Remedial Investigation and Feasibility Study

Gas Works Park Site
Seattle, Washington

for
Puget Sound Energy and the City of Seattle

January 2023

GeoEngineers
Earth Science + Technology

APPENDICES

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APPENDIX 1A
1996 Deferral Agreement

Keep final

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DEFERRAL AGREEMENT
Washington Natural Gas - Seattle Plant (A/K/A Gas Works Park) Site
July 15, 1996

I. PURPOSE

This agreement describes actions the Washington Department of Ecology (Ecology) will take to ensure adequate response actions at the Washington Natural Gas - Seattle Plant (A/K/A Gas Works Park) Site (Site), CERCLIS ID#WAD980639280. This site consists of both the upland's area and contaminated sediments. EPA intends to defer consideration of the Site for listing on the Superfund National Priorities List (NPL). Consideration for listing will be deferred while the State oversees response actions conducted and funded by the responsible parties (RPs). Once the necessary response actions at the Site are successfully completed, EPA will have no further interest in considering the Site for listing, unless there is a release or potential release that poses a significant threat to human health or the environment. In addition, when necessary response actions are completed, the site will be removed from the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS).

II. IMPLEMENTATION

A. State Program - The State is fully authorized to implement a hazardous waste clean up program which should ensure that response actions at the site are carried out and that these actions are protective of human health and the environment.

The State confirms through this agreement that it has sufficient capabilities, resources, expertise, and authorities to ensure that a CERCLA-protective cleanup is conducted and to coordinate with EPA, other interested agencies, and the public on different phases of implementation.

B. Site Eligibility - The State has expressed interest in having the site listing deferred and in overseeing the response at the site under state law. In addition, the State and EPA agree that the State will address the Site sooner than, and at least as quickly as, EPA expects to respond.

The Site is included in the CERCLIS inventory and it is NPL caliber as determined by EPA. Development of a site-specific Hazard Ranking System (HRS) package has not been initiated. The State will not request, nor utilize, Federal trust fund money to implement any portion of the actions required by this agreement.

C. Community Acceptance - The State has taken appropriate steps to inform the affected community and other affected parties of this proposed agreement. The State has explained to the community and other parties any differences between a response action under state law pursuant to this agreement and a response conducted under the National Contingency Plan (NCP). In addition, the State has documented all of its interactions with the community and has informed EPA that there is no opposition to the deferral.

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If at any time, the community or other parties have significant valid objections to the deferred listing of the Site, which cannot be resolved, EPA will consider listing the site.

D. Clean-Up Levels - The State will pursue a protective clean up of the site, which is substantially similar to a response required under CERCLA. The response action should be protective of human health and the environment, as generally defined by a 10^{-4} to 10^{-6} risk range for carcinogens and a hazard index of 1 or less for non-carcinogens. Generally, the State should also consider giving preference to solutions that will be reliable over the long-term. The State will ensure that any remedy selected at the Site will comply with all applicable Federal and State requirements. Additionally, the State should generally select a remedy which provides a level of protectiveness comparable to relevant and appropriate Federal and State requirements for the Site.

E. Natural Resource Trustees - The State agrees to promptly notify the appropriate State and Federal trustees for natural resources of discharges and releases from the Site that are injuring or may injure natural resources and include the trustees, as appropriate, in activities at the Site.

III. PROCEDURAL REQUIREMENTS

A. Roles and Responsibilities - The State has responsibility, with minimal EPA involvement, to provide for a timely and CERCLA- protective cleanup under State authority and to support the public's right of participation in the decision-making process. EPA's role will generally be limited to review of State annual and semi-annual reports, described in Section D below, and consultation on the proposed remedy, described in Section B below. EPA will not provide financial assistance to the State or the community. EPA may request other reports, data, or other documentation as it deems appropriate.

B. Schedule for Performance - A proposed schedule of events for the Gas Works Park site cleanup is given in Table 1. The dates in Table 1 are subject to change.

Table 1: Proposed Schedule of Events, Gas Works Park.

Task	Proposed Completion Date
Final Report on Screening of Remedial Alternatives and Life-Cycle Costs	July 15, 1996
Start of MTCA Agreed Order Negotiations - City of Seattle and Washington Natural Gas	July 15, 1996
Completion of Negotiations on the MTCA Agreed Order - City of Seattle and Washington Natural Gas	October 1, 1996
Feasibility Study Completion	March '97
Public Comment - Feasibility Study	April '97
Prepare MTCA Cleanup Action Plan	September '97
Begin Negotiations on a MTCA Consent Decree	December '97
Design Remedial Systems	1998
Construction of Remedial Systems	1999

C. Documentation Submissions to EPA - The State will make available all data, reports, and other documentation to EPA upon request.

D. State Reporting to EPA - The State will report to EPA at least annually on whether the conditions agreed upon in this agreement are being met. In addition, the State will report to EPA at least semi-annually any difficulties it is having meeting the conditions of this agreement.

In addition, Ecology will brief EPA on the proposed cleanup action plan (CAP) before and after public comment.

IV. COMMUNITY PARTICIPATION

The State will assure public involvement that is substantially similar to the intent of the National Continency Plan (NCP). Also, the State will assure that the affected community does not have significant objections to this agreement. The State will ensure the following actions are undertaken:

A. Site files will be maintained at the State's office and at another location near the site.

B. Site related information will be provided to community groups.

C. The affected community will be able to acquire from the State technical assistance in interpreting information with regard to the nature of the hazard, investigations and studies conducted, and implementation decisions at the site.

V. COMPLETION OF STATE RESPONSE ACTION

Certification and Confirmation - Once the State considers the response action at the Site to be complete it will certify to EPA and the affected community that it has successfully completed its selected remedy and achieved its intended cleanup levels. As part of the certification, the State will submit to EPA response action completion documentation substantially similar to that described in the June 1992 OSWER Directive "Remedial Action Report; Documentation for Operable Unit Completion" (OSWER Directive 9355.0-39FS).

EPA will review the certification and supporting information, and may choose to initiate a deferral completion inquiry to confirm the certification. EPA will work with the State to address any data deficiencies hindering the confirmation and agree to a time frame for completion of the inquiry. If the response at the site is confirmed as complete, the site will not be further evaluated for NPL listing unless EPA received information of a release or potential release at the site which poses a significant threat to human health or the environment. Upon completion of response actions and confirmation by EPA, the Site will be removed from CERCLIS.

I. AGREEMENT TERMINATION AND MODIFICATION

If, at any time during or upon completion of a response action, EPA determines that the response is not CERCLA-protective, is unreasonably delayed or inappropriate, or does not adequately address the affected community's concerns, EPA may terminate this agreement, after 30 days notice and discussion with the State. In addition, EPA may terminate the deferral and implement an emergency or time-critical response action without 30 days notice to the State is such actions are determined necessary. EPA may also terminate this agreement if the RPs breaches its agreement with the State, and the State is unable to enforce compliance or provide other sources of funding to complete the response action. In addition, the State may also choose at any time, after 30 days notice, to terminate this agreement for any reason.

Upon terminating this agreement, EPA will consider taking any necessary response actions and initiate consideration of the site for NPL listing. EPA and the State will coordinate efforts to notify the community and RPs of the termination of this agreement. These actions will assure the public that EPA will continue to respond at a site where response actions have begun and will encourage the RPs to forge successful agreements with the State. At EPA's request, the State will provide to EPA all information in its possession regarding the site.

This agreement adheres to EPA's "Guidance on Deferral of NPL Listing Determinations While States Oversee Response Actions" dated May 3, 1995. Furthermore, this agreement may be modified at any time upon agreement of both parties. Notwithstanding any provision of this agreement, EPA retains all authority and reserves all rights to take any and all response actions authorized by law.

VII. AGREEMENT APPROVALS

Tim Nord
Section Chief - Headquarters Section
Toxics Cleanup Program
Washington Department of Ecology

7/17/96
Date

Michael Gearheard, Associate Director
Office of Environmental Cleanup
Environmental Protection Agency,
Region 10

7-15-96
Date

APPENDIX 1B
Operational History

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APPENDIX 1B
OPERATIONAL HISTORY

The Area of Investigation (AOI) history reflects the evolution of the Puget Sound region. Once territory occupied by three indigenous tribes (the Duwamish, Hachooabsh, and Shilsholes), the area surrounding North Lake Union was settled by non-natives in the mid- to late-1800s. The first industries were associated with sawmills and forest products supporting small farms and homesteads in the area. In 1891, Wallingford and other communities on the north side of Lake Union were annexed by the City of Seattle (City). In 1907, construction of a manufactured gas plant (MGP) was completed at the present-day upland portion of the AOI to provide lighting, cooking, and heating fuel for the growing population in the region. Other industries (e.g., tar refining, bulk fuel storage, shipbuilding) followed, operating along the North Lake Union shoreline adjacent to the MGP. Lake Union was a major barge route for coal mined in eastern King County, timber, and other materials. The operation, deactivation, and demolition of the MGP from 1907 onward are discussed in the following sections, along with historical information about other industrial activities on or adjacent to the AOI. Historical features associated with the AOI are shown on Figure 1B-1.

1.0 MGP OPERATIONAL HISTORY

Before natural gas was widely available, combustible gas was produced from coke, coal, and oil at MGPs throughout the United States (EPA 1988). These MGPs, often called gasworks or town gas plants, provided fuel to the towns in which they operated and were instrumental in the early development of many communities. The MGP constructed by the Seattle Gas Light Company on the eastern side of what was then known as Brown's Point operated from 1907 to 1956 and was known as the Lake Station MGP. When the Trans Mountain Pipeline began providing natural gas to the Seattle area in 1954, decreasing demand for manufactured gas led to plant closure in 1956 (Sabol et al. 1988). The MGP was placed in standby mode in 1956; tanks were added to the facility for storage of natural gas and the property was used for natural gas storage until transferred to the City in 1973.

Three gas manufacturing processes were used over the life of plant operations:

- Coal carbonization from 1907 to 1937
- Carbureted water gas (CWG) from 1907 to 1952
- Oil gas (OG) from 1937 to 1956
    - Low (500) British thermal unit (BTU) OG from 1937 to 1956
    - High (1,150) BTU oil gas from around 1951 to 1956 (Ahlquist 1954)

Raw materials used in the manufacture of gas varied depending on the manufacturing process, but generally consisted of coal, oil, and water. Waste products and commercially valuable byproducts also differed by manufacturing process.

Coal carbonization was a high-temperature destructive distillation of coal under reduced oxygen conditions in a closed vessel (retort or coke oven) that produced a gas that could be burned for heat or light. Additional processing removed impurities (e.g., ammonia, sulfur) prior to piping the gas to a storage unit (gas holder)

for subsequent distribution to customers. The high-value industrial materials tar[1] and coke were byproducts of this process. Coke was either used in the CWG process or sold.

The CWG process used coke, oil, and water as raw materials to manufacture gas. In a CWG generator, steam was passed through heated coke to release a gas called "blue gas" or "water gas." The blue gas was then piped to a carburetor, where a mist of oil was sprayed and vaporized. The mixture was converted to a gas in a third vessel called a superheater. CWG tar (CWGT) and other materials were byproducts of the CWG process.

The existing gas production towers (Cracking Towers) were associated with the OG process. The last of the towers was installed during a plant expansion in 1945. OG was manufactured by passing oil through a chamber of heated checker bricks (EPA 1988). Two different temperatures were used to "crack" the oil, resulting in gases with different BTU content. The main byproduct was lampblack; other products or byproducts included light oil and oil gas tar (OGT).

Tar, a high-value product produced by all the gasification processes at the MGP, was used for a variety of purposes and refined into a variety of products. Tars (primarily coal tar) were sold to manufacturers of creosote, pitch, and roofing materials[2]. American Tar Company (ATCO) and other tar refiners purchased tars from the MGP. Tar was also shipped off-site via rail or water (see former tar loading dock on eastern shoreline shown on Figure 1B-1).

Tars were also burned for energy in the MGP steam boilers, but only occasionally because these materials had higher value when sold to manufacturers of the secondary products. CWGTs and OGTs were used as a substitute for fuel oil in the MGP steam boilers during later periods of plant operation[3].

Manufactured gases typically contained impurities and needed to be stabilized prior to delivery. Auxiliary processes (e.g., cooling and scrubbing) were used to remove the small amounts of free carbon (i.e., lampblack), tar, light oil, sulfur, ammonia, and other chemicals that were present in the gas. Many of these purification processes created products that had high commercial value and were resold. Lampblack, along with some tar, was used to create briquettes for resale or reuse as boiler fuel. Light oils including benzene and toluene, were recovered during the cooling process, and further refined and sold.

Tar was removed from gas by cooling with water (e.g., wash boxes, water scrubbers), condensing, physical separation (e.g., settling, decanting), and electrostatic precipitation. To improve tar separation from cooling water, the water was continuously passed through baffled wells and tanks. Tar emulsions in tank bottoms were periodically pumped out and processed for resale or reused at the plant. Pitch produced in the low BTU OG process was removed from gases by bubbling through water in wash boxes.

[1] In this appendix, "tar" is used as a general term, unless modified by the process that created it (e.g., OGT). In sections of the remedial investigation report, the term is used more technically to mean a dark semisolid to solid material that occurs as small particles or small discrete masses in layers or deposits.

[2] Information compiled from individual Brown's Directories from 1914 to 1937.

[3] Information compiled from individual Brown's Directories from 1933 to 1952.

Cooling also served to remove free carbon (lampblack), oil, and impurities. Lampblack was typically concentrated in mechanical thickeners. Lampblack produced from the low BTU OG process, along with some tar, was used to create briquettes for resale or reuse as boiler fuel.

Light oils removed from oil gases were refined for resale; any low-grade oil from the refining was reused as boiler fuel or feedstock. Additional water cooling of the light oils improved the recovery of benzene and toluene, which were also refined and sold. The benzene and toluene recovery process caused naphthalene to condense, creating an oily precipitate. This naphthalene was pumped to another scrubbing system and re-dissolved to prevent the precipitate from plugging lines. Light-oil refining and recovery of benzene used sulfuric acid as part of the process; the resulting acid sludge waste material required disposal in a landfill.

Sulfur constituted the largest volume of waste produced in MGP processes (Ahlquist 1954). When all the tars were removed from the gas, the gas was purified to remove sulfur. Initially, sulfur was removed by passing the gases through wood shavings coated with hydrated iron oxide in a series of purifier boxes. Later, the Thylox purification process was used, see historical structures on the eastern half of Figure 1B-1. The Thylox process consisted of introducing gases into a tank with a recirculating sodium thioarsenate solution, which bound the sulfur. Oxygen bubbled through the solution in a second tank displaced the elemental sulfur, which was skimmed off, dewatered in a Kelly filter press, and then disposed. After Thylox purification, a final process to remove the remaining sulfur relied on passing the gases through purifier boxes.

All byproducts generated by the MGP processes that could not be reused or sold were typically delivered to off-site landfills. However, based on historical research (see Appendix 1B) and results of environmental explorations, some of the historical MGP wastes (e.g., cinders, brick, concrete, clinker, ash), raw materials, products, and byproducts (e.g., coke, tar, lampblack, coal) were accidentally spilled or released to AOI media (Figure 1B-2). The United States Geological Survey (USGS) and others have described a Gas Works Deposit—a fill layer that can contain agglomerate, lampblack, oil, tar, ash, cinders, brick, wood, concrete or other material—as being present below ground surface at the park (Sabol et al. 1988). Land regrading and park development activities performed in the mid-1970s, and discussed in Section 4.0 of this appendix, redistributed MGP raw materials, products, byproducts, and residuals contained in the fill.

