Final 2018
Sampling Report
Two-Party Site

Former Building 3564
HQAES No. 02871.1076
ADEC Hazard ID. 25015, File No. 108.26.028
U.S. Army Garrison Alaska

Contract No. W911KB-16-D-0005
Task Order 11

February 2019

FES
FAIRBANKS ENVIRONMENTAL SERVICES INC.

COVER LETTERS

DEPARTMENT OF THE ARMY
INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, U.S. ARMY GARRISON ALASKA
1046 MARKS ROAD #6000
FORT WAINWRIGHT, ALASKA 99703-6000

February 12, 2019

Directorate of Public Works

SUBJECT: Submission of the Final 2018 Monitoring Report, Former Building 3564, to State of Alaska Department Environmental Conservation (ADEC)

Ms. Erica Blake
Environmental Program Specialist
Alaska Department of Environmental Conservation
610 University Avenue
Fairbanks, AK 99709

Dear Mr. Fraley:

This letter documents transmission of the Final 2018 Monitoring Report, Former Building 3564, on Fort Wainwright Alaska to the ADEC.

A digital copy of the document will be emailed to you and two Compact Disc will be delivered to (ADEC) in Fairbanks. A copy of the letter is being provided to Kevin Fraley, Environmental Program Specialist, ADEC. If you would like to receive a hard copy of this document, please notify us within the next few weeks.

If you have questions or concerns regarding this action please contact the Remedial Program Manager at (907) 361-6623/ brian.m.adams18.civ@mail.mil; Ms. Tamara Scholten, Alternate Remedial Program Manager, at (907) 361-3001/tamara.a.scholten.civ@mail.mil; or Mr. Seth Reedy, Alternate Remedial Program Manager, at (907) 361-6489/ seth.a.reedy.civ@mail.mil.

Sincerely;

Richard L. Morris
Chief, Environmental Division

cc:
HQ, USAG FWA CERCLA Administrative Records (w/o encls)

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FINAL
2018 SAMPLING REPORT
TWO-PARTY SITE

Former Building 3564,
Hazard ID 25015, ADEC File ID 108.26.028
HQAES NO. 02871.1076

For:
U.S. Army Garrison Alaska

February 2019

Prepared under contract to

U.S. Army Corps of Engineers, Alaska District

Post Office Box 6898
JBER, Alaska 99506-6898
Contract W911KB-16-D-0005, TO #11

Prepared by

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FES Project No. 9011-08

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AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AFCEE	Air Force Center for Engineering and the Environment
AS	air sparge
bgs	below ground surface
CDQR	Chemical Data Quality Review
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	Cost Effective Sampling
COC	contaminant of concern
DERA	Defense Environmental Restoration Account
DO	dissolved oxygen
DOD	Department of Defense
DRO	diesel range organics
EPA	U.S. Environmental Protection Agency
FES	Fairbanks Environmental Services Inc.
FFA	Federal Facility Agreement
GIS	geographic information system
GRO	gasoline range organics
HQAES	Headquarters Army Environmental System
IC	Institutional Control
IDW	investigation-derived waste
LTMO	Long Term Monitoring Optimization
MAROS	Monitoring and Remediation Optimization System
mg/L	milligrams per liter
µg/L	micrograms per liter
msl	mean sea level
NRC	National Response Corporation
POL	petroleum, oil, and lubricants
QSM	Quality Systems Manual
RRO	residual range organics
SGS	SGS North America Inc.
SVE	soil vapor extraction
TCLP	toxicity characteristic leaching procedure
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
USACE	U.S. Army Corps of Engineers
USAGAK	U. S. Army Garrison-Alaska
UST	underground storage tank

EXECUTIVE SUMMARY

Groundwater samples were collected from 7 monitoring wells at the Building 3564 Two-Party source area on Fort Wainwright during August 2018. The following is a summary of the sampling results and recommendations.

Site	Wells Sampled	Analysis	2018 Analytical Results	Recommendations
Former Building 3564 (Hazard ID 25015, ADEC File ID 108.26.028, HQAES NO. 02871.1076)	AP-7189, AP-7187, AP-7178, AP-6729, AP-7191, AP-7183, MW3564-1	DRO, RRO, and dissolved iron and sulfate	Five out of seven wells sampled contained diesel range organics (DRO) above the Alaska Department of Environmental Conservation (ADEC) cleanup level. Two wells exceeded ADEC cleanup levels for residual range organics (RRO). Due to the rise of the water table in recent years, groundwater that came in contact with residual soil contamination within the source area may have caused an increase in contaminant concentrations within and immediately downgradient of the source area that continues to be observed through 2018. The farthest downgradient well (MW3564-1) and well AP-7183, located between the source area and the Building 3559 water well pump house, did not have contaminants of concern (COCs) above ADEC cleanup levels. Based on a plume stability evaluation using Monitoring and Remediation Optimization System (MAROS) software, the mass of the DRO plume has not migrated significantly from the source area.	Continued monitoring of these wells in 2019 for analysis of DRO and RRO. It is recommended that AP-7187 be converted to a flushmount well during the 2019 field season to minimize future damage to the well.

1.0 INTRODUCTION

This report presents results of the groundwater sampling event conducted at the Former Building 3564 Two-Party site on Fort Wainwright, Alaska during August 2018. Fairbanks Environmental Services (FES) is providing this service under contract to the U.S. Army Corps of Engineers (USACE), Contract Number W911KB-16-D-0005. The work was completed according to the 2018 Postwide Work Plan (FES, 2018).

1.1 Project Overview and Monitoring Report Organization

The purpose of the 2018 sampling effort was to provide current data on groundwater contaminant concentrations for the Former Building 3564 site at Fort Wainwright. The data collected are compared to historical data to evaluate trends in contaminant attenuation over time. A description of the procedures and results associated with these activities are presented in the following sections:

- Section 2 – Sampling Program
- Section 3 – Former Building 3564 Groundwater Monitoring Results and Discussion
- Section 4 – Institutional Control (IC) Survey
- Section 5 – References

Supporting information can be found in the appendices listed below. Additional information not provided in hard copy, such as laboratory reports, are provided in the Supplemental Information folder on the compact disc accompanying this report.

- Appendix A – Groundwater Sampling Forms and Field Parameter Summary
- Appendix B – Chemical Data Quality Review (CDQR) and Alaska Department of Environmental Conservation (ADEC) Laboratory Data Review Checklists
- Appendix C – Groundwater Sample Summary and Analytical Result Tables
- Appendix D – Monitoring and Remediation Optimization System (MAROS) Software Concentration Trend and Plume Stability Results
- Appendix E Photographic Log

1.2 Project Location and Background

The Two-Party sites are located on Fort Wainwright, Alaska. Fort Wainwright is located on the eastern edge of Fairbanks, within the Fairbanks North Star Borough, in interior Alaska. The 911,604 acre site (as identified in the Federal Facility Agreement [FFA]) includes the main Post

area, a range complex, and two maneuver areas. The Former Building 3564 site is located on the Main Cantonment Area of Fort Wainwright. Figure 1-1 presents the site location map.

Fort Wainwright was originally established in 1938 as a cold weather testing station. Currently, primary missions are deployment of combat-ready forces to support joint military operations worldwide, and to serve as the Joint Force Land Component Command to support Joint Task Force Alaska. In 2001, Fort Wainwright was selected to be the home of the 1st Stryker Brigade Combat Team, and in 2006 the post was selected as the home of Task Force 49 Aviation Brigade. In 2011, Task Force 49 was restructured as part of the 16th Combat Aviation Brigade and a portion of the troops were transferred to Joint-Base Lewis-McChord. Fort Wainwright is also home to the 1st Attack Reconnaissance Battalion, 25th Infantry Division; and the Medical Department Activity-Alaska.

Fort Wainwright is located in the interior of Alaska within the Tanana and Chena River drainage basins. The area is subject to extreme seasonal temperature variations and light precipitation (approximately 11 inches).

The aquifer material beneath Fort Wainwright is Chena alluvium consisting of sands and sand and gravel mixtures. These deposits are up to 400 feet thick (to bedrock), and are overlain by silt in some areas. Vadose-zone moisture contents are commonly 2 to 9 percent by weight. Regional groundwater flow south of the Chena River is to the northwest.

Past releases of petroleum hydrocarbons at the Building 3564 site are attributed to vehicle maintenance operations, fuel storage, and fuel transfer supporting troop operations at Fort Wainwright. Continued monitoring of this location is part of the Fort Wainwright groundwater sampling program.

1.3 Site Description Building 3564 (Hazard ID 25015, ADEC File ID 108.26.028, HQAES NO. 02871.1076)

The location of the Former Building 3564 site is shown on Figure 1-1. Former Building 3564 was the standby generator plant for the Post between 1954 and 1999. Arctic diesel fuel for the generators was stored in two 25,000-gallon underground storage tanks (USTs) north of Former Building 3564. The northernmost tank had developed holes about 1 to 1½-inch in diameter from which an unknown quantity of arctic diesel fuel leaked to the groundwater. USTs at Building 3564 were removed in 1994 (Oil Spill Technology, 1994). A release investigation conducted in 1994 found diesel range organics (DRO), gasoline range organics (GRO), and benzene in groundwater (Hart Crowser, 1997). A former leach pit was also located on the north side of Former Building 3564. The pit was connected to a sump pump beneath a diesel generator in Former Building 3564. Water mixed with diesel fuel, lubricating oil, and antifreeze was pumped into the leach pit.

Air sparge (AS)/soil vapor extraction (SVE) was approved as the corrective action at the site (CH2MHill, 1996) and a AS/SVE system was installed in 1996 and operated until 1998. The AS/SVE system was removed in October 2002. Additionally, a study was conducted in 1997 to demonstrate the applicability of intrinsic remediation that would work in concert with the AS/SVE system (CH2MHILL, 1997). Groundwater monitoring has been conducted at the site since 1996; annual sampling has been conducted since 1999, partly due to the proximity of the site to the Post drinking water well.

1.4 Regulatory Considerations

The following groundwater cleanup levels are the most significant regulations that apply to the Fort Wainwright site sampled under this contract:

- State cleanup levels are relevant and appropriate for groundwater that is a potential drinking water source (Title 18, Section 75.345, of the Alaska Administrative Code [AAC], Table C; ADEC, 2018).

In this report, the term "cleanup level" refers to these State of Alaska regulations. Groundwater cleanup levels are summarized in Table 1-1.

Table 1-1 – Groundwater Contaminants of Concern

Contaminants of Concern	ADEC Cleanup Level (µg/L)
RRO	1,100
DRO	1,500

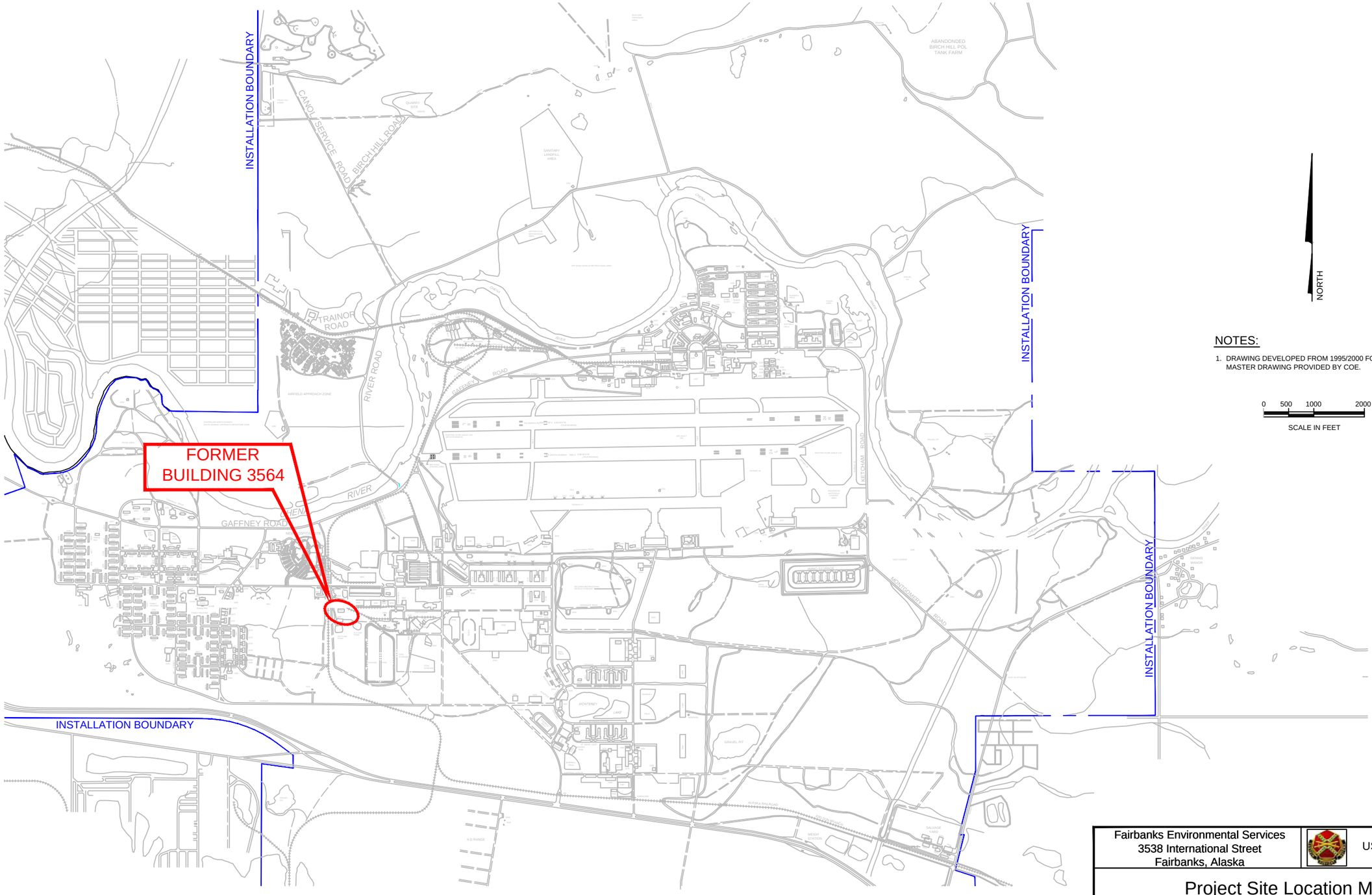
µg/L – micrograms per liter

In November 2016, the ADEC cleanup levels were revised utilizing risk-based calculations. This resulted in a significant change in the groundwater cleanup level for many compounds (ADEC, 2017a). ADEC has updated cleanup levels several times; the most recent were promulgated on September 29, 2018 (ADEC, 2018). The revised levels will be utilized for Two-Party sites to attain cleanup complete under ADEC regulations.

1.5 Work Plan Deviation

Manganese sampling conducted during the 2017 sampling effort was a deviation from the 2017 Work Plan requirements and an erroneous recommendation was made in the 2017 Sampling Report to continue manganese sampling in 2018. Since there are no known anthropogenic

sources of manganese at the Former Building 3564 source area and manganese analysis has never been a requirement at this source area, the erroneous recommendation made in the 2017 Sampling Report to continue manganese sampling was disregarded. Manganese was not included in the 2018 Work Plan and was therefore not requested for analysis in 2018.



NOTES:

1. DRAWING DEVELOPED FROM 1995/2000 FORT WAINWRIGHT MASTER DRAWING PROVIDED BY COE.

0 500 1000 2000

SCALE IN FEET

Fairbanks Environmental Services
3538 International Street
Fairbanks, Alaska

USAGAK

Project Site Location Map

2018 Sampling Report
Two Party Sites
U.S. Army Garrison Alaska

USACE Contract: W911KB-16-D-0005	Figure: 1-1	Date: 2/19

2.0 SAMPLING PROGRAM

Groundwater sampling was conducted on August 8 and 9, 2018. Groundwater samples were collected from seven monitoring wells at the Former Building 3564 site on Fort Wainwright, Alaska.

2.1 Groundwater Sampling and Analysis

Groundwater monitoring wells were sampled to assess contaminant trends over time. Techniques used to purge and sample groundwater were consistent with low-flow sampling methodology (Puls and Barcelona, 1996). This method was developed by the U.S. Environmental Protection Agency (EPA) and allows for faster stabilization of geochemical parameters while purging, due to the decreased agitation of the groundwater. Groundwater samples were collected with variable-speed submersible pumps, using dedicated Teflon-lined tubing at each monitoring well, and groundwater met the stabilization criteria identified in the ADEC *Field Sampling Guidance* (ADEC, 2017a) prior to sample collection.

