APPENDIX I

SAMPLING AND ANALYSIS PLAN

Sampling and Analysis Plan

This Sampling and Analysis Plan describes sampling activities intended for monitoring the groundwater treatment system (GWTS) located at Kirtland Air Force Base (AFB), New Mexico. These activities are to occur whether the GWTS is discharging to irrigation, injection well(s), and/or other approved discharge locations.

I.1 Discharge Requirements

Treated groundwater discharged from the GWTS must comply with Discharge Permit (DP)-1839. As stated in the introduction to DP-1839: "The New Mexico Environment Department's (NMED's) Hazardous Waste Bureau (HWB) and Groundwater Quality Bureau (GWQB) both provide regulatory oversight at the BFF project site. The HWB regulated the evaluation and remediation of the KAFB BFF dissolved-phase plume and the associated GWTS. The GWQB regulates the procedures that ensure treated groundwater discharged from the GWTS to underground injection control (UIC) well(s) meet DP requirements."

Effluent discharged from the GWTS must not exceed the following criteria as currently stipulated in Table 2 of the Discharge Permit DP-1839 (NMED, 2017):

- Ethylene dibromide (EDB) – 0.05 micrograms per liter (µg/L)
- Benzene – 5 µg/L
- Ethylbenzene – 700 µg/L
- Toluene – 750 µg/L
- Total xylenes – 620 µg/L
- Iron (dissolved) – 1 milligram per liter (mg/L)
- Manganese (dissolved) – 0.2 mg/L.

Additionally, the approved National Pollutant Discharge Elimination System (NPDES) permit authorizes discharge into the Tijeras Arroyo segment number 20.6.4.098, from outfall 001. The NPDES outfall is considered a non-continuous discharge permit and will ONLY BE USED in instances where other discharge locations (Golf Course Main Pond, KAFB-7, and KAFB-106IN2) are not available for use. Effluent discharged to the NPDES outfall must not exceed the following criteria whenever discharge occurs, as stipulated in Part 1, Section A of the NPDES Permit Number NM0031216 (U.S. Environmental Protection Agency [EPA], 2019). Note the criteria are provided for both the 30-day average concentration (30-DA) and daily maximum concentration (DM); *** indicates no 30-day average concentration.

- pH – 6.6 (minimum) and 9.0 (maximum)
- Total residual chlorine -- ***(30-DA), 11 µg/L (DM)
- Total suspended solids (TSS) – 21mg/L (30-DA), 33mg/L (DM)
- Biochemical oxygen demand – 26 mg/L (30-DA), 48 mg/L (DM)
- Oil and grease – 8 mg/L (30-DA), 15 mg/L (DM)

Additionally, the concentrations of EDB, the chemical oxygen demand (COD), nitrate-nitrite nitrogen, ammonia (as nitrogen), heptachlor, per- and polyfluoroalkyl substances (PFAS) and whole effluent toxicity for *Daphnia pulex* sp. (48-hour acute) must be reported for both the 30-day average concentration and daily maximum concentration during discharge. As stated above, the NPDES outfall is for emergency use only and not part of the standard operation of the GWTS. Detailed sampling requirements are not discussed in the following sections. Sampling requirements for NPDES outfall are discussed in Part 1 Section A (1) of the NPDES permit.

I.2 Sample Locations and Sampling Interval

I.2.1 Extraction Wells

All four of the extraction wells are capable of being sampled individually. The sample will be collected from the sample valve in the wellhead vault and/or collected at the sample valves located in the well control house just downstream of the flowmeter for each well. Samples will be analyzed for EDB; benzene, toluene, ethylbenzene, and total xylenes (BTEX); dissolved iron; and manganese in accordance with the criteria outlined in DP-1839 Table 2.

All extraction wells are sampled annually in the second quarter of the calendar year at a minimum. Sampling of individual extraction wells is also required when the combined influent concentrations increase more than 35 percent, the same range as a field duplicate, from the previous month's results for any of the monitored contaminants. This applies unless the samples are collected during an operational change condition that impacts influent concentrations, such as during partial operation of the extraction well network, or if analyte concentrations are below the effluent discharge criteria concentrations provided in DP-1839 Table 2 (NMED, 2017). In the event that the combined influent samples are collected during an operational change condition, sampling of individual extraction wells is required when the combined influent concentrations increase more than 35 percent from the maximum results for any of the monitored contaminants from either the combined influent or individual wells over the previous four quarters and exceed the effluent discharge criteria concentrations provided in DP-1839 (NMED, 2017).

I.2.2 Treatment System

Sampling of the treatment system will be performed in accordance with DP-1839, Condition 20. Samples will be collected at a minimum of monthly at three locations from each treatment train in the GWTS to monitor the performance of the carbon treatment system (Table I-1). These monthly samples will be collected at the outlet of the influent pumps, prior to the pretreatment bag filters, at the outlet of the first or lead carbon vessel, and at the outlet of the effluent pumps prior to the post-treatment bag filters.

After a monthly sampling event has taken place, and the samples have been analyzed, if a sample taken between the granular activated carbon (GAC) vessels (outlet of the first carbon vessel) is shown to be detect of EDB, a special procedure will be followed that includes an additional sampling port during the next month's sampling event. This port shall be a vertical port on the lag GAC vessel of the train with the detected EDB. A flowchart describing this procedure is provided in Attachment L-1.

In addition to the monthly sampling, samples will be collected annually and once every 5 years for the analytes listed on Table I-1. The annual and 5-year samples are collected from both influent and effluent skids (4 sample locations) of the GWTS but not between the GAC vessels. Any analytes detected in the samples collected as part of the 5-year sampling event will be added to the annual sampling list. The most recent 5-year sampling event occurred in the third quarter of 2017. The next 5-year sampling event will need to take place in the third quarter of 2022.

In the event that equipment modifications are made to the GWTS, such as the beginning of operation of a new extraction well, treatment train, or changing out GAC, samples will be collected from the three locations from each treatment train daily for the first 7 days, then weekly until the end of the first month, and monthly thereafter. The same effluent sampling schedule will be implemented in the event that conditions at the GWTS are believed to be potentially impacting GWTS effluent water quality.

Prior to discharging treated water from a new extraction well to any permitted injection well, NMED will be supplied with adequate documentation showing that the treated effluent produced from this new extraction well meets the effluent discharge criteria provided in Section I.1.

I.2.3 Non-Extraction Well Influent Monitoring

Non-extraction well water (e.g., investigation-derived wastewater from drilling and sampling at Kirtland AFB Bulk Fuels Facility, GAC backwash water, etc.) from the groundwater monitoring network can be introduced as influent to the GWTS for treatment and discharged to an approved location. In order to meet the acceptance criteria for treatment, the water must be characterized for EDB, BTEX, dissolved iron, and manganese. Water that has not been characterized or does not meet the requirements provided in Table 5-1of the Operations and Maintenance Plan is not acceptable for treatment and disposal through the GWTS (as described in Section 6 of the Operations and Maintenance Plan).

I.2.4 Underground Injection Control Groundwater Monitoring Wells

In accordance with DP-1839 Condition 23, monitoring wells within the vicinity of UIC wells KAFB-7 (KAFB-0505, KAFB-0507R, and KAFB-0508) and KAFB-106IN2 (KAFB-2628 and KAFB-2629) are sampled annually. Sampling will be performed during the fourth quarter of each year and will be reported in the Annual report. This monitoring will be performed to detect any changes in aquifer chemistry that may be a result of the injection effluent water. Samples will be analyzed for the analytes listed in Table I-1. In the event that the chemical quality of the groundwater being injected changes over time, additional geochemical modeling will be performed.

I.3 Sampling Procedure

The following sections are provided to meet the requirements of Condition 18 of DP-1839. Samples will be collected from their respective sampling ports by opening the port and discharging process water into the sampling containers. The port will be opened in such a way that it does not readily cause entraining of air and subsequent off-gassing of the samples and will not cause loss of sample preservatives from sample containers. Waste containers will be placed under sampling ports prior to sampling to ensure capture of all process water. Excess water collected in the waste containers will be emptied into the GWTS building sump for treatment.

Field filtering for dissolved metals will be performed by affixing a clean piece of poly tubing onto the sampling port. The inline 0.45-micron field filter will be attached to the open end of the poly tubing. The port will then be opened so as to condition the poly tubing and filter with process water for approximately 30 seconds. Samples will then be collected from the process water flowing through the filter. All process water not collected in the sample container will be collected into an appropriate waste container and then discharged to the GWTS building sump for treatment.

I.4 Field Measurements

Field parameters including temperature, turbidity, specific conductance, and pH will be collected in the field using water quality and turbidity meters. See Table I-2 for field meter calibration requirements and associated corrective actions. Free chlorine concentration will be measured with an inline chlorine analyzer for influent measurements and a handheld colorimeter or chlorine test strips for mid-GAC, effluent, or extraction well measurements. See Table I-6 for field measurement frequency.

I.5 Field Quality Control Samples

Field quality control (QC) samples will be collected in association with the GWTS sampling to ensure field sample collection precision and representativeness. Field duplicate samples will be collected per month, year, and 5-year sampling event associated with an effluent sample and shipped to the laboratory for the same analyses as the parent sample. In addition, trip blank samples for EDB, BTEX, and volatile organic compounds will accompany each shipment of GWTS samples to the laboratory to monitor for volatile organics contamination during sampling, sample shipping, and storage of samples at the laboratory. Matrix spike/matrix spike duplicates will also be collected in conjunction with each sampling event for laboratory QC. Field blank samples for volatile organic compounds will be collected as deemed necessary based on site conditions at the time of sample collection.

I.6 Sample Bottles, Preservation, and Shipping

Water samples collected from the GWTS will be collected and analyzed in accordance with EPA guidelines for analytical methods and parameters, sample containers, sample preservation, and sample preparation and analysis holding times presented on Table I-3.

Sample packaging and shipping requirements are designed to maintain sample integrity from the time a sample is collected until it is received at the analytical laboratory. All chain-of-custody forms, sample labels, custody seals, and other sample documents will be completed. Specific procedures for packaging and shipping of environmental samples are presented below:

- A sample label, completed with indelible ink, will be attached to the sample bottle.
- A cooler will be used as a shipping container.
- In preparation for shipping samples, the drain plug will be taped shut so that no fluids, such as melted ice, will drain out of the cooler during shipment. A large plastic bag may be used as a liner for the cooler. Ice will be placed at the bottom of the cooler.
- The containers will be placed in the lined cooler. Cardboard separators or bubble wrap may be placed between the containers at the discretion of the shipper.
- All samples for chemical analysis must be shipped cooled to ≤6 degrees Celsius with ice. All samples will require icing before shipment. A temperature blank will be included in each shipment of samples.
- The liner will be taped closed, if used, and sufficient packing material will be used to prevent sample containers from making contact or rolling around during shipment.
- A copy of the chain-of-custody form will be placed inside the cooler.
- The cooler will be closed and taped shut with clear packing tape.
- Custody seals will be placed on the cooler. Clear tape will be placed over the custody seals to help prevent them from being accidentally torn or ripped off.
- The cooler of samples will be shipped via an overnight carrier. A copy of the shipping bill will be retained for the field records and sent electronically to the project chemist.

I.7 Laboratory Analyses and Methods

Information regarding analytical methods, reporting limits, and project screening levels are listed in Table I-4.

I.8 Data Validation

All samples collected for permit compliance will undergo EPA Stage 3 data validation on 100 percent of data. The data validation will be performed by a third-party subcontractor using the criteria specified in the Quality Assurance Project Plan, data validation guidelines, and DoD Quality System Manual:

- Project-specific Quality Assurance Project Plan (Kirtland AFB, 2021)
- Department of Defense (DoD) and Department of Energy (DoE) *Consolidated Quality Systems Manual for Environmental Laboratories Version 5.3* (DoD and DoE, 2019)
- DoD *General Data Validation Guidelines* (DoD, 2019)
- EPA Contract Laboratory Program, National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2017a)
- EPA Contract Laboratory Program, National Functional Guidelines for Inorganic Superfund Data Review (EPA, 2017b).

The following QC elements will be included in the EPA Stage 3 data validation:

- Sample extraction and analysis holding times
- Laboratory method blanks
- Surrogate spike recoveries
- Laboratory control sample/laboratory control sample duplicate recoveries
- Matrix spike/matrix spike duplicate recoveries
- Relative percent difference
- Initial calibrations
- Continuing calibrations
- Trip blank results
- Field duplicate sample precision.

Data will be validated and flagged with the data qualifiers found in Table I-5 as applicable:

As a result of the data validation process, EPA qualifiers will be generated and applied to the affected sample results that exceeded the established QC criteria. EPA Stage 3 data review findings will be summarized and documented with each quarterly monitoring report in accordance with DP-1839 Condition 17.

I.9 Data Analysis and Reporting Triggers

Treated groundwater samples are collected monthly between the two GAC vessels to monitor for breakthrough as required in Condition 20 of DP-1839. When a detectable concentration of a regulated constituent is observed between the GAC vessels, an assessment of the GAC will be performed to determine if a GAC change-out is required. When any regulated constituent is detected leaving the lead GAC vessel at a concentration of 90 percent of the effluent limit, that GAC vessel undergoes GAC change-out and the lag GAC vessel is placed into the lead position. However, a GAC change-out may be performed at lower effluent concentrations if deemed appropriate for efficient system operation. After completion of the GAC exchange, additional sampling will be performed as specified in Section I.2.2. If dissolved iron and manganese concentrations reach 90 percent of the project screening levels (Section I.1) downstream of the sand filters, then the sand filter catalytic media will need to be replaced.

I.10 Reporting

I.10.1 Compliance

Compliance reporting will occur quarterly in the respective Quarterly Reports as specified in DP-1839 Condition 17. The Quarterly Report is submitted 90 days after the conclusion of the quarter in which the quarterly groundwater sampling event occurred as specified in DP-1839 Condition 19. These quarterly reports will be produced in accordance with DP-1839 Conditions 19, 20, 21, 22, 23, and 24 including but not limited to the following:

- Monthly, quarterly, and cumulative operational run-time
- Monthly, quarterly, and cumulative average, maximum, and minimum flow rates
- Monthly, quarterly, and cumulative volume of treated effluent discharged to each discharge location
- Monthly average, maximum, and minimum head values of injection water for each UIC well
- Quarterly and cumulative treated volumes of investigation-derived waste purge water
- Analytical sampling results (e.g., influent, between the GAC tanks, and treated effluent)
- Maintenance activities including but not limited to the following:
    - Mechanical integrity testing of the effluent conveyance line
    - GAC changes
    - System instrumentation repair or replacement (pumps, flow meters, pressure sensors, etc.)
    - Well rehabilitation
    - Major alarm conditions
    - Shutdown periods of greater than 48 hours

  - And any additional operational changes.

- Groundwater monitoring well analytical results

- Groundwater elevation contour maps.

I.10.2 Exceedance

An exceedance in discharge criteria at either the GCMP or the UIC wells will trigger a system shut down and regulatory notification. As soon as Kirtland AFB has knowledge that effluent water quality exceeds the discharge criteria for one or more of the contaminants listed in DP-1839 Table 2, the NMED HWB and GWQB shall be notified. The contingency plan (Appendix C of DP-1839) as well as any actions that can be taken to correct the problem and achieve the required effluent concentrations will be performed. Following plant operational adjustments, the effluent groundwater will be re-tested. Per DP-1839 Condition 20, the monitoring frequency will be increased to daily for the first week, weekly for the first month, and monthly thereafter.

In the event that an exceedance in discharge criteria is experienced at the NPDES outfall, the system will be immediately shut down and oral notification shall be given to EPA and NMED within 24-hours as specified in Part III.B.7. of the NPDES permit. Following plant operational adjustments, the effluent groundwater will be re-tested. Per DP-1839 Condition 20, the monitoring frequency will be increased to daily for the first week, weekly for the first month, and monthly thereafter.

If the required actions are considered to be outside the scope of work for plant operations, then the system will be shut down pending submittal of a corrective action plan to NMED.

REFERENCES

Department of Defense (DoD). 2019. *General Data Validation Guidelines*. Environmental Data Quality Workgroup. September.

Department of Defense (DoD) and Department of Energy (DoE). 2019. *Consolidated Quality Systems Manual for Environmental Laboratories*. Version 5.3. Prepared by DoD Environmental Data Quality Workgroup, Department of Navy, Lead Service. May.

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EPA. 2017b. *EPA National Functional Guidelines for Inorganic Superfund Data Review, EPA-540-R-2017-001*. Office of Superfund Remediation and Technology Innovation. January.

EPA. 2019. Authorization to Discharge Under the National Pollutant Discharge Elimination System, issued to U.S. Air Force located at Kirtland Air Force Base. September.

Kirtland Air Force Base (AFB). 2021. *Quality Assurance Project Plan Groundwater Monitoring and Interim Remedial Operations, Bulk Fuels Facility Solid Waste Management Units ST-106/SS-111, Kirtland Air Force Base, New Mexico.* March

NMED. 2017. *Discharge Permit Issuance, DP-1839, Kirtland Air Force Base*. Ground Water Quality Bureau. April.

TABLES

Table I-1
Groundwater Treatment System Monitoring Requirements

Analysis	Analytes	Frequency[a]	Sample Location
EPA Method SW8011	EDB	Monthly	Influent, between tanks, and effluent
EPA Method SW8260C	Benzene, ethylbenzene, toluene, and total xylenes	Monthly	
EPA Method SW6010C	Dissolved iron and dissolved manganese	Monthly	
EPA Method E300.0A	Chloride and sulfate	Annually[b]	Trains 1 and 2 – influent and effluent
	Chloride, sulfate, fluoride	5-year[c]	
EPA Method E353.2	Nitrogen (nitrate-nitrite)	Annually[b]	Trains 1 and 2 – influent and effluent
EPA Method SW8260C[(b)]		Annually[b]	Trains 1 and 2 – influent and effluent UIC Groundwater Monitoring Wells[f]
EDB – Method SW8011		Annually[b]	Trains 1 and 2 – influent and effluent UIC Groundwater Monitoring Wells[f]
EPA Method SW6010C		Annually[b]	UIC Groundwater Monitoring Wells[f]
SVOCs – Method SW8270D[(b)]		Annually[b]	Trains 1 and 2 – influent and effluent
Total phenol – E420.4		Annually[b]	Trains 1 and 2 – influent and effluent
Cyanide (free) – OIA-1677-09		Annually[b]	Trains 1 and 2 – influent and effluent
Total mercury – SW7470A		5-year[c]	Trains 1 and 2 – influent and effluent
Total and dissolved metals – SW6010C/SW6020A[(c)]		5-year[c]	Trains 1 and 2 – influent and effluent
Total and dissolved metals – SW6010C/SW6020A[(d)]		Geochemical modeling[d]	Trains 1 and 2 – influent and effluent UIC Groundwater Monitoring Wells[f]
Total and dissolved silica – SM4500-SiO2 C-1997		Geochemical modeling[d]	Trains 1 and 2 – influent and effluent UIC Groundwater Monitoring Wells[f]
Carbonate alkalinity – SM2320B		Geochemical modeling[d]	Trains 1 and 2 – influent and effluent UIC Groundwater Monitoring Wells[f]
Dissolved organic carbon – SM5310 C-2000		Geochemical modeling[d]	Trains 1 and 2 – influent and effluent UIC Groundwater Monitoring Wells[f]
EDB – Method SW8011	EDB	3/Week[e]	Trains 1 and 2 – effluent
SW8081B	Heptachlor	3/Week[e]	Trains 1 and 2 – effluent
EPA 537 Modified	Per- and Polyfluorinated Alkyl Substances	3/Week[e]	Trains 1 and 2 – effluent
EPA 350.1	Ammonia Nitrogen	1/Week[e]	Trains 1 and 2 – effluent
SM5210B	Biochemical oxygen demand	3/Week[e]	Trains 1 and 2 – effluent
EPA 410.4	Chemical oxygen demand	1/Week[e]	Trains 1 and 2 – effluent
EPA 353.2	Nitrate-Nitrite Nitrogen	1/Week[e]	Trains 1 and 2 – effluent
E1664A	Oil and Grease (Hexane extractable)	3/Week[e]	Trains 1 and 2 – effluent
SM4500-CIG	Total residual chlorine	1/Week[e]	Trains 1 and 2 – effluent
SM2540D	Total Suspended Solids	3/Week[e]	Trains 1 and 2 – effluent
EPA 2021.0	Whole Effluent Toxicity - Daphnia Pulex (48-hour acute NOEC freshwater)	Yearly[e]	Trains 1 and 2 – effluent

Table I-1
Groundwater Treatment System Monitoring Requirements

a. Sampling frequency will be increased (daily, weekly, etc.) during shakedown testing of new components.
b. List of analytes per the Kirtland Air Force Base Discharge Permit DP-1839, Table 3, Annual Monitoring Constituent List.
c. List of analytes per the Kirtland Air Force Base Discharge Permit DP-1839, Table 4, Five-year Monitoring Constituent List. The next 5-year sampling event must take place in Q3 2022.
d. List of analytes per the Kirtland Air Force Base Discharge Permit DP-1839, Table 5, Geochemical Modeling Analyte List.
e. Samples will be collected only when discharge to the NPDES occurs.
f. UIC groundwater monitoring wells for KAFB-7 (KAFB-0505, KAFB-0507, and KAFB-0508) and KAFB-106IN2 (KAFB-2628 and KAFB-2629) in accordance with DP-1839 Condition 23.

E = EPA Methods for Chemical Analysis of Water and Wastes, 1983 and Updates.
EDB = Ethylene dibromide.
EPA = U.S. Environmental Protection Agency.
OIA = EPA Office of International Affairs Method OIA-1677-09, 2010.
SM = American Public Health Organization Standard Methods for the Examination of Water and Wastewater, 22nd Edition.
SVOC = Semivolatile organic compound.
SW = EPA SW-846-Test Methods for Evaluating Solid Waste, 3rd Edition, 1986 and Updates.
VOC = Volatile organic compound.

Table I-2
Field Instrument Quality Control

Field Equipment	Calibration Verification Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	Standard Operating Procedure Reference
YSI (or equivalent) water quality meter with flow cell	Check calibration against two of the following three traceable standards with nominal pH of 4.0, 7.0, and 10.0 Check calibration of outside of range -10–60 ºC (14–140 ºF)	Calibrate probe once per week and then verify once per day before first use	± 0.2 pH units	Recalibrate	Field personnel	Manufacturer's Operation Manual
	Check calibration against specific conductance standard Check calibration of outside of range -10–60 ºC (14–140 ºF)	Calibrate probe once per week and then verify once per day before first use	± 0.5 percent of standard value or 0.0001 millisiemens per centimeter, whichever is greater	Recalibrate	Field personnel	Manufacturer's Operation Manual
Turbidity Meter	Calibrate with primary standard of 10 nephelometric turbidity units	Calibrate every 3 months; verify once a week reading is within acceptable value	±10 percent	Recalibrate	Field personnel	Manufacturer's Operation Manual

°C = Degree Celsius
°F = Degree Fahrenheit

Table I-3
Analytical Parameter, Method, Sample Container, Preservation, and Holding Time Requirements

Parameter	Preparation/ Analysis Method	Bottle Type	Preservative	Preparation Holding Time	Analytical Holding Time
Volatile Organic Compounds and BTEX	SW5030B/8260C	3 x 40-ml glass VOA vials	HCl to pH <2; Cool ≤6°C	NA	14 days
Ethylene dibromide	SW8011	2 x 40-ml glass VOA vials	HCl to pH <2; Cool ≤6°C	NA	14 days
Semivolatile Organic Compounds	SW3510C/8270D	2 x 250-ml amber	Cool ≤6°C	7 days	40 days
Total and dissolved metals	SW3005A/6010C; SW3020A/6020A	1 x 250-ml HDPE	HNO3 to pH <2; Cool ≤6°C	NA	180 days
Total mercury	SW7470A	1 x 250-ml HDPE	HNO3 to pH <2; Cool ≤6°C	NA	28 days
Total and dissolved silica	SM4500-SiO2 C-1997	1 x 250-ml HDPE	Cool ≤6°C	NA	28 days
Anions (chloride, sulfate, fluoride	E300.0A	2 x 40-ml VOA vials	Cool ≤6°C	NA	28 days
Nitrate-nitrite nitrogen	E353.2	1 x 250-ml HDPE	H_2SO4 to pH<2; Cool to 6ºC	NA	28 days
Total phenol	E420.4	1 x 250-ml glass	H2SO4 to pH<2; Cool to 6ºC	NA	28 days
Cyanide (free)	OIA-1677-09	1 x 250-ml glass	NaOH to pH>12; Cool to 6ºC	NA	14 days
Carbonate alkalinity	SM2320B	1 x 250-ml HDPE	Cool to 6ºC	NA	14 days
Dissolved organic carbon	SM5310 C-2000	2 x 40-ml VOA vials	Cool to 6ºC	NA	28 days
Ammonia	EPA 350.1	1 x 500-mL plastic or glass	H2SO4 to pH<2; Cool to <6°C	NA	28 days
Biochemical oxygen demand	SM5210B	1 x 500-mLplastic	Cool to <6°C	NA	2 days
Chemical oxygen demand	EPA 410.1	1 x 125-mL plastic	Cool to <6°C	NA	28 days
Heptachlor	SW8081B	1 x 1000-mL amber glass	Cool to <6°C	7 days	40 days
Oil and grease	E1664A	1 x 1000-mL glass	HCL or H2SO4 to pH<2	NA	28 days
Total residual chlorine	SM4500-CL-G	1 x 1000-mL plastic	Cool to <6°C	NA	2 days
Total suspended solids	SM2540D	1 x 1000-mL plastic	Cool to <6°C	NA	7 days
Whole Effluent Toxicity - Daphnia Pulex (48-hour acute NOEC freshwater)	EPA 2021.0	1 x 1-gallon HDPE	Cool to <6°C	NA	3 days

Table I-3
Analytical Parameter, Method, Sample Container, Preservation, and Holding Time Requirements

°C = Degree Celsius.
BTEX = Benzene, toluene, ethylbenzene, and total xylenes.
E = EPA Methods for Chemical Analysis of Water and Wastes, 1983 and Updates.
H2SO4 = Sulfuric acid.
HCl = Hydrochloric acid.
HDPE = High density polyethylene.
HNO3 = Nitric acid.
ml = Milliliter.
NA = Not applicable.
NaOH = Sodium hydroxide.
NOEC= No observed effect concentration.
OIA = EPA Office of International Affairs Method OIA-1677-09, 2010.
SM = American Public Health Organization Standard Methods for the Examination of Water and Wastewater, 22nd Edition.
SW = U.S. Environmental Protection Agency SW846 – Test Methods for Evaluating Solid Waste, Third Edition and Updates.
VOA = Volatile organics analysis.

TABLE I-4
Analytical Parameter, Analyte Reporting Limits, and Screening Criteria for Water

DP-1839									
							Achievable Laboratory Limits[4]		
Analyte	Analytical Method	CASRN	Units	NMWQCC[1]	EPA MCL[2]	Project Screening Level[3]	LOQ	LOD	DL
Volatile Organic Compounds									
1,1,2,2-Tetrachloroethane	SW8260C	79-34-5	µg/L	10	NS	10	1.0	1.0	0.5
1,1,2-Trichloroethane	SW8260C	79-00-5	µg/L	10	5.0	5.0	1.0	1.0	0.5
1,1-Dichloroethane	SW8260C	75-34-3	µg/L	25	NS	25	1.0	1.0	0.5
1,2-Dibromoethane (EDB)	SW8011	106-93-4	µg/L	0.1	0.05	0.05	0.03	0.02	0.01
1,2-Dichloroethane	SW8260C	107-06-2	µg/L	10	5.0	5.0	1.0	1.0	0.5
Benzene	SW8260C	71-43-2	µg/L	10	5.0	5.0	1.0	1.0	0.5
Chloroform	SW8260C	67-66-3	µg/L	100	80	80	1.0	1.0	0.5
cis-1,2-Dichloroethene	SW8260C	156-59-2	µg/L	NS	70	70	1.0	1.0	0.5
Dibromochloromethane	SW8260C	124-48-1	µg/L	NS	80	80	1.0	1.0	0.5
Ethylbenzene	SW8260C	100-41-4	µg/L	750	700	700	1.0	1.0	0.5
Methyl tert-Butyl Ether (MTBE)	SW8260C	1634-04-4	µg/L	NS	NS	NS	1.0	1.0	0.5
Methylene Chloride	SW8260C	75-09-2	µg/L	100	5.0	5.0	4.0	4.0	2.0
Naphthalene[5]	SW8260C	91-20-3	µg/L	30	NS	30	5.0	2.0	1.0
Tetrachloroethene (PCE)	SW8260C	127-18-4	µg/L	20	5.0	5.0	1.0	1.0	0.5
Toluene	SW8260C	108-88-3	µg/L	750	1000	750	1.0	1.0	0.5
Trichloroethene (TCE)	SW8260C	79-01-6	µg/L	100	5.0	5.0	1.0	1.0	0.5
m,p-Xylene	SW8260C	179601-23-1	µg/L	NS	10,000	10,000	1.0	1.0	0.5
o-Xylene	SW8260C	95-47-6	µg/L	NS	10,000	10,000	1.0	1.0	0.5
Xylene (Total)	SW8260C	1330-20-7	µg/L	620	10,000	620	1.0	1.0	0.5
Semivolatile Organic Compounds									
bis(2-Ethylhexyl)phthalate	SW8270D	117-81-7	µg/L	NS	6	6	5	4	2
1-Methylnaphthalene[5]	SW8270D	90-12-0	µg/L	30	NS	30	0.5	0.2	0.1
2-Methylnaphthalene[5]	SW8270D	95-95-4	µg/L	30	NS	30	0.5	0.2	0.1
Naphthalene[5]	SW8270D	91-20-3	µg/L	30	NS	30	0.5	0.4	0.1
Pyrene	SW8270D	129-00-0	µg/L	NS	NS	120	0.5	0.4	0.1

TABLE I-4
Analytical Parameter, Analyte Reporting Limits, and Screening Criteria for Water

Analyte	Analytical Method	CASRN	Units	NMWQCC[1]	EPA MCL[2]	Project Screening Level[3]	Achievable Laboratory Limits[4]		
							LOQ	LOD	DL
Metals - Total and dissolved									
Aluminum	SW6010C	7429-90-5	mg/L	5.0	NS	5.0	0.400	0.400	0.0870
Antimony	SW6020A	7440-36-0	mg/L	NS	0.006	0.006	0.002	0.001	0.00033
Arsenic	SW6020A	7440-38-2	mg/L	0.1	0.01	0.01	0.004	0.002	0.00054
Barium	SW6010C	7440-49-3	mg/L	1.0	2.0	1.0	0.010	0.0063	0.0003
Beryllium	SW6020A	7440-41-7	mg/L	NS	0.004	0.004	0.001	0.00013	0.00007
Cadmium	SW6020A	7440-43-9	mg/L	0.01	0.005	0.005	0.001	0.005	0.00023
Calcium	SW6010C	7440-70-2	mg/L	NS	NS	NS	0.004	0.050	0.033
Chromium	SW6020A	7440-47-3	mg/L	0.05	0.1	0.05	0.004	0.002	0.0007
Copper	SW6010C	7440-50-8	mg/L	1.0	1.3	1.0	0.02	0.005	0.0025
Iron	SW6010C	7439-89-6	mg/L	1.0	NS	1.0	0.4	0.05	0.033
Lead	SW6020A	7439-92-1	mg/L	0.05	0.015	0.015	0.002	0.00025	0.00013
Magnesium	SW6010C	7439-95-4	mg/L	NS	NS	NS	0.2	0.05	0.017
Manganese	SW6010C	7439-96-5	mg/L	0.2	NS	0.2	0.01	0.0013	0.0008
Mercury (total)	SW7470A	7439-97-6	mg/L	0.002	0.002	0.002	0.0002	0.0001	0.00005
Potassium	SW6010C	7440-09-7	mg/L	NS	NS	NS	1.0	5.0	0.192
Selenium	SW6020A	7782-49-2	mg/L	0.05	0.05	0.05	0.004	0.001	0.0005
Silver	SW6020A	7440-22-4	mg/L	0.05	NS	0.05	0.001	0.00025	0.00011
Sodium	SW6010C	7440-23-5	mg/L	NS	NS	NS	2.0	0.5	0.167
Strontiuim	SW6020A	7440-24-6	mg/L	NS	NS	NS	0.002	0.002	0.000436
Thallium	SW6020A	7440-28-0	mg/L	NS	0.002	0.002	0.001	0.00025	0.00015
Uranium	SW6020A	NS	mg/L	0.03	0.03	0.03	0.0005	0.0002	0.0000618
Zinc	SW6010C	7440-66-6	mg/L	10	NS	10	0.04	0.01	0.0039
Miscellaneous									
Alkalinity, carbonate	SM2320B	NS	mg/L	NS	NS	NS	2	2	0.7
Chloride	E300.0A	16887-00-6	mg/L	250	NS	250	2.0	2.0	1.0
Cyanide (free)	OIA-1677-09	57-12-5	mg/L	0.2	0.2	0.2	0.006	0.006	0.002
Dissolved organic carbon	SM5310 C-2000	NS	mg/L	NS	NS	NS	1.0	1.0	0.5
Fluoride	E300.0A	16984-48-8	mg/L	1.6	NS	1.6	0.5	0.5	0.25
Nitrate-nitrite nitrogen[6]	E353.2	84145-82-4	mg/L	10	10	10	1.0	0.1	0.04
Silica	SM4500-SiO2 C-1997	7631-86-9	mg/L	NS	NS	NS	0.4	0.4	0.1
Sulfate	E300.0A	18785-72-3	mg/L	600	250	250	5.0	5.0	1.5
Total phenols	E420.4	108-95-2	mg/L	0.005	NS	0.04	0.04	0.04	0.015

TABLE I-4
Analytical Parameter, Analyte Reporting Limits, and Screening Criteria for Water

Analyte	Analytical Method	CASRN	Units	NMWQCC[1]	EPA MCL[2]	Project Screening Level[3]	Achievable Laboratory Limits[4]		
							LOQ	LOD	DL
NPDES No NM0031216									
Volatile Organic Compounds									
1,2-Dibromoethane (EDB)	SW8011	106-93-4	µg/L	0.1	0.05	Report[10]	0.03	0.02	0.01
Miscellaneous									
Ammonia Nitrogen	EPA 350.1	7664-41-7	mg/L	NS	NS	Report[10]	0.05	0.05	0.017
Biochemical oxygen demand	SM5210B	NS	mg/L	NS	NS	26/48[11]	2	2	1
Chemical oxygen demand	EPA 410.4	NS	mg/L	NS	NS	Report[10]	20	20	9
Nitrate-nitrite nitrogen	E353.2	84145-82-4	mg/L	10	10	Report[10]	1.0	0.1	0.04
Oil and Grease (Hexane extractable)	E1664A	NS	mg/L	NS	NS	8/15[11]	5.0	5	1.4
Total residual chlorine	SM4500-Cl G	NS	mg/L	NS	NS	0.011	0.05	0.05	0.017
Total Suspended Solids	SM 2540D	NS	mg/L	NS	NS	21/33[11]	5.00	5.00	1.4
Whole Effluent Toxicity - Daphnia Pulex (48-hour acute NOEC freshwater)[9]	EPA 2021.0	NS	LC50	NS	NS	Report[10]	NA	NA	NA
Organochlorine Pesticides									
Heptachlor	SW8081B	76-44-8	µg/L	0.4	NS	Report[4]	0.02	0.02	0.006
Per- and Polyfluorinated Alkyl Substances									
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (PFPrOPrA)*	EPA 537 Modified	13252-13-6	ng/L			Report[10]	2.00	1.32	0.66
Perfluorooctanesulfonate (PFOS)	EPA 537 Modified	1763-23-1	ng/L			Report[10]	2.00	1.32	0.66
Perfluoroundecanoic acid (PFUdA)	EPA 537 Modified	2058-94-8	ng/L			Report[10]	2.00	1.44	0.72
N-methylperfluoro-1-octanesulfonamidoacetic acid	EPA 537 Modified	2355-31-9	ng/L			Report[10]	4.00	2.64	1.32
Perfluoropentanoic acid (PFPeA)	EPA 537 Modified	2706-90-3	ng/L			Report[10]	2.00	1.32	0.66
Perfluoropentanesulfonate (PFPeS)	EPA 537 Modified	2706-91-4	ng/L			Report[10]	1.88	1.32	0.66
Fluorotelomer sulfonate 6:2 (6:2 FTS)	EPA 537 Modified	27619-97-2	ng/L			Report[10]	1.90	1.32	0.66
N-ethylperfluoro-1-octanesulfonamidoacetic acid	EPA 537 Modified	2991-50-6	ng/L			Report[10]	4.00	2.64	1.32
Perfluorohexanoic acid (PFHxA)	EPA 537 Modified	307-24-4	ng/L			Report[10]	2.00	1.32	0.66
Perfluorododecanoic acid (PFDoA)	EPA 537 Modified	307-55-1	ng/L			Report[10]	2.00	1.32	0.66
Perfluorooctanoic acid (PFOA)	EPA 537 Modified	335-67-1	ng/L			Report[10]	2.00	1.32	0.66
Perfluorodecanoic acid (PFDA)	EPA 537 Modified	335-76-2	ng/L			Report[10]	2.00	1.32	0.66
Perfluorodecanesulfonate (PFDS)	EPA 537 Modified	335-77-3	ng/L			Report[10]	1.94	1.32	0.66
Perfluorohexanesulfonate (PFHxS)	EPA 537 Modified	355-46-4	ng/L			Report[10]	1.82	1.32	0.66
Perfluorobutyric acid (PFBA)	EPA 537 Modified	375-22-4	ng/L			Report[10]	2.00	1.64	0.82
Perfluorobutanesulfonate (PFBS)	EPA 537 Modified	375-73-5	ng/L			Report[10]	1.78	1.60	0.8
Perfluoroheptanoic acid (PFHpA)	EPA 537 Modified	375-85-9	ng/L			Report[10]	2.00	1.32	0.66
Perfluoroheptanesulfonate (PFHpS)	EPA 537 Modified	375-92-8	ng/L			Report[10]	1.90	1.32	0.66
Perfluorononanoic acid (PFNA)	EPA 537 Modified	375-95-1	ng/L			Report[10]	2.00	1.32	0.66
Perfluorotetradecanoic acid (PFTeDA)	EPA 537 Modified	376-06-7	ng/L			Report[10]	2.00	1.32	0.66
Fluorotelomer sulfonate 8:2 (8:2 FTS)	EPA 537 Modified	39108-34-4	ng/L			Report[10]	3.84	2.64	1.32
Perfluorononanesulfonate (PFNS)	EPA 537 Modified	68259-12-1	ng/L			Report[10]	1.92	1.40	0.7
Perfluorotridecanoic acid (PFTrDA)	EPA 537 Modified	72629-94-8	ng/L			Report[10]	2.00	1.32	0.66
Perfluorooctanesulfonamide (PFOSA)	EPA 537 Modified	754-91-6	ng/L			Report[10]	1.86	1.32	0.66
Fluorotelomer sulfonate 4:2 (4:2 FTS)	EPA 537 Modified	757124-72-4	ng/L			Report[10]	1.88	1.32	0.66

TABLE I-4
Analytical Parameter, Analyte Reporting Limits, and Screening Criteria for Water

[1] NMWQCC standards per the New Mexico Administrative Code Title 20.6.2.3101A, Standards for Ground Water of 10,000 mg/L Total Dissolved Solids Concentration or Less (NMAC 2004). For metals, the NMWQCC standard applies to dissolved metals and total mercury.

[2] EPA National Primary Drinking Water Regulations, Maximum Contaminant Levels and Secondary Maximum Contaminant Levels, Title 40 Code of Federal Regulations Part 141, 143 (May 2009).

[3] The project screening level was selected to satisfy the requirements of the Kirtland Air Force Base Hazardous Waste Permit Number NM9570024423 as the lowest of (1) NMWQCC standard or (2) EPA MCL. If no MCL or NMWQCC standard exists for any analyte, then the project screening level will be the EPA Tapwater Regional Screening Level. Project screening levels below the LOD are highlighted and the screening level is set at the LOQ.

[4] Achievable laboratory limits are for Eurofins Lancaster Laboratories Environmental, LLC, Lancaster Pennsylvania.

[5] NMWQCC specifies a standard for the sum of naphthalene and mononaphthalenes (1-methylnaphthalene and 2-methylnaphthalene). Conservatively, this standard is shown for each of the three compounds.

[6] The MCL for nitrate is 10 mg/L.

[7] USEPA Region 6 - Kirtland AFB NPDES Permit No. NM0031216 (September 2019).

[8] Achievable laboratory limits are for GEL Labortories, LLC (GEL).

[9] Whole effluent toxicity will be performed by EA Engineering, Science & Technology, Inc., Ecotoxicology Laboratory.

[10] NPDES permit specifies to report the results from the laboratory. No screening value is provided in the permit.

[11] NPDES permit specifies allowable concentration for 30-day average and daily maximum.

µg/L = Microgram(s) per liter.

CASRN = Chemical Abstracts Service Registry Number.

DL = Detection limit.

E = EPA Methods for Chemical Analysis of Water and Wastes, 1983 and Updates.

EPA = U.S. Environmental Protection Agency.

LOD = Limit of detection.

LOQ = Limit of quantitation.

MCL = Maximum Contaminant Level.

mg/L = Milligram(s) per liter.

NMWQCC = New Mexico Water Quality Control Commission.

NS = Not specified.

SW = EPA SW846 - Test Methods for Evaluating Solid Waste, Third Edition and Updates.

Table I-5
Data Qualification Flags and Reason Codes

Qualifier	Definition
	No Qualifier indicates that the data are acceptable both qualitatively and quantitatively.
U	The analyte was analyzed for but was not detected above the reported limit of quantitation.
J	The analyte was analyzed for and was positively identified, but the reported numerical value may not be consistent with the amount actually present in the environmental sample. Results are estimated, although the data are considered usable and may be used as appropriate to meet project objectives. Results are qualitatively acceptable and quantitatively uncertain.
J-	The analyte was positively identified; the associated numerical value is its approximate concentration with a low bias in the sample.
J+	The analyte was positively identified; the associated numerical value is its approximate concentration with a high bias in the sample.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The analyte was analyzed for, but the presence or absence of the analyte has not been verified. Re-sampling and re-analysis may be necessary to confirm or deny the presence of the analyte. Results are rejected, and data are unusable for any purposes.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project QC criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

Table I-6
Field Measurement Frequency

Field Equipment	Values Measured (Units)	Frequency	Sample Locations
YSI (or equivalent) water quality meter with flow cell	Temperature (°C) Saturated DO (%) DO (mg/L) Specific Conductance (µS/cm) pH ORP (mV)	Concurrently with monthly, annual, and 5-year GWTS samples; with annual extraction well samples; as needed	Influent, mid-GAC, effluent sampling ports; extraction well sampling ports; any location as needed.
Turbidity Meter	Turbidity (NTU)	Concurrently with monthly, annual, and 5-year GWTS samples; with annual extraction well samples; as needed	Influent, mid-GAC, effluent sampling ports; extraction well sampling ports; any location as needed
Handheld Colorimeter (0-2 mg/L)	Free chlorine (mg/L)	As needed	Influent, mid-GAC, effluent sampling ports; extraction well sampling ports; any location as needed
Chlorine Test Papers (0-200 mg/L)	Free chlorine (mg/L)	As needed	Influent, mid-GAC, effluent sampling ports; extraction well sampling ports; any location as needed
Inline Influent Chlorine Analyzer (0-5 mg/L)	Free chlorine (mg/L)	Continuous	Permanently in line with influent, pre-influent pump skid

°C = Degree Celsius
µS/cm = microSiemens per centimeter
DO = dissolved oxygen
GAC = granular activated carbon
GWTS = groundwater treatment system
mg/L = milligram(s) per liter
mV = millivolt(s)
NTU = Nephelometric turbidity unit
ORP = oxidation reduction potential

APPENDIX J

WASTE CHARACTERIZATION DOCUMENTATION

BAG FILTER DISPOSAL APPROVAL

From:	Simpler, Trent SPA
To:	Jercinovic, Devon; Phaneuf, Mark J SPA; Dreeland, Linda SPA; Sanchez, Amy E. SPA; Adria Bodour; BITNER, LUDIE W GS-13 USAF AFCEC/CZO; Vic Branson; Amdurer, Mike; Tarbert, Jason A
Subject:	Bag filters
Date:	Thursday, June 09, 2016 7:50:47 AM

Devon and Mike,

We spoke with Katrina and she is good with us throwing the bag filters away. There is no official reply.

Consider this your approval to put used bag filters in the dumpster.

Trent

Trent Simpler, P.E.
Project Manager BFF
Chair Wind Energy CX
Red Team LGL
US Army Corps of Engineers
Trent.Simpler@usace.army.mil
505-342-4823 (office)
505-301-6996 (Blackberry)

HAZARDOUS WASTE PROCESS DESCRIPTION

ORGANIZATION CODE & UEC NAME:

WASTE COLLECTION SITE ID (IAP#):

SHOP CODE:

BUILDING NUMBER/LOCATION: Building 19150 Bulk Fuels Facility Groundwater Treatment System (GWTS)

DATE: 4/27/16

D**ESCRIPTION OF PROCESS:**
Bag filters are located at both the inlet and outlet of the granular-activated carbon beds at the GWTS to remove suspended solids resulting from groundwater extraction, and fines released from the activated carbon beds. During normal operation of the GWTS, bag filters are replaced on an as-needed basis, or semiannually as required in the *Operation and Maintenance Manua*l, *Mid-Plume Pump and Treat System* (USACE, 2016).

WASTE DESCRIPTION:
Non-hazardous solid waste. See Attachment 1 for a description of how the waste was characterized, and Attachment 2 for the analytical data.

LIST MATERIALS AND NSNs SPECIFIC TO THIS PROCESS:
Used bag filters (10 micron size #2, 7-inch by 32-inch) stored in DOT-approved 55-gallon drums

IS THIS A NEW PROCESS? YES____X____ NO_____
DESCRIBE ANY CHANGES MADE TO PROCESS SINCE LAST EVALUATION
(If no change, a negative response is required)
N/A

PREPARER'S NAME, JOB TITLE, PHONE NUMBER, & SIGNATURE
(This person must be actively involved in the process)

I certify that to the best of my knowledge and belief, all of the process description information contained herein is accurate and complete. Caitlin Q. LaChance

Signature of Person Actively Involved in the Process
Caitlin LaChance, Scientist
505-262-8942

PLEASE include, if applicable:

- Any T. O. or other references related to the process;

- A diagram of the process; and
- Any comments relevant to process description not otherwise included.

****FOR HAZARDOUS WASTE PERSONNEL USE ONLY****

ASSIGNED WASTE PROFILE:_____

COMMENTS: _____

Attachment 1: Bag Filter Waste Characterization and Request for Disposal

Background

Kirtland Air Force Base (KAFB) is investigating and remediating a historical release of aviation gasoline and jet fuel from the Bulk Fuels Facility (BFF) pursuant to the Resource Conservation and Recovery Act (RCRA) corrective action provisions in Part 6 of KAFB's Hazardous Waste Treatment Facility Operating Permit (HWTF Permit No. NM9570024423). The HWTF Permit is enforced by the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB).

KAFB is currently implementing an ethylene dibromide (EDB) groundwater treatment interim measure (IM) in accordance with Part 6.2.2.2.12 of the HWTF Permit. The EDB plume IM consists of extraction wells and treatment with granulated activated carbon (GAC) at the Groundwater Treatment System (GWTS) facility. The groundwater treated at the GWTS is non-hazardous. The treated effluent from the system is non-detect for all fuel-related constituents.

Bag filters are located at both the inlet and outlet of the GAC beds at the GWTS to remove suspended solids resulting from groundwater extraction, and fines released from the GAC beds. During normal operation of the GWTS, bag filters are replaced on an as-needed basis, or semiannually as required in the *Operation and Maintenance Manua*l, *Mid-Plume Pump and Treat System* (USACE, 2016). The waste was accumulated from January 1, 2016 through April 12, 2016. Currently, the waste is being stored on-site in a 55-gallon drum and requires disposal.

Waste Characterization

A generator may use testing, acceptable knowledge (i.e.: process knowledge), or a combination of the two to satisfy its RCRA waste characterization responsibilities (40 CFR 262.11). Waste characterization requirements are detailed in Part 2.6 of the HWTF Permit. Part 2.6.2 states that "Acceptable knowledge may be used as the sole method to characterize waste only when the waste is from a process that is consistent and well-documented".

The influent and effluent from the GWTS meets this permit requirement for the use of acceptable knowledge as the sole method to characterize the inlet and outlet bag filters. As stated above, the influent to the treatment system that goes through the inlet bag filters is nonhazardous and contains no constituents other than EDB above applicable groundwater standards. The treated groundwater that goes through the outlet bag filters has no detectable fuel constituents and meets drinking water quality standards.

Analytical results from two extraction wells (KAFB-106233 and KAFB-106234) and GWTS influent and effluent samples were evaluated as part of the acceptable knowledge review for the inlet filters. The extraction well groundwater and GWTS samples were analyzed for EDB, benzene, toluene, ethylbenzene, total xylenes, dissolved manganese, and dissolved iron. Benzene is the only analyte in this analytical suite that has an established toxicity characteristic standard (500 micrograms per liter; Title 40 Code of Federal Regulations Part 264.24, Table 1). As shown in Attachment 2, benzene concentrations were non-detect for all samples taken for the treatment system, and therefore below the established toxicity characteristic standard.

Conclusion

The totality of the acceptable knowledge demonstrates that the inlet and outlet bag filters are not hazardous waste; therefore, the waste is considered to be non-hazardous. The used bag filters are also not considered to be special waste, as defined in 20.9.7.S(13) NMAC. If the concentrations of contaminants in the system increase to a level at or above the regulatory limits, this process will be reevaluated and revised to comply with disposal requirements.

