These activities were conducted at sites adjacent to and/or upland from the Willamette River. More than 130 activities, defined as on-site operations that could result in SOC releases to the assessment area, were identified. Subsequently, as part of the Phase 2 process, participating parties provided information on activities associated with their ownership and operations at assessment area sites. The Trustee Council revised the initial list of relevant activities to remove and update the initial characterization of activities as well as add new activities to the allocation (Appendix A). For example, three landfilling activities were combined into a single activity, Landfilling of Doane Lake by surrounding properties, which is defined as the filling of Doane Lake with coal tar, lead battery waste, and other contaminated waste by surrounding industries from the 1920s to the 1940s. Combining multiple related activities resulted in a more accurate estimation of contamination releases by avoiding overlapping activity rankings. The Trustee Council also added activities to the allocation model based on new information; for example, discharge of roadway runoff and disposal of liquid manufactured gas plant waste. The activities that were added during the course of Phase 2 are included in Appendix A (gray highlighted text).

In addition, the Trustee Council occasionally received factual information or a request from a participating party that resulted in a re-evaluation of the SOCs associated with an activity. In these cases, the Trustee Council conducted a review to determine if a harbor-wide allocation update was warranted. One such harbor-wide adjustment was performed in response to questions from a participating party about a potential association between PCBs and sandblasting activities (the initial allocation model did not associate PCBs with sandblasting). The Trustee Council subsequently reviewed the primary literature to determine whether PCBs could reasonably be expected to be associated with sandblasting, concluding that PCBs were historically used in marine vessel paints and subsequently measured in used sandblast grit resulting from the sandblasting of marine vessels. Therefore, the Trustee Council updated the three activities associated with sandblasting painted boats and/or vessels (i.e., landfilling of used sandblast grit; sandblasting / pressure washing of painted boats or vessels; and unprotected storage of spent sandblasting grit from boats or vessels) to include an association with PCBs. Occasionally, a party provided site-specific information about the SOCs associated with an activity that occurred on their site. This site-specific information was accounted for within the party's allocation but did not necessarily lead to a harbor-wide update to the list of SOCs commonly associated with a particular activity.

4.3 APPROACH TO UPDATING SOC ALLOCATION RULES

During the Phase 2 early settlement process, the Trustee Council received information from participating parties that, when reviewed in the context of the allocation model, resulted in the Trustee Council conducting additional research. In several instances, the Trustee Council concluded that revisions to harbor-wide allocation parameters were warranted, including updates to the allocation rankings and the allocation rules for DDx and PAHs.

4.3.1 ADJUSTMENTS TO ACTIVITY RANKINGS

As part of the site allocation, activities were evaluated and ranked across four categories: General Activity, Size and/or Quantity, Duration, and Proximity. The allocation model assigned a value for each ranked category based on the potential for a hazardous substance to be released and contaminate sediment in the Willamette River. As new information became available, such as from a participating party, publicly available documentation, or the primary literature, the Trustee Council reviewed the information to determine whether a harbor-wide adjustment to the activity categories and their associated values was appropriate. For example, the Coal/Coal Tar Pitch Storage/Distribution activity was updated to increase the activity ranking for PAH at sites where overwater handling of coal tar pitch occurred. This revision was based on a review of the primary literature, which showed that coal tar pitch contains very high levels of PAH and has low mobility from the initial location of release, indicating coal tar pitch likely settled into sediment after incidental spills.

In addition, the Trustee Council evaluated the performance of the allocation model on a rolling, iterative basis, such that deviations from the expected contribution of a given activity were flagged to determine if an update to the activity rankings was warranted. For example, if the Landfill of Dredged Sediment activity was an allocation driver at a site, that may indicate an information gap on historical activities that occurred at the site and prompt additional questions to the participating party.

4.3.2 ADJUSTMENTS TO ALLOCATION OF DDX

Party allocations conducted early in the Phase 2 process resulted in greater-than-expected liability for DDx footprints for parties whose only DDx-related activity was landfill of dredged sediment. This finding prompted the Trustee Council to conduct a supplemental literature review focused on the physical and chemical properties of DDx in abiotic media. The primary literature indicated that DDx compounds may move from soil to groundwater but have low solubility in water and strongly bind to sediments. The Trustee Council concluded that DDx was more likely to remain bound to sediments and less likely to migrate from sediments to surface water or groundwater. This affected the rankings for two activities associated with DDx:

- The General Activity ranking for the Landfill of Dredged Willamette River Sediments activity was decreased to reflect low mobility of DDx from those landfilled sediments back to the Willamette River.
- The General Activity ranking for the Application and Disposal of Pesticides activity was increased to reflect greater persistence within the assessment area as a result of the low mobility of DDx within Willamette River sediment.

In addition, the Trustee Council applied a revised approach to trigger an allocation of DDx footprints: DDx footprints within a half mile upstream, and all footprints downstream of sites where pesticides were manufactured, applied, and disposed of, were allocated to the party(ies) responsible for those activities.

For all other footprints, the DDx methodology did not change. That is:

- DDx footprints more than a half mile upstream of the sites where pesticides were manufactured, applied, or disposed of, were allocated based on activities conducted at upstream sites (i.e., activities other than manufacturing, applying, or disposing of pesticides).

- DDx footprints within Swan Island and privately owned inlets were allocated to parties based on activities conducted at sites adjacent to or upland of Swan Island (i.e., activities other than manufacturing, applying, or disposing of pesticides).

4.3.3 ADJUSTMENTS TO ALLOCATION OF PAH

During the course of Phase 2, a party not participating in the process provided the Trustee Council with information and reports related to chemical fingerprinting of PAH in Portland Harbor. While the allocation model does not explicitly incorporate chemical fingerprinting, the Trustee Council reviewed the primary literature to investigate whether the allocation model could more clearly define the amount, type, and spatial extent of PAH contamination released from relevant activities. The Trustee Council's review indicated that the quantity of PAHs varies by product. For example, the quantity of total PAHs in manufactured gas plant (MGP) waste was approximately one hundred times greater (by weight) than in refined petroleum products such as gasoline and diesel fuel. Therefore, the Trustee Council concluded that several harbor-wide updates to the allocation model were warranted, including:

- PAH footprints downstream of sites that contributed MGP waste, extending to river mile 4, were allocated to the party or parties responsible for those activities.
- The General Activity rankings for two activities, Coal/Oil Gasification Plant/Refinery Operations and Disposal of Liquid Manufactured Gas Plant Waste, were increased to reflect a higher percentage of PAHs in MGP waste than in other PAH-containing products.

