HISTORICAL SUMMARY REPORT
Revised Final

Former Portland Gas Manufacturing
Portland, Oregon

June 11, 2009

DEQ File No. 1138
HISTORICAL SUMMARY REPORT

REVISED FINAL

Former Portland Gas Manufacturing Site
Portland, Oregon

June 11, 2009

Prepared for:

NW Natural
Portland, Oregon

Prepared by:

Hahn and Associates, Inc.
and
Anchor Environmental LLC
Portland, Oregon

HAI Project No. 7532
DEQ File No. 1138
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1.0 INTRODUCTION

On behalf of NW Natural, Hahn and Associates, Inc. (HAI) and Anchor Environmental, LLC (Anchor) have prepared a summary of available historical information on the former Portland Gas Manufacturing Site (PGM Site or the Site). The summary and evaluation included within this report follows the general outline provided to DEQ on September 10, 2008, as the memorandum Proposed Outline and Schedule for Historical Summary Report for the Portland Gas Manufacturing Site (Anchor 2008) and approved by DEQ in e-mail correspondence dated September 10, 2008 (Mr. Dan Hafley to Mr. John Edwards). This Revised Final Report has been updated to incorporate changes as requested within DEQ comments provided in correspondence dated February 25, 2009 (Mr. Dan Hafley to Mr. Bob Wyatt), as described within NW Natural’s April 8, 2009 response (Mr. Rob Ede to Mr. Dan Hafley), and as further clarified during a April 16, 2009 meeting with DEQ and NW Natural.

1.1 Purpose and Methods

This report summarizes the available historical information regarding the former PGM Site operations, including its historical practices, dates of operation, and hazardous materials usage, storage, generation and disposal. Further, this report documents the current usage and practices within the areas formerly occupied by the Site, and also hazardous materials releases and remedial actions that have been documented at the Site and within the immediately surrounding area.

Information on the Site and immediately surrounding area was gathered through physical inspection (site survey); review of available historical documents including those within NW Natural archives and as described within NW Natural’s September 19, 2008 Response to U.S. EPA CERCLA Section 104(e) Information Request (NWN 2008); a survey of the surrounding land uses; review of Federal, tribal, state, and local government records; as well as from examination of other pertinent documents including photographs and maps.
1.2 Report Organization

This report is organized as follows:

- Section 1 provides a summary of the purpose, methods, and organization of this Historical Summary Report.

- Section 2 describes the Site boundaries as well as the limits of the immediately surrounding area, as defined for the purposes of this Report. This section further describes the Site and surrounding area location, boundaries, size, current structures and land use, as well as subsurface sewer utilities in the vicinity of the site.

- Section 3 describes the ownership and operational history of the Site and surrounding area. This section provides a summary of the documented history of the former PGM Site operations, including its historical practices, dates of operation, and hazardous materials usage, storage, generation and disposal.

- Section 4 describes the regulatory history of the Site and provides summaries of the publicly available information regarding documented releases within the Site and surrounding area. Further, this section also provides summaries of documented subsurface investigations that have been conducted within the Site and surrounding area, as provided by the City of Portland Bureau of Environmental Services and/or NW Natural.

- Sections 5 through 8 provide signatures, limitations, glossary of abbreviations, and a description of professional qualifications, respectively.
2.0 SITE BACKGROUND

2.1 Site Location and Description

The Site and the surrounding area were located in the vicinity of River Mile 12.2 on the west side of the Willamette River, in Couch’s Addition, Portland, Multnomah County, Oregon (Figure 1). The Site and surrounding area consisted of numerous Tax Lots located in Section 34, Township 1 North, Range 1 East of the Willamette Meridian (W.M.). For purposes of this historical review, the Site and surrounding area will be referred to by the historical City of Portland Block designations (Figure 2).

2.1.1 The Site – Overview

The Portland Gas Manufacturing Site was used for manufacturing gas from coal, carbureted water (water enriched with oil), and/or oil between 1860 and 1913. From 1860 until the early 1900s, the gas manufacturing area was limited to one historical city block (Block 5), with office space and coal storage located on a second city block (Block 6). During the early 1900s, the gasification operations were expanded to include all or portions of three additional city blocks (Blocks 7, 15, and 23).

The Portland Gas Manufacturing Site began its operations by H.C. Leonard and John Green on Block 5 (Figure 2) in 1860, initially to provide manufactured gas for Portland city street lights covering an area of less than one square mile, and serving only 49 people. Ownership was transferred to Portland Gas Light Company in 1864, which entity owned and operated the plant until 1910, when it was purchased by Portland Gas & Coke Company (PGC). By 1913, when gas manufacturing was moved to another location (the Gasco facility) and Site operations ceased, the Site was supplying manufactured gas for fueling lights, water heaters, and furnaces to approximately 28,500 customers.

Gas at the Site was initially manufactured exclusively from coal through at least the late 1890s, when a flood shut down operations and carbureted oil gas processes were incorporated during reconstruction of the plant. Coal continued to be utilized as feedstock through the early 1900s, but in lesser quantities. In 1906 and until shutdown in 1913, the Site began producing gas almost exclusively from oil, with carbureted water gas processes retained for emergency needs only.
For the purposes of this report, the Site was defined to include all operational areas related to historical gas manufacturing operations. Gasification operations were considered to include manufacturing structures and processes, waste management areas, as well as storage areas for feedstock, gas purification materials, by-products, and storage of manufactured gas reserves. Ancillary support structures and processes, such as gas plant administrative offices, horse stables, lodgings, and miscellaneous equipment and materials storage areas were not considered to be operational or waste disposal areas, and therefore were not included within the Site boundaries, but instead are described as part of the surrounding area.

2.1.2 The Surrounding Area

In addition to the Site operational areas, two nearby city blocks and one partial city block were also historically owned and operated by PGC or its predecessors, and were used for horse stables, pipe storage, coal storage, and lodgings. Further, and at the request of the DEQ, the surrounding blocks located adjacent to the west and south of the Site were included in this review.

As described above, the Site and surrounding area included in the historical summary described herein was bounded by NW Glisan Street to the north, NW Davis Street to the south, NW 3rd Avenue to the west, and by the Willamette River to the east (Figure 2).

2.2 Current Site and Surrounding Area Description

The Site and surrounding area were used for general commercial purposes, including administrative and professional offices, retail stores, restaurants, for automobile parking, and recreational usage at the time of the site assessment. Historical Blocks 4, 5, 6, 21 and the eastern portion of Block 7 have been redeveloped as part of the current Tom McCall Waterfront Park and Steel Bridge access ramps. The following Sections provide a more detailed description of current site layout and ownership. Section 4 of this Report will provide a description of historical ownership and operations.
2.2.1 Site Description

The Site was historically located on part or all of five (5) city blocks, including all of Blocks 5, 6, and 23, the northern half of Block 7, and the northern half of Block 15. At its greatest extent, the Site included approximately 3.7 acres in total (Figures 1 and 2). A Table summarizing current ownership, types of improvements, and year of construction of the current improvement is provided below, followed by a description of each block.

Current Site Structures and Ownership by Block and Tax Lot

<table>
<thead>
<tr>
<th>Historical Block #</th>
<th>Map &amp; Tax Lot</th>
<th>Address</th>
<th>Current Improvement</th>
<th>Year Built</th>
<th>Current Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>Seawall; Waterfront Park</td>
<td>1928-1930; Waterfront Park: 1974</td>
<td>City of Portland Bureau of General Services</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>-</td>
<td>Roads; Access Ramps for Steel Bridge</td>
<td>1946</td>
<td>City of Portland Bureau of General Services</td>
</tr>
<tr>
<td>7</td>
<td>1N1E34DB 100</td>
<td>202 NW 1st Ave.</td>
<td>220,000-sq.ft. Parking Garage (covers entire block)</td>
<td>1989</td>
<td>City of Portland Bureau of General Services</td>
</tr>
<tr>
<td>15</td>
<td>1N1E34CA 4300</td>
<td>315 NW 1st Ave.</td>
<td>160,044-sq.ft. Office Building (covers entire block)</td>
<td>2000</td>
<td>WREH Portland LLC</td>
</tr>
<tr>
<td>23</td>
<td>1N1E34CA 100</td>
<td>123 NW Flanders St.</td>
<td>90,075-sq. ft. Office Building</td>
<td>1961</td>
<td>Oregon Department of Transportation</td>
</tr>
</tbody>
</table>

Block 5 (approximately 1.2 acres) was formerly located between NW Front Avenue to the west, the Willamette River to the east, NW Flanders Street to the north and NW Everett Street to the south. Currently, Block 5 is covered with portions of Steel Bridge access ramp foundation, a section of NW Naito Parkway/NW Front Avenue, and grass-covered areas and a paved walkway at its eastern portion (Tom McCall Waterfront Park). The eastern limit of former Block 5 is presently defined by a seawall constructed by the City of Portland during the years 1928-1930.

Block 6 (approximately 0.6 acres) was formerly located between NW 1st Avenue to the west, NW Front Avenue to the east, NW Flanders Street to the north and NW Everett Street to the south. Currently, Block 6 is covered with Steel Bridge access ramps and foundations, and a landscaped area
between the access ramps and NW Naito Parkway (historically designated NW Front Avenue).

**Block 7** (northern half is approximately 0.5 acres) is bounded by NW Naito Parkway to the east, NW 1st Avenue to the west, NW Everett Street to the north and NW Davis Street to the south. NWN’s predecessors owned only the northern half of this property. The entire block was developed in 1989 with a multi-level parking garage with ground-floor retail usage and a roof Heliport, and is addressed as 202 NW 1st Avenue and 33 NW Davis Street. The parking garage comprises approximately 220,000-square feet.

**Block 15** (northern half is approximately 0.4 acres) is bounded by NW 1st Avenue to the east, NW 2nd Avenue to the west, NW Flanders Street to the north and NW Everett Street to the south. PGC first acquired parts of Block 15 in 1904 and used it for various ancillary supply activities, with the northern half used for coal storage, and possibly also for iron oxide storage in the 1904-1913 timeframe. Block 15 is currently improved with an approximate 160,000-square foot, six-story building (built in 2000) occupied by Port of Portland Administrative Offices and some ground floor retail. The Port of Portland Building is addressed as 121 NW Everett Street.

**Block 23** (approximately 1.0 acres) is bounded by NW 1st Avenue to the east, Naito Parkway/NW Front Avenue to the northeast, NW 2nd Avenue to the west, NW Flanders Street to the south and NW Glisan Street to the north. It is currently developed with a three-story office building occupied by the Oregon Department of Transportation (ODOT), and is addressed as 123 NW Flanders Street. The building was constructed in 1961 as NWN’s previous Administration Building.

### 2.2.2 Surrounding Area Description

The area surrounding the Site includes city blocks historically designated as Blocks 4, 7 (southern half), 14, 15 (southern half), 16, 17, 21, and 24 (Figures 1 and 2). A Table summarizing current ownership, types of improvements, and year of the current development is provided below followed by a description of each block.
### Surrounding Area Structures and Current Ownership by Block and Tax Lot

<table>
<thead>
<tr>
<th>Historical Block #</th>
<th>Map &amp; Tax Lot</th>
<th>Address</th>
<th>Current Improvement</th>
<th>Year Built</th>
<th>Current Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1N1E34DB 100</td>
<td>202 NW 1st Ave.</td>
<td>Seawall; Waterfront Park Roads; NW Naito Parkway</td>
<td>1928-1930; Waterfront Park: 1974 Roads: 1946</td>
<td>City of Portland Bureau of General Services</td>
</tr>
<tr>
<td>7 (southern 1/2)</td>
<td>1N1E34CA 4500</td>
<td>220 NW 2nd Ave.</td>
<td>220,000-sq.ft. Parking Garage</td>
<td>1989</td>
<td>City of Portland Bureau of General Services</td>
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<td>14</td>
<td>1N1E34CA 4400</td>
<td>121 NW Everett St.</td>
<td>317,205-sq.ft. One Pac Square Building</td>
<td>1982</td>
<td>One Pacific Square CF LLC/Ashforth Pacific</td>
</tr>
<tr>
<td>15 (southern 1/2)</td>
<td>1N1E34CA 4400</td>
<td>121 NW Everett St.</td>
<td>160,044-sq.ft. Office Building (covers entire block)</td>
<td>2000</td>
<td>WREH Portland LLC</td>
</tr>
<tr>
<td>16</td>
<td>1N1E34CA 3600; 3700; 3800; 3900; 4000; 4100; 4200</td>
<td>350 NW 3rd Ave., 214 NW Flanders St.</td>
<td>Portland Classical Chinese Garden</td>
<td>2000</td>
<td>Northwest Natural Gas Co. leased to City of Portland</td>
</tr>
<tr>
<td>17</td>
<td>1N1E34CA 4600;</td>
<td>216 NW 3rd Ave.;</td>
<td>51,528-sq.ft. Darcelle’s Building; 31,016-sq.ft. Office Building</td>
<td>1910; 1985</td>
<td>Musolf Manor Ltd. Partnership/Innovation Housing Inc.; Philanthropy Center LLC</td>
</tr>
<tr>
<td>21</td>
<td>1N1E34CA 200</td>
<td>200 NW Glisan St.</td>
<td>Paved Parking Lot</td>
<td>N/A</td>
<td>Northwest Natural Gas Co.</td>
</tr>
</tbody>
</table>

**Blocks 4 and 21** were formerly to the north (Block 21) and south (Block 4) of former Block 5 and were between NW Front Avenue to the west and the Willamette River to the east. Blocks 4 and 21 have been redeveloped as part of the current Tom McCall Waterfront Park (circa 1974) and include grass-covered areas and a paved walkway at their eastern portions. The eastern limit of former Blocks 4 and 21 are presently defined by a seawall constructed by the City of Portland in the 1928 to 1930 timeframe. The western portion of Block 4 is covered by a section of NW Naito Parkway and
the western portion of Block 21 is covered with Steel Bridge access ramps and a section of NW Naito Parkway.

**Block 7 (southern half)** is bounded by NW Naito Parkway to the east, NW 1st Avenue to the west, NW Everett Street to the north and NW Davis Street to the south. NWN’s predecessors owned only the northern half of Block 7. The entire block was developed in 1989 with a multi-level parking garage as described in Section 2.2.1 above.

**Block 14** is located between NW 1st and NW 2nd Avenues, bordered by NW Everett and NW Davis Streets. Block 14 was acquired by NWN in 1961 and is currently owned by One Pacific Square CF LLC. The property was developed in 1984 with One Pac Square, an approximately 317,000-square foot multi-story office building. NWN leases a number of floors in this building for use as its central offices. The building also contains various office tenants, ground-level retail tenants, and basement-level parking.

**Block 15 (southern half)** is bounded by NW 1st Avenue to the east, NW 2nd Avenue to the west, NW Flanders Street to the north and NW Everett Street to the south. PGC first acquired parts of Block 15 in 1904 and used it for various ancillary supply activities, with the northern half used for coal feedstock storage in the early 1900s timeframe. The entire block was developed with an approximate 160,000-square foot, six-story building in 2000 as described in Section 2.2.1 above.

**Block 16** is located between NW 2nd and NW 3rd Avenues and is bordered by NW Everett and NW Flanders Streets. NWN acquired the entire block in approximately 1973 and in 1999 donated the property, through a 99-year lease with the City of Portland, for Portland Classical Chinese Garden (developed in 2000), which consists of open air landscaping including water features, a tea house, and a souvenir shop.

**Block 17** is located between NW 2nd and NW 3rd Avenues and is bordered by NW Davis and NW Everett Streets. NWN owned the north half of this block from 1961 until 1984 – using it for parking and equipment storage. The northern half of Block 17 was developed in 1985 with an approximately 31,000-square foot, three-story office building. The first floor of the structure is occupied by a credit union while the upper floors include general office tenants and City of Portland Chamber of Commerce offices. The southern half of Block 17 was developed in 1910 with an approximately 52,000-square foot, three-story structure currently occupied by Darcelle’s and
CC Slaughters nightclubs. The upper floors are used for single residence occupied (SRO) lodging.