				LOCATION CODE	GWTS-INF		GWTS-GAC1		GWTS-EFF		GWTS-INF		GWTS-GAC1	
				SAMPLE NO	GWTS-INF-0001		GWTS-GAC1-0001		GWTS-EFF-0001		GWTS-INF-0002		GWTS-GAC1-0002	
				SAMPLE DATE	12/16/2015		12/16/2015		12/16/2015		12/18/2015		12/18/2015	
				SAMPLE TIME	16:00		16:00		16:00		14:15		14:25	
				SAMPLE DAY	Wednesday		Wednesday		Wednesday		Friday		Friday	
				DAY NUMBER	1		1		1		2		2	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
				LABORATORY	Empirical		Empirical		Empirical		Empirical		Empirical	
				LAB DATA DUE	12/18/2015		12/18/2015		12/18/2015		12/20/2015		12/20/2015	
Chemical Class & Analytical Method	Parameter	Toxicity Characteristics (40 CFR 264.24)	NMED Ground Water Protection Standards (Sec. 20.6.2.3103)	EPA MCLs[a]	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ
Draft Analytical Data														
EDB (ug/L)SW8011	1,2-DIBROMOETHANE	NE	0.1	0.05	0.194	0.03	ND	0.03	ND	0.03	0.18	0.0281	ND	0.0288
VOC (ug/L)/ SW8260B	BENZENE	500	10	5	ND	1	ND	1	ND	1	ND	1	ND	1
	ETHYLBENZENE	NE	750	700	ND	1	ND	1	ND	1	0.316J	1	ND	1
	TOLUENE	NE	750	1000	ND	1	ND	1	ND	1	ND	1	ND	1
	XYLENES	NE	620	10000	0.918J	3	ND	3	ND	3	2.89J	3	ND	3
Metals (ug/L)/SW6010C	IRON, DISSOLVED	NE	1,000	NE	36.8J	100	ND	100	ND	100	239	100	ND	100
	MANGANESE, DISSOLVED	NE	200	NE	ND	15	5.02J	15	3.55J	15	15.5	15	5.46J	15
TDS (mg/L)/SM2540C	TDS	NA	1,000	NE	-	-	-	-	-	-	-	-	-	-
TSS (mg/L)/SM2540D	TSS	NA	NE	NE	-	-	-	-	-	-	-	-	-	-
Field Data														
	Temperature (Deg.C)	---	---	---	17.48		17.33		13.78		17		16.4	
	Spec. Conductivity (us/cm)	---	---	---	354.2		373.5		609		393		388	
	pH	---	---	---	8.1		9.1		8.5		7.82		8.86	
	ORP (mV)	---	---	---	214		225		231		79.9		117.4	
	DO (mg/L)	---	---	---	6.91		0.57		7.53		7.64		1.48	

				LOCATION CODE	GWTS-EFF		GWTS-INF		GWTS-GAC1		GWTS-EFF		GWTS-INF	
				SAMPLE NO	GWTS-EFF-0002		GWTS-INF-0003		GWTS-GAC1-0003		GWTS-EFF-0003		GWTS-INF-0004	
				SAMPLE DATE	12/18/2015		21-Dec-15		21-Dec-15		21-Dec-15		22-Dec-15	
				SAMPLE TIME	14:35		12:15		12:30		12:40		15:20	
				SAMPLE DAY	Friday		Monday		Monday		Monday		Tuesday	
				DAY NUMBER	2		3		3		3		4	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
				LABORATORY	Empirical		Empirical		Empirical		Empirical		Empirical	
				LAB DATA DUE	12/20/2015		12/23/2015		12/23/2015		12/23/2015		12/24/2015	
Chemical Class & Analytical Method	Parameter	Toxicity Characteristics (40 CFR 264.24)	NMED Ground Water Protection Standards (Sec. 20.6.2.3103)	EPA MCLs[a]	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ
Draft Analytical Data														
EDB (ug/L)SW8011	1,2-DIBROMOETHANE	NE	0.1	0.05	ND	0.0284	0.195	0.0281	ND	0.0282	ND	0.028	0.182	0.0283
VOC (ug/L)/ SW8260B	BENZENE	500	10	5	ND	1	ND	1	ND	1	ND	1	ND	1
	ETHYLBENZENE	NE	750	700	ND	1	ND	1	ND	1	ND	1	ND	1
	TOLUENE	NE	750	1000	ND	1	ND	1	ND	1	ND	1	ND	1
	XYLENES	NE	620	10000	1.08J	3	ND	3	ND	3	ND	3	ND	3
Metals (ug/L)/SW6010C	IRON, DISSOLVED	NE	1,000	NE	81.2J	100	37.3J	100	ND	100	30.4J	100	ND	100
	MANGANESE, DISSOLVED	NE	200	NE	4.3J	15	ND	15	5.56J	15	5.87J	15	ND	15
TDS (mg/L)/SM2540C	TDS	NA	1,000	NE	-	-	-	-	-	-	-	-	-	-
TSS (mg/L)/SM2540D	TSS	NA	NE	NE	-	-	-	-	-	-	-	-	-	-
Field Data														
	Temperature (Deg.C)	---	---	---	14.7		18.3		17.3		16.3		19.3	
	Spec. Conductivity (us/cm)	---	---	---	542		387		388		434		397	
	pH	---	---	---	8.02		7.64		8.7		8.17		8.2	
	ORP (mV)	---	---	---	175.5		181.3		177		154.1		265.5	
	DO (mg/L)	---	---	---	6.54		7.95		3.16		6.62		7.42	

				LOCATION CODE	GWTS-GAC1		GWTS-EFF		GWTS-INF		GWTS-GAC1		GWTS-EFF	
				SAMPLE NO	GWTS-GAC1-0004		GWTS-EFF-0004		GWTS-INF-0005		GWTS-GAC1-0005		GWTS-EFF-0005	
				SAMPLE DATE	22-Dec-15		22-Dec-15		29-Dec-05		29-Dec-05		29-Dec-05	
				SAMPLE TIME	15:10		15:00		13:55		13:47		13:38	
				SAMPLE DAY	Tuesday		Tuesday		Tuesday		Tuesday		Tuesday	
				DAY NUMBER	4		4		5		5		5	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
				LABORATORY	Empirical		Empirical		Empirical		Empirical		Empirical	
				LAB DATA DUE	12/24/2015		12/24/2015		12/31/2015		12/31/2015		12/31/2015	
Chemical Class & Analytical Method	Parameter	Toxicity Characteristics (40 CFR 264.24)	NMED Ground Water Protection Standards (Sec. 20.6.2.3103)	EPA MCLs[a]	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ
Draft Analytical Data														
EDB (ug/L)SW8011	1,2-DIBROMOETHANE	NE	0.1	0.05	ND	0.0278	ND	0.0283	0.181	0.0289	ND	0.0288	ND	0.0287
VOC (ug/L)/ SW8260B	BENZENE	500	10	5	ND	1	ND	1	ND	1	ND	1	ND	1
	ETHYLBENZENE	NE	750	700	ND	1	ND	1	ND	1	ND	1	ND	1
	TOLUENE	NE	750	1000	ND	1	ND	1	ND	1	ND	1	ND	1
	XYLENES	NE	620	10000	ND	3	ND	3	ND	3	ND	3	ND	3
Metals (ug/L)/SW6010C	IRON, DISSOLVED	NE	1,000	NE	ND	100	39.4J	100	ND	100	ND	100	63J	100
	MANGANESE, DISSOLVED	NE	200	NE	5.3J	15	18.5	15	ND	15	6.65J	15	9.47J	15
TDS (mg/L)/SM2540C	TDS	NA	1,000	NE	-	-	-	-	-	-	-	-	-	-
TSS (mg/L)/SM2540D	TSS	NA	NE	NE	-	-	-	-	-	-	-	-	-	-
Field Data														
	Temperature (Deg.C)	---	---	---	19		18.2		18.2		16.1		17.7	
	Spec. Conductivity (us/cm)	---	---	---	363		391		405		393		419	
	pH	---	---	---	8.91		8.36		8.05		8.81		7.38	
	ORP (mV)	---	---	---	266.1		268.2		114.5		115.3		113.8	
	DO (mg/L)	---	---	---	2.13		6.5		7.66		2.46		6.47	

				LOCATION CODE	GWTS-INF		GWTS-GAC1		GWTS-EFF		GWTS-INF		GWTS-GAC1	
				SAMPLE NO	GWTS-INF-0006		GWTS-GAC1-0006		GWTS-EFF-0006		GWTS-INF-0007		GWTS-GAC1-0007	
				SAMPLE DATE	30-Dec-05		30-Dec-05		30-Dec-15		31-Dec-15		31-Dec-15	
				SAMPLE TIME	13:05		13:00		13:10		9:47		9:43	
				SAMPLE DAY	Wednesday		Wednesday		Wednesday		Thursday		Thursday	
				DAY NUMBER	6		6		6		7		7	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
				LABORATORY	Empirical		Empirical		Empirical		Empirical		Empirical	
				LAB DATA DUE	1/4/2016		1/4/2016		1/4/2016		1/5/2016		1/5/2016	
Chemical Class & Analytical Method	Parameter	Toxicity Characteristics (40 CFR 264.24)	NMED Ground Water Protection Standards (Sec. 20.6.2.3103)	EPA MCLs[a]	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ
Draft Analytical Data														
EDB (ug/L)SW8011	1,2-DIBROMOETHANE	NE	0.1	0.05	0.194	0.0284	ND	0.0284	ND	0.0282	0.183	0.0287	ND	0.0286
VOC (ug/L)/ SW8260B	BENZENE	500	10	5	ND	1	ND	1	ND	1	ND	1	ND	1
	ETHYLBENZENE	NE	750	700	ND	1	ND	1	ND	1	ND	1	ND	1
	TOLUENE	NE	750	1000	ND	1	ND	1	ND	1	ND	1	ND	1
	XYLENES	NE	620	10000	ND	3	ND	3	ND	3	ND	3	ND	3
Metals (ug/L)/SW6010C	IRON, DISSOLVED	NE	1,000	NE	ND	100	ND	100	ND	100	38.3J	100	ND	100
	MANGANESE, DISSOLVED	NE	200	NE	ND	15	6.9J	15	6.21J	15	ND	15	8.22J	15
TDS (mg/L)/SM2540C	TDS	NA	1,000	NE	-	-	-	-	-	-	-	-	-	-
TSS (mg/L)/SM2540D	TSS	NA	NE	NE	-	-	-	-	-	-	-	-	-	-
Field Data														
	Temperature (Deg.C)	---	---	---	17		18.8		17.1		17.2		18.4	
	Spec. Conductivity (us/cm)	---	---	---	421		407		425		424		401	
	pH	---	---	---	8.1		8.75		8.02		8.05		8.54	
	ORP (mV)	---	---	---	172.3		171.2		142.5		186.8		182.4	
	DO (mg/L)	---	---	---	7.7		3.33		6.46		7.47		2.95	

				LOCATION CODE	GWTS-EFF		GWTS-INF		GWTS-GAC1		GWTS-EFF		KAFB-106233	
				SAMPLE NO	GWTS-EFF-0007		GWTS-INF-0008		GWTS-GAC1-0008		GWTS-EFF-0008		GW2601	
				SAMPLE DATE	31-Dec-15		7-Jan-16		7-Jan-16		7-Jan-16		13-Jan-16	
				SAMPLE TIME	8:30		9:00		9:10		9:20		14:36	
				SAMPLE DAY	Thursday		Thursday		Thursday		Thursday		Wednesday	
				DAY NUMBER	7		Week 1		Week 1		Week 1		Initial Sample	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
				LABORATORY	Empirical		Empirical		Empirical		Empirical		Empirical	
				LAB DATA DUE	1/5/2016		1/15/2016		1/15/2016		1/15/2016		1/21/2016	
Chemical Class & Analytical Method	Parameter	Toxicity Characteristics (40 CFR 264.24)	NMED Ground Water Protection Standards (Sec. 20.6.2.3103)	EPA MCLs[a]	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ
Draft Analytical Data														
EDB (ug/L)SW8011	1,2-DIBROMOETHANE	NE	0.1	0.05	ND	0.0287	0.176	0.0283	ND	0.0286	ND	0.0284	0.00982J	0.0284
VOC (ug/L)/ SW8260B	BENZENE	500	10	5	ND	1	ND	1	ND	1	ND	1	ND	1
	ETHYLBENZENE	NE	750	700	ND	1	ND	1	ND	1	ND	1	0.26J	1
	TOLUENE	NE	750	1000	ND	1	ND	1	ND	1	ND	1	1.17	1
	XYLENES	NE	620	10000	ND	3	ND	3	ND	3	ND	3	1.54J	3
Metals (ug/L)/SW6010C	IRON, DISSOLVED	NE	1,000	NE	54.9J	100	ND	100	ND	100	ND	100	ND	25
	MANGANESE, DISSOLVED	NE	200	NE	7.8J	15	ND	15	7.05J	15	8.37J	15	69.3	3.75
TDS (mg/L)/SM2540C	TDS	NA	1,000	NE	-	-	-	-	-	-	-	-	195	20
TSS (mg/L)/SM2540D	TSS	NA	NE	NE	-	-	-	-	-	-	-	-	ND	4
Field Data														
	Temperature (Deg.C)	---	---	---	17.9		18.4		17.1		16.4		18.8	
	Spec. Conductivity (us/cm)	---	---	---	416		424		418		430		387	
	pH	---	---	---	8.42		7.94		8.3		7.87		6.42	
	ORP (mV)	---	---	---	194.9		151		164.7		158.16		200.1	
	DO (mg/L)	---	---	---	6.28		7.76		2.8		6.68		8.16	

				LOCATION CODE	KAFB-106234		GWTS-INF		GWTS-GAC1		GWTS-EFF		GWTS-INF	
				SAMPLE NO	GW2602		GWTS-INF-0009		GWTS-GAC1-0009		GWTS-EFF-0009		GWTS-INF-0010	
				SAMPLE DATE	13-Jan-16		14-Jan-16		14-Jan-16		14-Jan-16		21-Jan-16	
				SAMPLE TIME	14:52		9:28		9:40		9:53		16:08	
				SAMPLE DAY	Wednesday		Thursday		Thursday		Thursday		Thursday	
				DAY NUMBER	Initial Sample		Week 2		Week 2		Week 2		Week 3 & Day 1	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
				LABORATORY	Empirical		Empirical		Empirical		Empirical		Empirical	
				LAB DATA DUE	1/21/2016		1/22/2016		1/22/2016		1/22/2016		1/26/2016	
Chemical Class & Analytical Method	Parameter	Toxicity Characteristics (40 CFR 264.24)	NMED Ground Water Protection Standards (Sec. 20.6.2.3103)	EPA MCLs[a]	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ
Draft Analytical Data														
EDB (ug/L)SW8011	1,2-DIBROMOETHANE	NE	0.1	0.05	0.112	0.0284	0.15	0.286	ND	0.0287	ND	0.0284	0.146	0.0284
VOC (ug/L)/ SW8260B	BENZENE	500	10	5	ND	1	ND	1	ND	1	ND	1	ND	1
	ETHYLBENZENE	NE	750	700	ND	1	ND	1	ND	1	ND	1	ND	1
	TOLUENE	NE	750	1000	0.278J	1	ND	1	ND	1	ND	1	0.661J	1
	XYLENES	NE	620	10000	0.921J	3	ND	3	ND	3	ND	3	ND	3
Metals (ug/L)/SW6010C	IRON, DISSOLVED	NE	1,000	NE	ND	25	ND	100	ND	100	37.3J	100	ND	100
	MANGANESE, DISSOLVED	NE	200	NE	8.23	3.75	ND	15	ND	15	3.69J	15	5.55J	15
TDS (mg/L)/SM2540C	TDS	NA	1,000	NE	360	20	-	-	-	-	-	-	-	-
TSS (mg/L)/SM2540D	TSS	NA	NE	NE	ND	4	-	-	-	-	-	-	-	-
Field Data														
	Temperature (Deg.C)	---	---	---	16.4		18.8		18.9		18.8		14.3	
	Spec. Conductivity (us/cm)	---	---	---	701		425		431		444		490	
	pH	---	---	---	7.86		7.62		7.83		7.47		7.35	
	ORP (mV)	---	---	---	219.9		202.8		221.9		188.3		188.9	
	DO (mg/L)	---	---	---	3.22		7.2		1.7		6.54		7.99	

				LOCATION CODE	GWTS-GAC1		GWTS-EFF		GWTS-INF		GWTS-GAC1		GWTS-EFF	
				SAMPLE NO	GWTS-GAC1-0010		GWTS-EFF-0010		GWTS-INF-0020		GWTS-GAC1-0020		GWTS-EFF-0020	
				SAMPLE DATE	21-Jan-16		21-Jan-16		23-Feb-16		23-Feb-16		23-Feb-16	
				SAMPLE TIME	15:58		15:40		13:25		13:45		14:05	
				SAMPLE DAY	Thursday		Thursday		Tuesday		Tuesday		Tuesday	
				DAY NUMBER	Week 3 & Day 1		Week 3 & Day 1		Monthly		Monthly		Monthly	
				SAMPLE PURPOSE	REG		REG		REG		REG		REG	
				LABORATORY	Empirical		Empirical		Empirical		Empirical		Empirical	
				LAB DATA DUE	1/26/2016		1/26/2016		3/2/2016		3/2/2016		3/2/2016	
Chemical Class & Analytical Method	Parameter	Toxicity Characteristics (40 CFR 264.24)	NMED Ground Water Protection Standards (Sec. 20.6.2.3103)	EPA MCLs[a]	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ	Result	LOQ
Draft Analytical Data														
EDB (ug/L)SW8011	1,2-DIBROMOETHANE	NE	0.1	0.05	ND	0.0286	ND	0.0281	0.0842	0.0284	ND	0.0282	ND	0.0281
VOC (ug/L)/ SW8260B	BENZENE	500	10	5	ND	1	ND	1	ND	1	ND	1	ND	1
	ETHYLBENZENE	NE	750	700	ND	1	ND	1	ND	1	ND	1	ND	1
	TOLUENE	NE	750	1000	ND	1	ND	1	ND	1	ND	1	ND	1
	XYLENES	NE	620	10000	ND	3	ND	3	ND	3	ND	3	ND	3
Metals (ug/L)/SW6010C	IRON, DISSOLVED	NE	1,000	NE	ND	100	ND	100	ND	100	ND	100	ND	100
	MANGANESE, DISSOLVED	NE	200	NE	25.6	15	11.5J	15	ND	15	ND	15	ND	15
TDS (mg/L)/SM2540C	TDS	NA	1,000	NE	-	-	-	-	-	-	-	-	-	-
TSS (mg/L)/SM2540D	TSS	NA	NE	NE	-	-	-	-	-	-	-	-	-	-
Field Data														
	Temperature (Deg.C)	---	---	---	10.8		17.2		19.4		19.4		19.5	
	Spec. Conductivity (us/cm)	---	---	---	463		570		505		471		496	
	pH	---	---	---	7.42		7.34		7.38		7.49		7.41	
	ORP (mV)	---	---	---	191.6		195.4		153		179.2		192.6	
	DO (mg/L)	---	---	---	3		6.96		7.21		4.2		6.87	

				LOCATION CODE	GWTS-INF		GWTS-GAC1		GWTS-EFF	
				SAMPLE NO	GWTS-INF-0012		GWTS-GAC1-0012		GWTS-EFF-0012	
				SAMPLE DATE	22-Mar-16		22-Mar-16		22-Mar-16	
				SAMPLE TIME	13;40		13:20		13:00	
				SAMPLE DAY	Tuesday		Tuesday		Tuesday	
				DAY NUMBER	Monthly		Monthly		Monthly	
				SAMPLE PURPOSE	REG		REG		REG	
				LABORATORY	Empirical		Empirical		Empirical	
				LAB DATA DUE	3/30/2016		3/30/2016		3/30/2016	
Chemical Class & Analytical Method	Parameter	Toxicity Characteristics (40 CFR 264.24)	NMED Ground Water Protection Standards (Sec. 20.6.2.3103)	EPA MCLs[a]	Result	LOQ	Result	LOQ	Result	LOQ
Draft Analytical Data										
EDB (ug/L)SW8011	1,2-DIBROMOETHANE	NE	0.1	0.05	0.0756	0.0283	ND	0.0286	ND	0.0282
VOC (ug/L)/ SW8260B	BENZENE	500	10	5	ND	1	ND	1	ND	1
	ETHYLBENZENE	NE	750	700	ND	1	ND	1	ND	1
	TOLUENE	NE	750	1000	ND	1	ND	1	ND	1
	XYLENES	NE	620	10000	ND	3	ND	3	ND	3
Metals (ug/L)/SW6010C	IRON, DISSOLVED	NE	1,000	NE	ND	100	ND	100	ND	100
	MANGANESE, DISSOLVED	NE	200	NE	ND	15	ND	15	ND	15
TDS (mg/L)/SM2540C	TDS	NA	1,000	NE	-	-	-	-	-	-
TSS (mg/L)/SM2540D	TSS	NA	NE	NE	-	-	-	-	-	-
Field Data										
	Temperature (Deg.C)	---	---	---	19.9		19.5		19.5	
	Spec. Conductivity (us/cm)	---	---	---	460		472		473	
	pH	---	---	---	7.57		7.46		7.42	
	ORP (mV)	---	---	---	92.6		74.7		59.2	
	DO (mg/L)	---	---	---	6.29		5.85		6.15	

Appendix J

Notes:
Laboratory results greater than EPA MCLs or NMED Groundwater Protection Standards are highlighted in yellow.
a = EPA MCLs are from the EPA RSL Table, dated Nov. 2015.
ND = not detected
NE = not established
- = not required
LOQ = Limit of Quantitation
J = analyte was detected at a trace level below the LOQ
ug/L = micrograms per liter
mg/L = milligrams per liter
The concentrations of iron and manganese for day 7 samples (12/31/15 sample date) are reported as total, not dissolved. Samples were not filtered in the field and were collected nitric acid containers.
12/16/15 thru 1/14/16: influent samples were collected from KAFB-106228
Starting 1/21/16: influent samples were collected from KAFB-106228, 106233 and 106234

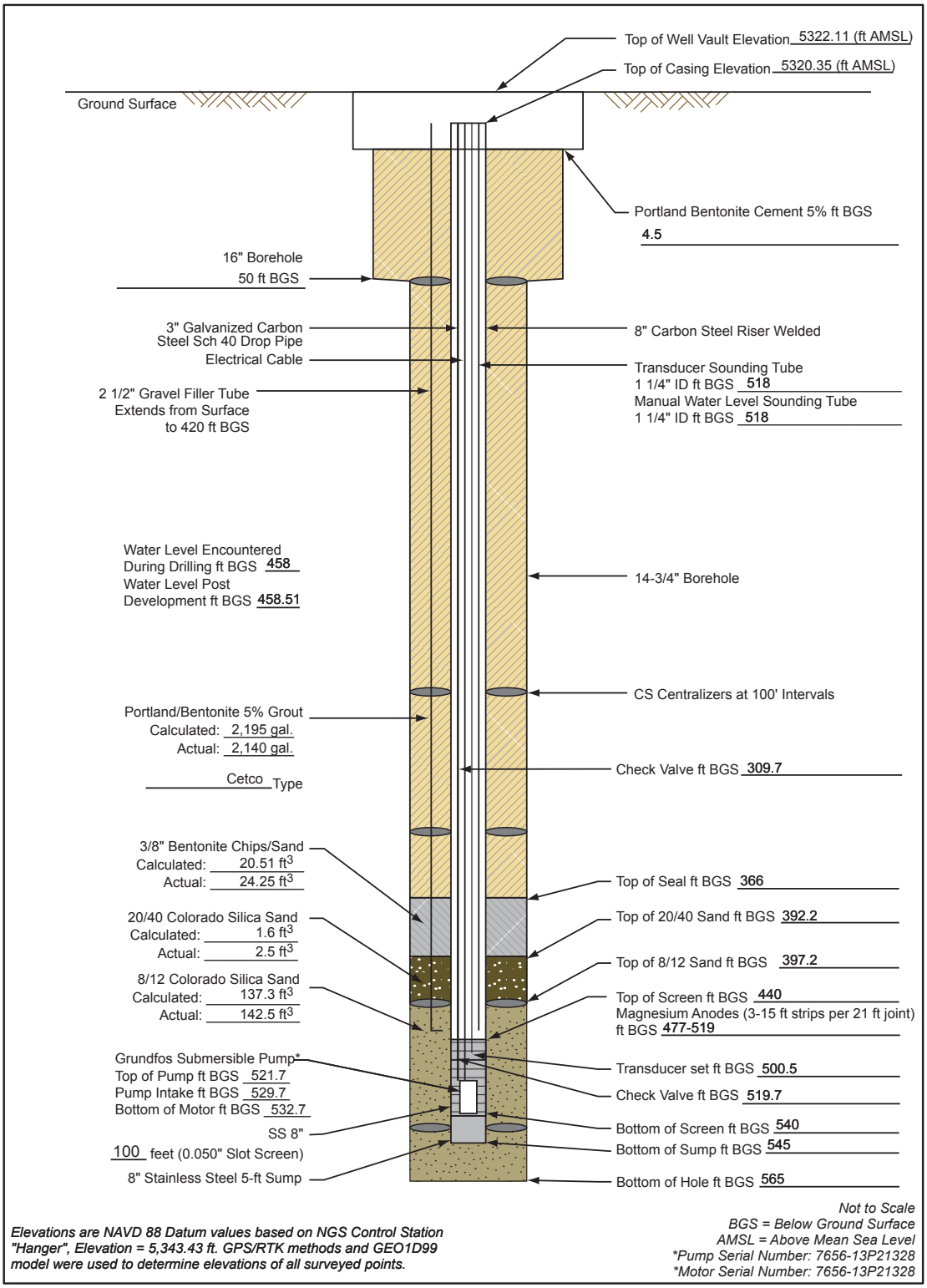
APPENDIX L

WELL CONSTRUCTION DIAGRAMS AND BOREHOLE LOGS

EXTRACTION WELL CONSTRUCTION DIAGRAMS

Extraction Well Construction Diagram KAFB-106228

Installation Start Date/Time: 5/18/2015
Installation End Date/Time: 6/2/2015
Magnesium Anodes and Sounding Tubes added: 7/6/2016

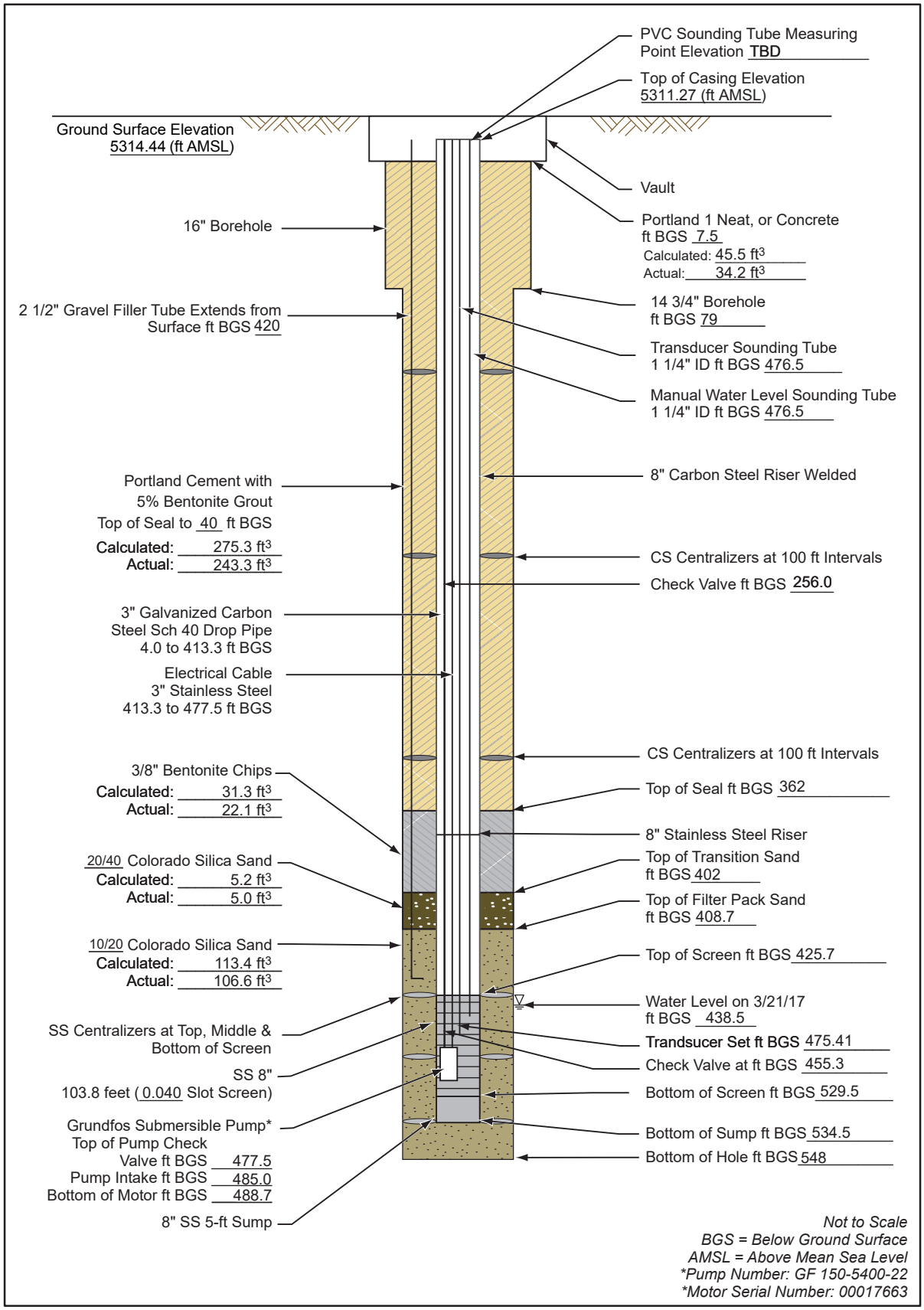


Elevations are NAVD 88 Datum values based on NGS Control Station "Hanger", Elevation = 5,343.43 ft. GPS/RTK methods and GEO1D99 model were used to determine elevations of all surveyed points.

Not to Scale
BGS = Below Ground Surface
AMSL = Above Mean Sea Level
**Pump Serial Number: 7656-13P21328*
**Motor Serial Number: 7656-13P21328*

140705.CB020403.A19

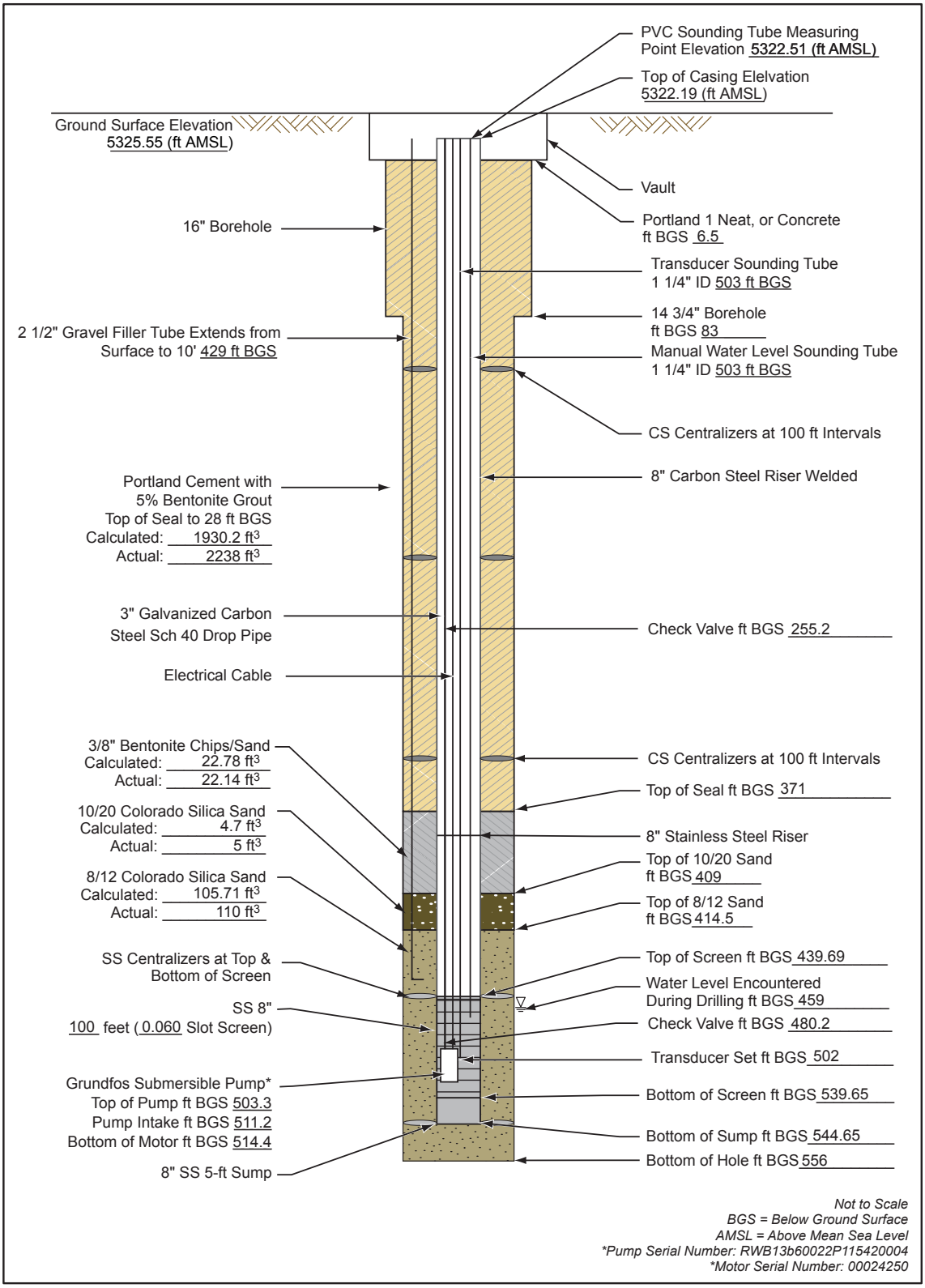
Extraction Well Construction Diagram KAFB-106233



500433.04010300.A4

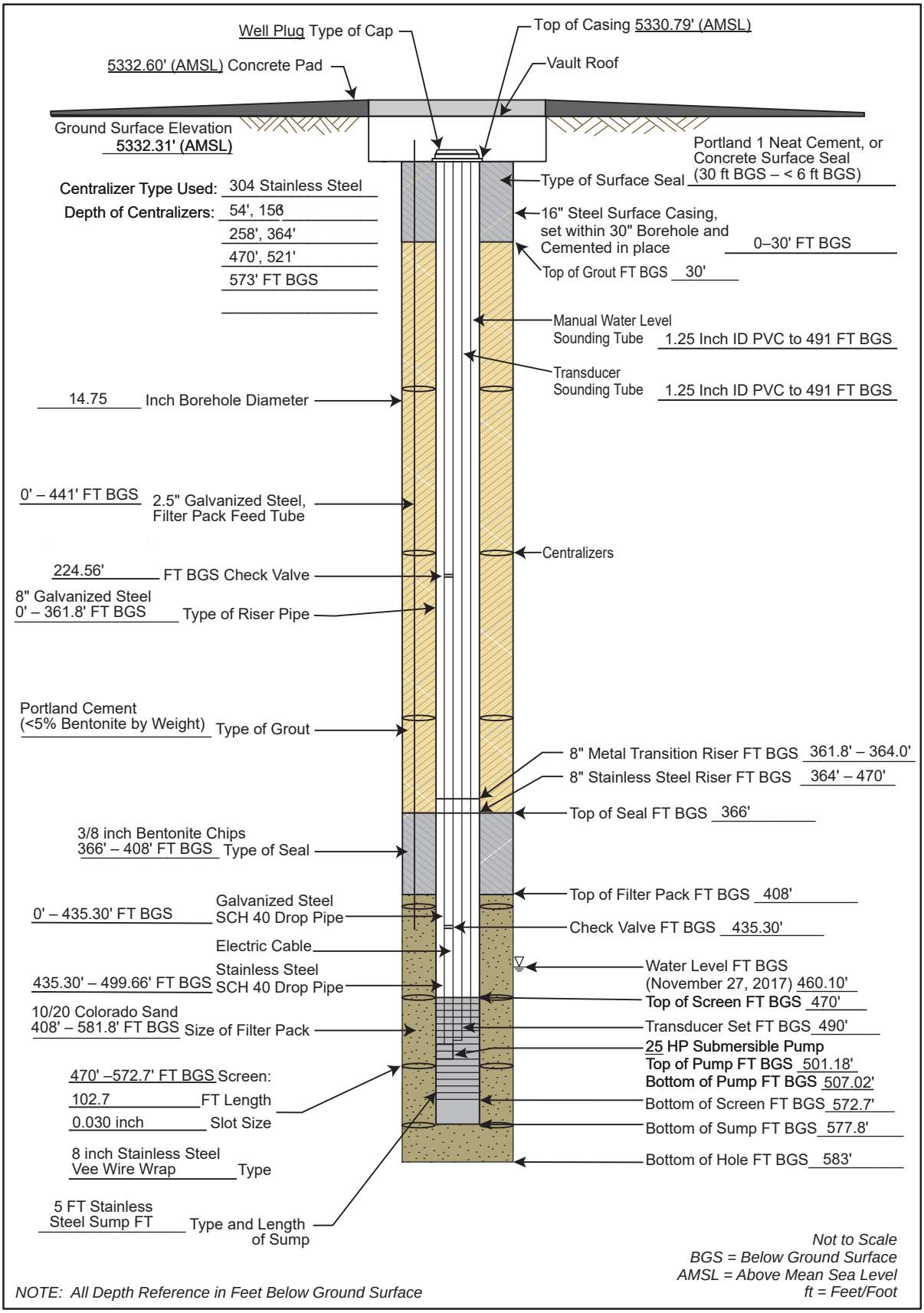
Extraction Well Construction Diagram KAFB-106234

Installation Start Date/Time: 10/2/2015
Installation End Date/Time: 10/9/2015

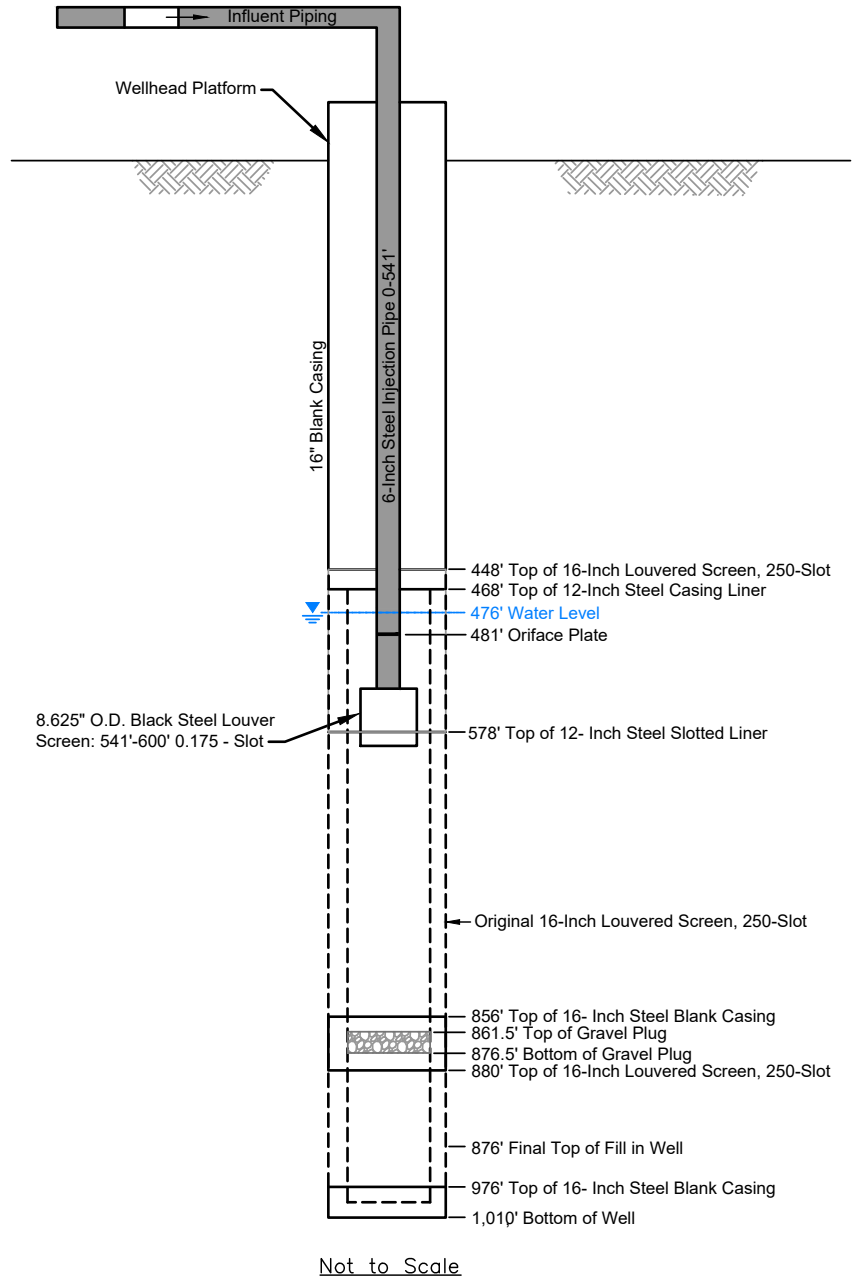


500433.04010300.A5

Extraction Well Construction - KAFB-106239



INJECTION WELL CONSTRUCTION DIAGRAMS



Note: Valves, Meters, and Wellhead are Located Above Ground

OFFICE	DATE	DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
Pittsburgh, PA	11/7/19	C. LaChance	B. O'Connor	--	--	501397-A1

APTIM

APTIM Federal Services LLC
500 Penn Center Boulevard
Building 5, 9th Floor
Pittsburgh, PA 15235

FIGURE 1-2

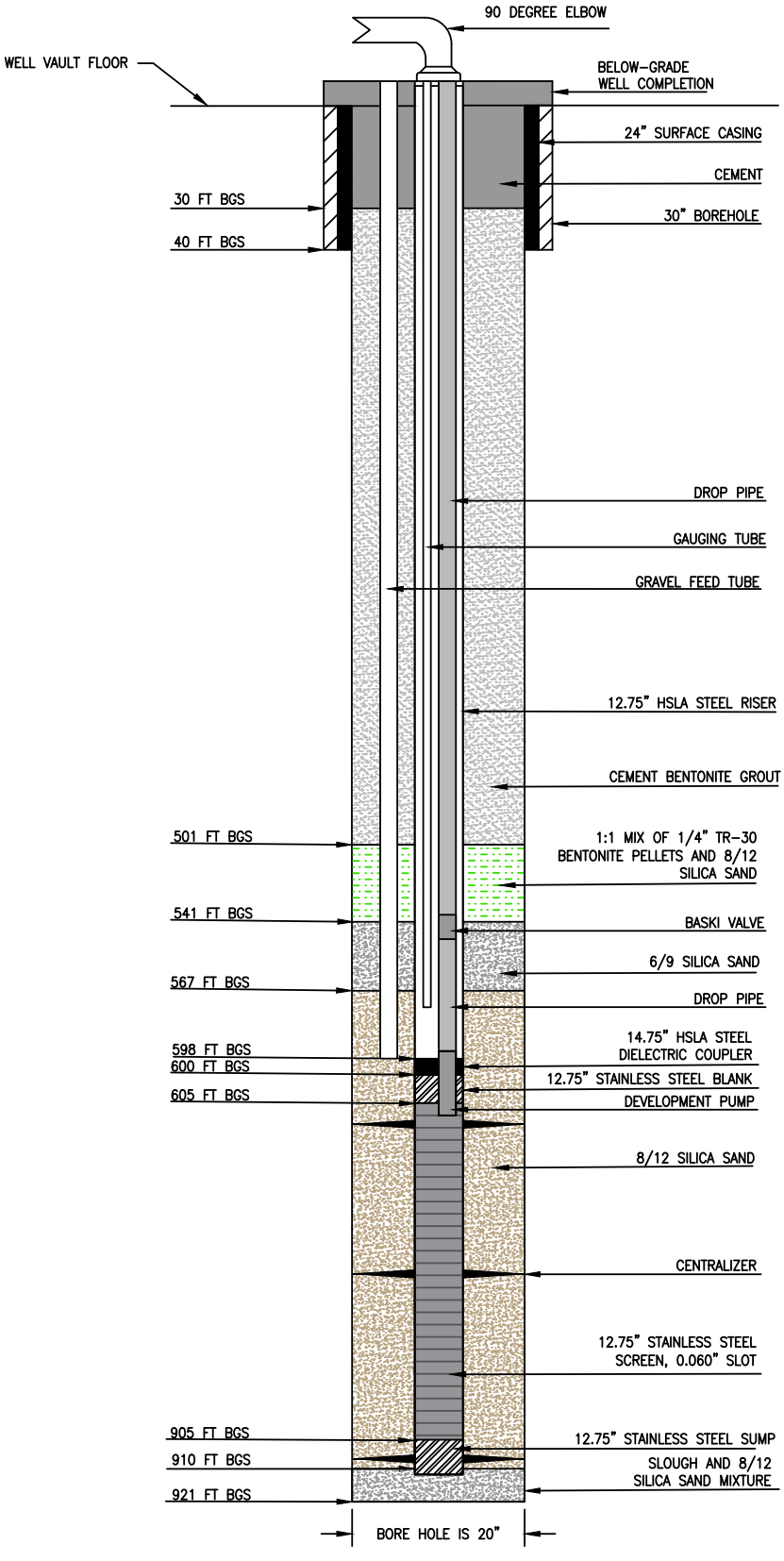
KAFB-7 INJECTION WELL SCHEMATIC

INJECTION WELL KAFB-7 MAINTENANCE REPORT
KIRTLAND AIR FORCE BASE, NEW MEXICO

Xref Image : APTIM Logo Standard Color.jpg EXHIBIT_2_Well_Completion_Diagram.jpg

File: O:\project\USACE Projects\501397\501397-A1.dwg
Plot Date/Time: Sep 15, 2020 - 2:49pm
Plotted By: bernadette.oconnor

FIGURE 2 - KIRTLAND AIR FORCE BASE INJECTION WELL KAFB106IN2 DESIGN



NOTE:
GPM = GALLON PER MINUTE
HSLA = HIGH STRENGTH LOW ALLOY
TBD = TO BE DETERMINED

NOT TO SCALE
BGS=BELOW GROUND SURFACE
FT=FEET

CAD FILE: C:\Users\ecorpio\Desktop\KAFB106IN2\Figure_X_KAFB106IN2_02102021.dwg
PLOT DATE/TIME: 2/11/2021 - 6:56am

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC
320 Gold Avenue, SW Suite 1300
Albuquerque, NM 87102
Phone: (505) 224-9013
Fax: (505) 224-9016

KIRTLAND AIR FORCE BASE		INSTALLATION START DATE/TIME: 07/02/2020	INSTALLATION END DATE/TIME: 10/19/2020
PROJECT NO.: 62735DM02	WELL ID: KAFB106IN2	GEOLOGIST: JM	DRILLER: STEWART BROS.

EXTRACTION/INJECTION WELL BOREHOLE LOGS

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▽ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

LICENSED PROFESSIONAL GEOLOGIST
VIRGINIA BRACHT
8881903-2250
STATE OF UTAH

7/13/15

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
0					ASPHALT			
					Water jetted to 9', lithology disturbed.			Begin advancing 16" casing @ 1507 on 5/18/15.
5							- Top of Casing/ Top of Bentonite Cement	
10					Well-graded GRAVEL with Sand (GW); strong brown (7.5YR 5/6); 60% fine to coarse gravel to 2"; angular to subangular; gravel is mafics and quartzite; 35% fine to coarse sand; angular to subrounded; sand is quartz and quartzite; 5% silt.	GW		
15					Same as above (9 ft).		- Portland Bentonite Cement	
20								Kelly down @ 1517, resume drilling @ 1700.
					Poorly graded SAND with Silt (SP-SM); yellowish brown (10YR 5/8); 90% medium sand; trace fine and coarse sand; subangular to subrounded; sand is quartz; 10% silt.	SP-SM		
25					Silty GRAVEL with Sand (GM); yellowish brown (10YR 5/8); 55% fine to coarse gravel to 1 1/2"; subangular; gravel is mafics; 25% fine to coarse sand; subangular to subrounded; sand is quartz; 20% silt.	GM		
30								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
30								
					Silty GRAVEL with Sand (GM); yellowish brown (10YR 5/8); 55% fine to coarse gravel to 1 1/2"; subangular; gravel is mafics; 25% fine to coarse sand; subangular to subrounded; sand is quartz; 20% silt.	GM		Cuttings moist after driller added water.
35								
					Silty SAND (SM); yellowish brown (10YR 5/8); 85% fine to coarse sand; subangular to subrounded; sand is quartz and mafics; 15% silt.	SM		Kelly down @ 1800, resume drilling @ 1810.
40								
					Same as above (35 ft); 75% fine to medium sand; trace coarse sand; 25% silt.			
45							- Portland Bentonite Cement	
					Same as above (35 ft); 75% fine to medium sand; trace coarse sand; 25% silt.			End day @ 47' @ 1820. on 5/18/15.
50								Push 16" casing to 50' @ 0935 on 5/19/15. @ 1648 begin mud rotary. Begin drilling with 2 collars and 7' of lot/sub/pound.
					Lean CLAY with Sand (CL); reddish yellow (7.5YR 6/6); 75% clay; 25% coarse sand; trace medium and fine sand; angular to subangular; trace silt.			
55								
					Same as above (50 ft).	CL		
60								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
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▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
60					Lean CLAY with Sand (CL); reddish yellow (7.5YR 6/6); 75% clay; 25% coarse sand; trace medium and fine sand; coarse sand is quartz and granite; angular to subangular; trace silt.			Add 3rd collar @ 60' @ 1800.
65					Same as above (60 ft).			
70					Lean CLAY (CL); reddish yellow (7.5YR 6/8); medium plasticity; 90% clay; 10% medium to coarse sand; sand is quartz and granite; trace silt.			
75					Same as above (70 ft).	CL	- Portland Bentonite Cement	Stop drilling @ 75' on 5/19/15. Resume drilling @ 0840 on 5/21/15.
80					Same as above (70 ft).			Add 4th collar @ 80' @ 0857. Total of 77' of collar.
85					Same as above (70 ft).			
90								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 458.00
At End of Drilling: Not Recorded
After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
90					Sandy lean CLAY (CL); strong brown (7.5YR 5/8); medium plasticity; 60% clay; 40% coarse sand; subangular; sand is quartz, mafics, and quartzite.			
95					Lean CLAY (CL); yellowish red (5YR 5/8); medium plasticity; 90% clay; 10% medium to coarse sand; subangualr; sand is granite, mafics, and quartzite.			
100					Same as above (95 ft).			
105					Same as above (95 ft).	CL	- Portland Bentonite Cement	Kelly down @ 0940, resume drilling @ 1240.
110					Same as above (95 ft); 95% clay; 5% medium to coarse sand; trace fine gravel.			
115					Same as above (95 ft); 95% clay; 5% medium to coarse sand; trace fine gravel.			
120								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

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Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
120					Sandy lean CLAY (CL); strong brown (7.5YR 5/8); low plasticity; 60% clay; 40% fine sand.			
125					Same as above (120 ft).	CL		Kelly down @ 1313, resume drilling @ 1330.
130					Same as above (120 ft).			
135					Clayey SAND (SC); strong brown (7.5YR 5/8); 60% fine to medium sand; subangular; sand is quartz; 40% clay.		- Portland Bentonite Cement	
140					Same as above (135 ft); clay is firmer.	SC		
145					Clayey SAND with Gravel (SC); strong brown (7.5YR 5/6); 40% fine to medium sand; subangular; 20% fine gravel to 3/4"; subangular; 40% clay; medium plasticity; sand is quartz; gravel is mafics.			Kelly down @ 1352, resume drilling.
150								

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Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
150								
155					Gravelly lean CLAY (CL); strong brown (7.5YR 5/6); medium plasticity; 70% clay; 30% fine gravel to 1/2"; angular; gravel is black.	CL		
160					Clayey SAND with Gravel (SC); strong brown (7.5YR 5/6); 50% fine to coarse sand; subangular; 30% fine gravel to 3/4"; angular to subangular; 20% clay; sand is quartz; gravel is mafics. Same as above (155 ft).	SC		
165							- Portland Bentonite Cement	Kelly down @ 1438, resume drilling @ 1503.
170					Gravelly lean CLAY (CL); strong brown (7.5YR 5/6); medium plasticity; 60% clay; 30% fine gravel to 1/2"; angular to subangular; 10% medium to coarse sand; subangular; gravel is mafics.	CL		
175					Clayey GRAVEL (GC); strong brown (7.5YR 5/6); 80% fine gravel to 1/2"; angular to subangular; 20% clay; gravel is mafics.	GC		
180					Poorly graded GRAVEL with Silt and Sand (GP-GM); strong brown (7.5YR 5/6); 60% fine gravel to 1/2"; angular to subangular; 30% fine sand; trace medium and coarse sand; subangular; 10% silt; gravel is mafics and granite; sand is quartz, mafics, and granite.	GP-GM		

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
180					Poorly graded GRAVEL with Silt and Sand (GP-GM); strong brown (7.5YR 5/6); 60% fine gravel to 1/2"; angular to subangular; 30% fine sand; trace medium and coarse sand; subangular; 10% silt; gravel is mafics and granite; sand is quartz, mafics, and granite.	GP-GM		
185					Silty GRAVEL with Sand (GM); reddish yellow (7.5YR 6/6); 70% fine gravel; subangular; 15% fine to coarse sand; subangular; 15% silt; gravel is mafics, granite, and quartzite; sand is mafics.			End day on 5-21-15 @ 183'. Kelly down @ 1542. 1500 gallons mud used on 5/21/15. Resume drilling on 5/22/15 @ 0830.
190					Same as above (185 ft).			
195					Same as above (185 ft).		- Portland Bentonite Cement	
200					Silty GRAVEL (GM); reddish yellow (7.5YR 6/6); 70% fine gravel; subangular; 10% fine to coarse sand; subangular to subrounded; 20% silt; gravel is mafics and granite; sand is quartz.	GM		
205					Same as above (200 ft); 60% fine gravel; 10% coarse sand; subrounded; 30% silt.			Kelly down @ 0905, resume drilling @ 0940.
210								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 458.00
At End of Drilling: Not Recorded
After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
210								
215					Poorly graded GRAVEL with Silt and Sand (GP-GM); reddish yellow (7.5YR 6/8); 70% fine gravel to 3/8"; subangular to subrounded; 20% fine to coarse sand; 10% silt; gravel is mafics and quartz; sand is quartz and mafics.	GP-GM		
220					Poorly graded SAND (SP); reddish yellow (7.5YR 6/8); 90% coarse sand; trace fine and medium sand; subrounded; 5% fine gravel to 3/8"; 5% silt; sand is mafics, quartzite, and granite; gravel is mafics. Same as above (215 ft).	SP		
225							- Portland Bentonite Cement	Kelly down @ 1002, resume drilling @ 1023.
230					Silty GRAVEL with Sand (GM); reddish yellow (7.5YR 6/8); 70% coarse gravel; trace fine gravel; subangular to subrounded; 15% fine sand; 15% silt; gravel is mafics and granite; sand is mafics. Same as above (225 ft).	GM		Hard drilling @ 227', possibly cemented formation.
235					Same as above (225 ft).			
240								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
240								
					Silty SAND (SM); reddish yellow (7.5YR 6/6); 70% fine to coarse sand; subangular to subrounded; 10% fine gravel to 3/8"; 20% silt; sand is mafics and granite; gravel is feldspar.			Kelly down @ 1150, resume drilling @ 1258.
245					Same as above (240 ft).	SM		
250					Well-graded SAND with Silt and Gravel (SW-SM); reddish yellow (7.5YR 6/6); 60% fine to coarse sand; subangular to subrounded; 30% fine gravel to 3/8"; angular to subrounded; 10% silt; sand is mafics and granite; gravel is mafics, granite, and quartz.			Gravel clasts are generally flat.
255					Same as above (250 ft).	SW-SM	- Portland Bentonite Cement	
260					Silty SAND (SM); yellowish brown (10YR 5/6); 80% coarse sand; trace fine and medium sand; angular to subrounded; 20% silt; sand is mafics and granite.			Kelly down @ 1410, resume drilling @ 1420.
265					Same as above (260 ft); 70% coarse sand; trace fine and medium sand; 30% silt.	SM		
270								

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Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
270					Silty SAND (SM); yellowish brown (10YR 5/6); 70% coarse sand; trace fine and medium sand; angular to subrounded; 30% silt; sand is mafics and granite.			Some color change due to mud added.
275					Same as above (270 ft).	SM		
280					Same as above (270 ft).			Kelly down @ 1455, resume drilling @ 1515.
285					Silty GRAVEL with Sand (GM); light yellowish brown (10YR 6/4); 60% fine gravel; angular to subangular; 15% fine sand; trace medium and coarse sand; 25% silt; gravel is granite and quartzite; sand is quartz.		- Portland Bentonite Cement	
290					Same as above (285 ft)	GM		
295					Silty GRAVEL (GM); light brown (7.5YR 6/4); 80% fine gravel; angular to subangular; 20% silt; gravel is mafics and granite.			Coarse mafic gravel observed @ 294' likely causing pipe to bounce.
300								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
300					Poorly graded GRAVEL (GP); light brown (7.5YR 6/4); 90% fine gravel to 3/8"; angular to subangular; 5% coarse sand; subangular; 5% silt; gravel is mafics, granite, and quartzite; sand is mafics.			Kelly down @ 1550. Lost circulation @ 1600. Resume drilling @ 1605 with circulation.
305					Same as above (300 ft).			Drilling bit binding up at 305 to 310' likely due to coarse gravel.
310					Poorly graded GRAVEL with Sand (GP); light brown (7.5YR 6/4); 80% fine gravel to 3/8"; angular to subangular; 15% medium to coarse sand; subangular; 5% silt; gravel is mafics, granite, and quartzite; sand is quartz and mafics.			Stop drilling @ 310' @ 1620 on 5/22/15. 1500 gallons mud used on 5/22/15. Resume drilling @ 0842 on 5/26/15, redrill 3' due to fill in bottom of hole.
315					Same as above (310 ft).	GP	Portland Bentonite Cement	
320					Poorly graded GRAVEL (GP); light brown (7.5YR 6/4); 85% fine gravel to 3/8"; angular to subangular; 10% fine sand; subangular; 5% silt; gravel is mafics and quartzite; sand is quartz.			Drill bit bouncing likely due to coarse gravel. Kelly down @ 0902, resume drilling @ 0936.
325					Poorly graded GRAVEL with Sand (GP); light brown (7.5YR 6/4); 80% fine gravel to 3/8"; angular to subangular; 15% fine sand; subangular; 5% silt; gravel is granite and quartz; sand is quartz.			
330								

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Borehole ID: KAFB-106228

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Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
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Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
330								
					Poorly graded GRAVEL with Sand (GP); light brown (7.5YR 6/4); 80% fine gravel to 3/8"; angular to subangular; 15% fine sand; subangular; 5% silt; gravel is granite and quartz; sand is quartz.	GP		
335								
					Silty GRAVEL with Sand (GM); light brown (7.5YR 6/4); 70% fine gravel to 3/8"; angular to subangular; 15% fine sand; subangular; 15% silt; gravel is mafics and granite; sand is quartz.			
340					Same as above (335 ft).	GM		
345							- Portland Bentonite Cement	Kelly down @ 1103, resume drilling @ 1125.
					Silty SAND (SM); brown (7.5YR 5/4); 80% fine sand; trace medium sand; subangular to subrounded; 20% silt; sand is quartz.			
350					Same as above (345 ft).	SM		
355								
					Poorly graded GRAVEL with Sand (GP); brown (7.5YR 5/4) 75% fine gravel to 3/8"; angular to subangular; 20% fine to coarse sand; 5% silt; gravel is mafics, granite, and quartzite; sand is quartz and mafics.	GP		Rig bouncing slightly.
360								

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Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 458.00
At End of Drilling: Not Recorded
After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
360					Silty SAND (SM); brown (7.5YR 5/4); 80% fine to coarse sand; angular to subangular; 20% silt; trace crushed coarse gravel; sand is quartz, mica, and quartzite.	SM	Portland Bentonite Cement	Slow drilling, bit bouncing at 358 to 363 ft. Kelly down @ 1436, resume drilling @ 1438.
365					Well-graded SAND with Gravel (SW); brown (7.5YR 5/4); 60% fine to coarse sand; angular to subangular; 35% fine gravel to 3/8"; angular to subangular; 5% silt; sand is mafics and quartz; gravel is mafics and granite.	SW	Top of Bentonite Seal	
370					Same as above (365 ft).			Drill bit bouncing.
375					Same as above (365 ft).			
380					Well-graded SAND with Silt (SW-SM); brown (7.5YR 5/4); 80% fine to coarse sand; angular to subangular; 10% fine gravel to 3/8"; 10% silt; sand is quartz and mafics; gravel is mafics and quartz.	SW-SM	Bentonite Seal	
385					Silty SAND (SM); brown (7.5YR 5/3); 80% fine to coarse sand; angular to subangular; 20% silt; sand is quartz and mafics.	SM		Kelly down @ 1710, resume drilling @ 1715. Used 1500 gallons mud on 5/26/15.
390								Bit bouncing @ 1804.

