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ENVIRONMENTAL CONSULTANTS

Sent Via Messenger

Letter of Transmittal

To: Mr. Dana Bayuk
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From: Mr. Rob Ede
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Date: April 27, 2020

Regarding: Transmittal of Report – *Former Mult 802 Water Supply Well Decommissioning, NW Natural Gasco Property, 7900 NW St. Helens Road, Portland, Oregon* dated April 2020

Dana,

Hahn and Associates, Inc., is providing the following document as a follow-up to the submittal via FTP site on April 22, 2020. This flash drive contains the full report: *Former Mult 802 Water Supply Well Decommissioning, NW Natural Gasco Property, 7900 NW St. Helens Road, Portland, Oregon* dated April 2020 including all appendices. As indicated in the April 22, 2020 e-mailed FTP download description, Appendix E was too large for the download and therefore is included on the enclosed flash drive.

-Rob

Copies	Description
1	Flash Drive Containing: *Former Mult 802 Water Supply Well Decommissioning, NW Natural Gasco Property, 7900 NW St. Helens Road, Portland, Oregon* dated April 2020

Copied recipients:

Mr. Bob Wyatt, NW Natural with Flash Drive
Ms. Patty Dost, Pearl Legal Group PC with Flash Drive
Ms. Jen Mott, Anchor QEA, LLC with Flash Drive

FORMER MULT 802 WATER SUPPLY WELL DECOMMISSIONING

NW Natural Gasco Property
7900 NW St Helens Road
Portland, Oregon

April 2020

HAI Project No. 2708
DEQ ECSI No. 83

FORMER MULT 802 WATER SUPPLY WELL DECOMMISSIONING

NW Natural Gasco Property
7900 NW Front Avenue
Portland, Oregon

April 2020

Prepared for:

NW Natural
Portland, Oregon

Prepared by:

Hahn and Associates, Inc.
Portland, Oregon

HAI Project No. 2708

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 WELL CONSTRUCTION SUMMARY 3

3.0 PRE-DECOMMISSIONING ASSESSMENT ACTIVITIES 5

4.0 DECOMMISSIONING ACTIVITIES 8

- 4.1 Casing and Borehole Contents Removal 8
- 4.2 Post Drill-Out / Waste Removal Observations 11
- 4.3 Water Column Pumping, Flushing, and Sampling 13
  - 4.3.1 Pump and Plumbing Test – June 14, 2019 13
  - 4.3.2 Purging Event No. 1 – June 17, 2019 14
  - 4.3.3 Purging Event No. 2 – June 20, 2019 16
  - 4.3.4 Purging Event No. 3 with Water Flushing – June 25, 2019 17
  - 4.3.5 Purging Event No. 4 – June 26, 2019 18
- 4.4 Sample Collection and Laboratory Testing 19
- 4.5 Downhole Camera Survey 20
- 4.6 Borehole Sealing 23

5.0 LABORATORY TESTING RESULTS 26

- 5.1 Solids – Tar and Pitch Materials 26
- 5.2 Oil Blebs 27
- 5.3 Groundwater 28

6.0 WASTE DISPOSAL 31

- 6.1 Liquids 31
- 6.2 Solids 31

7.0 SUMMARY AND CONCLUSIONS 33

8.0 LIMITATIONS AND SIGNATURES 35

9.0 GLOSSARY OF ABBREVIATIONS 36

TABLES

1 Sample Description: Solids/Wastes and Oil Blebs Removed from Well Borehole

2 Sample Availability and Laboratory Testing Program

3 Summary of Analytical Results for Removed Solids: TPH and VOCs

4 Summary of Analytical Results for Removed Solids: TCLP VOCs

5 Summary of Analytical Results for Removed Solids: SPLP VOCs

6 Summary of Analytical Results for Removed Solids: SVOCs

7 Summary of Analytical Results for Removed Solids: SPLP SVOCs and PAHs

8 Summary of Analytical Results for Removed Solids: Metals and Cyanide

9 Summary of Analytical Results for Oil Blebs: TPH and VOCs

10 Summary of Analytical Results for Oil Blebs: SVOCs

11 Summary of Analytical Results for Oil Blebs: Metals

12 Summary of Analytical Results for Tar and Oil Blebs: Viscosity and Density

13 Summary of Analytical Results for Groundwater Samples: TPH and VOCs

14 Summary of Analytical Results for Groundwater Samples: SVOCs

15 Summary of Analytical Results for Groundwater Samples: Metals

16 Summary of Analytical Results for Groundwater Samples: Cyanide

17 Grout Volumes and Properties (Per Batch)

FIGURES

1 Location Map

2 Site Map with Former MGP Features

3 Contaminant Concentrations as a Function of Volume of Water Pumped, Mult 802 Well Decommissioning

APPENDICES

A Well Construction Documentation

B Photographs

C Well Log (Decommissioning)

D Laboratory Analytical and Data Validation Reports

E Downhole Video of Mult 802 Well Bore (July 8, 2019)

F Oregon Water Resources Department Documentation

G Waste Disposal Documentation

1.0 INTRODUCTION

On behalf of NW Natural, Hahn and Associates, Inc. (HAI) has prepared this report to document activities related to the identification, assessment, and decommissioning of a former (unused and inactive) water supply well located at the NW Natural Gasco property, 7900 NW St. Helens Road, Portland, Oregon (Figure 1). This well, identified as "*Mult 802*" by the Oregon Water Resources Department (WRD), was constructed in 1942 by Portland Gas and Coke Company (PG&C) for the purpose of providing cooling water for use in manufactured gas plant (MGP) operations at the property.

Direction to locate and decommission former supply well *Mult 802* was provided to NW Natural in correspondence received from the Oregon Department of Environmental Quality (DEQ) in 2014[1]. NW Natural's efforts to locate this well, described in Section 3, had been unsuccessful until 2018, at which time materials moved coincident with the demolition of infrastructure on the Koppers, Inc. (KI) leasehold portion of the property exposed the *Mult 802* wellhead. The location of former water supply well *Mult 802* is shown on Figures 1 and 2.

This report documents activities related to the decommissioning of well *Mult 802* and is organized as follows:

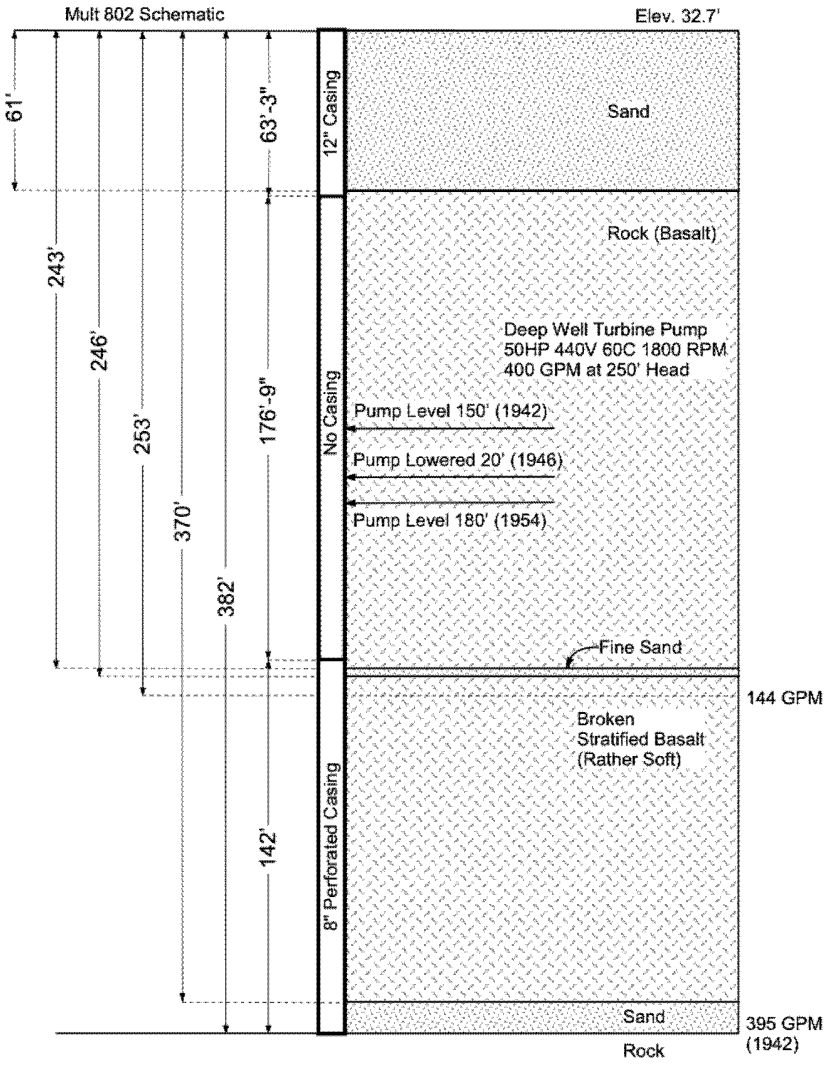
- Section 1 Introduction
- Section 2 Description of *Mult 802* construction details
- Section 3 Summary of initial locating and assessment activities
- Section 4 Description of decommissioning and sampling and laboratory testing activities

[1] DEQ (2014). Correspondence to NW Natural (Dana Bayuk to Bob Wyatt), *Comments on the Draft Human Health and Ecological Risk Assessment Report, NW Natural Gasco Site, Portland, Oregon, ECSI No. 84.* May 8, 2014.

- Section 5 Description of decommissioning-related laboratory testing results
- Section 6 Description of characterization and disposal of decommissioning-related waste materials
- Section 7 Conclusions and recommendations

2.0 WELL CONSTRUCTION SUMMARY

Historical records indicate that a water supply well was constructed on the Gasco property in 1942 by PG&C, with this well being identified in the WRD Well Log Database as *Mult 802*. A schematic for *Mult 802* is provided below, with the original PG&C construction diagram and related records included in Appendix A.



Source: Portland Gas & Coke Company Well at Coke Oven Plant
Drawing No. SK-194B, dated July 6, 1943

As shown above, *Mult 802* was drilled to a depth of 382 feet below ground surface (bgs) and completed within the Columbia River Basalt (bedrock) aquifer. The well was constructed with 12-inch diameter steel casing to a depth of 63 feet bgs (2 feet into bedrock) isolating the bedrock aquifer from the overlying fill and alluvium water bearing zones (WBZs).

Well *Mult 802* is shown to have been constructed as an open hole bedrock completion from 63 feet bgs to 243 feet bgs, below which 8-inch diameter perforated steel casing is shown to have been placed across a zone of broken or "soft" basalt to the total well depth at 382 feet bgs.

Driller information from the installation of *Mult 802* indicates an estimated yield of 144 gallons per minute (gpm) of water production from a thin sandy/broken rock interval at 246 to 253 feet bgs, and a second more productive zone near the base of the well, where a yield of 395 gpm was estimated from a sand interval at 370 to 382 feet bgs (Appendix A).

Notes from an inspection of the well conducted by the United States Geological Survey (USGS) in 1954 indicate that *Mult 802* was intended to supply water for MGP-related cooling purposes, but that it provided an insufficient yield for that need. The notes written by the USGS indicate that this well would go dry (water level drop beneath the pump at 170 feet bgs) when production exceeded 140 gpm (Appendix A). This well would have been taken out of service by PG&C at the time that MGP operations were terminated in 1956, if not removed from service at an earlier point in time due to insufficient well yield.

3.0 PRE-DECOMMISSIONING ASSESSMENT ACTIVITIES

Documentation regarding the installation of supply well *Mult 802* had been previously identified in water well surveys completed as part of Remedial Investigation activities for the Gasco property. However, except for Township, Range, Section, Quarter Section and depth to bedrock information, the specific location for this well had not been known.

Substantial efforts to locate *Mult 802* were conducted by NW Natural in February 2015, at which time HAI contracted with GeoPotential, Inc. of Brightwood, Oregon to perform geophysical survey activities to identify ferrous or non-ferrous features that could be attributable to a possible buried water well. The area of the survey activities, developed in coordination with DEQ, was based on known generalized location information for the well, in conjunction with available site features and known depth to bedrock information. The available information indicated that the likely location for *Mult 802*, if it was still present, would be near the northern end of the former KI leasehold or in the vicinity of the adjacent liquified natural gas (LNG) storage tank basin.

The results of the February 2015 geophysical survey identified 6 magnetic anomalies with the potential to be representative of a well head or similar feature. On July 10, 2015, test pits were completed at each of these 6 magnetic anomalies and other areas of interest. The results of the test pit activities did not identify any features that would potentially be attributable to a buried water supply well. These well locating efforts were documented in a 2015 report[2] that was provided to DEQ.

On April 11, 2017, while on the Gasco property performing unrelated work activities, HAI discovered a feature that appeared to be a water supply well in the targeted area but had been previously obscured by NW Natural materials staged in this area. The feature consisted of a 12-inch diameter covered steel casing that was almost flush with the ground surface at a location near the northern end of the KI leasehold. Initial measurements indicated that this steel casing was filled with soil and debris below a depth of approximately 12 feet bgs, with water measured in the casing at a depth

[2] Hahn and Associates, Inc. (HAI 2015). *Technical Memorandum: Evaluation of Former Industrial Use Water Supply Well Mult 802, NW Natural Gasco Property, 7900 NW St. Helens Road, Portland, Oregon*. November 15, 2015.

of 6 feet bgs. The location of this feature (steel casing), later confirmed to be *Mult 802*, is shown on Figure 2.

On April 19, 2017, Anchor QEA, LLC (Anchor QEA) assisted HAI by performing downhole video-logging within the casing of the suspected *Mult 802 feature*. The camera was advanced down the hole to inspect the sides of the 12-inch diameter steel casing. Two openings were observed on the wall of the casing: one approximate 3-inch diameter opening was present on the north side of the casing at 1-foot bgs and one approximate 8-inch diameter opening was observed on the south side of the casing at 6 feet bgs. The line leading away from the south side of the casing was later traced by geophysical methods approximately 80 feet to the south, at which point the signal was lost. The line leading away from the north side of the casing was traced approximately 5 feet to the north where the signal was lost near an existing water line. No other features of interest were noted in the observable portion of the casing present above the soil/debris present at 12 feet bgs. Although unknown if related to the former supply well, an adjacent line that daylighted at a flanged elbow joint just west of the well casing was traced west and then south of the well casing to a point where the signal was lost (Figure 2).

On July 6, 2017, HAI met on-site with Cowlitz Clean Sweep, Inc. (CCS) of Longview, Washington to oversee vacuum removal activities of the water and soil/debris present in the well. Vacuum activities were brief, as only one foot of debris was removed before refusal due to dense materials was encountered at 13 feet bgs. The material present beneath an upper layer of soft soil/debris appeared to be compacted gravel and cobbles with some fines.

On July 31 and August 1, 2017, HAI again contracted CCS, this time equipped with new tooling, to perform high-pressure water cutting and vacuum removal of the gravel and cobble within the steel casing. Upon arrival, soil and debris were observed in the well at 13 feet bgs with only several inches of water present. Starting at approximately 13 feet bgs, the crew was able to penetrate and remove the materials from within the casing to a depth of 37 feet bgs, where refusal was again encountered. Contents that were evacuated from the well casing were visually identified as heterogeneously mixed gravel, cobbles, sand, debris (e.g., a welding hammer), and chunks of solid, hard, brittle tar-like material. No oil or viscous tar was observed within the steel casing or the removed materials to the

depth of at 37 feet bgs. The nature of the materials suggest that miscellaneous debris and rock had been used to fill the 12-inch diameter steel casing.

On August 17, 2017, Anchor QEA assisted HAI by performing well scoping activities using the same camera and methods as described above. Upon completion of the camera scoping, similar materials as those removed from the casing appeared to still be present at 37 feet bgs (i.e. dense cobbles, gravel, sand), but at a depth beyond the limits for the vacuum extraction tooling. As such, NW Natural prepared a work plan to proceed with decommissioning utilizing a drill rig under the assumption that this feature was in fact the inactive unused former supply well *Mult 802*.

4.0 DECOMMISSIONING ACTIVITIES

DEQ reviewed a May 2019 work plan[3] prepared on behalf of NW Natural for decommissioning the former supply well *Mult 802*. The work plan provided NW Natural's approach to the well decommissioning under the assumption that it was constructed as per available specifications (Appendix A). DEQ provided approval of the work plan in correspondence dated May 10, 2019[4], with the approval contingent on the following clarifying comments:

1. Regardless of the final depth of drilling/clean-out work, downhole camera-logging and borehole sealing will follow the sequence of steps laid-out in the work plan.

2. Material removed from the borehole will be photo-logged.

3. Based on visual observations and field screening, representative samples of potentially impacted material removed from the borehole will be collected and analyzed using the suite of laboratory methods approved for the Gasco property.

Decommissioning activities related to *Mult 802* occurred between the dates of May 13, 2019 and August 22, 2019, with all work completed in accordance with the approved work plan, or in consultation with DEQ and WRD where modifications were necessary. Decommissioning activities are described in Sections 4.1 through 4.6. Photographs documenting various portions of the well decommissioning are included in Appendix B.

4.1 Casing and Borehole Contents Removal

Cascade Drilling, L.P. (Cascade) of Clackamas, Oregon performed the decommissioning of *Mult 802* by removing materials filling the casing and borehole of the well with a rotosonic drilling rig. A 7-inch outside diameter (OD) core barrel was used to remove materials that had been plugging the 12-inch diameter steel casing, the underlying open bedrock portion of the borehole, and the 8-inch diameter cased lower portion of the borehole. The cleanout / removal of the materials physically plugging the cased and open

[3] Hahn and Associates, Inc. (HAI 2019). *Revised Work Plan for Water Well Decommissioning Activities, NW Natural Gasco Property, 7900 NW St. Helens Road, Portland, Oregon*. May 7, 2019.

[4] Oregon Department of Environmental Quality (DEQ 2019). Correspondence from Mr. Dana Bayuk to Mr. Rob Ede providing approval of the May 7, 2019 Revised Work Plan subject to specified clarifying comments. May 10, 2019.

hole portions of the well was conducted between the dates of May 13, 2019 and May 24, 2019.

All materials removed from the *Mult 802* borehole between a depth of 37 feet bgs and 136 feet bgs were vibrated from the core barrel sampler into plastic liners for description, field screening, sampling, and photo documentation purposes on May 13, 2019. Materials recovered across most of this depth interval were observed to consist of a black granular solid pitch material with minor amounts of solid tar and debris (pipe fragments were observed). The lowermost portion of the recovered material (129 to 136 feet bgs) was observed to contain brown sand and gravel with lesser amounts of pitch and tar.

Photographs representative of the materials removed from *Mult 802* are included in Appendix B. Additionally, the full photo library of all the materials removed from the upper 136 feet bgs from *Mult 802* (retained within the sonic drill rig core bags) are included electronically in a separate folder included in Appendix B. A well abandonment log for *Mult 802*, providing a detailed description of materials removed from the borehole, is included in Appendix C.

The terms “pitch” and “tar” are used for descriptive purposes and are not meant to imply a particular process or origin. Pitch, when used herein, refers to a black granular solid, often with a conchoidal fracture, no plasticity, and a lack of softening or melting under warm to hot ambient temperatures. The term “tar”, when used herein, refers to a black solid to highly viscous semi-solid material with varying amounts of plasticity. As described herein, unlike pitch, the tar was found to soften or become less viscous after several hours of storage in the higher daytime ambient temperatures present at the time the work took place, becoming noticeably firmer and less viscous when ambient temperatures dropped.

The core barrel sampler did not encounter resistance or recover any materials across a depth interval of 136 to 290 feet bgs, suggesting that this portion of the borehole had remained unobstructed, possibly due to bridging of materials.

Beneath the unobstructed borehole encountered at 136 feet bgs, resistance to the lowering of the core barrel sampler was again encountered within the borehole at a depth of 290 feet bgs. During retrieval of the core barrel from 290 feet bgs, it was discovered that the core barrel was stuck in solid tar,

and that the lower 8-inch diameter steel casing for *Mult 802* (installed from 243 to 382 feet bgs) had been lifted to the surface along with the core barrel sampler. Once it was brought to the surface, the diameter of the lower casing was measured and found to be of 8-inch inner diameter (ID) and approximately 8 3/4-inch OD. Photographs 10 through 15 (Appendix B) show the 8-inch casing brought to the surface of the borehole with the 7-inch OD sampler stuck inside, while photos 16 through 30 show removal of the 8-inch casing and its contents.

The scope of work for the decommissioning of *Mult 802* did not envision that the removal of the lower 8-inch steel casing was going to be feasible and therefore it had been planned that the 8-inch casing (139 feet in length) would be perforated and grouted in-place. On May 14 and 15, 2019 the 8-inch casing, which was found to be filled with a solid (putty-like) tar and a semi-solid viscous tar (consistency of thick honey) below a depth of approximately 290 feet bgs, was lifted from the borehole and cut into sections until it was possible to free the core barrel sampler. This work successfully removed 70 feet of the 8-inch casing from the well. After the sampler was removed, work was paused while plans for the safe removal of the remaining 69 feet of casing and its contents could be formulated in consultation with DEQ and WRD.

In consultation with DEQ and WRD it was determined that the optimum path forward would be the coring out of the wastes within the remaining 8-inch ID casing while it remained hung within the upper portion of the borehole. Cascade fabricated a clamp durable enough to hold the 8-inch ID casing in-place while a 7-inch OD core barrel sampler could vibrate into, and then remove, remaining waste materials within the hanging portion of the casing. The clean-out of the remaining portion of the 8-inch ID casing occurred on May 20 and 21, 2019. The removed waste material, generally ranging from thick viscous tar to solid putty-like tar, could not effectively be extruded into core bags and was therefore extruded directly into 55-gallon drums positioned under the drill rig platform (Photos 26 through 28, Appendix B). The last 5 feet of the 8-inch diameter casing was left plugged with wastes until after it was completely removed from the borehole in order to prevent pushing the sampler through the plug of material at the base of the casing and allowing wastes to drop back into the well bore. A full description of the removed wastes, as well as the 8-inch ID casing, which was found to be slotted from 243 to 285 feet bgs, and again from 343 to 382 feet bgs, is provided on the well decommissioning log included in Appendix C.

A total depth measurement was made within the well after the 8-inch diameter casing was removed from the borehole. Total depth was measured at 338 feet bgs on May 21, 2019, indicating that wastes or sloughed soils were present in the lower 44 feet of the borehole of the well (338 to 382 feet bgs). Remaining materials were removed from the well bore using the 7-inch OD core barrel sampler between May 22 and May 24, 2019. Materials removed from within the bottom 44 feet of the open borehole consisted predominantly of a gummy/putty-like tar (Photos 31 through 34, Appendix B). A clean gravel with broken basalt fragments (no tar) was encountered at the base of the well from 380 to 382 feet bgs (Photo 36, Appendix B). Total depth in the well as measured at the end of the day on May 24, 2019 was 378 feet bgs, indicating approximately 4 feet of materials remained in the base of the well, at least two feet of which appeared to be gravel/basalt fragments (Photo 35, Appendix B). In consultation with WRD and with DEQ it was concluded that additional removal of materials from the base of the well was not warranted.

4.2 Post Drill-Out / Waste Removal Observations

After removal of all waste materials and the lower 8-inch ID casing from the well bore, measurements were made to determine if there was a presence of light non-aqueous phase liquid (LNAPL) floating on the water column, or of dense non-aqueous phase liquid (DNAPL) at the base of the water column. Further, measurements of the depth to water and also the total depth of the well were made during this timeframe.