4.4 SUMMARY

During the course of the Phase 2 early settlement process, the Trustee Council reviewed new factual information either provided by participating parties or gathered from publicly available documentation and primary literature reviews. The Trustee Council evaluated this information to determine if a harbor-wide allocation model update was warranted, and in several instances, implemented revisions as appropriate. This process ensured that allocation model changes were consistent with the approach taken to develop the initial allocation, and enabled the Trustee Council to maintain a consistent, equitable, transparent, and replicable model.

REFERENCES

DEQ (Oregon Department of Environmental Quality). 2013. Environmental Cleanup Site Information Database. [ONLINE] Available at: http://www.deq.state.or.us/lq/ECSI/ecsiquery.asp?listtype=lis&listtitle=Environmental+Cleanup+Site%20Information+Database

IEc (Industrial Economics, Inc.). 2018. Portland Harbor Superfund Site Natural Resource Damage Assessment Plan Addendum 2: Phase 3 Damage Assessment Plan. Prepared for the National Oceanic and Atmospheric Administration. October. Available at: https://casedocuments.darrp.noaa.gov/northwest/portharbor/pdf/Portland_Harbor_Addendum_to_Nat_Res_Damage_Assess_Plan_0309_2018_Public.pdf

LWG (Lower Willamette Group). 2004-2007. Portland Harbor RI/FS Conceptual Site Model Update. Prepared for the Lower Willamette Group. Integral Consulting, Inc. and Groundwater Solutions, Inc. September 17, 2004. Appendix A. Site Summaries. September 2004, March 2005, and February 2007.

LWG. 2007. Portland Harbor RI/FS Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report. Prepared for the Lower Willamette Group. Integral Consulting, Inc., Windward Environmental LLC, Kennedy/Jenks Consultants, and Anchor QEA, LLC. February.

LWG. 2009. Portland Harbor Draft Remedial Investigation Report. Prepared for the Lower Willamette Group. Integral Consulting, Inc., Windward Environmental LLC, Kennedy/Jenks Consultants, and Anchor QEA, LLC. October.

LWG. 2012. Portland Harbor Draft Feasibility Study. Prepared for the Lower Willamette Group. Anchor QEA, LLC, Windward Environmental LLC, Kennedy/Jenks Consultants, and Integral Consulting, Inc. March.

NOAA (National Oceanic and Atmospheric Administration). 2002. Natural Resources Damage Allocation of Injuries to Natural Resources in the Hylebos Waterway. Prepared for NOAA Damage Assessment Center and US Department of Justice. EcoChem, Inc. and GeoSphere. February.

Stratus (Stratus Consulting, Inc.). 2010. Portland Harbor Superfund Site Natural Resource Damage Assessment Plan. Prepared for the Portland Harbor Natural Resource Trustee Council. June. Available at: https://www.fws.gov/portlandharbor/sites/portland/files/documents/NavigationClaimAddendum.pdf

EPA (U.S. Environmental Protection Agency). 1994. Developing allocations among potentially responsible parties for the costs of Superfund site cleanups. Prepared by the Office of Site Remediation Enforcement. October. Accessed at: https://www.epa.gov/sites/default/files/2020-02/documents/allocation-prps-1994.pdf