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
390					Silty SAND (SM); brown (7.5YR 5/3); 80% fine to coarse sand; angular to subangular; 20% silt; sand is quartz and mafics.	SM	- Top of 20/40 Sand	Stop drilling @ 392.5' @ 1843 on 5/26/15. Used 1600 gallons mud on 5/26/15. Resume drilling @ 0805 on 5/27/15.
395					Well-graded SAND with Silt (SW-SM); gray (7.5YR 6/1); 80% fine to coarse sand; subangular to subrounded; 10% fine gravel to 3/8"; subangular to subrounded; 10% silt; sand and gravel are quartz and mafics.	SW-SM	- Top of 10/20 Sand	
400					Fat CLAY with Sand (CH); strong brown (7.5YR 5/6); medium plasticity; 80% clay; 20% fine sand; trace medium and coarse sand.	CH		
405					Same as above (399 ft).			
410					Same as above (399 ft); sand is more coarse.			Stop drilling @ 1145. Trip out and replace drill bit, dump mud in shaker, and repair sand pump. Resume drilling @ 1738.
415					Clayey SAND (SC); strong brown (7.5YR 5/6); 70% fine to coarse sand; subangular to subrounded; 30% clay; sand is mafics, quartz, and granite.	SC		
420								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
420					Poorly graded SAND with Silt (SP-SM); pinkish gray (7.5YR 6/2); 90% coarse sand; trace fine and medium sand; subangular to subrounded; 10% silt; sand is mafics, granite, quartz, and quartzite.	SP-SM		
425					Same as above (420 ft).			
430					Same as above (420 ft).			Pipe bouncing.
435					Same as above (420 ft).			Pipe bouncing.
440					Same as above (420 ft).		- Top of 8" Stainless Steel 0.050 Slot Screen	
445								Stop drilling @ 443' @ 1846 on 5/27/15. Used 1600 gallons mud on 5/27/15. Resume drilling @ 0816 on 5/28/15.
450					Poorly graded SAND (SP); brown (7.5YR 5/4); 95% coarse sand; trace fine and medium sand; subangular to subrounded; 5% silt; sand is mafics, quartz, quartzite, and granite.	SP		Fine sand coming off the shaker.

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 458.00
At End of Drilling: Not Recorded
After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
450								
					Poorly graded SAND (SP); brown (7.5YR 5/4); 95% coarse sand; trace fine and medium sand; subangular to subrounded; 5% silt; sand is mafics, quartz, quartzite, and granite.	SP		Fine sand coming off the shaker.
455								
					Poorly graded SAND with Silt (SP-SM); brown (7.5YR 5/4); 90% coarse sand; trace fine and medium sand; angular to subrounded; 10% silt; sand is quartz, mafics, and granite.	SP-SM	8" Stainless Steel 0.050 Slot Screen	
460					Same as above (455 ft); 90% fine sand; trace medium and coarse sand; subangular; sand is quartz.			
465					Same as above (455 ft); 90% fine sand; trace medium and coarse sand; subangular; sand is quartz.			
470					Same as above (455 ft); 90% fine sand; trace medium and coarse sand; subangular; sand is quartz.			
475					Well-graded SAND with Silt (SW-SM); brown (7.5YR 5/4); 90% fine to coarse sand; subangular to subrounded; 10% silt; fine sand is quartz and mafics; coarse sand is quartz, granite, and mafics.	SW-SM		Bit bouncing @ 478'.
480								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 458.00
At End of Drilling: Not Recorded
After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
480					Well-graded SAND with Silt (SW-SM); brown (7.5YR 5/4); 90% fine to coarse sand; subangular to subrounded; 10% silt; fine sand is quartz and mafics; coarse sand is quartz, granite, and mafics.	SW-SM	8" Stainless Steel 0.050 Slot Screen	A little bouncing.
485					Same as above (480 ft); fine sand is quartz; medium and coarse sand is quartz, mafics, and quartzite.			
490					Same as above (480 ft); fine sand is quartz; medium and coarse sand is quartz, mafics, and quartzite.			
495					Silty SAND (SM); brown (7.5YR 5/4); 85% fine to coarse sand; subangular to subrounded; 15% silt; fine sand is quartz; medium and coarse sand is granite, quartzite, and mafics.	SM		
500					Same as above (495 ft).			A little bouncing.
505					Well-graded SAND (SW); brown (7.5YR 5/4); 95% fine to coarse sand; angular to subrounded; 5% silt; sand is quartz, mafics, and granite.	SW		
510								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
510								
515					Well-graded SAND (SW); brown (7.5YR 5/4); 95% fine to coarse sand; angular to subrounded; 5% silt; sand is quartz, mafics, and granite.	SW		
520					Poorly graded SAND (SP); brown (7.5YR 5/4); 95% coarse sand; trace fine sand; subangular to subrounded; 5% silt; sand is quartz, mica, and granite.	SP	- 8" Stainless Steel 0.050 Slot Screen	Bit bouncing.
525					Same as above (515 ft).			Bit bouncing.
530					Same as above (515 ft).			Bit bouncing.
535					Same as above (515 ft).			Bit bouncing.
540					Well-graded SAND (SW); brown (7.5YR 5/4); 95% fine to coarse sand; subangular to subrounded; 5% silt; sand is quartz, granite, and mica.	SW		Bit bouncing.

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Borehole ID: KAFB-106228

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB BFF SWMU ST-106 and SS-111
Project Number: 140705

Date Started: 5/18/2015
Date TD Reached: 5/29/15
Date Completed: 6/2/2015

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 458.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.51

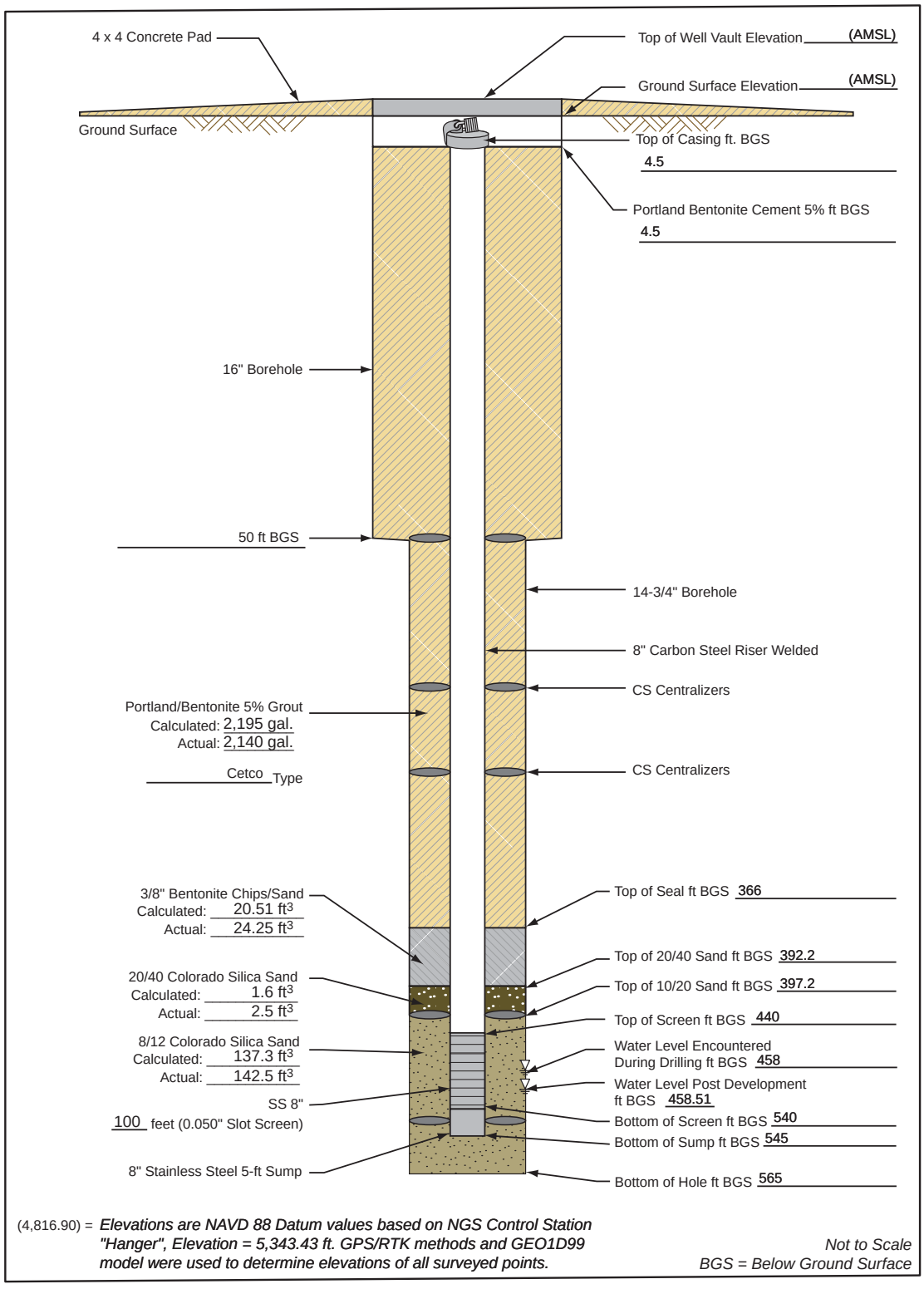
Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
540					Well-graded SAND (SW); brown (7.5YR 5/4); 95% fine to coarse sand; subangular to subrounded; 5% silt; sand is quartz, granite, and mica.		Botton of Screen	Bit bouncing.
							Sump	
545					Same as above (540 ft).	SW	Bottom of Sump	
550					Poorly graded SAND (SP); brown (7.5YR 5/4); 95% coarse sand; trace fine and medium sand; angular to subrounded; 5% silt; sand is quartz, mica, and granite.			Stop drilling @ 1845 on 5/28/15. Used 2,300 gallons of mud on 5/28/15. Resume drilling @ 0803 on 5/29/15.
555					Same as above (550 ft).			
						SP		
560					Same as above (550 ft).			
565							Bottom of Filter Pack	Total depth = 565 ft. Reached total depth @ 0847 on 5/29/15. Used 600 gallons of mud on 5/29/15. Used a total of 9,100 gallons mud on the entire boring.
570								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 7/13/15 13:12 - Z:\KAFB BFF\GINT\KAFB_PROJECT\KAFB_BFF.GPJ

Extraction Well Completion Diagram KAFB-106228

Installation Start Date/Time: 5/18/2015
Installation End Date/Time: 6/2/2015



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Groundwater Extraction Well Development

Project Name:	KAFB BFF	**Well No.:**	KAFB-106228
Location:	Gibson	**Date Installed:**	6/2/2015
Personnel:	VB, RW, EP	**Casing Diameter (I.D.):**	8-inch
Start Date:	6/4/2015	**Total Depth (ft. BGS):**	545
End Date:	6/16/2015		

Method of Development:

[X] Surging [X] Bailing [X] Pumping [X] Jetting

[X] Original Development [ ] Redevelopment [ ] Other

Depth to Water Before Developing Well (ft. BGS): NR

Screened Interval (ft. BGS): 440 - 540

Weather: Varied

Equipment Numbers: **pH:** NR **Conductivity:** NR

Turbidity: NR

Equipment Decontaminated Prior to Development? [X] Yes [ ] No

Describe:

Collected Sample of Water Added to Well? [ ] Yes [X] No

Describe:

Comments:

Summary of development procedure, including key decision-points, calculations, and observations (described in detail in the following pages):

Well development consisted of bailing, surging, pumping, and jetting. The first step of development removed mud and cuttings from the well casing and filter pack, which were generated during the drilling process, by surging and bailing. The second step entailed physical well development using surging, bailing, and pumping to assess development progress. These actions included taking measurements of sediment content in the water using the Imhoff cone technique, and applying 30 minutes of sustained pumping, measuring, and plotting drawdown to estimate development effectiveness. The third step used jetting with simultaneous pumping.

Groundwater Extraction Well Development

Bailing				
Date	Time	Total Volume Bailed (gallons)	Imhoff Cone Measurement (mL sediment per L water)	Comments
6/4/2015	1157	15	25	Bailer was full of dark mud.
6/4/2015	1215	120	5	Wait until 993 gallons to begin purging well.
6/4/2015	1530	1,000	30	Water/mud is dark brown.
6/5/2015	1243	1,015	25	Continue bailing. Water/mud is dark brown.
6/5/2015	1323	1,300	10	Water/mud is dark brown.
6/5/2015	1356	1,375	10	Water/mud is dark brown.
6/5/2015	1428	1,600	15	Lighter brown in color.
6/6/2015	1018	1,765	10	Lighter brown in color.
6/6/2015	1032	1,840	3	Lighter brown in color. Sand to 1 mm.
6/8/2015	1157	2,935	0.7	Water is light brown.
6/8/2015	1207	2,980	3.0	Water is light brown.
6/8/2015	1220	2,995	0.5	Water is light brown.
6/8/2015	1226	3,040	0.9	Water is light brown.

L = liter

mL = milliliter

Groundwater Extraction Well Development

Surging				
Interval (feet below ground surface)	Date	Start Time	End Time	Comments
540-535	6/5/2015	1746	1750	Begin purging.
535-530	6/5/2015	1752	1756	
530-525	6/5/2015	1757	1801	
525-520	6/5/2015	1802	1806	
520-515	6/5/2015	1807	1811	
515-510	6/5/2015	1812	1816	
510-505	6/5/2015	1816	1820	
505-500	6/5/2015	1821	1825	
500-495	6/5/2015	1826	1830	
495-490	6/5/2015	1834	1838	
490-485	6/5/2015	1838	1642	Stop purging for 6/5/2015.
485-480	6/6/2015	0844	0848	
480-475	6/6/2015	0850	0854	
475-470	6/6/2015	0855	0859	
470-465	6/6/2015	0900	0904	
465-460	6/6/2015	0905	0909	
460-455	6/6/2015	0910	0914	
455-450	6/6/2015	0915	0919	
450-445	6/6/2015	0921	0925	
445-440	6/6/2015	0926	0930	
540-440	6/6/2015	0940	0950	Four strokes.
540-535	6/8/2015	0910	0914	
535-530	6/8/2015	0916	0920	
530-525	6/8/2015	0921	0925	
525-520	6/8/2015	0926	0930	
520-515	6/8/2015	0932	0936	
515-510	6/8/2015	0937	0941	
510-505	6/8/2015	0943	0947	
505-500	6/8/2015	0951	0955	
500-495	6/8/2015	0957	1001	
495-490	6/8/2015	1002	1006	
490-485	6/8/2015	1008	1012	
485-480	6/8/2015	1014	1018	
480-475	6/8/2015	1022	1026	
475-470	6/8/2015	1029	1034	
470-465	6/8/2015	1035	1039	
465-460	6/8/2015	1040	1045	
460-455	6/8/2015	1046	1050	Out of saturated screen
540-455	6/8/2015	1056	1130	Six strokes.

Groundwater Extraction Well Development

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Comments
6/6/2015	1325	4.55	NR	1,930	23.02	8.38	1.270	>1,000	NR	Water level meter malfunction prior to pumping
6/6/2015	1345	4.5	NR	2,020	25.24	8.71	1.104	>1,000	NR	
6/6/2015	1400	4.5	NR	2,100	23.48	8.78	1.090	>1,000	NR	Imoff = 1.5 mL
6/6/2015	1415	4.5	NR	2,170	23.66	8.79	0.986	>1,000	NR	Imoff =0.25 mL
6/6/2015	1430	4.5	NR	2,240	23.29	8.61	0.835	>1,000	NR	Imoff = 0.5 mL
6/6/2015	1445	4.5	NR	2,310	23.70	8.53	0.699	>1,000	NR	Imoff = 0.25 mL
6/6/2015	1500	4.0	NR	2,380	23.97	8.31	0.622	>1,000	NR	Imoff = 0.25 mL
6/6/2015	1515	4.0	NR	2,440	22.91	7.83	0.562	>1,000	NR	Imoff = 0.4 mL
6/6/2015	1530	4.0	NR	2,500	22.66	7.89	0.548	>1,000	NR	Imoff = 0.3 mL
6/6/2015	1545	4.0	NR	2,560	23.11	7.87	0.540	>1,000	NR	Imoff = 0.2 mL
6/6/2015	1600	4.0	NR	2,620	22.85	7.88	0.533	>1,000	NR	Imoff = 0.2 mL
6/6/2015	1615	4.0	479.00	2,680	22.49	7.78	0.534	>1,000	NR	Imoff = 0.4 mL
6/6/2015	1630	4.0	479.80	2,740	22.70	7.81	0.529	>1,000	NR	Imoff = 0.3 mL
6/6/2015	1645	4.0	NR	2,800	22.50	7.91	0.535	>1,000	NR	Imoff = 0.1 mL
6/6/2015	1700	4.0	NR	2,860	22.27	7.69	0.544	>1,000	NR	Imoff = 0.3 mL
6/6/2015	1715	4.0	NR	2,920	22.44	7.72	0.522	>1,000	NR	Imoff = 0.2 mL
6/9/2015	0720	11.0	467.15	3,722	21.19	8.42	0.529	>1,000	NR	Imoff = 0.1 mL; Pump at 532 feet bgs
6/9/2015	0740	11.0	467.80	3,940	21.16	8.32	0.508	781	NR	Imoff = < 0.1 mL
6/9/2015	0750	11.0	470.65	4,050	21.16	8.22	0.499	313	NR	Imoff = < 0.1 mL
6/9/2015	0800	11.0	471.10	4,160	21.16	8.21	0.503	278	NR	Imoff = < 0.1 mL
6/9/2015	0810	11.0	471.50	4,270	21.16	8.21	0.497	207	0.6	Imoff = < 0.1 mL
6/9/2015	0820	18.0	478.1	4,380	21.10	8.21	0.488	165	NR	Imoff = < 0.1 mL
6/9/2015	0830	19.0	482.80	4,560	20.85	8.21	0.522	196	NR	Imoff = < 0.1 mL
6/9/2015	0840	18.0	486.20	4,750	20.87	8.25	0.514	429	NR	Imoff = < 0.1 mL
6/9/2015	0850	18.5	487.00	4,930	20.88	8.26	0.507	452	NR	Imoff = < 0.1 mL
6/9/2015	0900	19	486.00	5,125	20.80	8.20	0.491	351	NR	Imoff = 0.1 mL
6/9/2015	0910	18	485.20	5,315	20.75	8.17	0.496	262	NR	Imoff = < 0.1 mL
6/9/2015	0920	18	485.10	5,495	20.75	8.16	0.493	230	NR	Imoff = < 0.1 mL
6/9/2015	0930	18	484.50	5,670	20.77	8.16	0.487	184	NR	Imoff = 0.1 mL
6/9/2015	0940	18	484.00	6,850	20.63	8.14	0.491	176	0.64	Imoff = 0.1 mL
6/9/2015	1025	21	471.20	6,930	21.41	8.19	0.910	146	NR	Imoff = 0.1 mL; Pump at 511 feet bgs

Groundwater Extraction Well Development

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U.)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Comments
6/9/2015	1035	20	476.95	7,130	20.86	7.99	0.503	75.4	NR	Imoff = 0.1 mL
6/9/2015	1045	20	480.50	7,330	20.85	8.11	0.487	11.5	NR	Imoff = < 0.1 mL
6/9/2015	1055	20	481.75	7,530	20.94	8.15	0.478	143	NR	Imoff = < 0.1 mL
6/9/2015	1055	20	482.35	7,730	20.87	8.15	0.480	147	0.79	Imoff = < 0.1 mL
6/9/2015	1135	21	468.00	7,830	22.84	8.24	0.478	136	NR	Imoff = < 0.1 mL Pump at 490 feet bgs
6/9/2015	1145	22	480.00	8,050	20.66	7.96	0.490	96.4	NR	Imoff = < 0.1 mL
6/9/2015	1155	20	479.00	8,270	20.71	8.05	0.456	88.2	NR	Imoff = < 0.1 mL
6/9/2015	1205	20	479.50	8,470	20.72	8.08	0.454	96.5	NR	Imoff = < 0.1 mL
6/9/2015	1215	20	479.50	8,670	20.66	8.08	0.468	89.0	NR	Imoff = < 0.1 mL
6/9/2015	1225	20	479.50	8,870	20.64	8.08	0.461	76.6	NR	Imoff = < 0.1 mL
6/9/2015	1235	20	479.50	9,070	20.63	8.08	0.460	73.5	0.89	Imoff = < 0.1 mL
6/9/2015	1245	20	479.50	9,270	20.66	8.09	0.450	73.7	0.89	Imoff = < 0.1 mL
6/9/2015	1255	20	479.50	9,470	20.71	8.10	0.458	72.1	0.89	Imoff = < 0.1 mL
6/9/2015	1305	20	479.50	9,670	20.73	8.10	0.455	79.8	0.89	Imoff = < 0.1 mL
6/9/2015	1320	20	479.00	9,970	20.71	8.08	0.452	68.8	0.90	Imoff = < 0.1 mL
6/9/2015	1415	20	465.00	10,010	21.02	8.24	0.458	125	2.5	Imoff = < 0.1 mL; Pump at 506 feet bgs
6/9/2015	1425	21	474.00	10,220	20.61	7.85	0.444	50.2	2.4	Imoff = < 0.1 mL
6/9/2015	1435	21	477.15	10,420	20.66	7.99	0.452	82.4	1.05	Imoff = < 0.1 mL
6/9/2015	1445	21	477.00	10,630	20.68	8.00	0.494	80.0	1.05	Imoff = < 0.1 mL
6/9/2015	1455	21	477.00	10,840	20.65	8.01	0.452	73.7	1.05	Imoff = < 0.1 mL; Pump at 501 feet bgs
6/9/2015	1505	21	476.50	11,050	20.74	8.02	0.458	72.4	1.08	Imoff = < 0.1 mL; Pump at 496 feet bgs
6/9/2015	1515	21	476.50	11,260	20.64	8.03	0.449	68.8	1.08	Imoff = < 0.1 mL
6/9/2015	1540	22	467.30	11,360	20.68	7.47	0.406	155	2.14	Imoff = < 0.1 mL; Pump at 527 feet bgs
6/9/2015	1550	22	477.50	11,580	20.59	7.89	0.432	45.2	1.07	Imoff = < 0.1 mL; Pump at 527 feet bgs
6/9/2015	1600	22	477.90	11,800	20.65	7.95	0.442	74.1	1.05	Imoff = < 0.1 mL
6/9/2015	1610	22	477.69	12,020	20.60	7.99	0.446	67.0	1.06	Imoff = < 0.1 mL; Pump at 522 feet bgs

Groundwater Extraction Well Development

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U.)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Comments
6/9/2015	1620	22	477.40	12,240	20.62	8.02	0.441	59.9	1.08	Imoff = < 0.1 mL
6/9/2015	1630	21	477.50	12,450	20.69	8.00	0.500	49.3	1.02	Imoff = < 0.1 mL; Pump at 502 feet bgs
6/9/2015	1640	21	477.39	12,660	20.69	8.03	0.446	48.7	1.03	Imoff = < 0.1 mL
6/9/2015	1650	45	496.30	13,110	20.51	8.00	0.474	87.0	1.15	Imoff = < 0.1 mL; Pump at 532 feet bgs
6/9/2015	1700	43	507.90	13,540	20.31	8.04	0.476	92.0	0.84	Imoff = 1.0 mL
6/10/2015	1700	45	471.90	15,810	22.82	8.69	0.448	143	3.02	Imoff = < 0.1 mL; Pump at 513 feet bgs
6/10/2015	1710	45	474.00	16,260	21.25	7.97	0.443	70.9	2.65	Imoff = < 0.1 mL
6/10/2015	1720	45	474.90	16,710	21.02	7.96	0.429	59.9	2.15	Imoff = < 0.1 mL
6/11/2015	0810	46	466.00	17,537	21.59	7.20	0.459	17.6	5.11	Imoff = 0 mL; Pump at 481.5 feet bgs
6/11/2015	0820	45.5	470.60	17,442	20.33	7.19	0.458	49.7	3.31	Imoff = 0 mL
6/11/2015	0830	45.5	471.70	18,447	20.46	7.31	0.444	62.3	3.10	Imoff = 0 mL
6/11/2015	0840	45.5	472.30	18,902	19.91	7.37	0.440	45.9	2.97	Imoff = 0 mL
6/12/2015	1435	45	460.50	20,098	26.45	6.79	0.527	15.2	12.16	Imoff = 0 mL; Pump at 533 feet bgs
6/12/2015	1445	45	461.31	20,548	25.42	7.31	0.526	5.79	9.20	Imoff = 0 mL
6/12/2015	1455	45	461.64	20,998	22.71	7.57	0.443	2.55	9.20	Imoff = 0 mL
6/12/2015	1505	45	461.89	20,448	21.57	7.64	0.428	1.90	8.84	Imoff = 0 mL
6/12/2015	1515	45	462.02	20,898	20.98	7.61	0.426	1.72	8.65	Imoff = 0 mL
6/13/2015	2031	45	460.00	38,341	25.52	8.63	0.511	13.7	15	Imoff = < 0.1 mL; Pump at 533 feet bgs
6/13/2015	2041	45	460.66	38,791	20.98	8.19	0.364	8.58	12.30	Imoff = 0 mL
6/13/2015	2051	45	460.77	39,241	20.76	8.12	0.380	9.79	11.94	Imoff = 0 mL
6/13/2015	2101	45.5	460.91	39,691	20.65	8.10	0.380	6.95	11.64	Imoff = 0 mL
6/13/2015	2111	45	460.99	40,141	20.56	8.10	0.379	4.96	11.28	Imoff = 0 mL
6/13/2015	2121	45	461.05	40,591	20.51	8.10	0.378	4.64	11.11	Imoff = 0 mL
6/13/2015	2131	45	461.10	41,041	20.48	8.11	0.378	4.32	10.98	Imoff = 0 mL
6/13/2015	2141	45	461.10	41,491	20.49	8.12	0.377	5.48	10.98	Imoff = 0 mL
6/15/2015	2120	45	452.05	53,048	27.21	7.87	0.500	14.3	NR	Imoff = < 0.1 mL
6/15/2015	2130	45	460.62	53,498	25.03	7.88	0.481	31.0	12.61	Imoff = < 0.1 mL
6/15/2015	2140	45	460.77	53,948	23.53	7.91	0.429	16.3	12.01	Imoff = < 0.1 mL
6/15/2015	2150	45	460.82	54,398	22.80	7.93	0.399	8.86	11.94	Imoff = < 0.1 mL

Groundwater Extraction Well Development

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U.)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Comments
6/15/2015	2200	45	460.90	54,848	22.28	7.96	0.391	5.14	11.69	Imoff = < 0.1 mL
6/15/2015	2208	NR	NR	55,208	--	--	--	--	--	Shut off pump.
6/16/2015	1900	56	462.75	56,273	21.79	8.31	0.423	109	12.97	Imoff = < 0.1 mL
6/16/2015	1910	55	462.76	56,823	21.05	8.27	0.401	58.6	12.97	Imoff = < 0.1 mL
6/16/2015	1920	55	462.84	57,373	20.88	8.30	0.396	27.7	12.70	Imoff = < 0.1 mL
6/16/2015	1930	55	462.87	57,923	20.76	8.30	0.396	21.3	12.61	Imoff = < 0.1 mL
6/16/2015	1940	55	462.91	58,473	20.68	8.30	0.392	17.1	12.5	Imoff = < 0.1 mL
6/16/2015	1950	55	462.94	59,023	20.63	8.31	0.391	12.6	12.42	Imoff = < 0.1 mL
6/16/2015	2000	55	462.97	59,573	20.57	8.31	0.391	12.6	12.33	Imoff = < 0.1 mL
6/16/2015	2020	55	463.01	60,673	20.50	8.32	0.390	7.90	12.22	Imoff = < 0.1 mL
6/16/2015	2040	55	461.66	61,773	20.43	8.33	0.389	7.64	12.14	Imoff = < 0.1 mL
6/16/2015	2130	55	461.75	63,523	20.37	8.32	0.388	4.46	11.90	Imoff = < 0.1 mL

°C = degrees Celsius
EC = Electric Conductivity
ft bgs = feet below ground surface
gpm = gallons per minute
gpm/ft = gallons per minute per foot
mL = milliliter
mS/cm = millisiemen per centimeter
NR = not recorded
NTU = Nephelometric Turbidity Unit
S.U. = Standard Unit

Groundwater Extraction Well Development

Jetting

Date	Time	Depth (ft bgs)	Jetting Rate (gpm)	Pumping Rate (gpm)	Imhoff Cone Measurement (mL sediment per L water)	Comments
6/9/2015	1715	484.5	29	45.5	0.2	Jet = 130 psi
6/9/2015	1721	481.5	29	45.5	0.7	Jet = 130 psi
6/9/2015	1724	478.5	29.5	45	0.5	Jet = 129 psi
6/9/2015	1736	475.5	29	--	--	Shut pump off @ 1734
6/9/2015	1740	472.5	29	--	--	Jet = 130 psi
6/9/2015	1744	469.5	29.5	--	--	Jet = 130 psi
6/9/2015	1748	466.5	29	--	--	Jet = 129 psi
6/9/2015	1751	463.5	29	--	--	Jet = 129 psi
6/9/2015	1755	460.5	29.5	--	--	Jet = 129 psi
6/10/2015	1450	531.5	22	44	< 0.1	Jet = 72 psi
6/10/2015	1505	536.5	24	45	0.3	Jet = 118 psi
6/10/2015	1514	533.5	24	45	0.1	Jet = 118 psi
6/10/2015	1518	530.5	24	45	0.2	Jet = 118 psi
6/10/2015	1524	527.5	24	46	0.5	Jet = 118 psi
6/10/2015	1529	524.5	24	46	0.1	Jet = 118 psi
6/10/2015	1534	521.5	24	45.5	0.1	Jet = 118 psi; Pumped 2,300 gallons
6/10/2015	1632	517.5	25	46	< 0.1	Jet = 117 psi
6/10/2015	1636	514.5	25	45	0.3	Jet = 117 psi
6/10/2015	1640	511.5	25	45.5	2.0	Jet = 117 psi
6/10/2015	1644	508.5	25	45.5	0.5	Jet = 117 psi
6/10/2015	1802	505.5	28	46	0.1	Jet = 117 psi
6/10/2015	1806	502.5	28	46	0.1	Jet = 116 psi
6/10/2015	1812	499.5	28.5	45.5	0.1	Jet = 116 psi
6/10/2015	1816	496.5	29	45	0.1	Jet = 117 psi
6/10/2015	1819	493.5	28	45	0.1	Jet = 117 psi
6/10/2015	1824	490.5	28	44	0.2	Jet = 117 psi
6/10/2015	1830	487.5	28	44.5	0.1	Jet = 117 psi; Stop jetting.
Jetted a total of 2,585 gallons and pumped out 6,490 gallons on 6/10/2015						
6/12/2015	0756	536.5	27	46	< 0.1	Jet = 129 psi
6/12/2015	0802	533.5	27	46	0.4	Jet = 129 psi
6/12/2015	0808	530.5	27	46	0.3	Jet = 128 psi
6/12/2015	0814	527.5	26	46	0.5	Jet = 128 psi
6/12/2015	0820	524.5	29	46	0.3	Jet = 129 psi
6/12/2015	0826	521.5	30	46	< 0.1	Jet = 128 psi
6/12/2015	0832	518.5	30	46	< 0.1	Jet = 128 psi
6/12/2015	0838	--	--	--	--	Breaking Connection.
6/12/2015	0934	515.5	26	45.5	< 0.1	Jet = 130 psi
6/12/2015	0940	512.5	26	46	0.1	Jet = 129 psi

Groundwater Extraction Well Development

Jetting

Date	Time	Depth (ft bgs)	Jetting Rate (gpm)	Pumping Rate (gpm)	Imhoff Cone Measurement (mL sediment per L water)	Comments
6/12/2015	0946	509.5	26.5	46	< 0.1	Jet = 130 psi
6/12/2015	0952	--	--	--	--	Breaking Connection.
6/12/2015	1032	506.5	27.5	45	< 0.1	Jet = 132 psi
6/12/2015	1038	503.5	28	45	< 0.1	Jet = 131 psi
6/12/2015	1044	500.5	28	45	< 0.1	Jet = 131 psi
6/12/2015	1050	497.5	28	45	< 0.1	Jet = 132 psi
6/12/2015	1056	494.5	28	45	< 0.1	Jet = 131 psi
6/12/2015	1102	491.5	28	46	< 0.1	Jet = 131 psi
6/12/2015	1108	--	--	--	--	Breaking Connection.
6/12/2015	1234	488.5	16	44	< 0.1	Jet = 130 psi
6/12/2015	1248	485.5	16	45	< 0.1	Jet = 132 psi
6/12/2015	1254	482.5	16	45	< 0.1	Jet = 132 psi; Stop pumping
6/12/2015	1300	479.5	16	--	--	Jet = 132 psi
6/12/2015	1306	476.5	16	--	--	Jet = 132 psi
6/12/2015	1312	473.5	16	--	--	Jet = 132 psi
6/12/2015	1318	470.5	16	--	--	Jet = 132 psi
6/12/2015	1324	467.5	16	--	--	Jet = 132 psi
6/12/2015	1330	464.5	15.5	--	--	Jet = 132 psi
6/12/2015	1336	--	--	--	--	Stop Jetting; Drop pump to bottom.
6/12/2015	1544	536.5	12	45	< 0.1	Jet = 132 psi; DTW = 460.20
6/12/2015	1551	533.5	11	45	< 0.1	Jet = 132 psi; DTW = 460.50
6/12/2015	1557	530.5	11	45	0.1	Jet = 132 psi
6/12/2015	1605	527.5	11	45	< 0.1	Jet = 132 psi
6/12/2015	1612	524.5	10	45	< 0.1	Jet = 132 psi
6/12/2015	1618	521.5	11	45	< 0.1	Jet = 132 psi; DTW = 461.50
6/12/2015	1620	--	--	--	--	Stop Jetting for repairs.
6/13/2015	1340	536.5	42	45	< 0.1	Jet = 120 psi
6/13/2015	1348	533.5	42	45	0.2	Jet = 120 psi
6/13/2015	1356	530.5	42	45	0.1	Jet = 120 psi
6/13/2015	1402	527.5	42	45	0.1	Jet = 120 psi
6/13/2015	1409	524.5	42	45	0.3	Jet = 120 psi
6/13/2015	1415	521.5	41	45.5	< 0.1	Jet = 120 psi
6/13/2015	1639	518.5	42	45	0.1	Jet = 122 psi
6/13/2015	1646	515.5	42	45.5	0.2	Jet = 121 psi
6/13/2015	1652	512.5	42	45.5	0.1	Jet = 121 psi
6/13/2015	1659	509.5	42	45	0.1	Jet = 121 psi
6/13/2015	1730	506.5	42	45	< 0.1	Jet = 122 psi

Groundwater Extraction Well Development

Jetting

Date	Time	Depth (ft bgs)	Jetting Rate (gpm)	Pumping Rate (gpm)	Imhoff Cone Measurement (mL sediment per L water)	Comments
6/13/2015	1736	503.5	42	45	0.1	Jet = 122 psi
6/13/2015	1811	500.5	42	45	< 0.1	Jet = 122 psi
6/13/2015	1818	497.5	42	45	< 0.1	Jet = 122 psi
6/13/2015	1825	494.5	42	45	< 0.1	Jet = 122 psi
6/13/2015	1831	491.5	42	45	0.1	Jet = 122 psi
6/13/2015	1837	488.5	42	45	0.2	Jet = 122 psi
6/13/2015	1924	485.5	42	45	0.1	Jet = 121 psi
6/13/2015	1931	482.5	42	45.5	0.1	Jet = 121 psi
6/13/2015	1937	479.5	42	45.5	< 0.1	Jet = 121 psi
6/13/2015	1941	--	--	--	--	Stop Jetting; Out of water
6/15/2015	0723	536.5	42	45.5	0.7	Jet = 124 psi
6/15/2015	0729	533.5	42	45.5	0.1	Jet = 124 psi
6/15/2015	0735	530.5	42	45.5	< 0.1	Jet = 124 psi
6/15/2015	0741	527.5	42	45	< 0.1	Jet = 124 psi
6/15/2015	0746	524.5	42	45.5	< 0.1	Jet = 123 psi
6/15/2015	0752	521.5	42	46	< 0.1	Jet = 123 psi
6/15/2015	0758	518.5	--	46	--	Stop Jetting; Out of water
6/15/2015	0906	518.5	18	45	< 0.1	Jet = 50 psi
6/15/2015	0912	515.5	42	45	< 0.1	Jet = 120 psi
6/15/2015	0918	512.5	42	45	< 0.1	Jet = 122 psi
6/15/2015	0924	509.5	42	45.5	< 0.1	Jet = 122 psi
6/15/2015	0930	--	--	--	--	Remove stick
6/15/2015	1013	506.5	41	45	< 0.1	Jet = 119 psi
6/15/2015	1019	503.5	42	45	< 0.1	Jet = 120 psi; Out of water
6/15/2015	1100	500.5	42	46	< 0.1	Jet = 120 psi
6/15/2015	1106	497.5	41	46	< 0.1	Jet = 120 psi
6/15/2015	1112	494.5	41	46	< 0.1	Jet = 120 psi
6/15/2015	1118	491.5	40.5	46	< 0.1	Jet = 120 psi
6/15/2015	1124	488.5	40.5	46	< 0.1	Jet = 120 psi
6/15/2015	1201	485.5	41	45	0.1	Jet = 120 psi
6/15/2015	1207	482.5	41	45	< 0.1	Jet = 120 psi; Out of water
6/15/2015	1303	479.5	41	45	< 0.1	Jet = 117 psi; DTW = 457.7
6/15/2015	1309	476.5	41	45	< 0.1	Jet = 117 psi
6/15/2015	1315	473.5	41	46	< 0.1	Jet = 117 psi
6/15/2015	1321	470.5	41	46	< 0.1	Jet = 117 psi
6/15/2015	1327	467.5	41	--	--	Jet = 117 psi; Pump off
6/15/2015	1333	464.5	41	--	--	Jet = 117 psi
6/15/2015	1339	461.5	41	--	--	Jet = 117 psi
6/15/2015	1447	461.5	41	--	--	Jet = 117 psi

Groundwater Extraction Well Development

Jetting

Date	Time	Depth (ft bgs)	Jetting Rate (gpm)	Pumping Rate (gpm)	Imhoff Cone Measurement (mL sediment per L water)	Comments
6/15/2015	1451	--	--	--	--	Stop jetting due to lightning
6/15/2015	1602	461.5	41	--	--	Jet = 122 psi; Finish section
6/15/2015	1604	464.5	41	--	--	Jet = 122 psi
6/15/2015	1610	467.5	41	--	--	Jet = 122 psi
6/15/2015	1616	470.5	41	45	< 0.1	Jet = 121 psi; Start pumping
6/15/2015	1622	473.5	41	46	< 0.1	Jet = 121 psi
6/15/2015	1628	476.5	41	46	< 0.1	Jet = 121 psi
6/15/2015	1634	479.5	41	45	< 0.1	Jet = 121 psi
6/15/2015	1640	482.5	41	45	< 0.1	Jet = 121 psi
6/15/2015	1646	--	--	--	--	Out of water; Add 20 feet of pipe
6/15/2015	1741	485.5	41	44	0.1	Jet = 121 psi
6/15/2015	1747	488.5	41	45	0.1	Jet = 121 psi
6/15/2015	1753	491.5	41	45	< 0.1	Jet = 121 psi
6/15/2015	1759	494.5	41	45	< 0.1	Jet = 121 psi
6/15/2015	1805	497.5	41	45	< 0.1	Jet = 121 psi
6/15/2015	1811	500.5	41	45	< 0.1	Jet = 121 psi
6/15/2015	1817	--	--	--	--	Add pipe
6/15/2015	1841	503.5	41	45	< 0.1	Jet = 121.5 psi
6/15/2015	1847	506.5	41	45	< 0.1	Jet = 121 psi
6/15/2015	1853	--	--	--	--	Out of water
6/15/2015	1931	509.5	42	45	< 0.1	Jet = 121 psi
6/15/2015	1937	512.5	41	46	< 0.1	Jet = 121 psi
6/15/2015	1945	515.5	41	45	< 0.1	Jet = 121 psi
6/15/2015	1950	518.5	42	45.5	< 0.1	Jet = 121 psi
6/15/2015	1956	521.5	42	45	< 0.1	Jet = 121 psi
6/15/2015	2002	521.5	--	--	--	Add pipe
6/15/2015	2030	524.5	42	46	< 0.1	Jet = 121 psi
6/15/2015	2036	527.5	42	46	< 0.1	Jet = 121 psi
6/15/2015	2042	530.5	42	46	< 0.1	Jet = 121 psi
6/15/2015	2048	533.5	42	46	< 0.1	Jet = 121 psi
6/15/2015	2054	--	--	--	--	Turn off jet pump

ft bgs = feet below ground surface

gpm = gallons per minute

L = liter

mL = millliliter

psi = pounds per square inch

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
- At Time of Drilling: 450.00
- At End of Drilling: Not Recorded
- After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

LICENSED PROFESSIONAL GEOLOGIST
VIRGINIA BRACHT
8881903-2250
STATE OF UTAH
12/9/15

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
0					No lithologic description.		Top of Casing/Top of Portland Bentonite Cement	Borehole was potholed from 0 - 12'.
15					Sandy SILT (ML); pinkish white (7.5YR 8/2); dry; soft; 60% silt; 40% fine to coarse sand; angular to subangular. Note: sand is quartz and mafics.	ML	Portland Bentonite Cement	Begin advancing 16" casing @ 1140 on 9/8/15.
20					Poorly graded GRAVEL with Silt and Sand (GP-GM); reddish yellow (7.5YR 7/6); 60% fine gravel to 3/4"; angualr to subangular; 30% fine to coarse sand; subangular to subrounded; 10% silt. Note: gravel is mafics and granite. Sand is mafics, quartzite, and quartz.	GP-GM		Kelly down @ 1201, new 10' connection. Resume drilling @ 1400.
25					Poorly graded SAND with Silt and Gravel (SP-SM); brown (7.5YR 5/3); 70% coarse sand; trace fine and medium sand; subangular to subrounded; 20% fine gravel to 1/2"; subangular; 10% silt. Note: sand is quartz, mafics, and quartzite. Gravel is mafics.	SP-SM		Kelly down @ 1506, new connection. Resume drilling @ 1528.
30								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
30								
35					Poorly graded SAND with Silt and Gravel (SP-SM); brown (7.5YR 5/3); 70% coarse sand; trace fine and medium sand; subangular to subrounded; 20% fine gravel to 1/2"; subangular; 10% silt. Note: sand is quartz, mafics, and quartzite. Gravel is mafics.	SP-SM		
40					Gravelly SILT with Sand (ML); light brown (7.5YR 6/4); low plasticity; 60% silt; 25% fine gravel to 1/2"; angular to subangular; 15% medium to coarse sand.	ML		Cuttings come out of cyclone as mush.
45					Sandy SILT (ML); light brown (7.5YR 6/4); low plasticity; 50% silt; 40% coarse sand; angular to subangular; 10% fine gravel to 1/2"; angular to subangular. Note: gravel is mafics.			Kelly down @ 1615, new connection. Resume drilling @ 1735.
50					Same as above (40 ft).		- Portland Bentonite Cement	
55					Same as above (40 ft); trace clay.			Kelly down @ 1820. End of 9/8/15. Resume drilling with 16" casing @ 0812 on 9/9/15. Used approximately 500 gallons of water.
60					Same as above (40 ft).			
					Silty SAND (SM); brown (7.5YR 4/4); 85% very fine to fine sand; trace gravel; 15% silt.	SM		
					Same as above (53 ft); 80% fine to coarse sand; 20% silt. Note: sand is quartz and mafics.			Kelly down @ 0902, new 10' connection. Resume drilling @ 1011.
					Same as above (53 ft); 80% fine to coarse sand; 20% silt; trace clay. Note: sand is quartz and mafics.			

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
60					Sandy SILT (ML); strong brown (7.5YR 4/6); low plasticity; 50% silt; 40% fine sand; trace medium sand; 10% fine gravel to 3/8".			PID = 0.0 ppm @ mud pit.
								PID = 0.0 ppm @ mud pit.
65					SILT (ML); yellowish red (5YR 5/6); 90% silt; 10% coarse sand; angular.			Driller added water to clean out hose and cyclone. Kelly down @ 1107, new 10' connection. Resume drilling @ 1123.
70					Same as above (65 ft); yellowish red (5YR 5/8); trace clay.	ML		
75					Same as above (65 ft); yellowish red (5YR 5/8); trace clay.		Portland Bentonite Cement	PID = 0.0 ppm @ mud pit.
								Kelly down @ 1212 @ 77'.
80								Reach total depth with 16" casing @ 1246. End of 9/9/15. Resume drilling with mud rotary @ 1010 on 9/10/15. Used a total of 1,100 gallons of water to date.
85					Lean CLAY with Sand (CL); light greenish gray (Gley1 8/1); soft; low plasticity; 80% clay; 20% fine sand; trace coarse sand.	CL		
					SILT with Sand (ML); brown (7.5YR 5/4); low plasticity; 75% silt; 25% very fine to fine sand.	ML		PID = 0.0 ppm @ mud pit.
90								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
90					SILT with Sand (ML); brown (7.5YR 5/4); low plasticity; 75% silt; 25% very fine to fine sand.	ML		PID = 0.0 ppm @ mud pit.
95					Lean CLAY with Sand (CL); yellowish red (5YR 5/8); soft; low plasticity; 70% clay; 10% silt; 20% fine to medium sand.			
100					Same as above (95 ft); 20% coarse sand; angular.			Kelly down @ 1152, new 20' connection. Resume drilling @ 1247.
105					Same as above (95 ft); 30% fine to coarse sand; no silt.	CL	- Portland Bentonite Cement	
110					Lean CLAY (CL); yellowish red (5YR 5/8); soft; low plasticity; 90% clay; 10% meduim to coarse sand.			PID = 0.0 ppm @ mud pit.
115					Same as above (110 ft).			
120								PID = 0.0 ppm @ mud pit.

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
120					Sandy SILT (ML); brown (7.5YR 5/4); low plasticity; 70% silt; 30% fine sand.	ML		Kelly down @ 1305, new 20' connection. Resume drilling @ 1315.
125					Silty SAND (SM); light brown (7.5YR 6/4); loose; 75% very fine sand; 25% silt.	SM		PID = 0.0 ppm @ mud pit.
130					Sandy SILT (ML); strong brown (7.5YR 5/6); 60% silt; 40% fine to coarse sand. Note: sand is mafics.	ML		
135					Poorly graded SAND with Silt (SP-SM); strong brown (7.5YR 5/6); 90% coarse sand; angular to subangular; 10% silt. Note: sand is quartz, granite, and mafics.	SP-SM	- Portland Bentonite Cement	PID = 0.0 ppm @ mud pit.
140					Silty SAND (SM); strong brown (7.5YR 5/6); 70% fine to coarse sand; angular to subangular; 30% silt. Note: sand is mafics.	SM		Kelly down @ 1330, new 20' connection. Resume drilling @ 1352.
145					Well-graded SAND with Silt (SW-SM); strong brown (7.5YR 5/6); 90% fine to coarse sand; angular to subrounded; 10% silt. Note: sand is mafics, quartz, and granite.	SW-SM		
150								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
150								
155					Well-graded SAND with Silt (SW-SM); strong brown (7.5YR 5/6); 90% fine to coarse sand; angular to subrounded; 10% silt. Note: sand is mafics, quartz, and granite.	SW-SM		PID = 0.0 ppm @ mud pit.
160					Silty SAND (SM); brown (7.5YR 5/4); 75% fine to coarse sand; angular to subrounded; 25% silt. Note: sand is quartz and mafics.	SM		
165					Poorly graded SAND with Silt (SP-SM); strong brown (7.5YR 5/6); 90% coarse sand; trace fine and medium sand; angular to subangular; 10% silt. Note: sand is mafics and quartz.	SP-SM	- Portland Bentonite Cement	Kelly down @ 1410, new 20' connection. Resume drilling @ 1428.
170					Same as above (160 ft).			PID = 0.0 ppm @ mud pit.
175					Poorly graded SAND (SP); strong brown (7.5YR 5/6); 95% coarse sand; trace fine and medium sand; angular to subangular; 5% silt. Note: sand is mafics, quartz, and quartzite.	SP		
180					Same as above (170 ft).			PID = 0.0 ppm @ mud pit.

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
180					Well-graded SAND (SW); strong brown (7.5YR 5/6); 95% fine to coarse sand; angular to subrounded; 5% silt. Note: sand is quartz and mafics.			Kelly down @ 1445, new 20' connection. Resume drilling @ 1500.
185					Same as above (180 ft).			PID = 0.0 ppm @ mud pit.
190					Same as above (180 ft).	SW		
195					Same as above (180 ft).		- Portland Bentonite Cement	
200					Silty SAND (SM); brown (10YR 5/3); 85% fine to coarse sand; angular to subangular; 15% silt. Note: sand is quartz with mafics and quartzite.			Kelly down @ 1527, new 20' connection. Resume drilling @ 1547. PID = 0.0 ppm @ mud pit.
205					Same as above (200 ft); 80% fine to coarse sand; 20% silt.	SM		
210								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
210								
215					Silty SAND (SM); brown (10YR 5/3); 80% fine to coarse sand; angular to subangular; 20% silt. Note: sand is quartz with mafics and quartzite.	SM		
220					Poorly graded SAND (SP); strong brown (7.5YR 5/6); 95% coarse sand; trace medium sand; angular to subangular; 5% silt. Note: sand is quartz with mafics and quartzite.	SP		PID = 0.0 ppm @ mud pit.
225					Well-graded SAND (SW); strong brown (7.5YR 5/6); 95% fine to coarse sand; angular to subangular; 5% silt. Note: sand is quartz, mafics, and quartzite.	SW	- Portland Bentonite Cement	Kelly down @ 1612, new 20' connection. Resume drilling @ 1636.
230					Same as above (220 ft); 95% medium to coarse sand.			
235					Same as above (220 ft); 95% medium to coarse sand.			
240					Silty SAND (SM); brown (7.5YR 4/2); 60% fine sand; trace medium sand; subangular to subrounded; 40% silt. Note: sand is quartz with mafics.	SM		PID = 0.0 ppm @ mud pit.