As indicated in Section 4.1, the total measured depth of *Mult 802* on May 24, 2019 was 378 feet bgs, indicating approximately 4 feet of material remained in the base of the borehole immediately after completion of drill-out activities. On June 11, 2019, after approximately 2.5 weeks of no activity (while the next stages of work were coordinated), the total depth of the well was measured to remain unchanged at 378 feet bgs, indicating that additional debris/tar, if any remained in the borehole, was not settling out of the water column or sloughing off the borehole sidewalls at a measurable rate.

Depth to static water within the well had been measured between the May 24, 2019 to June 11, 2019 timeframe to consistently be in the range of 14 to 15 feet bgs. No LNAPL layer was measured on top of the water column and no DNAPL was measured at the base of the well during this timeframe. However, a brown to black oil was observed to be present within the upper

water column portion of *Mult 802* as evidenced by the oil coating the measuring tape used for making total well depth measurements. Observations of retrieved measuring tape indicated brown oil higher on the tape and darker (black) oil lower on the tape - suggesting that segregation of the oil blebs by density was likely occurring in the water column.

The presence of the oil within the upper water column as described in the preceding paragraph was interpreted to be in the form of blebs/droplets due to several observations, including: 1) soundings with the interface probe did not indicate measurable accumulations of oil in the water column, 2) lowering a bottom-filling bailer to various depths within the water column did not collect oil, though the bailer walls became smeared with oil, and 3) lowering a peristaltic pump to various depths within the water column did not pump discernable oil from the water column across any depth.

Water was pumped from multiple depths within the well using a peristaltic pump. Water pumped from the upper approximate 40 feet of the water column contained a sheen with discernable oil blebs, while water pumped from depths greater than approximately 40 feet bgs did not have a sheen or discernable oil blebs. A small sample of the oil from within the upper 40 feet of the well's water column was collected and analyzed as described in Section 4.4.

Due to the interpreted presence of oil blebs/droplets in the upper water column, in consultation with DEQ and WRD, it was recommended that a high capacity submersible pump be temporarily plumbed into the well to support purging/flushing of the well in an effort to remove remaining waste materials and oil blebs from the water column.

Pump placement and the subsequent purging, flushing, and sampling of *Mult 802* are described in Section 4.3. Laboratory tests conducted on removed solid waste materials, oil, and groundwater samples are described in Section 4.4. A description of a down hole video survey, completed across the depth of the well bore immediately after pumping/flushing and prior to borehole sealing, is provided in Section 4.5.

4.3 Water Column Pumping, Flushing, and Sampling

On June 11, 2019, Westerberg Drilling, Inc., under the direction of HAI, placed a 6-inch diameter electric submersible pump within *Mult 802*, with the intake set at a depth of 129 feet bgs, correlating to a depth of approximately 115 feet below the water level in the well. The pump was plumbed with 2-inch diameter steel pipe to the surface, with a flow controller, in-line totalizer, and a sample collection port placed just beyond the well head (Photos 41 and 42, Appendix B). The 2-inch diameter pipe was connected to a flexible hose that directed pumped water from the wellhead over to three permanent in-line 20,000-gallon equalization tanks, which are used to meter uneven flows into the Gasco pre-treatment portion of the Groundwater Treatment System (GTS).

After initial testing of the pump (Section 4.3.1), four separate purging / well flushing events were conducted at *Mult 802* in an effort to clean out any remaining waste materials / oil blebs from the well bore. Summaries for each of the four purging events are provided in Sections 4.3.2 through 4.3.5.

4.3.1 Pump and Plumbing Test – June 14, 2019

The pump and plumbed connections as installed by Westerberg Drilling, Inc. were tested by HAI on June 14, 2019 at which time the pump was powered on, variability in flow rates was measured, and water-tight connections were confirmed. The pump was operated only long enough to ensure all pipe and hose connections were water-tight and to throttle the discharge rate up to its target of approximately 100 gpm. The pump was operated for a total of approximately 5 minutes while the above items were confirmed and while a groundwater sample was collected by directly filling the laboratory-provided containers at the well-head sampling port. This initial sample was collected to document the water quality within the well immediately after waste removal and prior to purging / borehole flushing efforts. A total of approximately 500 gallons of water was removed from the well during this initial check and test of the pump and associated plumbed connections. The table below identifies the sample number and approximate volume of groundwater purged from the well at the time of sample collection. The laboratory testing conducted on this and all other samples collected as part of the well bore purging/flushing project is described in Section 4.4.

Groundwater Samples – Pump and Plumbing Test

Sample Number	Pump and Plumbing Test Volume Purged (Gallons)	Total Volume Purged (Gallons)
2708-190614-MULT802-100	500	500

4.3.2 Purging Event No. 1 – June 17, 2019

Mult 802 was purged non-stop at a rate of between 90 and 100 gpm for 12 hours and 44 minutes on June 17, 2019. Over the course of this pumping event a total of 70,643 gallons of groundwater were removed from the well. Observations of the pumped groundwater via periodic checks at the sample port indicated the water to be generally clear with only a minor sheen noted and occasional black particles (suspected pitch) present. No oil was noted to be present in groundwater as visually evaluated from water periodically discharged into a bucket at the wellhead sampling port. Further, only minor amounts of oil (minor blebs) were noted in water as present in the equalization tanks.

Groundwater samples were collected over the course of this purging event at prescribed intervals based on the volume of groundwater removed from the well, with the sampling frequency selected in consultation with Mr. Dana Bayuk and Mr. Henning Larsen of DEQ. As discussed with DEQ, the objective of the sampling regime was to allow evaluation of groundwater quality changes over time as more groundwater from the surrounding bedrock aquifer was drawn through the well. The sampling regime is summarized below and the laboratory testing for the collected samples is described in Section 4.4.

Groundwater Samples – Purging Event 1

Sample Number	Event 1 Volume Purged (Gallons)	Total Volume Purged (Gallons)
2708-190617-MULT802-101	1,000	1,500
2708-190617-MULT802-102	5,000	5,500
2708-190617-MULT802-103	10,000	10,500
2708-190617-MULT802-103D (Duplicate Sample)	10,000	10,500
2708-190617-MULT802-104	20,000	20,500
2708-190617-MULT802-105	40,000	40,500
2708-190617-MULT802-106	70,000	70,500

The initial water level in the well prior to starting the pump on June 17, 2019 was 14.38 feet below top of casing (btc), dropping to a depth of 45 feet btc within 10 minutes; 55 feet btc after 5 hours; and reaching a maximum depth of approximately 56.8 feet btc after approximately 12 hours, near the end of the purging event.

Inspection of the water column with a measuring tape after pumping showed that the water column above the well pump still contained blebs of oil. The presence of oil blebs above the pump, in conjunction with the low contaminant concentrations (Section 5) and lack of observable oil in the discharged water, suggest that the primary water producing zones (lower portion of the well below the pump intake) were successfully cleaned out, while the upper portion of the water column, stabilizing after the initial 42 feet

of drawdown, may have stagnated above the pump and was not effectively flushed from the well.

4.3.3 Purging Event No. 2 – June 20, 2019

Additional purging was conducted on June 20, 2019 to determine if a higher discharge rate (greater than the 90 to 105 gpm previously produced) could be attained. The objective of pumping at a higher rate was to achieve greater drawdown within the well to a level below the zone that contained oil blebs. This additional drawdown closer to the pump intake, would also increase flushing from the well.

After confirming that the pump and generator were running optimally and that the pump was throttled to its maximum output, it was determined that the maximum achievable discharge rate for the pump was 105 gpm, matching the rate of the previous purging event.

Approximately 10,000 gallons of groundwater were pumped from *Mult 802* on June 20, 2019 after approximately 1 hour and 40 minutes of pumping. A total drawdown of approximately 56 feet bgs was measured immediately prior to turning the pump off, leaving 73 feet of water column above the pump intake. Observations of the discharged groundwater did not indicate the presence of a sheen or oily blebs, although minor amounts of floating particles (apparent pitch) were periodically observed.

Groundwater samples were collected on June 20, 2019 immediately after starting the pump, and again immediately prior to turning the pump off at the end of this purging event, as summarized below.

Groundwater Samples – Purging Event No. 2

Sample Number	Event 2 Volume Purged (Gallons)	Total Volume Purged (Gallons)
2708-190620-MULT802-107	500	71,000
2708-190620-MULT802-108	10,000	80,500

4.3.4 Purging Event No. 3 with Water Flushing – June 25, 2019

In a continued effort to clean out the portion of the water column within *Mult 802* above the pump intake, on June 25, 2019 HAI and Anchor QEA conducted a purging event that included the addition of potable water to the well during purging. The objective of the potable water addition was to maintain a water level in the well that would provide sufficient head pressure to drive the upper water column (with oil blebs) down into the pump intake for removal from the well.

The pump was operated at a constant discharge rate of approximately 100 gpm for the duration of the purging event. Potable water was added at the wellhead using a fire hydrant and hose. The potable water additions ranged from 50 gpm to 85 gpm with the water added for durations ranging from 10 minutes to 30 minutes and with 10 to 15 minutes between individual water flushings. Over the course of the purging and flushing activities, which lasted approximately 5.5 hours, observations at the sample port indicated the water contained a heavy sheen and alternating between clear and brown (oil blebs) early in the process and transitioning to clear water towards the end of the process. Observations of water contained in the equalization tanks from this purging and flushing event confirmed that larger volumes of oily water were produced than were derived from the previous (purging only) events.

In total, it is estimated that approximately 7,000 gallons of potable water were used for flushing the well, with a total of 29,096 gallons purged from the well during the 5.5 hour event – for a net volume of 22,096 gallons groundwater purged (summarized below). No groundwater samples were collected during the purging and flushing event on June 25, 2019.

Purging Event No. 3

Sample Number	Event 3 Net Volume Purged (Gallons)	Total Volume Purged (Gallons)
No Samples Collected	22,096	93,596

4.3.5 Purging Event No. 4 – June 26, 2019

On June 26, 2019, the day after purging and flushing with potable water (Section 4.3.4), HAI conducted one additional purging event for a final borehole cleanse prior to pump removal and down-hole camera work (Section 4.5). This final purging was conducted with a discharge rate of approximately 103 gpm between 7:30 AM and 3:50 PM on June 26, 2019. Over the course of purging, the water level within the well dropped from 14.45 feet btc (initial) to 58.00 feet btc (final). The water produced over the duration of the pumping was clear with only trace black solids (possible pitch material). A total of 50,278 gallons of groundwater were pumped from *Mult 802* during purging event No. 4. A groundwater sample was collected on June 26, 2019 immediately prior to turning the pump off at the end of this purging event, as summarized below.

Groundwater Samples – Purging Event No. 4

Sample Number	Event 4 Volume Purged (Gallons)	Total Volume Purged (Gallons)
2708-190626-MULT802-109	50,278	143,874

Westerberg Drilling, Inc. removed the pump from the well on July 1, 2019. On July 3, 2019 HAI conducted an additional check of the well bore for oil. Consistent with previous findings, no LNAPL layer was measured on top of the water column and no DNAPL was measured at the base of the well. Blebs of light brown oil were still present in the upper approximate 40 feet of the water column within the well. Several oil absorbent socks were hung

within the upper water column of the well in an effort to remove these remaining oily blebs.

4.4 Sample Collection and Laboratory Testing

Samples of removed wastes/solids from the *Mult 802* borehole (tar, pitch, debris); oil blebs from the upper water column; and groundwater from the purging / flushing of the borehole subsequent to waste removal were collected and shipped under chain-of-custody documentation in chilled, thermally-insulated coolers to Apex Laboratories LLC (Apex Labs), an Oregon-accredited analytical laboratory located in Portland, Oregon. All solid material samples that did not undergo immediate analysis were frozen by the laboratory in order to extend the analytical holding times.

Sampling protocols for the solid / waste materials and groundwater were in accordance with standard protocols as approved for the Gasco remedial investigation. Due to the dispersed nature of the oil blebs in the upper water column it was necessary to lower a weighted line wrapped with an absorbent pad to collect a sufficient volume of oil for testing. The absorbent pad was lowered across the upper 40 feet of the water column, retrieved, and was squeezed / decanted directly into a 4-ounce sample jar, collecting approximately 2 ounces of oil on June 6, 2019 and only about 1 ounce of oil during a second collection event on June 19, 2019.

The well decommissioning log containing full descriptions of removed solids/wastes as well as sample information (sample identification and depth) is included within Appendix C. Further, a summary of the solids/wastes and oil bleb samples submitted to the laboratory, along with a brief description of theses samples, is presented in Table 1.

As summarized in Table 2, and based on consultation with DEQ, samples of the solids/wastes removed from the well bore were analyzed for the standard analytical suite of contaminants related to the Former Gasco Manufactured Gas Plant Operable Unit (Gasco OU), including polynuclear aromatic hydrocarbons (PAHs), semi-volatile organic hydrocarbons (SVOCs), volatile organic compounds (VOCs), cyanide, metals, gasoline-, diesel-, and oil-range petroleum hydrocarbons. Additionally, several samples were tested for leachability of VOCs, SVOCs, and PAHs using toxicity characteristic leaching procedure (TCLP) and synthetic precipitation leaching procedure (SPLP).

included in Appendix E. Notes and key observations from the downhole video are summarized below.

Notes on Viewing the Video

1) The video depth counter was inadvertently reset to depth of 0 feet at an actual depth equaling 200 feet btc during the camera trip down-hole.

2) The depth interval of 13.6 feet to 27.3 feet btc was inadvertently not recorded on the trip down-hole, but can be viewed on the trip up-hole (see -186.4 feet to -172.7 feet btc on depth counter).

3) Note that the 8-inch slotted steel casing, previously present between the depths of 243 to 382 feet bgs, was removed from the borehole as part of decommissioning activities completed prior to recording the downhole video.

4) The tar adhering to the inside of the 12-inch casing (0 to 64 feet btc) occurred during decommissioning activities resulting from retrieval and clean-out of the 8-inch casing while temporarily clamped within the upper portion of the borehole. Tar was not visible on the observable portions of the 12-inch casing prior to removal of the 8-inch casing.

Key Observations

1) No oil is observed floating on the water within the well, encountered at approximately 14 feet btc. Field measurements with an interface probe confirm this video observation.

2) Pipes are observed leading from the 12-inch casing at depths of approximately 2 feet btc and 7 feet btc. The pipe openings appear unclogged and silt is observed within the lower portion of the pipes beyond the opening into the well.

3) Threaded connections of the 12-inch steel casing are observed at 23 feet btc and 43 feet btc. No tar or oil is observed on the threaded connection at 23 feet btc. Viscous tar is visible on the threaded connection at 43 feet btc, but also on surrounding portions of casing (above and below). These observations suggest that the observed tar or oil did not leak into the well from the surrounding formation.

4) Several areas of brown oil staining are visible on the steel casing between depths of 30 and 53 feet btc. Several blebs of brown oil are suspended in the water column within the steel casing portion of the well (e.g., above 64 feet btc).

5) The base of the 12-inch casing is observed at approximately 64 feet btc. No evidence of oil leakage from the adjacent formation around the base of the steel casing is observed.

6) The water column within the uncased portion of the borehole (below approximately 64 feet btc) is relatively clear with no oil or tar observed suspended across any depth.

7) No DNAPL or evidence of DNAPL is observed on the base of the borehole, where soft sediments are encountered at a depth of approximately 377 feet btc.

8) The overall borehole appearance is that of basalt bedrock, ranging from smooth to blocky and some areas that are vesicular. Iron staining or iron bacteria are present in upper portions of the borehole (appearing yellow in the camera light). Zones of blocky or broken rock were observed across depths of 241 to 252 feet btc, 330 to 334 feet btc, and 372 to 376 feet btc, generally correlating with descriptions from the driller's log for this well.

9) A thin layer of tar or pitch materials is observed adhering to borehole walls as patchy occurrences between depths of approximately 121 feet btc and 376 feet btc. The materials are solid with no movement observed. The water column directly adjacent to zones of tar adherence on the borehole walls is clear and no oil component is observed.

10) No brown oil is observed on borehole walls within the uncased portion of the borehole.

11) With exception of areas where the borehole walls have a thin layer of tar or pitch adherence, the video shows that removal of wastes from the borehole of this well was successful.

4.6 Borehole Sealing

The *Mult 802* borehole was sealed between the dates of August 13, 2019 and August 22, 2019 by Cascade under the direction of HAI.

The approved *Mult 802* Decommissioning Work Plan specified that the borehole for this well would be sealed with bentonite grout from the base of the well up to a depth of 30 feet bgs within the 12-inch diameter steel surface casing. Due to the known presence of DNAPL in portions of the Fill WBZ in this area (with this WBZ present across depths of approximately 10 to 30 feet bgs) a bentonite-organoclay grout was to be used to seal the portion of the casing above 30 feet bgs that extended across the Fill WBZ.

During a July 15, 2019 telephone conversation between Mr. Joel Jeffery of WRD and Mr. Rob Ede of HAI, because tar wastes were removed from much of the borehole with oily blebs present in the upper portion of the water column, WRD requested that NW Natural use the bentonite-organoclay mixture within all portions of the borehole deeper than the water table (e.g., between 10 feet bgs to the base of the well at 382 feet bgs) as a precautionary measure.

Cascade submitted a *Special Standards Request Form* to WRD on July 24, 2019 for the use of bentonite-organoclay to seal *Mult 802* beneath a depth of 10 feet bgs. In response, WRD provided the *Final Order* dated July 30, 2019 addressed to Joe Staloch of Cascade in which WRD confirmed receipt of the July 24, 2019 *Special Standards Request Form* for Start Card Number 1042794, and approved the use of organoclay grout to abandon the former *Mult 802* supply well interval of 10 to 382 feet bgs. All WRD documentation related to the decommissioning of *Mult 802* is included within Appendix F.

The WRD-required variance from the approved decommissioning work plan was discussed with DEQ during a telephone conservation on July 29, 2019 (Rob Ede to Dana Bayuk), with DEQ providing concurrence for this modification.

As per the approved Special Standards Request, the bentonite-organoclay grout mixture was prepared with 9 parts Wyoming sodium bentonite and 1 part organoclay by volume, mixed to a 20% solids content. The resulting mud weight of the 20% solids grout, if correctly mixed to these specifications, would be 71.7 pounds per cubic foot (plus or minus 1 pound per cubic foot), equating to a mud weight of between 9.5 to 9.7 pounds per gallon.

Each batch of the bentonite-organoclay grout mixture was prepared using 50 pounds granular sodium bentonite; 5 pounds of granular organoclay media; and 37 gallons of water. In order to maintain a consistent grout meeting the specifications of 9.5 to 9.7 pounds per gallon (20% solids content), a mud balance was used with each batch to confirm the proper mud weight prior to placement within the *Mult 802* borehole.

Between August 13, 2019 and August 21, 2019, a total of 81 batches of bentonite-organoclay grout consisting of approximately 37 gallons each, were emplaced downhole from bottom to top by pressurized tremie pipe. The total volume of grout emplaced in the former *Mult 802* supply well was approximately 2,980 gallons between the interval 10.5 to 382 feet bgs. The depth to the top of the grout column remained stable overnight based on measurements made immediately prior to filling the upper 10.5 feet of casing with hydrated bentonite (described in paragraphs below). All groundwater that was displaced upward in the borehole during the grouting process was pumped into nearby 500 gallon capacity totes before reaching the top of the borehole.

The calculated volume of grout for the estimated 10-inch diameter borehole interval extending from 63 to 382 feet bgs is approximately 1,301 gallons, and the actual volume of grout emplaced across that interval was 2,590 gallons. The calculated volume of grout for the 12-inch diameter interval from 10 to 63 feet bgs is approximately 311 gallons, and the actual volume of grout emplaced across that interval was 390 gallons. Minimum required grout volumes (equal to calculated borehole volume) were satisfied across the entirety of the borehole, with excess grout (approximately 1,368 gallons) likely moving into the adjacent formation, indicative of adequate grout penetration into the area immediately surrounding the borehole.

The upper 12-inch steel casing for *Mult 802* was perforated by Cascade between August 19, 2019 and August 21, 2019. Cascade utilized a Mills Knife perforator with a two-line rig to punch a series of 8 vertical slots (45-degree radial separation) through the casing wall each vertical foot starting at 61.5 feet bgs and ending at 10.5 feet bgs. Granular bentonite, hydrated in 2-foot lifts, was then emplaced across depths of approximately 1 to 10.5 feet bgs. To account for swelling, the hydrated bentonite was allowed to settle and stabilize for two days before concrete was poured within the upper foot of the well casing as a surface seal for the former supply well.

Documentation of the measured mud weight of each individually emplaced batch of bentonite-organoclay mixture, along with depth to grout measurements that were made during the sealing process is tabulated within Table 17. A generalized summary of the overall *Mult 802* borehole sealing material depths, type and amount of sealing materials used, and range in mud weight measurements are provided below.

Mult 802 Borehole Sealing Summary

Depth (ft bgs)	Backfill Material	Amount	Mud Weight (lbs/gal)
0 – 1	Concrete	2 50-lb bags	NA
1 – 10	Hydrated Bentonite Chips	9 50-lb bags	NA
10 – 382	Organoclay-Bentonite Grout	2,980 gallons	9.5 – 9.7

Notes:
lbs/gal = pounds per gallon
ft bgs = feet below ground surface
NA = not applicable

5.0 LABORATORY TESTING RESULTS

5.1 Solids – Tar and Pitch Materials

Samples of the solids removed from the *Mult 802* borehole were collected and analyzed for the standard analytical suite of contaminants for the Gasco OU (Section 4.4). Samples were collected of the various types of materials removed from the well bore, as described on the well decommissioning log (Appendix C), with sample descriptions included on Table 1. Test results for these materials are summarized in Tables 3 through 8. As summarized on these tables, samples of the mixed tar and pitch; the viscous semi-solid tar (viscous "honey-like" tar); and the deeper more solid/competent tar were analyzed from multiple depths within the borehole. A sample of the gravel and broken rock fragments from the base of the well was also collected in order to document the condition of the borehole immediately underlying the removed tar and pitch materials.

Testing of all tar and pitch materials detected concentrations of gasoline-, diesel-, and oil-range total petroleum hydrocarbons (TPH), with the diesel-range TPH predominating. The highest detected diesel-range TPH concentration was 305,000 milligrams per kilogram (mg/kg) from a sample of the viscous tar material (sample -006 from 318 feet bgs). Benzene concentrations up to 288 mg/kg (sample -013 from 378 feet bgs) and naphthalene concentrations up to 15,400 mg/kg (sample -009 from 368 feet bgs) were also detected in the solid tar samples. No chlorinated VOCs (e.g., halogenated solvents) were detected in any of the samples analyzed (Table 3).

Several VOCs leached from the tar/pitch materials when undergoing TCLP (Table 4) or SPLP (Table 5) leachability testing, with benzene and naphthalene being predominant. As provided in the disposal characterization and profiling for these materials (Section 6.2), the leachable concentrations of benzene via the TCLP methodology (3.15 milligrams per liter (mg/L)) rendered these materials to be a Resource Conservation and Recovery Act (RCRA) regulated hazardous waste for the purposes of disposal (D018-benzene toxicity characteristic). Similar leachate concentrations were detected by both the TCLP (simulates landfill leachate

contact) and the less aggressive SPLP (simulates rainfall contact) leaching methods.

