FALL 2017 SEMIANNUAL RCRA REPORT

Former Martin Marietta Reduction Facility

Lockheed Martin Corporation

The Dalles, Oregon

ORD 052 221 025

Prepared for:

Lockheed Martin Corporation
2550 N. Hollywood Way, Suite 406
Burbank, CA 91505

Prepared by:

Amec Foster Wheeler Environment & Infrastructure, Inc.
7376 SW Durham Road
Portland, Oregon 97224
(503) 639-3400

December 1, 2017

Project No. 661M129556

Fall 2017
Semiannual Resource Conservation and Recovery Act Report

Former Martin Marietta Reduction Facility
Lockheed Martin Corporation
The Dalles, Oregon
ORD 052 221 025

Prepared for:

Lockheed Martin Corporation
2550 N. Hollywood Way, Suite 406
Burbank, CA 91505

Prepared by:

Amec Foster Wheeler Environment & Infrastructure, Inc.
7376 SW Durham Road
Portland, Oregon 97224

Prepared by: _____ Date: 12/1/17

Christy Duitman, RG
Senior Geologist, Project Manager

Reviewed/Approved By: _____ Date: 12/1/17

Russ Bunker, RG
Senior Associate Geologist

TABLE OF CONTENTS

TABLES

FIGURES

FIGURES cont.

CHARTS

APPENDICES

ABBREVIATIONS

ACL	Alternate Concentration Limit
Amec Foster Wheeler	Amec Foster Wheeler Environment & Infrastructure, Inc.
Apex Labratories	Apex
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COCs	Constituents of Concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
DEQ	Oregon Department of Environmental Quality
DGWR	The Dalles Groundwater Reservoir
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
ft	feet
LCS	leachate collection system
Lockheed Martin	Lockheed Martin Corporation
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MMRF	Martin Marietta Reduction Facility
MOA	Memorandum of Agreement
msl	mean sea level
NAC	Northwest Aluminum Company
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System

ABBREVIATIONS (cont.)

NPL	National Priorities List
ORELAP	State of Oregon Environmental Laboratory Accreditation Program
ORP	oxidation-reduction potential
POTW	Publicly Owned Treatment Works
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SMCL	Secondary Maximum Contaminant Level
WAD	weak acid-dissociable cyanide

FALL 2017 SEMIANNUAL RCRA REPORT
Former Martin Marietta Reduction Facility
The Dalles, Oregon

1.0 INTRODUCTION

1.1 PURPOSE

Lockheed Martin Corporation (Lockheed Martin) contracted Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), to conduct post-closure monitoring for the closed Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) landfills and to implement the Final Work Plan (Tetra Tech, Inc. 2014) for the Comprehensive Groundwater Investigation at the former Martin Marietta Reduction Facility (MMRF) in The Dalles, Oregon (Site).

This report presents the results of groundwater and site monitoring activities as summarized below:

- RCRA site monitoring (April through September 2017) and groundwater monitoring (September 2017);
- CERCLA site monitoring (April through September 2017); and
- Groundwater monitoring as part of the site-wide Comprehensive Groundwater Monitoring Program (September 2017).

1.2 BACKGROUND

The former MMRF Site is located on the west bank of the Columbia River. The former facility was a primary aluminum smelter that operated from 1958 through 2001. During production operations, the former MMRF occupied approximately 350 acres within an 800-acre area zoned for heavy industry and manufacturing (Figure 1).

Wastes, including cathode waste (to include spent potliner, currently classified as a RCRA listed waste [K088]), were generated during aluminum production and accumulated on site. After Oregon listed spent potliner as a hazardous waste, a lined storage pad was constructed and permitted under

RCRA as a waste pile. Cathode waste and some underlying soil from an area historically used for storing of spent potliner were consolidated into this permitted waste pile. The waste pile was subsequently closed in place as the RCRA Landfill in 1984, in accordance with a closure plan approved by the Oregon Department of Environmental Quality (DEQ). Post-closure care has been performed in accordance with RCRA Post-Closure Care Permit ORD 052 221 025.

In 1987, the U.S. Environmental Protection Agency (EPA) listed the MMRF property as the "Martin Marietta Aluminum Company" on the CERCLA National Priorities List (NPL). The RCRA Landfill portion of the Site was exluded from the NPL. Martin Marietta remediated the CERCLA site under a 1988 Record of Decision (ROD), a 1989 Consent Decree, and a 1994 Explanation of Significant Differences (ESD). In 1996, the EPA delisted the Site from the NPL.

In 2004, a Memorandum of Agreement (MOA) between the DEQ and EPA integrated management of the CERCLA Landfill, Scrubber Sludge Ponds, and the Cyanide Destruction System (now known as the CERCLA Treatment System or Permanent Treatment System) into the RCRA Post-Closure Care Permit. In 2006, the RCRA Post-Closure Care Permit was modified to integrate CERCLA and RCRA groundwater monitoring and reporting requirements, including preparing a combined RCRA and CERCLA report. The RCRA Post-Closure Care Permit specifies semiannual groundwater monitoring at the RCRA Landfill and annual groundwater monitoring at the CERCLA Landfill. EPA terminated the MOA on October 4, 2012; however, the 2006 RCRA Post-Closure Care Permit, with approved modifications through the present, remains the governing document. The specific components of the Site owned by Lockheed Martin and covered under the Post-Closure Care Permit are listed below and shown on Figure 2:

- RCRA Landfill,
- RCRA Leachate Collection System (LCS),
- CERCLA Landfill,
- CERCLA LCS,
- CERCLA Treatment System or Permanent Treatment System, and

- Scrubber Sludge Ponds.