APPENDICES

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
adhesives production/use[2]	MPT	Adhesives production/use is considered an activity because phthalates are used as plasticizers in adhesives.
adhesives waste disposal[2]	MST	Adhesives waste disposal is considered an activity because phthalates are used as plasticizers in adhesives.
aluminum smelting/nonferrous smelting[2]	MPT	Aluminum smelting/nonferrous smelting refers to activities in the metals recycling business such as cutting, torching, segregating, storing, and distributing metals, as well as recovering metals from wire (primarily copper, aluminum, and lead). Wire coatings and insulation are included in this activity.
application/disposal of pesticides[2]	MST	Application/disposal of pesticides is considered an activity because once released into the environment, pesticides and their breakdown products can move through the hydrologic system to streams and ground water. Application may refer to spraying during and after WWII or discharge into West and North Doane Lake.
asphalt batch plant/asphalt production[2]	MPT	Asphalt batch plant/asphalt production refers to the production of asphalt from the residual product of petroleum distillation. Asphalt and fumes generated through production contain PAH.
ASR generation/storage[2,3]	MPT	Asphalt batch plant/asphalt production refers to the production of asphalt from the residual product of petroleum distillation. Asphalt and fumes generated through production contain PAH.
ASR used as fill[2]	LT	ASR (Automobile Shredder Residue) used as fill refers to the materials from end-of- life vehicles that are landfilled. This material includes substances of concern.
AST bilge water[2,4]	MST	AST bilge water refers to any container used to store oil that is 55 gallons or greater and is above ground. Bilge water contains shipboard wastewater which can contain PAH.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
AST bunker c[2]	FST	AST Bunker C refers to any container used to store oil that is 55 gallons or greater and is above ground. Petroleum based fuels and oils contain PAH. MP4 is a natural product present in crude oil and coal tar.
AST diesel[2]	FST	AST diesel refers to any container used to store oil that is 55 gallons or greater and is above ground. Petroleum based fuels and oils such as diesel contain PAH. MP4 is a natural product present in crude oil and coal tar.
AST gasoline[2]	FST	AST gasoline refers to any container used to store oil that is 55 gallons or greater and is above ground. Petroleum based fuels and oils such as gasoline contain PAH. MP4 is a natural product present in crude oil and coal tar.
AST heating oil[2]	FST	AST heating oil refers to any container used to store oil that is 55 gallons or greater and is above ground. Petroleum based fuels and oils such as gasoline, diesel and motor oil contain PAH.
AST hydraulic fluid[2]	FST	AST hydraulic fluid refers to any container used to store oil that is 55 gallons or greater and is above ground. Any leakage or spillage of hydraulic fluid either directly to the waterway or to the ground could cause a release of PAH. Hydraulic fluids were identified as high-risk sources of PCBs.
AST jet fuel/aviation gas[2]	FST	AST Jet Fuel/Aviation Gas refers to any container used to store oil that is 55 gallons or greater and is above ground. Petroleum based fuels and oils contain PAH. MP4 is a natural product present in crude oil and coal tar. Lead is known to be an additive to petroleum mixtures.
AST kerosene[2]	FST	AST Kerosene refers to any container used to store oil that is 55 gallons or greater and is above ground. Petroleum based fuels and oils contain PAH.
AST lubrication oil[2]	FST	AST lubrication oil refers to any container used to store oil that is 55 gallons or greater and is above ground. Petroleum based fuels and oils contain PAH.
AST naphtha solvent[2]	MPT	AST naptha solvent refers to any container used to store oil that is 55 gallons or greater and is above ground. Naptha solvent contains PAH. Any leakage or spillage could result in contamination to the waterway.
AST other petroleum/unknown petroleum[2]	FST	AST Other Petroleum/Unknown Petroleum refers to any container used to store oil that is 55 gallons or greater and is above ground. Petroleum based fuels and oils such as gasoline, diesel and motor oil contain PAH.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
AST waste oil[2]	FST	AST waste oil refers to any container used to store oil that is 55 gallons or greater and is above ground. Petroleum based fuels and oils such as gasoline, diesel and motor oil contain PAH. MP4 is a natural product present in crude oil and coal tar.
ballast water storage/treatment[2]	MST	Ballast water storage/treatment refers to pretreated ballast water that contains oil. Petroleum based fuels and oils such as gasoline, diesel and motor oil contain PAH.
battery breaking/recycling[2]	MST	Battery breaking or recycling is the process of separating, crushing, and processing batteries. The goal is to recover the component materials (e.g., metals) from the disposed batteries for reuse. Prior to 1980, it was common practice to dump residual wastes on-site or in pits. Toxic metals including lead and cadmium are found in battery acid waste.
battery manufacturing[2]	MPT	Battery manufacturing is considered an activity because toxic metals are found in significant amounts in battery manufacturing wastewater.
boat moorage or marina operations[2]	MST	Boat moorage or marina operations refers to activities and materials associated with boat moorage and marina operations that have the potential to contaminate stormwater.
bulk lead product overwater handling[2]	MST	Bulk lead product overwater handling and any associated spills or leakage could contaminate the waterway.
burning waste, debris[2]	MPT	Burning waste and debris is considered an activity because construction and demolition debris can include various wastes that may potentially contain contaminants.
cement manufacturing/cement terminal[2]	MPT	Cement manufacturing/cement terminal is considered an activity because manufacturing, storing, transporting, and transferring cement is a possible source of contamination.
chromated copper arsenate manufacture[2]	MPT	Chromated copper arsenate manufacture refers to the production of chromated copper arsenate using solid copper oxide. Any drips, spills or discharges to surface or ground water would result in contamination.
coal/oil gasification plant/refinery operations[2]	MPT	Coal gasification plant/refinery operations refers to the gasification process to produce gas, lampblack briquettes, light oil, tar, coke. Multiple SOCs may be associated with these products. PAH are organic compounds that occur naturally in coal. MP4 is a natural product present in crude oil and coal tar. Mercury and lead are substances identified in wastewater associated with coal tar production and operations. Lead is known to be an additive for petroleum mixtures.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
coal tar distillation plant operations[2]	MPT	Coal tar distillation plant operations refers to the distillation of coal tar to produce chemical oil, creosote, and pitch. Multiple SOCs may be associated with these products. PAH are organic compounds that occur naturally in coal. MP4 is a natural product present in crude oil and coal tar. Mercury and lead are substances identified in wastewater associated with coal tar production and operations.
coal/coal tar pitch storage/distribution[2]	MST	Coal/coal tar pitch storage/distribution refers to the storage of coal or coal tar pitch for distillation and distribution. PAH are organic compounds that occur naturally in coal. MP4 is a natural product present in crude oil and coal tar. Mercury and lead are substances identified in wastewaters associated with coal tar production and operations.
concrete manufacturing/batching[2]	MPT	Concrete manufacturing/batching refers to the manufacturing, storage, transporting, mixing, and discharging of concrete. These activities are a potential source of contamination.
construction debris transfer station operation[2]	MST	Construction debris transfer station operation is considered an activity because construction and demolition debris can include various wastes known to contain potential contaminants.
contaminant release from sunken ships[2]	ST	Contaminant release from sunken ships is considered an activity because materials of concern used on ships can be released into the water and cause high levels of environmental pollution.
copper wire stripping[2]	MST	Copper wire stripping refers to the insulated coverings of copper wires which have been stripped from the wires. These coverings can include lead, plastics, and PCBs.
creosote oil seepage[2]	ST	Creosote oil has been found seeping from soils in the Willamette River due to migration of creosote oil products from on-site waste disposal pits. Creosote contains PAHs and phenols.
creosote treated railroad ties[5]	MST	Creosote treated railroad ties refers to railroad ties that are treated with creosote, which may leach into the environment. Creosote contains PAHs and phenols.
creosote treated wood pilings[5]	MST	Creosote treated wood pilings is considered an activity because creosote treated wood can contain PAH and copper, which may leach into the environment.
discharge of machine shop metal shavings[2]	ST	Discharge of marine shop metal shavings is considered an activity because copper is a component of steel shavings.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
discharge of roadway runoff[2]	ST	Discharge of roadway runoff refers to the runoff from highways and other roadways, including bridges, into the Willamette River.
disposal of coal tar distillation wastewater[2]	ST	Disposal of coal tar distillation wastewater refers to the disposal of liquid coal tar distillation wastewater, which may contain several SOCs. PAH are organic compounds that occur naturally in coal. MP4 is a natural product present in crude oil and coal tar. Mercury and lead are substances identified in wastewater associated with coal tar production and operations.
disposal of liquid manufactured gas plant waste	MST	Disposal of liquid manufactured gas plant waste refers to wastewater containing petroleum emulsions, lampblack, and tars that has been discharged to the river or to a settling pond which drains to the river. PAH are organic compounds that occur naturally in coal. MP4 is a natural product present in crude oil and coal tar. Mercury and lead are substances identified in wastewater associated with coal tar production and operations.
disposal of unknown chemical waste[2]	ST	Disposal of unknown chemical waste refers to chemical releases to the river or on shore. SOCs are determined based on each individual event.
