ENTERED

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 377TH AIR BASE WING (AFGSC)

Mr. L. Wayne Bitner
Chief, Environmental Restoration
2000 Wyoming Blvd SE
Kirtland AFB NM 87117-5600

DEC 21 2015

Ms. Michelle Hunter
Ground Water Quality Bureau
New Mexico Environment Department
1190 St Francis Drive
Santa Fe, New Mexico 87502

Subject: Request for Temporary Permission to Discharge for Pilot Test KAFB-7 Gravity Injection, Bulk Fuels Facility, Kirtland Air Force Base, New Mexico

Dear Ms. Hunter

A Class V underground injection control (UIC) discharge permit application (UIC application; DP-1839) was submitted to the New Mexico Environment Department (NMED) Ground Water Quality Bureau (GWQB) on December 4, 2015. This UIC permit application describes a system that will consist of up to five injection wells to support the ethylene dibromide (EDB) plume Interim Measure (IM) Kirtland Air Force Base (KAFB) is implementing to address the historical fuel leak from the former Bulk Fuel Facility (BFF). The application was determined to be administratively complete by the GWQB letter dated December 17, 2015.

This letter requests that the GWQB issue a temporary permission (TP) pursuant to the UIC application to allow KAFB to implement an injection well pilot test. This test will be performed in production well KAFB-7, which is being retrofitted as an injection well. The objective of this pilot test is twofold: to evaluate the feasibility of using KAFB-7 as an injection well and to have a winter 2016 water disposition option for the treated groundwater from the full-scale groundwater treatment system (GWTS).

The scope of work for this pilot test is described in the following documents:

- The September 18, 2015 Rapid Response Action to Notice of Violation Groundwater Disposition Work Plan;
- The October 30, 2015 Groundwater Disposition Letter Work Plan Addendum #1; and
- The November 9, 2015 Groundwater Disposition Letter Work Plan Addendum #2.

Background

Some of scope described in these documents has already been performed so that the pilot test may begin immediately upon receipt of the TP. As detailed in the attached "Well KAFB-7 Pumping/Recovery Test and Well Rehabilitation Report":

- A pumping/recovery test was performed in October 2015 to ensure that KAFB-7 is capable of accepting the anticipated maximum 400 gallons per minute (gpm) of treated groundwater;
- A pre-rehabilitation well video survey was conducted on October 26, 2015;
- Well rehabilitation activities were performed from November 5 through 12, 2015 to remove debris and screen incrustations;
- A downhole camera was used on November 23, 2015 to obtain a post-rehabilitation well video

KAFB4378

Survey (DVDs of the video footage were provided to the GWQB); and

- A V-Smart Injection Valve (downhole flow control valve) was installed in KAFB-7 on December 1 and 2, 2015 (the top of the valve placed at approximately 560 feet).

The "Well KAFB-7 Pumping/Recovery Test and Well Rehabilitation Report" concludes that Well KAFB-7 is capable of accepting the anticipated maximum 400 gallons per minute (gpm) of treated groundwater with only a 5-foot rise in water table. Additionally, water levels will be monitored with transducers near (KAFB-10523, KAFB-10524, KAFB-10507, and KAFB-10508) and in Well KAFB-7. The water level monitoring along with United States Geological Survey gravity survey at Well KAFB-7 will be used to evaluate water entering the regional aquifer and will be used to monitor any potential impacts of injection on Well KAFB-7.

Groundwater samples were collected from KAFB-7 and treated effluent from the GWTS to determine how injection may influence geochemistry in the regional aquifer using PHREEQC geochemical modeling. Summary results reported in email from Dr. Patrick Longmire dated December 11, 2015, indicates that "clogging of the KAFB-7 well screen is not likely, based on the close chemical similarities of treated effluent and groundwater". A final report will be prepared by Dr. Patrick Longmire detailing model construction and results of the simulations and will be submitted January 31, 2016.

Temporary Permission Request

KAFB is requesting a maximum allowable discharge rate of 500 gpm, which will accommodate any fluctuation in the volume of treated groundwater from the full-scale GWTS. As detailed in the UIC application the effluent from the full-scale GWTS will not exceed the lowest of the applicable federal maximum contaminant limit (MCL) or human health standard in 20.6.2.3103(A) NMAC.

