PUBLIC REVIEW DRAFT
REMEDIAL INVESTIGATION REPORT
ICS/NWC RI/FS
SEATTLE, WASHINGTON

VOLUME II
Appendices

October 2025

Dalton, Olmsted & Fuglevand, Inc.

APPENDIX A
DOF TECHNICAL MEMORANDA

REMEDIAL INVESTIGATION REPORT
ICS/NWC
SEATTLE, WASHINGTON

- Results of Embayment Site Reconnaissance, Work Plan Task EB-1, Industrial Container Services, Seattle, Washington; December 8, 2010

- Results of Upland Site Reconnaissance, Work Plan Task UP-1, Industrial Container Services, Seattle, Washington; December 8, 2010

- GPR and Sewer Video Survey – RI Testing, ICS/NWC Site, Seattle, Washington; October 4, 2013

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MEMORANDUM

TO: Vickie Sutton - Department of Ecology

FROM: Matt Dalton

DATE: December 8, 2010

SUBJECT: Results of Embayment Site Reconnaissance
Work Plan Task EB-1
Industrial Container Services, Seattle, Washington

REF. NO: SUM-008-00

CC: Phil McCune - Summit Law Group
Steve Thiele - Summit Law Group

This technical memorandum presents the results of a site reconnaissance and other evaluations completed for the embayment portion of the ICS site located at 7152 1st. Avenue South, Seattle, Washington (Figure 1). The work was completed to meet the objectives of Task EB-1 of the draft Remedial Investigation and Feasibility Study (RI/FS) work plan (DOF 2010). It was requested that Ecology provide early approval of this task that was received in early September 2010. Staff from Dalton, Olmsted & Fuglevand, Inc., (DOF) completed the embayment site reconnaissance on September 7, 2010 to take advantage of a daylight low tide (-0.45 feet mean lower low water - MLLW @1029 hrs.) that occurred on this day. A second site visit was made with Ecology staff on October 4, 2010.

The general objectives of Task EB-1 were as follows:

- Complete detailed mapping of the embayment shoreline including describing visual evidence of contaminated bank soils and identify areas where seep and bank soil samples could be collected for laboratory analysis.

- Assess the thickness of fine grained sediment, to the extent possible, using hand equipment.

- Provide information to fine tune (revise) the embayment sediment sampling program described in the draft work plan. The revised sediment sampling

program will be submitted to Ecology for review and comment in a separate technical memorandum.

DESCRIPTION OF EMBAYMENT

The embayment was created by the placement of fill to form the north shoreline bank on what is now known as the Douglas property. Prior to placement of the fill, an "L" shaped dock structure extended from the south bank in an eastward direction (DOF 2010). Numerous piles that supported the dock, other marine related facilities and bulkheads are present in the embayment (Figure 2).

The embayment is approximately 600 feet long and ranges in width from approximately 35 feet at the west end (head of embayment) to 120 feet (east end near embayment mouth). A "neck" approximately 60 feet wide is located within the central portion of the embayment.

Top of bank elevations range between approximately 14 to 17 feet MLLW. Bottom elevations range between less that 1 foot MLLW at the east end (mouth) to approximately 10 feet MLLW at the west end (head). Approximately 70% to 75% of the embayment lies within the intertidal zone.

West End (Head) of Embayment - The west end of the embayment is covered with broken concrete, rebar, wood and other debris (Figure 3, top photograph). The broken concrete appears to have been placed as a scour protection apron for discharges from a reservoir overflow outfall. The relatively steep bank walls are covered with blackberries and other vegetation.

North Embayment Shoreline (Bank) - Figures 3 (bottom photograph) to 10 show the general condition of the north embayment shoreline. A partially pile supported wood frame structure and concrete ecology block wall are present along approximately 135 feet of shoreline (Figures 3, bottom photograph and 4). The north end of the structure is supported by fill, including large boulders. The top of the ecology block wall (composed of at least five levels of blocks) rises approximately eight to ten feet above the bottom sediment. A partially buried concrete truck drum was observed on the west end of the wood frame structure (Figure 4, top photograph).

The east end of the block wall transitions to a shoreline composed of concrete debris, bulkheads and piling (Figures 4, bottom photograph to 6). The top of bank is heavily vegetated. At least three tiers of bulkheads, supported by piling, are present at the east end of the north shoreline.

Much of the north bank is covered by a harder, erosion resistant, material that appears to have capped underlying sediment. The harder material is composed of two distinct material types including waste concrete and a chemical precipitate that appears to have

cemented together sand and finer grained material. The approximate extent of these capping materials are shown on Figure 2.

The waste concrete flows are present along the north bank near the neck of the embayment (Figures 6, top photograph and 7). The stratigraphy of the flows (Figure 7) suggests multiple releases to the embayment.

The western portion of the north bank is covered with a chemical precipitate that has cemented together sand and other materials (Figure 2). Figures 8 and 9 show the general layered nature of the material. Exploration in a number of locations indicate the deposit to be approximately 8 to 12 inches in thickness.

The waste concrete and chemical precipitate are not associated with typical barrel recycling operations. The source of these materials was likely Seattle Ready Mix, a ready-mix concrete plant that operated on the southern portion of the Douglas property from at least 1969 to 1977 (SAIC 2008). Waste concrete from cement trucks appears to have been directly deposited to the north side of the embayment. The chemical precipitate appears related to the dissolution and precipitation of silica associated with the pH of discharges to the north bank from the concrete plant.

A small amount of asphalt-like material was observed within the neck area on the north bank (Figure 10). This material appears to have flowed out from the north bank.

South Embayment Shoreline (Bank) - Figures 11 to 15 show the general condition of the south embayment shoreline. The south shoreline east of the neck is relatively gentle in slope (Figures 11 and 12, top photograph). Cobbles, wood and other debris are scattered on the sediment surface, along with the remains of a number of wooden piles. Large woody debris, large cobbles and the remains of concrete foundations are present along the shoreline. The top of bank is heavily vegetated.

Within and west of the embayment neck, the south shoreline is generally covered with fine grained sediment, cobbles, concrete slabs, wire and wood debris (Figure 12, bottom photograph; Figures 13 and 14). The 2nd Ave. Outfall discharges to the middle portion of the embayment from the south bank (Figure 13). The remains of the land access point to the former dock (Figure 14) is present along the south bank on the north side of the existing ICS facility. West of the former dock area, the south shoreline is heavily vegetated.

A asphalt-like material was observed on the west side of the neck and east of the 2nd Ave. Outfall, along the south shoreline (Figures 2 and 15). The deposit appears to be a localized, surface feature. Plastic sheeting/bag material was observed to be entrained in the matrix.

Other Features/Observations - Within the central portion of the embayment, pile supported, heavy milled timbers were observed (Figures 13 and 16). These timbers

appear to be formerly associated with marine boat dismantling/shipbuilding activities that occurred along the south shoreline prior to the filling of the Douglas property based on information contained in SAIC (2008).

The remains of two small boats are present within the embayment (Figure 14). The locations of these features are illustrated on Figure 2 as "Ruins".

Hand probing of sediment within the embayment channel indicated very soft sediment thicknesses of at least three feet thick. Machine coring will be necessary to determine the thickness and chemical quality of sediment that has accumulated within the embayment.

In the vicinity of the former entrance to the dock, oily sheens were observed when the hand-probe was extracted. The sheens are near the 2007 SAIC SED -1 and SED-2 surface sediment sampling locations where residual range organics (heavy oil) concentrations were between 15,000 and 20,000 mg/kg (DOF 2010).

In early September 2010, no seeps were observed along the north bank and only one seep was observed along the south bank in the neck area. Other seeps have been observed by SAIC as outlined in the draft RI/FS work plan (DOF 2010).

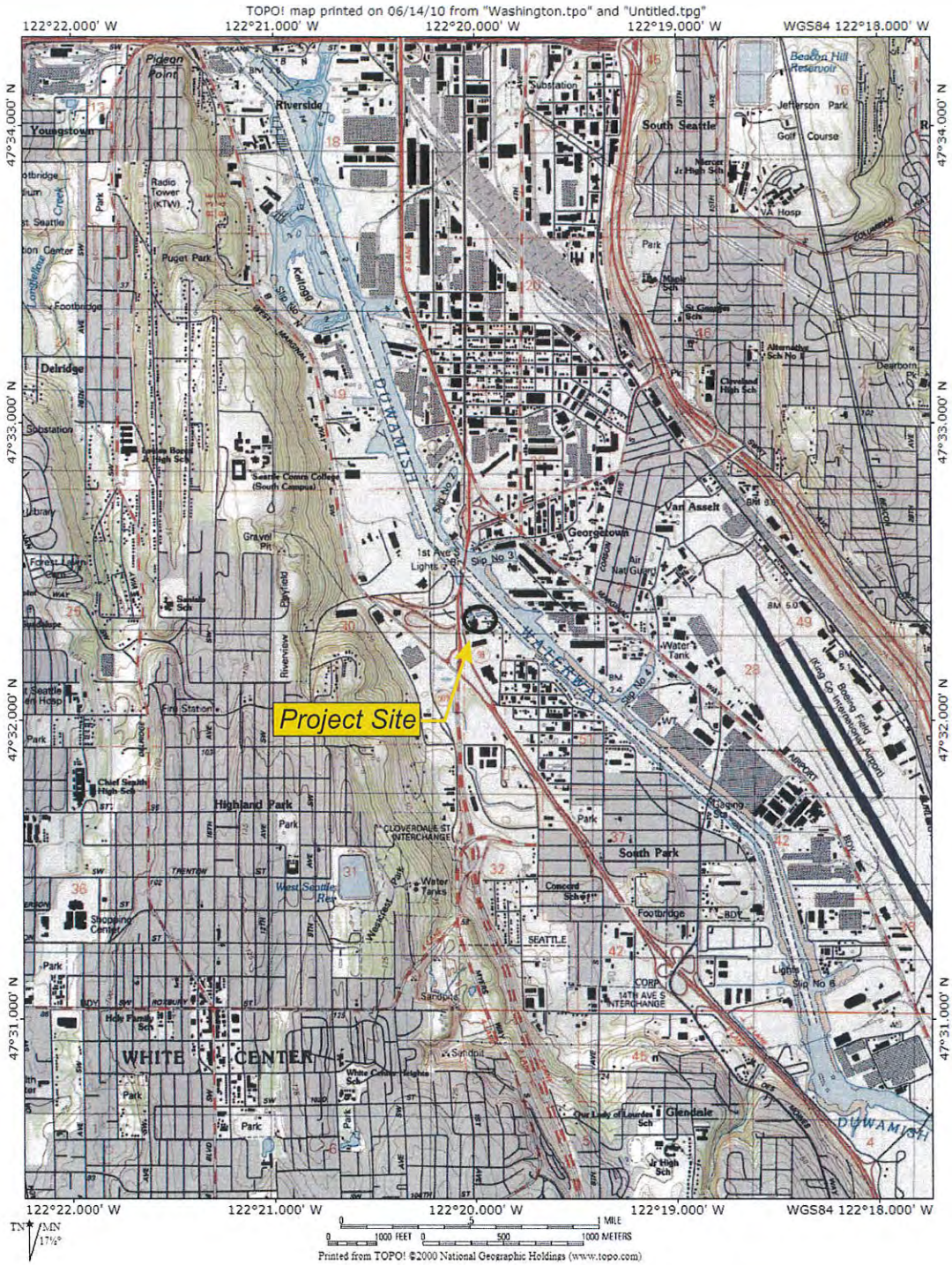
REFERENCES

DOF (Dalton, Olmsted & Fuglevand, Inc.), 2010, Agency Review Draft - Remedial Investigation/Feasibility Study (RI/FS) Work Plan, Industrial Container Services/Former NW Cooperage Site, Seattle, Washington, prepared for Herman and Jacqualine Trotsky and Industrial Container Services, WA LLC, July 16, 2010.

SAIC, 2008, Supplemental Data Gaps Report, Douglas Management Company Property, 7100 2nd Avenue SW, Seattle; prepared for the Washington State Department of Ecology (Ecology), December 2008.

Attachments

Figure 1 - Vicinity Map
Figure 2 - Embayment Reconnaissance Observations - Sept. 7, 2010.
Figure 3 - Embayment Photographs (9-7-10) - Head and North Bank
Figure 4 to 10 - Embayment Photographs (9-7-10) - North Bank
Figure 11 to 15 - Embayment Photographs (9-7-10) - South Bank
Figure 16 - Embayment Photographs (9-7-10) - Middle Portion



N

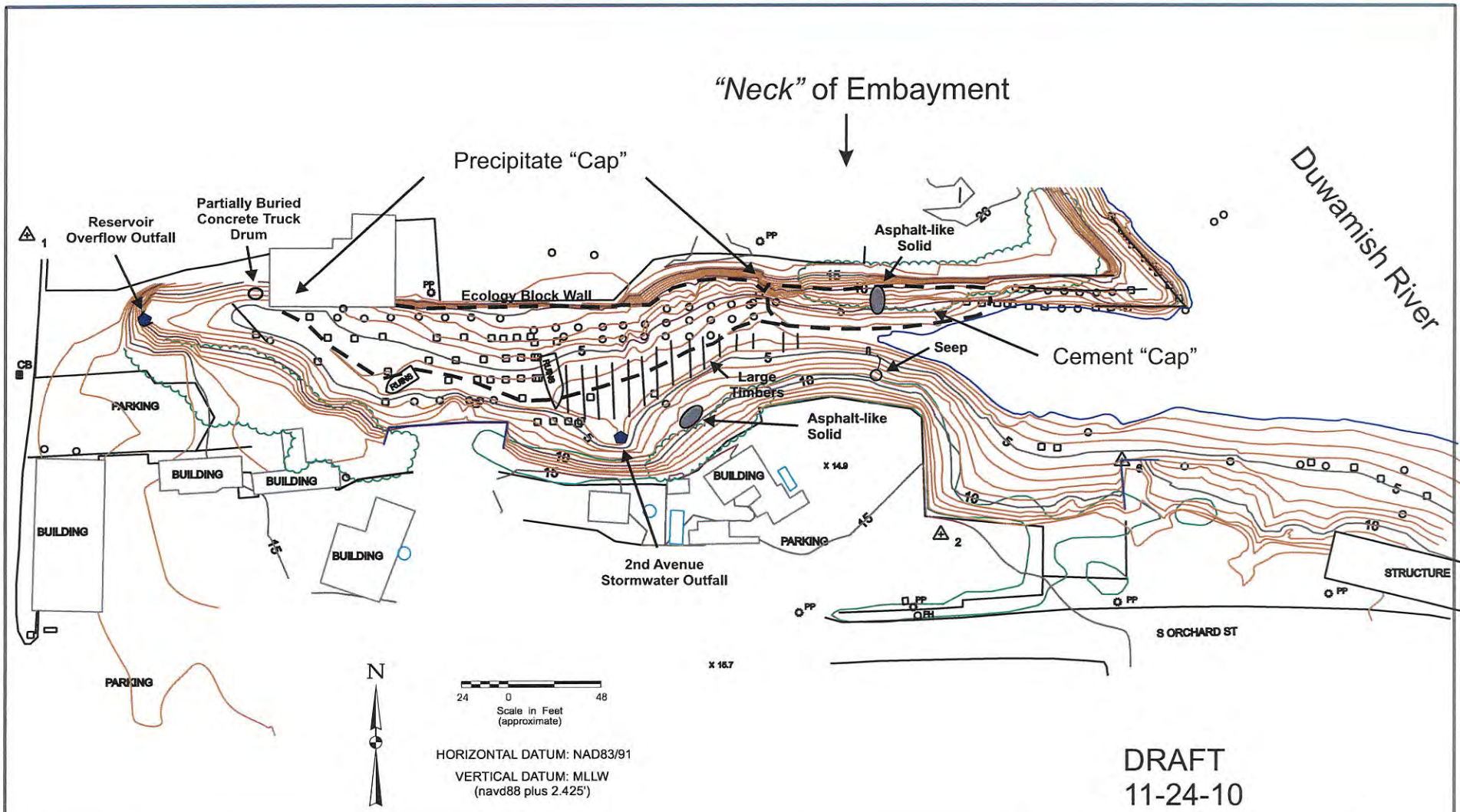
ICS/Trotsky Property

Vicinity Map

SUM-008-00 (ICS) *June 2010*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 1



Legend

- Pole/Piling
- Post
- PP Power Pole
- X 15.8 Spot Elevation (ft-MLLW)
- Photogrametry Marker
- CB Catch Basin
- Public Outfall
- Tax Parcel Boundary

Ref: ICS-NW Embay Site Recon 9-7-10.cdr

ICS/Trotsky Property

Embayment Reconnaissance Observations - Sept. 7, 2010

SUM-008 (ICS) *June 2010*

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 2

West End of Embayment (view to west toward reservoir overflow outfall)

West End of North Bank (view to northwest)

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (Head - North Bank)	**FIGURE 3**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

Ref: NWC Photo 9-7-10 No. 1.cdr

Structure West End of
North Bank
(view to northwest)

East End of Block Wall
(view to north)

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (North Bank)	**FIGURE 4**
SUM-008-00 (ICS) *Nov. 2010*	
Dalton, Olmsted & Fuglevand, Inc.	