The main processes (heating, cooling, tar removal and initial purification) took place in the south-central area of the present-day park. The removal, refining and storage of light oil (including benzene) took place at the light oil plant near the southeast shoreline (south of the Play Barn). The Thylox purification system operated in the east-central portion of the current park. Purifier boxes containing iron-oxide-coated wood chips were located in the southeast area of the present-day park between the light oil plant and the Cracking Towers. Lampblack was stored in a large area in the south-central area, south/southwest of the Cracking Towers.

Three docks were present along the eastern shoreline and are identified from north to south as the lake suction dock, tar loading dock, and oil dock (see Figures 1B-1 and 1B-2). The lake suction dock appears to have been constructed by 1919 (Sanborn Fire Insurance 1919) and was used to provide cooling water to the plant. The tar loading dock, used for offloading and shipping commercial products from the MGP, was first evident on a 1927 U.S. Army Corps of Engineers (USACE) “lake conditions” map. In 1937, the MGP received a permit from the USACE to install three dolphins along the eastern shoreline to guide navigation for oil tankers delivering raw material (USACE 1937); the oil dock was likely constructed at this time.

At least six outfalls conveyed surface runoff, steam boiler blowdown water, condensed steam, and cooling water from multiple MGP sources to the lake (Figure 1B-3). Some discharges were filtered before entering surface waters (Foster 1943).

Seventeen historical MGP-related outfalls are mapped in Figure 1B-3; associated structures and areas drained are depicted in Figure 1B-1. One outfall, located west of the Prow, discharged from coolers surrounding a water gas relief holder. Three outfalls, located at the Prow, discharged from lampblack process structures purifier boxes and areas to the north. One outfall, east of the Prow, connected purifier boxes. Two outfalls, located on the southeast shoreline, connected to the light-oil plant. Six outfalls, located west of the boiler house (part of the current Play Barn structure), connected to exhauster structures, Thylox process structures and scrubbers may have extended to the light oil absorber and an inland catch basin. Four outfalls, in the northeast corner of present-day upland portion of the AOI, connected to a water gas house and nearby structures as well as the office and laboratory. Most of these outfalls were located along the eastern shoreline of the facility.

2.0 OTHER INDUSTRIAL OPERATIONS

Many types of non-MGP industrial activities have occurred on the present-day upland portion of the AOI: tar refining, boatbuilding and boat repair, municipal waste incineration, municipal landfilling, light-oil refining, chemical manufacturing, briquetting operations, fuel storage and sales, shingle milling, coal and gravel storage, and barge and tug operations. Additional information about onsite activities for these facilities is provided below; potential impacts were assessed as part of investigations and are described as part of the nature and extent evaluation and in the conceptual site model.

2.1. ATCO

West of the MGP, a tar refinery founded as Barrett Company began operating between 1907 and 1912 (Seattle Times 1924). Subsequently known as ATCO, the refinery occupied the property until the mid-1960s (EPA 1995). Steam distillation was used to produce various grades of tar and tar derivatives from source material (i.e., tar) generated by the nearby MGP as well as other gas plants throughout the Pacific Northwest (Seattle Times 1924).

Spills or oily discharges occurred on several occasions. In 1947, Griffin Fuel Company complained about heavy crude oil discharging from an 8-inch diameter outfall just east of its property[4]; research revealed the outfall came from ATCO (WPCC 1947). Although available sewer cards do not show the location of the outfall, a 1943 State Pollution Commission report (Foster 1943) identifies a “storm overflow from sewer” “at the foot of Wallingford Avenue just west of the gas plant” and depicts the overflow point as being south of what is now Kite Hill. The estimated location of the Wallingford Avenue outfall is depicted on Figure 1B-3[5]. ATCO moved some operations across North Northlake Way in the mid-1950s and was later renamed Nortar (see Section 1.4.3 of the RI).

[4] Griffin Fuel Company was located on a rectangular shoreline parcel that is now the southwest flank of Kite Hill. A rectangular “Vacated Foot of Wallingford” parcel immediately east is presumed to be the location of the outfall “at the foot of Wallingford Avenue” (Figure 1B-3).

[5] The historical outfall at the foot of Wallingford Avenue (Figure 1B-3) should not be confused with the current Kite Hill outfall, an approximate 200-foot-long, 6-inch-diameter outfall that was constructed in the 1970s in the same area as the historical outfall (RI Figure 3-21).

2.2. Harbor Patrol

The Harbor Patrol parcel was formerly occupied by Paramount Briquetting, which operated from 1919 to 1936 (Sanborn Fire Insurance 1919; Walker and Associates 1936). According to a bulkhead and fill permit sought in 1929 (USACE 1929), the company manufactured "Circle-S Brand Sootless Briquettes"; the raw materials and byproducts are not precisely known. Based on subsequent soil sampling, the fill placed as part of the 1929 permit contained contaminated materials including waste coal fragments, soft asphaltic material, cinders, ash, and other debris (Electric Power Research Institute 1999).

Foss occupied a parcel east of the Paramount Briquetting plant, where the Harbor Patrol helicopter pad is currently located (Figure 1B-1). In 1938, this parcel was occupied by Puget Sound Tug & Barge (Parks and Recreation 1963).

A gravel bunker appears to have been located on the Harbor Patrol parcel in the 1930s (Walker and Associates 1936). From 1959 to 1964, Murphy-Francis Marine offered moorage, repair and drydock facilities (sometimes referred to as a marina) at the property (King County 1960; Rouse 1962; Murphy-Francis Marine 1964). Since 1964, the Seattle Police Department Harbor Patrol has operated at this location.

An underground storage tank (UST) was installed in 1966 northeast of the Harbor Patrol office; in Washington Department of Ecology's (Ecology's) Facility/Site Database, a UST had been registered in use since 1970 (Garry Struthers Associates 1999). In 1999, Harbor Patrol decommissioned the 2,000-gallon diesel fuel UST, which involved removing the tank and capping the vent and product piping (Garry Struthers Associates 1999). Assessment at the time of the UST decommissioning indicated that diesel fuel was present in soil at the UST site. Although impacted soil was removed, groundwater depth was too shallow (6 feet below ground surface [bgs]) to allow removal of all soil with elevated concentrations of diesel fuel and polycyclic aromatic hydrocarbons (PAHs), and some such soil remained in place following the removal activities.

2.3. Municipal Incinerator and Landfill

The City operated a landfill from 1911 to 1920 and a refuse incinerator from 1912 to 1914 near the base of Wallingford Avenue right-of-way (Parks and Recreation 1984; Phelps 1975). In a 1919 Sanborn map, the shoreline of the City landfill appears similar to that of the present. Recent (2013) explorations along the shoreline near the former foot of Wallingford Avenue encountered occasional rubber, ceramic, and metal debris at depths of 20 to 35 feet bgs.

2.4. Solvents Inc. and Griffin Fuels

In 1935, the City leased its shoreline parcel east of Harbor Patrol to Solvents, Inc. In City directories (Seattle Directories 1938, 1940), Solvents, Inc. is described with the term "coal tar products"; the company operated from circa 1938 to 1940. A former employee stated he worked as a chemist for Solvents, Inc., "a small oil refiner of benzene, toluene and xylene, the latter known as solvent naphtha" (Orth 1984).

Griffin Fuels leased the property from the City for use as a "retail and wholesale fuel yard" operating from 1944 to 1958 (Seattle Directories 1941; Walker and Associates 1956). Griffin Fuels listed "heating oils" and "dustless coals" on its stationary.

2.5. Waterway 19 and Gas Works Park Marina

Waterway 19, located adjacent to the eastern boundary of Gas Works Park, is owned by the State of Washington. As shown on Figure 1B-5 a portion of Waterway 19, including part of the current park's eastern shoreline, was filled before 1919; the head of Waterway 19 was filled later. Aerial photographs from 1936 through 1977 (Walker and Associates 1936, 1946, 1956, 1960, 1974, 1977) indicate that over-water structures have typically been present at Waterway 19. The general dock configuration at present appears to date to at least 1977 (Walker and Associates 1977).

Gas Works Park Marina occupies shoreland property east of Waterway 19, a location formerly occupied by Arctic Trading and Transport (RETEC 2002a) for commercial mooring and repair services (RETEC 2002b).

An online search by address of Ecology listings did not indicate previous or ongoing Ecology permitting or enforcement activity on this property (Ecology 2013a); however, discharges to the lake from marinas have been documented (Foster 1943; Tomlinson et al. 1977). Both recently and historically, Waterway 19 has received storm sewer discharges.

In 2007, an oil sheen was observed on the lake surface at Gas Works Park Marina; a submerged drum (likely dropped overboard) was subsequently removed by Ecology. Analytical results of oily water samples revealed detectable concentrations of diesel, motor oil, certain non-carcinogenic PAHs, and bis(2-ethylhexyl)phthalate (BEHP) (AECOM 2007). Oil sorbent booms were deployed to contain the oil sheen.

2.6. Waterway 20

Waterway 20 is located within (offshore portion) and outside (filled upland portion) of the AOI. Originally, combined sewage and stormwater was discharged to Waterway 20 through a municipal outfall (Figure 1B-2). Side sewer permits for connections to the conveyance system discharging at this outfall included those issued to the MGP, the tar refinery, tar products packaging facilities, and fuel storage operations (e.g., Griffin Fuels and the North Yard of Standard Oil Company [METRO Lake Union facility]).

The discharges changed over the years from combined sewage and stormwater to stormwater only. Nortar and the North Yard of Standard Oil Company, which are not shoreline properties, have historically discharged at the Waterway 20 outfall (City of Seattle 1964). In 1970, a "heavy brown oil" plume just west of Harbor Patrol was traced to the pipe draining both the ATCO site (former Nortar facility in Figure 1B-2) and Standard Oil (WPCC 1970). Investigators concluded the "frequent source of oils in the North end of Lake Union has been traced definitely to Standard Oil Company or American Tar Company." Historical documents indicate Standard Oil Company had a documented release of oil to Lake Union in 1970, through the stormwater outfall, and following that release improvements were made to prevent similar releases (Chevron and Metro 2019).

3.0 ADJACENT LAKE UNION SITES AND RELEVANT HISTORY

In the 1890s, Lake Union's partially wooded and sparsely populated shorelines supported only a few sawmills (Tomlinson et al. 1977). In 1916, the lake's hydrology was significantly altered by the Fremont and Montlake cuts and completion of the Ship Canal. By the 1920s, improved navigation, urbanization, and industrial production established Lake Union as a "working lake" with over half the shoreline acreage

used for manufacturing operations and industries, including boat works and maritime-related industries, engine repair facilities, machine shops, asphalt companies, and oil and fueling operations. Many discharged wastes to the lake (Foster 1943; WPCC 1946; WPCC 1958).

A 1943 publication from the State Pollution Commission (Foster 1943) listed industrial businesses that operated along the shores of Lake Union and the Ship Canal. In addition to the manufactured gas facility, the following industries were listed:

- 15 boat-building operations
- 12 fuel and oil storage and service facilities
- 10 lumber and plywood mills and associated in-water log storage
- 10 machine shops and metal foundries
- 8 sand, gravel, concrete, and/or asphalt facilities
- 1 power plant

The 1943 publication (Foster 1943) also describes spills into Lake Union from fueling facilities and oil loss at other facilities. Spillages during barge unloading of raw materials and products (e.g., coal, petroleum, gravel) are also reported.

Lake Union also received discharges from combined sewer/stormwater overflows (CSOs), private sewage outfalls, and storm drains serving the urbanizing area. Between 1943 and 1977, the number of City and King County CSO pipes that discharged to Lake Union nearly doubled, from 10 to 19 (Tomlinson et al. 1977). New storm drains were also added, such as those carrying runoff from Interstate-5.

As a hub for historical marine and boating activities, Lake Union also received waste[6] from marinas, boats, and houseboats (Foster 1943; Tomlinson et al. 1977). In Ecology's online Water Quality Permit Life Cycle System database, 14 industrial National Pollutant Discharge Elimination System (NPDES) permits for discharge to Lake Union are currently listed, all related to the boatyard/shipbuilding industry; four industrial stormwater NPDES permits are also listed. The nature of development has broadened to include more marinas, houseboats, offices, restaurants, and shoreline residences (City of Seattle 1986).

Some of the current and historical industries that might have contributed to contamination found in the AOI and surrounding Lake Union are discussed below.

3.1. Northlake Shipyard

Northlake Shipyard is an active shipyard located adjacent to and west of the AOI (Figure 1B-2). Between 1936 and 1952, Pacific Coast Coal operated at this location, loading coal onto ships that would deliver it to Puget Sound industries (Ecology 2009).

The property has been a shipyard since at least 1956, when it was operating under the name Marine Power and Equipment (MP&E). Complaints about MP&E's discharges into Lake Union date back to the 1960s. After a 1985 U.S. Environmental Protection Agency (EPA) investigation (Hadley 1985), the federal

[6] Typical wastes from these sources included oils and grease, fuels, anti-fouling chemicals, and sewage.

government filed a civil complaint under the federal Clean Water Act and Refuse Act alleging that MP&E dumped used sandblasting material (which typically contains heavy metals including arsenic, copper, lead, and zinc), paint chips, tar, rust, solvents, spilled liquids, and grease and oil into Lake Union. During the investigation, EPA agents also observed MP&E workers discharging milky brown liquid directly into the lake through a hose from a barge moored at the facility (Lane 1985). Eventually, MP&E was charged with several counts of violating anti-pollution laws (Whitely 1986). In 1988, EPA and Ecology entered into a Consent Decree with MP&E under the CWA. MP&E ownership was transferred to United Marine International (UNIMAR) in the late 1980s and then to Northlake Shipyard in the 1990s.

Since 1994, Northlake Shipyard has been listed as Ecology Site 23849623, with noted releases of diesel fuels, tars, solvents, greases, oils, and metals associated with drydock operation (Ecology 1994). The 1994 Prospective Purchaser Consent Decree (PPCD) (WA No. 94-2-20115-8) states that "Discharges from operations at the property have included polychlorinated biphenyls (PCBs), PAHs, oils, metals, chlorinated and non-chlorinated solvents, pesticides, organotins, and soft-bottom copper paints." A deed restriction was recorded for the property in 1998 to ensure that subsequent owners follow the terms of the decree. The PPCD also required Northlake Shipyard to fund a trust allowing the State to conduct cleanup. Ecology conducted an interim action to remove an area of sandblast grit released during past shipyard operations; dredging was completed in early 2014 (Hart Crowser 2014).

3.2. METRO

The Metro Lake Union facility, formerly known as the Chevron Bulk Fueling Terminal, is located west and north of the AOI (Figure 1B-4). The Metro Lake Union Facility is divided into the North and South Yards, separated by public roadways and the former Northern Pacific Railroad right-of-way. The South Yard borders the AOI and the waterfront west of Waterway 20. Until purchased by Metro in 1982, the facility was owned by Standard Oil (and then Chevron) since 1925. It was used as a bulk fuel storage and distribution terminal (Ecology 1998).

The North Yard consisted of the tank farm containment area. The North Yard tanks were once connected to the South Yard via a series of eight subsurface pipes. At the South Yard, the fuel distribution pipes were suspended beneath over-water dock structures (Foster and Wheeler 1998). Recorded contents of the North Yard's former above-ground storage tanks (ASTs) include gasoline and gasoline distillates, fuel oil, refined oil, lubricating oils, and diesel oil. In addition, the metals arsenic, cadmium, lead, and mercury formerly found in surface soil are believed to have been the result of sand-blasting the lead-based paints from the tank exteriors at the North Yard (Foster Wheeler 1998). Metro decommissioned the tanks in 1992.