We appreciate your attention to this matter. Please contact me at 505.853.3484 or at ludie.bitner@us.af.mil or Mr. Scott C. Clark at 505.846.9017 or at scott.clark@us.af.mil if you have any questions.

Sincerely,

L. Wayne Bitner
Chief, Environmental Restoration

Attachment: Well KAFB-7 Pumping/Recovery Test and Well Rehabilitation Report

cc:
NMED-EHD (Roberts)
NMED (McQuillan, Longmire, Agnew)
NMED-HWB (Kieling, Cobrain)
NMED-GWQB (Huddleson, Pullen)
NMED-PSTB (Reuter)
NMED-OGC (Kendall)

SAF-IEE (Lynnes)
AFGSC 377th ABW (Col Froehlich)
U.S.EPA Region 6 (King, Ellinger)
AFCEC-CZRX (Bodour)
AFCEC-CZOW (Bitner, Branson, Clark)
USACE-ABQ District Office (Simpler, Phaneuf)
Public Info Repository (Central New Mexico Community College), Administrative Record/Information Repository (AR/IR), and File

ATTACHMENT

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December 7, 2015

Subject: Draft Well KAFB-7 Pumping/Recovery Test and Well Rehabilitation Report

Executive Summary

This Letter Report describes the pumping and recovery test conducted at Kirtland Air Force Base (KAFB) production well KAFB-7 in October 2015 as well as work performed in accordance with Groundwater Disposition Letter Work Plan Addendum #1 dated October 30, 2015 (USACE, 2015a) and Addendum #2 dated November 9, 2015 (USACE, 2015b). The pumping and recovery test was conducted prior to well rehabilitation and retrofitting of KAFB-7 for use as an injection well. This well will be used to dispose of treated groundwater from the pump-and-treat interim measure designed to collapse the solid waste management unit (SWMU) ST-106/SS-111 dissolved ethylene dibromide (EDB) groundwater plume. The results of this test show that KAFB-7 is capable of accepting the anticipated maximum 400 gallons per minute (gpm) of treated groundwater.

KAFB-7 was pumped for 24 hours and allowed to recover for 72 hours. Data from the pumping well and observation wells were corrected for non-pumping stresses, and there was measurable drawdown in two observation wells, KAFB-0508 and KAFB-0523, which are located 194 and 860 feet respectively from KAFB-7. After 24 hours of pumping, the well efficiency was estimated to be 54 percent (%). Based on the data analyses, the aquifer transmissivity was 34,000 square feet ($feet^2$) per day, hydraulic conductivity was 90 feet per day, the specific yield was 0.027, and the specific storage was 7.6×10^{-6} per foot. These results were used to calculate that, at a maximum injection rate of 400 gpm, the water level adjacent to KAFB-7 would rise approximately 5 feet. Since there is 43 feet of screen above the water table, an anticipated rise of only 5 feet indicates that KAFB-7 is suitable for use as an injection well.

KAFB-7 was purged, sampled, and rehabilitated to support injection. The KAFB-7 rehabilitation and valve installation summary of activities conducted are described below.

Pumping and Recovery Test Procedure

KAFB-7 was turned off 4 days prior to the start of the test. Pressure transducers were installed in four observation wells (Table 1 and Figure 1). A pressure transducer was attached to the air line feeding into KAFB-7 to monitor water levels in accordance with the method described on pages 550 to 552 of *Groundwater and Wells* (Driscoll, 1986).

A 24-hour pumping test began at noon on October 6, 2015. At the end of the 24-hour pumping period, a sample was collected for total and dissolved metals by U.S. Environmental Protection Agency (EPA) Method 6020, total and dissolved silicon by EPA Method 6010, anions by EPA Method 300, total and dissolved alkalinity by Standard Method (SM) 2320B, total dissolved solids by SM2540C, total and dissolved organic carbon by SM5310B, and total Kjeldahl nitrogen by SM4500. Following sampling, the pump was shut off at noon on October 7, 2015, and the aquifer was allowed to recover for a 72-hour period while the pressure transducers continued to record water-level changes.

Data and Analysis

Sampling

The preliminary sampling results are provided in Table 2. None of the analyte concentrations exceeded their respective regulatory limits.