Ref: NWC Photo 9-7-10 No. 2.cdr

Conditions Near East End of Block Wall North Bank (view to northwest)

East End of Block Wall (view to north)

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (North Bank)	**FIGURE 5**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

Ref: NWC Photo 9-7-10 No. 3.cdr

Mouth of Embayment
North and South Banks
(view to east)

Waste Concrete Flows

East End of North Bank
(view to northwest)

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (North Bank)	**FIGURE 6**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

Ref: NWC Photo 9-7-10 No. 4.cdr

Waste Concrete Flows - North Bank - East Side of Neck
(view to northwest)

Waste Concrete Flows - North Bank - East Side of Neck
(view to north)

ICS/Trotsky Property

Embayment Photographs - 9-7-10 (North Bank)

SUM-008-00 (ICS) ***Nov. 2010***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 7

Ref: NWC Photo 9-7-10 No. 11.cdr

Chemical Precipitate -
North Bank -
(view to north)

Chemical Precipitate -
North Bank -
(closer view)

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (North Bank)	**FIGURE 8**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

Ref: NWC Photo 9-7-10 No. 12.cdr

Chemical Precipitate - North Bank - (cemented material)

Chemical Precipitate - North Bank -

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (North Bank)	**FIGURE 9**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

Ref: NWC Photo 9-7-10 No. 13.cdr

Asphalt-Like Material
North Bank
(view to north)

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (North Bank)	**FIGURE 10**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

Ref: NWC Photo 9-7-10 No. 14.cdr

East End of South Bank (view to east)

South Bank - Near Mouth of Embaymnet (view to east)

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (South Bank)	**FIGURE 11**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

Ref: NWC Photo 9-7-10 No. 6.cdr

Near Mouth of Embayment - Towards Neck (view to west)

South Bank - Just East of 2nd. Ave. Outfall (view to southeast)

Ref: NWC Photo 9-7-10 No. 7.cdr

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (South Bank)	**FIGURE 12**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

South Bank - Area of 2nd Ave. Outfall (view to southwest)

South Bank - 2nd Ave. Outfall (view to south)

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (South Bank)	**FIGURE 13**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

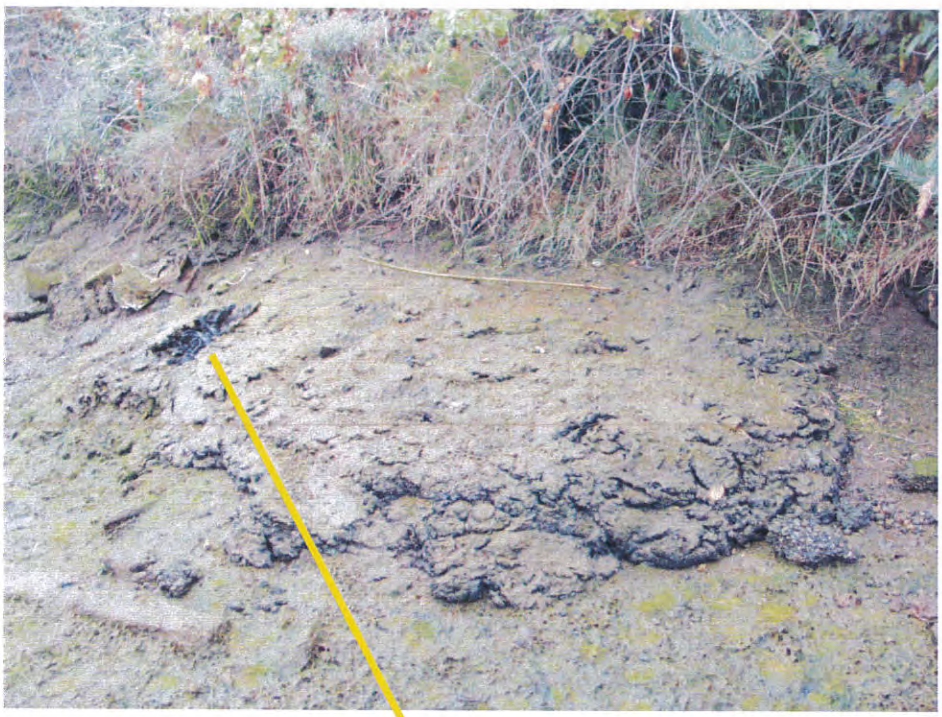
Ref: NWC Photo 9-7-10 No. 8.cdr

South Bank - Near Entrance to Former Dock (view to southwest)

South Bank - Near West End of Embayment (view to southwest)

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (South Bank)	**FIGURE 14**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

Ref: NWC Photo 9-7-10 No. 9.cdr



Asphalt-Like Material
South Bank
(view to south)

Asphalt-Like Material
South Bank
(view to south)

ICS/Trotsky Property

Embayment Photographs - 9-7-10 (South Bank)

SUM-008-00 (ICS) ***Nov. 2010***

Dalton, Olmsted & Fuglevand, Inc.

FIGURE 15

Ref: NWC Photo 9-7-10 No. 15.cdr

West Portion of Embayment - West of Neck
(view to west)

Central Portion of Embayment - Near Neck
(view to east)

ICS/Trotsky Property	
Embayment Photographs - 9-7-10 (Middle Portions)	**FIGURE 16**
SUM-008-00 (ICS) ***Nov. 2010***	
Dalton, Olmsted & Fuglevand, Inc.	

Ref: NWC Photo 9-7-10 No. 10.cdr

Dalton, Olmsted & Fuglevand, Inc. *Environmental Consultants*

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TECHNICAL MEMORANDUM

TO: Vickie Sutton - Department of Ecology

FROM: Matt Dalton

DATE: December 8, 2010

SUBJECT: Results of Upland Site Reconnaissance
Work Plan Task UP-1
Industrial Container Services (ICS), Seattle, Washington

REF. NO: SUM-008-00

CC: Phil McCune - Summit Law Group
Steve Thiele - Stoel Rives

This technical memorandum presents the results of a site reconnaissance and other evaluations completed for the upland portion of the ICS site located at 7152 1st. Avenue South, Seattle, Washington (Attachment 1). The work was completed to meet the objectives of Task UP-1 of the draft Remedial Investigation (RI) and Feasibility Study (FS) work plan (DOF 2010). It was requested that Ecology provide early approval of this task that was received on September 1, 2010. Each of the objectives and supporting discussion are presented below. The site reconnaissance by staff from Dalton, Olmsted & Fuglevand, Inc. (DOF) was completed on September 7, 2010. A second site visit was made on October 4, 2010 with staff of the Washington State Department of Ecology (Ecology).

- **Assess the condition of the ditch or unpaved area within the southeastern portion of the Site.**

  As outlined in the draft work plan, a stormwater drainage ditch was historically present along the eastern boundary of the project site. The ditch received drainage from properties located to the south of the ICS site including several wrecking yards. A stormwater pipe was installed and the ditch was filled in the 1960s. The stormwater pipe is connected to the City of Seattle, 2nd Ave. outfall that discharges to the embayment on the north side of the upland (Attachment 2).

A visit was made to the City of Seattle engineering archives to acquire further information on the buried stormwater pipe. The trend of the buried stormwater pipe with respect to the site is shown on Sewer Card No. 5340-79 (Attachment 3). The buried pipe system is located on the site along the eastern boundary and appears to consist of two man-holes and buried piping. The man-holes are located near the southeast ICS corner. The man-holes are connected by 30" CMP (corrugated metal pipe). From the north (last) man-hole to the 2nd Ave. outfall, the system consists of *"342' - 24" drain"*. No site catch basins are shown to connect into the stormwater pipe.

The approximate position of the buried pipe and man-holes are shown on Revised Figure 11 of the Work Plan (Attachment 2). The northern most manhole (MH91) appears to be the same manhole sampled in 1991. As part of future RI work, the horizontal coordinates of the manholes will be determined and accurately located on the project base maps (note the 1991 soil sample locations may need to be adjusted). The construction of the man-holes will also need to be assessed to facilitate sampling of stormwater solids migrating onto the site and into the embayment.

Portions of the former ditch alignment appear to be paved. Access appears to be generally good, although ICS may need to move stored drums or other materials in paved areas and some brushing may be required in upaved areas to facilitate sampling.

- **Determine likely location of the former settling tank (lagoon).**

Information in a number of documents indicated the presence of an "impoundment" (Ecology 1991) or "lagoon" (Parametrix and SAIC 1991; SAIC 1993) where water generated by the facility discharged to an on-site lagoon prior to approximately 1970. The property owner did not recall that a lagoon existed and indicated the presence of an open-topped "tank" that was used for settling and oil skimming prior to 1968 (DOF 2010). There is no visual surface evidence of either of these features, but both features were thought to exist in generally the same area to the east of the main facility, along the east property line.

A property survey map by Horton Dennis & Associates, Inc. dated September and November 1963 show a "*lagoon*" and a "*slough*" on the site along the east boundary line. The locations of the lagoon and slough shown on the survey map are presented on revised Figure 11 from the DOF draft work plan (see Attachment 2). The trend of these features indicate that they were most likely the visual remnants of the filled in drainage ditch which now flows in a buried stormwater drainage pipe to the 2nd Avenue Outfall (see above discussion).

Based on the site reconnaissance and the 1963 survey drawing, the locations and types of soil sampling shown on draft work plan Figure 21 were revised as follows (see revised Figure 21 - Attachment 4):

- The locations of the two push-probe borings in the former lagoon area were revised to reflect the lagoon position shown on the 1963 survey drawing.
- The surface soil sample locations were changed to subsurface sample locations using a push-probe to collect samples from the former bottom of the slough.

- **Assess the discharge location of the roof drains that do not discharge to the sanitary sewer.**

A site visit and discussion with the ICS general manager indicates that the large majority of roof drainage is directed to the sanitary sewer. Roofs that do not drain to the sanitary sewer are located within the northwest portion of the site as shown on Revised Figure 11 (Attachment 2). The small amount of roof drainage is to surrounding unpaved areas, outside of where barrels were recycled, along the northwest upland site periphery where infiltration likely occurs.

- **Research and complete reconnaissance of possible stormwater contributions to the public outfall at the head of the embayment.**

Sewer Card No. 5340-79 shows the outfall at the west end of the embayment to be a "*Res. Overflow*" (Attachment 3). Sewer Card No. 916-10B (Attachment 5) shows the overflow line to continue in a southward direction along 1st Ave. South. The overflow line is labeled *"Ex. 36" Conc. Overflow"*. No stormdrains are connected to the reservoir overflow line, at least in the vicinity of the site.

- **Determine location coordinates using DGPS for previously installed wells and probes (to extent possible).**

Determining the horizontal locations of previous wells and probes has yet to be completed. The coordinates will be included in the revised draft work plan due to Ecology in late January 2011. In addition, the location coordinates and construction features of the stormwater man-holes will also be completed while DOF staff is on-site.

- **Field mark final upland sampling locations and complete utility checks.**

  Final upland sampling locations have not yet been selected. Field locations and utility checks will be completed before sampling is conducted.

References

DOF (Dalton, Olmsted & Fuglevand, Inc. 2010, Remedial Investigation/Feasibility Study (RI/FS) Work Plan, Industrial Container Services/Former NW Cooperage Site, Seattle, Washington, Prepared for Herman and Jacqualine Trotsky and Industrial Container Services, WA, LLC., Agency Review Draft: July 16, 2010.

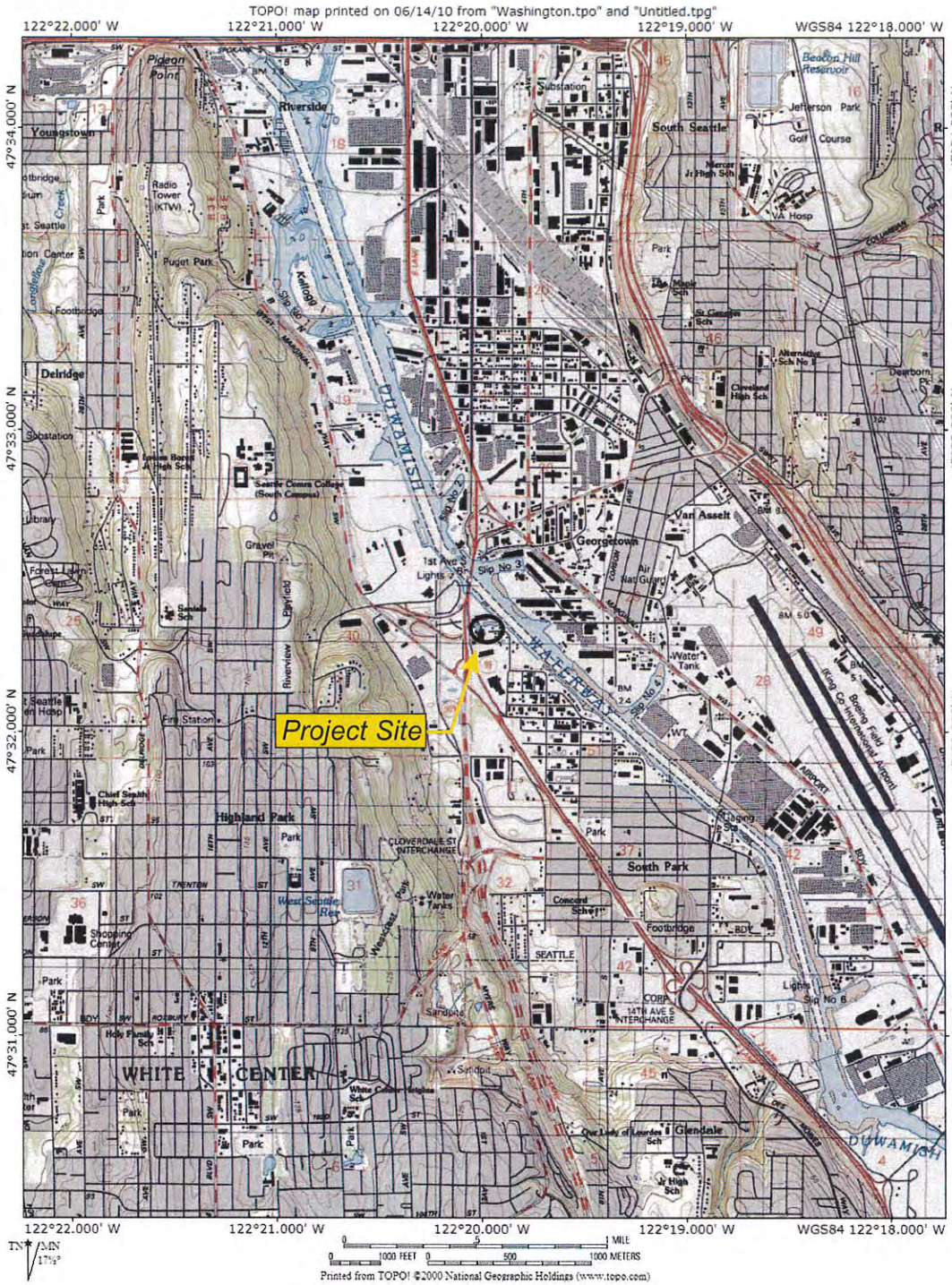
Ecology (Washington State Department of Ecology), 1991, Letter to Herman Trotsky from Michael Gallagher (Ecology), August 15, 1991 (Re: Hazard Ranking Score).

Parametrix and SAIC, 1991, Site Hazard Assessment Summary Report for Northwest Cooperage Company, Seattle, Washington prepared for Washington State Department of Ecology, July 1991.

SAIC, 1993, SIP Report for Northwest Cooperage Co., Inc. in Seattle, Washington, W.A. C10025, EPA No. 68-W9-0008, SAIC/TSC Project No. 6-788-03-1408-340 - Letter to Deborah Robinson (EPA), April 14, 1993.