Elevated concentrations of PAHs and other SVOCs were detected in the tar and pitch as would be expected based on the nature of the material (Tables 6 and 7), with metals and cyanide testing also being completed for characterization purposes (Table 8).

As shown on Table 9, physical testing of the viscous tar (sample -007 from 352 feet bgs) found the dynamic viscosity for this material to be 10,096 millipascals per second (mPa-s) at a temperature of 86 degrees Fahrenheit (F), similar to the room temperature viscosity of honey. The viscosity of this material at typical groundwater temperatures (generally below 55F) would be significantly higher, and was observed to have a gummy/solid consistency in ambient air temperatures (50F to 60F).

As summarized on Tables 3 through 8, concentrations of all analytes with exception of certain metals (abundant earth elements) were sharply attenuated in the sample of gravel and rock fragments collected at the base of the borehole (sample -014 from 381 to 382 feet bgs) immediately underlying the emplaced tar and pitch materials. The lack of vertical mobility of the tar material downward into the sand and gravel at the base of the well, as evidenced from visual observation (Photo Nos. 35 and 36, Appendix B) and from sample chemistry (sample -014), further demonstrates the lack of mobility of the tar and pitch materials.

5.2 Oil Blebs

Samples of oil blebs removed from the *Mult 802* borehole (presence was limited to approximately the upper 40 feet of water column) were collected and analyzed for the standard analytical suite of contaminants for the Gasco OU as well as for physical properties (Section 4.4). Chemical test results for this sample are summarized in Tables 10 through 12. Physical testing results are summarized in Table 17.

Testing of the oil detected 412,000 mg/kg gasoline-range and 681,000 mg/kg diesel-range total petroleum hydrocarbons. Benzene was detected at a concentration of 10,500 mg/kg and naphthalene was detected at a concentration of 140,000 mg/kg, as were elevated concentrations of other PAHs and SVOCs (Tables 10 and 11). No chlorinated VOCs (e.g., halogenated solvents) were detected in the oil (Table 10).

As summarized on Table 17, physical testing of the oil found the dynamic viscosity for this material to be 16.09 mPa-s at a temperature of 50F, with a specific gravity of 1.0 (equal to water).

The oil blebs in the water column were likely derived from the cleanout of the tarry material from the 8-inch casing while it hung in the upper borehole, and these blebs likely remained in the upper water column even after several weeks since they have a density equivalent to water and therefore would not have a tendency to rise or to sink.

5.3 Groundwater

As described in Section 4.3, a groundwater sample was collected after the removal of the tar and pitch materials in order to document the quality of stagnant water in the well bore prior to purging. Additionally, groundwater samples were collected from the well bore during the extended purging of the well to document how concentrations changed as additional tar, pitch, and oily blebs were cleansed from the water column and the sides of the well bore as groundwater from the surrounding bedrock aquifer entered the well.

As described in Section 4.3, groundwater samples were collected from *Mult 802* on the following frequency to document concentration trends as a function of volume purged:

- 500 gallons purged
- 1,500 gallons purged
- 5,500 gallons purged
- 10,500 gallons purged
- 20,500 gallons purged
- 40,500 gallons purged
- 70,500 gallons purged
- 80,500 gallons purged
- 143,874 gallons purged

For reference in comparisons to total volumes purged, the approximate volume of water contained within the well bore, considering the 12-inch diameter upper casing (0 to 63 feet bgs) and assuming the open borehole portion of the well is 10-inch diameter (63 to 382 feet bgs), would be approximately 1,600 gallons.

Because there was a small amount of residual tar or pitch in the well bore and oil presence on surfaces of the pump and plumbing (Photos 43 and 44, Appendix B) after completion of all clean-out activities, data from groundwater samples collected from the well bore will be skewed high relative to groundwater quality within the surrounding bedrock aquifer.

Time-series groundwater quality data from *Mult 802* are useful in evaluating the presence or significance of possible impacts to the bedrock aquifer. For example, an increasing trend or a high level stable trend in contaminant concentrations over the course of purging may indicate the presence of elevated contaminants in the basalt aquifer beyond the immediate vicinity of the well bore. Alternatively, a decreasing trend or a low level stable concentration trend would indicate clean or cleaner groundwater is being pumped through the borehole as the localized contaminants within the borehole (e.g., tar and pitch fragments) are being effectively removed.

A concentration plot of benzene and toluene (both highly soluble), naphthalene (less soluble) and benzo(a)pyrene (least soluble), as a function of volume of waste purged is presented in Figure 3. All available data are summarized in Tables 13 through 16.

As depicted on Figure 3, the pumping and flushing of the *Mult 802* well bore resulted in a significant decline in concentrations for all contaminants. Benzene concentrations in water removed from the well bore declined from an initial concentration of 33,900 micrograms per liter (µg/L) prior to any pumping, to a low of 441 µg/L after flushing approximately 70,000 gallons of through the well during the first purging event. Water within the well bore 3 days after the first purging event ended showed a slight rebound to 4,590 µg/L of benzene, which is substantially lower than the initial concentration and considered to be a function of tar/pitch materials still within the water column at that time. As shown on Figure 3, concentrations of benzene diminished to a low of 194 µg/L after completion of the next three purging events, which included the successful removal of a majority of the oil blebs from the upper water column, as well as additional pitch and tar from the water column.

In addition to declines in benzene concentration as a function of increased groundwater removal, similar trends were observed with toluene (7,090 µg/L initial; and 80 µg/L final concentration), naphthalene (11,900 µg/L initial; and 1,030 µg/L final concentration), and benzo(a)pyrene (9,590 µg/L early and 29.1 µg/L final).

The significant decline in dissolved phase contaminant concentrations over the course of pumping from the bedrock aquifer is indicative that the tar and pitch materials formerly present within the *Mult 802* well bore had not resulted in significant impact to the bedrock aquifer beyond the area immediately surrounding the well bore. It is likely that the lack of mobility of these materials, combined with the finite volume and limited presence within the borehole, were a factor in minimizing their impact to the subsurface environment.

6.0 WASTE DISPOSAL

6.1 Liquids

Liquid wastes that were generated during the *Mult 802* decommissioning project included groundwater that was pumped from the well during the borehole pumping and sampling activities; potable water that was used during the flushing of the well; and minor amounts of oil that was entrained in some of these waters.

Consistent with DEQ approved protocols, all decontamination water and water that was pushed to the surface during well sealing activities as well as decontamination water was containerized in 500-gallon storage totes located near the areas of generation. These storage totes were discharged to the on-site Groundwater Treatment System (GTS) via the purge water and decontamination water discharge box located at the Siltronic Pre-Treatment System.

All groundwater and potable water that was generated during the pumping, flushing, and sampling of *Mult 802* was discharged directly to three 20,000 gallon equalization tanks which were plumbed to the on-site GTS via the Gasco Pre-Treatment System.

All liquids were fully treated through the pre-treatment and primary treatment components of the GTS prior to permitted discharge to the Willamette River under National Pollution Discharge Elimination System (NPDES) Permit No. 103061.

6.2 Solids

Solid materials generated during the decommissioning of *Mult 802* included tar and pitch removed from the borehole; the removed 8-inch diameter steel casing, plastic sheeting, personal protective equipment, and other miscellaneous equipment and debris that was contaminated through contact with the recovered tar and pitch materials. A total of 23 55-gallon drums of tar and pitch materials and a 20 cubic yard capacity drop box containing steel casing, PPE, plastic, and miscellaneous contaminated debris were generated during the *Mult 802* decommissioning work.

All of the wastes were characterized and managed consistent with procedures established for investigative or cleanup derived wastes for the

site. Characterization of the tar and pitch media indicated that wastes generated during the *Mult 802* decommissioning exhibited the RCRA toxicity characteristic. Because the configuration of this material within the well suggested it had been directly placed there, and because of other characteristics of the material, it was determined that the MGP exemption to the toxicity characteristic did not apply, Therefore, the drop box containing the steel casing, personal protective equipment, and related debris was transported to the Chemical Waste Management, Inc. permitted hazardous waste landfill located in Arlington, Oregon for disposal as a D018 RCRA hazardous waste. The 23 drums of tar and pitch material were transported to the Clean Harbors, Inc. Aragonite permitted hazardous waste incinerator located in Dugway, Utah for incineration.

All waste disposal documentation, including waste characterization profiles with supporting laboratory reports and waste disposal manifests, are included in Appendix G.

7.0 SUMMARY AND CONCLUSIONS

The decommissioning of former industrial water supply well *Mult 802* was successfully completed between May 13, 2019 and August 22, 2019. As part of the decommissioning it was discerned that apparent waste materials (tar and pitch) were placed within the *Mult 802* well bore at some point in the past. As such, the decommissioning included the characterization and full clean-out and disposal of these materials.

Though not planned, the lower 8-inch perforated steel casing, which had been present in the borehole from 243 to the base of the well at 382 feet bgs, was removed in its entirety as part of the decommissioning. The removal of this casing, which contained much of the removed tar and pitch materials, was instrumental in the effective removal of wastes and the successful decommissioning of this well.

After the physical removal of the tar and pitch materials, the *Mult 802* well bore was purged and flushed, removing over 140,000 gallons of groundwater from the well bore and cleansing remaining tar and pitch from the well to the extent possible. Also, the addition of potable water while purging was conducted during one of the purging events (Purging Event No. 3) and was successful in forcing oily blebs suspended in the upper cased portion of the water column down into the pump intake for removal. With the exception of areas on the borehole wall with a thin layer of tar and pitch adherence and several oil blebs still remain in the upper 12 inch OD cased portion of the hole, a downhole video showed that the removal of wastes from the *Mult 802* well bore had been highly effective.

Chemical testing of groundwater samples collected at regular intervals during the purging and flushing of the *Mult 802* well bore showed concentrations of contaminants sharply declining as larger volumes of groundwater from the surrounding basalt aquifer were flushed through the borehole. Benzene concentrations, for example, declined from 33,900 ug/L (initial) to just 194 ug/L (final).

The significant decline in dissolved phase contaminant concentrations over the course of pumping from the bedrock aquifer is indicative that the tar and pitch materials formerly present within the *Mult 802* well bore had not

resulted in significant impact to the bedrock aquifer beyond the area immediately surrounding the well bore. It is likely that the limited mobility and volume of these materials within the confines of the *Mult 802* well bore was a factor in minimizing their lasting impact to the highly transmissive bedrock aquifer.

After waste material removal, water column purging/flushing and down-hole video documentation, the entirety of the *Mult 802* well bore was sealed with bentonite-organoclay grout (10 to 382 feet bgs), hydrated bentonite pellets (1 to 10 feet bgs) and a concrete surface seal (0 to 1 foot bgs). Minimum required grout volumes (equal to calculated borehole volume) were satisfied across the entirety of the borehole, with excess grout (approximately 1,368 gallons) likely moving into the adjacent formation, indicative of adequate grout penetration into the area immediately surrounding the borehole.

The decommissioning of *Mult 802* was completed in full accordance with Oregon WRD requirements. Data collected over the course of the decommissioning were sufficient for the characterization of the materials that had been placed within the borehole and for the evaluation of potential impacts to the bedrock aquifer. The findings suggest that the lack of mobility of the materials placed within the well, combined with the finite volume and limited presence of tar and pitch materials within the confines of the borehole were a factor in minimizing their impact to the subsurface environment. With the successful removal of the tar and pitch and the sealing of the *Mult 802* well bore, no additional actions related to former water supply well *Mult 802* appear necessary. No evidence of significant impacts to the basalt aquifer were identified.

8.0 LIMITATIONS AND SIGNATURES

The information presented in this report was collected, analyzed, and interpreted following the standards of care, skill, and diligence ordinarily provided by a professional in the performance of similar services as of the time the services were performed. This report and the conclusions and/or recommendations contained in it are based solely upon research and/or observations, and physical sampling and analytical activities, if any, that were conducted at the Client's (NW Natural) request.

The information presented in this report is based only upon activities witnessed by HAI or its contractors, and/or upon information provided to HAI by the Client and/or its contractors. The analytical data presented in this report, if any, document only the concentrations of the target analytes in the particular sample, and not the property as a whole.

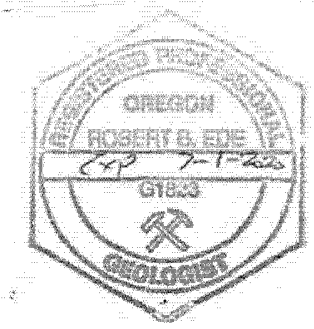
Unless otherwise specified in writing, this report has been prepared solely for the use by the Client and for use only in connection with the evaluation of the subject property. Any other use by the Client or any use by any other person shall be at the user's sole risk, and HAI shall have neither liability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

Hahn and Associates, Inc.

Prepared by:

Robert B. Ede, R.G.
Principal

Date April 20, 2020



9.0 GLOSSARY OF ABBREVIATIONS

Anchor QEA	Anchor QEA, LLC
Apex Labs	Apex Laboratories, LLC
bgs	below existing ground surface
btc	below top of casing
Cascade	Cascade Drilling, L.P.
CCS	Cowlitz Clean Sweep, Inc.
DEQ	Oregon Department of Environmental Quality
DNAPL	dense non-aqueous phase liquid
ECSI	Environmental Cleanup Site Characterization Database
F	degrees Fahrenheit
gpm	gallons per minute
GTS	groundwater treatment system
HAI	Hahn and Associates, Inc.
ID	inner diameter
KI	Koppers, Inc.
lbs/gal	pounds per gallon
LNAPL	light non-aqueous phase liquid
LNG	liquified natural gas
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MGP	manufactured gas plant
mPa-s	millipascal per second
OD	outer diameter
OU	operable unit
PAHs	polynuclear aromatic hydrocarbons
PG&C	Portland Gas & Coke
RCRA	Resource Conservation and Recovery Act
SPLP	synthetic precipitation leaching procedure
SVOCs	semi-volatile organic compounds
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbons

µg/L	micrograms per liter
USGS	United States Geological Survey
VOCs	volatile organic compounds
WBZ	water-bearing zone
WRD	Oregon Water Resources Department

Table 1 - Sample Availability and Laboratory Testing Program

MULT 802 Supply Well Decommissioning
NW Natural Gasco Property
Portland, Oregon

					Sample Analyses																																						
					ASTM D7042/D4052																	**Metals** (EPA 6020A)																					
Sample ID	**Sample Media (Soil, Groundwater, Surfacewater, Tar, Pitch, Other)**	**Sample Depth Interval (feet bgs)**	**Sample Date**	**Lab SDG**	**Dynamic Viscosity**	**Kinematic Viscosity**	**Density**	**API Gravity**	**Specific Gravity**	**Total Cyanide** (ASTM D7511-12)	**Available Cyanide** (ASTM D688	**Free Cyanide** (ASTM D4282-02)	**VOCs** (EPA 5035A/8260C)	**TCLP VOCs** (EPA 1311/8260C)	**SPLP VOCs** (EPA 1312/8260C)	**SVOCs** (EPA 8270D)	**SPLP SVOCs** (EPA 1312/8270D SIM)	**PAHs** (EPA 8270D SIM)	**SPLP PAHs** (EPA 1312/8270D SIM)	**TPH-Dx** (NWTPH-Dx)	**TPH-Gx** (NWTPH-Gx)	**Aluminum**	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Calcium**	**Chromium**	**Copper**	**Iron**	**Lead**	**Magnesium**	**Manganese**	**Mercury**	**Nickel**	**Potassium**	**Selenium**	**Silver**	**Sodium**	**Tahllium**	**Vanadium**	**Zinc**
COMP1	Tar / Pitch	47, 96, 136	14-May-19	A9E0508						X			X	X		X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2708-190515-005	Tar / Pitch	298 - 299	15-May-19	A9E0582						X			X			X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2708-190520-006	Tar	318 - 319	20-May-19	A9E0677						X			X			X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2708-190521-007	Tar	352 - 353	21-May-19	A9E0723	X	X	X						X	X	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2708-190521-008	Tar	358 - 359	21-May-19	A9E0723									X																														
2708-190521-009	Tar / Pitch	368 - 369	21-May-19	A9E0723										X						X	X																						
2708-190521-010	Tar / Pitch	380 - 381	21-May-19	A9E0723									X																														
2708-190522-011	Tar / Pitch	363 - 364	22-May-19	A9E0785									X		X			X	X	X	X																						
2708-190523-013	Tar	378 - 379	23-May-19	A9E0832									X		X			X	X	X	X																						
2708-190524-014	Soil	381 - 382	24-May-19	A9E0902						X			X					X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2708-190606-OIL	Oil	14 - 50	06-Jun-19	A9F0287	X	X	X	X	X																																		
2708-190619-OIL	Oil	14 - 50	19-Jun-19	A9F0684									X			X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2708-190614-MULT802-100	Groundwater	63-382	14-Jun-19	A9F0498						X	X	X	X			X				X	X	X	X	X	X	X	X		X	X	X	X		X	X	X		X	X		X	X	X
2708-190617-MULT802-101	Groundwater	63-382	17-Jun-19	A9F0573						X	X	X	X			X				X	X	X	X	X	X	X	X		X	X	X	X		X	X	X		X	X		X	X	X
2708-190617-MULT802-102	Groundwater	63-382	17-Jun-19	A9F0573						X	X	X	X			X				X	X	X	X	X	X	X	X		X	X	X	X		X	X	X		X	X		X	X	X
2708-190617-MULT802-103	Groundwater	63-382	17-Jun-19	A9F0573						X	X	X	X			X				X	X	X	X	X	X	X	X		X	X	X	X		X	X	X		X	X		X	X	X
2708-190617-MULT802-103D	Groundwater	63-382	17-Jun-19	A9F0573						X	X	X	X			X				X	X	X	X	X	X	X	X		X	X	X	X		X	X	X		X	X		X	X	X
2708-190617-MULT802-104	Groundwater	63-382	17-Jun-19	A9F0573						X	X	X	X			X				X	X	X	X	X	X	X	X		X	X	X	X		X	X	X		X	X		X	X	X
2708-190617-MULT802-105	Groundwater	63-382	17-Jun-19	A9F0573						X	X	X	X			X				X	X	X	X	X	X	X	X		X	X	X	X		X	X	X		X	X		X	X	X
2708-190617-MULT802-106	Groundwater	63-382	17-Jun-19	A9F0573						X	X	X	X			X				X	X	X	X	X	X	X	X		X	X	X	X		X	X	X		X	X		X	X	X
2708-190620-MULT802-107	Groundwater	63-382	20-Jun-19	A9F0692									X																														
2708-190620-MULT802-108	Groundwater	63-382	20-Jun-19	A9F0692									X																														
2708-190626-MULT802-109	Groundwater	63-382	26-Jun-19	A9F0860						X	X	X	X			X				X	X	X	X	X	X	X	X		X	X	X	X		X	X	X		X	X		X	X	X
2708-190626-MULT802-TB	QA/QC	-	26-Jun-19	A9F0860									X																														
2708-190614-MULT802-TB	QA/QC	-	14-Jun-19	A9F0498									X																														
2708-190617-MULT802-TB	QA/QC	-	17-Jun-19	A9F0573									X																														
2708-190620-MULT802-TB	QA/QC	-	20-Jun-19	A9F0692									X																														

Notes:
API = American Petroleum Institute
ASTM = American Society for Testing and Materials
bgs = below ground surface
EPA = Environmental Protection Agency
PAH = polyaromatic hydrocarbons
SDG = sample delivery group
SPLP = Synthetic Precipitation Leaching Procedure
SVOCs = semivolatile organic compounds
TCLP = Toxicity Characteristic Leaching Procedure
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

Table 2 - Sample Description: Solids/Wastes and Oil Blebs Removed from Well Borehole
Mult 802 Water Supply Well Decommissioning

Sample ID	Date	Time	Number of 8 oz Jars	Sample Headspace (ppm)	Approximate Depth in MULT 802 (feet bgs)	Sample Description
2708-190513-001	13-May-19	15:15	2	369	47	Black granular pitch (glassy, hard fragments) and black tar, with tar ranging from hard and brittle to soft and plastic. Large amount of pitch is fine- to coarse-grained sand sized, cohesive, but crumbles easily. Material does not become soft or begin to "seep" in the warm sun. Appears to be mostly pitch / minor tar.
2708-190513-002	13-May-19	16:00	2	168	96	Granular (fine to coarse) black tar and pitch ranging from hard and brittle (pitch) to soft and plastic (tar). Pitch fragments appear glassy, reflective, conchoidal fracture, a few coarse-grained basalt gravels are present. Much black fine-grained apparent pitch material throughout. slight decrease in tar/pitch percentage with brown gravels visible in matrix. No oil is visible.
2708-190513-003	13-May-19	16:05	1	167	136	Sample contains only large pitch fragments removed from overall matrix at this depth (overall matrix is included as sample-004).
2708-190514-004	14-May-19	15:00	2	-	136	Coarse sand or fine grained gravel, brown but mixed with pitch and fragments of black sticky tar.
COMP1	13-May-19	-	-	-	-	Lab-prepared composite of samples-001, -002, and -004.
2708-190515-005	15-May-19	14:45	2	128	298	Black viscous, competent tar (putty-like) with black oily viscous more liquid-like tar blebs present.
2708-190520-006	20-May-19	15:00	4	-	318	Sample consists of thick honey or fresh taffy like black tar; Falls out of core barrel sampler (to drum) like ropes of thick taffy. This material becomes less viscous in sun/heat. Has an oily component visible on contacted surfaces when handled though little oil is visible in tar.
2708-190521-007	21-May-19	10:55	2	-	352	Sample of material similar in description to that described above for sample -006.
2708-190521-008	21-May-19	11:00	2	38.7	358	Sample of material similar in description to that described above for sample -006 and -007.
2708-190521-009	21-May-19	11:55	4	66.2	368	Black solid tar, appears weathered with a sand-like texture. This material does not have the honey/taffy "flowable" consistency as samples -006 through -008. Instead, this is a more dense, competent tar.
2708-190521-010	21-May-19	15:30	5	-	380	Black solid tar mixed with coarse sand and gravels - some brown coloration to sand and gravel indicating tar is not pervasive throughout. Tar is competent (not the flowable viscous honey/taffy) but is soft/gummy.
2708-190522-011	22-May-19	16:30	6 (4oz jars)	208	363	Black solid tar with some fine grained sand, competent, highly viscous and sticky, high plasticity. Black oily component on surface of material.
2708-190523-012	23-May-19	12:50	3	331	338	Black solid tar mixed with fine grained sand. Tar is competent (not the flowable viscous honey/taffy) but is soft/gummy. Tar contents slough like soil from core barrel unlike the viscous less competent tar (which fell from the core barrel like a rope of taffy) that as represented by samples -006 through -008.
2708-190523-013	23-May-19	15:00	3	142	378	Black solid tar with some fine to medium grained sand, plastic and sticky mixed with hard brittle tar or pitch fragments (fragments have a glassy appearance).
2708-190524-014	24-May-19	12:50	3	105.4	382	Gravel with sand, grey, wet, sub rounded and angular, large broken basalt fragment (grey, massive) approximately 4" x 3" x 2". Water has a minor sheen, but no oil or tar is observed.
2708-190528-015	28-May-19	10:55	3	44.8	37	Black granular pitch (glassy, hard fragments) and black tar, with tar ranging from hard and brittle to soft and plastic. Large amount of pitch is fine- to coarse-grained sand sized, cohesive, but crumbles easily. Material becomes soft in the warm sun. Collected from stored core bags.
2708-150928-016	28-May-19	11:00	3	3.7	67	Granular (fine to coarse) pitch and tar ranging from hard and brittle (pitch) to soft and plastic (tar). Pitch fragments appear glassy, reflective, conchoidal fracture. Much black fine-grained apparent pitch material throughout. Appears majority pitch with minor tar. No oil is visible. Collected from stored core bags.
2708-190528-017	28-May-19	11:05	3	11.1	86	Granular (fine to coarse) black tar and pitch ranging from hard and brittle (pitch) to soft and plastic (tar). Pitch fragments appear glassy, reflective, conchoidal fracture. Much black fine-grained apparent pitch material throughout. No oil is visible. Collected from stored core bags.
2708-190606-OIL	6-Jun-19	14:00	1	-	upper water column (14 to 50 feet)	Sample of oil (approximately 2 oz.) that was present in water column. No recordable thickness and appears to be mixed into water column.
2708-190619-OIL	6/19/19	14:00	1	-	upper water column (14 to 50 feet)	Sample of oil (less than 1 oz.) that was present in water column. No recordable thickness and appears to be mixed into water column.