The South Yard is currently leased to the Center for Wooden Boats, a nonprofit entity, for repair work on historic boats on land (King County and Seattle 2013). A draft cleanup action plan (Foster and Wheeler 1998) lists previous occupants of the South Yard as Puget Sound Sheet Metal Works, a tannery, an oil and asphalt warehouse, and California Spray and Chemical Company (a predecessor of Chevron) which historically produced lead arsenate insecticide spray (Applied Geotechnology 1993). The Schultz Distributing Company also occupied the South Yard from the late 1970s to early 1980s. According to a 1991 Ecology memo, 'Ecology staff indicate that Schultz Distributing has contributed to contamination on a number of sites through their operational practices' (Ecology 1991)."

King County Metro implemented independent remedial actions in the North and South Yards between 1988 and 1997 to address contaminated soil and groundwater. Consent Decree WA No. 99-2-08651-1SEA was

executed in 1999 for the upland units; cleanup of related sediment contamination was deferred to a separate, future agreement. The cleanup action plan called for two phases of activity (Foster and Wheeler 1998; Ecology 1998). The first phase was completed in December 1999; the second in 2003. The North Yard was redeveloped by a private developer as a commercial building with underground parking following mass excavation of contaminated soil in 2014 and 2015.

Groundwater monitoring has been ongoing since approval of the cleanup action plan in 1998. In November 2014, groundwater results from the 10 compliance wells in the South Yard met required levels for benzene, toluene, ethylbenzene, and xylenes (BTEX), naphthalene, carcinogenic PAHs (cPAHs), and lead.

3.3. Nortar

Former Nortar is located immediately north of Gas Works Park on North Northlake Way, between Densmore and Wallingford Avenues, east of the Metro Lake Union facility's North Yard (Figure 1B-4). Although it did not border the shoreline, its stormwater discharged to Lake Union via a municipal outfall located in Waterway 20. Nortar (formerly ATCO) manufactured roofing products and formulated wood preservatives at this location from about 1956 until the late 1980s (Equipoise Corporation 1999). After conducting a Model Toxics Control Act (MTCA)-compliant hazard assessment in 1997, Ecology added it to the list of Hazardous Sites and Confirmed and Suspected Contaminated Sites with a rank of 1. Soil and groundwater had been impacted primarily by petroleum hydrocarbons, pentachlorophenol (PCP), ethylbenzene, xylenes, and PAHs.

Triad Northlake, LLC purchased and redeveloped the Nortar property beginning in 1998. In association with excavation for a commercial/residential construction project, Triad Northlake, LLC removed and disposed of soil and perched groundwater. Ecology issued a notice of completion for the soil cleanup in October 1999. Compliance monitoring of groundwater quality is ongoing. Ecology removed the site from its Hazardous Sites List in early 2001 (Ecology 2001; Ecology 2013b).

3.4. Marinas and Boatyards

In 2007, the City and PSE conducted a joint source control evaluation (JSCE) to identify other potential sources to the lake that might re-contaminate a future sediment remedy. Boatyards and marinas composed many of the nearby sources. These facilities were considered potential, but relatively minor sources of contamination to the lake, particularly if they compile with best management practices for these industries and commercial operations. The results of the JSCE evaluation are provided in Appendix 6B, Attachment 6B-1.

4.0 PROPERTY REDEVELOPMENT AND PARK CONSTRUCTION

Gas manufacturing at the former MGP terminated in 1956. In 1962, the City entered an agreement with Washington Natural Gas (WNG) to purchase the MGP property over time. From 1956 to 1970, the MGP property was utilized mainly for storage by WNG. From 1962 to 1970, the City used the western portion of the upland to stockpile material generated from construction along Interstate-5, the Safeco building in the University District (now owned by the University of Washington) and other off-site areas. The stockpile became known as the Great Mound and was later reconfigured as Kite Hill (Ecology 2000; Sabol et al. 1988; Parks and Recreation 1984).

From 1970 to 1971, a master plan for Gas Works Park was drafted by Richard Haag Associates (Haag) and approved by the City (Haag 1971). In 1971, WNG began dismantling plant structures in accordance with the purchase agreement. In 1972, Haag amended the demolition strategy to retain the six Cracking Towers (oil gas generators), light-oil absorber, boiler house, and machine building (Play Barn) (Parks and Recreation 1984; Haag 1973a).

The bulk of demolition and park construction occurred from 1973 to 1976. Demolition and excavation of the below-grade purifier boxes[7] began in March 1973. For 12 months starting August 1973, the Great Mound was opened for public use and viewing while the remainder of the former MGP facility was being developed (Haag circa 1970s).

Demolition, including targeted excavation and off-site disposal of contaminated soil identified in a 1971 study (Cole and Machno 1971), continued to July 1974. Following the amended demolition strategy by Haag, former MGP structures were saved, completely demolished, or partially demolished (Haag 1973a; Haag 1973b; Haag circa 1970s). The fate of former MGP structures, researched as part of the RI historical source[8] evaluation, is presented in Appendix 1B.

In 1976, the areas west and north of the Cracking Towers were sculpted into their current topographic form. The Great Mound was regraded to the general current topography[9] of Kite Hill using soil stockpiled on property (Parks and Recreation 1984; Haag 1975). This regrading phase also included filling of the landscaping berms north of Kite Hill. Sawdust and dewatered biosolids were tilled into the top 18 to 24 inches, followed by hydroseeded topsoil.

In the course of redevelopment, the vast majority of the former MGP property was recontoured, including the northeast corner, eastern shoreline, and the gully between Kite Hill and Cracking Towers. Net cut-and-fill contours are shown on Figure 1B-6.

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[7] The concrete walls of the purifier boxes were lowered a maximum of 3 feet to match the proposed grade in the southeast corner of the park (Haag circa 1970, 1973b).

[8] Historical sources are those constituting the original releases from process, conveyance, storage, and handling areas.

[9] Kite Hill was regraded and capped with clean soil in late 2014.

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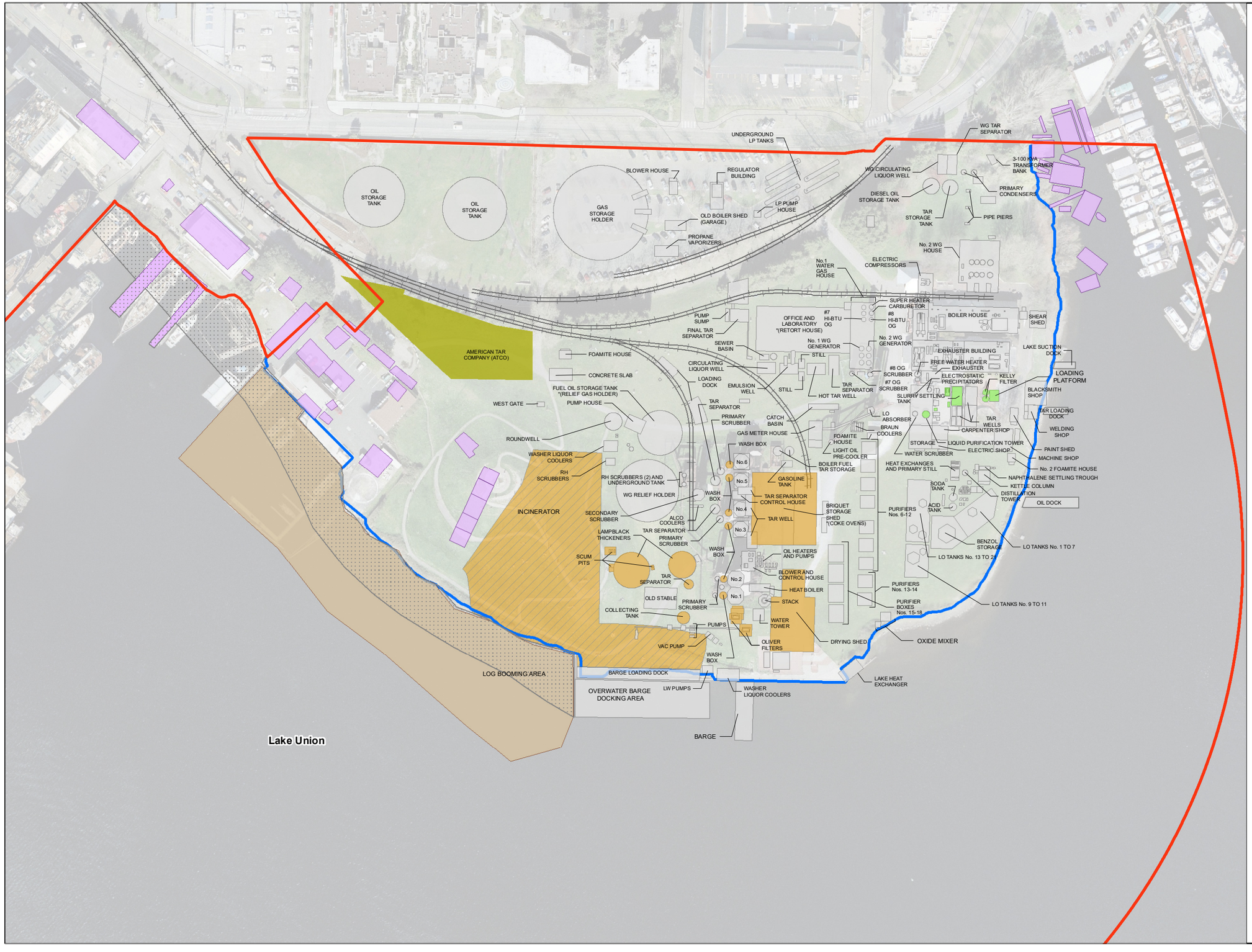


Legend

- Area of Investigation
- Shoreline (OHWM)
- Historical Railroad Features
- Former Tar Refinery Footprint
- Other Historical Non-MGP Operational Structures
- Former MGP Materials Storage (Lampblack)
- Former MGP Structures
- Thylox Process Facility
- Lampblack use/storage/processing
- Western Overwater Docking
- Log Booming Area

Notes:

1. Site structures delineated as shown in the General Plan, Lake Station,Seattle Gas Company, April 1949, revised in June 1953. Historical railroad features shown as delineated in General Plan, Lake Station, Seattle Gas Co., June 1938. ATCO footprint as shown on 1919 Sanborn map. Sanborn Fire Insurance Map, 1950; Parametrix (1998) FFS; 1946, 1956 aerial photo; Haag 1973. Western Shoreline Overwater Docking Area from 1956 aerial photo.
2. Structure labels shown in *( ) indicate previous MGP operational uses (pre-1946).
3. Basemap 2005 USGS aerial photograph. Does not show current conditions.
4. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

Abbreviations

MGP = Manufactured Gas Plant
ATCO = American Tar Company
FFS = Focused Feasibility Study
LP = Liquid Propane
LW = Lake Water
LO = Light Oil
OG = Oil Gas
WG = Water Gas

N W E S

150 0 150

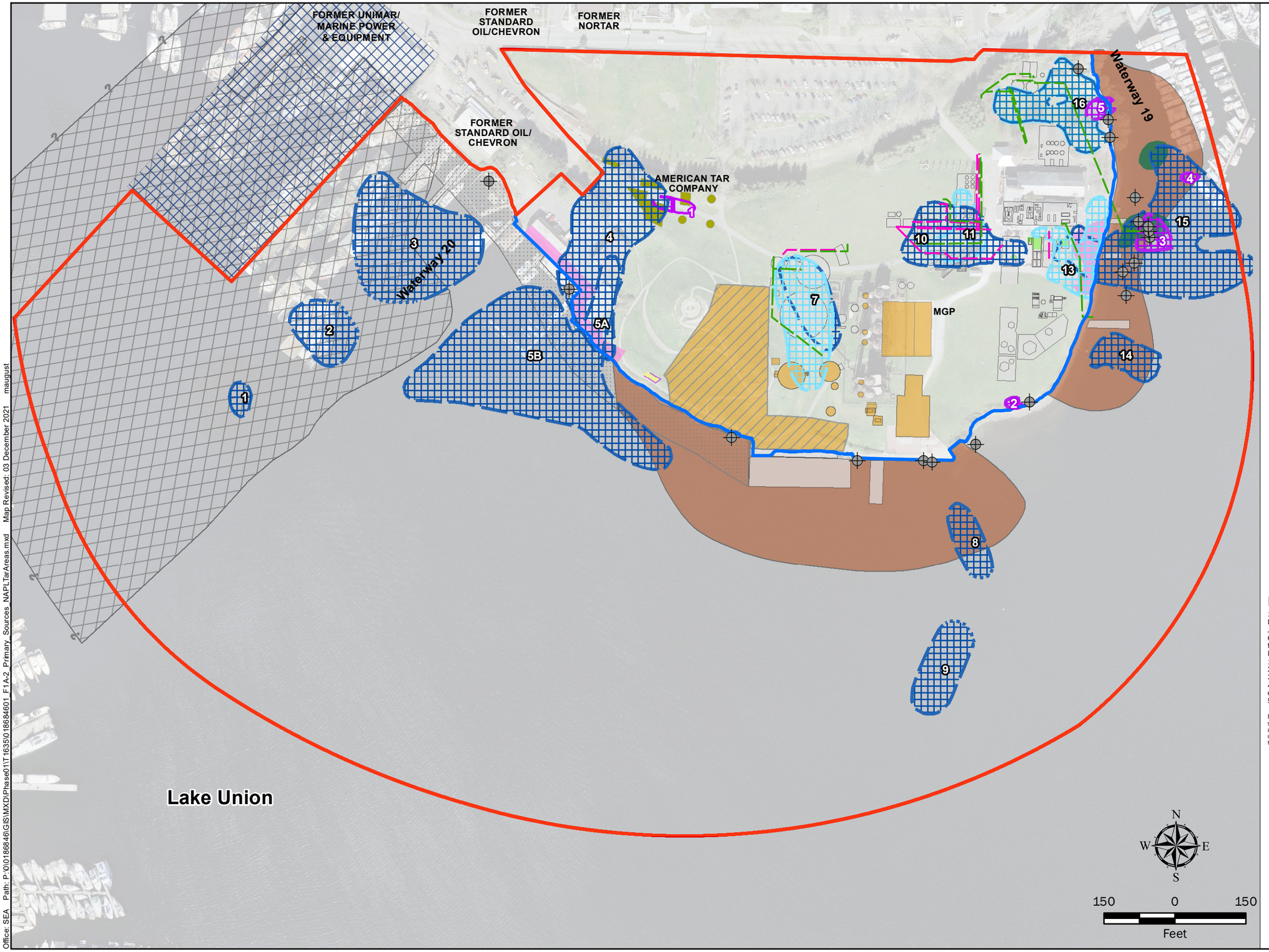
Feet

Historical Operations

Gas Works Park Site
Seattle, Washington

GeoEngineers | **Figure 1B-1**

Path: P:\0018684G\GIS\MXD\Phase01\T1635\018684601_F1A-1_HistoricalOperations.mxd Map Revised: 03 December 2021 maugust



Legend

- Area of Investigation
- Shoreline (OHWM)

Historical Sources

- Oil Line
- Tar Line
- Potential MGP Historical Sources
- Former MGP Materials Storage (Lampblack)
- Lampblack Use/storage/processing
- Thylox Process
- Tar Refinery Structures
- Historical Outfall
- Approximate location of former Wallingford Avenue Outfall
- Western Overwater Docking
- Shipyard Operations