Attachments

Attachment 1 - Vicinity Map
Attachment 2 - Previous Sampling Locations (Revised Figure 11 from draft RI/FS Work Plan
Attachment 3 - Sewer Card No. 5340-79
Attachment 4 - Proposed Soil Probe and New Monitoring Well Sampling Locations (Revised Figure 21 from draft RI/FS Work Plan
Attachment 5 - Sewer Card No. 916-10B



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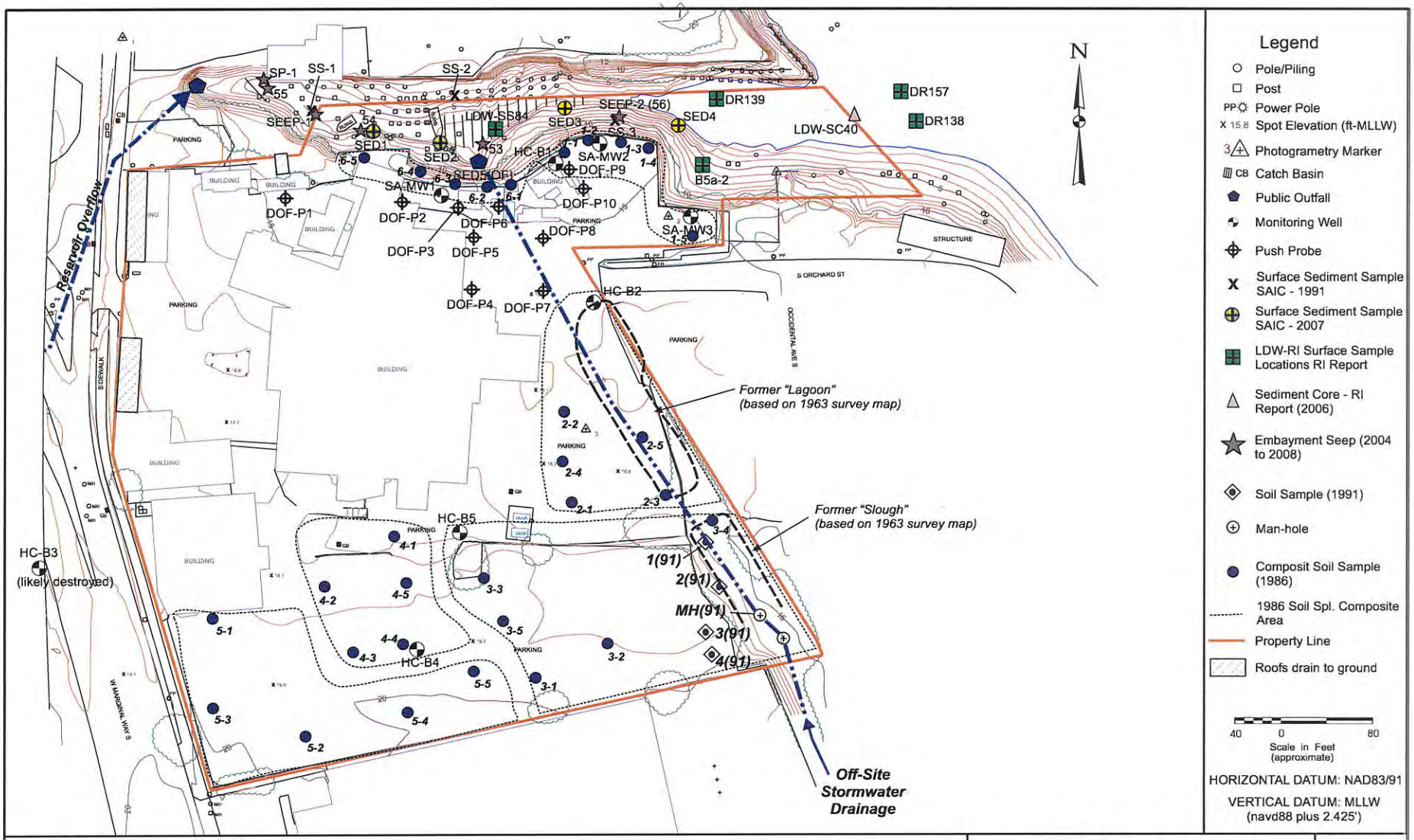
ICS/Trotsky Property

Vicinity Map

SUM-008-00 (ICS) ***June 2010***

Dalton, Olmsted & Fuglevand, Inc.

ATTACHMENT 1



Legend

- Pole/Piling
- Post
- PP Power Pole
- X 15.8 Spot Elevation (ft-MLLW)
- Photogrametry Marker
- CB Catch Basin
- Public Outfall
- Monitoring Well
- Push Probe
- Surface Sediment Sample SAIC - 1991
- Surface Sediment Sample SAIC - 2007
- LDW-RI Surface Sample Locations RI Report
- Sediment Core - RI Report (2006)
- Embayment Seep (2004 to 2008)
- Soil Sample (1991)
- Man-hole
- Composit Soil Sample (1986)
- 1986 Soil Spl. Composite Area
- Property Line
- Roofs drain to ground

40 0 80
Scale in Feet (approximate)

HORIZONTAL DATUM: NAD83/91

VERTICAL DATUM: MLLW (navd88 plus 2.425')

Notes:

1) Property Survey by Continental Survey Co. (12-15-09)
2) Topography by David C. Smith Associates (Flown 3-18-10)

Ref: ICS-NW Cooperage Sample Loc.cdr

ICS/Trotsky Property

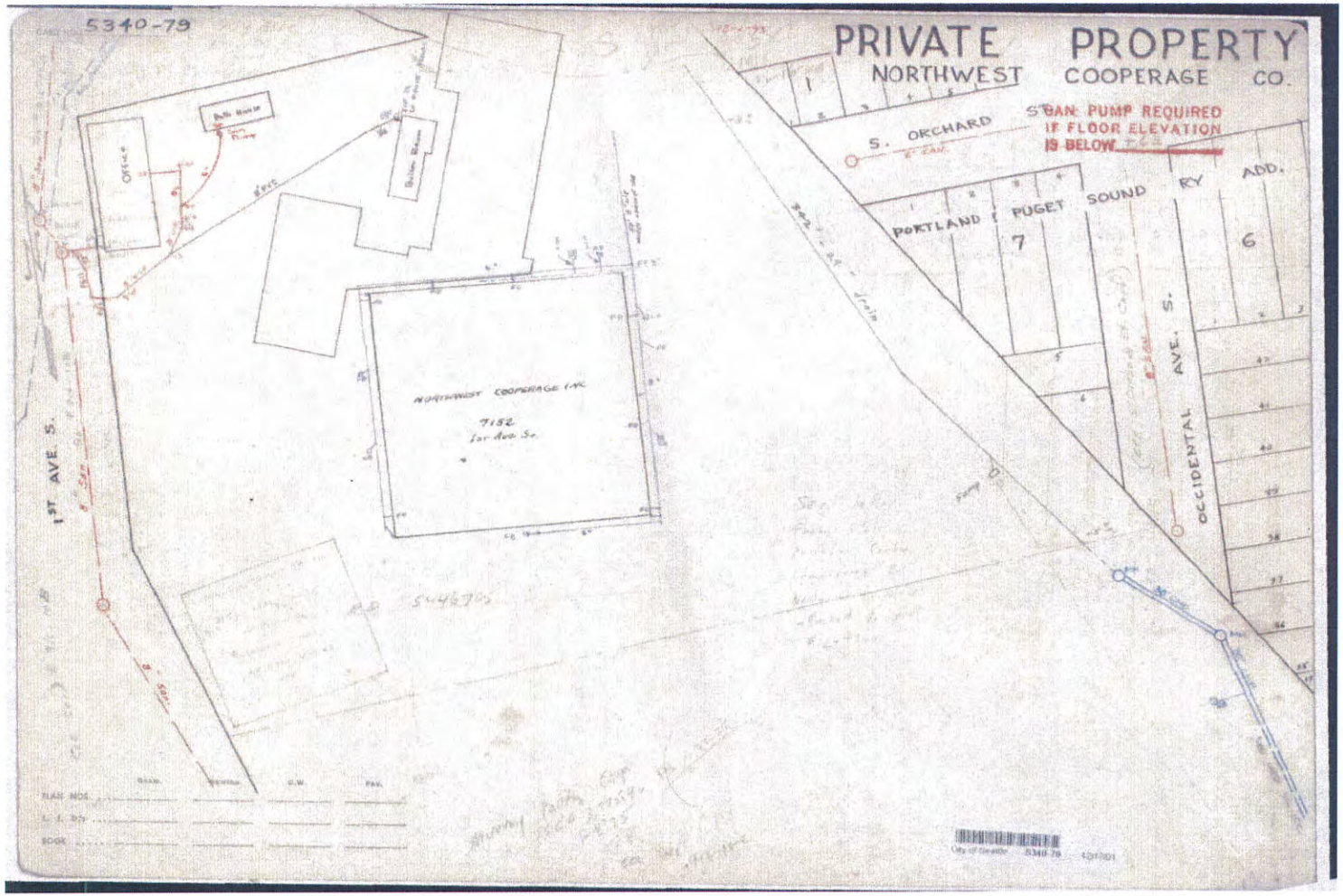
Previous Sampling Locations

SUM-008 (ICS) *Nov. 2010*

Dalton, Olmsted & Fuglevand, Inc.

ATTACHMENT 2

(Revised FIGURE 11)

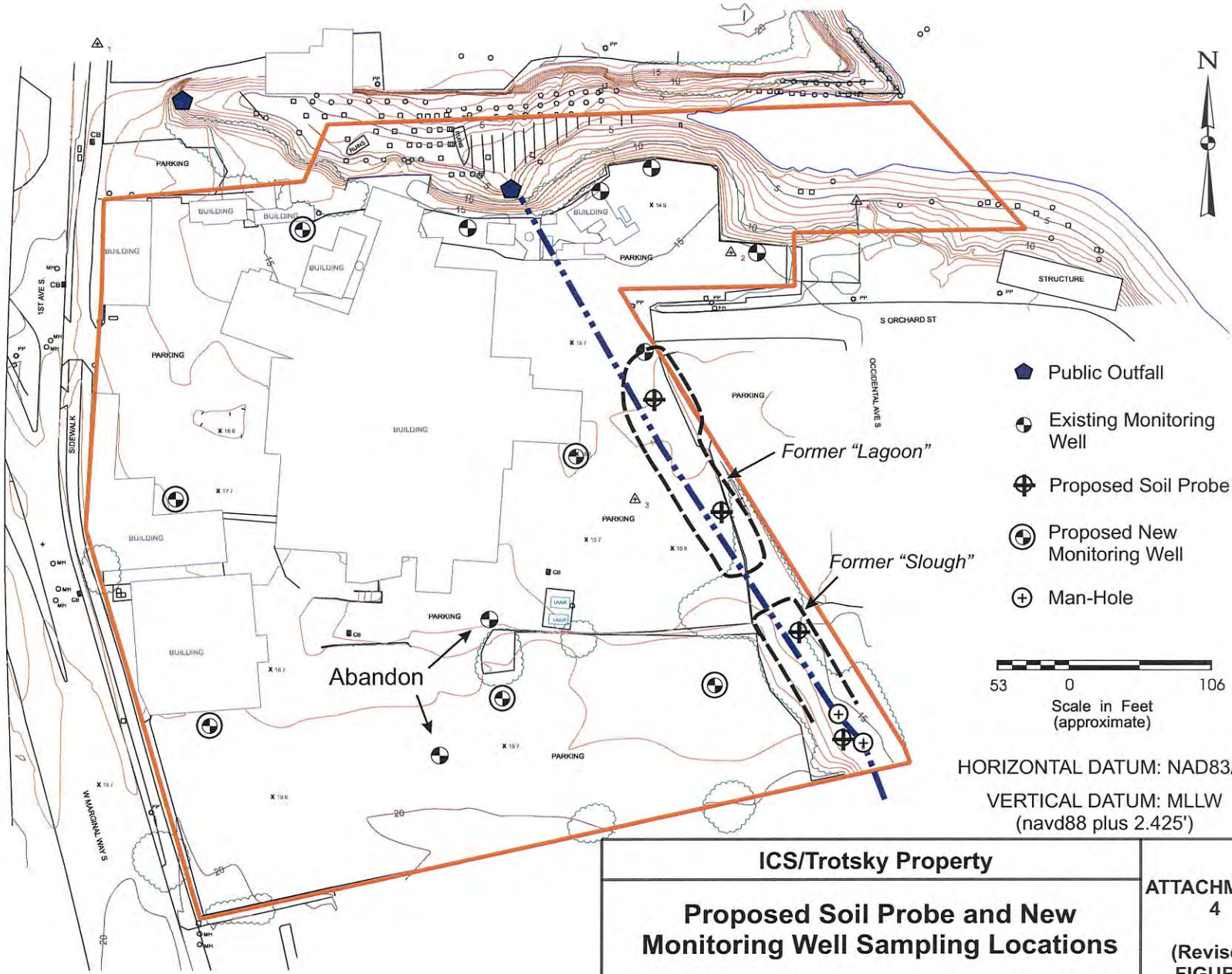


ICS/Trotsky Property
Seattle, Washington

Sewer Card No. 5340-79
Fm. Seattle Engineering Archives

SUM-008-00 **ATTACHMENT 3** Nov. 2011
Dalton, Olmsted & Fuglevand, Inc.

Ref: Sewer Card 5340-79 NWC.cdr



ICS/Trotsky Property

Proposed Soil Probe and New Monitoring Well Sampling Locations

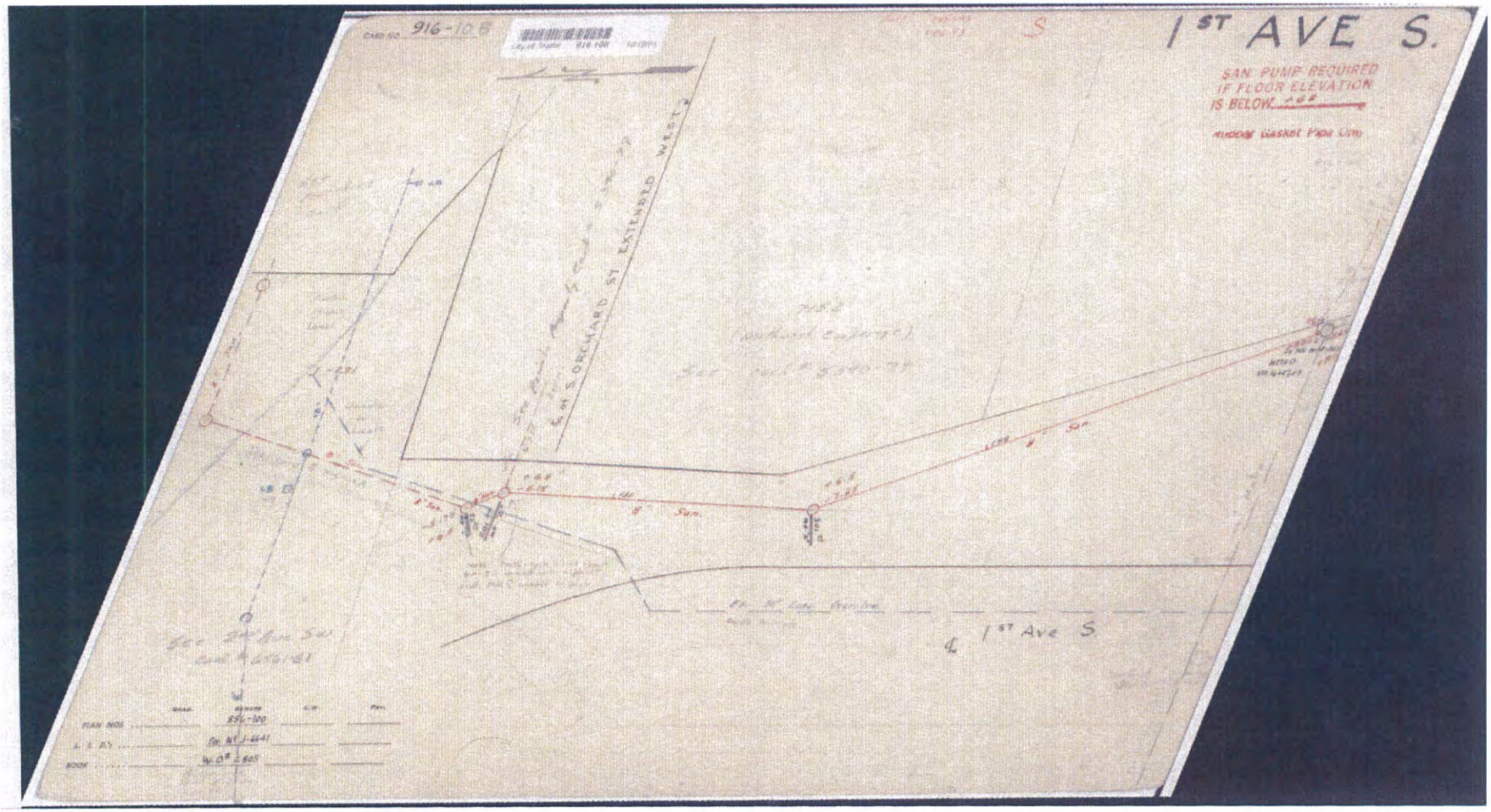
SUM-008-00 (ICS) *Nov. 2010*

Dalton, Olmsted & Fuglevand, Inc.

ATTACHMENT 4

(Revised FIGURE 21)

Ref: Prop New Wells.cdr



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ICF/Trotsky Property
Seattle, Washington

Sewer Card 916-10B
Fm. Seattle Engineering Archives

SUM-008-00 **ATTACHMENT 5** Nov. 2010
Dalton, Olmsted & Fuglevand, Inc.