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
240					Silty SAND (SM); brown (7.5YR 4/2); 70% fine sand; trace medium sand; subangular to subrounded; 30% silt. Note: sand is quartz with mafics.	SM		Kelly down @ 1705, new 20' connection. Resume drilling @ 1713.
245					Same as above (240 ft); 60% fine sand; 40% silt.			
250					Same as above (240 ft); 80% fine sand; 20% silt.			
255					Same as above (240 ft); 80% fine sand; 20% silt.		- Portland Bentonite Cement	PID = 0.0 ppm @ mud pit.
260					Same as above (240 ft); brown (7.5YR 5/3); 75% very fine to fine sand; trace medium and coarse sand; 25% silt.			Kelly down @ 1728, new 20' connection. Resume drilling @ 1745.
265					Poorly graded SAND with Silt (SP-SM); brown (7.5YR 5/3); 90% fine to medium sand; trace coarse sand; angular to subrounded; 10% silt. Note: sand is quartz, mafics, and quartzite.	SP-SM		
270								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
270								
275					Poorly graded SAND with Silt (SP-SM); brown (7.5YR 5/3); 90% fine to medium sand; trace coarse sand; angular to subrounded; 10% silt. Note: sand is quartz, mafics, and quartzite.	SP-SM		Rig chatter @ 273'. PID = 0.0 ppm @ mud pit.
280					Well-graded SAND with Silt (SW-SM); brown (7.5YR 5/3); 90% fine to coarse sand; angular to subangular; 10% silt. Note: sand is quartz, mafics, and quartzite.	SW-SM		
285					Poorly graded GRAVEL (GP); brown (7.5YR 5/3); 85% fine gravel to 3/8"; angular to subrounded; 10% coarse sand; 5% silt. Note: gravel and sand are mafics, quartz, and felspar.	GP	- Portland Bentonite Cement	Kelly down @ 1800. End of 9/10/15. Resume drilling @ 1003 on 9/11/15. Used 2,400 gallons of water on 9/10/15.
290					Same as above (280 ft).			
295					Poorly graded GRAVEL with Silt and Sand (GP-GM); brown (7.5YR 5/3); 50% fine gravel to 3/8"; angular to subrounded; 40% fine sand; 10% silt. Note: gravel is mafics, quartz, and feldspar. Sand is quartz.	GP-GM		
300					Same as above (290 ft); 70% fine gravel to 3/8"; 20% fine sand.			

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
300					Silty GRAVEL with Sand (GM); light brown (7.5YR 6/4); 55% fine gravel to 3/8"; angular to subangular; 30% fine sand; 15% silt. Note: gravel is mafics and feldspar. Sand is quartz.	GM		Kelly down @ 1020, new 20' connection. Resume drilling @ 1028.
305					Same as above (300 ft); 70% fine gravel to 3/8"; 15% fine sand; subangular to subrounded. Note: gravel is mafics and quartz.			PID = 0.0 ppm @ mud pit.
310					Silty SAND with Gravel (SM); light brown (7.5YR 6/4); 70% fine to coarse sand; angular to subrounded; 15% fine gravel to 3/8"; 15% silt. Note: sand and gravel are mafics, granite, quartzite, and quartz.	SM		
315					Poorly graded GRAVEL with Sand (GP); light brown (7.5YR 6/4); 60% fine gravel to 3/8"; angular to subrounded; 35% fine to coarse sand; 5% silt. Note: gravel is mafics, feldspar, and quartz. Sand is quartz.	GP	- Portland Bentonite Cement	PID = 0.0 ppm @ mud pit.
320					Well-graded SAND with Silt and Gravel (SW-SM); light brown (7.5YR 6/4); 65% fine to coarse sand; angular to subrounded; 25% fine gravel to 3/8"; 10% silt. Note: sand and gravel are mafics, quartzite, felspar, and quartz.			Kelly down @ 1058, new 20' connection. Resume drilling @ 1112.
325					Same as above (320 ft). Note: greater fine sand fraction.	SW-SM		
330								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
330					Silty SAND (SM); light brown (7.5YR 6/4); 80% fine to coarse sand; angular to subrounded; 5% fine gravel to 3/8"; 15% silt. Note: sand and gravel are mafics, quartz, and feldspar.			
335					Same as above (330 ft).	SM		
340					Poorly graded SAND with Silt (SP-SM); light brown (7.5YR 6/4); 90% coarse sand; trace fine and medium sand; angular to subangular; 10% silt. Note: sand is quartz, mafics, and granite.			Kelly down @ 1127, new 20' connection. Resume drilling @ 1140.
345					Same as above (340 ft).	SP-SM	- Portland Bentonite Cement	
350					Silty SAND with Gravel (SM); light brown (7.5YR 6/4); 65% fine to coarse sand; angular to subangular; 20% fine gravel to 3/8"; 15% silt. Note: sand and gravel are quartz, mafics, quartzite, and granite.			
355					Same as above (350 ft).	SM		
360								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
360								
					Silty SAND (SM); light brown (7.5YR 6/3); 80% very fine to fine sand; trace medium and coarse sand; subangular to subrounded; 20% silt. Note: sand is quartz with some mafics.	SM	- Top of 3/8" Bentonite Chip Seal	Kelly down @ 1155, new 20' connection. Resume drilling.
365								
					Poorly graded SAND with Silt (SP-SM); light brown (7.5YR 6/3); 90% coarse sand; trace fine and medium sand; subangular to subrounded; 10% silt. Note: sand is mafics, quartz, feldspar, and granite.	SP-SM		
370								
					Silty SAND with Gravel (SM); light brown (7.5YR 6/3); 50% fine to coarse sand; angular to subrounded; 40% fine gravel to 3/8"; 15% silt. Note: sand and gravel are mafics, quartz, feldspar, and granite.	SM		
375								
					Poorly graded GRAVEL (GP); light brown (7.5YR 6/3); 85% fine gravel to 1/2"; angular to subrounded; 10% fine sand; 5% silt. Note: gravel and sand are mafics, feldspar, quartz, and granite.	GP	- 3/8" Bentonite Chip Seal	PID = 0.0 ppm @ mud pit.
380								
					Poorly graded GRAVEL with Silt and Sand (GP-GM); light brown (7.5YR 6/3); 75% fine gravel to 1/2"; subangular to subrounded; 15% fine sand; 10% silt. Note: gravel and sand are mafics, feldspar, quartz, and granite.	GP-GM		Kelly down @ 1324, new 20' connection. Resume drilling @ 1335.
385								
					Same as above (380 ft).			
390								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
390								
395					Silty GRAVEL with Sand (GM); light brown (7.5YR 6/3); 70% fine gravel to 1/2"; angular to subangular; 15% fine sand; 15% silt. Note: gravel and sand are mafics, quartz, feldspar, and granite.	GM	- 3/8" Bentonite Chip Seal	
400					Silty GRAVEL (GM); light brown (7.5YR 6/3); 70% fine gravel to 1/2"; angular to subrounded; 10% fine sand; 20% silt. Note: gravel and sand are mafics, quartz, feldspar, and granite.			
405					Silty SAND with Gravel (SM); light brown (7.5YR 6/3); 50% fine to coarse sand; subangular to subrounded; 20% fine gravel to 3/8"; 30% silt. Note: sand and gravel are mafics, quartz, and granite.	SM	- Top of 20/40 Sand	Kelly down @ 1459, new 20' connection. Resume drilling @ 1508.
410					Clayey SAND with Gravel (SC); reddish brown (5YR 5/4); low plasticity; 50% fine to coarse sand; subangular to subrounded; 25% fine gravel to 3/8"; 25% clay. Note: sand and gravel are quartz, mafics, feldspar, and granite.	SC	- Top of 10/20 Sand	
415					Silty SAND with Gravel (SM); light brown (7.5YR 6/3); 50% fine to coarse sand; subangular to subrounded; 25% fine gravel to 3/8"; 25% silt. Note: sand and gravel are quartz, mafics, and granite.	SM		PID = 0.0 ppm @ mud pit.
420					Same as above (410 ft); 55% fine to coarse sand; 30% fine gravel to 3/8"; 15% silt. Note: sand and gravel are quartz, mafics, granite, and feldspar.			

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/8/2015
Date TD Reached: 9/18/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
420								
425					Silty SAND with Gravel (SM); light brown (7.5YR 6/3); 55% fine to coarse sand; subangular to subrounded; 30% fine gravel to 3/8"; 15% silt. Note: sand and gravel are quartz, mafics, granite, and feldspar.	SM		Kelly down @ 1437. End of mud rotary drilling @ 425' @ 1450 on 9/11/15.
430								
435								
440								
445								
450					▽			

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:33 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/14/2015
Date TD Reached: 9/24/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
420								
					Silty SAND with Gravel (SM); light brown (7.5YR 6/3); 55% fine to coarse sand; subangular to subrounded; 30% fine gravel to 3/8"; 15% silt. Note: sand and gravel are quartz, mafics, granite, and feldspar.	SM		Drill with mud rotary to 425'.
425								
					Poor recovery.			Begin sonic coring @ 1650 on 9/14/15 for test run. @ 425 - 430 ft, geologist noted loose, coarse gravel with trace fine gravel; subangular to subrounded.
430								
					@ 430 ft. Fat CLAY (CH); red (10R 5/8); hard; high plasticity; 100% clay.		- Top of 8" Stainless Steel 0.050 Slot Screen	@ 430 ft occasional black specs, streaks, and gray material interfilling cracks of the clay. End of 9/14/15. Resumed drilling on 9/15/15.
					@ 432.1 ft. Fat CLAY with Sand (CH); greenish gray (Gley 1 6/1); hard; high plasticity; 80% clay; 20% fine sand.	CH		@ 431.7 - 435 ft sand is quartz with occasional biotite.
435								

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Borehole ID: KAFB-106233-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/14/2015
Date TD Reached: 9/24/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
435					@ 434.8 ft. Poorly graded SAND with Silt (SP-SM); light brown (7.5YR 6/4); 90% fine sand; subangular; 10% silt.	SP-SM		@ 435 - 435.7 ft drilled instead of cored due to possible obstruction.
					@435 ft. No recovery.			
					@ 435.7 ft. Poorly graded SAND with Silt (SP-SM); light brown (7.5YR 6/4); 90% fine sand; trace medium sand; subangular to subrounded; 10% silt.			@ 435 - 445.9 ft sand is quartz with biotite and occasional microcline.
440					Same as above (435.7 ft).	SP-SM	8" Stainless Steel 0.050 Slot Screen	@ 440 ft occasional layers of slightly higher silt.
445					@ 443.7 ft. Same as above (435.7 ft); light brown (7.5YR 6/3); 90% fine to medium sand; trace coarse sand.			
					@ 445.9 ft. No recovery.			Driller reported that it felt like coring through a gravel interval.
450					▽			

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:24 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/14/2015
Date TD Reached: 9/24/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: M. Giles

Depth (ft)	Material Description	U.S.C.S.	Well Diagram	Remarks
450	@ 450 ft. Well-graded SAND (SW); light brown (7.5YR 6/3); 95% fine to coarse sand; subangular to subrounded; 5% silt.	SW		@ 450 - 454 ft sand is quartz and biotite with occasional microcline. Gravel is mafics and occasional quartzite. @ 450.8 - 451.1 ft trace fine gravel to 3/8".
	@ 451.8 ft. Poorly graded SAND with Silt and Gravel (SP-SM); light brown (7.5YR 6/3); 75% fine sand; trace medium sand; subangular to subrounded; 15% coarse gravel to 2-1/2"; 10% silt.	SP-SM		
	@ 452.8 ft. No lithologic description. Core removed for testing.	SP-SM/CL		
455	@ 453.6 ft. Poorly graded SAND with Silt (SP-SM); light brown (7.5YR 6/3); 90% fine to medium sand; subangular to subrounded; 10% silt.	SM		@ 455 - 457.1 ft sand is quartz with occasional biotite. Gravel is mafics, quartz, and quartzite. @ 455.6 - 455.7 ft cored rock.
	@ 453.8 ft. Lean CLAY with Gravel (CL); strong brown (7.5YR 5/6); low plasticity; 75% clay; 25% fine gravel to 1/2"; subrounded.	GW-GM		
	@ 454 ft. No recovery.	SP-SM		
	@ 455 ft. Silty SAND (SM); brown (10YR 5/3); 70% very fine sand; 30% silt.		8" Stainless Steel 0.050 Slot Screen	
	@ 455.7 ft. Well-graded GRAVEL with Silt and Sand (GW-GM); strong brown (7.5YR 5/6); 50% fine to coarse gravel to 2"; subrounded; 40% fine to coarse sand; subangular to subrounded; 10% silt.			
460	@ 456.3 ft. Poorly graded SAND with Silt (SP-SM); strong brown (7.5YR 5/6); 90% fine sand; subangular to subrounded; 10% silt.	SP-SM		@ 460 - 462.8 ft sand is quartz with biotite and occasional microcline. Gravel is mafics with occasional sandstone and quartzite.
	@ 457.1 ft. No recovery.			
	@ 460 ft. Poorly graded SAND with Silt and Gravel (SP-SM); brown (7.5YR 5/4); 70% fine to medium sand; subangular to subrounded; 20% fine gravel to 1/2"; subangular to subrounded; 10% silt.	GW-GM		@ 462.7 ft, silt is very hard, possibly cemented.
	@ 460.8 ft. Well-graded GRAVEL with Silt and Sand (GW-GM); brown (7.5YR 5/4); 60% fine to coarse gravel to 1"; subrounded; 30% fine to coarse sand; subangular to subrounded; 10% silt.	SM		
465				

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Borehole ID: KAFB-106233-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/14/2015
Date TD Reached: 9/24/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
465					@ 462.7 ft. Silty SAND (SM); light brownish gray (10YR 6/2); 75% fine to coarse sand; subangular to subrounded; 25% silt.	SP-SM		@ 465 - 466.6 ft sand is quartz and biotite with occasional microcline. Gravel is mafics.
					@ 462.8 ft. No recovery.	GW-GC		
					@ 465 ft. Poorly graded SAND with Silt (SP-SM); light brownish gray (10YR 6/2); 90% fine to medium sand; subangular to subrounded; 10% silt.			
					@ 466 ft. Well-graded GRAVEL with Clay and Sand (GW-GC); brown (7.5YR 5/3); 60% fine to coarse gravel to 2"; subangular; 30% fine to coarse sand; subangular to subrounded; 10% clay.	SP		@ 467.5 ft 2-1/2" clay lense; light red (2.5YR 6/8). @ 467.5 - 468.4 ft sand is quartz. @ 468.3 ft coarse gravel to 1"; subrounded, mafics.
470					@ 466.6 ft. No recovery.			
					@ 467.5 ft. Poorly graded SAND (SP); brown (7.5YR 5/3); 95% fine sand; trace medium sand; subangular to subrounded; 5% silt.	GW-GM		@ 470 - 471.4 ft sand is quartz with biotite and quartzite. Gravel is mafics, feldspar, and quartzite. @ 471.4 ft. 2" piece of gravel in shoe of core barrel with multiple rock fragments. End of 9/15/15 @ 472.5 ft. Used approximately 500 gallons of water to date. Resume coring on 9/16/15 @ 0750.
					@ 468.4 ft. No recovery.			
					@ 470 ft. Well-graded GRAVEL with Silt and Sand (GW-GM); strong brown (7.5YR 4/6); 60% fine to coarse gravel to 2"; angular to subangular; 30% fine to coarse sand; 10% silt.		8" Stainless Steel 0.050 Slot Screen	
					@ 471.4 ft. No recovery.			
475					@ 475 ft. No lithologic description. Core removed for testing.			
					@ 476 ft. Poorly graded SAND (SP); strong brown (7.5YR 4/6); 95% fine sand; subangular to subrounded; 5% silt.	SP		@ 475 - 476.3 ft sand is quartz with biotite.
					@ 476.3 ft. No recovery.			
					@ 477.5 ft. Poorly graded SAND with Silt (SP-SM); strong brown (7.5YR 4/6); 90% fine sand; trace medium sand; subangular to subrounded; 10% silt.	SP-SM		@ 477.5 - 478.2 ft sand is quartz with some biotite.
					@ 478.2 ft. No recovery.			
480								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:24 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/14/2015
Date TD Reached: 9/24/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
480					@ 480 ft. Poorly graded SAND (SP); light brown (7.5YR 6/4); 95% fine sand; trace coarse sand; subangular to subrounded; 5% silt.	SP		@ 480 - 481.2 ft sand is quartz with some biotite.
					@ 481.2 ft. No recovery.			
					@ 482.5 ft. Poorly graded SAND (SP); light brown (7.5YR 6/4); 95% fine sand; trace medium sand; subangular to subrounded; 5% silt.	SP		@ 482.5 - 483.4 ft sand is quartz with some biotite. @ 483.1 ft conglomerate rock fragment jamming shoe in core barrel.
					@ 483.4 ft. No recovery.			
485								@ 485 - 486 ft drilled without coring due to rock fragments in shoe of the core barrel.
					@ 487.5 ft. Poorly graded SAND (SP); light brown (7.5YR 6/3); 95% fine to medium sand; trace coarse sand; subangular to subrounded; trace fine gravel to 1/2"; subrounded; 5% silt.	SP	8" Stainless Steel 0.050 Slot Screen	@ 487.5 - 490.5 ft sand is quartz with biotite and occasional microcline. Gravel is mafics.
					@ 488.6 ft. Silty SAND (SM); light brown (7.5YR 6/3); 80% fine to coarse sand; subangular to subrounded; 20% silt.	SM		
490					@ 490 ft. Well-graded SAND with Silt (SW-SM); light brown (7.5YR 6/3); 90% fine to coarse sand; subangular to subrounded; 10% silt.	SW-SM		@ 490.4 ft cemented sandstone, fine to coarse grained.
					@ 490.5 ft. No recovery.			
					@ 492.5 ft. Well-graded SAND with Gravel (SW); light brown (7.5YR 6/3); 75% fine to coarse sand; subangular to subrounded; 20% fine to coarse gravel to 1-1/2"; subrounded; 5% silt.	SW		@ 492.5 ft coarse gravel is cemented sandstone. @ 492.5 - 495 ft sand is quartz, biotite, and microcline. Gravel is mafics.
495								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:24 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/14/2015
Date TD Reached: 9/24/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
495					@ 495 ft. Well-graded SAND (SW); brown (7.5YR 5/3); 95% fine to coarse sand; subangular to subrounded; 5% silt.	SW		@ 495 - 497.2 ft, sand is quartz, biotite, microcline, and occasional quartz.
					@ 495.8 ft. Poorly graded SAND (SP); brown (7.5YR 5/3); 95% fine to medium sand; subangular to subrounded; 5% silt.	SP		
					@ 497.2 ft. No recovery.			
					@ 497.5 ft. Poorly graded SAND (SP); brown (7.5YR 5/3); 90% fine to medium sand; subangular to subrounded; 5% fine gravel to 3/4"; subrounded; trace coarse gravel; 5% silt.	SP		@ 497.5 - 499 ft sand is quartz with biotite. Gravel is mafics. Occasional coarse gravel in shoe.
					@ 499 ft. No recovery.			
500					@ 500 ft. Poorly graded SAND (SP); brown (10YR 4/3); 90% fine to medium sand; trace coarse sand; subangular to subrounded; 5% fine gravel to 3/4"; subrounded; 5% silt.	SP		@ 500 - 501.1 ft sand is quartz, biotite, and microcline. Gravel is mafics.
					@ 501.1 ft. No recovery.			
					@ 502.5 ft. Well-graded SAND (SW); brown (10YR 4/3); 90% fine to coarse sand; angular to subrounded; 5% fine gravel to 1/2"; subrounded; 5% silt.	SW	8" Stainless Steel 0.050 Slot Screen	@ 502.5 - 504.5 ft sand is quartz, biotite, and microcline. Gravel is mafics.
					@ 504.5 ft. No recovery.			
505					@ 505 ft. Poorly graded GRAVEL (GP); yellowish red (5YR 5/8); 85% coarse gravel to 2"; trace fine gravel to 1/2"; subangular; 10% fine to medium sand; 5% clay.	GP		@ 505 - 505.4 ft sand is quartz. Gravel is mafics.
					@ 505.4 ft. No recovery.			
					@ 507.5 ft. Well-graded SAND (SW); brown (10YR 4/3); 95% fine to coarse sand; subangular to subrounded; 5% silt.	SW		@ 507.5 - 509.5 ft sand is quartz with occasional biotite and microcline. Gravel is mafics.
					@ 508.3 ft. Poorly graded SAND (SP); brown (10YR 4/3); 95% fine to medium sand; 5% silt.	SP SM		
510					@ 509 ft. Silty SAND with Gravel (SM);	SW		

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:24 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/14/2015
Date TD Reached: 9/24/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 450.00
At End of Drilling: Not Recorded
After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
510					brown (10YR 4/3); 50% fine sand; 35% coarse gravel to 1-1/4"; subrounded; 15% silt.	SW-SM		@ 510 - 510.8 ft sand is quartz with biotite, microcline, and quartzite. Gravel is mafics.
					@ 509.3 ft. Well-graded SAND (SW); brown (10YR 4/3); 95% fine to coarse sand; subangular to subrounded; 5% silt.			
					@ 509.5 ft. No recovery.			
					@ 510 ft. Well-graded SAND with Silt (SW-SM); brown (10YR 4/3); 80% fine to coarse sand; subangular to subrounded; 10% fine gravel to 1/2"; subrounded; 10% silt.	SW		@ 512.5 - 514.5 ft sand is quartz with biotite and occasional microline. Gravel is mafics.
					@ 510.8 ft. No recovery.	SP		
515					@ 512.5 ft. Well-graded SAND (SW); brown (10YR 4/3); 85% fine to coarse sand; subangular to subrounded; 10% fine to coarse gravel; 5% silt.			Interval 515 - 515.5 ft was not opened to obtain a minimally disturbed sample.
					@ 514 ft. Poorly graded SAND (SP); brown (10YR 4/3); 95% fine to medium sand; subangular to subrounded; 5% silt.	SW / SP-SM		@ 515.5 - 516.2 ft sand is quartz with biotite and occasional microcline. Gravel is mafics.
					@ 514.5 ft. No recovery.			
					@ 515 ft. No lithologic description. Core removed for testing.		8" Stainless Steel 0.050 Slot Screen	
					@ 515.5 ft. Well-graded SAND (SW); light brown (7.5YR 6/4); 90% fine to coarse sand; subangular to subrounded; 5% fine gravel to 1/2"; subrounded; 5% silt.	GW / SP		@ 517.5 - 518.9 ft sand is quartz and microcline, with occasional mafics, biotite, and quartzite. Gravel is mafics and quartzite.
520					@ 516 ft. Poorly graded SAND with Silt (SP-SM); light brown (7.5YR 6/4); 90% fine sand; 10% silt.			@ 520 - 521.8 ft sand is quartz, biotite, and microcline.
					@ 516.2 ft. No recovery.			
					@ 517.5 ft. Well-graded GRAVEL with Sand (GW); light brown (7.5YR 6/4); 60% fine to coarse gravel to 1-1/4"; angular to subrounded; 35% fine to coarse sand; subangular to subrounded; 5% silt.	SP		
					@ 517.9 ft. Poorly graded SAND (SP); light brown (7.5YR 6/4); 95% fine to medium sand; subangular to subrounded; 5% silt.	SP-SM		End of 9/16/15 @ 522.5 ft. Used approximately 300 gallons of water. Resume coring on 9/17/15. @ 522.5 - 523.1 ft sand is quartz with trace biotite.
					@ 518.9 ft. No recovery.			
525					@ 520 ft. Poorly graded SAND (SP);			

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Borehole ID: KAFB-106233-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/14/2015
Date TD Reached: 9/24/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
525					brown (7.5YR 4/4); 95% fine to medium sand; subangular to subrounded; 5% silt.	SP		@ 525 - 527.2 ft sand is quartz with occasional biotite.
					@ 521.8 ft. No recovery.	ML		
					@ 522.5 ft. Poorly graded SAND with Silt (SP-SM); brown (7.5YR 5/4); 90% fine to medium sand; trace coarse sand; subangular to subrounded; 10% silt.	SP		
					@ 523.1 ft. No recovery.	GC		@ 526.8 ft clay is firm with high plasticity.
					@ 525 ft. Poorly graded SAND (SP); brown (7.5YR 5/4); 95% fine to medium sand; subangular to subrounded; 5% silt.	CH		@ 527.9 - 529 ft sand is quartz with biotite.
					@ 525.3 ft. SILT with Sand (ML); brown (7.5YR 5/4); firm; low plasticity; 85% silt; 15% fine sand.	SP	8" Stainless Steel 0.050 Slot Screen	
530					@ 525.6 ft. Poorly graded SAND (SP); brown (7.5YR 5/4); 95% fine to medium sand; subangular to subrounded; trace fine gravel; rounded; 5% silt.			End of continuous coring @ 530 ft on 9/17/15. Resumed drilling on 9/18/15 with mud rotary.
					@ 526.8 ft. Clayey GRAVEL (GC); reddish yellow (7.5YR 6/6); 80% coarse gravel to 2-1/2"; subangular; 20% clay.			
					@ 527.2 ft. No recovery.		Bottom of Screen	
					@ 527.5 ft. Fat CLAY (CH); light reddish brown (5YR 6/4); dry; hard; high plasticity; 100% clay.			
					@ 527.9 ft. Poorly graded SAND (SP); brown (7.5YR 5/4); 95% fine to medium sand; subangular to subrounded; 5% silt.			
535					@ 529.7 ft. No recovery.			
					@ 530 ft. Poorly graded GRAVEL with Silt and Sand (GP-GM); light brown (7.5YR 6/3); 50% fine gravel to 3/8"; subangular to subrounded; 40% fine to coarse sand; subangular to subrounded; 10% silt. Note: Gravel is mafics, quartz, and granite. Sand is quartz, mafics, and microcline.	GP-GM		
							Bottom of Sump	
540								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:24 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106233-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/14/2015
Date TD Reached: 9/24/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

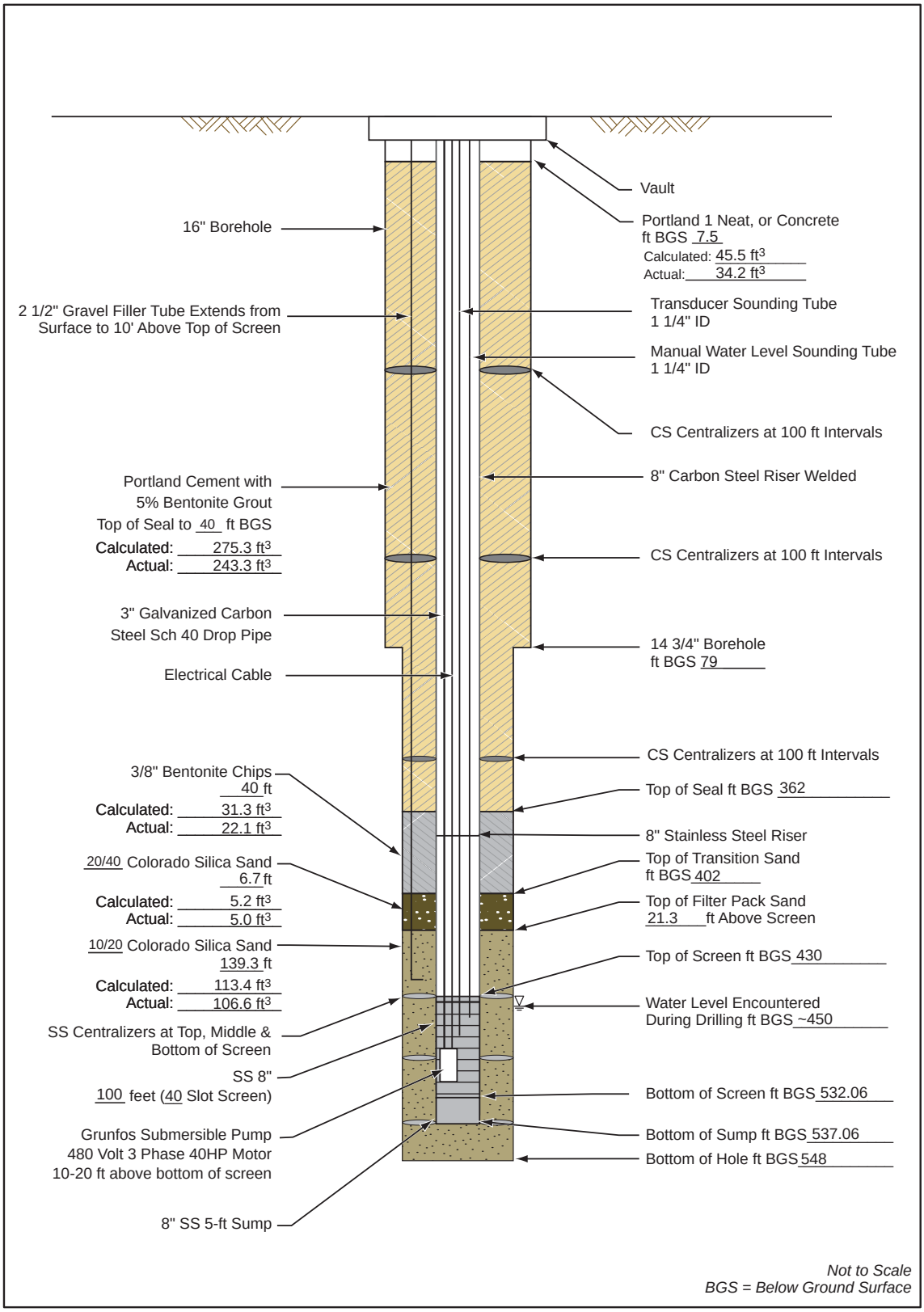
Groundwater Levels BGS (ft):
▽ At Time of Drilling: 450.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 459.60

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: M. Giles

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
540					@ 540 ft. Poorly graded GRAVEL with Silt and Sand (GP-GM); light brown (7.5YR 6/3); 50% fine gravel to 3/8"; subangular to subrounded; 40% fine to coarse sand; subangular to subrounded; 10% silt. Note: Gravel is mafics, quartz, and granite. Sand is quartz, mafics, and microcline.			12" reaming stopped @ 543 ft on 9/18/15 @ 1155. Resume drilling @ 1020 on 9/24/15.
545					Same as above (540 ft); 60% fine gravel to 3/8"; angular to subrounded; 30% medium to coarse sand; subangular to subrounded. Note: gravel is mafics and quartz. Sand is quartz with some mafics and granite.	GP-GM		
550					Same as above (540 ft); 60% fine gravel to 3/8"; angular to subrounded; 30% medium to coarse sand; subangular to subrounded. Note: gravel is mafics and quartz. Sand is quartz with some mafics and granite.		Bottom of Filter Pack/Bottom of Hole Native Backfill Bottom of Rat Hole	Total depth = 552 ft bgs. Reached total depth on 9/24/15 @ 1055.
555								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/9/15 13:24 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Extraction Well Construction Diagram KAFB-106233



500433.04010300.A4

Project Name: KAFB BFF
Location: Gibson and California
Personnel:
Start Date: 10/1/2015
End Date: /2015

Well No.: KAFB-106233
Date Installed: 9/30/2015
Casing Diameter (I.D.): 8-inch
Total Depth (ft. BGS): 537.06

Method of Development:

[X] Surging [X] Bailing [X] Pumping [X] Jetting

[X] Original Development [ ] Redevelopment [ ] Other

Depth to Water Before Developing Well (ft. BGS): NR
Screened Interval (ft. BGS): 430 – 532.06
Weather: Varied

Equipment Numbers: **pH:** NR **Conductivity:** NR
Turbidity: NR

Equipment Decontaminated Prior to Development? [X] Yes [ ] No
Describe:

Collected Sample of Water Added to Well? [ ] Yes [X] No
Describe:

Comments:

Summary of development procedure, including key decision-points, calculations, and observations (described in detail in the following pages):

Well development consisted of bailing, surging, pumping, and jetting. The first step of development removed mud and cuttings from the well casing and filter pack, which were generated during the drilling process, by surging and bailing. The second step entailed physical well development using surging, bailing, and pumping to assess development progress. These actions included taking measurements of sediment content in the water using the Imhoff cone technique, and applying 30 minutes of sustained pumping, measuring, and plotting drawdown to estimate development effectiveness. The third step used jetting with simultaneous pumping.

Bailing				
Date	Time	Total Volume Bailed (gallons)	Imhoff Cone Measurement (mL sediment per L water)	Comments
10/1/2015	1638	0	--	Begin bailing
10/1/2015	1815	480	--	Stop bailing
10/2/2015	1038	480	--	Resume bailing on 10/2/15
10/2/2015	1044	495	0.2	First reading; thick mud; solids still suspended after 5 minutes
10/2/2015	1103	540	8.0	Diluted 250 mL mud with 750 mL of clean water; readings multiplied by 4.
10/2/2015	1113	600	10.0	Same as above
10/2/2015	1125	705	11.3	Same as above
10/2/2015	1147	825	6.0	Same as above
10/2/2015	1205	930	6.0	Same as above
10/2/2015	1330	1005	4.0	Same as above
10/2/2015	1348	1080	6.5	Same as above
10/2/2015	1407	1155	4.0	Same as above
10/2/2015	1418	1230	4.0	Same as above
10/2/2015	1423	1305	3.0	Same as above
10/2/2015	1517	1395	2.6	Same as above
10/2/2015	1530	1420	10.0	Same as above
10/2/2015	1609	1620	3.0	Same as above
10/2/2015	1617	1680	3.0	Same as above
10/3/2015	0900	1785	0.3	Getting 1,000 mL of well water
10/3/2015	0910	1840	1.0	Getting 1,000 mL of well water
10/3/2015	0923	1915	1.0	Getting 1,000 mL of well water
10/3/2015	0938	1990	1.0	Getting 1,000 mL of well water
10/6/2015	1408	4046	1.5	Begin bailing
10/6/2015	1425	4121	1.5	
10/6/2015	1436	4196	1.5	
10/6/2015	1446	4271	0.6	
10/6/2015	1458	4346	1.0	
10/6/2015	1508	4421	0.5	
10/6/2015	1519	4481	0.4	
10/7/2015	1036	4496	1.3	Begin bailing
10/7/2015	1051	4571	2.0	
10/7/2015	1105	4646	1.5	
10/7/2015	1130	4721	1.1	
10/7/2015	1142	4796	1.0	

Bailing				
Date	Time	Total Volume Bailed (gallons)	Imhoff Cone Measurement (mL sediment per L water)	Comments
10/7/2015	1205	4931	0.7	
10/7/2015	1249	4946	0.1	
10/7/2015	1256	4991	0.5	
10/18/2015	1103	68922	--	Bailer full of sand; use suction to get sand off of bottom
10/18/2015	1630	69147	--	Still sandy with some water; 225 gallons bailed, 45 gallons of which was sand.

L = liter

mL = milliliter

Surging				
Interval (feet below ground surface)	Date	Start Time	End Time	Comments
532-527	10/6/2015	0905	0915	
527-522	10/6/2015	0915	0926	
522-517	10/6/2015	0927	0937	
517-512	10/6/2015	0938	0948	
512-507	10/6/2015	0948	0958	
507-502	10/6/2015	1009	1019	
502-497	10/6/2015	1020	1030	
497-492	10/6/2015	1030	1040	
492-487	10/6/2015	1040	1050	
487-482	10/6/2015	1050	1100	
482-477	10/6/2015	1116	1126	
477-472	10/6/2015	1127	1137	
472-467	10/6/2015	1137	1147	
467-462	10/6/2015	1147	1157	
462-457	10/6/2015	1157	1207	
457-452	10/6/2015	1255	1305	
452-447	10/6/2015	1302	1315	
532-448	10/6/2015	1315	1326	
532-527	10/6/2015	1629	1640	
527-522	10/6/2015	1641	1651	
522-517	10/6/2015	1651	1701	
517-512	10/6/2015	1701	1702	
512-507	10/6/2015	1720	1730	
507-502	10/6/2015	1730	1740	
402-497	10/6/2015	1740	1750	
497-492	10/6/2015	1750	1800	
492-487	10/7/2015	0808	0819	
487-482	10/7/2015	0827	0837	
482-477	10/7/2015	0837	0847	
477-472	10/7/2015	0847	0857	
472-467	10/7/2015	0857	0907	
467-462	10/7/2015	0907	0917	
462-457	10/7/2015	0923	0933	
457-452	10/7/2015	0934	0944	
452-447	10/7/2015	0944	0954	
532-449	10/7/2015	0954	1009	

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Imhoff Cone (mL sediment per L water)	Depth of pump (Feet)
10/3/2015	1707	8	474.00	1995	20.7	8.23	0.689	>1,000	0.31	0.3	491.3
10/3/2015	1715	5	474.00	1075	21.3	8.17	0.745	>1,000	0.31	0.1	491.3
10/3/2015	1725	6.5	471.00	2125	21.5	8.11	0.813	>1,000	0.22	0.2	491.3
10/3/2015	1735	6.5	473.65	2190	21.8	7.96	0.808	>1,000	0.25	0.1	491.3
10/3/2015	1745	6	476.80	2255	21.5	7.95	0.721	>1,000	0.21	0.1	491.3
10/3/2015	1755	6	475.50	2310	21.5	7.91	0.707	>1,000	0.22	0.1	491.3
10/3/2015	1805	6	475.80	2370	21.4	7.89	0.665	>1,000	0.21	<0.1	491.3
10/3/2015	1815	6	476.00	2430	21.3	7.89	0.645	>1,000	0.21	<0.1	491.3
10/3/2015	1825	6	476.30	2490	21.3	7.89	0.633	>1,000	0.21	<0.1	491.3
10/3/2015	1835	6	476.55	2550	21.3	7.90	0.626	>1,000	0.21	<0.1	491.3
10/5/2015	0908	--	448.9	2557	--	--	--	--	--	--	491.3
10/5/2015	0910	8.5	452.1	2557	14.7	6.89	0.608	185	2.66	<0.1	491.3
10/5/2015	0920	8.5	463.2	2642	20.7	7.34	0.614	>1,000	0.59	<0.1	491.3
10/5/2015	0930	8.0	470.45	2727	20.2	7.30	0.599	125	0.37	<0.1	491.3
10/5/2015	0940	8.0	474.05	2807	20.7	7.83	0.592	123	0.32	<0.1	491.3
10/5/2015	0950	7.5	477.35	2887	20.8	7.90	0.604	217	0.28	<0.1	491.3
10/5/2015	1000	7.5	479.00	2962	20.8	7.87	0.585	334	0.25	<0.1	491.3
10/5/2015	1010	7.5	479.75	3037	20.8	7.63	0.611	>1,000	0.24	<0.1	491.3
10/5/2015	1108	--	449.41	3037	--	--	--	--	--	--	530.7
10/5/2015	1110	8	451.20	3037	21.6	7.85	0.607	>1,000	3.5	<0.1	530.7
10/5/2015	1120	8	459.53	3117	21.1	7.84	0.586	810	0.75	<0.1	530.7
10/5/2015	1130	7.5	463.95	3197	20.5	7.96	0.631	>1,000	0.53	<0.1	530.7-525.7
10/5/2015	1140	7.5	467.20	3172	20.8	7.92	0.606	666	0.41	<0.1	530.7-525.7
10/5/2015	1150	7.5	469.40	3247	20.7	7.80	0.535	238	0.37	<0.1	525.7-520.7
10/5/2015	1200	7.5	471.45	3322	20.7	7.78	0.514	264	0.33	<0.1	525.7-520.7
10/5/2015	1240	7.5	452.80	3322	22.0	7.74	0.516	302	1.92	<0.1	520.7-515.7
10/5/2015	1250	7.5	461.65	3397	21.0	7.76	0.514	149	0.59	<0.1	520.7-515.7
10/5/2015	1300	7.5	467.98	3472	20.9	7.74	0.525	109	0.38	<0.1	515.7-510.7
10/5/2015	1322	8	452.40	3472	21.9	7.74	0.512	79.1	2.28	<0.1	510.7-505.7

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Imhoff Cone (mL sediment per L water)	Depth of pump (Feet)
10/5/2015	1342	7.5	471.50	3632	20.8	7.77	0.498	165	0.33	<0.1	505.7-500.7
10/5/2015	1352	7.5	476.23	3707	21.0	7.77	0.509	326	0.27	<0.1	500.7-495.7
10/5/2015	1402	8	474.90	3782	21.1	7.77	0.526	455	0.31	<0.1	495.7-490.7
10/5/2015	1427	8	453.90	3782	23.3	7.74	0.528	414	1.6	<0.1	490.7-485.7
10/5/2015	1437	8	464.20	3862	21.1	7.75	0.514	373	0.52	<0.1	490.7-485.7
10/5/2015	1448	7.5	471.35	3942	20.7	7.75	0.487	183	0.33	<0.1	480.7-485.7
10/7/2015	1518	--	448.35	4991	--	--	--	--	--	--	512.3
10/7/2015	1525	9	450.4	4991	24.7	7.00	0.561	>1,000	6.42	0.2	512.3
10/7/2015	1535	9	450.35	5081	20.2	7.84	0.570	>1,000	6.67	<0.1	512.3
10/7/2015	1545	9	450.35	5171	20.5	7.87	0.547	>1,000	6.67	<0.1	512.3
10/7/2015	1552	30	453.90	5171	19.4	7.77	0.509	555	6.12	<0.1	512.3
10/7/2015	1602	29	453.80	5471	19.0	7.74	0.511	572	6.04	<0.1	512.3
10/7/2015	1612	29.5	453.95	5771	18.9	7.71	0.496	392	5.96	<0.1	512.3
10/7/2015	1622	29	454.15	6071	18.8	7.68	0.479	222	5.63	<0.1	512.3
10/7/2015	1632	29	454.30	6371	18.8	7.67	0.472	138	5.47	<0.1	512.3
10/7/2015	1648	28.5	453.65	6371	19.6	7.75	0.465	139	6.13	<0.1	530.4-525.4
10/7/2015	1658	28	454.18	6656	18.8	7.69	0.463	137	5.40	<0.1	530.4-525.4
10/7/2015	1708	28	454.45	6936	18.8	7.68	0.461	95.2	5.14	<0.1	530.4-525.4
10/7/2015	1718	28	454.49	7216	18.7	7.68	0.442	110	5.10	<0.1	525.4-520.4
10/7/2015	1728	28	454.52	7496	18.7	7.67	0.447	43.2	5.07	<0.1	520.4-515.4
10/7/2015	1738	28	454.60	7776	18.7	7.68	0.441	111	5.00	<0.1	515.4-510.4
10/7/2015	1815	30	453.80	7776	18.0	7.80	0.466	81.7	6.25	<0.1	510.4-505.4
10/7/2015	1825	30	454.80	8076	18.5	7.70	0.445	101	5.17	<0.1	510.4-505.4
10/8/2015	0824	30	453.37	8568	11.7	7.17	0.458	38	7.48	<0.1	505.4-500.4

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Imhoff Cone (mL sediment per L water)	Depth of pump (Feet)
10/8/2015	0834	30	454.70	8868	12.2	7.32	0.458	40.9	5.62	<0.1	505.4-500.4
10/8/2015	0844	30	454.70	9168	12.9	7.44	0.460	13.6	5.62	<0.1	500.4-495.4
10/8/2015	0854	30	454.70	9468	14.0	7.56	0.460	8.1	5.62	<0.1	500.4-495.4
10/8/2015	0904	30	455.20	9768	14.1	7.57	0.459	5.83	5.17	<0.1	495.4-490.4
10/8/2015	0931	30	453.30	9768	19.1	7.64	0.466	15.9	7.61	<0.1	490.4-485.4
10/8/2015	0941	31	454.90	10068	18.6	7.71	0.462	10.8	5.60	<0.1	490.4-485.4
10/8/2015	0951	31	455.22	10378	18.6	7.71	0.444	24.2	5.29	<0.1	480.4-475.4
10/8/2015	1001	31	455.41	10688	18.6	7.70	0.447	20.0	5.12	<0.1	480.4-475.4
10/8/2015	1011	31	455.37	10998	18.6	7.70	0.453	13.5	5.16	<0.1	475.4-470.4
10/8/2015	1054	31	453.25	10998	19.3	7.68	0.450	9.98	7.97	<0.1	470.4-465.4
10/8/2015	1104	31	453.90	11308	18.6	7.71	0.435	4.22	6.82	<0.1	470.4-465.4
10/8/2015	1114	31	455.25	11618	18.6	7.69	0.435	9.63	5.26	<0.1	470.4
10/8/2015	1124	31	455.25	11928	18.6	7.69	0.443	6.41	5.26	<0.1	470.4
10/8/2015	1134	31	455.44	12238	18.6	7.69	0.442	5.21	5.09	<0.1	470.4
10/8/2015	1144	31	455.55	12548	18.6	7.68	0.443	3.5	5.00	<0.1	470.4
10/8/2015	1154	31	455.30	12858	18.6	7.68	0.445	59.4	5.21	<0.1	470.4
10/8/2015	1204	31	455.60	13168	18.6	7.69	0.445	76.0	4.96	<0.1	470.4
10/8/2015	1347	31	455.08	13168	18.9	7.68	0.492	34.5	5.42	<0.1	470.4
10/8/2015	1358	31	453.80	13478	18.7	7.73	0.444	9.0	6.98	<0.1	470.4
10/8/2015	1408	31	455.50	13788	18.6	7.71	0.444	8.29	5.04	<0.1	470.4
10/8/2015	1418	31	--	--	--	--	--	--	--	--	--
10/15/2015	1400	40	450.36	--	22.5	7.62	0.508	142	36.04	<0.1	529
10/15/2015	1412	39.5	451.20	--	19.8	7.72	0.461	97.8	20.26	<0.1	529
10/15/2015	1422	39.5	451.26	--	19.2	7.69	0.465	24.8	19.65	<0.1	529
10/16/2015	0932	42.5	451.25	42809	18.9	7.29	0.484	545	24.29	0.2	488
10/16/2015	0942	42	451.34	43123	18.8	7.61	0.458	51.1	22.8	0.15	488
10/16/2015	0952	42	451.39	43165	18.6	7.72	0.463	15.3	23.22	<0.1	488

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Imhoff Cone (mL sediment per L water)	Depth of pump (Feet)
10/16/2015	1002	42	451.42	43207	18.5	7.73	0.464	10.0	21.88	<0.1	488
10/16/2015	1022	42	451.44	43209	18.4	7.72	0.465	5.76	21.65	<0.1	488
10/16/2015	1042	42	451.47	43375	18.3	7.72	0.463	4.08	21.32	<0.1	488
10/16/2015	1102	42	451.49	43459	18.3	7.72	0.464	4.14	21.11	<0.1	488
10/16/2015	1122	42	451.49	43543	18.3	7.71	0.462	2.11	21.11	<0.1	488
10/16/2015	1142	42	451.49	43627	18.2	7.71	0.460	2.23	21.11	<0.1	488
10/16/2015	1202	42	449.65	43711	20.0	7.86	0.515	198	--	<0.1	488
10/16/2015	1222	42	451.40	43795	18.4	7.74	0.462	4.58	22.11	<0.1	488
10/16/2015	1312	42	451.30	44005	19.8	7.80	0.466	96.8	23.33	<0.1	488
10/16/2015	1318	42	451.37	44306	18.5	7.74	0.455	30.2	22.46	<0.1	488
10/16/2015	1625	42	451.15	--	19.8	7.76	0.507	>1,000	25.45	6.0	468
10/16/2015	1635	43.5	451.66	--	20.6	7.82	0.523	748	20.14	0.2	468
10/16/2015	1645	44	451.70	--	19.6	7.79	0.498	227	20.00	0.2	468
10/16/2015	1655	44	451.74	--	18.9	7.77	0.473	114	--	--	468
10/20/2015	1528	63.78	452.07	--	18.1	7.65	0.463	78.7	22.34	<0.1	509.4
10/20/2015	1538	63.90	452.11	--	18.0	7.64	0.488	10.4	21.59	<0.1	509.4
10/20/2015	1548	63.08	452.15	--	18.0	7.63	0.486	3.88	21.46	<0.1	509.4
10/20/2015	1621	63.08	452.43	--	--	--	--	--	19.59	--	--

°C = degrees Celsius
EC = Electric Conductivity
ft bgs = feet below ground surface
gpm = gallons per minute
gpm/ft = gallons per minute per foot
mL = milliliter
mS/cm = millisiemen per centimeter
NR = not recorded
NTU = Nephelometric Turbidity Unit
S.U. = Standard Unit

Jetting

Date	Time	Depth (ft bgs)	Jetting Rate (gpm)	Pumping Rate (gpm)	Imhoff Cone Measurement (mL sediment per L water)	Depth to Water (feet bgs)	Comments
10/12/2015	1820	520.0	--	--	--	--	Pump on
10/12/2015	1823	520.0	--	46.5	<0.1	458.0	
10/12/2015	1828	520.0	37.44	46.5	0.2	454.2	
10/12/2015	1834	525-520	36.12	46.0	0.2	452.0	
10/13/2015	0914	520-515	--	47.0	0.2	451.0	Pump on
10/13/2015	0928	520-515	26.0	47.0	2.0	454.2	Turn on jet
10/13/2015	0958	520-515	26.0	44.0	1.5	454.0	
10/13/2015	1011	520-515	--	44.0	0.3	454.1	
10/13/2015	1123	515-510	43.9	46.0	0.3	453.1	
10/13/2015	1137	510-505	30.0	44.0	0.7	452.3	
10/13/2015	1144	520-515	30.0	43.0	1.0	453.0	
10/13/2015	1149	525-505	30.0	43.0	0.5	453.0	Turn off jet/pump
10/13/2015	1240	505-500	32.0	47.0	0.9	453.9	Turn on jet/pump
10/13/2015	1247	500-495	30.0	46.0	0.5	451.6	
10/13/2015	1257	495-490	32.0	45.0	0.6	452.5	Turn off jet/pump
10/13/2015	1408	495-490	30.0	44.0	1.5	451.1	Turn on jet/pump
10/13/2015	1418	490-485	30.0	44.0	2.0	451.3	Turn off jet/pump
10/13/2015	1513	485-480	32.0	46.0	0.3	451.5	Turn on jet/pump
10/13/2015	1520	480-475	32.0	45.0	2.5	451.2	Turn off jet/pump
10/13/2015	1630	475-470	24.0	45.0	0.4	451.1	Turn on jet/pump
10/13/2015	1635	470-465	22.0	45.0	0.7	451.8	Turn off jet/pump
10/13/2015	1726	465-460	35.0	46.0	1.5	451.5	Turn on jet/pump
10/13/2015	1732	460-455	24.0	45.0	2.5	451.8	
10/13/2015	1739	455-450	23.0	43.0	3.0	451.0	Turn off jet/pump
10/14/2015	0830	465-460	26	46.5	2.5	451.3	Turn on jet/pump
10/14/2015	0835	460-455	25	44	7.5	451.5	
10/14/2015	0840	455-450	24	44	10.0	451.5	
10/15/2015	0906	465-460	39	46	7.0	450.0	
10/15/2015	0913	460-455	37	44	4.0	450.0	
10/15/2015	0920	455-450	36	43	7.0	449.9	
10/15/2015	1028	470-465	36	44	18.0	451.1	
10/15/2015	1034	475-470	36	43	10.0	449.7	
10/15/2015	1041	480-475	39	42	6.0	449.7	
10/15/2015	1045	485-480	38	40	5.0	449.7	
10/15/2015	1150	490-485	37	44	6.5	449.6	
10/15/2015	1155	495-490	37	40	4.5	449.7	
10/15/2015	1202	450-495	37	41	1.5	449.6	
10/15/2015	1208	505-500	38	40	3.0	449.6	

Jetting

Date	Time	Depth (ft bgs)	Jetting Rate (gpm)	Pumping Rate (gpm)	Imhoff Cone Measurement (mL sediment per L water)	Depth to Water (feet bgs)	Comments
10/15/2015	1339	510-505	36	42	1.1	449.6	
10/15/2015	1345	515-510	36	40	1.5	449.5	
10/15/2015	1350	520-515	36	40	2.5	449.5	
10/15/2015	1356	525-520	36	40	0.8	449.5	
10/15/2015	1432	525-520	35	39	0.6	449.2	
10/15/2015	1438	520-515	36	38	2.5	449.5	
10/15/2015	1444	515-510	36	37	1.9	449.4	
10/15/2015	1450	510-505	35	38	5.0	449.6	
10/15/2015	1530	505-500	34	41	1.6	449.8	
10/15/2015	1535	500-495	36	40	3.5	449.6	
10/15/2015	1548	495-490	32	38	2.5	449.8	
10/15/2015	1554	490-485	35	38	4.0	499.6	
10/15/2015	1654	485-480	35	42	4.5	449.4	
10/15/2015	1659	480-475	35	39.5	7.5	449.6	
10/15/2015	1705	475-470	34	39	8.0	449.8	
10/15/2015	1710	470-465	34	39	7.0	450.0	
10/16/2015	0637	465-460	35	44	10.0	450.2	
10/16/2015	1458	430-445	34	--	--	--	In unsaturated zone
10/16/2015	1618	445-440	34	--	--	--	In unsaturated zone
10/16/2015	1706	465-460	27	44	2.3	450.8	
10/16/2015	1711	460-455	24	43	9.8	450.6	
10/16/2015	1718	455-450	24	43	7.0	450.5	
10/16/2015	1738	465-460	35	40	3.5	450.6	
10/16/2015	1743	460-455	35	40	8.0	450.5	
10/16/2015	1749	455-450	24	40	5.0	450.3	
10/17/2015	0826	465-460	24	13	5.5	449.5	
10/17/2015	0831	460-455	24	42	7.5	450.3	
10/17/2015	0837	455-450	24	41	5.5	450.3	
10/17/2015	0842	455-450	25	40	7.5	450.4	
10/17/2015	0847	460-455	24	39	8.0	450.4	
10/17/2015	0852	465-460	24	38	6.0	450.3	
10/17/2015	0857	465-460	25	38	4.5	450.3	
10/17/2015	0902	460-455	24	38	5.5	450.4	
10/17/2015	0908	455-450	25	38	3.5	450.3	
10/17/2015	1010	480-475	35	39	1.2	450.0	
10/17/2015	1016	475-470	33	39	3.0	449.8	
10/17/2015	1026	470-465	24	38	4.75	450.4	

