



**Data Summary Report**  
**July 2020**  
**Groundwater Monitoring**  
**Waste Oil Dump**

Goddard Space Flight Center  
Wallops Flight Facility  
Wallops Island, Virginia

**February 2021**

**DATA SUMMARY REPORT  
JULY 2020 GROUNDWATER MONITORING  
WASTE OIL DUMP**

**NASA WALLOPS FLIGHT FACILITY  
WALLOPS ISLAND, VIRGINIA**

**Submitted to:  
National Aeronautics and Space Administration  
Goddard Space Flight Center  
Code 250.W  
Building F-160  
Wallops Island, Virginia 23337**

**Submitted by:  
LJT & Associates, Inc.**

**Submitted under:  
NASA Contract Task Order 8-14-2020**

**February 2021**

## CERTIFICATION

The enclosed document was prepared, and is being submitted, in accordance with the requirements of the Administrative Agreement On Consent between the United States Environmental Protection Agency and the National Aeronautics and Space Administration [U.S. EPA Docket Number RCRA-03-2004-0201TH].

I certify that the information contained in or accompanying this document is true, accurate, and complete.

I certify under penalty of law that this document and all attachments were prepared in accordance with procedures designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, or the immediate supervisor of such person(s), the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Signature: \_\_\_\_\_

Name: Mr. David Liu

Title: NASA Project Coordinator

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## ACRONYMS

CoC	Chain of Custody
EPA	Environmental Protection Agency
FFTA	Former Fire Training Area
GSFC	Goddard Space Flight Center
LTM	Long-Term Monitoring
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NASA	National Aeronautics and Space Administration
NTU	Nephelometric Turbidity Units
ORP	Oxidation Reduction Potential
PID	Photoionization Detector
QA/QC	Quality Assurance/Quality Control
ROD	Record of Decision
Tetra Tech	Tetra Tech, Inc.
WFF	Wallops Flight Facility
WOD	Waste Oil Dump
µg/L	microgram per liter

## **1.0 INTRODUCTION**

This Data Summary Report has been prepared by LJT and Associates, Inc. for the National Aeronautics and Space Administration (NASA) under Task Order 8-14-2020. This report summarizes the field activities completed and presents data collected from the July 2020 sampling event for the long-term monitoring (LTM) program established for groundwater at the Waste Oil Dump (WOD) site at the NASA Goddard Space Flight Center (GSFC) Wallops Flight Facility (WFF) located in Accomack County, Virginia (Figures 1-1 and 1-2).

### **1.1 SCOPE AND OBJECTIVE**

This report documents the July 2020 groundwater monitoring activities and presents the analytical results at the WOD as part of the LTM program. Sampling and analysis activities are conducted on a schedule of twice per five years beginning December 2018. The LTM sampling was planned for Spring 2020, however sampling was delayed four months due to facility access restrictions related to the coronavirus disease 2019 (COVID-19) pandemic. The objective of the LTM is to assess progress towards achieving the groundwater remediation goals as documented in the Record of Decision (ROD) for the WOD (Tetra Tech, 2008).

### **1.2 REPORT ORGANIZATION**

This report includes four sections. Section 1.0 provides the introduction. Section 2.0 summarizes the field activities. Section 3.0 presents the analytical results. Section 4.0 provides the conclusions and recommendations.

## **2.0 FIELD INVESTIGATION**

### **2.1 GROUNDWATER SAMPLING**

Groundwater sampling activities were conducted at the WOD site on July 20 and July 21, 2020, in accordance with the final LTM Plan – Rev 3 (Tetra Tech, 2015).

On July 20, 2020, a synoptic round of groundwater level measurements was collected from 12 monitoring wells at the WOD (See Appendix A for the Groundwater Level Measurement Sheet). Table 2-1 presents the water level measurement, surveyed elevation, and groundwater elevation for each monitoring well. Figure 2-1 presents a potentiometric surface map of the water table at the WOD based on the July 2020 groundwater level measurements.

Groundwater samples were collected from 6 monitoring wells on July 20 and July 21, 2020. Each groundwater sample was analyzed for total and dissolved arsenic.

Groundwater samples were collected following EPA Region 3 low-flow purging and sampling techniques using dedicated tubing. Samples were collected at each monitoring well after field parameters stabilized. A multi-parameter water quality meter measured field parameters during the low-flow purging activities. These parameters included: turbidity, dissolved oxygen, pH, oxidation reduction potential (ORP), specific conductivity, and temperature. Each sample analyzed for dissolved arsenic was field filtered using an in-line 0.45-micron filter. Field test kits were also used to measure the dissolved oxygen concentrations. Log sheets documenting the low-flow purging, groundwater sampling, and field test kit results are provided in Appendix B.

Quality Assurance/Quality Control (QA/QC) samples were collected during the sampling event and included a matrix spike/matrix spike duplicate (MS/MSD), field duplicate, field blank, and trip blank. Sample log sheets documenting QA/QC samples are provided in Appendix C. Chain of Custody (CoC) forms documenting the collected samples are presented in Appendix D. The samples were shipped to Eurofins Test America Savannah, Georgia, via overnight courier service.

All purge water and instrument decontamination fluids were containerized in a 55-gallon drum and transported to the NASA hazardous waste building (B-29). The purge water was properly managed and disposed by NASA.

## **2.2 DEVIATIONS FROM THE SAMPLING PLAN**

During the sampling event, monitoring well WOD-MW002S went dry during the initial set-up of low-flow purging. The following day, low-flow purging was attempted again with similar results, therefore a groundwater sample was not collected from WOD-MW002S.

## **2.3 FIELD OBSERVATIONS**

The following summarizes the field observations made during the July 2020 field investigation at the WOD.

- No free product was encountered during the groundwater sampling activities.
- There was no rainfall during the sampling period or the week leading up to the sampling event (Weather Underground, 2020).
- Turbidity measurements were less than 10 nephelometric turbidity units (NTUs) at the time of sampling for all groundwater samples.

### **3.0 GROUNDWATER ANALYTICAL RESULTS AND FINDINGS**

#### **3.1 ANALYTICAL RESULTS**

Groundwater samples were analyzed for total and dissolved arsenic. A summary of validated analytical results, groundwater quality parameters and field test kit results are presented in Table 3-1. Appendix E provides the data validation report.

Total and dissolved arsenic was detected in samples from four of six monitoring wells sampling, concentrations ranging from a concentration of 5.4 µg/L to 51µg/L (59 µg/L duplicate). Total arsenic concentrations exceeded the site cleanup goal of 10 µg/L in samples from two monitoring wells: 15-MW001 (30 µg/L) and 15-MW007 (µg/L 51; 59 µg/L duplicate). The dissolved arsenic concentrations were similar to the total arsenic concentrations from each monitoring well. Dissolved arsenic was detected above the total arsenic cleanup goal of 10 µg/L in the same two monitoring wells 15-MW001 (31 µg/L) and 15-MW007 (54 µg/L; 56 µg/L duplicate).

Figure 3-1 illustrates the spatial distribution of the July 2020 arsenic results and presents the area where the arsenic concentration exceeded the cleanup goal.

## **4.0 CONCLUSIONS AND RECOMMENDATIONS**

### **4.1 CONCLUSIONS**

The groundwater analytical results from the July 2020 sampling event indicate total arsenic exceeded the site cleanup goal in two monitoring wells, 15-MW001 and 15-MW007. Table 4-1 provides a summary of the historical groundwater analytical results from monitoring wells sampled at the WOD. Monitoring well WOD-MW002D decreased in total arsenic concentration to below the cleanup goal for the first time since the March 2015 LTM sampling event. However, the total arsenic concentration in monitoring well 15-MW007 exceeded the cleanup goal for the first time since the March 2015 LTM sampling event, when the cleanup goal was met. The previous four LTM sampling events reported total arsenic concentrations below the cleanup goal.

### **4.2 RECOMMENDATIONS**

No changes to the current LTM sampling are recommended. The sampling interval previously agreed upon between the Environmental Protection Agency, Virginia Department of Environmental Quality, and NASA Project Team includes LTM sampling twice over the next five years. The next LTM sampling event is recommended in Fall 2022.

## REFERENCES

Tetra Tech, 2018. *Data Summary Report for October 2017 Groundwater Monitoring Activities, Waste Oil Dump*, March.

TtNUS, 2008. *Record of Decision, Waste Oil Dump, NASA Wallops Flight Facility, Wallops Island, Virginia*. December.

Tetra Tech, 2015. *Long Term Monitoring Plan – Rev 3, Waste Oil Dump, NASA Wallops Flight Facility, Wallops Island, Virginia*. September.