Groundwater parameters were measured with a handheld YSI multiparameter instrument connected to a flow-through cell. Measured parameters included pH, temperature, specific conductivity, dissolved oxygen (DO) concentration, and oxidation/reduction potential. Turbidity was also measured using an Oakton turbidity meter. When the parameters stabilized, the flow-through cell was disconnected and samples were collected using the pump set at a low-flow rate. Field parameters were recorded on groundwater sampling forms presented in Appendix A, and are summarized on Table A-1.

Groundwater samples were submitted for the following contaminant analysis: DRO by Alaska Method AK 102 and residual range organics (RRO) by Alaska Method AK 103. To allow evaluation of groundwater geochemical changes resulting from biodegradation processes, groundwater samples were also submitted for laboratory analysis of dissolved (field-filtered) iron and sulfate by EPA Methods 6020A and 300.0, respectively. All project and quality control samples were analyzed by SGS North America, Inc. (SGS) of Anchorage, Alaska.

The seven wells listed below were sampled at Former Building 3564 on August 8 and 9, 2018 for the analytes and methods listed above. Groundwater sampling activities at the Former Building 3564 site are discussed in Section 3.

AP-7189	AP-7187	AP-7178	AP-6729
AP-7191	AP-7183	MW3564-1	

2.2 Groundwater Sample Data Quality

The Former Building 3564 groundwater data were reviewed in order to assess whether analytical data met data quality objectives and were acceptable for use. The project data were reviewed for deviations to the requirements presented in the Final 2018 Postwide Work Plan (FES, 2018); Final Postwide Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP; FES, 2016); ADEC Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling Technical Memo (ADEC, 2017b); and U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (QSM), Version 5.1 (DoD, 2017).

Several results were qualified as potential estimates during the data review process; however, no data were rejected. In all cases, the impact to the overall project due to the data qualifications was minor. The specific data quality issues found during the review are presented in the CDQR and ADEC Laboratory Data Review Checklist in Appendix B. The reviewed data are presented in Appendix C, and are used in tables and figures throughout the report.

2.3 Investigation-Derived Waste Handling and Disposal

Investigation-derived waste (IDW) generated during Two Party field activities in 2018 included purge water and general refuse (disposable tubing, nitrile gloves, etc.) from monitoring well sampling activities. All IDW and other waste streams were managed according to the procedures outlined in the 2018 Postwide Work Plan (FES, 2018).

Purge water was containerized at the time of sampling in 15-gallon polyethylene drums. The drums were labeled with a unique ID, and a form was completed documenting the ID and purge volume from each well. The drums were taken to the Fort Wainwright Defense Environmental Restoration Account (DERA) building for temporary storage. The purge water from the Building 3564 Two-Party site was characterized using the results from individual wells and a separate toxicity characteristic leaching procedure (TCLP) analysis, and disposed of as petroleum-contaminated water by National Response Corporation (NRC) Alaska at their facility in Anchorage, Alaska. The disposal was conducted in accordance with their permit with the Anchorage Water and Wastewater Utility. The work was completed as part of a separate task in the scope of work for the Fort Wainwright contract, and copies of the manifest and sampling results will be included the 2018 IDW Technical Memorandum.

2.4 Institutional Controls

IC inspections were conducted at Former Building 3564 on May 22, 2018. The purpose of the inspection is to ensure that the ICs are being met. The following are the site-specific ICs:

- Prevent unauthorized soil disturbing activities to a depth more than six inches below ground surface (bgs)
- Prevent installation of wells for drinking water purposes
- Prevent use of groundwater except for monitoring and remediation activities
- Protect existing monitoring wells

The results of the IC survey are presented in the 2018 Annual Institutional Controls Report and summarized in Section 4.

3.0 FORMER BUILDING 3564 GROUNDWATER MONITORING RESULTS AND DISCUSSION

This section presents the 2018 groundwater monitoring results for the Former Building 3564 site. Groundwater monitoring was completed in accordance with the 2018 Postwide Work Plan (FES, 2018).

3.1 Groundwater Elevations

Groundwater elevation data were collected prior to sampling each well during the 2018 sampling event. A comparison of groundwater elevations shows a very slight northwest trend in the groundwater flow direction; however, overall, the groundwater gradient is relatively flat. A boring log/well completion log for MW3564-1 cannot be located and it is believed that this well has never been surveyed; therefore, MW3564-1 is not included in the groundwater elevation comparison. Groundwater levels are shown on Figure 3-1, and annual groundwater elevations between 2004 and 2018 are shown on Table 3-1. The elevation data show that the water levels were approximately 0.5 feet higher in August 2018 than in August 2017. Elevations are fairly consistent, ranging between 429 and 431 feet above mean sea level (msl) with the exception of July 2014 and August 2016 where elevations were between 433 and 434 feet msl, the highest levels measured at the site since groundwater elevations were first recorded in 2001.

3.2 Groundwater Analytical Results

Current and historical contaminants of concern (COC) concentrations are summarized on Figure 3-1. Groundwater samples were submitted for laboratory analysis of DRO, RRO, and dissolved iron and sulfate. Complete analytical results are presented in Appendix C, Table C-2. Well AP-7178 is located within the former AS/SVE treatment area; wells AP-7187, AP-7189, AP-6729, AP-7191, AP-7183, and MW3564-1 are located downgradient of the source area. Five out of seven wells sampled contained DRO in concentrations that exceed the ADEC cleanup level (1,500 micrograms per liter [µg/L]), ranging from 6,150 µg/L to 33,700 µg/L. RRO exceeded the ADEC cleanup level (1,100 µg/L) in two of the seven wells sampled with concentrations of 2,190 µg/L and 4,530 µg/L. Contaminant concentrations in groundwater at the Former Building 3564 monitoring wells exhibited the following characteristics:

DRO in the Source Area Well

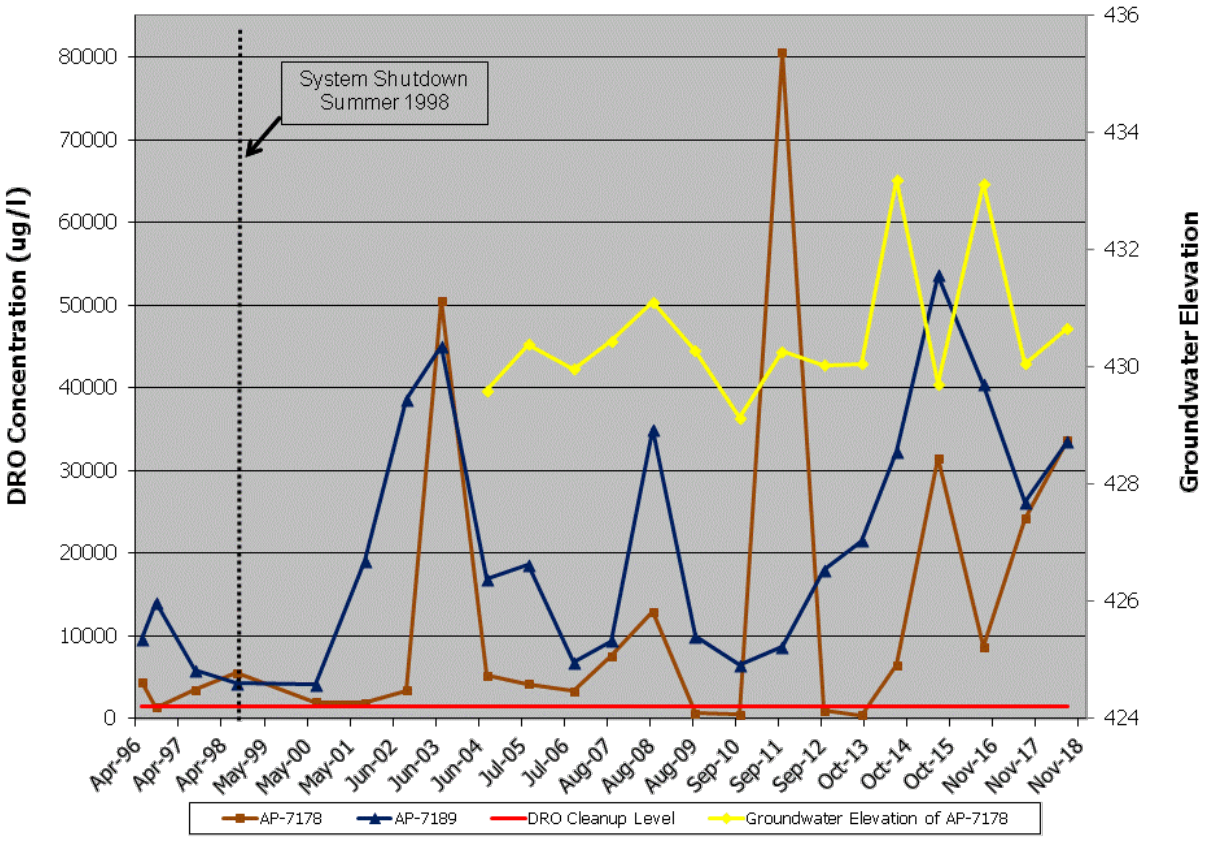
- DRO in source area well AP-7178 had been below cleanup levels for two consecutive years (2012 and 2013); however, DRO increased to 6,490 µg/L in 2014, increased again in 2015 to 31,500 µg/L and in 2016 was 8,650 µg/L. The DRO concentration in 2018 was 33,700 µg/L, which is an increase from the 2017 result of 24,200 µg/L. It is possible that the increase in the DRO concentration can be attributed to high water levels that were seen during 2014 and 2016, causing groundwater to come into contact with residual soil contamination within the

source area that is normally above the water table. Figure 3-2 depicts DRO concentration changes over time and visual trends in AP-7178.

DRO in Downgradient Wells AP-7187 and AP-7189

- Two of the five wells that exceeded DRO cleanup levels are located immediately downgradient of the source area; AP-7187 and AP-7189.
- The DRO concentration recorded during 2015 in AP-7189 was 53,600 µg/L, which is the highest concentration seen since sampling began in this well in 1996. The DRO concentration decreased in 2016 and 2017 to 40,400 µg/L and 26,200 µg/L, respectively. DRO was detected at 33,700 µg/L in 2018. Figures 3-2 below depicts DRO concentration changes over time and visual trends in AP-7189.
- The DRO concentration of 20,700 µg/L detected in 2016 in well AP-7187 is comparable to the concentration detected in 2014 when groundwater level measurements are also comparable. DRO concentrations appear to be increasing since sampling began in 1996; however, a trend is not clear due to variable data in this well. The DRO concentration in well AP-7187 decreased significantly during 2017 to 4,762 µg/L and was detected an order of magnitude lower compared to the concentration detected in 2016. DRO increased in 2018 to 8,900 µg/L.

Figure 3-2. DRO Concentrations in AP-7178 within the Source Area and AP-7189 Immediately Downgradient

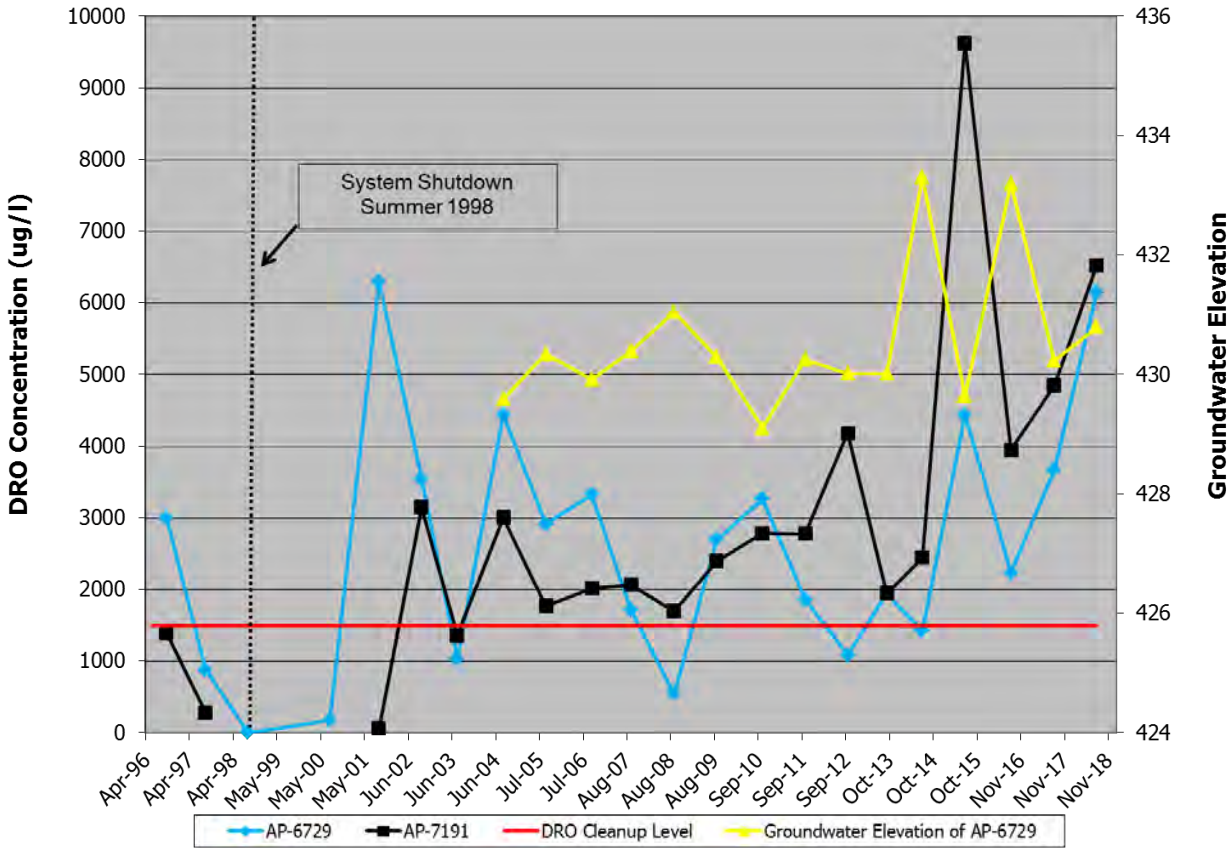


DRO in Additional Downgradient Wells

- DRO in downgradient well AP-7191 had remained at typical concentrations historically observed in this well through 2014; however, DRO in this well increased during the 2015 sampling event to 9,630 µg/L, which is the highest concentration seen since sampling began in this well in 1996. The DRO concentration in 2017 was 4,850 µg/L, similar to the 2016 concentration of 3,950 µg/L, and comparable to previous years' DRO results. The DRO concentration increased to 6,530 µg/L in 2018.
- DRO in AP-6729, located between the source area and the Post water well, was above the cleanup level at 2,240 µg/L in 2016 and 3,670 µg/L in 2017. DRO increased to 6,150 µg/L in 2018, which is comparable to the highest concentration of 6,300 µg/L detected in this well in 2004. Due to variable data in this well, a trend is not apparent.
- Downgradient well AP-7183 had a DRO concentration below the ADEC cleanup level and DRO was not detected in downgradient well MW3564-1 during the 2018 sampling event.

Figure 3-3 below depicts DRO concentration changes over time and visual trends in wells AP-6729 and AP-7191:

Figure 3-3. DRO Concentrations in Downgradient Wells AP-6729 and AP-7191



RRO in All Wells

- RRO was above the cleanup level (1,100 µg/L) in downgradient well AP-7189 at 2,190 µg/L, and source area well AP-7178 at 4,530 µg/L; these concentrations are comparable to those observed in previous years.
- RRO in downgradient well AP-7187 had been below cleanup levels for almost five sampling events (2009 to 2013) then increased to 3,830 µg/L in 2014. RRO was again below the cleanup level in 2015 and increased to 2,430 µg/L in 2016. The increase in RRO during the 2014 and 2016 sampling events was attributed to high water levels, resulting in contact between groundwater and residual soil contamination. The RRO concentration in AP-7187 decreased to below the ADEC cleanup level in 2017 and 2018.

3.3 Natural Attenuation Processes

In general, the geochemical sample results are consistent with expected changes resulting from anaerobic biodegradation of hydrocarbons. Wells located within the contaminant plume generally have reduced concentrations of electron acceptors, and increased concentrations of biodegradation byproducts. Relative changes in these geochemical indicators can provide an indirect measure of the biodegradation of petroleum hydrocarbons. A petroleum-contaminated area undergoing biodegradation would be expected to have more reduced conditions (such as elevated dissolved iron and lower sulfate concentrations) than non-contaminated areas. The following geochemical trends indicate that biodegradation is occurring:

- DO concentrations were between 0.54 and 1.80 milligrams per liter (mg/L) at all well locations, indicating that available oxygen is limited for aerobic biodegradation in these wells. Therefore the favorable pathway is generally anaerobic biodegradation, where ferric iron and sulfate act as electron acceptors.
- Background dissolved iron concentrations at Fort Wainwright are typically around 1 mg/L. Dissolved iron in site monitoring wells ranged between 0.80 mg/L and 57.8 mg/L. All wells except for MW3564-1, the farthest downgradient well, have dissolved iron concentrations greater than background indicating that iron reduction may be occurring at the site.
- Background sulfate concentrations at Fort Wainwright are typically around 40 mg/L. Sulfate ranged from not detected to 37.3 mg/L in site monitoring wells. Sulfate concentrations were well below the background in the source area wells, indicating that sulfate reduction may be occurring at this site.