Jetting

Date	Time	Depth (ft bgs)	Jetting Rate (gpm)	Pumping Rate (gpm)	Imhoff Cone Measurement (mL sediment per L water)	Depth to Water (feet bgs)	Comments
10/17/2015	1031	470-465	23	38	4.0	450.4	
10/17/2015	1036	475-470	23	38	4.5	450.2	
10/17/2015	1041	480-475	27	38	3.75	450.0	
10/17/2015	1047	480-475	27	38	3.0	450.0	
10/17/2015	1053	475-470	27	38	2.0	450.3	
10/17/2015	1058	470-465	25	38	2.0	450.2	
10/17/2015	1249	465-460	23	40	4.0	449.9	
10/17/2015	1254	460-455	22	39	3.5	450.0	
10/17/2015	1259	455-450	22	38	11.0	450.2	
10/17/2015	1304	455-450	21	38	3.0	450.0	
10/17/2015	1310	460-455	22	38	6.5	450.4	
10/17/2015	1315	465-460	23	38	4.0	450.4	
10/17/2015	1321	465-460	24	38	2.5	450.3	
10/17/2015	1326	460-455	24	38	7.0	450.3	
10/17/2015	1331	455-450	23	38	6.5	450.1	
10/17/2015	1336	455-450	23	38	6.0	450.2	
10/17/2015	1341	460-455	24	38	7.0	450.1	
10/17/2015	1347	455-450	23	38	9.0	450.5	
10/17/2015	1354	460-455	23	34	10.0	450.3	
10/17/2015	1413	460	--	33	1.5	451.1	
10/17/2015	1418	455	--	33	0.7	451.1	
10/17/2015	1423	455	--	33	0.3	451.1	
10/17/2015	1427	465	--	33	0.3	451.1	
10/17/2015	1435	465	--	33	0.1	451.1	
10/17/2015	1445	465	--	34	0.1	451.3	
10/17/2015	1500	465	--	35	0.1	451.4	

ft bgs = feet below ground surface

gpm = gallons per minute

L = liter

mL = millliliter

psi = pounds per square inch

Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

LICENSED PROFESSIONAL GEOLOGIST
VIRGINIA BRACHT
8881903-2250
STATE OF UTAH
12/3/15

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
0					ASPHALT			
					No lithologic description.			Borehole was air knifed from 0.5 - 8.7 ft for utility clearance on 8/31/15. Sand, silt, and gravel observed.
5							- Top of Casing/Cement Seal	
10					SILT (ML); brown (10YR 4/3); hard; 100% silt. SILT with Sand (ML); reddish brown (5YR 5/4); 80% silt; 20% fine sand.	ML		Begin ARCH drilling with 3/4" O.D. bit @ 1715 on 9/2/15. PID = 0.0 ppm @ breathing zone. Resume drilling @ 0835 on 9/3/15 @ 12 ft. PID = 0.0 ppm @ cyclone and breathing zone.
15					Same as above (10 ft).		- Cement Seal	
					Silty SAND (SM); dark reddish brown (5YR 3/3); 70% fine to medium sand; subangular to subrounded; 30% silt. Note: sand is biotite. @ 17 ft. Same as above (16 ft); trace gravel.	SM		Injected water to control dust. Depth of stabilization. Begin drilling with mud @ 1705.
20					Well-graded SAND with Gravel (SW); reddish brown (5YR 4/3); dry; 75% fine to coarse sand; subangular to rounded; 20% gravel; angular to rounded; 5% silt. Note: sand is quartz, feldspars, and mafics.	SW		PID = 0.0 ppm @ breathing zone. Rig bouncing and chattering.
25					Same as above (18 ft); sand is subrounded to rounded.			Color cannot be determined.
30							Top of Portland Bentonite Cement	

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Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
30					Well-graded SAND with Gravel (SW); 75% fine to coarse sand; subrounded to rounded; 20% gravel; 5% silt. Note: sand is quartz, feldspar, and mafics.			Occasional chatter from drill stem.
35					Same as above (30 ft).			End of 9/3/15 @ 34 ft. Resume drilling @ 0905 on 9/4/15. PID = 0.0 ppm @ breathing zone. Gravel layer observed from 35 - 37 ft.
40					Same as above (30 ft); dark reddish brown (5YR 3/3); 55% fine to very coarse sand; 40% coarse gravel; angular.			Significant drill chatter.
45					Same as above (30 ft); dark reddish brown (5YR 3/3); 55% fine to very coarse sand; 40% coarse gravel; angular.	SW	- Portland Bentonite Cement	Hard drilling. Add 150 gallons of water.
50					Same as above (30 ft); dark reddish brown (5YR 3/3); 55% fine to very coarse sand; 40% coarse gravel; angular.			
55					Same as above (30 ft); dark reddish brown (5YR 3/3); dense; 55% fine to very coarse sand; 40% coarse gravel; angular; 5% silt.			PID = 0.0 ppm @ breathing zone. Added stabilizing collar @ 1140. Hole sloughted approximately 8 ft @ 1230. Continuous chatter from 55 - 58 ft.
60								

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Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 459.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
60					Poorly graded SAND with Gravel (SP); dark reddish brown (5YR 3/3); 60% fine to medium sand; subrounded to rounded; 35% fine gravel; subangular to rounded; 5% silt. Note: sand is quartz and mafics. Gravel is quartz, feldspar, and mafics.			Collection of very coarse gravel in sieve from mud tub.
65					Same as above (60 ft).			
70					Same as above (60 ft); Note: percentage of mafics in gravel increases.	SP		Stopped drilling due to low circulation.
75					Same as above (60 ft).		- Portland Bentonite Cement	Borehole collapsed due to inability to remove fine gravel. Backfill borehole with 8/12-grade sand from 61.7 - 18.1 ft. Added third 20' collar @ 75 ft. Resume drilling with ARCH @ 1430 on 9/12/15.
80					Same as above (60 ft); gravel to 1"; angular.			Very hard drilling from 76 - 84.6 ft. Drill stem bouncing and chattering. PID = 0.0 ppm @ breathing zone.
85								Continue advancing casing using ARCH to 83 ft on 9/14/15. Could not advance any further.
90					Well-graded SAND with Gravel (SW); dark reddish brown (5YR 3/3); 60% very fine to coarse sand; subrounded to rounded; 35% fine gravel; subangular to rounded; 5% silt. Note: sand is quartz and mafics. Gravel is quartz, feldspar, and mafics.	SW		

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Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
90					Well-graded SAND with Gravel (SW); dark reddish brown (5YR 3/3); 60% very fine to coarse sand; subrounded to rounded; 35% fine gravel; subangular to rounded; 5% silt. Note: sand is quartz and mafics. Gravel is quartz, feldspar, and mafics.	SW		Begin drilling using mud @ 0835 on 9/15/15.
95					Same as above (90 ft); 50% very fine to coarse sand; 45% coarse gravel to 3 cm; angular. Note: sand is quartz, mafics, and feldspar.			PID = 0.0 ppm @ breathing zone.
100					Well-graded GRAVEL with Sand (GW); dark reddish brown (5YR 3/3); 60% fine to coarse gravel; angular to rounded; 35% very fine to medium sand; subrounded to rounded; 5% silt. Note: gravel is quartz and feldspar. Sand is quartz.	GW		
105					Same as above (97 ft).		- Portland Bentonite Cement	
110					Clayey GRAVEL with Sand (GC); dark reddish brown (5YR 3/4); 50% fine to coarse gravel; angular to rounded; 30% very fine sand; rounded; 20% clay. Note: gravel is quartz and feldspar.	GC		
115					Same as above (107 ft); 50% very fine to coarse gravel; 20% very fine sand; 30% clay.			
120					Clayey GRAVEL (GC); strong brown (7.5YR 5/6); 50% gravel; angular to rounded; 10% very fine sand; rounded;			

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Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
120					40% clay. Note: gravel is quartz and feldspar.	GC		
					Clayey GRAVEL (GC); strong brown (7.5YR 5/6); 50% gravel; angular to rounded; 10% very fine sand; rounded; 40% clay. Note: gravel is quartz and feldspar.			PID = 0.0 ppm @ breathing zone.
125					Gravelly fat CLAY with Sand (CH); strong brown (7.5YR 5/6); 50% clay; 30% fine to coarse gravel; subrounded; 20% very fine sand.			
						CH		
130					Fat CLAY with Gravel (CH); brown (7.5YR 4/3); 70% clay; 20% fine to coarse gravel; angular to subrounded; 10% very fine sand. Note: sand is quartz.			
					Fat CLAY (CH); brown (7.5YR 4/3); 90% clay; 10% very fine sand; subrounded to rounded.			
135							- Portland Bentonite Cement	
					Clayey SAND (SC); brown (7.5YR 5/4); 60% very fine sand; subrounded; 40% clay.			
						SC		
140					Same as above (135 ft).			Kelly down, new 20' connection.
					Sandy fat CLAY (CH); brown (7.5YR 5/3); 60% clay; 40% very fine sand.			PID = 0.0 ppm @ breathing zone.
145						CH		
150								

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Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
150					Sandy fat CLAY (CH); brown (7.5YR 5/3); 60% clay; 40% very fine sand.			
155					Same as above (150 ft).	CH		
160					Same as above (150 ft).			Kelly down @ 1345, new 20' connection. Difficult drilling and chatter.
					Well-graded SAND with Gravel (SW); brown (7.5YR 4/3); 60% very fine to coarse sand; 35% fine to coarse gravel; subrounded to rounded; 5% silt. Note: gravel is quartz, feldspar, and mafics.			
165					Same as above (161 ft).		- Portland Bentonite Cement	
170					Same as above (161 ft).	SW		PID = 0.0 ppm @ breathing zone.
175					Same as above (161 ft); 35% coarse gravel.			
180								Kelly down @ 1447, new

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:49 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
180					Well-graded SAND with Gravel (SW); brown (7.5YR 4/3); 60% very fine to coarse sand; 35% coarse gravel; angular to rounded; 5% silt. Note: gravel is feldspar and mafics.	SW		20' connection. Bit chatter.
185					Poorly graded SAND with Gravel (SP); brown (7.5YR 4/3); 55% very fine sand; 40% fine gravel; subrounded to rounded; 5% silt. Note: gravel is quartz, feldspar, and mafics.	SP		PID = 0.0 ppm @ breathing zone.
190					Same as above (184 ft); 65% very fine sand; 30% fine gravel.			
195					Poorly graded GRAVEL with Sand (GP); brown (7.5YR 4/3); 60% fine gravel; subrounded to rounded; 35% very fine sand; rounded; 5% silt. Note: gravel is quartz, fedspar, and mafics.	GP	- Portland Bentonite Cement	
200					Same as above (192 ft); 60% coarse gravel.			Kelly down @ 1540, new 20' connection.
205					Well-graded SAND with Gravel (SW); brown (7.5YR 4/4); 60% very fine to coarse sand; 35% medium gravel; subrounded to rounded; 5% clay. Note: sand is quartz. Gravel is quartz and feldspar.	SW		
210								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:49 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 459.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
210					Well-graded SAND with Gravel (SW); brown (7.5YR 4/4); 60% very fine to coarse sand; 35% medium gravel; subrounded to rounded; 5% clay. Note: sand is quartz. Gravel is quartz and feldspar.			
215					Same as above (210 ft); 70% very fine to coarse sand; 25% fine to medium gravel. Note: gravel is quartz, feldspar, and mafics.			
220					Same as above (215 ft).			Kelly down @ 1620, new 20' connection.
225					Same as above (215 ft).	SW	- Portland Bentonite Cement	
230					Same as above (215 ft).			Hammer chatter.
235					Same as above (215 ft).			
240								Kelly down @ 1719, new

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:49 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
240					Well-graded SAND with Gravel (SW); brown (7.5YR 4/4); 60% very fine to coarse sand; subrounded to rounded; 35% fine to coarse gravel; subrounded to rounded; 5% clay. Note: gravel is quartz, feldspar, and mafics.			20' connection.
245					Same as above (240 ft).			
250					Same as above (240 ft); 35% fine gravel.			
255					Same as above (240 ft); 35% fine gravel.	SW	- Portland Bentonite Cement	Drill stem chattering.
260					Same as above (240 ft); 35% coarse gravel.			Kelly down, new 20' connection. End of 9/15/15 @ 1817. Resume drilling @ 0820 on 9/16/15.
265					Same as above (240 ft); 35% fine gravel.			PID = 0.0 ppm @ breathing zone.
270								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:49 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 459.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
270					Well-graded SAND with Gravel (SW); brown (7.5YR 4/3); 55% very fine to coarse sand; subrounded to rounded; 40% fine to coarse gravel; rounded; 5% silt. Note: gravel is quartz, feldspar, and mafics.			PID = 0.0 ppm @ breathing zone.
275					Same as above (270 ft).	SW		
280					Silty SAND with Gravel (SM); brown (7.5YR 4/2); 50% very fine to coarse sand; subrounded to rounded; 20% fine to coarse gravel; angular to subrounded; 30% silt. Note: gravel is quartz, feldspar, and mafics.	SM		Kelly down @ 281 ft, new 20' connection.
285					Same as above (279 ft).		- Portland Bentonite Cement	
290					Well-graded SAND with Gravel (SW); brown (7.5YR 4/3); 60% very fine to coarse sand; subrounded to rounded; 35% fine to medium gravel; subrounded to rounded; 5% silt. Note: gravel is quartz, feldspar, and mafics.	SW		
295					Same as above (287 ft).			Rig chatter.
300								

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Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 459.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
300					Well-graded SAND with Gravel (SW); brown (7.5YR 4/3); 60% very fine to coarse sand; subrounded to rounded; 35% fine to coarse gravel; subrounded to rounded; 5% silt. Note: sand is quartz and mafics. Gravel is quartz, feldspar, and mafics.	SW		Kelly down @ 301 ft, new 20' connection.
305					Poorly graded GRAVEL with Sand (GP); brown (7.5YR 4/3); 60% coarse gravel; subrounded to rounded; 35% very fine to coarse sand; subrounded to rounded; 5% silt. Note: gravel is quartz, feldspar, and mafics.	GP		Constant rig chatter.
310					Well-graded SAND with Gravel (SW); dark brown (7.5YR 3/3); 60% very fine to coarse sand; subrounded to rounded; 35% fine to coarse gravel; subrounded to rounded; 5% silt. Note: sand is quartz. Gravel is quartz, feldspar, and mafics.			PID = 0.0 ppm @ breathing zone.
315					Same as above (309 ft).		- Portland Bentonite Cement	
320					Same as above (309 ft).	SW		Bit chatter. Kelly down @ 1045, new 20' connection.
325					Same as above (309 ft); 55% very fine to coarse sand; 40% fine gravel.			
330								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:49 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 459.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
330					Well-graded SAND with Gravel (SW); dark brown (7.5YR 3/4); 60% very fine to coarse sand; subrounded to rounded; 35% fine to coarse gravel; angular to rounded; 5% silt. Note: sand and gravel are quartz, feldspar, and mafics.			PID = 0.0 ppm @ breathing zone.
335					Same as above (330 ft); 35% coarse gravel.			Rig chatter.
340					Same as above (330 ft); 35% coarse gravel.			Kelly down @ 1334, new 20' connection.
345					Same as above (330 ft); 35% coarse gravel.	SW	- Portland Bentonite Cement	Rig chatter.
350					Same as above (330 ft); 35% coarse gravel.			Rig chatter; hard cuttings.
355					Same as above (330 ft); 35% coarse gravel.			
360								

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Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
360					Well-graded SAND with Gravel (SW); dark brown (7.5YR 3/4); 60% very fine to coarse sand; subrounded to rounded; 35% fine to coarse gravel; angular to rounded; 5% silt. Note: sand is quartz and mafics. Gravel is quartz, feldspar, and mafics.	SW		Kelly down @ 1459, new 20' connection.
365					Same as above (360 ft); 35% coarse gravel.		- Portland Bentonite Cement	
370					Poorly graded SAND with Gravel (SP); brown (7.5YR 4/2); 60% fine sand; trace coarse sand; subrounded to rounded; 35% fine to coarse gravel; angular to rounded; 5% silt. Note: sand is quartz and mafics. Gravel is quartz, mafics, and feldspar.		- Top of 3/8" Bentonite Chip Seal	
375					Same as above (368 ft); trace medium to coarse sand.			
380					Poorly graded SAND (SP); brown (7.5YR 4/2); 85% very fine to fine sand; subrounded to rounded; 10% fine gravel; angular to rounded; 5% silt. Note: gravel is quartz, feldspar, and mafics.	SP	- 3/8" Bentonite Chip Seal	End of 9/16/15 @ 379 ft. Begin drilling with 12 1/4" bit mud rotary on 9/17/15 @ 0901. Kelly down @ 381 ft, new 20' connection.
385					Same as above (380 ft).			PID = 0.0 ppm @ breathing zone.
390								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:49 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
390					Poorly graded SAND (SP); brown (7.5YR 4/2); 85% very fine to fine sand; subrounded to rounded; 10% fine gravel; angular to rounded; 5% silt. Note: gravel is quartz, feldspar, and mafics.			Rig chatter.
395					@ 391 ft. Poorly graded SAND with Gravel (SP); brown (7.5YR 5/3); 70% fine sand; subrounded to rounded; 25% fine to coarse gravel; angular to subangular; 5% silt. Note: sand is quartz and mafics. Gravel is quartz, feldspar, and mafics.		- 3/8" Bentonite Chip Seal	
400					Same as above (391 ft); 60% fine sand; 35% fine to coarse gravel.			Rig chatter; slowed drilling rate. PID = 0.0 ppm @ breathing zone. Kelly down @ 1002, new 20' connection.
405					Same as above (391 ft); brown (7.5YR 4/3); 60% fine sand; 35% fine to coarse gravel.	SP		
410					Same as above (391 ft); brown (7.5YR 4/3); 60% fine sand; trace medium to coarse sand; 35% fine to coarse gravel.		- Top of 10/20 Sand	
415					Same as above (391 ft); brown (7.5YR 4/3); 60% fine sand; trace medium to coarse sand; 35% fine to coarse gravel.		- Top of 8/12 Sand	
420								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:49 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/2/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 459.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Mud Rotary
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
420					Poorly graded SAND with Gravel (SP); brown (7.5YR 4/2); 75% fine sand; subrounded to rounded; 20% fine gravel; subrounded to rounded; 5% silt. Note: sand is quartz and mafics. Gravel is quartz, mafics, and feldspar.	SP		
425					Well-graded SAND with Gravel (SW); brown (7.5YR 4/2); 65% fine to coarse sand; subrounded to rounded; 30% fine to coarse gravel; angular to rounded; 5% silt. Note: sand is quartz and mafics.	SW	8/12 Sand	
430					Silty SAND (SM); 60% fine sand; subrounded to rounded; 10% fine gravel; angular to subrounded; 30% silt. Note: sand is quartz, feldspar, and mafics.	SM		PID = 0.0 ppm @ breathing zone.
435								End of mud rotary drilling @ 435 ft on 9/17/15.
440								
445								
450								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:49 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/18/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: David Kessler

Depth (ft)	Material Description	U.S.C.S.	Well Diagram	Remarks
435	@ 435 ft. Poorly graded SAND (SP); brown (7.5YR 5/3); 95% fine sand; subrounded to rounded; trace fine gravel; 5% silt.	SP		Begin sonic coring with mud on 9/18/15 with 6" O.D. bit. @ 435 - 449 ft sand is quartz with occasional mafics. @ 436.6 - 437 ft gravel is quartz, mafics, and feldspar.
	@ 435.5 ft. Fat CLAY (CH); reddish brown (5YR 5/4); high plasticity; 100% clay.	CH		
	@ 436.2 ft. Poorly graded SAND with Silt (SP-SM); brown (7.5YR 5/3); 90% very fine to fine sand; subrounded to rounded; 10% silt.	SP-SM		
	@ 436.6 ft. Well-graded SAND with Gravel (SW); brown (7.5YR 5/3); 60% fine to coarse sand; subrounded to rounded; 35% fine to coarse gravel; subrounded to rounded; 5% silt.	SW		
440	@ 437 ft. No recovery.		- Top of 8" Stainless Steel 0.050 Slot Screen	@ 440 - 442.8 ft sediments are fining upwards and laminated. @ 440.52 ft cobble to 1-5/8"; subangular; sandstone.
	@ 440 ft. Poorly graded SAND (SP); brown (7.5YR 4/4); 95% fine sand; subrounded to rounded; 5% silt.	SP		
	@ 442.8 ft. Well-graded GRAVEL with Silt and Sand (GW-GM); brown (7.5YR 4/4); 50% fine to coarse gravel; subrounded; 40% fine to coarse sand; angular to rounded; 10% silt.	GW-GM		@ 442.8 - 449 ft gravel is quartz, mafics, and feldspars with occasional granite and quartzite.
445	@ 443.1 ft. No recovery.			
	@ 445 ft. Silty GRAVEL (GM); brown (7.5YR 5/3); 60% fine to coarse gravel; subrounded; 10% fine to coarse sand; subrounded to rounded; 30% silt.	GM		@ 445 - 446.7 ft the percentage of silt decreases with depth.
	@ 446.7 ft. No recovery.			
	@ 447.5 ft. Poorly graded SAND with Gravel (SP); brown (7.5YR 5/3); 80% fine to medium sand; trace coarse sand; subrounded to rounded; 15% fine to coarse gravel; subrounded to rounded; 5% silt.	SP		
450	@ 449 ft. No recovery.			

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:54 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/18/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
450					@ 450 ft. Well-graded SAND with Silt and Gravel (SW-SM); brown (7.5YR 5/3); 70% fine to coarse sand; 20% coarse gravel; 10% silt.	SW-SM		End of 9/18/15 @ 450 ft. Resume coring @ 1030 on 9/23/15. @ 450 - 464.2 ft sand is quartz with occasional granite, mafics, and feldspar. Gravel is quartz with occasional mafics.
					@ 450.7 ft. Silty SAND with Gravel (SM); brown (7.5YR 5/4); 50% fine to coarse sand; subrounded to rounded; 20% gravel; 30% silt; trace clay. @ 451.7 ft. Same as above (450.7 ft); 20% very coarse gravel to 40 mm; subrounded to rounded.	SM		
455					@ 452 ft. Same as above (450.7 ft); brown (7.5YR 4/4); 60% fine to coarse sand; 15% coarse gravel to 40 mm; 25% silt.			
					@ 453.9 ft. No recovery.			
					@ 455 ft. Silty SAND with Gravel (SM); brown (7.5YR 4/4); 70% fine to coarse sand; subrounded to rounded; 15% coarse gravel to 40 mm; 15% silt.	SM		
						SP-SM		
					@ 455.8 ft. Poorly graded SAND with Silt (SP-SM); brown (7.5YR 5/3); 90% fine sand; subrounded to rounded; trace fine gravel; 10% silt. @ 456.5 ft. No recovery.		8" Stainless Steel 0.050 Slot Screen	@ 456.5 ft driller states that coring feels like gravel. Gravel was likely pushed aside instead of recovered, causing loss of core sample.
460					@ 461.4 ft. Poorly graded SAND (SP); brown (7.5YR 5/3); 95% fine sand; trace medium sand; subrounded to rounded; 5% silt.	SP		
						GM		
					@ 461.9 ft. Silty GRAVEL with Sand (GM); brown (7.5YR 5/4); 50% fine to coarse gravel; subrounded to rounded; 35% fine to coarse sand; subrounded to rounded; 15% silt.	SP		
465					@ 462.5 ft. Poorly graded SAND (SP); dark brown (7.5YR 3/3); 95% fine sand;			

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Borehole ID: KAFB-106234-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/18/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: David Kessler

Depth (ft)	Material Description	U.S.C.S.	Well Diagram	Remarks
465	subrounded to rounded; trace gravel; rounded; 5% silt. @ 464.2 ft. No recovery.	SP		@ 465 - 479.4 ft sand is quartz with occasional mafics. Gravel is quartz with occasional mafics.
	@ 465 ft. Poorly graded SAND (SP); brown (7.5YR 4/3); 95% medium sand; trace coarse sand; trace fine gravel; subrounded to rounded; 5% silt.	GW-GM		
	@ 466.2 ft. Well-graded GRAVEL with Silt and Sand (GW-GM); brown (7.5YR 4/3); 60% fine to coarse gravel; subrounded to rounded; 30% fine to coarse sand; 10% silt.	SW / GW-GM		@ 468.4 ft driller reported drilling in gravel, which likely caused loss of core.
	@ 466.5 ft. No recovery.			
470	@ 467.5 ft. Well-graded SAND with Gravel (SW); brown (7.5YR 4/3); 80% fine to coarse sand; 15% fine to coarse gravel; 5% silt.			
	@ 468 ft. Well-graded GRAVEL with Silt and Sand (GW-GM); brown (7.5YR 4/3); 70% fine to coarse gravel to 40 mm; subrounded to rounded; 20% coarse sand; trace fine and medium sand; 10% silt.		8" Stainless Steel 0.050 Slot Screen	
	@ 468.4 ft. No recovery.			
	@ 472.5 ft. Poorly graded SAND with Silt (SP-SM); brown (7.5YR 4/3); 90% fine sand; subrounded; trace gravel; 10% silt.	SP-SM		
475	@ 474.7 ft. No recovery.			@ 474.6 - 474.7 ft clay lense.
	@ 475 ft. Silty SAND (SM); brown (7.5YR 4/3); 80% fine sand; subrounded to rounded; trace coarse gravel; 20% silt.	SM		End of 9/23/15 @ 475 ft. Resume drilling on 9/24/15.
	@ 476.6 ft. No recovery.			@ 476.1 ft silt lense, 7 mm thick.
	@ 477.5 ft. Silty SAND (SM); brown (7.5YR 4/3); 85% fine sand; subrounded to rounded; 15% silt.	SM		@ 476.5 ft silt lense, 5 mm thick. Two 5 mm clay nodules.
	@ 478.4 ft. Fat CLAY (CH); yellowish brown (10YR 5/4); hard; medium plasticity; 100% clay.	CH / CL / SM		
480	@ 478.7 ft. Lean CLAY (CL); reddish			

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:54 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/18/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
480					brown (2.5YR 4/3); low plasticity; 95% clay; 5% gravel.	SM		@ 480 - 494.8 ft sand is quartz with occasional mafics.
					@ 479 ft. Silty SAND (SM); brown (7.5YR 4/3); 80% fine sand; subrounded to rounded; 20% silt.	CL		
					@ 479.4 ft. No recovery.			
					@ 480 ft. Silty SAND (SM); brown (7.5YR 5/3); 80% fine to coarse sand; subrounded to rounded; 20% silt.			@ 483.5 - 484 ft sediment is laminated.
					@ 480.7 ft. Lean CLAY with Sand (CL); reddish brown (5YR 5/4); low plasticity; 80% clay; 20% very fine sand; rounded.	SP		
					@ 480.8 ft. No recovery.			
485					@ 482.5 ft. Poorly graded SAND (SP); brown (7.5YR 5/3); 95% fine sand; subrounded to rounded; 5% silt.			
					@ 484.3 ft. No recovery.	SP		@ 485.65 - 485.7 ft laminations observed.
					@ 485 ft. Poorly graded SAND (SP); brown (7.5YR 5/3); 95% fine sand; subrounded to rounded; 5% silt.			@ 486 ft drilling through gravels; weathered sandstone; white (10YR 8/1).
					@ 486.1 ft. No recovery.		- 8" Stainless Steel 0.050 Slot Screen	
					@ 487.6 ft. Poorly graded SAND with Silt (SP-SM); brown (7.5YR 5/3); 90% fine sand; subrounded to rounded; 10% silt.	SP-SM		@ 488 ft texture is blocky.
					@ 488 ft. Lean CLAY with Sand (CL); reddish brown (2.5YR 4/4); low plasticity; 80% clay; 20% fine sand; trace gravel to 30 mm.	CL		
490						SP-SM		
					@ 489.3 ft. Poorly graded SAND with Silt (SP-SM); brown (7.5YR 5/3); 90% fine sand; subrounded to rounded; 10% silt.	SM		@ 490 - 494.8 ft sediment is fining upward.
					@ 489.9 ft. No recovery.			
					@ 490 ft. Silty SAND with Gravel (SM); dark brown (7.5YR 3/3); 65% fine to coarse sand; subrounded to rounded; 15% fine to coarse gravel; rounded; 20% silt.			
					@ 491.8 ft. No recovery.			@ 492.6 ft cobble.
					@ 492.5 ft. Poorly graded SAND with Silt (SP-SM); brown (7.5YR 4/3); 90% fine to medium sand; trace coarse sand; subrounded to rounded; trace gravel to 45 mm; 10% silt.	SP-SM		
495								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:54 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/18/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 459.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
495					@ 494.8 ft. No recovery.			
					@ 495 ft. Well-graded SAND with Silt (SW-SM); brown (7.5YR 4/2); 90% fine to coarse sand; subrounded to rounded; trace gravel; 10% silt.	SW-SM		@ 495 - 507.8 ft sand is quartz with occasional mafics.
					@ 496.2 ft. Poorly graded SAND with Silt (SP-SM); brown (7.5YR 4/2); 90% fine sand; subrounded to rounded; trace gravel; 10% silt.	SP-SM		@ 496.3 ft lost what appeared to be saturated sands.
					@ 496.3 ft. No recovery.	GW		@ 497.5 ft sand and silt likely washed out from core sample.
					@ 497.5 ft. Well-graded GRAVEL (GW); 100% fine to coarse gravel to 24 mm.			@ 497.7 ft drilling through gravels. All core lost during core rod and drill stem removal.
					@ 497.7 ft. No recovery.			
500								
					@ 502.5 ft. Well-graded GRAVEL (GW); 100% gravel; rounded.	GW	8" Stainless Steel 0.050 Slot Screen	End of 9/24/15 @ 502.5 ft. Resume drilling on 9/25/15. Silt and sand fraction washed away.
					@ 502.7 ft. SILT (ML); light reddish brown (2.5YR 6/3); hard; low plasticity; 85% silt; trace clay; 10% fine sand; rounded; 5% fine gravel; rounded.	ML		
					@ 503.1 ft. Well-graded SAND with Silt (SW-SM); 90% sand; trace gravel; 10% silt.	SW-SM		@ 504.1 ft gravel encountered.
505					@ 503.5 ft. Poorly graded SAND (SP); 95% sand; 5% silt.	SP		
					@ 504.1 ft. No recovery.	GP		@ 505.6 ft gravel encountered.
					@ 505 ft. Poorly graded GRAVEL with Sand (GP); brown (7.5YR 4/3); 60% fine gravel to 25 mm; subrounded; 35% fine to coarse sand; 5% silt.			
					@ 505.6 ft. No recovery.	GP		@ 507.8 ft gravel encountered.
					@ 507.5 ft. Poorly graded GRAVEL with Sand (GP); brown (7.5YR 4/3); 60% fine gravel to 25 mm; subrounded; 35% fine to coarse sand; 5% silt.			
510					@ 507.8 ft. No recovery.			

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:54 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/18/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 459.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
510					@ 510 ft. Poorly graded GRAVEL with Sand (GP); brown (7.5YR 4/3); 60% fine gravel; subrounded; 35% fine to coarse sand; 5% silt.	GP		@ 510.2 ft gravel encountered.
					@ 510.2 ft. No recovery.			
					@ 512.5 ft. Poorly graded GRAVEL with Sand (GP); brown (7.5YR 4/3); 60% fine gravel; subrounded; 35% fine to coarse sand; 5% silt.	GP		@ 512.8 ft very coarse pebble in shoe of core barrel.
					@ 512.8 ft. No recovery.			
515								
					@ 517.5 ft. Poorly graded GRAVEL (GP); brown (7.5YR 4/2); 95% fine gravel to 4 mm; subangular to subrounded; 5% silt.	GP	- 8" Stainless Steel 0.050 Slot Screen	End of 9/25/15 @ 517.5 ft. Resume coring on 9/26/15.
					@ 518.1 ft. Poorly graded SAND with Silt and Gravel (SP-SM); brown (7.5YR 4/2); 60% fine sand; rounded; 30% coarse gravel; 10% silt.	SP-SM		@ 518.1 - 520.6 ft sand is quartz.
520					@ 518.3 ft. No recovery.	ML		@ 520 ft gravel encountered.
					@ 520.1 ft. SILT (ML); brown (7.5YR 4/2); nonplastic; 90% silt; 10% very fine to fine sand.	SW		@ 520.6 ft loose, wet sand and gravel encountered.
					@ 520.2 ft. Well-graded SAND with Gravel (SW); brown (7.5YR 5/4); 65% fine to coarse sand; subrounded to rounded; 30% fine to coarse gravel; subangular to subrounded; 5% silt.			@ 522.5 ft gravel within coring interval caused core barrel thread sheering.
					@ 520.6 ft. No recovery.			
525								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:54 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Borehole ID: KAFB-106234-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/18/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
At Time of Drilling: 459.00
At End of Drilling: Not Recorded
After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
525					@ 525 ft. Poorly graded GRAVEL with Silt and Sand (GP-GM); brown (7.5YR 4/2); 60% fine gravel to 8 mm; subangular to subrounded; 30% fine to coarse sand; 10% silt.	GP-GM		@ 525 - 537.2 ft gravel is quartz, mafics, and occasional granite.
					@ 525.6 ft. Poorly graded SAND with Silt (SP-SM); brown (7.5YR 4/2); dense; 90% fine sand; subangular to subrounded; 10% silt.	SP-SM		@ 525.6 - 537.2 ft sand is quartz and mafics.
					@ 525.9 ft. No recovery.			@ 525.9 ft gravel encountered.
					@ 527.5 ft. Poorly graded GRAVEL with Sand (GP); brown (7.5YR 4/2); loose; 70% fine gravel to 4 mm; subrounded to rounded; 25% fine to coarse sand; subrounded to rounded; 5% silt.	GP		@ 528.5 ft gravel encountered.
530					@ 528.5 ft. No recovery.	SW		@ 530 ft top section of sample shows little sand. Inferred that the sand washed out.
					@ 530 ft. Well-graded SAND with Gravel (SW); dark brown (7.5YR 3/3); 65% very fine to coarse sand; subrounded to rounded; 30% fine to coarse gravel to 35 mm; subrounded; 5% silt.			@ 530.4 ft gravel encountered.
					@ 530.4 ft. No recovery.			
					@ 532.5 ft. Well-graded GRAVEL with Sand (GW); gray (7.5YR 6/1); 50% fine to coarse gravel; subrounded to rounded; 45% fine to coarse sand; subrounded to rounded; 5% silt.	GW	- 8" Stainless Steel 0.050 Slot Screen	End of 9/26/15 @ 532.5 ft. Resume drilling on 9/28/15. @ 532.5 ft portions of the gravel are cemented with calcium carbonate.
					@ 533.7 ft. No recovery.			@ 533.7 ft sand was washed away and gravel not recovered.
535					@ 535 ft. Well-graded GRAVEL with Sand (GW); gray (7.5YR 6/1); 50% fine to coarse gravel; subrounded to rounded; 45% fine to coarse sand; subrounded to rounded; 5% silt.	GW		@ 535 ft hard to very hard conglomerate rock; calcite-cemented.
					@ 535.2 ft. No recovery.	SW-SM		@ 536.5 - 536.55 ft silt lense; gray (7.5YR 5/1).
					@ 536.5 ft. Well-graded SAND with Silt and Gravel (SW-SM); dark brown (7.5YR 3/2); 60% very fine to coarse sand; subrounded to rounded; 30% fine to coarse gravel to 35 mm; subrounded; 10% silt.			@ 537.2 ft gravel obstructed sample collection.
					@ 537.2 ft. No recovery.			
540							- Bottom of	

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Borehole ID: KAFB-106234-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/18/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

Groundwater Levels BGS (ft):
▽ At Time of Drilling: 459.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
540					@ 540 ft. Poorly graded GRAVEL with Sand (GP); dark brown (7.5YR 3/2); 55% fine gravel; angular to subrounded; 40% very fine to coarse sand; angular to subrounded; 5% silt.	GP	Screen	End of continuous coring @ 540 ft on 9/28/15. @ 540 - 556 ft sand is quartz and mafics. Gravel is quartz, mafics, and granite.
545					@ 545 ft. Same as above (540 ft); 55% fine gravel to 6 mm; angular.		Bottom of Sump	Very hard drilling from 547 - 556 ft.
550					@ 550 ft. Same as above (540 ft) 80% fine gravel; angular; 20% very fine to coarse sand.			Reamed borehole using 12-1/4" bit from 435 - 550 ft on 9/26/15 through 9/28/15.
555								

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Borehole ID: KAFB-106234-Sonic

Client: US Army Corps of Engineers
Project Location: KAFB, Albuquerque, NM
Project Name: KAFB RAPID SWMU ST-106 and SS-111
Project Number: 500433

Date Started: 9/18/2015
Date TD Reached: 10/1/2015
Date Completed:

Ground Elevation AMSL (ft): Not Recorded
Y Coordinate:
X Coordinate:

Hole Diameter Upper (in.): 16
Hole Diameter Lower (in.): 14-3/4
Surface Completion Type: Flush

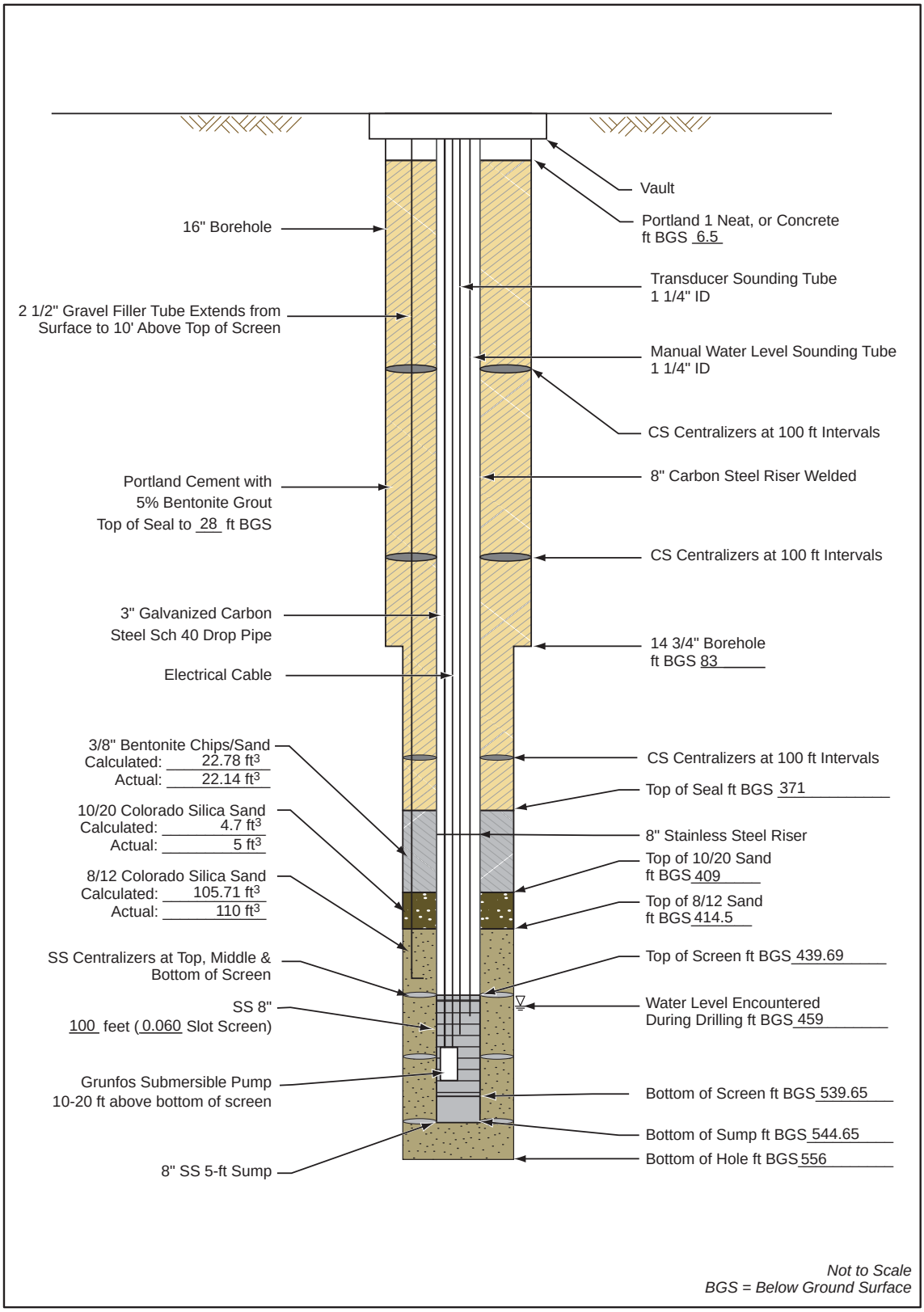
Groundwater Levels BGS (ft):
▽ At Time of Drilling: 459.00
▼ At End of Drilling: Not Recorded
▼ After Drilling: 458.90

Drillling Contractor: National Drilling
Drilling Method: Sonic Coring
Logged By: David Kessler

Depth (ft)	Sample Type	Number	Headspace PID	Lithologic Log	Material Description	U.S.C.S.	Well Diagram	Remarks
555					@ 555 ft. Poorly graded GRAVEL with Sand (GP); dark brown (7.5YR 3/2); 80% fine gravel; angular; 20% very fine to coarse sand; angular to subrounded.	GP	- Bottom of Filter Pack/Bottom of Hole	Total depth = 556 ft bgs. Reached total depth on 10/1/15. Reamed borehole using 14-3/4" bit from 83 - 556 ft on 9/30/15 through 10/1/15.
560								
565								
570								

KAFB_BOREHOLE_LOG - SHAW_DRILLING.GDT - 12/2/15 15:54 - Z:\KAFB RAPID\GINT\KAFB_RAPID.GPJ

Extraction Well Construction Diagram KAFB-106234



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Project Name:	KAFB BFF	**Well No.:**	KAFB-106234
Location:	Anderson and Georgia	**Date Installed:**	10/9/2015
Personnel:	MG	**Casing Diameter (I.D.):**	8-inch
Start Date:	10/1/2015	**Total Depth (ft. BGS):**	544.65
End Date:	11/3/2015		

Method of Development:

[X] Surging [X] Bailing [X] Pumping [X] Jetting

[X] Original Development [ ] Redevelopment [ ] Other

Depth to Water Before Developing Well (ft. BGS): NR

Screened Interval (ft. BGS): 439.69-539.65

Weather: Varied

Equipment Numbers: **pH:** NR **Conductivity:** NR

Turbidity: NR

Equipment Decontaminated Prior to Development? [X] Yes [ ] No

Describe:

Collected Sample of Water Added to Well? [ ] Yes [X] No

Describe:

Comments:

Summary of development procedure, including key decision-points, calculations, and observations (described in detail in the following pages):

Well development consisted of bailing, surging, pumping, and jetting. The first step of development removed mud and cuttings from the well casing and filter pack, which were generated during the drilling process, by surging and bailing. The second step entailed physical well development using surging, bailing, and pumping to assess development progress. These actions included taking measurements of sediment content in the water using the Imhoff cone technique, and applying 30 minutes of sustained pumping, measuring, and plotting drawdown to estimate development effectiveness. The third step used jetting with simultaneous pumping.

Bailing				
Date	Time	Total Volume Bailed (gallons)	Imhoff Cone Measurement (mL sediment per L water)	Comments
10/12/2015	1800	135	--	Very muddy, 4 mL of coarse sand and more suspended at 100 gallons
10/13/2015	0910	150	117	Mostly coarse sand
10/13/2015	1005	300	20	Mostly coarse sand
10/13/2015	1055	450	200	Mostly coarse sand
10/13/2015	1100	465	750	All coarse sand
10/13/2015	1305	600	10	Collected from the middle of screen
10/13/2015	1340	750	12	Collected from the middle of screen
10/13/2015	1415	900	10	Collected from the middle of screen
10/13/2015	1440	1050	4	1 mL fine grained, 3 mL very fine grained
10/13/2015	1513	1200	0.8	0.5 mL fine grained, 0.3 mL very fine grained
10/13/2015	1536	1350	0.8	0.5 mL fine grained, 0.3 mL very fine grained
10/13/2015	1605	1500	--	Stop bailing, tag bottom at 544.1 bgs
10/16/2015	1033	--	0.7	Collected after 4 bailing runs, sediment is very fine to fine sand
10/16/2015	1056	--	0.5	Collected after 6 bailing runs, sediment is very fine to fine sand
10/16/2015	1355	--	0.5	Collected after 4 bailing runs, sediment is very fine to fine sand
10/16/2015	1408	--	0.5	Collected after 6 bailing runs, sediment is very fine to fine sand

L = liter

mL = milliliter

Surging				
Interval (feet below ground surface)	Date	Start Time	End Time	Comments
540-535	10/15/2015	1640	1645	
535-530	10/15/2015	1645	1650	
530-525	10/15/2015	1650	1655	
525-520	10/15/2015	1655	1700	
520-515	10/15/2015	1700	1705	
515-510	10/15/2015	1705	1710	
510-505	10/15/2015	1710	1715	
505-500	10/15/2015	1715	1720	
500-495	10/15/2015	1720	1725	
495-490	10/15/2015	1725	1730	
490-485	10/15/2015	1730	1735	
485-480	10/15/2015	1735	1740	
480-475	10/15/2015	1740	1745	
475-470	10/15/2015	1745	1750	
470-465	10/15/2015	1750	1755	
465-462.9	10/15/2015	1755	1800	
540-530	10/16/2015	0845	0850	
530-525	10/16/2015	0850	0855	
525-520	10/16/2015	0900	0905	
520-515	10/16/2015	0905	0910	
515-510	10/16/2015	0910	0915	
510-505	10/16/2015	0915	0920	
505-500	10/16/2015	0920	0925	
500-495	10/16/2015	0925	0930	
495-490	10/16/2015	0930	0935	
490-485	10/16/2015	0935	0940	
485-480	10/16/2015	0940	0945	
480-475	10/16/2015	0945	0950	
475-470	10/16/2015	0950	0955	
470-465	10/16/2015	0955	1000	
540-530	10/16/2015	1130	1135	
535-530	10/16/2015	1135	1140	
530-525	10/16/2015	1140	1145	
525-520	10/16/2015	1145	1150	
520-515	10/16/2015	1150	1155	
515-510	10/16/2015	1155	1200	
510-505	10/16/2015	1200	1205	
505-500	10/16/2015	1205	1210	

Surging				
Interval (feet below ground surface)	Date	Start Time	End Time	Comments
500-495	10/16/2015	1210	1215	
495-490	10/16/2015	1215	1220	
490-485	10/16/2015	1220	1225	
485-480	10/16/2015	1225	1230	
480-475	10/16/2015	1320	1325	
475-470	10/16/2015	1330	1335	

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Imhoff Cone (mL sediment per L water)	Pump Intake (Feet bgs)
10/14/2015	1114	0	462.7	--	--	--	--	--	--	--	490.5
10/14/2015	1312	0	464.5	--	--	--	--	--	--	--	511.5
10/14/2015	1340	16.5	502	259	21.78	5.99	1.029	1502	--	--	511.5
10/14/2015	1359	16.5	500	481.6	21.55	7.23	0.971	506	--	--	511.5
10/14/2015	1423	16.5	500	748.5	21.46	7.64	0.900	208	--	0.5	511.5
10/14/2015	1455	16.5	495	923	21.24	7.69	0.878	117.5	--	0.0	521.5
10/14/2015	1515	16.5	505	1238	21.32	7.91	08.35	214.3	--	Trace	521.5
10/14/2015	1530	25	514	1862	20.94	7.86	0.766	988.1	--	0.2	521.5
10/14/2015	1633	40	522	2675	20.77	8.19	0.788	620.1	--	0.5	532.5
10/14/2015	1647	37	525	3187	20.93	7.92	0.793	375.5	--	0.3	532.5
10/14/2015	1745	24.5	475	3812	--	--	--	--	1.84	--	532.5
10/15/2015	1005	20.6	--	4722	20.21	8.67	0.720	13.3	2.98	0.0	527.5
10/15/2015	1016	21.04	--	5149	20.45	8.26	0.398	10.6	--	0.0	527.5
10/15/2015	1026	20.72	--	5157	20.63	8.19	0.632	9.3	--	0.0	517.5
10/15/2015	1036	20.88	--	5359	20.77	8.18	0.757	9.6	--	0.0	512.5
10/15/2015	1103	20.88	--	5586	21.13	8.15	0.757	9.9	--	0.0	506.5
10/15/2015	1113	15.21	--	5745	21.21	8.11	0.755	9.3	--	0.0	501.5
10/15/2015	1123	15.38	--	5886	21.20	8.08	0.752	10.1	--	0.0	496.5
10/15/2015	1133	15.21	--	6037	21.31	8.08	0.750	10.5	--	0.0	491.5
10/15/2015	1305	14.25	--	6212	21.47	8.07	0.754	14.7	--	0.0	485.5
10/15/2015	1315	14.24	--	6338	21.52	8.07	0.759	11.0	--	0.0	480.5
10/15/2015	1325	14.24	--	6504	21.53	8.08	0.754	11.9	--	0.0	475.5
10/16/2015	1720	36.14	428.25	7365	19.92	8.47	0.705	259	6.4	<0.1	521.5
10/16/2015	1735	36.30	428.25	8630	19.82	8.13	0.692	140.8	--	--	521.5
10/17/2015	0820	--	--	9116.18	19.46	8.61	0.692	31.4	--	Trace	521.5
10/17/2015	0832	42.98	--	9781.18	20.25	8.35	0.695	72.0	--	Trace	521.5
10/17/2015	0855	4298	--	10831.18	19.70	8.06	0.692	30.7	--	Trace	521.5
10/17/2015	1100	40.3	467.4	13972.18	20.19	8.21	0.695	41.0	--	Trace	521.5

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U.)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Imhoff Cone (mL sediment per L water)	Depth of pump (Feet bgs)
10/30/2015	1250	66.76	465.92	15013.18	17.7	7.66	0.811	10.4	25.98	<0.1	513.6
10/30/2015	1254	66.76	465.92	16424.18	17.7	7.59	0.817	6.30	25.98	<0.1	513.6
10/30/2015	1317	66.64	465.85	18302.18	18.0	7.57	0.806	44.7	26.65	<0.1	513.6
10/30/2015	1325	66.40	465.88	20642.18	17.7	7.59	0.805	12.7	26.25	<0.1	513.6
10/30/2015	1347	66.04	465.82	23453.18	17.8	7.58	0.807	21.4	26.74	<0.1	513.6
10/30/2015	1355	65.80	465.82	26667.18	17.7	7.60	0.808	7.15	26.64	<0.1	513.6
10/30/2015	1406	66.76	465.81	30240.18	17.9	7.65	0.807	17.1	27.13	<0.1	513.6
10/30/2015	1411	66.52	465.84	34162.18	17.8	7.60	0.807	5.21	26.71	<0.1	513.6
10/30/2015	1424	66.28	465.82	38502.18	17.6	7.65	0.807	13.4	26.83	<0.1	513.6
10/30/2015	1428	66.16	465.84	43312.18	17.6	7.59	0.808	4.41	26.57	<0.1	513.6
10/30/2015	1441	66.16	465.78	48447.18	17.4	7.60	0.805	11.0	27.23	<0.1	513.6
10/30/2015	1447	65.80	465.83	53972.18	17.6	7.59	0.806	3.93	26.56	<0.1	513.6
10/30/2015	1458	66.16	465.79	59863.18	17.5	7.65	0.806	8.59	27.11	<0.1	513.6
10/30/2015	1504	65.92	465.84	66147.18	17.6	7.59	0.807	2.84	26.47	<0.1	513.6
10/30/2015	1522	65.80	465.81	72957.18	17.9	7.56	0.810	4.32	26.75	<0.1	513.6
10/30/2015	1526	65.8	465.72	80041.18	17.6	7.54	0.786	O.R	--	1	513.6
10/30/2015	1545	65.8	465.73	88350.18	17.6	7.54	0.804	144	--	0.4	513.6
10/30/2015	1604	65.68	465.87	97725.18	17.9	7.55	0.808	35.5	--	<0.1	513.6
10/30/2015	1615	65.68	--	107823.18	17.7	7.57	0.790	557	--	0.5	513.6
10/30/2015	1622	65.68	--	118380.18	--	--	--	54.2	--	0.1	513.6
10/30/2015	1635	65.68	465.87	129331.18	18.1	7.55	0.802	51.1	26.59	0.1	513.6
10/30/2015	1648	65.44	465.81	140282.18	18.1	7.56	0.812	35.3	26.60	<0.1	513.6
10/30/2015	1712	66.04	465.74	152415.18	18.0	7.58	0.909	10.5	27.07	<0.1	513.6
10/30/2015	1729	65.80	4685.77	165009.18	17.8	7.59	0.806	7.11	27.19	<0.1	513.6

