Source Control Program:
Lower Duwamish Waterway Superfund

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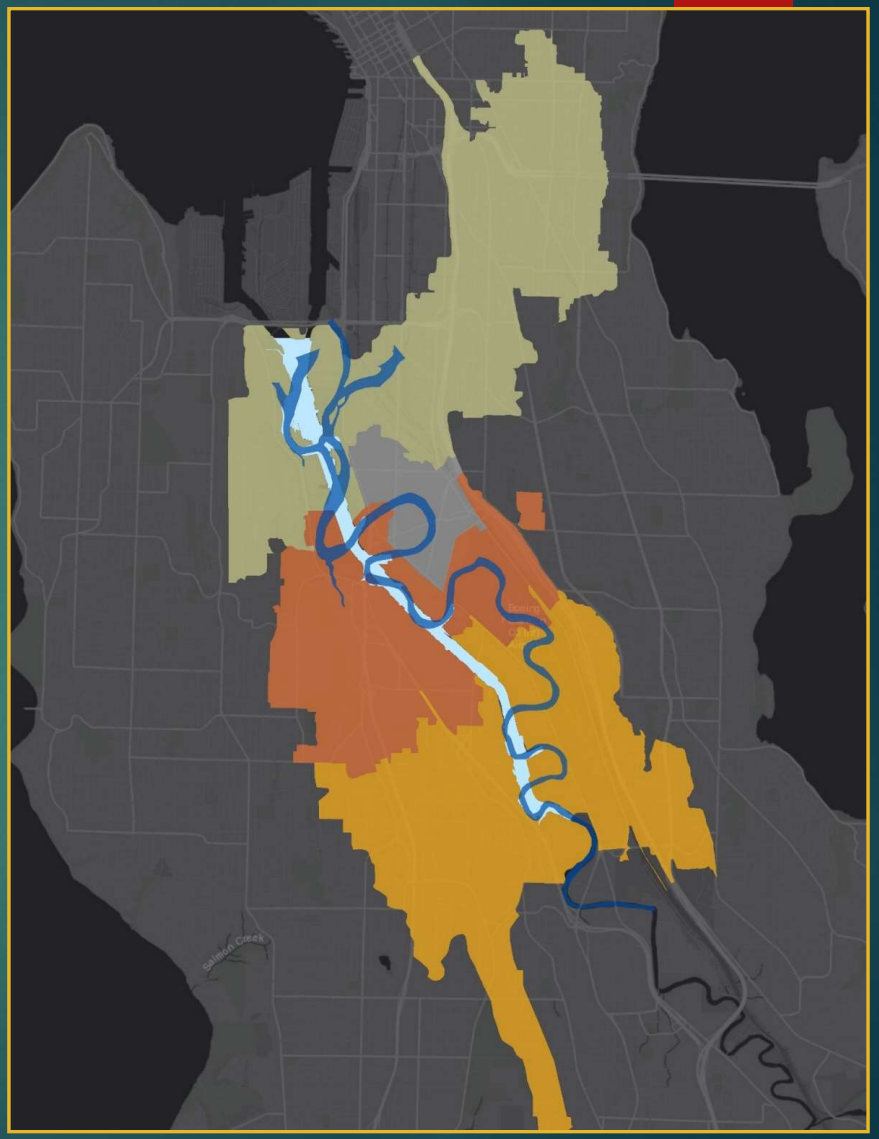
05/2023

Presentation Outline

1. Overview of the Lower Duwamish Waterway (LDW)
2. LDW Source Control:
   - What is a "source", what are pathways?
   - What we've accomplished
3. Status of LDW Source Control. My role.



1900-1935
Early Times

1935-1955
War Time & Pre-Regulation

1955-2000
Recent Times

2000-2023
Superfund Times

Lower Duwamish Waterway Superfund

1

Listed in 2001

Record of Decision 2014

EPA: lead for sediment cleanup (~400 acres)

Ecology: lead for source control (20,000+ acres)

Primary Human Health Risks: arsenic, cPAHs, PCBs, dioxins/furans

Responsible Parties:

- The Boeing Company
- City of Seattle
- King County
- Port of Seattle

Ecology's LDW Source Control

- Framework documented in the **2016 LDW Source Control Strategy**
- Focuses on remediation of media and restriction of pathways
- It is a collaborative effort with the **Source Control Work Group**

DEPARTMENT OF ECOLOGY State of Washington

EPA

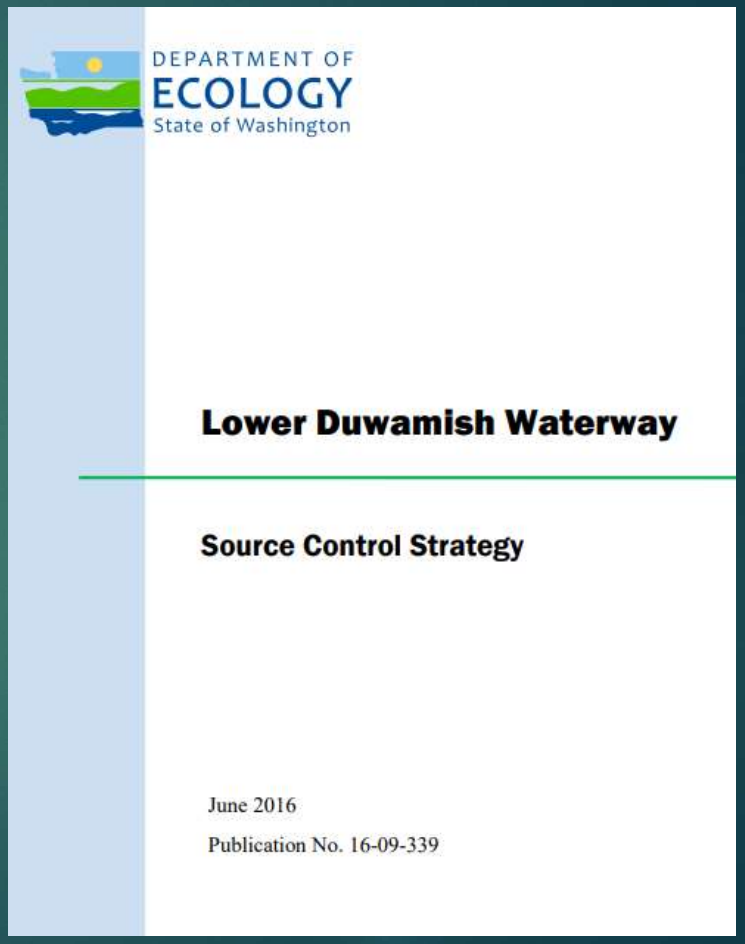
…and others!