Data Corrections

To determine the response of observation wells during pumping and recovery, water levels were corrected for non-pumping stresses, including barometric fluctuations and regional water-level changes. Well KAFB-0524 was located approximately 2570 feet from KAFB-7, which put it outside of the expected zone of influence from pumping at KAFB-7. Therefore, the displacement observed at KAFB-0524 was responding only to non-pumping stresses during testing. As a result, the water-level displacement in KAFB-0524 was subtracted from the displacement observed in each of the other test wells to correct the data at those wells for non-pumping stresses. The corrected water levels for the duration of pumping and recovery are presented on Figure 2 for observation wells and on Figure 3 for KAFB-7. Two of the observation wells, KAFB-0508 and KAFB-0523, had a response to pumping of KAFB-7 sufficient for the determination of aquifer characteristics (Figure 2).

The water level in KAFB-0507 responded to an additional stress, most likely the pumping at another production well (Figure 2); the same response was observed in the recovery water levels in KAFB-7 (Figure 3). Both of these wells had screen intervals in a deeper part of the aquifer than the remaining test wells, which may explain why the other wells did not respond to the same stress. This signature was removed from the KAFB-7 data by subtracting the corrected displacement observed in KAFB-0507; the results are presented on Figure 3.

As shown on Figure 4, there was an initial water-level drop of approximately 8.8 feet observed in KAFB-7 when the pump first turned on and the drop pipe filled with water with little back-pressure. Once the pipe was filled, by 4 minutes into the test, the additional pressure in the pipeline caused the pumping rate to decrease, and the water level recovered to a displacement of approximately 4.4 feet below the pre-pumping level. After this, the water level steadily declined for the duration of pumping. Likewise, there was an initial rise in water level of approximately 8.4 feet when the pump was shut off, and the water from the drop pipe drained into the well. By 6 minutes into the recovery period, the water level declined to a displacement of approximately 5.4 feet above the water levels at the end of pumping, approximately 0.5 foot below the pre-pumping level. After this, the water level steadily rose until it stabilized at the pre-pumping level, approximately 900 minutes (15 hours) after the pump was shut off. These initial pumping and recovery pump-related pulse data were removed from both the pumping and recovery data sets prior to analysis.

Assumptions

The following assumptions were made prior to analysis, and are based on data obtained during testing and from KAFB-7 documentation:

1. To calculate aquifer characteristics, both pumping and recovery data were analyzed.
2. The aquifer is characterized as unconfined; therefore, analysis methods applicable to unconfined conditions were used.
3. For the data analysis, the pumping well is characterized as fully penetrating in the aquifer. The liner installed in 1979 has mill slots from 578 feet down to 1,010 feet—the original bottom of the well. The top of the original louvered screen, the top of which is 43 feet above the current water level at 486

feet, is assumed to be in hydraulic communication with the aquifer and the slotted liner. The bottom 60 feet of the well is filled with material and heavy incrustation has covered the majority of slots below a depth of 851 feet. Therefore, for calculating hydraulic conductivity and specific storage, an aquifer thickness of 365 feet of water is used (851'-486' = 365'). If the full aquifer thickness of 488 feet is used for calculating these two parameters, the results will be reduced by 25% (100*(1-(365'/488')) = 25%).

Aquifer Characteristics Analysis Method

The aquifer testing software AQTESOLV® (Duffield, 2007) was used to conduct the analysis of aquifer characteristics. The Moench (1997) solution for unsteady flow to a fully or partially penetrating finite diameter well with well-bore storage and skin effect in a homogeneous, anisotropic unconfined aquifer with delayed gravity response was selected as the analytical solution to determine aquifer properties. This method generates values for transmissivity (T), storage coefficient (S), hydraulic conductivity (K), and specific yield (Sy). The Moench solution also allows for the determination of values for the ratio of horizontal to vertical hydraulic conductivity times radial distance squared and divided by aquifer thickness squared ($\beta = K_z r^2/K_r b^2$), well-bore skin effect (Sw), nominal casing radius (r(c)), effective well radius (r(w)), and an empirical constant for delayed drainage from the water table (α_1).