3.4 Contaminant Concentration Trend and Plume Stability Evaluation

The MAROS software was used to evaluate contaminant concentration trends in monitoring wells and plume stability at the Former Building 3564 site. The Air Force Center for Engineering and the Environment (AFCEE) developed the MAROS software (AFCEE, 2006) as a tool to evaluate

groundwater data trends, and it is one among several tools that have been recommended for use in Long Term Monitoring Optimization (LTMO) (EPA, 2005).

The analysis for the Former Building 3564 site was based on the current site characteristics and post-treatment monitoring well data. Although the treatment system was shut down in 1998, data between 2002 and 2018 were used for the analysis as this time period included the most consistent and representative monitoring events. Complete results are included in Appendix D and summarized in the following paragraphs.

Concentration trends for DRO in the individual Former Building 3564 monitoring wells were evaluated at the Former Building 3564 site using Mann-Kendall trend analysis. The results showed three wells exhibited "No Trend" (result of data variability) (AP-6729, AP-7178, and AP-7189), two wells exhibited a "Stable" trend (AP-7187 and MW3564-1), and two wells had "Increasing" trends (AP-7183 and AP-7191) for DRO.

The Mann-Kendall trend for DRO in downgradient well AP-7183 was "Increasing", due to variability in trace DRO concentrations. Qualitative evaluation of the data does not suggest an increasing trend that may result in a future exceedance of the cleanup level. The Mann-Kendall trend in downgradient monitoring well AP-7191 was "Increasing", with the results between 2015 and 2018 among the highest that have been observed. This trend will continue to be evaluated following future sampling events. However, the DRO trend in the furthest downgradient well, MW3564-1, has remained "Stable", with DRO concentrations well below the DRO cleanup level since sampling began in 2004.

The MAROS software spatial moment analysis was used to evaluate plume stability based on estimated contaminant mass, the trend in the distance from the source to the center of mass, and the trend of plume spread around the center of mass. The DRO plume was evaluated using data between 2006 and 2018 so the analysis could include the same number of wells in each analysis year. The calculated location of the center of mass over time is shown on Figure 3-4, and the moment analysis results are shown on Table D-2 in Appendix D. The analysis showed that the DRO mass exhibited an "Increasing" trend due to the recent overall increase in mass since 2014. The distance from the source to the center of mass and spread around the center of mass had "Stable" trends. This is also exhibited on Figure 3-4, which shows the 2018 center of mass location between the maximum from 2010 and minimum from 2011. The plume spread results, presented as the second moment analysis in Appendix D, also had a "Stable" trend in the direction of groundwater flow, and a "Probably Decreasing" trend perpendicular to groundwater flow.

The MAROS software was also used to evaluate sampling frequency at the Former Building 3564 site (see complete results in Appendix D). Sampling frequency is evaluated within the MAROS software using the Modified Cost Effective Sampling (CES) method. The CES method is based on the rate of change of contaminant concentrations in individual wells relative to the cleanup level. The results of the frequency analysis showed a recommended sampling frequency of

biennial for one well (MW3564-1), annual for five wells (AP-6729, AP-7178, AP-7183, AP-7187, and AP-7191), and quarterly sampling for AP-7189. The quarterly sampling result was due to the wide range in DRO concentrations relative to the cleanup level that have been observed in this well during recent sampling events.

3.5 Discussion and Conclusions

Annual monitoring for natural attenuation has been conducted at this site since 1999, partly due to the proximity of the site to the Post drinking water well. Groundwater concentration results have showed variability in DRO concentrations, but limited contaminant migration to date. Additional detail regarding contaminant concentration trends in source area and downgradient wells are discussed in the following paragraphs.

Source Area Well AP-7178

One source area well, AP-7178, was sampled during the 2018 monitoring event.

- It appears that AS/SVE operation (the system was operated between 1996 and 1998) successfully removed benzene concentrations within the source area. Benzene has not been above the ADEC cleanup level since 1996.
- GRO has never been detected above the cleanup level within the source area.
- RRO concentrations have fluctuated over the years and have remained above the ADEC cleanup levels for the past three years.
- DRO in this well decreased to below the cleanup level in 2009 and remained below the cleanup level until 2013 with the exception of a single significant detection of DRO (80,600 µg/L) in 2011. DRO increased to above the cleanup level in July 2014 and has remained above the cleanup level since. This increase in DRO concentrations is possibly due to higher than typical groundwater levels in recent years, causing the groundwater to come in contact with residual soil contamination that is typically above the water table.

Downgradient Wells AP-7187 and AP-7189

Wells AP-7187 and AP-7189 are the closest downgradient wells to the source area.

- Successful removal of GRO and benzene by the AS/SVE treatment system has prevented further migration of these contaminants to downgradient wells. GRO and benzene have not been above the cleanup level in AP-7187 since 1997. Benzene was detected sporadically in AP-7189, but has been below the cleanup level since 2004.
- While RRO had been below the cleanup level in AP-7189 between 2008 and 2010, it has been detected above the cleanup level since 2014. RRO has been detected above and below the cleanup level in AP-7187, but has been below the cleanup level in 2017 and 2018. Natural attenuation appears to be limiting further migration of this contaminant.

- DRO concentrations remain elevated in these two wells. The DRO concentration increased significantly during 2015 in AP-7189 to the highest concentration seen since sampling began in this well. The DRO concentration has decreased the past three years, but remains relatively high. Due to variability in the data from AP-7189, the concentration trend is considered "No Trend" based on MAROS software analysis. In comparison, the DRO concentration in well AP-7187, located approximately 30 feet southeast of AP-7189, decreased significantly during 2015 to the lowest concentration that has ever been detected in this well, then increased significantly during 2016. In 2017 and 2018 the DRO concentration decreased but remains above the ADEC cleanup levels. Trend analysis indicates DRO concentrations are "Stable" in AP-7187.

Additional Downgradient Wells

Two additional downgradient wells, AP-6729 and AP-7191, have consistently exhibited DRO at concentrations that exceed the cleanup level. Recent increases in DRO concentrations may be attributed to increases in water levels in 2014 and 2016. Overall data from AP-6729 has been variable and the 2018 trend analysis using MAROS software indicated "No Trend" in this well.

DRO in AP-7191 had been relatively stable (above the cleanup level) for many years; however, a recent increase in the DRO concentration has been observed and the trend analysis indicated an "Increasing" trend in this well. The DRO concentration detected in 2015 was the highest concentration detected since sampling this well began in 1996, though detections in 2016 and 2017 were more consistent with previous detections. DRO increased in 2018, but remains below the 2015 concentration.

The farthest two downgradient wells are MW3564-1 and AP-7183. Well AP-7183 is located in an area between the Post water well pump house (Building 3559) and the site, and no COC has ever been detected above the cleanup level in this well. Although DRO concentrations in AP-7183 are well below ADEC cleanup levels, MAROS analysis does indicate an increasing trend in this well. Additionally, no COC has ever been detected above the cleanup level in the farthest downgradient well, MW3564-1, and DRO concentrations remain below the ADEC cleanup levels. Trend analysis indicates DRO concentrations are "Stable" in this well.

Conclusions

Based on an evaluation of the groundwater data collected annually since 1996, as well as an evaluation of the sampling frequency using MAROS software and the CES method, continued annual sampling at the Former Building 3564 site should be considered. The following seven wells should be sampled once for DRO, RRO, and dissolved iron and sulfate during the fall of 2019.

AP-7178	AP-7187	AP-7189	AP-6729
AP-7183	AP-7191	MW3564-1	

Table 3-1 – Former Building 3564 Groundwater Elevations

Well Number	Total Well Depth (feet btoc)	Top of Casing Elevations[2] (feet MSL)	Water Elevations September 2004[1]	Water Elevations September 2005[1]	Water Elevations October 2006[1]	Water Elevations September 2007[1]	Water Elevations September 2008[1]	Water Elevations September 2009[1]	Water Elevations October 2010[1]	Water Elevations October 2011[1]	Water Elevations October 2012[1]	Water Elevations September 2013[1]	Water Elevations July 2014[1]	Water Elevations July 2015[1]	Water Elevations August 2016[1]	Water Elevations August 2017[1]	Water Elevations August 2018[1]
AP-7189	21.8	446.54	429.61	430.39	429.97	430.45	431.12	430.28	429.14	430.27	430.04	430.06	433.2	429.72	433.14	430.06	430.67
AP-7178	21.33	444.94	429.82	430.35	429.81	430.22	430.35	431.04	429.88	430.84	430.59	430.75	433.98	430.32	433.85	430.86	431.39
AP-6729	26.5	447.93	429.59	430.35	429.92	430.4	431.06	430.3	429.11	430.26	430.02	430.02	433.32	429.65	433.2	430.24	430.8
AP-7191	21.73	446.92	429.56	430.25	429.87	430.12	430.72	430.19	428.97	430.11	429.92	429.96	433.04	429.5	433.01	430.01	430.48
AP-7183	21.7	447.31	429.56	430.28	429.98	430.31	430.93	430.18	429.09	430.11	429.81	429.91	433.19	429.37	433.12	430.13	430.71
AP-7187	17.9	446.41	429.68	NS	430.03	430.49	431.16	430.28	429.26	430.31	430.06	430.18	433.3	429.72	433.19	430.26	430.55
MW3564-1	23.43	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

btoc - below top of casing

NA - not available

NM - not measured

[1] Feet above mean sea level (MSL)

[2] Wells were surveyed using Alaska State Plane Coordinate System, NAD83, Zone 3, and Fort Wainwright local grid coordinate system, with elevations recorded in both the NGVD 29 and NAVD88 vertical datum

NORTH

AP-7191	Water Level (BTOC) (feet)	DRO µg/L	RRO µg/L	GRO µg/L	Benzene µg/L
JUN 1996	NR	2,100	NA	150	0.25
OCT 1996	NR	1,400	NA	74	ND (1)
SEP 1997	NR	280	NA	ND (34)	ND (0.1)
AUG 2000	NR	62	NA	ND (100)	ND (2)
OCT 2002	16.18	3,150	ND (1,100)	ND (90)	ND (0.5)
AUG 2003	15.05	1,360	ND (330)	ND (90)	ND (0.5)
SEP 2004	17.36	3,010	704	37.3	0.158
SEP 2005	16.67	1,770	499	ND (90)	ND (0.5)
OCT 2006	17.05	2,020	445	23.8	ND (0.5)
SEP 2007	16.60	2,070	536	20.1	ND (0.5)
SEP 2008	16.00	1,700	190	30	ND (1)
SEP 2009	16.73	2,400	200	NA	NA
OCT 2010	17.95	2,790	518	NA	NA
OCT 2011	16.81	2,780	NA	NA	NA
OCT 2012	17.00	4,190	NA	NA	ND (0.24)
SEP 2013	16.96	1,950	NA	NA	NA
JULY 2014	13.88	2,450	175	NA	NA
JULY 2015	17.42	9,630	837	NA	NA
AUG 2016	13.91	3,950	540	NA	NA
AUG 2017	16.91	4,850	385	NA	NA
AUG 2018	16.44	6,530	598	NA	NA

MW3564-1	Water Level (BTOC) (feet)	DRO µg/L	RRO µg/L	GRO µg/L	Benzene µg/L
SEP 2004	18.57	420	358	17.6	ND (0.5)
SEP 2005	17.90	138	233	ND (90)	ND (0.5)
OCT 2006	18.28	305	231	14	ND (0.5)
SEP 2007	17.73	388	306	23.9	0.223
SEP 2008	17.14	220	63	ND (50)	0.35
SEP 2009	17.91	470	120	NA	NA
OCT 2010	19.18	359	255	NA	NA
OCT 2011	17.94	325	NA	NA	NA
OCT 2012	18.34	326	NA	NA	ND (0.24)
SEP 2013	18.15	ND(386)	NA	NA	NA
JULY 2014	15.07	283	ND(261)	NA	NA
JULY 2015	18.48	ND(347)	ND(289)	NA	NA
AUG 2016	14.98	332	ND(272)	NA	NA
AUG 2017	18.06	497	ND(250)	NA	NA
AUG 2018	17.52	ND(329)	ND(274)	NA	NA

AP-7189	Water Level (BTOC) (feet)	DRO µg/L	RRO µg/L	GRO µg/L	Benzene µg/L
JUN 1996	NR	9,600	NA	2,600	45
OCT 1996	NR	14,000	NA	3,400	28
SEP 1997	NR	5,900	NA	ND (34)	11
SEP 1998	NR	4,300	NA	830	ND (1)
AUG 2000	NR	4,100	NA	1,100	5.5
OCT 2001	16.65	19,100	1,300	970	9.7
OCT 2002	15.70	39,600	ND (6,060)	755	3.8
AUG 2003	14.60	45,100	2,320	712	1.9
SEP 2004	16.93	16,900	1,280	999	5.10
SEP 2005	16.15	18,600	2,330	394	3.91
OCT 2006	16.57	6,760	506	371	3.59
SEP 2007	16.09	9,410	1,500	418	2.79
SEP 2008	15.42	35,000	990	420	0.71
SEP 2009	16.26	10,000	730	NA	NA
OCT 2010	17.4	6,530	811	NA	NA
OCT 2011	16.27	8,650	NA	NA	NA
OCT 2012	16.50	18,000	NA	NA	1.9
SEP 2013	16.48	21,500	NA	NA	NA
JULY 2014	13.34	32,300	3,070	NA	NA
JULY 2015	16.82	53,600	2,960	NA	NA
AUG 2016	13.40	40,400	2,800	NA	NA
AUG 2017	16.48	26,200	1,760	NA	NA
AUG 2018	15.87	33,600	2,190	NA	NA

AP-7187	Water Level (BTOC) (feet)	DRO µg/L	RRO µg/L	GRO µg/L	Benzene µg/L
JUN 1996	NR	4,500	NA	3,100	29
OCT 1996	NR	4,400	NA	2,000	13
SEP 1997	NR	4,300	NA	930	9.8
SEP 1998	NR	4,600	NA	1,100	ND (5)
AUG 2000	NR	2,700	NA	600	ND (2)
OCT 2001	16.48	4,900	ND (1,100)	520	ND (0.5)
OCT 2002	15.52	31,300	ND (5,750)	350	0.6
AUG 2003	14.39	39,200	2,380	770	ND (0.5)
SEP 2004	16.73	2,840	534	122	0.160
OCT 2006	16.38	4,310	526	92.8	0.353
SEP 2007	15.92	30,600	3,780	159	ND (0.5)
SEP 2008	15.25	44,000	3,000	610	0.38
SEP 2009	16.00	9,500	730	NA	NA
OCT 2010	17.15	7,360	1,060	NA	NA
OCT 2011	16.10	10,500	1,260	NA	NA
OCT 2012	16.35	5,390	454	NA	ND (0.24)
SEP 2013	16.23	5,850	291	NA	NA
JULY 2014	13.11	28,400	3,830	NA	NA
JULY 2015	16.69	1,840	501	NA	NA
AUG 2016	13.22	20,700	2,430	NA	NA
AUG 2017	16.15	4,762	249	NA	NA
AUG 2018	15.86	8,900	834	NA	NA

AP-7178	Water Level (BTOC) (feet)	DRO µg/L	RRO µg/L	GRO µg/L	Benzene µg/L
JUN 1996	NR	4,500	NA	940	22
OCT 1996	NR	14,000	NA	600	19
SEP 1997	NR	3,500	NA	ND (34)	ND (0.1)
SEP 1998	NR	5,600	NA	ND (100)	ND (1)
AUG 2000	NR	2,000	NA	ND (100)	ND (2)
OCT 2001	14.90	1,900	ND (1,100)	ND (90)	ND (0.5)
OCT 2002	13.94	3,440	1,180	ND (90)	ND (0.5)
AUG 2003	12.90	50,600	6,550	ND (50)	ND (0.5)
SEP 2004	15.12	5,200	1,340	30.8	ND (0.5)
SEP 2005	14.59	4,240	941	ND (90)	0.216
OCT 2006	15.13	3,400	704	22.3	0.351
SEP 2007	14.72	7,560	1,240	18.6	ND (0.5)
SEP 2008	14.59	13,000	670	ND (50)	0.38
SEP 2009	13.90	650	120	NA	NA
OCT 2010	15.06	480	185	NA	NA
OCT 2011	14.10	80,600	NA	NA	NA
OCT 2012	14.35	1,010	NA	NA	ND (0.24)
SEP 2013	14.19	431	NA	NA	NA
JULY 2014	10.98	6,490	438	NA	NA
JULY 2015	14.62	31,500	4,060	NA	NA
AUG 2016	11.09	8,650	1,850	NA	NA
AUG 2017	14.08	24,200	4,590	NA	NA
AUG 2018	13.55	33,700	4,530	NA	NA