King County

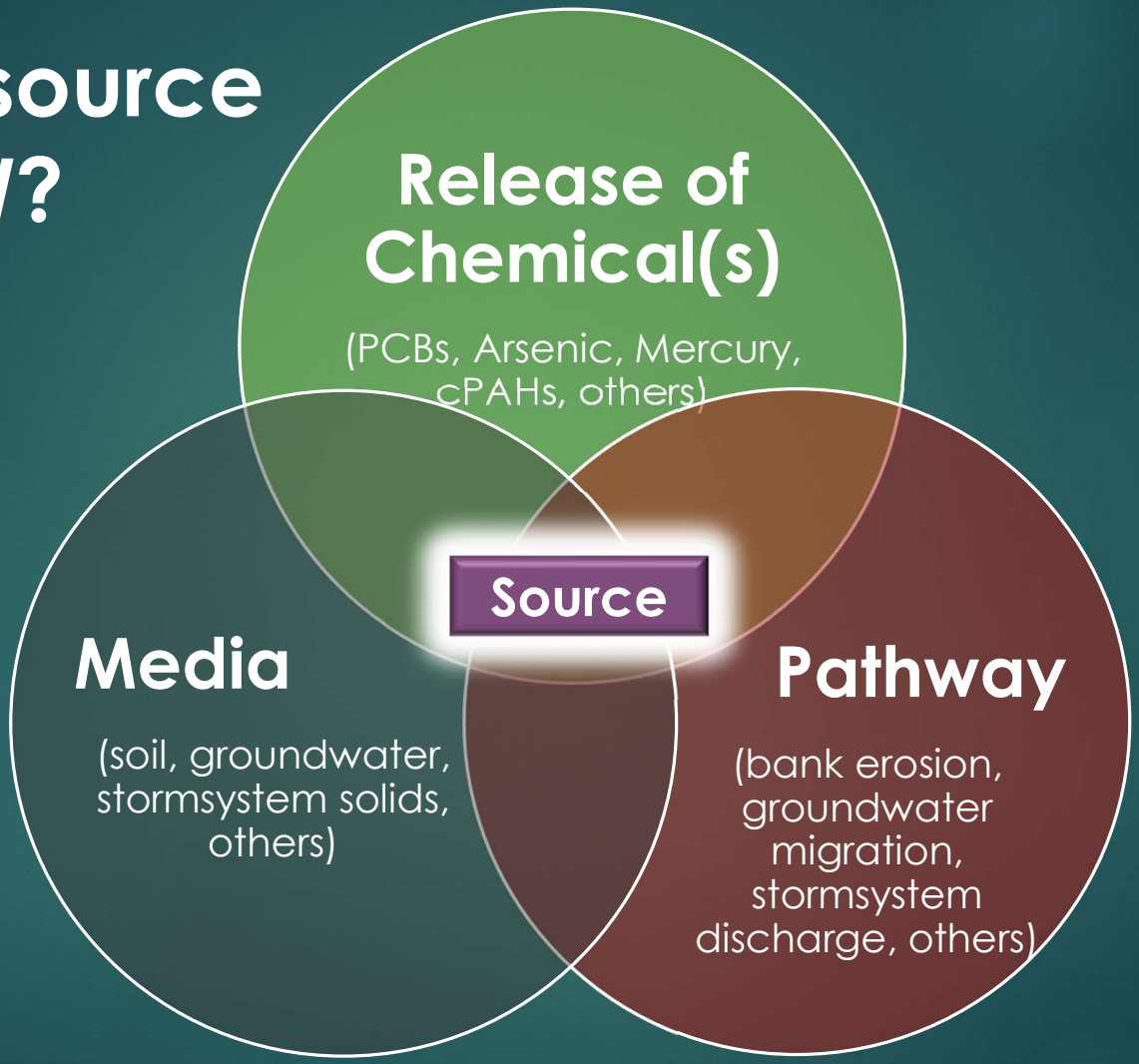
City of Seattle

CITY OF TUKWILA

Port of Seattle

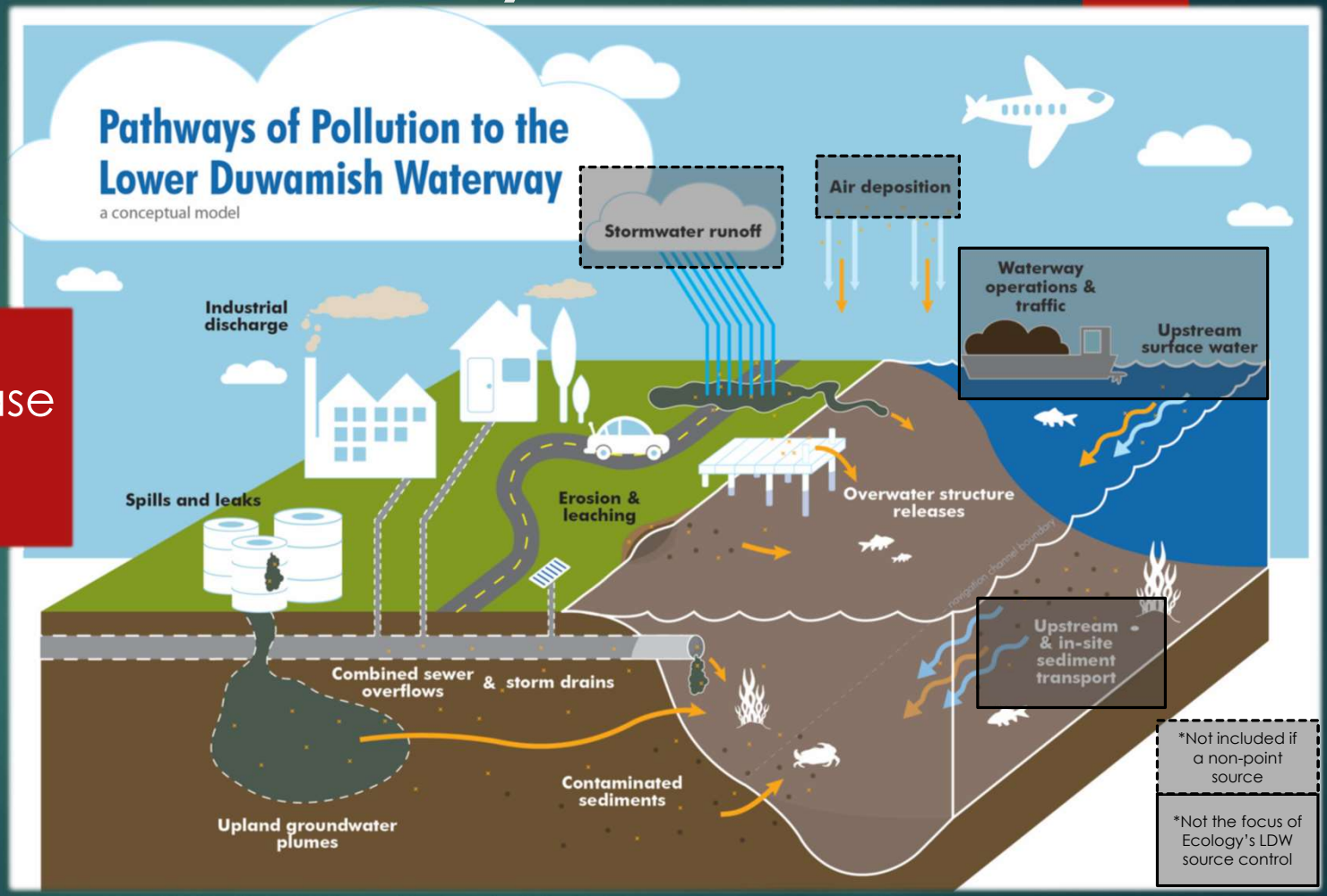


What is a source to the LDW?



