

**Remedial Investigation and Feasibility Study**

Gas Works Park Site  
Seattle, Washington

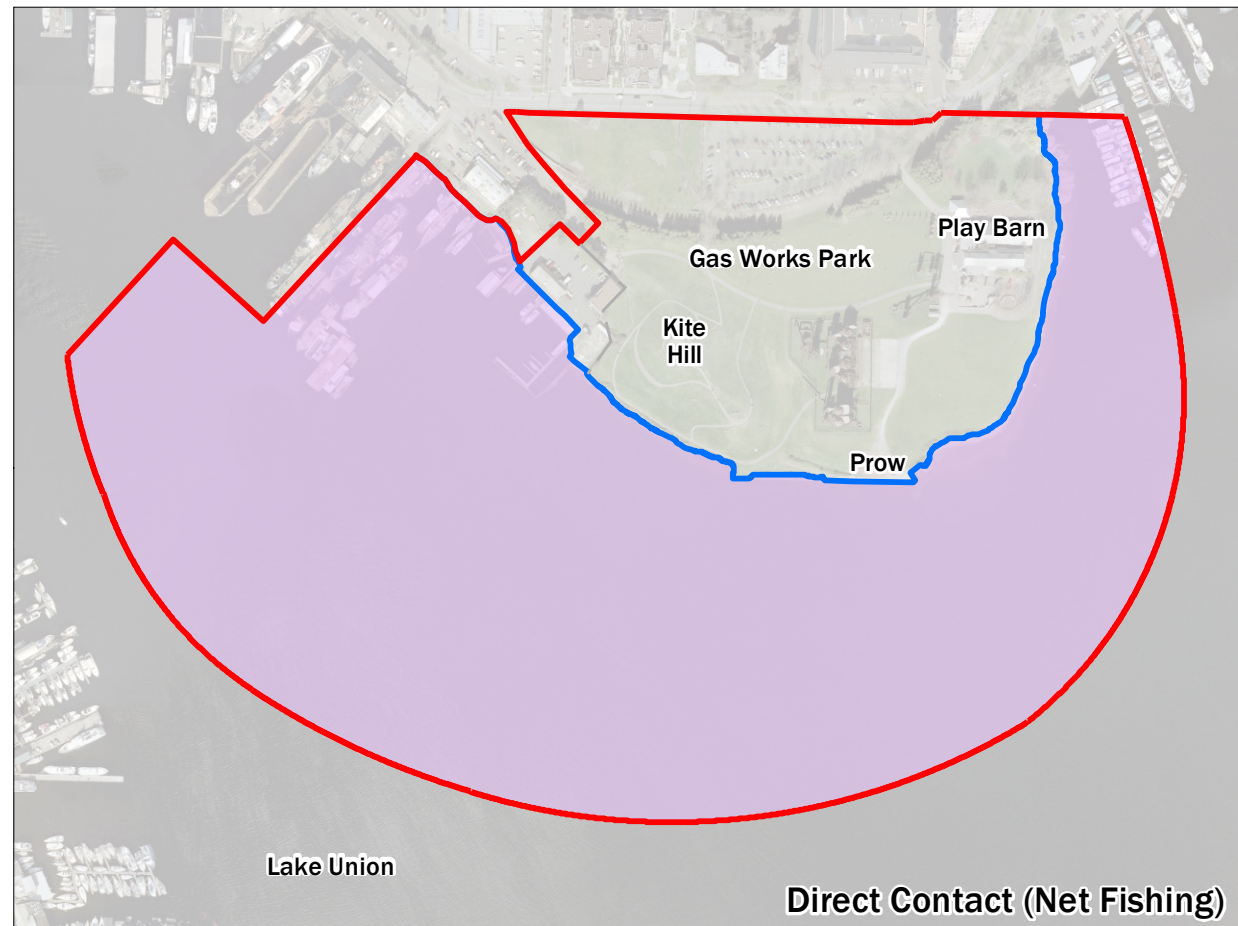
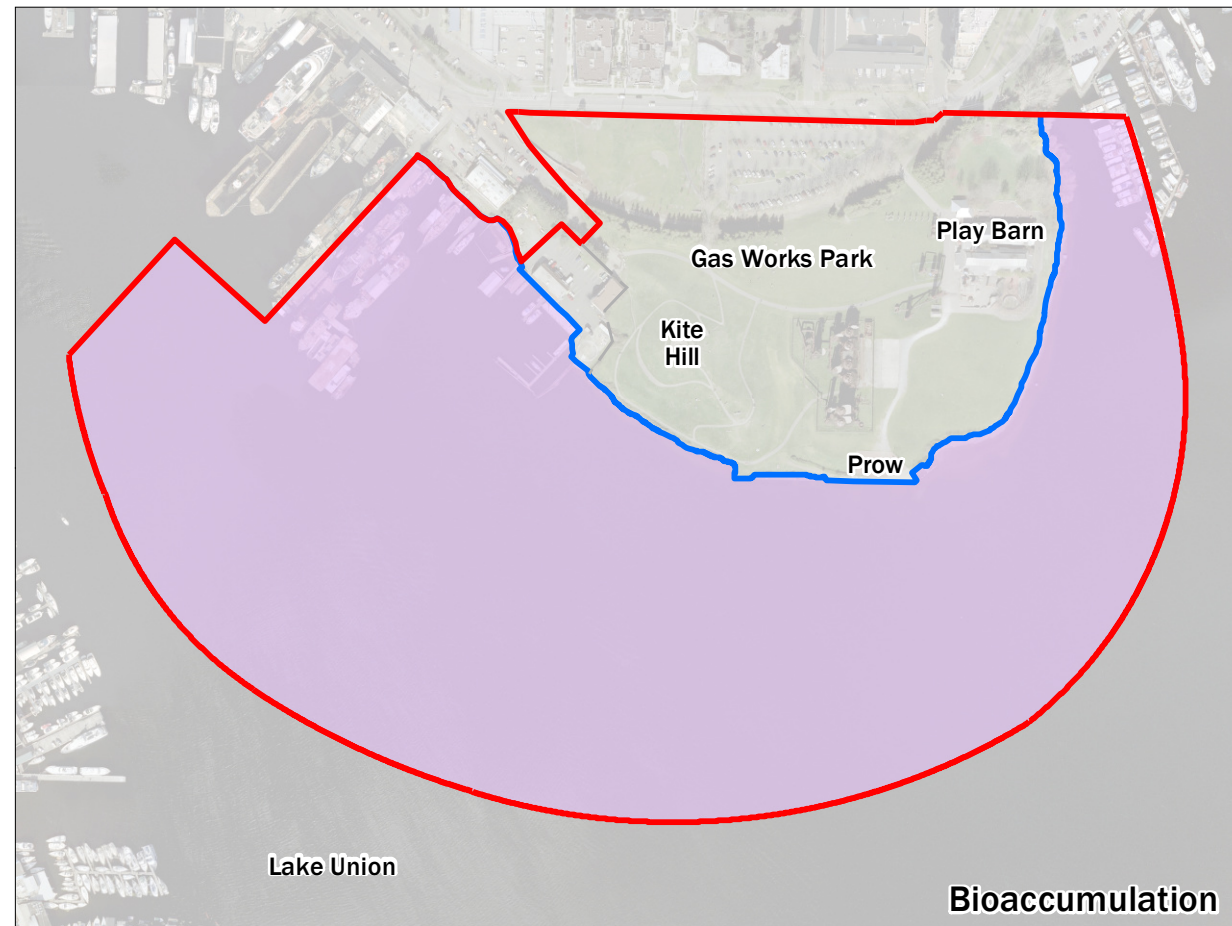
*for*

**Puget Sound Energy and the City of Seattle**

January 2023







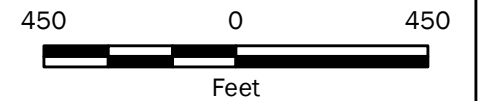
**Legend**

- Area of Investigation
- Shoreline (OHWM)
- Benthic Toxicity Area
- Uncertain Benthic Toxicity Area
- Bioaccumulation and Direct Contact (Beach Play and Wading and Net Fishing) Risk Area
- Direct Contact (Park User) Exposure Area

**Notes:**

1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 HARN StatePlane Washington North FIPS 4601 Feet.

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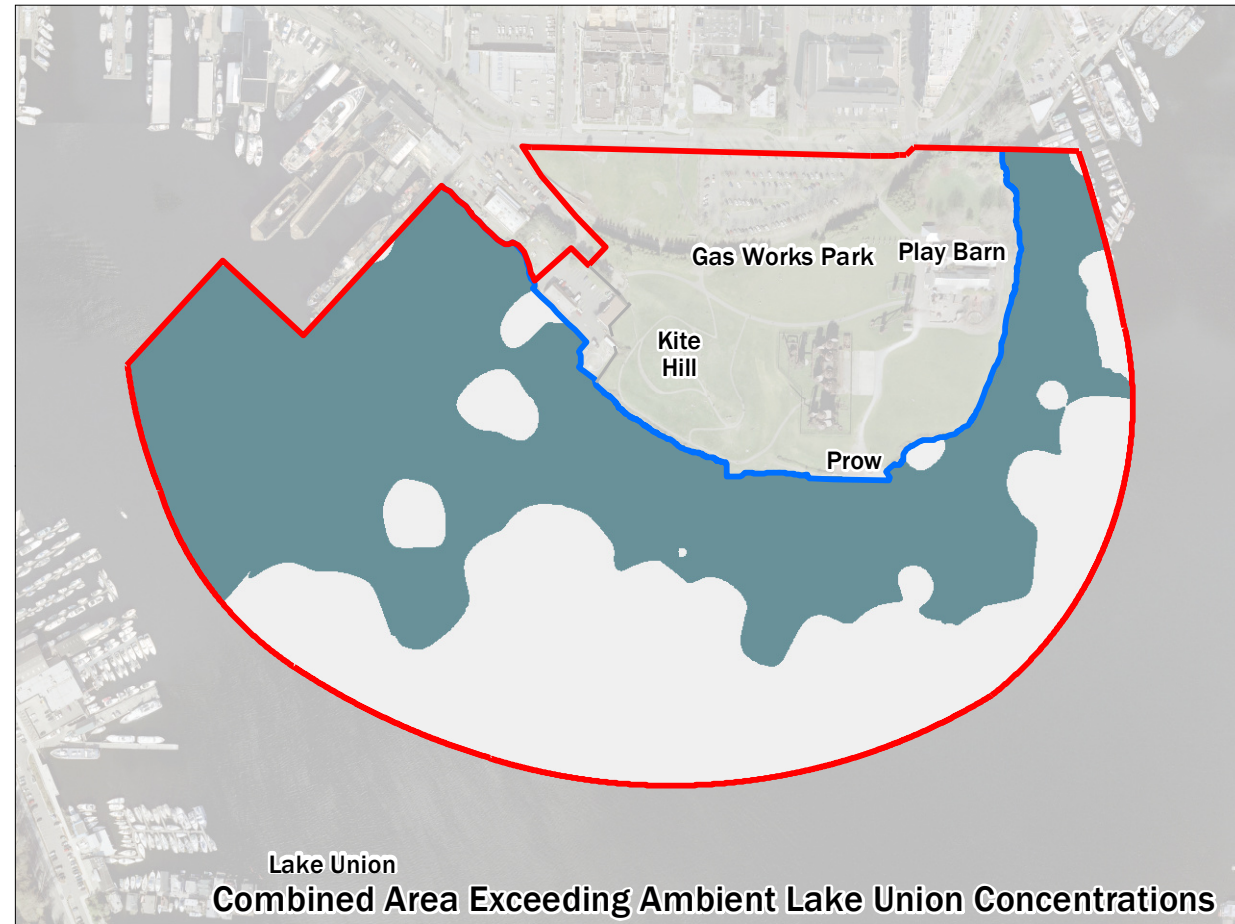


**Benthic, Bioaccumulation, and Direct Contact Exposure Areas**

Gas Works Park Site  
Seattle, Washington



**Figure 8-1**



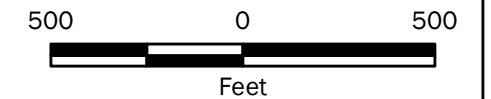
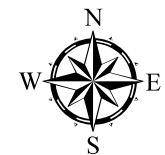
**Legend**