Weather Underground, 2020. Weather History for KWAL – July 2020. Accessed September 2020.  
<https://www.wunderground.com/history/weekly/us/md/salisbury/KSBY/date/2020-7-18>

## **TABLES**



**TABLE 2-1  
GROUNDWATER MEASUREMENTS FROM JULY 20, 2020  
WASTE OIL DUMP  
NASA WALLOPS FLIGHT FACILITY**

Monitoring Well (actual)	Monitoring Well (alias)	Screened Interval (ft bgs)	Total Depth BTOC (ft)	Surveyed Elevation Top of Casing (ft)	Static Water Level Measurement BTOC (ft)	Water Level Elevations (ft MSL)
WOD-MW003R	15-MW3R	21-31	32.71	32.42	27.60	4.82
15-MW001	15-GW1	1-5	10.19	6.27	3.70	2.57
15-MW002	15-GW2	1-5	9.02	9.21	5.64	3.57
15-MW003	15-GW3	1-5	10.20	8.70	5.00	3.70
15-MW007	15-GW7	15-30	32.96	30.58	25.69	4.89
WOD-MW001	16-GW1	17-22	26.22	30.39	25.60	4.79
WOD-MW002D	16-GW2D	23-28	32.07	21.35	17.18	4.17
WOD-MW002S	16-GW2S	9-19	23.01	21.19	16.88	4.31
WOD-MW003	16-GW3	7-12	10.82	16.18	11.22*	DRY
WOD-MW004-2	16-GW4	6-11	10.81	14.94	10.13*	DRY
WOD-MW006	16-GW6	4-9	11.05	9.66	7.90	1.76
WOD-MW008	16-GW8	18-28	30.61	13.35	9.41	3.94

**Notes:**

ft - feet

MSL - Mean Sea Level

BTOC - Below Top of Casing

bgs - below ground surface

\* - No water in well

**TABLE 3-1  
JULY 2020 GROUNDWATER MONITORING WELL ANALYTICAL RESULTS  
WASTE OIL DUMP  
NASA WALLOPS FLIGHT FACILITY**

LOCATION SAMPLE DATE	Cleanup Goal	15-MW001 20200721	15-MW002 20200721	15-MW007 20200720	15-MW007 20200720 Duplicate	WOD-MW002D 20200720	WOD-MW003R 20200721	WOD-MW008 20200720
<b>Metals (µg/L)</b>								
Total Arsenic	10	<b>30</b>	5.4	<b>51</b>	<b>59</b>	6.2	3.00 U	3.00 U
Dissolved Arsenic	NC	34	5.4	54	56	7.2	3.00 U	3.00 U
<b>Field Parameters</b>								
pH (S.U.)	NC	6.3	6.33	6.34	--	5.86	5.95	6.22
S. Conductivity (mS/cm)	NC	0.156	0.092	0.266	--	0.11	0.089	0.087
Dissolved Oxygen (mg/L) - Horiba	NC	0.00	19.26	0.00	--	0.80	8.27	8.62
Dissolved Oxygen (mg/L) - Test Kit	NC	0.00	9.0	0	--	4.0	7.0	6.0
Temperature (°C)	NC	16.56	19.55	21.67	--	17.92	19.22	18.64
Oxygen Reduction Potential (mV)	NC	-14	6	-79	--	36	258	319
Turbidity (NTU)	NC	1.36	5.12	2.04	--	2.90	0.00	0.00

**Notes:**

NC - No Criteria

-- - Not Analyzed

µg/L - micrograms per liter water

J - Estimated Value

U - Analyte was not detected in the sample at a level greater than the instrument detection

S.U. - Standard Units

mS/cm - millisiemens per centimeter

mg/L - milligrams per liter

°C - degrees Celsius

mV - millivolts

NTU - Nephelometric Turbidity Units

**Bolded and shaded cells indicate exceedances of the Cleanup Goal**

TABLE 4-1  
HISTORICAL GROUNDWATER ANALYTICAL RESULTS  
WASTE OIL DUMP  
NASA WALLOPS FLIGHT FACILITY  
WALLOPS ISLAND, VIRGINIA  
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LOCATION SAMPLE DATE	Cleanup Goal	15-MW001 19970425	15-MW001 19980318	15-MW001 19980318 DUPLICATE	15-MW001 20030312	15-MW001 20081205	15-MW001 20081205	15-MW001 20100316	15-MW001 20100607	15-MW001 20100914	15-MW001 20101206	15-MW001 20110322	15-MW001 20110913	15-MW001 20120312	15-MW001 20120917	15-MW001 20130319
<b>VOCs (ug/L)</b>																
Benzene	5	10 U	2 J	10 U	1 U	1 U	1 U	0.3 U	0.3 U	0.3 J	0.8 J	0.3 U	1.08	0.5 U	0.2 U	0.11 U
<b>Metals (ug/L)</b>																
Total Arsenic	10	1.8 U	1.6 U	2	3 U	3.3	3.3	6.6	6.5 B	7.4 B	8.2	<b>10.9 J</b>	<b>13</b>	<b>11.7</b>	<b>12</b>	<b>11</b>
Dissolved Arsenic	NC	1.8 U	--	--	3 U	--	--	5.9	7.1 B	8.2 B	8.4	9.5 J	10.8	11.8	10	11
<b>Field Parameters</b>																
pH (S.U.)	NC	--	--	--	--	4.66	4.66	6.39	5.32	6.17	5.65	6.06	5.82	6.13	6.10	5.99
S. Conductivity (mS/cm)	NC	--	--	--	--	0.191	0.191	0.200	0.074	0.254	0.200	0.290	0.218	0.192	0.199	0.160
Dissolved Oxygen (mg/L) - Horiba	NC	--	--	--	--	0.32	0.32	0.00	0.13	1.70	0.00	4.81	5.90	0.00	0.60	0.59
Dissolved Oxygen (mg/L) - Test Kit	NC	--	--	--	--	--	--	--	--	--	--	--	4.0	0.0	0.0	1.0
Temperature (°C)	NC	--	--	--	--	14.56	14.56	11.61	16.72	17.64	14.26	12.27	17.46	13.89	18.13	11.20
Oxygen Reduction Potential (mV)	NC	--	--	--	--	41	41	-45	-8	-55	-117	-57	-252.9	-16	2	-32
Turbidity (NTU)	NC	--	--	--	--	0.79	0.79	3.42	56.8	2.01	0.83	1.32	1.24	0.00	0.00	2.10

LOCATION SAMPLE DATE	Cleanup Goal	15-MW001 20130903	15-MW001 20140319	15-MW001 20140922	15-MW001 20150316	15-MW001 20150923	15-MW001 20160412	15-MW001 20160926	15-MW001 20171017	15-MW001 20200721
<b>VOCs (ug/L)</b>										
Benzene	5	0.25 U	0.25 U	--	--	--	--	--	--	--
<b>Metals (ug/L)</b>										
Total Arsenic	10	<b>13</b>	<b>11</b>	8 J	<b>12</b>	<b>15</b>	<b>18</b>	<b>20</b>	<b>21</b>	<b>30</b>
Dissolved Arsenic	NC	11	10	9.8	11	14	17	19	21	31
<b>Field Parameters</b>										
pH (S.U.)	NC	5.55	5.79	5.68	6.23	6.42	5.75	6.28	6.39	6.3
S. Conductivity (mS/cm)	NC	0.122	0.135	0.189	0.177	0.113	0.106	0.149	0.185	0.156
Dissolved Oxygen (mg/L) - Horiba	NC	0.00	0.00	0.68	2.46	0.90	0.00	0.00	0.00	0.00
Dissolved Oxygen (mg/L) - Test Kit	NC	0.1	0.4	0.0	0.2	1.0	0.05	0.00	0.00	0.00
Temperature (°C)	NC	20.58	10.86	17.03	10.76	18.54	15.3	17.44	16.38	16.56
Oxygen Reduction Potential (mV)	NC	175	4	-60	4	-15	30	-4	-17	-14
Turbidity (NTU)	NC	2.30	1.06	2.31	2.14	2.45	3.34	0.59	0.00	1.36

LOCATION SAMPLE DATE	Cleanup Goal	15-MW002 19970424	15-MW002 19980318	15-MW002 20030312	15-MW002 20081205	15-MW002 20081205	15-MW002 20100316	15-MW002 20100608	15-MW002 20100914	15-MW002 20101206	15-MW002 20110322	15-MW002 20110912	15-MW002 20120312	15-MW002 20120917	15-MW002 20130319	15-MW002 20130903
<b>VOCs (ug/L)</b>																
Benzene	5	--	--	1 U	1 U	1 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.5 U	0.5 U	0.2 U	0.11 U	0.25 U
<b>Metals (ug/L)</b>																
Total Arsenic	10	5	3.5	4.4 B	4.8 B	4.8 B	3.2 J	9.3 B	7.3 B	4.4 J	3.2 J	4.87 J	3 J	5	1.9	5.1 J
Dissolved Arsenic	NC	2.5	--	3.4 U	4.1 B	4.1 B	3.4 J	5.9 B	7.1 B	3.9 J	2.6 J	4.35 J	4 UL	6.6	1.7	4.8 J
<b>Field Parameters</b>																
pH (S.U.)	NC	--	--	--	5.49	5.49	4.65	6.1	5.34	5.16	5.63	5.23	5.59	5.3	4.53	5
S. Conductivity (mS/cm)	NC	--	--	--	0.000	0.000	0.086	0.199	0.114	0.074	0.101	0.107	0.134	0.118	0.125	0.093
Dissolved Oxygen (mg/L) - Horiba	NC	--	--	--	9.01	9.01	0.00	0.00	2.98	0.00	5.51	1.88	0.00	0.63	0.12	0.00
Dissolved Oxygen (mg/L) - Test Kit	NC	--	--	--	--	--	--	--	--	--	--	1.0	0.0	1.0	0.2	0.1
Temperature (°C)	NC	--	--	--	12.61	12.61	9.71	15.64	19.55	13.48	10.89	19.86	11.95	23.07	10.80	20.41
Oxygen Reduction Potential (mV)	NC	--	--	--	52	52	-56	-31	14	-73	-13	68.3	43	9	64	260
Turbidity (NTU)	NC	--	--	--	16.00	16.00	36.8	1.32	3.01	17.6	21.1	8.59	27.2	9.40	81.7	3.72