Contaminant Source Pathways

***Pollution Source*:**
1. Contaminant release
2. Medium
3. Pathway to LDW

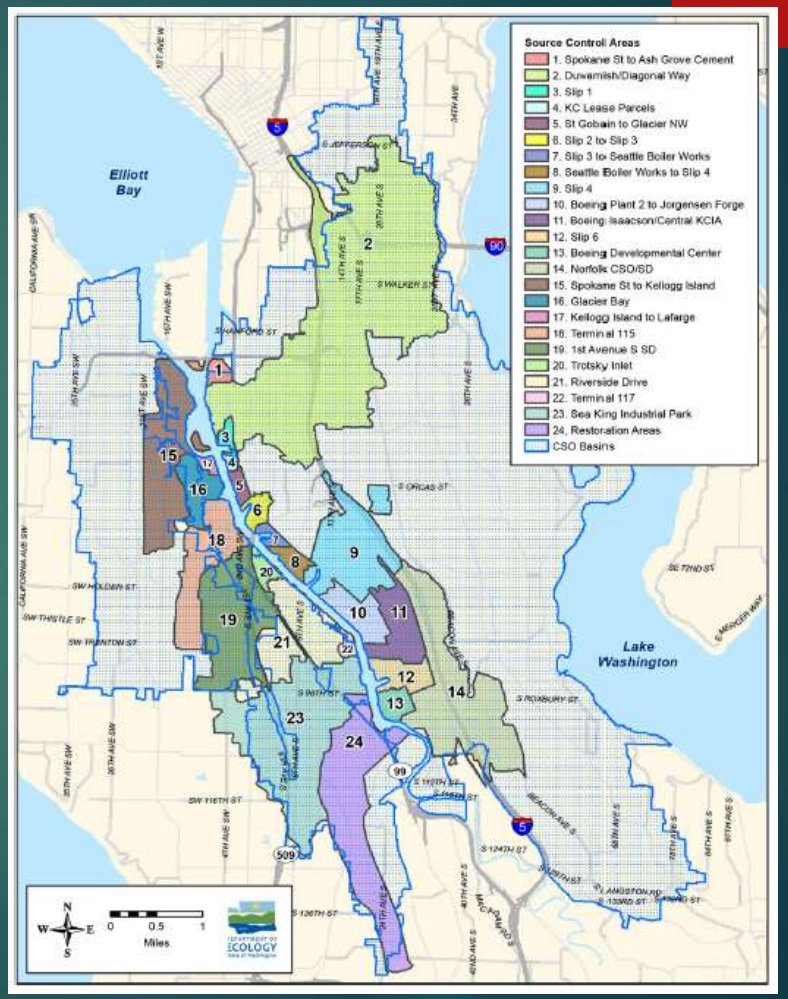


*note, not all pathways are considered for LDW Source Control

Accomplishments

- **Data Gaps Reports** (2003-2006)
- **Action Plans for 24 areas** (2004-2013)
- **Status Reports** (2010-2020, and on...)
- **Sufficiency Evaluations** (2023-on)

LDW Source Control: Finding sources of contamination that are entering the LDW Superfund Site from lands surrounding the river, and then taking actions to stop or reduce them before they reach the LDW.



Notable Source Control Activities

Contaminated site cleanups permitting compliance

Image taken from Ecology Generated Site Page

Habitat Restoration and Development

Image taken from: Duwamish River People's Park Habitat Restoration and Shoreline Access Project | Port of Seattle (portseattle.org)

Notable Source Control Activities

Source Investigations

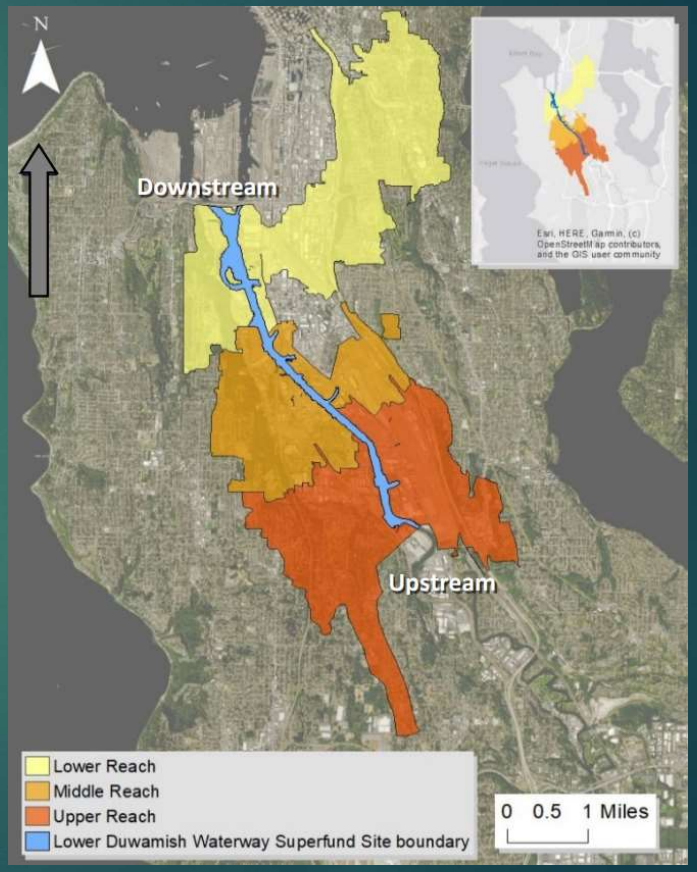
Image taken from: LDWSourceControlImplementationPlan2021-2026.pdf (seattle.gov)

Combined Sewer Overflow and Stormwater Treatment Facilities

Image taken from: kcr3156-2021.pdf (kingcounty.gov)