**Block 24** is located between NW 2nd and NW 3rd Avenues and is bordered by NW Glisan and NW Flanders Streets. NW Natural owns this property, and it is developed with a paved parking lot for NWN employees and service vehicles and is used for limited storage of some event display materials. An approximately 100-square foot storage building was located on the northeastern corner of the block.

### 2.2.3 Subsurface Utilities

The following brief description of City subsurface utilities (sewer and water) at and in the area immediately surrounding the Site is based on information available from the on-line information source provided by the City of Portland ([www.portlandmaps.com](http://www.portlandmaps.com)), a December 19, 2008 discussion with Ms. Dawn Sanders of the Bureau of Environmental Services, and the City of Portland’s April 8, 2009 *Technical Memorandum: City Sewers in the Vicinity of the Portland Gas Manufacturing Site (ECSI #1138)*.

The two primary purposes of the utility evaluation are: 1) to determine if deep utilities exist within the Site area that could act as a preferential pathway for groundwater migration to the river, and 2) to determine if historical information exists that would indicate the possible wastewater discharge design of the former gas plant operations.

In addition to City of Portland utilities, numerous private utilities (e.g., electric, natural gas, fiber optic) exist in the area. Because these utilities, as well as City water mains, all tend to be shallow (typically within the upper 2 to 10 feet of ground surface) relative to typical depths to groundwater (15 to 25 feet bgs) they are not deemed potential pathways of preferential groundwater migration and so are not described in this report.

The April 8, 2009 City of Portland Technical Memorandum, as well as maps depicting sewer lines within the Site area, are included within Appendix B and depict all known existing sewer infrastructure in the area (storm, sanitary, combined), as well as abandoned mains within the area.

As shown within Appendix B, within the Site area are a storm gravity main, a combined gravity main, as well as a new (still under construction) combined gravity main (West Side CSO Tunnel). All of the indicated sewer lines are...
constructed parallel to the river with no outfalls or sub-river crossings in the Site area that would act as an ongoing preferential pathway to the Willamette river.

The West Side CSO Tunnel, completed in 2006, is a 14 foot diameter 3.5 mile long tunnel that extends adjacent to the Site beneath NW Naito Parkway between SW Clay Street and Swan Island. The West Side CSO pipe is present at a depth of approximately 60 feet below NW Naito Parkway as it passes adjacent to the Site. The Tunnel turns north and passes below the Willamette River at the Nicolai Shaft, approximately 2 miles northwest of the Site. Pre-construction soil and groundwater sampling beneath Naito Parkway identified evidence of contamination (black granular solid material) within shallow fill, as well as impacts to shallow groundwater in the Site vicinity (discussed in Section 4 of this report). No oil phase impacts were observed in any borings at any depth and soil and groundwater samples collected beneath the fill did not identify the presence of contamination. Because the West Side CSO Tunnel is constructed well below the fill at the Site (60 feet bgs for the tunnel vs. approximately 20 to 25 feet bgs for the base of the fill) this feature is not expected to act as a preferential pathway for impacted groundwater that may be present in the fill in vicinity of the Site.

Combined and storm gravity main sewers in the Site vicinity do not daylight or otherwise extend to the river in the vicinity of the Site. A survey of manhole and sewer pipe segment information in the area indicates that these sewer lines are buried between approximately 20 to 25 feet bgs and flow to the south. According to the April 8, 2009 City of Portland Technical Memorandum (Appendix B), since being constructed in 1928, a combined north-south sewer present just west of NW Front Avenue (Naito Parkway) has directed all discharge to City Outfall No. 9 (OF-9), located at the Ankeny pumping station immediately south of the Burnside Bridge, approximately 0.2 miles south-southeast of the Site. City OF-9 is reportedly still active and discharges effluent to the Willamette River, although combined overflow is now directed to the Westside CSO Tunnel. Because the north-south combined sewer is present across depths corresponding to uppermost groundwater within the fill, it is possible that this sewer line could act as a preferential migration pathway to OF-9 via granular backfill material or by infiltration of shallow groundwater as present across its pathway in Northwest Portland, including the Site vicinity.
The City’s Technical Memo reports that there were no sewers connected to OF-9 within the area of the Site until 1928, fifteen years after all PGM operations ceased. Instead, according to research completed by the City, three east-west combined sewers (below NW Glisan, NW Flanders, and NW Everett Streets) were present in the Site vicinity at the time of gas manufacturing operations. (see Technical Memo, Appendix B). Each of these east-west combined sewers discharged directly to the Willamette River at the apparent terminus of the street / shoreline until 1928, when the seawall and the north-south combined sewer was constructed.

The City of Portland Bureau of Development Services was contacted by HAI to determine if a plumbing permit was on file for the Site corresponding to the timeframe of operation (pre-1913). The purpose of this records review was to ascertain if confirmative evidence of a sewer hook-up to the City sewer system from the PGM Site was in existence. The City of Portland identified no permits or records for the Site that coincided with the operational history of the Gas Manufacturing Plant and as such no documentation to support any particular connection to a former City outfall location has been identified. However, regardless of whether PGM Site effluent discharge to the Willamette River was made via a City sewer connection, or via a facility-owned outfall, then such discharge would have likely been in the immediate Site vicinity at or between former City outfalls as historically located at the terminus of NW Everett and NW Flanders Streets – which were immediately north and south of the PGM Site operational areas.

Figure 20 provides a conceptualized east-west cross-section of the former PGM Site vicinity depicting existing above-ground site features, estimated fill thickness, typical depth to uppermost groundwater, the Willamette River, as well as the depths of the north-south combined sewer and the much deeper West Side CSO Tunnel. The approximate line of Section is depicted on Figure 19.

### 2.2.4 Fill Material

The Site and surrounding area has been graded and redeveloped, and undocumented fill has been imported at various times since the 1850s. The area was also filled in conjunction with the 1928-1930 construction of the existing seawall along the Willamette River. Soil borings that were installed during various subsurface investigation activities within the Site and
surrounding area indicated the presence of fill material throughout the area. In general, the fill material appears to be present to depths of up to approximately 25 feet bgs at various locations across the Site and the surrounding area (see Cross-Section in Figure 20). Fill was variously described as containing wood waste and demolition debris as well as silt, sand, gravel, concrete, brick, and glass debris (see Section 4.0 Regulatory History and Documented Releases for further detail).
3.0 OWNERSHIP AND OPERATIONAL HISTORY

3.1 Historical Site Ownership History

Historical Site ownership history was obtained from information summarized in the 104(e) Response (NWN 2008), and as derived from NW Natural files. Current Ownership information was obtained from Tax Assessor information located on the City of Portland website www.PortlandMaps.com.

The founders of the Portland Gas Light Company, H.C. Leonard and John Green, purchased property (Block 5) for the gas plant in 1859 and began operating the plant in 1860. Ownership of the property was transferred to the Portland Gas Light Company 1864, which entity operated the gas plant until 1892, when the Portland Gas Company gained ownership. The Portland Gas Company operated the gas plant until 1910, when it was purchased by Portland Gas & Coke Company (PGC). PGC ceased site operations in 1913.

3.1.1 Site Blocks

The Site Blocks included Blocks 5, 6, 23, the northern half of Block 7, and the northern half of Block 15. Property ownership information as derived from NWN files and reported in the 104e Response (NWN 2008) is listed by Block in the tables below:

**Block 5**

NWN’s predecessor, Portland Gas & Coke Company (PGC) or its predecessors, owned Block 5 from 1859 through 1942.

<table>
<thead>
<tr>
<th>Purchase Date</th>
<th>Purchaser</th>
<th>Property Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/30/1859</td>
<td>Portland Gas Light Co. from John and Caroline Couch</td>
<td>Block 5, Couch’s Addition, Lot 2</td>
</tr>
<tr>
<td>10/18/1859</td>
<td>H.C. Leonard and John Green from George Flanders</td>
<td>Block 5, Couch’s Addition, Lots 3, 4</td>
</tr>
<tr>
<td>1/3/1862</td>
<td>H.C. Leonard and John Green from George Flanders</td>
<td>Block 5, Couch’s Addition; Lot 1</td>
</tr>
<tr>
<td>Purchase Date</td>
<td>Purchaser</td>
<td>Property Description</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
<td>----------------------</td>
</tr>
<tr>
<td>10/24/1864</td>
<td>Portland Gas Light Co. from H.C. Leonard and John Green</td>
<td>Block 5, Couch’s Addition, listed only as “that certain lot tract”</td>
</tr>
<tr>
<td>9/16/1940</td>
<td>City of Portland</td>
<td>Block 5, Couch’s Addition</td>
</tr>
<tr>
<td>10/27/1942</td>
<td>City of Portland from Portland Gas &amp; Coke Co.</td>
<td>Block 5, Couch’s Addition; (all lots)</td>
</tr>
</tbody>
</table>

**Block 6**

NWN’s predecessors owned Block 6 from 1859 until 1946, when the City of Portland began road construction at this location.

<table>
<thead>
<tr>
<th>Purchase Date</th>
<th>Purchaser</th>
<th>Property Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/30/1859</td>
<td>Portland Gas Light Co. from John and Caroline Couch</td>
<td>Block 6, Couch’s Addition, “Fractional Lot”</td>
</tr>
<tr>
<td>11/16/1877</td>
<td>C.S. Schenck and George Weidler from Portland Gas Light Co.</td>
<td>Block 6, Couch’s Addition</td>
</tr>
</tbody>
</table>

**Block 7**

NWN’s predecessors owned the northern half of Block 7 from 1859 through 1937.

<table>
<thead>
<tr>
<th>Purchase Date</th>
<th>Purchaser</th>
<th>Property Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/25/1859</td>
<td>H.C. Leonard from the City of Portland</td>
<td>Block 7 (North half), Couch’s Addition (Lots 5, 6, 7, and 8)</td>
</tr>
<tr>
<td>12/07/1872</td>
<td>Herman C. Leonard and John Green from John and Caroline Couch</td>
<td>Block 7, Couch’s Addition, (No specific lots listed)</td>
</tr>
<tr>
<td>9/5/1895</td>
<td>H.C. Leonard from John Green (1/2 interest)</td>
<td>Block 7, Couch’s Addition (North half)</td>
</tr>
</tbody>
</table>
### Purchase Date

<table>
<thead>
<tr>
<th>Purchase Date</th>
<th>Purchaser</th>
<th>Property Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/1/1905</td>
<td>Portland Gas Co. from H.C. Leonard</td>
<td>Block 7 (North half), Couch's Addition (Lots 5, 6, 7, and 8)</td>
</tr>
<tr>
<td>12/1/1905</td>
<td>Portland Gas Co. from H.C. Leonard</td>
<td>Block 7 (North half), Couch's Addition (Lots 5, 6, 7, and 8)</td>
</tr>
<tr>
<td>3/1/1937</td>
<td>Minnie Heins Neupert from Portland Gas &amp; Coke Co.</td>
<td>Block 7 (North half), Couch’s Addition (Lots 5, 6, 7, and 8)</td>
</tr>
</tbody>
</table>

The Broadway Cab Company owned the entire Block 7 from at least 1952 to 1985.

### Block 15

NWN or its predecessors acquired the northern half of Block 15 in 1904. NWN also acquired the southern half of the block in 1961. NWN sold the entire Block in 2000. WREH Portland LLC, the owner of the Port of Portland building, purchased the block in January 2008.

<table>
<thead>
<tr>
<th>PURCHASE DATE</th>
<th>PURCHASER</th>
<th>PROPERTY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/4/1904</td>
<td>Portland Gas Co. from F.S. Stanley and Ruth Stanley</td>
<td>Block 15, Couch's Addition; Lots 5-8</td>
</tr>
<tr>
<td>11/7/1904</td>
<td>Portland Gas Co. from F.S. Stanley</td>
<td>Block 15, Couch’s Addition; Lots 5-8</td>
</tr>
<tr>
<td>1/10/1910</td>
<td>Portland Gas &amp; Coke Co. from Portland Gas Light Co. (Company Name Change)</td>
<td>Block 15, Couch's Addition; Lots 5-7 out of 1-8 (Flanders St. between NW 1st and NW 2nd Avenue).</td>
</tr>
<tr>
<td>12/20/1955</td>
<td>Portland Gas &amp; Coke Co. from Portland Trust Bank</td>
<td>Block 15, Couch's Addition; Lot 4 and south half of Lot 5</td>
</tr>
<tr>
<td>10/13/1961</td>
<td>Northwest Natural Gas Co. from Nicolai-Neppach Co.</td>
<td>Block 15, Couch's Addition; Lots 1-4</td>
</tr>
<tr>
<td>10/18/1961</td>
<td>Northwest Natural Gas Co. from Nicolai-Neppach Co.</td>
<td>Block 15, Couch's Addition; Lots 1-4</td>
</tr>
<tr>
<td>8/30/2000</td>
<td>The Port of Portland from Northwest Natural Gas Co.</td>
<td>Block 15, Couch’s Addition; Lots 1-8 (all)</td>
</tr>
</tbody>
</table>
Block 23

NWN or its predecessors owned Block 23 from 1903 through 1983.

<table>
<thead>
<tr>
<th>PURCHASE DATE</th>
<th>PURCHASER</th>
<th>PROPERTY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/30/1903</td>
<td>Portland Gas Co. (1/2 interest) from R. Kochler and Bertha Kochler</td>
<td>Block 23, Couch's Addition; Lots 2 and 3</td>
</tr>
<tr>
<td>8/20/1903</td>
<td>Portland Gas Co. (1/2 interest) from Ben Dorey, et al.</td>
<td>Block 23, Couch's Addition; Lots 6, 7, and 8</td>
</tr>
<tr>
<td>1/4/1904</td>
<td>Portland Gas Co. from Agnes Dolph Nixon, Richard Nixon, et al.</td>
<td>Block 23, Couch's Addition; Lots 1, 2, 3, and 4</td>
</tr>
<tr>
<td>1/4/1904</td>
<td>Portland Gas Co. from C.A. Dolph and Eliza C. Dolph</td>
<td>Block 23, Couch's Addition; Lots 1, 2, 3, and 4</td>
</tr>
<tr>
<td>4/4/1904</td>
<td>Portland Gas Co. from The Nicolai Brother Co.</td>
<td>Block 23, Couch's Addition; Lots 6, 7, and 8</td>
</tr>
<tr>
<td>1/11/1905</td>
<td>Portland Gas Co. from Rosalie Sassceer</td>
<td>Block 23, Couch's Addition; Lot 5</td>
</tr>
<tr>
<td>8/15/1983</td>
<td>Hayden Corp. from Northwest Natural Gas Co.</td>
<td>Block 23, Couch’s Addition; Lots 1-8 (all)</td>
</tr>
</tbody>
</table>

3.1.2 Surrounding Area Blocks

The Blocks surrounding the Site include Blocks 4, 14, 16, 17, 21, 24, the southern half of Block 7, and the southern half of Block 15. Property ownership information as derived from NWN files and reported in the 104e Response (NWN 2008) is listed by Block in the tables below. Ownership history for Blocks 4, 7 (southern half), and 21 were not available. Ownership history for Block 15 is detailed above,
Block 14

NW Natural acquired Block 14 in 1961 and sold it in 1981.

<table>
<thead>
<tr>
<th>PURCHASE DATE</th>
<th>PURCHASER</th>
<th>PROPERTY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/13/1961</td>
<td>Northwest Natural Gas Co. from Nicolai-Neppach Co.</td>
<td>Block 14, Couch's Addition; Lots 1-8</td>
</tr>
<tr>
<td>10/18/1961</td>
<td>Northwest Natural Gas Co. from Nicolai-Neppach Co.</td>
<td>Block 14, Couch's Addition; Lots 1-8</td>
</tr>
<tr>
<td>7/17/1981</td>
<td>Pacific Square Corp. from Northwest Natural Gas Co.</td>
<td>Block 14, Couch's Addition; Lots 1-8</td>
</tr>
</tbody>
</table>

Block 15

NWN acquired the southern half of Block 15 in 1961. Prior ownership information was not available. Ownership history for the northern half of Block 15 is described in Section 4.1.1 as part of the Site. NWN sold the entire Block in 2000.