LOCATION SAMPLE DATE	Cleanup Goal	15-MW002 20140319	15-MW002 20140922	15-MW002 20150316	15-MW002 20150923	15-MW002 20160412	15-MW002 20160926	15-MW002 20171017	15-MW002 20200721
<b>VOCs (ug/L)</b>									
Benzene	5	0.25 U	--	--	--	--	--	--	--
<b>Metals (ug/L)</b>									
Total Arsenic	10	2.8 J	3.2 J	1.6	4.3 J	5 U	4.8 J	5.5	5.4
Dissolved Arsenic	NC	2.5 U	4	3.1	4 J	2.9 U	7	4.4 J	5.4
<b>Field Parameters</b>									
pH (standard units)	NC	5.55	5.78	5.85	5.95	5.63	5.83	6.21	6.33
S. Conductivity (millisiemens per centimeter)	NC	0.085	0.107	0.122	0.067	0.119	0.059	0.15	0.092
Dissolved Oxygen (mg/L) - Horiba	NC	0.00	2.16	3.20	0.94	0.00	0.00	0.00	19.26
Dissolved Oxygen (mg/L) - Test Kit	NC	0.6	2.0	1.0	1.0	1.0	1.0	0.1	9.0
Temperature (degrees Celsius)	NC	8.31	18.39	8.86	19.66	13.51	20.77	17.67	19.55
Oxygen Reduction Potential (millivolts)	NC	19	-7	11	58	-9	44	-11	6
Turbidity (nephelometric turbidity units)	NC	52.9	14.80	100.5	9.03	7.31	9.02	0.00	5.12

**Notes:**  
NC - no criteria  
-- - not analyzed  
µg/L - micrograms per liter water  
J - Estimated Value  
L - Biased Low  
U - Analyte was not detected in the sample at a level greater than the instrument detection  
R - Surrogate Recovery Noncompliance  
mg/L - milligrams per liter  
**Bolded and shaded cells indicate exceedances of the Cleanup Goal**

TABLE 4-1  
HISTORICAL GROUNDWATER ANALYTICAL RESULTS  
WASTE OIL DUMP  
NASA WOLLOPS FLIGHT FACILITY  
WALLOPS ISLAND, VIRGINIA  
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LOCATION SAMPLE DATE	Cleanup Goal	15-MW007 19930314	15-MW007 19970425	15-MW007 19980318	15-MW007 20000218	15-MW007 20030314	15-MW007 20081208	15-MW007 20090114	15-MW007 20100316	15-MW007 20100608	15-MW007 20100608 duplicate
<b>VOCs (ug/L)</b>											
Benzene	5	--	42	23 K	58	11	32	2	0.3 U	0.3 U	0.3 J
<b>Metals (ug/L)</b>											
Total Arsenic	10	15.6	68.8	88.2	60.4	15.6 B	27	9.7	3.9 J	15.5 J	27.7 J
Dissolved Arsenic	NC	15.1				15.1 B	--	--	4.6 J	22.4 J	22.4 J
<b>Field Parameters</b>											
pH (S.U.)	NC	--	--	--	--	--	5.37	4.18	5.54	6.06	--
S. Conductivity (mS/cm)	NC	--	--	--	--	--	0.173	0.100	0.087	0.111	--
Dissolved Oxygen (mg/L) - Horiba	NC	--	--	--	--	--	0.73	4.12	0.00	2.35	--
Dissolved Oxygen (mg/L) - Test Kit	NC	--	--	--	--	--	--	--	--	--	--
Temperature (°C)	NC	--	--	--	--	--	16.38	15.70	11.90	17.36	--
Oxygen Reduction Potential (mV)	NC	--	--	--	--	--	-192	58	-35	-132	--
Turbidity (NTU)	NC	--	--	--	--	--	9.15	4.46	7.50	5.76	--
LOCATION SAMPLE DATE	Cleanup Goal	15-MW007 20100915	15-MW007 20101206	15-MW007 20101206 duplicate	15-MW007 20110321	15-MW007 20110321 duplicate	15-MW007 20110912	15-MW007 20110912 duplicate	15-MW007 20120312	15-MW007 20120312 duplicate	15-MW007 20120917
<b>VOCs (ug/L)</b>											
Benzene	5	33	2	1	4	5	11.1	14.2	12	11	2.4 J
<b>Metals (ug/L)</b>											
Total Arsenic	10	54.4	24.5	23.8	58 J	39.9 J	46.6	45.9	46.8	57.4	19
Dissolved Arsenic	NC	39.7	28.5	26.8	48.5 J	34.6 J	45.6	47.1	60.5	60.4	18
<b>Field Parameters</b>											
pH (S.U.)	NC	6.08	5.31	--	6.37	--	5.42	--	6.00	--	6.02
S. Conductivity (mS/cm)	NC	0.446	0.142	--	0.137	--	0.212	--	0.288	--	0.163
Dissolved Oxygen (mg/L) - Horiba	NC	1.62	0.59	--	--	--	2.24	--	0.00	--	0.72
Dissolved Oxygen (mg/L) - Test Kit	NC	--	--	--	--	--	0.0	--	1.0	--	1.0
Temperature (°C)	NC	18.60	15.40	--	16.60	--	19.08	--	16.85	--	20.24
Oxygen Reduction Potential (mV)	NC	-118	-132	--	-87	--	-237.6	--	-110	--	-7.6
Turbidity (NTU)	NC	3.19	2.75	--	1.71	--	2.20	--	1.87	--	3.85
LOCATION SAMPLE DATE	Cleanup Goal	15-MW007 20120917 duplicate	15-MW007 20130318	15-MW007 20130318 duplicate	15-MW007 20130903	15-MW007 20130903 duplicate	15-MW007 20140319	15-MW007 20140319 duplicate	15-MW007 20140922	15-MW007 20140922 duplicate	15-MW007 20150316
<b>VOCs (ug/L)</b>											
Benzene	5	2.1 J	0.11 U	0.11 U	0.51 J	0.54 J	0.5 J	0.46 J	--	--	--
<b>Metals (ug/L)</b>											
Total Arsenic	10	16	0.29 U	0.51 J	3.3 J	2.8 J	4.1 J	4 J	3.3 J	4.3 J	10
Dissolved Arsenic	NC	22	1.9	0.29 U	3.2 J	2.9 J	3.3 U	3.4 U	1.7	2.9	9.1
<b>Field Parameters</b>											
pH (S.U.)	NC	--	4.61	--	4.95	--	5.12	--	5.15	--	5.55
S. Conductivity (mS/cm)	NC	--	0.096	--	0.074	--	0.094	--	0.138	--	0.168
Dissolved Oxygen (mg/L) - Horiba	NC	--	0.55	--	5.09	--	0.00	--	0.97	--	1.82
Dissolved Oxygen (mg/L) - Test Kit	NC	--	0.4	--	4.0	--	0.3	--	0.8	--	2.0
Temperature (°C)	NC	--	12.67	--	21.71	--	15.12	--	17.90	--	15.24
Oxygen Reduction Potential (mV)	NC	--	101	--	-122	--	-5	--	6	--	-42
Turbidity (NTU)	NC	--	23.8	--	3.02	--	4.31	--	1.49	--	7.44
LOCATION SAMPLE DATE	Cleanup Goal	15-MW007 20150316 duplicate	15-MW007 20150923	15-MW007 20150923 duplicate	15-MW007 20160412	15-MW007 20160412 duplicate	15-MW007 20160926	15-MW007 20160926 duplicate	15-MW007 20160926	15-MW007 20160926 duplicate	15-MW007 20200720
<b>VOCs (ug/L)</b>											
Benzene	5	--	--	--	--	--	--	--	--	--	--
<b>Metals (ug/L)</b>											
Total Arsenic	10	10	5.4	6.1	3.4 U	6.4	3.4 J	3 J	6.4	5.6	51 Duplicate 59
Dissolved Arsenic	NC	9.1	5 J	5.4	3.9 U	4.3 U	3.6 J	6.2	4.4 J	4.9 J	54 56
<b>Field Parameters</b>											
pH (standard units)	NC	--	5.63	--	4.67	--	5.17	--	5.46	--	6.34 --
S. Conductivity (millisiemens per centimeter)	NC	--	0.097	--	0.073	--	0.081	--	0.125	--	0.266 --
Dissolved Oxygen (mg/L) - Horiba	NC	--	0.00	--	0.00	--	0.00	--	0.00	--	0.00 --
Dissolved Oxygen (mg/L) - Test Kit	NC	--	0.3	--	0.0	--	0.0	--	0.1	--	0.0 --
Temperature (degrees Celsius)	NC	--	20.95	--	15.79	--	21.51	--	17.49	--	21.67 --
Oxygen Reduction Potential (millivolts)	NC	--	73	--	89	--	-37	--	35	--	-79 --
Turbidity (nephelometric turbidity units)	NC	--	1.53	--	13.4	--	5.49	--	0.00	--	2.04 --

Notes:  
NC - no criteria  
-- - not analyzed  
µg/L - micrograms per liter water  
J - Estimated Value  
L - Biased Low  
U - Analyte was not detected in the sample at a level greater than the instrument detection  
R - Surrogate Recovery Noncompliance  
mg/L - milligrams per liter  
**Bolded and shaded cells indicate exceedances of the Cleanup Goal**