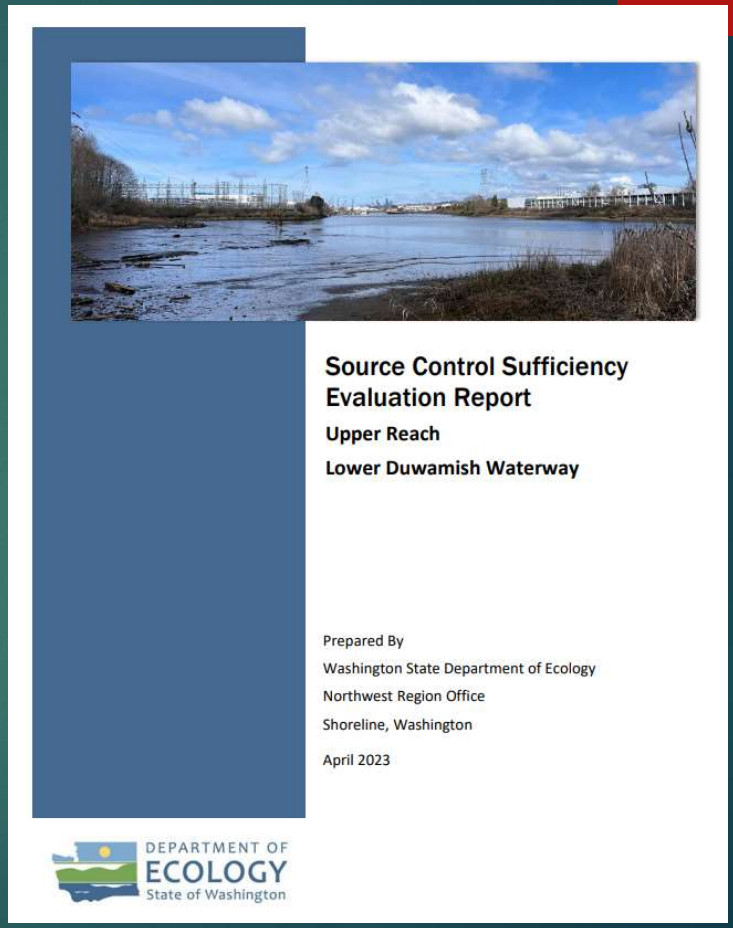
Status of LDW Source Control

- Upper Reach sediment remedy begins 2024-2027.
  - 94% of action items completed. One source area of concern remains.
- Middle Reach sediment remedy begins ~2027-2028.
  - Cleanups ongoing, in varying stages of MTCA process. Source Control actions being completed. Several notable activities planned by our partners.
- Lower Reach sediment remedy to begins ~2031.



My role in the LDW

- Source Control "Sufficiency"
  - Near-term goal of the agency
  - Enables EPA to proceed with sediment cleanup. Evaluates sediment recontamination potential.
  - Focuses on three pathways and suite of COCs.
  - Evaluates many information, generates conclusions.
  - Uncertainty in the findings, but a bias for action.



Source Control Lessons from the LDW

- Source control is complicated and comes with uncertainty, but there is a bias for action
- We share success in controlling sources:
  - Source tracing and line cleaning efforts
  - Habitat restoration and development
  - Water quality permitting compliance and stormwater BMPs
  - Contaminated Site cleanup
  - Education and outreach, businesses and public
- Coordination and cooperation are key to success
- We can address point sources and legacy impacts, but urbanization and industry will present some level of sources to the LDW. What then?

Relevant Information

- Ecology's Lower Duwamish Waterway Page
  - LDW Source Control Sufficiency Focus Sheet
- LDW Source Control Work Group
  - City of Seattle's LDW Webpage and Information
  - King County's LDW Webpage and Information
  - Port of Seattle's Maritime Stormwater Program
    - Port of Seattle's Salmon Safe Certification Program
  - City of Tukwila's NPDES Permit Program
- EPA's LDW Superfund Webpage
  - Lower Duwamish Waterway Group's LDW Superfund Webpage

Source Control Policy and Guidance

- Sediment Cleanup User's Manual (Sediment Management Standards)
- How to Find and Address PCBs in Building Materials
- A Review of Select PCB Source Tracing Programs
- Ecology's Priority Toxic Chemicals (Action Plans)

LDW Superfund Project

Ecology-led LDW Source Control

Near-term Goal
(Source Control and **Sufficiency** to support EPA's sediment cleanup)

Long-term Goal
(ongoing Source Control, recontamination assessment and mitigation)

EPA-led Sediment Remedy

Near-term Goal
(early ID and sediment cleanup)

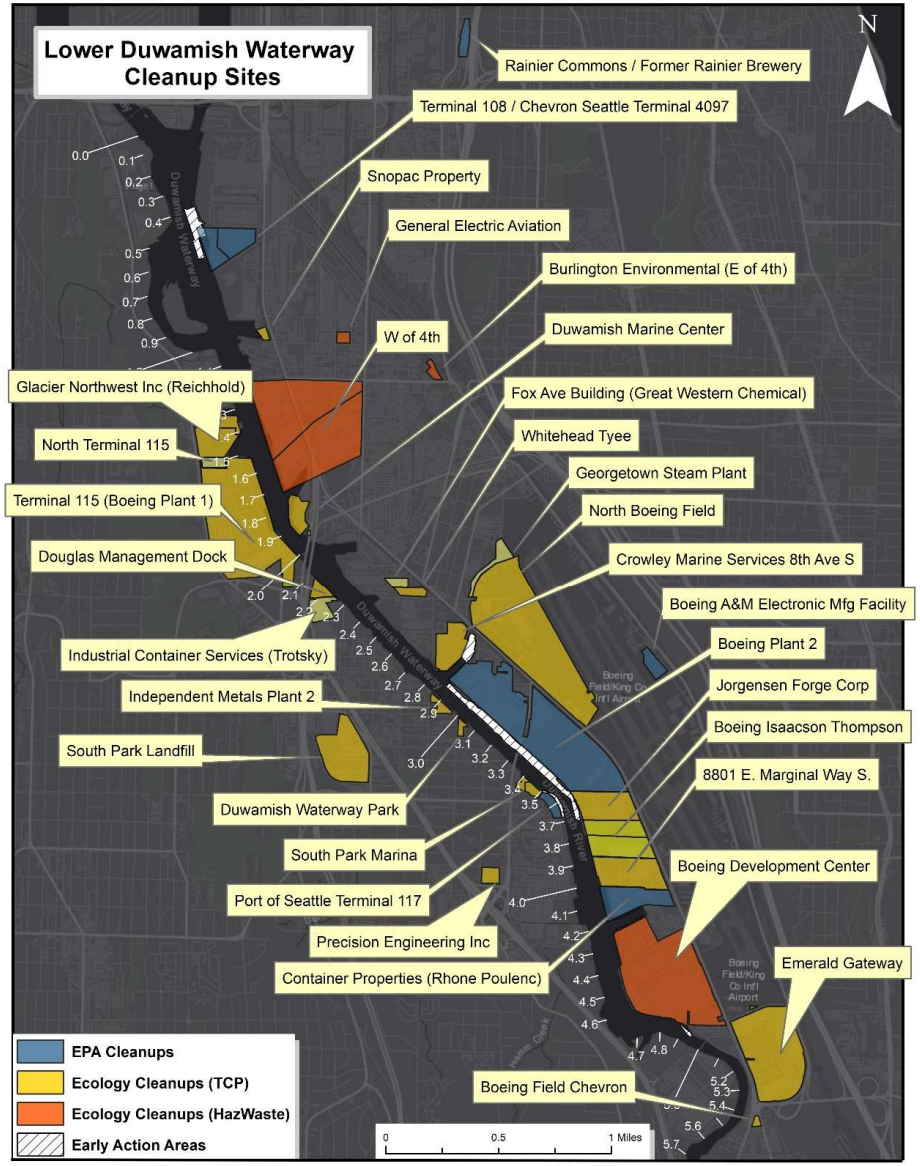
Long-term Goal
In-waterway remedy
(sediment monitoring of remedy success)