<table>
<thead>
<tr>
<th>PURCHASE DATE</th>
<th>PURCHASER</th>
<th>PROPERTY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/13/1961</td>
<td>Northwest Natural Gas Co. from Nicolai-Neppach Co.</td>
<td>Block 15, Couch's Addition; Lots 1-4</td>
</tr>
<tr>
<td>10/18/1961</td>
<td>Northwest Natural Gas Co. from Nicolai-Neppach Co.</td>
<td>Block 15, Couch's Addition; Lots 1-4</td>
</tr>
<tr>
<td>8/30/2000</td>
<td>The Port of Portland from Northwest Natural Gas Co.</td>
<td>Block 15, Couch's Addition; Lots 1-8 (all)</td>
</tr>
</tbody>
</table>
Block 16

NWN or its predecessors acquired Block 16 through multiple purchases between 1957 and 1975. In 1999, NWN donated a 99-year lease of Block 16 to the City of Portland for the Portland Classical Chinese Garden.

<table>
<thead>
<tr>
<th>PURCHASE DATE</th>
<th>PURCHASER</th>
<th>PROPERTY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/15/1884</td>
<td>Herman Waterholter (by agreement between he and George Marshall)</td>
<td>Block 16, Couch’s Addition; Lots 6 and 7 (Easterly 30 feet of both)</td>
</tr>
<tr>
<td>4/15/1884</td>
<td>George Marshall (by agreement between he and Herman Waterholter)</td>
<td>Block 16, Couch’s Addition; Lots 8, north half of Lot 5</td>
</tr>
<tr>
<td>10/9/1889</td>
<td>George and Larissa Ainslie from George and Margaretta Marshall</td>
<td>Block 16, Couch’s Addition; Lot 5</td>
</tr>
<tr>
<td>6/11/1937</td>
<td>Hattie Goff Anderson from W.F. Schiller, et ux.</td>
<td>Block 16, Couch’s Addition; Lots 5 and 8 (parts of both)</td>
</tr>
<tr>
<td>10/17/1955</td>
<td>Portland Trust Bank from Red Transfer and Storage Co.</td>
<td>Block 16, Couch’s Addition; Lot 4 and south half of Lot 5</td>
</tr>
<tr>
<td>12/1/1955</td>
<td>Portland Gas &amp; Coke Co. from Portland Trust Bank</td>
<td>Block 16, Couch’s Addition; Lot 4 and south half of Lot 5</td>
</tr>
<tr>
<td>12/16/1955</td>
<td>Portland Gas &amp; Coke Co. from Morris B. Glicksman</td>
<td>Block 16, Couch’s Addition; Lot 3</td>
</tr>
<tr>
<td>5/20/1957</td>
<td>Portland Gas &amp; Coke Co. from Fred Knudsen, George and Lucille Faust</td>
<td>Block 16, Couch’s Addition; Lots 5 and 8 (parts of both)</td>
</tr>
<tr>
<td>5/31/1957</td>
<td>Portland Gas &amp; Coke Co. from Norris, Beggs &amp; Simpson (representing Fred Knudsen)</td>
<td>Block 16, Couch’s Addition; Part of Lots 5 and 8</td>
</tr>
<tr>
<td>6/3/1957</td>
<td>Portland Gas &amp; Coke Co. from Fred Knudsen</td>
<td>Block 16, Couch’s Addition; Lots 5 and 8 (parts of both)</td>
</tr>
<tr>
<td>5/7/1963</td>
<td>Northwest Natural Gas Co. from Pete and Belle Maletis</td>
<td>Block 16, Couch’s Addition; Lot 2</td>
</tr>
<tr>
<td>12/20/1971</td>
<td>Elaine J. Kerley from Hattie Goff Anderson</td>
<td>Block 16, Couch’s Addition; Lots 5 and 8 (parts of both)</td>
</tr>
<tr>
<td>12/4/1972</td>
<td>Northwest Natural Gas Co. from That Hot Coffee Investments, Inc. and Byrl S. Coyle</td>
<td>Block 17, Couch’s Addition; Lot 8 (West 24.9 feet)</td>
</tr>
<tr>
<td>PURCHASE DATE</td>
<td>PURCHASER</td>
<td>PROPERTY DESCRIPTION</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
<td>----------------------</td>
</tr>
<tr>
<td>11/2/1973</td>
<td>Northwest Natural Gas Co. from Elaine J. Kerley</td>
<td>Block 16, Couch's Addition; Lots 5 and 8 (parts of both)</td>
</tr>
<tr>
<td>2/15/1974</td>
<td>Northwest Natural Gas Co. from Elaine J. Kerley</td>
<td>Block 16, Couch's Addition; Lots 5 and 8 (parts of both)</td>
</tr>
<tr>
<td>4/26/1974</td>
<td>Northwest Natural Gas Co. from Union Gospel Mission of Portland</td>
<td>Block 16, Couch's Addition; Lots 6 and 7</td>
</tr>
<tr>
<td>3/14/1975</td>
<td>Northwest Natural Gas Co. from Opera House Laundry</td>
<td>Block 16, Couch's Addition; Lot 1</td>
</tr>
<tr>
<td>6/1/1999</td>
<td>City of Portland (lease)</td>
<td>Block 16, Couch's Addition; All Lots</td>
</tr>
</tbody>
</table>

Block 17

NWN purchased the northern half of Block 17 in 1961, and sold it in 1984.

<table>
<thead>
<tr>
<th>PURCHASE DATE</th>
<th>PURCHASER</th>
<th>PROPERTY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/12/1961</td>
<td>Northwest Natural Gas Co. from Susie R. Minx, Executrix of the Estate of Fred Graap</td>
<td>Block 17, Couch's Addition; Lot 8 (East 75.1 feet)</td>
</tr>
<tr>
<td>10/13/1961</td>
<td>Northwest Natural Gas Co. from Nicolai-Neppach Co.</td>
<td>Block 17, Couch's Addition; Lots 5, 6, and 7</td>
</tr>
<tr>
<td>10/18/1961</td>
<td>Northwest Natural Gas Co. from Nicolai-Neppach Co.</td>
<td>Block 17, Couch's Addition; Lots 5, 6, and 7</td>
</tr>
<tr>
<td>12/4/1972</td>
<td>Northwest Natural Gas Co. from That Hot Coffee Investments, Inc. and Byrl S. Coyle</td>
<td>Block 17, Couch's Addition; Lot 8 (West 24.9 feet)</td>
</tr>
<tr>
<td>1/11/1984</td>
<td>Pacific Square Corp. from Northwest Natural Gas Co.</td>
<td>Block 17, Couch's Addition; Lots 5, 6, 7, and 8</td>
</tr>
<tr>
<td>12/21/1984</td>
<td>Portland Chamber of Commerce from Pacific Square Corp.</td>
<td>Block 17, Couch's Addition; Lots 5, 6, 7, and 8</td>
</tr>
</tbody>
</table>
Block 24

NWN currently owns Block 24. NWN’s predecessor, Portland Gas Company, purchased Lot 1 of Block 24 in 1905, and in 1910, PGC purchased Lots 1, 4, 5, 8 and a portion of lot 3. Between 1955 and 1961, NWN or its predecessors purchased the remaining lots of Block 24.

<table>
<thead>
<tr>
<th>PURCHASE DATE</th>
<th>PURCHASER</th>
<th>PROPERTY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/31/1905</td>
<td>Portland Gas Co. from Security Savings Bank</td>
<td>Block 24, Couch's Addition; Lot 1</td>
</tr>
<tr>
<td>1/10/1910</td>
<td>Portland Gas &amp; Coke Co. from Portland Gas Light Co.</td>
<td>Block 24, Couch's Addition, Lots 1, 4, 5, 8, and a tiny portion of 3. (Glisan/Flanders/2nd Avenue.) This is a descriptive document and not a Legal Deed</td>
</tr>
<tr>
<td>10/25/1925</td>
<td>Portland Gas &amp; Coke Co. from Portland Realty Board</td>
<td>Block 24, Couch's Addition; Lots 4 and 5 and a tiny portion of Lot 3</td>
</tr>
<tr>
<td>3/9/1926</td>
<td>Portland Gas &amp; Coke Co. from Margaretta Marshall, Vidae Marshall, Margaretta Jones, Laurence Jones, Bessie Wilson, and George Wilson</td>
<td>Block 24, Couch's Addition; Lot 8 (all)</td>
</tr>
<tr>
<td>11/10/1955</td>
<td>Portland Trust Bank from Matthew J. Lynch, et ux.</td>
<td>Block 24, Couch's Addition; Lot 7 (1/2 half interest)</td>
</tr>
<tr>
<td>12/1/1955</td>
<td>Portland Gas &amp; Coke Co. from Portland Trust Bank</td>
<td>Block 24, Couch's Addition; Lot 7 Block 16, Couch's Addition; Lot 4 and south half of Lot 5</td>
</tr>
<tr>
<td>12/20/1955</td>
<td>Portland Gas &amp; Coke Co. from Portland Trust Bank</td>
<td>Block 24, Couch's Addition; Lot 7</td>
</tr>
<tr>
<td>4/18/1956</td>
<td>Portland Gas &amp; Coke Co. from Theodore and Betty Cherkezov</td>
<td>Block 24, Couch's Addition; North half of Lot 6</td>
</tr>
<tr>
<td>6/21/1956</td>
<td>Portland Gas &amp; Coke Co. from P. and Bessie Harowitz</td>
<td>Block 24, Couch's Addition; South half of Lot 6</td>
</tr>
<tr>
<td>5/29/1957</td>
<td>Portland Gas &amp; Coke Co. from Henry Henneman</td>
<td>Block 24, Couch's Addition, Lot 3</td>
</tr>
</tbody>
</table>
3.2 Historical Site Operational History

A combination of practically reviewable information, including historical documents and photographs provided by NWN, along with information obtained from publicly available federal, state and local regulatory record sources, Sanborn Fire Insurance Maps, and historical aerial photographs, was used to determine the prior uses of the Site and of the surrounding properties.

The following resources were reviewed in an effort to establish the history of the Site and surrounding Study Area:

- NW Natural’s Response to U.S. EPA CERCLA Section 104(e) Information Request (NWN 2008) prepared by NW Natural and provided to HAI and Anchor for review. The information presented in the 104(e) Response was obtained from NW Natural’s archives. HAI did not review the primary resources cited in the 104(e) Response.

- Historical photographs of the Site and surrounding area, provided to HAI from NWN archives. Historical photographs are included in Appendix A of this report.


- Oregon Department of Environmental Quality (DEQ) Northwest Regional Office, available regulatory file information for the Portland Gas Manufacturing Site (DEQ ECSI File Number 1138), and also for several surrounding DEQ regulatory sites.

- Sanborn Fire Insurance Maps (Sanborn maps) for the Site and surrounding area dated 1886, 1895 and 1926 were obtained from the Oregon Historical Society. Sanborn maps for the Site and surrounding area...
Historical Summary Report, Revised Final
Former Portland Gas Manufacturing Site
Portland, Oregon

area dated 1889, 1901, 1908, 1950 and 1969 were obtained from Environmental Database Resources, Inc. (EDR). Sanborn Maps are included in the Appendix C of this report.

- Aerial Photographs for the Site and surrounding area dated 1936, 1948, 1957, 1961, 1972, 1980, 1995 and 2004 were obtained from U.S. Army Corps of Engineers Central Map Files, Portland, Oregon. Aerial photographs are included as Figures 9, 10, 12, 13, 15, 16, 17, and 18 of this report.

The resources reviewed for this Historical Summary Report did not include site plans, maps, or aerial photographs of the Site or surrounding area prior to 1886. The descriptions of surface structures that were located on the Site prior to 1886 were derived from the 104(e) Response, and from historical drawings and photographs of the Site obtained from NWN archives. These descriptions pertained to Block 5 but not Block 6 or the surrounding area. In summary, information for structures located within the Site and surrounding area was not available for the years prior to 1886, with the exception of Block 5 structures.

3.2.1 Overview of Site Gas Manufacturing History

Based on the available historical information, the Site gas manufacturing facility (Gas Works) produced manufactured gas from 1860 through 1913. From 1859 through the early 1900s, the Site Gas Works comprised Blocks 5 and 6. During the early 1900s, it expanded to Block 23, and also included the northern portion of Blocks 7 and 15. From its inception in 1860 through the early 1900s, all of the known Site gas manufacturing processes were located on Block 5, with administrative offices and storage located on Block 6.

Gas purification processes were moved from Block 5 to Block 6 during the Gas Works expansion in the early 1900s. The 1900s expansion also included additional oil storage, gas holders, and secondary purifiers, variously located on Blocks 6, 7 and 23. However, all of the primary gas manufacturing operations remained on Block 5 during the entire history of the Site Gas Works as documented in the available resources. The following Sections provide a detailed description of historical facility layout and gas works operations through time at the Site, with time intervals selected to correlate with significant process or layout changes. Figures 3
through 18 depict the Site and surrounding area layout as made possible through available records.

The Portland Gas Works used three different gasification processes over time, each of which utilized a different raw material, or feedstock, to create gas. The feedstocks historically used at the Site Gas Works included coal, carbureted water (i.e. water enriched with oil), and oil. The gas manufacturing process involved heating the feedstock material in the absence of oxygen to drive off its volatile content as gas. The gas was then captured and cleansed of impurities before it was supplied to the end user.

Coal was used as the sole feedstock at the Site from 1860 through the mid-1890s, during all but the final decade of the Gas Works operations. During the mid-1890s, carbureted water gasification was implemented, which used a mixture of water and crude oil as the feedstock. During the early 1900s, following renovation and expansion of the Gas Works operations area, gasification of oil as the primary feedstock was implemented, with the carbureted water gas process retained for emergency needs only. Coal continued to be used onsite, but solely to fuel the boilers and generators that provided heat for the gasification processes.

Beginning in 1860, the Site Gas Works initially provided manufactured gas for lighting purposes, primarily for Portland street lights covering an area of less than one square mile. As the City of Portland grew in size, and as manufactured gas usage was expanded for heating and cooking purposes, Site gas production volume increased. The original Gas Works was designed to supply a maximum of 40,000 cubic feet of gas per day (NWN 2008). Early production figures for the 1860s through the 1880s were not available, but during the 1890s, the Site annual gas production ranged from approximately 60 to 75 million cubic feet. Average annual production from 1903 through 1906, during the expansion of the Gas Works and just prior to its conversion to oil gasification, was approximately 310 million cubic feet. In 1913, in its final year of operation, the Gas Works produced 1,641 million cubic feet of gas (gas production volumes were obtained from NWN archives as presented in the 104(e) Response and tabulated below).
## Annual Total Gas Production

<table>
<thead>
<tr>
<th>Year</th>
<th>Gas Generated MM. Cu. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1893</td>
<td>74</td>
</tr>
<tr>
<td>1894</td>
<td>66</td>
</tr>
<tr>
<td>1895</td>
<td>64</td>
</tr>
<tr>
<td>1896</td>
<td>60</td>
</tr>
<tr>
<td>1897</td>
<td>60</td>
</tr>
<tr>
<td>1898</td>
<td>65</td>
</tr>
<tr>
<td>1899</td>
<td>72</td>
</tr>
<tr>
<td>1900</td>
<td>83</td>
</tr>
<tr>
<td>1901</td>
<td>99</td>
</tr>
<tr>
<td>1902</td>
<td>127</td>
</tr>
<tr>
<td>1903</td>
<td>171</td>
</tr>
<tr>
<td>1904</td>
<td>245</td>
</tr>
<tr>
<td>1905</td>
<td>371</td>
</tr>
<tr>
<td>1906</td>
<td>450</td>
</tr>
<tr>
<td>1907</td>
<td>694</td>
</tr>
<tr>
<td>1908</td>
<td>858</td>
</tr>
<tr>
<td>1909</td>
<td>893</td>
</tr>
<tr>
<td>1910</td>
<td>1,078</td>
</tr>
<tr>
<td>1911</td>
<td>1,262</td>
</tr>
<tr>
<td>1912</td>
<td>1,470</td>
</tr>
<tr>
<td>1913</td>
<td>1,641</td>
</tr>
</tbody>
</table>

MM Cu. Ft. = Million Cubic Feet
3.2.2 Gas Manufacturing Processes and Typical Residuals

As stated above, three different gasification processes were used over the operating history of the PGM Site, with a differing feedstock for each process. The different processes included coal carbonization (1859 to 1894); carbureted water gas (1894-1906); and oil gas (1906 to 1913).