Ref: Sewer Card 916010B NWC.cdr

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ATTACHMENT A
GPR and SEWER VIDEO SURVEY

ICS/NWC RI/FS
SEATTLE, WASHINGTON
October 2025

Dalton, Olmsted & Fuglevand, Inc. *Environmental Consultants*

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(Kirkland, WA Office – 425-827-4588)

MEMORANDUM

TO: Victoria Sutton – Department of Ecology

FROM: Matt Dalton/Dave Cooper

DATE: October 4, 2013

SUBJECT: GPR and Sewer Video Survey – RI Testing
ICS/NWC Site, Seattle, Washington

REF. NO: SUM-008-00

CC: Phil McCune/Ralph Palumbo – Summit Law Group
Steve Thiele – Stoel Rives

This memorandum summarizes the Remedial Investigation (RI) work completed in September 2013. The purpose of the work was to address a data gap identified in the Data Gap Memorandum (DOF 2013) and several of the review comments received in an e-mail from Ecology dated August 23, 2013 as follows:

- Previous RI testing identified a buried "*container*" with oily fluid at location LP4. A ground penetrating radar (GPR) survey of the LP4 location was conducted in an attempt to identify the size and type of the buried container, as it lies below paving.
- GPR was used to attempt to locate a suspected buried "O*utlet Box*" associated with the former lagoon. The outlet box is shown to be located near the southwest corner of the former lagoon on a design drawing by Dodd & Millegan prepared in 1962.
- GPR was used to attempt to locate the trend of the existing storm sewer pipe in relation to the former filled-in lagoon. Design drawings show the buried concrete pipe to trend along the southwest bank of the former lagoon.
- A video survey of the storm water piping system was completed to assess:
    - The possible cause of high chloride concentrations in samples from monitoring well MW-1 (i.e. exfiltration through separated pipe joints or cracks when saline water enters the pipe during high tides),
    - Whether groundwater potentially could infiltrate into the pipe and be discharged to the embayment,

- The horizontal position of the buried piping, and
- The general interior pipeline condition.

The results of this work will be used, in part, to prepare a Data Gap Work Plan to collect additional information necessary to complete the RI for the site.

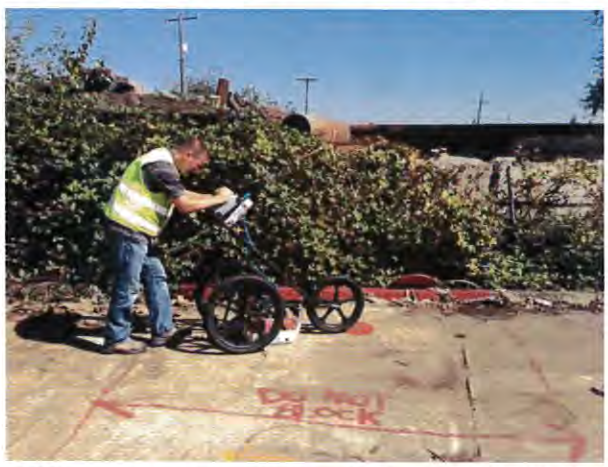
In addition to the above objectives, the existing monitoring wells and control structures were professionally surveyed to firmly establish the site elevation datum as NAVD88. The NAVD88 datum is required to upload monitoring well and groundwater analytical data to Ecology's EIM data base.

GROUND PENETRATING RADAR (GPR) SURVEY

APS Locates (North Bend, WA) was retained to provide ground penetrating radar (GPR) services to attempt to locate/assess:

- The size and type of the buried container with oil discovered during the initial attempt of drilling probe LP4. The oil was discovered in an apparent void located 4 to 5 feet below ground level (see log of LP-4 in DOF 2013).
- The location of an outlet box identified on the 1962 Plat Plan by Dodd & Milligan.
- Horizontal position of the buried sewer line trend and width of the former lagoon.

Steve Brown with APS arrived on-site on September 9, 2013 and met with David Cooper of Dalton, Olmsted & Fuglevand, Inc. (DOF). Mr. Cooper laid out a series of transect lines (A thru E on Figure 1) and identified potential target areas to survey (shaded areas on Figure 1). APS proceeded to scan the areas using a SIR 3000 GPR system equipped with a 400MHz antenna, as illustrated in the following photograph.



GPR survey equipment – September 9, 2013.

The equipment is generally capable of scanning the subsurface to a depth of approximately 5 feet. Multiple passes were made in a logical pattern to attempt to discern subsurface anomalies. The operator observed scan patterns on a monitor in real-time as the equipment was rolled along. Potential anomalies were approached in perpendicular directions to isolate them and the location painted on the ground.

The results of the GPR survey are summarized below:

- No void, pipe or underground container was detected in the vicinity of LP4.
- The only anomaly detected in the surveyed areas was near the suspected location of the outlet box, where two linear features were observed approximately ten feet north of monitoring well MW1. However, no connecting features indicating a buried box or structure were detected.
- No anomalies were detected during the traverse surveys of the lagoon area.

The APS summary letter is included as Attachment A to this memorandum.

STORM SEWER EVALUATION

DOF subcontracted APS locates to provide a robotic camera to video survey the 2nd Avenue storm sewer pipe crossing the project area to its outfall in the intertidal embayment located on the north side of the site. The objectives of the video survey were as follows:

- Determine the general integrity of the pipeline, i.e. identify any cracks, joint separations, or other obvious damage.
- Confirm the horizontal trend of the buried pipeline.
- Observe differences in flow volume, if any, indicating possible groundwater infiltration or high tide pipeline exfiltration.
- Assist in locating several buried structures; buried man-hole/control structure (MH-2) and buried outlet box associated with the former lagoon.

APS first attempted to video the pipeline on September 4, 2013. The pipeline was accessed via Manhole 1 (MH1), the southernmost manhole in the southeast corner of the property. The camera revealed the pipeline at that point to consist of 30-inch diameter corrugated metal pipe (CMP), consistent with available design drawings. The pipe contained up to 3 to 4 inches of sediment and standing water to a depth of 6 to 8 inches, above the bottom of the CMP. The robotic camera was too small and was only able to penetrate the first 40 feet of CMP pipe. The attempt was aborted and rescheduled to use a larger robotic camera.

On September 17, 2013, Pro-Vac Services, under subcontract to APS, arrived on-site with larger equipment capable of traversing sediment and equipped with an articulated robotic camera that could "*see*" above standing water in the 30-inch CMP. The robot was also equipped with a sonde used to detect the horizontal position of the camera. DOF also subcontracted Ron's Earth Works to provide a backhoe to assist in locating the second sewer control structure shown on available drawings, the top of which appeared to be buried. The camera was launched at 0830 hours during a predicted low tide of +0.1 feet Mean Lower Low Water (MLLW) @ 0953 hours, providing a window of opportunity (drained pipeline), until the tide would reach the outfall invert at +3 feet (approximately noon). The inside of the pipelines were viewed in real time on a video monitor and recorded. The equipment used to complete the survey is shown below.

Video camera support truck and monitor

In Pipe Robotic Camera

The camera was initially deployed into the accessible control structure (MH1) and advanced north. Progress was measured in feet (as indicated on the video monitor) from the control structure, with the following observations (a CD with the video survey is included in Attachment C):

- The pipeline consisted of a 30-inch diameter CMP, with no discernible perforations or indication of collapse.
- A belly or low-spot was observed in the line at station +50 feet (50 feet north of MH1).
- The pipe had standing water throughout, and up to 6 inches of sediment at the low-point.
- A slight flow to the north was observed; estimated to be less than 1 gallon per minute (GPM).
- The CMP segment of the pipeline ended at station +80 feet at a second control structure (buried manhole MH2).

The camera position adjacent to the second (buried) control structure was located at the surface. The backhoe was used to scrape away surficial soils at the indicated control structure location[i]. The second manhole or control structure (MH2) was revealed approximately two feet below current grade. Soils were cleared and sloped away to provide access to MH2. The control structure was observed to have standing water approximately 5.3 feet below the rim which was coincident with the invert of the outlet pipeline to the north. The base of the control structure was filled with sediment to a depth of approximately 2.5 feet.

The robotic camera was retrieved and redeployed from MH2 to survey the remaining pipeline. The camera was launched at 1000 hours and advanced north from MH2, measured in feet of progress from the control structure, with the following observations:

- The second pipeline consisted of 24-inch reinforced concrete pipe (RCP), consistent with available design drawings. The pipe was observed to be generally clear of sediment.
- A belly or low-spot, with standing water was observed from station +25 to +115 feet (as measured north of MH2). The lower slip-joints appeared to have pulled apart 1 to 2 inches, but still appeared to overlap. No voids or surrounding soils were observed.
- 6-8 inches of debris consisting of gravel, cobbles and shells was observed from station +42 to +50 feet.

[i] The design drawings indicated a distance of 65 feet between the two man-holes as compared to the actual distance of approximately 80 feet (see survey drawing in Attachment B).

- An 8-inch diameter lateral pipeline was observed on the west side at station +97 to +98 feet (Figure 2). This likely represents the connection to the former outlet box. The location was marked on the surface (shown on Figure 1). Horizontal coordinates are included in Attachment B.
- The remainder of the RCP pipeline was videotaped and located, ending at the outfall to the embayment at approximate station +404 feet at 1130 hours.
- The RCP generally appeared to be in good condition. With no discernible cracks or collapse. No additional joint separations were observed.
- The same flow of water was observed in the 24-inch RCP as was observed within the upstream 30- inch CMP. There was no discernible difference in flow volume.
- The trace of the pipeline was marked in paint at the surface. Horizontal coordinates of the marks were later established using a GeoXH GPS (the trace and coordinates are included in Attachment B).
- No tide gates or weirs were observed in the pipes or control structures.

Observed pooling water (at low tide) in the 30-inch CMP located between MH1 and MH2, is governed by the invert of the 24-inch RCP as it exits MH2. The 24-inch pipe MH2 exit invert elevation is at a slightly higher elevation than the invert elevation of the 30-inch pipe inlet.

The control structure invert elevations were determined in relation to the manhole rim elevations as shown on the Tyee Surveyors drawing, based on a survey completed on September 24, 2013, included in Attachment B. The low tide depth to water in each structure was subtracted from the rim elevation to determine the invert elevations as follows:

- Invert elevation MH1 – +7.2 feet NAVD88[ii] (9.6 feet MLLW)
- Invert elevation MH2 – +7.05 feet NAVD88 (9.4 feet MLLW)
- Invert elevation of Outfall – +0.83 feet NAVD88 (3.3 feet MLLW)

Using a 24-inch RCP length of 404 feet and the MH2 and Outfall invert elevations, an average pipeline slope of 1.5% is calculated ([7.05 feet – 0.83 feet]/404 feet x100 = 1.54%).

DISCUSSION OF RESULTS

General Observations. The estimated vertical position of the 2nd Avenue storm sewer is shown on Figure 3. A 30-inch CMP connects upstream sources to MH1 and a 30-inch CMP is present between MH1 and MH2. A 24-inch RCP connects MH2 to the

[ii] To convert NAVD88 elevations to MLLW elevations, add 2.43 feet (e.g. 0 feet MLLW = +2.43 NAVD88).

embayment outfall. Pooling water is present in the manholes and sediment has accumulated in the manholes, as the bottoms of the structures are below the invert elevations. Pooling water and sediment are also present in the 30-inch CMP between MH1 and MH2 because of differences in the invert elevations. Upstream storm water and sediment that enters the property currently discharges to the embayment. Other than a historical pipe connection for the lagoon outlet box, no other connections to the storm water system were observed, confirming that no ICS/NWC storm water has entered the system since the outlet box ceased to be used and was covered over.

High Chloride Concentrations in DOF-MW1. With the exception of one short section of the 24-inch RCP, no cracks, joint separations, etc. were observed. Flow entering the property near MH1 appears to be similar to flow observed in the pipelines and at the outfall based on the video survey and visual observations in the control structures. These observations indicate that at the time of the video survey, no groundwater was entering the buried pipeline system.

Pooling water was present in a low elevation portion of the 24-inch RCP, approximately 40 to 50 feet downstream of MH2. The cause of the pooling water appears to be pipe line settlement where joints have separated 1 to 2 inches. A water level measurement made in monitoring well DOF-MW1 located adjacent to the low elevation portion of the pipeline (Figure 1) indicated a water table elevation of 3.6 feet NAVD88. As shown on Figure 3, the water table was below the bottom of the pipeline at the time of the video survey.

Anomalously high chloride concentrations were detected in groundwater samples from DOF-MW1 (see Figure 10 in Date Gap Report). The coincident location of the observed pipe joint separations and the DOF-MW1 monitoring well[iii] indicate that the high chloride concentrations are likely related to leakage from the pipeline during higher tides when saline river water enters and flows into the pipeline system.

Using the average slope of the pipeline (1.5%), invert elevations and accounting for some settlement of the pipeline where the water is pooling, the bottom of the pipeline in the area where the joints have separated has an elevation of approximately 5.0 to 5.5 feet NAVD88 or approximately 7.4 to 7.9 feet MLLW. High tides range up to approximately 13 feet MLLW in Puget Sound, so when tidal levels are above approximately 8 feet MLLW, saline river water would enter the pipe and flow upstream to and beyond where the low area was observed in the video survey. Such saline water would leak from the pipe into the groundwater system, as there would be a positive gradient from inside the pipe to the groundwater system.

[iii] The relative position of the pipeline and DOF-MW1 were refined based on the video survey and are plotted on attached Figure 1.

Location of the Outlet Box. The outlet box and it's connection to the 24-inch RCP is shown on a portion of the 1962 design drawing prepared by Dodd & Millegan (Figure 4). The video survey found the connection with the existing sewer pipeline to be approximately 98 feet down stream of MH2 (Figure 1). If the design drawing is representative of what was constructed, the outlet box should lie 5 to 10 feet south and southeast of the pipe connection. The design drawing shows the outlet box to be constructed of concrete and approximately 7.5 feet x 5 feet in plan view and 6 feet deep.

OTHER SURVEY INFORMATION

The Tyee survey completed on September 24, 2013 also established the monitoring well top of casing (TOC) elevations to the NAVD88 datum. The survey data is presented in Attachment B. Updated coordinate locations and elevations for sample locations are presented in attached Table 1.

CLOSING

The services described in this memorandum were performed consistent with generally accepted professional consulting principles and practices. No other warranty, expressed or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this document.

REFERENCES

DOF (Dalton, Olmsted & Fuglevand, Inc.), 2013, Data Gap Memorandum, ICS/NWC Remedial Investigation Testing, Seattle, Washington, Agency Review Draft: February 14, 2013.

Attachments

Table 1 – Updated Survey Information – September 2013
Figure 1 – GPR and Storm Water Sewer Survey Locations
Figure 2 – Outlet Box Pipe Connection to 24-Inch RCP
Figure 3 – Storm Sewer Section
Figure 4 – Outlet Box Location
Attachment A – APS – GPR Letter Report (September 9, 2013)
Attachment B – Survey Information
Attachment C – Video Survey (on CD)

TABLE 1 - Sample Location Survey Data - September 2013

SURFACE SEDIMENT SAMPLE LOCATIONS

Sample #	Northing	Easting
DSS-01	200361	1269757
DSS-02	200359	1269797
DSS-03	200373	1269829
DSS-04	200323	1269823
DSS-05	200350	1269867
DSS-06	200304	1269886
DSS-07	200363	1269925
DSS-08	200336	1269926
DSS-09	200296	1269935
DSS-10	200288	1269967
DSS-11	200289	1269996
DSS-12	200311	1270016
DSS-13	200318	1270038
DSS-14	200382	1270016
DSS-15	200363	1270018
DSS-16	200380	1270065
DSS-17	200331	1270081
DSS-18	200370	1270116
DSS-19	200363	1270177
DSS-20	200370	1270209
DSS-21	200361	1270227
DSS-22	200367	1270258
DSS-23	200324	1270140
DSS-24	200331	1270215
DSS-25	200334	1270265
DSS-26	200272	1270156
DSS-27	200274	1270208
DSS-28	200302	1270233
DSS-29	200277	1270273
DSS-30	200288	1270328
DSS-31	200320	1269997
DSS-32	200323	1270015

Notes:
NAD 83/96 - Based on DOF survey using GeoXH GPS

TABLE 1 - Sample Location Survey Data - September 2013

EMBAYMENT CORE LOCATIONS

Core	Northing	Easting	Comment
A	200360	1269800	
B	200357	1269857	
C	200352	1269851	
D	200325	1269895	refusal
E	200349	1269926	
F	200322	1269928	
G	200350	1269965	
H	200317	1269980	
I	200354	1270036	
J	200348	1270100	
K	200357	1270196	
L	200303	1270196	
M	200337	1270246	

Notes:
NAD 83/96 - Based on DOF survey using GeoXH GPS

SEEP / STORMWATER SAMPLE LOCATIONS

Sample #	Northing	Easting
SEEP1	200332	1270124
SEEP2	200306	1269864
2nd Ave Outfall	200294	1269982
2nd Ave Manhole 1	199896	1270253