Superfund sediment cleanup

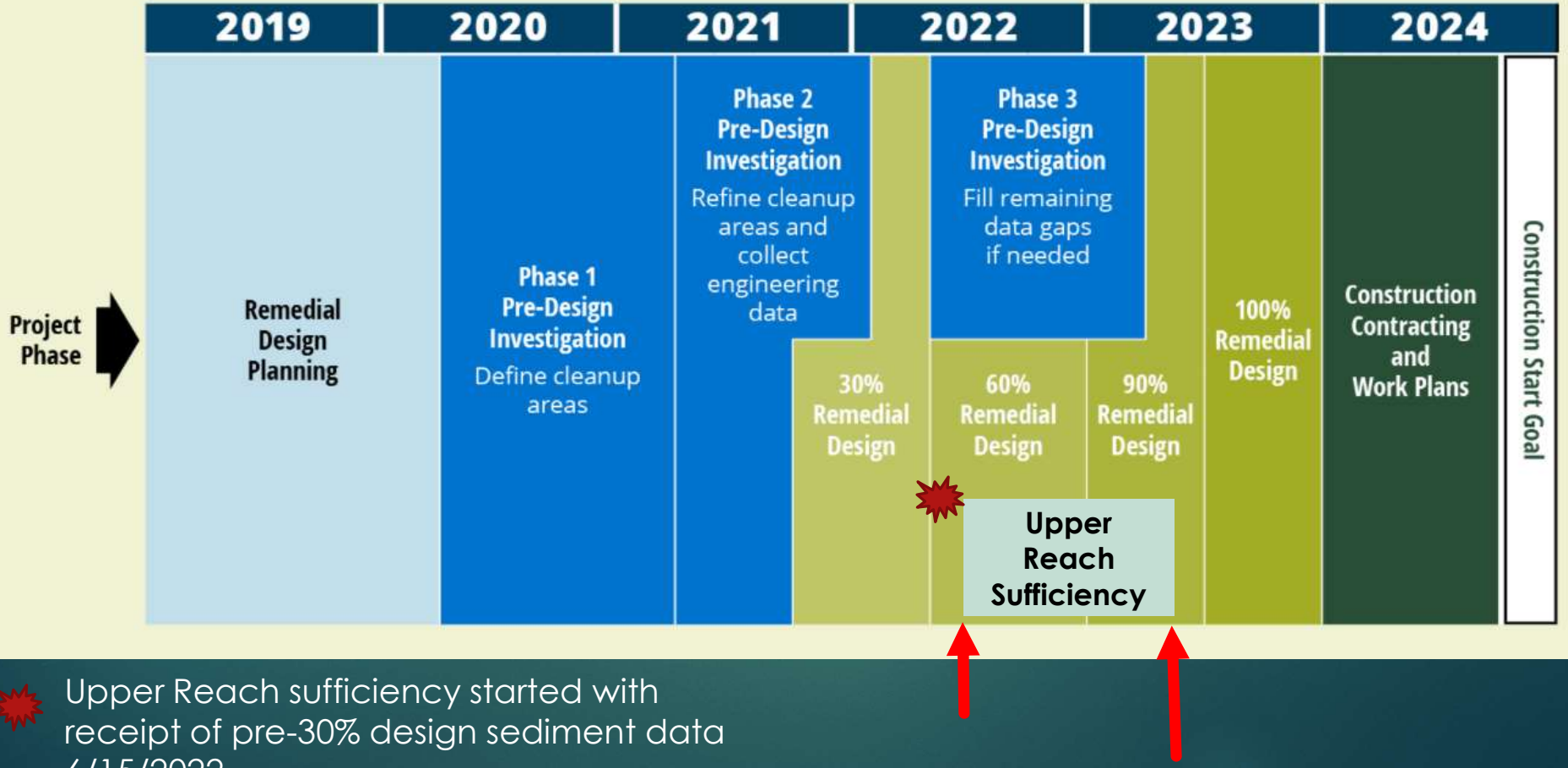
1

Cleanup Activity	Area (acres)	Time
Dredging sediments	105	7 years
Capping sediments	24	
Enhanced natural recovery	48	
Monitored natural recovery	235	10 years
TOTAL	412	17 years