Northwest Aluminum Company (NAC) is the current owner of record for the largest part of the former plant property not owned by Lockheed Martin.

2.0 RCRA POST-CLOSURE CARE PROGRAM

The RCRA Post-Closure Care Permit specifies post-closure requirements for the RCRA Landfill:

- Maintain the integrity and effectiveness of the final landfill cover, including preventing stormwater run-on and runoff from eroding or otherwise damaging the final cover, and repairing the cover as necessary to correct the effects of settling, subsidence, erosion, or other events.
- Operate and monitor the leachate collection and removal system.
- Maintain and monitor the groundwater monitoring system and comply with other applicable requirements of Title 40 Code of Federal Regulations (CFR) Part 264.
- Protect and maintain surveyed benchmarks used in complying with surveying and recordkeeping requirements of 40 CFR 264.309.

To support these requirements, the following activities were performed:

- Inspections of the RCRA Landfill final cover,
- Inspections of the LCS,
- Periodic removal and offsite disposal of RCRA Landfill leachate, and
- Semiannual groundwater monitoring in accordance with the Sampling and Analysis Plan (SAP) (Amec Foster Wheeler, 2017).

The layout of the MMRF Site, including the RCRA Landfill is shown on Figure 2. Figure 3 shows the locations of all Site monitoring wells. Figure 4 shows a close-up view of the locations of the RCRA monitoring wells. Figures 5 and 6 provide details on groundwater elevations and groundwater quality near the RCRA Landfill. Water level information for September 2017 is provided on Table 1. Groundwater quality data for the RCRA Landfill is provided in Table 2. Chart 1 presents the RCRA LCS production rate through September 2017, the last time leachate was removed for disposal at a

Lockheed Martin-approved Subtitle C facility. Groundwater elevation data are presented graphically on Chart 2. Groundwater quality data are presented graphically on Charts 3 through 5.

2.1 RCRA LANDFILL AND LCS INSPECTIONS

The RCRA Landfill cover and LCS are inspected semiannually and quarterly, respectively. Inspections are also performed after severe weather events. The inspections monitor for deterioration, malfunction, or improper operation of the run-on and run-off systems, and to verify proper functioning of the leachate collection system.

The semiannual inspection of the RCRA Landfill consisted of:

- Cover inspection (checking for erosion, animal burrows, and woody vegetation),
- Fence and gate inspection (checking fence and gate integrity to ensure that warning signs are in place),
- Drainage system inspection (checking for ponded water or blockages in the channels or culverts and checking cap drain discharge pipes), and
- Inspection of the area adjacent to the landfill (checking for riprap erosion, ponded water, silt deposits, and damaged well heads).

The quarterly RCRA LCS inspections consisted of:

- Inspecting the sump leak detection system, fluid high-level warning lights, and testing of the system alarm autodialer,
- Inspecting the temporary storage drums, and
- Inspecting the building and building slab.

The following quarterly RCRA inspections were performed during the reporting period:

Inspection	2nd Quarter 2017	3rd Quarter 2017
RCRA Landfill	June 13, 2017	September 19, 2017*
RCRA LCS	June 13, 2017	September 19, 2017

*Note: In addition to the semiannual RCRA Landfill inspection, the RCRA Landfill was also volutarily inspected during the third quarter inspection period (Section 2.0 of Amec Foster Wheeler, 2016b). Next required inspection due December 2017.

During the LCS inspections, all items were found to be in good condition. The depth of the leachate measured in the bottom of the sump during June 2017 was approximately 0.76 feet (corresponding to approximately 72 gallons of leachate in the sump structure). In September 2017, the depth of leachate measured in the bottom of the sump was approximately 2.14 feet (corresponding to approximately 288 gallons of leachate in the sump structure). Inspection forms for this reporting period are provided in Appendix A.

Visual comparison of precipitation data provided by National Oceanic and Atmospheric Administration (NOAA) with leachate production records indicates that precipitation had little effect, if any, on the quantity of leachate generated from the RCRA Landfill (Chart 1 and Appendix B). As reported in Appendix B, the maximum daily precipitation during the reporting period was 0.41 inches on April 19, 2017 (NOAA, 2017; Appendix B).

2.2 LEACHATE TRANSFER SAMPLING AND ANALYSIS

2.2.1 Background

In accordance with RCRA Post-Closure Care Permit Condition V.C.1.b. (modified in February 2015), leachate collected from the RCRA sump is transported to an offsite disposal facility as necessary.

2.2.2 Leachate Transfer

Leachate was removed from the RCRA sump twice during the reporting period. The first removal was conducted on April 24, 2017 and consisted of approximately 225 gallons. The second removal was on September 20, 2017 and consisted of approximately 260 gallons. Both removals were managed as K088 listed waste and disposed of at Chemical Waste Management in Arlington, Oregon, a Subtitle C facility.

2.2.3 Leachate Sampling and Analysis

No sampling of leachate was conducted during the reporting period. The two transfers were disposed of under exisiting Chemical Waste Management profile OR333176.

2.3 RCRA LANDFILL GROUNDWATER MONITORING

2.3.1 Objective

The groundwater monitoring points of compliance consist of one upgradient monitoring well (MW-5S) and eight downgradient or cross-gradient wells (MW-3S, MWR-4S, MW-17S, MW-22S, MW-23S, MW-35S, MW-36S, and MW-37S). The monitoring well locations are shown on Figure 4.