TABLE 4-1  
HISTORICAL GROUNDWATER ANALYTICAL RESULTS  
WASTE OIL DUMP  
NASA WALLOPS FLIGHT FACILITY  
WALLOPS ISLAND, VIRGINIA  
PAGE 3 OF 4

LOCATION SAMPLE DATE	Cleanup Goal	WOD-MW002S 19980528	WOD-MW002S 20000218	WOD-MW002S 20030312	WOD-MW002S 20081205	WOD-MW002S 20100316	WOD-MW002S 20100607	WOD-MW002S 20100915	WOD-MW002S 20101207	WOD-MW002S 20110321	WOD-MW002S 20110913	WOD-MW002S 20120312	WOD-MW002S 20120917	WOD-MW002S 20130318	WOD-MW002S 20130903	WOD-MW002S 20140319
<b>VOCs (ug/L)</b>																
Benzene	5	10 U	10 U	1 U	5	0.3 U	0.4 J	1	1 J	0.3 U	0.5 U	0.5 U	0.17 J	0.11 U	0.25 U	0.25 U
<b>Metals (ug/L)</b>																
Total Arsenic	10	<b>11</b>	<b>18.2</b>	<b>12.5 B</b>	<b>18.4</b>	4.2 J	<b>15.3 B</b>	<b>26.9</b>	<b>18.2</b>	4 J	5.72	4 UL	5.3	0.29 U	5.4 J	1.7 J
Dissolved Arsenic	NC	--	--	9.5 B	16	1.5 U	19.2 J	23.1	16	6.7 J	3 U	4 UL	11	2	4.4 J	1.3 U
<b>Field Parameters</b>																
pH (S.U.)	NC	--	--	--	6.44	6.43	5.77	6.65	6.40	6.02	3.12	6.56	6.45	6.73	6.35	6.45
S. Conductivity (mS/cm)	NC	--	--	--	0.233	0.195	0.380	0.320	0.225	0.240	0.268	0.278	0.242	0.313	0.141	0.244
Dissolved Oxygen (mg/L) - Horiba	NC	--	--	--	5.73	0.00	10.02	3.73	0.00	--	1.91	1.45	2.86	3.15	1.91	2.44
Dissolved Oxygen (mg/L) - Test Kit	NC	--	--	--	--	--	--	--	--	--	4.0	1.0	1.5	1.0	2.0	3.0
Temperature (°C)	NC	--	--	--	13.95	11.57	17.01	20.65	13.14	14.50	20.06	15.89	21.06	10.52	19.20	11.62
Oxygen Reduction Potential (mV)	NC	--	--	--	-14	-15	-72	-101	-88	-15	697	9	-4	9	-26	28
Turbidity (NTU)	NC	--	--	--	19.0	10.50	24.1	1.35	78.2	32.5	41.1	37.1	6.39	4.03	19.2	17.76

LOCATION SAMPLE DATE	Cleanup Goal	WOD-MW002S 20140922	WOD-MW002S 20150316	WOD-MW002S 20150923	WOD-MW002S 20160412	WOD-MW002S 20160926	WOD-MW002S 20171017
<b>VOCs (ug/L)</b>							
Benzene	5	--	--	--	--	--	--
<b>Metals (ug/L)</b>							
Total Arsenic	10	2.8 J	3.8	7.3	3.8 U	2.9 J	2.3 U
Dissolved Arsenic	NC	6.6	2.3	5.5	2.3 U	2.3 U	2.3 U
<b>Field Parameters</b>							
pH (S.U.)	NC	6.06	6.76	6.85	6.55	6.61	6.81
S. Conductivity (mS/cm)	NC	0.151	0.286	0.155	0.217	0.224	0.247
Dissolved Oxygen (mg/L) - Horiba	NC	1.67	3.13	0.44	2.00	0.00	1.78
Dissolved Oxygen (mg/L) - Test Kit	NC	--	--	1.0	2.0	--	1.5
Temperature (°C)	NC	17.62	13.72	20.17	20.46	21.7	17.1
Oxygen Reduction Potential (mV)	NC	-27	-12	57	33	-3	-9
Turbidity (NTU)	NC	11.70	47.2	9.61	9.87	--	0.00

LOCATION SAMPLE DATE	Cleanup Goal	WOD-MW002D 19980528	WOD-MW002D 19980528 DUPLICATE	WOD-MW002D 20000218	WOD-MW002D 20030312	WOD-MW002D 20081205	WOD-MW002D 20100316	WOD-MW002D 20100316 duplicate	WOD-MW002D 20100607	WOD-MW002D 20100914	WOD-MW002D 20101207	WOD-MW002D 20110321	WOD-MW002D 20110913	WOD-MW002D 20120312	WOD-MW002D 20120917	WOD-MW002D 20130318
<b>VOCs (ug/L)</b>																
Benzene	5	<b>22</b>	<b>23</b>	<b>25</b>	<b>8</b>	3	<b>8</b>	<b>8</b>	1 J	0.6 J	0.3 U	3	2.57	2.2	1.9	4.5
<b>Metals (ug/L)</b>																
Total Arsenic	10	<b>27.5</b>	<b>29.2</b>	<b>30.2</b>	<b>21.4</b>	<b>12.3</b>	<b>10.9</b>	<b>10.5</b>	8.4 B	<b>10.6</b>	9.6	8.7 J	<b>11.2</b>	<b>11</b>	<b>14</b>	<b>13</b>
Dissolved Arsenic	NC	--	--	--	19.5	--	10.5	11.4	6.8 B	10	9.1	7.6 J	9.03	9.6 L	9.8	9
<b>Field Parameters</b>																
pH (S.U.)	NC	--	--	--	--	6.17	7	--	5.71	7.22	6.19	6.02	4.66	6.22	6.17	6.25
S. Conductivity (mS/cm)	NC	--	--	--	--	0.168	0.327	--	62.500	0.126	0.118	0.117	0.154	0.167	0.186	0.237
Dissolved Oxygen (mg/L) - Horiba	NC	--	--	--	--	1.84	3.96	--	4.40	15.58	2.63	--	1.17	0.00	0.58	0.01
Dissolved Oxygen (mg/L) - Test Kit	NC	--	--	--	--	--	--	--	--	--	--	--	0.15	0.0	0.5	0.1
Temperature (°C)	NC	--	--	--	--	15.16	11.15	--	17.15	18.40	16.10	15.20	18.12	17.22	19.00	11.66
Oxygen Reduction Potential (mV)	NC	--	--	--	--	-19	17	--	-72	-65	16	-44	113.2	-39	-10	-34
Turbidity (NTU)	NC	--	--	--	--	0.70	4.09	--	0.71	0.62	0.54	1.32	0.41	0.21	8.04	17.30

LOCATION SAMPLE DATE	Cleanup Goal	WOD-MW002D 20130903	WOD-MW002D 20140319	WOD-MW002D 20140922	WOD-MW002D 20150316	WOD-MW002D 20150923	WOD-MW002D 20160411	WOD-MW002D 20160926	WOD-MW002D 20171017	WOD-MW002D 20200720
<b>VOCs (ug/L)</b>										
Benzene	5	2 J	1.2 J	--	--	--	--	--	--	--
<b>Metals (ug/L)</b>										
Total Arsenic	10	<b>16</b>	<b>11</b>	9 J	9.1	<b>11</b>	<b>16</b>	<b>14</b>	<b>11</b>	6.2
Dissolved Arsenic	NC	15	8.8 J	8.7	9.5	11	15	14	9.4	7.2
<b>Field Parameters</b>										
pH (standard units)	NC	6.05	6.23	5.78	6.23	6.42	6.33	6.36	6.25	5.86
S. Conductivity (millisiemens per centimeter)	NC	0.115	0.159	0.176	0.145	0.105	0.137	0.125	0.134	0.11
Dissolved Oxygen (mg/L) - Horiba	NC	0.20	0.00	1.09	1.19	0.00	0.00	0.00	0.00	0.80
Dissolved Oxygen (mg/L) - Test Kit	NC	< 1	0.6	3.0	0.3	0.3	0	0.1	0.1	4.0
Temperature (degrees Celsius)	NC	21.68	13.05	17.43	14.17	17.29	15.81	19.98	15.07	17.92
Oxygen Reduction Potential (millivolts)	NC	-83	-33	-10	-7	22	-12	-38	-7	36
Turbidity (nephelometric turbidity units)	NC	7.58	24.6	1.11	5.83	0.53	2.14	0.14	0.00	2.90

**Notes:**  
NC - no criteria  
-- - not analyzed  
µg/L - micrograms per liter water  
J - Estimated Value  
L - Biased Low  
U - Analyte was not detected in the sample at a level greater than the instrument detection  
R - Surrogate Recovery Noncompliance  
mg/L - milligrams per liter  
**Bolded and shaded cells indicate exceedances of the Cleanup Goal**



TABLE 4-1  
HISTORICAL GROUNDWATER ANALYTICAL RESULTS  
WASTE OIL DUMP  
NASA WALLOPS FLIGHT FACILITY  
WALLOPS ISLAND, VIRGINIA  
PAGE 4 OF 4