- Area of Investigation
- Shoreline (OHWM)
- Areas  $\leq$  Ambient (cPAH, TPAH & Arsenic)
- cPAH  $>$  6.0 mg/kg<sup>1</sup>
- TPAH  $>$  40 mg/kg<sup>1</sup>
- Arsenic  $>$  70 mg/kg<sup>1</sup>
- Areas  $>$  Ambient (cPAH, TPAH & Arsenic)

**Notes:**

1. The 90:90 UTL was used for ambient Lake Union concentrations.
2. The areas exceeding ambient concentrations were mapped using surface sediment GWPS COC collected and analyzed data in 2002 and later. This data set represents the most recent data that provide sufficient coverage for mapping.
3. Concentration contour maps generated through interpolation using the Inverse Distance Weighted scheme (Power = 6, Neighbors = 8, Reach = 1,000).
4. Basemap 2005 USGS aerial photograph. Does not show current conditions.
5. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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**Sediment Areas Exceeding Ambient Lake Union Concentrations of Primary GWPS COCs**

Gas Works Park Site  
Seattle, Washington



**Figure 8-2A**

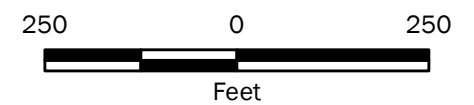
P:\01\_86846\GIS\MXD\Phase01\1678\_018684601\_F8-2B\_EstAreaExcAmbientLU\_Conc2021.mxd Date Exported: 04/08/22 by maugust



- Legend**
- Area of Investigation
  - Shoreline (OHWM)
  - Sediment Area Exceeding Ambient Lake Union Concentrations of Primary GWPS COCs

- Notes:**
1. The areas exceeding ambient concentrations were mapped using surface sediment GWPS COC data collected and analyzed in 2002 and later. This data represents the most recent data that provide sufficient coverage for mapping.
  2. Basemap 2005 USGS aerial photograph. Does not show current conditions.
  3. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

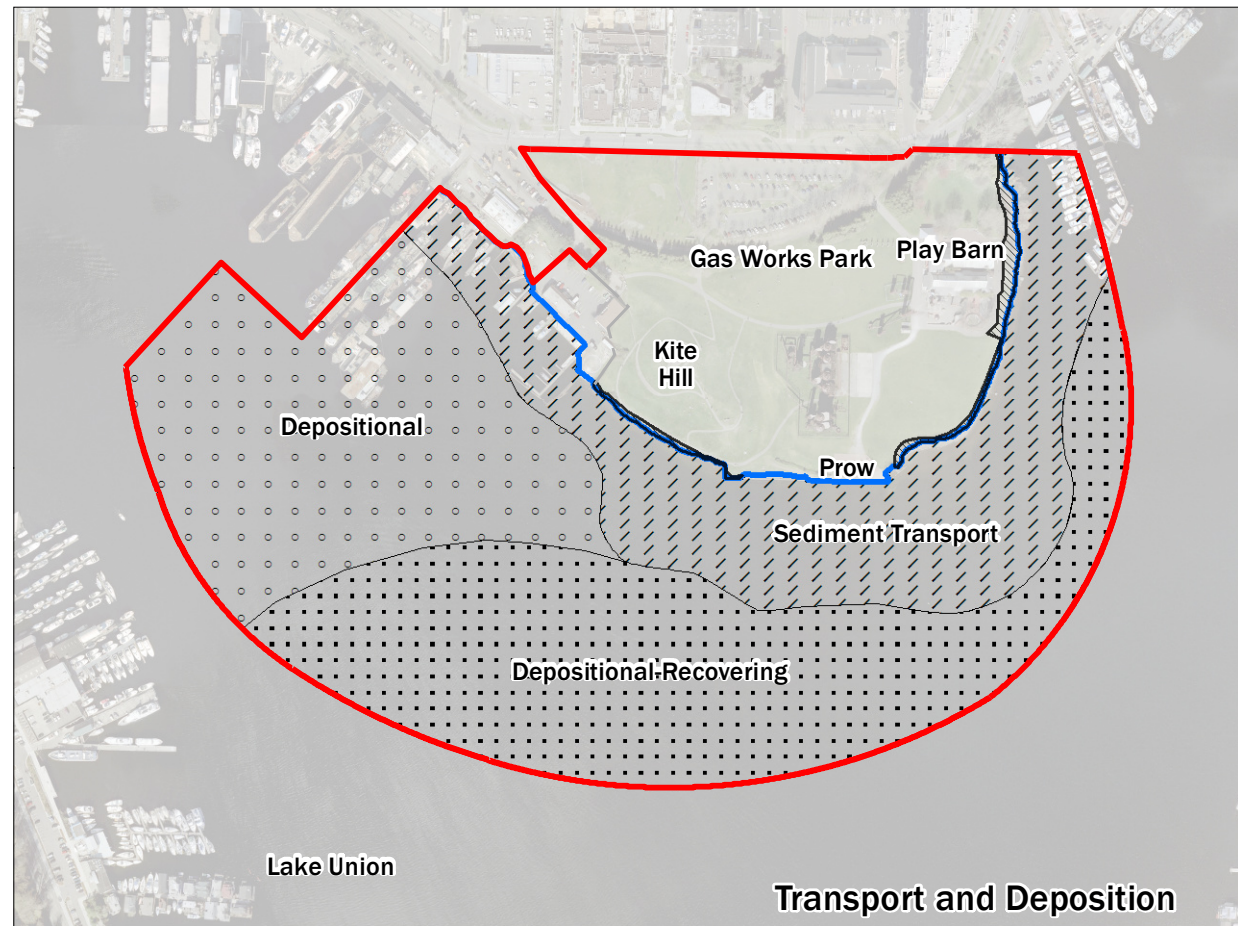
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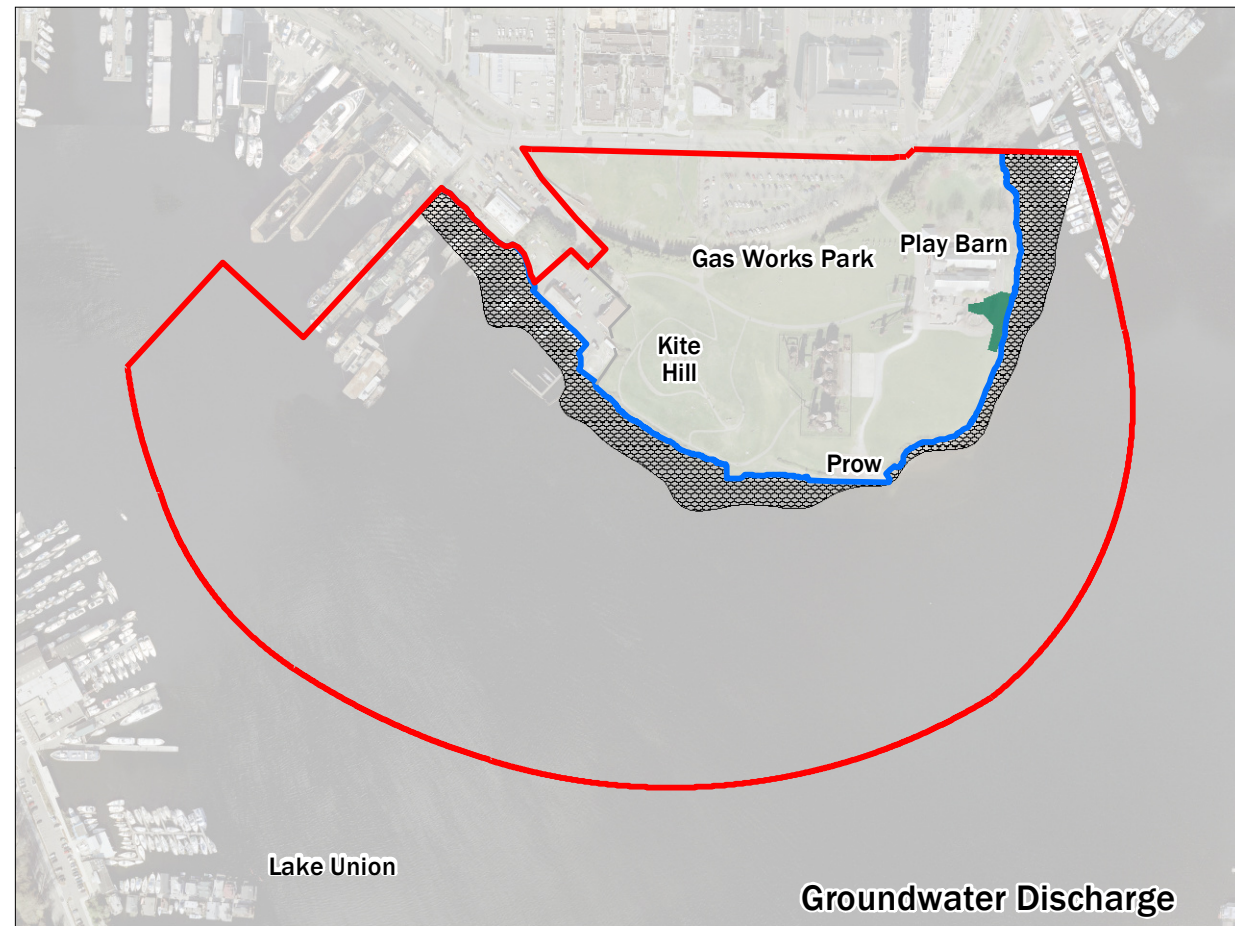
**Simplified Sediment Area Where  
Primary GWPS COCs Exceed  
ALU Concentrations**