The primary objective of the RCRA Landfill groundwater monitoring program is to document constituent concentrations in groundwater and determine if the following groundwater protection standards are met, which were developed as part of the Consent Decree (EPA and DEQ, 1989) and are the approved groundwater protection standard in the currently active Post-Closure Permit:

- Free Cyanide (represented by Weak acid dissociable [WAD] Cyanide): 0.77 milligrams per liter (mg/L; Perched and S Zones);
- Fluoride: 9.7 mg/L (Perched and S Zones);
- Sulfate: 3,020 mg/L (Perched and S Zones);

Groundwater monitoring for the RCRA Post-Closure Care Permit program was conducted in accordance with the project SAP (Amec Foster Wheeler, 2017), which was revised under a II.S permit modification.

2.3.2 September 2017 Semiannual Monitoring Well Sampling

Groundwater was sampled for RCRA Landfill Post-Closure Care Permit compliance from September 20 through 21, 2017. The samples were collected with a peristaltic pump using pre-installed, dedicated tubing using EPA low-flow sampling techniques. At each well, field groundwater quality parameters (turbidity, dissolved oxygen, pH, specific conductivity, oxidation reduction potential [ORP], and temperature) were measured and recorded. Groundwater sampling field forms are presented in Appendix C.

The groundwater samples were collected using laboratory-supplied bottles, placed on ice, and transported under chain of custody to the contract laboratory, Apex Laboratories (Apex) in Tigard, Oregon, for analysis. Apex is accredited by the State of Oregon Environmental Laboratory Accreditation Program (ORELAP OR100062) and is an approved laboratory for analysis of the RCRA Post-Closure Care Permit groundwater samples. The groundwater samples were analyzed for:

- WAD cyanide by method SM 4500-CN-I/E
- Total cyanide by EPA Method 335.4
- Fluoride by EPA SW-846-9056
- Sulfate by EPA Method 300.0

The analytical report (received on October 17, 2017) is provided in Appendix D. Validation of the data was completed on October 20, 2017 (See Appendix E). Data collected in 2015 through 2017 are presented in Table 2. Groundwater quality data are presented graphically in Charts 3 through 5. The RCRA groundwater quality analytical results from September 2076 for WAD cyanide, total cyanide, fluoride, and sulfate are shown on Figure 6.

2.3.3 Water Level Measurements

The RCRA groundwater monitoring program includes measuring water levels in the monitoring wells. The reference points for determining water level elevations are the tops of the polyvinyl chloride (PVC) well casings, which have been surveyed relative to mean sea level (msl); (North American Vertical Datum of 1988). To reduce variation in groundwater level measurements, static water levels for all wells are measured on the same day before the wells are purged and sampled. Groundwater levels were measured to the nearest 0.01 foot using an electronic water level meter. Groundwater measurements from September 25, 2017, are shown in Table 1. Groundwater elevation data are presented graphically in Chart 2 and Figure 5.

2.4 HYDROGEOLOGY

Water levels are measured semiannually as part of the ongoing RCRA monitoring program. The stratigraphy and hydrogeology of the Site were characterized during the Remedial

Investigation/Feasibility Study (RI/FS) (Geraghty & Miller 1988) and the characterization was updated as part of the Comprehensive Groundwater Monitoring Program (Tetra Tech, 2014; AMEC, 2014d, 2015a). The site is underlain by the Columbia River Basalt Group, which includes the following stratigraphic units (listed in order of descending depth):

- The Lolo Flow of the Priest Rapids Member,
- The Byron Interbed,
- The Rosalia Flow of the Priest Rapids Member,
- The Quincy/Squaw Creek Interbed, and
- The Sentinel Gap Flow of the Frenchman Springs Member.

Four hydrostratigraphic units were identified in the RI/FS: the S Zone (unconfined), the A aquifer (semi-confined), the B aquifer (confined), and The Dalles Groundwater Reservoir (DGWR). The S Zone is the interflow zone between the Lolo and Rosalia flows, including the Byron Member. The A and B aquifers are the upper and lower pillow complexes, respectively, in the Rosalia flow. The DGWR is a permeable groundwater system within the Sentinel Gap Flow.

This system was refined in the Comprehensive Groundwater Investigation Work Plan (Tetra Tech, 2014; AMEC, 2014b and 2014c) to include two additional zones: the Perched Zone and the S_L Zone. The Perched Zone consists of shallow groundwater found in fractures within the Lolo flow within about 25 feet of ground surface and higher than the Byron Interbed zone and, where present, in saturated soil (fill or natural) in depressions on top of the flow. The S_L aquifer is the S Zone where the overlying Lolo flow and Byron Member components are missing because of erosion. The S_L aquifer is relevant in the area of the Scrubber Sludge Ponds.

RCRA monitoring wells are completed in the S Zone with the exceptions of monitoring well MW-5S and MW-37S, which are completed in the Perched Zone. Assignment of these wells to the Perched Zone is based on additional characterization data developed in the First and Second Comprehensive Groundwater Investigation Technical Memorandums (AMEC, 2014d; Amec Foster Wheeler, 2015b).

2.4.1 Groundwater Flow

Water level measurements were evaluated to assess the magnitude and direction of the hydraulic gradient. Water levels in all nine RCRA groundwater monitoring wells were measured and recorded on September 25, 2017. These water levels were used to prepare a water level map for the S Zone (See Figure 5).

Groundwater flow velocities within the S Zone were estimated on the basis of the measured groundwater gradient and hydraulic conductivity estimates from aquifer tests (ARCADIS G&M, 2001). The estimated average hydraulic conductivity value for the S Zone at intervals intercepting the Byron Interbed is approximately 6×10^{-3} centimeters per second (the measured range is 3.2×10^{-4} to 1.2×10^{-2} centimeters per second; ARCADIS G&M, 2001).