Notes:
bgs = below ground surface
ppm = parts per million

Table 3 - Summary of Analytical Results for Removed Solids: TPH and VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Media ==>	Tar / Pitch	Tar - Viscous				Tar - Solid				Gravel/Sand
Sample Number ==>	2708-190513-COMP1	2708-190515-005	2708-190520-006	2708-190521-007	2708-190521-008	2708-190521-009	2708-190521-010	2708-190522-011	2708-190523-013	2708-190524-014
Sample Date ==>	13-May-19	15-May-19	20-May-19	21-May-19	21-May-19	21-May-19	21-May-19	22-May-19	23-May-19	24-May-19
Sample Depth (feet bgs) ==>	47, 96, and 136	298 - 299	318 - 319	352 - 353	358 - 359	368 - 369	380 - 381	363 - 364	378 - 379	381 - 382
Location ==>	12-inch Casing	12-inch Casing	8-inch Casing	8-inch Casing	8-inch Casing	8-inch Casing	8-inch Casing	Borehole	Borehole	Borehole
	Analytical Results in mg/kg (ppm)									
Volatile Organic Compounds (VOCs) by EPA Method 8260C										
Bromodichloromethane	29.6 U	58.5 U	319. U	565. U	826. U	42.7 UJ	180. U	35. UJ	46.3 UJ	8.73 U
Bromoform (Tribromomethane)	59.1 U	117. U	639. U	1,130. U	1,650. U	85.5 UJ	360. U	69.9 UJ	92.6 UJ	17.5 U
Bromomethane (Methyl bromide)	148. U	292. U	1,600. U	2,820. U	4,130. U	427. UJ	901. U	350. UJ	463. UJ	87.3 U
Carbon disulfide	148. U	292. U	1,600. U	2,820. U	4,130. U	427. UJ	901. U	350. UJ	463. UJ	87.3 U
Carbon tetrachloride (Tetrachloromethane)	29.6 U	58.5 U	319. U	565. U	826. U	42.7 UJ	180. U	35. UJ	46.3 UJ	8.73 U
Chlorobenzene	7.39 U	14.6 U	79.9 U	141. U	207. U	21.4 UJ	45. U	17.5 UJ	23.1 UJ	4.36 U
Chloroethane	148. U	292. U	1,600. U	2,820. U	4,130. U	427. UJ	901. UJ	350. UJ	463. UJ	87.3 U
Chloroform	14.8 U	29.2 U	160. U	282. U	413. U	42.7 UJ	90.1 U	35. UJ	46.3 UJ	8.73 U
Chloromethane	73.9 U	146. U	799. U	1,410. U	2,070. U	214. UJ	450. U	175. UJ	231. UJ	43.6 U
Cymene, p- (4-Isopropyltoluene)	14.8 U	29.2 U	160. U	282. U	413. U	42.7 UJ	90.1 U	35. UJ	46.3 UJ	8.73 U
Dibromochloromethane	29.6 U	58.5 U	319. U	565. U	826. U	85.5 UJ	180. U	69.9 UJ	92.6 UJ	17.5 U
Dibromomethane	14.8 U	29.2 U	160. U	282. U	413. U	42.7 UJ	90.1 U	35. UJ	46.3 UJ	8.73 U
Dichlorodifluoromethane	29.6 U	58.5 U	319. U	565. U	826. U	85.5 UJ	180. U	69.9 UJ	92.6 UJ	17.5 U
Dichloromethane (Methylene chloride)	73.9 UJ	146. UJ	799. UJ	1,410. UJ	2,070. UJ	214. UJ	450. UJ	175. UJ	231. UJ	43.6 U
Ethylbenzene	**12.4**	**61.7**	**95.5**	141. U	207. U	**144. J**	**56.9**	**104. J**	**73.6 J**	**6.37**
Ethylene dibromide (1,2-Dibromoethane)	14.8 U	29.2 U	160. U	282. U	413. U	42.7 UJ	90.1 U	35. UJ	46.3 UJ	8.73 U
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	29.6 U	58.5 U	319. U	565. U	826. U	85.5 UJ	180. U	69.9 UJ	92.6 UJ	17.5 U
Isopropylbenzene (Cumene)	14.8 U	29.2 U	160. U	282. U	413. U	42.7 UJ	90.1 U	35. UJ	46.3 UJ	8.73 U
m,p-Xylene	**17.1**	**93.5**	160. U	282. U	413. U	**220. J**	90.1 U	**156. J**	**141. J**	**10.3**
Methyl ethyl ketone (2-Butanone)	148. U	292. U	1,600. U	2,820. U	4,130. U	427. UJ	901. U	350. UJ	463. UJ	87.3 U
Methyl tert-butyl ether (MTBE)	14.8 U	29.2 U	160. U	282. U	413. U	42.7 UJ	90.1 U	35. UJ	46.3 UJ	8.73 U
n-Butylbenzene	14.8 U	29.2 U	160. U	282. U	413. U	42.7 UJ	90.1 U	35. UJ	46.3 UJ	8.73 U
n-Propylbenzene	7.39 U	14.6 U	79.9 U	141. U	207. U	21.4 UJ	45. U	17.5 UJ	23.1 UJ	4.36 U
Naphthalene	**475.**	**5,630.**	**10,300.**	**10,500.**	**6,640.**	**15,400. J**	**7,940.**	**9,020.**	**5,570. J**	**677.**
o-Xylene	**8.02**	**30.4**	79.9 U	141. U	207. U	**74.8 J**	45. U	**50.3 J**	46.8 J	4.36 U
sec-Butylbenzene	14.8 U	29.2 U	160. U	282. U	413. U	42.7 UJ	90.1 U	35. UJ	46.3 UJ	8.73 U
Styrene	14.8 U	29.2 U	160. U	282. U	413. U	**53.8 J**	90.1 U	**39.5 J**	46.3 UJ	8.73 U
tert-Butylbenzene	14.8 U	29.2 U	160. U	282. U	413. U	42.7 UJ	90.1 U	35. UJ	46.3 UJ	8.73 U
Tetrachloroethene (PCE)	7.39 U	14.6 U	79.9 U	141. U	207. U	21.4 UJ	45. U	17.5 UJ	23.1 UJ	4.36 U
Toluene	**29.3**	**99.8**	160. U	282. U	413. U	**185. J**	90.1 U	**145. J**	**212. J**	**10.1**
Trichloroethene (TCE)	7.39 U	14.6 U	79.9 U	141. U	207. U	21.4 UJ	45. U	17.5 UJ	23.1 UJ	4.36 U
Trichlorofluoromethane (Fluorotrichloromethane)	29.6 U	58.5 U	319. U	565. U	826. U	85.5 UJ	180. U	69.9 UJ	92.6 UJ	17.5 UJ
Vinyl chloride	7.39 U	14.6 U	79.9 U	141. U	207. U	21.4 UJ	45. U	17.5 UJ	23.1 UJ	4.36 U

Notes:

bgs = below ground surface

bold = detected concentration

EPA = Environmental Protection Agency

J = estimated concentration

mg/kg = milligrams per kilogram

ppm = parts per million

TPH = total petroleum hydrocarbons

U = not detected

VOCs = volatile organic compounds

"-" = not tested

Table 4 - Summary of Analytical Results for Removed Solids: TCLP VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Media ==>	Tar / Pitch		Tar - Viscous	
Sample Number ==>	2708-190513-COMP1		2708-190521-007	
Sample Date ==>	13-May-19		21-May-19	
Sample Depth (feet bgs) ==>	47, 96, and 136		352 - 353	
Location ==>	12-inch Casing		8-inch Casing	
	Analytical Results in mg/L (ppm)			
TCLP Volatile Organic Compounds (VOCs) by EPA Method SW1311/8260C				
1,1-Dichloroethane	0.03	U	0.03	U
1,1-Dichloroethene	0.03	U	0.03	U
1,1-Dichloropropene	0.05	U	0.05	U
1,1,1-Trichloroethane	0.03	U	0.03	U
1,1,1,2-Tetrachloroethane	0.03	U	0.03	U
1,1,2-Trichloroethane	0.03	U	0.03	U
1,1,2,2-Tetrachloroethane	0.03	U	0.03	U
1,2-Dibromo-3-chloropropane	0.25	U	0.25	U
1,2-Dichlorobenzene	0.03	U	0.03	U
1,2-Dichloroethane	0.03	U	0.03	U
1,2-Dichloroethene, cis-	0.05	U	0.05	U
1,2-Dichloroethene, trans-	0.03	U	0.03	U
1,2-Dichloropropane	0.03	U	0.03	U
1,2,3-Trichlorobenzene	0.05	U	0.05	U
1,2,3-Trichloropropane	0.05	U	0.05	U
1,2,4-Trichlorobenzene	0.1	U	0.1	U
1,2,4-Trimethylbenzene	0.05	U	**0.06**	
1,3-Dichlorobenzene	0.03	U	0.03	U
1,3-Dichloropropane	0.05	U	0.05	U
1,3-Dichloropropene, cis-	0.05	U	0.05	U
1,3-Dichloropropene, trans-	0.05	U	0.05	U
1,3,5-Trimethylbenzene (Mesitylene)	0.05	U	0.05	U
1,4-Dichlorobenzene	0.03	U	0.03	U
2-Chlorotoluene	0.05	U	0.05	U
2-Hexanone (Methyl butyl ketone)	0.5	U	0.5	U
2,2-Dichloropropane	0.05	U	0.05	U
4-Chlorotoluene	0.05	U	0.05	U
4-Methyl-2-pentanone (Methyl isobutyl ketone)	0.5	U	0.5	U
Acetone	1.	U	1.	U
Benzene	**0.72**		**3.15**	
Bromobenzene	0.03	U	0.03	U
Bromochloromethane	0.05	U	0.05	U
Bromodichloromethane	0.05	U	0.05	U
Bromoform (Tribromomethane)	0.05	U	0.05	U
Bromomethane (Methyl bromide)	0.25	U	0.25	U
Carbon tetrachloride (Tetrachloromethane)	0.05	U	0.05	U
Chlorobenzene	0.03	U	0.03	U
Chloroethane	0.25	U	0.25	U
Chloroform	0.05	U	0.05	U
Chloromethane	0.25	U	0.25	UJ
Cymene, p- (4-Isopropyltoluene)	0.05	U	0.05	U
Dibromochloromethane	0.05	U	0.05	U
Dibromomethane	0.05	U	0.05	U
Dichlorodifluoromethane	0.05	U	0.05	U
Dichloromethane (Methylene chloride)	0.3	U	0.25	U
Ethylbenzene	**0.13**		**0.38**	
Ethylene dibromide (1,2-Dibromoethane)	0.03	U	0.03	U
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	0.25	U	0.25	U

Table 4 - Summary of Analytical Results for Removed Solids: TCLP VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Media ==>	Tar / Pitch		Tar - Viscous	
Sample Number ==>	2708-190513-COMP1		2708-190521-007	
Sample Date ==>	13-May-19		21-May-19	
Sample Depth (feet bgs) ==>	47, 96, and 136		352 - 353	
Location ==>	12-inch Casing		8-inch Casing	
	Analytical Results in mg/L (ppm)			
TCLP Volatile Organic Compounds (VOCs) by EPA Method SW1311/8260C				
Isopropylbenzene (Cumene)	0.05	U	0.05	U
m,p-Xylene	**0.11**		**0.52**	
Methyl ethyl ketone (2-Butanone)	0.5	U	0.5	U
Methyl tert-butyl ether (MTBE)	0.05	U	0.05	U
n-Butylbenzene	0.05	U	0.05	U
n-Propylbenzene	0.03	U	0.03	U
Naphthalene	**1.76**	**J**	**11.2**	
o-Xylene	**0.06**		**0.18**	
sec-Butylbenzene	0.05	U	0.05	U
Styrene	0.05	U	**0.18**	
tert-Butylbenzene	0.05	U	0.05	U
Tetrachloroethene (PCE)	0.03	U	0.03	U
Toluene	**0.26**		**1.56**	
Trichloroethene (TCE)	0.03	U	0.03	U
Trichlorofluoromethane (Fluorotrichloromethane)	0.1	U	0.1	U
Vinyl chloride	0.03	U	0.03	U

Notes:

bgs = below ground surface

bold = detected concentration

EPA = Environmental Protection Agency

J = estimated concentration

mg/L = milligrams per liter

ppm = parts per million

TCLP = Toxicity Characteristic Leaching Procedure

U = not detected

VOCs = volatile organic compounds

Table 5 - Summary of Analytical Results for Removed Solids: SPLP VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Media ==>	Tar - Viscous		Tar - Solid			
Sample Number ==>	2708-190521-007		2708-190522-011		2708-190523-013	
Sample Date ==>	21-May-19		22-May-19		23-May-19	
Sample Depth (feet bgs) ==>	352 - 353		363 - 364		378 - 379	
Location ==>	8-inch Casing		Borehole		Borehole	
	Analytical Results in mg/L (ppm)					
SPLP Volatile Organic Compounds (VOCs) by EPA Method SW1312/8260C						
1,1-Dichloroethane	0.05	U	0.03	U	0.025	U
1,1-Dichloroethene	0.05	U	0.03	U	0.025	U
1,1-Dichloropropene	0.1	U	0.05	U	0.05	U
1,1,1-Trichloroethane	0.05	U	0.03	U	0.025	U
1,1,1,2-Tetrachloroethane	0.05	U	0.03	U	0.025	U
1,1,2-Trichloroethane	0.05	U	0.03	U	0.025	U
1,1,2,2-Tetrachloroethane	0.05	U	0.03	U	0.025	U
1,2-Dibromo-3-chloropropane	0.5	U	0.25	U	0.25	U
1,2-Dichlorobenzene	0.05	U	0.03	U	0.025	U
1,2-Dichloroethane	0.05	U	0.03	U	0.025	U
1,2-Dichloroethene, cis-	0.05	U	0.03	U	0.025	U
1,2-Dichloroethene, trans-	0.05	U	0.03	U	0.025	U
1,2-Dichloropropane	0.05	U	0.03	U	0.025	U
1,2,3-Trichlorobenzene	0.2	U	0.1	U	0.1	U
1,2,3-Trichloropropane	0.1	U	0.05	U	0.05	U
1,2,4-Trichlorobenzene	0.2	U	0.1	U	0.1	U
1,2,4-Trimethylbenzene	0.1	U	0.05	U	0.05	U
1,3-Dichlorobenzene	0.05	U	0.03	U	0.025	U
1,3-Dichloropropane	0.1	U	0.05	U	0.05	U
1,3-Dichloropropene, cis-	0.1	U	0.05	U	0.05	U
1,3-Dichloropropene, trans-	0.1	U	0.05	U	0.05	U
1,3,5-Trimethylbenzene (Mesitylene)	0.1	U	0.05	U	0.05	U
1,4-Dichlorobenzene	0.05	U	0.03	U	0.025	U
2-Chlorotoluene	0.1	U	0.05	U	0.05	U
2-Hexanone (Methyl butyl ketone)	1.	U	0.5	U	0.5	U
2,2-Dichloropropane	0.1	U	0.05	U	0.05	U
4-Chlorotoluene	0.1	U	0.05	U	0.05	U
4-Methyl-2-pentanone (Methyl isobutyl ketone)	1.	U	0.5	U	0.5	U
Acetone	2.	U	1.	U	1	U
Benzene	**3.4**		**1.17**		**2.42**	
Bromobenzene	0.05	U	0.03	U	0.025	U
Bromochloromethane	0.1	U	0.05	U	0.05	U
Bromodichloromethane	0.1	U	0.05	U	0.05	U
Bromoform (Tribromomethane)	0.1	U	0.05	U	0.05	U
Bromomethane (Methyl bromide)	0.5	U	0.25	U	0.25	U
Carbon tetrachloride (Tetrachloromethane)	0.1	U	0.05	U	0.05	U
Chlorobenzene	0.05	U	0.03	U	0.025	U
Chloroethane	0.5	U	0.25	U	0.25	U
Chloroform	0.1	U	0.05	U	0.05	U
Chloromethane	0.5	U	0.25	U	0.25	U
Cymene, p- (4-Isopropyltoluene)	0.1	U	0.05	U	0.05	U
Dibromochloromethane	0.1	U	0.05	U	0.05	U
Dibromomethane	0.1	U	0.05	U	0.05	U
Dichlorodifluoromethane	0.1	U	0.05	U	0.05	U
Dichloromethane (Methylene chloride)	0.5	U	0.25	U	0.25	U
Ethylbenzene	**0.31**		**0.21**		**0.196**	
Ethylene dibromide (1,2-Dibromoethane)	0.05	U	0.03	U	0.025	U
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	0.5	U	0.25	U	0.25	U
Isopropylbenzene (Cumene)	0.1	U	0.05	U	0.05	U
m,p-Xylene	**0.42**		**0.28**		**0.307**	

Table 5 - Summary of Analytical Results for Removed Solids: SPLP VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Media ==>	Tar - Viscous		Tar - Solid			
Sample Number ==>	2708-190521-007		2708-190522-011		2708-190523-013	
Sample Date ==>	21-May-19		22-May-19		23-May-19	
Sample Depth (feet bgs) ==>	352 - 353		363 - 364		378 - 379	
Location ==>	8-inch Casing		Borehole		Borehole	
	Analytical Results in mg/L (ppm)					
SPLP Volatile Organic Compounds (VOCs) by EPA Method SW1312/8260C						
Methyl ethyl ketone (2-Butanone)	1.	U	0.5	U	0.5	U
Methyl tert-butyl ether (MTBE)	0.1	U	0.05	U	0.05	U
n-Butylbenzene	0.1	U	0.05	U	0.05	U
n-Propylbenzene	0.05	U	0.03	U	0.025	U
Naphthalene	**13.9**		**9.71**		**6.62**	
o-Xylene	**0.14**		**0.09**		**0.106**	
sec-Butylbenzene	0.1	U	0.05	U	0.05	U
Styrene	**0.14**		**0.08**		**0.107**	
tert-Butylbenzene	0.1	U	0.05	U	0.05	U
Tetrachloroethene (PCE)	0.05	U	0.03	U	0.025	U
Toluene	**1.46**		**0.72**		**1.09**	
Trichloroethene (TCE)	0.05	U	0.03	U	0.025	U
Trichlorofluoromethane (Fluorotrichloromethane)	0.2	U	0.1	U	0.1	U
Vinyl chloride	0.05	U	0.03	U	0.025	U

Notes:

bgs = below ground surface

bold = detected concentration

EPA = Environmental Protection Agency

mg/L = milligrams per liter

ppm = parts per million

SPLP = Synthetic Precipitation Leaching Procedure

U = not detected

VOCs = volatile organic compounds

Table 6 - Summary of Analytical Results for Removed Solids: SVOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Media ==>	Tar / Pitch	Tar - Viscous			Tar - Solid		
Sample Number ==>	2708-190513-COMP1	2708-190515-005	2708-190520-006	2708-190521-007	2708-190522-011	2708-190523-013	2708-190524-014
Sample Date ==>	13-May-19	15-May-19	20-May-19	21-May-19	22-May-19	23-May-19	24-May-19
Sample Depth (feet bgs) ==>	47, 96, and 136	298 - 299	318 - 319	352 - 353	363 - 364	378 - 379	381 - 382
Location ==>	12-inch Casing	12-inch Casing	8-inch Casing	8-inch Casing	Borehole	Borehole	Borehole
	Analytical Results in mg/kg (ppm)						
SVOCs by EPA Method 8270D							
1-Methylnaphthalene	1,720. U	2,000. U	**6,420.**	**0.58**	**2,960.**	**2,450.**	**113.**
1,2-Dichlorobenzene	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
1,2-Dinitrobenzene	21,600. U	25,000. U	19,600. U	5. U	-	-	-
1,2,4-Trichlorobenzene	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
1,3-Dichlorobenzene	2,160. U	2,500. U	1,960. U	0.5 UJ	-	-	-
1,3-Dinitrobenzene	21,600. U	25,000. U	19,600. U	5. U	-	-	-
1,4-Dichlorobenzene	2,160. U	2,500. U	1,960. U	0.5 UJ	-	-	-
1,4-Dinitrobenzene	21,600. U	25,000. U	19,600. U	5. U	-	-	-
2-Chloronaphthalene	863. U	1,000. U	785. U	0.2 U	-	-	-
2-Chlorophenol	4,300. U	4,990. U	3,910. U	1. U	-	-	-
2-Methylnaphthalene	1,720. U	**3,340. J**	**13,300.**	**0.81**	**5,650.**	**4,560.**	**226.**
2-Methylphenol (o-Cresol)	2,160. U	2,500. U	1,960. U	**8.84**	-	-	-
2-Nitroaniline	17,200. U	20,000. U	15,700. U	4. U	-	-	-
2-Nitrophenol	8,630. U	10,000. U	7,850. U	2. U	-	-	-
2,2'-Oxybis (1-chloropropane)	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
2,3,4,6-Tetrachlorophenol	4,300. U	4,990. U	3,910. U	1. U	-	-	-
2,3,5,6-Tetrachlorophenol	4,300. U	4,990. U	3,910. U	1. U	-	-	-
2,4-Dichlorophenol	4,300. U	4,990. U	3,910. U	1. U	-	-	-
2,4-Dimethylphenol	4,300. U	4,990. U	3,910. U	**2.93**	-	-	-
2,4-Dinitrophenol	21,600. U	25,000. U	19,600. U	5. U	-	-	-
2,4-Dinitrotoluene	8,630. U	10,000. U	7,850. U	2. U	-	-	-
2,4,5-Trichlorophenol	4,300. U	4,990. U	3,910. U	1. U	-	-	-
2,4,6-Trichlorophenol	4,300. U	4,990. U	3,910. U	1. U	-	-	-
2,6-Dinitrotoluene	8,630. U	10,000. U	7,850. U	2. U	-	-	-
3-Methylphenol & 4-Methylphenol (m&p-Cresol)	2,160. U	2,500. U	1,960. U	**23.9**	-	-	-
3-Nitroaniline	17,200. U	20,000. U	15,700. U	4. U	-	-	-
3,3'-Dichlorobenzidine	17,300. U	20,000. U	15,700. U	-	-	-	-
4-Bromophenyl-phenyl ether	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
4-Chloro-3-methylphenol	8,630. U	10,000. U	7,850. U	2. U	-	-	-
4-Chloroaniline	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
4-Chlorophenyl phenyl ether	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
4-Nitroaniline	17,200. U	20,000. U	15,700. U	4. U	-	-	-
4-Nitrophenol	8,630. U	10,000. U	7,850. U	2. U	-	-	-
4,6-Dichloro-2-methylphenol	21,600. U	25,000. U	19,600. U	5. U	-	-	-
Acenaphthene	**880. J**	**7,000. J**	**22,600.**	**0.86**	**9,320.**	**7,180.**	**349.**
Acenaphthylene	863. U	1,000. U	785. U	0.2 U	877. U	862. U	8.36
Aniline	4,300. U	4,990. U	3,910. U	7.23	-	-	-
Anthracene	**2,050.**	**5,190.**	**11,700.**	0.2 U	**6,230.**	**4,900.**	**206.**
Azobenzene	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
Benzo(a)anthracene	**7,230.**	**7,140.**	**6,200.**	0.2 U	**5,750.**	**4,340.**	**157.**
Benzo(a)pyrene	**9,030.**	**8,540.**	**6,980.**	0.3 U	**6,830.**	**5,030.**	**185.**
Benzo(b)fluoranthene	**10,100.**	**9,780.**	**7,190.**	0.3 U	**7,020.**	**5,200.**	**175.**
Benzo(g,h,i)perylene	**6,990.**	**6,470.**	**4,560.**	0.2 U	**4,250.**	**3,010.**	**101.**
Benzo(k)fluoranthene	**3,740.**	**3,610.**	**2,850.**	0.3 U	**2,840.**	**2,130.**	**67.3**
Benzoic acid	108,000. U	125,000. U	97,900. U	20. U	-	-	-
Benzyl alcohol	4,300. U	4,990. U	3,910. U	2. U	-	-	-
bis(2-Chloroethoxy)methane	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
bis(2-Chloroethyl)ether	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
bis(2-Ethylhexyl)adipate	21,600. U	25,000. U	19,600. U	5. U	-	-	-
bis(2-Ethylhexyl)phthalate	12,900. U	15,000. U	11,800. U	4. U	-	-	-
Butylbenzyl phthalate	8,630. U	10,000. U	7,850. U	4. U	-	-	-
Carbazole	**2,280.**	**3,270.**	**5,590.**	**0.74**	-	-	-
Chrysene	**7,850.**	**7,880.**	**6,140.**	0.2 U	**5,980.**	**4,500.**	**142.**