Notes:
NAD 83/96 - Based on DOF survey using GeoXH

UPLAND PROBE LOCATIONS

Probe	Northing	Easting
P1	200332	1269819
P2	200250	1269935
P3	200258	1269958
P4	200191	1269974
P5	200228	1269976
P6	200246	1269991
P7	200177	1270037
P8	200208	1270040
P9	200296	1270057
P10	200273	1270082
LP1	199889	1270243
LP2	199970	1270215
LP3	200044	1270155
LP4	200125	1270110

Notes:
NAD 83/96 - Based on DOF survey using GeoXH

(ICS-NW Cooperage Master GPS coordinates 9-26-13
-ICS 2013 coordinates)

TABLE 1 - Sample Location Survey Data - September 2013

MONITORING WELL LOCATIONS

Well	Northing	Easting	Ground Surface Elevation	TOC Elevation
DOF-MW1	199988	1270151	14.05	13.74
DOF-MW2	199928	1269979	17.12	16.8
DOF-MW3	199878	1269775	17.15	16.79
DOF-MW4	199985	1269797	15.86	15.54
DOF-MW5	200064	1269721	15.51	15.14
DOF-MW6	200248	1269827	11.88	11.53
DOF-MW7	200184	1269970	13.02	12.67
DOF-MW8	200098	1270037	13.84	13.51
SA-MW1	200268	1269944	13.03	12.57
SA-MW2	200311	1270090	12.33	11.97
SA-MW3	200249	1270174	13.04	12.57
HC-B1	200304	1270043	17.0	18.01
HC-B2	200174	1270080	13.5	13.95

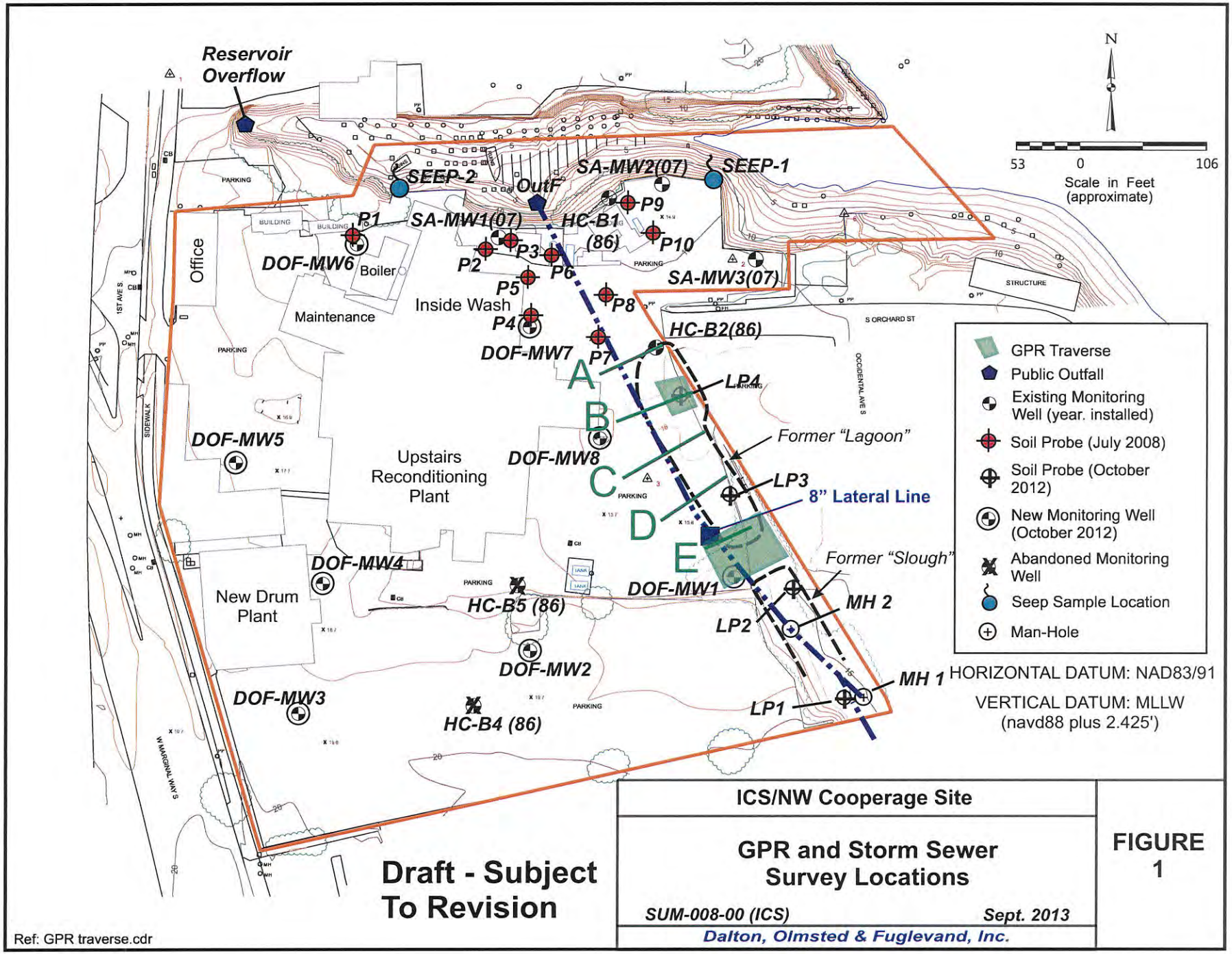
Notes:
Horizontal Datum - Washington State Plane NAD 83 / 91
Vertical Datum - NAVD88
Based on Tyee Surveyors September 2013 - Seattle Benchmarks 49360/49358

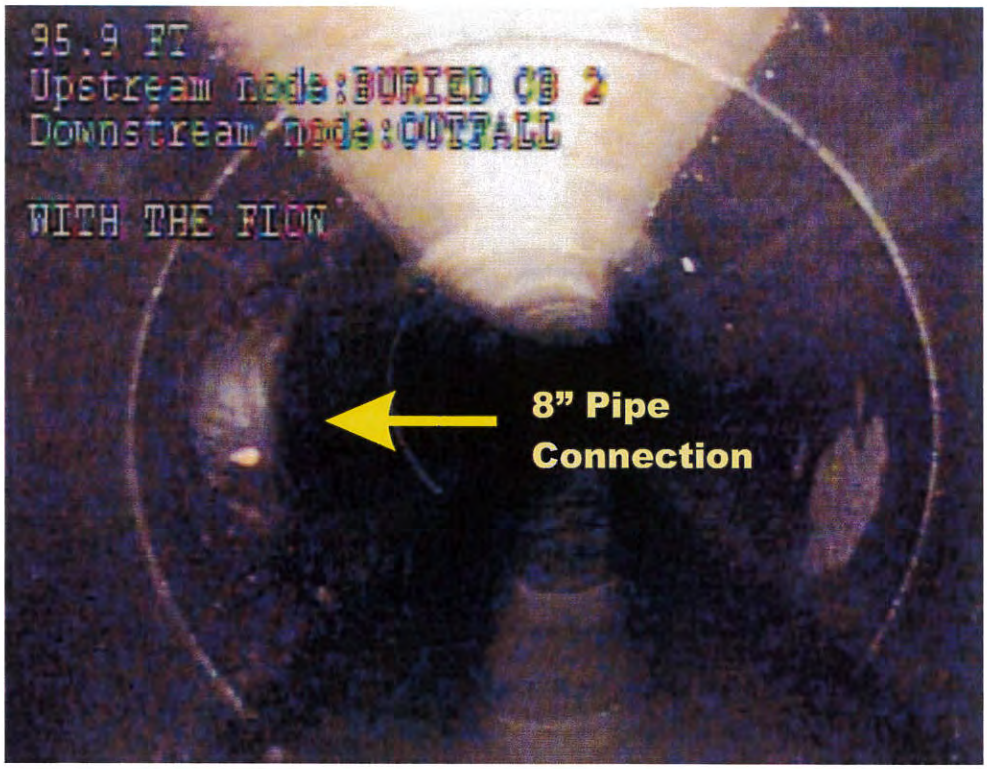
STORMWATER LOCATIONS

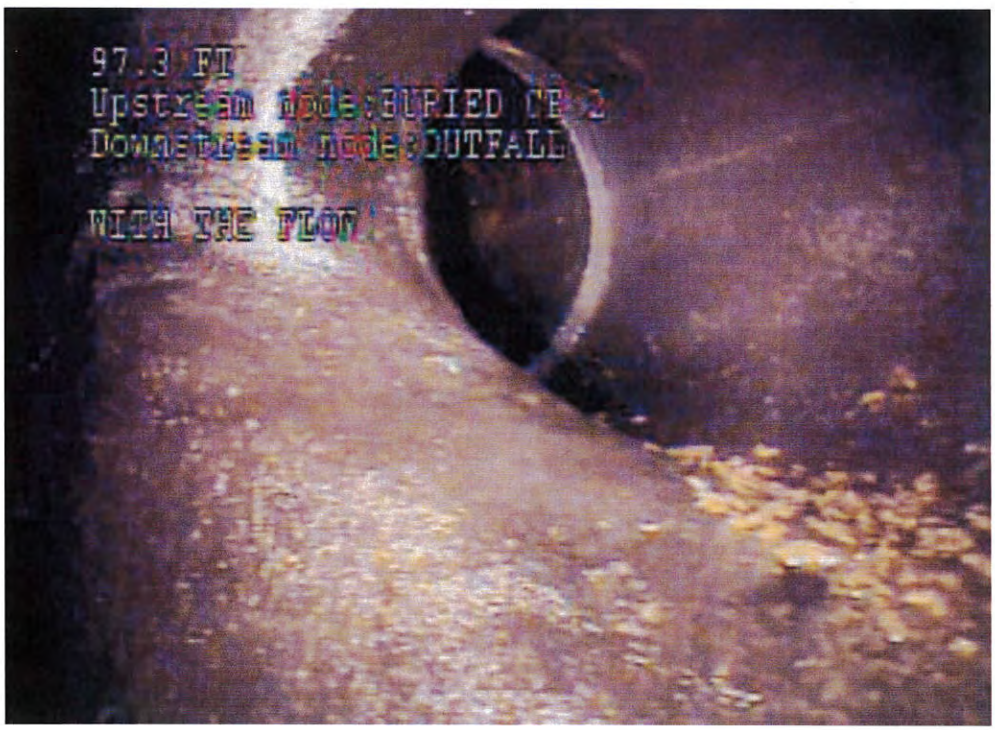
Sample #	Northing	Easting	Invert Elevation	Notes
South Manhole (MH 1)	199896	1270253	7.20	to water level *
North Manhole (MH 2)	199948	1270190	7.05	to water level *
2nd Ave Outfall End	200293	1269981	0.827	to pipe invert

Notes:
* governed by inlet of 24" outfall exiting MH 2
Horizontal Datum - Washington State Plane NAD 83 / 91
Vertical Datum - NAVD88
Based on Tyee Surveyors September 2013 - Seattle Benchmarks 49360/49358

(ICS-NW Cooperage Master GPS coordinates 9-26-13
-ICS 2013 coordinates)


Reservoir Overflow
SEEP-2
OutF
SA-MW2(07)
SEEP-1
P1
SA-MW1(07)
HC-B1 (86)
P9
P10
P3
P2
P6
P5
P8
P4
P7
SA-MW3(07)
DOF-MW6
Boiler
Office
Maintenance
Inside Wash
DOF-MW7
HC-B2(86)
LP4
DOF-MW5
Upstairs Reconditioning Plant
DOF-MW8
Former "Lagoon"
LP3
8" Lateral Line
DOF-MW4
New Drum Plant
HC-B5 (86)
DOF-MW1
Former "Slough"
MH 2
LP2
DOF-MW2
DOF-MW3
HC-B4 (86)
MH 1
LP1
A
B
C
D
E
PARKING
BUILDING
STRUCTURE
S ORCHARD ST
OCCIDENTAL AVE S
1ST AVE S
SIDEWALK
W MARGINAL WAY S
N
53
0
106
Scale in Feet (approximate)
GPR Traverse
Public Outfall
Existing Monitoring Well (year. installed)
Soil Probe (July 2008)
Soil Probe (October 2012)
New Monitoring Well (October 2012)
Abandoned Monitoring Well
Seep Sample Location
Man-Hole
HORIZONTAL DATUM: NAD83/91
VERTICAL DATUM: MLLW (navd88 plus 2.425')
Draft - Subject To Revision
ICS/NW Cooperage Site
GPR and Storm Sewer Survey Locations
SUM-008-00 (ICS)
Sept. 2013
Dalton, Olmsted & Fuglevand, Inc.
FIGURE 1
Ref: GPR traverse.cdr



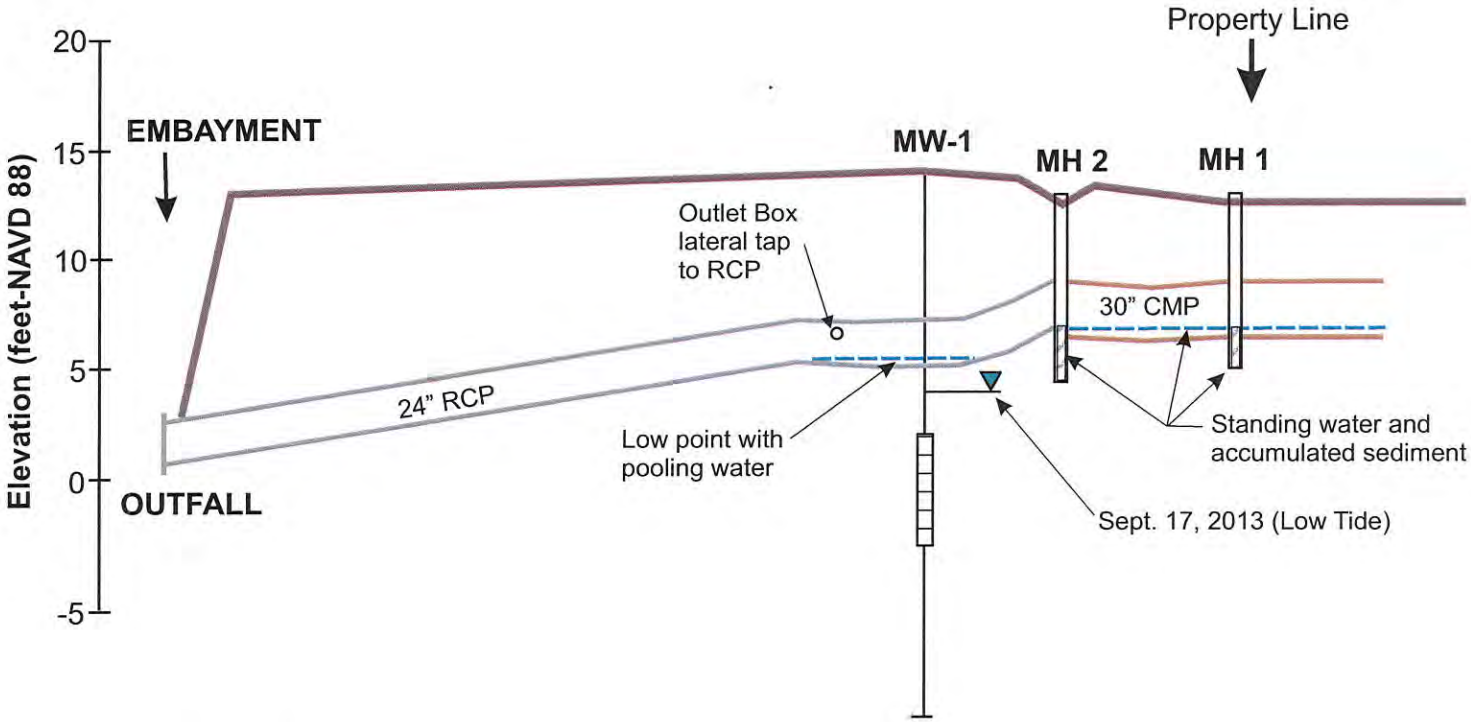


ICS/NWC Site
Seattle, Washington

Outlet Box Pipe Connection to 24-Inch RCP

SUM-008-00 **FIGURE 2** October 2013
Dalton, Olmsted & Fuglevand, Inc.