Because groundwater moves only through pores (a combination of fractures within basalt and the interstitial spaces between sediments within the Byron Interbed of the S Zone at the NAC Site), a term for effective porosity (n_e) is included in the expression for seepage velocity (V_s) or average linear velocity, where (i) is the hydraulic gradient:

$$V_s = \frac{Ki}{n_e}$$

A reasonable estimate of effective porosity of the S Zone at intervals intercepting the Byron Interbed is 10 percent (Divine, C. E. and Rask, B, 2002). A hydraulic gradient of 0.003 was calculated between S Zone monitoring wells MWR-4S and MW-23S in the area of the RCRA Landfill on September 25, 2017. Using the equation above, the average linear velocity of groundwater in the S Zone in the area of the RCRA Landfill is estimated at approximately 1.8×10^{-3} centimeters per second (193 feet [ft] per year).

2.4.2 Water Level Variations

Groundwater elevations for the RCRA monitoring wells for September 2017 ranged from 126.90 ft above msl (North American Vertical Datum 88) in MW-36S to 134.79 ft above msl in MW-5S (Table 1). Water level data collected between March 1994 and September 2017 were used to construct

hydrographs comparing all RCRA monitoring wells (Chart 2). Seasonal fluctuations are evident, and the seasonal range of fluctuations remains relatively unchanged for the period of record. The water level elevations observed in the area of the RCRA Landfill in September 2017 were within the historical range.

2.5 DATA VALIDATION RESULTS

The RCRA groundwater monitoring results were reviewed in accordance with the Data Validation Checklist (Appendix E).

Documentation provided in the analytical data package was acceptable. Data quality was acceptable and results from these samples may be considered usable with the limitations described in the data validation checklist. Data qualifiers added during validation are summarized below:

Amec Foster Wheeler J-qualified (estimated) one duplicate result as being an estimated concentration due to the sample being run outside of the method specified analytical hold time. There was no relative percent difference between the primary and duplicate sample concentrations. A list of qualified data is presented in the data validation checklist (Appendix E).

Based on the data validation, 100 percent of the data are useable, meeting the SAP-specified minimum completeness goal of 90 percent.

2.6 SEPTEMBER 2017 RCRA GROUNDWATER QUALITY SUMMARY

Table 2 summarizes groundwater quality data from March 2015 through September 2017 for the RCRA monitoring wells.

All concentrations of detected constituents are below their applicable groundwater protection standard from the Post-Closure Care Permit (Table 2). Samples analyzed for WAD cyanide were compared to the free cyanide groundwater protection standards. WAD cyanide concentrations ranged from nondetect (monitoring wells MW-3S, MWR-4S, MW-17S, MW-23S, MW-35S, MW-36S, and MW-37S) to 0.0229 mg/L at monitoring well MW-5S. Total Cyanide concentrations ranged from nondetect (monitoring wells MW-3S, MWR-4S, and MW-36S) to 0.460 mg/L (MW-5S). Fluoride

concentrations ranged from 0.136 mg/L (MW-36S) to 9.21 mg/L (MW-5S). Sulfate concentrations ranged from 22.9 mg/L (MW-23S) to 77.5 mg/L (MWR-4S).

3.0 CERCLA POST-CLOSURE CARE PROGRAM

The CERCLA Landfill and LCS and Scrubber Sludge Ponds Post-Closure Care requirements consist of the following:

- Maintain the integrity and effectiveness of the final cover, including prevention of run-on and run-off from eroding or otherwise damaging the final cover and repairing the cap as necessary to correct the effects of settling, subsidence, erosion, or other events.
- Continue to operate and monitor the leachate collection and treatment system.
- Maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of 40 CFR Part 264.
- Present groundwater quality and hydrogeology data.
- Protect and maintain surveyed benchmarks.

To help meet these requirements, the following activities are performed:

- Inspections of the CERCLA Landfill final cover,
- Inspections of the LCS,
- Inspection of the Scrubber Sludge Ponds, and
- Annual groundwater monitoring in accordance with the SAP.

The layout of the CERCLA Landfill is provided on Figure 2. Landfill leachate production and quality data for the CERCLA Landfill are provided in Tables 3 and 4. Chart 6 presents the CERCLA leachate production rate versus precipitation data.

3.1 CERCLA LANDFILL AND LCS INSPECTIONS

The CERCLA Landfill is inspected annually to detect and repair, if necessary, defects in the landfill cover. The LCS is inspected quarterly to detect and repair, if necessary, defects in the infrastructure in accordance with the 1989 Consent Decree and the RCRA Post-Closure Care Permit.

Annual inspection of the CERCLA Landfill consised of the following:

- Cover inspection (checking for erosion, slumping, animal burrows, woody vegetation, and survey benchmarks),
- Fence and gate inspection (checking fence and gate integrity and ensuring that warning signs are in place),
- Drainage system inspection (checking for ponded water or blockages in the channels or culvert and checking cap drain discharge pipes), and
- Inspection of the area adjacent to the landfill (checking for riprap erosion, ponded water, silt deposits, and damaged well heads).

The quarterly CERCLA LCS inspection consists of the following:

- Inspecting the lift station pumps and alarm lights,
- Inspecting the piping, and
- Inspecting CERCLA Tank integrity.

The following CERCLA inspections were performed during the reporting period for this report:

Inspection	2nd Quarter 2017	3rd Quarter 2017
CERCLA Landfill	June 14, 2017	September 19, 2017*
CERCLA LCS	June 14, 2017	September 19, 2017

*Note: In addition to the required annual CERCLA Landfill inspection, the CERCLA Landfill was also voluntarility inspected during the third quarter inspection period (Section 2.0, Amec Foster Wheeler, 2016c). Next required inspection due June 2018.