Gas Works Park Site  
Seattle, Washington

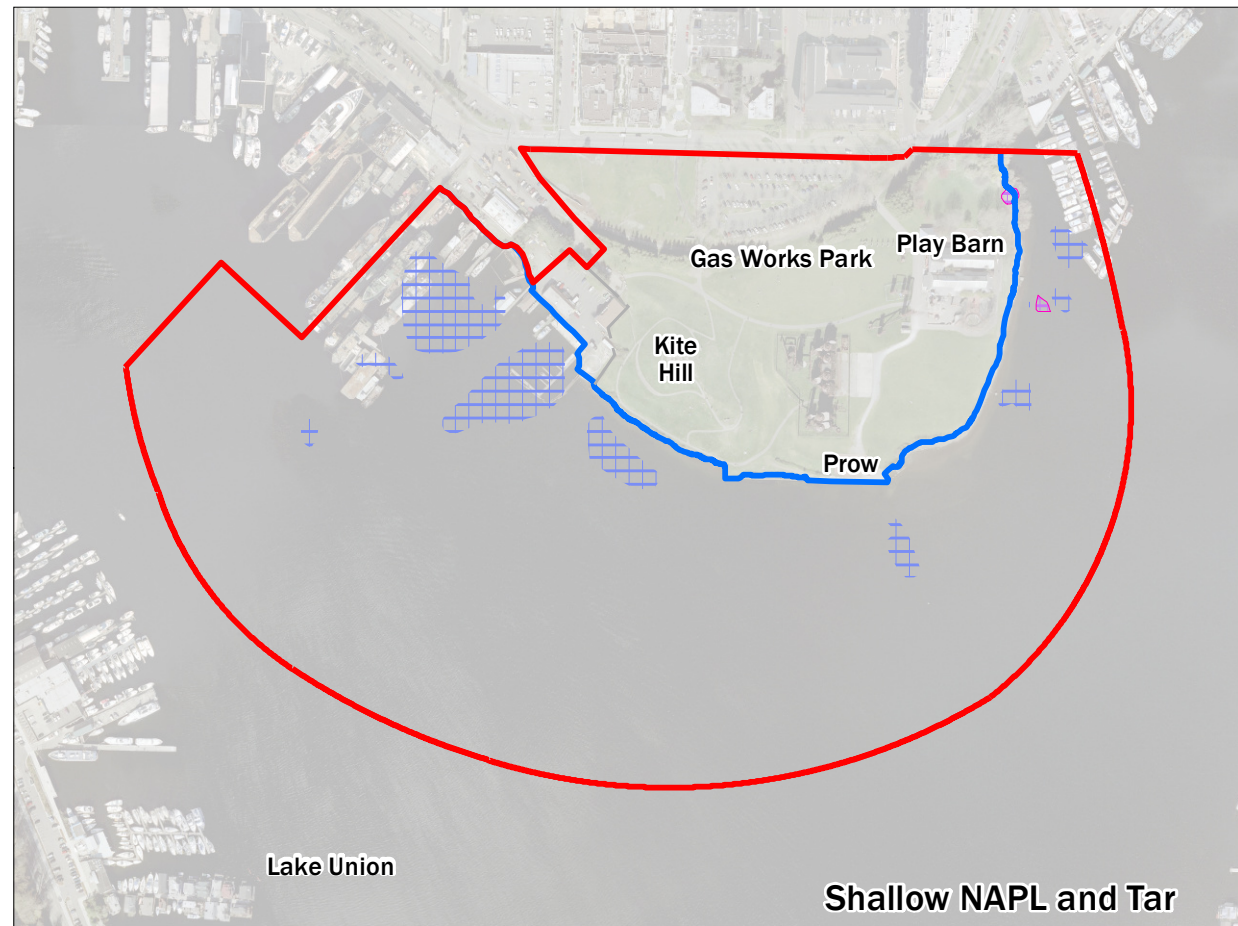
**GeoENGINEERS** **Figure 8-2B**



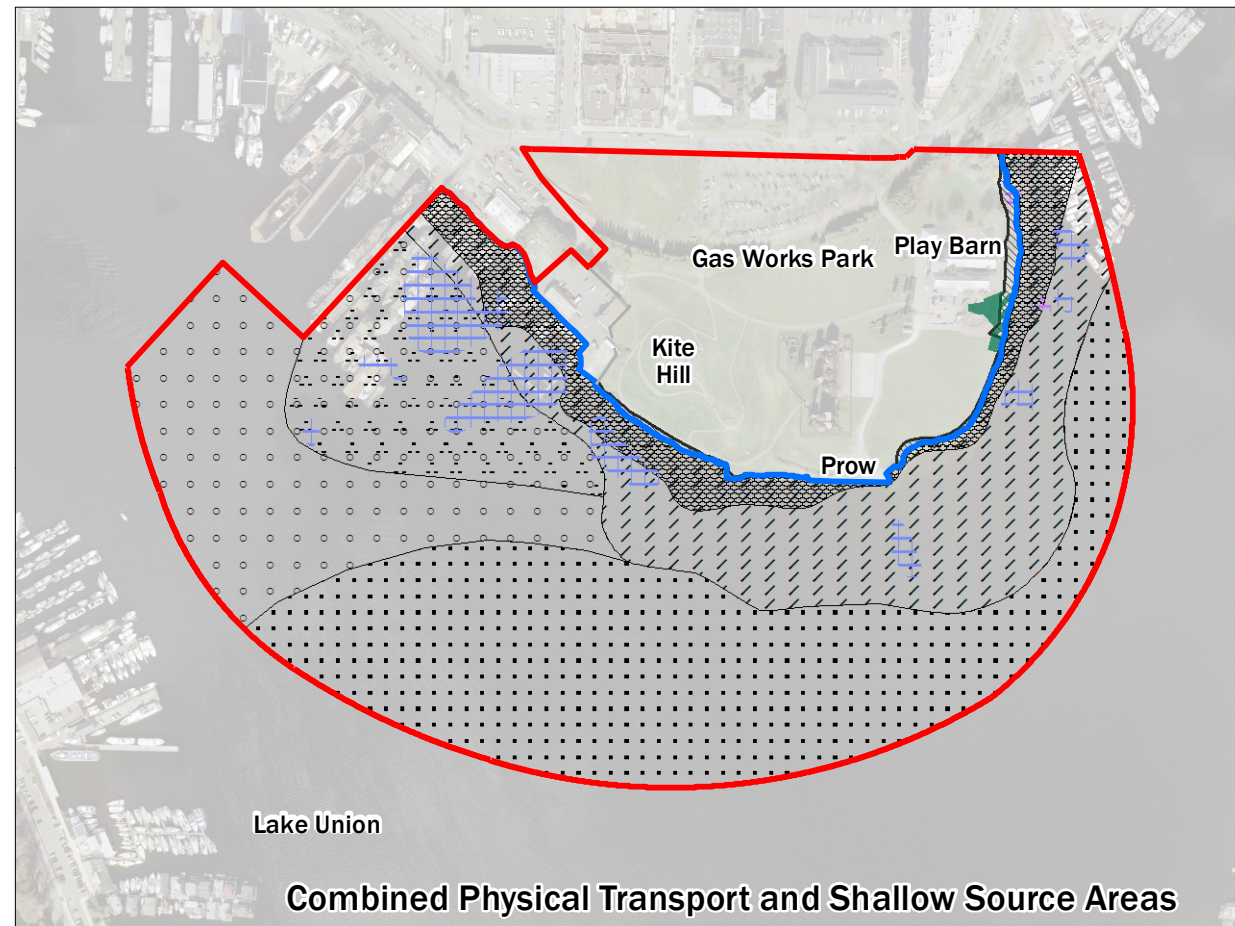
Lake Union  
Transport and Deposition



Lake Union  
Groundwater Discharge



Lake Union  
Shallow NAPL and Tar



Lake Union  
Combined Physical Transport and Shallow Source Areas

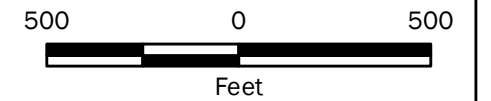
**Legend**

- Area of Investigation
- Shoreline (OHWM)
- Soil Transport (Unstable Bank)
- Sediment Transport
- Depositional Area
- Depositional-Recovering Area
- Groundwater Discharge Zone (>0.001 feet/day)
- Depositional Source Area (Includes Shallow NAPL)
- Shallow Tar
- Shallow NAPL
- Shoreline Arsenic-Contaminated Groundwater Area

**Notes:**

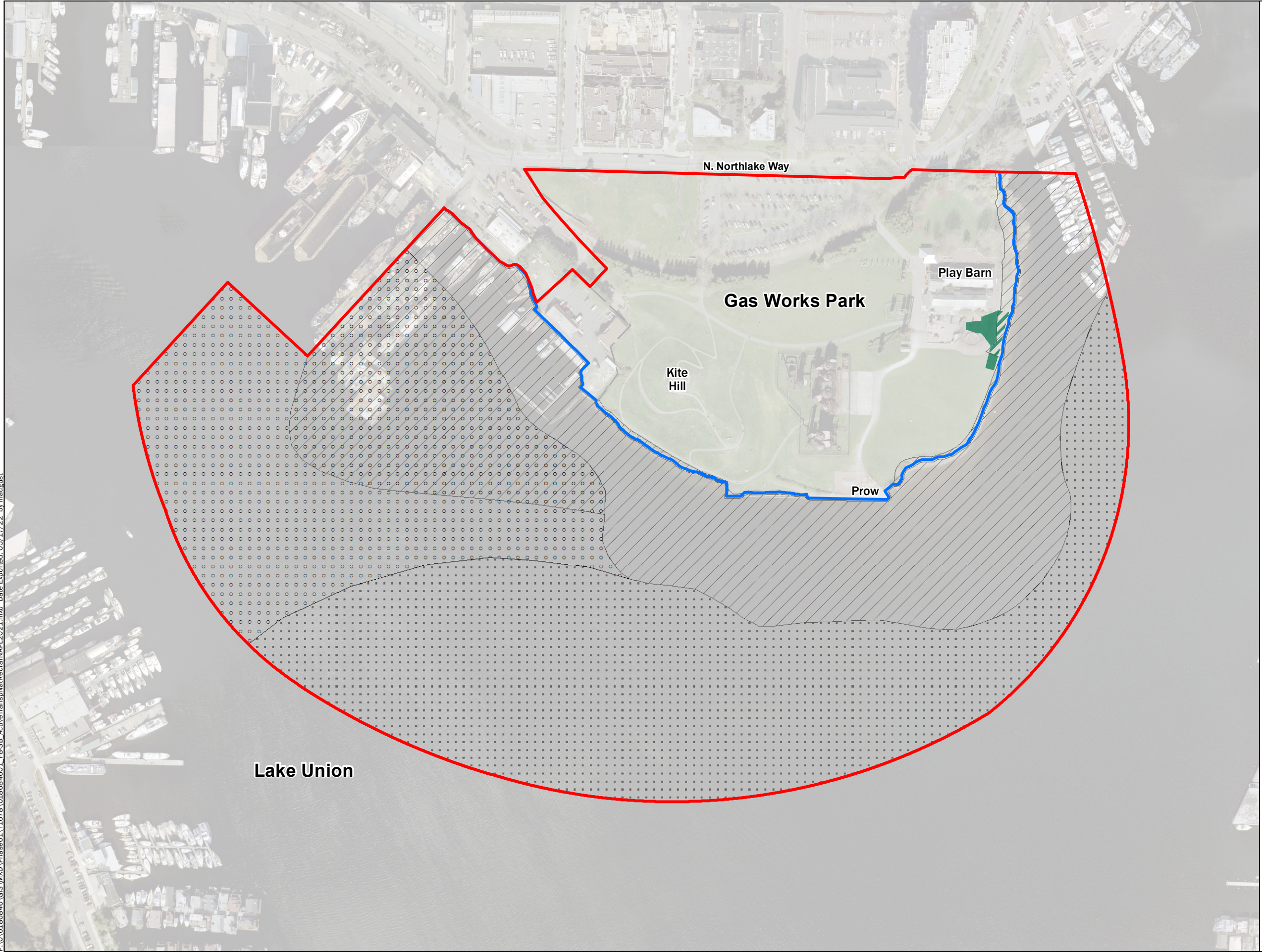
1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.






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<b>Physical Transport and Shallow Source Areas</b>	
Gas Works Park Site Seattle, Washington	
	<b>Figure 8-3A</b>

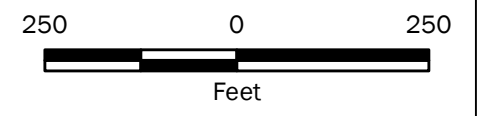
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- Legend**
-  Area of Investigation
  -  Shoreline (OHWM)
  -  Soil and Sediment Transport, Groundwater Discharge Zone, and NAPL/Tar Area
  -  Depositional Source Area (Includes Shallow NAPL)
  -  Depositional-Recovering Area
  -  Depositional Area
  -  Shoreline Arsenic-Contaminated Groundwater Area


- Notes:**
1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
  2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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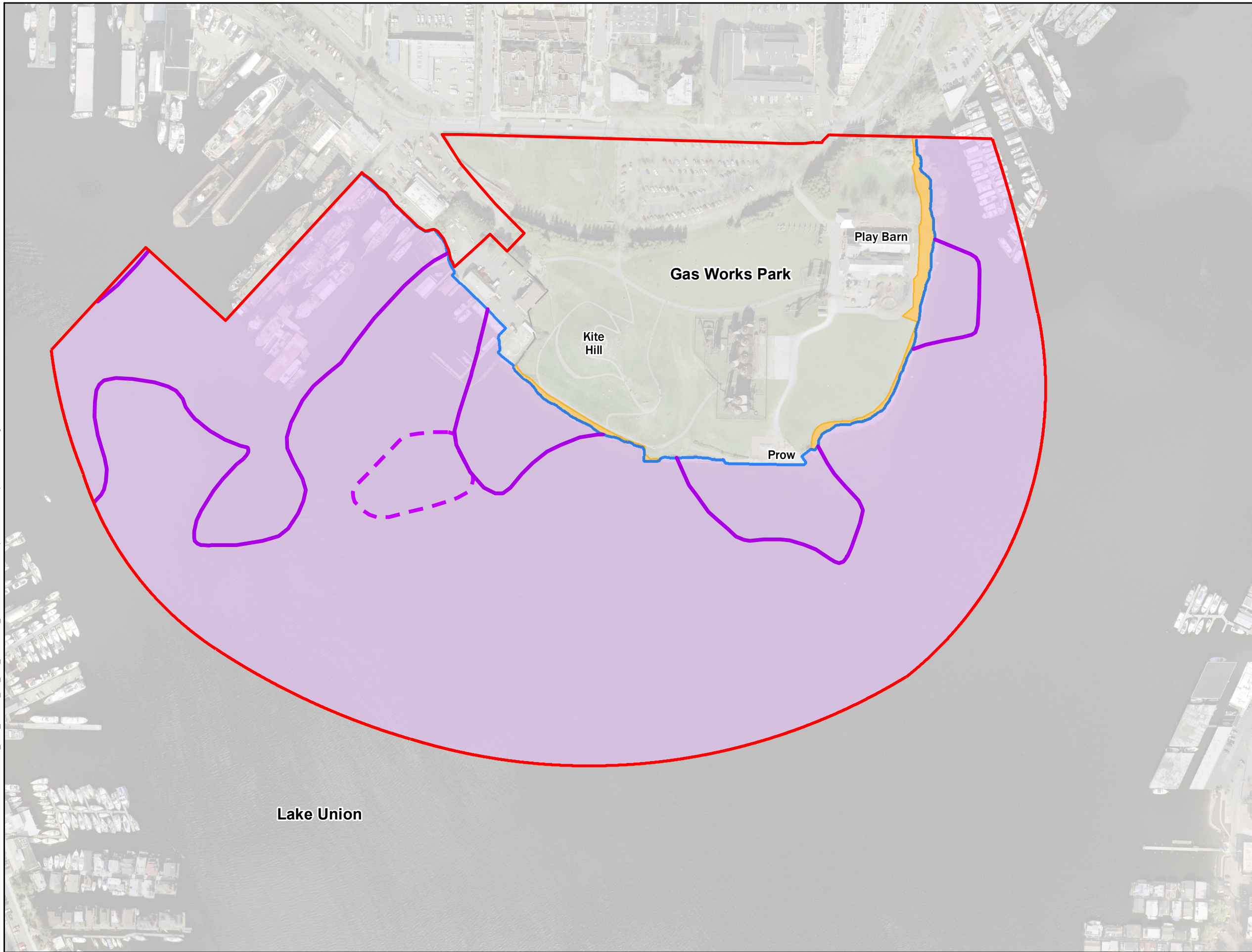