Ref: Pipe Connection.cdr



CMP - Corrugated Metal Pipe
RCP - Reinforced Concrete Pipe

25 0 50
Scale in Feet
(approximate)

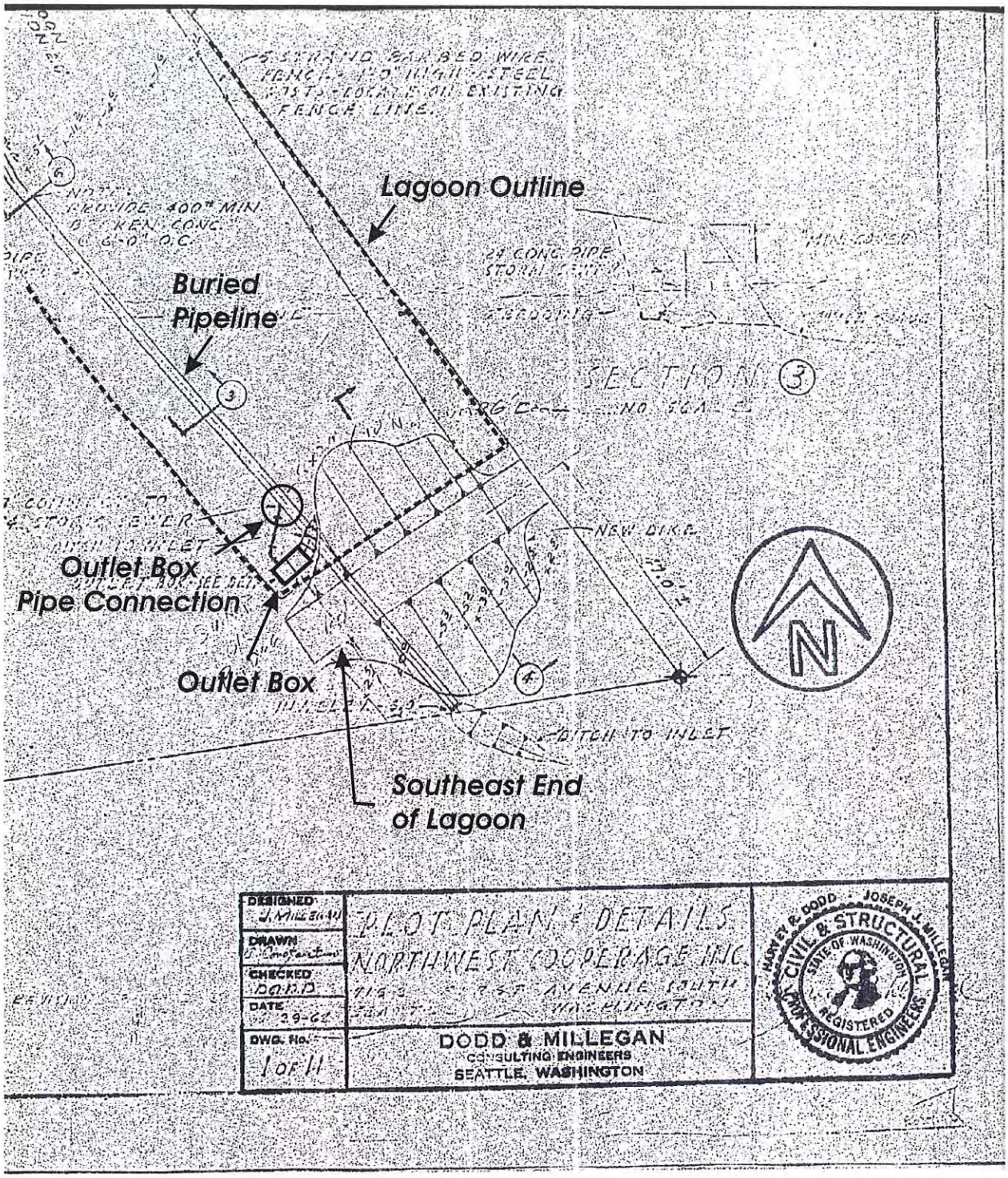
Ref: ICS Storm Section.cdr

ICS/NW Cooperage Site

Storm Sewer Section

SUM-008-00 **FIGURE 3** Oct. 2013

Dalton, Olmsted & Fuglevand, Inc.



0 Scale in Feet (approximate) 20

ICS/NW Cooperage Site
Seattle, WA

Outlet Box Location

SUM-008 **FIGURE 4** October 2013
Dalton, Olmsted & Fuglevand, Inc.

Ref: Outlet Box.cdr

ATTACHMENT A
APS – GPR LETTER REPORT
ICS/NWC Site, Seattle, Washington

September 9, 2013

DOF Environmental
10827 NE 68th, Suite B
Kirkland, WA 98033

September 9th, 2013

Attn: David Cooper

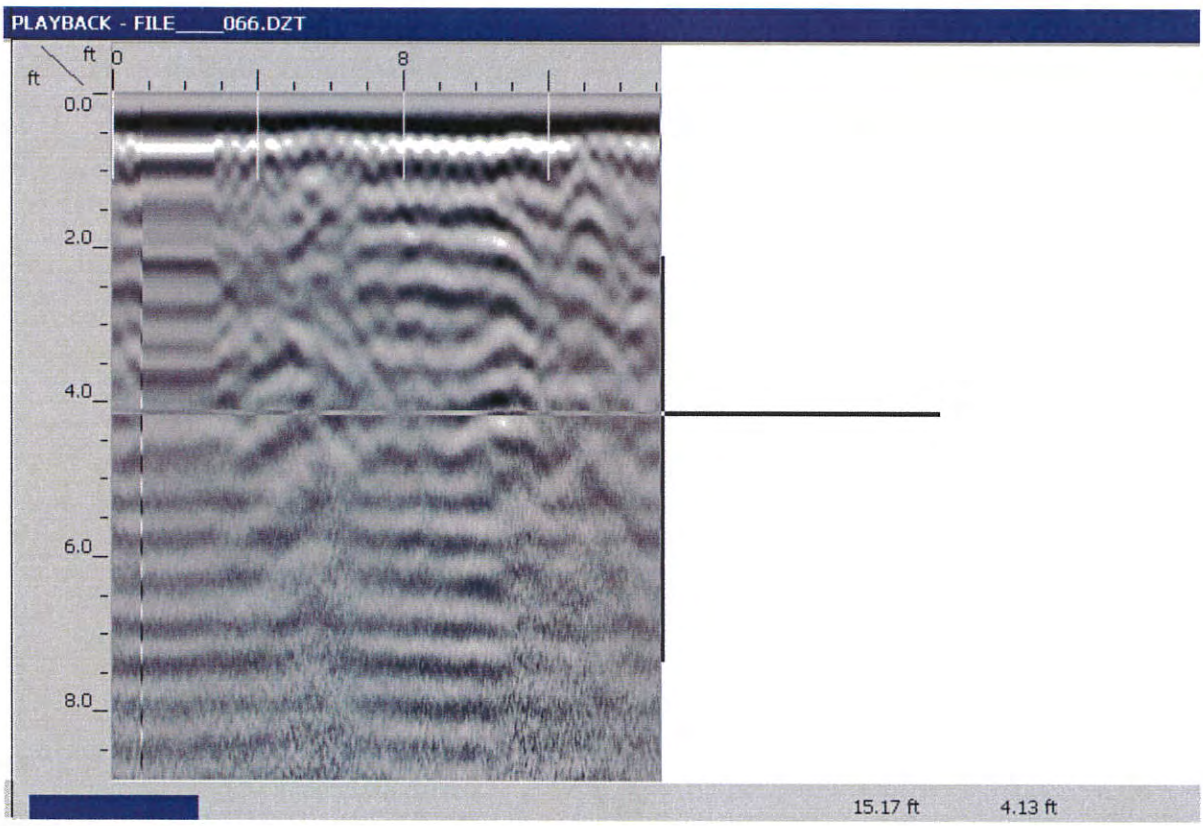
Re: GPR Survey: ICS. Seattle, WA

APS utilized a 400 MHz (Model 5103) antenna and the SIR system 3000 control unit manufactured by Geophysical Survey Systems to scan the defined work area for vaults, former lagoons and any other unknown utilities or objects. The scan included 5 transects labeled A-E across the former lagoon area. There was no significant change in lithology. A scan of area LP-4 produced no apparent UST or other object. A scan of the former sump area, roughly 50' x 50', produced a faint reflection in the E-W direction (screen shot provided). A magnetometer sweep of the area where a missing manhole is believed to be returned multiple signals but most were found to be buried scrap metal or deeper then 2'.

Sincerely,

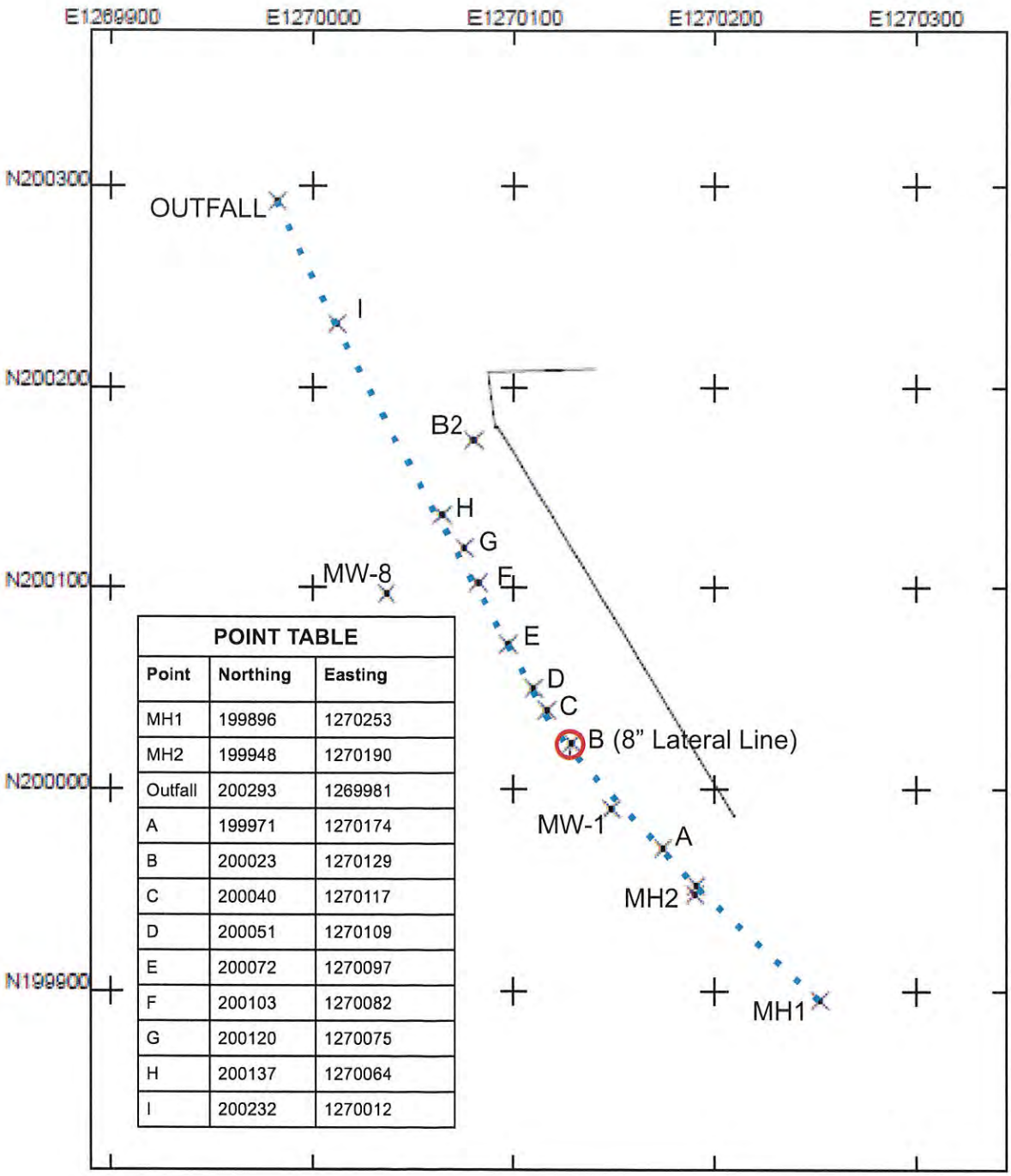
Steve B Brown
Vice President

APS GPR SCREEN SHOT
SUMP AREA
September 9, 2013



ATTACHMENT B
Survey Information
ICS/NWC Site, Seattle,Washington

September 2013



POINT TABLE		
Point	**Northing**	**Easting**
MH1	199896	1270253
MH2	199948	1270190
Outfall	200293	1269981
A	199971	1270174
B	200023	1270129
C	200040	1270117
D	200051	1270109
E	200072	1270097
F	200103	1270082
G	200120	1270075
H	200137	1270064
I	200232	1270012

ICS Storm Sewer Trace

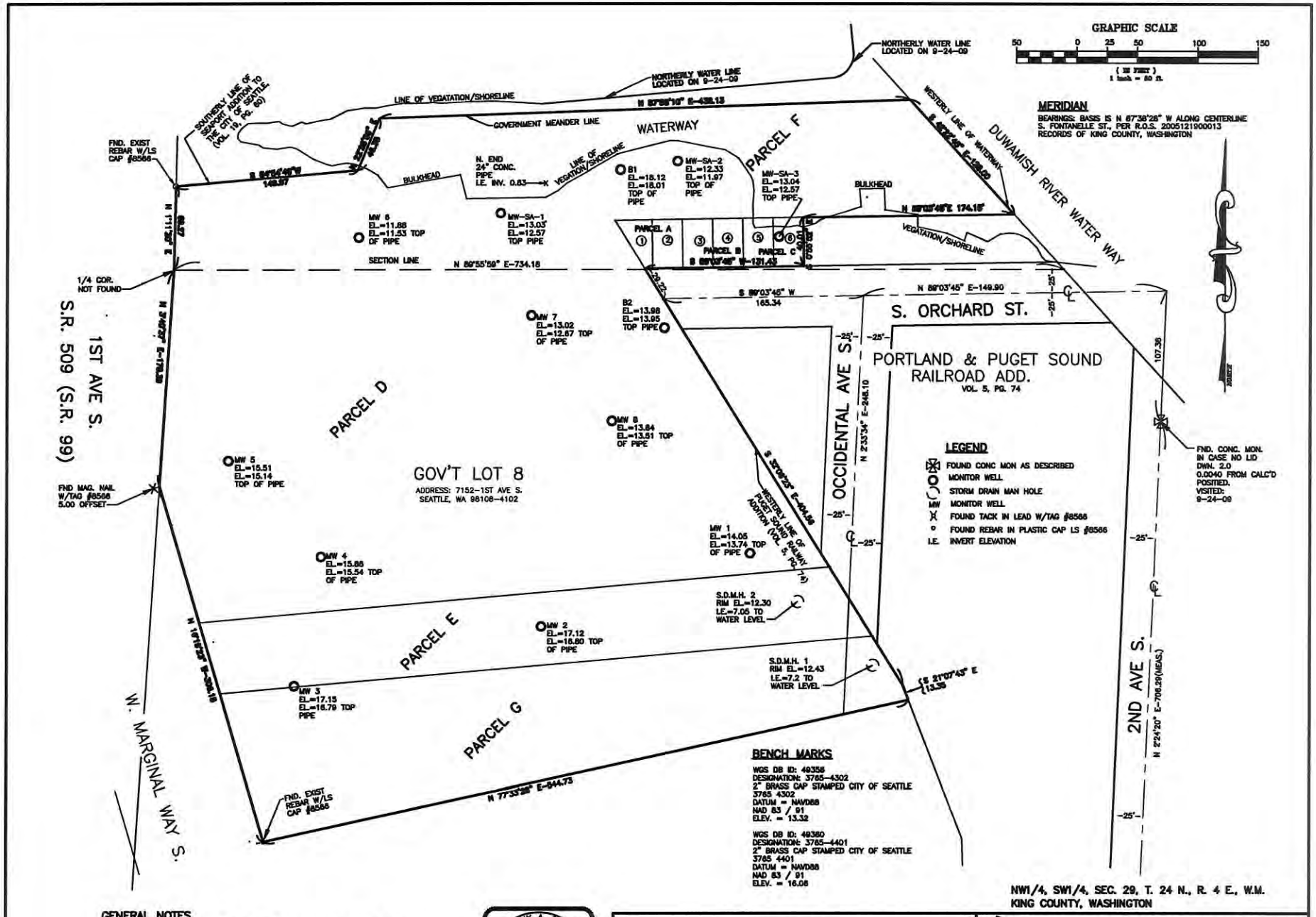
US State Plane 1983
Washington North 4601
NAD 1983 (Conus) CORS96

N

Scale 1:1,000
0 125.0
Feet

ICS STORM 9-17-13.cor
10/1/2013

GPS Pathfinder® Office
Trimble.



GENERAL NOTES

1. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF A SURVEY MADE ON THE DATE INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITION EXISTING AT THAT TIME.
2. THIS MAP DOES NOT PURPORT TO SHOW EASEMENTS OF RECORD, IF ANY.
3. NO PROPERTY CORNERS WERE SET IN CONJUNCTION WITH THIS SURVEY.
4. REFER TO RECORD OF SURVEY IN VOL 274 OF SURVEYS, PG(S) 034-037 RECORDING NO. 20100806900003 FOR ADDITIONAL SURVEY CONTROL.