All items were found to be in good condition during the quarterly inspections in June and September 2017. Inspection forms for this reporting period are provided in Appendix F.

3.2 LEACHATE COLLECTION, TREATMENT, SAMPLING AND ANALYSIS, AND DISCHARGE

The following sections describe activities associated with the CERCLA LCS between April and September 2017.

3.2.1 Background

The CERCLA LCS, which consists of perforated pipe buried in a covered collection trench, surrounds three sides of the landfill (Figure 2) and captures both shallow groundwater and leachate that migrates to the shallow groundwater. Leachate drains under gravity to two lift stations; Lift Station 2 pumps leachate over a rock outcrop to Lift Station 1, and Lift Station 1 pumps directly to the CERCLA Treatment System. Discharge of treated leachate is then conveyed to the City of The Dalles Publicly Owned Treatment Works (POTW) system. Discharge to the POTW is conducted under City of The Dalles Industrial Pretreatment Program under Permit Number 2016-003.

3.2.2 Leachate Collection

Total influent to the CERCLA Treatment System during the reporting period (April 2017 through September 2017) was 399,600 gallons. Table 3 presents monthly LCS flows measured at Lift Stations 1 and 2. Table 3 also presents monthly precipitation data totals. Increases in leachate production lag slightly behind increases in precipitation as shown on Chart 6.

3.2.3 Treatment

An ion exchange resin treatment system was constructed at the CERCLA facility in the fall of 2014. The CERCLA Treatment System uses ion exchange resin media to remove cyanide compounds from the combined CERCLA landfill leachate and shallow groundwater that are collected in the LCS and conveyed to the Treatment System from Lift Station #1. The CERCLA Treatment System is located within the CERCLA Building located within the CERCLA secondary containment. Untreated leachate is first conveyed through particulate bag filters to remove solids before treatment in a series (ion exchange media in lead and lag vessels) configuration. After removing cyanide compounds through ion exchange in the two vessels, the treated leachate is routed through another bag filter to collect potential resin media that have exited the vessels. The treated leachate is then conveyed to the City of The Dalles POTW system (Permit Number 2016-003).

The CERCLA Treatment System has been operating almost continuously since start-up in November 2014. The CERCLA Treatment System is formally inspected quarterly to detect and repair, if necessary, defects in the system detected during the inspections.

The quarterly CERCLA Treatment System inspection consists of the following:

- Testing of gauges and transmitters
- Testing of the flow meter
- Checking the building temperature sensor
- Testing autodialer alarm notification and delivery

The following CERCLA Treatment System inspections were performed during the reporting period for this report:

Inspection	2nd Quarter 2017	3rd Quarter 2017
CERCLA Treatment System	June 15, 2017	September 19, 2017

All items were found to be in good condition during the quarterly inspections in June and September 2017. Inspection forms for this reporting period are provided in Appendix F.

Table 3 presents the monthly total flow volumes of influent to the LCS, flow through the CERCLA Treatment System, and monthly discharge volumes to the POTW during the reporting period. Approximately 351,375 gallons of leachate were treated by the CERCLA Treatment System m from April 2017 through September 2017. Table 4 presents the analytical data for samples collected from the influent (Lift Station #1). Table 5 presents the performance monitoring data for the ion exchange treatment process after passing through the lead and lag vessels. The performance monitoring data indicate that the CERCLA Treatment System is meeting effluent objectives and decreasing WAD cyanide concentrations to below design criteria limit (0.1 mg/L). Laboratory reports for the LCS and Treatment System performance monitoring are included in Appendix D.

3.2.4 Sampling and Analysis

Industrial Wastewater Discharge Permit No. 2016-003 requires regular sampling of treated effluent, conducted at least monthly. In addition, leachate at Lift Stations 1 and 2 and Manholes 2 and 4 is sampled at a minimum yearly or quarterly as needed for system checks.

Leachate in the LCS (Lift Station #1 and Lift Station #2 and Manholes 2 and 4) was sampled on June 13, 2017, and September 20, 2017 (Table 4). The LCS samples were analyzed for:

- WAD cyanide by method SM 4500-CN-I/E
- Total cyanide by EPA Method 335.4
- Fluoride by EPA SW-846-9056
- Sulfate by EPA Method 300.0

Results of the analytical data from the CERCLA LCS for between 2014 and 2017 are presented in Table 4. Laboratory reports and chain-of-custody documentation are provided in Appendix D.

3.2.5 POTW Discharge and Sampling

In February 2017, discharge of treated effluent to the POTW began under Industrial Wastewater Discharge Permit No. 2016-003. Semi-continuous POTW discharge replaced the previous conveyance and discharge through a multi-party National Pollutant Discharge Elimination System (NPDES) outfall. Treated leachate is conveyed to the City of The Dalles POTW collection system through a discharge pipeline that was constructed in 2016. DEQ was notified of the change in discharge method in a II.S Permit Change - Temporary Leachate Treatment Discharge Method letter dated December 14, 2016 (Lockheed Martin, 2016). A total of 351,375 gallons were discharged to the POTW during the reporting period (Table 3). Volume-weighted compliance sampling was performed at the frequency and for the analytes specified in the Industrial Discharge Permit. Analytes are total metals, biological oxygen demand, total suspended solids, total cyanide, and fluoride. Compliance sample results and discharge records were reported to the City of The Dalles in monthly Discharge Monitoring Reports (Appendix G) in accordance with the discharge permit.