Pumping

Date	Time	Rate (gpm)	Depth to Water (ft BGS)	Volume Removed (gallons)	Temp (°C)	pH (S.U.)	EC (mS/cm)	Turbidity (NTU)	Specific Capacity (gpm/ft)	Imhoff Cone (mL sediment per L water)	Depth of pump (Feet bgs)
11/02/2015	1330	208.5	471.6	168389.18	17.7	7.52	0.791	6.86	25.18	0.1	512.5
11/02/2015	1340	205.68	471.82	173279.18	17.6	7.49	0.784	1.91	24.19	<0.1	512.5
11/02/2015	1350	205.32	471.91	179959.18	17.7	7.50	0.784	2.21	23.90	<0.1	512.5
11/02/2015	1400	205.32	471.95	188499.18	17.7	7.51	0.783	1.17	23.79	<0.1	512.5
11/02/2015	1405	205.32	471.97	198499.18	--	--	--	--	23.74	--	512.5
11/02/2015	1420	150	469.02	208999.18	17.9	7.59	0.782	21.7	26.74	<0.1	512.5
11/02/2015	1430	152.41	469.45	220074.18	17.8	7.56	0.787	3.04	25.36	<0.1	512.5
11/02/2015	1503	153.46	469.20	231849.18	18.0	7.63	0.781	31.2	--	<0.1	512.5
11/02/2015	1510	152.64	469.35	244409.18	17.7	7.59	0.788	2.24	--	<0.1	512.5
11/02/2015	1530	154.20	469.25	257529.18	17.7	7.62	0.780	22.3	--	<0.1	512.5
11/02/2015	1538	152.64	--	271535.18	--	--	--	3.13	--	<0.1	512.5
11/03/2015	0940	150.04	469.32	273535.18	17.8	7.08	0.854	1.67	24.88	<0.1	512
11/03/2015	0950	150.16	469.36	276635.18	17.9	7.41	0.854	1.90	24.74	<0.1	512
11/03/2015	1000	150.16	469.43	281235.18	17.9	7.51	0.855	0.50	24.45	<0.1	512
11/03/2015	1010	150.40	469.46	287335.18	17.9	7.53	0.854	0.80	24.38	<0.1	512
11/03/2015	1020	150.28	469.51	294935.18	17.9	7.54	0.854	1.81	24.16	<0.1	512
11/03/2015	1030	150.4	469.52	304035.18	17.9	7.54	0.838	2.03	24.14	<0.1	512
11/03/2015	1050	150.04	464.53	316135.18	17.9	7.55	0.837	1.42	24.04	<0.1	512
11/03/2015	1110	150.16	469.55	331235.18	18.1	7.55	0.839	1.28	23.99	<0.1	512
11/03/2015	1130	150.16	469.57	349335.18	19.2	7.55	0.838	3.37	23.90	<0.1	512
11/03/2015	1150	150.16	469.58	370435.18	18.0	7.55	0.837	0.38	23.87	<0.1	512
11/03/2015	1210	150.16	469.59	394535.18	18.2	7.55	0.837	0.86	23.83	<0.1	512

°C = degrees Celsius
EC = Electric Conductivity
ft bgs = feet below ground surface
gpm = gallons per minute
gpm/ft = gallons per minute per foot
mL = milliliter
mS/cm = millisiemen per centimeter
NR = not recorded
NTU = Nephelometric Turbidity Unit
S.U. = Standard Unit

Jetting							
Date	Time	Depth (ft bgs)	Jetting Rate (gpm)	Pumping Rate (gpm)	Imhoff Cone Measurement (mL sediment per L water)	Depth to Water (feet bgs)	Comments
10/24/2015	1255	532-537	37.44	55	9/9/9.8/4.5	--	
10/24/2015	1305	527-532	37.2	80 /45	4/1.2/1.3	--	Had to change flow meter
10/24/2015	1317	522-527	36.4	45	9/7.5/5/9	--	
10/24/2015	1327	517-522	35.9	--	3.5/4/4.5	--	
10/24/2015	1340	--	--	--	--	--	Moved jetting tool back to the bottom of the screen
10/24/2015	1343	537	0	85	3/0.35/0.4/0.75/0.1	--	
10/24/2015	1507	511-516	36.35	55	1.9/4/5/2.5/2.9	--	
10/24/2015	1524	506-511	36.23	62	3/5/3.5/2/4.5	--	
10/24/2015	1538	501-506	36.11	68/65/55	2.5/4/5/2.5	--	
10/24/2015	1634	496-501	37	--	--	--	
10/24/2015	1644	496-501	--	--	--	--	At 1644, determine flow meter is not functioning correctly. Calculate flow rate using bucket and stopwatch for remainder of 10/24
10/24/2015	1705	491-496	37	42	9.5/1.3/1.5/6/11	--	
10/24/2015	1720	--	--	--	--	--	Stop jetting at 1720
10/24/2015	1730	501	0	42	9.5	--	Jett off, pumping only
10/24/2015	1735	501	0	42	0.1	--	
10/24/2015	1740	501	0	42	--	--	Trace of fines
10/26/2015	0951	485-490	36	45 / 39.5	4.5/3.7	464.1	Stop jetting at 0955
10/26/2015	1007	485-490	--	44 / 40.5	--	466.4	Resume jetting at 1005
10/26/2015	1014	485-490	25	40.5 / 37	6.0/12/23	464.4	
10/26/2015	1021	480-485	24.91	40	12.7/13/10/2.5	464.3	
10/26/2015	1026	475-480	24.30	40	1.5/8/11	463.7/464.3	
10/26/2015	1037	470-475	23.86	40	30/11	464.0	

Jetting							
Date	Time	Depth (ft bgs)	Jetting Rate (gpm)	Pumping Rate (gpm)	Imhoff Cone Measurement (mL sediment per L water)	Depth to Water (feet bgs)	Comments
10/26/2015	1045	485	0	40	7/2.5/0.6		Jett off, pumping only
10/26/2015	1210	479	0	40	0.1/trace	466.2	
10/26/2015	1327	485	0	43.7	2.5/0.2/<0.1	466.27	
10/26/2015	1348	470-475	31.69	46.0	16/7/5	463/464.2	
10/26/2015	1354	465-470	31.69	44	10/5.5/1.78	464/464.7	
10/26/2015	1420	--	--	--	--	--	Set jet at 524 ft bgs
10/26/2015	1534	519-524	0	48.23	4/0.2/0.1	465.19/ 465.3	Jett off pumping only
10/26/2015	1554	519-524	33.72	47.34	10/12.5/5	463.37	
10/26/2015	1600	524-519	32.66	46.15	8/3.0/3.25	463.4/ 463.6	
10/26/2015	1606	519-514	32.54	44.1	4.5/4/5	463.8	
10/26/2015	1611	514-509	32.54	44.1	7.5/6.5/1.5	463.5	
10/26/2015	1653	509-504	0	50	0.3	464.4	Jet off pumping only
10/26/2015	1704	509-504	31.57	47.85	3.0/2.75/2.75	463.6	
10/26/2015	1710	504-499	31.69	46.30	8.0/13/5.25	463.64	
10/26/2015	1717	499-494	31.45	48.23	15.5/7.5/10.0	463.75	
10/26/2015	1722	494-489	31.22	46.15	19/24	464.1	Jet turned off in middle of the time interval
10/26/2015	1736	494-489	32.66	46.00	25/49	463.9	
10/27/2015	0919	489-484	0	50	0.1	464.95	Jett off, pumping only
10/27/2015	0926	489-484	34.80	45.39	12/10/3.5	463.6	
10/27/2015	0934	484-479	33.84	45	24/18/32	463.75	
10/27/2015	0939	479-474	33.60	45	3.5/6/17/5	463.62	
10/27/2015	0945	474-469	33.60	45	7/8.5/10/5	464.10	
10/27/2015	1003	469-464	33.60	47.03	4/10/33/8	463.40	
10/27/2015	1115	519-524	0	48.91	--	463.08	Jett off, pumping only
10/27/2015	1118	519-524	0	48.91	--	465.95	
10/27/2015	1126	519-524	33.02	48.91	6/20/7.5/2.0	463.52	
10/27/2015	1133	514-519	29.42	47.18	7/4.5/3/3.5	463.7	
10/27/2015	1141	509-514	29.3-31.45	43.21	5/4.5/4/4.5	463.5	
10/27/2015	1152	524	0	42	< 1	463.6	Jet off, pumping only

Jetting							
Date	Time	Depth (ft bgs)	Jetting Rate (gpm)	Pumping Rate (gpm)	Imhoff Cone Measurement (mL sediment per L water)	Depth to Water (feet bgs)	Comments
10/27/2015	1302	504-509	0	49.71	--	462.98	
10/27/2015	1306	504-509	29.9-31.45	49.71	5/11/2.5/2.8	463.63	
10/27/2015	1313	499-504	32.78	47.12	18/16/18/15	463.20	
10/27/2015	1320	494-499	30.26	46.97	19/25/20/19	463.5	
10/27/2015	1329	489-494	30.14	44	27/25/45	463.82	
10/27/2015	1336	509	--	44	--	--	Jett off, pumping only. Stop pump at 1343
10/27/2015	1428	484-489	0	48.9	--	462.95	Jett off, pumping only
10/27/2015	1432	484-489	0	48.9	--	464.9	
10/27/2015	1434	484-489	31.6	48.9	11/41/29/26	463.58	
10/27/2015	1442	479-484	32.66	47.1	26/30/41/25	463.30	
10/27/2015	1448	474-479	32.52	43.74	29/75/20	464.15	
10/27/2015	1455	469-474	32.42	43.69	49/44/22/21	464.05	
10/27/2015	1503	464-469	32.42	42.1	21/26/23	464.25	
10/27/2015	1512	489	0	421	--	463.95	Jet off, pumping only. Sop pump at 1518

ft bgs = feet below ground surface

gpm = gallons per minute

L = liter

mL = millliliter

psi = pounds per square inch

EA Engineering, Science, and Technology, Inc., PBC

Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **1 of 12**

Drilling Company: **Yellow Jacket Drilling**	Geologist: **Bob Marley**	DTW During Drilling (ft): **Unknown**
Drilling Method: **Direct Mud Rotary**	Boring Depth (ft): **583**	Top of Casing Elev. (ft): **5332.32**
Drill Bit: **Tricone**	Boring Diameter (in): **14.75**	Northing: **1475415.85**
Driller: **Quentin Stevens**	Well Diameter: **8**	Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description	Completion Details
0–30		SP		Poorly graded sand: 5 YR 6/4, light reddish brown, very loose, dry, fine grained sand, subrounded grains, >70% quartz	Portland Cement 0-30 ft bgs 8" Galvanized Carbon Steel Riser 0.5-364 ft bgs
30–40		SP		Poorly graded sand: 5 YR 5/4, reddish brown, very loose, dry, fine grained sand, subrounded grains, >70% quartz	
40–45		SM		Silty sand: 5 YR 6/4, light reddish brown, >15% fines, fine to coarse grained sand (65% fine; 20% coarse [2-4 millimeters in diameter]), subangular to subrounded grains, sand composed of quartz, feldspar, and dark minerals	Bentonite Grout 30-366 ft bgs
45–50		SW		Well graded sand: 5 YR 6/4, light reddish brown, 10% fines, fine to coarse grained sand (30% fine to medium; 60% coarse), subangular to subrounded grains, sand composed of 95% quartz/feldspar, 5% dark minerals. Driller notes increased fines starting at 45 feet below ground surface.	

Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **2 of 12**

Drilling Company: **Yellow Jacket Drilling**	Geologist: **Bob Marley**	DTW During Drilling (ft): **Unknown**
Drilling Method: **Direct Mud Rotary**	Boring Depth (ft): **583**	Top of Casing Elev. (ft): **5332.32**
Drill Bit: **Tricone**	Boring Diameter (in): **14.75**	Northing: **1475415.85**
Driller: **Quentin Stevens**	Well Diameter: **8**	Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description	Completion Details
50–55		SM		Silty sand: 5 YR 6/3, light reddish brown, >20% fines, fine to coarse grained sand (40% fine; 40% medium to coarse), subangular to subrounded grains, coarse grained sand composed of 95% quartz/feldspar, 5% dark minerals	
55–60		SW		Well graded sand: 5 YR 6/2, pinkish grey, <10% fines, fine to coarse grained sand (30% fine to medium; 60% coarse [1-4 millimeters in diameter]), subangular to subrounded grains, coarse grained sand composed of 95% quartz/feldspar, 5% dark minerals	
60–70		SM		Silty sand: 5 YR 6/4, light reddish brown, >25% fines, fine to coarse grained sand (60% fine; 15% coarse [1-4 millimeters in diameter]), subangular to subrounded grains, coarse grained sand composed of 95% light quartz/feldspar, 5% dark minerals	
70–80		SM		Silty sand: 5 YR 6/3, light reddish brown, >30% fines, 55% fine to coarse grained sand (>40% fine to medium; 15% coarse), 3% fine gravel (up to 8 millimeters in diameter), subangular to subrounded sand and gravel, sand and gravel composed of primarily feldspar, minor chert and limestone, 3-5% dark minerals, lithics (angular)	
80–100		SM		Silty sand: 5 YR 6/4, light reddish brown, 30% silt, fine to coarse grained sand (60% fine; 10% coarse), 1-2% lithic fragments (up to 8 millimeters in diameter), subangular to subrounded coarse sand grains, 95% quartz/feldspar, 5% lithics/basalt	

Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **3 of 12**

Drilling Company: **Yellow Jacket Drilling**	Geologist: **Bob Marley**	DTW During Drilling (ft): **Unknown**
Drilling Method: **Direct Mud Rotary**	Boring Depth (ft): **583**	Top of Casing Elev. (ft): **5332.32**
Drill Bit: **Tricone**	Boring Diameter (in): **14.75**	Northing: **1475415.85**
Driller: **Quentin Stevens**	Well Diameter: **8**	Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description	Completion Details
100		SM		Silty sand: 5 YR 6/4, light reddish brown, >15% fines, fine to coarse grained sand (50% fine; 25% coarse), 1-2% lithic fragments (up to 10 millimeters in diameter), subangular to subrounded sand and gravel, sand composed of 30% quartz, 60% feldspar, 5% basalt	
105					
110		ML		Silt: 5 YR 6/4, light reddish brown, nonplastic to slightly plastic, >60% fines, 30% very fine grained sand, 2% lithic fragments (up to 3 millimeters in diameter)	
115					
120		ML		Silt with sand: 5 YR 6/3, light reddish brown, slightly plastic, 75% silt, 25% very fine to fine grained sand	
125					
130		SW		Well graded sand: 5 YR 5/3, reddish brown, <5% fines, fine to coarse grained sand (>20% fine to medium; 60% coarse), 15% gravel, lithic fragments (up to 12 millimeters in diameter), subangular gravel, 30% quartz (subrounded), 30% feldspar, 40% dark minerals/basalt (subangular)	
135					
140		ML		Sandy silt: 5 YR 6/4, light reddish brown, slightly plastic, 70% silt, >30% very fine grained sand	
145					
150					

Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **4 of 12**

Drilling Company: **Yellow Jacket Drilling**	Geologist: **Bob Marley**	DTW During Drilling (ft): **Unknown**
Drilling Method: **Direct Mud Rotary**	Boring Depth (ft): **583**	Top of Casing Elev. (ft): **5332.32**
Drill Bit: **Tricone**	Boring Diameter (in): **14.75**	Northing: **1475415.85**
Driller: **Quentin Stevens**	Well Diameter: **8**	Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description	Completion Details
150		SM		Silty sand: 5 YR 6/4, light reddish brown, nonplastic, 30% fines, fine to coarse grained sand (50% fine; 10% coarse), 10% fine gravel (up to 10 millimeters in diameter), subangular gravel, 25% quartz, 25% feldspar, 50% dark minerals	
155					
160		SM		Silty sand: 5 YR 6/4, light reddish brown, 30% fines, very fine to fine grained sand, 10% fine gravel, 10% coarse gravel, angular to subangular gravel (up to 19 millimeters in diameter), 20% feldspar, 50% basalt, 10% tuff	
165					
170		ML		Sandy silt: 5 YR 6/4, light reddish brown, 40% very fine to fine grained sand, <10% coarse grained sand to fine gravel (up to 6 millimeters in diameter), angular to subangular gravel, gravel composed of >50% basalt	
175					
180		SW		Well graded sand with gravel: 5 YR 5/3, reddish brown, <5% fines, coarse grained sand, 25% fine gravel (up to 10 millimeters in diameter), subangular gravel, sand composed of quartz and feldspar, gravel composed of basalt and tuff	
185					
190		SP		Poorly graded sand with gravel: 5 YR 4/2, dark reddish brown, <5% fines, coarse grained sand, 20% fine gravel (up to 6 millimeters in diameter), subangular to subrounded gravel, sand composed of 30% quartz, 30% feldspar, 30% basalt, gravel composed of basalt	
195					
200					

Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **5 of 12**

Drilling Company: **Yellow Jacket Drilling**
Drilling Method: **Direct Mud Rotary**
Drill Bit: **Tricone**
Driller: **Quentin Stevens**

Geologist: **Bob Marley**
Boring Depth (ft): **583**
Boring Diameter (in): **14.75**
Well Diameter: **8**

DTW During Drilling (ft): **Unknown**
Top of Casing Elev. (ft): **5332.32**
Northing: **1475415.85**
Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description	Completion Details
200		ML		Silt with sand: 5 YR 6/3, light reddish brown, nonplastic, 15-29% very fine grained sand	
205					
210		SP		Poorly graded sand with gravel: 5 YR 5/3, reddish brown, <5% fines, coarse grained sand, 15% fine gravel (up to 6 millimeters in diameter), subangular gravel, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt	
215					
220		GP		Poorly graded gravel with sand: 5 YR 4/3, reddish brown, <5% fines, 20% coarse grained sand, fine gravel (up to 6 millimeters in diameter), gravel subangular to subrounded, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt	
225					
230		SM		Silty sand: 5 YR 4/3, reddish brown, >15% fines, very fine to coarse grained sand (30% very fine; >15% fine; 30% coarse), 5% fine gravel (up to 9 millimeters in diameter), subangular gravel, sand and gravel composed of 25% quartz, 25% feldspar, 40% basalt	
235					
240		SM		Silty sand with gravel: 5 YR 5/3, reddish brown, >15% silt, very fine to coarse grained sand (30% very fine; 30% coarse), 15% fine gravel (up to 8 millimeters in diameter), subangular to subrounded gravel, sand and gravel composed of 25% quartz, 25% feldspar, 50% basalt	
245					
250					

Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **6 of 12**

Drilling Company: **Yellow Jacket Drilling**	Geologist: **Bob Marley**	DTW During Drilling (ft): **Unknown**
Drilling Method: **Direct Mud Rotary**	Boring Depth (ft): **583**	Top of Casing Elev. (ft): **5332.32**
Drill Bit: **Tricone**	Boring Diameter (in): **14.75**	Northing: **1475415.85**
Driller: **Quentin Stevens**	Well Diameter: **8**	Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description	Completion Details
250		SM		Silty sand with gravel: 5 YR 5/3, reddish brown, >15% silt, very fine to coarse grained sand (30% very fine; 30% coarse), 15% fine gravel (up to 8 millimeters in diameter), subangular to subrounded gravel, sand and gravel composed of 25% quartz, 35% feldspar, 50% basalt	
260		ML		Sandy and clayey silt with gravel: 5 YR 7/4, pink, 75% fines, very fine to coarse grained sand (80% very fine; 10% coarse), gravel (up to 8 millimeters in diameter), subangular to subrounded gravel, sand composed of 20% quartz, 50% feldspar, 30% basalt, gravel composed of 20% quartz, 30% feldspar, 50% basalt	
270		ML		Sandy and clayey silt with gravel: 5 YR 7/4, pink, 75% fines, very fine to coarse grained sand (80% very fine; 10% coarse), gravel (up to 8 millimeters in diameter), angular shards, subangular to subrounded gravel, sand and gravel composed of 20% quartz, 20% feldspar, 60% basalt	
280		SM		Silty sand with gravel: 5 YR 7/3, pink, >15% fines, fine to coarse grained sand (30% fine; 30% coarse), 20% fine gravel (up to 6 millimeters in diameter), angular to subrounded gravel, sand and gravel composed of 25% quartz, 25% feldspar, 50% basalt	
290					
295					
300					

Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **7 of 12**

Drilling Company: **Yellow Jacket Drilling**	Geologist: **Bob Marley**	DTW During Drilling (ft): **Unknown**
Drilling Method: **Direct Mud Rotary**	Boring Depth (ft): **583**	Top of Casing Elev. (ft): **5332.32**
Drill Bit: **Tricone**	Boring Diameter (in): **14.75**	Northing: **1475415.85**
Driller: **Quentin Stevens**	Well Diameter: **8**	Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description	Completion Details
300		SW		Well graded gravelly sand: 5 YR 5/2, reddish gray, <15% fines, fine to coarse grained sand (30% fine; 30% coarse), gravel (up to 12 millimeters in diameter), angular to subrounded gravel, sand and gravel composed of 35% quartz, 30% feldspar, 35% basalt	
305					
310		SW		Well graded gravelly sand: 5 YR 5/2, reddish gray, <15% fines, fine to coarse grained sand (40% fine; 30% coarse), gravel (up to 8 millimeters in diameter), angular to subrounded gravel, sand and gravel composed of 30% quartz, 40% feldspar, 30% basalt	
315					
320		SW		Well graded sand: 5 YR 4/2, dark reddish gray, <5% fines, fine to coarse grained sand (20% fine to medium; 50% coarse), <15% fine gravel (up to 8 millimeters in diameter), subangular to subrounded gravel, sand composed of 30% quartz, 30% feldspar, 30% basalt	
325					
330		SP		Poorly graded sand: 5 YR 5/3, reddish brown, <5% fines, fine to coarse grained sand (20% fine to medium; 60% coarse), 10% fine gravel (up to 6 millimeters in diameter), subangular gravel, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt	
335					
340		SM		Silty sand with gravel: 5 YR 5/3, reddish brown, 20% fines, fine to coarse grained sand (20% fine to medium; 40% coarse), 15% fine gravel (up to 8 millimeters in diameter), subangular to subrounded gravel, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt	
345					
350					

Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **8 of 12**

Drilling Company: **Yellow Jacket Drilling**	Geologist: **Bob Marley**	DTW During Drilling (ft): **Unknown**
Drilling Method: **Direct Mud Rotary**	Boring Depth (ft): **583**	Top of Casing Elev. (ft): **5332.32**
Drill Bit: **Tricone**	Boring Diameter (in): **14.75**	Northing: **1475415.85**
Driller: **Quentin Stevens**	Well Diameter: **8**	Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description	Completion Details
350					
355		SM		Silty sand with gravel: 5 YR 5/3, reddish brown, 30% fines, fine to coarse grained sand (10% fine to medium; 40% coarse), 15% fine gravel (up to 8 millimeters in diameter), subangular to subrounded gravel, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt	
360		SM		Silty sand: 5 YR 5/3, reddish brown, 30% fines, fine to coarse grained sand (20% fine to medium; 40% coarse), <5% fine gravel (up to 8 millimeters in diameter), subangular to subrounded gravel, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt	
365					8" Stainless Steel Riser 364-470 ft bgs
370		SW		Well graded sand: 5 YR 5/3, reddish brown, <5% fines, fine to coarse grained sand (40% fine to medium; 50% coarse), <5% fine gravel (up to 8 millimeters in diameter), subangular to subrounded gravel, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt	3/8" Bentonite Chip Seal 366-408 ft bgs
375					
380		SW		Well graded sand with gravel: 5 YR 5/2, reddish gray, <5% fines, fine to coarse grained sand (25% fine to medium; 50% coarse), 20% fine gravel (up to 8 millimeters in diameter), angular shards, subangular to subrounded gravel, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt	
385					
390		SW		Well graded sand: 5 YR 5/2, reddish gray, <5% fines, fine to coarse grained sand (25% fine to medium; 60% coarse), <15% fine gravel (up to 6 millimeters in diameter), subangular to subrounded gravel, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt	
395					
400					

Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

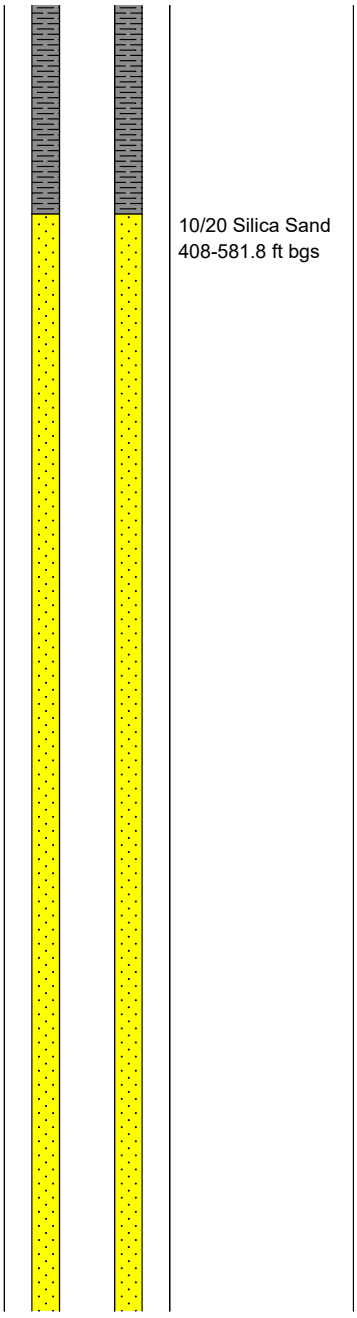
Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **9 of 12**

Drilling Company: **Yellow Jacket Drilling**	Geologist: **Bob Marley**	DTW During Drilling (ft): **Unknown**
Drilling Method: **Direct Mud Rotary**	Boring Depth (ft): **583**	Top of Casing Elev. (ft): **5332.32**
Drill Bit: **Tricone**	Boring Diameter (in): **14.75**	Northing: **1475415.85**
Driller: **Quentin Stevens**	Well Diameter: **8**	Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description
400		SW		Well graded sand: 5 YR 5/2, reddish gray, <5% fines, fine to coarse grained sand (25% fine to medium; 60% coarse), <15% fine gravel (up to 6 millimeters in diameter), subangular gravel, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt
405				
410	0.9	SM		Silty sand: 5 YR 5/2, reddish gray, 25% fines, fine to coarse grained sand (25% fine to medium; 40% coarse), <10% fine gravel (up to 6 millimeters in diameter), subangular to subrounded gravel, sand and gravel composed of 30% quartz, 30% feldspar, 30% basalt, 5% chert
415				
420		SM		Silty sand: 5 YR 6/2, pinkish gray, 30% fines, fine to coarse grained sand (20% fine to medium; 40% coarse), <10% fine gravel (up to 10 millimeters in diameter), fractured shards, subangular to subrounded gravel, sand composed of 30% quartz, 30% feldspar, 30% basalt, 5% chert, gravel composed of 30% quartz, 30% feldspar, 30% basalt
425				
430	0.8	SM		Silty sand: 5 YR 6/2, pinkish gray, 30% fines, fine to coarse grained sand (40% fine; 20% medium to coarse), trace fine gravel (up to 6 millimeters in diameter), shards (primarily basalt), subangular to subrounded gravel, sand composed of 35% quartz, 20% feldspar, 30% basalt, 5% chert, gravel composed of 30% quartz, 30% feldspar, 30% basalt
435				
440	0.8	SM		Silty sand: 5 YR 6/2, pinkish gray, 30% fines, fine to coarse grained sand (35% fine; 30% medium to coarse), shards (primarily basalt), subrounded grains (minor subangular), sand composed of 35% quartz, 20% feldspar, 30% basalt, 5% chert
445				
450				



Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

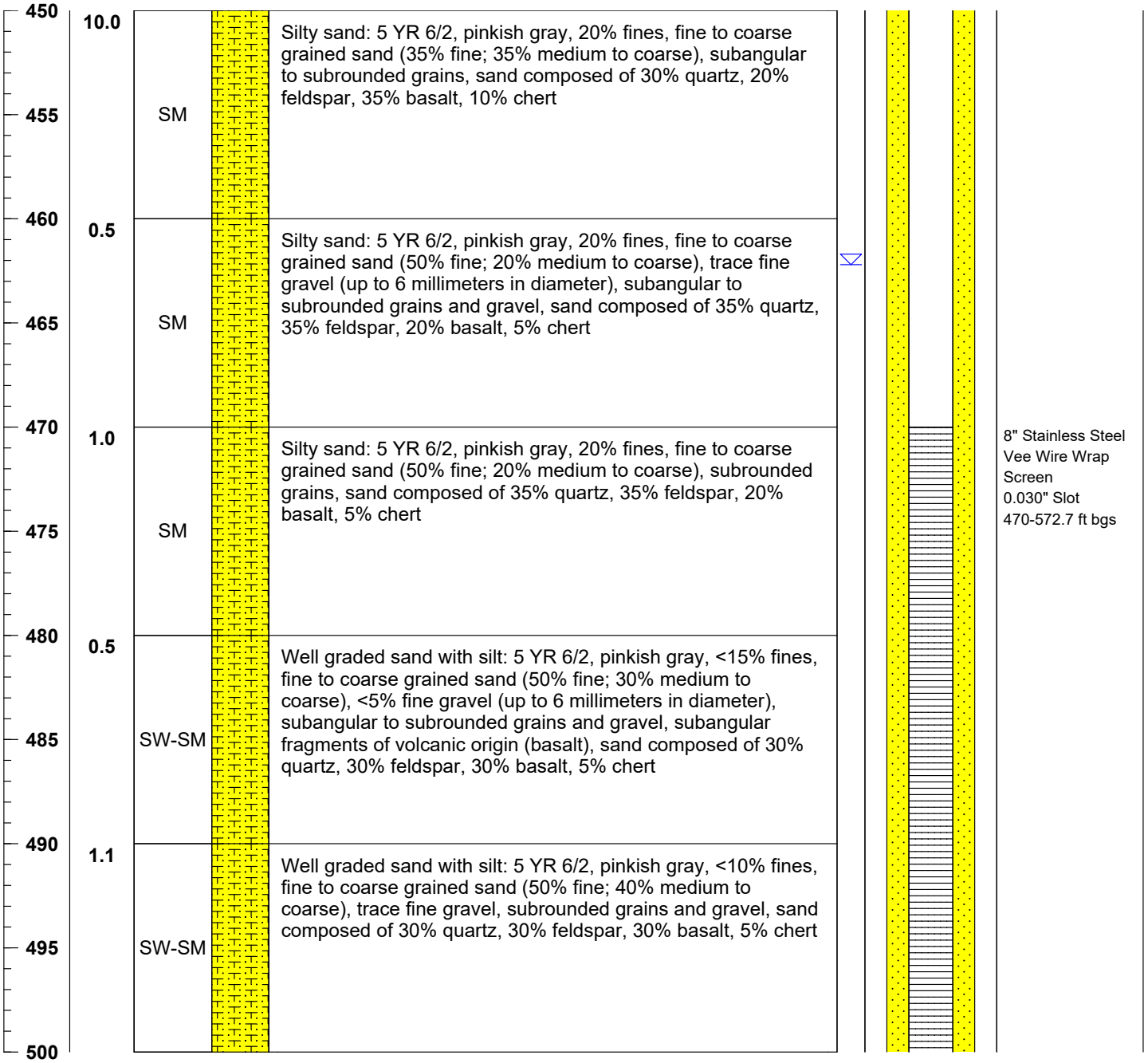
Well ID: **KAFB-106239**
Page: **10 of 12**

Drilling Company: **Yellow Jacket Drilling**
Drilling Method: **Direct Mud Rotary**
Drill Bit: **Tricone**
Driller: **Quentin Stevens**

Geologist: **Bob Marley**
Boring Depth (ft): **583**
Boring Diameter (in): **14.75**
Well Diameter: **8**

DTW During Drilling (ft): **Unknown**
Top of Casing Elev. (ft): **5332.32**
Northing: **1475415.85**
Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description
450–455	10.0	SM		Silty sand: 5 YR 6/2, pinkish gray, 20% fines, fine to coarse grained sand (35% fine; 35% medium to coarse), subangular to subrounded grains, sand composed of 30% quartz, 20% feldspar, 35% basalt, 10% chert
455–460	0.5	SM		Silty sand: 5 YR 6/2, pinkish gray, 20% fines, fine to coarse grained sand (50% fine; 20% medium to coarse), trace fine gravel (up to 6 millimeters in diameter), subangular to subrounded grains and gravel, sand composed of 35% quartz, 35% feldspar, 20% basalt, 5% chert
460–465	1.0	SM		Silty sand: 5 YR 6/2, pinkish gray, 20% fines, fine to coarse grained sand (50% fine; 20% medium to coarse), subrounded grains, sand composed of 35% quartz, 35% feldspar, 20% basalt, 5% chert
465–470	0.5	SW-SM		Well graded sand with silt: 5 YR 6/2, pinkish gray, <15% fines, fine to coarse grained sand (50% fine; 30% medium to coarse), <5% fine gravel (up to 6 millimeters in diameter), subangular to subrounded grains and gravel, subangular fragments of volcanic origin (basalt), sand composed of 30% quartz, 30% feldspar, 30% basalt, 5% chert
470–475	1.1	SW-SM		Well graded sand with silt: 5 YR 6/2, pinkish gray, <10% fines, fine to coarse grained sand (50% fine; 40% medium to coarse), trace fine gravel, subrounded grains and gravel, sand composed of 30% quartz, 30% feldspar, 30% basalt, 5% chert



Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

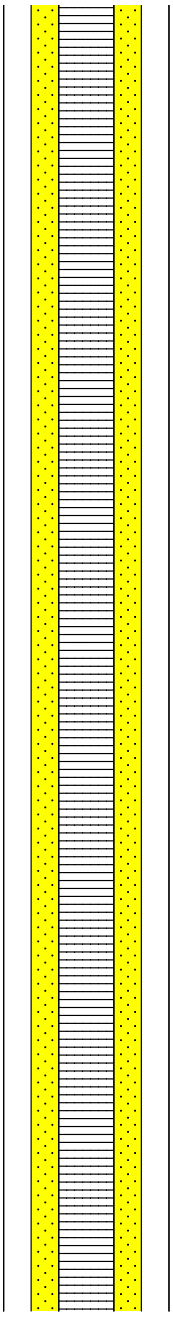
Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **11 of 12**

Drilling Company: **Yellow Jacket Drilling**	Geologist: **Bob Marley**	DTW During Drilling (ft): **Unknown**
Drilling Method: **Direct Mud Rotary**	Boring Depth (ft): **583**	Top of Casing Elev. (ft): **5332.32**
Drill Bit: **Tricone**	Boring Diameter (in): **14.75**	Northing: **1475415.85**
Driller: **Quentin Stevens**	Well Diameter: **8**	Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description	Completion Details
500	1.2	SW-SM		Well graded sand with silt: 5 YR 6/2, pinkish gray, <10% fines, fine to coarse grained sand (50% fine; 40% medium to coarse), trace fine gravel, subangular to subrounded grains and gravel (quartz subrounded; feldspar/basalt subangular), sand composed of 30% quartz, 30% feldspar, 30% basalt, 5% chert	
505					
510	1.0	SW-SM		Well graded sand with silt: 5 YR 6/2, pinkish gray, <10% fines, fine to coarse grained sand (50% fine; 40% medium to coarse), subangular to subrounded grains (quartz subrounded; feldspar/basalt subangular), sand composed of 30% quartz, 30% feldspar, 30% basalt, 5% chert	
515					
520	1.0	SM		Silty sand: 5 YR 6/2, pinkish gray, 20% fines, fine to coarse grained sand (60% fine; 20% medium to coarse), subrounded grains, sand composed of 30% quartz, 30% feldspar, 30% basalt, 5% chert	
525					
530	0.5	SM		Silty sand: 5 YR 6/2, pinkish gray, 20% fines, fine to coarse grained sand (40% fine; 40% medium to coarse), subrounded grains, sand composed of 30% quartz, 30% feldspar, 30% basalt, 5% chert	
535					
540	0.3	SM		Silty sand: 5 YR 6/2, pinkish gray, 20% fines, fine to coarse grained sand (50% fine; 25% medium to coarse), subrounded grains, sand composed of 30% quartz, 30% feldspar, 30% basalt, 5% chert	
545					
550					



Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

EA Engineering, Science, and Technology, Inc., PBC

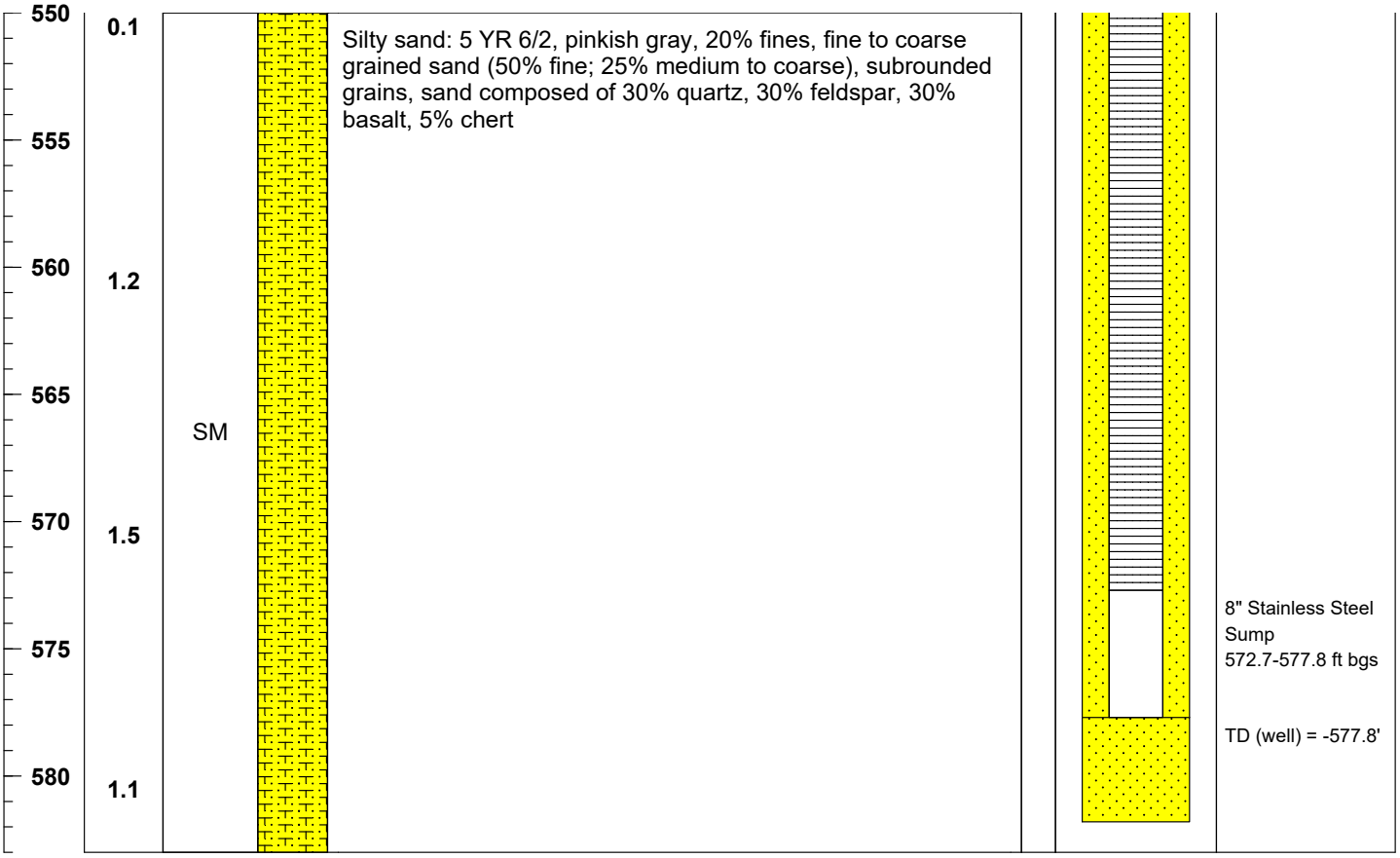
Project: **62599DM01.1028**
Location: **Kirtland AFB, New Mexico**
Start Date: **11/3/2016**
Completion Date: **12/9/2016**

WELL LOG

Well ID: **KAFB-106239**
Page: **12 of 12**

Drilling Company: **Yellow Jacket Drilling**	Geologist: **Bob Marley**	DTW During Drilling (ft): **Unknown**
Drilling Method: **Direct Mud Rotary**	Boring Depth (ft): **583**	Top of Casing Elev. (ft): **5332.32**
Drill Bit: **Tricone**	Boring Diameter (in): **14.75**	Northing: **1475415.85**
Driller: **Quentin Stevens**	Well Diameter: **8**	Easting: **1542702.31**

Depth (ft)	PID (ppmv)	USCS	Lithology	Sample Description	Completion Details
550	0.1	SM		Silty sand: 5 YR 6/2, pinkish gray, 20% fines, fine to coarse grained sand (50% fine; 25% medium to coarse), subrounded grains, sand composed of 30% quartz, 30% feldspar, 30% basalt, 5% chert	
555					
560	1.2				
565					
570	1.5				8" Stainless Steel Sump 572.7-577.8 ft bgs
575					TD (well) = -577.8'
580	1.1				



Notes: Survey performed 1/16/2017.

▽ = Depth to water measured 12/17/2016.

KAFB-7

DATA WELL NO. 7 KIRTLAND EAST

ELEVATION (FT)	LOCATION	DATE CONSTR ENDED
5349.0	NW¼-NW¼-NW¼-SEC 6-T10N-R4E	February 1955

WELL

TYPE		
Rotary Drilled, Gravel Packed, 3/4" Gravel		
DEPTH	**DIAMETER**	**PUMPSETTING DEPTH**
1010'	28" Hole 16" Casing	475'
ORIGINAL STATIC LEVEL	**DRAWDOWN**	**RECOVERY TIME**
395'	22'	

TEST DATA		AIR LINE AND GAGES					SPECIFIC CAPACITY (GAL) PER (FT)
WELL CAPACITY	PUMPING LEVEL	YES	X	NO		LENGTH	$\frac{\text{GPM}}{\text{DRAWDOWN}}$ = 64 GPM/FT
1400GPM	417'					475'	

WELL PUMPING EQUIPMENT

PUMP

TYPE AND MAKE			CAPACITY
Submersible, Byron-Jackson			1150 GPM
SUCTION (FT)	**SIZE AND LENGTH**	**COLUMN**	
N/A	N/A	10" w/check valve at water level	

HEAD			NUMBER BOWLS	SIZE AND TYPE	NO. STAGES
ABOVE GRD	BELOW GRD	TOTAL			
161'	425'	586'		12" 3CK	7

MOTOR

SERIAL NO.	TYPE	MAKE	HP	RPM	FRAME	PHASE	CYCLES	VOLTAGE
	14" H Submersible	B&J	200	1750		3	60	440

STAND BY POWER	MAKE	SIZE
440 volt	Cummins Installed 1970	300KW

HP	RPM	DESCRIPTION
	1800	Diesel powered generator

CASING AND WELL SCREENING MATERIAL USED	SETTING DEPTH	LENGTH EACH
16" O.D. Blank Casing	448	448
16" O.D. ¼" Shutter Screen casing	856	408
16" O.D. Blank Casing	880	24
16" O.D. ¼" Shutter screen casing	976	96
16" O.D Blank Casing	1,010	34

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KAFB-7

FORMATIONS ENCOUNTERED DURING DRILLING #7(KE)	DEPTH (FT)	STRATUM
Top soil, sand and gravel	35	35
Sand, gravel and clay	95	60
Course sand and gravel	125	30
Sandy clay and gravel	190	65
Sand and gravel	240	50
Coarse sand and gravel	275	35
Sand, gravel and streaks of clay	315	40
Sand, gravel and boulders	465	250
Sand, gravel and streaks of clay	525	60
Sand, gravel and boulders	740	215
Coarse sand and boulders	855	115
Sandy clay	945	90
Coarse sandy clay and boulders	1,000	55

CHANGES MADE FROM ORIGINAL DATA

1961: Motor failed,equipment removed. Well bailed and surged and added 40 CY of gravel (3/4") and removed 30 CY of 1/4" gravel. Installed new pump and motor identical to original. Static level 418 feet.

1967: Pump failed to operate, equipment removed. Well bailed, surged and caged. 80 CY of 1/4 inch gravel removed and 100 CY of 3/4 inch gravel added. Installed new identical equipment. Static level 420 feet.

1970: Equipment failed, removed. Installed Johnson pump and 250 HP GE submersible motor, 1400 GPM @ 615' head. Static level 425 feet.

1973: Equipment failed, removed. Installed 7 stage Fairbanks-Morse lineshaft pump w/250 HP Westinghouse hollowshaft motor, 1400 GPM @ 560' head. Static level 425 feet.

1975: Motor burned out, replaced w/250 HP GE hollowshaft. (Jan-Apr) $6,171.03
Sand sampler installed.

1976: July, replaced water meter and installed drawdown recorder. $4,500.00
September, replaced seal and bearings in motor. $1,800.00

1977: March, Motor Overhauled (Shops). $1,500.00

DRILLING COMPANY	LOCATION
ROSCOE MOSS CO	LOS ANGELES, CALIFORNIA

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Kirtland AFB
Well KAFB-7
Grade
16-inch Steel Casing
0 to 448'
6-inch Steel Injection Pipe
0 to 541-feet
6"x 5" Orifice Plate - 481'
448-feet
468-feet
541-feet
12-inch Steel Casing Liner
468' to 578'
8-inch steel Louver
Screen, .175-slot
541' to 600'
No plate bottom
600-feet
578-feet
12-inch Steel Slotted Liner
578' to 1010'
16-inch Shutter Screen 250-slot
448' to 856'
856-feet
16-inch Steel Casing Blank
856' to 880'
880-feet
16-inch Shutter Screen 250-slot
880' to 976'
976-feet
16-inch Steel Casing Blank
976' to 1010'
Well Depth and
Sizes is not
confirmed
1010-feet

EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

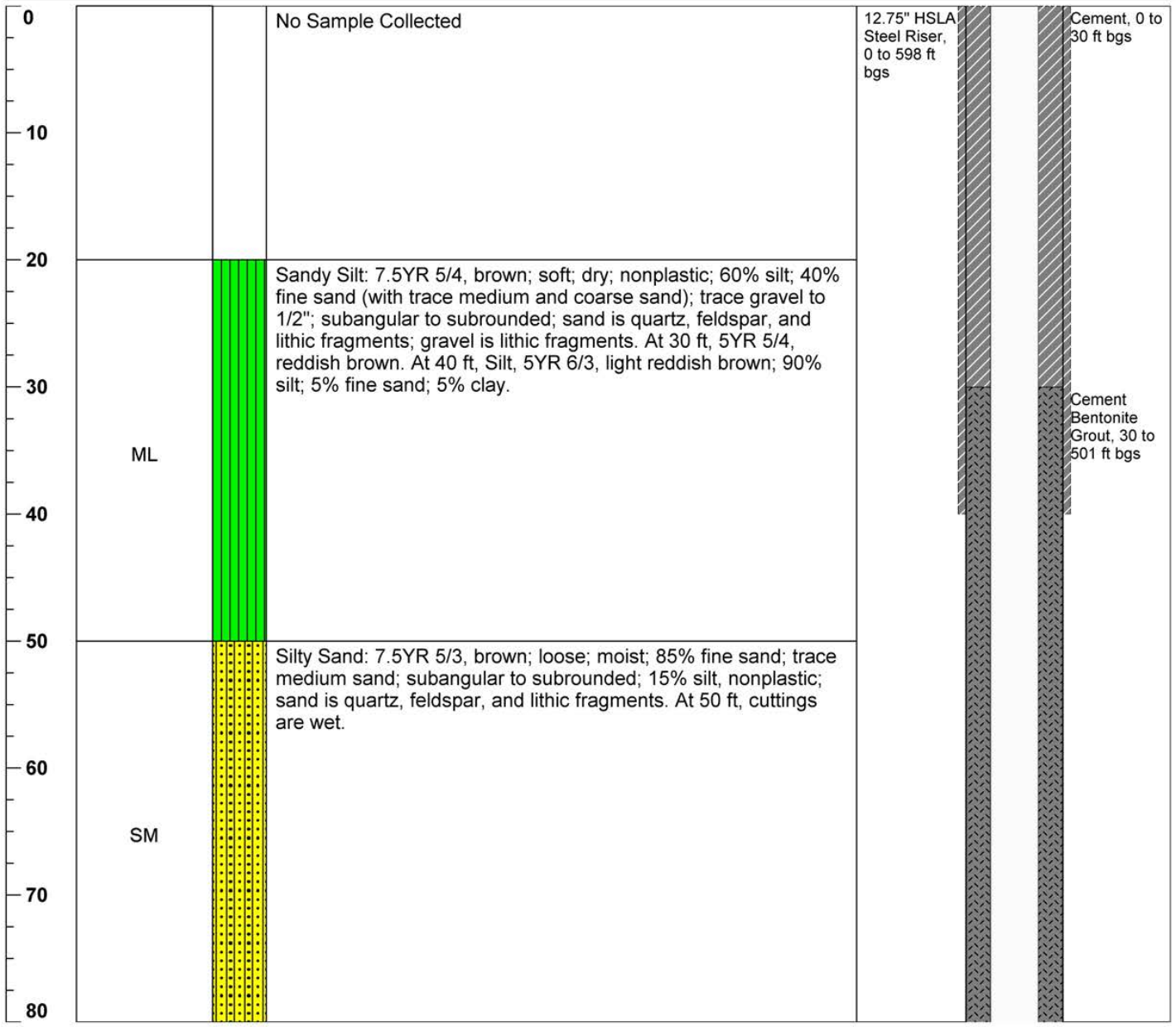
Well ID: **KAFB-106IN2**
Page: **1 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description
0			No Sample Collected
20	ML		Sandy Silt: 7.5YR 5/4, brown; soft; dry; nonplastic; 60% silt; 40% fine sand (with trace medium and coarse sand); trace gravel to 1/2"; subangular to subrounded; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments. At 30 ft, 5YR 5/4, reddish brown. At 40 ft, Silt, 5YR 6/3, light reddish brown; 90% silt; 5% fine sand; 5% clay.
50	SM		Silty Sand: 7.5YR 5/3, brown; loose; moist; 85% fine sand; trace medium sand; subangular to subrounded; 15% silt, nonplastic; sand is quartz, feldspar, and lithic fragments. At 50 ft, cuttings are wet.
80			



Note:
ags = above ground surface
bgs = below ground surface
ft = foot(feet)
HSLA = high-strength low-alloy
in = inch(es)
OD = outside diameter

EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **2 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description	Completion Details
90	SP		Poorly Graded Sand: 10YR 5/3, brown; loose; wet; 95% fine to medium sand (90% fine, 10% medium); trace coarse sand; subangular to subrounded; 5% silt, nonplastic; sand is quartz, feldspar, and lithic fragments.	
	ML		Silt: 5YR 5/4, reddish brown; soft; wet; nonplastic; 90% silt; 10% fine to medium sand (95% fine, 5% medium); subangular to subrounded; sand is quartz, feldspar, and lithic fragments.	
100	SM		Silty Sand: 7.5YR 5/3, brown; loose; wet; 80% fine to medium sand (95% fine, 5% medium); trace coarse sand; trace gravel to 1/2"; subangular to subrounded; 20% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments. At 110 ft, 80% sand (85% fine, 10% medium, 5% coarse); 15% silt; 5% clay.	
110				
120	SP-SC		Poorly Graded Sand with Clay: 7.5YR 5/4, brown; loose; wet; 85% fine to medium sand (90% fine, 10% medium); trace coarse sand; trace gravel to 3/8"; subangular to subrounded; 10% clay, slightly plastic; 5% silt; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments.	
130	SM		Silty Sand: 7.5YR 5/3, brown; loose; wet; 60% fine to medium sand (95% fine, 5% medium); trace coarse sand; trace gravel to 1/2"; subangular to subrounded; 40% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments.	
140	SW		Well-Graded Sand: 10YR 5/3, brown; loose; wet; 95% fine to coarse sand (20% fine, 70% medium, 10% coarse); trace gravel to 1/2"; subangular to subrounded; 5% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments.	
150	SW-SC		Well-Graded Sand with Clay: 10YR 6/4, light yellowish brown; loose; wet; 85% fine to coarse sand (60% fine, 30% medium, 10% coarse); trace gravel to 5/8"; subangular to subrounded; 10% clay, slightly plastic nodules to 1/2"; 5% silt; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments.	
160				

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bgs = below ground surface
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HSLA = high-strength low-alloy
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EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **3 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description	Completion Details
170	SW		Well-Graded Sand: 10YR 6/3, pale brown; loose; wet; 95% fine to coarse sand (20% fine, 60% medium, 20% coarse); 5% gravel to 1/2"; subangular to subrounded; trace silt; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
180	CL		Sandy Clay: 7.5YR 5/4, brown; soft; wet; nonplastic; 50% clay; 10% silt; 40% fine to medium sand (60% fine, 40% medium); trace coarse sand; trace gravel to 3/8"; subangular to subrounded; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments. At 180 ft, 80% clay, plastic nodules to 1"; 10% silt; 10% fine to medium sand (85% fine, 15% medium).	
190	SC		Clayey Sand: 7.5YR 5/4, brown; loose; wet; 60% fine to medium sand (80% fine, 20% medium); trace coarse sand; subangular to subrounded; 25% clay; 15% silt, nonplastic; sand is quartz, feldspar, and lithic fragments. At 200 ft, trace gravel to 1/2"; gravel is quartz and lithic fragments.	
210	CL		Sandy Clay: 7.5YR 5/4, brown; soft; wet; nonplastic; 60% clay; 10% silt; 30% fine to medium sand (90% fine, 10% medium); trace coarse sand; trace gravel to 3/8"; subangular to subrounded; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments. At 220 ft, Clay with Sand: 70% clay; 5% silt; 20% sand; trace gravel up to 5/8". At 230 ft, 80% clay; plastic, nodules up to 1-1/2"; 5% silt; 15% sand; trace gravel to 5/8".	
220				
230				
240				

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EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **4 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description	Completion Details
250	CL		Clay with Sand: 7.5YR 5/4, brown; soft; wet; plastic; 80% clay nodules to 1-1/2"; 5% silt; 15% fine to medium sand (90% fine, 10% medium); trace gravel to 5/8"; subangular to subrounded; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
260	SC		Clayey Sand: 7.5YR 5/4, brown; soft; wet; 60% fine to coarse sand (65% fine, 20% medium, 15% coarse); 10% gravel up to 1"; subangular to subrounded; 20% clay, nonplastic; 10% silt; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
270	SW		Well-Graded Sand: 10YR 5/4, yellowish brown; loose; wet; 80% fine to coarse sand (20% fine, 60% medium, 20% coarse); 10% gravel up to 3/8"; subangular to subrounded; 5% silt; 5% clay, nonplastic; sand is quartz feldspar, and lithic fragments.	
280	SP		Poorly Graded Sand: 10YR 5/3, brown; loose; wet; 95% fine to medium sand (60% fine, 40% medium); trace coarse sand; subangular to subrounded; 5% silt, nonplastic; sand is quartz, feldspar, and lithic fragments. At 280 ft, 90% sand; 5% gravel to 1/2"; 5% silt; gravel is quartz and lithic fragments.	
290	CL		Clay: 10YR 5/3, brown; soft to medium stiff; wet; plastic; 100% clay; nodules up to 2"; clay is moderately mottled to 10YR 7/1, light gray; moderate reaction with acid.	
300	SC		Clayey Sand; 2.5Y 7/2, light gray; loose; wet; 50% fine to coarse sand (30% fine, 60% medium, 10% coarse); 10% gravel to 5/8"; subangular to subrounded; 40% clay, nonplastic to slightly plastic; sand is quartz, feldspar, lithic fragments, and caliche; gravel is caliche. Note: secondary calcium carbonate throughout with a strong reaction with acid.	
310	CL		Clay: 2.5Y 7/2, light gray; soft; wet; slightly plastic; 90% clay; 10% fine sand; sand is caliche. Note: secondary calcium carbonate throughout with a moderate reaction with acid.	
320				