**Simplified Physical Transport and Shallow Source Areas**







Gas Works Park Site  
Seattle, Washington

**GEOENGINEERS**  **Figure 8-3B**

Path: P:\00186846\GIS\MXD\Phase01\1678\018684601\_FB-4\_Benthic\_HH\_Eco\_RiskAreas\_SMA2021.mxd Map Revised: 08 April 2022 maugust



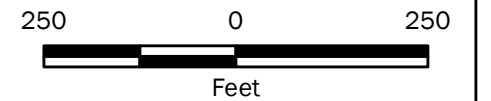
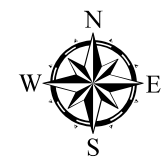
**Legend**

-  Area of Investigation
-  Shoreline (OHWM)
-  Benthic Toxicity Area
-  Uncertain Benthic Toxicity Area
-  Bioaccumulation and Direct Contact Exposure Area
-  cPAH-Impacted Soil/ Exposed Unstable Bank

**Notes:**

1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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**Exposure Areas to be Addressed in the FS**

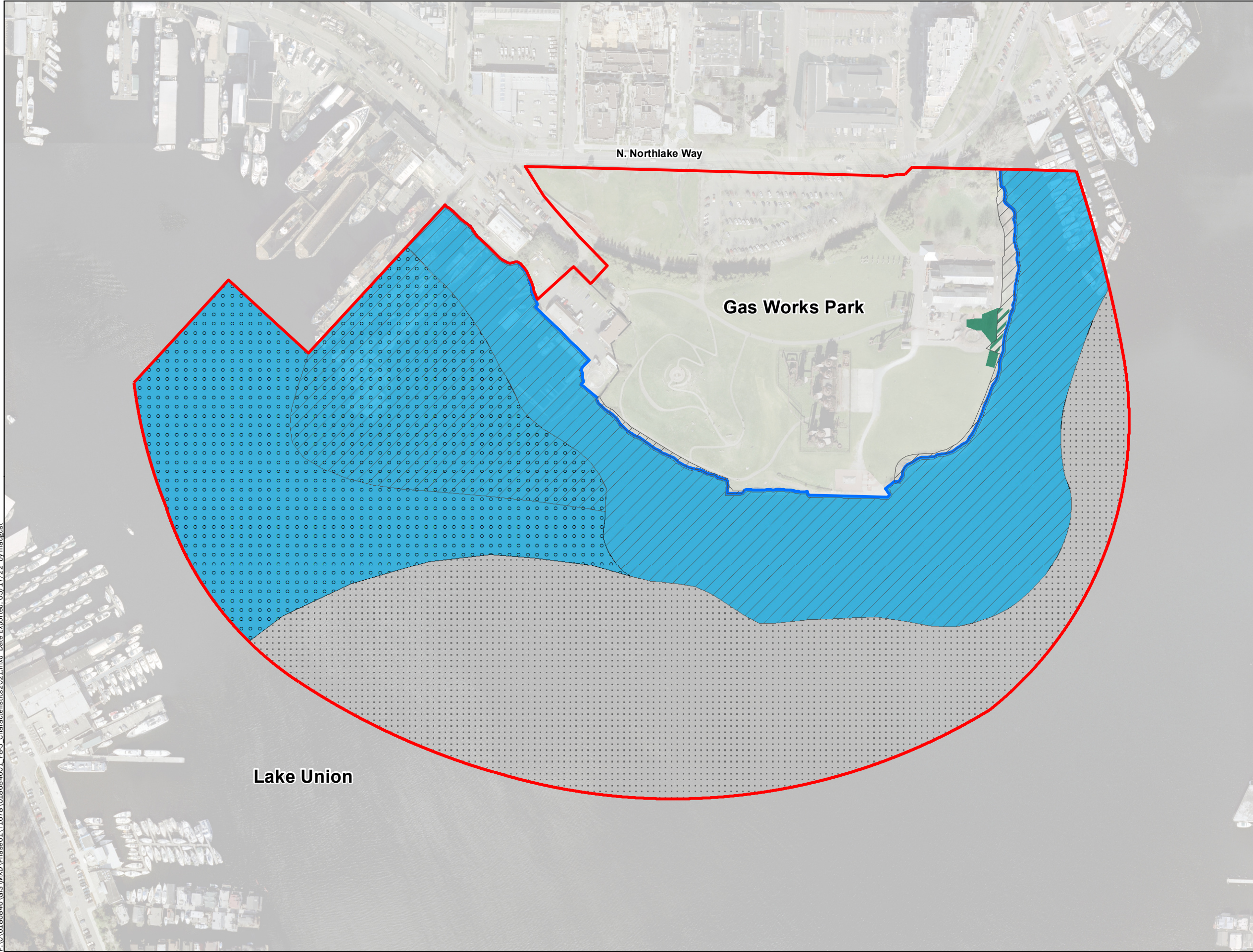
Gas Works Park Site  
Seattle, Washington











**Figure 8-4**



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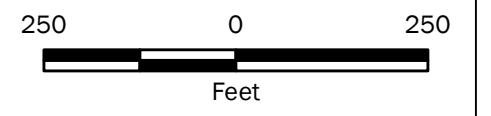
**Legend**

-  Area of Investigation
-  Shoreline (OHWM)
-  Sediment Area Where Primary GWPS COCs Exceed ALU Concentrations
-  Soil and Sediment Transport, Groundwater Discharge Zone, and NAPL/Tar Area
-  Depositional Source Area (Includes Shallow Tar and NAPL)
-  Depositional-Recovering Area
-  Depositional Area
-  Shoreline Arsenic-Contaminated Groundwater Area

**Notes:**

1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

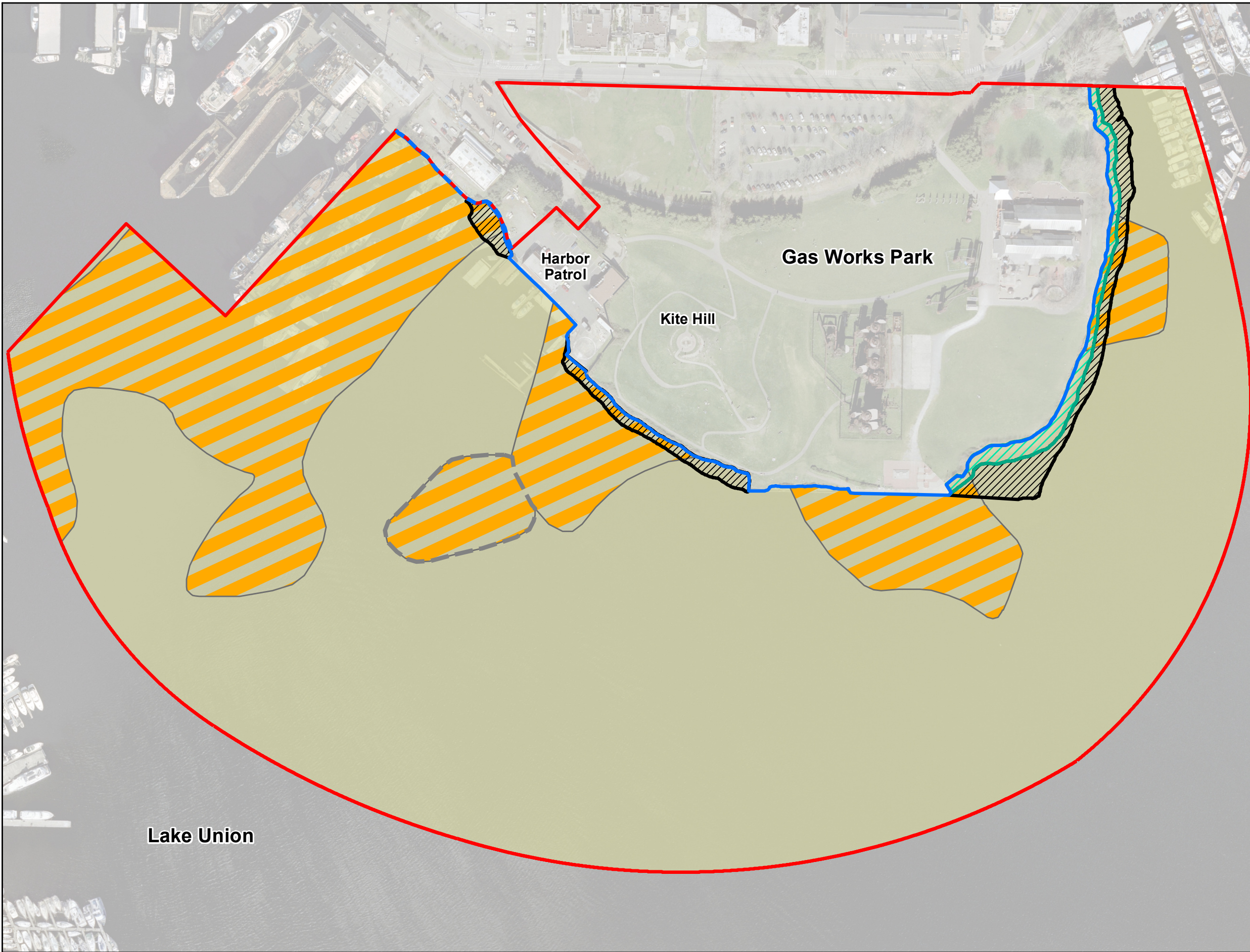
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


**Sediment Characteristics to be Considered in the FS**

Gas Works Park Site  
Seattle, Washington

Path: P:\00186846\GIS\MXD\Phase0\11\1678\018684601\_F9-1\_Sediment\_Compliance\_Areas2021.mxd Map Revised: 31 March 2022 maugust



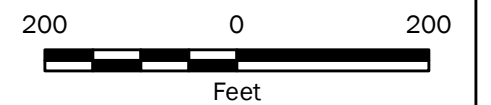
**Legend**

-  Area of Investigation
-  Shoreline (OHWM)
-  Direct Contact Beach Play and Wading Exposure Area (point of compliance = upper 45 cm)
-  Direct Contact Wading Exposure Area (point of compliance = upper 10 cm)
-  Bioaccumulation Exposure Area (point of compliance = upper 10 cm)
-  Benthic Toxicity Area (point of compliance = upper 10 cm)
-  Location of Benthic Toxicity Area Uncertain