For coal gas manufacture, coal is typically heated in a retort in a process called carbonization. This process produces a combustible gas consisting predominantly of hydrogen and methane with a typical heating value of between 400 and 550 British Thermal Units (BTU)/cubic foot (EPA 1985). Residuals of the coal gasification process generally included coke, ash, coal tar, tar decanter sludge, ammonia, and gas purifier wastes.

For water gas manufacture, steam is typically passed through hot coke to create a gas consisting predominantly of hydrogen and carbon monoxide – with a typical heating value of roughly 300 BTU/cubic foot. For “carbureted water gas” such as generated at the Portland GMP (1894 to 1906), the water gas would be enriched by the addition of gas created from the cracking of oil. The mixture of the oil gas, with a typical heating value of 1,700 BTU/cubic foot, and the water gas would typically result in a gas similar to that generated by coal carbonization (EPA 1985). Residuals of the carbureted water gasification process generally included ash, coal tar, oil tar, tar/oil/water emulsions, and gas purifier wastes.

Oil gas was produced at the Portland GMP from 1907 to 1913. Oil gas is typically produced by the thermal cracking of oil that is conducted by spraying oil onto hot brickwork. Oil gas would have a typical heating value of roughly 1,000 BTU/cubic foot. Residuals of the oil gas manufacture generally consisted of ash, oil tar, lampblack, tar/oil/water and gas purifier wastes.

A Table providing a summary of process residuals typical to each of the gas production methods used at the Portland GMP is provided below. This information, obtained from the reference guide entitled Management of Manufactured Gas Plant Sites (GRI 1996), is provided for general background information, as records concerning the specific types, volumes, or type of on-site or off-site management of residuals generated at the PGM Site are not available. Further, specific residuals associated with any gas manufacturing plant will be a function of plant layout and differing feedstock...
characteristics. Finally, it is typical that certain residuals would be used on-site for fuel or sold or sent off-site for processing, while other residuals would be managed via on-site or off-site disposal practices and therefore the generation of a residual does not equate with the generation of a waste.

<table>
<thead>
<tr>
<th>Typical Process Residual</th>
<th>Coal Carbonization</th>
<th>Carburetted Water Gas</th>
<th>Oil Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal Tar</td>
<td>X</td>
<td>X</td>
<td>--</td>
</tr>
<tr>
<td>Oil Tar</td>
<td>--</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lampblack</td>
<td>--</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Tar/Oil/Water</td>
<td>--</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tar Decanter Sludge</td>
<td>X</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Ammonia Saturator</td>
<td>X</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Hydrocarbon Treatment</td>
<td>X</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Wastewater Treatment</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Coke</td>
<td>X</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Ash</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Spent Oxide or Lime</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sulfur Scrubber</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ammonium Sulfate</td>
<td>X</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

“X” means residual typically produced by the process. “X” (bold uppercase) means it was typically a predominant residual.

A brief description of the predominant residuals, as provided in the Handbook on Manufactured Gas Plant Sites (ERTI 1984) and Management of Manufactured Gas Plant Sites (GRI, 1996), follows:
Tar / Tar Sludges (coal or oil): A solid/semisolid, black pitchy material derived from residual heavy hydrocarbons in the coke or from tars that accumulated in the mains, decanter tanks, and through gas cleaning operations. Tar sludges contained a high solids content and tended to be heavy and stable.

Lampblack: A solid often granular material that formed by decomposition or gasification of oil constituents under reducing conditions. Lampblack would have been produced at the PGM Site from 1907 to 1913, and based on Sanborn maps, this material was stored in a covered building on the wharf.

Oil Sludges, Oil/Water Emulsions, and Liquors: Liquids formed during the cleaning of the gas, especially as excess steam/water vapor was condensed. During condensation, the hydrocarbon phases present could form emulsions which would be very difficult to break. If water content of the emulsions was sufficiently low, then they would often be used for fuel.

Ash, Clinkers, and Coke: Originated from ash in the coke or coal feed. Ash or coke breeze would be generated in various forms, from a fine dust to large clinkers. Coke would be used for fuel.

Spent Oxide or Lime: Spent lime and spent oxide (purifier box wastes) resulted from use of lime and iron oxide as solid reactants for removal of sulfur from product gas. Both lime and oxide materials could be regenerated numerous times, although they would ultimately become spent. In addition to removing sulfur, these materials would remove cyanide (typically complexed with iron) as well as hydrocarbons. These wastes were often wood shavings coated with iron oxide and the spent material would have a characteristic blue color (Prussian blue) from the ferric/ferrocyanide complexes.

Sulfur Scrubber Blowdown / Ammonium Sulfate Liquor: Aqueous residuals produced during gas cleanup. Ammonia liquor resulted from a water wash of the product gas while sulfur blowdown was generated through the use of a sodium carbonate solution to remove sulfur from the gas. These solutions would typically be processed in an on-site wastewater treatment system.
Data concerning the quantities of process residuals generated by the PGM Site over the course of its operational life were not identified through completion of an exhaustive records review as documented in the 104e response. However, research as reported in EPA (1985) has derived a “tar factor” of 730 gallons produced for every 1 million cubic feet of gas generated. This factor was derived from 1930 data by estimating the tar production rate as a function of gas production across the United States. The year 1930 was selected because of a reportedly robust by-product data set for plants across the United States that year (e.g., 40% of sites reporting tar generation and gas output). This “tar factor” does not account for variations in type or variation in feedstock, and therefore the actual tar production will be highly variable between sites and years and therefore only gives a relative order of magnitude indication of potential quantities produced and how those quantities may have changed through time with increased gas production (EPA 1985).

Applying the “tar factor” to PGM Site gas production figures results in a possible 54,000 gallons of tar produced at the PGM Site in 1893 (the earliest year that gas production figures are available) to approximately 1,200,000 gallons in 1913 (the last year of production). Again, these are not known actual volumes produced, but instead are hypothetical volumes, using the generic EPA “tar factor”. Further, the estimated volume of tar produced is a total volume and it does not assist in evaluating the volume that may have been used as fuel or sold as by-product versus the fraction that may have been disposed. The bulk of the tar production would have occurred in proximity to the retort and generator houses (Block 5), with settling occurring in the “tar well” (a collection sump – further described in Section 3.2.4). Tar and oil/water emulsions not otherwise used for fuel or sold as by-product would have likely been part of the PGM Site effluent stream, with possible discharge to the Willamette River as described above in Section 2.2.3. Lampblack residual generated during the timeframe of oil gas production (1907 to 1913) was stored in the former sheds located on the wharf (former coal sheds), with the lampblack reportedly being used to fuel PGM Site boilers.

Spent oxide is another residual that has a general production guideline figure that can be estimated based on gas production volumes. With this regard, GRI (1996) provides “typical” normalized production rates for spent oxide materials – with the understanding that the actual rate of production will be directly related to the sulphur content of the feedstock. GRI provides
an estimated range of 0.26 to 0.67 tons of spent oxide produced for every one million cubic feet of gas produced by coal carbonization; 0.07 to 0.20 tons for the same amount of gas produced by carburetted water; and 0.27 to 0.34 tons per every one million cubic feet of gas produced by oil. The preceding would result in an estimated 20 to 50 tons of spent oxide material produced in 1893 (coal carbonization); 5 to 20 tons of spent oxide material in 1900 (carbureted water); to between 450 and 600 tons of spent oxide materials produced in 1913 (oil gas). As with the tar estimates, the estimated volume of oxide materials produced is a total volume and it does not assist in evaluating the fraction that may have been sold as by-product versus the fraction that may have been disposed.

With regard to known areas of residual generation or storage, gas purification and gas purification material storage occurred on Block 5 through at least 1901 with the purifier house and adjacent lime and dry houses at the southeast corner of this Block, until approximately 1906 when gas purification operations were moved to Block 6, with ancillary purification on Block 23. As stated above, only relatively small amounts of spent oxide would have been generated each year and it is not known what the final disposition of these spent materials was. With the generation of lampblack residue coinciding with the start of oil gas production (1907), sheds on the wharf formerly used for coal storage were instead used for lampblack storage. A detailed description of PGM activities that occurred on the wharf is included in Section 3.2.5. Oils and tars would have been generated in proximity to the retorts and gas generator house on Block 5 and would have accumulated in the tar well located on this Block for periodic recovery of the material for use as fuel. All of these areas are described in further detail below.

The following Sections provide a detailed description of operations and facility layout during each of the three distinct operating periods as well as post-GMS operational uses of the property for the PGM Site based on available Sanborn Maps and photographs.

3.2.3 Coal Gasification Operations - 1859 to 1894

The founders of the Site gas manufacturing facility (Gas Works) acquired title to Blocks 5, 6, and the northern half of Block 7 in 1859 (NWN 2008). An 1857 artist rendition (Appendix A) of the “Portland Gas Works” depicted a brick building with a smokestack (the original retort house) and a wood-
framed shed (a coal storage shed) on Block 5. Additionally, a large aboveground storage tank (likely a gas holder) was depicted in the background. From 1860 through the mid-1890s, the Site Gas Works were located on Block 5, with administrative offices and coal storage located on Block 6 (Figures 3, 4, and 5).

A wharf that was constructed at the Site riverfront in approximately 1859 provided shipping access to the Site. The wharf extended along approximately 200 feet of Willamette riverfront between NW Everett Street and NW Flanders Street, adjacent to Block 5. Bulk coal, used both as feedstock and for fueling the retorts, was shipped to the Site from Vancouver Island, Canada. The coal was unloaded at the Block 5 wharf and carried by wheelbarrow to the storage sheds located on the wharf, or directly to the Gas Works retort house (NWN 2008, Figures 3-8).

The original 1860 Gas Works, located on Block 5, appears to have consisted of one retort house, equipped with six small retorts, and coal storage sheds located on the wharf (NWN 2008, 1857 Artist Rendition). Additionally, from 1860 through at least 1882, a gas holder was located to the south of the retort house (as depicted in the above-referenced 1857 artist’s rendition, and also in an 1882 photograph). Although the exact location of the gas holder could not be determined, it appeared to have been located on either the southern portion of Block 5 or the northern portion of Block 7. The 1886 Sanborn map does not indicate a gas holder location (Figure 3).

Administrative offices and a coal storage depot were located on Block 6, through the early 1900s (NWN 2008, Figures 3-6), and likely dated from the original 1860 construction.

The first recorded local use of gas for any purpose other than lighting was in 1868, when manufactured gas was used to keep the water hot in the boilers of Portland's horse-drawn steam fire engines (NW Natural website, www.nwnatural.com). From the 1850s through approximately the mid-1870s, the demand for manufactured gas increased steadily throughout the United States. During this time period, census records for Portland indicate that the population increased from 821 residents in 1850 to almost 3,000 in 1860, to just over 8,000 in 1870, and to more than 17,000 in 1880.

In 1872, a purifying house, exhauster, and meter room were constructed on the southern portion of Block 5 (NWN 2008). This expansion of the Site Gas Works was corroborated by an 1882 photograph of Block 5 (Appendix A),
which depicts a larger coal storage shed along with additional structures, as compared to the 1857 artist rendition. In addition to coal storage, the wharf storage sheds were also reportedly used for storing lime and iron oxide (i.e. materials that were used to remove impurities from the manufactured gas) (NWN2008) (Figures 3-6).

Unspecified additions to the Gas Works that were reportedly made in 1878 and 1883 (NWN 2008) may have included the construction of two additional sheds on Block 5, as depicted in the 1886 Sanborn map (Figure 3).

1886 and 1889 Sanborn Maps (Figures 3 and 4)
Block 5 was identified as the Portland Gas Works on the 1886 and 1889 Sanborn maps. The maps depict the above-described retort (boiler) house, coal sheds, purifying house and meter room, as well as an “iron building,” that appears to have been part of the same (1872) construction as the purifying house and meter room. The iron building likely was an iron oxide storage shed. The exhauster noted in NW Natural’s 104(e) Response (NWN 2008) in conjunction with the purifier building and meter room was not noted on the Sanborn Maps.

The central portion of Block 6 was identified as a “Gas Company coal shed” on the 1886 Sanborn map and as a “Coal and Coke Depot” on the 1889 map. The maps did not depict an associated structure. The northern and southern portions of Block 6 were developed with offices, a store, a saloon, and an “oil clothing” room. These Block 6 usages correspond to information contained in NW Natural’s archives (NWN 2008).

In 1892, the Site Gas Works (the Portland Gas Light Company) was merged with an east-side system (the East Portland Gas Company), to form the Portland Gas Company. A gas pipe was installed across the Willamette River to service east Portland from the Site, and the east-side plant was shut down and dismantled (NWN 2008).

With regard to waste products, the Gas Works (during the coal gasification period) would have likely generated coal tars, sludges, coke, and ash, as well as spent oxide (iron-impregnated wood chips) used to remove sulphides and cyanide from the gas stream. Plans and Sanborn maps do not indicate the method or location for storage or disposal of any such wastes during this timeframe. However, a newspaper article from October 1906 reports that tar and other waste from the Gas Works were discharged to the Willamette.
River during that time-frame, although no specific point of discharge was described (NWN 2008).

The October 1906 newspaper article is included herein as Appendix C. No historical photographs depicting site outfalls or other waste management practices have been identified.

### 3.2.4 Carbureted Water Gas Process - 1894 to 1906

In 1894, a flood temporarily shut down operations at the Site (see 1894 photograph, Appendix A). The Gas Works was subsequently reconstructed above the high water mark, still at Block 5. At the same time, the plant was modified to implement carbureted water gasification in addition to coal gasification processes (NWN 2008). Carbureted water gas processes used crude oil as a feedstock, and continued to use lime and iron oxide to remove impurities from the gas. As part of the carbureted water gas implementation, a crude oil aboveground storage tank (AST), and two water gas sets were installed on Block 5. Carbureted water gasification was implemented in 1897.

In addition to the original Retort House and Coal Storage Sheds, dating from the late 1850s, and the Purifying House, Meter Room, and Iron Building, dating from 1872, structures located on Block 5 as depicted on the 1895 Sanborn map included (Figure 5):

- a 5,000-barrel crude oil AST
- a second retort house (later converted for usage as a generator house)
- an “oil gas house”, equipped with generators, carburetors, and superheaters
- a generator
- scales
- a 15,000 cubic-foot relief gas holder
- a tar well

NW Natural has no information about the actual construction or use of the “tar well” at the Site. According to available literature, tar wells were subsurface collection and holding vessels that received tar and ammoniacal liquor overflows from distillation in the retorts and drippage from subsequent condensers. Gravity separation would occur within the tar well after which the tar well would be pumped out, with the pumpage generally used as fuel, routed for additional refining, or would be sold to others (e.g., tar refiners) as
product. According to the Handbook for Gas Engineers and Managers (Newbigging 1904), tar wells would be covered to keep surface waters out; were made of brick, cement, or steel; and ideally were sized such that they could contain at least 6 weeks of distillate and condensate products.