Impacted Media

- NAPL Area
- Tar Area
- Tar
- DNAPL
- LNAPL
- Mixed LNAPL/DNAPL
- Former Tar*
- Estimated Extent of NAPL—Greater Uncertainty
- Arsenic Sediment Impacts
- Benzene/Naphthalene Groundwater Plume
- Extent of Black Carbon
- Shipyard metals impact

Notes:

1. Site structures delineated as shown in the General Plan, Lake Station,Seattle Gas Company, April 1949, revised in June 1953. Historical railroad features shown as delineated in General Plan, Lake Station, Seattle Gas Co., June 1938. ATCO footprint as shown on 1919 Sanborn map. Sanborn Fire Insurance Map, 1950; Parametrix (1998) FFS; 1946, 1956 aerial photo; Haag 1973.
2. *Tar Area 1 partially removed in 1997.
3. Reference Appendix 1B for structure names.
4. Basemap 2005 USGS aerial photograph. Does not show current conditions.
5. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

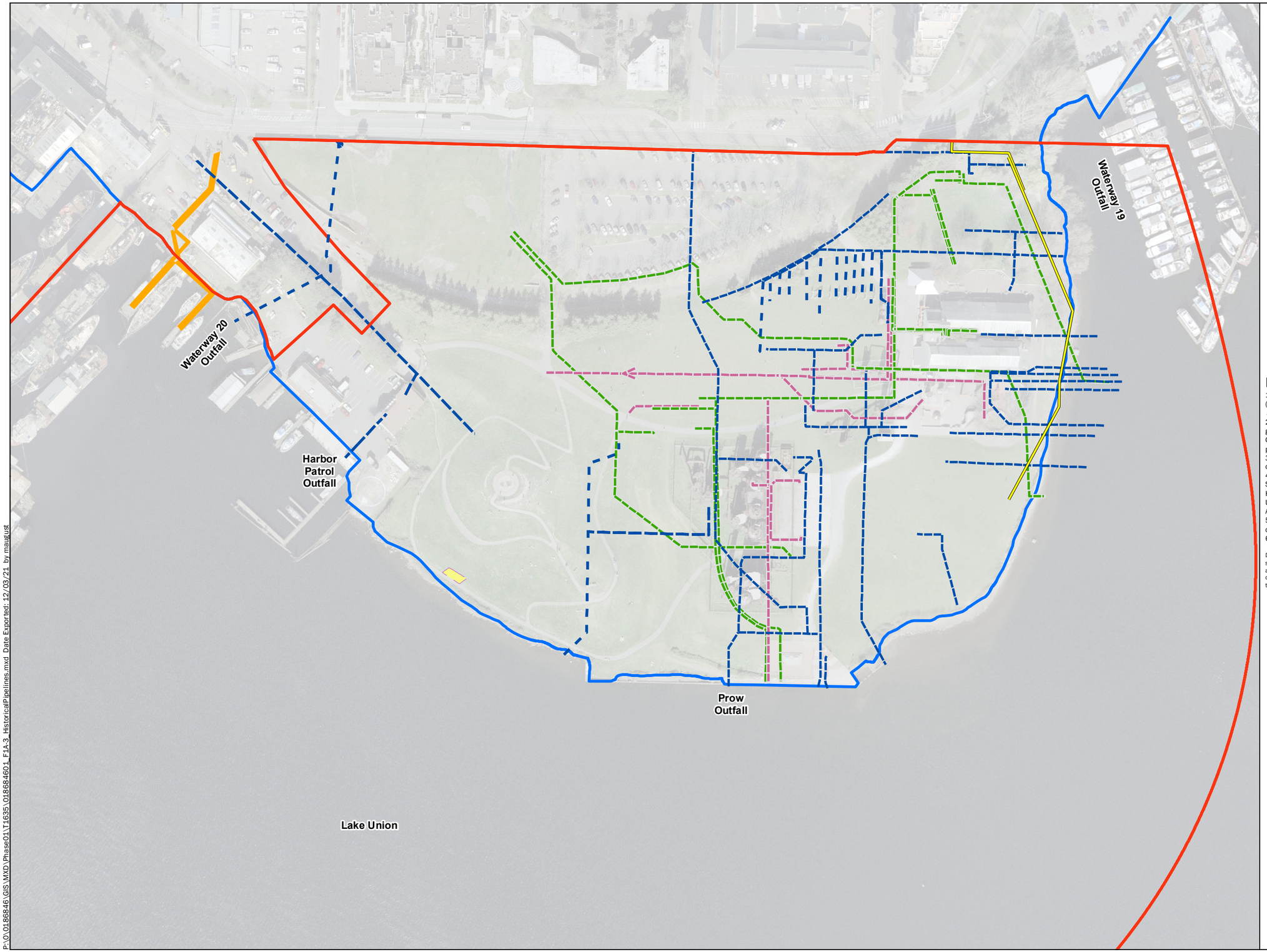
Historical Sources and Impacted Media

Gas Works Park Site
Seattle, Washington

GeoEngineers

Figure 1B-2

Office: SEA Path: P:\0186846\GIS\MXD\Phase01\T1635\0186846 01_F1A-2_Primary_Sources_NAPLTarAreas.mxd Map Revised: 03 December 2021 maugust



Legend

- Area of Investigation
- Shoreline (OHWM)

Historical Pipelines

- Aboveground Benzol Pipeline
- Standard Oil Co. Pipeline
- Oil Line
- Tar Line
- Sewer/Storm Line
- Approximate Location of former Wallingford Avenue Outfall

Notes:

1. Benzol: Schedule for construction specifications for Benzol line (Dow Chemical Co.1951) aerial photo provided by City of Seattle and date (Geo-referencing approximate).
2. Former MGP Sewer/Storm/Creosote/Oil/Tar: Existing underground piping, Seattle Gas Co. Original work Plat by Seattle Gas Co., 1943. Compilation of piping by Seattle Gas Co. (1945), presented by Richard Haag Associates (1973). EBASCO (1946).
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5. Basemap 2005 USGS aerial photograph. Does not show current conditions.
6. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

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Feet

Historical Pipelines (pre-1966)

Gas Works Park Site
Seattle, Washington

GeoEngineers | **Figure 1B-3**

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Legend

- Area of Investigation
- Shoreline (OHWM)
- Consent Decree
- Impervious (Paved or Structures)
- Gravel

Notes:

1. The AOI is documented in the 2013 Amendment of Agreed Order DE 2008 (Ecology 2013).
2. Basemap 2005 USGS aerial photograph. Does not show current conditions.
3. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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Site Plan

Gas Works Park Site
Seattle, Washington

GeoEngineers **Figure 1B-4**

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1899 to 1907 Shoreline Changes

200 0 200
Feet

1907 to 1919 Shoreline Changes

1919 to 1929 Shoreline Changes

1929 to 1973 Shoreline Changes

1973 to Current OHWM Shoreline Changes

Legend

Approximate Shoreline

- 1899
- 1907
- 1919
- 1929
- 1973
- Shoreline (OHWM)

Approximate Shoreline Changes

- 1899 to 1907
- 1907 to 1919
- 1919 to 1929
- 1929 to 1973
- 1973 to Current OHWM

N
W E
S

100 0 100
Feet

Notes:

1. Source: Current shoreline shown as observed in a 2011 aerial photo. The 1973 shoreline shown as in Gas Works Park Grading Plan by Haag (1973) a or b.
The 1929 shoreline shown as delineated in USACE bathymetric map, drafted in 1927 revised in 1929. The 1919 shoreline shown as delineated in 1919 Sanborn Maps.
The 1907 shoreline shown as delineated in the Lake Union Shore Lands, 1907. The 1899 shoreline shown as delineated in US Coast and Geodetic Survey (1899).
2. Shoreline depictions are approximate and do not take into account seasonal fluctuations of lake level.
3. Basemap 2005 USGS aerial photograph. Does not show current conditions.

Shoreline Changes and Fill History

Gas Works Park Site
Seattle, Washington

GeoEngineers

Figure 1B-5

Path: P:\0\0186846\GIS\MXD\Phase01\T1678\018684601_F3-12_ShorelineProgression2021.mxd Map Revised: 23 February 2021 maugust

Legend

- Area of Investigation Line
- 1973 Shoreline
- Limit of Historical Topographic Coverage Overlap
- Fill 5 — Net Fill Contour (1973-1976)
- Cut 5 — Net Cut Contour (1973-1976)

Notes:

1. Reference: Cut and Fill Map prepared by AECOM (2009). Contours are approximate.
2. Source: Gas Works Park Grading Plan by Haag (1973). Gas Works Park Site Plan As-built revised by Haag (1976). Master Plan for Myrtle Edwards Park by Haag (1971).

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

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Park Development: Net Cut and Fill Contours

Gas Works Park Site
Seattle, Washington

GeoEngineers

Figure 1B-6

P:\0\0186846\01\CAD\Task 1678 RIFS\Stakeholder RD RI-FS_2021\Appendix 1A\0186846_F1A-6_Net Cut and Fill Contours.dwg TAB:Net Cut Fill Contours Date Exported: 11/29/21 - 17:21 by cstickel

APPENDIX 1C
Historical Sources Evaluation

Table of Contents

TABLES

FIGURES

APPENDIX 1C
HISTORICAL SOURCES EVALUATION

1.0 INTRODUCTION AND APPROACH

Contamination at the Gas Works Park site originates, in part, from a manufactured gas plant (MGP) that formerly operated on the Gas Works Park property. As part of the remedial investigation (RI), historical information on MGP-related structures and processes was collected and evaluated to identify the main historical sources of contamination and identify those that remain that may act as a current source. When the park was redeveloped in the 1970s, most of the MGP structures were demolished in-place or removed and the landscape was reshaped. The fate of those structures is documented in Table 1C-1. This document provides a synopsis of information gathered regarding the following:

- The fate of the former and existing MGP structures,
- Potential historical MGP sources of impacted media,
- Sources that remain and could act as a current source of contamination.

The following two methods were used to examine the effects of historical MGP activities (e.g., manufacturing, storage, conveyance) on current conditions:

- Review of historical records;
- Evaluation of the results of a non-intrusive geophysical survey;
- Comparison of historical structures and their fate to the present-day distributions of nonaqueous phase liquids (NAPLs), tar, elevated arsenic and other MGP-related chemicals and materials.

2.0 HISTORICAL RECORDS

Available public and private historical records associated with the former MGP were thoroughly reviewed. The research focused on historical documents associated with the following:

- The former MGP
    - Sanborn fire insurance maps,
    - General plans from the Lake Station Seattle Gas Company,
    - MGP process flow diagrams,
    - MGP construction reports,
    - Brown's Directories,
    - Ground and aerial photographs.
- Redevelopment and park construction
    - Soil investigations,
    - Demolition plans and specifications,
    - Regrading, excavation and earthwork plans,

- Concrete work plans,
- As-built drawings,
- Additional architectural records,
- Regrading and waste disposal memos,
- Construction, ground and aerial photographs.

Redevelopment was completed in several stages, as documented in a diagram outlining the schedule for park construction (Haag circa 1970s). Demolition and selective retention of former MGP structures is recorded in park development plans (Haag 1970, 1973a, 1973b) and demolition specifications (Haag 1973b).

In original demolition plans, MGP structures were assigned to one of three categories:

- Complete demolition
- Partial demolition
- Save

Records indicate that regardless of fate, most structures underwent general cleanup such as removal of debris, insulation material, and asbestos. Complete demolition included removal of all structures, including foundations. Partial demolition involved removal of structural members, wood floors, roofs or a combination thereof (foundations or below-ground structures were typically left in place). Saved MGP structures were preserved but modified by removing ladders, cages and pipes.

As-built drawings, additional plans and historical photographs were used to confirm the proposed demolition work. As part of this evaluation, former MGP structures were categorized again into one of five conditions (these are described in more detail in Section 4), which are summarized and color-coded in Table 1C-1:

- All structures demolished and removed (coded light blue in Table 1C-1),
- Below-grade structure demolished in place (green in Table 1C-1),
- Cleaned and saved (orange in Table 1C-1),
- Retained (excluded from demolition and refurbishing) (lavender in Table 1C-1), or
- Inconclusive (no color code).

Structures initially assigned to the partial demolition category in original demolition plans were split into two categories: “below-grade structure demolished in place” or “cleaned and saved” by using as-built drawings. Findings are summarized on Figure 1C-1 and in Table 1C-1. Each structure is numbered and color-coded as described above. For convenience, the area has been subdivided into geographic areas, which are included in both the table and figure. Table 1C-1 also provides direct quotations from the historical records and references to support the interpretations. References to the historical documents cited are provided below.

Historical records review also identified potential sources associated with redevelopment and park construction activities. Possible sources are the arsenic-sulfur burial area and oxide woodchips disposal berm. Historical records map the arsenic burial area near the former washer liquor coolers footprint (west

of structures 56 and 57) by the central and south sections (Haag 1974); the area was excavated to 6 feet prior to backfilling. The oxide woodchips stockpile is mapped in the central section near a former concrete slab (structure 100) (Haag 1973a, Parametrix 1996, Tetra Tech 1987).

3.0 GEOPHYSICAL SURVEY

A geophysical survey was conducted in 2013; results are reported in Appendix 2A Attachment 2A-1 of the RI report. The non-intrusive geophysical survey used magnetic, electromagnetic (EM) and ground-penetrating radar (GPR) technologies. In general, magnetic technologies generate a response to iron and steel objects. EM technologies respond to electrically conductive objects such as tanks, pipelines and reinforcing steel; some soil types may also generate a measurable response.

Although the survey did not reveal large subsurface anomalies indicative of large buried tanks or structures (Zonge 2013), smaller magnetic and EM anomalies were observed, as noted in the Geophysical Results column of Table 1C-1 and depicted in Figure 1C-2.

In general, the geophysical anomalies coincide with locations of structures indicated in historical records. Anomalies B, E, G, H, and J identified by the geophysical study (Figure 1C-2) align with documented broken bottoms of former structures. Rubble and soil redistribution throughout redevelopment and park construction could explain anomalies A, C, D, and F. Anomaly I is inconclusive; there are no records of MGP structures or utilities in this area. The majority of the linear anomalies identified are current underground utilities. However, the interpreted pipe between anomalies A and B matches the orientation and general area of a former MGP oil line connecting oil heaters (structure 83 in Figure 1C-1) and the fuel oil storage tank (structure 60 in Figure 1C-1) (Seattle Gas Company 1949).

4.0 EVALUATION OF THE FATE OF HISTORICAL STRUCTURES AND THEIR POTENTIAL IMPACT ON CURRENT CONDITIONS

Comparison of historical structures and their fate to the present-day distributions of NAPLs, tar, elevated arsenic and other MGP-related chemicals and materials was used to identify historical and potentially current sources of contamination (e.g., tar) in the upland.

4.1. Fate of Historical Structures

The fate of historical structures was evaluated to identify any current potential sources of contamination (e.g., tar). There is documentation that most of the historical structures were demolished and removed, making it unlikely that they are current contaminant sources. Structures categorized as cleaned and saved underwent general cleanup, including removal of debris, insulation material, and asbestos. These actions suggest that, in general, cleaned and saved structures are not serving as significant current sources of contamination[1].

Several of the below-grade structures or below-grade portions of structures were demolished in place (historical records note that broken bottoms were left in place). Because such structures would be unable to retain product, they are unlikely to be current sources.

[1] Removal of raw materials, products and byproducts was incomplete in some cases. One example is the partially buried scrubber tank (structure 62 in Figure 1C-1), which was discovered and pumped out in 1998 (see Table 1C-1).

Current potential sources of contamination are discussed in Section 4.3.