**Notes:**

1. Elevation of 20 feet USACE generally defines the extent of the Direct Contact Beach Play and Wading Exposure Area. Elevation of 15 feet USACE generally defines the extent of the Direct Contact Wading Exposure Area.
2. Beach Play area is not included southwest of Kite Hill because the bank is steep, inaccessible, and armored.
3. Basemap 2005 USGS aerial photograph. Does not show current conditions.
4. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

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**Sediment Point of Compliance Areas**

Gas Works Park Site  
Seattle, Washington



**Figure 9-1**

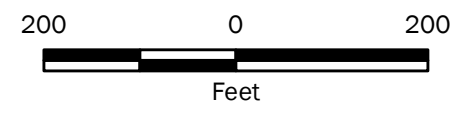


**Legend**

- Area of Investigation
- Shoreline (OHWM)
- Groundwater Compliance Area<sup>1</sup>

- Notes:**
1. Groundwater Compliance Area is equal to the Groundwater Discharge Zone (see Section 3).
  2. Basemap 2005 USGS aerial photograph. Does not show current conditions.
  3. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

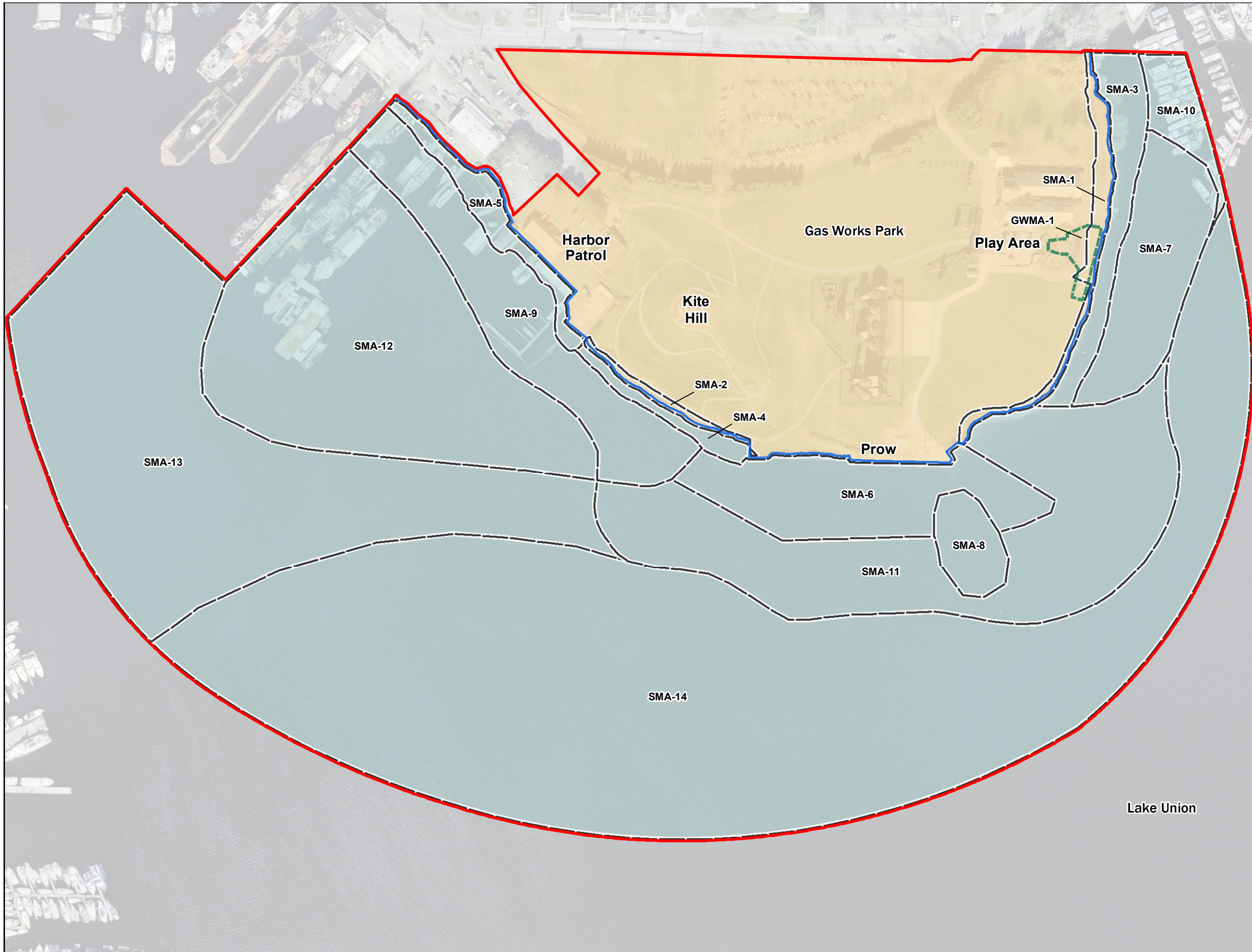
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<b>Groundwater Compliance Area</b>	
Gas Works Park Site Seattle, Washington	
	<b>Figure 9-2</b>

P:\0186846\GIS\MXD\Phase01\1678\018684601\_F9-2\_GW\_Compliance\_Zone2021.mxd Date Exported: 03/31/22 by maugust

Office: SEA Path: \\geoengineers.com\wan\Projects\0186846\GIS\MXD\Phase0\1T805018684600\_F10-1\_SMA2021.mxd Map Revised: 28 September 2021 maugust



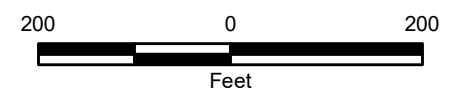
**Legend**

- Area of Investigation
- Shoreline (OHWM)
- - - Sediment Management Area (SMA) Boundary
- - - Groundwater Management Area (GWMA) Boundary
- Upland Cleanup Unit (UCU)
- Sediment Cleanup Unit (SCU)

**Notes:**

1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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<b>Cleanup Units and Management Areas</b>	
Gas Works Park Site Seattle, Washington	
	<b>Figure 10-1</b>

Office: SEA Path: P:\010186846\GIS\MXD\Phase011T805\018684601\_F11-1\_SoftSedimentAreas.mxd Map Revised: 01 April 2022 \_maugust

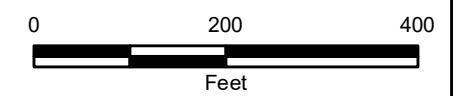


### Legend

- Area of Investigation
- Shoreline (OHWM)
- Estimated Extent of Very Soft Sediment/Fluid Mud at Thicknesses Not Suitable for Dredging (>3 feet)
- Estimated Extent of Very Soft Sediment/Fluid Mud at Dredgeable Thicknesses (up to 3 feet)

### Very Soft Sediment/Fluid Mud Evaluation Results (See Appendix 11A)

- Very soft sediments/fluid mud likely. Up to ~20 feet thickness.
- Very soft sediments/fluid mud possible. >3 to ~4.5 feet thickness.
- Very soft sediments/fluid mud possible. Up to 3 feet thickness.
- No indication of very soft sediments/fluid mud.



**Notes:**  
1. Basemap - 2005 USGS aerial photograph. Does not show current conditions.  
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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<b>Very Soft Sediment/ Fluid Mud Areas</b>	
Gas Works Park Site Seattle, Washington	
	<b>Figure 11-1</b>

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**Legend**

- Area of Investigation
- Shoreline (OHWM)
- Slopes > 5:1
- Slopes < 5:1

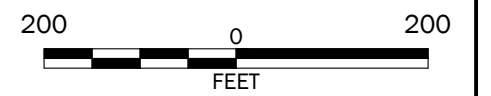
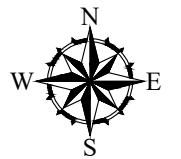
**Bathymetric Contour in Feet (USACE Locks Datum)**

- 1' Contour Interval
- 5' Contour Interval

**Notes:**

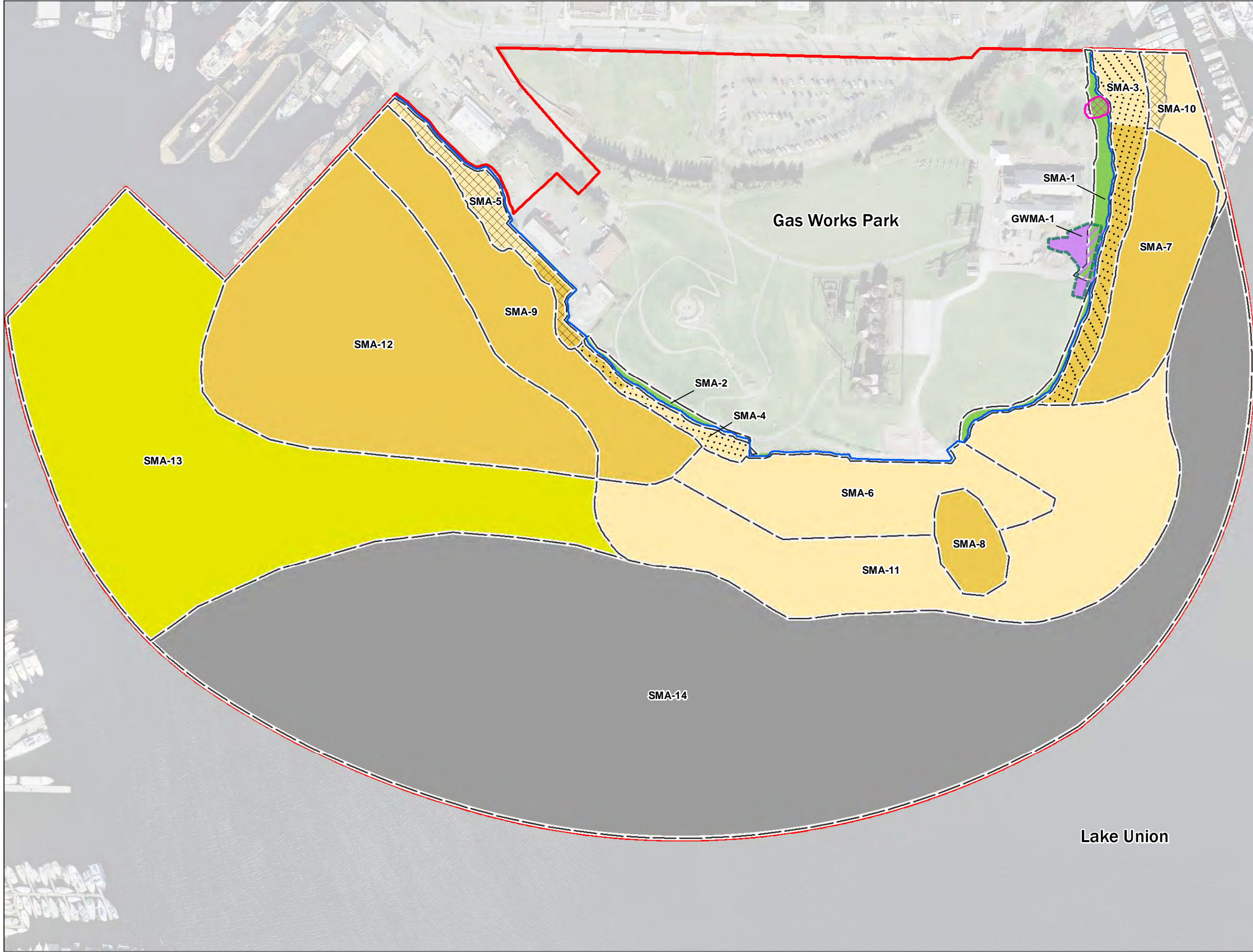
1. Data Source: Upland topographic base map supplemented with True North Land Surveying, Inc., Gas Works Park, Kite Hill Soil Cover Project, drawing J14-80.00, August 20, 2015; and Northwest Corner topography from City of Seattle (2005). Northeast Corner topography does not reflect 2012 capping. Bathymetry generated from side-scan sonar surveys (RETEC, September 1999; City of Seattle November 2002), nearshore singlebeam bathymetry survey (RETEC, October 2002), multibeam bathymetry surveys (Parametrix, December 2002; Tetra Tech, October 2006), leadline survey (RETEC, 2005).
2. Basemap 2005 USGS aerial photograph. Does not show current conditions.
3. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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<b>Sediment Areas with Slope Greater than 5:1</b>	
Gas Works Park Site Seattle, Washington	
	<b>Figure 11-2</b>