electric arc welding[2]	MPT	Electric arc welding is considered an activity because particulate matter and particulate-phase hazardous air pollutants are released in the welding processes. Electric arc welding generates these pollutants in substantial quantities.
epoxy resin waste disposal[2]	MST	Epoxy resin waste disposal refers to solid resins or plastics in the waste stream. Phthalates are used as plasticizers in resins and plastics.
extensive vehicle operations or washing facilities[2]	MST	Extensive vehicle operations or washing facilities may potentially release PAH by way of waste oil discharges through operations or cleaning.
extensive vehicle operations – railyard[2]	MST	Extensive vehicle operations – railyard refers to extensive use of railcars which could potentially release PAH by way of waste oil discharges through operations or cleaning.
fuel oil use[2]	MST	Fuel oil use includes fuel used to power boilers and other equipment. Petroleum based fuels and oils such as gasoline, diesel, and motor oil contain PAH. MP4 is a natural product present in crude oil and coal tar.
fueling operations[2]	MST	Fueling operations include gas stations, transfer of petroleum products from ship to pipeline or tank to truck, fueling ships/boats, fueling trains. Petroleum based fuels and oils such as gasoline, diesel, and motor oil contain PAH. MP4 is a natural product present in crude oil and coal tar.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
gas turbine power generation[2]	MST	Gas turbine power generation uses petroleum based fuels and oils such as gasoline, which contains PAH. Lead is known to be an additive for petroleum mixtures.
hazardous waste report at Site 125[2]	MST	The Oregon DEQ Hazardous Waste Site Report indicated that wastes containing PAHs, Hg, and BEPH were handled on site.
hazardous waste report at Site 131[2]	MST	The Oregon DEQ Hazardous Waste Site Report indicated that wastes containing Cd, Cu, Hg, and Pb were handled on site.
hydraulic fluid use[2]	MST	Hydraulic fluid use is considered an activity because any leakage or spillage of hydraulic fluid, either directly to the waterway or to the ground, could cause a release of PAH. Hydraulic fluids were identified as high-risk sources of PCBs.
hydraulic oil leakage/spills[2]	ST	Hydraulic oil leakage/spills refers to any leakage or spillage of hydraulic fluid either directly to the waterway or to the ground, which could release PAH. Hydraulic fluids were identified as high-risk sources of PCBs.
hydrocarbon based wood preservative use/storage[2]	MST	Hydrocarbon based wood preservative use/storage may involve various wood treating products. SOCs are assigned based on what was used at the site.
ink manufacturing[2]	MPT	Ink manufacturing is considered an activity because heavy metals and oils are used in the manufacturing of ink and ink pigments.
land application of oily bilge water[2]	ST	Land application of oily bilge water could contain petroleum oils, which contain PAH.
landfill of coal tar distillates	LT	Landfill of coal tar distillates refers to spent oxide, waste coal tar distillates, and tank bottom sludges that are potentially mixed with quarry rock and tar. This material was used to fill low-lying areas.
landfill of construction and demolition debris[6]	LT	Landfill of construction and demolition debris can include various wastes (such as bricks, concrete rubble, floor slabs, piers, pilings, etc.) known to potentially contain substances of concern.
landfill of dredged sediments-Willamette prior to 1980[5]	LT	Landfill of dredged sediments – Willamette prior to 1980 refers to the dredging of Willamette River sediments and deposition of these sediments on land. Dredging occurred over many years. The river has been contaminated with all SOCs from various sources, and the dredged material is assumed to contain multiple SOCs.
landfill of manufactured gas plant waste[6]	LT	Landfill of manufactured gas plant waste refers to the landfilling of solid manufactured gas plant waste. PAHs, copper, mercury and lead are all SOCs identified in gas plant waste.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
landfill of scrap metal[6]	LT	Landfill of scrap metal includes rebar and waste metal buried on site. Cadmium, copper, mercury and lead are common metals in scrap metals.
landfill of shredded battery casings[6]	LT	Landfill of shredded battery casings refers to battery casings that contained a lead core.
landfill of WWII ship debris[6]	LT	Landfill of WWII ship debris is considered an activity because materials used on ships may include SOCs that can be released into the water and cause environmental pollution.
landfilling of Doane Lake by surrounding properties[6]	LT	Landfilling of Doane Lake by surrounding properties refers to the filling of Doane Lake with coal tar, lead battery waste, and other contaminated waste. This occurred from the 1920s to the 1940s and was conducted by heavy industries along the shores of Doane Lake to fill in most of East, West, and North Doane Lake.
landfilling used sandblast grit[6]	LT	Landfilling used sandblast grit in inter-tidal or bank areas could result in releases of any contaminants associated with the grit. SOCs may include PAH, PCB, TBT, Cd, Cu, Hg, and Pb.
lead smelting[2]	MST	Lead smelting refers to lead processing and smelting operations that work with both primary and secondary lead. Primary lead is mined and secondary lead is recovered from used objects such as used lead-acid batteries.
locomotive maintenance/manufacturing[2]	MPT	Locomotive maintenance/manufacturing refers to railroad maintenance and manufacturing activities, which may include sand-blasting, painting, machining, welding, and dismantling and reassembly of locomotives, rail cars, and switching operations.
lubricating oil used in manufacturing[2]	MST	Lubricating oil used in manufacturing is considered an activity due to the use of petroleum based fuels and oils that may contain PAH.
manufacturing abrasives[2]	MPT	Manufacturing abrasives is considered an activity because emissions generated in the manufacturing of abrasives include cadmium, mercury, and lead.
manufacturing of paint products[2]	MPT	Manufacturing of paint products is considered an activity because paint products typically consist of pigment, resin, solvent and additives.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
manufacturing of resins[2]	MPT	Manufacturing of resins is considered an activity because both the plastic resin industry and the manmade fiber industry use refined petroleum products and synthetic organic chemicals to make selected polymers. Unreacted or improperly reacted polymer synthesis or regeneration residues may include monomers, oligomers, metals, degradation products, solvents, and coagulants (EPA, 1995). MP4 is a natural product present in crude oil and coal tar.
mechanical/electric motor repair and maintenance[2]	MST	Mechanical/electric motor repair and maintenance refers to a wide variety of processes used in repair shops. Contaminants of concern are used in these processes and if not stored and disposed of properly can potentially cause environmental contamination.
mercury spill[2]	ST	Mercury spill refers to the leakage or spillage of mercury directly to the waterway or to the ground.
metal casting[2]	MPT	Metal casting may use cadmium, copper, and mercury.
metal plating operations[2]	MST	Metal plating operations refers to metal finishing operations that use, generate, or emit cadmium and copper.
motor vehicle manufacturing[2]	MPT	Motor vehicle manufacturing is considered an activity because many different manufacturing processes are used to make components used in motor vehicle manufacturing, including metals, plastics, fluids and lubricants.
municipal landfill operation[2]	LT	Municipal landfill operation refers to landfilled municipal wastes which can contain substances of concern and become sources of environmental contamination.
non-magnetic ASR generation/storage[2]	MPT	Non-magnetic ASR generation/storage refers to the materials from end-of-life vehicles that are not recycled. This material includes substances of concern.
oil/petroleum product packaging[2]	MPT	Oil/petroleum product packaging is the process of canning bulk oil or petroleum products into drums or bottles. Petroleum products may contain PAHs and MP4.
oil/water separation/filtration use[2]	ST	Oil/water separation/filtration use refers to any waste oils captured in an oil-water separator that were released in the event of a device malfunction. These waste oils could release PAH.
oil used in machine maintenance[2]	MST	Oil used in machine maintenance is considered an activity due to the use of petroleum based fuels and oils such as gasoline, diesel, and motor oil that may contain PAH.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
painting boats or marine vessels[2]	MST	Painting boats or marine vessels is considered an activity because marine paints contain metals that could be released at shipyards where paint application or removal takes place.
PCB capacitor use[5]	MST	PCB capacitor use is considered an activity because the use of PCB capacitors may be a potential source of contamination.
PCB contaminated oil spill[2]	ST	PCB contaminated oil spill refers to a spill of oil that contains PCBs, which poses a potential risk if released either directly to the waterway or to the ground where surface water or ground water contact is possible.
PCB contaminated oil use[2]	MST	PCB contaminated oil use is considered an activity due to the use of PCB containing oils in applications other than electrical equipment (e.g. coolant or insulating fluids containing PCBs). SOCs may include PCB.
PCB transformer use/spills/storage[5]	MST	PCB transformer use/spills/storage is considered an activity because the use or storage of electrical transformers containing PCBs may be a potential source of contamination.
pesticide storage[2]	MST	Pesticide storage refers to the storage of pesticides in storage tanks, drums, or bottles which have the potential to leak and release contaminants. DDT and diesel were stored in the study area for pest control purposes.
pesticides formulation[2]	MPT	Pesticides formulation refers to formulating solutions of pesticides by mixing the pure form with various solvents.
pesticides manufacturing[2]	MPT	Pesticides manufacturing refers to DDT manufacturing, storage, and distribution. Manufacturing process residue (MPR) from DDT manufacturing was historically discharged to floor drains.
petroleum leaks from ship maintenance & repairs[2]	ST	Petroleum leaks from ship refers to the potential leaks of petroleum from ships, during activities such as ship repair and maintenance work on vessels which used various PAH containing fuels and oils. MP4 is a natural product present in crude oil and coal tar.
petroleum leaks/spills[2]	ST	Petroleum leaks/spills refers to the leakage or spillage of petroleum-based products directly to the waterway or to the ground, which may cause the release of PAH and MP4 (a natural product present in crude oil and coal tar).