4.2. Potential Historical Sources

Individual structures were evaluated to identify potential historical sources of impacted media; results are presented in Table 1C-1. Structures needed to meet the following two criteria to be considered a potential historical source of contamination:

- The structure housed manufacturing equipment, or stored or conveyed manufactured gas raw materials, products, and byproducts; and
- The structure was located in or near an area of significantly impacted media.

Only areas of substantial impacts (e.g., the presence of tar or NAPL, or contaminants of concern [COCs] at concentrations substantially above screening levels) were considered for this evaluation. Areas where impacted media were redistributed (e.g., during redevelopment) were not considered, as the impacted media cannot be connected to an original source. The following presentation is organized by geographic area, as depicted in Figure 1C-1 and Table 1C-1.

4.2.1. Northwest

Original structures in the northwest were not considered historical sources of contaminated media because substantial contamination has not been observed in this area.

4.2.2. North

Former structures in the north were not considered historical sources, as substantial contamination has not been observed in this area.

4.2.3. Northeast

The northeast area contained process and storage structures that may have acted as historical sources of contamination. MGP structures/activities potentially contributed to tar, dense nonaqueous phase liquid (DNAPL) and light non-aqueous phase liquid (LNAPL) impacts in the area. A geophysical anomaly is identified in the area, possibly consisting of buried debris. Potential historical sources in the northeast area are tallied in Table 1:

TABLE 1. POTENTIAL HISTORICAL SOURCES, NORTHEAST AREA

Structure Number	Structure Name
Potential historical sources of tar and/or DNAPL	
8	Water-Gas Circulating Liquor Well
9	Water-Gas Tar Separator
11	Tar Storage Tank
13	Primary Condensers (2)
15	No. 2 Water-Gas House
Potential historical sources of LNAPL	
10	Diesel Oil Storage Tank

Most of the structures in the northeast area functioned as storage vessels; leaks and spills from the vessels potentially released contaminated materials. All structures listed in Table 1 have been removed, except structures 8 and 9.

4.2.4. East

Historical process and storage structures in the east area potentially contributed to tar, DNAPL, arsenic and additional COC releases in the area. The east area was not included in the 2013 geophysical survey. Potential historical sources in the east area are tallied in Table 2 below.

TABLE 2. POTENTIAL HISTORICAL SOURCES, EAST AREA

Structure Number	Structure Name
Potential historical sources of tar and/or DNAPL	
21	Exhauster Building
23	Exhauster
24	Liquid Purification House
25	Electrostatic Precipitators (2)
32	NE Tar Well
33	SW Tar Well
34	SE Tar Well
36	Loading Platform
Potential historical sources of arsenic	
26	Liquid Purification Tower
31	NW Tar Well (slurry settling tank)
35	Kelly Filter
Potential historical sources of other COCs	
27	Water Scrubber
39	Paint Shed
40	Machine Shop

Review of historical MGP process flow diagrams identified that the Thylox process structures were located in the east area (structures 26, 31, and 35). The liquid purification tower (structure 26) is associated with the Thylox process, in which hydrogen sulfide in the gas was absorbed by a recirculating sodium thioarsenate solution (Seattle Gas Company 1939, Ahlquist 1954, Washington Natural Gas 1984). The solution was regenerated by aeration in a slurry settling tank (structure 31). Elemental sulfur precipitate was skimmed off and dewatered in the Kelly filter (structure 35) before being hauled off-site.

4.2.5. Southeast

Historical process and storage structures in the southeast area potentially contributed to LNAPL, benzene, and naphthalene impacts in soil and groundwater. Geophysical anomalies are identified in the area including potentially current utilities (see Figure 1C-2) and below-grade structures that were demolished in

place, particularly the purifiers (structures 52 and 54). Potential historical sources in the southeast area are tallied in Table 3 below.

TABLE 3. POTENTIAL HISTORICAL SOURCES, SOUTHEAST AREA

Structure Number	Structure Name
Potential historical sources of LNAPL, benzene, and/or naphthalene	
42	Naphthalene Settling Trough
43	Kettle Column
44	Kettles (2)
45	Heat Exchangers, Primary Still and Distillation Tower
48	Tanks No. 1 to 7: Finished, Crude, Absorption, Treated, Distilled Oil Tanks and Light & Heavy Ends Tank
49	Benzol Storage
50	Tanks No. 9 to 11: Washed, Re-Run Oil Tanks and Crude Light Oil Tank
51	Tanks No. 13 to 21

Review of historical MGP process flow diagrams identified that the light oil plant was located in this area. Product entered the area from two locations: the water scrubber (structure 27), which led to the naphthalene trough (structure 42), and the light oil absorber (structure 107), which led to the distillation tower (structure 45). The light oils were separated into various vessels and later sold.

4.2.6. South

Historical process and storage structures in the south potentially contributed to the presence of tar, DNAPL, LNAPL, and lampblack in the southern portion of the upland. Geophysical anomalies are identified in the area, potentially former and/or current utilities and below-grade structures that were demolished in place. Potential historical sources in the south area are tallied below in Table 4.

TABLE 4. POTENTIAL HISTORICAL SOURCES, SOUTH AREA

Structure Number	Structure Name
Potential historical sources of tar and/or DNAPL	
56	Roundwell
57	Washer Liquor Coolers
58	Coolers
61	Water Gas Relief Holder
62	RH Scrubbers (2) and Underground Relief Holder Scrubber Tank
63	Secondary Scrubber
64	Alco Coolers
65	Tar Separator
66	Tar Separator
70	Tar Separator

Structure Number	Structure Name
Potential historical sources of LNAPL	
59	Pump House
60	Fuel Oil Storage Tank
Potential historical sources of lampblack	
67	60-foot-diameter Lampblack Thickener
68	40-foot-diameter Lampblack Thickener
69	Scum Pits (4)
72	Collecting Tank
74	Oliver Filters (2)
79	Dryer Shed

MGP material stored on-site was a source to the south area. Aerial photographs indicate that an area adjacent to the shoreline was formerly used as an open storage yard for lampblack, coal, coke, and other MGP raw materials, byproducts and products. Lampblack was the main byproduct of oil gasification; it was separated from the gas stream in wash boxes (structures 52, 53, and 54), extracted from the resulting slurry in the Dorr clarifier (structures 67 and 68) and then dewatered in the Oliver filters (structure 74). Wet lampblack was stored in stockpiles near the western corner of the Prow prior to going into the drying shed (structure 95) for use on-site as a fuel or to make briquettes for commercial sale. All these facilities were in the south-central area. These materials were potentially transported to the lake by sloughing of stockpiles, stormwater runoff, discharge through the stormwater system or direct deposition in the water during over-water loading of barges docked along the Prow at the MGP.

4.2.7. Central

Historical facilities in the central area potentially contributed to tar, DNAPL, and LNAPL releases in the area. Geophysical anomalies are identified in this portion of the upland including potentially current utilities and below-grade structures that were demolished in place. Table 5 identifies potential historical sources.

TABLE 5. POTENTIAL HISTORICAL SOURCES, CENTRAL AREA

Structure Number	Structure Name
Potential historical sources of tar and/or DNAPL	
102	Loading Dock
108	Braun Cooler
114	Sewer Basin
115	Circulating Liquor Well
116	Emulsion Well
117	Hot Tar Well
118	Tar Separator
120	No. 1 Water-Gas House
121	Super Heater
122	Carburetor

Structure Number	Structure Name
123	# 8 HI-BTU Oil-Gas Generator
124	# 7 HI-BTU Oil-Gas Generator
125	No. 1 Water-Gas Generator
126	No. 2 Water-Gas Generator
127	# 7 Oil-Gas Scrubber
128	# 8 Oil-Gas Scrubber
Potential historical sources of LNAPL and/or DNAPL	
103	Catch Basin and Gasoline Tank
106	Light Oil Pre-Cooler
107	Light Oil Absorber and Overhead Pipes

Notes:
BTU = British thermal unit

Review of historical MGP process flow diagrams identified the light-oil absorber (structure 107) as a structure where purified gas was forced to pass through a cascade of heavy oil; the heavy oil was recirculated (Seattle Gas Company 1939, Washington Natural Gas 1984, Eggers 1998).

4.2.8. General

Over-water structures and piping potentially contributed to tar, DNAPL and LNAPL releases around their former footprints. Docks were removed however, some pilings and support structures remain in place. Below-grade piping was to be removed during redevelopment. The normal range for underground piping is 3 to 6 feet below ground surface. Demolition instructions indicate extreme care was to be taken near the lake's edge; product was to be pumped out and piping was to be plugged prior to removal. The majority of the linear anomalies identified by the geophysical survey are existing underground utilities or rubble. Table 6 list potential over-water and other historical sources.

TABLE 6. OTHER POTENTIAL HISTORICAL SOURCES IN SHORELINE AND UPLAND

Structure ID	Structure Name
Overwater structures	
75	Barge Loading Dock
132	Tar Unloading Dock
133	Oil Dock
Pipelines	
N/A	Piping

4.3. Potential Current Sources

The evaluation of the fate of historical structures eliminated all but two structures (8 and 9) as potential ongoing sources.

TABLE 7. POTENTIAL HISTORICAL AND CURRENT POTENTIAL SOURCES, NORTHEAST AREA

Structure Number	Structure Name
Potential current source of tar and/or DNAPL	
8	Water-Gas Circulating Liquor Well
9	Water-Gas Tar Separator

Limited information was available in historical records for Structures 8 and 9. Notes in the historical record state that "foundations remain as is" for these two structures. Both structures are in the northeast corner of the park and, for the purposes of this evaluation, are conservatively included as both historical and current potential sources of DNAPL and tar. The tops of these structures were originally at-grade or slightly above; further information about the subsurface design of structures 8 and 9 is unknown.

Given the amount of time since historical industrial operations ended (these structures likely have not been used since carburetted-water-gas operations ended in 1952), it is unlikely that these structures are a current source of a contamination. Any product contained in these structures would have evaporated and/or hardened over the past 60 plus years. Investigation data suggest these structures were not a historical source of contamination. Borings (TG-01 and TG-03) along the perimeter did not detect NAPL impacted soil. Plus, neither NAPL or tar is mapped beneath these structures. These same data support that these structures are not a current source.

5.0 CONCLUSION

This evaluation helped to characterize former MGP structures and to identify those that may have been historical sources of contamination or may continue to act as a source. The footprints of the potential historical or current source structures in relation to the distribution of NAPL, tar, soil, sediment and groundwater impacts were used to develop the conceptual site model in the RI.

6.0 REFERENCES

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Table 1C-1

Fate of MGP Structures and Source Evaluation[1]

Gas Works Park Site

Seattle, Washington

Structure Number	Section	Former MGP Structure	Fate of Former MGP Structure[2]	Notes from Historical Records Review[3]	Historical References[4]	Geophysical Results[5]	Source Evaluation[6]	Potential Historical Source
1	North	Gas Storage Holder		2-million-cubic-foot capicity holder labeled "remove concrete base" and "to be removed."	6,8	Outside geophysical survey area	NC	
2	North	Blower House		Demolition instructions note, "foundations of the blower house ... shall be removed." Labeled "remove concrete slabs."	5,6	Outside geophysical survey area	NC	
3	North	Old Boiler Shed		Demolition instructions note, "foundations of ... old boiler shed ... shall be removed." Labeled "remove concrete slabs."	5,6	Outside geophysical survey area	NC	
4	North	Propane Vaporizers		Demolition instructions note, "foundations of ... propane vaporizers ... shall be removed." Labeled "remove concrete slabs."	5,6	Outside geophysical survey area	NC	
5	North	Regulator Building		Demolition instructions note, "foundations of ... regulators building ... shall be removed." Labeled "remove" and "remove concrete slabs."	4,6	Outside geophysical survey area	NC	
6	North	LP Pump House		Demolition instructions note, "foundations of ... L.P. pump house ... shall be removed." Labeled "remove" and "remove concrete slabs."	4,6	Outside geophysical survey area	NC	
7	North	Underground LP Storage Tanks		90,000-gallon-capacity storage labeled "underground." Demolition instructions note "North Section ... miscellaneous concrete and all sumps or pits shall be removed;" inconclusive if the underground propane storage tanks included.	2,7	Outside geophysical survey area	NC	
8	NE	WG Circulating Liquor Well		Demolition instructions note, "The Water Gas circulating liquor ... foundations shall remain as is." As-built notes "retained structure above grade ... approximate elevation 26.3 feet COS."	5,7,9	Outside geophysical survey area	Potential current source of tar and NAPL.	X
9	NE	WG Tar Separator		Demolition instructions note, "... Water Gas tar separator ... foundations shall remain as is." As-built notes "retained structure above grade ... approximate elevation 26.3 feet COS."	5,7,9	Outside geophysical survey area	Potential current source of tar and NAPL.	X
10	NE	Diesel Oil Storage Tank		Demolition instructions note, "No. 1 Diesel Oil storage tank ... shall be removed to depth noted on plan." Labeled "remove" and "excavate 4 feet."	5,7,9,13	"G - Indicative of shallow buried material." Possibly related to broken bottoms left in place and/or demolition debris. Approximate location of refusal explorations during 2013 SI and 2007 NE Corner investigation (Floyd|Snider 2008).	Potential source of LNAPL.	X
11	NE	Tar Storage Tank		Demolition instructions note, "... No. 2 tar storage tank ... shall be removed to depth noted on plan." Labeled "remove" and "excavate 4 feet."	5,7,9,13	"G - Indicative of shallow buried material." Possibly related to broken bottoms left in place and/or demolition debris. Approximate location of refusal explorations during 2013 SI and 2007 NE Corner investigation (Floyd|Snider 2008).	Potential source of tar and DNAPL.	X
12	NE	3-100KVA Transformer Bank		Demolition instructions note, "The transformer bank foundation ... shall be removed".	5,7	Outside geophysical survey area	NC	
13	NE	Primary Condensers (2)		Demolition instructions note, "... primary condenser (2) foundations ... shall be removed". Labeled "remove." As-built notes, "bases broken ... remaining structure below grade ... may be encountered at approximate elevation 19 feet COS."	5,7,9	Outside geophysical survey area	Potential source of tar and DNAPL.	X
14	NE	Pipe Piers		Demolition instructions note "... pipe piers shall be removed."	2,5	"G - Indicative of shallow buried material." Possibly related to demolition debris left in place.	NS	
15	NE	No. 2 WG House		Demolition instructions note, "No. 2 WG slab and pilings, trestle foundations north of Boiler House shall be removed."	5,7,9	"G - Indicative of shallow buried material." Possibly related to demolition debris left in place.	Potential source of tar and DNAPL.	X
16	NE	Electric Compressors		Demolition instructions note, "The electrical compressor foundation and footings shall be removed a minimum of 4 feet depth." Labeled "remove."	4,5,7	Outside geophysical survey area	NS	
17	East	Boiler House		Demolition instructions note, "The structural I-Beams, interior drums and tubing shall remain ... All pipes entering the Exhauster Building and Boiler House are to be removed at the foundation line. Do not disturb foundations."	4,5,7,9	Outside geophysical survey area	NC	
18	East	Boiler No. 9		Demolition instructions note, "Boiler No. 9 shall be removed completely."	5	Outside geophysical survey area	NC	
19	East	Boiler No. 11		Demolition instructions note, "Boiler No. 11 shall be partially demolished as follows: remove all masonry, insulation, steel plates and exterior piping." As-built notes, "retained structure above grade."	5,9	Outside geophysical survey area	NC	
20	East	Shear Shed		Demolition instructions note, "Concrete slab and pit east of Boiler House shall be removed."	5,7	Outside geophysical survey area	NS	
21	East	Exhauster Building		Demolition instructions note, "Exhauster Building - weld or braze spots in two thread groves of all gear shafts to prevent removal of the wheels. The wheels are to remain free to move. All pipes entering the Exhauster Building and Boiler House are to be removed at the foundation line. Do not disturb foundations." Labeled "clean & paint."	5,7,8	Outside geophysical survey area	Gas exhausters pumped the gas through the system and also caused fine drops of tar to impinge upon its pump blades, also referred to as "tar extractors". Potential source of tar.	X
22	East	Free Water Heater		Labeled "save, no major demolition."	5	Outside geophysical survey area	NS	
23	East	Exhauster		Labeled "partial demolition."	5	Outside geophysical survey area	Gas exhausters pumped the gas through the system and also caused fine drops of tar to impinge upon its pump blades, also referred to as "tar extractors". Potential source of tar.	X
24	East	Liquid Purification House		Demolition instructions note, "Liquid Purification House ... remove slab and foundation as shown on plan, piping and I-Beams."	4,5,7	Outside geophysical survey area	Potential source of arsenic, tar, and DNAPL.	X