The method developed by Agarwal (1980) was used to apply the Moench (1997) analytical solution to the recovery data. In this method, equivalent time and recovery drawdown for recovery data are calculated using the following formulas:

$$t_{equiv} = \frac{t_p - t'}{t_p + t'}$$

$$s_r = s_p - s'$$

where:
t_{equiv} is the Agarwal equivalent time
t' is time since pumping stopped
t_p is the total time of pumping
s_r is recovery drawdown
s_p is drawdown in well at time t_p,
s' is residual drawdown in the well after pumping stopped

Results

At 24 hours of pumping at an average discharge rate of 740 gpm, the drawdown in KAFB-7 was 5.89 feet, resulting in an estimated specific capacity of 120 gpm per foot. With extended pumping until drawdown stabilizes, it is expected that the specific capacity estimate would decrease, possibly by as much as 50%, or 60 gpm per foot. This is consistent with the original specific capacity of 64 gpm per foot measured upon well installation. Following the KAFB-7 well rehabilitation in 2002, a specific capacity test indicate 16 gpm per foot, which is significantly lower than either the initial or 2015 specific capacity estimates.

At KAFB-7, a well efficiency of 54% was calculated after 24 hours of pumping. To determine well efficiency, the drawdown at observation wells KAFB-0508 and KAFB-0523 was plotted versus the distance from the pumping well on a semi-log plot (Figure 5). A straight line was projected through these points onto the KAFB-7 casing radius (1 foot). The point where the projected line met the radius was the expected drawdown in the pumping well for a 100% efficient well. The well efficiency is the expected drawdown divided by the observed drawdown in the pumping well.

Table 3 summarizes the results of the Moench (1997) analysis on recovery data for the pumping well and observation wells, and the results for each well are provided in Attachment 1. Using the geometric mean of analysis results, the aquifer transmissivity was 34,000 feet^2 per day, hydraulic conductivity was 90 feet per day, the specific yield was 0.027, and the specific storage was 7.6×10^{-6} per foot.

To determine the expected rise in water level in the vicinity of KAFB-7 based on the maximum anticipated injection rate, the following equation for an injection well penetrating an unconfined aquifer at steady state was used (Driscoll, 1986):

$$Q_r = \frac{K\left(h_w{}^2 - H_0{}^2\right)}{1055\log((r_0/r_w)}$$

rearranged to:

$$h_w = \left(\frac{Q_r \times 1055\log[r_0/r_w]}{K} + H_0{}^2\right)^{1/2}$$

where:
h_w is the head above the bottom of the aquifer while recharging (in feet)
Q_r is the injection rate (gpm)
K is the hydraulic conductivity (gallons per day per square foot [gpd per foot^2])
H_0 is the static head above the bottom of the aquifer (feet, equal to the aquifer thickness)
r_0 is the radius of influence (feet)
r_w is the injection well radius (feet)

The anticipated rise in water level would therefore be equal to $h_w - H_0$.

The following conservative values were assumed for the input parameters:

- Q_r = 400 gpm. This is the maximum anticipated injection rate.
- K = 340 gpd per foot^2. This converts to 45 feet per day, which is half of the calculated hydraulic conductivity of 90 feet per day (670 gpd per foot^2) to account for the estimated well efficiency of 54%.
- H_0 = 365 feet. This is the aquifer thickness used for data analysis.
- r_0 = 1,300 feet. During the 24-hour pumping period, drawdown was observed in KAFB-0523, 860 feet from KAFB-7, and not in the next closest well, KAFB-0507, at a distance of 1,340 feet from KAFB-7. The value of 1,300 feet assumes that KAFB-0507 is only 40 feet beyond the radius of influence, and is consistent with the distance drawdown plot on Figure 5.
- r_w = 1 foot. This is the radius of KAFB-7.

Using these values, h_w was calculated as 370 feet, which is 5 feet higher than the H_0 value of 365 feet.

Pumping and Recovery Test Conclusions

Based on the data analysis presented here, there is an expected rise in water level of 5 feet at KAFB-7 at a maximum anticipated injection rate of 400 gpm. Because there is 43 feet of louvered screen in the original casing above the water table, an anticipated rise of only 5 feet indicates that KAFB-7 is capable of accepting the treated groundwater from the pump-and-treat interim measure designed to collapse the SWMU ST-106/SS-111 dissolved EDB groundwater plume.