Table 6 - Summary of Analytical Results for Removed Solids: SVOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Media ==>	Tar / Pitch	Tar - Viscous			Tar - Solid		
Sample Number ==>	2708-190513-COMP1	2708-190515-005	2708-190520-006	2708-190521-007	2708-190522-011	2708-190523-013	2708-190524-014
Sample Date ==>	13-May-19	15-May-19	20-May-19	21-May-19	22-May-19	23-May-19	24-May-19
Sample Depth (feet bgs) ==>	47, 96, and 136	298 - 299	318 - 319	352 - 353	363 - 364	378 - 379	381 - 382
Location ==>	12-inch Casing	12-inch Casing	8-inch Casing	8-inch Casing	Borehole	Borehole	Borehole
	Analytical Results in mg/kg (ppm)						
SVOCs by EPA Method 8270D							
Di-n-butyl phthalate	8,630. U	10,000. U	7,850. U	4. U	-	-	-
Di-n-octyl phthalate	8,630. U	10,000. U	7,850. U	4. U	-	-	-
Dibenzo(a,h)anthracene	**973.**	**1,000.** U	785. U	0.2 U	**904.**	862. U	**15.9**
Dibenzofuran	863. U	**3,350.**	**12,500.**	**0.39**	**5,590.**	**4,230.**	**217.**
Diethyl phthalate	8,630. U	10,000. U	7,850. U	4. U	-	-	-
Dimethyl phthalate	8,630. U	10,000. U	7,850. U	4. U	-	-	-
Fluoranthene	**18,700.**	**22,000.**	**27,500.**	0.2 U	**19,300.**	**14,800.**	**1,180.**
Fluorene	863. U	**3,560.**	**11,600.**	**0.21**	**5,240.**	**4,120.**	**207.**
Hexachlorobenzene	863. U	1,000. U	785. U	0.2 U	-	-	-
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	2,160. U	2,500. U	1,960. U	0.5 UJ	-	-	-
Hexachlorocyclopentadiene	4,300. U	4,990. U	3,910. U	1. UJ	-	-	-
Hexachloroethane	2,160. U	2,500. U	1,960. U	0.5 UJ	-	-	-
Indeno(1,2,3-c,d)pyrene	**6,560.**	**6,480.**	**4,470.**	0.2 U	**4,670.**	**3,330.**	**106.**
Isophorone	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
n-Nitrosodi-n-propylamine	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
n-Nitrosodimethylamine	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
n-Nitrosodiphenylamine	2,160. U	2,500. U	1,960. U	0.5 U	-	-	-
Naphthalene	1,720. U	**11,200.** J	**36,900.**	**9.36**	**16,200.** J	**12,700.** J	**1,190.**
Nitrobenzene	8,630. U	10,000. U	7,850. U	2. U	-	-	-
Pentachlorophenol	8,630. U	10,000. U	7,850. U	2. U	-	-	-
Phenanthrene	**8,820.**	**19,300.**	**42,000.**	**0.27**	**20,600.**	**16,000.**	**1,470.**
Phenol	1,720. U	2,000. U	1,570. U	**16.4** J	-	-	-
Pyrene	**18,500.**	**20,500.**	**23,400.**	0.2 U	**18,100.**	**13,900.**	**1,070.**
Pyridine	4,300. U	4,990. U	3,910. U	**2.31**	-	-	-

Notes:

bgs = below ground surface

bold = detected concentration

EPA = Environmental Protection Agency

J = estimated concentration

mg/kg = milligrams per kilogram

ppm = parts per million

SVOCs = semivolatile organic compounds

U = not detected

"-" = not tested

Table 7 - Summary of Analytical Results for Removed Solids: SPLP SVOCs and PAHs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Media ==>	Tar - Viscous		Tar - Solid			
Sample Number ==>	2708-190521-007		2708-190522-011		2708-190523-013	
Sample Date ==>	21-May-19		22-May-19		23-May-19	
Sample Depth (feet bgs) ==>	352 - 353		363 - 364		378 - 379	
Location ==>	8-inch Casing		Borehole		Borehole	
	Analytical Results in mg/L (ppm)					
SPLP Semi-Volatile Organic Compounds (SVOCs) by EPA Method SW1312/8270D						
Chrysene	0.2	U	0.2	U	0.2	U
Di-n-butyl phthalate	4.	U	-		-	
Di-n-octyl phthalate	4.	U	-		-	
Dibenzo(a,h)anthracene	0.2	U	0.2	U	0.2	U
Dibenzofuran	**0.39**		**0.361**		**0.396**	
Diethyl phthalate	4.	U	-		-	
Dimethyl phthalate	4.	U	-		-	
Fluoranthene	0.2	U	0.2	U	0.2	U
Fluorene	**0.21**		**0.23**		**0.248**	
Hexachlorobenzene	0.2	U	-		-	
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	0.5	UJ	-		-	
Hexachlorocyclopentadiene	1.	UJ	-		-	
Hexachloroethane	0.5	UJ	-		-	
Indeno(1,2,3-c,d)pyrene	0.2	U	0.2	U	0.2	U
Isophorone	0.5	U	-		-	
n-Nitrosodi-n-propylamine	0.5	U	-		-	
n-Nitrosodimethylamine	0.5	U	-		-	
n-Nitrosodiphenylamine	0.5	U	-		-	
Naphthalene	**9.36**		**9.95**		**10.7**	
Nitrobenzene	2.	U	-		-	
Pentachlorophenol	2.	U	-		-	
Phenanthrene	**0.27**		**0.27**		**0.296**	
Phenol	**16.4**	**J**	-		-	
Pyrene	0.2	U	0.2	U	0.2	U
Pyridine	**2.31**		-		-	

Notes:

bgs = below ground surface

bold = detected concentration

EPA = Environmental Protection Agency

J = estimated concentration

mg/L = milligrams per liter

ppm = parts per million

SPLP = Synthetic Precipitation Leaching Procedure

SVOCs = semivolatile organic compounds

U = not detected

"-" = not tested

Table 8 - Summary of Analytical Results for Removed Solids: Metals and Cyanide

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Media ==>	Tar / Pitch		Tar - Viscous						Tar - Solid	
Sample Number ==>	2708-190513-COMP1		2708-190515-005		2708-190520-006		2708-190521-007		2708-190524-014	
Sample Date ==>	13-May-19		15-May-19		20-May-19		21-May-19		24-May-19	
Sample Depth (feet bgs) ==>	47, 96, and 136		298 - 299		318 - 319		352 - 353		381 - 382	
Location ==>	12-inch Casing		12-inch Casing		8-inch Casing		8-inch Casing		Borehole	
	Analytical Results in mg/kg (ppm)									
Metals by EPA Method 6020A										
Aluminum	**1,690.**	**J**	**954.**	**J**	55.6	U	238.	U	**7,540.**	**J**
Antimony	1.04	U	1.08	U	1.11	U	4.76	U	0.99	U
Arsenic	**1.66**		**3.03**		1.11	U	4.76	U	**2.63**	**J**
Barium	**20.5**		**10.2**		**2.27**	**J**	4.76	U	**94.6**	**J**
Beryllium	**0.21**		0.22	U	0.22	U	0.95	U	**0.51**	**J**
Cadmium	**0.35**		**0.25**		**0.37**		0.95	U	**0.55**	**J**
Calcium	**559.**		**488.**	**J**	111.	U	476.	U	**3,840.**	
Chromium	**2.83**		**2.47**		1.11	U	4.76	U	**2.14**	
Copper	**10.9**	**J**	**10.4**		**1.78**		4.76	U	**9.88**	
Iron	**30,800.**		**36,900.**		**1,250.**	**J**	**1,130.**	**J**	**43,800.**	**J**
Lead	**26.8**		**18.3**		**27.9**		**13.1**	**J**	**6.19**	
Magnesium	**82.2**		**145.**		55.6	U	238.	U	**1,400.**	
Manganese	**363.**		**211.**		**8.74**		**16.7**		**323.**	
Mercury	0.08	U	0.09	U	0.09	U	0.38	U	0.08	U
Nickel	**7.86**	**J**	**8.31**		1.11	UJ	4.76	U	**4.06**	**J**
Potassium	104.	U	108.	U	111.	U	476.	U	**466.**	
Selenium	1.04	U	1.08	U	1.11	U	4.76	U	0.99	U
Silver	0.21	U	0.22	U	0.22	U	0.95	U	0.2	U
Sodium	104.	U	108.	U	**160.**		476.	U	**231.**	
Thallium	0.21	U	0.22	U	0.22	U	0.95	U	0.2	U
Vanadium	**16.3**		**43.9**	**J**	**1.16**		4.76	U	**83.2**	**J**
Zinc	**71.3**	**J**	**42.8**	**J**	**35.**	**J**	19.	U	**40.1**	**J**
Total Cyanide by ASTM D7511-12										
Total Cyanide	14.5		7.16		0.846	J	-		1.28	

Notes:

ASTM = American Society for Testing and Materials

bgs = below ground surface

bold = detected concentration

EPA = Environmental Protection Agency

J = estimated concentration

mg/kg = milligrams per kilogram

ppm = parts per million

U = not detected

"-" = not tested

Table 9 - Summary of Analytical Results for Oil Blebs: TPH and VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	**MULT 802 Pumping**	
Sample Number ==>	2708-190619-OIL	
Sample Date ==>	19-Jun-19	
Sample Depth (feet bgs) ==>	Upper 40 Feet of Water Column	
	Analytical Results in ug/kg (ppb)	
Total Petroleum Hydrocarbons by NW Method		
Gasoline-Range TPH	**412,000,000.**	
Diesel-Range TPH	**681,000,000.**	
Oil-Range TPH	333,000,000.	U
Volatile Organic Compounds (VOCs) by EPA Method 8260C		
1,1-Dichloroethane	53,200.	U
1,1-Dichloroethene	53,200.	U
1,1-Dichloropropene	106,000.	U
1,1,1-Trichloroethane	53,200.	U
1,1,1,2-Tetrachloroethane	53,200.	U
1,1,2-Trichloroethane	53,200.	U
1,1,2,2-Tetrachloroethane	106,000.	U
1,2-Dibromo-3-chloropropane	532,000.	U
1,2-Dichlorobenzene	53,200.	U
1,2-Dichloroethane	53,200.	U
1,2-Dichloroethene, cis-	53,200.	U
1,2-Dichloroethene, trans-	53,200.	U
1,2-Dichloropropane	53,200.	U
1,2,3-Trichlorobenzene	532,000.	U
1,2,3-Trichloropropane	106,000.	U
1,2,4-Trichlorobenzene	532,000.	U
1,2,4-Trimethylbenzene	**2,740,000.**	
1,3-Dichlorobenzene	53,200.	U
1,3-Dichloropropane	106,000.	U
1,3-Dichloropropene, cis-	106,000.	U
1,3-Dichloropropene, trans-	106,000.	U
1,3,5-Trimethylbenzene (Mesitylene)	**1,030,000.**	
1,4-Dichlorobenzene	53,200.	U
2-Chlorotoluene	106,000.	U
2-Hexanone (Methyl butyl ketone)	1,060,000.	U
2,2-Dichloropropane	106,000.	U
4-Chlorotoluene	106,000.	U

Table 9 - Summary of Analytical Results for Oil Blebs: TPH and VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	**MULT 802 Pumping**	
Sample Number ==>	2708-190619-OIL	
Sample Date ==>	19-Jun-19	
Sample Depth (feet bgs) ==>	Upper 40 Feet of Water Column	
	Analytical Results in ug/kg (ppb)	
Volatile Organic Compounds (VOCs) by EPA Method 8260C		
4-Methyl-2-pentanone (Methyl isobutyl ketone)	1,060,000.	U
Acetone	2,130,000.	U
Acrylonitrile	213,000.	U
Benzene	**10,500,000.**	
Bromobenzene	53,200.	U
Bromochloromethane	106,000.	U
Bromodichloromethane	106,000.	U
Bromoform (Tribromomethane)	213,000.	U
Bromomethane (Methyl bromide)	1,060,000.	UJ
Carbon disulfide	1,060,000.	U
Carbon tetrachloride (Tetrachloromethane)	106,000.	U
Chlorobenzene	53,200.	U
Chloroethane	1,060,000.	U
Chloroform	106,000.	U
Chloromethane	532,000.	U
Cymene, p- (4-Isopropyltoluene)	106,000.	U
Dibromochloromethane	213,000.	U
Dibromomethane	106,000.	U
Dichlorodifluoromethane	213,000.	U
Dichloromethane (Methylene chloride)	532,000.	U
Ethylbenzene	**891,000.**	
Ethylene dibromide (1,2-Dibromoethane)	106,000.	U
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	213,000.	U
Isopropylbenzene (Cumene)	**181,000.**	
m,p-Xylene	**5,720,000.**	
Methyl ethyl ketone (2-Butanone)	1,060,000.	U
Methyl tert-butyl ether (MTBE)	106,000.	U
n-Butylbenzene	106,000.	U
n-Propylbenzene	**140,000.**	
Naphthalene	**140,000,000.**	
o-Xylene	**2,480,000.**	
sec-Butylbenzene	**614,000.**	

Table 9 - Summary of Analytical Results for Oil Blebs: TPH and VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	MULT 802 Pumping	
Sample Number ==>	2708-190619-OIL	
Sample Date ==>	19-Jun-19	
Sample Depth (feet bgs) ==>	Upper 40 Feet of Water Column	
	Analytical Results in ug/kg (ppb)	
Volatile Organic Compounds (VOCs) by EPA Method 8260C		
Styrene	**2,710,000.**	
tert-Butylbenzene	106,000.	U
Tetrachloroethene (PCE)	53,200.	U
Toluene	**9,020,000.**	
Trichloroethene (TCE)	53,200.	U
Trichlorofluoromethane (Fluorotrichloromethane)	213,000.	U
Vinyl chloride	53,200.	U

Notes:
bgs = below ground surface
bold = detected concentration
EPA = Environmental Protection Agency
J = estimated concentration
NW = Northwest Method
ppb = parts per billion
TPH = total petroleum hydrocarbons
U = not detected
ug/kg = micrograms per kilogram
VOCs = volatile organic compounds

Table 10 - Summary of Analytical Results for Oil Blebs: SVOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	**MULT 802 Pumping**	
Sample Number ==>	2708-190619-OIL	
Sample Date ==>	19-Jun-19	
Sample Depth (feet bgs) ==>	Upper 40 Feet of Water Column	
	Analytical Results in ug/kg (ppb)	
SVOCs by EPA Method 8270D		
1-Methylnaphthalene	**21,800,000.**	
1,2-Dichlorobenzene	2,270,000.	U
1,2-Dinitrobenzene	22,700,000.	U
1,2,4-Trichlorobenzene	2,270,000.	U
1,3-Dichlorobenzene	2,270,000.	U
1,3-Dinitrobenzene	22,700,000.	U
1,4-Dichlorobenzene	2,270,000.	U
1,4-Dinitrobenzene	22,700,000.	U
2-Chloronaphthalene	909,000.	U
2-Chlorophenol	4,550,000.	U
2-Methylnaphthalene	**43,900,000.**	
2-Methylphenol (o-Cresol)	2,270,000.	U
2-Nitroaniline	18,200,000.	U
2-Nitrophenol	9,090,000.	U
2,2'-Oxybis (1-chloropropane)	2,270,000.	U
2,3,4,6-Tetrachlorophenol	4,550,000.	U
2,3,5,6-Tetrachlorophenol	4,550,000.	U
2,4-Dichlorophenol	4,550,000.	U
2,4-Dimethylphenol	4,550,000.	U
2,4-Dinitrophenol	22,700,000.	U
2,4-Dinitrotoluene	9,090,000.	U
2,4,5-Trichlorophenol	4,550,000.	U
2,4,6-Trichlorophenol	4,550,000.	U
2,6-Dinitrotoluene	9,090,000.	U
3-Methylphenol & 4-Methylphenol (m&p-Cresol)	2,270,000.	U
3-Nitroaniline	18,200,000.	U

Table 10 - Summary of Analytical Results for Oil Blebs: SVOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	MULT 802 Pumping	
Sample Number ==>	2708-190619-OIL	
Sample Date ==>	19-Jun-19	
Sample Depth (feet bgs) ==>	Upper 40 Feet of Water Column	
	Analytical Results in ug/kg (ppb)	
SVOCs by EPA Method 8270D		
3,3'-Dichlorobenzidine	18,200,000.	U
4-Bromophenyl-phenyl ether	2,270,000.	U
4-Chloro-3-methylphenol	9,090,000.	U
4-Chloroaniline	2,270,000.	U
4-Chlorophenyl phenyl ether	2,270,000.	U
4-Nitroaniline	18,200,000.	U
4-Nitrophenol	9,090,000.	U
4,6-Dichloro-2-methylphenol	22,700,000.	U
Acenaphthene	**3,470,000.**	
Acenaphthylene	**6,520,000.**	
Aniline	4,550,000.	U
Anthracene	**3,280,000.**	
Azobenzene	2,270,000.	U
Benzo(a)anthracene	**1,870,000.**	
Benzo(a)pyrene	**1,940,000.**	
Benzo(b)fluoranthene	**1,620,000.**	
Benzo(g,h,i)perylene	**1,420,000.**	
Benzo(k)fluoranthene	1,360,000.	U
Benzoic acid	114,000,000.	U
Benzyl alcohol	4,550,000.	U
bis(2-Chloroethoxy)methane	2,270,000.	U
bis(2-Chloroethyl)ether	2,270,000.	U
bis(2-Ethylhexyl)adipate	22,700,000.	U
bis(2-Ethylhexyl)phthalate	18,200,000.	U
Butylbenzyl phthalate	18,200,000.	U
Carbazole	1,360,000.	U
Chrysene	**2,320,000.**	

Table 10 - Summary of Analytical Results for Oil Blebs: SVOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	MULT 802 Pumping	
Sample Number ==>	2708-190619-OIL	
Sample Date ==>	19-Jun-19	
Sample Depth (feet bgs) ==>	Upper 40 Feet of Water Column	
	Analytical Results in ug/kg (ppb)	
SVOCs by EPA Method 8270D		
Di-n-butyl phthalate	4,550,000.	U
Di-n-octyl phthalate	18,200,000.	U
Dibenzo(a,h)anthracene	909,000.	U
Dibenzofuran	**2,000,000.**	
Diethyl phthalate	4,550,000.	U
Dimethyl phthalate	4,550,000.	U
Fluoranthene	**7,220,000.**	
Fluorene	**6,690,000.**	
Hexachlorobenzene	909,000.	U
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	2,270,000.	U
Hexachlorocyclopentadiene	4,550,000.	U
Hexachloroethane	2,270,000.	U
Indeno(1,2,3-c,d)pyrene	**1,160,000.**	
Isophorone	2,270,000.	U
n-Nitrosodi-n-propylamine	2,270,000.	U
n-Nitrosodimethylamine	2,270,000.	U
n-Nitrosodiphenylamine	2,270,000.	U
Naphthalene	**131,000,000.**	
Nitrobenzene	9,090,000.	U
Pentachlorophenol	9,090,000.	U
Phenanthrene	**25,500,000.**	
Phenol	1,820,000.	U
Pyrene	**8,710,000.**	
Pyridine	4,550,000.	U

Notes:

bgs = below ground surface

bold = detected concentration

EPA = Environmental Protection Agency

ppb = parts per billion

SVOCs = semivolatile organic compounds

U = not detected

ug/kg = micrograms per kilogram

Table 11 - Summary of Analytical Results for Oil Blebs: Metals

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	**MULT 802 Pumping**	
Sample Number ==>	2708-190619-OIL	
Sample Date ==>	19-Jun-19	
Sample Depth (feet bgs) ==>	Upper 40 Feet of Water Column	
	Analytical Results in ug/L (ppb)	
Metals by EPA Method 6020A		
Aluminum	111.	U
Antimony	2.21	U
Arsenic	4.42	U
Barium	4.42	U
Beryllium	0.44	U
Cadmium	0.89	U
Calcium	221.	U
Chromium	4.42	U
Copper	2.21	U
Iron	**161.**	
Lead	**1.21**	
Magnesium	111.	U
Manganese	**2.72**	
Mercury	0.35	U
Nickel	2.21	U
Potassium	221.	U
Selenium	4.42	U
Silver	0.89	U
Sodium	221.	U
Thallium	0.44	U
Vanadium	2.21	U
Zinc	**10.1**	