Table 1C-1

Fate of MGP Structures and Source Evaluation[1]

Gas Works Park Site

Seattle, Washington

Structure Number	Section	Former MGP Structure	Fate of Former MGP Structure[2]	Notes from Historical Records Review[3]	Historical References[4]	Geophysical Results[5]	Source Evaluation[6]	Potential Historical Source
25	East	Electrostatic Precipitators (2)		Demolition instructions note "Block foundations near the electric precipitators shall remain." Labeled "to remain" and "save, no major demolition."	4,5,7	Outside geophysical survey area	Electrostatic precipitators removed the finest drops of tar attracting them to high voltage wires. The tar would then run down the wires and out the bottom of the precipitators.	X
26	East	Liquid Purification Tower		Demolition instructions note, "Remove debris from circular pit shown as the liquid purification tower and cover pit with 4x10 wood deck."	5	Outside geophysical survey area	Operated in the removal of sulfur from gas as part of the Thylox process which used sodium thio-arsenate solution to purify the gas of sulfur. Potential source of arsenic.	X
27	East	Water Scrubber		Labeled "remove, complete demolition."	5	Outside geophysical survey area	Operated in the removal of light oils. Following the electrostatic precipitators, the gas was cooled to improve the recovery of benzene and toluene. This was accomplished by direct contact with cold water in the water scrubber, causing considerable naphthalene to condense and become suspended in the water as an oily solid. Potential source of benzene and naphthalene.	X
28	East	Storage		Demolition instructions note, "... storage area ... remove slab foundation as shown on plan." Labeled "remove slab foundation."	4,5,7	No anomaly	NS	
29	East	Carpenter Shop		Demolition instructions note, "... carpenter shop ... remove slab foundation as shown on plan." Labeled "remove slab foundation."	4,5,7	Outside geophysical survey area	NS	
30	East	Electric Shop		Demolition instructions note, "... electric shop ... remove slab foundation as shown on plan." Labeled "remove slab foundation."	4,5,7	Outside geophysical survey area	NS	
31	East	NW Tar Well (slurry settling tank)		Demolition instructions note, "Remove the ...northwest ... tar wells completely and stockpile the contaminated material in the on-site stockpile." General area labeled "arsenic area remove 2 feet & dump." As-built notes, "bottoms of tar wells broken... remaining structure below grade ... may be encountered at approximate elevation 10 feet COS." Also labeled "slurry settling tank."	4,5,6,7,8,9	Outside geophysical survey area	The slurry settling tank regenerated the Thylox sodium thio-arsenate solution by aeration in open concrete pits. The Thylox solution was recirculated in the sulfur purification process. Potential source of arsenic.	X
32	East	NE Tar Well		Demolition instructions note ,"Remove the northeast ... tar wells completely and stockpile the contaminated material in the on-site stockpile." General area labeled "arsenic area remove 2 feet & dump." As-built notes, "bottoms of tar wells broken... remaining structure below grade ... may be encountered at approximate elevation 10 feet COS."	4,5,6,7,8,9	Outside geophysical survey area	Tar possibly originated from electrostatic precipitators or exhauster building. Tar well is located near tar loading dock, where tar was sold to tar companies. Potential source of tar and DNAPL.	X
33	East	SW Tar Well		Demolition instructions note, "Remove the ...southwest ... tar wells completely and stockpile the contaminated material in the on-site stockpile." General area labeled "arsenic area remove 2 feet & dump." As-built notes, "bottoms of tar wells broken... remaining structure below grade ... may be encountered at approximate elevation 10 feet COS."	4,5,6,7,8,9	Outside geophysical survey area	Tar possibly originated from electrostatic precipitators or exhauster building. Tar well is located near tar loading dock, where tar was sold to tar companies. Potential source of tar and DNAPL.	X
34	East	SE Tar Well		Demolition instructions note, "Remove the ... southeast ... tar wells completely and stockpile the contaminated material in the on-site stockpile." General area labeled "arsenic area remove 2 feet & dump." As-built notes, "bottoms of tar wells broken... remaining structure below grade ... may be encountered at approximate elevation 10 feet COS."	4,5,6,7,8,9	Outside geophysical survey area	Tar possibly originated from electrostatic precipitators or exhauster building. Tar well is located near tar loading dock, where tar was sold to tar companies. Potential source of tar and DNAPL.	X
35	East	Kelly Filter		Demolition instructions note, "Sulfur area - remove this material to depths shown on plan." Area surrounding Kelly Filter shaded and labeled "sulfur excavate 2 ft." General area labeled "arsenic area remove 2 feet & dump." As-built notes, "sulfur-arsenic excavated to 12 feet COS."	5,6,7,8,9	Outside geophysical survey area	The Kelly filter dewatered the elemental sulfur skimmed from the top of the slurry tank, decreasing the moisture content of the residual sulfur -arsenic paste before it was hauled off-site. Potential source of arsenic.	X
36	East	Loading Platform		Absent in as-built plans. Comment: Demolition captured by aerial and ground photographs.	10,11	Outside geophysical survey area	NS	X
37	East	Blacksmith Shop		Absent in as-built plans. Comment: Demolition captured by aerial and ground photographs.	10,11	Outside geophysical survey area	NS	
38	East	Welding Shop		Demolition instructions note, "Machine shop ... and small foundation east of the machine shop to be removed."	5,7	Outside geophysical survey area	NS	
39	East	Paint Shed		Labeled "remove, complete demolition."	5	Outside geophysical survey area	Storage of products potentially contributing COCs.	X
40	East	Machine Shop		Demolition instructions note, "... paint shed foundation ... to be removed."	5,7	Outside geophysical survey area	Storage of products potentially contributing COCs.	X
41	SE	No. 2 Foamite House		Absent in as-built plans.	10	Outside geophysical survey area	NS	
42	SE	Naphthalene Settling Trough		Demolition instructions note, "Remove all foundations, slabs, bases, etc."	5,7	Outside geophysical survey area	Operated in the removal of light oils from gas. Following the light oil absorber, heavy oil and light oils were separated by fractional distillation in a distillation tower adjacent the naphthalene settling trough. General area is noted as "naphthalene plant" in 1938 plan. Light oils were stored in tanks within the light oil plant and later sold. Potential source of naphthalene.	X

Table 1C-1

Fate of MGP Structures and Source Evaluation[1]

Gas Works Park Site
Seattle, Washington

Structure Number	Section	Former MGP Structure	Fate of Former MGP Structure[2]	Notes from Historical Records Review[3]	Historical References[4]	Geophysical Results[5]	Source Evaluation[6]	Potential Historical Source
43	SE	Kettle Column		Demolition instructions note, "Remove all foundations, slabs, bases, etc."	5,7	Outside geophysical survey area	Part of the light oil plant. Potential source of LNAPL, benzene, and naphthalene.	X
44	SE	Kettles (2)		Demolition instructions note, "Remove all foundations, slabs, bases, etc."	5,7	Outside geophysical survey area	Part of the light oil plant. Potential source of LNAPL, benzene, and naphthalene.	X
45	SE	Heat Exchangers, Primary Still, and Distillation Tower		Demolition instructions note, "Remove all foundations, slabs, bases, etc."	5,7	Outside geophysical survey area	Part of the light oil plant. The distillation tower separated light oils (benzene, toluene, and naphthalene) and "straw oil." Straw oil was sent back to the light oil absorber, and the light oils were stored in tanks and later sold. Potential source of LNAPL, benzene, and naphthalene.	X
46	SE	Soda Tank		Demolition instructions note, "Remove all foundations, slabs, bases, etc."	5,7	Outside geophysical survey area	NS	
47	SE	Acid Tank		Demolition instructions note, "Remove all foundations, slabs, bases, etc."	5,7	Outside geophysical survey area	NS	
48	SE	Tanks No. 1 to 7: Finished, Crude, Absorption, Treated, Distilled Oil Tanks and Light & Heavy Ends Tank		Demolition instructions note, "Remove all foundations, slabs, bases, etc. ... Excavating oil contaminated material shall be performed with extreme care. This excavation extends to the lake level and shall commence 30 feet or more inland from the water's edge. Demolition work and pipe removal shall be completed prior to any excavating." Labeled "excavate to 2 feet below proposed grade - to water level within 10 feet of shoreline. Fill with material from north section."	5,7	Outside geophysical survey area	Structure within the light oil plant. Potential l source of LNAPL, and benzene. Remediated by AS/SVE 2001-2006.	X
49	SE	Benzol Storage		Demolition instructions note, "Remove all foundations, slabs, bases, etc. ... Excavating oil contaminated material shall be performed with extreme care. This excavation extends to the lake level and shall commence 30 feet or more inland from the water's edge. Demolition work and pipe removal shall be completed prior to any excavating." Labeled "excavate to 2 feet below proposed grade - to water level within 10 feet of shoreline. Fill with material from north section."	5,7	No anomaly	Structure within the light oil plant. Potential l source of LNAPL, and benzene. Remediated by AS/SVE 2001-2006.	X
50	SE	Tanks No. 9 to 11: Washed, Re-Run Oil Tanks and Crude Light Oil Tank		Demolition instructions note, "Remove all foundations, slabs, bases, etc. ... Excavating oil contaminated material shall be performed with extreme care. This excavation extends to the lake level and shall commence 30 feet or more inland from the water's edge. Demolition work and pipe removal shall be completed prior to any excavating." Labeled "excavate to water level."	5,7	No anomaly	Structure within the light oil plant. Potential l source of LNAPL, and benzene. Remediated by AS/SVE 2001-2006.	X
51	SE	Tanks No. 13 to 21		Demolition instructions note, "Remove all foundations, slabs, bases, etc."	5,7	No anomaly	Structure within the light oil plant. Potential l source of LNAPL, and benzene. Remediated by AS/SVE 2001-2006.	X
52	SE	Purifiers No. 6 to 12		Specifications note, "Remove all wood chips and stockpile where shown." Labeled "Purifiers - break in top 2 feet of concrete, remove top 2 feet of iron oxide." As-built notes, "bottoms of concrete purifiers broken ... remaining structure below grade ... may be encountered at 13 feet COS."	3,5,6,8,9	"H - Indicative of steel pipe or series of pipes." Anomaly follows footprint of purifiers; potential response to broken bottoms left in place.	Operated in the removal of sulfur. Gas passed through layers of moist wood shavings coated with hydrated iron-oxide. Reaction with the hydrogen sulfide in the gas formed ferric sulfide and water. The sulfur remained in the shavings as elemental sulfur. Spent shavings were hauled off-site. NC	
53	SE	Purifiers No. 13 to 14		Specifications note ,"Remove all wood chips and stockpile where shown ... No. 13 and No. 14 shall be completely removed including the bottoms."	3,5,6,8,9	No anomaly	Operated in the removal of sulfur. Gas passed through layers of moist wood shavings coated with hydrated iron-oxide. Reaction with the hydrogen sulfide in the gas formed ferric sulfide and water. Air was added and oxygen replaced the sulfur in the iron sulfide and restored the active iron oxide. The sulfur remained in the shavings as elemental sulfur. Spent shavings were hauled off-site. NC	

Table 1C-1

Fate of MGP Structures and Source Evaluation[1]

Gas Works Park Site

Seattle, Washington

Structure Number	Section	Former MGP Structure	Fate of Former MGP Structure[2]	Notes from Historical Records Review[3]	Historical References[4]	Geophysical Results[5]	Source Evaluation[6]	Potential Historical Source
54	SE	Purifiers No. 15 to 18		Specifications note ,"Remove all wood chips and stockpile where shown ... Reduce concrete to maximum 3 feet on a side." Labeled "Purifiers - break in top 2 feet of concrete, remove top 2 feet of iron oxide." As-built notes, "bottoms of concrete purifiers broken ... remaining structure below grade ... may be encountered at 13 feet COS."	3,5,6,8,9	"J - Indicative of a buried object. ... Its close proximity to the landscape structures (The Prow) and utility lines suggest that it may be associated with current infrastructure, irrigation or electrical." Anomaly follows footprint of purifiers; potential response to broken bottoms left in place. Additionally east wall of former drying shed is a below grade structure left in place. Anomaly is also in proximity to multiple subsurface current electrical utilities.	Operated in the removal of sulfur. Gas passed through layers of moist wood shavings coated with hydrated iron-oxide. Reaction with the hydrogen sulfide in the gas formed ferric sulfide and water. The sulfur remained in the shavings as elemental sulfur. Spent shavings were hauled off-site. NC	
55	SE	Oxide Mixer		General area labeled "excavate to 2 feet below proposed grade - to water level within 10 feet of shoreline. Fill with material from north section." Labeled "remove, complete demolition."	5,7	No anomaly	NS	
56	South	Roundwell		Demolition instructions note, "Remove ... roundwell concrete base." Structure labeled "remove, complete demolition," and shaded area labeled "excavate 3 feet."	4,5,7	No anomaly	Storage of tar/DNAPL. Water gas tar pipes directed to this structure. DNAPL observed in the area. Potential source of DNAPL.	X
57	South	Washer Liquor Coolers		Demolition instructions note, "Remove ... washer liquor coolers base and footings near the relief holder." Structure labeled "remove, complete demolition," and shaded area labeled "excavate 3 feet."	4,5,7	"C - Indicative of buried metallic objects". Anomaly possibly related to demolition of structures or fill material related to Kite Hill regrading.	Potential source of tar and NAPL.	X
58	South	Coolers		Demolition instructions note, "Remove ... cooler base and footings." Structure labeled "remove, complete demolition," and shaded area labeled "excavate 3 feet."	4,5,7	"C - Indicative of buried metallic objects". Anomaly possibly related to demolition of structures or fill material related to Kite Hill regrading.	Potential source of tar and NAPL.	X
59	South	Pump House		Demolition instructions note, "Remove ... pump house slab, footings, foundations." Structure labeled "remove, complete demolition," and shaded area labeled "excavate 3 feet."	4,5,7	No anomaly	Potential source of LNAPL	X
60	South	Fuel Oil Storage Tank		Structure labeled "remove, complete demolition," and shaded area labeled "excavate 3 feet."	5,7	Linear anomaly possibly related to linear anomaly identified west of # 2 OG generator, which coincides with former subsurface oil lines.	Potential source of LNAPL. Also general area of oil spill in 1969.	X
61	South	WG Relief Holder		Demolition instructions note, "Remove ... water gas relief holder concrete base and steel tank bottom." 500-million-cubic-foot holder labeled "remove, complete demolition," and shaded area labeled "excavate 3 feet."	4,5,7	No anomaly	Potential source of tar and DNAPL.	X
62	South	RH Scrubbers (2) and Underground Relief Holder Scrubber Tank		Demolition instructions note, "Structures to remain ... RH scrubbers." Structure labeled "save, no major demolition," and general shaded area labeled "excavate 3 feet." Comment: The partially buried scrubber tank was discovered in 1997 with approximately 2,500 gallons of viscous tarry liquid (refer to RI Figure 2-7). The liquid was removed and transported off-site. The tank walls were inspected after product removal and appeared in excellent condition.	4,5,7,12	Outside geophysical survey area	Potential source of DNAPL. Source material removed in 1998.	X
63	South	Secondary Scrubber		Demolition instructions note, "Structures to remain ... secondary scrubber." Structure labeled "save, no major demolition," and general shaded area labeled "excavate 3 feet."	4,5,7	Outside geophysical survey area	Operated in removed residual tar, following wash boxes and primary scrubbers. Potential source of DNAPL.	X
64	South	Alco Coolers		Demolition instructions note, "Remove ... Alco cooler footings." Labeled "remove," general shaded area labeled "excavate 3 feet."	4,5,7	Outside geophysical survey area	Potential source of DNAPL.	X
65	South	Tar Separator		Labeled "remove." General area stripped a minimum of 18 inches.	5	Outside geophysical survey area	Operated in removal of tar following wash boxes, and primary and secondary scrubbers. Surrounding soil was stripped during redevelopment. Potential source of tar and DNAPL.	X
66	South	Tar Separator		Labeled "remove." General area stripped a minimum of 18 inches.	5	Outside geophysical survey area	Operated in removal of tar following wash boxes, and primary and secondary scrubbers. Surrounding soil was stripped during redevelopment. Potential source of tar and DNAPL.	X