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
petroleum refining[2]	MPT	Petroleum refining refers to the process of refining petroleum, which generates wastes containing PAH that are classified as RCRA hazardous material. MP4 is a natural product present in crude oil and coal tar.
petroleum transporting and storage in leaking containers[2]	ST	Petroleum transporting and storage in leaking containers/drums includes petroleum products such as gasoline, diesel, and motor oil that are transported or stored in leaking containers and are potential sources of PAH releases. MP4 is a natural product present in crude oil and coal tar.
production of creosote[2]	MPT	Production of creosote is considered an activity because creosote contains PAHs and phenols.
production/storage of electric arc furnace dust[2]	MPT	Production/storage of electric arc furnace dust refers to electric arc furnace dust that is a by-product of the steel production process. Cadmium, copper, and lead are constituents in electric arc furnace dust.
pulp mill operations[2]	MPT	Pulp mill operations process black liquor wastewater that may contain high molecular weight PAH.
pump manufacturing/refurbishing[2]	MPT	Pump manufacturing/refurbishing uses processes such as metal fabrication and machining, pump testing, and painting.
reconditioning/washing used steel drums[2]	MST	Reconditioning/washing used steel drums includes drums received for reconditioning that contain residual material including oils, solvents, paints, and food. Wastewater generated by the refurbishing process and not properly discharged could result in contamination of the waterway.
recycling of PCB transformers[2]	MST	Recycling of PCB transformers is considered an activity because transformers containing PCBs were noted as handled or recycled within the assessment area and may be a potential source of contamination.
sandblasting for other than boats or vessels[2]	MST	Sandblasting for other than boats or vessels refers to sanding, sandblasting, and pressure washing meant to remove paint from various surfaces (excluding boats and vessels). In the process, metals used in paints may be released.
sandblasting/pressure washing of painted boat vessels[2]	MST	Sanding/sandblasting/pressure washing of painted boats or vessels refers to sanding, sandblasting, and pressure washing meant to remove paint and marine growth from boats and vessels. In the process, metals and organics used as antifouling agents may be released.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
scrap metal yard operation[2]	MST	Scrap metal yard operation is considered an activity because cadmium, copper, mercury, and lead are common in scrap metals.
ship berthing[6]	ST	Ship berthing is considered an activity because of the potential and actual contamination resulting from the physical presence of a docked ship and the anti- fouling paint used on marine vessels.
ship dismantling[2]	MST	Ship dismantling may release waste oils and fuels, a potential source of PAH. Releases could occur from oil and fuel spills or leaks directly into the waterway. PCBs were commonly used in larger vessels for various purposes, and dismantling of ships could cause releases of PCBs. TBT was a common component of the paint applied to larger vessels due to its anti-fouling properties.
ship/boat maintenance and/or construction[6]	MST	Ship/boat maintenance and/or construction refers to maintenance and/or construction performed on ships or boats. PCBs were commonly used in larger vessels for various purposes. Ship building could potentially cause releases of PCBs. PAH compounds are present in most of the fuels and oils used during ship maintenance/construction.
slag storage or landfilling[2]	LT	Slag storage or landfilling refers to the storage or landfilling of slag, which is a byproduct of smelter operations and can contain arsenic, cadmium, copper, lead, and zinc.
steel fabrication[2]	MPT	Steel fabrication, regardless of the forming method, usually employs the use of cutting oils (e.g., ethylene glycol), degreasing and cleaning solvents, acids, alkalis, and heavy metals.
steel manufacturing[2]	MPT	Steel manufacturing processes generate cadmium, which is used as an electroplated coating on steel. Copper is added to steel to increase corrosion resistance.
storage of lead batteries[2]	MST	Storage of lead batteries is considered an activity because the electrode grids contained within lead-acid battery housings are made of lead.
storage of tires[2]	MST	Storing used tires outside may result in PAHs and heavy metals leaching into the environment.
storage or transporting PCB contaminated material[2]	MST	Storage or transporting PCB contaminated material may be a potential source of PCB contamination.
storage/disposal of mercury contaminated materials/debris at Site 139[2]	MST	The Oregon DEQ Hazardous Waste Site Report indicated that wastes containing HG were handled on site.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
storage/recycling of waste oils containing PCBs[2]	MST	Storage/recycling of waste oils containing PCBs may be a potential source of contamination.
uncovered coal/coal tar storage[2]	MST	Uncovered coal/coal tar storage may be a potential source of several SOCs. For example, PAH are organic compounds that occur naturally in coal. MP4 is a natural product present in crude oil and coal tar. Exposure to storm water may leach PAH from the coal and transport these compounds to the ground where they could contact surface or ground water.
unprotected petroleum sump[2]	ST	Unprotected petroleum sump includes sumps on unpaved ground. An unprotected petroleum sump could lead to contamination of the waterway. Petroleum based fuels and oils such as gasoline, diesel, and motor oil contain PAH. MP4 is a natural product present in crude oil and coal tar.
unprotected storage of lead-acid batteries[2]	ST	Unprotected storage of lead-acid batteries could lead to contamination of the environment from the mercury and lead used in those batteries.
unprotected storage of nickel-cadmium batteries[2]	ST	Unprotected storage of nickel-cadmium batteries could lead to contamination of the environment from the mercury and cadmium used in those batteries.
unprotected storage of paints/waste disposal/spills[2]	ST	Unprotected storage of paints/waste disposal/spills refers to paints that may have contained lead, mercury, copper and/or TBT. Any leakage of spill could lead to environmental contamination.
unprotected storage of petroleum contaminated soil[2]	ST	Unprotected storage of petroleum contaminated soil includes areas of petroleum contaminated soil that remain in place for a period of time, as well as excavated contaminated soil that was improperly stored or disposed. Petroleum products are potential sources of PAH releases. MP4 is a natural product in crude oil and coal tar. The storage of petroleum contaminated soil may be a source of contamination.
unprotected storage of spent sandblasting grit[2]	MST	Unprotected storage of spent sandblasting grit is considered an activity because sandblasting of vessels with contaminant-containing paints would result in the accumulation of the contaminants in the waste grit.
UST bunker c[6,7]	FST	UST Bunker C refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Petroleum based fuels and oils contain PAH. MP4 is a natural product present in crude oil and coal tar.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
UST diesel[6]	FST	UST diesel refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Petroleum based fuels and oils such as diesel contain PAH. MP4 is a natural product in crude oil and coal tar.
UST gasoline[6]	FST	UST gasoline refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Petroleum based fuels and oils such as gasoline contain PAH. MP4 is a natural product in crude oil and coal tar.
UST heating oil[6]	FST	UST heating oil refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Petroleum based fuels and oils such as gasoline, diesel and motor oil contain PAH. MP4 is a natural product present in crude oil and coal tar.
UST hydraulic fluid[6]	FST	UST hydraulic fluid refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Any leakage or spillage of hydraulic fluid either to directly to the waterway or to the ground could cause a release of PAH. Hydraulic fluids were identified as high-risk sources of PCBs.
UST Jet Fuel/Aviation gas[6]	FST	UST Jet Fuel/AV Gas refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Petroleum based fuels and oils such as gasoline, diesel and motor oil contain PAH. MP4 is a natural product present in crude oil and coal tar. Lead is known to be an additive to petroleum mixtures.
UST leaded gasoline[6]	FST	UST leaded gasoline refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Petroleum based fuels and oils such as gasoline, contain PAH. MP4 is a natural product present in crude oil and coal tar. Lead is an additive for leaded gasoline.
UST lubrication oil[6]	FST	UST lubrication oil refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Petroleum based fuels and oils contain PAH.