The only specific reference to tar wells that was identified within NW Natural archives (1909 Appraisal Report) indicated: “very little tar is formed in the crude oil water gas process and the tar wells at this works are small and of little importance”.

Several structures were located on the southern portion of the Block 5 wharf, in addition to the original coal storage sheds, located on its northern portion. These structures included:

- a coal hopper,
- a “lime house” (subsequently called the blacksmith oxide house)
- a “dry house” (previously called the iron house, and subsequently called the oxide drying house)

**1901 Sanborn Map (Figure 6)**

The 1901 Sanborn map depicts two additional structures at the Site as compared to the 1895 map, including a third retort house located in the Flanders Street right-of-way immediately adjacent and to the north of Block 5, and a shed located immediately to the east of the original 1860 retort house, also on Block 5. Other minor changes included changes to the notations that identified usages. The “oil gas house” on block 5 was identified as an “oil water gas house,” the generator was not identified, the relief gas holder was indicated to be 30,000 cubic feet in capacity rather than 15,000 cubic feet in capacity, the lime house was identified as a blacksmith oxide house, and the dry house was identified as pipe storage and oxide drying house.

Block 6 usage appeared to be essentially unchanged from 1886 and 1889.

With regard to waste products, the Gas Works (during the carbureted water gas period) would have likely generated coal and oil tars, tar/water/oil emulsions, sludges, and ash, as well as spent oxide. Plans and Sanborn maps do not indicate the method or location for storage or disposal of any such wastes during this timeframe with exception of the tar well on Block 5 (Figures 5 and 6) that would have likely been used to store/accumulate tar. A newspaper report from October 1906 did indicate prior discharge of tar.
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and other waste to the Willamette River from the Gas Works (Appendix C). No historical photographs depicting site outfalls or other waste management practices have been identified as part of this review. Known City outfalls, as described in Section 2.2.3 were present immediately north and south of Block 5 and 6 operations beneath NW Flanders (to the north) and NW Everett (to the south).

3.2.5 Site Expansion and Conversion to Oil Gas – 1906 to 1913

During the early 1900s, the Portland Gas Company acquired Block 23 and the northern half of Block 15, and the Site Gas Works operations were modified and expanded. Although the primary Site gas manufacturing processes (retorts and generator houses) always remained on Block 5, the gas purification processes were moved from Block 5 to Block 6 during this final renovation and expansion of the Site. The Site Gas Works conversion from carbureted water gas processes to oil gasification was completed in 1906, with a significant increase in gas production over its former capacity.

Block 5 Expansion

In 1903, two carbureted water gas machines were installed on Block 5, either in addition to, or as replacements for, the previously installed water gas sets. In 1905, a third carbureted water gas machine was installed. In 1906, two of these machines were converted for oil gas processes, and two additional oil gas machines were also installed. One of the 1903 carbureted water gas machines was retained onsite for emergency back-up usage. The 1908 Sanborn map further indicated that the 1872 purifier house was not in use at that time (Figure 7)

Additional changes on Block 5, as depicted on the 1908 Sanborn map, included the removal, installation, replacement and/or conversion of various earlier structures as summarized below:

- removal of the 15,000 cubic-foot relief gas holder
- discontinued usage of the 1872 purifier house
- installation of a small oil AST (capacity not indicated)
- installation of a pump house
- replacement of the coal hopper with an elevated hoist
- conversion of the wharf coal sheds to lampblack storage
- conversion of the original (1860) retort house to a blower room and boiler house
• conversion of the second (1872) retort house to usage as a generator house
• removal of the third (late 1890s) retort house, formerly located in the Flanders Street right-of-way
• conversion of the (1872) meter room to a compressor house
• conversion of the oxide house to a blacksmith and carpentry shop
• installation of a conveyor belt between the lampblack storage sheds and the boiler house/blower room (lampblack provided the fuel for the boilers)

Block 6 expansion
Primary purification processes were moved from Block 5 to Block 6 during the early 1900s. As depicted on the 1908 Sanborn map, and in a 1909 historical photograph (Appendix A), the entire block was used for Gas Works operations. The 1908 map depicts the following structures:

• a 120,000 cubic-foot gas holder
• a 2,000-barrel crude oil AST
• 4 purifiers
• 4 shaving scrubbers
• an exhaust house
• an office

The purifiers and shaving scrubbers were constructed and installed on Block 6 between 1903 and 1906 (1909 Appraisal Report). The purifiers contained iron oxide, and the scrubbers contained four layers of oxide shavings. A conveyor belt transferred iron oxide to Block 6 from storage sheds located on either Block 15 or Block 23. Information regarding the capacity (145,000 cubic feet) and date of construction (1899) of the gas holder, as listed in the 1909 Report, differed slightly from the Sanborn maps.

Expansion to Blocks 7, 15, and 23 during this timeframe included the following:

• A 15,000-barrel oil AST on the northeastern portion of Block 7 (see 1912 photograph, Appendix A)
• coal storage and a freight (distribution) house on Block 15
• a 1.5 million cubic-foot gas holder (Holder 3), two secondary purifiers, a meter room, a reheating plant, and a pipe shed on Block 23.

Historical photographs are included in Appendix A that depict many of the preceding features. Also, several photographs from 1909 through 1912
provide a partial view of the shoreline (eastern edge of the generator house). These photographs in conjunction with review of historic Sanborn maps were used to interpret the location of the historical (pre-seawall construction) shoreline (depicted on Figures 3 through 8).

**Block 15 Expansion**
The northern half of Block 15 was developed with a “coal storage” shed and a freight house. However, by 1909 the storage shed may have been used for storing iron oxide materials rather than coal based on information within the 1909 Appraisal Report.

**Block 23 Expansion**
In approximately 1905-1906, a 1.5 million cubic-foot gas storage holder (Holder 3) was constructed on Block 23, as were two secondary purifiers and a “new” meter house during the same time period. A shed with a concrete floor that was located on the block was initially used for storing coal, and later for storing iron oxide and for general storage (NWN 2008). The 1908 Sanborn map also depicted a generator, a pipe shed, and a reheating plant on Block 23, in addition to Holder 3, the purifiers and the meter room.

With regard to waste products, the Gas Works (during the oil gas period) would have likely generated oil tar, lampblack, tar/water/oil emulsions, sludges, and ash as well as spent oxide.

Lampblack was generated from the oil gas process only (the last approximately seven years of operations at the Portland Gas Manufacturing plant). Documents indicate that lampblack was initially discarded, although the location is unknown. Later, lampblack was stored in bins for use as boiler fuel. Lampblack was removed through separators, where process water containing lampblack was run through the separators. The lampblack would fall to the bottom bin. When a sufficient quantity had accumulated, the separator would shut off and the lampblack was shoveled out through a sliding door into troughs, which were carried by conveyor to bins in the boiler room. Excess lampblack was stored in the former coal storage shed on the Block 5 wharf (NWN 2008). In approximately 1911, PGC began producing lampblack briquettes.

Plans and Sanborn maps do not indicate the method or location for disposal of any gas plant wastes during this timeframe. An October 1906 newspaper story did indicate prior discharge of tar and other waste to the Willamette River from the Gas Works (Appendix C). No historical photographs
depicting site outfalls or other waste management practices have been identified. Known City outfalls, as described in Section 2.2.3 were present immediately north and south of Block 5 and 6 operations beneath NW Flanders (to the north) and NW Everett (to the south).

3.2.6 **Summary of Gas Works Activities Occurring on the Block 5 Wharf**

From the earliest artist rendition of the plant in 1857 (Appendix A), to the earliest available Sanborn Fire Insurance map in 1886 (Figure 3), as well as subsequent Sanborn maps (Figures 4 through 7) and Photographs (Appendix A), there is evidence that certain gas works activities were conducted on a pier supported wharf above the Willamette River throughout the operational history of the plant.

The estimated location of the wharf is depicted on Figures 3 through 8 and is based on both Sanborn map locational information, as well as historical photographs as included in Appendix A. The estimated wharf location – based on the 1908 Sanborn map depiction, is also depicted on the conceptualized cross-section included as Figure 20. The historical photographs were especially helpful in determining the upland extent of the wharf – something that was not easily interpreted directly from the Sanborn maps.

Over-water pier supported wharf gas works activities would have all taken place along the approximate 200 foot shoreline segment on the eastern portion of Block 5 where the wooden wharf was constructed, and are summarized below.

- The 1857 artist rendition (Appendix A) depicts a small wharf onto which coal was apparently unloaded from boats and placed in an uncovered pile. The figure depicts less than an estimated 100 cubic yards of coal that is being transported by one individual from the wharf to the adjacent gasworks by use of wheelbarrow.

- An 1882 photograph depicts a portion of the Block 5 wharf to the south from an adjacent ferry slip (Appendix A). The photograph appears to depict several men using horse-drawn containers of likely coal to load into the coal storage shed by use of a vertical bucket-type conveyor.
• The 1886, 1889, and 1895 Sanborn maps (Figures 3, 4, and 5) depicts coal storage and iron oxide (gas purification material) storage within buildings constructed on the Wharf. The 1895 Sanborn map (Figure 5) is similar to the preceding maps, except that a coal hopper is present. Additionally, by 1895 the iron oxide storage is referred to as the lime house, and a new structure (dry house) is present on the wharf. The dry house is apparently used for the drying out of oxide (gas purification) materials. Gas manufacturing processes changed from coal to carbureted water in 1894, so oil storage became necessary during that time-frame. It is unknown if oil arrived to the site by boat or by train, but no indication of oil storage on the wharf was evident from photos and available maps.

• By 1901, in addition to the wharf features/activities described above, a structure on the north end of the wharf (previously identified as “shed”, was instead indicated to be used for fire brick storage. And the former “lime house” is indicated to be a “blacksmith/oxide house”, while the oxide drying house was apparently also used for pipe storage in 1901.

• By 1908, after conversion to oil gas, the storage shed capacity on the wharf was increased (Figure 7) and changed from coal to lampblack, a solid carbon-like by-product generated during the oil gas process. The lime house and oxide drying house, formerly located on the southern end of the wharf adjacent to the off-wharf purifying house had been converted to a blacksmith and carpenter shop by 1908.

No documentation (plan, written, or photographs) were identified suggesting the location of waste discharges from the Gas Works to the river. The estimated / approximated location of the shoreline present at the time of PGM operations, relative to the existing seawall, is provided on figures referenced above (3 through 8). If direct discharge from the PGM operation to the river occurred at the former shoreline, then it would have been likely beneath the wharf along that line. If connected to the City sewer system (see Section 2.2.3), then discharge at a City of Portland combined sanitary / stormwater outfall formerly located immediately north or south of Block 5 at the end of NW Flanders or Everett Streets (1887 to 1928) may have occurred.
3.2.7 Site Gas Works Deconstruction and Redevelopment – Post 1913

The Site Gas Works operations were shut down in 1913, at which time gas manufacturing operations were consolidated at the GASCO Facility in Linniton (NWN 2008). This timing coincided with both technological development (e.g. seamless pipe welding) that promoted the centralization of manufacturing operations, and likely also with increased gas demands that exceeded the Site Gas Works capacity for production (1909 Appraisal Report).

The Site Gas Works structures were dismantled or demolished at various times between 1913 and 1960. Except for the absence of the oil AST previously located on Block 7, the 1926 Sanborn map depicts the Site essentially as it was in 1908.

Block 5
Demolition of the Block 5 structures began in 1918 (1918 historical photographs, Appendix A), but may not have been completed until after 1926 (1926 Sanborn map, Figure 8). A 1918 photograph (Appendix A) depicts the transfer (by barge) of a gas holder from the Site to the Linniton Gasco Site. The photograph similarly provides a good overview of the shoreline (appears to be north of Block 5) at this timeframe.

The City of Portland constructed the seawall along the Willamette River (eastern portion of Block 5) between 1928 and 1930, with fill having been placed behind the seawall to raise the ground surface elevation during construction. Fill was also reportedly placed on Block 5 prior to 1920 (E&E 1987). Block 5 was redeveloped with the existing roadways, and bridge access ramps during the 1940s. A 1949 photograph (Appendix A) shows construction activities related to the Steel Bridge on-ramp across Blocks 5 and 6 – with much reworking of the fill occurring. No obvious areas of discoloration are noted that would be indicative of potential large areas of impact. Since that time, Waterfront Park was developed along the Willamette River (beginning in 1974) and the roadways and access ramps were modified, however the usage of the block has remained essentially unchanged.

Block 6
Information regarding the fate of the Block 6 Gas Works structures (i.e. purifiers, scrubbers, gas holder, and crude oil tank) was not included in the available resources. Block 6 was reportedly used for pipe storage in at least
1940 (NWN 2008). The City of Portland acquired Blocks 5 and 6 during the 1940s, and by 1950 the construction of the existing roadways, and bridge access ramps had been completed. Since that time, Waterfront Park was developed along the Willamette River (beginning in 1974) and the roadways and access ramps were modified, however the usage of the block has remained essentially unchanged.

**Block 7**
Block 7 appears to have remained undeveloped after the removal of the Site Gas Works oil AST (date unknown, but likely after the 1913 shut down of operations) through at least 1926 (Sanborn maps, Figures 7 and 8). By 1936 it was developed with several structures that were noted on the 1950 Sanborn map to have been used for pipe cutting, threading and storage (1936 and 1948 aerial photographs, 1950 Sanborn map, Figures 9, 10, 11). In 1952, Broadway Cab Company acquired the block and developed it with an automotive fuel pump island, an auto repair shop, and a car wash. In 1985, the City of Portland purchased the block and the Broadway Cab Company structures were demolished. A petroleum release from underground storage tanks (USTs) was identified, the USTs were removed, and remediation activities were conducted. Additional investigation revealed soil contaminated with possible coal tar constituents. The investigation and remediation activities are described in further detail in Section 4.1 Site Regulatory History. The existing Old Town Parking Garage was constructed on Block 7 in 1989.

**Block 15, northern half**
The Site Gas Works freight house and storage shed remained on Block 15 through at least the early 1960s, and were used during at least the 1950s for pipe dipping and pipe storage. By 1969, the former Gas Works structures had been demolished (NWN 2008, Figures 13, 14, and 15), and the block was paved for use as a parking lot. The existing Port of Portland Administration building was constructed on the entire block in 2000.

**Block 23**
The Site Gas Works structures on Block 23 were used as a garage for NWN fleet vehicles from 1917 through at least the 1930s, and remained onsite through 1960 (NWN 2008, Appendix A). Historical photographs from 1919 and 1924 (Appendix A) depict an automotive fueling island and apparent underground tank at the northeastern portion of Block 23 (Figure 8). Additionally, during at least the 1930s, an auto repair shop was located on
the northeastern corner of the block, at the location of the former Gas Works meter room (1932 Sanborn map, obtained from the DEQ ECSI file for the PGM Site). The Block 23 gas holder was dismantled in 1960 (1960 photograph, Appendix A), and in 1961 the existing building was constructed by NW Natural for usage as administrative offices. NW Natural sold the property in 1983, and it is currently owned and occupied by ODOT.
4.0 REGULATORY HISTORY AND DOCUMENTED RELEASES

As a part of this Historical Site Assessment of the Site and surrounding area inquiries were made to governmental agencies with jurisdiction over current and prior activities conducted at the subject property that could have affected the environment. When available and as necessary, files on nearby properties were also reviewed and agency personnel knowledgeable about activities conducted in the Site and surrounding area were interviewed. The following federal and state databases were reviewed as part of this assessment:

- Federal National Priority List (NPL) and De-Listed NPL
- Federal Corrective Action Report (CORRACTS) List
- Federal Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) List
- Federal CERLIS No Further Remedial Action Planned (NFRAP) List
- Federal Resources Conservation and Recovery Act (RCRA) Treatment, Storage and Disposal (TSD) Facilities List
- Federal RCRA Handlers List
- Federal Emergency Response Notification System (ERNS) List
- Federal Brownfields Program Sites List
- Oregon DEQ Solid Waste Disposal Facilities (SWDF) List
- Oregon DEQ Environmental Cleanup Site Information (ECSI) List
- Oregon DEQ Leaking Underground Storage Tank (LUST) List
- Oregon DEQ Registered UST List
- Oregon DEQ Emergency Response Information System (ERIS) List
- Oregon Building Codes Division Drug Lab Cleanup Program List
- Oregon Engineering Controls List
- Oregon Institutional Controls List
- Oregon State Fire Marshal’s Hazardous Substance Information Survey (HSIS) List
- Indian Lands LUST List
- Indian Lands Registered UST List
- City of Portland Mayor’s Message and Annual Reports List

For databases organized by zip code, the 97209 zip code was reviewed. For databases organized by address, current addresses within the study area were reviewed. The address ranges were identified as 200 to 100 NW 1st Avenue, 200 to 400 NW 2nd Avenue, 200 to 400 NW 3rd Avenue, 0 to 100 NW Davis Avenue, 0 to 300 NW Everett Street, 0 to 300 NW Flanders
Street, 0 to 300 NW Glisan Street, NW Naito Parkway, Steel Bridge and NW Front Avenue. The lists reviewed by HAI were the most recent lists available.