LOCATION SAMPLE DATE	Cleanup Goal	WOD-MW003A 19970425	WOD-MW003A 19980319	WOD-MW003R 20030312	WOD-MW003R 20090114	WOD-MW003R 20100315	WOD-MW003R 20100608	WOD-MW003R 20100915	WOD-MW003R 20101207	WOD-MW003R 20110322	WOD-MW003R 20110913	WOD-MW003R 20120312	WOD-MW003R 20120917	WOD-MW003R 20130318	WOD-MW003R 20130903	WOD-MW003R 20140319
<b>VOCs (ug/L)</b>																
Benzene	5	--	--	1 U	1 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.5 U	0.5 U	0.2 U	0.11 U	0.25 U	0.25 U
<b>Metals (ug/L)</b>																
Total Arsenic	10	5.1	1.6 U	3 U	1.45	1.5 U	2.2 B	1.6 B	0.8 U	2.25 UJ	1.5 U	4 UL	0.5 U	1.2	1.2 U	1.2 U
Dissolved Arsenic	NC	--	--	3 U	--	1.5 U	3.1 B	0.8 U	0.8 U	2.25 UJ	1.5 U	4 UL	0.5 U	0.75 J	1.2 U	1.2 U
<b>Field Parameters</b>																
pH (S.U.)	NC	--	--	--	5.65	6.69	6.38	5.14	5.91	6.13	4.40	6.34	5.98	6.26	6.01	5.80
S. Conductivity (mS/cm)	NC	--	--	--	0.170	0.132	0.100	0.131	0.127	0.090	0.107	0.116	0.107	0.119	0.056	0.061
Dissolved Oxygen (mg/L) - Horiba	NC	--	--	--	8.56	11.9	10.02	19.99	11.01	--	9.18	6.52	5.42	7.74	5.61	5.99
Dissolved Oxygen (mg/L) - Test Kit	NC	--	--	--	--	--	--	--	--	--	9.0	6.0	5.0	10.0	6.0	6.0
Temperature (°C)	NC	--	--	--	15.30	13.44	16.09	19.40	14.66	15.40	18.36	18.60	19.21	13.09	22.49	14.60
Oxygen Reduction Potential (mV)	NC	--	--	--	75	239	370	49	156	159	615.5	147	158	354	173	208
Turbidity (NTU)	NC	--	--	--	1.18	0.33	5.30	5.99	2.42	4.28	7.42	6.53	7.32	0.60	7.14	0.17

LOCATION SAMPLE DATE	Cleanup Goal	WOD-MW003R 20140922	WOD-MW003R 20150316	WOD-MW003R 20150923	WOD-MW003R 20160412	WOD-MW003R 20160926	WOD-MW003R 20171017	WOD-MW003R 20200721
<b>VOCs (ug/L)</b>								
Benzene	5	--	--	--	--	--	--	--
<b>Metals (ug/L)</b>								
Total Arsenic	10	0.29 UJ	0.29 U	2.3 U	2.3 U	2.3 U	2.3 U	3 U
Dissolved Arsenic	NC	0.29 U	0.34 J	2.3 U	4.2 U	2.3 U	2.3 U	3 U
<b>Field Parameters</b>								
pH (S.U.)	NC	6.02	6.15	6.25	5.71	5.88	6.38	5.95
S. Conductivity (mS/cm)	NC	0.067	0.073	0.044	0.075	0.049	0.106	0.089
Dissolved Oxygen (mg/L) - Horiba	NC	5.85	7.23	8.00	3.00	4.64	6.99	8.27
Dissolved Oxygen (mg/L) - Test Kit	NC	5.0	3.0	8.0	3.0	3.0	6.0	7.0
Temperature (°C)	NC	18.20	13.82	18.20	15.56	21.76	17.28	19.22
Oxygen Reduction Potential (mV)	NC	200	240	184	159	188	145	258
Turbidity (NTU)	NC	5.26	0.93	1.80	1.44	4.30	0.00	0.00

LOCATION SAMPLE DATE	Cleanup Goal	WOD-MW008 20081210	WOD-MW008 20100315	WOD-MW008 20100607	WOD-MW008 20100914	WOD-MW008 20101206	WOD-MW008 20110321	WOD-MW008 20110913	WOD-MW008 20120312	WOD-MW008 20120917	WOD-MW008 20130318	WOD-MW008 20130903	WOD-MW008 20140319	WOD-MW008 20140922	WOD-MW008 20150316	WOD-MW008 20150923
<b>VOCs (ug/L)</b>																
Benzene	5	1 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.5 U	0.5 U	0.2 U	0.11 U	0.25 U	0.25 U	--	--	--
<b>Metals (ug/L)</b>																
Total Arsenic	10	6.3	1.5 U	4.9 B	1 B	0.8 U	2.25 UJ	1.5 U	4 UL	0.5 U	0.29 U	1.2 U	1.2 U	0.29 UJ	0.34 J	2.3 U
Dissolved Arsenic	NC	--	1.5 U	4.7 B	2.7 B	0.8 U	2.25 UJ	1.5 U	4 UL	0.5 U	0.29 U	1.2 U	1.2 U	1.7	0.29 U	2.3 U
<b>Field Parameters</b>																
pH (S.U.)	NC	5.77	6.29	5.7	4.35	6.09	5.61	3.26	6	5.74	5.34	4.91	5.44	5.27	5.84	6.06
S. Conductivity (mS/cm)	NC	0.120	0.098	0.090	0.094	0.104	0.096	0.081	0.085	0.102	0.097	0.060	0.098	0.102	0.109	0.069
Dissolved Oxygen (mg/L) - Horiba	NC	1.98	3.75	6.23	18.82	9.89	10.67	13.78	11.94	6.66	7.69	6.65	5.43	6.04	6.10	7.47
Dissolved Oxygen (mg/L) - Test Kit	NC	--	--	--	--	--	--	> 12	10.0	6.0	2.0	7.0	5.0	6.0	3.0	5.0
Temperature (°C)	NC	15.17	11.87	15.01	18.80	16.71	15.04	18.00	14.78	18.48	10.98	22.71	13.22	15.70	12.93	17.56
Oxygen Reduction Potential (mV)	NC	84	132	358	138	294	262	-170.2	267	253	231	366	222	205	172	234
Turbidity (NTU)	NC	7.10	1.56	2.01	0.79	1.20	0.00	0.62	0.00	8.31	0.15	1.70	2.98	0.48	0.26	1.54

LOCATION SAMPLE DATE	Cleanup Goal	WOD-MW008 20160411	WOD-MW008 20160926	WOD-MW008 20171017	WOD-MW008 20200720
<b>VOCs (ug/L)</b>					
Benzene	5	--	--	--	--
<b>Metals (ug/L)</b>					
Total Arsenic	10	2.3 U	2.3 U	2.3 U	3 U
Dissolved Arsenic	NC	2.3 U	2.3 U	2.3 U	3 U
<b>Field Parameters</b>					
pH (standard units)	NC	6.35	5.94	6.11	6.22
S. Conductivity (millisiemens per centimeter)	NC	0.080	0.091	0.1	0.087
Dissolved Oxygen (mg/L) - Horiba	NC	2.40	0.90	6.61	8.62
Dissolved Oxygen (mg/L) - Test Kit	NC	1.0	2.0	6.0	6.0
Temperature (degrees Celsius)	NC	15.10	17.51	15.82	18.64
Oxygen Reduction Potential (millivolts)	NC	83	305	216	319
Turbidity (nephelometric turbidity units)	NC	0.29	0.33	0.00	0.00

**Notes:**  
NC - no criteria  
-- - not analyzed  
µg/L - micrograms per liter water  
J - Estimated Value  
L - Biased Low  
U - Analyte was not detected in the sample at a level greater than the instrument detection  
R - Surrogate Recovery Noncompliance  
mg/L - milligrams per liter  
**Bolded and shaded cells indicate exceedances of the Cleanup Goal**