ACTIVITY	ACTIVITY TYPE[1]	DESCRIPTION
UST other petroleum/unknown petroleum[6]	FST	UST Other Petroleum/Unknown Petroleum refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Petroleum based fuels and oils such as gasoline, diesel and motor oil contain PAH.
UST paint sludge[6]	MPT	UST paint sludge refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Lead and cadmium are components in paint sludge. Any leakage or spill could lead to environmental contamination.
UST septic tank[6]	MST	UST septic tank refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. MP4 was identified in septic tank effluent.
UST waste oil[6]	FST	UST waste oil refers to an underground storage tank system in which at least ten percent of the combined volume of the tank and the underground piping connected to that tank are located underground. Petroleum based fuels and oils such as gasoline, diesel and motor oil contain PAH. MP4 is a natural product present in crude oil and coal tar.
vehicle recycling and wrecking[2]	MPT	Vehicle recycling and wrecking may release lead, arsenic, PCBs, plastics, cadmium, copper, and mercury, as well as common vehicle-related petroleum products such as oils, lubricants, and fuels contain PAH. These components could be introduced into the ASR.
waste transfer station operation[2]	MST	Waste transfer station operation is considered an activity because waste transfer stations may contain potential sources of pollution which can result in environmental contamination.
wood preservative use[2]	MST	Wood preservative use includes preservative use on dry docks as well as other operations. Wood preservatives can contain creosote, PAH, and copper.