3.3 SCRUBBER SLUDGE PONDS INSPECTION

The Scrubber Sludge Ponds are inspected annually as well as following a significant precipitation event (2.5 inches of precipitation in a 24-hour period). The annual inspection includes the following:

- Cover inspection (checking for erosion, animal burrows, and exposed sludge),
- Drainage system (checking for ponded water and sedimentation or blockage in ditches and culverts),
- Fence and gate inspection (checking fence and gate integrity and ensuring that warning signs are in place, as well as checking that the fence is clear of trees), and
- Inspection of the area adjacent to the Scrubber Sludge Ponds (vegetation control and intrusions).

The annual inspection form is provided in Appendix H. No significant precipitation events occurred during the reporting period.

4.0 COMPREHENSIVE GROUNDWATER INVESTIGATION PROGRAM

This section summarizes the scope of work completed to implement the recommended long term Comprehensive Groundwater Monitoring Program presented in Table 5 of the Final Second Technical Memorandum (Amec Foster Wheeler, 2015b). The sampling focused on additional groundwater monitoring at wells installed in September 2015, resampling of locations with rejected January 2015 cyanide data to develop four consecutive quarters of groundwater quality data, and semi-annual sampling of the groundwater monitoring network at locations not routinely sampled as part of the RCRA and CERCLA Landfill programs or locations with less than five years of monitoring data. The scope of work was completed in accordance with the Final Work Plan (Tetra Tech, Inc. 2014), associated addenda (AMEC, 2014a,b,c; Amec Foster Wheeler, 2015a), and Table 5 of Final Second Technical Memorandum (Amec Foster Wheeler, 2015b).

4.1 OBJECTIVE

In the 2013 EPA five-year review, EPA recommended implementing a comprehensive site-wide groundwater characterization investigation to refine the understanding of groundwater flow and contaminant transport at the Site and to evaluate the effectiveness of the groundwater monitoring

network. EPA directed Lockheed Martin to prepare a Work Plan for a Comprehensive Site-Wide Groundwater Investigation and develop and implement a Comprehensive Site-Wide Groundwater Monitoring Program in a letter dated September 20, 2013. The Work Plan responding to this EPA directive was prepared and subsequently approved by the EPA (Tetra Tech, Inc., 2014).

Section 2.4 of the Work Plan (Tetra Tech, Inc., 2014) identified three data gaps and associated data needs:

- Characterization and groundwater monitoring of the Perched Zone;
- Groundwater monitoring and characterization in the S Zone for areas east and downgradient of the Scrubber Sludge Ponds and the former main plant area; and
- Groundwater characterization and monitoring near recently demolished former operating areas of the plant.

The field activities completed after well installation and the initial rounds of sampling were reported in the First Technical Memorandum and Final Second Technical Memorandum (AMEC, 2014d; Amec Foster Wheeler, 2015b). The field activities for the additional groundwater monitoring conducted in December 2015 and March 2016 are documented in the 2016 Combined Annual RCRA and CERCLA Monitoring Report (Amec Foster Wheeler, 2016a). The September 2017 groundwater monitoring events conducted as recommended in the Final Second Technical Memorandum are summarized in Section 4.3. Findings from the groundwater monitoring are presented in Section 4.5.

4.2 CLEANUP LEVELS

The 1988 EPA ROD and 1989 Consent Decree established groundwater cleanup levels. Three Alternate Concentration Levels (ACLs) were established for groundwater quality in the then-defined uppermost aquifer (S Zone). The ACLs were 9.7 mg/L for fluoride and 3,020 mg/L for sulfate.

The 1988 EPA ROD specified EPA Safe Drinking Water Act Maximum Concentration Levels (MCLs) as applicable cleanup standards for fluoride and the Secondary Maximum Contaminant Level (SMCL) for sulfate as the cleanup standard for the deeper A and B aquifers. The MCL for cyanide is 0.2 mg/L, the MCL for fluoride is 4 mg/L, and the SMCL for sulfate is 250 mg/L. The cyanide MCL is based on free cyanide concentrations, which are currently measured as WAD cyanide. WAD

cyanide provides a conservative estimate of free cyanide, because it will detect both the free form and disassociated complexes.

The 2013 EPA five-year review indicated that carcinogenic polycyclic aromatic hydrocarbons (cPAH) compounds should be considered as constituents of concern (COCs) at the site, with MCLs being the relevant comparison basis. This has not been promulgated in an ESD, but is considered in discussion of the analytical data collected for the Comprehensive Groundwater Monitoring Program.

4.3 GROUNDWATER MONITORING

Groundwater monitoring consisted of manual water level measurements, monitoring of pressure transducers in MW13-01P and MW13-01S, and the collection of groundwater samples for chemical testing in September 2017. Monitoring well locations are shown on Figure 3.

4.3.1 Monitoring Activities

Groundwater samples were collected using EPA low-flow sampling techniques consistent with the Work Plan. At each well, field groundwater quality parameters (turbidity, dissolved oxygen, pH, specific conductivity, ORP, and temperature) were measured and recorded. The field records are found in Appendix C.

The groundwater samples were collected using laboratory-supplied bottles, placed on ice, and transported under chain-of-custody to the contract laboratory, Apex in Tigard, Oregon, for analysis. Apex is accredited by ORELAP (OR100062).

Apex analyzed the samples for one or more of the following:

- WAD cyanide by EPA Method 4500-CN-I/E;
- Total cyanide by EPA Method 335.4;
- Fluoride by EPA Method SW-846-9056;
- Sulfate by EPA Method 300.0; and

The data from the September 2017 sampling event is summarized on Tables 6 and 7. The laboratory reports are provided in Appendix D. Appendix E present the data validation reports.