## FIGURES





**Figure 1-1: Facility Location Map - WFF Main Base, Mainland, Wallops Island**





Waste Oil Dump

Former Fire Training Area

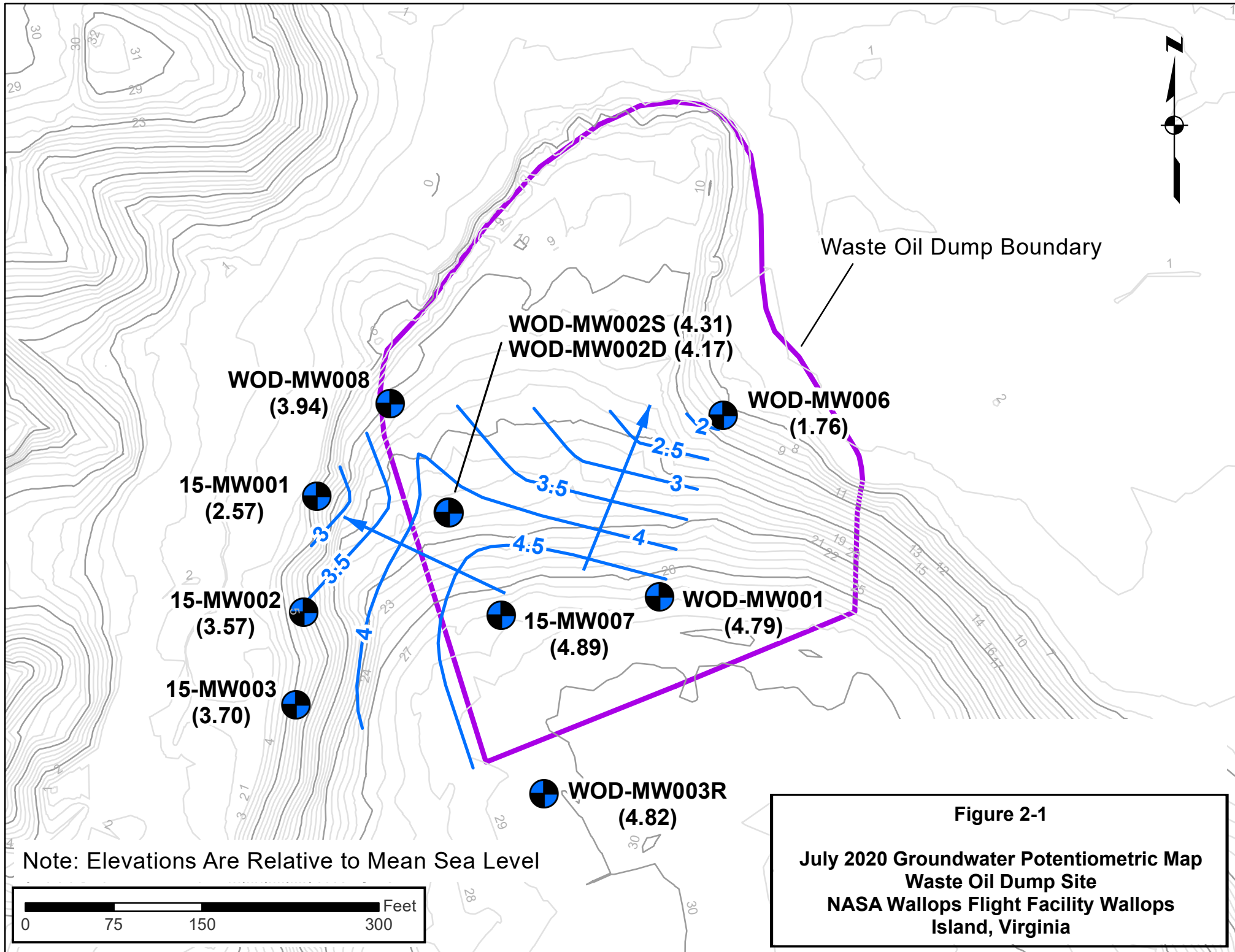
NSA WILLIAMS DR 55



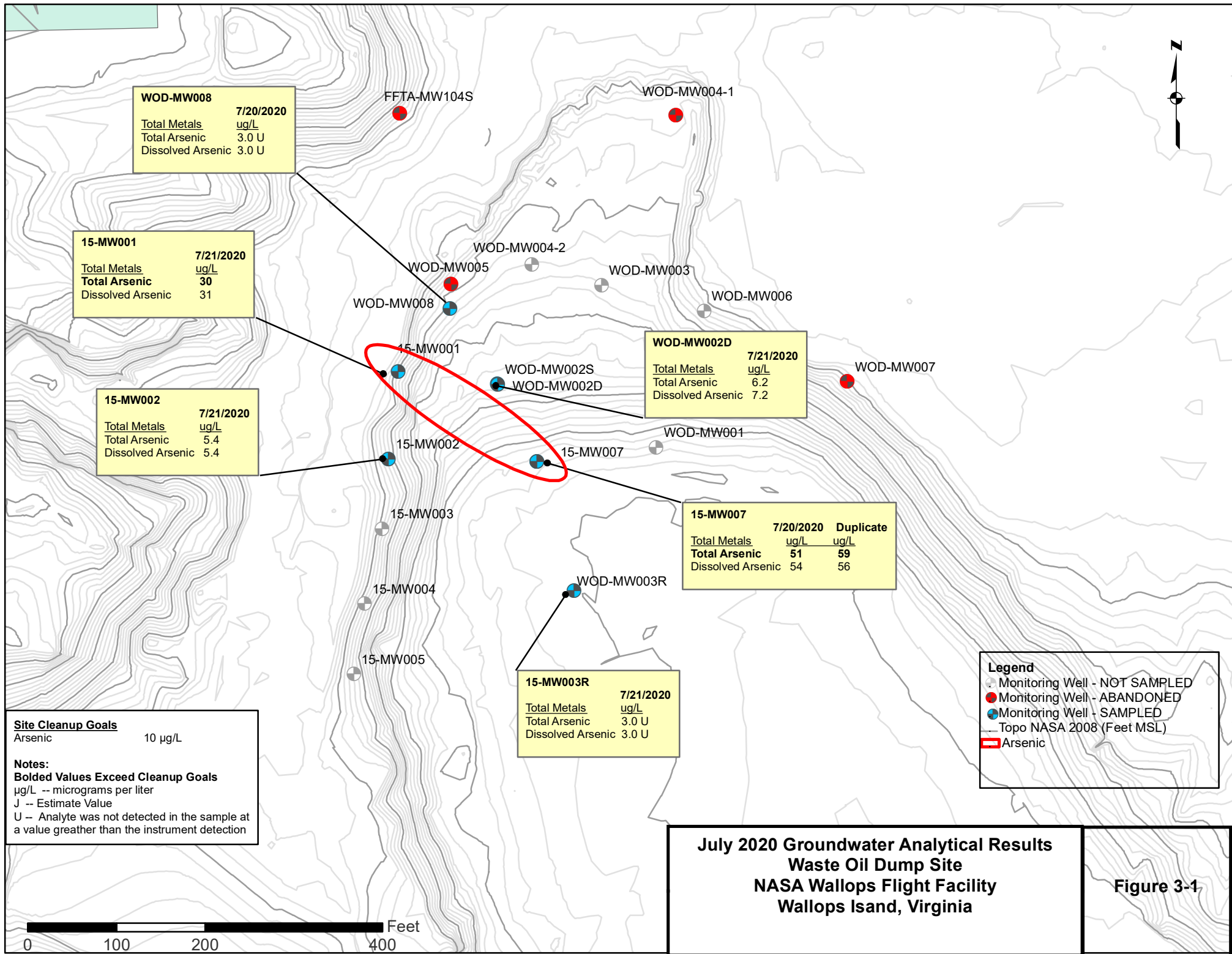
**Figure 1-2 Site Location Map**

0 500 1,000 2,000 Feet





**Figure 2-1**  
**July 2020 Groundwater Potentiometric Map**  
**Waste Oil Dump Site**  
**NASA Wallops Flight Facility Wallops**  
**Island, Virginia**



**WOD-MW008** 7/20/2020  
 Total Metals ug/L  
 Total Arsenic 3.0 U  
 Dissolved Arsenic 3.0 U

**15-MW001** 7/21/2020  
 Total Metals ug/L  
**Total Arsenic 30**  
 Dissolved Arsenic 31

**15-MW002** 7/21/2020  
 Total Metals ug/L  
**Total Arsenic 5.4**  
 Dissolved Arsenic 5.4

**WOD-MW002D** 7/21/2020  
 Total Metals ug/L  
**Total Arsenic 6.2**  
 Dissolved Arsenic 7.2

**15-MW007** 7/20/2020 Duplicate  
 Total Metals ug/L ug/L  
**Total Arsenic 51 59**  
 Dissolved Arsenic 54 56

**15-MW003R** 7/21/2020  
 Total Metals ug/L  
 Total Arsenic 3.0 U  
 Dissolved Arsenic 3.0 U

**Site Cleanup Goals**  
 Arsenic 10 µg/L

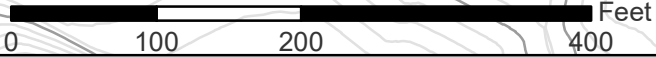
**Notes:**  
**Bolded Values Exceed Cleanup Goals**  
 µg/L -- micrograms per liter  
 J -- Estimate Value  
 U -- Analyte was not detected in the sample at a value greater than the instrument detection

**Legend**

- Monitoring Well - NOT SAMPLED
- Monitoring Well - ABANDONED
- Monitoring Well - SAMPLED
- Topo NASA 2008 (Feet MSL)
- ▭ Arsenic

**July 2020 Groundwater Analytical Results  
 Waste Oil Dump Site  
 NASA Wallops Flight Facility  
 Wallops Isand, Virginia**

**Figure 3-1**



**APPENDIX A**

**GROUNDWATER LEVEL MEASUREMENT SHEET**



**APPENDIX B**

**GROUNDWATER SAMPLE, LOW FLOW PURGE, AND FIELD ANALYTICAL LOG SHEETS**



## GROUNDWATER SAMPLE LOG SHEET

Project Site Name: <u>W00</u>	Sample ID Number: <u>15-MW001</u>
Project Number: _____	Sample Location: _____
Sampled By: <u>ML</u>	

SAMPLING DATA:								
Date:	Color (visual)	pH (S.U.)	S.C. (mS/Cm)	Temperature (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (mV)
<u>7/21/2020</u>		<u>6.30</u>	<u>0.156</u>	<u>16.56</u>	<u>1.36</u>	<u>0.0</u>	<u>0.1</u>	<u>-14</u>
<u>9:13</u>								
Method: Low Flow - Peristaltic								