Several sites (see Section 4.1) located within the Site and surrounding area were identified on the following lists:

- **Federal CERLIS No Further Remedial Action Planned (NFRAP) List**
  which lists all CERCLIS No Further Remedial Action Planned (NFRAP) sites, i.e. CERCLIS sites that have been removed from the CERCLIS List. Either contamination was not found, the contamination has been remediated, or the contamination has been deemed to not be significant enough to require consideration under CERCLIS or NPL. The listing of a site on the CERCLIS NFRAP does not necessarily imply that contamination has been deemed insignificant or remediated based upon Oregon DEQ standards.

- **Federal Resources Conservation and Recovery Act (RCRA) Handlers List**
  The EPA RCRA Handlers list identifies facilities which have given notification as hazardous waste generators, including Large Quantity Generators (LQG), Small Quantity Generators (SQG), or Conditionally Exempt Generators (CEGs).

- **Oregon DEQ Environmental Cleanup Site Information (ECSI) List**
  The DEQ Environmental Cleanup Site Information (ECSI) list includes hazardous substance sites undergoing DEQ investigations, along with DEQ Voluntary Cleanup Program (VCP) sites and State Brownfield sites.

- **Oregon Leaking Underground Storage Tank (LUST) List**

- **Oregon DEQ Registered Underground Storage Tank (UST) List**

- **Oregon DEQ Emergency Response Information System (ERIS) List**
  The Oregon ERIS list identifies reported releases of petroleum and/or hazardous materials to land or water since 1995.

- **Oregon State Fire Marshal’s Hazardous Substances Incidents (HSI) List**
  The Oregon State Fire Marshal’s Office HSI List identifies reports of
hazardous substance incidents in Oregon dating to 1986.

- City of Portland Mayor’s Message and Annual Reports
  This document contains the City Auditors List of Fuel Oil and Gasoline Storage Tank, Filling Stations, and Curb Pumps, covering the period from 1890 to 1927

In addition, several reports of subsurface investigations that have been conducted within the Site and surrounding area were obtained from the Bureau of Environmental Services (BES) and from NW Natural. These reports are discussed by location.

### 4.1 Site Regulatory Listings and Documented Releases

#### 4.1.1 Historic Soil and Groundwater Data

Soil and groundwater data from historic investigations are compiled in tables and the sample locations mapped on figures presented in this report. Within the tables the data are organized by media and parameter group, as listed below. For example, the soil VOC data are shown on Table 3 and the Groundwater VOC data are on Table 7. Soil data are on Tables 2 through 5 and groundwater data are on Tables 6 through 8. Within each table the data are organized by historic city blocks, as they are discussed in the text. The data provided in these tables and figures have not been validated as part of this reporting effort, but have simply been transcribed as they are found in the historic reports referenced herein.

For reference and quick screening purposes, the data summary tables include 2008 DEQ Risk-Based Concentrations (RBCs) for select soil and groundwater pathways. These RBCs have been included for general screening and comparison purposes and it is not implied that any or all of the RBC pathways indicated are appropriate for the posted data.

In addition to a summary of chemical testing results as described above, Table 1 has been modified to include visual descriptions and field screening evidence of potential impact as described in available boring logs for the Site and surrounding area, while the boring logs have all been compiled within Appendix D. At DEQ’s request this tabulation was prepared to compile and identify areas where potential PGM Site residues (e.g., tar, oil, lampblack, gas purification wastes) may have been placed or mixed into fill. PGM Site
residues, as described in Section 3.2.2, would include zones of tar, heavy oil, lampblack (black granular), and spent oxide/gas purification wastes (typically oily wood debris with prussian blue discoloration). Table 1 includes all screening evidence of impact, regardless of potential origin – so zones with odor, sheen, or discoloration are noted and an effort to attribute a source has not been completed.

As summarized in Table 1, field screening evidence of significant waste or residue disposal potentially related to the PGM operation were not identified in area borings. Oil saturation was identified at only a single location (boring B-3)– coincident with leaking USTs decommissioned from the former Broadway Cab site (Block 7). The type of oil saturation was not described. With regard to tar, other than a small piece of tar identified in the fill on Block 24, no visual indication of tar was described in any area soil boring. It is not clear what the origin of the tar fragment on Block 24 (boring B-8) is, but the lack of such observations at other borings on that block do not suggest the presence of PGM tar disposal in this area. Although wood debris was noted in boring logs summarized on Table 1 at numerous locations at many different blocks, nowhere was it identified along with other indicators of spent oxide material (typically wood shavings with petroleum odor or staining and Prussian blue discoloration).

Field screening evidence with the greatest potential to be attributable to historical PGM activities include borings installed proximate to Blocks 5 and 6 where zones of coal tar odor and black granular material (could be descriptive of coal or lampblack) were noted (borings JG-B1 through JG-B4). Otherwise, according to RETEC (1994), evidence of coal tar impact was identified during soil removal activities conducted on Block 7 related to the leaking gasoline UST / parking garage construction, although no coal tar impacts are readily discernable in any of the numerous soil borings constructed on the Block 7 property as summarized in Table 1 and included in Appendix D.

The historic sample locations identified are shown on the map on Figure 19. Smaller scale maps showing the sample locations in more detail are on the maps in Figures 21 through 28. Available data for indicator analytes (benzene, naphthalene, and total cyanide) in both soil and groundwater have been posted on Figures 29 through 31 (groundwater) and 32 through 44 (soil). Descriptions of specific investigations on Blocks surrounding the PGM Site are included in the following Sections. All references in this report to
regulatory significance of the analyte concentrations, including comparisons to RBCs, or exceedances of criteria, are not the result of screening the historic data during preparation of this report, but simply a reporting of information provided in historic reports by others.

4.1.2 Portland Gas Manufacturing Site, Blocks 5, 6, 7, 15, and 23

Portland Gas Manufacturing Site, NW 1st Avenue and Everett, Portland, Oregon, was identified on the following lists:

• Oregon DEQ Environmental Cleanup Site Information (ECSI) List
  ECSI Site #1138
• Federal CERLIS No Further Remedial Action Planned (NFRAP) List
• City of Portland Mayor’s Message and Annual Reports

The DEQ ECSI file for the former Portland Gas Manufacturing Site contained a Preliminary Assessment (PA) report for the former PGM Site, prepared by Ecology & Environment, Inc. (E&E) for the U. S. Environmental Protection Agency (EPA) in May 1987 (E&E 1987). According to the report, the former PGM Site consisted of four city blocks: Blocks 5, 6, 15 and 23. Information regarding the former PGM Site waste disposal methods was not identified during the course of the PA. Sampling was not performed. Based upon the nature of typical gas manufacturing waste materials, E&E reasoned that any such wastes that may have been historically disposed on site or in the river would likely have stabilized or degraded. Based on these assumptions, E&E concluded that any remaining gas manufacturing wastes were not anticipated to pose a threat to human health or the environment, and recommended No Further Action. However, E&E also recommended that future excavation or construction activities in the area be monitored for the presence of typical gas manufacturing waste materials.


The DEQ ECSI file also contained a memo entitled DEQ Site Assessment Program-Strategy Recommendation, Portland Gas Manufacturing Site, dated December 7, 2000 and prepared by Mr. Steve Fortuna of DEQ. The purpose of the memo was to re-evaluate the priority for conducting an Expanded Preliminary Assessment (XPA) of the site, in light of revised guidance documentation and evidence of threatened species of Chum, Chinook Salmon and Steelhead located in the Willamette River basin. According to the memo, in 1992 DEQ assigned the site a low priority for additional investigation at the site, based on the expected low mobilization of
coal tar. The 2000 memo revised the priority rank from low to high priority, and recommended that further investigation should include sampling and analysis of subsurface soil, groundwater, and river sediments for chemicals commonly associated with manufactured gas operations, including coal and oil tars, process wastewater, and spent iron oxide. The memo identified chemicals of concern associated with these wastes, including petroleum hydrocarbons such as tars, oils, creosote, as well as phenols, methylphenols, PAHs, volatile organic compounds (VOCs) semi-VOCs, benzene, toluene, ethylbenzene and total xylenes (BTEX), metals and cyanide.

There was no additional information on file with the DEQ for this site.

The PGM Site was also identified on the CERCLIS NFRAP List. The listing for the Portland Gas Manufacturing Site was related to the EPA's 1987 NFA determination, as summarized above.

Several sites with addresses that may have been historically associated with the Site blocks appeared in the City of Portland Mayor's Message and Annual Reports. However, the available information was not sufficient to identify the location or type of fuel oil tanks or gasoline filling pumps that may have been associated with these historical addresses.
4.1.3 North Waterfront Park, Blocks 4, 5 and 21

North Waterfront Park, NW Front Avenue, Portland, Oregon, the eastern portion of the Site, was identified on the following list:

- Oregon DEQ Environmental Cleanup Site Information (ECSI) List
  ECSI Site #876

According to information contained in the DEQ ECSI file for North Waterfront Park, in 1989 Sweet Edwards/EMCON, Inc. conducted a subsurface investigation along the Willamette River and the eastern portions of the former PGM Site (Blocks 4, 5 and 21) for the Portland Development Commission as part of an environmental audit (Emcon 1989). The audit was performed to evaluate potential impact from historical PGM Site operations, and also from historical automotive gasoline fueling, auto repair and car washing activities at Block 7 (Broadway Cab Company, ECSI Site #383, detailed below). As part of the 1989 subsurface investigation, six soil borings and four hand auger locations were advanced along the waterfront park between NW Burnside Street and NW Flanders Street. Three of the soil borings (BH-4, BH-5, and BH-6) were advanced along the historical city Blocks 4, 5 and 21. In addition, one soil boring (BH-3) was advanced just south of Block 4. The six soil borings were also completed as monitoring wells to depths of 31.5 feet below ground surface (bgs). Soil and groundwater samples were collected and analyzed for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, xylene (BTEX). Soil samples were also analyzed for total organic halogens. Laboratory analytical data were not available for this report, however, chemicals of interest were not detected in the samples that were analyzed, with the exception of samples collected from Block 21 (boring BH-6). Heavy oil range petroleum hydrocarbons (“characteristic of coal tar” according to the laboratory, and low levels of BTEX constituents were detected in both soil and groundwater at Block 21 (Figures 29 and 36). Boring logs describing these soils were not available, but the text of the report does not refer to field indications of heavily impacted soils within any boring. The report concluded that the elevated concentrations of benzene detected in groundwater (11 ppb) should be reported to DEQ.

A memo entitled DEQ Site Assessment Section – Strategy Recommendation for the North Waterfront Park, dated July 14, 1992 was prepared by Kevin Dana and Loretta Pickerell of DEQ. According to the memo, additional
subsurface investigations were warranted in order to evaluate the extent of contamination, the potential for migration, and the potential for the contamination to pose a threat to human health or the environment. Additional information for this site was not on file at DEQ.

4.1.4 Westside CSO Construction, NW Front Avenue

Willamette River Westside CSO Construction, SW Taylors Ferry Road to NW Front Avenue, Portland, Oregon, was identified on the following list:

- Oregon DEQ Environmental Cleanup Site Information (ECSI) List
  ECSI Site #3172

In preparation for the City of Portland sewer upgrade project (Westside CSO Tunnel), a sampling plan was prepared in order to characterize subsurface conditions along the planned sewer alignment – including NW Front Avenue in the vicinity of the former PGM Site operations. On November 29, 2001, CH2M Hill, in conjunction with Parsons Brinckerhoff, completed a report entitled *Westside CSO Tunnel, Steel Bridge and Former Glisan Street Access Shaft Area, Soil and Groundwater Analysis, Portland, Oregon* for the City of Portland Bureau of Environmental Services (BES) (CH2M Hill 2001). As part of the investigation, four geotechnical borings were advanced between former Blocks 5 and 6, and to the east of Block 23 of the former PGM Site. A fifth boring was advanced to the north of Block 21. Samples were collected and analyzed for metals arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver and zinc, total cyanide, Toxicity Characteristic Leaching Procedure (TCLP) lead, total petroleum hydrocarbons (TPH), polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs). Of the metals, only arsenic concentrations in soil exceeded DEQ Residential and Occupational Risk Based Concentrations (RBCs), but were consistent with naturally occurring background. Levels of PAH constituents benzo(a)anthracene, chrysene and naphthalene were detected in soil above the Residential cleanup goal in one sample collected at 5 feet bgs from the boring located to the east of Block 23. PAH constituents were also detected in the former Block 6 area borings at depths of up to 27 feet bgs (fill), but at concentrations below the RBC risk screening levels. The complete laboratory report was unavailable at the time this report was prepared, and the data were therefore not summarized in tables.
In 2002, Century West Engineering Corporation (Century West) conducted additional subsurface investigations (Century West 2002). Seventeen (17) soil borings were advanced along NW Naito Parkway in four focus areas located within or nearby and up-gradient for the former PGM Site. These areas were designated Areas B, C, D and E. In general, the borings were advanced to depths of 75 feet bgs. Boring logs indicate the presence of fill material containing wood waste and demolition debris was encountered from the ground surface to depths of up to approximately 25 feet bgs, with uppermost groundwater identified at approximately 20 feet bgs. Soil and groundwater samples were collected and analyzed for TPH, PCBs, PAHs, VOCs and lead, with analytical results compared to Region 9 Preliminary Remediation Goals (PRGs).