4.3.2 Water Level Measurements

Water level monitoring was also conducted at 49 locations on September 25, 2017. Groundwater levels were measured to the nearest 0.01 foot at all wells sampled using an electronic water level meter. The depth to groundwater was also measured in sampled wells on the day of sampling. Tabulated water level measurements are presented in Table 1. Beginning in December 2014, groundwater levels in MW13-01P and MW13-01S were also measured using pressure transducers to support conceptual site model development for the Perched and S zones. Instrument Northwest PT2X pressure transducers fitted with vented, direct-read communication cables were used to measure water levels once per hour over the monitoring period. Graphs of groundwater levels from MW13-01P and MW13-01S are presented in Appendix I.

4.4 HYDROGEOLOGY, GROUNDWATER GRADIENTS AND FLOW DIRECTIONS

A potentiometric surface map was prepared for the Perched Zone (Figure 7), S Zone (Figure 5), and A Aquifer (Figure 8) monitoring wells using water levels measured on September 25, 2017. The water level measurements are summarized in Table 1.

Groundwater levels were measured near the RCRA Landfill in September 2017 to evaluate groundwater flow in the Perched and S Zones in this portion of the site. Well MW-5S, which was installed in 1987 to monitor the RCRA Landfill, is screened in the interval above the Byron Interbed, based on available logs, which have limited detail. Since the monitored interval at well MW-5S may be representative of either the Perched or S Zones, the water levels from September 2017 for this well along with the Perched Zone wells MW15-18P and MW15-20P installed in September 2015 are shown on the September 2017 Perched Zone potentiometric surface map.

In the Perched Zone near the RCRA Landfill, the September 2017 horizontal direction of groundwater flow is generally to the east (Figure 7). In the S Zone near the RCRA Landfill, the September 2017 overall horizontal groundwater flow direction varies from southwest to northwest, away from a high centered near wells MW-35S and MW13-13S and toward lows near MW-36S (Figure 5).

The hydraulic gradient for the S Zone (including the S_L wells) shown on Figure 5 (September 2017) indicates that the horizontal groundwater flow direction for the S Zone for much of the Site is to the southeast, toward the Columbia River. Near the CERCLA landfill, however, the horizontal flow direction is to the north, towards Chenoweth Creek, which in turn drains northeastward to the Columbia River. The water levels plotted on Figure 5 also indicate locally higher groundwater elevations around wells MW13-11S, MW-42S, MW13-01S, and MW-26S.

The horizontal groundwater flow direction in the A aquifer beneath the southeastern portion of the CERCLA landfill is generally to the northwest away from the Columbia River (Figure 8).

4.5 DATA VALIDATION RESULTS

Data validation for the September 2017 groundwater data was completed by Amec Foster Wheeler in accordance with the Data Validation Checklist (See Appendix E) and the SAP (Amec Foster Wheeler, 2017). Documentation provided by the laboratory was acceptable, and results from these samples may be considered usable with the limitations described in the data validation checklist. Based on the data validation, 100 percent of the data from the September 2017 event is useable, meeting the SAP-specified minimum completeness goal of 90 percent.

4.6 GROUNDWATER QUALITY SUMMARY

This section compares the analytical results from the September 2017 monitoring event with the ACLs for the Perched, S, and S_L Zones for fluoride, sulfate, and cyanide. The analytical results for the A Aquifer are compared with the MCLs.

The ACLs are 0.22 mg/L for free cyanide, 9.7 mg/L for fluoride, and 3,020 mg/L for sulfate. The MCLs are 0.20 mg/L for free cyanide and 4 mg/L for fluoride. The SMCL for sulfate is 250 mg/L.

Perched Zone

Analytical results for the Perched Zone are summarized in Table 7, and in Figures 9 through 12 and Figures 20 through 22.

Thirteen Perched Zone monitoring wells were sampled in September 2017 event and one detection (MW13-01P, 2.08 mg/L) exceeded the free cyanide ACL of 0.22 mg/L (Figures 9 and 20).

In September 2017, fluoride was detected in all thirteen Perched Zone monitoring wells with concentrations ranging from 0.333 mg/L (MW13-03P) to 106 mg/L (MW13-07P). Five wells had detections that exceeded the ACL of 9.7 mg/L (Figures 10 and 21).

No sulfate detections from the September 2017 sampling event exceeded the ACL of 3,020 mg/L (Figures 11 and 22).

No P Zone wells were sampled for cPAHs; however, historical data is presented for comparison on Figure 12.

S Zone

Analytical results for the S Zone are summarized in Table 7, and in Figures 13 through 16 and Figures 23 through 25. No WAD cyanide detections in the eighteen S Zone wells sampled during September 2017 exceeded the free cyanide ACL of 0.22 mg/L (Figure 13).

No fluoride or sulfate detections from the September 2017 sampling event exceeded their respective ACLs of 9.7 mg/L and 3,020 mg/L (Figures 14, 15, 24, and 25).

No S Zone monitoring wells were analyzed for cPAHs; however, historical data is presented for comparison on Figure 16.

S_L Zone

Five S_L Zone wells were sampled in September 2017. Analytical results for the S_L Zone are summarized in Table 7, and in Figures 13 through 16 and Figures 23 through 25.

No WAD cyanide or sulfate detections in the S_L Zone monitoring wells sampled in September 2017 exceeded their respective ACLs (Figures 13 and 15).

Fluoride detection in one well, MW13-14SL (26.1 mg/L) exceeded the ACL of 9.7 mg/L (Figure 14).