Office: SEA Path: P:\010186846\GIS\MXD\Phase01\T805\018684600\_F12-1\_Alt1\_NearshoreDredge\_ConvertCap\_2021.mxd Map Revised: 03 August 2021 maugust



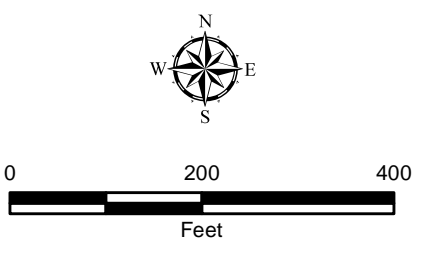
**Legend**

- Area of Investigation
- Shoreline (OHWM)
- Sediment Management Area (SMA) Boundary
- Groundwater Management Area (GWMA) Boundary
- Shallow Tar Removal
- Permeable Vegetated Cap
- Arsenic In-situ Treatment (Groundwater)
- Sand Cap (2 ft Isolation Layer)
- Thick (>3 ft Isolation Layer) Sand Cap
- Enhanced Natural Recovery (ENR)
- Monitored Natural Recovery (MNR)
- Dredging to facilitate placement of cap material without modification to shoreline elevations
- Potential dredging to facilitate placement of cap material in water depths less than 15 feet to minimize disruption to facility operations

**Notes:**

1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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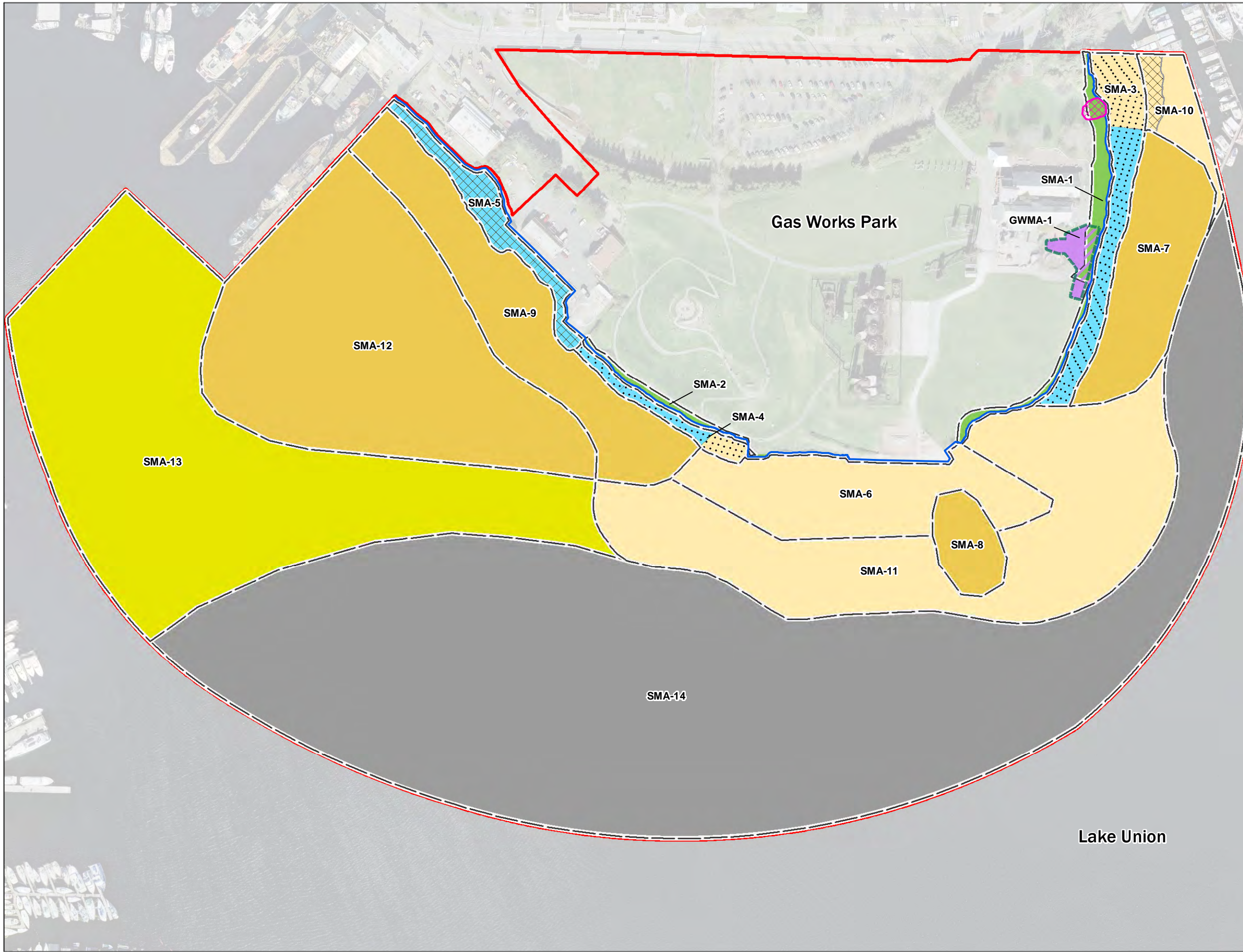


**Alternative 1**

Gas Works Park Site  
Seattle, Washington

**GEOENGINEERS** **Figure 12-1**

Office: SEA Path: P:\010186846\GIS\MXD\Phase01\1805\018684600\_F12-2\_A12\_Nearshore\_Enhanced\_2021.mxd Map Revised: 21 September 2021 maugust

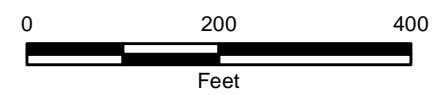


**Legend**

- Area of Investigation
- Shoreline (OHWM)
- Sediment Management Area (SMA) Boundary
- Groundwater Management Area (GWMA) Boundary
- Shallow Tar Removal
- Permeable Vegetated Cap
- Arsenic In-situ Treatment (Groundwater)
- Sand Cap (2 ft Isolation Layer)
- Thick (>3 ft Isolation Layer) Sand Cap
- Enhanced Cap
- Enhanced Natural Recovery (ENR)
- Monitored Natural Recovery (MNR)
- Dredging to facilitate placement of cap material without modification to shoreline elevations
- Potential dredging to facilitate placement of cap material in water depths less than 15 feet to minimize disruption to facility operations

**Notes:**

1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
  2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.
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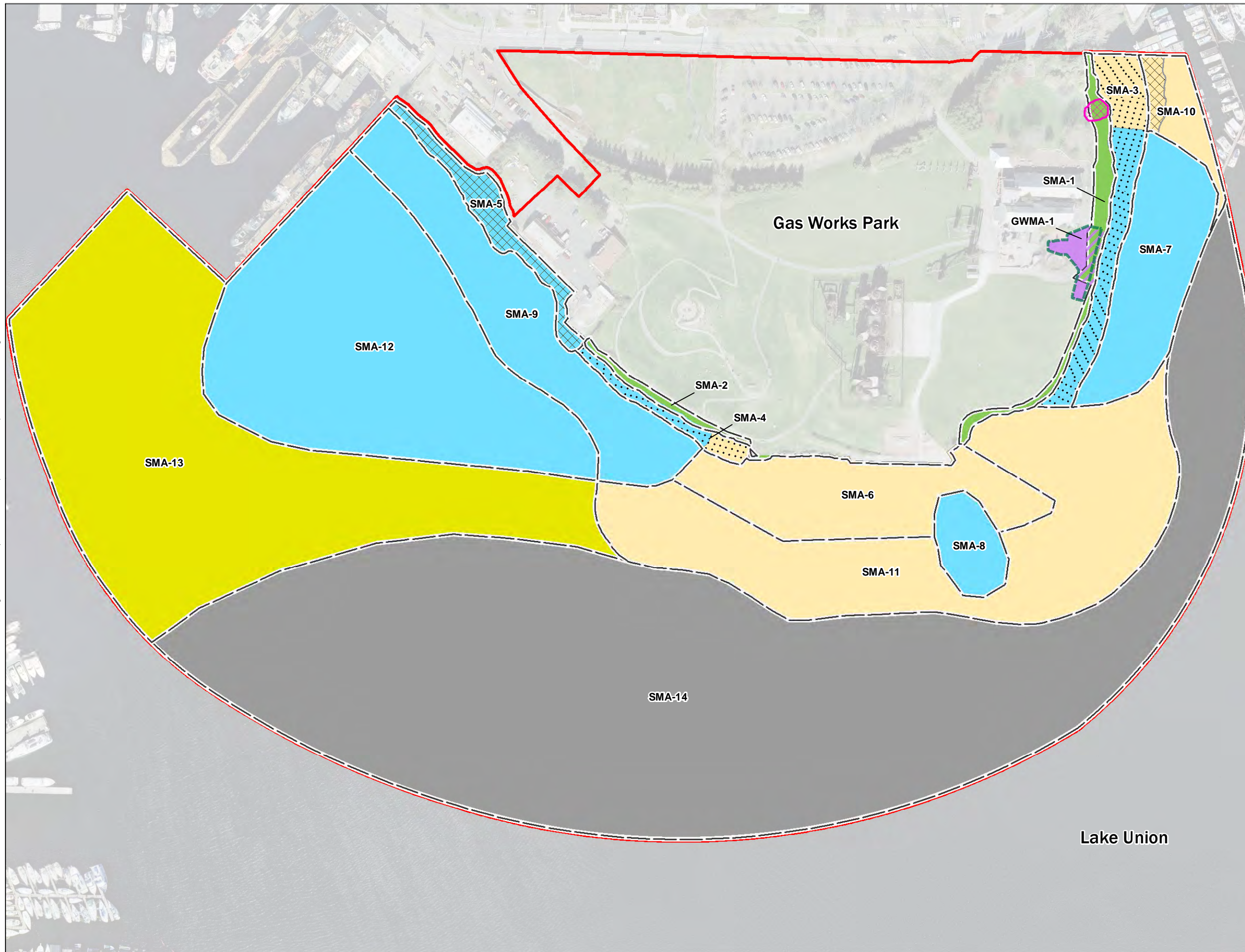
**Alternative 2**

**Gas Works Park Site**  
Seattle, Washington

**GEOENGINEERS** **Figure 12-2**



Office: SEA Path: P:\010186846\GIS\MXD\Phase01\1805\018684600\_F12-3\_A13\_NearshoreDredge\_AmendedCap\_2021.mxd Map Revised: 21 September 2021 maugust



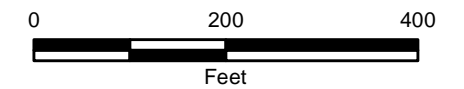
**Legend**

- Area of Investigation
- Shoreline (OHWM)
- Sediment Management Area (SMA) Boundary
- Groundwater Management Area (GWMA) Boundary
- Shallow Tar Removal
- Permeable Vegetated Cap
- Arsenic In-situ Treatment (Groundwater)
- Sand Cap (2 ft Isolation Layer)
- Enhanced Cap
- Enhanced Natural Recovery (ENR)
- Monitored Natural Recovery (MNR)
- Dredging to facilitate placement of cap material without modification to shoreline elevations
- Potential dredging to facilitate placement of cap material in water depths less than 15 feet to minimize disruption to facility operations

**Notes:**

1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

DISCLAIMER: This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. The locations of all features are approximate. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.