PURGE DATA:								
Date:	<u>7/21/2020</u>							
Total Well Depth:	<u>10.19</u>							
Static Water Level:	<u>3.70</u>							
One Casing Volume:								
Start Purge (hrs):	<u>8:35</u>							
End Purge (hrs):	<u>9:15</u>							
Total Purge Time (min):	<u>40</u>							
Total Volume Purged (gal/L):	<u>2.3</u>							

SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
Metals Total Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	
Metals Dissolved Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	

OBSERVATIONS/NOTES:			
<u>DO Kit = 0</u>			

MS/MSD	DUPLICATE ID NUMBER:	SIGNATURE(S): 
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# GROUNDWATER SAMPLE LOG SHEET


Project Site Name: <u>W00</u>	Sample ID Number: <u>15-MW002</u>
Project Number: _____	Sample Location: _____
Sampled By: <u>ML</u>	

SAMPLING DATA:								
Date:	Color (visual)	pH (S.U.)	S.C. (mS/Cm)	Temperature (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (mV)
<u>7/21/2020</u>		<u>6.33</u>	<u>0.092</u>	<u>19.55</u>	<u>5.12</u>	<u>19.24</u>	<u>0.0</u>	<u>6</u>
Time: <u>8:30</u>								
Method: Low Flow - Peristaltic								

PURGE DATA:								
Date: <u>7/21/2020</u>								
Total Well Depth: <u>9.03</u>								
Static Water Level: <u>5.67</u>								
One Casing Volume: <u>41</u>								
Start Purge (hrs): <u>7:25</u>								
End Purge (hrs): <u>8:10</u>								
Total Purge Time (min): <u>40</u>								
Total Volume Purged (gal/L): <u>4</u>								

SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
Metals Total Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	
Metals Dissolved Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	

OBSERVATIONS/NOTES:			
<u>DO Kit = 9</u>			

MS/MSD	DUPLICATE ID NUMBER:	SIGNATURE(S): 
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# GROUNDWATER SAMPLE LOG SHEET


Project Site Name: <u>W00</u>	Sample ID Number: <u>18-MW007</u>
Project Number: _____	Sample Location: _____
Sampled By: <u>SES</u>	

SAMPLING DATA:								
Date:	Color (visual)	pH (S.U.)	S.C. (mS/Cm)	Temperature (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (mV)
<u>7/20/2020</u>	<u>clear</u>	<u>6.34</u>	<u>266</u>	<u>21.67</u>	<u>2.00</u>	<u>0.0</u>	<u>0.1</u>	<u>-79</u>

PURGE DATA:								
Date:								
<u>7/20/2020</u>								
Total Well Depth:								
<u>32.94</u>								
Static Water Level:								
<u>25.68</u>								
One Casing Volume:								
Start Purge (hrs):								
<u>2:05</u>								
End Purge (hrs):								
<u>3:20</u>								
Total Purge Time (min):								
<u>75</u>								
Total Volume Purged (gal/L):								
<u>5.6</u>								

SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
Metals Total Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	
Metals Dissolved Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	

OBSERVATIONS/NOTES:			
<u>DO Test Kit = 0</u>			

MS/MSD <u>✓</u>	DUPLICATE ID NUMBER: <u>W00-DUP-01</u>	SIGNATURE(S): 
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## GROUNDWATER SAMPLE LOG SHEET


Project Site Name: <u>W00</u>	Sample ID Number: <u>W00-mw/002D</u>
Project Number: _____	Sample Location: _____
Sampled By: <u>SA</u>	

SAMPLING DATA:								
Date:	Color (visual)	pH (S.U.)	S.C. (mS/Cm)	Temperature (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (mV)
<u>7/20/2020</u>	<u>Clear</u>	<u>5.86</u>	<u>.110</u>	<u>17.92</u>	<u>2.9</u>	<u>.8</u>	<u>0.1</u>	<u>36</u>
Method: Low Flow - Peristaltic								

PURGE DATA:								
Date:	<u>7/20/2020</u>							
Total Well Depth:	<u>32.07</u>							
Static Water Level:	<u>19.3</u>							
One Casing Volume:								
Start Purge (hrs):	<u>12:25</u>							
End Purge (hrs):	<u>1:15</u>							
Total Purge Time (min):	<u>50mm</u>							
Total Volume Purged (gal/L):	<u>5</u>							

SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
Metals Total Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	
Metals Dissolved Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	

OBSERVATIONS/NOTES:			
<u>DO kit = 4</u>			

MS/MSD	DUPLICATE ID NUMBER:	SIGNATURE(S):  
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# GROUNDWATER SAMPLE LOG SHEET


Project Site Name: <u>W00</u>	Sample ID Number: <u>W00-mw003E</u>
Project Number: _____	Sample Location: _____
Sampled By: <u>SLD</u>	

SAMPLING DATA:								
Date:	Color (visual)	pH (S.U.)	S.C. (mS/Cm)	Temperature (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (mV)
<u>7/21/2020</u>		<u>5.95</u>	<u>0.89</u>	<u>19.22</u>	<u>0.0</u>	<u>8.27</u>	<u>0.0</u>	<u>258</u>
Time: <u>8:35</u>								
Method: Low Flow - Peristaltic								

PURGE DATA:								
Date: <u>7/21/2020</u>								
Total Well Depth: <u>32.71</u>								
Static Water Level: <u>27.94</u>								
One Casing Volume:								
Start Purge (hrs): <u>7:53</u>								
End Purge (hrs): <u>8:25</u>								
Total Purge Time (min): <u>32</u>								
Total Volume Purged (gal/L): <u>2.5</u>								

SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
Metals Total Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	
Metals Dissolved Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	

OBSERVATIONS/NOTES:			
<u>DOKIT = 1</u>			

MS/MSD	DUPLICATE ID NUMBER:	SIGNATURE(S):  
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## GROUNDWATER SAMPLE LOG SHEET


Project Site Name: <u>W00</u>	Sample ID Number: <u>W00-mw008</u>
Project Number: _____	Sample Location: _____
Sampled By: <u>ML</u>	

SAMPLING DATA:								
Date:	Color (visual)	pH (S.U.)	S.C. (mS/Cm)	Temperature (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	ORP (mV)
<u>7/20/2020</u>		<u>6.22</u>	<u>0.087</u>	<u>18.64</u>	<u>0</u>	<u>8.62</u>	<u>.04</u>	<u>319</u>
Time: <u>3:15</u>								
Method: Low Flow - Peristaltic								

PURGE DATA:								
Date: <u>7/20/2020</u>								
Total Well Depth: <u>3061</u>								
Static Water Level: <u>941</u>								
One Casing Volume:								
Start Purge (hrs): <u>2:35</u>								
End Purge (hrs): <u>3:05</u>								
Total Purge Time (min): <u>30</u>								
Total Volume Purged (gal/L): <u>2</u>								

SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
Metals Total Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	
Metals Dissolved Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	

OBSERVATIONS/NOTES:			
<u>DO VIT = 6</u>			

MS/MSD	DUPLICATE ID NUMBER:	SIGNATURE(S):  
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**APPENDIX C**

**QA/QC SAMPLE LOG SHEET**

## QA SAMPLE LOG SHEET

Project Site Name: <u>WOD</u>		Sample ID Number: <u>FBO1</u>	
Project Number: _____		Sample Location: _____	
Sampled By: _____		QA Sample Type: <input type="checkbox"/> Trip Blank <input checked="" type="checkbox"/> Field Blank	
<b>SAMPLING DATA:</b>		<b>WATER SOURCE:</b>	
Date: <u>7/20/2020</u>	Time: <u>4:00</u>	<input checked="" type="checkbox"/> Laboratory Prepared <input type="checkbox"/> Tap <input type="checkbox"/> Purchased <input type="checkbox"/> Fire Hydrant <input type="checkbox"/> Other	
Method: <u>Peristaltic Pump</u>			
<b>PURCHASED WATER INFORMATION</b>		<b>RINSATE INFORMATION (If Applicable)</b>	
Product Name: _____ Supplier: _____ Manufacturer: _____ Order Number: _____ Lot Number: _____ Expiration Date: _____		Media Type: _____ Equipment Used: _____	
<b>SAMPLE COLLECTION INFORMATION:</b>			
Analysis	Preservative	Container Requirements	Collected
Metals Total Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	<u>Yes</u>
Metals Dissolved Arsenic and Manganese	HNO3 and 4°C	1 250-mL poly bottle	
SVOCs <u>4-methylphenol and naphthalene</u>	4°C	2 1-L amber glass bottles	
<b>OBSERVATIONS/NOTES:</b>			
<p style="font-size: 1.2em;">New tubing through per pump to fill 2 250mL bottles          with Lab supplied water          Field Filtered Dissolved As with 0.45 micron filter</p>			
<b>SIGNATURE(S):</b>			
			