AP-7183	Water Level (BTOC) (feet)	DRO µg/L	RRO µg/L	GRO µg/L	Benzene µg/L
JUN 1996	NR	210	NA	49	0.05
OCT 1996	NR	160	NA	ND (100)	ND (1)
SEP 1997	NR	110	NA	ND (34)	ND (1)
SEP 1998	NR	ND (250)	NA	ND (100)	ND (1)
AUG 2000	NR	65	NA	ND (100)	ND (2)
OCT 2002	16.70	ND (550)	ND (1,100)	ND (90)	ND (0.5)
AUG 2003	15.50	ND (120)	ND (190)	ND (90)	ND (0.5)
SEP 2004	17.75	96.3	302	ND (90)	ND (0.5)
SEP 2005	17.03	101	222	ND (90)	ND (0.5)
OCT 2006	17.43	94.9	284	14.7	0.181
SEP 2007	17.00	68	206	ND (100)	ND (0.5)
SEP 2008	16.38	43	54	ND (50)	ND (1)
SEP 2009	17.13	110	98	NA	NA
OCT 2010	18.22	ND(800)	219	NA	NA
OCT 2011	17.20	ND(652)	NA	NA	NA
OCT 2012	17.50	ND(388)	NA	NA	ND (0.24)
SEP 2013	17.40	ND(396)	NA	NA	NA
JULY 2014	14.12	ND(300)	ND(250)	NA	NA
JULY 2015	17.94	ND(332)	ND(202)	NA	NA
AUG 2016	14.19	175	204	NA	NA
AUG 2017	17.18	325	ND(256)	NA	NA
AUG 2018	16.60	227	ND(272)	NA	NA

AP-6729	Water Level (BTOC) (feet)	DRO µg/L	RRO µg/L	GRO µg/L	Benzene µg/L
JUN 1996	NR	1,900	NA	50	8.9
OCT 1996	NR	3,000	NA	180	16
SEP 1997	NR	890	NA	ND (34)	ND (0.1)
SEP 1998	NR	ND (250)	NA	ND (100)	ND (1)
AUG 2000	NR	180	NA	ND (100)	ND (2)
OCT 2001	18.09	6,300	1,100	ND (90)	ND (0.5)
OCT 2002	17.14	3,550	ND (1,130)	ND (90)	ND (0.5)
AUG 2003	16.20	1,040	ND (335)	ND (90)	ND (0.5)
SEP 2004	18.31	4,440	884	40.8	ND (0.5)
SEP 2005	17.55	2,920	759	ND (90)	ND (0.5)
OCT 2006	17.98	3,330	477	41.3	0.319
SEP 2007	17.53	1,720	801	43.4	ND (0.5)
SEP 2008	16.87	550	110	0.02	0.35
SEP 2009	17.63	2,700	320	NA	NA
OCT 2010	18.82	3,270	701	NA	NA
OCT 2011	17.67	1,860	NA	NA	NA
OCT 2012	17.91	1,090	NA	NA	ND (0.24)
SEP 2013	17.91	1,950	NA	NA	NA
JULY 2014	14.61	1,430	ND(250)	NA	NA
JULY 2015	18.28	4,440	703	NA	NA
AUG 2016	14.73	2,240	381	NA	NA
AUG 2017	17.69	3,670	476	NA	NA
AUG 2018	17.13	6,150	909	NA	NA

BUILDING 3563

EXISTING RAILROAD TRACKS

MW3564-1

AP-7191

AP-7183

BUILDING 3559 (WATER WELL PUMP HOUSE)

AP-6729

AP-7189

AP-7187

AP-7180

AP-7178

APPROXIMATE EXTENT OF CONCRETE BALLAST BURIED 12.5' TO 15' BELOW GRADE

APPROXIMATE EXTENT OF FORMER AS/SVE TREATMENT SYSTEM

FORMER BUILDING 3564

AP-7185

AP-7176

BUILDING 3565

APPROXIMATE DIRECTION OF REGIONAL GROUNDWATER FLOW

0 20 40 80

SCALE IN FEET

ADEC Cleanup Levels in µg/L

4.6	Benzene
1,500	DRO
2,200	GRO
1,100	RRO

SOURCE:

CH2MHILL, FORT WAINWRIGHT GROUNDWATER SAMPLING PROGRAM 2003, OCTOBER 2003

LEGEND

AP-7183 Monitoring Well

AP-7180 Monitoring Well No Longer Sampled

Water Supply Well

µg/L Micrograms per Liter

NA - Not Analyzed

ND - Not Detected (LOD)

NR - Not Reported

BTOC - Feet Below Top of Casing

DRO - Diesel-Range Organics

GRO - Gasoline-Range Organics

RRO - Residual-Range Organics

Notes:

1. Sample data shown in RED indicate analyte concentration exceeds ADEC Cleanup Level (18 AAC 75, Table C)
2. Wells no longer sampled are shown in grayscale.
3. ADEC Cleanup levels for GRO changed from 1,300 µg/L to 2,200 µg/L in October 2008.
4. Data flags are not included on figure for clarity. Data flags are presented on Table C-2.

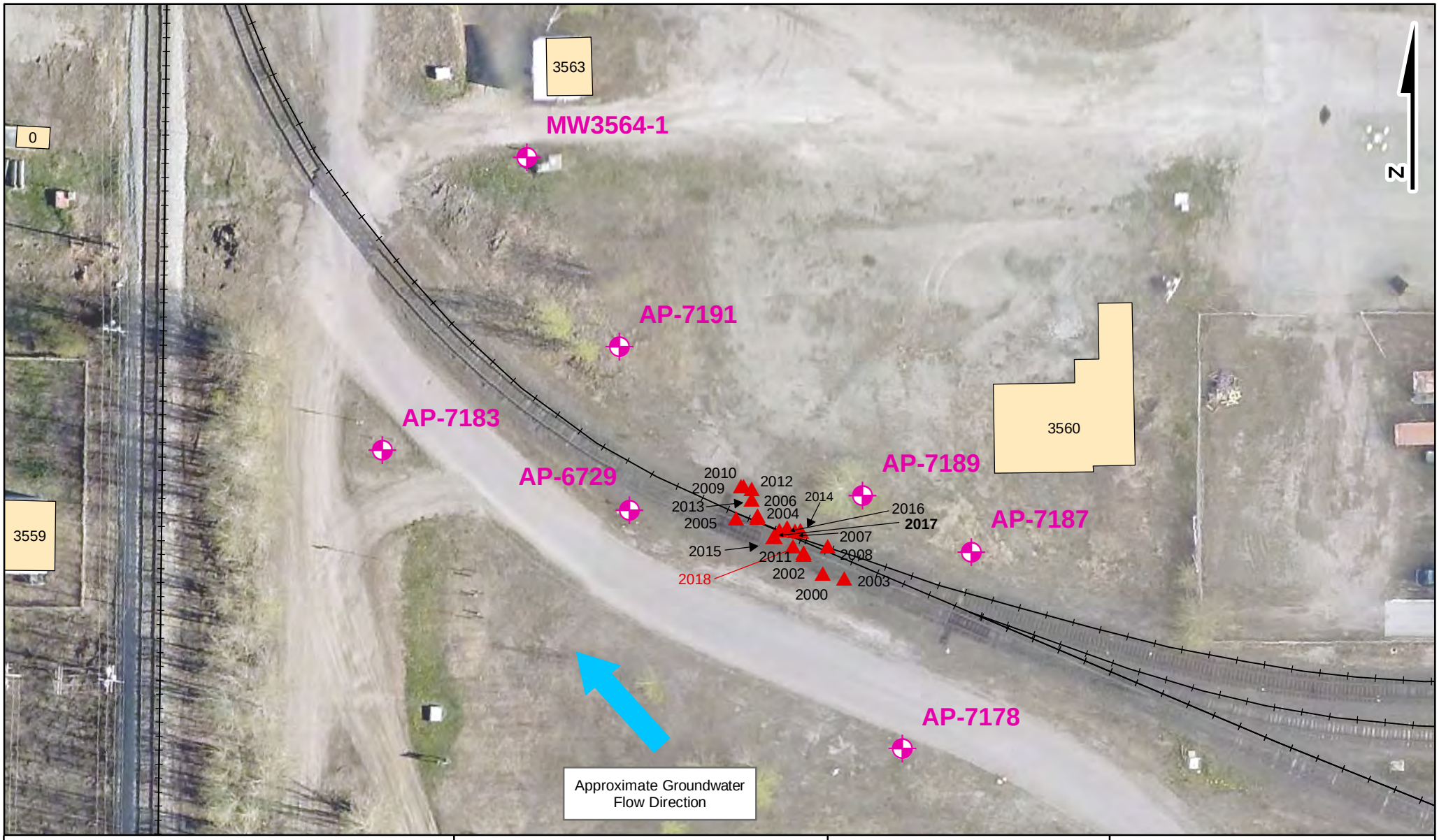
Fairbanks Environmental Services
3538 International Street
Fairbanks, Alaska

USAGAK

Concentrations of Analytes in Groundwater at Former Building 3564

2018 Sampling Report
Two Party Sites
U.S. Army Garrison Alaska

USACE Contract: W911KB-16-D-0005 | Figure: 3-1 | Date: 2/19



NOTES:
1. Center of Mass Locations based on MAROS software spatial moment analysis

2. Aerial image provided by Fairbanks North Star Borough, 2017

Monitoring Well

DRO Center of Mass

Railroad

Fairbanks Environmental Services
3538 International Street
Fairbanks, AK 99701

USAGAK

DRO Center of Mass at Former Building 3564

2018 Sampling Report
Two Party Sites
US Army Garrison Alaska

USACE Contract: W911KB-16-D-0005	Figure: 3-4	Date: 2/19

4.0 INSTITUTIONAL CONTROL SURVEY

ICs include restrictions for unauthorized excavation and restrictions for installation of drinking water wells to prevent exposure to contaminants remaining on site above ADEC cleanup levels (ADEC, 2018). These ICs are maintained as part of the Fort Wainwright Land Use Controls/ICs program (FWA Garrison Policy #38) (U.S. Army Garrison-Alaska [USAGAK], 2017).

An IC survey was completed on May 22, 2018. The purpose of the IC inspection is to ensure that the ICs for Former Building 3564 are being met. The following are the site specific ICs:

- Prevent unauthorized soil disturbing activities to a depth more than six inches bgs
- Prevent installation of wells for drinking water purposes
- Prevent use of groundwater except for monitoring and remediation activities
- Protect existing monitoring wells

The IC inspection included a site visit, review of the Fort Wainwright IC geographic information system (GIS) layer, and a review of the site-specific information in the ADEC Contaminated Sites database. The results of the IC survey are presented in the 2018 Annual Institutional Controls Report (FES, anticipated in 2019) and summarized below:

- No changes to site or adjacent land use were noted
- The IC policy for this site is being followed
- There was no visual evidence of unauthorized on-site well installation or groundwater use, and no evidence of soil disturbing activities

All of the monitoring wells at the Building 3564 source area were inspected and found to be in satisfactory condition with one exception, AP-7187. It was noted during the 2013 IC inspection that AP-7187 was bent and had potentially been hit by a vehicle. Maintenance was not conducted on this well and it has been observed to be in the same condition each year since 2013; however, the well is still viable and a sample has been collected from this well each year. During the 2018 IC inspection, it was noted that the well had a significant dent in the lower portion of the metal outer casing and it appeared the well had again been hit by a vehicle. The 2018 groundwater sampling form noted that the well casing on AP-7187 was broken, most likely due to the most recent damage. This well is still viable for sampling with a submersible pump; however, drawdown parameters were not able to be collected when the well was purged for sampling. It is recommended that AP-7187 be converted to a flushmount well to minimize future damage to the well. It is recommended that implementation of the repair to AP-7187 be conducted during the 2019 field season. Photographs of the damage to AP-7187 are provided in Appendix E. An IC inspection will be conducted in 2019 at Building 3564.

5.0 REFERENCES

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APPENDIX A

GROUNDWATER SAMPLING FORMS AND
GROUNDWATER FIELD MEASUREMENTS

Table A-1 -Two Party Sites Groundwater Sample Field Measurements

Well ID	Sample ID	Sample Date	Sample Time	Field Measurements								
				Water Depth (feet btoc)	Drawdown (feet)	Temp (°C)	Conductivity (mS/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (NTU)	Well Stabilized[1] (Y/N)
Former Building 3564												
AP-7178	18FW6406WG	8/9/2018	1000	13.55	0.01	6.51	0.91	0.68	6.49	-104.70	9.61	Y
AP-7187	18FW6405WG	8/9/2018	830	15.86	*	7.30	0.64	1.39	6.52	-91.70	5.81	Y
AP-7189	18FW6404WG	8/8/2018	1320	15.87	0.02	7.80	0.91	1.80	6.55	-113.50	32.89	Y
AP-6729	18FW6407WG	8/9/2018	1100	17.13	0.00	7.62	0.86	0.54	6.92	-128.50	6.48	Y
AP-7183	18FW6408WG	8/9/2018	1210	16.60	0.00	9.30	0.99	0.82	6.91	46.00	0.61	Y
AP-7191	18FW6402WG	8/8/2018	1145	16.44	0.00	6.63	0.73	1.00	7.01	-146.10	6.91	Y
MW3564-1	18FW6401WG	8/8/2018	1030	17.52	0.00	15.72	0.85	1.60	7.00	-30.40	7.30	Y

Notes:

[1] Well stabilization as defined by ADEC Draft Field Sampling Guidance (August 2017).
Individulal parameter stabilization discrepancies and potential impact to data quality is discussed in the CDQR.
* Unable to measue drawdown due to broken well casing and insufficient water in well

Acronyms

°C - degree Celcius
bgs - below ground surface
DO - dissolved oxygen
mg/L - milligrams per liter
mS/cm - millisiemens per centimeter
mV - millivolts
NTU - nephelomatic turbidity units
ORP - oxidation reduction potential

GROUNDWATER SAMPLE FORM | **Former Building 3564** | **Ft. Wainwright, Alaska**

Project #: 9011-08 | Site Location: Former Building 3564

Date: 8/8/18 | Probe/Well #: MW3564-1

Time: 1030 | Sample ID: 18FW64 01 WG

Sampler: SK

Weather: Cloudy | Outside Temperature: 51°F

QA/QC Sample ID/Time/LOCID: | MS/MSD Performed? Yes/(No)

Purge Method: Peristaltic Pump / (Submersible) / Bladder | Sample Method: Peristaltic Pump / (Submersible) / Hydrasleeve / Bladder / Other

Equipment Used for Sampling: YSI # 8 | Turbidity Meter #: 12 | Water Level: SOL 13

Free Product Observed in Probe/Well? Yes/(No) | If Yes, Depth to Product: 2

Column of Water in Probe/Well | Sampling Depth: 10' screen

Total Depth in Probe/Well (feet btoc): 23.60 | Well Screened (Across) / Below water table

Depth to Water from TOC (feet): - 17.52 | Depth tubing / pump intake set* approx. 18.5 feet below top of casing

Column of Water in Probe/Well (feet): = 6.08 | *Tubing/pump intake must be set approximately 2 feet below the water table for wells screened across the water table, or in the middle of the screened interval for wells screened below the water table

Circle: Gallons per foot of 1.25" (X 0.064) or 2" (X 0.163) or 4" (X 0.65)

Volume of Water in 1 Probe/Well Casing (gal): 0.99

Micropurge well/probe at a rate of 0.03 to 0.15 GPM until parameters stabilize or 3 casing volumes have been removed. If well draws down below tubing or pump intake, stop purging and sample as a low-yield well using a no-purge technique.

Field Parameters:		±3% (or ±0.2°C max)	At least 3 of the 5 parameters below must stabilize					<0.33 feet after initial drawdown
			±3%	±10% (<1mg/L, ±0.2 mg/L)	±0.1 units	±10 mV	±10% (<10NTU, ±1NTU)	
Water Removed (gal)	Time Purged (min)	Temperature (°C)	Conductivity (mS/cm)	Dissolved O_2 (mg/L)	pH	Potential (mV)	Turbidity (NTU)	Water Level (ft)
0.5	5	16.88	0.860	3.95	6.98	86.4	62.25	17.58
1.0	10	16.40	0.845	2.13	6.99	22.4	14.99	17.58
1.5	15	16.30	0.842	1.78	6.99	-14.2	11.57	17.58
2.0	20	15.99	0.851	1.69	6.99	-20.1	9.24	17.58
2.5	25	15.86	0.849	1.58	6.99	-29.4	8.07	17.58
3.0	30	15.75 x	0.850	1.67 ✓	6.99 ✓	-28.3 ✓	7.83 x	17.58
3.5	35	15.72	0.847	1.60	7.00	-30.4	7.30	17.58

Did groundwater parameters stabilize? (Yes) / No If no, why not?