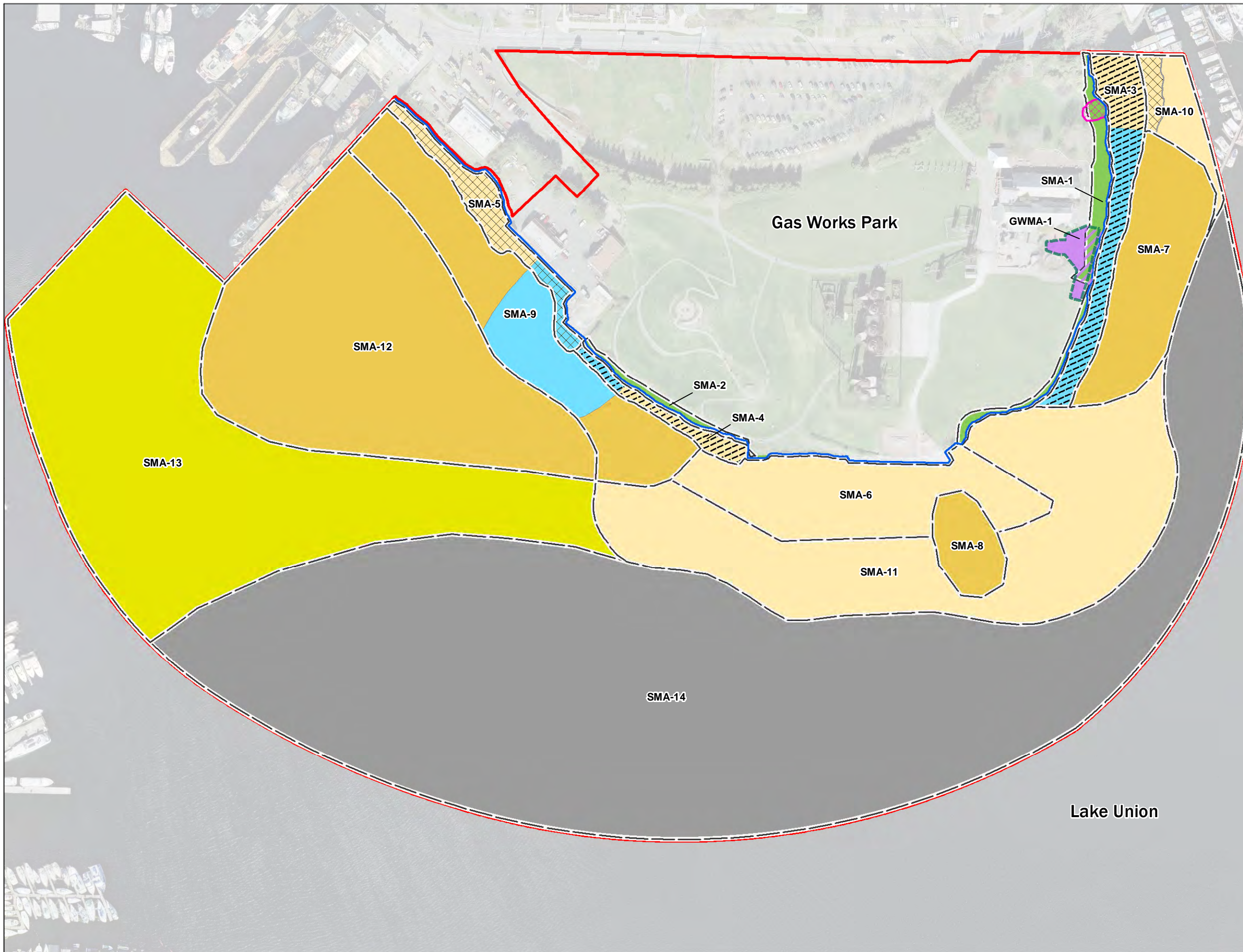
**Alternative 3**

Gas Works Park Site  
Seattle, Washington



**Figure 12-3**

Office: SEA Path: P:\010186846\GIS\MXD\Phase01\1805\018684600\_F12-4\_Alt4\_ExpandedNearshore\_Multicomponent\_2021.mxd Map Revised: 21 September 2021 maugust



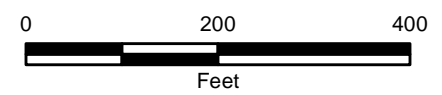
**Legend**

- Area of Investigation
- Shoreline (OHWM)
- Sediment Management Area (SMA) Boundary
- Groundwater Management Area (GWMA) Boundary
- Shallow Tar Removal
- Permeable Vegetated Cap
- Arsenic In-situ Treatment (Groundwater)
- Sand Cap (2 ft Isolation Layer)
- Thick (>3 ft Isolation Layer) Sand Cap
- Enhanced Cap
- Enhanced Natural Recovery (ENR)
- Monitored Natural Recovery (MNR)
- Dredging for mass reduction and to facilitate placement of cap material without modification to shoreline elevations
- Potential dredging to facilitate placement of cap material in water depths less than 15 feet to minimize disruption to facility operations

**Notes:**

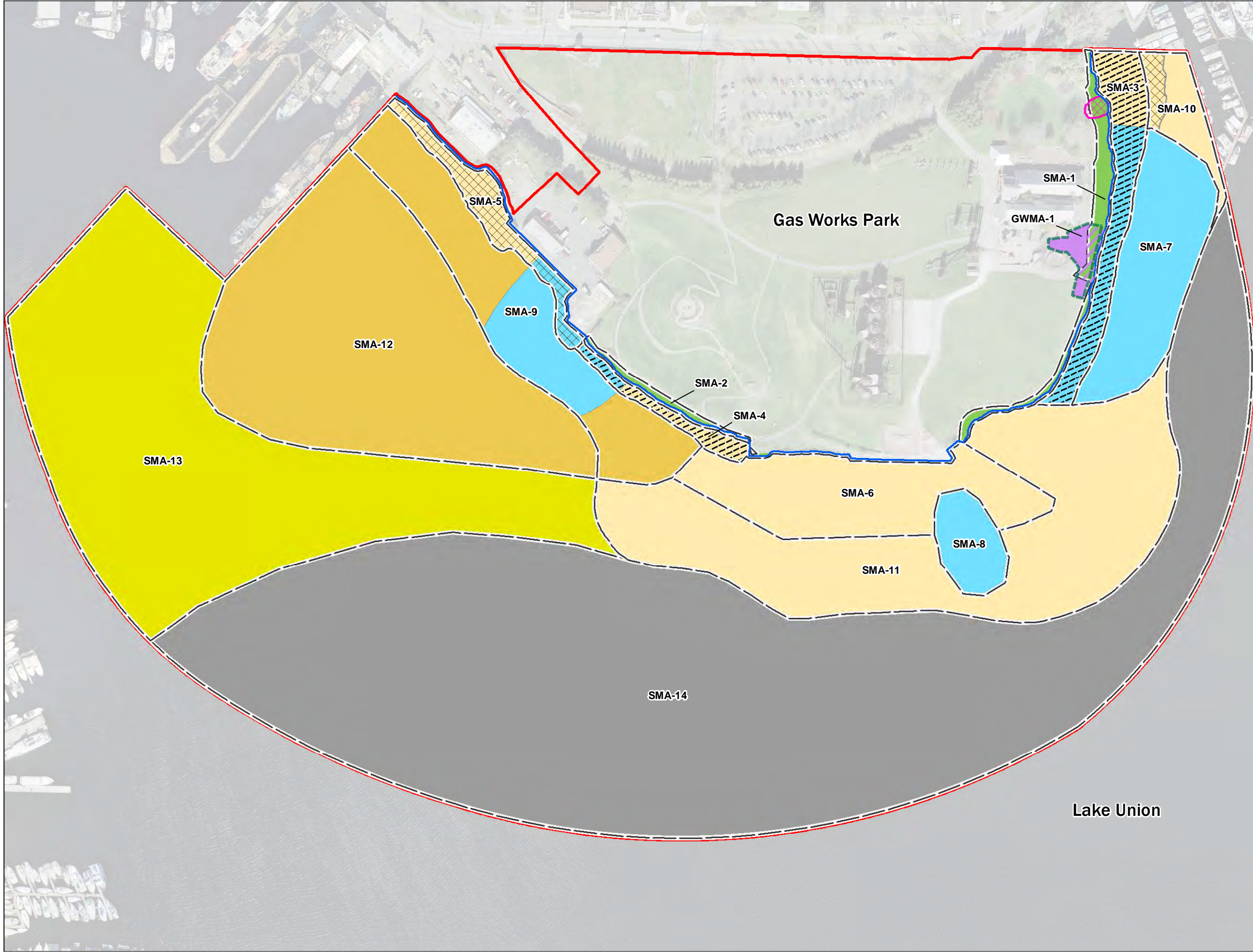
1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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<b>Alternative 4</b>	
Gas Works Park Site Seattle, Washington	
	<b>Figure 12-4</b>

Office: SEA Path: P:\010186846\GIS\MXD\Phase01\1805\018684600\_F12-5\_A15\_ExpandedNearshore\_MultiComponent.mxd Map Revised: 21 September 2021 maugust

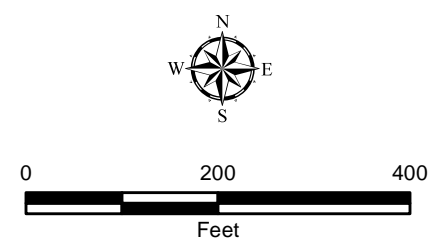


- Legend**
- Area of Investigation
  - Shoreline (OHWM)
  - Sediment Management Area (SMA) Boundary
  - Groundwater Management Area (GWMA) Boundary
  - Shallow Tar Removal
  - Permeable Vegetated Cap
  - Arsenic In-situ Treatment (Groundwater)
  - Sand Cap (2 ft Isolation Layer)
  - Thick (>3 ft Isolation Layer) Sand Cap
  - Enhanced Cap
  - Enhanced Natural Recovery (ENR)
  - Monitored Natural Recovery (MNR)
  - Dredging for mass reduction and to facilitate placement of cap material without modification to shoreline elevations
  - Potential dredging to facilitate placement of cap material in water depths less than 15 feet to minimize disruption to facility operations

**Notes:**

1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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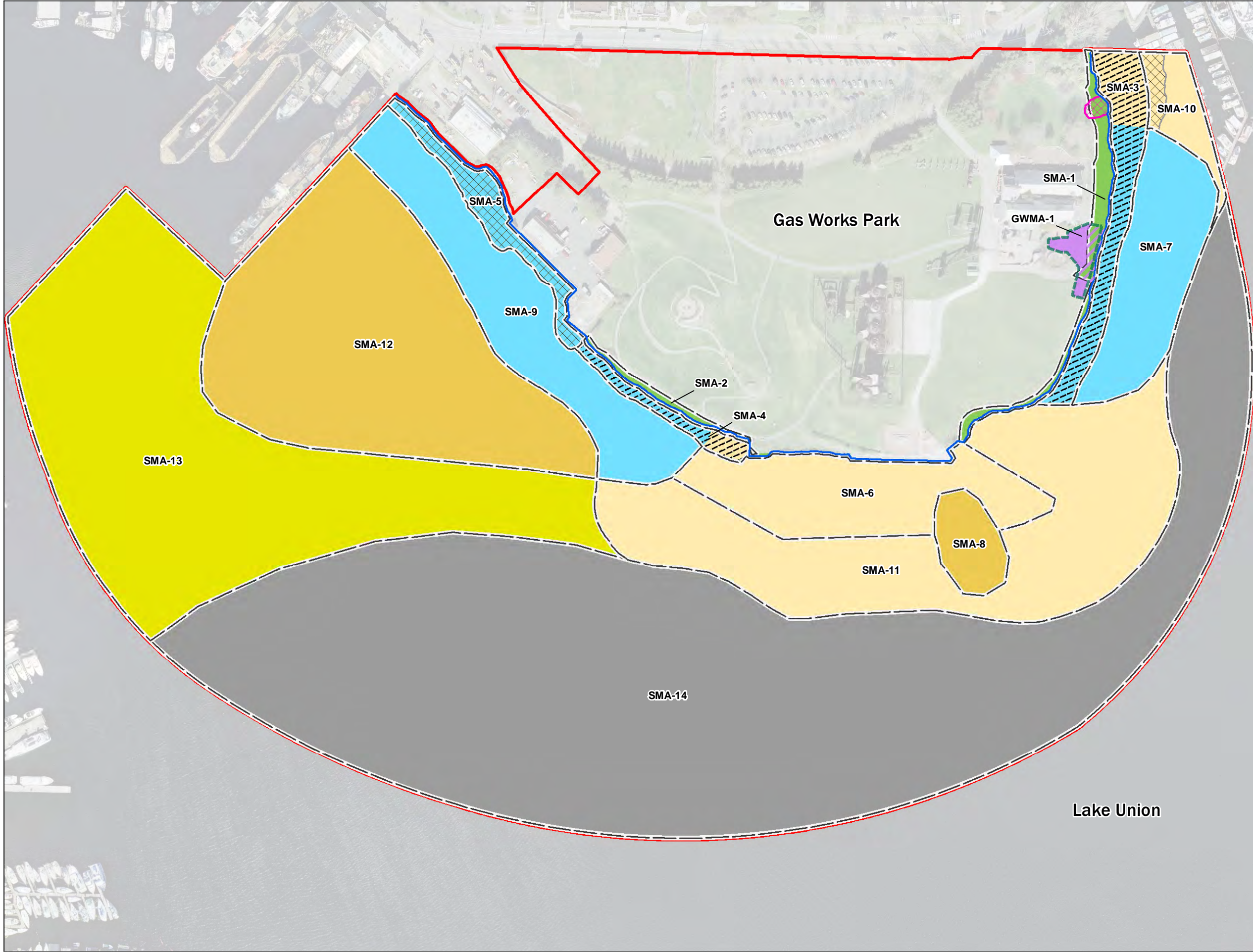