**APPENDIX D**  
**CHAIN OF CUSTODY FORMS**



# Chain of Custody Record 422305

Environment Testing  
TestAmerica

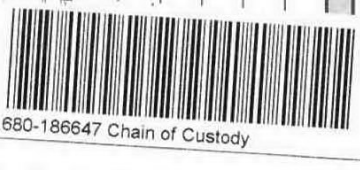
Address: \_\_\_\_\_

TAL-8210

Regulatory Program:  DW  NPDES  RCRA  Other: \_\_\_\_\_

Company Name: <u>Ingenicom LLC</u> Address: <u>NASA Wallops Flight Facility</u> City/State/Zip: <u>Wallops Island, VA 23337</u> Phone: <u>(757) 824-1832</u> Fax: _____ Project Name: <u>Waste at Dump</u> Site: _____ P O #: _____	Client Contact Project Manager: <u>Susan Dunn</u> Tell/Email: <u>Susan.K.Dunn@ingenicom.com</u>	Date: _____ Carrier: _____ COC No: _____ of _____ COCs Sampler: _____ For Lab Use Only: Walk-in Client: _____ Lab Sampling: _____ Job / SDG No.: _____
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Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Analysis Turnaround Time		Filtered Sample (Y/N)	Perform MS/MSD (Y/N)	Total Arsenic, Mercury, Lead, Cadmium, Manganese	Sample Specific Notes:
						CALENDAR DAYS	WORKING DAYS				
15-MW001-20200721	7/21	9:15	GW	GW	2						DISSOLVED
15-MW002-20200721	7/21	9:30	GW	GW	2						AS <sub>2</sub> Mn
15-MW007-20200720	7/20	3:45	GW	GW	6						were Field Filtered
WDD-MW002D-20200720	7/20	1:20	GW	GW	2						
WDD-MW003R-20200721	7/21	9:55	GW	GW	2						
WDD-MW008-20200720	7/20	3:15	GW	GW	2						
WDD-FB01	7/20	4:00	AB	AB	2						
WDD-FW01-20200720	7/20	12:00	GW	GW	2						



Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4= HNO3; 5= NaOH; 6= Other \_\_\_\_\_

Possible Hazard Identification: \_\_\_\_\_ Please List any EPA Waste Codes for the sample in the Are any samples from a listed EPA Hazardous Waste? \_\_\_\_\_  
 Comments Section if the lab is to dispose of the sample. \_\_\_\_\_

Non-Hazard  Flammable  Skin Irritant  Poison B  Unknown

Special Instructions/QC Requirements & Comments: \_\_\_\_\_

Return to Client  Disposal by Lab  Archive for \_\_\_\_\_ Months

Sample Disposal (A fee may be assessed if sample is longer than 1 month) \_\_\_\_\_

3.4/3.8

Relinquished by: _____	Company: <u>Ingenicom</u>	Date/Time: <u>7/22 4:00</u>	Received by: _____	Company: _____	Date/Time: _____
Relinquished by: _____	Company: _____	Date/Time: _____	Received in Laboratory by: <u>[Signature]</u>	Company: <u>SA</u>	Date/Time: <u>7-23-2020/09:00</u>

Cooler Temp. (°C): Obs'd: \_\_\_\_\_ Corrd: \_\_\_\_\_ Therm ID No.: \_\_\_\_\_



**APPENDIX E**  
**DATA VALIDATION REPORT**





TO: .  
SDG: 680-186647-1

PAGE 2

**Executive Summary**

**Laboratory Performance:** None.

**Other Factors Affecting Data Quality:** None.

The data for these analyses were reviewed with reference to the "National Functional Guidelines for Inorganic Review" (January 2017). The text of this report has been formulated to address only those areas affecting data quality.

*Michelle L. Woeber*

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Tetra Tech, Inc.  
Michelle L. Woeber  
Chemist/Data Validator

*Joseph A. Samchuck*

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Tetra Tech, Inc.  
Joseph A. Samchuck  
Data Validation Manager

Attachments:  
Appendix A – Qualified Analytical Results  
Appendix B – Results as Reported by the Laboratory  
Appendix C – Support Documentation

### Data Qualifier Definitions

The following definitions provide brief explanations of the validation qualifiers assigned to results in the data review process.

<b>U</b>	The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted detection limit.
<b>J</b>	The result is an estimated value with an unknown bias. The associated numerical value is the approximate concentration of the analyte in the sample.
<b>J+</b>	The result is an estimated quantity, but the result may be biased high.
<b>J-</b>	The result is an estimated quantity, but the result may be biased low.
<b>UJ</b>	The analyte was analyzed for, but was not detected. The reported detection limit is approximate and may be inaccurate or imprecise.
<b>NJ</b>	The analyte has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the sample.
<b>R</b>	The sample result (detected) is unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.
<b>UR</b>	The sample result (nondetected) is unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.
<b>X</b>	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team, but exclusion of the data is recommended.

**Appendix A**

Qualified Analytical Results

**Qualifier Codes:**

- A = Lab Blank Contamination
- B = Field Blank Contamination
- C = Calibration Noncompliance (i.e., % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
- C01 = GC/MS Tuning Noncompliance
- D = MS/MSD Recovery Noncompliance
- E = LCS/LCSD Recovery Noncompliance
- F = Lab Duplicate Imprecision
- G = Field Duplicate Imprecision
- H = Holding Time Exceedance
- I = ICP Serial Dilution Noncompliance
- J = ICP PDS Recovery Noncompliance; MSA's  $r < 0.995$
- K = ICP Interference - includes ICS % R Noncompliance
- L = Instrument Calibration Range Exceedance
- M = Sample Preservation Noncompliance
- N = Internal Standard Noncompliance
- N01 = Internal Standard Recovery Noncompliance Dioxins
- N02 = Recovery Standard Noncompliance Dioxins
- N03 = Clean-up Standard Noncompliance Dioxins
- O = Poor Instrument Performance (i.e., base-time drifting)
- P = Uncertainty near detection limit ( $< 2 \times$  IDL for inorganics and  $<$ CRQL for organics)
- Q = Other problems (can encompass a number of issues; i.e.chromatography,interferences, etc.)
- R = Surrogates Recovery Noncompliance
- S = Pesticide/PCB Resolution
- T = % Breakdown Noncompliance for DDT and Endrin
- U = RPD between columns/detectors  $>40\%$  for positive results determined via GC/HPLC
- V = Non-linear calibrations; correlation coefficient  $r < 0.995$
- W = EMPC result
- X = Signal to noise response drop
- Y = Percent solids  $<30\%$
- Z = Uncertainty at 2 standard deviations is greater than sample activity
- Z1 = Tentatively Identified Compound considered presumptively present
- Z2 = Tentatively Identified Compound column bleed
- Z3 = Tentatively Identified Compound aldol condensate
- Z4 = Sample activity is less than the at uncertainty at 3 standard deviations and greater than the MDC
- Z5 = Sample activity is less than the at uncertainty at 3 standard deviations and less than the MDC

<b>PROJ_NO: 09246</b> <b>SDG: 680-186647-1</b> <b>FRACTION: M</b> <b>MEDIA: WATER</b>	NSAMPLE	15-MW001-20200721			15-MW002-20200721			15-MW007-20200721			WOD-DUP01-20200720		
	LAB_ID	680-186647-1			680-186647-2			680-186647-3			680-186647-8		
	SAMP_DATE	7/21/2020			7/21/2020			7/20/2020			7/20/2020		
	QC_TYPE	NM			NM			NM			NM		
	UNITS	UG/L			UG/L			UG/L			UG/L		
	PCT_SOLIDS	0.0			0.0			0.0			0.0		
	DUP_OF										15-MW007-20200720		
PARAMETER	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	
ARSENIC	30			5.4			51			59			

<b>PROJ_NO: 09246</b> <b>SDG: 680-186647-1</b> <b>FRACTION: M</b> <b>MEDIA: WATER</b>	NSAMPLE	WOD-FB01			WOD-MW002D-20200720			WOD-MW003R-20200721			WOD-MW008-20200720		
	LAB_ID	680-186647-7			680-186647-4			680-186647-5			680-186647-6		
	SAMP_DATE	7/20/2020			7/20/2020			7/21/2020			7/20/2020		
	QC_TYPE	NM			NM			NM			NM		
	UNITS	UG/L			UG/L			UG/L			UG/L		
	PCT_SOLIDS	0.0			0.0			0.0			0.0		
	DUP_OF												
PARAMETER	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	
ARSENIC	3	U		6.2			3	U		3	U		



<b>PROJ_NO: 09246</b> <b>SDG: 680-186647-1</b> <b>FRACTION: MF</b> <b>MEDIA: WATER</b>	NSAMPLE	15-MW001-20200721			15-MW002-20200721			15-MW007-20200721			WOD-DUP01-20200720		
	LAB_ID	680-186647-1			680-186647-2			680-186647-3			680-186647-8		
	SAMP_DATE	7/21/2020			7/21/2020			7/20/2020			7/20/2020		
	QC_TYPE	NM			NM			NM			NM		
	UNITS	UG/L			UG/L			UG/L			UG/L		
	PCT_SOLIDS	0.0			0.0			0.0			0.0		
	DUP_OF										15-MW007-20200720		
PARAMETER	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	
ARSENIC	34			5.4			54			56			

<b>PROJ_NO: 09246</b> <b>SDG: 680-186647-1</b> <b>FRACTION: MF</b> <b>MEDIA: WATER</b>	NSAMPLE	WOD-FB01			WOD-MW002D-20200720			WOD-MW003R-20200721			WOD-MW008-20200720		
	LAB_ID	680-186647-7			680-186647-4			680-186647-5			680-186647-6		
	SAMP_DATE	7/20/2020			7/20/2020			7/21/2020			7/20/2020		
	QC_TYPE	NM			NM			NM			NM		
	UNITS	UG/L			UG/L			UG/L			UG/L		
	PCT_SOLIDS	0.0			0.0			0.0			0.0		
	DUP_OF												
PARAMETER	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	
ARSENIC		3 U		7.2				3 U			3 U		