Well Rehabilitation and Valve Installation Summary

The following activities were conducted at well KAFB-7:

- On November 4, 2015, slightly more than three casing volumes (approximately 9,118 gallons) were purged from KAFB-7 to remove flocculant. Groundwater was then sampled for primary drinking water standards for metals (EPA Method 200.8 for 18 metals), nitrate/nitrite (EPA Method 300.0), total Kjehldahl nitrogen (TKN) (EPA Method 351.2), total nitrogen (by calculation), volatile organic compounds (EPA Method 524.2), and ethylene dibromide (EDB) (EPA Method 504.1). None of the results were greater than the drinking water regulatory standards. The samples were analyzed in accordance with the Groundwater Disposition Letter Work Plan Addendum #1 dated October 30, 2015 (USACE, 2015a) and NMED's response letter dated November 12, 2015.
- On November 5, 2015, plastic strip debris was successfully removed from KAFB-7. This debris had been identified during the initial pre-rehabilitation well video survey conducted on October 26, 2015.
- On November 11, 2015, a wireline nylon Cotey casing brush, built to fit tightly inside the well, was used to brush and swab the length of the well. Additional effort was focused on brushing and swabbing from approximately 580 feet to 700 feet where there was less incrustation visible in the pre-rehabilitation well video.
- On November 12, 2015, a sand pump run on a wire line was used to remove loosened incrustation material. Approximately 14 feet of incrustation material was removed from the bottom of the well. The solid incrustation material was placed in an onsite poly 55-gallon drum and sampled for disposal purposes. Sample results indicated a detection of total petroleum hydrocarbons in the diesel range at 169 milligrams per kilograms (mg/kg) which is above the KAFB landfill limit of 100 mg/kg. The probable cause of the detection was determined to be FM32 dripper oil which fed the downhole pump and was floating on top of the groundwater inside the well.
- On November 13, 2015, a submersible pump was placed in the well and slightly less than two well casing volumes (approximately 5,000 gallons) was removed. The water was placed in an onsite storage tank prior to transportation and discharge to the BFF temporary treatment system.
- On November 20, 2015, an NMED-approved National Safety Foundation (NSF) flocculant certified for use in drinking water supply wells was used to ensure that solids settle out and turbidity is minimized prior to the post-rehabilitation video survey.
- On November 23, 2015, a downhole camera was used to provide a post-rehabilitation well video survey. DVDs of the video footage were provided to NMED. The video indicated that approximately half of the incrustation present before the rehabilitation had been removed and there was no visible damage to the casing. The brushing opened up some of the slots in the deeper part of the liner. The video shows a noticeable amount of floating particulate matter still in the water.
- On December 1 and 2, 2015, a V-Smart Injection Valve (downhole flow control valve) was installed in KAFB-7 with the top of the valve placed at approximately 560 feet.

References

Agarwal, R.G., 1980, *A New Method to Account for Producing Time Effects When Drawdown Type Curves are Used to Analyze Pressure Buildup and Other Test Data.* SPE Paper 9289 presented at the 55th SPE Annual Technical Conference and Exhibition, Dallas, Texas. September.

Driscoll, F.G, *Groundwater and Wells,* St. Paul, Minnesota: Johnson Filtration Systems, Inc., 1986, 2nd ed.