Did drawdown stabilize? (Yes) / No If no, why not?

Was flowrate between 0.03 and 0.15 GPM? (Yes) / No If no, why not?

Water Color: (Clear) Yellow Orange Brown/Black (Sand/Silt) Other:

Well Condition: Locked (Y) / N Labeled with LOC ID (Y) / N Comments:

Sheen: Yes / (No) Odor: Yes / (No) Notes/Comments:

Laboratory Analyses (Circle): (DRO, RRO, Iron, Sulfate)

pH checked of samples: (Y) / N Approximate volume added (mL): HCl = 0 HNO_3 = 0

Purge Water

Gallons generated: 3.5 Containerized and disposed as IDW? (Yes) / No If No, why not?

Disposal method: (POL Water) / CERCLA Waste * Purge water stored in the DERA Building for characterization prior to disposal

Sampler's Initials: SK

GROUNDWATER SAMPLE FORM | **Former Building 3564** | **Ft. Wainwright, Alaska**

Project #: 9011-08
Site Location: Former Building 3564
Date: 8/8/18
Probe/Well #: AP-7191
Time: 1145
Sample ID: 18FW64 02 WG
Sampler: SK
Weather: Cloudy
Outside Temperature: 51°F
QA/QC Sample ID/Time/LOCID: 18FW6403WG / 1200 / AP7070
MS/MSD Performed? (Yes) No

Purge Method: Peristaltic Pump / (Submersible) / Bladder
Sample Method: Peristaltic Pump / (Submersible) / Hydrasleeve / Bladder / Other

Equipment Used for Sampling: YSI # 8 Turbidity Meter #: 12 Water Level: SOL 13

Free Product Observed in Probe/Well? Yes (No) If Yes, Depth to Product: 0

Column of Water in Probe/Well
Total Depth in Probe/Well (feet btoc): 22.03
Depth to Water from TOC (feet): - 16.44
Column of Water in Probe/Well (feet): = 5.59
Circle: Gallons per foot of 1.25" (X 0.064) or 2" (X 0.163) or 4" (X 0.65)
Volume of Water in 1 Probe/Well Casing (gal): 0.91

Sampling Depth 10' screen
Well Screened (Across) / Below water table
Depth tubing / pump intake set* approx. 17.4 feet below top of casing
*Tubing/pump intake must be set approximately 2 feet below the water table for wells screened across the water table, or in the middle of the screened interval for wells screened below the water table

Micropurge well/probe at a rate of 0.03 to 0.15 GPM until parameters stabilize or 3 casing volumes have been removed. If well draws down below tubing or pump intake, stop purging and sample as a low-yield well using a no-purge technique.

Field Parameters:		±3% (or ±0.2°C max)	At least 3 of the 5 parameters below must stabilize					<0.33 feet after initial drawdown
			±3%	±10% (<1mg/L, ±0.2 mg/L)	±0.1 units	±10 mV	±10% (<10NTU, ±1NTU)	
Water Removed (gal)	Time Purged (min)	Temperature (°C)	Conductivity (mS/cm)	Dissolved O_2 (mg/L)	pH	Potential (mV)	Turbidity (NTU)	Water Level (ft)
0.5	5	7.42	0.693	1.79	6.99	-138.4	44.32	16.51
1.0	10	6.91	0.702	1.30	7.00	-141.0	25.38	16.51
1.5	15	6.83	0.718	1.13	7.00	-143.3	19.73	16.51
2.0	20	6.79	0.717	1.05	7.01	-145.3	11.26	16.51
2.5	25	6.67	0.725	1.02	7.01	-145.6	7.05	16.51
3.0	30	6.63 ✓	0.726 ✓	1.00 ✓	7.01 ✓	-146.1 ✓	6.91	16.51

SK

Did groundwater parameters stabilize? (Yes) / No If no, why not?
Did drawdown stabilize? (Yes) / No If no, why not?
Was flowrate between 0.03 and 0.15 GPM? (Yes) / No If no, why not?
Water Color: (Clear) Yellow Orange Brown/Black (Sand/Silt) Other:
Well Condition: Locked (Y) / N Labeled with LOC ID: (Y) / N Comments:
Sheen: Yes / (No) Odor: (Yes) / No Notes/Comments:

Laboratory Analyses (Circle): (DRO, RRO, Iron, Sulfate)
pH checked of samples: (Y) / N Approximate volume added (mL): HCl = 0 HNO_3 = 0

Purge Water
Gallons generated: 4.10 Containerized and disposed as IDW? (Yes) / No If No, why not?
Disposal method? (POL Water) / CERCLA Waste * Purge water stored in the DERA Building for characterization prior to disposal
Sampler's Initials: SK

GROUNDWATER SAMPLE FORM | **Former Building 3564** | **Ft. Wainwright, Alaska**

Project #: 9011-08 | Site Location: Former Building 3564

Date: 8/8/18 | Probe/Well #: AP-7189

Time: 1320 | Sample ID: 18FW64 04 WG

Sampler: JK

Weather: Cloudy | Outside Temperature: 52°F

QA/QC Sample ID/Time/LOCID: | MS/MSD Performed? Yes / No

Purge Method: Peristaltic Pump / Submersible / Bladder | Sample Method: Peristaltic Pump / Submersible / Hydrasleeve / Bladder / Other

Equipment Used for Sampling: YSI # 8 | Turbidity Meter #: 12 | Water Level: SOL 13

Free Product Observed in Probe/Well? Yes/No | If Yes, Depth to Product: 2

Column of Water in Probe/Well | Sampling Depth

Total Depth in Probe/Well (feet btoc): 21.92 | Well Screened Across / Below water table

Depth to Water from TOC (feet): - 15.87 | Depth tubing / pump intake set* approx. 16.8 feet below top of casing

Column of Water in Probe/Well (feet): = 6.05 | *Tubing/pump intake must be set approximately 2 feet below the water table for wells screened across the water table, or in the middle of the screened interval for wells screened below the water table

Circle: Gallons per foot of 1.25" (X 0.064) or 2" (X 0.163) or 4" (X 0.65)

Volume of Water in 1 Probe/Well Casing (gal): 0.99

Micropurge well/probe at a rate of 0.03 to 0.15 GPM until parameters stabilize or 3 casing volumes have been removed. If well draws down below tubing or pump intake, stop purging and sample as a low-yield well using a no-purge technique.

Field Parameters:		±3% (or ±0.2°C max)	At least 3 of the 5 parameters below must stabilize					<0.33 feet after initial drawdown
			±3%	±10% (<1mg/L, ±0.2 mg/L)	±0.1 units	±10 mV	±10% (<10NTU, ±1NTU)	
Water Removed (gal)	Time Purged (min)	Temperature (°C)	Conductivity (mS/cm)	Dissolved O_2 (mg/L)	pH	Potential (mV)	Turbidity (NTU)	Water Level (ft)
0.5	5	7.80	0.902	5.67	6.53	-86.8	23.72	15.94
1.0	10	7.76	0.913	3.65	6.51	-94.5	27.21	15.94
1.5	15	7.75	0.918	2.23	6.52	-103.9	30.37	15.92
2.0	20	7.69	0.917	2.01	6.54	-110.0	33.49	15.92
2.5	25	7.76	0.914	1.87	6.54	-114.0	35.23	15.92
3.0	30	7.80 ✓	0.909 ✓	1.80 ✓	6.55 ✓	-113.5 ✓	32.89	15.92

JK

Did groundwater parameters stabilize? Yes / No If no, why not?

Did drawdown stabilize? Yes / No If no, why not?

Was flowrate between 0.03 and 0.15 GPM? Yes/No If no, why not?

Water Color: Clear / Yellow / Orange / Brown/Black (Sand/Silt) Other:

Well Condition: Lock Y / N Labeled with LOC ID: Y / N Comments:

Sheen: Yes / No Odor: Yes / No Notes/Comments:

Laboratory Analyses (Circle): DRO, RRO, Iron, Sulfate

pH checked of samples: Y / N Approximate volume added (mL): HCl = 0 HNO_3 = 0

Purge Water

Gallons generated: 3.25 Containerized and disposed as IDW? Yes / No If No, why not?

Disposal method*: POL Water / CERCLA Waste * Purge water stored in the DERA Building for characterization prior to disposal

Sampler's Initials: JK

GROUNDWATER SAMPLE FORM | **Former Building 3564** | **Ft. Wainwright, Alaska**

Project #: 9011-08 | Site Location: Former Building 3564

Date: 8/9/18 | Probe/Well #: AP-7187

Time: 0830 | Sample ID: 18FW6405WG

Sampler: SK

Weather: P.Cloudy | Outside Temperature: 45°F

QA/QC Sample ID/Time/LOCID: | MS/MSD Performed? Yes/(No)

Purge Method: Peristaltic Pump / (Submersible) / Bladder | Sample Method: Peristaltic Pump / (Submersible) / Hydrasleeve / Bladder / Other

Equipment Used for Sampling: YSI # 8 | Turbidity Meter #: 12 | Water Level: SOL 13

Free Product Observed in Probe/Well? Yes/(No) | If Yes, Depth to Product: —

Column of Water in Probe/Well | Sampling Depth: 10' screen

Total Depth in Probe/Well (feet btoc): 17.70 | Well Screened (Across) / Below water table

Depth to Water from TOC (feet): - 15.86 | Depth tubing / pump intake set* approx. 16.8 feet below top of casing

Column of Water in Probe/Well (feet): = 1.84 | *Tubing/pump intake must be set approximately 2 feet below the water table for wells screened across the water table, or in the middle of the screened interval for wells screened below the water table

Circle: Gallons per foot of 1.25" (X 0.064) or 2" (X 0.163) or 4" (X 0.65)

Volume of Water in 1 Probe/Well Casing (gal): 0.3

Micropurge well/probe at a rate of 0.03 to 0.15 GPM until parameters stabilize or 3 casing volumes have been removed. If well draws down below tubing or pump intake, stop purging and sample as a low-yield well using a no-purge technique.

Field Parameters:		±3% (or ±0.2°C max)	At least 3 of the 5 parameters below must stabilize					<0.33 feet after initial drawdown
			±3%	±10% (<1mg/L, ±0.2 mg/L)	±0.1 units	±10 mV	±10% (<10NTU, ±1NTU)	
Water Removed (gal)	Time Purged (min)	Temperature (°C)	Conductivity (mS/cm)	Dissolved O_2 (mg/L)	pH	Potential (mV)	Turbidity (NTU)	Water Level (ft)
0.5	5	7.33	0.668	3.32	6.53	-88.6	13.21	NA
1.0	10	7.32	0.652	1.81	6.49	-90.8	7.77	—
1.5	15	7.28	0.648	1.67	6.50	-92.1	6.13	—
2.0	20	7.29	0.646	1.51	6.51	-91.9	5.16	—
2.5	25	7.25	0.645	1.40	6.51	-91.6	6.22	—
3.0	30	7.30 ✓	0.644 ✓	1.39 ✓	6.52 ✓	-91.7	5.81	—

SK

Did groundwater parameters stabilize? (Yes) / No If no, why not?

Did drawdown stabilize? Yes / No If no, why not? Well casing broken. using top of overcasing for measurement

Was flowrate between 0.03 and 0.15 GPM? (Yes)/No If no, why not? ↳ pump obstructing the top of water.

Water Color: (Clear) Yellow Orange Brown/Black (Sand/Silt) Other:

Well Condition: Locked (Y) / N Labeled with LOC ID (Y) / N Comments:

Sheen: (Yes) / No Odor (Yes) / No Notes/Comments:

Laboratory Analyses (Circle): (DRO, RRO, Iron, Sulfate)

pH checked of samples: (Y) / N Approximate volume added (mL): HCl = 0 HNO_3 = 0

Purge Water

Gallons generated: 3.25 Containerized and disposed as IDW? (Yes) / No If No, why not?

Disposal method*: (POL Water) / CERCLA Waste * Purge water stored in the DERA Building for characterization prior to disposal

Sampler's Initials: SK

GROUNDWATER SAMPLE FORM | **Former Building 3564** | **Ft. Wainwright, Alaska**

Project #: 9011-08
Date: 8/9/18
Time: 1000
Sampler: SK
Weather: Cloudy
QA/QC Sample ID/Time/LOCID:

Site Location: Former Building 3564
Probe/Well #: AP-7178
Sample ID: 18FW64 06 WG
Outside Temperature: 45
MS/MSD Performed? Yes/(No)

Purge Method: Peristaltic Pump / (Submersible) / Bladder
Sample Method: Peristaltic Pump / (Submersible) / Hydrasleeve / Bladder / Other
Equipment Used for Sampling: YSI # 8 Turbidity Meter #: 12 Water Level: SOL/3
Free Product Observed in Probe/Well? Yes/(No) If Yes, Depth to Product:

Column of Water in Probe/Well
Total Depth in Probe/Well (feet btoc): 17.56
Depth to Water from TOC (feet): - 13.55
Column of Water in Probe/Well (feet): = 4.01
Circle: Gallons per foot of 1.25" (X 0.064) or 2" (X 0.163) or 4" (X 0.65)
Volume of Water in 1 Probe/Well Casing (gal): 0.65

Sampling Depth
Well Screened (Across) / Below water table
Depth tubing / pump intake set* approx. 14.5 feet below top of casing
*Tubing/pump intake must be set approximately 2 feet below the water table for wells screened across the water table, or in the middle of the screened interval for wells screened below the water table

Micropurge well/probe at a rate of 0.03 to 0.15 GPM until parameters stabilize or 3 casing volumes have been removed. If well draws down below tubing or pump intake, stop purging and sample as a low-yield well using a no-purge technique.

Field Parameters:		±3% (or ±0.2°C max)	At least 3 of the 5 parameters below must stabilize					<0.33 feet after initial drawdown
			±3%	±10% (<1mg/L, ±0.2 mg/L)	±0.1 units	±10 mV	±10% (<10NTU, ±1NTU)	
Water Removed (gal)	Time Purged (min)	Temperature (°C)	Conductivity (mS/cm)	Dissolved O_2 (mg/L)	pH	Potential (mV)	Turbidity (NTU)	Water Level (ft)
0.5	5	7.12	0.874	1.89	6.49	-74.8	36.87	13.58
1.0	10	6.62	0.905	1.08	6.48	-88.6	22.28	13.59
1.5	15	6.40	0.909	0.84	6.48	-94.7	17.32	13.59
2.0	20	6.53	0.909	0.75	6.48	-98.6	13.42	13.59
2.5	25	6.54	0.905	0.72	6.48	-101.6	10.87	13.59
3.0	30	6.51	0.905	0.68	6.49	-104.7	9.61	13.59
			SK					

Did groundwater parameters stabilize? (Yes) / No If no, why not?
Did drawdown stabilize? (Yes) / No If no, why not?
Was flowrate between 0.03 and 0.15 GPM? (Yes) No If no, why not?
Water Color: (Clear) Yellow Orange Brown/Black (Sand/Silt) Other:
Well Condition: Lock: (Y) / N Labeled with LOC ID: Y / N Comments:
Sheen: Yes / (No) Odor: (Yes) / No Notes/Comments:

Laboratory Analyses (Circle): (DRO, RRO) Iron, Sulfate
pH checked of samples: (Y) / N Approximate volume added (mL): HCl = 0 HNO_3 = 0

Purge Water
Gallons generated: 3.5 Containerized and disposed as IDW? (Yes) / No If No, why not?
Disposal method* (POL Water) / CERCLA Waste * Purge water stored in the DERA Building for characterization prior to disposal
Sampler's Initials: SK

GROUNDWATER SAMPLE FORM | **Former Building 3564** | **Ft. Wainwright, Alaska**

Project #: 9011-08
Site Location: Former Building 3564
Date: 8/9/18
Probe/Well #: AP-6729
Time: 1100
Sample ID: 18FW64 07 WG
Sampler: JK
Weather: P. Cloudy
Outside Temperature: 50°F
QA/QC Sample ID/Time/LOCID:
MS/MSD Performed? Yes/No

Purge Method: Peristaltic Pump / Submersible / Bladder
Sample Method: Peristaltic Pump / Submersible / Hydrasleeve / Bladder / Other
Equipment Used for Sampling: YSI # 8 Turbidity Meter #: 12 Water Level: SOL 13
Free Product Observed in Probe/Well? Yes/No If Yes, Depth to Product: X

Column of Water in Probe/Well
Total Depth in Probe/Well (feet btoc): 26.81
Depth to Water from TOC (feet): - 17.13
Column of Water in Probe/Well (feet): = 9.68
Circle: Gallons per foot of 1.25" (X 0.064) or 2" (X 0.163) or 4" (X 0.65)
Volume of Water in 1 Probe/Well Casing (gal): 1.6

Sampling Depth 10' screen
Well Screened Across / Below water table
Depth tubing / pump intake set* approx. _____ feet below top of casing
*Tubing/pump intake must be set approximately 2 feet below the water table for wells screened across the water table, or in the middle of the screened interval for wells screened below the water table

Micropurge well/probe at a rate of 0.03 to 0.15 GPM until parameters stabilize or 3 casing volumes have been removed. If well draws down below tubing or pump intake, stop purging and sample as a low-yield well using a no-purge technique.