TIMOTHY A. GRIFFIN — STATE OF WASHINGTON — 29276 — REGISTERED PROFESSIONAL LAND SURVEYOR

SITE PLAN
for
DOF ENVIRONMENTAL

10827 NE 68TH SUITE B KIRKLAND, WASHINGTON 98053

Tyee Surveyors
PROFESSIONAL LAND SURVEYORS
10007 GREENWOOD AVE N., SEATTLE, WA 98133 (206)525-3660

DRAWN BY:	DATE:	JOB NO.:
NP	9-24-13	13188
CHKD BY:	SCALE:	SHEET:
TG	1" = 50'	1 OF 1

ATTACHMENT C
Storm Sewer Video Survey (on CD)
ICS/NWC Site, Seattle,Washington

September 17, 2013

APPENDIX B
SAMPLE COORDINATES AND ELEVATIONS

REMEDIAL INVESTIGATION REPORT
ICS/NWC
SEATTLE, WASHINGTON
October 2025

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TABLE B-1 - Sample Location Survey Data - As of December 2015

SURFACE SEDIMENT SAMPLE LOCATIONS

Sample #	Date Sampled	Northing (ft)	Easting (ft)	Comment
DSS-01	Jul-12	200361	1269757	DOF GeoXH GPS
DSS-02	Jul-12	200359	1269797	DOF GeoXH GPS
DSS-03	Jul-12	200373	1269829	DOF GeoXH GPS
DSS-04	Jul-12	200323	1269823	DOF GeoXH GPS
DSS-05	Jul-12	200350	1269867	DOF GeoXH GPS
DSS-06	Jul-12	200304	1269886	DOF GeoXH GPS
DSS-07	Jul-12	200363	1269925	DOF GeoXH GPS
DSS-08	Jul-12	200336	1269926	DOF GeoXH GPS
DSS-09	Jul-12	200296	1269935	DOF GeoXH GPS
DSS-10	Jul-12	200288	1269967	DOF GeoXH GPS
DSS-11	Jul-12	200289	1269996	DOF GeoXH GPS
DSS-12	Jul-12	200311	1270016	DOF GeoXH GPS
DSS-13	Jul-12	200318	1270038	DOF GeoXH GPS
DSS-14	Jul-12	200382	1270016	DOF GeoXH GPS
DSS-15	Jul-12	200363	1270018	DOF GeoXH GPS
DSS-16	Jul-12	200380	1270065	DOF GeoXH GPS
DSS-17	Jul-12	200331	1270081	DOF GeoXH GPS
DSS-18	Jul-12	200370	1270116	DOF GeoXH GPS
DSS-19	Jul-12	200363	1270177	DOF GeoXH GPS
DSS-20	Jul-12	200370	1270209	DOF GeoXH GPS
DSS-21	Jul-12	200361	1270227	DOF GeoXH GPS
DSS-22	Jul-12	200367	1270258	DOF GeoXH GPS
DSS-23	Jul-12	200324	1270140	DOF GeoXH GPS
DSS-24	Jul-12	200331	1270215	DOF GeoXH GPS
DSS-25	Jul-12	200334	1270265	DOF GeoXH GPS
DSS-26	Jul-12	200272	1270156	DOF GeoXH GPS
DSS-27	Jul-12	200274	1270208	DOF GeoXH GPS
DSS-28	Jul-12	200302	1270233	DOF GeoXH GPS
DSS-29	Jul-12	200277	1270273	DOF GeoXH GPS
DSS-30	Jul-12	200288	1270328	DOF GeoXH GPS
DSS-31	Jul-12	200320	1269997	DOF GeoXH GPS
DSS-32	Jul-12	200323	1270015	DOF GeoXH GPS
SED-1	May-07	200331	1269892	Est. Site Plan
SED-2	May-07	200319	1269941	Est. Site Plan
SED-3	May-07	200339	1270053	Est. Site Plan
SED-4	May-07	200332	1270162	Est. Site Plan
SED-1	Sep-14	200325	1269897	DOF GeoXH GPS
SED-2	Sep-14	2000316	1269941	DOF GeoXH GPS
SED-3	Sep-14	200339	1270053	DOF GeoXH GPS
SED-4	Sep-14	200332	1270162	DOF GeoXH GPS
LDW-SS84	Jan-05	200324	1269997	From LDW RI
B5a-2	Sep-04	200299	1270183	From LDW RI
DR-139	Sep-98	200341	1270186	From LDW RI

Notes: Horizontal Datum - Washington State Plane North NAD 83 / 91

TABLE B-1 - Sample Location Survey Data - As of December 2015

EMBAYMENT CORE LOCATIONS

Core	Date Sampled	Northing (ft)	Easting (ft)	Comment
A	Nov-12	200360	1269800	DOF GeoXH GPS
B	Nov-12	200357	1269857	DOF GeoXH GPS
C	Nov-12	200342	1269851	DOF GeoXH GPS
D (refusal)	Nov-12	200325	1269895	DOF GeoXH GPS
E	Nov-12	200349	1269926	DOF GeoXH GPS
F	Nov-12	200322	1269928	DOF GeoXH GPS
G	Nov-12	200350	1269965	DOF GeoXH GPS
H	Nov-12	200317	1269980	DOF GeoXH GPS
I	Nov-12	200354	1270036	DOF GeoXH GPS
J	Nov-12	200348	1270100	DOF GeoXH GPS
K	Nov-12	200357	1270196	DOF GeoXH GPS
L	Nov-12	200303	1270196	DOF GeoXH GPS
M	Nov-12	200337	1270246	DOF GeoXH GPS
LDW-SC40	Feb-06	200339	1270298	From LDW RI

Notes: Horizontal Datum - Washington State Plane North NAD 83 / 91

SEEP / STORMWATER SAMPLE LOCATIONS

Sample #	Northing (ft)	Easting (ft)	Comment
SEEP1 (2012)	200332	1270124	DOF GeoXH GPS
SEEP2 (2012)	200306	1269864	DOF GeoXH GPS
2nd Ave Outfall	200294	1269982	DOF GeoXH GPS
2nd Ave Manhole 1	199896	1270253	DOF GeoXH GPS
SP-1	200368	1269795	From LDW RI
55	200361	1269799	From LDW RI
54	200323	1269880	From LDW RI
53	200312	1269986	From LDW RI
56	200335	1270105	From LDW RI

Notes: Horizontal Datum - Washington State Plane North NAD 83 / 91

UPLAND SURFACE SOIL LOCATIONS (coordinates est. from location maps)

Location	Date Sampled	Northing (ft)	Easting (ft)	Comment
#1	1991	199964	1270181	Discrete Spl.
#2	1991	199925	1270192	Discrete Spl.
#3	1991	199886	1270181	Discrete Spl.
#4	1991	199866	1270186	Discrete Spl.
1-1	Feb-86	200304	1270057	Composite Sample
1-2	Feb-86	200315	1270078	
1-3	Feb-86	200314	1270106	
1-4	Feb-86	200308	1270130	
1-5	Feb-86	200231	1270169	
2-1	Feb-86	199999	1270064	Composite Sample
2-2	Feb-86	200078	1270057	
2-3	Feb-86	200006	1270146	
2-4	Feb-86	200035	1270056	
2-5	Feb-86	200056	1270125	

TABLE B-1 - Sample Location Survey Data - As of December 2015

Location	Date Sampled	Northing (ft)	Easting (ft)	Comment
3-1	Feb-86	199846	1270033	Composite Sample
3-2	Feb-86	199876	1270095	
3-3	Feb-86	199933	1269987	
3-5	Feb-86	199896	1270004	
4-1	Feb-86	199970	1269910	Composite Sample
4-2	Feb-86	199926	1269849	
4-3	Feb-86	199868	1269874	
4-4	Feb-86	199875	1269917	
4-5	Feb-86	199929	1269920	
5-1	Feb-86	199898	1269752	Composite Sample
5-2	Feb-86	199795	1269833	
5-3	Feb-86	199820	1269752	
5-4	Feb-86	199816	1269921	
5-5	Feb-86	199851	1269979	
6-1	Feb-86	200276	1270010	Composite Sample
6-2	Feb-86	200274	1269990	
6-3	Feb-86	200277	1269962	
6-4	Feb-86	200288	1269932	
6-5	Feb-86	200300	1269883	

Notes:
Horizontal Datum - Washington State Plane North NAD 83 / 91
Coordinates estimated from 1986 site plan.

UPLAND PROBE LOCATIONS

Probe	Date Sampled	Northing (ft)	Easting (ft)	Comment
P1	Jul-08	200270	1269840	DOF GeoXH GPS
P2	Jul-08	200250	1269935	DOF GeoXH GPS
P3	Jul-08	200258	1269958	DOF GeoXH GPS
P4	Jul-08	200191	1269974	DOF GeoXH GPS
P5	Jul-08	200228	1269976	DOF GeoXH GPS
P6	Jul-08	200246	1269991	DOF GeoXH GPS
P7	Jul-08	200177	1270037	DOF GeoXH GPS
P8	Jul-08	200208	1270040	DOF GeoXH GPS
P9	Jul-08	200296	1270057	DOF GeoXH GPS
P10	Jul-08	200273	1270082	DOF GeoXH GPS
P11	Nov-14	200029	1269980	DOF GeoXH GPS
P12	Nov-14	200103	1269981	DOF GeoXH GPS
P13	Nov-14	200118	1269928	DOF GeoXH GPS
P14	Nov-14	200170	1269882	DOF GeoXH GPS
P15	Nov-14	200186	1269923	DOF GeoXH GPS
P16	Dec-14	200228	1270120	DOF GeoXH GPS
P17	Nov-14	200289	1269833	DOF GeoXH GPS
P18	Dec-14	200176	1270073	DOF GeoXH GPS
P19	Dec-14	200102	1270073	DOF GeoXH GPS

TABLE B-1 - Sample Location Survey Data - As of December 2015

Probe	Date Sampled	Northing (ft)	Easting (ft)	Comment
P20	Nov-14	200131	1270135	DOF GeoXH GPS
P21	Dec-14	200078	1270110	DOF GeoXH GPS
P22	Nov-14	200045	1270101	DOF GeoXH GPS
P23	Nov-14	200088	1270159	DOF GeoXH GPS
P24	Nov-14	200002	1270177	DOF GeoXH GPS
P25	Nov-14	199938	1270191	DOF GeoXH GPS
P26	Nov-14	199981	1270213	DOF GeoXH GPS
P27	Nov-14	199886	1270262	DOF GeoXH GPS
P28	Dec-14	200247	1269824	DOF GeoXH GPS
P29	Dec-14	200265	1269944	DOF GeoXH GPS
P30	Dec-14	200295	1270067	DOF GeoXH GPS
P31	Dec-14	200244	1270179	DOF GeoXH GPS
P32	Dec-14	200183	1269973	DOF GeoXH GPS
P33	Dec-14	199983	1270159	DOF GeoXH GPS
P34	Jun-15	199798	1270299	DOF GeoXH GPS
P35	Jun-15	199693	1270348	DOF GeoXH GPS
P36	Jun-15	199556	1270372	DOF GeoXH GPS
LP1	Oct-12	199889	1270243	DOF GeoXH GPS
LP2	Oct-12	199970	1270215	DOF GeoXH GPS
LP3	Oct-12	200044	1270155	DOF GeoXH GPS
LP4	Oct-12	200125	1270110	DOF GeoXH GPS

Notes: Horizontal Datum - Washington State Plane North NAD 83 / 91

MONITORING WELL LOCATIONS

Well	Date Installed	Northing (ft)	Easting (ft)	Rim- Ground Surface Elevation (feet)	TOC Elevation (feet)
DOF-MW1	Oct-12	199988	1270151	14.05	13.74
DOF-MW2	Oct-12	199928	1269979	17.12	16.80
DOF-MW3	Oct-12	199878	1269775	17.15	16.79
DOF-MW4	Oct-12	199985	1269797	15.86	15.54
DOF-MW5	Oct-12	200064	1269721	15.51	15.14
DOF-MW6	Oct-12	200248	1269827	11.88	11.53
DOF-MW7	Oct-12	200184	1269970	13.02	12.67
DOF-MW8	Oct-12	200098	1270037	13.84	13.51
SA-MW1	Apr-07	200268	1269944	13.03	12.57
SA-MW2	Apr-07	200311	1270090	12.33	11.97
SA-MW3	Apr-07	200249	1270174	13.04	12.57
HC-B1	May-86	200304	1270043	12.9	13.74
HC-B2	May-86	200174	1270080	13.5	13.95
HC-B3	May-86	199943	1269602	Likely destroyed	
HC-B4	Sep-86	199867	1269934	Abandoned 2014	
HC-B5	Sep-86	199983	1269979	Abandoned 2014	
MW-Ap	Oct-15	200173	1269797	13.45	13.08
MW-Bp	Oct-15	200095	1269852	15.88	15.60
MW-Cp	Oct-15	199995	1269943	13.95	13.69

(2015-12-3 ICS-NW Cooperage Master GPS coordinates.xlsx -ICS 12-2015 coordinates)

TABLE B-1 - Sample Location Survey Data - As of December 2015

Well	Date Installed	Northing (ft)	Easting (ft)	Rim- Ground Surface Elevation (feet)	TOC Elevation (feet)
MW-Dp	Oct-15	200271	1269723	13.78	13.53
MW-Du	Oct-15	200273	1269723	13.77	13.57
MW-Eu	Oct-15	200297	1270058	12.15	11.83
MW-Fu	Oct-15	200170	1270230	13.06	12.68
$MW\text{-}F_L$	Oct-15	200168	1270230	13.07	12.80
MW-Gu	Oct-15	200055	1270222	13.52	13.13
$MW\text{-}G_L$	Oct-15	200055	1270221	13.65	13.32
$MW\text{-}H_L$	Oct-15	200269	1269831	11.94	11.73
$MW\text{-}I_L$	Oct-15	200248	1270172	12.92	12.59
MW-Ju	Oct-15	200282	1270134	12.45	12.18
MW-Ku	Oct-15	199927	1270348	11.95	11.59
$MW\text{-}K_L$	Oct-15	199925	1270348	11.94	11.57
MW-Lu	Oct-15	199901	1270258	12.04	11.69
$MW\text{-}L_L$	Oct-15	199899	1270260	12.08	11.65
HC-B2(R)	Oct-15	200186	1270108	12.83	12.50
LNAP-1	Oct-15	200212	1270040	12.61	12.24
LNAP-2	Oct-15	200254	1269921	12.22	11.96

Notes:
Horizontal Datum - Washington State Plane North NAD 83 / 96
Vertical Datum - NAVD88
Based on Tyee Surveyors September 2013 - Seattle Benchmarks 49360/49358 (updated September 2014 and November 2015)
HC-B3 to HC-B5 coordinates estimated from 1986 site plan.

STORMWATER LOCATIONS

Sample #	Northing (ft)	Easting (ft)	Invert Elevation	Notes
South Manhole (MH 1)	199896	1270253	7.20	to water level *
North Manhole (MH 2)	199948	1270190	7.05	to water level *
2nd Ave Outfall End	200293	1269981	0.827	to pipe invert

Notes:
* governed by invert of 24" outfall exiting MH 2
Horizontal Datum - Washington State Plane North NAD 83 / 96
Vertical Datum - NA+A250VD88
Based on Tyee Surveyors September 2013 - Seattle Benchmarks 49360/49358

TABLE B-1 - Sample Location Survey Data - As of December 2015

DOUGLAS PROPERTY MONITORING WELL LOCATIONS

Well/Installer	Date Installed	Northing (ft)	Easting (ft)	Ground Surface Elevation (ft)	TOC Elevation (ft)
DMC-MW1 (DM)	Oct-90	200452.0	1269870.2	18.04	17.39
DMC-MW2R	Jul-13	200473.3	1269973.3	17.19	17.37
DMC-MW3 (DM)	Oct-90	200482.0	1269932.0	18.14	17.29
DMC-MW4 (DM)	Oct-90	200539.6	1269935.6	17.66	16.51
DMC-MW5 (DM)	Jan-91	200608.6	1269977.9	15.92	15.02
DMC-MW6 (DM)	Jan-91	Destroyed			
DMC-MW7 (DM)	Jan-91	Destroyed			
DMC-MW8 (SAIC)	Jun-08	200399.7	1270060.3	17.33	16.93
DMC-MW9 (SAIC)	Jun-08	200384.3	1269979.5	16.72	16.32
DMC-MW10 (SAIC)	Jun-08	200386.6	1269915.3	17.03	16.73
DMC-MW11 (SAIC)	Jun-08	200407.6	1269834.3	17.89	17.59
DMC-MW12 (SAIC)	Jun-08	200465.5	1269907.8	18.30	17.88
DMC-MW13 (GEO)	Jul-13	200441.2	1270168.3	18.00	17.60
DMC-MW14 (GEO)	Jul-13	200570.5	1270057.0	16.56	16.16
DMC-MW15 (GEO)	Jul-13	200652.6	1269984.9	15.94	15.49
DMC-MW16 (GEO)	Jul-13	200514.6	1269911.8	18.24	17.59
DMC-MW17 (GEO)	Jul-13	200611.5	1269897.0	17.01	16.51
DMC-MW18 (GEO)	Jul-13	200466.7	1270047.9	17.90	17.60
DMC-MW19 (GEO)	Jul-13	200513.6	1269975.9	17.49	16.99
DMC-MWA (DOF) (a)	Feb-15	200383.1	1269954.5	17.74 (N. Rim)	17.10
DMC-MWB (DOF) (a)	Feb-15	200401.5	1270065.7	18.41 (N. Rim)	18.00
DMC-MWC (DOF) (a)	Feb-15	200397.7	1270178.7	17.75 (N. Rim)	17.48

Notes:
Horizontal Datum - Washington State Plane North NAD 83
Vertical Datum - NAVD88
(DM) - Dames and Moore
(GEO) - GeoEngineers
(DOF) - Dalton, Olmsted & Fuglevand, Inc.
(a) - Survey information by Tyee Surveyors

APPENDIX C
FIELD PROCEDURES

REMEDIAL INVESTION REPORT
ICS/NWC RI/FS
SEATTLE, WASHINGTON
October 2025

Dalton, Olmsted & Fuglevand, Inc.