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EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **5 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description	Completion Details
330	SP-SM		Poorly Graded Sand with Silt: 10YR 6/3, pale brown; loose; wet; 90% fine to medium sand (50% fine, 50% medium); trace coarse sand; subangular to subrounded; 10% silt, nonplastic; sand is quartz, feldspar, and lithic fragments.	
340	SM		Silty Sand: 10YR 6/3, pale brown; loose; wet; 75% fine sand; trace medium sand; subangular to subrounded; 25% silt, nonplastic; sand is quartz, feldspar, and lithic fragments.	
350	GW		Well-Graded Gravel with Sand: 10YR 5/3, brown; loose; wet; 85% gravel up to 1"; 15% medium to coarse sand (40% medium, 60% coarse); subangular to subrounded; gravel and sand are quartz, feldspar, and lithic fragments.	
360	SM		Silty Sand: 10YR 6/3, pale brown; loose; wet; 75% fine sand; trace medium sand; subangular to subrounded; 25% silt, nonplastic; sand is quartz, feldspar, and lithic fragments. At 370 ft, 60% fine to coarse sand (85% fine, 10% medium, 5% coarse); 10% gravel to 1/2"; 30% silt; gravel is quartz and lithic fragments.	
370				
380	GW-GC		Well-Graded Gravel with Clay and Sand: 10YR 6/3, pale brown; loose; wet; 50% gravel to 5/8"; 40% fine to coarse sand (50% fine, 30% medium, 20% coarse); subangular to subrounded; 10% clay, slightly plastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
390	SW-SC		Well-Graded Sand with Clay: 10YR 6/3, pale brown; loose; wet; 80% fine to coarse sand (70% fine, 15% medium, 15% coarse); 10% gravel to 5/8"; subangular to subrounded; 10% clay, slightly plastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
400				

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EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **6 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description	Completion Details
410	SW-SC		Well-Graded Sand with Clay: 10YR 6/3, pale brown; loose; wet; 80% fine to coarse sand (70% fine, 15% medium, 15% coarse); 10% gravel to 5/8"; subangular to subrounded; 10% clay, slightly plastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
	SW-SM		Well-Graded Sand with Silt: 10YR 6/3, pale brown; loose; wet; 80% fine to coarse sand (70% fine, 15% medium, 15% coarse); 10% gravel to 5/8"; subangular to subrounded; 10% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
420	SM		Silty Sand: 10YR 5/3, brown; loose; wet; 70% fine sand; trace medium sand; subangular to subrounded; 30% silt, nonplastic; sand is quartz, feldspar, and lithic fragments.	
430	SP-SM		Poorly Graded Sand with Silt: 10YR 5/3, brown; loose; wet; 90% fine to medium sand (80% fine, 20% medium); trace coarse sand; trace gravel to 3/8"; subangular to subrounded; 10% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments. At 440 ft, no gravel. At 450 ft, 80% fine to medium sand; trace coarse sand; 10% gravel to 1/2"; 10% silt.	
440				
450				
460	SP		Poorly Graded Sand: 10YR 5/3, brown; loose; wet; 95% fine to medium sand (60% fine, 40% medium); trace coarse sand; trace gravel to 5/8"; subangular to subrounded; 5% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments.	
470	SW		Well-Graded Sand: 10YR 5/3, brown; loose; wet; 95% fine to coarse sand (40% fine, 40% medium, 20% coarse); trace gravel to 3/8"; subangular to subrounded; 5% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
480				

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Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **7 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description
490	SW		Well-Graded Sand: 10YR 5/3, brown; loose; wet; 95% fine to coarse sand (40% fine, 40% medium, 20% coarse); trace gravel to 3/8"; subangular to subrounded; 5% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments. At 480 ft, 85% fine to coarse sand (25% fine, 50% medium, 25% coarse); 10% gravel to 1/2"; 5% silt.
500	SM		Silty Sand: 10YR 5/3, brown; loose; wet; 85% fine to coarse sand (80% fine, 15% medium, 5% coarse); trace gravel to 3/8"; subangular to subrounded; 15% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.
510	SW		Well-Graded Sand with Gravel: 10YR 5/3, brown; loose; wet; 80% fine to coarse sand (30% fine, 40% medium, 30% coarse); 15% gravel to 5/8"; subangular to subrounded; 5% silt, nonplastic; sand and gravel are quartz, feldspar, and lithic fragments.
520	SP-SC		Poorly Graded Sand with Clay: 10YR 5/3, brown; loose; wet; 90% fine to medium sand (80% fine, 20% medium); trace coarse sand; subangular to subrounded; 10% clay, slightly plastic; sand is quartz, feldspar, and lithic fragments; clay exists as 7.5YR 5/3, brown, nodules to 1-1/2".
530	SP-SM		Poorly Graded Sand with Silt: 10YR 5/3, brown; loose; wet; 90% fine to medium sand (80% fine, 20% medium); trace coarse sand; subangular to subrounded; 10% silt; trace clay; sand is quartz, feldspar, and lithic fragments.
540	SW		Well-Graded Sand: 10YR 5/3, brown; loose; wet; 95% fine to coarse sand (50% fine, 40% medium, 10% coarse); trace gravel to 1/2"; subangular to subrounded; 5% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments. At 540 ft, trace gravel to 3/8".
550			
560			

Completion Details:
- 1:1 Mix of 1/4" TR-30 Bentonite Pellets and 8/12 Silica Sand, 501 to 541 ft bgs
- 6/9 Silica Sand, 541 to 567 ft bgs

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EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **8 of 12**

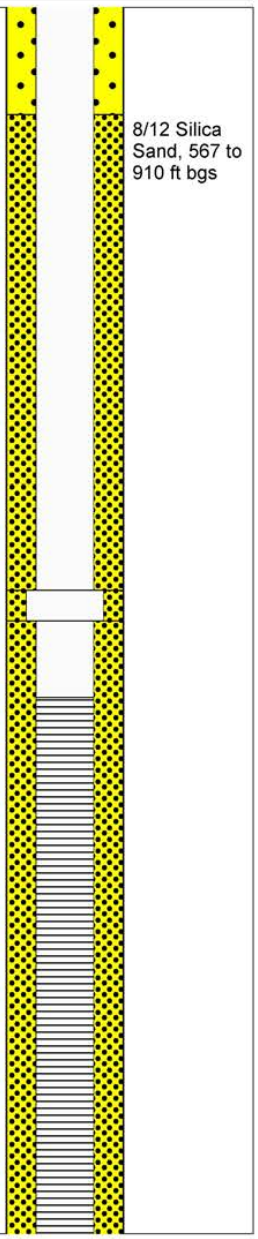
Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description
570	GW-GC		Well-Graded Gravel with Clay and Sand: 10YR 5/3, brown; loose; wet; 60% gravel to 1/2"; 30% fine to coarse sand (50% fine, 30% medium, 20% coarse); subangular to subrounded; 10% clay, nonplastic; gravel and sand are quartz, feldspar, and lithic fragments.
580	SW		Well-Graded Sand: 10YR 5/3, brown; loose; wet; 90% fine to coarse sand (50% fine, 40% medium, 10% coarse); 5% gravel to 3/8"; subangular to subrounded; 5% clay, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.
590	SP-SM		Poorly Graded Sand with Silt: 10YR 5/3, brown; loose; wet; 90% fine to medium sand (70% fine, 30% medium); subangular to subrounded; 10% silt, nonplastic; sand is quartz, feldspar, and lithic fragments.
600	SM		Silty Sand: 10YR 5/3, brown; loose; wet; 85% fine to medium sand (90% fine, 10% medium); trace coarse sand; subangular to subrounded; 15% silt, nonplastic; sand is quartz, feldspar, and lithic fragments.
610	SP-SM		Poorly Graded Sand with Silt: 10YR 5/3, brown; loose; wet; 90% fine to medium sand (60% fine, 40% medium); trace coarse sand; trace gravel to 3/8"; subangular to subrounded; 10% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments.
620	SM		Silty Sand: 10YR 5/3, brown; loose; wet; 85% fine to medium sand (90% fine, 10% medium); subangular to subrounded; 15% silt, nonplastic; sand is quartz, feldspar, and lithic fragments.
630	SW-SC		Well-Graded Sand with Clay: 10YR 5/3, brown; loose; wet; 85% fine to coarse sand (50% fine, 40% medium, 10% coarse); 5% gravel to 3/8"; subangular to subrounded; 10% clay, nonplastic to slightly plastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.
640	SW		Well-Graded Sand: 10YR 5/3, brown; loose; wet; 85% fine to coarse sand (15% fine, 45% medium, 40% coarse); 10% gravel to 3/4"; subangular to subrounded; 5% clay, nonplastic to slightly plastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.

Completion Details



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EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **9 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description
650	SW		Well-Graded Sand: 10YR 5/3, brown; loose; wet; 85% fine to coarse sand (15% fine, 45% medium, 40% coarse); 10% gravel to 3/4"; subangular to subrounded; 5% clay, nonplastic to slightly plastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments. At 640 ft, 90% fine to coarse sand (40% fine, 50% medium, 10% coarse); trace gravel to 3/8"; subangular to subrounded; 5% silt; 5% clay. At 650 ft, 90% sand (40% fine, 55% medium, 5% coarse); no trace gravel.
660	CL		Clay: 7.5YR 5/3, brown; soft to stiff; moist; plastic; 90% clay; 10% fine to medium sand (80% fine, 20% medium); subangular to subrounded; sand is quartz, feldspar, and lithic fragments. Note: clay is highly mottled to 2.5Y 6/4, light yellowish brown, and exhibits a strong reaction with acid. At 670 ft, Sandy Clay: 7.5YR 5/4, brown; soft; wet; slightly plastic; 60% clay; 40% fine to medium sand (80% fine, 20% medium); trace coarse sand; trace lithic gravel to 3/8". Note: clay exhibits a weak reaction with acid.
680	SP-SC		Poorly Graded Sand with Clay: 10YR 5/3, brown; loose; wet; 90% fine to medium sand (65% fine, 35% medium); trace coarse sand; subangular to subrounded; 10% clay, nonplastic; sand is quartz, feldspar, and lithic fragments.
690	SC		Clayey Sand: 2.5Y 6/4, light yellowish brown; soft; wet; 70% fine to coarse sand (70% fine, 25% medium, 5% coarse); 5% gravel to 5/8"; subangular to subrounded; 25% clay, nonplastic to slightly plastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.
700	SP-SC		Poorly Graded Sand with Clay: 10YR 5/3, brown; loose; wet; 90% fine to medium sand (75% fine, 25% medium); trace coarse sand; trace gravel to 3/8"; subangular to subrounded; 10% clay, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments.
710	SW-SC		Well-Graded Sand with Clay: 10YR 5/3, brown; loose; wet; 85% fine to coarse sand (50% fine, 35% medium, 15% coarse); 5% gravel to 1/2"; subangular to subrounded; 10% clay, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.
720			

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EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **10 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description	Completion Details
730	SW-SC		Well-Graded Sand with Clay: 10YR 5/3, brown; loose; wet; 85% fine to coarse sand (35% fine, 50% medium, 15% coarse); 5% gravel to 1/2"; subangular to subrounded; 10% clay, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
740	SC		Clayey Sand: 10YR 6/3, brown; loose; wet; 70% fine to medium sand (80% fine, 20% medium); trace coarse sand; subangular to subrounded; 20% clay; 10% silt, nonplastic; sand is quartz, feldspar, and lithic fragments.	
750	SW-SC		Well-Graded Sand with Clay: 10YR 6/3, pale brown; loose; wet; 80% fine to coarse sand (40% fine, 35% medium, 25% coarse); 10% gravel to 1/2"; subangular to subrounded; 10% clay, slightly plastic; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments. Note: clay exists as 7.5YR 5/3, brown, nodules. At 750 ft, 70% sand (20% fine, 60% medium, 20% coarse); 20% quartz and lithic gravel to 1"; 10% clay.	
760				
770			Poorly Graded Sand with Silt: 10YR 5/3, brown; loose; wet; 85% fine to medium sand (70% fine, 30% medium); trace coarse sand; subangular to subrounded; 10% silt; 5% clay, nonplastic; sand is quartz, feldspar, and lithic fragments. At 770 ft, sand is 80% fine, 20% medium.	
780	SP-SM			
790				
800				

Note:
ags = above ground surface
bgs = below ground surface
ft = foot(feet)
HSLA = high-strength low-alloy
in = inch(es)
OD = outside diameter

EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **11 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description	Completion Details
810	SP-SM		Poorly Graded Sand with Silt: 10YR 5/3, brown; loose; wet; 85% fine to medium sand (80% fine, 20% medium); trace coarse sand; subangular to subrounded; 10% silt; 5% clay, nonplastic; sand is quartz, feldspar, and lithic fragments.	
820	SC		Clayey Sand: 10YR 5/3, brown; loose; wet; 80% fine to coarse sand (60% fine, 30% medium, 10% coarse); 5% gravel to 3/4"; subangular to subrounded; 15% clay, nonplastic to slightly plastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
830	CL		Clay with Sand: 10YR 7/2, light gray; soft to stiff; wet; slightly plastic to plastic; 75% clay; 20% fine to coarse sand (70% fine, 20% medium, 10% coarse); 5% gravel to 3/8"; subangular to subrounded; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments. Note: clay exhibits a weak reaction with acid.	
840	SC		Clayey Sand: 10YR 5/3, brown; loose; wet; 80% fine to coarse sand (70% fine, 25% medium, 5% coarse); trace gravel to 3/8"; subangular to subrounded; 15% clay, nonplastic to slightly plastic; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments.	
850	SP-SC		Poorly Graded Sand with Clay: 10YR 5/3, brown; loose; wet; 90% fine to medium sand (80% fine, 20% medium); subangular to subrounded; 10% clay, nonplastic; sand is quartz, feldspar, and lithic fragments. At 850 ft, trace coarse sand; trace lithic gravel to 3/8"; clay exists as nonplastic to slightly plastic 7.5YR 5/3, brown, nodules; medium stiff. At 860 ft, 10YR 6/3, pale brown.	
860				
870				
880				

Note:
ags = above ground surface
bgs = below ground surface
ft = foot(feet)
HSLA = high-strength low-alloy
in = inch(es)
OD = outside diameter

EA Engineering, Science, and Technology, Inc., PBC

Project: **62735DM02.1016**
Location: **Kirtland Air Force Base, New Mexico**
Start Date: **07-02-2020**
Completion Date: **10-19-2020**

WELL LOG

Well ID: **KAFB-106IN2**
Page: **12 of 12**

Drilling Company: **Stewart Brothers Drilling Co.**
Drilling Method: **Reverse Circulation Mud Rotary**
Drill Bit: **20" Tricone Bit**
Drillers: **T. Holmes, M. Rodriguez, J. Russette Jr., O. Chacho**
Geologist: **J. Messenger**

Boring Depth (ft bgs): **921**
Boring Diameter (in): **20**
Well Diameter (in): **12.75 OD**
DTW After Completion (ft bgs): **494.68**
Riser Material: **12.75" OD HSLA Steel**

Screen Material: **12.75" OD Stainless Steel; 0.060" Slot Screen**
Seal Material(s): **Cement, Bentonite Cement Grout, Bentonite/Sand**
Barrier Material: **6/9 Silica Sand**
Filter Pack: **8/12 Silica Sand**

Depth (ft)	USCS	Lithology	Sample Description	Completion Details
890	SC		Clayey Sand: 10YR 6/3, brown; loose; wet; 80% fine to medium sand (70% fine, 30% medium); trace coarse sand; subangular to subrounded; 20% clay, nonplastic to slightly plastic; sand is quartz, feldspar, and lithic fragments.	
	CL		Sandy Clay: 10YR 6/3, pale brown: soft; wet; slightly plastic; 65% clay; 35% fine to coarse sand (60% fine, 30% medium, 10% coarse); trace gravel to 3/8"; subangular to subrounded; sand is quartz, feldspar, and lithic fragments; gravel is quartz and lithic fragments. Note: clay is weakly mottled to 10YR 7/3, very pale brown, and exhibits a weak reaction with acid.	
900	SP-SM		Poorly Graded Sand with Silt: 10YR 5/4, brown; loose; wet; 90% fine to medium sand (80% fine, 20% medium); subangular to subrounded; 10% silt, nonplastic; sand is quartz, feldspar, and lithic fragments.	12.75" Stainless Steel Sump, 905.85 to 911.4 ft bgs
910	SM		Silty Sand: 10YR 5/3, brown; loose; wet; 80% fine to medium sand (75% fine, 25% medium); subangular to subrounded; 15% silt, nonplastic; sand is quartz, feldspar, and lithic fragments.	Slough and 8/12 Silica Sand Mixture, 910 to 921 ft bgs
920	SP-SM		At 920 ft, Poorly Graded Sand with Silt: 10YR 5/3, brown; loose; wet; 90% fine to medium sand (40% fine, 60% medium); trace coarse sand; trace gravel to 3/8"; subangular to subrounded; 10% silt, nonplastic; sand is quartz, feldspar, and lithic fragments; gravel is lithic fragments. TD = 921 ft bgs as confirmed by geophysical logs	

Note:
ags = above ground surface
bgs = below ground surface
ft = foot(feet)
HSLA = high-strength low-alloy
in = inch(es)
OD = outside diameter

APPENDIX K

USER OPERATIONAL ADJUSTMENTS DOCUMENTATION

REPLACEMENT KUNKLE LIQUID RELIEF VALVE IN KAFB-106233

McKeage, Kevin

From: SANCHEZ, AMY ELIZABETH CIV USARMY CESPA (US) <Amy.E.Sanchez@usace.army.mil>
Sent: Tuesday, May 16, 2017 10:31 AM
To: Salazar, Carlos F CIV USARMY CESPA (US); Simpler, Trent W CIV USARMY CESPA (US); McKeage, Kevin; Phaneuf, Mark J CIV USARMY CESPA (US); Dreeland, Linda E CIV USARMY CESPA (US)
Cc: Jercinovic, Devon; Curley, Tyler; Becker, Lee
Subject: RE: Kirtland BFF - Operational Vault Changes

I also concur with proposed recommendations.

Thanks,
Amy

-----Original Message-----
From: Salazar, Carlos F CIV USARMY CESPA (US)
Sent: Tuesday, May 16, 2017 10:23 AM
To: Simpler, Trent W CIV USARMY CESPA (US) <Trent.Simpler@usace.army.mil>; McKeage, Kevin <kmckeage@eaest.com>; SANCHEZ, AMY ELIZABETH CIV USARMY CESPA (US) <Amy.E.Sanchez@usace.army.mil>; Phaneuf, Mark J CIV USARMY CESPA (US) <Mark.J.Phaneuf@usace.army.mil>; Dreeland, Linda E CIV USARMY CESPA (US) <Linda.E.Dreeland@usace.army.mil>
Cc: Jercinovic, Devon <djercinovic@eaest.com>; Curley, Tyler <tcurley@eaest.com>; Becker, Lee <lbecker@eaest.com>
Subject: RE: Kirtland BFF - Operational Vault Changes

I also concur.

Carlos

-----Original Message-----
From: Simpler, Trent W CIV USARMY CESPA (US)
Sent: Tuesday, May 16, 2017 10:20 AM
To: McKeage, Kevin <kmckeage@eaest.com>; SANCHEZ, AMY ELIZABETH CIV USARMY CESPA (US) <Amy.E.Sanchez@usace.army.mil>; Salazar, Carlos F CIV USARMY CESPA (US) <Carlos.F.Salazar@usace.army.mil>; Phaneuf, Mark J CIV USARMY CESPA (US) <Mark.J.Phaneuf@usace.army.mil>; Dreeland, Linda E CIV USARMY CESPA (US) <Linda.E.Dreeland@usace.army.mil>
Cc: Jercinovic, Devon <djercinovic@eaest.com>; Curley, Tyler <tcurley@eaest.com>; Becker, Lee <lbecker@eaest.com>
Subject: RE: Kirtland BFF - Operational Vault Changes

I concur with these recommendations. Amy? Carlos?

Thanks
Trent

Trent Simpler, P.E.
Project Manager BFF
Chair Wind Energy CX
Red Team LGL
US Army Corps of Engineers
Trent.Simpler@usace.army.mil
505-342-4823 (office)
505-301-6996 (mobile)

-----Original Message-----

From: McKeage, Kevin [mailto:kmckeage@eaest.com]
Sent: Tuesday, May 16, 2017 9:16 AM
To: Simpler, Trent W CIV USARMY CESPA (US) <Trent.Simpler@usace.army.mil>; SANCHEZ, AMY ELIZABETH CIV USARMY CESPA (US) <Amy.E.Sanchez@usace.army.mil>; Salazar, Carlos F CIV USARMY CESPA (US) <Carlos.F.Salazar@usace.army.mil>; Phaneuf, Mark J CIV USARMY CESPA (US) <Mark.J.Phaneuf@usace.army.mil>; Dreeland, Linda E CIV USARMY CESPA (US) <Linda.E.Dreeland@usace.army.mil>
Cc: Jercinovic, Devon <djercinovic@eaest.com>; Curley, Tyler <tcurley@eaest.com>; Becker, Lee <lbecker@eaest.com>
Subject: [Non-DoD Source] Kirtland BFF - Operational Vault Changes

USACE Team,

KAFB-106233 Liquid Relief Valve:

Currently, KAFB-106233 is equipped with a Kunkle Model 20-H01 liquid relief valve with a pressure set point of 200 psi which began leaking during pumping operations 12MAY17. EA recommends decreasing the pressure set point to provide a margin of safety between the liquid relief valve set point pressure and the maximum pressure rating of the HDPE dual wall conveyance line (200 psi rated). EA is proposing to replace the leaking liquid relief valve with the same model valve (20-H01) but with a lower set point of 150 psi.

Vault Leak Detection Elevation Increase:

Currently the wellhead vaults for KAFB-106233 and KAFB-106234 can contain a total volume of approximately 628 gallons (7'x3'x4', assuming negligible volume loss due to the presence of installed lines and equipment) and the leak detection sensors are placed approximately 4 inches off of the vault floor which is the equivalent of approximately 50 gallons of water in the vault (8% of the vault volume). With the current position of the leak detection sensors, rain events typically cause the vaults to collect enough surface water run-off to activate the sensors and result in erroneous well and/or system shutdowns. EA is proposing that the leak sensors be moved to approximately 12 inches above the vault floor which is approximately 157 gallons (25% of the vault volume). This height is equivalent to the top of the 3-inch steel pipe in the vault.

In the event that the line between the pitless adaptor and the check valve were to fail while the pump was not currently in operation, approximately 2.5 gallons of water would be leaked into the vault resulting in a depth of less than a quarter of an inch in the vault (not enough to be detected by the current leak detection sensor position). Additionally if the line failed during pumping, the current sensor position (4 inches) would alarm and shutdown the system within 17 seconds. If the leak detection sensors are adjusted to approximately 12 inches from the vault bottom, a line failure during pumping would be detected within 1 minute of the failure. Since the system currently responds to vault leak alarms nearly instantaneously, there is very little increase in risk imposed by this short delay in system shutdown. Additionally this would decrease the amount of unnecessary downtime for wells and/or the entire system during and after rain events.

Please let us know how you would like these field changes documented and if you have any questions or concerns.

Thank you,

Kevin McKeage, E.I.

Engineer

Cell: (316) 765-1486

Office: (505) 933-6417

kmckeage@eaest.com <mailto:kmckeage@eaest.com>

EA Engineering, Science, and Technology, Inc., PBC

320 Gold Ave, Suite. 1300

Albuquerque, NM 87102

Blockedwww.eaest.com <Blockedhttp://www.eaest.com>

-----Original Message-----

From: Simpler, Trent W CIV USARMY CESPA (US) [mailto:Trent.Simpler@usace.army.mil <mailto:Trent.Simpler@usace.army.mil>]

Sent: Monday, May 15, 2017 2:03 PM

To: Jercinovic, Devon <djercinovic@eaest.com <mailto:djercinovic@eaest.com> >; McKeage, Kevin <kmckeage@eaest.com <mailto:kmckeage@eaest.com> >

Cc: SANCHEZ, AMY ELIZABETH CIV USARMY CESPA (US) <Amy.E.Sanchez@usace.army.mil <mailto:Amy.E.Sanchez@usace.army.mil> >; Salazar, Carlos F CIV USARMY CESPA (US) <Carlos.F.Salazar@usace.army.mil <mailto:Carlos.F.Salazar@usace.army.mil> >; Dreeland, Linda E CIV USARMY CESPA (US) <Linda.E.Dreeland@usace.army.mil <mailto:Linda.E.Dreeland@usace.army.mil> >; Phaneuf, Mark J CIV USARMY CESPA (US) <Mark.J.Phaneuf@usace.army.mil <mailto:Mark.J.Phaneuf@usace.army.mil> >

Subject: Vault changes

Devon,

Your proposed changes to the pressure valve and moving the flood sensor (and other standard maintenance items) are considered user maintenance or safety changes and you only need to send us an email explaining what you want to change and why (short email) and we will approve.

Thanks

Trent

Trent Simpler, P.E.

Project Manager BFF

Chair Wind Energy CX

Red Team LGL

US Army Corps of Engineers

Trent.Simpler@usace.army.mil <mailto:Trent.Simpler@usace.army.mil>

505-342-4823 (office)

505-301-6996 (mobile)

Kunkle Safety and Relief Products
Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

KUNKLE

Non-code Bronze Liquid Relief Valves

Features

- Both inlet and outlet connections are cast integral with body to permit easy inspection and servicing without disconnecting piping.
- Beveled seats lapped for optimum performance.
- Stainless Steel (SS) spring for optimum corrosion resistance.
- Each Kunkle valve is tested and inspected for pressure setting and leakage.

Model Descriptions

Model 19: All bronze, equipped with handwheel for easy adjustment within spring ranges.

Model 19M: Same as model 19 except SS trim (seat and disc). Available 2½" and 3" only. For higher pressure settings or severe applications.

Model 20: All bronze, with pressure-tight cap. Suitable for maximum back pressure of 50 psig.[1]

Model 20M: Same as model 20 except SS trim. Available in 2½" and 3" only (seat and disc). For higher pressure settings or severe applications. Maximum back pressure of 50 psig.[1]

Model 20P: Same as model 20 except with packed lift lever. Suitable for maximum back pressure of 50 psig.[1]

Model 20MP: Same as model 20M except with packed lift lever. Maximum back pressure of 50 psig.[1]

Model 200A: Special non-chattering design. Recommended for light oils and continuous by-pass or pressure regulation. UL842 listed for light oil service. Available ¾" to 1½" sizes. Female NPT connections only.

Model 200H: Same as model 20. UL842 listed for use with fuel oils. Available ¾" to 2" sizes.

Applications

- Non-code liquid relief.
- Overpressure relief and protection of pumps, tanks, lines and hydraulic systems.

Model 20

- Pressure regulation.
- Continuous by-pass relief.

Options

- Available with optional female NPT inlet or flanged inlet and outlet connections.
- **Model 19**
  Variation 10: 1 to 150 psig adjustable spring range
  Variation 11: 151 to 300 psig adjustable spring range
- **Model 20-D**
  Variation 05: 50 to 150 psig spring range
  Variation 06: 100 to 300 psig

Pressure and Temperature Limits

Models 19, 20, 20P:
1 to 300 psig
-60° to 406°F

Models 19M, 20M, 20MP:
1 to 500 psig
-60° to 406°F

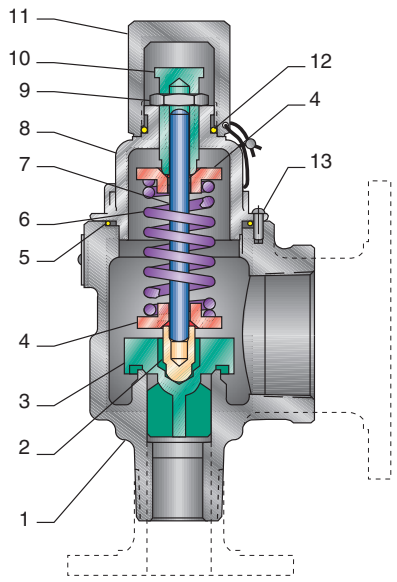
Models 200A, 200H:
1 to 200 psig
-60° to 406°F

Note

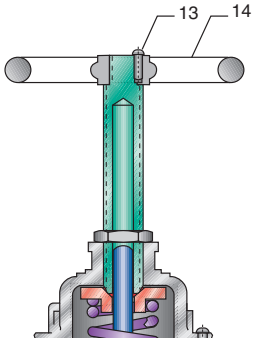
1. Back pressure increases set pressure on a one to one basis, and reduces capacity. Back pressure in excess of 10% of set pressure is not recommended.

Kunkle Safety and Relief Products
Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

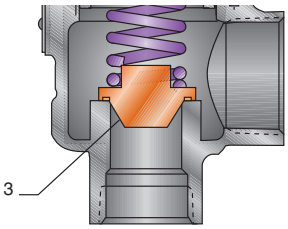
Parts and Materials



Models 20, 200H with Pressure Tight Cap



Model 19, 19M



Model 200A

Parts and Materials

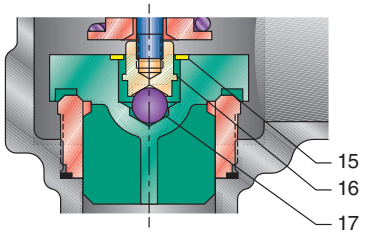
No.	Part Name	19, 19M	20, 20M, 20P, 20MP, 200A, 200H
1	Body[1]	Bronze B62	Bronze B62
2	Stem Retainer	Brass B16	Brass B16
3	Disc	Bronze B584 Alloy 84400[2,3]	Bronze B584 Alloy 84400[2,3]
4	Spring Step	Brass B16	Brass B16
5	O-ring	Teflon®	Teflon®
6	Spring	SS 316 or 17-7	SS 316 or 17-7
7	Stem	Brass B16	Brass B16
8	Bonnet	Bronze B584 Alloy 84400	Bronze B584 Alloy 84400
9	Jam Nut	Steel A108 Zinc Plated	Brass B16
10	Compression Screw	Brass B16	Brass B16
11	Cap	N/A	Brass B16
12	O-ring	N/A	BUNA-N
13	Drive Screw[6]	SS Commercial	SS Commercial
14	Handwheel	Iron A126 Zinc Plated[5]	N/A

Notes

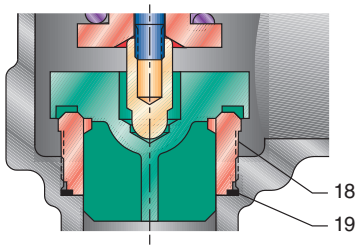
1. Flanged connections optional.
2. Models 19, 20, 20P, 200H are brass, B283, Alloy 485, for 1/2", 3/4", and 1".
3. Models 19M, 20M, and 20MP are SS A743-CF8.
4. Model 200A is brass B16.
5. Bronze B584 Alloy 84400 for 1/2", 3/4", 1 1/4".
6. Not used on bonnet for 2 1/2" and 3".

Kunkle Safety and Relief Products
Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

Parts and Materials



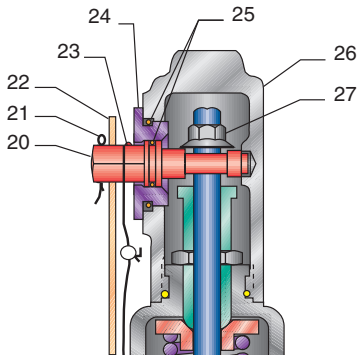
Models 19M, 20M and 20MP
2½" Seat Configuration



Models 19M, 20M and 20MP
3" Seat Configuration

Parts and Materials

No.	Part Name	Material
15	Retainer Washer	SS PH15-7MO
16	Stem End	SS A582-303
17	Ball	SS A756-440
18	Insert	SS A743 GR CF8
19	O-ring	Teflon®



Models 20MP and 20P With Lever

Parts and Materials

No.	Part Name	20P, 20MP
20	Lift Cam	SS A743-316
21	Cotter Pin	Steel
22	Lever	Steel A108 Zinc Plated
23	Drive Screw	SS Commercial
24	Retainer Cam	Brass B16
25	O-ring	BUNA-N
26	Cap	Bronze B584 Alloy 84400
27	Lift Nut	Steel A108

Kunkle Safety and Relief Products

Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

Liquid Relief Valves

Specifications

Size Inlet/Outlet NPT, (in)	Min/Max Set Pressure, (psig[1]) 19, 20, 20P	200A, 200H	19M, 20M, 20MP	Min/Max Temp. (°F)	Approximate Wt., (lb)
1/2[2]	1/300	—	—	-60/406	2 1/4
3/4	1/300	1/200	—	-60/406	2 1/4
1	1/300	1/200	—	-60/406	3 1/2
1 1/4	1/300	1/200	—	-60/406	5
1 1/2	1/300	1/200	—	-60/406	6 1/4
2	1/300	1/200	—	-60/406	11
2 1/2	1/300	—	1/500	-60/406	16
3	1/300	—	1/500	-60/406	25

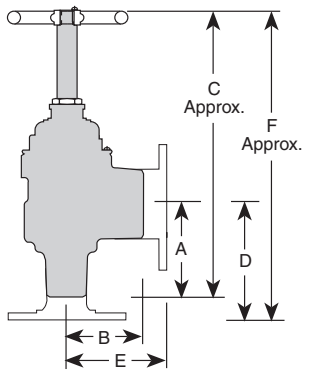
Dimensions

Valve Model	Threaded A	B	C	150/300 Flange D	E	F
1/2" Size						
19	2	1 5/8	6 1/8	3 5/16	3 5/16	7 3/8
20	2	1 5/8	5 7/8	3 5/16	3 5/16	7 1/4
20P	2	1 5/8	7 3/8	—	—	—
3/4" Size						
19	2	1 5/8	6 1/8	3 5/16	3 5/16	7 3/8
20	2	1 5/8	5 7/8	3 5/16	3 5/16	7 1/4
20P	2	1 5/8	7 3/8	3 5/16	3 5/16	8 3/4
200A	2	1 5/8	5 7/8	—	—	—
200H	1 15/16	1 5/8	5 7/8	3 5/16	3 5/16	7 3/8
1" Size						
19	2 1/4	1 7/8	7 1/8	3 7/16	3 7/16	8 1/4
20	2 1/4	1 7/8	6 3/4	3 7/16	3 7/16	7 7/8
20P	2 1/4	1 7/8	8 3/4	3 7/16	3 7/16	9 1/2
200A	2 1/4	1 7/8	6 3/4	—	—	—
200H	2 1/4	1 7/8	6 11/16	3 7/16	3 7/16	8

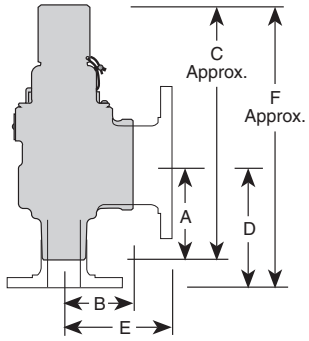
Dimensions are for reference only.

Notes

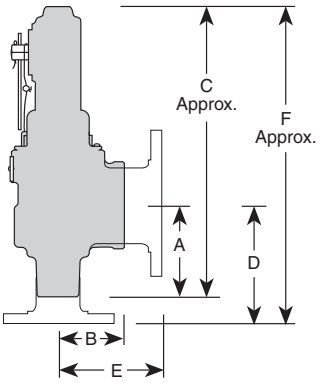
1. All flanges rated per ANSI B16.24.
2. Standard with 3/4" outlet - 1/2" outlet optional.



Models 19, 19M



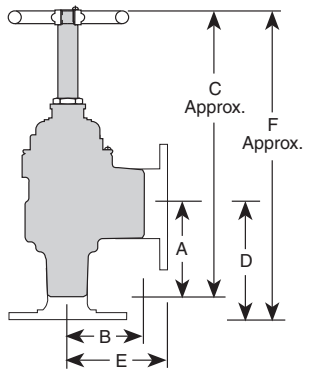
Models 20, 20M, 200A, 200H



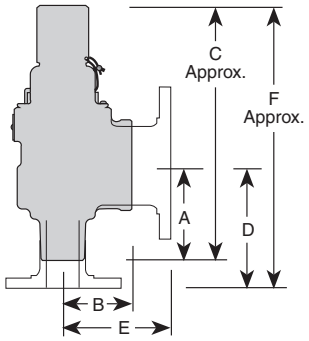
Models 20P, 20MP

Kunkle Safety and Relief Products
Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

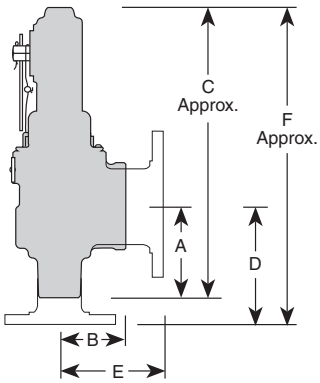
Liquid Relief Valves



Models 19, 19M



Models 20, 20M, 200A, 200H



Models 20P, 20MP

Dimensions, inches

Valve Model	Threaded			150/300 Flange		
	A	B	C	D	E	F
1¼" Size						
19	2 5/8	2 1/16	8 1/8	3 11/16	3 11/16	9 1/8
20	2 5/8	2 1/16	8 1/8	3 11/16	3 11/16	8 3/8
20P	2 5/8	2 1/16	9	3 11/16	3 11/16	10
200A	2 5/8	2 1/16	7 3/8	—	—	—
200H	2 5/8	2 1/16	7 3/8	3 11/16	3 11/16	8 5/8
1½" Size						
19	2 11/16	2 1/8	8 5/8	4 1/8	4 1/8	10 1/8
20	2 11/16	2 1/8	8 5/8	4 1/8	4 1/8	9 1/4
20P	2 11/16	2 1/8	9 1/4	4 1/8	4 1/8	10 3/4
200A	2 11/16	2 1/8	7 7/8	—	—	—
200H	2 11/16	2 1/8	7 7/8	4 1/8	4 1/8	9 1/2
2" Size						
19	3 1/2	2 11/16	10 5/8	4 1/4	4 1/4	11 1/4
20	3 1/2	2 11/16	10 5/8	4 1/4	4 1/4	10 5/8
20P	3 1/2	2 11/16	12 1/2	4 1/4	4 1/4	13 1/8
200H	3 1/2	2 11/16	9 15/16	4 1/2	4 1/4	10 15/16
2½" Size						
19	3 7/8	3	11 1/8	4 3/4	4 3/4	12
19M	3 7/8	3	11 1/8	4 3/4	4 3/4	12 1/4
20	3 7/8	3	10	4 3/4	4 3/4	13 5/16
20M	3 7/8	3	10	4 3/4	4 3/4	13 9/16
20P	3 7/8	3	12 1/2	4 3/4	4 3/4	15 3/4
20MP	3 7/8	3	12 1/2	5 4 3/4	4 3/4	16 1/16
3" Size						
19	4 5/8	3 7/8	12 1/4	5	5	12 5/8
19M	4 5/8	3 7/8	12 1/4	5	5	13 1/8
20	4 5/8	3 7/8	12 1/4	5	5	14 3/4
20M	4 5/8	3 7/8	12 1/4	5	5	15 1/8
20P	4 5/8	3 7/8	14 3/8	5	5	16 7/8
20MP	4 5/8	3 7/8	14 3/8	5	5	17 1/4

Dimensions are for reference only.

Kunkle Safety and Relief Products
Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

Models 19, 19M, 20, 20M, 20MP, 20P and 200H Capacities Liquid Relief Valves

Non-code Liquid Capacity - 25% Accumulation (GPM)

Set Pressure (psig)	Valve Inlet and Outlet Size							
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"
1	1	2	4	6	10	19	31	45
5	2	5	8	14	22	42	68	100
10	3	7	11	20	31	59	97	141
20	4	9	16	28	43	84	137	200
30	5	11	20	34	53	102	168	244
40	6	13	23	39	61	118	193	282
50	7	15	25	44	68	132	216	315
60	7	16	28	48	75	145	237	346
70	8	17	30	52	81	156	256	373
80	8	19	32	55	87	167	274	399
90	9	20	34	59	92	177	290	423
100	9	21	36	62	97	187	306	446
110	10	22	37	65	102	196	321	468
120	10	23	39	68	106	205	335	489
130	11	24	41	71	110	213	349	509
140	11	25	42	73	115	221	362	528
150	11	25	44	76	119	229	375	546
160	12	26	45	78	123	236	387	564
170	12	27	47	81	126	244	399	582
180	13	28	48	83	130	251	410	599
190	13	29	49	86	134	258	422	615
200	13	29	50	88	137	264	433	631
210	14	30	52	90	140	271	443	646
220	14	31	53	92	144	277	454	662
230	14	32	54	94	147	284	464	677
240	14	32	55	96	150	290	474	691

Note

1. Liquid Overpressure Factors

   To determine capacities at other than 25% overpressure/accumulation, multiply capacity shown by:

   10% Acc. = 0.6
   15% Acc. = 0.8
   20% Acc. = 0.9

Models 19, 19M, 20, 20M, 20MP, 20P and 200H Capacities Liquid Relief Valves

Non-code Liquid Capacity - 25% Accumulation (GPM)

Set Pressure (psig)	Valve Inlet and Outlet Size							
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"
250	15	33	56	98	153	296	484	705
260	15	34	58	100	156	301	493	719
270	15	34	59	102	159	307	503	733
280	16	35	60	104	162	313	512	746
290	16	35	61	106	165	318	521	760
300	16	36	62	107	168	323	530	773
310	—	—	—	—	—	—	539	785
320	—	—	—	—	—	—	547	798
330	—	—	—	—	—	—	556	810
340	—	—	—	—	—	—	564	823
350	—	—	—	—	—	—	572	835
360	—	—	—	—	—	—	580	846
370	—	—	—	—	—	—	588	858
380	—	—	—	—	—	—	596	870
390	—	—	—	—	—	—	604	881
400	—	—	—	—	—	—	612	892
410	—	—	—	—	—	—	619	903
420	—	—	—	—	—	—	627	914
430	—	—	—	—	—	—	634	925
440	—	—	—	—	—	—	642	936
450	—	—	—	—	—	—	649	946
460	—	—	—	—	—	—	656	957
470	—	—	—	—	—	—	663	967
480	—	—	—	—	—	—	670	977
490	—	—	—	—	—	—	677	987
500	—	—	—	—	—	—	684	998

Note

1. Liquid Overpressure Factors

   To determine capacities at other than 25% overpressure/accumulation, multiply capacity shown by:

   10% Acc. = 0.6
   15% Acc. = 0.8
   20% Acc. = 0.9

Kunkle Safety and Relief Products

Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

200A Capacities at 25%, 50%, 75% and 100% Accumulation (GPM)

Model 200A "D" - 3/4"

	Overpressure			
psi	25%	50%	75%	100%
5	1.2	1.9	2.7	3.7
10	1.2	2.0	2.8	4.4
15	1.3	2.0	2.9	4.7
20	1.5	2.2	3.0	5.2
25	1.5	2.2	3.0	6.0
30	1.5	2.2	3.1	6.5
35	1.5	2.5	3.3	7.4
40	1.7	2.6	3.5	8.5
45	1.9	2.8	3.6	9.6
50	2.0	3.0	3.8	11.0
55	2.2	3.2	4.0	12.2
60	2.3	3.4	4.2	13.5
65	2.4	3.5	4.4	14.8
70	2.5	3.7	4.5	16.0
75	2.6	4.0	4.7	17.1
80	2.8	4.2	5.0	18.2
85	2.9	4.4	5.1	19.3
90	3.0	4.6	5.4	20.2
95	3.1	4.7	5.5	21.0
100	3.1	4.8	5.7	21.4
105	3.3	5.0	6.0	21.5
110	3.4	5.1	6.1	21.4
115	3.4	5.3	6.2	21.0
120	3.5	5.5	6.4	20.5
125	3.5	5.6	6.5	20.2
130	3.5	5.8	6.7	19.8
135	3.7	6.0	6.9	20.0
140	3.7	6.1	7.0	20.2
145	3.8	6.2	7.0	20.8
150	3.8	6.3	7.2	21.5
155	4.0	6.5	7.4	22.0
160	4.0	6.5	7.5	22.9
165	4.0	6.5	7.6	23.7
170	4.0	6.6	7.8	24.6
175	4.1	6.8	8.2	25.5
180	4.2	6.9	8.5	26.8
185	4.3	6.9	9.0	28.5
190	4.4	7.0	10.0	30.5
195	4.4	7.0	11.5	33.5
200	4.5	7.0	12.9	36.2

Model 200A "E" - 1"

	Overpressure			
psi	25%	50%	75%	100%
5	0.7	1.0	1.3	2.5
10	1.1	1.5	2.0	4.2
15	1.5	2.0	2.7	5.9
20	1.7	2.5	3.5	7.5
25	2.0	2.9	4.1	9.5
30	2.2	3.2	4.6	11.0
35	2.5	3.6	5.0	12.9
40	2.6	4.0	5.5	14.5
45	2.8	4.2	5.8	16.5
50	2.9	4.5	6.0	18.4
55	3.0	4.8	6.4	20.1
60	3.2	5.0	6.6	22.0
65	3.4	5.2	6.8	24.0
70	3.5	5.5	7.1	26.0
75	3.5	5.7	7.3	27.8
80	3.6	6.1	7.5	29.5
85	3.8	6.4	7.7	31.0
90	3.9	6.7	8.1	32.7
95	4.0	6.9	8.2	34.2
100	4.1	7.0	8.5	35.5
105	4.3	7.2	8.7	37.0
110	4.4	7.4	9.0	38.0
115	4.5	7.5	9.1	39.0
120	4.5	7.6	9.2	39.8
125	4.7	7.7	9.5	40.2
130	4.8	7.8	9.6	40.5
135	4.8	8.0	9.7	40.5
140	4.9	8.0	9.8	40.1
145	5.0	8.4	10.0	39.5
150	5.0	8.5	10.0	38.3
155	5.0	8.5	10.2	37.2
160	5.1	8.7	10.4	36.0
165	5.2	9.0	10.5	34.8
170	5.4	9.2	10.8	33.7
175	5.5	9.4	10.9	33.0
180	5.5	9.5	11.0	33.0
185	5.5	9.5	11.2	34.2
190	5.4	9.5	11.3	37.5
195	5.2	9.5	11.5	43.5
200	5.0	9.5	11.6	48.8

Kunkle Safety and Relief Products
Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

200A Capacities at 25%, 50%, 75% and 100% Accumulation (GPM)

Model 200A "F" - 1¼"

	Overpressure			
psi	25%	50%	75%	100%
5	1.0	4.0	5.0	7.0
10	2.5	7.0	7.0	13.5
15	4.0	10.0	12.5	20.0
20	5.0	14.0	16.5	27.5
25	7.5	18.0	21.5	35.0
30	8.0	20.2	25.0	41.5
35	9.5	25.5	29.5	48.5
40	10.0	27.0	33.5	54.5
45	11.0	28.2	38.0	60.0
50	11.8	30.0	42.5	66.5
55	12.5	31.5	47.5	73.0
60	13.0	33.0	52.0	79.0
65	14.0	34.5	56.5	85.5
70	14.8	36.0	61.0	92.0
75	15.5	37.7	65.5	97.5
80	16.2	39.0	69.5	102.7
85	17.0	40.0	73.0	108.0
90	18.0	41.0	76.0	112.0
95	18.5	42.0	78.0	115.5
100	17.5	42.0	78.5	116.7
105	16.5	41.0	77.5	115.7
110	15.5	39.5	74.5	113.0
115	14.5	37.5	70.5	108.5
120	13.5	35.0	66.0	103.5
125	12.5	33.7	62.7	99.8
130	11.5	33.0	60.0	98.0
135	10.5	33.5	60.5	99.0
140	11.8	35.0	63.0	103.0
145	13.0	37.5	66.5	109.0
150	14.5	40.0	71.0	116.0
155	16.0	43.5	76.0	123.7
160	17.2	47.0	81.5	132.0
165	18.8	50.5	87.0	140.0
170	20.0	54.0	92.5	148.0
175	21.5	57.8	97.5	155.5
180	23.0	61.0	102.0	160.5
185	24.0	63.5	105.0	163.0
190	25.0	65.5	106.0	160.0
195	26.2	67.5	106.5	153.5
200	27.5	69.0	106.8	147.5

Model 200A "G" - 1½"

	Overpressure			
psi	25%	50%	75%	100%
5	1.5	2.2	4.5	8.5
10	2.0	3.2	8.7	18.0
15	2.8	4.3	13.0	27.9
20	3.4	5.3	17.0	37.0
25	3.8	6.2	20.8	44.5
30	4.0	6.8	24.0	51.8
35	4.5	7.5	27.0	57.7
40	5.0	8.0	30.0	62.5
45	5.0	8.3	32.5	67.5
50	5.5	8.5	35.0	72.0
55	5.7	8.9	37.7	76.5
60	6.0	9.5	40.0	80.5
65	6.5	9.5	42.5	84.5
70	6.5	9.7	45.0	88.3
75	6.7	9.8	47.0	91.7
80	6.7	10.0	49.0	94.7
85	6.8	10.0	51.0	97.5
90	7.0	10.3	53.0	99.5
95	7.2	10.5	54.0	100.6
100	7.2	11.0	55.0	100.3
105	7.5	11.0	54.0	97.5
110	7.5	11.3	53.0	93.0
115	7.5	11.7	51.0	87.0
120	7.5	11.8	49.0	80.5
125	7.7	12.0	47.5	75.5
130	7.9	12.0	46.8	73.0
135	8.0	12.2	47.2	73.5
140	8.0	12.2	48.7	77.0
145	8.0	12.4	50.7	83.0
150	8.0	12.4	53.0	90.0
155	8.0	12.4	56.0	98.0
160	8.0	12.4	59.0	106.5
165	8.0	12.5	62.3	115.7
170	8.0	12.7	65.5	124.5
175	8.0	13.0	69.0	133.5
180	8.5	14.0	73.0	140.5
185	9.0	15.8	77.0	146.0
190	10.0	19.0	82.5	150.0
195	11.8	23.5	89.0	152.2
200	13.5	27.7	95.5	154.7

Kunkle Safety and Relief Products

Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

Model Number/Order Guide

Model Number Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Example	0	0	1	9	—	F	0	1	—	M	G	0	0	7	5

Model

0019	019M
0020	020M
020P	20MP
200A	200H

Inlet Size

C - 1/2"	G - 1 1/2"
D - 3/4"	H - 2"
E - 1"	J - 2 1/2"
F - 1 1/4"	K - 3"

Variation

See chart page 11

Design Revision

Indicates non-interchangeable revision. Dash (-) if original design.

Spring Material

G - 316 SS
H - 304 SS (only for Model 19M-K 300 psig or greater)

Set Pressure

0005 - 5 psig
0025 - 25 psig
0400 - 400 psig

Kunkle Safety and Relief Products
Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

		Variation														
		1/2" Male x 3/4" Female	1/2" Male x 1/2" Female	1/2" Female x 3/4" Female	Male x Female with Gag	1/2" Female x 1/2" Female	1/2" 150 Flg x 1/2" 150 Flg	1/2" 300 Flg x 1/2" 150 Flg	Male x Female	Female x Female (200A)	Female x Female	150 Flg x 150 Flg	300 Flg x 150 Flg (200H)	300 Flg x 150 Flg	150 Flg x 150 Flg (200H)	3/4" 300 Flg x 3/4" 150 Flg (020P-D)
Model - Inlet Size	**Inlet x Outlet**	**01**	**02**	**03**	**03**	**04**	**05**	**06[1]**	**01**	**01**	**02**	**03**	**03**	**04**	**04**	**05**
19-C, 20-C, 20P-C	1/2" x 1/2" (3/4")	X	X	X		X	X	X								
19-D, 20-D	3/4" x 3/4"								X		X	X		X		
200A-D	3/4" x 3/4"									X						
200H-D	3/4" x 3/4"								X		X		X		X	
19-E, 20-E, 20P-E[2]	1" x 1"								X		X	X		X		
200A-E	1" x 1"									X	X					
200H-E	1" x 1"								X		X		X		X	
19-F, 20-F, 20P-F[2]	1 1/4" x 1 1/4"								X		X	X		X		
200A-F	1 1/4" x 1 1/4"									X						
200H-F	1 1/4" x 1 1/4"								X		X		X		X	
19-G, 20-G, 20P-G[2]	1 1/2" x 1 1/2"								X		X	X		X		
200A-G	1 1/2" x 1 1/2"									X						
200H-G	1 1/2" x 1 1/2"								X		X		X		X	
19-H, 20-H, 20P-H[2]	2" x 2"								X		X	X		X		
200H-H	2" x 2"								X		X		X		X	
19-J, 19M-J, 20J, 20P-J, 20M-J, 20MP-J	2 1/2" x 2 1/2"								X		X	X		X		
19-K, 19M-K, 20-K, 20P-K, 20M-K, 20MP-K	3" x 3"								X		X	X		X		
20P-D	3/4" x 3/4"				X				X		X				X	X

Notes

1. Not available for 20P-C
2. Variation 04 not available for 20P-E, 20P-F, 20P-G, and 20P-H

Kunkle Safety and Relief Products
Models 19, 19M, 20, 20M, 20P, 20MP, 200A and 200H

SUMP PUMP REPLACEMENT MODEL

Liberty Pumps®

280-Series

Available with Vertical Float

Cast Iron Submersible Effluent/Sump Pumps

1/2 hp
1-1/2" Discharge
3/4" Solids Handling

Features:

- Liberty's unique, one-piece "Uni-Body" casting
- Quick-disconnect 10' standard power cord allows replacement of cord in seconds without breaking seals to motor (other lengths available)
- Permanently lubricated upper and lower bearings
- Oil-filled, hermetically sealed motors with thermal overload protection
- Stainless steel, removable bottom screen
- Stainless steel rotor shaft
- Stainless steel fasteners

115 V. Models:

280 Manual

281 Wide-Angle Float with Quick Disconnect

283 Wide-Angle Float, Series Plug

287 VMF, vertical magnetic float for heavy-duty sump pump applications

208-230 V. Models:

280HV Manual

281HV Wide-Angle Float with Quick Disconnect

283HV Wide-Angle Float, Series Plug

287HV Vertical Magnetic Float (VMF) Switch

Wide-Angle Floats are mercury-free, mechanically activated.

innovate. evolve.