Table 1C-1

Fate of MGP Structures and Source Evaluation[1]

Gas Works Park Site

Seattle, Washington

Structure Number	Section	Former MGP Structure	Fate of Former MGP Structure[2]	Notes from Historical Records Review[3]	Historical References[4]	Geophysical Results[5]	Source Evaluation[6]	Potential Historical Source
67	South	60-feet Diameter Lampblack Thickener		Demolition instructions note, "Expose 4 feet of the ... 60 feet diameter lampblack thickener and clean the interiors completely." Labeled "remove, complete demolition." Comment: Demolition captured in aerial and ground photographs.	4,5,7,11	"A - Indicative of scattered buried steel objects." Possibly related to lampblack thickener demolition (debris) or stockpiling/fill material related to Kite Hill regrading.	Operated in removal of lampblack following the OG generators and wash boxes. Surrounding soil was regraded during redevelopment. Potential source of lampblack.	X
68	South	40-feet Diameter Lampblack Thickener		Demolition instructions note, "Expose 4 feet of the 40 feet ... diameter lampblack thickener and clean the interiors completely." Partially demolition in aerial photograph. As-built notes "40 feet diameter lampblack thickener rim ... remaining structure below grade ... may be encountered at 25 feet COS."	4,5,7,11	"B - Collection of metallic material." Possibly related to demolition of lampblack thickener and/or demolition of remnants of tar separator.	Operated in removal of lampblack following the OG generators and wash boxes. Surrounding soil was stripped and regraded during redevelopment. Potential source of lampblack.	X
69	South	Scum Pits (4)		Demolition instructions note, "Remove ... scum sump." Labeled "remove."	4,5,7	"A - Indicative of scattered buried steel objects," or "B - collection of metallic material." Possibly related to demolition debris.	Operated in processing of lampblack. Surrounding soil was stripped and regraded during redevelopment. Potential source of lampblack.	X
70	South	Tar Separator		Demolition instructions note, "Remove ... tar separator pit." General area stripped a minimum of 18 inches.	4,5,7	"B - Collection of metallic material." Possibly related to demolition of lampblack thickener and/or demolition of remnants of tar separator.	Operated in removal of tar following wash boxes, and primary and secondary scrubbers. Surrounding soil was stripped during redevelopment. Potential source of tar.	X
71	South	Old Stable		Demolition instructions note "Remove ... old stable basement and foundation." Labeled "remove foundations."	4,5,7	No anomaly	NS	
72	South	Collecting Tank		Demolition instructions note "Remove ... collecting tank base." General area shaded and labeled "lampblack storage area, excavate to 2 feet below proposed grade - fill with material from the north section." General area stripped a minimum of 18 inches.	5,7	"B - Collection of metallic material." Possibly related to demolition or remnants of collection tank.	Potential source of lampblack.	X
73	South	Recirculating Pumps		Demolition instructions note, "Remove ... recirculating pump bases." General area stripped a minimum of 18 inches.	5,7	"B - Collection of metallic material." Possibly related to demolition debris.	NS	
74	South	Oliver Filters (2)		Demolition instructions note, "Remove ... Oliver Filter tank and pumps foundations." General area stripped a minimum of 18 inches. Comment: No historical documentation of below-grade obstructions. Approximate location of refusal explorations during 2013 SI (see Appendix 2A of main RI report).	4,5,13	No anomaly	Followed the lampblack thickeners in the lampblack to briquette process. Functioned as dewatering structure. Surrounding soil was stripped during redevelopment. Potential source of lampblack.	X
75	South	Barge Loading Dock		Labeled "save concrete bulkheads." Demolition instructions note, "Remove the pipes at the bulkhead and cap."	4,5	No anomaly	Potential overwater source.	X
76	South	LW Pumps		Demolition instructions note, "Remove ... LW pumps base."	5	"B - Collection of metallic material." Possibly related to demolition debris or washer liquor coolers structure left in place.	NS	
77	South	Washer Liquor Coolers		Demolition instructions note, "Remove ... washer liquor coolers base and footings near the relief holder ... Cover washer liquor cooler open pits with 4x12 timbers." Labeled "cover pits with wood pallets."	5,6	No anomaly	NC	
78	South	Lake Condenser		Labeled "save concrete bulkheads, remove machinery."	5	No anomaly	NS	
79	South	Dryer Shed		Demolition instructions note, "Dryer shed, remove foundations slab and bases to 3 feet depth." Labeled "remove, complete demolition." As-built notes, "dryer shed foundation ... remaining structure below grade ... may be encountered at 18 to 21 feet COS," and "wall ... remaining structure below grade ... may be encountered at 21 feet COS."	4,5,9	No anomaly	Operated in the lampblack to briquette process. Surrounding soil was regraded during redevelopment. Potential source of lampblack.	X
80	South	Water Tower		Demolition instructions note, "Remove ... water tower foundation." General area stripped a minimum of 18 inches.	5	No anomaly	NS	
81	South	Stack		Demolition instructions note, "Structures to retain ... Stack southeast of No. 1 OG Generator." General area stripped a minimum of 18 inches.	5	Outside geophysical survey area	NS	
82	South	Heat Boiler		Labeled "remove." General area stripped a minimum of 18 inches.	5	Outside geophysical survey area	Pre-heated oil prior to OG generators for more efficient oil gas process. Surrounding soil was stripped during redevelopment. NC	
83	South	Oil Heaters & Pumps		Labeled "save all pipes; remove insulation in this area." General area stripped a minimum of 18 inches.	5,7	Outside geophysical survey area	Pre-heated oil prior to OG generators for more efficient oil gas process. Surrounding soil was stripped during redevelopment. NC	

Table 1C-1

Fate of MGP Structures and Source Evaluation[1]

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Structure Number	Section	Former MGP Structure	Fate of Former MGP Structure[2]	Notes from Historical Records Review[3]	Historical References[4]	Geophysical Results[5]	Source Evaluation[6]	Potential Historical Source
84	South	Blower & Control House		Demolition instructions note, "Blower House - completely remove stairs and landing from grade to upper level." Labeled "remove" and "partial demolitions." General area stripped a minimum of 18 inches.	4,5	Outside geophysical survey area	NC	
85	South	No. 1 OG Generator & WB & PS		General area labeled "strip 18 inches. Fill with material from north section" and "general cleanup debris & insulation interior and/or exterior" plus "remove piping marked or 3 inches inside dia or smaller." Demolition instructions note, "WB foundation pits ... clean ... pits and fill with imported sand."	4,5,6,7	Outside geophysical survey area	Feed pipes injected oil and steam into the top of the hot OG generators, these pipes were removed by the redevelopment. Wash boxes collected the bulk of the tar and lampblack by-products. Tar was redirected to tar wells and later sold; lampblack was redirected to the lampblack thickeners for briquettes production. Surrounding soil was stripped during redevelopment. NC	
86	South	No. 2 OG Generator & WB & PS		General area labeled "strip 18 inches. Fill with material from north section" and "general cleanup debris & insulation interior and/or exterior" plus "remove piping marked or 3 inches inside dia or smaller." Demolition instructions note, "WB foundation pits ... clean ... pits and fill with imported sand."	4,5,6,7	Outside geophysical survey area	Feed pipes injected oil and steam into the top of the hot OG generators, these pipes were removed by the redevelopment. Wash boxes collected the bulk of the tar and lampblack by-products. Tar was redirected to tar wells and later sold; lampblack was redirected to the lampblack thickeners for briquettes production. Surrounding soil was stripped during redevelopment. NC	
87	South	No. 3 OG Generator & WB & PS		General area labeled "strip 18 inches. Fill with material from north section" and "general cleanup debris & insulation interior and/or exterior" plus "remove piping marked or 3 inches inside dia or smaller." Demolition instructions note, "No. 3 OG Generator - remove clay masonry at foundation" and "WB foundation pits ... clean ... pits and fill with imported sand."	4,5,6,7	Outside geophysical survey area	Feed pipes injected oil and steam into the top of the hot OG generators, these pipes were removed by the redevelopment. Wash boxes collected the bulk of the tar and lampblack by-products. Tar was redirected to tar wells and later sold; lampblack was redirected to the lampblack thickeners for briquettes production. Surrounding soil was stripped during redevelopment. NC	
88	South	No. 4 OG Generator & WB & PS		General area labeled "strip 18 inches. Fill with material from north section" and "general cleanup debris & insulation interior and/or exterior" plus "remove piping marked or 3 inches inside dia or smaller." Demolition instructions note, "WB foundation pits ... clean ... pits and fill with imported sand."	4,5,6,7	Outside geophysical survey area	Feed pipes injected oil and steam into the top of the hot OG generators, these pipes were removed by the redevelopment. Wash boxes collected the bulk of the tar and lampblack by-products. Tar was redirected to tar wells and later sold; lampblack was redirected to the lampblack thickeners for briquettes production. Surrounding soil was stripped during redevelopment. NC	
89	South	No. 5 OG Generator & WB & PS		Demolition instructions note, "Remove pits and sumps below No. 5 and 6 generators and control house." General area labeled "strip 18 inches. Fill with material from north section" and "general cleanup debris & insulation interior and/or exterior" plus "remove piping marked or 3 inches inside dia or smaller."	4,5,6,7	Outside geophysical survey area	Feed pipes injected oil and steam into the top of the hot OG generators, these pipes were removed by the redevelopment. Wash boxes collected the bulk of the tar and lampblack by-products. Tar was redirected to tar wells and later sold; lampblack was redirected to the lampblack thickeners for briquettes production. Surrounding soil was stripped during redevelopment. NC	

Table 1C-1

Fate of MGP Structures and Source Evaluation[1]

Gas Works Park Site
Seattle, Washington

Structure Number	Section	Former MGP Structure	Fate of Former MGP Structure[2]	Notes from Historical Records Review[3]	Historical References[4]	Geophysical Results[5]	Source Evaluation[6]	Potential Historical Source
90	South	No. 6 OG Generator & WB & PS		Demolition instructions note, "Remove pits and sumps below No. 5 and 6 generators and control house." General area labeled "strip 18 inches. Fill with material from north section" and "general cleanup debris & insulation interior and/or exterior" plus "remove piping marked or 3 inches inside dia or smaller."	4,5,6,7	Outside geophysical survey area	Feed pipes injected oil and steam into the top of the hot OG generators, these pipes were removed by the redevelopment. Wash boxes collected the bulk of the tar and lampblack by-products. Tar was redirected to tar wells and later sold; lampblack was redirected to the lampblack thickeners for briquettes production. Surrounding soil was stripped during redevelopment. NC	
91	South	Control House		Demolition instructions note, "Control House - remove steel frame shed structure on top level. On the operating level remove sheet metal, clay block masonry, toilet fixtures, control panels, pumps and miscellaneous hardware." Labeled "remove pits." General area stripped a minimum of 18 inches.	5,6,7	Outside geophysical survey area	NS	
92	South	Tar Separator		Structure noted in 1919 Sanborn, absent in 1949 site plan. Ground photograph from 1946 narrates, "removal of pitch from well prior to excavation for generator foundations."	1,2,11	Outside geophysical survey area	Removed prior to oil gas operations. NC	
93	South	Tar Well		Structure noted in 1919 Sanborn, absent in 1949 site plan. Ground photograph from 1946 narrates, "removal of pitch from well prior to excavation for generator foundations."	1,2,11	Outside geophysical survey area	Removed prior to oil gas operations. NC	
94	South	Tar Well		Structure noted in 1919 Sanborn, absent in 1949 site plan. Ground photograph from 1946 narrates, "removal of pitch from well prior to excavation for generator foundations."	1,2,11	Outside geophysical survey area	Removed prior to oil gas operations. NC	
95	South	Briquette Storage/Warehouse Shed		Demolition instructions note, "Briquette storage shed may be used for staging or storage and shall be removed prior to completion of contract; concrete slab to remain; remove footings to grade."	5,6,7	No anomaly	Operated in the lampblack to briquette process. A concrete slab. NC	
96	South	Gasoline Tank		Demolition instructions note, "gasoline tank shall be removed." Labeled "remove." General area stripped a minimum of 18 inches.	5,7	No anomaly	NC	
97	South	Boiler Fuel Tar Storage		Demolition instructions note, "boiler fuel storage tank shall be removed." General area stripped a minimum of 18 inches.	5,7	No anomaly	Surrounding soil was stripped during redevelopment. Potential source of tar and DNAPL.	X
98	Central	West Gate		Absent in as-built plans.	10	Outside geophysical survey area	NS	
99	Central	Concrete Slab		Demolition instructions note, "Remove ... piers and slabs at the west gate."	5	Outside geophysical survey area	NS	
100	Central	Foamite House		Absent in as-built plans.	10	Outside geophysical survey area	NS	
101	Central	Loading Dock		Demolition instructions note, "Remove ... loading dock."	5	No anomaly	NC	
102	Central	Loading Dock		Demolition instructions note, "Remove ... loading dock."	5	"D - Indicative of abandoned infrastructure, possibly pipes and other objects." Possibly related to demolition debris.	Potential source of tar and DNAPL.	X
103	Central	Catch Basin and Gasoline Tank		Demolition instructions note, "Remove ... catch basin and gasoline tank and concrete pump base." Labeled "remove, complete demolition" and "excavated 4 feet."	4,5,7	No anomaly	Potential source of LNAPL and DNAPL.	X
104	Central	Meter House		As-built notes, "meter house foundation ... remaining structure below grade ... may be encountered at approximate elevation 21feet COS."	5,7,9	No anomaly	NS	
105	Central	First Aid Station		Absent in as-built plans.	10	No anomaly	NS	
106	Central	LO Pre-Cooler		Labeled "save, no major demolition" and "general cleanup debris & insulation interior and/or exterior" plus "remove piping marked or 3 inches inside dia or smaller."	4,5	No anomaly	Potential source of LNAPL and DNAPL.	X
107	Central	LO Absorber & Overhead Pipes		Labeled "save, no major demolition."	5	No anomaly	Operated in removal of light oils. Following the electrostatic precipitators tar-free gas was forced to pass through a cascade of heavy oil. The heavy oil absorbed light oils from the gas. The heavy and light oil mixture was fractionally distilled and the heavy oil was recirculated back to the light oil absorber. Potential source of NAPL.	X