Notes:

bgs = below ground surface

bold = detected concentration

EPA = Environmental Protection Agency

ppb = parts per billion

U = not detected

ug/L = micrograms per liter

Table 13 - Summary of Analytical Results for Groundwater Samples: TPH and VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	MULT 802 Initial	MULT 802 Purging Event No. 1							MULT 802 Purging Event No. 2		MULT 802 Purging Event No. 4
Sample Number ==>	2708-190614-MULT802-100	2708-190617-MULT802-101	2708-190617-MULT802-102	2708-190617-MULT802-103	2708-190617-MULT802-103D	2708-190617-MULT802-104	2708-190617-MULT802-105	2708-190617-MULT802-106	2708-190620-MULT802-107	2708-190620-MULT802-108	2708-190626-MULT802-109
Sample Date ==>	14-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	20-Jun-19	20-Jun-19	26-Jun-19
Depth to Water (feet bgs) ==>	21.4	44.8	47.1	50.9	50.9	53.6	56.0	56.7	30.9	50.0	58.0
Pump Intake Depth (feet bgs) ==>	129	129	129	129	129	129	129	129	129	129	129
Gallons Removed Prior to Sample Collection ==>	400	1,000	5,000	10,000	10,000	20,000	40,000	70,000	400	10,000	50,000
	Analytical Results in ug/L (ppb)										
Total Petroleum Hydrocarbons by NW Method											
Gasoline-Range TPH	**165,000.**	**141,000.**	**25,700.**	**14,600.**	**13,000.**	**8,090.**	**27,300.**	**5,500.**	-	-	**6,450.**
Diesel-Range TPH	**33,500.**	**25,300.**	**74,600.**	**13,600.**	**13,600.**	**8,920.**	**29,600.**	**6,360.**	-	-	**7,600.**
Oil-Range TPH	**22,200. J**	**3,020.**	**54,100.**	**9,210.**	**9,850.**	**3,370.**	**25,500.**	**4,850.**	-	-	**1,540.**
Volatile Organic Compounds (VOCs) by EPA Method 8260C											
1,1-Dichloroethane	4. U	4. U	4. U	4. U	4. U	4. U	4. U	4. U	40. U	4. U	4. U
1,1-Dichloroethene	4. U	4. U	4. U	4. U	4. U	4. U	4. U	4. U	40. U	4. U	4. U
1,1-Dichloropropene	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
1,1,1-Trichloroethane	4. U	4. U	4. U	4. U	4. U	4. U	4. U	4. U	40. U	4. U	4. U
1,1,1,2-Tetrachloroethane	4. U	4. U	4. U	4. U	4. U	4. U	4. U	4. U	40. U	4. U	4. U
1,1,2-Trichloroethane	5. U	5. U	5. U	5. U	5. U	5. U	5. U	5. U	50. U	5. U	5. U
1,1,2,2-Tetrachloroethane	5. U	5. U	5. U	5. U	5. U	5. U	5. U	5. U	50. U	5. U	5. U
1,2-Dibromo-3-chloropropane	50. U	50. U	50. U	50. U	50. U	50. U	50. U	50. U	500. U	50. U	50. U
1,2-Dichlorobenzene	5. U	5. U	5. U	5. U	5. U	5. U	5. U	5. U	50. U	5. U	5. U
1,2-Dichloroethane	4. U	4. U	4. U	4. U	4. U	4. U	4. U	4. U	40. U	4. U	4. U
1,2-Dichloroethene, cis-	4. U	4. U	4. U	4. U	4. U	4. U	4. U	4. U	40. U	4. U	4. U
1,2-Dichloroethene, trans-	4. U	4. U	4. U	4. U	4. U	4. U	4. U	4. U	40. U	4. U	4. U
1,2-Dichloropropane	5. U	5. U	5. U	5. U	5. U	5. U	5. U	5. U	50. U	5. U	5. U
1,2,3-Trichlorobenzene	20. U	20. U	20. U	20. U	20. U	20. U	20. U	20. U	200. U	20. U	20. U
1,2,3-Trichloropropane	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
1,2,4-Trichlorobenzene	20. U	20. U	20. U	20. U	20. U	20. U	20. U	20. U	200. U	20. U	20. U
1,2,4-Trimethylbenzene	**201.**	**275.**	**96.8**	**27.8**	**21.9**	**15.2**	**95.9**	10. U	100. U	**12.7**	**24.8**
1,3-Dichlorobenzene	5. U	5. U	5. U	5. U	5. U	5. U	5. U	5. U	50. U	5. U	5. U
1,3-Dichloropropane	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
1,3-Dichloropropene, cis-	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
1,3-Dichloropropene, trans-	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
1,3,5-Trimethylbenzene (Mesitylene)	**61.8**	**87.6**	**33.4**	**11.1**	10. U	10. U	**32.6**	10. U	100. U	10. U	10. U
1,4-Dichlorobenzene	5. U	5. U	5. U	5. U	5. U	5. U	5. U	5. U	50. U	5. U	5. U
2-Chlorotoluene	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
2-Hexanone (Methyl butyl ketone)	100. U	100. U	100. U	100. U	100. U	100. U	100. U	100. U	1,000. U	100. U	100. U
2,2-Dichloropropane	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
4-Chlorotoluene	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U

Table 13 - Summary of Analytical Results for Groundwater Samples: TPH and VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	MULT 802 Initial	MULT 802 Purging Event No. 1							MULT 802 Purging Event No. 2		MULT 802 Purging Event No. 4
Sample Number ==>	2708-190614-MULT802-100	2708-190617-MULT802-101	2708-190617-MULT802-102	2708-190617-MULT802-103	2708-190617-MULT802-103D	2708-190617-MULT802-104	2708-190617-MULT802-105	2708-190617-MULT802-106	2708-190620-MULT802-107	2708-190620-MULT802-108	2708-190626-MULT802-109
Sample Date ==>	14-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	20-Jun-19	20-Jun-19	26-Jun-19
Depth to Water (feet bgs) ==>	21.4	44.8	47.1	50.9	50.9	53.6	56.0	56.7	30.9	50.0	58.0
Pump Intake Depth (feet bgs) ==>	129	129	129	129	129	129	129	129	129	129	129
Gallons Removed Prior to Sample Collection ==>	400	1,000	5,000	10,000	10,000	20,000	40,000	70,000	400	10,000	50,000
	Analytical Results in ug/L (ppb)										
Volatile Organic Compounds (VOCs) by EPA Method 8260C											
4-Methyl-2-pentanone (Methyl isobutyl ketone)	100. U	100. U	100. U	100. U	100. U	100. U	100. U	100. U	1,000. U	100. U	100. U
Acetone	200. U	200. U	200. U	**238.**	**204.**	200. U	**251.**	200. U	2,000. U	200. U	200. U
Acrylonitrile	20. U	20. U	20. U	20. U	20. U	20. U	20. U	20. U	200. U	20. U	20. U
Benzene	**33,900.**	**28,400.**	**2,070.**	**1,210.**	**1,100.**	**626.**	**1,930.**	**441.**	**4,590.**	**451.**	**365.**
Bromobenzene	5. U	5. U	5. U	5. U	5. U	5. U	5. U	5. U	50. U	5. U	5. U
Bromochloromethane	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
Bromodichloromethane	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
Bromoform (Tribromomethane)	40. U	40. U	40. U	40. U	40. U	40. U	40. U	40. U	100. U	10. U	10. U
Bromomethane (Methyl bromide)	50. UJ	50. UJ	50. UJ	50. UJ	50. UJ	50. UJ	50. UJ	50. UJ	500. UJ	50. UJ	50. U
Carbon disulfide	100. U	100. U	100. U	100. U	100. U	100. U	100. U	100. U	1,000. U	100. U	100. U
Carbon tetrachloride (Tetrachloromethane)	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
Chlorobenzene	5. U	5. U	5. U	5. U	5. U	5. U	5. U	5. U	50. U	5. U	5. U
Chloroethane	50. U	50. U	50. U	50. U	50. U	50. U	50. U	50. U	500. U	50. U	50. U
Chloroform	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
Chloromethane	50. U	50. U	50. U	50. U	50. U	50. U	50. U	50. U	500. U	50. U	50. UJ
Cymene, p- (4-Isopropyltoluene)	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
Dibromochloromethane	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
Dibromomethane	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
Dichlorodifluoromethane	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
Dichloromethane (Methylene chloride)	30. UJ	30. U	30. U	30. U	30. U	30. U	30. U	30. U	300. U	30. U	30. U
Ethylbenzene	**267.**	**302.**	**117.**	**46.4**	**43.3**	**25.4**	**59.3**	**15.7**	**79.8**	**21.9**	**19.6**
Ethylene dibromide (1,2-Dibromoethane)	5. U	5. U	5. U	5. U	5. U	5. U	5. U	5. U	50. U	5. U	5. U
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	50. U	50. U	50. U	50. U	50. U	50. U	50. U	50. U	500. U	50. U	50. U
Isopropylbenzene (Cumene)	**18.**	**24.3**	**10.6**	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
m,p-Xylene	**1,250.**	**1,350.**	**362.**	**118.**	**96.4**	**58.6**	**281.**	**35.6**	**270.**	**45.5**	**67.**
Methyl ethyl ketone (2-Butanone)	100. U	100. U	100. U	100. U	100. U	100. U	100. U	100. U	1,000. U	100. U	100. U
Methyl tert-butyl ether (MTBE)	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
n-Butylbenzene	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
n-Propylbenzene	**7.9**	**11.1**	5. U	5. U	5. U	5. U	5. U	5. U	50. U	5. U	5. U
Naphthalene	**11,900.**	**11,200.**	**5,480.**	**2,580.**	**2,290.**	**1,780.**	**2,860.**	**1,160.**	**4,320.**	**1,320.**	**1,520.**
o-Xylene	**579.**	**613.**	**152.**	**47.3**	**38.4**	**23.4**	**117.**	**14.5**	**110.**	**18.2**	26.5
sec-Butylbenzene	**15.5**	**27.7**	10. U	10. U	10. U	10. U	**15.2**	10. U	100. U	10. U	10. U
Styrene	**690.**	**699.**	**132.**	**40.9**	**32.8**	**18.3**	**113.**	**11.1**	108.	**14.6**	**23.7**
tert-Butylbenzene	10. U	10. U	10. U	10. U	10. U	10. U	10. U	10. U	100. U	10. U	10. U
Tetrachloroethene (PCE)	4. U	4. U	4. U	4. U	4. U	4. U	4. U	4. U	40. U	4. U	4. U

Table 13 - Summary of Analytical Results for Groundwater Samples: TPH and VOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	MULT 802 Initial	MULT 802 Purging Event No. 1							MULT 802 Purging Event No. 2		MULT 802 Purging Event No. 4
Sample Number ==>	2708-190614-MULT802-100	2708-190617-MULT802-101	2708-190617-MULT802-102	2708-190617-MULT802-103	2708-190617-MULT802-103D	2708-190617-MULT802-104	2708-190617-MULT802-105	2708-190617-MULT802-106	2708-190620-MULT802-107	2708-190620-MULT802-108	2708-190626-MULT802-109
Sample Date ==>	14-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	20-Jun-19	20-Jun-19	26-Jun-19
Depth to Water (feet bgs) ==>	21.4	44.8	47.1	50.9	50.9	53.6	56.0	56.7	30.9	50.0	58.0
Pump Intake Depth (feet bgs) ==>	129	129	129	129	129	129	129	129	129	129	129
Gallons Removed Prior to Sample Collection ==>	400	1,000	5,000	10,000	10,000	20,000	40,000	70,000	400	10,000	50,000
	Analytical Results in ug/L (ppb)										
Volatile Organic Compounds (VOCs) by EPA Method 8260C											
Toluene	**7,090.**	**5,530.**	**943.**	**346.**	**296.**	**170.**	**697.**	**108.**	**1,120.**	**127.**	**156.**
Trichloroethene (TCE)	4. U	4. U	4. U	4. U	4. U	4. U	4. U	4. U	40. U	4. U	4. U
Trichlorofluoromethane (Fluorotrichloromethane)	20. U	20. U	20. U	20. U	20. U	20. U	20. U	20. U	200. U	20. U	20. U
Vinyl chloride	4. U	4. U	4. U	4. U	4. U	4. U	4. U	4. U	40. U	4. U	4. U

Notes:

bgs = below ground surface

bold = detected concentration

EPA = Environmental Protection Agency

J = estimated concentration

NW = Northwest Method

ppb = parts per billion

TPH = total petroleum hydrocarbons

U = not detected

ug/L = micrograms per liter

VOCs = volatile organic compounds

"-" = not tested

Table 14 - Summary of Analytical Results for Groundwater Samples: SVOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	MULT 802 Initial	MULT 802 Purging Event No. 1							MULT 802 Purging Event No. 4
Sample Number ==>	2708-190614-MULT802-100	2708-190617-MULT802-101	2708-190617-MULT802-102	2708-190617-MULT802-103	2708-190617-MULT802-103D	2708-190617-MULT802-104	2708-190617-MULT802-105	2708-190617-MULT802-106	2708-190626-MULT802-109
Sample Date ==>	14-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	26-Jun-19
Depth to Water (feet bgs) ==>	21.4	44.8	47.1	50.9	50.9	53.6	56.0	56.7	58.0
Pump Intake Depth (feet bgs) ==>	129	129	129	129	129	129	129	129	129
Gallons Removed Prior to Sample Collection ==>	400	1,000	5,000	10,000	10,000	20,000	40,000	70,000	50,000
	Analytical Results in ug/L (ppb)								
SVOCs by EPA Method 8270D									
3,3'-Dichlorobenzidine	-	1,050. U	5,260. U	952. U	510. U	1,030. U	476. U	490. U	-
4-Bromophenyl-phenyl ether	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
4-Chloro-3-methylphenol	100. U	211. U	1,050. U	190. U	102. U	206. U	95.2 U	98. U	24. U
4-Chloroaniline	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
4-Chlorophenyl phenyl ether	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
4-Nitroaniline	100. U	421. U	2,110. U	381. U	204. U	412. U	190. U	196. U	24. U
4-Nitrophenol	200. U	211. U	1,050. U	190. U	102. U	206. U	95.2 U	98. U	48.1 U
4,6-Dichloro-2-methylphenol	200. U	526. U	2,630. U	476. U	255. U	515. U	238. U	245. U	48.1 U
Acenaphthene	**137.**	**228.**	**6,760.**	**470.**	**454.**	**204.**	**1,440.**	**360.**	**84.**
Acenaphthylene	**145.**	**123.**	**603.**	57.7 J	**36. J**	**22.**	**92.9**	**41.6**	**29.6**
Aniline	**601.**	**865.**	526. U	95.2 U	51. U	103. U	47.6 U	49. U	24. U
Anthracene	100. U	**61.7**	4,910.	**272.**	**246.**	**89.5**	**925.**	**220.**	**39.7**
Azobenzene	100. U	**52.6** U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
Benzo(a)anthracene	100. U	**39.2**	**6,520.**	**312.**	**304.**	**92.9**	**1,350.**	**272.**	**25.1**
Benzo(a)pyrene	100. U	**38.1**	**9,590.**	**452.**	**437.**	**116.**	**2,000.**	**323.**	**29.1**
Benzo(b)fluoranthene	100. U	**34.1**	**10,400.**	**492.**	**485.**	**128.**	**2,210.**	**357.**	**26.4**
Benzo(g,h,i)perylene	100. U	**22.5**	**5,700.**	**272.**	**257.**	**75.4**	**1,130.**	**238.**	24. U
Benzo(k)fluoranthene	100. U	31.6 U	**3,690.**	**192.**	**165.**	**49.3**	**825.**	**123.**	24. U
Benzoic acid	**1,740.**	**3,540.**	13,200. U	2,380. U	1,280. U	2,580. U	1,190. U	1,230. U	120. U
Benzyl alcohol	100. U	211. U	1,050. U	190. U	102. U	206. U	95.2 U	98. U	24. U
bis(2-Chloroethoxy)methane	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
bis(2-Chloroethyl)ether	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
bis(2-Ethylhexyl)adipate	100. U	526. U	2,630. U	476. U	255. U	515. U	238. U	245. U	24. U
bis(2-Ethylhexyl)phthalate	200. U	421. U	2,110. U	381. U	204. U	412. U	190. U	196. U	48.1 U
Butylbenzyl phthalate	200. U	421. U	2,110. U	381. U	204. U	412. U	190. U	196. U	48.1 U
Carbazole	**199.**	**272.**	**3,360.**	**245.**	**237.**	**105.**	**718.**	**192.**	**43.7**
Chrysene	100. U	38.	**7,010.**	**361.**	**343.**	**106.**	**1,490.**	**282.**	**28.6**
Di-n-butyl phthalate	200. U	421. U	2,110. U	381. U	204. U	412. U	190. U	196. U	48.1 U
Di-n-octyl phthalate	200. U	421. U	2,110. U	381. U	204. U	412. U	190. U	196. U	48.1 U
Dibenzo(a,h)anthracene	100. U	21.1 U	766.	35.2	**35.7**	20.6 U	175.	**33.3**	24. U

Table 14 - Summary of Analytical Results for Groundwater Samples: SVOCs

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	MULT 802 Initial	MULT 802 Purging Event No. 1							MULT 802 Purging Event No. 4
Sample Number ==>	2708-190614-MULT802-100	2708-190617-MULT802-101	2708-190617-MULT802-102	2708-190617-MULT802-103	2708-190617-MULT802-103D	2708-190617-MULT802-104	2708-190617-MULT802-105	2708-190617-MULT802-106	2708-190626-MULT802-109
Sample Date ==>	14-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	26-Jun-19
Depth to Water (feet bgs) ==>	21.4	44.8	47.1	50.9	50.9	53.6	56.0	56.7	58.0
Pump Intake Depth (feet bgs) ==>	129	129	129	129	129	129	129	129	129
Gallons Removed Prior to Sample Collection ==>	400	1,000	5,000	10,000	10,000	20,000	40,000	70,000	50,000
	Analytical Results in ug/L (ppb)								
SVOCs by EPA Method 8270D									
Dibenzofuran	100. U	**107.**	**3,900.**	**257.**	**252.**	**108.**	**829.**	**209.**	**45.8**
Diethyl phthalate	200. U	421. U	2,110. U	381. U	204. U	412. U	190. U	196. U	48.1 U
Dimethyl phthalate	200. U	421. U	2,110. U	381. U	204. U	412. U	190. U	196. U	48.1 U
Fluoranthene	**120.**	**143.**	**19,600.**	**1,000.**	**941.**	**303.**	**3,750.**	**744.**	**84.8**
Fluorene	**119.**	**145.**	**4,290.**	**268.**	**255.**	**110.**	**852.**	**210.**	**63.7**
Hexachlorobenzene	100. U	21.1 U	105. U	19. U	10.2 U	20.6 U	9.52 U	9.8 U	24. U
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
Hexachlorocyclopentadiene	100. U	105. U	526. U	95.2 U	51. U	103. U	47.6 U	49. U	24. U
Hexachloroethane	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
Indeno(1,2,3-c,d)pyrene	100. U	24.7	**5,530.**	**269.**	**255.**	**80.4**	**1,140.**	**219.**	24. U
Isophorone	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
n-Nitrosodi-n-propylamine	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
n-Nitrosodimethylamine	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
n-Nitrosodiphenylamine	100. U	52.6 U	263. U	47.6 U	25.5 U	51.5 U	23.8 U	24.5 U	24. U
Naphthalene	**6,470.**	**7,050.**	**22,700.**	**2,610.**	**2,120.**	**1,250.**	**4,750.**	**1,450.**	24. U
Nitrobenzene	100. U	211. U	1,050. U	190. U	102. U	206. U	95.2 U	98. U	24. U
Pentachlorophenol	200. U	211. U	1,050. U	190. U	102. U	206. U	95.2 U	98. U	48.1 U
Phenanthrene	**367.**	**408.**	**18,400.**	**1,150.**	**997.**	**418.**	**3,500.**	**854.**	**230.**
Phenol	**1,580.**	**3,770.**	2,110. U	381. U	204. U	412. U	190. U	196. U	24. U
Pyrene	**137.**	**151.**	**18,800.**	**963.**	**903.**	**297.**	**3,580.**	**711.**	**100.**
Pyridine	**215.**	**327.**	1,050. U	190. U	102. U	206. U	95.2 U	98. U	48.1 U

Notes:

bgs = below ground surface

bold = detected concentration

EPA = Environmental Protection Agency

J = estimated concentration

ppb = parts per billion

SVOCs = semivolatile organic compounds

U = not detected

ug/L = micrograms per liter

Table 15 - Summary of Analytical Results for Groundwater Samples: Metals

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	MULT 802 Initial	MULT 802 Purging Event No. 1							MULT 802 Purging Event No. 4
Sample Number ==>	2708-190614-MULT802-100	2708-190617-MULT802-101	2708-190617-MULT802-102	2708-190617-MULT802-103	2708-190617-MULT802-103D	2708-190617-MULT802-104	2708-190617-MULT802-105	2708-190617-MULT802-106	2708-190626-MULT802-109
Sample Date ==>	14-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	26-Jun-19
Depth to Water (feet bgs) ==>	21.4	44.8	47.1	50.9	50.9	53.6	56.0	56.7	58.0
Pump Intake Depth (feet bgs) ==>	129	129	129	129	129	129	129	129	129
Gallons Removed Prior to Sample Collection ==>	400	1,000	5,000	10,000	10,000	20,000	40,000	70,000	50,000
	Analytical Results in ug/L (ppb)								
Metals by EPA Method 6020A									
Aluminum	89,700.	42,200.	5,470.	2,430.	1,940.	740.	2,060.	1,270.	317.
Antimony	10. U	1. U	0.6 J	1. U	1. U	1. U	1. U	1. U	1. U
Arsenic	5.08 J	3.96	2.82	0.89 J	0.91 J	0.52 J	1.37	0.7 J	1. U
Barium	101.	82.1	86.4	48.2	47.8	42.1	56.7	41.9	33.9
Beryllium	7.45	4.13	0.55	0.26	0.17 J	0.2 U	0.24	0.1 J	0.2 U
Cadmium	1.8 J	0.95	0.66	0.15 J	0.14 J	0.2 U	0.26	0.08 J	0.2 U
Calcium	-	-	-	-	-	-	-	-	-
Chromium	28.4	13.1	9.12	2.15	2.1	0.62 J	3.26	1.4	1. U
Copper	33.7	5.5	37.4	5.35	6.13	1.79	10.4	3.86	1. U
Iron	398,000.	290,000.	46,400.	15,500.	14,400.	5,440.	19,900.	8,650.	1,390.
Lead	21.3	6.97	49.3	7.84	9.74	2.71	28.7	7.4	0.32
Magnesium	-	-	-	-	-	-	-	-	-
Manganese	23,600.	19,300.	2,010.	1,700.	1,600.	1,290.	1,280.	1,060.	800.
Mercury	0.8 U	0.08 U	0.33	0.05 J	0.06 J	0.08 U	0.09	0.08 U	0.08 U
Nickel	171.	105.	20.3	7.19	5.86	3.14	8.3	5.01	1.18
Potassium	-	-	-	-	-	-	-	-	-
Selenium	10. U	10. U	1. U	1. U	1. U	1. U	1. U	1. U	1. U
Silver	2. U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Sodium	-	-	-	-	-	-	-	-	-
Thallium	2. U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Vanadium	120.	64.	83.6	28.	28.9	20.4	50.1	30.5	22.5
Zinc	5,390.	3,150.	273.	139.	104.	48.6	87.9	47.7	17.8