Notes:

Gray shading indicates activities that were added to the allocation as new information became available.

1. The five activity types include the following: FST (fuel storage type), MST (maintenance/service type), MPT (manufacturing/production type), LT (landfill type), and ST (spill type).
2. These activities are allocated 100% to the operator(s) as part of the party allocation methodology.
3. ASR is auto shredder waste.
4. AST is an above-ground storage tank.

5. These activities are allocated 100% to the owner(s) as part of the party allocation methodology.
6. These activities are allocated 20% to the owner(s) and 80% to the operator(s) as part of the party allocation methodology.
7. UST is an underground storage tank.

APPENDIX B | ALLOCATION DETAILS

B.1 ALLOCATION OF NON-SITE-SPECIFIC SOURCES

First, the Trustee Council established a Total Assessment Area Budget (i.e., mass) for each SOC that had particulate loading modeled in the draft RI (LWG 2009). This budget represented the total amount of an SOC in assessment area sediments from both site-specific and non-site specific sources. The Trustee Council calculated the budget using the Trustee Council's GIS maps of SOC sediment concentrations and multiplied the area by the mean concentration in each contaminant contour and a depth of 30 cm (predominant depth of remedial sampling). The Total Assessment Area Budget (Kg) for each SOC NSS contribution and the formula for these calculations is provided in Exhibit B-1.

EXHIBIT B-1 TOTAL ASSESSMENT AREA BUDGET FOR NSS SOCS

SOC	TOTAL ASSESSMENT AREA BUDGET (KG)[1]
Total PAH	14,600
Total PCB	443
Total DDx	241
Copper	497,000
TBT	260
BEPH	2,500

Note.

1. Total SOC Kg = Summed for each concentration:
   ((area in square meters)*(depth in meters [.3])*(sediment dry weight conversion in Kg/cubic meters [1100])*(SOC conc in mg/Kg))/1,000,000

To determine the relative contribution from upstream sediments, the Trustee Council used the particulate concentrations from upstream sources as calculated in Kg/year in the draft RI for Total PAH, Total PCB, Total DDx, and copper (LWG 2009). TBT concentrations were reported as total ion values and evaluated based on the total estimated loading. BEPH concentrations were not available for the particulate fraction from upstream loading, and LWG (2009) indicated that "much of the surface water load passes through the site." Therefore, using the particulate loading (Ky/yr) for the other SOCs as a reference, the Trustee Council made a reasonable assumption that a minimal amount of the BEPH upstream loading (0.1%) is present in particulate.

The Kg/year concentrations for each NSS SOC considered were converted to Total Kg for comparison to the 30 cm Total Assessment Area Budget (Kg) by using the bathymetric estimate of a site-wide net sedimentation rate of 2.6 cm/year (Table 6.2-2, LWG 2012).[14,15] The resulting total Kg of particulate entering the assessment area was then further adjusted for the estimated amount that would remain in the river rather than continue to flow downstream. An overall trapping efficiency of 20% was used based on the LWG draft FS site-wide trapping efficiency estimates (LWG 2012).[16] After applying these factors, the total Kg of each SOC remaining in the assessment area was divided by the Total Assessment Area Budget (Kg) to arrive at an estimate of the percent contribution for each NSS SOC from upstream sediments (Exhibit B-2).

EXHIBIT B-2 TOTAL NSS CONTRIBUTIONS FROM UPSTREAM SEDIMENTS

SOC	UPSTREAM PARTICULATE KG/YR[1]	OVERALL NET SEDIMENTATION RATE (CM/YR)[1]	KG FROM UPSTREAM OVER TIME PERIOD FOR TOP 30 CM	KG AFTER APPLYING 20% TRAPPING EFFICIENCY	% CONTRIBUTED TO PH ASSESSMENT AREA SEDIMENTS
Total PAH	82.0	2.6	946.0	189.0	1.29%
Total PCB	2.0	2.6	23.1	4.6	1.04%
Total DDx	4.6	2.6	53.1	10.6	4.40%
Copper	27,000.0	2.6	311,538.0	62,307.0	12.53%
TBT	11.0	2.6	126.9	25.4	9.76%
BEPH[2]	7.5	2.6	86.5	17.3	0.70%

Notes:

1. Source: LWG (2012). For purposes of the streamlined allocation analysis, the sedimentation rate was used solely to estimate the amount of contaminated sediment (in kilograms) entering the assessment area (i.e., harbor-wide) from upstream sediment and stormwater contributions. It was not used to predict resource recovery or to identify specific erosional or depositional areas within the assessment area.
2. Assume 0.1% in particulate.