**Area B: Everett Ramp (Blocks 5 and 6)**

Four borings (JG-B1 through JG-B4) were advanced to depths of up to 75 feet bgs in the Block 5 and 6 area (Figures 19 & 20). Fill material was encountered to depths of 17 feet bgs. Soil samples were collected from depths of 5, 8, 10, 14, 15, 20, 25, 30, 40, 50, 60, and 70 feet bgs. Native soil was described as silt, silt-clay and fine silty-sand. Soil samples collected from fill in all four borings contained black granular material with either a “coal tar like” odor (JG-B2 and JG-B4), or with black discoloration or granular material (JG-B1, JG-B3, and JG-B4). No visual indication of tar or non-aqueous phase liquid (e.g., oil or gasoline) were observed in any boring (Table 1). Soil samples collected from borings JG-B2 and JG-B4 were analyzed at a laboratory. Concentrations of motor oil, diesel, gasoline, and/or fuel oil No.6-range petroleum hydrocarbons were detected in shallow soils samples (within the fill) collected from these borings (below RBCs). Lead (10 feet bgs at JG-B2), arsenic, and PAHs were detected in soil samples (multiple depths) at concentrations above RBCs within fill at these two boring locations. The greatest total cyanide concentration identified in soil was 11.2 ppm at 15 feet bgs at the JG-B4 location. The identified cyanide concentrations in soil were all well below RBCs. The identified arsenic concentrations were consistent with background levels. With regard to groundwater, 3,000 ppb total cyanide was identified at the JG-B4 location, exceeding DEQ RBCs established for drinking water. Otherwise, of the SVOCS, only fluorene (0.47 ppb), naphthalene (0.39 ppb), and phenanthrene (0.13ppb) were detected in the shallow groundwater sample at this location (boring JG-B4). No VOCs were identified in the groundwater samples collected from the JG-B4 location.
Area C (Blocks 21/23)
Three borings were advanced to depths of up to 75 feet bgs at the northwestern corner of Block 21 (Figure 19). Soil samples were collected from depths of 5, 10, 20, 30, 40, 50, 60, and 70 feet bgs. Fill material was interpreted to extend to depths of up to 18 feet bgs in these borings. A thin layer of black granular material was observed in one boring (JG-C1), below several layers of silt and wood debris. No visual indication of tar or non-aqueous phase liquid (e.g., oil or gasoline) were observed in any of the JG-C series borings (Table 1). Groundwater samples were collected at 70 feet bgs in boring JG-C1 within Area C (arsenic and lead were detected above drinking water RBCs in both the shallow and deeper groundwater samples collected in Area C). These were groundwater grab samples, and it is not known if the samples were field filtered. If the samples were unfiltered, that could have caused a high bias to metals concentrations. However, arsenic concentrations in both soil and groundwater were reportedly consistent with naturally-occurring background levels. No VOCs, SVOCs, or total cyanide were identified at concentrations greater than RBCs in the 75 foot water sample at JG-C1.

Area D (North of Blocks 21/23)
One boring (JG-D1) was advanced to a depth of 75 feet bgs to the north-northwest of Block 21, along the southern side of NW Glisan Street (Figure 19). Soil samples were collected from depths of 5, 10, 20, 30, 40, 50, 60, and 70 feet bgs. Fill material was encountered to depths of 22 feet bgs. No visual indication of tar or non-aqueous phase liquid (e.g., oil or gasoline) were observed in this boring (Table 1). Oil-range hydrocarbons and certain PAHs were detected above PRGs in shallow soil samples (fill) collected from this boring only. Groundwater samples were collected from depths of 25 feet bgs and 70 feet bgs. Arsenic was detected in soil and groundwater above the most conservative PRGs, but below naturally-occurring background concentration. No other contaminants of interest were reportedly identified in groundwater at this location. Area D laboratory reports were unavailable at the time this report was prepared and are not shown in summary data Tables 2-8.

Area E (North of Blocks 21/23)
One boring (JG-E1) was advanced to 75 feet bgs to the north-northwest of Block 21 and on the northern side of NW Glisan Street (Figure 19). Soil samples were collected from depths of 5, 10, 20, 30, 40, 50, 60, and 70 feet bgs. Fill material was encountered to depths of up to 22 feet bgs. No visual
indication of tar or non-aqueous phase liquid (e.g., oil or gasoline) were observed in this boring (Table 1), although the 5 foot soil sample reportedly had a “diesel odor”. PAHs at concentrations greater than RBCs were identified in the 5 foot, 20 foot, and 40 foot soil sample at this location. Groundwater samples were collected from depths of 25 feet bgs and 70 feet bgs. No VOCs or SVOCs were identified in groundwater at concentrations greater than RBCs within either depth interval. Arsenic was detected in soil and groundwater above the RBCs but below naturally-occurring background concentrations. Cyanide was detected at a concentration of 11 ppb in the deep ground water sample, while no detectable level of cyanide was identified within the fill at this location.

There was no additional information on file at DEQ or with the City of Portland, Bureau of Environmental Services (BES) for the site.

4.1.5 Broadway Cab Company, Block 7

Broadway Cab Company/Old Town Parking/Heliport Structure, 33 NW Davis Street, Portland, Oregon, Block 7 of the Site, was identified on the following lists:

- Oregon DEQ Environmental Cleanup Site Information (ECSI) List
  ECSI Site #383
- Oregon Leaking Underground Storage Tank (LUST) List
  UST Facility #2406

According to information obtained from the DEQ ECSI file for this site and from NWN’s 104(e) Response, the Broadway Cab Company occupied all of Block 7 from at least 1952 to 1985, and Shell Oil Company also occupied an unspecified portion of the Block at some time (information regarding dates or location of tenancy was not included in the file). The Broadway Cab Company services included gasoline fueling, auto repair, and car washing. Two 10,000-gallon gasoline USTs and one 5,000-gallon gasoline UST were decommissioned in place on March 4, 1983, and in 1986 a 375-gallon waste oil UST was also decommissioned in-place.

In 1987, a subsurface investigation was conducted by Geotechnical Resources, Inc., in conjunction with the redevelopment of the site with the existing Old Town garage and heliport. During excavation for redevelopment, soils reportedly containing coal tars were discovered (NWN 2008). Contaminated soils were identified and excavated. The previously
decommissioned USTs were removed, along with approximately 7,800 cubic yards of petroleum-contaminated soil. No documentation or detailed description concerning the specific type of “coal tar impacts” were identified in any available report or correspondence. Further, documentation of the precise area of the 7,800 cubic yards of soil removal could not be identified in DEQ or City of Portland (Portland Development Commission and Bureau of Environmental Services) project files. Boring logs for borings constructed on Block 7 (Table 1 and Appendix D) do not identify the presence of any zones of tar or oil – although numerous zones of “chemical/petroleum odor” are noted.

Gasoline (BTEX) –impacted soils were left in-place subsequent to the decommissioning and soil removal identified above. Six borings were installed across the block, and were advanced to depths ranging from 27.5 feet bgs to 97.5 feet bgs (Figure 21). The borings were subsequently developed as monitoring wells. Strong to moderate “chemical odors” were generally encountered at depths from 12 feet bgs to 32 feet bgs. Groundwater was encountered at approximately 16 feet bgs to 22 feet bgs, and was determined to flow toward the Willamette River to the east. Fill material was generally encountered to depths of up to approximately 20 feet bgs, with native silt and sandy-gravel material underlying the fill.

Laboratory analysis of soil and groundwater identified the presence of BTEX in both soil and groundwater (Figures 29 and 33). With regard to soil, BTEX concentrations ranged from 0.1 to 138 mg/kg for benzene; from non-detect to 134 mg/kg for toluene; from 0.7 to 86 mg/kg for ethylbenzene; and from non-detect to 194 mg/kg for xylenes (Table 3). With regard to groundwater, BTEX was detected at concentrations ranging from 9,700 to 18,200 micrograms per liter (µg/L) for benzene – with the greatest concentration proximate to the former gasoline UST location (e.g., B-3 area); from 8,140 to 27,670 µg/L for toluene; from 2,040 to 5,000 µg/L for ethylbenzene; and from 6,660 to 13,620 µg/L for xylenes (Table 7). All of the detected BTEX concentrations exceeded DEQ Residential Risk Based Concentration (RBC) for tap water. In addition, benzene concentrations in groundwater exceeded the Residential and Occupational RBC for Vapor Intrusion into Buildings. Certain PAHs were present in soil at concentrations greater than RBCs at several boring locations. Due to the depth of contaminated media and depth to groundwater (approximately 16 feet bgs), excavation of additional impacted soil was not practical. Alternative remedial actions implemented included the installation of a vapor barrier and an active soil vapor venting
system. The soil venting system consisted of pipes, installed to approximately 10 feet bgf, and fans. The fan exhaust was proposed to be monitored on a quarterly basis. Quarterly monitoring results were not contained within the DEQ files.

On March 22, 1990, a Consent Order to evaluate the nature and extent of subsurface hazards at the site was signed by the City of Portland Bureau of Environmental Services (BES) and the DEQ.

In July 1994, Remediation Technologies, Inc., completed a risk assessment at the site (RETEC 1994) in order to evaluate the potential risks to human health and the environment if no further remedial action was taken. The site structure housed ground-floor retail below the multi-level parking garage at the time of the Risk Assessment. Chemicals of concern included VOCs and metals associated with the historical use of the site by the PGM Site, and by the Broadway Cab and Shell Oil Companies from the 1950s through approximately 1985 (Tables 1, 2 & 3; Figure 21). The results of the Risk Assessment indicated that chemicals of concern on the site did not pose a significant threat to human or environmental health, with the exception of potential ingestion of groundwater for residential use. However, the report noted that the site and surrounding area were served by the municipal water supply, that the City of Portland had no future plans to ever use the site groundwater as a drinking water source, and that the likelihood of groundwater ingestion was unrealistic.

There was no additional information on file for this site.

**The Broadway Cab Cooperative Inc.** (UST Facility #2406), at 234 NW 1st Avenue, Portland, Oregon, also appeared on the DEQ Registered UST List with three decommissioned USTs. These USTs correspond to the three gasoline USTs that were removed from the property in 1987, as described above. The 375-gallon waste oil UST that was decommissioned in place was not required to be registered with DEQ, and did not appear on the list.

### 4.1.6 Port of Portland Administration Building, Block 15

**Port of Portland Administration Building**, 121 NW Everett Street, Portland, Oregon, Block 15 of the Site, was identified on the following lists:

- Federal Resources Conservation and Recovery Act (RCRA) Handlers List, RCRA ID ORQ000015115
• Oregon DEQ Emergency Response Information System (ERIS) List
• Oregon State Fire Marshal’s Hazardous Substances Incidents (HSI) List
• Additionally, several Previous Environmental Site Assessments were conducted for the Block 15 property, and are summarized below

The Port of Portland Administration Building at 121 NW Everett Street, Portland, Oregon, was identified as a Conditionally Exempt Generator (CEG). A CEG is defined as generating 100 kilograms (kg) or less of hazardous waste per calendar month, and accumulating 1000 kg or less of hazardous waste at any time; or generating one kg or less of acutely hazardous waste per calendar month, and accumulating at any time1 kg or less of acutely hazardous waste. According to the DEQ Facility Profiler listing, the DEQ Hazardous Waste (HW) Site Report, and the EPA ECHO database for the site, the Port of Portland Administration Building has been registered as a CEG since 2000, with no reported waste streams and no violations on file.

This Site also appeared on the Oregon State Fire Marshal’s HSI List and the Oregon ERIS List. According to the HSI report, in July 1999, approximately 115 gallons of diesel fuel were released from a transport truck at NW Flanders Street, adjacent and to the north of Block 15. According to the report, the truck fuel tank was punctured as the driver backed up over a curb. As reported by the onsite Oregon State Fire Emergency Response personnel, some fuel drained into a nearby sanitary sewer drain before it was contained. However, the release reportedly did not impact the Willamette River. The Oregon ERIS also listed this release, however, it did not provide additional information.

Previous Environmental Site Assessments
In 1997 Phase I and Phase II Environmental Site Assessments (ESAs) were conducted at Block 15 by HAI for NWN (HAI 1997a and HAI 1997b). The 1997 Phase I and II ESAs were performed for the entire block, which was covered with an asphalt-paved parking lot at that time. The Phase II ESA was conducted in order to determine the presence or absence of a suspected former UST, as depicted on a historical map, and to evaluate the baseline environmental condition of the property. HAI conducted a geophysical survey as part of the Phase II subsurface investigation of the block. The geophysical survey was conducted in the vicinity of the suspected tank and also for the entire block. USTs were not identified by the geophysical survey.
The baseline investigation involved installation of seven (7) soil borings across the property, advanced to between 20 and 40 feet bgs (Figure 22). Zones of perched groundwater were encountered at 4 feet bgs and 20 feet bgs. Fill material was encountered at depths extending to between an estimated 8 to 20 feet bgs. Pockets of petroleum-contaminated soil, above DEQ Level 2 Soil Cleanup Standard, were detected in two locations, at depths ranging from 0.5 feet bgs to 6 feet bgs (Table 2). Petroleum impacts were not detected in deeper soils. Petroleum contamination was not detected in the vicinity of the suspected former UST. Based on the apparently limited and isolated areas of impact within the surficial fill material, along with the fact that the site was capped with asphalt pavement, HAI did not recommend further investigation or cleanup activities at that time. Instead, HAI recommended that in the event of future site redevelopment, site soils should be appropriately managed and disposed.

In October 1997, Hart Crowser Associates, Inc. prepared a Site Characterization Report of the Block 15 property for the Port of Portland (HSA 1997). Hart Crowser advanced ten (10) soil borings to depths of 32 feet bgs at the site. Soil and groundwater samples were collected and selectively analyzed for TPH-Dx, metals, PAHs and VOCs (Tables 2 through 8; Figure 22). Fill material was generally encountered in borings to depths of up to 20 feet bgs, and uppermost groundwater was encountered at approximately the same depth. Heavy oil range hydrocarbons were detected in eight of the 10 soils samples, with concentrations ranging from 77 to 3,900 mg/kg. Concentrations of lead, mercury and zinc were detected in soil above the reported background concentrations for the area. PAHs were also detected, with carcinogenic PAH concentrations ranging from 0.1 to 23 mg/kg (Table 2). Metals and PAHs were detected in all groundwater samples. PAHs generally exceeded drinking water-based screening levels. Metals were below drinking water-based screening levels with the exception of lead (up to 0.20 mg/L) and chromium (up to 0.13 mg/L) which exceeded the screening levels of 0.015 and 0.1 mg/L, respectively (Table 5). VOCs were not detected in soil or groundwater, with the exception of low levels of naphthalene in soil (0.501 mg/kg to 1.19 mg/kg) and acetone in groundwater, in one location only at a concentration of 0.0441 mg/L (Tables 2 & 6). Recommendations were not made in the report.

As summarized in Table 1, several zones containing coal fragments or petroleum odor were noted in boring logs. Numerous zones containing
wood debris were identified, as is typical for the fill in the area. Wood debris can be an indication of spent oxide material – although wood fragments associated with spent oxide will also tend to contain indications of petroleum impact as well as a prussian blue discoloration – none of which was observed.

In summary, concentrations of TPH-Dx, certain metals (lead, mercury, zinc), and PAHs exceeding screening level values were identified in soil and groundwater at this site. Currently, the site is entirely covered by Port of Portland building and the associated paved parking lot.

4.2 Surrounding Area Regulatory History and Documented Releases

4.2.1 Block 14 – One Pac Square

One Pac Square, 220 NW 2nd Avenue, Portland, Oregon, Block 14 of the surrounding area, was identified on the following lists:

- Federal Resources Conservation and Recovery Act (RCRA) Handlers List, RCRA ID OR0000202788
- Oregon DEQ Underground Storage Tank (UST) List
  UST Facility #1531
- Oregon State Fire Marshal’s Hazardous Substance Information Survey (HSIS) List
- City of Portland Mayor’s Message and Annual Reports

Northwest Natural Gas Company, One Pac Square, 220 NW 2nd Avenue, Portland, Oregon, was identified as a CEG (defined as generating 100 kilograms (kg) or less of hazardous waste per calendar month, and accumulating 1000 kg or less of hazardous waste at any time; or generating one kg or less of acutely hazardous waste per calendar month, and accumulating at any time1 kg or less of acutely hazardous waste) from 1994 to 2000. According to the DEQ HW Site Report and the EPA ECHO Database, this site is currently identified as inactive. No violations were on file for the site.

Northwest Natural Building Garage, located at NW 1st Avenue and NW Everett Street, Portland, Oregon appeared on the DEQ Registered UST List with one decommissioned UST. According to Mr. Steve Paiko of the DEQ UST Division, a 250-gallon used oil UST had been scheduled to be decommissioned in March 1988. The file for the facility did not contain
documentation of decommissioning or any additional information regarding the UST.