No S_L Zone monitoring wells were analyzed for cPAHs during September 2017. Historical S_L Zone results are presented on Figure 16.

A Aquifer

Analytical results for the A Aquifer are summarized in Table 7, and in Figures 17 through 19 and Figures 26 through 28.

No MCLs or SMCLs (sulfate only) were exceeded in the three A Aquifer wells (MWR-2A, MW13-02A, and MW13-06A) sampled in September 2017.

5.0 CONCLUSIONS

- There are no exceedances of free cyanide, fluoride, and sulfate groundwater protection standards at monitoring wells sampled for the semi-annual RCRA Post-Closure Care Monitoring program.
- No exceedances of the sulfate ACL or MCLs have been observed in Site monitoring wells sampled since 2014 for the Comprehensive Groundwater Monitoring Program.
- Exceedances of the fluoride ACL/MCL are limited to monitoring wells in the Perched and S_L Zones for the Comprehensive Groundwater Monitoring Program.
- Exceedances of the free cyanide ACL/MCL are limited to monitoring wells in the Perched and S Zones near the CERCLA Landfill for the Comprehensive Groundwater Monitoring Program.
- With completion of the September 2017 Comprehensive Groundwater Monitoring Program, a statistical analysis will be performed on all data collected throughout the program during first half of 2018. The purpose of this analysis will be to perform long-term monitoring optimization of the groundwater monitoring programs at the Site.

6.0 REFERENCES

AMEC, 2014a Addendum 1.0 to Final Work Plan for Comprehensive Groundwater Investigation at the Former Martin Marietta Reduction Facility, Lockheed Martin Corporation, The Dalles, Oregon. June 9.

AMEC, 2014b. Addendum 2.0 to Final Work Plan for Comprehensive Groundwater Investigation at the Former Martin Marietta Reduction Facility, Lockheed Martin Corporation, The Dalles, Oregon. June 16.

AMEC, 2014c. Addendum 3.0 to Final Work Plan for Comprehensive Groundwater Investigation at the Former Martin Marietta Reduction Facility, Lockheed Martin Corporation, The Dalles, Oregon. June 24.

AMEC, 2014d. Comprehensive Groundwater Investigation First Technical Memorandum, Former Martin Marietta Reduction Facility, Lockheed Martin Corporation, The Dalles, Oregon. October 14.

Amec Foster Wheeler, 2015a. Addendum 4.0, Final Work Plan for Comprehensive Groundwater Investigation, Former Martin Marietta Reduction Facility, Lockheed Martin Corporation, The Dalles, Oregon. May 20.

Amec Foster Wheeler, 2015b. Final Second Technical Memorandum for Comprehensive Groundwater Investigation, Former Martin Marietta Reduction Facility, Lockheed Martin Corporation, The Dalles, Oregon. December 15.

Amec Foster Wheeler, 2016a. Combined 2016 Semiannual RCRA and Annual CERCLA Groundwater Monitoring Report, Former Martin Marietta Reduction Facility, Lockheed Martin Corporation, The Dalles, Oregon. May 25.

Amec Foster Wheeler, 2016b. Operations and Maintenance Manual, RCRA Landfill and Leachate Collection System, Former Martin Marietta Reduction Facility, Lockheed Martin Corporation, The Dalles, Oregon. December 5.

Amec Foster Wheeler, 2016c. Operations and Maintenance Manual, CERCLA Landfill, CERCLA Treatment Area, Leachate Collection System, and Scrubber Sludge Ponds, Former Martin Marietta Reduction Facility, Lockheed Martin Corporation, The Dalles, Oregon. December 16.

Amec Foster Wheeler, 2017. Sampling and Analysis Plan, Revision 3 Former Martin Marietta Reduction Facility, The Dalles, Oregon. September 26, 2017.

ARCADIS G&M, 2001. Semi-Annual Report, Sampling Dates: March 2001, The Dalles, Oregon, ORD 052 221 025 Appendix I, Aquifer Test Results and Velocity Calculations, May 24, 2001.

Divine, C. E. and Rask, B. 2002. Interpreting Pumping Tests for a Basalt-Interbed Hydrostratigraphic Unit. *Hydrology Days, American Geophysical Union,* 2002: 53-64.

Geraghty & Miller, 1998. RI/FS, Martin Marietta Reduction Facility, The Dalles, Oregon, March.

Lockheed Martin, 2016. II.S Permit Change—Temporary Leachate Discharge Method, Lockheed Martin Corporation The Dalles Facility, The Dalles, Oregon. December 14.

National Oceanographic and Atmospheric Administration (NOAA), 2017. National Weather Service Weather Observation Data The Dalles Municipal Airport. October 31.

Tetra Tech, Inc. 2014. Final Work Plan for Comprehensive Groundwater Investigation, Former Martin Marietta Reduction Facility, The Dalles, Oregon. April.

U.S. Environmental Protection Agency and Oregon Department of Environmental Quality (EPA and DEQ), 1989. United States of America and The State of Oregon, Department of Environmental Quality, Plaintiffs, v. Martin Marietta Corporation, Commonwealth Aluminum Corporation, Defendants. Consent Decree and Record of Decision. July 5, 1989.

EPA, 2013a. Fourth Five-Year Review Report for Lockheed Martin Corporation The Dalles Facility, Former Martin Marietta Company Reduction Facility, The Dalles, Wasco County, Oregon, Covering January 2055 through December 2012. May 15, 2013.

EPA, 2013b. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review. EPA 540 R 13 001.

EPA, 2013c. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review. EPA/540 R 014 002.