Total cost = $342 million

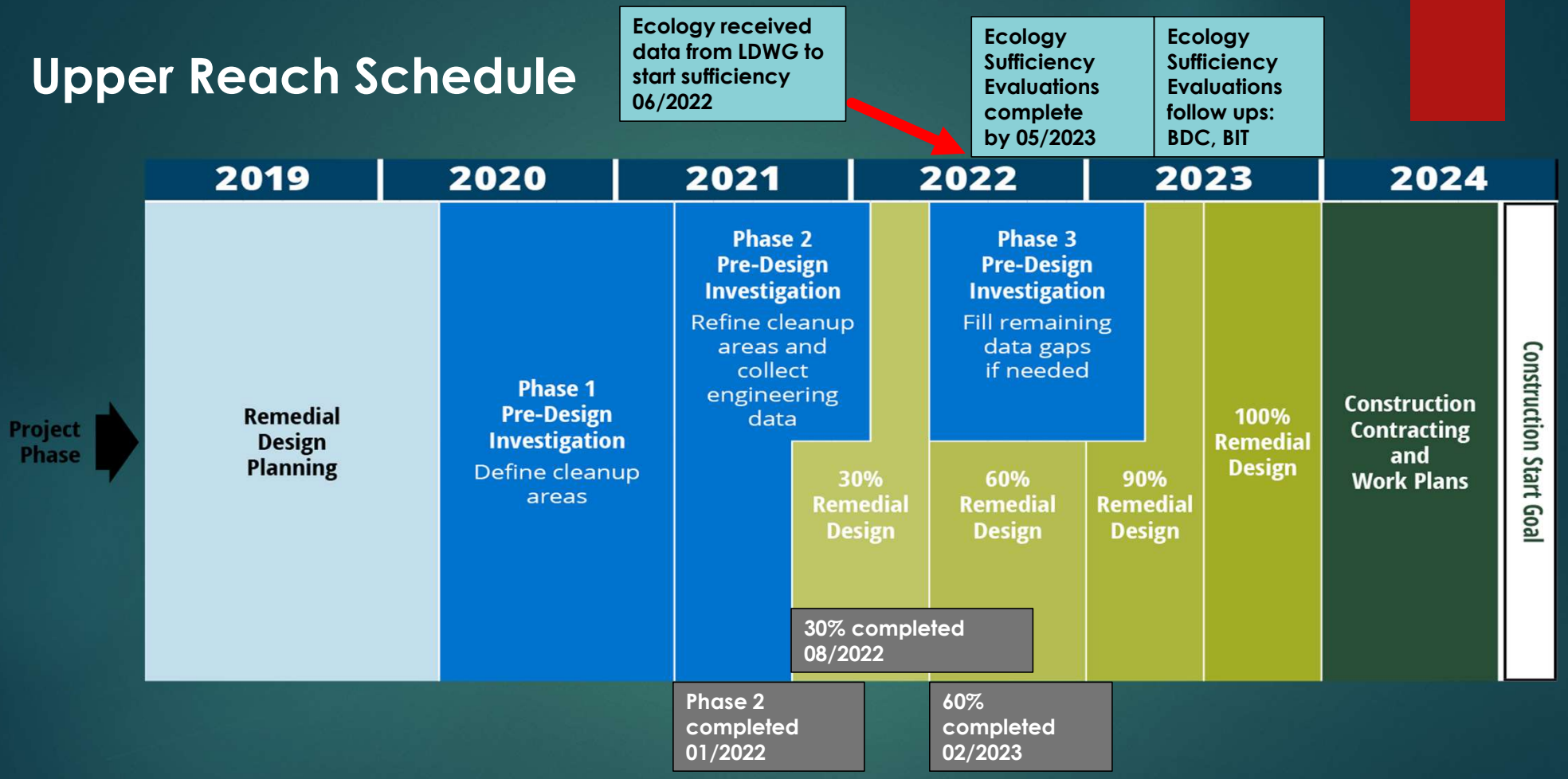

Lower Duwamish Waterway Cleanup Sites
N
Rainier Commons / Former Rainier Brewery
Terminal 108 / Chevron Seattle Terminal 4097
Snopac Property
General Electric Aviation
Burlington Environmental (E of 4th)
Duwamish Marine Center
W of 4th
Glacier Northwest Inc (Reichhold)
Fox Ave Building (Great Western Chemical)
North Terminal 115
Whitehead Tyee
Georgetown Steam Plant
Terminal 115 (Boeing Plant 1)
North Boeing Field
Douglas Management Dock
Crowley Marine Services 8th Ave S
Boeing A&M Electronic Mfg Facility
Industrial Container Services (Trotsky)
Boeing Plant 2
Jorgensen Forge Corp
Independent Metals Plant 2
Boeing Isaacson Thompson
South Park Landfill
8801 E. Marginal Way S.
Duwamish Waterway Park
South Park Marina
Boeing Development Center
Port of Seattle Terminal 117
Precision Engineering Inc
Container Properties (Rhone Poulenc)
Emerald Gateway
Boeing Field Chevron
EPA Cleanups
Ecology Cleanups (TCP)
Ecology Cleanups (HazWaste)
Early Action Areas
0
0.5
1 Miles

Lower Duwamish Waterway — *Upper Reach Remedial Design Timeline*



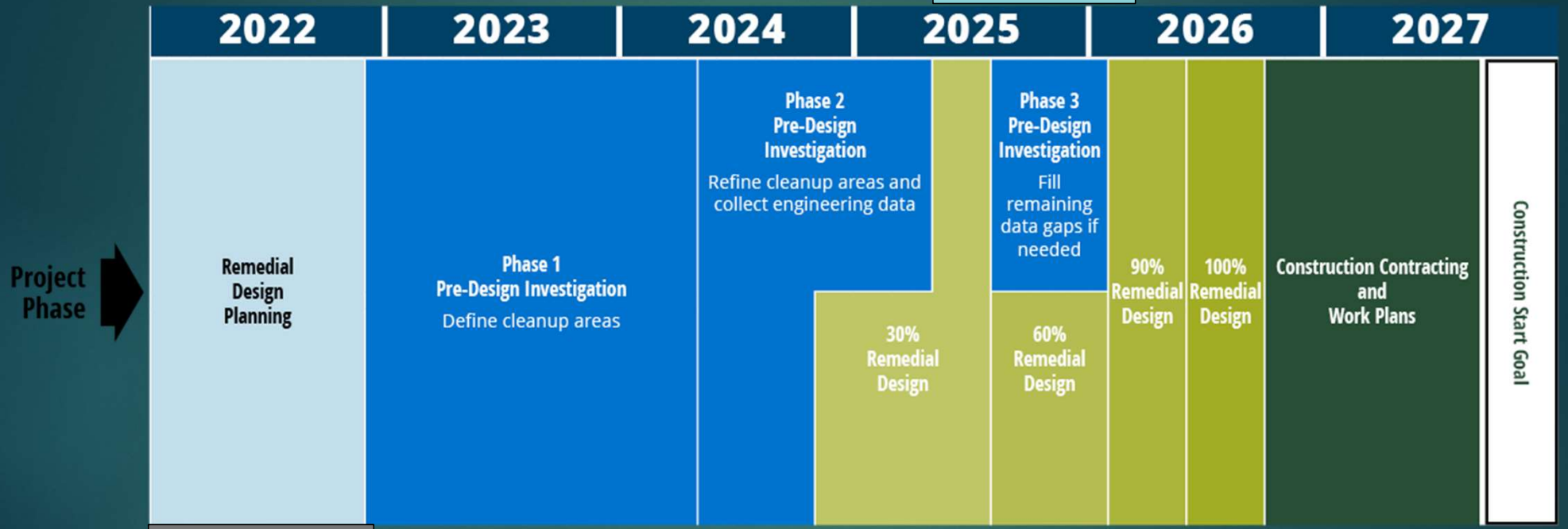
Upper Reach sufficiency started with receipt of pre-30% design sediment data 6/15/2022