Notes:

bgs = below ground surface

EPA = Environmental Protection Agency

J = estimated concentration

ppb = parts per billion

U = not detected

ug/L = micrograms per liter

"-" = not tested

Table 16 - Summary of Analytical Results for Groundwater Samples: Cyanide

MULT 802 Decommissioning

NW Natural, Gasco Property

Portland, Oregon

Sample Generation ==>	MULT 802 Initial	MULT 802 Purging Event No. 1							MULT 802 Purging Event No. 4
Sample Number ==>	2708-190614-MULT802-100	2708-190617-MULT802-101	2708-190617-MULT802-102	2708-190617-MULT802-103	2708-190617-MULT802-103D	2708-190617-MULT802-104	2708-190617-MULT802-105	2708-190617-MULT802-106	2708-190626-MULT802-109
Sample Date ==>	14-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	17-Jun-19	26-Jun-19
Depth to Water (feet bgs) ==>	21.4	44.8	47.1	50.9	50.9	53.6	56.0	56.7	58.0
Pump Intake Depth (feet bgs) ==>	129	129	129	129	129	129	129	129	129
Gallons Removed Prior to Sample Collection ==>	400	1,000	5,000	10,000	10,000	20,000	40,000	70,000	50,000
	Analytical Results in mg/L (ppm)								
Cyanide									
Total Cyanide by EPA Method 335.4	0.0247 J	0.0294 J	0.0287	0.0099	0.0094	0.0054	0.0073	0.0064	0.005 U
Available Cyanide by ASTM D6888-09	0.00146 J	0.00112 J	0.00134 J	0.00121 J	0.00133 J	0.00102 J	0.00148 J	0.00124 J	0.002 U
Free Cyanide by ASTM D4282-02	0.00582 J	0.00299 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U

Notes:

ASTM = American Society for Testing and Materials

bgs = below ground surface

EPA = Environmental Protection Agency

J = estimated concentration

ppm = parts per million

U = not detected

mg/L = milligrams per liter

TABLE 17 - Grout Volumes and Properties (Per Batch)

MULT 802 Decommissioning
NW Natural, Gasco Property
Portland, Oregon

Date	Batch No.	Batch Volume Emplaced (gallons)	Total Volume Emplaced (gallons)	Mud Weight (lbs/gallon)	Measured Depth to Top of Grout (ft bgs)
13-Aug-19	1	37	37	9.5	-
13-Aug-19	2	37	74	9.5	-
13-Aug-19	3	37	111	9.5	-
13-Aug-19	4	37	148	9.6	335.0
13-Aug-19	5	37	185	9.5	-
13-Aug-19	6	37	222	9.5	-
13-Aug-19	7	37	259	9.5	-
14-Aug-19	8	37	296	9.7	350.0
14-Aug-19	9	37	333	9.7	-
14-Aug-19	10	37	370	9.6	-
14-Aug-19	11	37	407	9.5	331.0
15-Aug-19	12	37	444	9.7	330.0
15-Aug-19	13	37	481	9.6	-
15-Aug-19	14	37	518	9.5	-
15-Aug-19	15	37	555	9.5	-
15-Aug-19	16	37	592	9.5	-
15-Aug-19	17	37	629	9.5	-
15-Aug-19	18	37	666	9.6	305.0
15-Aug-19	19	37	703	9.5	-
15-Aug-19	20	37	740	9.6	-
15-Aug-19	21	37	777	9.5	-
15-Aug-19	22	37	814	9.5	-
15-Aug-19	23	37	851	9.5	-
15-Aug-19	24	37	888	9.5	-
15-Aug-19	25	37	925	9.5	257.0
15-Aug-19	26	37	962	9.7	-
15-Aug-19	27	37	999	9.7	-
15-Aug-19	28	37	1036	9.6	-
15-Aug-19	29	37	1073	9.5	-
16-Aug-19	30	37	1110	9.5	245.0
16-Aug-19	31	37	1147	9.6	-
16-Aug-19	32	37	1184	9.6	-
16-Aug-19	33	37	1221	9.7	-
16-Aug-19	34	37	1258	9.5	-
16-Aug-19	35	37	1295	9.7	-
16-Aug-19	36	37	1332	9.5	-
16-Aug-19	37	37	1369	9.5	-
16-Aug-19	38	37	1406	9.7	218.0
16-Aug-19	39	37	1443	9.5	-
16-Aug-19	40	37	1480	9.7	-

TABLE 17 - Grout Volumes and Properties (Per Batch)

MULT 802 Decommissioning
NW Natural, Gasco Property
Portland, Oregon

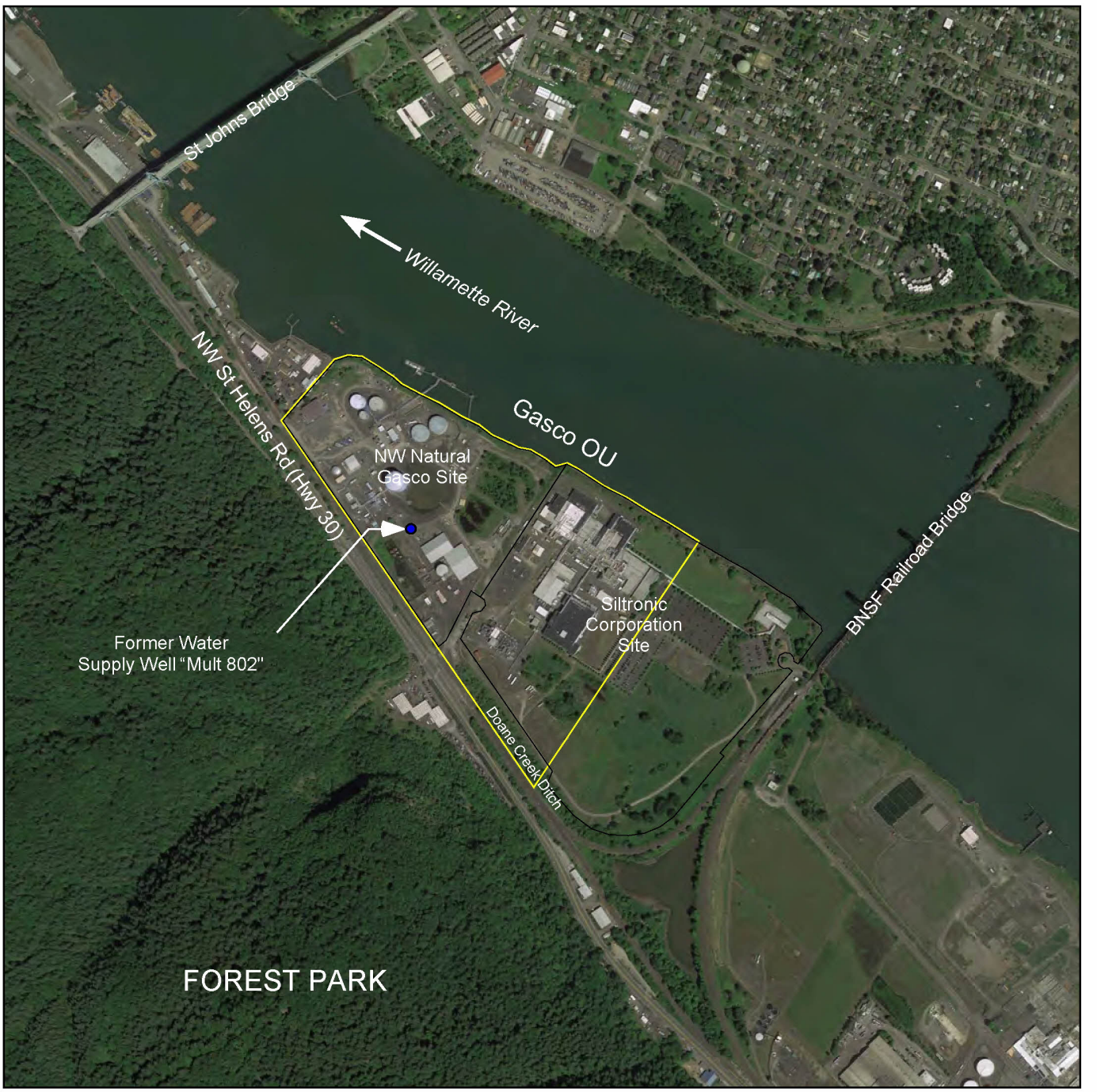
Date	Batch No.	Batch Volume Emplaced (gallons)	Total Volume Emplaced (gallons)	Mud Weight (lbs/gallon)	Measured Depth to Top of Grout (ft bgs)
16-Aug-19	41	37	1517	9.7	-
16-Aug-19	42	37	1554	9.7	-
16-Aug-19	43	37	1591	9.6	-
16-Aug-19	44	37	1628	9.7	-
16-Aug-19	45	37	1665	9.7	180.0
16-Aug-19	46	37	1702	9.5	-
16-Aug-19	47	37	1739	9.5	-
16-Aug-19	48	37	1776	9.5	-
16-Aug-19	49	37	1813	9.6	-
16-Aug-19	50	37	1850	9.5	-
16-Aug-19	51	37	1887	9.6	-
16-Aug-19	52	37	1924	9.6	150.0
16-Aug-19	53	37	1961	9.6	-
16-Aug-19	54	37	1998	9.6	-
16-Aug-19	55	37	2035	9.6	-
16-Aug-19	56	37	2072	9.5	-
16-Aug-19	57	37	2109	9.5	-
16-Aug-19	58	37	2146	9.6	-
16-Aug-19	59	37	2183	9.5	-
16-Aug-19	60	37	2220	9.5	115.0
16-Aug-19	61	37	2257	9.5	-
16-Aug-19	62	37	2294	9.5	-
16-Aug-19	63	37	2331	9.5	-
16-Aug-19	64	37	2368	9.5	-
16-Aug-19	65	37	2405	9.7	-
16-Aug-19	66	37	2442	9.7	-
16-Aug-19	67	37	2479	9.7	73.0
19-Aug-19	68	37	2516	9.7	79.0
19-Aug-19	69	37	2553	9.5	-
19-Aug-19	70	37	2590	9.5	63.0
19-Aug-19	71	37	2627	9.5	57.5
20-Aug-19	72	37	2664	9.5	-
20-Aug-19	73	37	2701	9.5	-
20-Aug-19	74	37	2738	9.5	44.0
20-Aug-19	75	37	2775	9.5	38.0
20-Aug-19	76	37	2812	9.5	34.0
20-Aug-19	77	37	2849	9.5	29.0
20-Aug-19	78	37	2886	9.6	23.0
21-Aug-19	79	37	2923	9.7	-
21-Aug-19	80	37	2960	9.5	13.0

TABLE 17 - Grout Volumes and Properties (Per Batch)

MULT 802 Decommissioning
NW Natural, Gasco Property
Portland, Oregon

Date	Batch No.	Batch Volume Emplaced (gallons)	Total Volume Emplaced (gallons)	Mud Weight (lbs/gallon)	Measured Depth to Top of Grout (ft bgs)
21-Aug-19	81	20	2980	9.6	10.0

Notes:
bgs = below ground surface
ft = feet
lbs = pounds



Notes:
Base Map from Google Earth
Imagery Date: 5/22/2017
OU = Operable Unit

NORTH

0 1000 2000 4000

1"=2000' Scale in Feet

FIGURE 1
Location Map

Mult 802 Water Supply Well Decommissioning
NW Natural Gasco Property
Portland, Oregon

HAHN AND ASSOCIATES, INC.
Project No. 2708 January 2020

NWN-PCI0781201

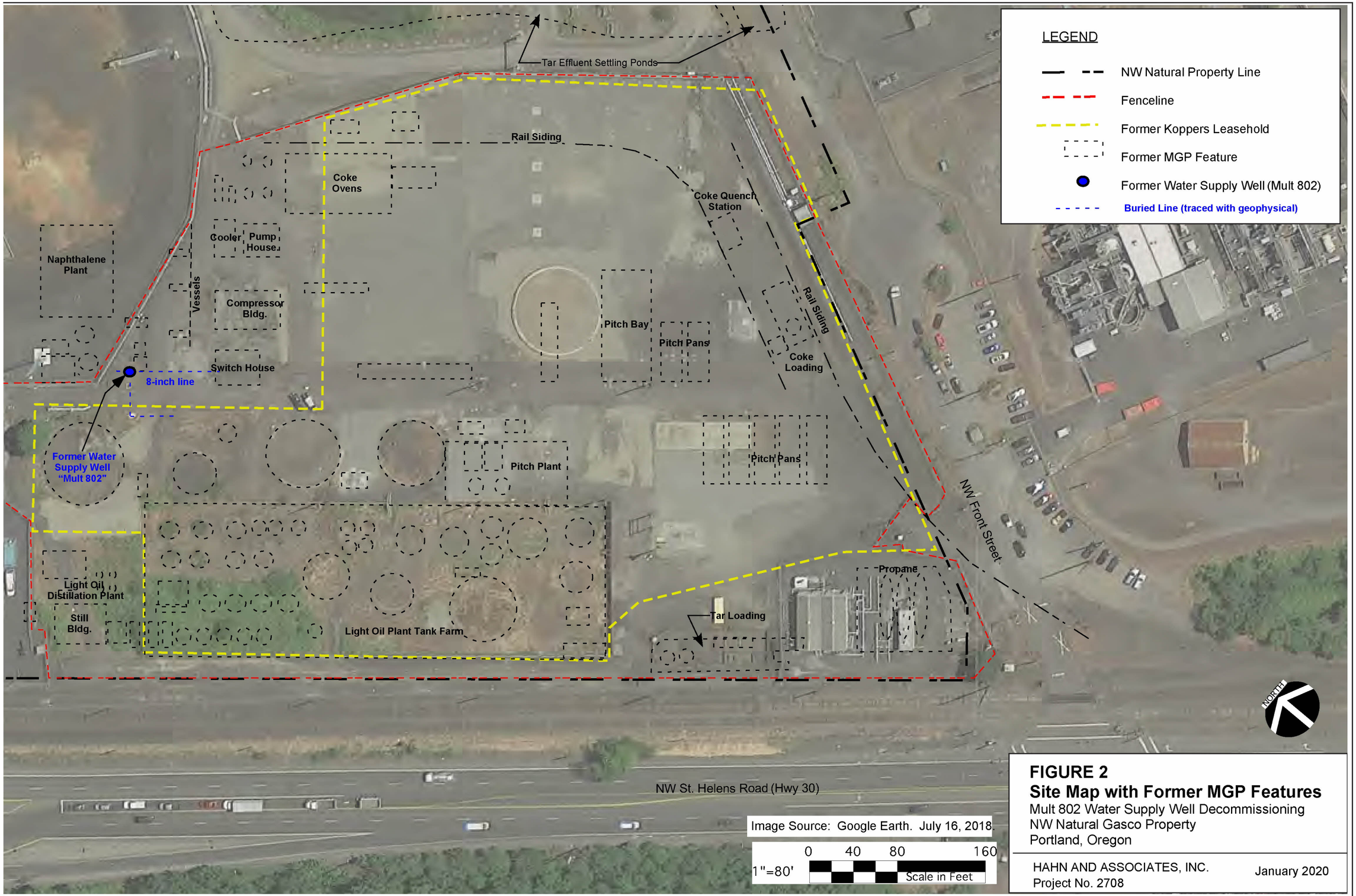


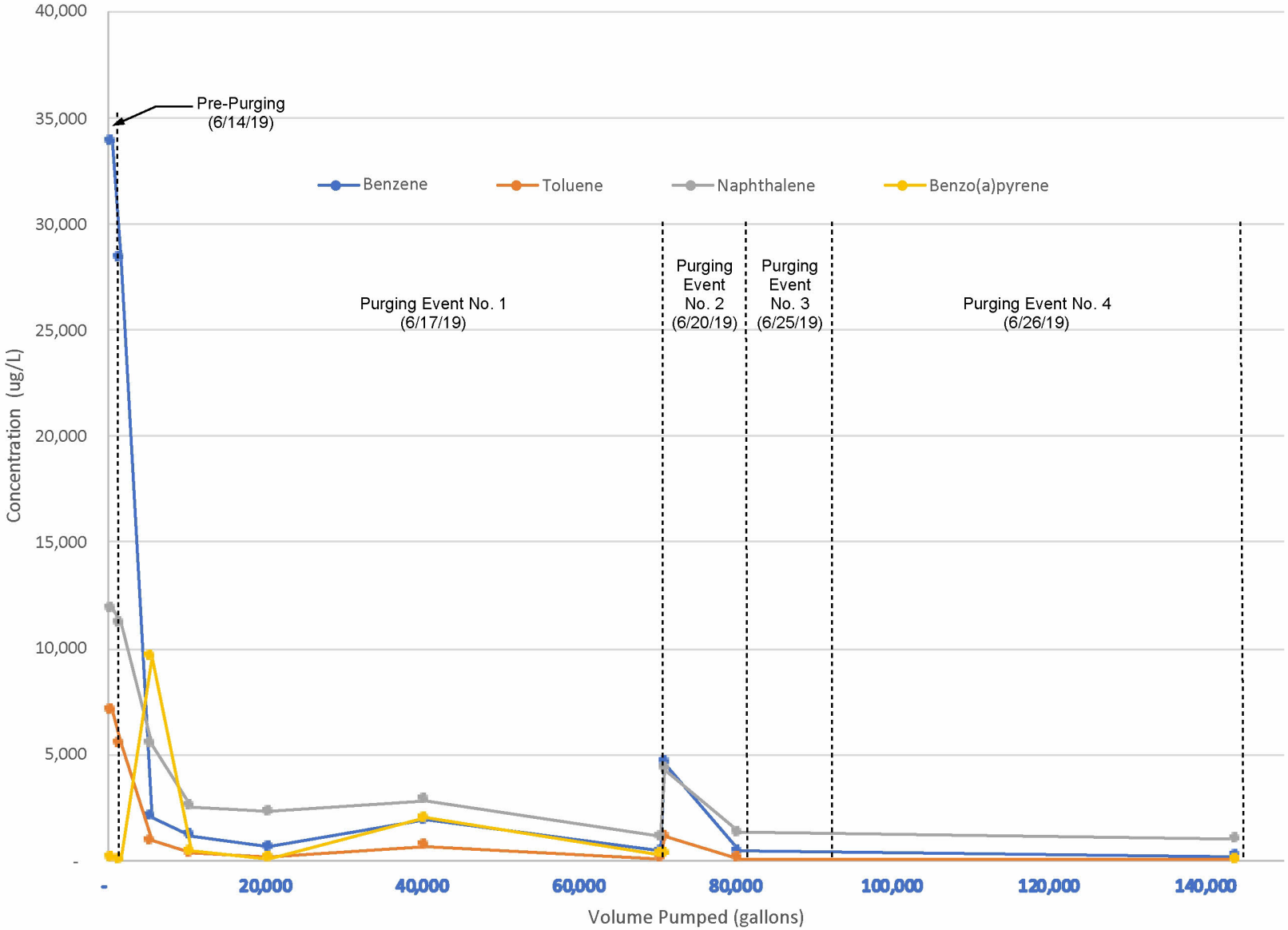
FIGURE 2
Site Map with Former MGP Features
Mult 802 Water Supply Well Decommissioning
NW Natural Gasco Property
Portland, Oregon

HAHN AND ASSOCIATES, INC.
Project No. 2708

January 2020

Figure 3: Contaminant Concentrations as a Function of Volume of Water Pumped

Mult 802 Well Decommissioning



NWN-PCI0781203

APPENDIX A

Well Construction Documentation

WRD Water Supply Well Log: Mult 802

HAI Map ID Number 2

MULT 802

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

WATER WELL REPORT

STATE OF OREGON
(Please type or print)

State Well No. 1N/1W-12N

State Permit No.

(1) OWNER:

Name Portland Gas & Coke Company

Address

(2) LOCATION OF WELL:

County Multnomah Driller's well number

SW ¼ SW ¼ Section 12 T. 1N R. 1W W.M.

Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):

New Well ☐ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 12.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED:

Threaded ☐ Welded ☐

12 " Diam. from 0 ft. to 63 ft. Gage

8 " Diam. from ft. to ft. Gage

" Diam. from ft. to ft. Gage

(7) PERFORATIONS:

Perforated? ☐ Yes ☐ No

Type of perforator used

Size of perforations in. by in.

perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS:

Well screen installed? ☐ Yes ☐ No

Manufacturer's Name

Type Model No.

Diam. Slot size Set from ft. to ft.

Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:

Well seal—Material used in seal

Depth of seal ft. Was a packer used?

Diameter of well bore to bottom of seal in.

Were any loose strata cemented off? ☐ Yes ☐ No Depth

Was a drive shoe used? ☐ Yes ☐ No

Was well gravel packed? ☐ Yes ☐ No Size of gravel:

Gravel placed from ft. to ft.

Did any strata contain unusable water? ☐ Yes ☐ No

Type of water? depth of strata

Method of sealing strata off

(10) WATER LEVELS:

Static level 48 ft. below land surface Date 1954

Artesian pressure lbs. per square inch Date

(11) WELL TESTS:

Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☐ No If yes, by whom?

Yield: 140 gal./min. with ft. drawdown after hrs.

" 150 " with drawdown to 200 feet

" " " "

Bailer test gal./min. with ft. drawdown after hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG:

Diameter of well below casing

Depth drilled ft. Depth of completed well 382 ft.

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand	0	61
Rock (basalt)	61	241
Sand and broken rock	241	246
Sand	246	258
Basalt, broken, soft	258	370
Data from USGS		

Work started 19 Completed 1948

Date well drilling machine moved off of well 19

(13) PUMP:

Manufacturer's Name

Type: H.P.

Water Well Contractor's Certification:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME A. M. Jannsen
(Person, firm or corporation) (Type or print)

Address

Drilling Machine Operator's License No.

[Signed]
(Water Well Contractor)

Contractor's License No. Date , 19

(USE ADDITIONAL SHEETS IF NECESSARY)

NWN-PCI0781206

HAI Map ID Number 2

NOTEBOOK SHEET

Name ______ Date ______

Port.	Gas & Coke
Linnton	St. Johns bridge.
	basalt at
	at 60 ft.
	400 ft. dep.
	12" casing
	Swl. 45 Mar 1954
	Pumps 159 gpm at 220 ft.
	Flowed when drilled 1941
	made 400 gpm.

U. S. GOVERNMENT PRINTING OFFICE 16—12406-1

9-185 (August 1949)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

WELL SCHEDULE

Date 1 April, 1954 Field N

Record by RHY Office N

Source of data Mr Wright, Engineer

1. *Location:* State Oregon County Mult
   Map Hillsboro
   ¼ ¼ sec. T N/S R
2. *Owner:* Portland Gas & Coke Address 2900 NW
   Tenant Address
   Driller A.M. Jannsen Address Ridgefield
3. *Topography* Valley plain
4. *Elevation* 30 ft. above/below S.L. Map.
5. *Type:* Dug, drilled, driven, bored, jetted 1948
6. *Depth:* Rept. 382' ft. Meas. ft.
7. *Casing:* Diam. 12 in., to 8 in., Type Iron
   Depth 131' 12 ft., Finish 140'-8" Perf.
8. *Chief Aquifer* Sand? From 241 ft. t
   Others
9. *Water level* ft. rept./meas. 19 abo/belo
   which is ft.
10. *Pump:* Type Capacity G.
    Power: Kind Horsepower
11. *Yield:* Flow G. M., Pump 140 G. M., Meas. Rep
    Drawdown ft. after hours pumping
12. *Use:* Dom., Stock, PS., RR., Ind., Irr., Obs. Cooling
    Adequacy, permanence Not adequate
13. *Quality* ok Temp
    Taste, odor, color Sample Y/N
    Unfit for
14. *Remarks:* (Log, Analyses, etc.) Well lost about of production soon after beginning ... Well was dynamited twice a day ...