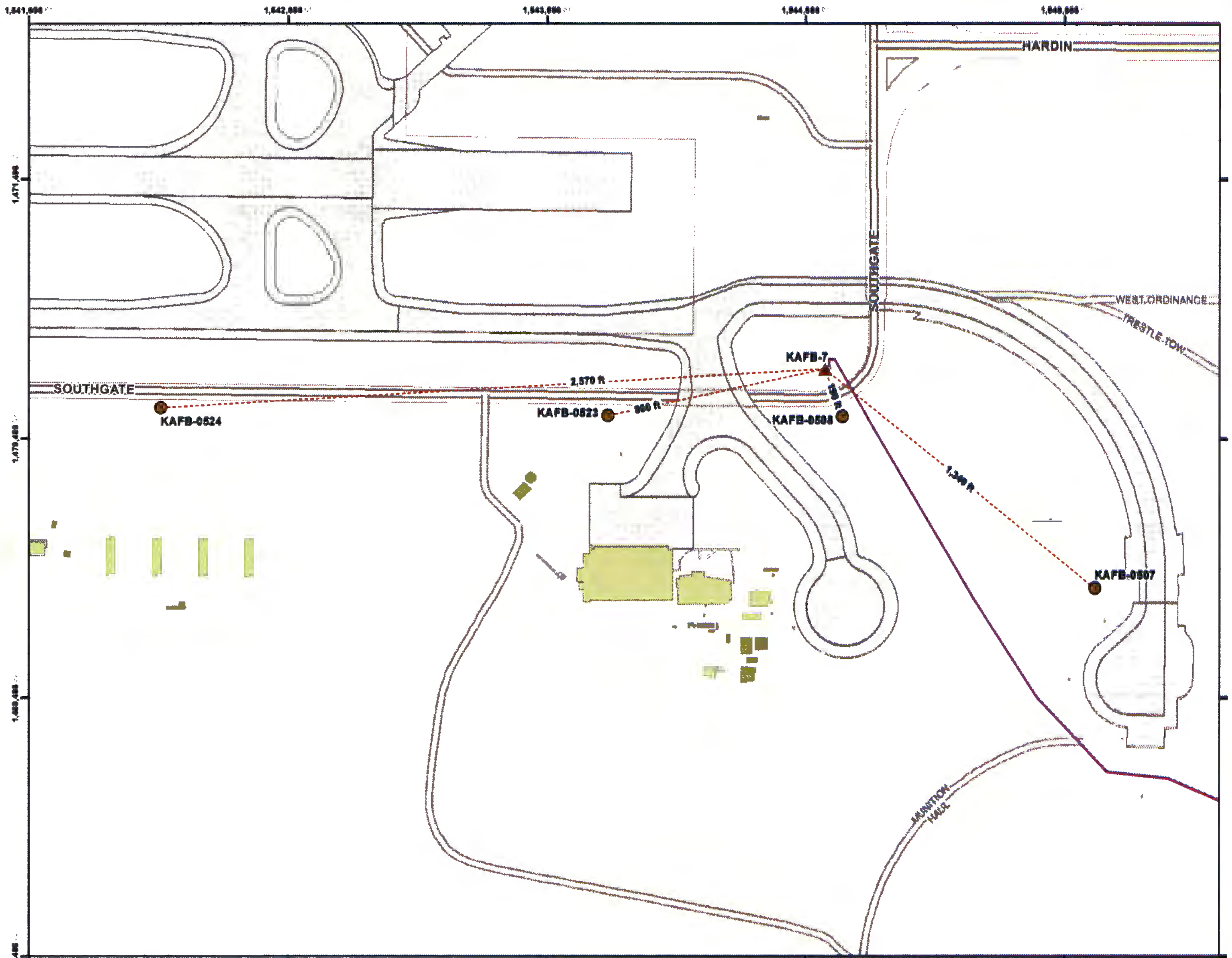
Duffield, G., 2007, *AQTESOLV® for Windows*. Reston, VA, HydroSOLVE, Inc.

Moench, A.F., 1997, *Flow to a Well of Finite Diameter in a Homogeneous, Anisotropic Water-Table Aquifer.* Water Resources Research, vol. 33, no. 6, pp. 1397 – 1407.

U.S. Army Corps of Engineers (USACE), 2015a, *Groundwater Disposition Letter Work Plan Addendum #1, Bulk Fuels Facility, Kirtland Air Force Base, New Mexico*. Prepared by CB&I Federal Services, LLC for the USACE Omaha District under Contract No. W9128F-12-D-0003, Task Order 0025. October 30.

U.S. Army Corps of Engineers (USACE), 2015b, *Groundwater Disposition Letter Work Plan Addendum #2, Bulk Fuels Facility, Kirtland Air Force Base, New Mexico*. Prepared by CB&I Federal Services, LLC for the USACE Omaha District under Contract No. W9128F-12-D-0003, Task Order 0025. November 9.