Field Parameters:		±3% (or ±0.2°C max)	At least 3 of the 5 parameters below must stabilize					<0.33 feet after initial drawdown
			±3%	±10% (<1mg/L, ±0.2 mg/L)	±0.1 units	±10 mV	±10% (<10NTU, ±1NTU)	
Water Removed (gal)	Time Purged (min)	Temperature (°C)	Conductivity (mS/cm)	Dissolved O_2 (mg/L)	pH	Potential (mV)	Turbidity (NTU)	Water Level (ft)
0.5	5	6.57	0.833	1.61	6.84	-83.1	90.07	17.21
1.0	10	7.20	0.850	0.78	6.89	-110.1	48.93	17.21
1.5	15	7.43	0.849	0.66	6.90	-117.2	19.79	17.21
2.0	20	7.52	0.855	0.61	6.92	-123.0	9.42	17.21
2.5	25	7.67	0.859	0.54	6.92	-127.0	7.71	17.21
3.0	30	7.62 ✓	0.862 ✓	0.54 ✓	6.92 ✓	-128.5	6.48	17.21

JK

Did groundwater parameters stabilize? Yes / No If no, why not?
Did drawdown stabilize? Yes / No If no, why not?
Was flowrate between 0.03 and 0.15 GPM? Yes/No If no, why not?
Water Color: Clear Yellow Orange Brown/Black (Sand/Silt) Other:
Well Condition: Locked (Y) / N Labeled with LOC ID (Y) / N Comments:
Sheen: Yes / No Odor: Yes / No Notes/Comments:

Laboratory Analyses (Circle): DRO, RRO, Iron, Sulfate
pH checked of samples: Y / N Approximate volume added (mL): HCl = 0 HNO_3 = 0

Purge Water
Gallons generated: 3.25 Containerized and disposed as IDW? Yes / No If No, why not?
Disposal method*: POL Water / CERCLA Waste * Purge water stored in the DERA Building for characterization prior to disposal
Sampler's Initials: JK

GROUNDWATER SAMPLE FORM | **Former Building 3564** | **Ft. Wainwright, Alaska**

Project #: 9011-08
Site Location: Former Building 3564
Date: 8/9/18
Probe/Well #: AP-7183
Time: 1210
Sample ID: 18FW6408WG
Sampler: JK
Weather: P.Cloudy
Outside Temperature: 52 °F
QA/QC Sample ID/Time/LOCID:
MS/MSD Performed? Yes/(No)

Purge Method: Peristaltic Pump / (Submersible) / Bladder
Sample Method: Peristaltic Pump / (Submersible) / Hydrasleeve / Bladder / Other
Equipment Used for Sampling: YSI # 8 Turbidity Meter #: 12 Water Level: SOL13
Free Product Observed in Probe/Well? Yes/(No) If Yes, Depth to Product: —
Column of Water in Probe/Well
Sampling Depth 10' screen
Total Depth in Probe/Well (feet btoc): 22.01
Well Screened (Across) / Below water table
Depth to Water from TOC (feet): - 16.60
Depth tubing / pump intake set* approx. 17.6 feet below top of casing
Column of Water in Probe/Well (feet): = 5.41
*Tubing/pump intake must be set approximately 2 feet below the water table for wells screened across the water table, or in the middle of the screened interval for wells screened below the water table
Circle: Gallons per foot of 1.25" (X 0.064) or 2" (X 0.163) or 4" (X 0.65)
Volume of Water in 1 Probe/Well Casing (gal): 0.88

Micropurge well/probe at a rate of 0.03 to 0.15 GPM until parameters stabilize or 3 casing volumes have been removed. If well draws down below tubing or pump intake, stop purging and sample as a low-yield well using a no-purge technique.

Field Parameters:		±3% (or ±0.2°C max)	At least 3 of the 5 parameters below must stabilize					<0.33 feet after initial drawdown
			±3%	±10% (<1mg/L, ±0.2 mg/L)	±0.1 units	±10 mV	±10% (<10NTU, ±1NTU)	
Water Removed (gal)	Time Purged (min)	Temperature (°C)	Conductivity (mS/cm)	Dissolved O_2 (mg/L)	pH	Potential (mV)	Turbidity (NTU)	Water Level (ft)
0.5	5	9.89	1.041	2.46	6.90	16.1	5.06	16.68
1.0	10	9.37	0.999	1.37	6.92	28.2	1.30	16.68
1.5	15	9.40	1.001	1.48	6.91	32.6	0.77	16.68
2.0	20	9.45	0.994	0.87	6.92	37.0	0.58	16.68
2.5	25	9.37	0.996	0.86	6.92	42.8	0.59	16.68
3.0	30	9.30	0.994	0.82	6.91	46.0	0.61	16.68

JK

Did groundwater parameters stabilize? (Yes) / No If no, why not?
Did drawdown stabilize? (Yes) / No If no, why not?
Was flowrate between 0.03 and 0.15 GPM? (Yes)/No If no, why not?
Water Color: (Clear) Yellow Orange Brown/Black (Sand/Silt) Other:
Well Condition: Lock: (Y) / N Labeled with LOC ID: (Y) N Comments:
Sheen: Yes / (No) Odor: Yes / (No) Notes/Comments:

Laboratory Analyses (Circle): (DRO, RRO, Iron, Sulfate)
pH checked of samples: (Y) / N Approximate volume added (mL): HCl = 6 HNO3 10

Purge Water
Gallons generated: 3.5 Containerized and disposed as IDW? (Yes) / No If No, why not?
Disposal method*: (POL Water) / CERCLA Waste * Purge water stored in the DERA Building for characterization prior to disposal
Sampler's Initials: JK

Submersible Pump Equipment Blank

Rinsate #: Rinsate 01 18FW64EB01WQ

Sample ID: ↓

Date: 8/9/18

Time: 1230

Analysis: DRO/RRO/SO4/Fe

Well that the pump was last used on: AP-7183

YSI AND TURBIDIMETER CALIBRATION FORM

Operable Unit

Name: FB3564

Calibration Liquid Lot Numbers/ Expiration Dates:

SPC	ORP	Ph 4	Ph 7 or Ph 10
176100637 / 01/2019	0621 / 10/2021	18E2R / 05/2020	17025 / 04/2019

Date	Project	YSI# / Turbidity #	Bar. PSI mmHg	D.O. Pre	D.O. Post	SPC Pre	SPC Post	ORP Pre	ORP Post	Ph 4 Pre	Ph 4 Post	Ph 7 Pre	Ph 7 Post	Calibrate Turbidity Meter (Y/N)
8/8/18	3564	8/12	753.4	10.15	9.31	1.000	1.000	246.6	240.0	4.04	4.00	6.95	7.00	Yes
8/9/18	3564	8/12	756.5	8.87	9.01	0.997	1.000	237.2	240.0	3.97	4.00	7.08	7.00	Y

Notes/ Maintenance Items:

APPENDIX B

CHEMICAL DATA QUALITY REVIEW AND ADEC CHECKLISTS

FINAL

CHEMICAL DATA QUALITY REVIEW

Two-Party Site (2018)

Former Building 3564

Fort Wainwright, Alaska

NPDL # 18-090

Prepared: October 22, 2018

Prepared for and Under Contract to

Army Corps of Engineers - Alaska District

Prepared by

Fairbanks Environmental Services, Inc.

I certify that all data quality review criteria described in Section 1.1 were assessed, and that qualifications were made according to the criteria outlined in the Postwide UFP-QAPP.

Vanessa Ritchie
Senior Chemist

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LIST OF ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AK	Alaska
B	analytical result is qualified as a potential high estimate due to contamination present in a blank sample
°C	degrees Celsius
CCV	continuing calibration verification
CDQR	Chemical Data Quality Review
COC	chain-of-custody
DL	detection limit
DoD	United States Department of Defense
DQO	data quality objective
DRO	diesel range organics
ELAP	Environmental Laboratory Accreditation Program
EPA	United States Environmental Protection Agency
FES	Fairbanks Environmental Services, Inc
ICV	initial calibration verification
J	analytical result is qualified as an estimated value because the concentration is less than the LOQ
J+	analytical result is qualified as an estimated value with a high-bias due to a QC deviation
J-	analytical result is qualified as an estimated value with a low-bias due to a QC deviation
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
µg/L	micrograms per liter
mg/L	milligrams per liter
MS	matrix spike sample
MSD	matrix spike duplicate sample
NA	not applicable
NPDL	North Pacific Division Laboratory
QC	quality control
QSM	Quality Systems Manual for Environmental Laboratories
R	analytical result is rejected and is not suitable for project use
RPD	relative percent difference
RRO	residual range organics
SDG	sample data group
SGS	SGS North America, Inc.
UFP-QAPP	Postwide Uniform Federal Policy Quality Assurance Project Plans
USACE	United States Army Corps of Engineers

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1.0 INTRODUCTION

This Chemical Data Quality Review (CDQR) summarizes the technical review of analytical results generated in support of groundwater sample collection at Former Building 3564 during 2018. The groundwater sampling event is summarized in Section 1.3. Groundwater sample summary and analytical results tables are presented in Appendix C.

Fairbanks Environmental Services, Inc (FES) reviewed project and quality control (QC) analytical data to assess whether the data met the designated quality objectives and were acceptable for project use. The project data were reviewed for deviations to the requirements presented in the Final 2018 Postwide Work Plan (FES, 2018); Final Postwide Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP; FES, 2016); Alaska Department of Environmental Conservation (ADEC) Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling Technical Memo (ADEC, 2017); and United States Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (QSM), Version 5.1 (DoD, 2017). The review included evaluation of the following: sample collection and handling, holding times, blanks (to assess contamination), project sample and laboratory quality control sample duplicates (to assess precision), laboratory control samples (LCSs) and sample surrogate recoveries (to assess accuracy), and matrix spike sample (MS) recoveries (to assess matrix effects). QC deviations that do not impact data quality (e.g., high LCS recovery associated with non-detect results), are not discussed. More elaborate data quality descriptions are reported in the ADEC Laboratory Data Review Checklist, which is included at the end of Appendix B.

Groundwater results (and limits of detection [LODs] for non-detect results) were compared to 2018 ADEC groundwater cleanup levels presented in Title 18 of the Alaska Administrative Code (AAC) Chapter 75.345, Table C (ADEC, 2018).

Groundwater data quality is discussed in Section 2. Applicable data quality indicators are discussed for each method under separate subheadings. Data which did not meet acceptance criteria have been described and the associated samples and data quality implications or qualifications are summarized. All cited documents within the CDQR are listed in Section 3.

1.1 Analytical Methods and Data Quality Objectives

The analytical methods and associated data quality objectives (DQOs) used for this review were established in the UFP-QAPP (FES, 2016). The DQOs represent the minimum acceptable QC limits and goals for analytical measurements and are used as comparison criteria during data quality review to determine both the quality and usability of the analytical data. Table B-1 below summarizes the analytical methods employed, and the associated DQO goals, for groundwater samples.

Table B-1. Groundwater Analytical Methods and Data Quality Objectives

Parameter	Preparation Method	Analytical Method	Limit of Detection	Precision (RPD, %)	Accuracy (%)	Completeness (%)
Diesel Range Organics (DRO)	SW3520C	AK102	0.300 mg/L	20	75-125	90
Residual Range Organics (RRO)	SW3520C	AK103	0.250 mg/L	20	60-120	90
Iron	SW3010A	SW6020A	250 µg/L	20	87-118	90
Sulfate	300.0		100 µg/L	20	90-110	90

µg/L – micrograms per liter
mg/L – milligrams per liter
RPD – relative percent difference

The six DQOs used for this review were accuracy, precision, representativeness, comparability, sensitivity, and completeness.

- *Accuracy* measures the correctness, or the closeness, between the true value and the quantity detected. It is measured by calculating the percent recovery of known concentrations of spiked compounds that were introduced into the appropriate sample matrix. Surrogate, LCS, and MS recoveries were used to measure accuracy for this project. LCS and surrogate recovery criteria are defined in the QSM.
- *Precision* measures the reproducibility of repetitive measurements. It is measured by calculating the relative percent difference (RPD) between duplicate samples. Laboratory duplicate samples, field duplicate samples, MS and matrix spike duplicate sample (MSD) pairs, and LCS and laboratory control sample duplicate (LCSD) pairs were used to measure precision for this project. LCS/LCSD precision criteria are defined in the QSM and field duplicate precision criteria are defined in the ADEC Laboratory Data Review Checklist (water: ≤30%).
- *Representativeness* describes the degree to which data accurately and precisely represents site characteristics. This is addressed in more detail in the following section(s).
- *Comparability* describes whether two data sets can be considered equivalent with respect to the project goal. This is addressed in more detail in the following section(s).
- *Sensitivity* describes the lowest concentration that the analytical method can reliably quantitate, and is evaluated by verifying that the detected results and/or LODs meet the project specific cleanup levels and/or screening levels.
- *Completeness* describes the amount of valid data obtained from the sampling event(s). It is calculated as the percentage of valid measurements compared to the total number of measurements. The completeness goal for this project was set at 90 percent.

In addition to these criteria for the six DQOs described above, sample collection and handling procedures and blank samples were reviewed to ensure overall data quality. Sample collection forms were reviewed to verify that representative samples were collected and samples were

without headspace (if applicable). Sample handling was reviewed to assess parameters such as chain-of-custody (COC) documentation, the use of appropriate sample containers and preservatives, shipment cooler temperature, and method-specified sample holding times. Blank samples were analyzed to detect potential field or laboratory cross-contamination. Each of these parameters contributes to the general representativeness and comparability of the project data. The combination of evaluations of the above-mentioned parameters will lead to a determination of the overall project data completeness.

1.2 Data Qualifiers

Table B-2 below outlines general flagging criteria used for this project, listed in increasing severity, to indicate QC deficiencies. Data are qualified pursuant to findings determined in the review of project data.

Table B-2. Data Qualifier Definitions

Qualifier	Definition
ND	The analyte was analyzed for, but not detected.
J	The analyte is considered an estimated value. The analyte may be estimated due to its quantitation level (≥ DL and <LOQ), or it may signify that there is a QC deviation and the bias is unknown.
J+	The analyte is considered an estimated value with a high-bias due to a QC deviation.
J-	The analyte is considered an estimated value with a low-bias due to a QC deviation.
B	The analyte is detected in an associated blank. Result is less than 5x or 10x (for the common lab contaminants) the concentration. Therefore, the result may be high-biased.
R	Analyte result is rejected because of deficiencies in meeting QC criteria and may not be used for decision making.

1.3 Summary of Groundwater Samples

A total of eight groundwater samples, including one field duplicate sample, were collected from monitoring wells at the former Building 3564 site in 2018. In addition, one MS/MSD sample for every analysis and analyte (minimum of one per 20 samples) was collected and submitted with the project samples. One equipment blank sample was collected to assess the potential for cross-contamination of the submersible pump. The submission of a trip blank sample was not required as no samples were submitted for volatile analyses. Samples were analyzed by methods presented in Table B-1.

All project and quality control samples were analyzed by SGS North America, Inc. (SGS) of Anchorage, Alaska. The laboratory is validated by the State of Alaska through the Contaminated Sites Program for all methods employed, with the exception of sulfate by United States Environmental Protection Agency (EPA) Method 300.0 (method 300.0 is not listed as a Contaminated Sites analysis). In addition, the laboratory is Environmental Laboratory Accreditation Program (ELAP)

certified for all methods. SGS is compliant with the DoD QSM for Environmental Laboratories, Version 5.1 (DoD, 2017), for the methods employed for this project.

All samples were shipped in one sample data group (SDG) and assigned the SGS report number 1184467. A sample summary table (Table C-1) and an analytical results table (Table C-2) are included in Appendix C. Groundwater sample data quality is discussed in Section 2.

2.0 GROUNDWATER DATA QUALITY REVIEW

This section presents the findings of the data quality review and the resulting data qualifications for groundwater samples. All samples were analyzed by SGS and are included in one SDG, as discussed in Section 1.3. See the associated ADEC Laboratory Data Review Checklist for more elaborate data quality descriptions.