The second source of NSS contributions to sediment contamination is non-industrial stormwater. This includes stormwater and runoff from transportation facilities as well as

---

14 LWG (2012) developed one sedimentation rate and trapping efficiency for the entire remedial study area. However, these parameters vary widely, and application of area-wide values overestimates sedimentation in some sections of the assessment area and underestimates sedimentation in others. Because information was insufficient to calculate sedimentation rate and trapping efficiency on a smaller scale, in the context of this allocation exercise the Trustee Council applied the LWG (2012) estimates to the whole assessment area.

15 For purposes of the site allocation, the sedimentation rate was used solely to estimate the amount of contaminated sediment (in kilograms) entering the assessment area (i.e., harbor-wide) from upstream sediment and stormwater contributions. It was not used to predict resource recovery or to identify specific erosional or depositional areas within the assessment area

16 See footnote 13.

stormwater collected from large areas of non-industrial land uses in the Willamette River watershed and discharged via storm drains to the assessment area. LWG measured overall stormwater contaminant loadings, including calculation of a basin weighted mean loading estimate to assessment area sediment based on stormwater sediment trap measurements (Table 6.1-4, LWG 2009). The Trustee Council adjusted that loading estimate to account for contributions from non-industrial sources (as industrial sources are allocated based on site-specific activities) using the percentage of representative land use types (Table 6.1-5b, LWG 2009). Similar to the upstream sediment contributions, the Trustee Council converted the resulting Kg/year to Total Kg in the top 30 cm of sediment by using the bathymetric estimate of assessment area-wide net sedimentation of 2.6 cm/year (Table 6.2-2, LWG 2012), and applied the 20% trapping efficiency. The Trustee Council divided the total Kg of each SOC in the assessment area by the Total Kg Budget to estimate the percent contribution for each relevant SOC from stormwater (Exhibit B-3).

EXHIBIT B-3 TOTAL NSS CONTRIBUTIONS FROM STORMWATER

SOC	SEDIMENT TRAP DATA (KG/YR)[1]	NON-INDUSTRIAL LAND USE CONTRIBUTION (%)[1]	KG PARTICULATE FROM NON-INDUSTRIAL SOURCES OVER TIME PERIOD FOR TOP 30CM	KG AFTER APPLYING 20% TRAPPING EFFICIENCY	% CONTRIBUTED TO PH ASSESSMENT AREA SEDIMENTS
Total PAH	15.20	6.54%	11.47	2.29	0.016%
Total PCB	0.43	4.22%	0.21	0.04	0.010%
Total DDx	0.37	1.17%	0.05	0.01	0.004%
Copper	310.00	3.37%	120.50	24.10	0.005%
TBT	No data	---	---	---	---
BEPH	5.30	21.97%	13.44	2.69	0.109%

Note.
1. Source: LWG (2009).

In the final step, the Trustee Council added together the percent contributions from upstream sediments and stormwater for each SOC (see Exhibit 2-7). To account for upstream contributions, the Trustee Council subtracted the NSS contributions per SOC from the site and party allocations.

B.2 ALLOCATION OF OUTFALLS

Owners of public outfalls benefit by having that infrastructure in place (e.g., outfalls provide a mechanism for drainage, which limits flooding) and may gain additional economic benefits from the discharge of contaminants from site-specific activities into the outfall system (e.g., the City of Portland benefits through its rate payers). The Trustee Council applied the following rules to allocate liability at *publicly owned* outfalls:

1. For all activities relevant to heavy and light industrial properties, the Trustee Council identified the land use percentage within the drainage area.[17]
    - Heavy industrial drainage accounts for 14% of the land use.
    - Light industrial drainage accounts for 9% of the land use.
2. Determined the percentage land use draining to the study area that is publicly owned by the City of Portland.
    - Approximately 30% of heavy industrial drainage flows through the City of Portland outfalls and the remaining 70% discharges through private outfalls or other pathways.
    - Approximately 75% of light industrial drainage flows through the City of Portland outfalls and the remaining 25% discharges through private outfalls or other pathways.
3. Determined the percentages of sediment loading for each SOC pertaining to heavy and light industrial land use drainage (Exhibit B-4; LWG 2009, Table 6.1-5b).

EXHIBIT B-4 SEDIMENT LOADING PER SOC, BY LAND USE DESIGNATION

SOC	HEAVY INDUSTRIAL	LIGHT INDUSTRIAL
Copper	11.08%	1.51%
Lead	44.27%	33.12%
Mercury	45.02%	10.24%
Total PCBs	33.65%	2.82%
DDE	2.86%	0.46%
DDD	8.62%	0.50%
DDT	7.11%	0.17%
Total PAHs	57.42%	9.91%
BEPH	49.79%	22.85%

4. For each SOC, determined the City of Portland contribution of site-specific sediment contamination from outfalls receiving inputs from both heavy and light industrial uses. For example, if the sediment loading for copper is estimated at 11.08% (heavy industrial) and 1.51% (light industrial; Exhibit A-4), the total industrial contribution through outfalls is calculated as:

[17] Heavy and light industrial are defined in the City of Portland's 2004 Industrial Districts Atlas, available at: https://www.portland.gov/sites/default/files/2020-02/industrial_districts_atlas.pdf.

Contribution = (% land use * % of drainage to public outfall * % sediment loading)

- Heavy industrial contribution = (0.14 * 0.3 * 0.1108) * 100 = 0.465%
- Light industrial contribution = (0.09 * 0.75 * 0.0151) * 100 = 0.102%
- Total industrial contribution = 0.465% + 0.102% = 0.567%

5. Determine relevant industrial discharge-related outfall liability (in DSAYs) for each SOC. For example:
    - (Total Copper DSAYs in the Assessment Area – Non-site specific source Copper DSAYs – Type III DSAYs) * **0.00567** = Copper DSAYs from Industrial Discharge
6. Determine the party outfall-related liability for a public landfall owner by applying a 10% ownership factor. That is, the Trustee Council allocate ten percent of the total outfall liability for each SOC to the owner(s) of public outfalls.
    - Copper DSAYs from Industrial Discharge * **0.10** = Copper DSAY Contribution