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FIELD PROCEDURES
REMEDIAL INVESTIGATION
ICS-NWC SITE, SEATTLE, WASHINGTON

FIELD SAMPLING ACTIVITIES

Field activities conducted as part of the Remedial Investigation (RI) consisted of the collection of upland soil, embayment sediment, storm water sediment, groundwater, and surface water and storm water samples. Water level measurements were also made to assess groundwater flow directions and in-situ slug-tests were completed to assess hydraulic conductivity. The field procedures used to collect the samples, make the measurements and document the results are outlined in the approved work plan (DOF 2012) and are summarized below.

General Soil and Sediment Sampling Procedures

- Soil and sediment were described using ASTM-D2488 as a general guide. Push-probe, monitoring well and sediment core logs are presented in Appendix D.
- Observations were documented in a field log book or on field forms that are part of the project file.
- Visual indications of contamination (oily soil/sediment, sheen, color, texture, etc.) were recorded when observed.
- Sample head-space vapor measurements were made using a photoionization detector (PID) using the "*Head-Space Analysis*" procedure described below.
- Sheen testing was completed on suspect sediments/soils. Observations were documented using the visual screening guide summarized in Table C1 below. Other obvious evidence of the presence of contamination was also recorded on the field logs.
- The horizontal position of significant features and sample locations were determined using a DGPS (Trimble GeoXH) to +/- 1.0 feet. Datum: NAD 1983(2007), based on National Geodetic Survey (NGS) continuously operation reference stations (CORS), WA State Plane Zone North 4601, U.S. Survey Feet.
- The approximate elevation of significant features and identified sample locations were determined by plotting the identified locations on the topographic base map. Well head elevations were determined by a licensed surveyor. Coordinates and survey elevations are summarized in Appendix B (Table B-1).
- Samples were labeled, placed in chilled coolers and transported to the analytical laboratory, Analytical Resources Inc., Tukwila, WA (ARI) within 48 hours of collection.
- Sample handling was documented using standard chain-of-custody procedures.

Head Space Analysis

A 1-quart zip-lock bag was filled about one-half full and sealed shut. After the sample temperature reached ambient temperature, the probe of the PID (MiniRae PGM7300) was inserted through the plastic into head space of the bag. The maximum measurement was recorded on the field form.

Sheen Test

A portion of the soil/sediment sample used to measure head-space vapors was removed from the 1-quart plastic bag and wetted with water to observe for petroleum sheen. The observed sheens were classified as follows and were documented on the field log forms.

Table C1 - Sheen Classification

Sheen Classification	Description
No Sheen (NS)	No visual sheen on water surface
Light Sheen (LS)	Light colorless sheen, spread is irregular, not rapid; film dissipates rapidly
Moderate Sheen (MS)	Light to heavy film, may have some color or iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on water surface
Heavy Sheen (HS)	Heavy colorful film with iridescence; spread is rapid, and sheen flows off the sample. Entire water surface may be covered with sheen

Embayment

Surface Sediment Sample Collection

Surface (0 to 10 cm) sediment samples DSS-01 through DSS-32 were collected in July of 2012 and samples SED 1 to 4 were collected in September 2014. All sample locations were accessed on foot and collected using hand equipment as follows:

- Clean stainless steel spoons were used to remove a uniform thickness of sediment to a depth of 10 cm.
- The sediment was placed in a clean stainless steel bowl, thoroughly mixed to a consistent texture and color, and placed in a clean glass jar provided by ARI.
- A portion of the sample was placed in a 1-quart plastic bag and head space and sheen testing completed as described above.
- The material type was described and sample location coordinates determined using a DGPS.

Collection of Deeper Sediment (Core) Samples

Sediment cores A to M identified in Table B1 were collected by crane–deployed vibracore sampling equipment (R/V Mud Hen) owned and operated by Marine Sampling Systems of Port Orchard, WA. Samples were collected in July of 2012. Vibracore sampling followed these procedures:

- The core was positioned over the pre-determined sample locations within the embayment. Once reasonably close to the work plan location, the crane lowered the vibracore frame to the mudline. The core was then advanced and the core extracted by the crane and swung to the vessel deck.
- The vibracore used a hydraulic system that vibrates and drove a 7 to 13 foot length of 4-inch outer diameter (O.D.) aluminum tubing into sediment. A continuous sediment sample was retained within the tubing with the aid of a stainless steel core cutter/catcher. Each sample location was cored with a pre-cleaned tube and equipment decontaminated by rinsing between each advancement.
- Core compaction was estimated (core length recovery vs. penetration) and used to determine in-situ sampling depths.
- Sediment at the end of each tube section was visually classified for qualitative sample characteristics. Changes from the top to the bottom of each section of the tube were noted and recorded on the core log sheet. Empty tubing was removed to assure that each section was full of sediment. The core ends were then covered with aluminum foil, a protective cap, and duct tape to prevent leakage. The core sections were stored upright in a container chilled with ice to approximately 4°C.
- Minimal processing of the cores occurred on site. For ease of handling and storage before processing, the cores were sectioned into maximum 4-foot lengths in the field. Each length was assigned a sample identification that reflected the relative depth of that specific core portion. The cores were transported to ARI the same day as sampling and stored in their cooler for later sample processing and sub-sampling.
- Core sections collected for chemical sampling were extruded at ARI by cutting the tube longitudinally. This process produced a generally intact core for visual classification of the sediments with depth.
- The material types were described.
- Each core was vertically sampled.
- Core depth intervals were selected to represent different strata (i.e. recent and alluvial sediment types).
- Samples of recent and alluvial sediment were obtained as follows:
    - The cores were segmented into approximately one foot intervals,
    - Samples were obtained of each segment but consisted entirely of a single material type.
    - Each sample interval was placed in a clean stainless steel bowl, thoroughly mixed to a consistent color and texture, and placed in a clean glass jar provided by ARI.
- A portion of each sample was placed in a 1-quart plastic bag and head space and sheen testing completed as described above.

Seep Sampling

Two seeps emanating from the southern embayment shoreline were sampled at the locations identified in Table B1. The samples were collected as follows:

- Horizontal coordinates were determined by DGPS.
- Seep samples were collected using a peristaltic pump. Samples were pumped directly into sample containers, containing the appropriate preservatives, provided by ARI.
- Samples for dissolved metals analysis were field filtered using an in-line 0.45 micron filter.
- Field measurements were made for pH, electrical conductivity, temperature, ORP[i], dissolved oxygen (DO) using an YSI 556 MPS meter. Turbidity was measured using an Oakton T-100 meter. Ferrous iron was measured using a HACH colorimetric kit.

Upland

Push-Probe Soil and Groundwater Sampling/Testing.

Push-probe soil and groundwater sampling was accomplished at 40 locations between 2008 and 2015. As identified in Table B1: probes P1 to P10 in July 2008; former lagoon probes (LP1 to LP4) in October 2012; data-gap probes P11 to P33 in November/December 2014; and off-site probes P34 to P36 in June 2015. Sample dates and results are summarized in Table B1 and Appendix H. Following sampling, each probe hole was backfilled with bentonite chip, in accordance with Chapter 173-160 WAC.

Pre-field activities included: obtaining drilling permits in accordance with Washington State Chapter 18.104 RCW for push-probe drilling and monitoring well installation; scheduling and coordinating field activities with subcontractors and other parties; surveying underground utilities at the proposed sampling locations and notifying the Utility Notification Center in accordance with RCW 19.122. Available existing building and utility plans were reviewed to assist in selecting the sampling locations.

Push-probe sampling procedures are described below:

Push-Probe Soil Sampling

- A push-probe rig (AMS 9630 or Geoprobe 7730 DT) was used to collect soil samples from the target locations. Drilling depths varied from 10 to 35 feet below ground surface.
- Continuous samples were collected using a core barrel with an acrylic liner.
- Samples were visually classified by Dave Cooper a licensed geologist.
- Portions of each sample interval were placed in laboratory supplied containers (for possible chemical analysis) and a 1-quart plastic bag (for field screening),
- Sample head-space vapor measurements were made using a photoionization detector (PID) using the procedure described above.
- Sheen testing was completed on suspect soils. Observations were documented using the visual screening guide summarized above in Table C1.

Push-Probe Groundwater Sampling

[i] The YSI probe uses an Ag/AgCL reference electrode to measure oxidation/reduction potential (ORP). To convert the ORP measurements to Eh, add 200 mV to the ORP voltage.

- Reconnaissance level grab groundwater samples were collected from target locations identified in the sampling and analysis plans during push-probe drilling.
- At the pre-determined vertical location, a 4-foot long temporary stainless steel screen was deployed through the probe rod (Geoprobe SP-16, 0.010 slot or equivalent).
- Samples were collected with a peristaltic pump using new polyethylene tubing at each location and analyzed for the suite of constituents listed in Table 9 "*Groundwater Analyses*" of the 2012 work plan.
- Low flow sampling procedures were used to minimize sample turbidity. Samples for dissolved metals analyses were field filtered using a 0.45 micron filter.

Installation of New Monitoring Wells

New monitoring wells were installed using a hollow-stem auger or direct-push probe rig. Twenty-eight wells were installed for this investigation between October 2012 and November 2015 (ICS site) and three wells on the Douglas property in February 2015 as summarized in Table B1. The work was documented by David Cooper, a licensed geologist with DOF. New well installations were completed by either Cascade Drilling Company or Holt Drilling, both licensed Washington State drilling contractors, consistent with the requirements of Chapter 173-160 WAC (Minimum Standards for Construction and Maintenance of Wells).

- Well depths ranged from 10 to 35 feet below ground surface.
- During drilling, soil samples were collected to determine stratigraphy using a split-spoon sampler on approximately 2.5 feet intervals or continuously using a macro sampler. The samples were described and logged in the field.
- Once the final drilling depth was reached in accordance with the work plan, a 2-inch diameter pre-packaged screen/sand pack PVC screen and riser pipe were installed through the casing center.
- Three LNAPL wells were installed in a similar manner as the monitoring wells describe above. Ten-foot long screens were set across the water table.
- The wells were completed with a surface seal and flush-to-ground monuments.
- The wells were subsequently developed by pumping until the pumped water visually cleared using a battery powered submersible pump.
- Geologic logs and well construction as-built details are included in Appendix D.

Well-Head Survey and Water Levels Measurement

- The top of the PVC riser pipe for all wells were surveyed by a licensed surveyor (Tyee Surveyors, Seattle) to 0.01 feet NAVD88.
- Horizontal coordinates were determined using a DGPS, referenced to Washington State Plane North NAD 83.
- Water levels were measured by hand to 0.01 feet using a calibrated electric well probe relative to top of PVC riser.

- Water level measurement in all wells were made on April 11, 2016 during high and low tides. The measurements were made by hand during a one hour period, centered on the predicted time of higher high tide and lower low tide.

Groundwater Sample Collection

Groundwater samples were collected on four different occasions between November 2012 and September 2016, from previously existing wells and the new wells installed as part of this RI. Sample dates and results are summarized in Appendix G.

- Prior to sampling, water levels were made using a calibrated electric well probe.
- Groundwater samples were collected using a peristaltic pump. New dedicated HDPE tubing was installed in all wells.
- Samples were obtained using low flow sampling procedures. Sampling flows were generally less than 500 ml/min.
- Field measurements were made for pH, electrical conductivity, temperature, ORP, dissolved oxygen, turbidity and ferrous iron. using the following:
    - pH, Temperature, Electrical Conductivity, ORP, DO – YSI 556 Meter
    - Ferrous iron – Hach Kit
    - Turbidity – Oakton T-100 Meter
- The field instruments (meters) were calibrated on a daily basis. Field observations and measurements were documented on the DOF Water Sampling Field Form.
- Samples were obtained once field parameters stabilized to within 10% or three casing volumes were removed from the well.
- Groundwater samples were pumped directly into labeled containers, with the appropriate preservatives, provided by ARI.
- Samples for dissolved metals analyses were <u>field</u> filtered using a new/disposable in-line 0.45 micron filter for each sample.
- Filled sample containers were placed in chilled coolers for transport to the laboratory. Samples were delivered to ARI for analyses, generally within 48 hours of collection. Sample handling was documented using standard chain-of-custody (COC) procedures.

Man-hole Sediment Sampling

A sediment sample was collected from Manhole 1 in the southeastern portion of the site in August 2012.

- The sample was collected using a stainless steel spoon attached to an extension pole.
- The material was described and placed in laboratory supplied containers for analysis.
- Sample dates and results are summarized in Appendix I.

2nd Ave. Storm Water System Sampling

Storm water samples were collected on three different occasions between August 2012 and September 2015. Sample dates and results are summarized in Appendix I.

- Two of the samples were collected during a drier period of the year, one during the higher-flow wet season.
- The sampling took place towards the end of a low tide when the outfall was exposed and upland storm water flow was exiting the system.
- Flow was sampled at two locations; within Manhole 1 and at the outfall mouth.
- Manhole 1 storm water was sampled using a peristaltic pump, with the intake tube positioned in the upstream pipe to best intercept active flow.
- Flow at the outfall mouth was accomplished by filling a glass container with water as it spilled over the invert of the outlet pipe and transferring the water to the laboratory supplied containers,
- Samples for dissolved metals analysis were pumped through new/disposable in-line 0.45 micron filters using a peristaltic pump.
- Field measurements were made for pH, temperature, conductivity, ORP, DO, ferrous iron, and turbidity.
- Embayment water samples were also collected and analyzed for electrical conductivity (field), sodium, chloride, hardness and sulfate.
    - Two samples were obtained from along the shoreline during a high tide. One sample was obtained from approximately two feet below the water surface and a second sample obtained approximately two feet above the mud-line.
    - All samples were collected from a boat using a peristaltic pump, with the tubing inlet positioned at the target location.

Assessment of Hydraulic Conductivity of Subsurface Sands

In-situ "*slug tests*" were completed in six wells to assess the hydraulic conductivity (permeability to water) of the sands that underlie the site. Tests were completed at the locations and wells listed in the following table.

Table C2 - Slug Test Locations

Location	Screen Depth (feet)	Material Type
DOF-MW1	12-17	Fine sand
DOF-MW6	13-18	Fine to medium sand
DOF-MW7	13-18	Fine Sand
MW-Eu	5-15	Gravelly Sand
MW-HL	20-30	Fine to Medium Sand
MW-IL	25-35	Fine to Medium Sand
HC-B1	Est. 25-30	Silty Sand

- Falling head slug tests were completed by quickly introducing a solid PVC blank into the well, displacing the water to a higher level. The blank was fixed into position and the water levels subsequently measured.
- The rates of water level decline were measured and recorded using a combination pressure transducer/data logger (Van Essen Micro Diver) dedicated to each well.
- The pressure transducer readings were compensated/corrected for changes in the atmospheric pressure during the tests.
- Background water levels were also measured in wells DOF-MW1 and DOF-MW8.
- Results are summarized in Appendix E.

Decontamination

Drilling tools (augers, rods, samplers etc.) were hot-water pressured washed between drilling locations. Stainless steel sampling spoons and bowls were washed in an Alconox solution, followed by a tap water rinse and a deionized (DI) water rinse. All cleaning water was contained and collected, then transferred to DOT 55 gallon drums for storage onsite and profiling for disposal.

Sampling spoons and mixing bowls were pre-cleaned prior to collecting the samples. A sufficient number of spoons and bowls were available during the sampling so no decontamination of this equipment in the field was necessary.

During sampling, samplers were used between locations were washed with a laboratory grade detergent and tap water and rinsed with tap water between each sampling run. Wash and rinse water was collected for proper disposal.

Handling of Sampling Waste Materials

Drill cuttings were segregated and placed in drums. Water resulting from the decontamination of equipment and personnel, and monitoring well development and sampling purge water were placed in labeled DOT 55 gallon drums and are currently held onsite for proper disposal.

REFERENCES

DOF (Dalton, Olmsted & Fuglevand, Inc.), 2012, Remedial Investigation/Feasibility Study (RI/FS) Work Plan, Industrial Container Services/Former NW Cooperage Site, Seattle, Washington; prepared for ICS/Former NW Cooperage, February 2012.