280-SERIES
1/2 hp Submersible Effluent/Sump Pumps

The Liberty 280-Series provides a cost effective "mid-range" pump for on-site waste water systems, liquid waste transfer and commercial heavy-duty sump pump applications that require higher head or more flow. Designed around Liberty's unique "Uni-Body" casting, the 280-Series will provide years of reliable performance.

All Models Feature:

- Vortex style impeller permitting passage of solids up to ¾"
- 416 stainless steel rotor shaft
- Permanently lubricated upper and lower ball bearing
- Epoxy powder coat finish
- All fasteners – corrosion-resistant stainless steel
- 1½" Discharge
- Stainless steel bottom screen – easily removable
- Maximum fluid temperature: 140˚ F.
- **280-Series Cord Lengths**

Model	10'	25'(-2)	35'(-3)	50'(-5)
280	Standard	Optional	Optional	Optional
281	Standard	Optional	Optional	Optional
283	Standard	Optional	Optional	N/A
287	Standard	Optional	N/A	N/A

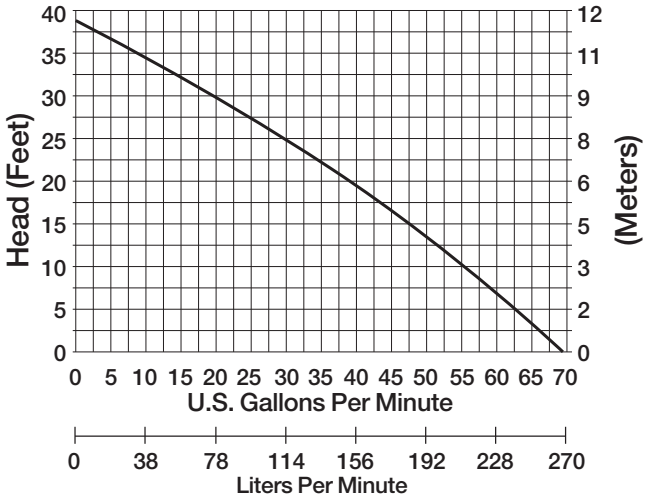
10' cord length standard on all models. For optional lengths, add "-2, -3 or -5" suffix to model number.
Example: for model 280 with 35' cord, order 280-3

Motor Specifications

½ hp 60 Hz 3450 RPM
Oil filled, thermally protected

8.0 amps (115V)
4.0 amps (208/230V)

Performance Curve: 280-Series



Dimensional Data:

Weight: 29 lbs.
Height: 13"
Major Width: 10" (model 287)

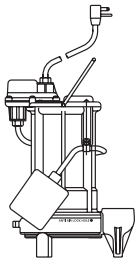
Minimum Sump Diameters:

Model 281, 283…14"
Model 287 VMF…10"

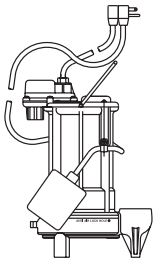
Factory switch settings	Model 281, 283	Model 287 VMF
Turn on level	13"	9.5"
Turn off level	7"	4.0"

The Model 283 features a fully adjustable wide-angle float. Differential adjustments can be made easily by tethering the float to the discharge pipe or other mounting point. Vertical float model 287 is not adjustable.

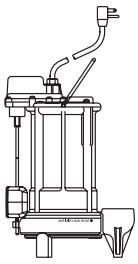
Model 280
Manual, no switch



Model 281
Wide angle float switch with quick-disconnect



Model 283
Wide angle float switch with series (piggy-back) plug



Model 287 VMF-Series
Vertical magnetic float for smaller pits – will operate in a 10" diameter sump

SSPMA CERTIFIED

c SA us Certified

Specifications are subject to change without notice.

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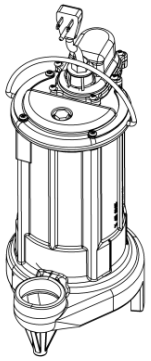
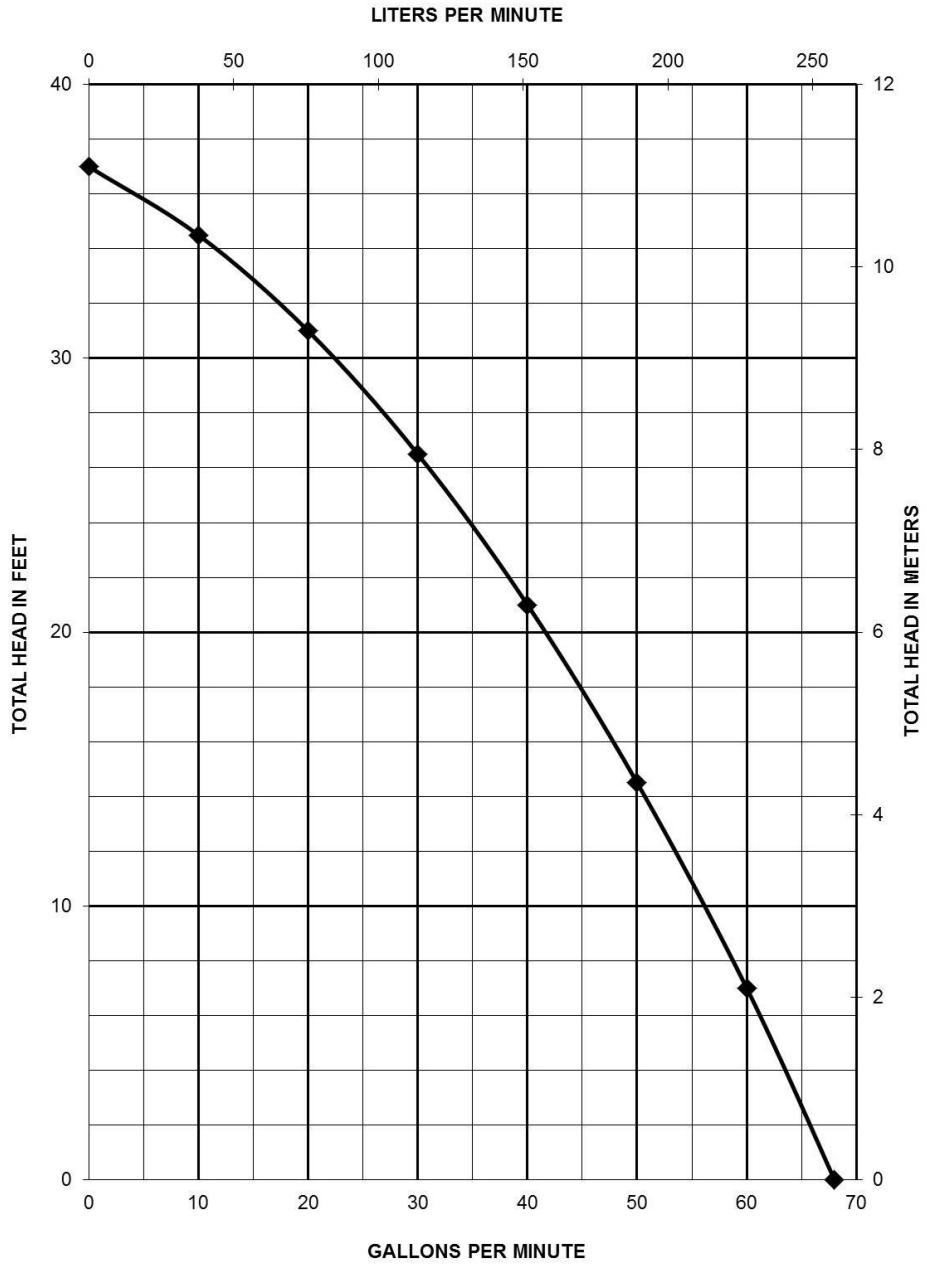


Pump Specifications

280 Series 1/2 hp Submersible Effluent Pump



280_P1 R010/7/2015

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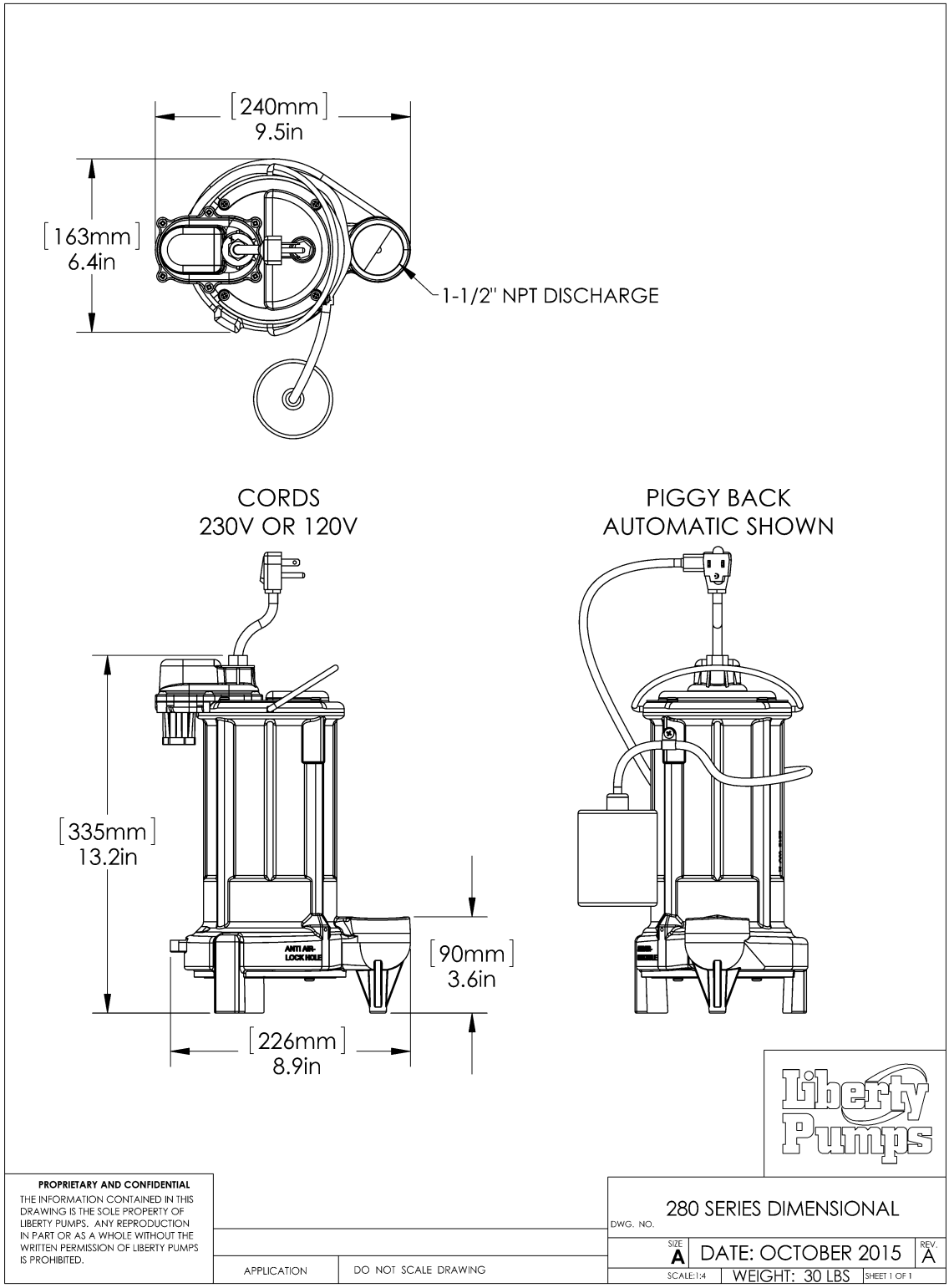
280-Series Dimensional Data



280-Series Electrical Data

MODEL	HP	VOLTAGE	PHASE	FULL LOAD AMPS	LOCKED ROTOR AMPS	THERMAL OVERLOAD TEMP	STATOR WINDING CLASS	CORD LENGTH FT	DISCHARGE	AUTOMATIC
280	1/2	115	1	8.0	23	105˚C / 221°F	B	10	1 1/2	NO MANUAL
281	1/2	115	1	8.0	23	105˚C / 221°F	B	10	1 1/2	YES INTEGRAL FLOAT
283	1/2	115	1	8.0	23	105˚C / 221°F	B	10	1 1/2	YES PIGGY BACK FLOAT
287	1/2	115	1	8.0	23	105˚C / 221°F	B	10	1 1/2	YES INTEGRAL VERTICLE FLOAT
280HV	1/2	208-230	1	4.0	12.5	105˚C / 221°F	B	10	1 1/2	NO MANUAL
281HV	1/2	208-230	1	4.0	12.5	105˚C / 221°F	B	10	1 1/2	YES INTEGRAL FLOAT
283HV	1/2	208-230	1	4.0	12.5	105˚C / 221°F	B	10	1 1/2	YES PIGGY BACK FLOAT
287HV	1/2	208-230	1	4.0	12.5	105˚C / 221°F	B	10	1 1/2	YES INTEGRAL VERTICLE FLOAT

280-Series Cord Length Options*

Model	10'	25'(-2)	35'(-3)	50'(-5)
280	Standard	Optional	Optional	Optional
281	Standard	Optional	Optional	Optional
283	Standard	Optional	Optional	N/A
287	Standard	Optional	N/A	N/A

10' cord length standard on all models. For optional lengths, add “-2, -3 or -5” suffix to model number.
Example: for model 280 with 35' cord. Order 280-3

**WARNING: ***Always use a replacement power cord assembly of the same length and type as originally installed on the Liberty product. Using a cord of improper gauge or length may lead to exceeding the electrical rating of the cord and could result in death, injury, fire or other significant failure.

280-Series Technical Data

IMPELLER	VORTEX ENGINEERED POLYMER
SOLIDS HANDLING SIZE	¾"
PAINT	POWDER COAT
MAX LIQUID TEMP	60˚C/ 140˚F
MAX STATOR TEMP	CLASS B 130˚C/ 266˚F
THERMAL OVERLOAD	105˚C / 221°F
POWER CORD TYPE	SJTW (10ft & 25ft models) SJTOOW (35ft & 50ft models)
MOTOR HOUSING/ VOLUTE	CLASS 25 CAST IRON
SHAFT	STAINLESS
HARDWARE	STAINLESS
ORINGS	BUNA N
MECHANICAL SEAL	UNITIZED CERAMIC CARBON
WEIGHT	30 LBS

280-Series Specifications

1.01 GENERAL:

The contractor shall provide labor, material, equipment, and incidentals required to provide_____(QTY) centrifugal pumps as specified herein. The pump models covered in this specification are Series 280 single phase pumps. The pump furnished for this application shall be model _____as manufactured by Liberty pumps.

2.01 OPERATING CONDITIONS:

Each submersible pump shall be rated at 1/2 hp_____volts, single phase, 60 Hz.,. 3450 RPM. The unit shall produce_____G.P.M. at _____ feet of total dynamic head.

The submersible pump shall be capable of handling effluent with 3/4" solid handling capability. The submersible pump shall have a shut-off head of 37 feet and a maximum flow of 62 GPM @ 5 feet of total dynamic head.

The pump shall be controlled with:

_____A piggy back style on/off float switch.

_____An integrally wired on/off float switch.

_____A Vertical Mechanical Float (VMF) type on/off switch.

_____A NEMA 4X outdoor simplex control panel with three float switches and a high water alarm.

_____A NEMA 1 indoor simplex control panel with three float switches and a high water alarm.

_____A NEMA 4X outdoor simplex control panel with four float switches and a high water alarm.

_____A NEMA 1 indoor simplex control panel with four float switches and a high water alarm.

_____A NEMA 4X outdoor duplex control panel with three float switches and a high water alarm.

_____A NEMA 1 indoor duplex control panel with three float switches and a high water alarm.

_____A NEMA 4X outdoor duplex control panel with four float switches and a high water alarm.

_____A NEMA 1 indoor duplex control panel with four float switches and a high water alarm.

3.01 CONSTRUCTION:

Each submersible pump shall be equal to the C US certified Series 280 SERIES pumps as manufactured by Liberty Pumps, Bergen NY. The castings shall be constructed of class 25 cast iron. The motor housing shall be oil filled to dissipate heat. Air filled motors shall not be considered equal since they do not properly dissipate heat from the motor. All mating parts shall be machined and sealed with a Buna-N o-ring. All fasteners exposed to the liquid shall be stainless steel. The motor shall be protected on the top side with sealed cord entry plate with molded pins to conduct electricity eliminating the ability of water to enter internally through the cord. The motor shall be protected on the lower side with a unitized ceramic/carbon seal with stainless steel housings and spring. The pump shall be furnished with stainless steel handle.

4.01 ELECTRICAL POWER CORD

The submersible pump shall be supplied with 10, 25, 35, or 50 feet of multiconductor power cord. It shall be cord type SJTW, or SJTOOW capable of continued exposure to the pumped liquid. The power cord shall be sized for the rated full load amps of the pump in accordance with the National Electric Code. The power cable shall not enter the motor housing directly but will conduct electricity to the motor by means of a water tight compression fitting cord plate assembly, with molded pins to conduct electricity. This will eliminate the ability of water to enter internally through the cord, by means of a damaged or wicking cord.

5.01 MOTORS

Single phase motors shall be oil filled, permanent split capacitor, class B insulated NEMA B design, rated for continuous duty. At maximum load the winding temperature shall not exceed 130 degrees C unsubmerged. Since air filled motors are not capable of dissipating heat they shall not be considered equal. The pump motor shall have an integral thermal overload switch in the windings for protecting the motor. The capacitor circuit shall be mounted internally in the pump.

6.01 BEARINGS AND SHAFT

An upper and lower ball bearing shall be required. The ball bearing shall be a single ball / race type bearing. Both bearings shall be permanently lubricated by the oil, which fills the motor housing. The motor shaft shall be made of 300 or 400 series stainless steel and have a minimum diameter of .311”

7.01 SEALS

The pump shall have a unitized carbon / ceramic seal with stainless steel housings and spring equal to Crane Type 6A. The motor plate / housing interface shall be sealed with a Buna-N o-ring.

8.01 IMPELLER

The impeller shall be vortex style made of an engineered polymer, with pump out vanes on the back shroud to keep debris away from the seal area. It shall be threaded to the motor shaft.

9.01 CONTROLS

All pumps can be supplied with a CSA and UL approved VMF type switch, an integrally wired wide angle tilt float switch, or piggy back type wide angle tilt float switches. The piggy back style switches are equipped with a plug that allows the pump to be operated manually without the removal of the pump in the event that a switch becomes inoperable. Manual pumps are operable by means of a pump control panel.

10.01 PAINT

The exterior of the casting shall be protected with powder coat paint.

11.01 SUPPORT

The pump shall have cast iron support legs, enabling it to be a free standing unit. The legs will be high enough to allow 3/4" solids to enter the volute.

12.01 SERVICEABILTY

Components required for the repair of the pump shall be shipped within a period of 24 hours.

13.01 FACTORY ASSEMBLED TANK SYSTEMS WITH GUIDE RAIL AND QUICK DISCONNECT DISCHARGE

_____Guide factory mounted rail system with pump suspended by means of bolt on quick disconnect which is sealed by means of nitrile grommets or o-rings. The Discharge piping shall be schedule 80 PVC and furnished with a PVC check valve and shut-off ball valve. The Tank shall be wound fiberglass or roto-molded plastic. An inlet hub shall be provided with the fiberglass systems.

_____Stainless steel Guide Rail
_____Zinc plated steel Guide Rail
_____"diameter of basin size
_____"height of basin size
_____"distance from top of tank to discharge pipe outlet
_____Fiberglass cover
_____Structural foam polymer cover
_____Steel cover
_____Simplex System with Outdoor panel and alarm
_____Duplex System with Outdoor panel and alarm
_____Separate Outdoor Alarm
_____Remote Outdoor Alarm

14.01 TESTING

The pump shall have a ground continuity check and the motor chamber shall be Hi-potted to test for electrical integrity, moisture content and insulation defects. The motor and volute housing shall be pressurized, and an air leak decay test is performed to ensure integrity of the motor housing. The pump shall be run, voltage and current monitored, and the tester checks for noise or other malfunction.

15.01 QUALITY CONTROL

The pump shall be manufactured in an ISO 9001 certified Facility.

16.01 WARRANTY

Standard limited warranty shall be 3 years.

APPENDIX M

EXAMPLE REPORTS

Example Reports

- **Weekly Update Report**
- **GWTS Monthly Summary Report**
- **NMOSE Monthly Reporting for GWTS**

WEEKLY UPDATE REPORT

Kirtland BFF Project - Site Monitoring Status

- Soil Vapor Monitoring – Q2 2019 sampling complete.
- Drinking Water Supply Wells – Next sampling event scheduled for 04JUN19.
- Groundwater Monitoring – Q2 2019 sampling and gauging complete.

GWTS Operation		Groundwater Treatment Totals (including Temporary Treatment System)
System Operational Dates	-	**6/4/15 - present**
Weekly Groundwater Treated (Gallons)(1)	06-Apr-19 to 13-May-19	4,860,000
Train 1 Weekly Groundwater Treated (Gallons)(1)	06-Apr-19 to 13-May-19	2,727,300
Train 2 Weekly Groundwater Treated (Gallons)	06-Apr-19 to 13-May-19	2,132,700
Cumulative Groundwater Treated (Gallons)	04-Jun-15 to present	637,007,400
Train 1 Cumulative Groundwater Treated (Gallons)	04-Jun-15 to present	405,106,900
Train 2 Cumulative Groundwater Treated (Gallons)	30-Jan-17 to present	231,900,500
Weekly Discharge Volume to Golf Course Main Pond (GCMP) (Gallons)(1)	06-Apr-19 to 13-May-19	2,180,900
Cumulative Discharge Volume to GCMP (Gallons)	01-Jan-16 to present	427,452,765
Weekly Discharge Volume to Injection Well KAFB-7 (Gallons)(1)	06-Apr-19 to 13-May-19	2,679,100
Cumulative Discharge Volume to Injection Well KAFB-7 (Gallons)	01-Jan-16 to present	209,554,635
Influent EDB Concentration (µg/L)(2)	1-May-19	0.022 J
Weekly Operational Run-time %(3)	06-Apr-19 to 13-May-19	99%
Cumulative EDB Removal (Grams)(4)	04-Jun-15 to present	115.54
Weekly Average Flow Rate (gpm)(5)	06-Apr-19 to 13-May-19	482
Weekly IDW Purge Water to GWTS-Golf Course (Gallons)	06-Apr-19 to 13-May-19	0
Cumulative IDW Purge Water to GWTS-Golf Course (Gallons)	24-Apr-16 to present	275,217
Weekly IDW Purge Water to GWTS-KAFB-7 (Gallons)	28-Apr-17 to present	0
Cumulative IDW Purge Water to GWTS-KAFB-7 (Gallons)	28-Apr-17 to present	0

(1) Volume totals for GCMP and KAFB-7 were calculated using the GWTS effluent totalizers.

(2) The 01MAY19 influent sample concentration for Train 1 and Train 2 were used to calculate EDB removal.

(3) All four extraction wells were in operation with effluent flow being directed approximately 55% to KAFB-7, and 45% to the GCMP to maintain the GCMP level. The entire system was shut down for 21 minutes on 08MAY19 due to one changeover in discharge between GCMP and KAFB-7, 63 minutes on 10MAY19 due to two changeovers in discharge between GCMP and KAFB-7 and to clean the Wye strainers, and 6 minutes on 12MAY19 due to one changeover in discharge between GCMP and KAFB-7.

(4) EDB mass removal is adjusted retroactively for the month based upon influent concentration from 01MAY19 for both Train 1 and Train 2.

(5) Average flow is total gallons treated divided by total treatment minutes available.

Current GWTS Discharge Destination GCMP

CURRENT GWTS EFFLUENT ANALYSES			Train 1		Train 2	
			Sample Date:	5/1/2019	Sample Date:	5/1/2019
Chemical Class & Analytical Method	Parameter	Project Screening Levels[a]	Result	LOD	Result	LOD
Draft Analytical Data						
EDB (µg/L) SW8011	ETHYLENE DIBROMIDE	0.05	ND	0.019	ND	0.019
VOC (µg/L) SW8260B	BENZENE	5	ND	0.5	ND	0.5
	ETHYLBENZENE	700	ND	0.8	ND	0.8
	TOLUENE	750	ND	0.5	ND	0.5
	XYLENES	620	ND	2	ND	2
Metals (µg/L) SW6010C	IRON, DISSOLVED	1,000	ND	100	ND	100
	MANGANESE, DISSOLVED	200	ND	2.5	ND	2.5

Notes
Laboratory results greater than EPA MCLs or NMED Groundwater Protection Standards are highlighted in yellow.

[a] Project Screening Levels are the lowest of either the EPA MCL (from the EPA RSL Table, dated June 2017) or the NMED Groundwater Protection Standards (NMAC 20.6.2.3103).

J = estimated value.
LOD = Limit of Detection.
ND = not detected.
µg/L = micrograms per liter.

Well 106228
Operational Flow Rate: 140 gpm
Operational Runtime: 99.1%; 0.9% offline for routine maintenance.

Well 106233
Operational Flow Rate: 161 gpm
Operational Runtime: 66.1%; 33.9% offline for routine maintenance, and to facilitate GCMP level management.

Well 106234
Operational Flow Rate: 159 gpm
Operational Runtime: 99.1%; 0.9% offline for routine maintenance.

Well 106239
Operational Flow Rate: 73 gpm
Operational Runtime: 99.1%; 0.9% offline for routine maintenance.

Well Control House (106233 and 106234)
No issues.

KAFB-7
KAFB-7 is currently operational and effluent injection is ongoing, with priority to GCMP discharge.

GWTS MONTHLY WATER SUMMARY REPORT

GWTS Operation	Total Groundwater Extracted (gallons)[a]	Treated Groundwater Injected to Injection Well KAFB-7 (gallons)	Treated Groundwater Discharged to the Golf Course Main Pond (gallons)[b]	Treated Groundwater Discharged for Dust Suppression (gallons)
Dec-15	17,664,900	0	17,664,900	0
2015 Total	17,664,900	0	17,664,900	0
Jan-16	1,777,200	0	1,777,200	0
Feb-16	881,000	181,300	699,700	0
Mar-16	22,168,080	1,231,350	20,936,730	0
Apr-16	12,649,920	582,570	12,067,350	0
May-16	12,090,000	0	12,090,000	0
Jun-16	8,850,000	0	8,850,000	0
Jul-16	9,940,000	0	9,940,000	0
Aug-16	9,400,000	0	9,400,000	0
Sep-16	12,980,000	0	12,980,000	0
Oct-16	8,300,000	0	8,300,000	0
Nov-16	7,200,000	2,970,000	4,230,000	0
Dec-16	14,570,100	14,501,190	68,910	0
2016 Total	120,806,300	19,466,410	101,339,890	0
Jan-17	6,177,000	5,877,600	299,400	0
Feb-17	3,994,500	2,216,600	1,777,900	0
Mar-17	11,256,600	5,172,800	6,083,800	0
Apr-17	13,981,700	2,248,062	11,733,638	0
May-17	18,688,600	4,722,563	13,966,037	0
Jun-17	18,761,200	1,592,700	17,168,500	0
Jul-17	24,136,000	3,023,500	21,112,500	0
Aug-17	18,460,700	4,847,500	13,613,200	0
Sep-17	18,962,100	6,752,400	12,209,700	0
Oct-17	21,626,600	14,775,800	6,850,800	0
Nov-17	12,513,400	3,734,900	8,778,500	0
Dec-17	13,304,300	10,724,700	2,579,600	0
2017 Total	181,862,700	65,689,125	116,173,575	0
Jan-18	15,362,700	13,887,700	1,475,000	0
Feb-18	17,571,400	13,765,300	3,806,100	0
Mar-18	18,098,900	9,235,300	8,863,600	0
Apr-18	13,268,900	0	13,268,900	0
May-18	19,300,000	0	19,300,000	0
Jun-18	24,933,200	0	24,933,200	0
Jul-18	19,939,600	0	19,939,600	0
Aug-18	24,557,000	0	24,557,000	0
Sep-18	17,026,500	0	17,026,500	0
Oct-18	8,861,100	0	8,861,100	0
Nov-18	12,471,200	7,517,100	4,954,100	0
Dec-18	25,803,600	23,080,800	2,722,800	0
2018 Total	217,194,100	67,486,200	149,707,900	0
Jan-19	21,536,900	19,494,500	2,042,400	0
Feb-19	21,265,100	13,624,600	7,640,500	0
Mar-19	26,516,500	13,435,900	13,080,600	0
Apr-19	21,201,900	7,170,800	14,031,100	0
2019 Total	90,520,400	53,725,800	36,794,600	0
Total	628,048,400	206,367,535	421,680,865	0

[a]Corrected volumes to include temporary treatment system in 2015.

[b]Corrected volumes from HMI datasets.

NMOSE MONTHLY REPORTING FOR GWTS

Injection and Extraction Well Volume Summary Table
January-August 2016

Month	Date Range[a]	Effluent Totalizer Reading (gallons)[c]	Well ID	KAFB-106228	KAFB-106233	KAFB-106234	KAFB-106239	KAFB-7[b]	KAFB-IN2[b]
			Well Type	Extraction Well	Extraction Well	Extraction Well	Extraction Well	Injection Well	Injection Well
			RG #	RG-1579	RG-1579	RG-1579	RG-1579	RG-1587	RG-1587
			POD	POD 292	POD 309	POD 310	POD 319	-	-
Jun-15	6/4/2015	0	Average Monthly Flow Rate (gpm)	3.82	0	0	NA		
	6/30/2015	143,200	Percentage of Monthly Extraction Volume	100%	0%	0%			
	Monthly Total (gallons)	143,200		143,200	0	0		0	--
Jul-15	6/30/2015	143,200	Average Monthly Flow Rate (gpm)	28.26	0	0			
	7/31/2015	1,404,800	Percentage of Monthly Extraction Volume	100%	0%	0%			
	Monthly Total (gallons)	1,261,600		1,261,600	0	0		0	--
Aug-15	7/31/2015	1,404,800	Average Monthly Flow Rate (gpm)	93.21	0	0			
	8/31/2015	5,565,900	Percentage of Monthly Extraction Volume	100%	0%	0%			
	Monthly Total (gallons)	4,161,100		4,161,100	0	0		0	--
Sep-15	8/31/2015	5,565,900	Average Monthly Flow Rate (gpm)	97.54	0	0			
	9/30/2015	9,779,800	Percentage of Monthly Extraction Volume	100%	0%	0%			
	Monthly Total (gallons)	4,213,900		4,213,900	0	0		0	--
Oct-15	9/30/2015	9,779,800	Average Monthly Flow Rate (gpm)	118.02	0	0			
	10/30/2015	14,878,100	Percentage of Monthly Extraction Volume	100%	0%	0%			
	Monthly Total (gallons)	5,098,300		5,098,300	0	0		0	--
Nov-15	10/30/2015	14,878,100	Average Monthly Flow Rate (gpm)	31.76	0	0			
	11/30/2015	16,295,700	Percentage of Monthly Extraction Volume	100%	0%	0%			
	Monthly Total (gallons)	1,417,600		1,417,600	0	0		0	--
Dec-15	11/30/2015	16,295,700	Average Monthly Flow Rate (gpm)	27.82	0	0			
	12/31/2015	17,373,622	Percentage of Monthly Extraction Volume	100%	0%	0%			
	Monthly Total (gallons)[c]	1,241,722		1,241,722	0	0		0	--
Jan-16	12/31/2015	163,800	Average Monthly Flow Rate (gpm)	23.84	2.70	2.47			
	1/27/2016	1,941,000	Percentage of Monthly Extraction Volume	82.18%	9.31%	8.51%			
	Monthly Total (gallons)[c]	1,904,678		1,565,299	177,381	161,998		0	--
Feb-16	1/27/2016	1,941,000	Average Monthly Flow Rate (gpm)	55.44	57.89	37.75			
	3/1/2016	6,358,500	Percentage of Monthly Extraction Volume	36.70%	38.32%	24.99%			
	Monthly Total (gallons)	4,417,500		1,621,066	1,692,566	1,103,868		-181,300	--
Mar-16	3/1/2016	6,358,500	Average Monthly Flow Rate (gpm)	85.00	143.35	142.58			
	3/31/2016	24,990,080	Percentage of Monthly Extraction Volume	22.91%	38.65%	38.44%			
	Monthly Total (gallons)	18,631,580		4,269,361	7,200,347	7,161,872		-1,231,350	--
Apr-16	3/31/2016	24,990,080	Average Monthly Flow Rate (gpm)	52.25	155.50	152.49			
	5/2/2016	40,710,000	Percentage of Monthly Extraction Volume	14.50%	43.17%	42.33%	NA		
	Monthly Total (gallons)	15,719,920		2,279,918	6,785,746	6,654,256		-582,570	--
May-16	5/2/2016	40,710,000	Average Monthly Flow Rate (gpm)	0.00	107.14	124.88			
	5/31/2016	49,730,000	Percentage of Monthly Extraction Volume	0.00%	46.18%	53.82%			
	Monthly Total (gallons)	15,719,920		0	7,259,100	8,460,820		0	--
Jun-16	5/31/2016	49,730,000	Average Monthly Flow Rate (gpm)	0.00	57.86	167.08			
	6/27/2016	58,580,000	Percentage of Monthly Extraction Volume	0.00%	25.72%	74.28%			
	Monthly Total (gallons)	8,850,000		0	2,276,436	6,573,564		0	--
Jul-16	6/27/2016	58,580,000	Average Monthly Flow Rate (gpm)	79.63	0.00	126.51			
	8/1/2016	68,520,000	Percentage of Monthly Extraction Volume	38.63%	0.00%	61.37%			
	Monthly Total (gallons)	9,940,000		3,839,825	0	6,100,175		0	--
Aug-16	8/1/2016	68,520,000	Average Monthly Flow Rate (gpm)	116.93	0.00	114.67			
	8/29/2016	77,920,000	Percentage of Monthly Extraction Volume	50.49%	0.00%	49.51%			
	Monthly Total (gallons)	9,400,000		4,745,722	0	4,654,278		0	--

Injection and Extraction Well Volume Summary Table
January-August 2016

Sep-16	8/29/2016	77,920,000	Average Monthly Flow Rate (gpm)	146.17	0.00	134.37	NA		
	10/3/2016	90,900,000	Percentage of Monthly Extraction Volume	52.10%	0.00%	47.90%			
	Monthly Total (gallons)	12,980,000		6,762,886	0	6,217,114		0	--
Oct-16	10/3/2016	90,900,000	Average Monthly Flow Rate (gpm)	99.28	0.00	104.84			
	10/31/2016	99,200,000	Percentage of Monthly Extraction Volume	48.64%	0.00%	51.36%			
	Monthly Total (gallons)	8,300,000		4,037,000	0	4,263,000		0	--
Nov-16	10/31/2016	99,200,000	Average Monthly Flow Rate (gpm)	90.31	0.00	95.87			
	11/28/2016	106,400,000	Percentage of Monthly Extraction Volume	48.51%	0.00%	51.49%			
	Monthly Total (gallons)	7,200,000		3,492,528	0	3,707,472		-2,970,000	--
Dec-16	11/28/2016	106,400,000	Average Monthly Flow Rate (gpm)	144.78	0.00	155.00			
	1/3/2017	120,970,100	Percentage of Monthly Extraction Volume	48.30%	0.00%	51.70%			
	Monthly Total (gallons)	14,570,100		7,036,722	0	7,533,378		-14,501,190	--
Jan-17[d]	1/3/2017	120,970,100	Average Monthly Flow Rate (gpm)	144.92	0.00	154.75			
	1/30/2017	127,059,800	Percentage of Monthly Extraction Volume	48.36%	0.00%	51.64%			
	Monthly Total (gallons)	6,089,700		2,944,976	0	3,144,724		-5,877,600	--
Feb-17[d]	1/30/2017	127,059,800	Average Monthly Flow Rate (gpm)	145.14	0.00	155.25			
	2/27/2017	131,141,600	Percentage of Monthly Extraction Volume	48.32%	0.00%	51.68%			
	Monthly Total (gallons)	4,081,800		1,972,238	0	2,109,562		-2,216,600	--
Mar-17[d]	2/27/2017	131,141,600	Average Monthly Flow Rate (gpm)	145.32	0.00	157.07			
	3/27/2017	142,398,200	Percentage of Monthly Extraction Volume	48.06%	0.00%	51.94%			
	Monthly Total (gallons)	11,256,600		5,409,542	0	5,847,058		-5,172,800	--
Apr-17[d]	3/27/2017	142,398,200	Average Monthly Flow Rate (gpm)	145.23	0.00	130.93			
	4/24/2017	152,005,300	Percentage of Monthly Extraction Volume	52.59%	0.00%	47.41%			
	Monthly Total (gallons)	9,607,100		5,052,356	0	4,554,744		-2,248,062	--
May-17[d]	4/24/2017	152,005,300	Average Monthly Flow Rate (gpm)	145.08	177.18	171.73			
	5/30/2017	175,068,500	Percentage of Monthly Extraction Volume	29.37%	35.87%	34.76%			
	Monthly Total (gallons)	23,063,200		6,773,382	8,272,246	8,017,572		-4,722,563	--
Jun-17[d]	5/30/2017	175,068,500	Average Monthly Flow Rate (gpm)	144.34	175.86	164.39			
	6/26/2017	193,829,700	Percentage of Monthly Extraction Volume	29.79%	36.29%	33.92%			
	Monthly Total (gallons)	18,761,200		5,588,212	6,808,528	6,364,460		-1,592,700	--
Jul-17[d]	6/26/2017	193,829,700	Average Monthly Flow Rate (gpm)	143.73	171.77	160.63			
	7/31/2017	217,965,700	Percentage of Monthly Extraction Volume	30.19%	36.08%	33.74%			
		24,136,000		7,286,046	8,707,321	8,142,633		-3,023,500	--
Aug-17[d]	7/31/2017	217,965,700	Average Monthly Flow Rate (gpm)	136.63	165.44	151.92			
	8/28/2017	236,426,400	Percentage of Monthly Extraction Volume	30.10%	36.44%	33.46%			
		18,460,700		5,555,799	6,727,324	6,177,577		-4,847,500	--
Sept-17[e]	8/28/2017	236,426,400	Average Monthly Flow Rate (gpm)	142.99	164.45	162.43			
	9/25/2017	255,388,500	Percentage of Monthly Extraction Volume	30.43%	35.00%	34.57%			
		18,962,100		5,769,400	6,636,200	6,555,000		-6,752,400	--
Oct-17[e]	9/25/2017	255,388,500	Average Monthly Flow Rate (gpm)	143.70	167.22	163.98			
	10/30/2017	277,015,100	Percentage of Monthly Extraction Volume	32.83%	29.38%	37.79%			
		21,626,600		7,084,200	6,340,100	8,155,300		-14,775,800	--
Nov-17[e]	10/30/2017	277,015,100	Average Monthly Flow Rate (gpm)	144.68	166.80	164.97			
	11/27/2017	289,528,500	Percentage of Monthly Extraction Volume	23.45%	24.98%	51.57%			
		12,513,400		2,934,200	3,126,300	6,452,900		-3,734,900	--
Dec-17[e]	11/27/2017	289,528,500	Average Monthly Flow Rate (gpm)	0.00	163.90	162.75			
	12/26/2017	302,832,800	Percentage of Monthly Extraction Volume	0.00%	50.18%	49.82%			
		13,304,300		0	6,685,500	6,638,400		-10,724,700	--

Injection and Extraction Well Volume Summary Table
January-August 2016

Jan-18[e]	12/26/2017	302,832,800	Average Monthly Flow Rate (gpm)	0.00	161.42	164.09	NA		
	1/29/2018	318,195,500	Percentage of Monthly Extraction Volume	0.00%	49.59%	50.41%			
		15,362,700		0	7,609,000	7,734,900		-13,887,700	--
Feb-18[e]	1/29/2018	318,195,500	Average Monthly Flow Rate (gpm)	143.31	159.42	162.84	74.80		
	2/26/2018	335,766,900	Percentage of Monthly Extraction Volume	23.96%	34.61%	36.48%	4.95%		
		17,571,400		4,187,100	6,048,200	6,375,700	864,700	-13,765,300	--
Mar-18[e]	2/26/2018	335,766,900	Average Monthly Flow Rate (gpm)	143.61	159.08	164.64	75.75		
	4/2/2018	353,865,800	Percentage of Monthly Extraction Volume	26.18%	24.93%	35.99%	12.90%		
		18,098,900		4,733,100	4,507,500	6,507,200	2,332,500	-9,235,300	--
Apr-18[e]	4/2/2018	353,865,800	Average Monthly Flow Rate (gpm)	144.91	159.78	164.66	76.30		
	4/30/2018	367,134,700	Percentage of Monthly Extraction Volume	31.60%	7.01%	49.94%	11.45%		
		13,268,900		4,168,900	924,800	6,587,800	1,510,800	0	--
May-18[e]	4/30/2018	367,134,700	Average Monthly Flow Rate (gpm)	141.94	162.90	164.16	73.27		
	5/29/2018	386,434,700	Percentage of Monthly Extraction Volume	27.71%	24.53%	33.52%	14.24%		
		19,300,000		5,356,800	4,741,600	6,479,400	2,752,100	0	--
Jun-18[e]	5/29/2018	386,434,700	Average Monthly Flow Rate (gpm)	140.50	157.90	162.51	74.38		
	7/2/2018	411,367,900	Percentage of Monthly Extraction Volume	27.25%	27.36%	31.79%	13.59%		
		24,933,200		6,767,300	6,794,100	7,894,700	3,375,500	0	--
Jul-18[e]	7/2/2018	411,367,900	Average Monthly Flow Rate (gpm)	140.42	154.64	163.46	74.43		
	7/30/2018	431,307,500	Percentage of Monthly Extraction Volume	25.83%	28.43%	32.05%	13.69%		
		19,939,600		5,151,700	5,671,600	6,392,800	2,730,500	0	--
Aug-18[e]	7/30/2018	431,307,500	Average Monthly Flow Rate (gpm)	139.12	154.79	162.92	73.79		
	9/4/2018	455,864,500	Percentage of Monthly Extraction Volume	25.39%	28.24%	32.90%	13.47%		
		24,557,000		6,207,600	6,906,700	8,046,200	3,292,800	0	--
Sep-18[e]	9/4/2018	455,864,500	Average Monthly Flow Rate (gpm)	139.43	154.37	164.32	74.38		
	10/1/2018	472,891,000	Percentage of Monthly Extraction Volume	28.33%	19.55%	36.51%	15.61%		
		17,026,500		4,809,100	3,318,500	6,197,900	2,649,700	0	--
Oct-18[e]	10/1/2018	472,891,000	Average Monthly Flow Rate (gpm)	135.57	174.60	162.92	71.83		
	10/29/2018	481,752,100	Percentage of Monthly Extraction Volume	24.73%	0.62%	65.30%	9.35%		
		8,861,100		2,179,200	55,000	5,753,500	823,400	0	--
Nov-18[e]	10/29/2018	481,752,100	Average Monthly Flow Rate (gpm)	140.33	167.25	162.99	77.48		
	11/26/2018	494,223,300	Percentage of Monthly Extraction Volume	21.80%	19.83%	49.05%	9.32%		
		12,471,200		2,702,200	2,459,100	6,081,800	1,154,900	-7,517,100	--
Dec-18[e]	11/26/2018	494,223,300	Average Monthly Flow Rate (gpm)	140.91	165.95	160.61	75.49		
	12/31/2018	520,026,900	Percentage of Monthly Extraction Volume	25.47%	30.67%	29.52%	14.35%		
		25,803,600		6,560,241	7,901,436	7,603,886	3,696,058	-23,080,800	--
Jan-19[e]	12/31/2018	520,026,900	Average Monthly Flow Rate (gpm)	140.60	169.32	159.30	74.03		
	1/28/2019	541,563,800	Percentage of Monthly Extraction Volume	26.10%	31.27%	29.57%	13.06%		
		21,536,900		5,612,359	6,722,864	6,358,914	2,807,842	-19,494,500	--
Feb-19[e]	1/28/2019	541,563,800	Average Monthly Flow Rate (gpm)	140.86	169.59	157.88	74.53		
	2/25/2019	562,828,900	Percentage of Monthly Extraction Volume	25.99%	30.89%	29.36%	13.75%		
		21,265,100		5,532,600	6,575,400	6,249,900	2,927,200	-13,624,600	--
Mar-19[e]	2/25/2019	562,828,900	Average Monthly Flow Rate (gpm)	139.78	166.96	157.18	73.10		
	4/1/2019	589,345,400	Percentage of Monthly Extraction Volume	26.13%	31.22%	29.39%	13.25%		
		26,516,500		6,913,300	8,260,200	7,776,100	3,506,400	-13,435,900	--
Apr-19[e]	4/1/2019	589,345,400	Average Monthly Flow Rate (gpm)	140.00	162.98	157.42	74.23		
	4/29/2019	610,547,300	Percentage of Monthly Extraction Volume	25.98%	30.58%	29.54%	13.91%		
		21,201,900		5,494,700	6,468,700	6,247,900	2,941,900	-7,170,800	--

May-19[e]	4/29/2019	610,547,300	Average Monthly Flow Rate (gpm)	134.18	160.37	156.66	74.42		
	6/3/2019	633,418,600	Percentage of Monthly Extraction Volume	27.81%	26.41%	32.51%	13.27%		
		22,871,300		6,349,000	6,030,700	7,423,700	3,029,800	-5,779,900	--
Jun-19[e]	6/3/2019	633,418,600	Average Monthly Flow Rate (gpm)	141.32	159.62	146.57	72.03		
	7/1/2019	650,786,100	Percentage of Monthly Extraction Volume	27.01%	31.95%	27.67%	13.36%		
		17,367,500		4,689,600	5,546,900	4,803,600	2,319,800	-1,512,500	--
Jul-19[e]	7/1/2019	650,786,100	Average Monthly Flow Rate (gpm)	144.15	165.55	168.91	75.72		
	7/29/2019	668,688,600	Percentage of Monthly Extraction Volume	30.33%	25.27%	32.43%	11.98%		
		17,902,500		5,419,200	4,515,300	5,793,700	2,139,800	-551,100	--
Aug-19[e]	7/29/2019	668,688,600	Average Monthly Flow Rate (gpm)	140.65	163.19	173.78	72.44		
	9/3/2019	696,360,800	Percentage of Monthly Extraction Volume	25.31%	29.98%	31.94%	12.77%		
		27,672,200		7,002,900	8,293,700	8,835,800	3,534,300	-5,494,800	--
Sep-19[e]	9/3/2019	696,360,800	Average Monthly Flow Rate (gpm)	141.46	162.16	173.35	73.85		
	9/30/2019	716,557,200	Percentage of Monthly Extraction Volume	25.84%	30.85%	33.02%	10.29%		
		20,196,400		5,219,200	6,232,600	6,671,400	2,078,500	-2,916,700	--
Oct-19[e]	9/30/2019	716,557,200	Average Monthly Flow Rate (gpm)	141.07	158.18	174.63	70.34		
	11/4/2019	740,061,500	Percentage of Monthly Extraction Volume	29.53%	19.20%	36.61%	14.67%		
		23,504,300		6,938,500	4,510,600	8,603,100	3,446,400	-17,177,900	--
Nov-19[e]	11/4/2019	740,061,500	Average Monthly Flow Rate (gpm)	140.17	0.00	175.14	72.81		
	12/2/2019	755,668,900	Percentage of Monthly Extraction Volume	36.11%	0.00%	45.13%	18.76%		
		15,607,400		5,620,700	0	7,023,800	2,919,100	-14,525,700	--
Dec-19[e]	12/2/2019	755,668,900	Average Monthly Flow Rate (gpm)	139.90	160.27	174.75	74.42		
	12/30/2019	771,498,700	Percentage of Monthly Extraction Volume	35.59%	1.59%	44.53%	18.30%		
		15,829,800		5,618,500	250,500	7,030,300	2,889,100	-15,695,800	--
Jan-20[e]	12/30/2019	771,498,700	Average Monthly Flow Rate (gpm)	139.63	164.02	175.16	73.45		
	2/3/2020	790,925,800	Percentage of Monthly Extraction Volume	35.86%	0.30%	44.98%	18.86%		
		19,427,100		6,956,800	57,900	8,727,900	3,659,500	-18,919,600	--
Feb-20[e]	2/3/2020	790,925,800	Average Monthly Flow Rate (gpm)	138.84	166.49	175.05	73.33		
	3/2/2020	806,160,600	Percentage of Monthly Extraction Volume	35.97%	0.20%	45.45%	18.38%		
		15,234,800		5,464,700	30,800	6,905,500	2,792,500	-12,237,600	--
Mar-20[e]	3/2/2020	806,160,600	Average Monthly Flow Rate (gpm)	138.77	162.65	175.06	75.31		
	3/30/2020	821,610,200	Percentage of Monthly Extraction Volume	35.08%	1.39%	45.09%	18.44%		
		15,449,600		5,407,000	214,700	6,950,100	2,843,300	-4,246,900	--
Apr-20[e]	3/30/2020	821,610,200	Average Monthly Flow Rate (gpm)	138.77	183.80	175.15	75.62		
	5/4/2020	841,962,100	Percentage of Monthly Extraction Volume	34.42%	3.39%	43.44%	18.75%		
		20,351,900		6,981,600	688,500	8,811,600	3,804,600	-5,110,300	--
May-20[e]	5/4/2020	841,962,100	Average Monthly Flow Rate (gpm)	138.94	159.46	174.66	75.15		
	6/1/2020	861,192,500	Percentage of Monthly Extraction Volume	29.21%	18.27%	36.72%	15.80%		
		19,230,400		5,595,400	3,500,400	7,034,100	3,026,400	-395,600	--
Jun-20[e]	6/1/2020	861,192,500	Average Monthly Flow Rate (gpm)	139.47	159.44	173.93	71.32		
	6/29/2020	881,743,000	Percentage of Monthly Extraction Volume	27.30%	26.92%	34.31%	11.46%		
		20,550,500		5,579,800	5,502,000	7,012,900	2,342,200	0	--
Jul-20[e]	6/29/2020	881,743,000	Average Monthly Flow Rate (gpm)	138.93	165.65	173.95	70.96		
	8/3/2020	904,475,300	Percentage of Monthly Extraction Volume	27.81%	23.15%	34.83%	14.20%		
		22,732,300		6,299,200	5,243,800	7,887,700	3,217,000	-1,550,800	--
Aug-20[e]	8/3/2020	904,475,300	Average Monthly Flow Rate (gpm)	139.08	162.82	174.08	73.77		
	8/31/2020	925,878,400	Percentage of Monthly Extraction Volume	26.05%	27.56%	32.61%	13.78%		
		21,403,100		5,563,400	5,885,200	6,963,200	2,942,900	-3,737,000	--

Sep-20[e]	8/31/2020	925,878,400	Average Monthly Flow Rate (gpm)	136.89	164.81	172.88	74.27		
	9/28/2020	947,154,600	Percentage of Monthly Extraction Volume	26.03%	27.38%	32.93%	13.66%		
		21,276,200		5,511,100	5,798,300	6,972,100	2,892,200	-4,711,800	--
Oct-20[e]	9/28/2020	947,154,600	Average Monthly Flow Rate (gpm)	138.28	161.18	172.80	76.26		
	11/2/2020	972,178,900	Percentage of Monthly Extraction Volume	25.04%	29.31%	31.83%	13.81%		
		25,024,300		6,261,100	7,327,300	7,958,100	3,453,000	-14,033,400	--
Nov-20[e]	11/2/2020	972,178,900	Average Monthly Flow Rate (gpm)	135.54	157.87	170.43	73.03		
	11/30/2020	992,944,800	Percentage of Monthly Extraction Volume	25.88%	28.95%	31.23%	13.94%		
		20,765,900		5,357,900	5,993,000	6,465,300	2,886,500	-11,704,300	-83,100
Dec-20[e]	11/30/2020	992,944,800	Average Monthly Flow Rate (gpm)	134.02	159.07	172.64	71.86		
	1/4/2021	1,019,545,300	Percentage of Monthly Extraction Volume	25.00%	29.68%	32.24%	13.09%		
		26,600,500		6,619,900	7,857,700	8,536,200	3,465,200	-23,482,400	-57,600
Total				308,389,800	247,139,695	389,450,425	97,048,400	-370,151,635	-140,700

[a] Flow rate data for wells is not available prior to 15JAN2016. The average flowrate is based on available data.

[b] Negative volumes presented indicate water injected.

[c] Flow meter information presented is from both temporary and permanent ground water treatment systems. Both systems were used during December 2015 and January 2016 and values reflect the sum of each for these months. During December 2015 163,800 gallons were treated by the GWTS. During January 2016 127,478 gallons were treated by the temporary treatment system.

[d] Average Monthly Flow Rate is calculated only during times of pump operation.

[e] Beginning in September 2017 extraction well volumes utilize individual wellhead totalizer readings following the installation of more accurate flowmeters, and KAFB-7 continues to utilize the effluent totalizer data from the groundwater treatment system even following the wellhead totalizer replacement on February 27, 2018. Average Monthly Flow Rate calculated is only during times of pump operation. An additional 156,900 gallons of water was injected into the aquifer during September 2017 which was not previously accounted for as the weekly report and changeover between distribution point occurred on the same day.