U. S. GOVERNMENT PRINTING OFFICE 16—59355-1

(over)

NWN-PCI0781207

HAI Map ID Number
2

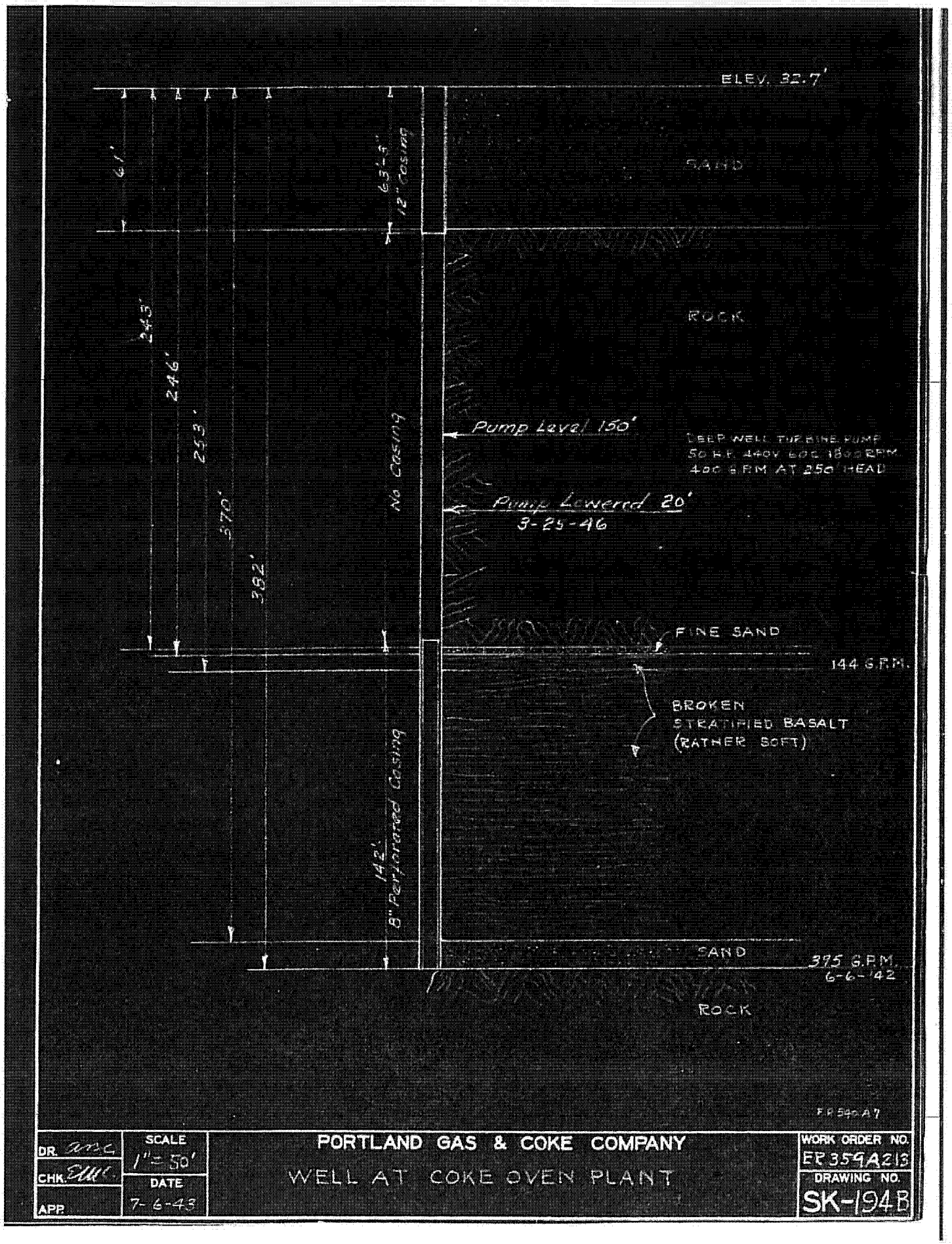
increase in production was noticed. Any production over 140 gpm will cause present pump set at 180 ft. to break suction.

Skeleton Log:

0-61 sand (12" casing to 63')
61-241 Rock (basalt?; not cased)
241-246 Sand and broken rock
246-258 Sand
253?-370 Basalt, broken, soft.
382' bottom of well

Mr Wright promised to send complete log. R. Rly. 1 Apr. 1954

PG&C Well Schematic – Supply Well *Mult 802*



APPENDIX B

Photographs

Please see accompanying file folder entitled
"Appendix B Photographs"

APPENDIX C

Well Log (Decommissioning)

HAI

Hahn and Associates, Inc.
Environmental Consultants

Site ID: MULT 802	Date(s): **5/13/19 to 8/22/19**	
Location: **NW Natural, Portland, Oregon**		
Logged By: **Ben Uhl**	Checked By: **Rob Ede**	
Driller: **Cascade Drilling, LP**		
Drilling Method: **Pro Sonic 600 - Rotosonic**	GS Elevation: **35.79**	TOC: **36.23**
Sampling Method: **7-inch core barrel**	Northing: **704869.64**	Easting: **7623457.78**
Borehole Sealing	Borehole Dia.: **12/10-inches**	Total Depth: **382.0 feet bgs**
Project Number: **2708-60F**		
Project Name: **NW Natural - MULT 802 (Decommissioning)**		
Remarks:		

Annular Fill:

Concrete	0-1 feet
3/8-inch Bentonite (hydrated)	1-10 feet
Organoclay - Bentonite Grout	10-382 feet

1 Bag Concrete
9 Bags Bentonite Chips
81 Bags Granular Bentonite
8 Bags Organoclay

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
35	1							A 12-inch diamater steel surface casing extends through the Fill and Alluvium water-bearing zones approximately 2 feet into bedrock to a depth of 63 feet bgs. Prior to grout placement within the 12-inch casing, a Mills Knife perforator was utilized to install 8 vertical perforations per foot from 10.5 feet bgs to 61.5 feet bgs.		Concrete
	2									
	3									
	4									Hydrated Granular Bentonite
	5									
30	6									
	7									
	8									
	9									
	10							Casing was observed to be packed with solid debris below a depth of 10 feet bgs. The contents were described as black granular pitch and tarry material. These materials were very hard and brittle with a glassy appearance. An apparent welder's hammer was found mixed into the debris at a deph of 35 feet bgs. These materials were removed from the well in August 2017 to a depth of 37 feet bgs by using high-pressure water and a vacuum truck.		
25	11									
	12									
	13									
	14							May 13, 2019	▽	
	15							July 3, 2019	▽	Organoclay Bentonite (20% Solids)
20	16									
	17									
	18									
	19									

NOTES: bgs=below ground surface; ft = feet; ID/OD = Inside Diameter/Outside Diameter; PID=photoionization detector; ▽ measured groundwater depth

HAI

Hahn and Associates, Inc.
Environmental Consultants

Site ID: MULT 802
Project Name: **NW Natural - MULT 802 (Decommissioning)**
Project Number: **2708-60F**

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
15	21									
	22									
	23							Threaded connection in 12-inch OD casing at 23 feet bgs (based on video).		
	24									
	25									
10	26									
	27							On May 13, 2019, Cascade Drilling, LP began drilling out material packed into the 12-inch OD portion of the borehole below 37 feet bgs using a ProSonic 600 rotosonic drilling rig with 10 to 20 foot lengths of 7-inch OD core barrel sampler. Materials were extruded into core bags for description and sampling.		
	28									
	29									
	30									
5	31									
	32									
	33									
	34									
	35									
0	36									
	37	⊠	2708-190528-015	13 (37-50)		44.8		**37.0 - 50.0 Feet:** Black granular pitch (glassy, hard fragments) and black tar, with tar ranging from hard and brittle to soft and plastic. Pitch is fine- to coarse-grained sand sized, cohesive, but crumbles easily. Material does not become soft or "seep" under higher ambient temperatures. Tar-like odor, gray sheen (pitch?) in water. No visible oil observed. Sample -015 (37 to 38 feet bgs) was collected on May 28, 2019 from material that had been secured in core bag and stored on/under plastic between removal from well and sample collection.		
	38	⊠								
	39									
	40									
-5	41									
	42									
	43							Threaded connection in 12-inch OD casing at 43 feet bgs (based on video).		
	44									
	45									
-10	46									

Organoclay Bentonite (20% Solids)

NOTES:
bgs=below ground surface
ft = feet
ID/OD = Inside Diameter/Outside Diameter
PID=photoionization detector

HAI

Hahn and Associates, Inc.
Environmental Consultants

Site ID: MULT 802
Project Name: **NW Natural - MULT 802 (Decommissioning)**
Project Number: **2708-60F**

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
-40	74									Organoclay Bentonite (20% Solids)
	75									
	76									
	77									
	78									
	79									
	80									
-45	81									
	82									
	83									
	84									
	85									
-50	86	X	2708-190528-017			11.1				
	87	X								
	88									
	89									
	90									
-55	91									
	92									
	93									
	94									
	95									
-60	96	X	2708-190513-002	11 (96-136)		168		**96.0 - 100.0 Feet:** Granular (fine to coarse) black pitch and tar ranging from hard and brittle (pitch) to soft and plastic (tar). Pitch fragments appear glassy, reflective with a conchoidal fracture. Few coarse-grained basalt gravels are present. Much black fine-grained apparent pitch material throughout. Slight decrease in tar/pitch percentage with brown gravels visible in matrix in lower 2 feet (98 to 100 feet). No oil observed. Sample -002 (96 to 97 feet bgs) collected on May 13, 2019.		
	97	X								
	98									
	99									

NOTES: bgs=below ground surface
ft = feet
ID/OD = Inside Diameter/Outside Diameter
PID=photoionization detector

HAI

Hahn and Associates, Inc.
Environmental Consultants

Site ID: MULT 802
Project Name: **NW Natural - MULT 802 (Decommissioning)**
Project Number: **2708-60F**

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
-65	101							Driller notes that the borehole appears to be open (e.g. no drilling resistance) between depths of 100 feet bgs and 129 feet bgs.		Organoclay Bentonite (20% Solids)
	102									
	103									
	104									
	105									
-70	106									
	107									
	108									
	109									
	110									
-75	111									
	112									
	113									
	114									
	115									
-80	116									
	117									
	118									
	119									
	120									
-85	121									
	122									
	123									
	124									
	125									
-90	126									

NOTES: bgs=below ground surface; ft = feet; ID/OD = Inside Diameter/Outside Diameter; PID=photoionization detector

HAI

Hahn and Associates, Inc.
Environmental Consultants

Site ID: MULT 802

Project Name: **NW Natural - MULT 802 (Decommissioning)**

Project Number: **2708-60F**

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
	127									Organoclay Bentonite (20% Solids)
	128									
	129							**129.0 - 136.0 Feet:** Coarse-grained brown sand/fine-grained gravel mixed with pitch fragments and tar. Sample -003 (135 to 136 feet bgs) consists of large pitch fragments retrieved from borehole (only) while sample -004 (135 to 136 feet bgs) consists of the entire matrix inclusive of coarse-grained sand/fine-grained gravel with pitch and black sticky tar.		
-95	130									
	131									
	132									
	133									
	134									
	135	X	2708-190513-003			167				
-100	136	X	2708-190514-004					Driller reports that borehole/well appears open (e.g. no drilling resistance) with no apparent debris between depths of 136 feet bgs and 290 feet bgs.		
	137									
	138									
	139									
	140									
-105	141									
	142									
	143									
	144									
	145									
-110	146									
	147									
	148									
	149									
	150									
-115	151									
	152									
	153									

NOTES: bgs=below ground surface; ft = feet; ID/OD = Inside Diameter/Outside Diameter; PID=photoionization detector

HAI

Hahn and Associates, Inc.
Environmental Consultants

Site ID: MULT 802
Project Name: **NW Natural - MULT 802 (Decommissioning)**
Project Number: **2708-60F**

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
	154							Driller reports that borehole/well appears open (e.g. no drilling resistance) with no apparent debris between depths of 136 feet bgs and 290 feet bgs.		Organoclay Bentonite (20% Solids)
	155									
-120	156									
	157									
	158									
	159									
	160									
-125	161									
	162									
	163									
	164									
	165									
-130	166									
	167									
	168									
	169									
	170									
-135	171									
	172									
	173									
	174									
	175									
-140	176									
	177									
	178									
	179									

NOTES: bgs=below ground surface; ft = feet; ID/OD = Inside Diameter/Outside Diameter; PID=photoionization detector

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
-145	181							Driller reports that borehole/well appears open (e.g. no drilling resistance) with no apparent debris between depths of 136 feet bgs and 290 feet bgs.		Organoclay Bentonite (20% Solids)
	182									
	183									
	184									
	185									
-150	186									
	187									
	188									
	189									
	190									
-155	191									
	192									
	193									
	194									
	195									
-160	196									
	197									
	198									
	199									
	200									
-165	201									
	202									
	203									
	204									
	205									
-170	206									

NOTES: bgs=below ground surface; ft = feet; ID/OD = Inside Diameter/Outside Diameter; PID=photoionization detector

HAI

Hahn and Associates, Inc.
Environmental Consultants

Site ID: MULT 802
Project Name: **NW Natural - MULT 802 (Decommissioning)**
Project Number: **2708-60F**

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
	207							Driller reports that borehole/well appears open (e.g. no drilling resistance) with no apparent debris between depths of 136 feet bgs and 290 feet bgs.		
	208									
	209									
	210									
-175	211									
	212									
	213									
	214									
	215									
-180	216									
	217									
	218									
	219									
	220									
-185	221									
	222									
	223									
	224									
	225									
-190	226									
	227									
	228									
	229									
	230									
-195	231									
	232									
	233									

Organoclay Bentonite (20% Solids)

NOTES: bgs=below ground surface; ft = feet; ID/OD = Inside Diameter/Outside Diameter; PID=photoionization detector

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number / Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
	234						Driller reports that borehole /well appears open (e.g. no drilling resistance) with no apparent debris between depths of 136 feet bgs and 290 feet bgs.		
	235								
-200	236								
	237								
	238								
	239								
	240								
-205	241								
	242								
	243						**243.0 Feet:** Open-hole construction terminates and 8-inch ID well casing extends within the estimated 10-inch OD borehole to base of well at 382 feet bgs. Casing is removed from borehole during decommissioning (see note at 290 feet bgs).		
	244						From 243 to 247 feet bgs, outside and inside of 8-inch ID casing was observed to be covered in rust with no visible tar or oil.		
	245								
-210	246						From 247 to 290 feet bgs, inside of 8-inch ID casing was observed to be coated with some sticky tar. Tar coating on inside of 8-inch ID casing appears to increase with depth. Minor amount of tar visible on outside of casing near vertical perforations to 290 feet bgs. Tar coating inside and outside of casing appears likely attributable to tar-covered core barrel sampler tripping out of 8-inch ID casing.		
	247								
	248								
	249								
	250								
-215	251						After removal, casing is observed to have vertical slots (hand-cut) measuring approximately 10-inches in length by 0.25 inches wide with a density of approximately 3 vertical slots per vertical foot. In total, approximately 125 slots were observed to be cut into the 8-inch well casing from 243 feet bgs to 285 feet bgs. Horizontal hand-cut perforations 4-inches long by 0.25-inches high with a density of approximately 6 horizontal slots per foot were present from 343 to 382 feet bgs. No end cap was present on removed 8-inch perforated well casing.		
	252								
	253								
	254								
	255								
-220	256								
	257								
	258								
	259								

Borehole Sealing Materials: Organoclay Bentonite (20% Solids)

NOTES: bgs=below ground surface; ft = feet; ID/OD = Inside Diameter/Outside Diameter; PID=photoionization detector

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Hahn and Associates, Inc.
Environmental Consultants

Site ID: MULT 802
Project Name: **NW Natural - MULT 802 (Decommissioning)**
Project Number: **2708-60F**

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
-225	261									Organoclay Bentonite (20% Solids)
	262									
	263									
	264									
	265									
-230	266									
	267									
	268									
	269									
	270									
-235	271									
	272									
	273									
	274									
	275									
-240	276									
	277									
	278									
	279									
	280									
-245	281									
	282									
	283									
	284									
	285									
-250	286							Vertical perforations in 8-inch ID steel casing terminate. 8-inch ID steel casing is observed to be free of perforations between depths of 285 feet bgs and 343 feet bgs.		

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Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
	287							Note: The entire length of the 8-inch ID casing was brought to the surface as a result of the sonic rig sample barrel getting wedged into the tarry material present in the casing at an estimated depth of 290 feet bgs. As a result, the entire 8-inch ID steel casing was pulled from the borehole while retrieving (tripping out) the drill rod and samlper.		
	288									
	289									
	290							The empty portion of the 8-inch ID casing, 47 feet, was lifted out of the borehole and cut. Lower portions of the 8-inch ID casing that were filled with pitch and tar were cleaned out using the core barrel sampler to remove materials while the casing was hung in upper portion of borehole. Upon cleanout, casing was removed from borehole, cut, and inspected.		
-255	291									
	292									
	293							**290.0 to 300 Feet:** Solid competant (putty-like) tar with viscous, black, oily tar blebs present, moderate plasticity, tar-like odor. Sample -005 (298 to 299 feet bgs) collected from this material on May 13, 2019 as it was removed from the 8-inch ID casing. The casing was brought to above ground surface where it was then cut and inspected.		
	294									
	295									
-260	296									
	297									
	298	X	2708-190515-005			128				
	299									
	300									
	301							**300.0 to 338.0 Feet:** Thick viscous tar with the consistency of stiff honey flows out from the core barrel sampler under gravity. The tar becomes less viscous (liquid tar seeps on surface) in sun/heat. The tar has a brown oily component when handled (stains gloves), though little oil is visible in tar. Sample -006 (318 to 319 feet bgs) and -007 (352 to 353 feet bgs) were collected of the viscous tar material removed from inside 8-inch well casing.		
-265	302									
	303									
	304									
	305									
-270	306									
	307									
	308									
	309									
	310									
-275	311									
	312									
	313									Organoclay Bentonite (20% Solids)

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Project Number: **2708-60F**

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
-280	314									Organoclay Bentonite (20% Solids)
	315									
	316									
	317									
	318	X	2708-190520-006							
	319	X								
-285	320									
	321									
	322									
	323									
	324									
	325									
-290	326									
	327									
	328									
	329									
	330									
-295	331									
	332									
	333									
	334									
	335									
-300	336									
	337									
	338	X	2708-190523-012			331		**338.0 to 339.0 Feet:** Black solid tar mixed with fine grained sand. Tar is putty-like (soft/gummy) as opposed to the viscous "thick honey" nature of tar observed between 300 and 338 feet bgs. Sample -012 (338 to 339 feet bgs) collected this material from the open borehole via 7-inch OD core barrel after 8-inch well casing was removed.		
	339	X								

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Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
-305	341							**339.0 to 354.0 Feet:** Thick viscous tar with the consistency of stiff honey flows out from the core barrel sampler under gravity. Has a minor oily component when handled (e.g. stains gloves and PPE) though little oil is visible in the tar. Sample -007 was collected from 8-inch well casing at 352 feet bgs. Tar material starting to become solid and granular texture around 354 feet bgs.		
	342									
	343									
	344							Note: 8-inch ID steel casing changes from solid wall (no perforations) to horizontal hand-cut perforations at a depth of 343 feet bgs with perforations extending to base. Horizontal hand cut perforations are approximately 4-inches long by 0.25-inches wide with a density of approximately 6 horizontal slots per foot.		
	345									
-310	346									
	347									
	348									
	349									
	350									
-315	351									
	352	X	2708-190521-007							
	353	X								
	354							**354.0 to 358.0 Feet:** Black solid and grainy tar, appears weathered with a sand-like texture. This material does not have the honey/taffy consistency as that observed between 339 and 354 feet bgs. Instead, this is a more dense, putty-like tar.		
	355									
-320	356									
	357									
	358	X	2708-190521-008					**358.0 to 363.0 Feet:** Thick viscous tar with the consistency of stiff honey. The tar becomes less viscous (liquid tar seeps on surface) after warming in the sun/heat. Has an oily component when handled (staining on gloves/PPE) though little oil is visible in tar. Sample -008 collected from inside 8-inch ID well casing at 358 to 359 feet bgs.		
	359	X				38.7				
	360									
-325	361									
	362									
	363	X	2708-190522-011			208		**363.0 to 368.0 Feet:** (Slough in hole after casing removed). Black solid tar with some fine grained sand, competent, highly viscous and sticky, high plasticity. Black oily component on the tar. Sample -011 collected from borehole during cleanout to total depth after removal of 8-inch ID well casing.		
	364	X								
	365									
-330	366									

Organoclay Bentonite (20% Solids)

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Site ID: MULT 802
Project Name: **NW Natural - MULT 802 (Decommissioning)**
Project Number: **2708-60F**

Elevation (ft)	Depth (ft)	Sample Interval	Sample Number	Recovery (ft) (core interval)	UV Screen	PID (ppm)	Pre-Decomm Casing Contents	Decommissioning Notes and Observations	Groundwater	Borehole Sealing Materials
	367									
	368	X	2708-190521-009			66.2		**368.0 to 378.0 Feet:** Black solid and grainy tar, appears weathered with a sand-like texture. This material does not have the honey/taffy consistency as that observed between 339 and 354 feet bgs. Instead, this is a more dense, putty-like tar. Sample -009 (368 to 369 feet bgs) collected from material as it is removed from 8-inch ID well casing.		
	369									
	370									
-335	371									
	372									
	373									
	374									
	375									
-340	376									
	377									
	378	X	2708-190523-013			142		**378.0 to 381.0 Feet:** Black solid tar with some fine grained sand, plastic and sticky mixed with hard brittle tar or pitch fragments (glassy appearance). Sample -013 (378 to 379 feet bgs) and -010 (380 to 381 feet bgs) collected from the open borehole after 8-inch well casing was removed.		Organoclay Bentonite (20% Solids)
	379									
	380	X	2708-190521-010							
-345	381	X	2708-190524-014			105.4		**381.0 to 382.0 Feet:** Gravel with sand, grey, wet, subrounded and angular, large broken basalt fragment (grey, massive) approximately 4" x 3" x 2". Water retrieved with gravel has a minor sheen, but no oil or tar is observed. Sample -014 (381 to 382 feet bgs) was collected from the open borehole after the 8-inch ID well casing was removed.		
	382							No end cap on removed 8-inch perforated well casing.		
	383							Bottom of well confirmed at 382 feet bgs on dense / very hard surface with visible basalt fragments (as described from 381 to 382 feet bgs). No DNAPL was measured at the base of the well and no LNAPL floating on water. Oil blebs suspended in upper portion of water column.		
	384									
	385									
-350	386									
	387							After clean-out of materials, total well depth was measured at 378 feet bgs, indicating 4 feet of slough at bottom of borehle. Borehole pumping, to further cleanout the water column and collect water samples followed by downhole video scoping, was conducted prior to well sealing.		
	388									
	389									
	390									
-355	391									
	392									
	393									

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APPENDIX D

Laboratory Analytical and Data Validation Reports

Please see accompanying file folder entitled
"Appendix D Laboratory Analytical and Data Validation Reports""

APPENDIX E

Downhole Video of Mult 802 Well Bore (July 8, 2019)

Please see accompanying file folder entitled
"Appendix E Downhole Video of Mult 802 Well Bore July 8, 2019"

APPENDIX F

Oregon Water Resources Department Documentation

Please see accompanying file folder entitled
"Appendix F Oregon Water Resources Department Documentation"

APPENDIX G

Waste Disposal Documentation

Please see accompanying file folder entitled
"Appendix G Waste Disposal Documentation"