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Fate of MGP Structures and Source Evaluation[1]

Gas Works Park Site
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Structure Number	Section	Former MGP Structure	Fate of Former MGP Structure[2]	Notes from Historical Records Review[3]	Historical References[4]	Geophysical Results[5]	Source Evaluation[6]	Potential Historical Source
108	Central	Braun Cooler		Labeled "remove."	5	No anomaly	Potential source of LNAPL and DNAPL.	X
109	Central	Foamite Benzol House		Demolition instructions note, "Structures to remain ... foamite house near light oil absorber." Labeled "save, no major demolition."	4,5	No anomaly	Fire safety precaution. Outfitted with an extensive network of subsurface foamite pipes and hydrants. NS.	
110	Central	Train Trestles		As-built notes, "5 trestle footings ... remaining structure below grade ... may be encountered approximately at 17ft" elevation COS."	9	"F - Indicative of the end (of) a pipe or vertical well casing." potential response to former trestle footings left in place.	NS	
111	Central	Pump Sump		Demolition instructions note, "Remove ... pump sump." General area shaded and labeled "excavate 8 feet."	5,7	"D - Indicative of abandoned infrastructure, possibly pipes and other objects." Anomaly coincides with broken bottoms of final tar separator. Also near general area of central stockpile generated during redevelopment, possibly related to debris from construction.	Soil was excavated 8 feet during redevelopment. NC	
112	Central	Final Tar Separator		Demolition instructions note, "Remove ... final separator and sump to the north." As-built notes, "bottom of final separator ... remaining structure below grade ... may be encountered at approximate elevation 8 feet COS." General area shaded and labeled "excavate 8 feet."	5,7,9	"D - Indicative of abandoned infrastructure, possibly pipes and other objects." Anomaly coincides with broken bottoms of final tar separator. Also near general area of central stockpile generated during redevelopment, possibly related to debris from construction.	Soil was excavated 8 feet during redevelopment. NC	
113	Central	Collector Box		Demolition instructions note, "Remove ... collector box." General area shaded and labeled "excavate 8 feet."	5,7	No anomaly	NC	
114	Central	Sewer Basin		Demolition instructions note, "Remove ... sewer basin." As-built shows it as "remaining structure below grade ...bottoms of tar wells broken may be encountered at approximate elevation 12 feet COS and conc rubble to 17 feet COS." General area shaded and labeled "excavate 8 feet" and "remove."	4,5,7,9	"E - May be due in part to a linear conductor, pipe or utility, possibly associated with additional metallic objects." Possibly related to broken bottoms left in place and/or demolition debris.	Soil was excavated 8 feet during redevelopment. Potential source of tar and DNAPL.	X
115	Central	Circulating Liquor Well		Demolition instructions note, "Remove ... circulating liquor well." As-built shows it as "remaining structure below grade ...bottoms of tar wells broken may be encountered at approximate elevation 12 feet COS and conc rubble to 17 feet COS." General area shaded and labeled "excavate 8 feet" and "remove."	4,5,7,9	"E - May be due in part to a linear conductor, pipe or utility, possibly associated with additional metallic objects." Possibly related to broken bottoms left in place and/or demolition debris.	Soil was excavated 8 feet during redevelopment. Potential source of tar and DNAPL.	X
116	Central	Emulsion Well		Demolition instructions note "Remove ... emulsion well." As-built shows it as "remaining structure below grade ...bottoms of tar wells broken may be encountered at approximate elevation 12 feet COS and conc rubble to 17 feet COS." General area shaded and labeled "excavate 8 feet" and "remove."	4,5,7,9	"E - May be due in part to a linear conductor, pipe or utility, possibly associated with additional metallic objects." Possibly related to broken bottoms left in place and/or demolition debris.	Soil was excavated 8 feet during redevelopment. Potential source of tar and DNAPL.	X
117	Central	Hot Tar Well		Demolition instructions note, "Remove ... hot tar well." As-built shows it as "remaining structure below grade ...bottoms of tar wells broken may be encountered at approximate elevation 12 feet COS and conc rubble to 17 feet COS." General area shaded and labeled "excavate 8 feet" and "remove."	4,5,7,9	"E - May be due in part to a linear conductor, pipe or utility, possibly associated with additional metallic objects." Possibly related to broken bottoms left in place and/or demolition debris.	Soil was excavated 8 feet during redevelopment. Potential source of tar and DNAPL.	X
118	Central	Tar Separator		Demolition instructions note, "Remove ... tar separator." As-built shows it as "remaining structure below grade ...bottoms of tar wells broken may be encountered at approximate elevation 12 feet COS and conc rubble to 17 feet COS." General area shaded and labeled "excavate 8 feet" and "remove."	4,5,7,9	"E - May be due in part to a linear conductor, pipe or utility, possibly associated with additional metallic objects." Possibly related to broken bottoms left in place and/or demolition debris.	Operated in the removal of tar. Potential source of tar and DNAPL.	X
119	Central	Office - Laboratory		Demolition instructions note, "Office Laboratory - remove concrete slab and footings completely." As-built notes, "office - laboratory conc rubble ... may be encountered to 15 feet COS and cinders and brick to 18 feet COS." General area labeled "existing concrete rubble stockpile."	4,5,6,7,9	No anomaly	NS	

Table 1C-1

Fate of MGP Structures and Source Evaluation[1]

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Structure Number	Section	Former MGP Structure	Fate of Former MGP Structure[2]	Notes from Historical Records Review[3]	Historical References[4]	Geophysical Results[5]	Source Evaluation[6]	Potential Historical Source
120	Central	No. 1 WG House		Demolition instructions note, "No. 1 WG House - remove concrete slab and footings north of the No. 2 WG Generator." As-built labels footing from No. 2 WG Generator and south as "No. 1 WG House slab & footings ... remaining structure below grade ... may be encountered at 20 feet COS."	5,7,9	No anomaly	Potential source of tar and NAPL.	X
121	Central	Super Heater		Labeled "save, no major demolition."	5	No anomaly	Soil in area was regraded. Potential source of tar and NAPL.	X
122	Central	Carburetor		Labeled "save, no major demolition."	5	No anomaly	Soil in area was regraded. Potential source of tar and NAPL.	X
123	Central	# 8 HI-BTU OG Generator		Demolition instructions note, "The footings/foundations of the No. 7 HI-BTU OG Generator and the two tanks immediately north must be removed to 6 inches below grade as proposed on the grading plan."	5	No anomaly	Soil in area was regraded. Potential source of tar and NAPL.	X
124	Central	# 7 HI-BTU OG Generator		Labeled "save, no major demolition."	5	No anomaly	Soil in area was regraded. Potential source of tar and NAPL.	X
125	Central	No. 1 WG Generator		As-built labels footing from No. 2 WG Generator and south as "No. 1 WG House slab & footings ... remaining structure below grade ... may be encountered at 20 feet COS."	9	No anomaly	Soil in area was regraded. Potential source of tar and NAPL.	X
126	Central	No. 2 WG Generator		As-built labels footing from No. 2 WG Generator and south as "No. 1 WG House slab & footings ... remaining structure below grade ... may be encountered at 20 feet COS."	9	No anomaly	Soil in area was regraded. Potential source of tar and NAPL.	X
127	Central	# 7 OG Scrubber		Demolition instructions note, "Structures to remain ... No. 7 and 8 OG scrubber and overhead piping." Labeled "save, no major demolition."	4,5	No anomaly	Operated in the removal of tar. Gas was forced through a cascading column of water. DNAPL observed in the area. Potential source of tar and DNAPL. Source material removed in 1998.	X
128	Central	# 8 OG Scrubber		Demolition instructions note, "Structures to remain ... No. 7 and 8 OG scrubber and overhead piping." Labeled "save, no major demolition."	4,5	No anomaly	Operated in the removal of tar. Gas was forced through a cascading column of water. DNAPL observed in the area. Potential source of tar and DNAPL. Source material removed in 1998.	X
129	NW	Oil Storage Tank		As-built notes general area as "concrete disposal site, broken concrete & rubble ... may be encountered to 22 feet COS and compost at 24 feet COS."	9,11	Outside geophysical survey area	Tanks isolated in the NW corner surrounded by concrete barrier wall. NC	
130	NW	Oil Storage Tank		As-built notes general area as "concrete disposal site, broken concrete & rubble ... may be encountered to 22 feet COS and compost at 24 feet COS."	9,11	Outside geophysical survey area	Tanks isolated in the NW corner surrounded by concrete barrier wall. NC	
131	Lake Union	Lake Suction Dock		Demolition instructions note, "Docks to be removed completely including piles."	5	Outside geophysical survey area	The boiler house and exhauster building used lake water to produce steam and operate pumps and exhausters. NS	
132	Lake Union	Tar Unloading Dock		Demolition instructions note, "Docks to be removed completely including piles."	5	Outside geophysical survey area	Potential source of residual tar and DNAPL along the shoreline and overwater source of tar and DNAPL.	X
133	Lake Union	Oil Dock		Demolition instructions note, "Docks to be removed completely including piles."	5	Outside geophysical survey area, however closest to "I - Indicative of vertical pipe or well casing or perhaps moderate size steel pipe." Possibly related to demolition debris.	Potential source of LNAPL along the shoreline and overwater source of LNAPL.	X

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Fate of MGP Structures and Source Evaluation[1]

Gas Works Park Site
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Structure Number	Section	Former MGP Structure	Fate of Former MGP Structure[2]	Notes from Historical Records Review[3]	Historical References[4]	Geophysical Results[5]	Source Evaluation[6]	Potential Historical Source
N/A	General	Piping		Demolition instructions note "All piping below grade shall be removed ... Normal range of piping was from 3 feet to 6 feet depths. Extreme care must be taken when pipes extend to the Lake's edge. These pipes have been plugged at the lake's edge. The contractor shall first sever the pipe inland a minimum of 50 feet to check for oil, tar, etc. When these petroleum products are encountered the pipes shall be pumped dry prior to removal."	5,13	The majority of the linear anomalies identified are present underground utilities. An exception is the interpreted pipe between anomalies A and B, which matches the orientation and general area of a former MGP oil line connecting oil heaters (structure ID 83) and the fuel oil storage tank (structure ID 60).	Potential source of tar and NAPL.	X

Notes:

[1] Information presented in this table accompanies Figure 1B-1 (Fate of Former MGP Structures.) Structure ID numbers match the figure.

[2] Fate of Former MGP Structures categories:

- Demolished and Removed
- Below Grade Structure Demolished In Place
- Cleaned and Saved
- Retained
- Inconclusive

[3] Elevations presented as in original records, City of Seattle (COS) datum. Add 12.93 feet to COS datum to convert to United States Army Corps of Engineers (USACE) datum.

[4] References:

1. Sanborn Fire Insurance 1919. Sanborn Fire Insurance Map 1905-1950 Volume 6 Sheet 699c.
2. Seattle Gas Company 1949. General Plan of Lake Station. April 1949. Revised June 19, 1953.
3. Richard Haag Associates. circa 1970s. Southeast Corner Cross-Sections. University of Washington Special Collections Library. Circa 1970s.
4. Richard Haag Associates. 1970. Demolition Plan Myrtle Edwards Park Sheets 1-4 1970. December 23, 1970.
5. Richard Haag Associates. 1973a. Demolition Section 3 pages 1-9. 1973.
6. Richard Haag and Associates. 1973b. Site Demolition & Clean-up Plan. January 15, 1973.
7. Richard Haag Associates. 1973c. Layout Plan Excavation and Demolition. February 8, 1973.
8. Richard Haag Associates. 1973d. Concrete and Demolition Work Plan. March 15, 1973.
9. Richard Haag Associates. 1974. Site Plan Lake Union Earthwork – Demolition. Revised for As-Built Condition. July 1, 1974.
10. Richard Haag Associates. 1975. Site Plan. As Built Revised. November 19, 1975.
11. Walker and Associates. 1960 to 1977. Aerial Photograph Collection.
12. Parametrix and Key Environmental 1998. Draft Gas Works Park Environmental Cleanup, Focused Feasibility Study Report, Parametrix, Inc., and KEY Environmental, Inc., Volumes 1 and 2. October 30, 1998. Prepared for City of Seattle and PSE.
13. Appendix 2A (Supplemental Investigation Data Report) of the main RI report.

[5] Anomalies identified in Zonge's 2013, Geophysical Investigation, Gas Works Park (Appendix 2A of the main RI report).

[6] NC = Not considered a source, as substantial contamination potentially associated with this source has not been observed in the area.
NS = Not a source. Not known to manufacture, store, or convey MGP raw materials, products, or byproducts.

BNSF = Burlington Northern Santa Fe
COS = City of Seattle
LO = Light Oil
LP = Liquid Propane
LW = Lake Water
NE = Northeast
OG = Oil Gas
PS = Primary Scrubber
RH = Relief Holder
ROW = Right of Way
SI = Supplemental Investigation
WB = Wash Box
WG = Water Gas

Legend

- Area of Investigation
- Shoreline (OHWM)
- Section
- 12 Structure Discussed in Table 1B-1
- Historical Railroad Features

Fate of Former MGP Structure

- Demolished and Removed
- Below Grade Structures Demolished in Place
- Cleaned and Saved
- Retained
- Inconclusive

MGP = Manufactured Gas Plant

Notes:

1. Information presented in this figure is discussed in Table 1B-1 Fate of Structures and Sources Evaluation.
2. References: Sanborn Fire Insurance 1919. Seattle Gas Company 1949. Richard Haag Associates circa 1970s, 1970, 1973a, 1973b, 1973c, 1973d, 1974, and 1975. Walker and Associates 1960 to 1977. Parametrix and Key Environmental 1998.
3. Basemap 2005 USGS aerial photograph. Does not show current conditions.
4. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

N W E S

0 100 200

Feet

Fate of Former MGP Structures

Gas Works Park Site
Seattle, Washington

GeoEngineers **Figure 1C-1**

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Legend

- Area of Investigation
- Shoreline (OHWM)
- Historical Railroad Features
- Former MGP Structures

Geophysical Results

- Geophysical Survey Limits
- A — Anomalies discussed in Table 1B-1
- Magnetic Anomalies
- EM Anomalies
- Geophysical Survey Interpreted Pipe or Utility
- Current Subsurface Utility Identified by Geophysical Survey

MGP = Manufactured Gas Plant

Notes:

1. Information presented in this figure is discussed in Table 1B-1 Historical Sources Evaluation.
2. References: Site structures delineated as shown in the General Plan, Lake Station, Seattle Gas Company, April 1949, revised in June 1953, the 1950 Oil Lines, Seattle Gas Co. Map, and a 1956 aerial photograph. Historical railroad features shown as delineated in General Plan, Lake Station, Seattle Gas Co., June 1938. Geophysical Site Investigation, Gas Works Park by Zonge 2013.
3. E and H anomalies presented by Zonge as both interpreted pipe or utility plans and magnetic or EM anomalies are presented here as only magnetic or EM anomalies.
4. Basemap 2005 USGS aerial photograph. Does not show current conditions.
5. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

N W E S

0 100 200

Feet

Geophysical Survey Results

Gas Works Park Site
Seattle, Washington

GeoEngineers

Figure 1C-2

Path: P:\0186846\GIS\MXD\Phase01\T1635\0186846_F1B-2_Geophysical_Survey_Results.mxd Map Revised: 03 December 2021 maugust