**Northwest Natural Gas Company**, 220 NW 2nd Avenue, Portland Oregon also appeared on the *Oregon State Fire Marshal's HSIS List*. According to the Oregon State Fire Marshal’s Community Right-to-Know database, an AST containing 1,000 to 4,999 gallons of Gas Odorant was located on the site. In addition, 200 to 499 cubic feet of High Meth Calibration Gas were contained inside cylinders on the property.

Additionally, the City of Portland *Mayor’s Message and Annual Reports* identified a gasoline filling pump that was historically located at 236 Everett Street, between 1st Street and 2nd Street. Nicolai-Neppach Company, the historical owner of Block 14, was identified as the owner of the pump. Additional information regarding this gasoline filling pump was not available.

### 4.2.2 Block 16 – Portland Chinese Garden, NW Natural

**Portland Classical Chinese Garden**, 220 NW 2nd Avenue, Portland, Oregon, Block 16 of the surrounding area, was identified on the following lists:

- *Oregon Leaking Underground Storage Tank (LUST) List*
  LUST Log #26-95-0058 and LUST Log #26-91-0280
- *Oregon DEQ Registered Underground Storage Tank (UST) List*
  UST Facility #10781
- City of Portland *Mayor’s Message and Annual Reports*

Two USTs, including a 10,000-gallon gasoline UST and a 750-gallon waste oil UST, were formerly located on Block 16. The USTs have been removed from the site. Releases from the USTs were investigated and were conferred DEQ NFA status, as discussed below:

**Northwest Natural** (LUST Log #26-95-0058), 311 NW 2nd Avenue, Portland, Oregon. The DEQ LUST file for this site pertained to a 10,000-gallon gasoline UST that was removed from the northeastern side of the property in 1994. Confirmation soil samples revealed the presence of gasoline-range and diesel-range petroleum hydrocarbons at concentrations below the Residential RBCs for soil. Subsurface investigations were conducted at this site in 1995 and 1996 by HAI for NW Natural (HAI 1995 and HAI 1996).
The 1995 investigation did not reveal the presence of petroleum hydrocarbons above laboratory method detection limits in soil or groundwater. During the 1996 investigation, groundwater was not encountered to depths of 20 feet bgs. Laboratory analysis of soil samples did not reveal the presence of total petroleum hydrocarbons above method detection limits. BTEX compounds were detected above method detection limits, but below the DEQ RBC values for remediation of petroleum-contaminated sites. On April 28, 2003, the DEQ conferred NFA status for the 10,000-gallon gasoline UST release.

**Northwest Natural** (LUST Log #26-91-0280), 312 NW 2nd Avenue, Portland, Oregon. The DEQ LUST file for this site pertained to a 750-gallon waste oil UST that was removed from the west side of the property in 1991 by Pegasus Environmental Management Services, Inc. Confirmatory soil sampling from the UST pit indicated the presence of diesel-range petroleum hydrocarbons. Analytical results for the worst case soil sample of waste oil constituents (volatile organic compounds, PCBs, and leachable metals) did not identify any concentrations exceeding the most conservative generic Risk-Based Concentrations (RBCs) that were then in effect. Gasoline-range petroleum hydrocarbons were not detected above laboratory method detection levels. The pit was over-excavated to the point at which removal of additional soil could compromise the integrity of the adjacent NW Third Avenue, and contaminated soil was disposed (Pegasus 1991).

At the request of DEQ, subsurface investigation activities related to the former waste oil tank were conducted by HAI during December 2002 and January 2003 (HAI 2003). Analytical testing of soil samples indicated the presence of gasoline- and diesel-type petroleum hydrocarbons (similar to mineral spirits) in subsurface soils in the vicinity of the former waste oil UST (Table 2). Contaminant delineation activities suggested the presence of approximately 600 cubic yards of petroleum-impacted soils at depths between 8 and 27 feet bgs in the vicinity of the former tank. Naphthalene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene were found in soil and groundwater at concentrations exceeding the most stringent DEQ risk-screening criteria). A site-specific risk evaluation concluded that there is not a current or reasonably likely future unacceptable risk to human health or the environment resulting from residual petroleum impacts to soil and groundwater at the property. The site was issued DEQ NFA status on July 28, 2005.
Northwest Natural Gas Company (UST Facility #10781), 311 NW 2nd Avenue, Portland Oregon was identified as having two decommissioned USTs. According to Mr. Steve Paiko of the DEQ UST Division, the decommissioned USTs matched information on file for the LUST sites summarized above.

Additionally, the City of Portland Mayor’s Message and Annual Reports, identified a fuel oil UST on 2nd Street, 30 feet north of Everett Street (i.e. at the southeastern corner of the block). As such, this historical UST would not appear to have been either of the two above-referenced USTs that were previously removed from the northeastern and western sides of the block. The Opera House Laundry, an historical occupant of Block 16, was identified as the owner of this former UST. Additional information regarding this UST was not identified.

4.2.3 Block 17 – Foster Apartments

Foster Apartments (LUST Log #26-02-568), 219 NW Davis Street, Portland, Oregon, Block 17 of the surrounding area, was identified on the following list:

- Oregon Leaking Underground Storage Tank (LUST) List
  LUST Log #26-02-568

According to information obtained from the DEQ LUST file for this site, a release from an abandoned 1,700-gallon heating oil UST was reported in August 2002 during tank decommissioning activities by Universal Applicators, Inc. (UAI). TPH was detected in two soil samples collected from beneath the UST at concentrations of 50,600 mg/kg and 34,900 mg/kg (Table 2; Figure 24). Because the UST was located beneath the basement floor of the site structure, the UST was decommissioned in place according to Risk Based Decision Making (RBDM) guidelines. Subsequent confirmation soil sampling revealed TPH concentrations of 73 mg/kg and 375 mg/kg in two soil samples that were collected at 21 feet bgs in the immediate vicinity of the tank (Table 2). TPH was not detected above laboratory method detection limits in three additional soil samples. UAI estimated that approximately 107 cubic yards of petroleum-impacted soil remained at depth. Groundwater was not encountered during the investigation activities. Based on these analytical results and a risk-based model for likely exposure pathways, UAI concluded that not further action
was warranted. The site was conferred administrative closure by DEQ on June 6, 2007.

4.2.4 Block 24 – NWN Parking Lot

Block 24 was not identified on any of the federal and state databases that were reviewed as part of this assessment. However, information regarding a release from a heating oil UST at Block 24 was obtained from NWN. Further, in 1997 subsurface investigation activities were conducted at Block 24 on behalf of NWN by HAI. This information is discussed below:

Based on information obtained from NWN archives, as presented in NW Natural's 104(e) Response, an abandoned heating oil UST with a capacity of approximately 1,800 to 2,000 gallons was discovered at Block 24 in 1996, during redevelopment of the Block for its current use as a paved parking lot. The UST was located below the sidewalk adjacent to third street at Block 24. It was decommissioned in place in 1996 by Enviro-Comp services.

In 1997, a subsurface investigation was conducted at Block 24 by HAI for NWN. A geophysical survey that was performed as part of the investigation did not identify any USTs at the site. Additionally, the investigation was completed to provide baseline environmental information for the property in the planning stages of the Portland Chinese Classical Garden (Block 24 was initially under consideration for this development). Nine (9) geotechnical borings were installed across the block, and were advanced to depths from 9 to 16.5 feet bgs. Groundwater was encountered at 10 feet bgs, however, samples were not collected. Fill material consisting of silt, sand, gravel, concrete, brick, and glass debris was encountered in all borings from the ground surface to the maximum depth of exploration (16.5 feet bgs). An apparent piece of hardened tar was noted within the fill material at one boring location, at approximately 9 feet bgs. Soil samples were initially analyzed by hydrocarbon identification (HCID) methods. Diesel- and heavy oil-range petroleum hydrocarbons were detected in the fill material at depths of 3 to 8 feet bgs, at concentrations of up to 2,600 ppm diesel-range and 2,900 oil-range petroleum hydrocarbons. The diesel-range hydrocarbons were not typical of a diesel pattern, as noted by the testing laboratory. Two of the petroleum-contaminated soil samples were further analyzed for PAHs (Table 1; Figure 25). Total PAHs were detected at concentrations of 42 mg/kg and 157 mg/kg, with carcinogenic PAHs concentrations of 13 mg/kg and 46 mg/kg. Certain PAHs within the samples exceed DEQ RBC values.
The petroleum impacts to fill were detected primarily at the central and southwestern portions of the block, and appeared to be localized with no apparent vertical or horizontal consistency. The specific source or sources of the impacts identified at select locations within the fill on Block 24 are not known, but appear related to the apparent heterogeneous origin of fill. HAI inferred that the observed inconsistent pattern suggested a lack of mobility beyond the limits of the original zones of contaminated fill placement. Due to the presence of petroleum-contaminated soils within the fill unit, HAI recommended that future trenching and/or redevelopment activities would require special soil management. Additionally, HAI indicated that any future development activities should be planned such that no complete exposure pathway with areas of contaminated fill material would result.
Any questions regarding the information presented in this report are welcome and should be referred to the undersigned. Thank you for the opportunity to be of service in this matter.

Hahn and Associates, Inc.

Prepared by:

Charlotte A. Berghoffer  
Project Manager

Nora H. Eskes  
Senior Project Manager

Date: June 11, 2009

Reviewed by:

Rob B. Ede, R.G.  
Principal
6.0 LIMITATIONS

The information presented in this report was collected, analyzed, and interpreted following the standards of care, skill, and diligence ordinarily provided by a professional in the performance of similar services as of the time the services were performed. This report and the conclusions and/or recommendations contained in it are based solely upon research and/or observations, and a review of physical sampling and analytical activities that were previously conducted.

The information presented in this report is based only upon the review of the referenced publicly available historical documents and environmental reports, and/or upon information provided to HAI by the Client and/or its contractors. The analytical data presented in this report document only the concentrations of the target analytes in the particular sample, as reported in the documents reviewed, and not the property as a whole.

Unless otherwise specified in writing, this report has been prepared solely for the use by the Client and for use only in connection with the evaluation of the subject property. Any other use by the Client or any use by any other person shall be at the user’s sole risk, and HAI shall have neither liability nor responsibility with respect to such use.
7.0 GLOSSARY OF ABBREVIATIONS

bgs  below ground surface
BTEX  benzene, toluene, ethylbenzene, and xylene
CEG  Conditionally Exempt Generator
CERCLA  Comprehensive Environmental Response Compensation and Liability Act
CERCLIS  Comprehensive Environmental Response Compensation and Liability Information System
CFR  Code of Federal Regulations
CORRACTS  RCRA Corrective Action Report
DEQ  Department of Environmental Quality
ECSI  Environmental Cleanup Site Information
EPA  U.S. Environmental Protection Agency
ERNS  EPA Emergency Response Notification System
HAI  Hahn and Associates, Inc.
LQG  Large Quantity Generator
LUST  Leaking Underground Storage Tank
NFA  No Further Action
NFRAP  No Further Remedial Action Planned
NPL  National Priority List
ODEQ  Oregon Department of Environmental Quality
PAH  polynuclear aromatic hydrocarbon
PCB  Polychlorinated Biphenyls
PGM  Portland Gas Manufacturing
ppm  parts per million
RBC  Risk-Based Concentration
RCRA  Resource Conservation and Recovery Act
SQG  Small Quantity Generator of Hazardous Waste
SWDF  Solid Waste Disposal Facility
SWDS  Solid Waste Disposal Site
TCLP  Toxicity Characteristic Leachability Potential
TSD  Treatment, Storage and Disposal
UST  Underground Storage Tank
VOC  volatile organic compound
W.M.  Willamette Meridian
8.0 PROFESSIONAL QUALIFICATIONS

CHARLOTTE A. BERGHOFFER
Project Manager

Technical Expertise
Ms. Berghoffer’s expertise is in conducting and managing Phase I Environmental Site Assessments (ESAs), including large and/or complex properties for which extensive historical and regulatory file research was required.

Experience Summary
Ms. Berghoffer has conducted numerous Phase I and II ESAs since 2002 for a variety of government and private parties. These projects have included industrial facilities, former mill properties, retail outlets, shopping centers, telecommunication facilities, warehouses, automotive service stations and residential communities.

Credentials
B.S. Geology, Portland State University
Registered Environmental Assessor II, R.E.A. State of Oregon, #30125

Professional Training
• OSHA 40-hour Health & Safety Training for Hazardous Waste (HW) Workers
• OSHA 8-Hour HW Refresher Course
• ASTM Environmental Site Assessment Course for Commercial Real Estate
• Environmental Data Resources, Inc. Due Diligence at Dawn Seminars
• AHERA Asbestos Inspector Certification Course, June 2007 and September 2004
• ASTM 2428-06 Baseline Survey Process 2-hour Mold Assessment and Water Intrusion Evaluation Training, August 2006
• USDOT Hazardous Materials and Dangerous Goods Transportation Training, December 2006

Employment History
Hahn and Associates, Inc. Project Manager 2008 to present
LFR Inc. Senior Staff Geologist 2002 to 2008

(6/08)
NORA H. ESKES
Senior Project Manager

Technical Expertise
Ms. Eskes has focused upon Phase I Environmental Site Assessments (ESAs) including large and/or complex properties for which extensive historical and regulatory file research was required.

Experience Summary
Ms. Eskes has conducted numerous Phase I ESAs since 1999 for a variety of government and private parties. These projects have included retail outlets, shopping centers, telecommunication facilities, warehouses, greenspace acquisitions, homesites, agricultural properties, automotive service stations, former bulk fuel plants, and industrial facilities.

Credentials
B.S. General Science, University of Oregon, Eugene, Oregon
B.A. Community Studies, The Evergreen State College, Olympia, Washington

Professional Training
• OSHA 24-hour Health & Safety Training for Hazardous Waste (HW) Workers
• OSHA 8-Hour HW Refresher Course
• ASTM Environmental Site Assessment Course for Commercial Real Estate
• ASTM Assessment of Vapor Intrusion into Structures on Property Involved in Real Estate Transactions
• Environmental Data Resources, Inc. Due Diligence at Dawn Seminars

Employment History
Hahn and Associates, Inc. Sr. Environmental Scientist 1999 to present
Saliva Diagnostic Systems, Inc. Director, Clinical Trials 1992-1997
ROBERT B. EDE, R.G.
Principal

Technical Expertise
Mr. Ede’s expertise is in the scoping and management of all aspects of hydrogeologic remedial investigation, corrective action, and regulatory interface. He has expertise relating to petroleum, solvent, and pesticide contamination. Mr. Ede has extensive experience with investigation and remedial action related to the presence of dense non-aqueous phase liquids (DNAPLs).

Experience Summary
Mr. Ede has worked in the environmental field since 1991 and has experience and a strong background in the evaluation of compliance with Federal and state environmental regulations as well as the scoping, performing, and supervising of subsurface soil and groundwater investigations and remedial actions, including remedial investigations, site investigations, beneficial use assessments for land and water, risk-based closure assessments, Brownfields assessments, and property reuse planning.

Credentials
M.S. Earth Resources Management, University of South Carolina
B.S. Geology & Environmental Science, Bowling Green State University

Professional Titles and Affiliations
• Washington Licensed Geologist No. 461
• Oregon Registered Professional Geologist No. G1823
• Member, National Groundwater Association

Selected Professional Training
• OSHA 40-Hour Health & Safety Training for Hazardous Waste (HW) Workers
• OSHA 8-Hour HW Refresher & Operations Supervisor Course
• MTCA Cleanup Levels Workshop
• Quality Assurance/Quality Control –Management of Environmental Data
• Ecological Risk Assessment Under the Oregon Cleanup Law Workshop, DEQ
• Risk-Based Corrective Actions, ASTM
• Hazardous Waste Training Institute, Region IV USEPA
• RCRA Orientation Training and Permit Writing, Region IV USEPA

Employment History
Hahn and Associates, Inc. Principal 1995 to present
S.C. Dept. of Health and Environmental Control Hydrogeologist 1991 to 1995
Hunt International Petroleum Company-TChad Field Geologist 1990