2.1 Sample Collection

All monitoring wells were purged and sampled with submersible pumps, and groundwater sampling activities were recorded on the groundwater sample forms provided in Appendix A. Groundwater sample forms were reviewed to ensure that well drawdown and groundwater parameters met the stabilization criteria identified in the ADEC Field Sampling Guidance (ADEC, 2017) and the UFP-QAPP (FES, 2016), that low-flow sampling criteria was employed (Puls and Barcelona, 1996), and that all groundwater levels were within the screened intervals at the time of sampling. The following was noted upon review of the groundwater sample forms:

- All samples met stabilization criteria (see one caveat in the next bullet) and all water levels were within the screened interval during sample collection. No free product was measured.
- Potential drawdown could not be measured in well AP-7187. The well was found broken. Although the well was successfully sampled with a submersible pump, the pump was obstructing the water level indicator so water level measurements could not be recorded.
- Petroleum sheen was observed on purge water from one well (AP-7187) and hydrocarbon odor was observed on purge water from four wells (AP-7187, AP-7191, AP-7189, and AP-7178).

An equipment blank sample was collected to evaluate the potential for submersible pump cross-contamination. Equipment blank results are further discussed in Section 2.3.

2.2 Sample Handling

The evaluation of proper sample handling procedures include verification of the following: correct COC documentation, appropriate sample containers and preservatives, cooler temperatures maintained within the ADEC-recommended temperature range (0 to 6 degrees Celsius [°C]), and sample analyses performed within method-specified holding times. No discrepancies were noted upon receipt at the laboratory.

2.3 Blanks

Method blank and equipment blank samples were utilized to detect potential cross-contamination of project samples. Method blanks detect laboratory cross-contamination and the equipment blanks evaluate the potential for cross-contamination associated with wells that were sampled with non-dedicated submersible pumps. The following blank contaminations were noted.

Method Blanks

Method blank samples were analyzed in every batch, as required. No method blank contamination was noted.

Equipment Blanks

One equipment blank sample (18FW64EB01WQ) was collected to evaluate the potential for submersible pump cross-contamination, as required. No equipment blank contamination was noted.

2.4 Laboratory Control Samples

The LCS/LCSD samples were prepared by adding spike compounds to blank samples in order to assess laboratory extraction and instrumentation performance. The performance of a LCS sample is a requirement for every QC batch to evaluate recovery accuracy. In addition, a LCSD is required for all Alaska fuel methods to evaluate batch precision. For QC batches that do not contain a LCSD, precision is evaluated by performing a sample duplicate, which is further discussed in Section 2.5.

All LCS and/or LCSD samples were performed, as required. The accuracy of analyte recoveries for LCS samples, and precision of the LCS/LCSD sample pair (when applicable), was evaluated. No LCS and/or LCSD accuracy or precision discrepancies requiring qualifications were noted.

2.5 Matrix Spike Samples and Sample Duplicates

MS samples were prepared by adding spike compounds to project samples in order to assess potential matrix interference. The performance of a MS sample analysis is a requirement in every QC batch, at a minimum frequency of 1 for every 20 samples, to evaluate recovery accuracy. In addition, precision of each QC batch was evaluated by performing either a MSD sample analysis or a sample duplicate analysis and calculating the RPD. All QC batches have met these criteria.

For these batches, the accuracy and precision of the MS/MSD pair were evaluated. No MS/MSD accuracy or precision discrepancies requiring qualifications were noted.

2.6 Surrogate Recovery

Surrogate compounds were added to project samples by the laboratory prior to analysis, in accordance with method requirements. Surrogate recoveries were then calculated as percentages and reported by the laboratory as a measure of analytical extraction efficiency. No surrogate recoveries were outside the established limits.

2.7 Field Duplicates

One field duplicate sample was collected and submitted to the laboratory as a blind sample during groundwater sampling operations at the former Building 3564 site. Field duplicates were collected at a minimum frequency of 10 percent for each analytical method, and for each SDG, which meets the UFP-QAPP requirement. Field duplicate results are summarized in Table B-3 below. All field duplicate sample results were within the ADEC criterion of ≤30% and, therefore, are considered comparable.

Table B-3. Groundwater Field Duplicate Sample Results Evaluation

Analyte	Method	Units	Primary 18FW6402WG (AP-7191)	Field Duplicate 18FW6403WG (AP-7070)	RPD, %	Comparable Criteria Met?[1]
DRO (C10 – C25)	AK102	mg/L	6.53 [0.321]	6.31 [0.329]	3	Yes
RRO (C25 – C36)	AK103	mg/L	0.584 [0.267]	0.598 [0.274]	2	Yes
Sulfate	E300.0	µg/L	694 [200]	657 [100]	5	Yes
Iron	SW6020A	µg/L	38600 [250]	37000 [250]	4	Yes

[1] – RPD of ≤30 percent was used for evaluating water-matrix field duplicate samples

2.8 Additional Quality Control Discrepancies

Additional QC samples and procedures not discussed in the preceding sections of this CDQR are evaluated if deviations are noted by the laboratory in the case narratives. Additional QC samples/procedures may include, but are not limited to, instrument tuning, initial calibration verification (ICV) samples, continuing calibration verification (CCV) samples, and internal standards.

No QC discrepancies were noted by the laboratory that affected project samples.

2.9 Analytical Sensitivity

Several project data analytes were reported above the detection limit (DL) but below the limit of quantitation (LOQ) and were thus qualified as estimates due to the unknown accuracy of the analytical method at those concentrations. These data qualifications are not reported again in this CDQR, but they are noted with a "J" in the associated results table in Appendix C.

Analytical sensitivity was evaluated to verify that LODs met applicable cleanup level for non-detect results. All analytes met the analytical sensitivity requirements of the project and are acceptable for use.

2.10 Summary of Qualified Results

The review process deemed the groundwater project data acceptable for use. No data were qualified pursuant to FES's data quality review.

2.11 Completeness

Completeness scores were calculated for each analytical method employed for the project. Scores were obtained by assigning points to 14 different data quality categories during the review process. A maximum of 10 points was awarded for each category; points were based on the number of samples successfully meeting data quality objectives for that category. The scores were then summed to determine the total points for a method, and completeness scores were determined as follows: (total points received)/(total points possible) x 100.

A breakdown of the points received for each category and method is shown in Table B-4 below. All Two-Party site data quality categories met the completeness criteria of 90 percent established in the UFP-QAPP for the sampling events. No data were rejected pursuant to the data quality review, and all data may be used, as qualified, for the purposes of the 2018 Two Party Monitoring Report.

Table B-4. Completeness Scores for Groundwater Samples

Data Quality Category	Points DRO	Points RRO	Points Fe/Mn	Points Sulfate
Sample Collection	10	10	10	10
COC Documentation	10	10	10	10
Sample Containers/Preservation	10	10	10	10
Cooler Temperature	10	10	10	10
Holding Times	10	10	10	10
Method Blanks	10	10	10	10
Trip Blanks	NA	NA	NA	NA
Equipment Blank	10	10	10	10
LCS/LCSD Recovery & RPD	10	10	10	10
MS/MSD Recovery & RPD	10	10	10	10
Surrogate Recovery	10	10	NA	NA
Field Duplicate	10	10	10	10
CCV, Internal Stds, other	10	10	10	10
Sensitivity (DL/LOD)	10	10	10	10
Total Points Received	130	130	120	120
Total Points Possible	130	130	120	120
Percent Completeness	100	100	100	100

NA – not applicable

3.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC), 2018). *18 AAC 75, Oil and Other Hazardous Substances Pollution Control*. As amended through September 29, 2018.

ADEC, 2017. *Technical Memorandum – Data Quality Objectives, Checklists, Quality Assurance Requirements for Laboratory Data, and Sample Handling.* March.

ADEC, 2017. *Field Sampling Guidance*. August.

Department of Defense (DoD), 2017. *DoD Quality Systems Manual for Environmental Laboratories, Version 5.1.*

Fairbanks Environmental Services (FES), 2018. *Final 2018 Postwide Work Plan, Fort Wainwright, Alaska.* July.

FES, 2016. *Final Postwide Uniform Federal Policy for Quality Assurance Project Plans, Fort Wainwright, Alaska.* August.

Puls, R.W. and M. J. Barcelona, 1996. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.* EPA/540/S-95/504. April.

Laboratory Data Review Checklist

Completed By:

Vanessa Ritchie

Title:

Senior Chemist

Date:

10/04/2018

CS Report Name:

Former Building 3564

Report Date:

09/13/2018

Consultant Firm:

Fairbanks Environmental Services

Laboratory Name:

SGS North America Inc. – Anchorage, AK

Laboratory Report Number:

1184467

ADEC File Number:

108.26.028

Hazard Identification Number:

25015

1184467

1. Laboratory

   a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

   (•) Yes ( ) No Comments:

Yes; however, EPA Method 300.0 is not listed as a CS analysis.

   b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

   ( ) Yes (•) No Comments:

Not applicable, samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

   a. CoC information completed, signed, and dated (including released/received by)?

   (•) Yes ( ) No Comments:

   b. Correct Analyses requested?

   (•) Yes ( ) No Comments:

3. Laboratory Sample Receipt Documentation

   a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

   (•) Yes ( ) No Comments:

The coolers arrived at the laboratory containing temperature blanks with readings within the ADEC recommended temperature range of 0° to 6°C.

   b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

   (•) Yes ( ) No Comments:

   c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

   (•) Yes ( ) No Comments:

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

(•) Yes ( ) No Comments:

Not applicable, the laboratory did not note any discrepancies.

e. Data quality or usability affected?

Comments:

No data quality or usability was affected by the sample receipt documentation.

4. Case Narrative

a. Present and understandable?

(•) Yes ( ) No Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

(•) Yes ( ) No Comments:

The case narrative described a low level quantitation check failure for mercury; however, mercury was not reported in this SDG so no data were impacted. No other discrepancies were noted.

c. Were all corrective actions documented?

( ) Yes (•) No Comments:

Not applicable. No corrective actions were required.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Case narrative does not discuss effect on data quality, it only discusses discrepancies and what was done in light of them. Any notable data quality issues mentioned in the case narrative are discussed above in 4b or elsewhere within this ADEC checklist.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

(•) Yes ( ) No Comments:

b. All applicable holding times met?

(•) Yes ( ) No Comments:

c. All soils reported on a dry weight basis?

○ Yes ◉ No Comments:

No soil samples were included in this work order.

d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project?

◉ Yes ○ No Comments:

Analytical sensitivity was evaluated to verify that LODs met the applicable cleanup level for non-detect results. All LODs met the applicable cleanup level for non-detect results.

e. Data quality or usability affected?

○ Yes ◉ No Comments:

See discussion above in 5d.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

◉ Yes ○ No Comments:

ii. All method blank results less than limit of quantitation (LOQ)?

◉ Yes ○ No Comments:

No target analytes were detected in method blank samples.

iii. If above LOQ, what samples are affected?

Comments:

Not applicable. See 6aii.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

○ Yes ◉ No Comments:

No samples were affected.

v. Data quality or usability affected?

Comments:

No samples were affected. See 6aii.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

(•) Yes ( ) No Comments:

LCS/LCSD and MS/MSD samples were analyzed as required.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

(•) Yes ( ) No Comments:

LCS/LCSD and MS/MSD samples were analyzed as required.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

(•) Yes ( ) No Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/MSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

(•) Yes ( ) No Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Not applicable. Accuracy and precision were within acceptance limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

( ) Yes (•) No Comments:

Not applicable. No data qualification was required.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

No data quality or usability was affected by the LCS/LCSD or MS/MSD samples.

c. Surrogates – Organics Only

i. Are surrogate recoveries reported for organic analyses – field, QC and laboratory samples?

(•) Yes ( ) No Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

(•) Yes ( ) No Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

(•) Yes ( ) No Comments:

Not applicable. All surrogate recoveries were within acceptance limits.

iv. Data quality or usability affected?

Comments:

No data quality or usability was affected by surrogate recoveries.

d. Trip blank – Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): Water and Soil

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

( ) Yes (•) No Comments:

Not applicable. No volatile analyses were requested as a part of this SDG.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

( ) Yes (•) No Comments:

Not applicable, see 6di above.

iii. All results less than LOQ?

( ) Yes (•) No Comments:

Not applicable, see 6di above.

iv. If above LOQ, what samples are affected?

Comments:

Not applicable, see 6di above.

v. Data quality or usability affected?

Comments:

Not applicable, see 6di above.

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

(•) Yes ( ) No Comments:

One groundwater field duplicate was collected for seven groundwater primary samples associated with this work order.

ii. Submitted blind to lab?

(•) Yes ( ) No Comments:

Sample 18FW6403WG was a field duplicate of 18FW6402WG.

iii. Precision – All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

RPD (%) = Absolute value of: $\frac{(R_1-R_2)}{((R_1+R_2)/2)} \times 100$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

(•) Yes ( ) No Comments:

All results for the primary and field duplicate samples are shown in the table below. All results were comparable (RPD ≤ 30%).

Analyte	Method	Units	Primary 18FW6402WG (AP-7191)	Field Duplicate 18FW6403WG (AP-7070)	RPD, %	Comparable Criteria Met?
Diesel Range Organics	AK102	mg/L	6.53 [0.321]	6.31 [0.329]	3	Yes
Residual Range Organics	AK103	mg/L	0.584 [0.267]	0.598 [0.274]	2	Yes
Sulfate	E300.0	µg/L	694 [200]	657 [100]	5	Yes
Iron	SW6020A	µg/L	38600 [250]	37000 [250]	4	Yes

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

Data quality or usability not affected, see 6eiii above.

f. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below).

○ Yes ◉ No ○ Not Applicable

Equipment blank sample 18FW64EB01WQ was included in this work order to assess the potential for cross-contamination of the submersible pump.

i. All results less than LOQ?

◉ Yes ○ No Comments:

No analytes were detected in the equipment blank sample.

ii. If above LOQ, what samples are affected?

Comments:

Not applicable. See discussion in 6fi above.

iii. Data quality or usability affected?

Comments:

Data quality or usability were not affected by the equipment blank sample.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

○ Yes ◉ No Comments:

No other data flags/qualifiers were used.

APPENDIX C

GROUNDWATER SAMPLE SUMMARY
AND ANALYTICAL RESULTS TABLES

Table C-1. Sample Summary
Two-Party Site - Former Building 3564
Fort Wainwright, Alaska

Sample Number	Sample Location	Sample Type	Matrix	Sampler Initials	Sample Date	Sample Time	DRO AK102	RRO AK103	Fe 6020A	SO_4 300.0	Cooler ID
Groundwater Samples											
18FW6401WG	MW3564-1	Primary	WG	JK	08/08/18	1030	X	X	X	X	080701
18FW6402WG	AP-7191	Primary/MS/MSD	WG	JK	08/08/18	1145	X	X	X	X	080701
18FW6403WG	AP-2020	Field Duplicate of 18FW6402WG	WG	JK	08/08/18	1200	X	X	X	X	080701
18FW6404WG	AP-7189	Primary	WG	JK	08/08/18	1320	X	X	X	X	080701
18FW6405WG	AP-7187	Primary	WG	JK	08/09/18	830	X	X	X	X	080701
18FW6406WG	AP-7178	Primary	WG	JK	08/09/18	1000	X	X	X	X	080701
18FW6407WG	AP-6729	Primary	WG	JK	08/09/18	1100	X	X	X	X	080701
18FW6408WG	AP-7183	Primary	WG	JK	08/09/18	1210	X	X	X	X	080701
Quality Control Sample											
18FW64EB01WQ	Rinsate 01	Equipment Blank	WQ	JK	08/09/18	1230	X	X	X	X	080701

Notes:
All samples were submitted to SGS North America, Inc., of Anchorage, AK for analysis. All results are reported in SGS report number 1184467. The standard 21-day turnaround time was requested for all analyses. All work was performed under NPDL work order number 18-090.