Upper Reach Schedule



Middle Reach Schedule

Ecology Sufficiency Evaluations: Spring 2025-Spring 2026



Remedial Design Planning completed 12/2022

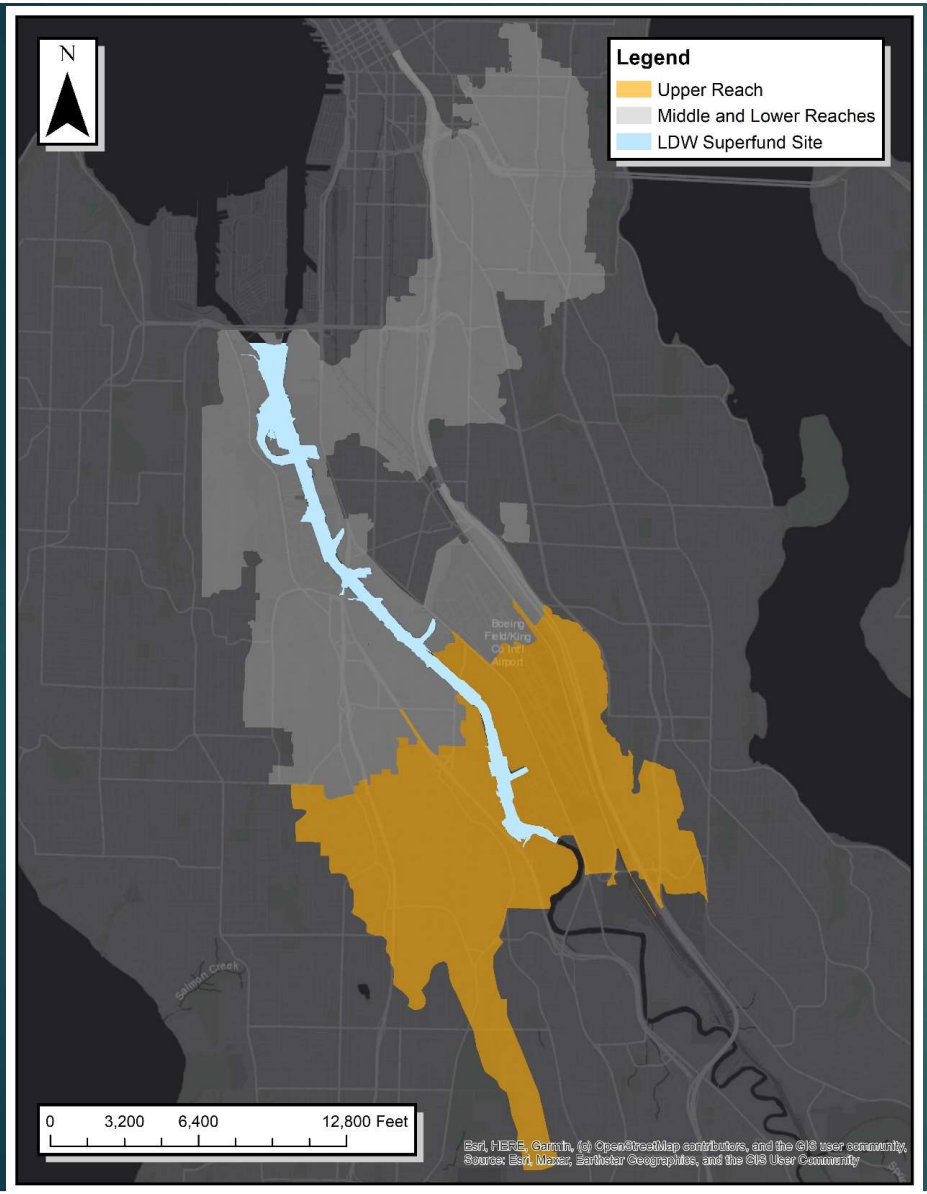
Lower Duwamish Waterway Timeline

1999	Sediment cleanup was completed at the Norfolk CSO/SD
2000	A CERCLA and MTCA Consent Order was issued by EPA and Ecology requiring LDWG to conduct the RI/FS
2001	LDW was listed as a Superfund site on the National Priorities List
2002	LDW was listed by Ecology as a cleanup site under MTCA
	EPA and Ecology signed a Memorandum of Understanding (MOU) designating EPA as the lead for in-waterway cleanup, and Ecology as the lead for source control. The MOU was revised in 2004, and was revised again in 2014 when the title was changed to Memorandum of Agreement (MOA).
	Ecology initiated the Source Control Work Group
2003	The LDW Phase 1 RI was completed, and additional cleanup was conducted at the Norfolk CSO/SD
2004	Ecology issued its Source Control Strategy
2005	Sediment cleanup was completed at the Duwamish/Diagonal CSO/SD
2006	EPA issued an Action Memorandum (cleanup plan) for the Slip 4 EAA
2010	The Final LDW RI was completed
2010	EPA issued an Action Memorandum for the Terminal 117 EAA
2011	EPA issued a RCRA corrective action Final Decision (cleanup plan) for Boeing Plant 2 sediment
	EPA issued an Action Memorandum for Jorgensen Forge sediments and shoreline bank soils
2012	Sediment cleanup was completed at the Slip 4 EAA
	The Final LDW FS was completed
2013	Cleanup started at Boeing Plant 2 and Terminal 117
2014	Cleanup started at Jorgensen Forge

Introduction to Sufficiency

- **What is "LDW Source Control Sufficiency"?**
  - It is a state at which **sources are controlled ***sufficiently*** such that recontamination is unlikely to trigger additional active in-waterway sediment remediation.*
  - Sufficiency project goal is the same as the near-term goal of LDW Source Control
- **Three project objectives**:
  - Evaluation of Principal Criteria Information
  - Assessment of Environmental Data
  - Provide recommendations to the EPA

* *Point sources of LDW Contaminants of Concern—transported along three pathways*


N
Legend
Upper Reach
Middle and Lower Reaches
LDW Superfund Site
Boeing Field/King Co Intl Airport
Salmon Creek
0
3,200
6,400
12,800 Feet
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

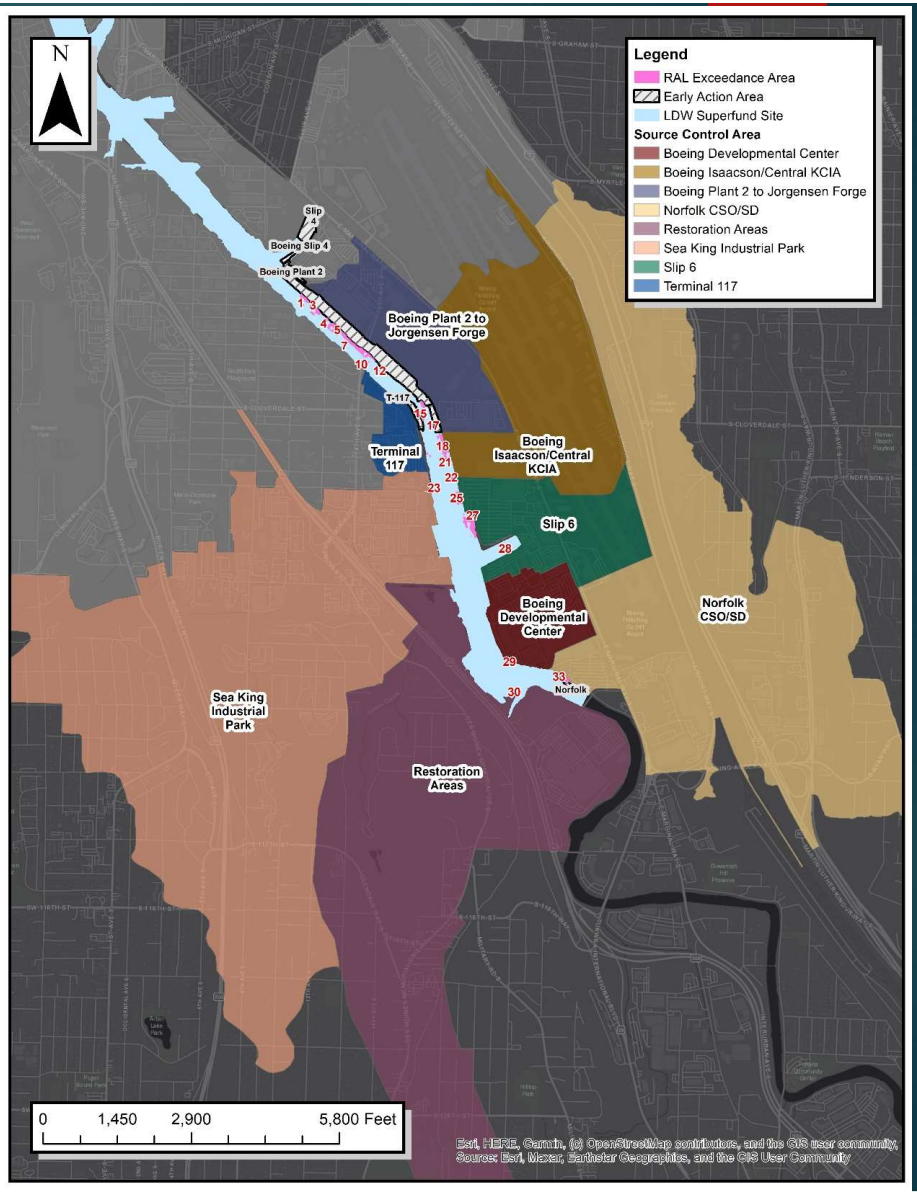

N
Legend
RAL Exceedance Area
Early Action Area
LDW Superfund Site
Source Control Area
Boeing Developmental Center
Boeing Isaacson/Central KCIA
Boeing Plant 2 to Jorgensen Forge
Norfolk CSO/SD
Restoration Areas
Sea King Industrial Park
Slip 6
Terminal 117
Slip 4
Boeing Slip 4
Boeing Plant 2
T-117
Boeing Plant 2 to Jorgensen Forge
Terminal 117
Boeing Isaacson/Central KCIA
Slip 6
Boeing Developmental Center
Norfolk CSO/SD
Norfolk
Sea King Industrial Park
Restoration Areas
0
1,450
2,900
5,800 Feet
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Table 19. Cleanup Levels for PCBs, Arsenic, cPAHs, and Dioxins/Furans in Sediment for Human Health and Ecological COCs (RAOs 1, 2 and 4)