**Alternative 5**

Gas Works Park Site  
Seattle, Washington

**GEOENGINEERS** **Figure 12-5**

Office: SEA Path: P:\010186846\GIS\MXD\Phase01\1805\018684600\_F12-6\_A16\_ExpandedNearshore\_Multicomponent\_2021.mxd Map Revised: 21 September 2021 maugust



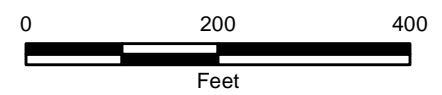
**Legend**

- Area of Investigation
- Shoreline (OHWM)
- Sediment Management Area (SMA) Boundary
- Groundwater Management Area (GWMA) Boundary
- Shallow Tar Removal
- Permeable Vegetated Cap
- Arsenic In-situ Treatment (Groundwater)
- Sand Cap (2 ft Isolation Layer)
- Thick (>3 ft Isolation Layer) Sand Cap
- Enhanced Cap
- Enhanced Natural Recovery (ENR)
- Monitored Natural Recovery (MNR)
- Dredging for mass reduction and to facilitate placement of cap material without modification to shoreline elevations
- Potential dredging to facilitate placement of cap material in water depths less than 15 feet to minimize disruption to facility operations

**Notes:**

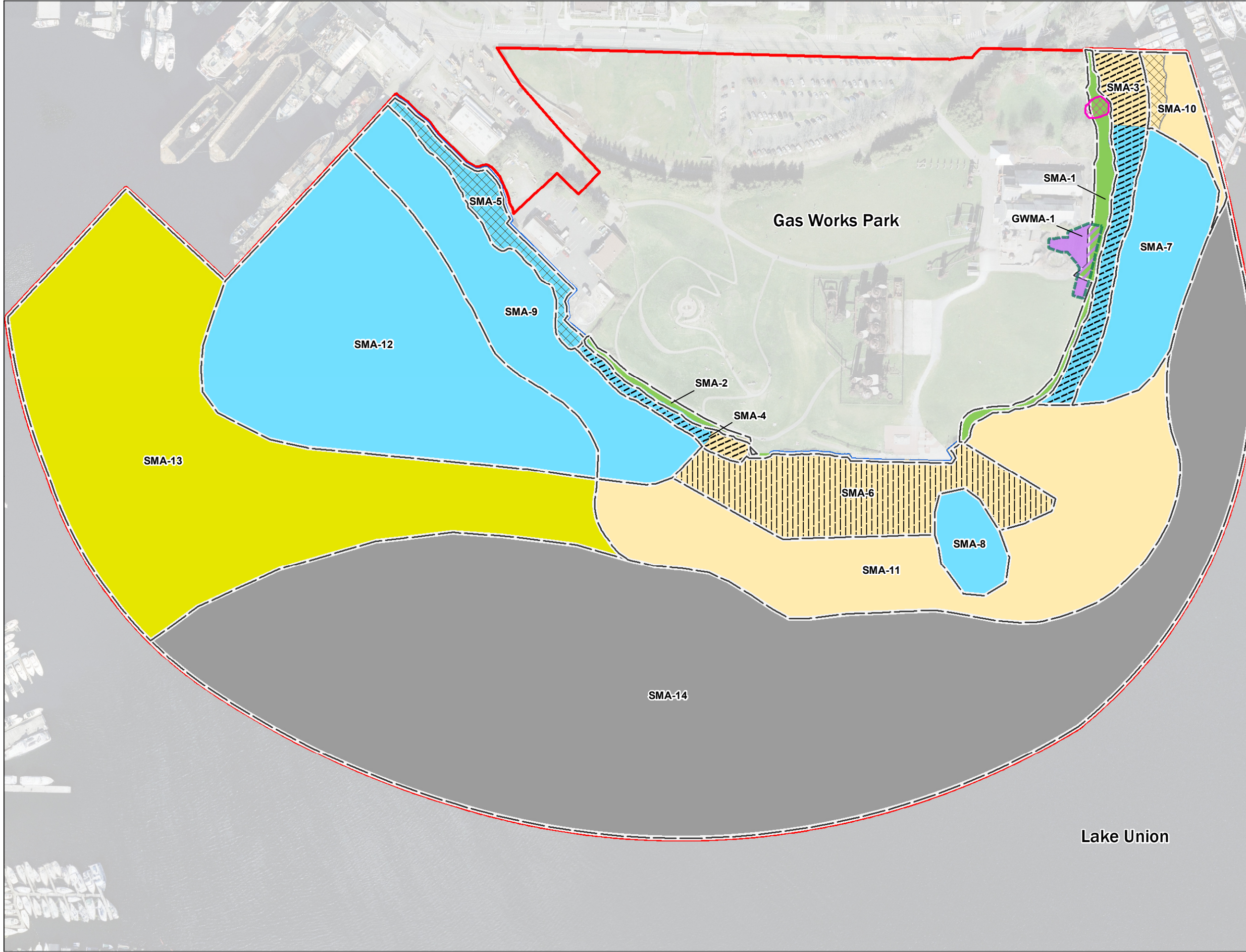
1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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<b>Alternative 6</b>	
Gas Works Park Site Seattle, Washington	
	<b>Figure 12-6</b>

Office: SEA Path: P:\010186846\GIS\MXD\Phase01\1805\018684600\_F12-7\_A17\_ExpandedNearshoreDredge\_Multi\_2021.mxd Map Revised: 29 March 2022 maugust



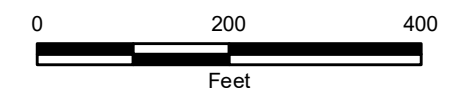
**Legend**

- Area of Investigation
- Shoreline (OHWM)
- - - Sediment Management Area (SMA) Boundary
- - - Groundwater Management Area (GWMA) Boundary
- Shallow Tar Removal
- Permeable Vegetated Cap
- Arsenic In-situ Treatment (Groundwater)
- Sand Cap (2 ft Isolation Layer)
- Enhanced Cap
- Enhanced Natural Recovery (ENR)
- Monitored Natural Recovery (MNR)
- Dredging for mass reduction and to facilitate placement of cap material without modification to shoreline elevations
- Potential dredging to facilitate placement of cap material in water depths less than 15 feet to minimize disruption to facility operations
- Dredging for mass removal

**Notes:**

1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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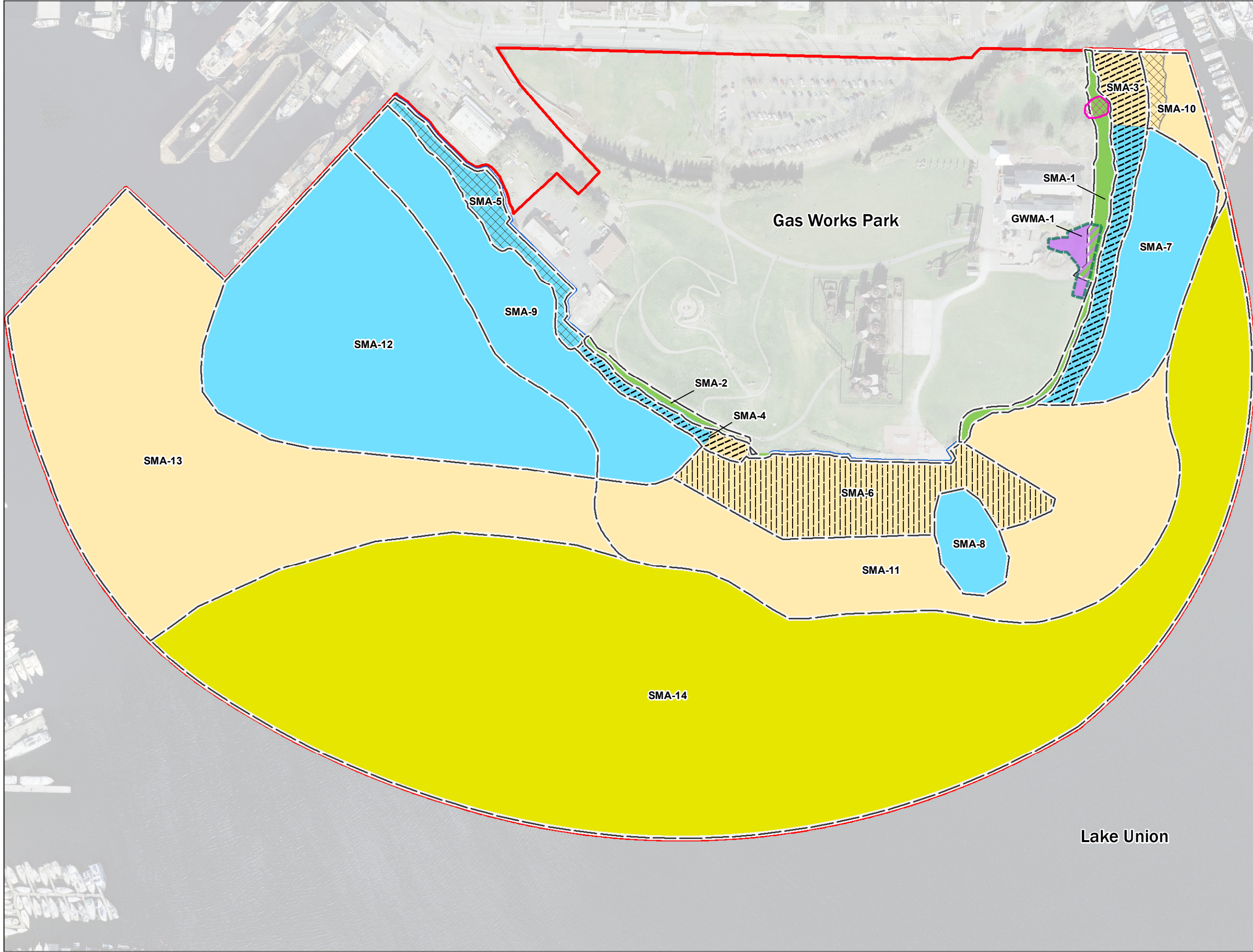


**Alternative 7**

**Gas Works Park Site  
Seattle, Washington**

**GEOENGINEERS** **Figure 12-7**

Office: SEA Path: P:\010186846\GIS\MXD\Phase01\1805\018684600\_F12-8\_A18\_ExpandedNearshoreDredge\_Multi\_2021.mxd Map Revised: 30 March 2022 maugust

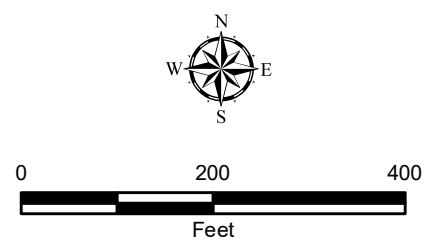


- Legend**
- Area of Investigation
  - Shoreline (OHWM)
  - - - Sediment Management Area (SMA) Boundary
  - - - Groundwater Management Area (GWMA) Boundary
  - Shallow Tar Removal
  - Permeable Vegetated Cap
  - Arsenic In-situ Treatment (Groundwater)
  - Sand Cap (2 ft Isolation Layer)
  - Enhanced Cap
  - Enhanced Natural Recovery (ENR)
  - Dredging for mass reduction and to facilitate placement of cap material without modification to shoreline elevations
  - Potential dredging to facilitate placement of cap material in water depths less than 15 feet to minimize disruption to facility operations
  - Dredging for mass removal

**Notes:**

1. Basemap 2005 USGS aerial photograph. Does not show current conditions.
2. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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**Alternative 8**

Gas Works Park Site  
Seattle, Washington

**Figure 12-8**



Figure 13-1 Disproportionate Cost Analysis Scoring Comparison