DRO - diesel range organics
Fe - iron
HCl - hydrochloric acid
HDPE - high-density polyethylene
JK - Josh Klynstra
mL - milliliter
MS/MSD - matrix spike/matrix spike duplicate
RRO - residual range organics
SO_4 - sulfate

Water Sample Collection (all samples were field-preserved at 0-6°C)
DRO/RRO - two HCl-preserved, 250 mL amber bottles
Fe - one HNO_3-preserved, 250 mL HDPE bottle, field-filtered
SO_4 - one non-preserved, 125 mL HDPE bottle

Table C-2. Groundwater Sample Results
Two-Party Site - Former Building 3564
Fort Wainwright, Alaska

			Sample ID	18FW6401WG	18FW6402WG	18FW6403WG	18FW6404WG	18FW6405WG	18FW6406WG	18FW6407WG	18FW6408WG	18FW64EB01WQ
			Location ID	MW3564-1	AP-7191	AP-7070	AP-7189	AP-7187	AP-7178	AP-6729	AP-7183	Rinsate01
			Sample Data Group	1184467	1184467	1184467	1184467	1184467	1184467	1184467	1184467	1184467
			Laboratory ID	1184467001	1184467002	1184467005	1184467006	1184467007	1184467008	1184467009	1184467010	1184467011
			Collection Date	8/8/2018	8/8/2018	8/8/2018	8/8/2018	8/9/2018	8/9/2018	8/9/2018	8/9/2018	8/9/2018
			Matrix	WG	WG	WG	WG	WG	WG	WG	WG	WQ
			Sample Type	Primary	Primary/MS/MSD	Field Duplicate of 18FW6402WG	Primary	Primary	Primary	Primary	Primary	Equipment Blank
Analyte	**Method**	**Units**	**ADEC Cleanup Level[1]**	**Result [LOD] Qualifier**	**Result [LOD] Qualifier**	**Result [LOD] Qualifier**	**Result [LOD] Qualifier**	**Result [LOD] Qualifier**	**Result [LOD] Qualifier**	**Result [LOD] Qualifier**	**Result [LOD] Qualifier**	**Result [LOD] Qualifier**
Iron	SW6020A	µg/L	NE	804 [250]	38600 [250]	37000 [250]	57800 [1250]	22300 [250]	50800 [1250]	34500 [250]	52500 [500]	ND [250]
Sulfate	E300.0	µg/L	NE	37300 [500]	694 [200]	657 [100]	1170 [500]	15800 [500]	369 [100]	3630 [500]	ND [250]	ND [100]
Diesel Range Organics	AK102	mg/L	1.5	ND [0.329]	**6.53 [0.321]**	**6.31 [0.329]**	**33.6 [0.326]**	**8.9 [0.332]**	**33.7 [0.329]**	**6.15 [0.324]**	0.227 [0.326] J	ND [0.321]
Residual Range Organics	AK103	mg/L	1.1	ND [0.274]	0.584 [0.267]	0.598 [0.274]	**2.19 [0.272]**	0.834 [0.277]	**4.53 [0.274]**	0.909 [0.27]	ND [0.272]	ND [0.267]

Yellow highlighted and **bolded** results exceed ADEC groundwater cleanup levels

[1] ADEC cleanup levels are Groundwater Human Health values listed in ADEC 18 AAC 75.345 (revised as of September 29, 2018).

Data Qualifiers:

J - result qualified as estimate because it is less than the LOQ
ND - not detected [LOD presented in brackets]

Acronyms:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
LOD - limit of detection
LOQ - limit of quantitation
MS/MSD - matrix spike/matrix spike duplicate
µg/L - micrograms per liter
mg/L - milligrams per liter
NE - not established
QC - quality control
WG - groundwater
WQ - water QC sample

APPENDIX D

MAROS SOFTWARE CONCENTRATION TREND AND PLUME STABILITY RESULTS

Table D-1. MAROS Statistical Analysis Summary for Former Building 3564

MAROS Statistical Trend Analysis Summary

Project: Bldg 3564_2018
Location: Fort Wainwright
User Name: FES
State: Alaska

Time Period: 10/1/2002 **to** 8/8/2018
Consolidation Period: No Time Consolidation
Consolidation Type: Average
Duplicate Consolidation: Average
ND Values: Detection Limit
J Flag Values : Actual Value

Well	Source/ Tail	Number of Samples	Number of Detects	Average Conc. (mg/L)	Median Conc. (mg/L)	All Samples "ND" ?	Mann-Kendall Trend	Linear Regression Trend
PHC as DIESEL FUEL								
AP-6729	T	17	17	2.7E+00	2.7E+00	No	NT	NT
AP-7178	S	17	17	1.6E+01	6.5E+00	No	NT	NT
AP-7183	T	17	9	1.2E-01	1.0E-01	No	I	I
AP-7187	T	16	16	1.6E+01	9.2E+00	No	S	S
AP-7189	T	17	17	2.5E+01	2.2E+01	No	NT	NT
AP-7191	T	17	17	3.3E+00	2.8E+00	No	I	I
MW3564-1	T	15	12	2.9E-01	3.3E-01	No	S	S

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); No Detectable Concentration (NDC)

The Number of Samples and Number of Detects shown above are post-consolidation values.

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Table D-2. MAROS Spatial Moment Analysis for the Former Building 3564 Site

MAROS Spatial Moment Analysis Summary

Project: Bldg 3564_2018
Location: Fort Wainwright
User Name: FES
State: Alaska

	0th Moment	1st Moment (Center of Mass)			2nd Moment (Spread)		
Effective Date	Estimated Mass (Kg)	Xc (ft)	Yc (ft)	Source Distance (ft)	Sigma XX (sq ft)	Sigma YY (sq ft)	Number of Wells
PHC as DIESEL FUEL							
10/1/2006	4.5E+00	1,382,281	3,959,998	102	1,474	1,223	7
9/1/2007	6.4E+00	1,382,285	3,959,992	91	1,491	1,202	7
9/1/2008	9.4E+00	1,382,307	3,959,986	80	1,198	1,040	7
9/1/2009	4.1E+00	1,382,276	3,960,009	114	1,557	1,382	7
10/1/2010	3.5E+00	1,382,273	3,960,010	117	1,553	1,323	7
10/1/2011	1.0E+01	1,382,297	3,959,984	83	1,353	850	7
10/1/2012	4.4E+00	1,382,278	3,960,009	114	1,541	1,449	7
9/25/2013	3.7E+00	1,382,279	3,960,004	109	1,403	1,239	7
7/7/2014	8.7E+00	1,382,287	3,959,992	90	1,405	1,196	7
7/21/2015	1.6E+01	1,382,287	3,959,990	93	1,056	921	7
8/19/2016	1.1E+01	1,382,292	3,959,993	93	1,445	1,201	7
8/3/2017	1.2E+01	1,382,285	3,959,993	96	1,426	1,136	7
8/8/2018	1.6E+01	1,382,290	3,959,987	89	1,262	844	7

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Table D-2 cont'd. MAROS Spatial Moment Analysis for the Former Building 3564 Site

Project: Bldg 3564_2018 User Name: FES
Location: Fort Wainwright State: Alaska

Moment Type	Constituent	Coefficient of Variation	Mann-Kendall S Statistic	Confidence in Trend	Moment Trend
Zeroth Moment: Mass					
	PHC as DIESEL FUEL	0.53	36	98.5%	I
1st Moment: Distance to Source					
	PHC as DIESEL FUEL	0.13	-8	66.2%	S
2nd Moment: Sigma XX					
	PHC as DIESEL FUEL	0.11	-20	87.4%	S
2nd Moment: Sigma YY					
	PHC as DIESEL FUEL	0.17	-26	93.6%	PD

Note: The following assumptions were applied for the calculation of the Zeroth Moment:

Porosity: 0.33 Saturated Thickness: Uniform 10 ft

Mann-Kendall Trend test performed on all sample events for each constituent. Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A)-Due to insufficient Data (< 4 sampling events).

Note: The Sigma XX and Sigma YY components are estimated using the given field coordinate system and then rotated to align with the estimated groundwater flow direction. Moments are not calculated for sample events with less than 6 wells.

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Table D-3. MAROS First Moment Analysis Results for DRO at Former Building 3564

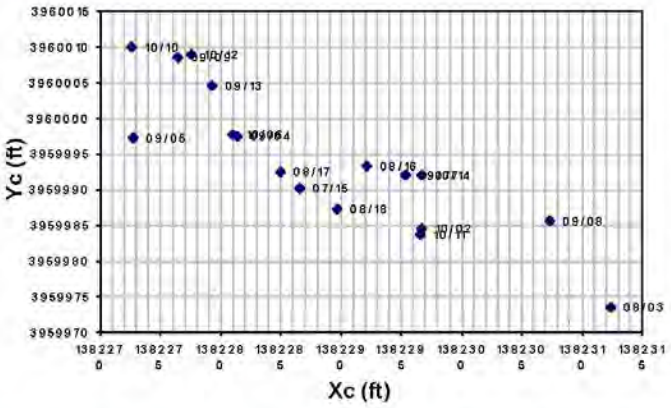
MAROS First Moment Analysis

Project: Bldg 3564_2018 **User Name:** FES

Location: Fort Wainwright **State:** Alaska

COC: PHC as DIESEL FUEL

Change in Location of Center of Mass Over Time



Effective Date	Constituent	Xc (ft)	Yc (ft)	Distance from Source (ft)	Number of Wells
10/1/2002	PHC as DIESEL FUEL	1,382,297	3,959,985	83	6
8/1/2003	PHC as DIESEL FUEL	1,382,312	3,959,974	67	6
9/1/2004	PHC as DIESEL FUEL	1,382,281	3,959,997	102	7
9/1/2005	PHC as DIESEL FUEL	1,382,273	3,959,997	107	6
10/1/2006	PHC as DIESEL FUEL	1,382,281	3,959,998	102	7
9/1/2007	PHC as DIESEL FUEL	1,382,295	3,959,992	91	7
9/1/2008	PHC as DIESEL FUEL	1,382,307	3,959,986	80	7
9/1/2009	PHC as DIESEL FUEL	1,382,276	3,960,009	114	7
10/1/2010	PHC as DIESEL FUEL	1,382,273	3,960,010	117	7
10/1/2011	PHC as DIESEL FUEL	1,382,297	3,959,984	83	7
10/1/2012	PHC as DIESEL FUEL	1,382,278	3,960,009	114	7
9/25/2013	PHC as DIESEL FUEL	1,382,279	3,960,004	109	7
7/7/2014	PHC as DIESEL FUEL	1,382,297	3,959,992	90	7
7/21/2015	PHC as DIESEL FUEL	1,382,287	3,959,990	93	7
8/19/2016	PHC as DIESEL FUEL	1,382,292	3,959,993	93	7
8/3/2017	PHC as DIESEL FUEL	1,382,285	3,959,993	96	7
8/8/2018	PHC as DIESEL FUEL	1,382,290	3,959,987	89	7

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events). Moments are not calculated for sample events with less than 6 wells.

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Table D-4. MAROS Sampling Frequency Optimization Results for the Former Building 3564

MAROS Sampling Frequency Optimization Results

Project: Bldg 3564_2018 **User Name:** FES

Location: Fort Wainwright **State:** Alaska

The Overall Number of Sampling Events: 17

"Recent Period" defined by events: **From** Sample Event 15 (10/1/2010) **To** Sample Event 23 (8/8/2018)

"Rate of Change" parameters used:

Constituent	Cleanup Goal	Low Rate	Medium Rate	High Rate
PHC as DIESEL FUEL	1.5	0.75	1.5	3

Units: Cleanup Goal is in mg/L; all rate parameters are in mg/L/year.

Well	Recommended Sampling Frequency	Frequency Based on Recent Data	Frequency Based on Overall Data
PHC as DIESEL FUEL			
AP-6729	Annual	Annual	Annual
AP-7178	Annual	Annual	Annual
AP-7183	Annual	Annual	Annual
AP-7187	Annual	Annual	Annual
AP-7189	Quarterly	Quarterly	Annual
AP-7191	Annual	Annual	Annual
MW3564-1	Biennial	Annual	Annual

Note: Sampling frequency is determined considering both recent and overall concentration trends. Sampling Frequency is the final recommendation; Frequency Based on Recent Data is the frequency determined using recent (short) period of monitoring data; Frequency Based on Overall Data is the frequency determined using overall (long) period of monitoring data. If the "recent period" is defined using a different series of sampling events, the results could be different.

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APPENDIX E

PHOTOGRAPHIC LOG

Overview of the Former Building 3564 Source Area (View to Southeast).

Damaged Monitoring well AP-7187 (View to North).

Broken casing at Monitoring Well AP-7187

View inside Overcasing of Monitoring Well AP-7187

TRANSMITTAL LETTER

FES

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FAIRBANKS ENVIRONMENTAL SERVICES

Letter of Transmittal

To: Army Corps of Engineers
Post Office Box 6898
JBER, AK 99506-0898

Date: February 12, 2019

Job No.: 9011-08

Attn: Bob Glascott, CEPOA-PM-E

Re: Final 2018 Sampling Report, Two Party Site, Former Building 3564, Fort Wainwright, Alaska
W911KB-16-D-0005, Task Order 11

Date	*Paper Copies*	*Electronic/CD's*	*Description*
February 2019	1	Email and CD	Final 2018 Sampling Report, Two-Party Site, Former Building 3564, Fort Wainwright, Alaska

These are transmitted:

☐ *For your information* ☐ *For action specified below* ☐ *For review and comment* X *For your use* ☐ *As requested*

Remarks

This transmittal letter documents submission of the Final 2018 Sampling Report, Two-Party Site, Former Building 3564. The work was completed by FES under contract to USACE (W911KB-16-D-0005, TO 11). The document was distributed and is submitted as follows:

I. USACE

Email/CD	Bob Hazlett (JBER, AK)

II. USAGAK DPW-Environmental

Email, Hardcopy and CD	Brian Adams, Tammy Scholten, Seth Reedy (Fort Wainwright, AK)

III. AEC

Email	Dave Mays and Jennifer Rawlings (Fort Sam Houston, TX)

IV. ADEC

Email and CDs	Erica Blake and Kevin Fraley (Fairbanks, AK)

By: Karol Johnson

Title: Project Manager

COMMENTS

REVIEW COMMENTS

PROJECT: Fort Wainwright, Alaska
DOCUMENT: 2018 Sampling Report, - Former Building 3564

ALASKA DEPT. OF ENVIRONMENAL CONSERVATION	DATE: 1/07/2019 REVIEWER: Kevin Fraley PHONE: 907-451-2104	Action taken on comment by: Karol Johnson

Item No.	Drawing Sheet No., Spec. Para.	COMMENTS	REVIEW CONFERENCE A - comment accepted W - comment withdrawn (if neither, explain)	CONTRACTOR RESPONSE	ADEC RESPONSE ACCEPTANCE (A-AGREE) (D-DISAGREE)
1.	Executive Summary, page v	DEC notes some inconsistencies with sampling for manganese at the Former Building 3564 site. The approved 2017 Former Building 3564 report included manganese results, some of those results were above the new, established cleanup level for manganese (430 µg/L). The recommendation to continue sampling the seven monitoring wells, indicated manganese would be an analyte tested for during the fall 2018 sampling event. However, the 2018 Work Plan Addendum and results did not include manganese. Please clarify, is there an anthropogenic source of manganese at this site? If there is an anthropogenic source, please explain why there have been inconsistencies in sampling for manganese at this site. If there is no anthropogenic source, why is manganese even being sampled at all? Please clarify what is going on with manganese in the report text.	A	There are no known anthropogenic sources of manganese at the Fort Wainwright Former Building 3564 source area. It is likely that the petroleum contamination at the source area causes the aquifer to become anaerobic and manganese in soil to become more soluble in groundwater. Manganese is routinely analyzed at select Fort Wainwright sites as a means of monitoring natural attenuation processes; however, sampling for manganese has never been a requirement at the 3564 source area. Analyzing for manganese in 2017 was done in error. Manganese analysis was not a requirement in the 2017 Work Plan, but the analysis was inadvertently requested on the chain-of-custody so the analysis was performed. Manganese should not have been recommended for analysis in the 2017 Sampling Report for 2018. Since manganese analysis has never been a requirement at this site, the erroneous recommendation made in the 2017 Sampling Report to continue manganese sampling was disregarded. Manganese was not included in the 2018 Work Plan and was therefore not requested for analysis in 2018. The 2018 Sampling Report will be revised to clarify that the analysis of manganese in 2017 was a deviation from the 2017 Work Plan.	A

REVIEW COMMENTS

PROJECT: Fort Wainwright, Alaska
DOCUMENT: 2018 Sampling Report, - Former Building 3564

ALASKA DEPT. OF ENVIRONMENAL CONSERVATION	**DATE: 1/07/2019** **REVIEWER: Kevin Fraley** **PHONE: 907-451-2104**	**Action taken on comment by: Karol Johnson**

Item No.	Drawing Sheet No., Spec. Para.	COMMENTS	REVIEW CONFERENCE A - comment accepted W - comment withdrawn (if neither, explain)	CONTRACTOR RESPONSE	ADEC RESPONSE ACCEPTANCE (A-AGREE) (D-DISAGREE)
2.	Section 4.0, page 4-1	DEC concurs that the damaged well AP-7187 should be repaired/converted to a flush mount well in order to avoid future damage to it from vehicles. Please clarify in the report text when a timeline discussing when this repair would be made.	A	The Army plans to implement the recommendation to repair AP-7187 during the 2019 field season. This timeline for repairing AP-7187 will be clarified in the Executive Summary and in Section 4.	A
End Comments.					