COC	Cleanup Levels				Application Area and Depth		
	RAO 1: Human Seafood Consumption	RAO 2: Human Direct Contact	RAO 4: Ecological (River Otter)	Basis for Cleanup Levels[a]	Spatial Scale of Application[b]	Spatial Compliance Measure[e]	Compliance Depth[b]
PCBs (µg/kg dw)	**2**	1,300	128	background (RAO 1) RBTC (RAO 2) RBTC (RAO 4)	LDW-wide	UCL95	0 – 10 cm
	NA	500	NA	RBTC	All Clamming Areas[c]	UCL95	0 – 45 cm
	NA	1,700	NA	RBTC	Individual Beaches[d]	UCL95	0 – 45 cm
Arsenic (mg/kg dw)	NA	7	NA	background	LDW-wide	UCL95	0 – 10 cm
	NA	7	NA	background	All Clamming Areas[c]	UCL95	0 – 45 cm
	NA	7	NA	background	Individual Beaches[d]	UCL95	0 – 45 cm
cPAH (µg TEQ/kg dw)	NA	380	NA	RBTC	LDW-wide	UCL95	0 – 10 cm
	NA	150	NA	RBTC	All Clamming Areas[c]	UCL95	0 – 45 cm
	NA	90	NA	RBTC	Individual Beaches[d]	UCL95	0 – 45 cm
Dioxins/Furans (ng TEQ/kg dw)	**2**	37	NA	background (RAO 1) RBTC (RAO 2)	LDW-wide	UCL95	0 – 10 cm
	NA	13	NA	RBTC	All Clamming Areas[c]	UCL95	0 – 45 cm
	NA	28	NA	RBTC	Individual Beaches[d]	UCL95	0 – 45 cm

Table 20. Sediment Cleanup Levels for Ecological (Benthic Invertebrate) COCs for RAO 3[a]

Benthic COC	Cleanup Level for RAO 3[a]	Benthic COC	Cleanup Level for RAO 3[a]
Metals, (mg/kg dw)[c]		***OC-normalized Organic Compounds (continued) (mg/kg OC)***	
Arsenic	57	Total PCBs	12
Cadmium	5.1	Benzo(g,h,i)perylene	31
Chromium	260	Chrysene	110
Copper	390	Dibenz(a,h)anthracene	12
Lead	450	Indeno(1,2,3-cd)pyrene	34
Mercury	0.41	Fluoranthene	160
Silver	6.1	Fluorene	23
Zinc	410	Naphthalene	99
Dry Weight Basis Organic Compounds, (µg/kg dw)		Phenanthrene	100
4-methylphenol	670	Pyrene	1,000
2,4-dimethylphenol	29	HPAH	960
Benzoic acid	650	LPAH	370
Benzyl alcohol	57	Bis(2-ethylhexyl)phthalate	47
Pentachlorophenol	360	Butyl benzyl phthalate	4.9
Phenol	420	Dimethyl phthalate	53
		1,2-dichlorobenzene	2.3
OC-normalized Organic Compounds, (mg/kg OC)[b]		1,4-dichlorobenzene	3.1
Acenaphthene	16	1,2,4-trichlorobenzene	0.81
Anthracene	220	2-methylnaphthalene	38
Benzo(a)pyrene	99	Dibenzofuran	15
Benz(a)anthracene	110	Hexachlorobenzene	0.38
Total benzofluoranthenes	230	n-Nitrosodiphenylamine	11

a. Cleanup Levels for RAO 3 are based on the benthic SCO chemical criteria in the SMS (WAC 173-204-562). Benthic SCO biological criteria (WAC 173-204-562, Table IV) may be used to override benthic SCO chemical criteria where human health-based RALs are not also exceeded.

Table 27. Selected Remedy RAO 3 RALs

SMS Contaminant of Concern for RAO 3	RAL for Recovery Category 1 Areas[a] (Benthic SCO)	RAL for Recovery Category 2 & 3 Areas (2 x Benthic SCO)[b]
Metals (mg/kg dw)		
Arsenic	57	n/a
Cadmium	5.1	10.2
Chromium	260	520
Copper	390	780
Lead	450	900
Mercury	0.41	0.82
Silver	6.1	12.2
Zinc	410	820
PAHs (mg/kg OC)		
2-Methylnaphthalene	38	76
Acenaphthene	16	32
Anthracene	220	440
Benzo(a)anthracene	110	220
Benzo(a)pyrene	99	198
Benzo(g,h,i)perylene	31	62
Total benzofluoranthenes	230	4650
Chrysene	110	220
Dibenzo(a,h)anthracene	12	24
Dibenzofuran	15	30
Fluoranthene	160	320
Fluorene	23	46
Indeno(1,2,3-cd)pyrene	34	68
Naphthalene	99	198
Phenanthrene	100	200
Pyrene	1,000	2,000
Phthalates (mg/kg OC)		
Bis(2-ethylhexyl)phthalate	47	94
Butyl benzyl phthalate	4.9	9.8
Dimethyl phthalate	53	106
Chlorobenzenes (mg/kg OC)		
1,2,4-Trichlorobenzene	0.81	1.62
1,2-Dichlorobenzene	2.3	4.6
1,4-Dichlorobenzene	3.1	6.2
Hexachlorobenzene	0.38	0.76
Other SVOCs and COCs, (µg/kg dw except as shown)		
2,4-Dimethylphenol	29	58
4-Methylphenol	670	1,340
Benzoic acid	650	1,300
Benzyl alcohol	57	114
n-Nitrosodiphenylamine, mg/kg OC	11	22
Pentachlorophenol	360	720
Phenol	420	840
PCBs (mg/kg OC)		
Total PCBs	12	n/a

Notes:
General:

- PCBs and arsenic are also human health COCs (see Table 28 for RALs for human health COCs), and RALs for the the human health category take precedence over RAO 3 RALs. The surface sediment (10 cm) Recovery Category 1 RALs for PCBs and arsenic are the same for human health and benthic invertebrates, but the 2 X SCO Recovery Category 2 and 3 criteria are not applicable to PCBs and arsenic. Figure 22 and Figure 23 list all RALs for human health COCs.