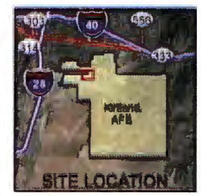
FIGURES



H:\Kirtland_AFB\GIS_Documents\Project_Maps\RAPID\KAFB_063_KAFB7_pump_test.mxd 10/30/15

Legend

- Extraction Well
- Monitoring Well
- Pipe from KAFB-7



Revision Date: 10/30/15

N

0 200 400 800

Feet

1 inch = 400 feet

Projection : NAD83 State Plane New Mexico Central FIPS3002 Feet

KAFB-7 PUMPING AND
RECOVERY TEST REPORT
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 1

KAFB-7 TESTING LOCATIONS

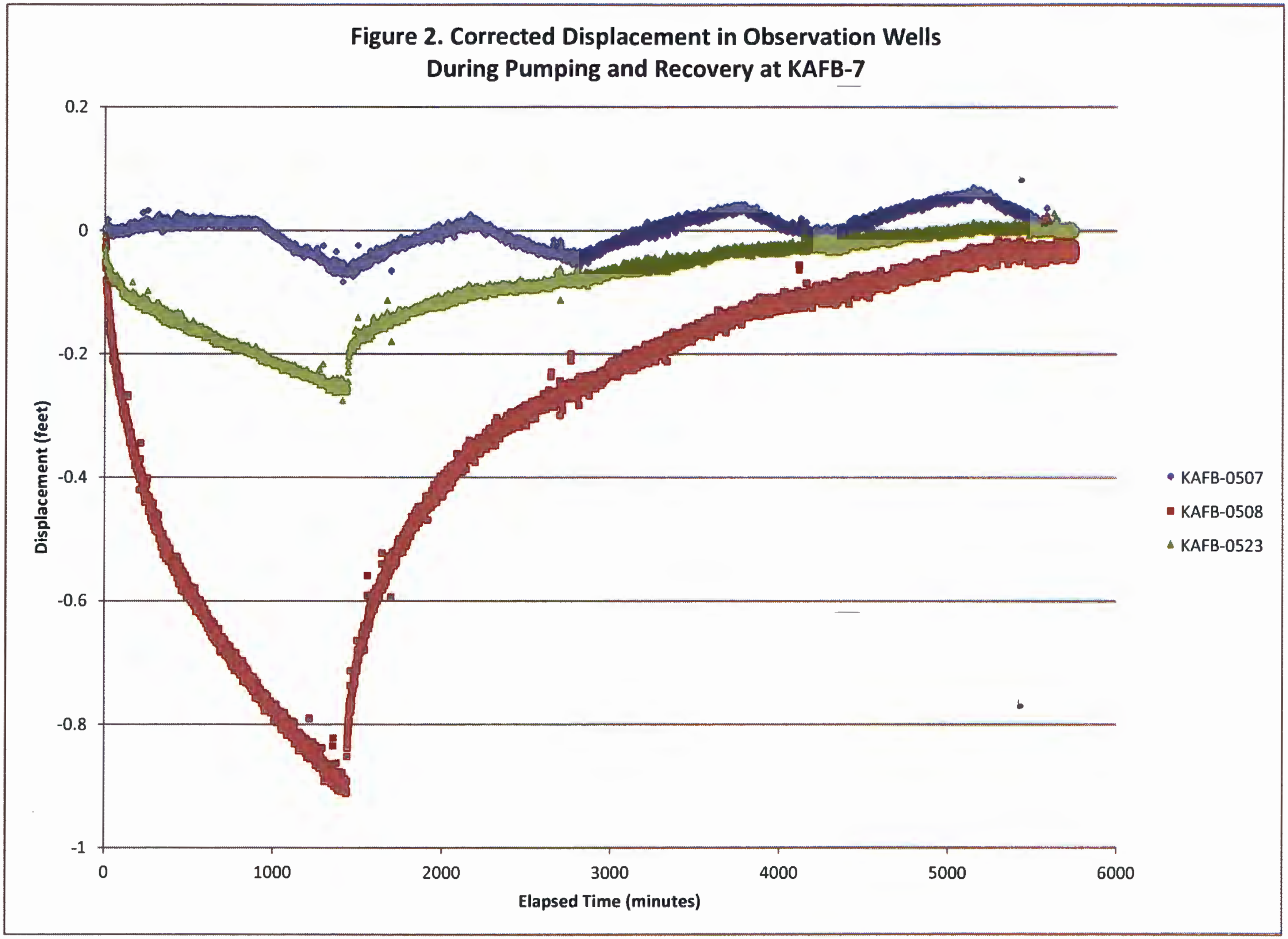


Figure 2. Corrected Displacement in Observation Wells
During Pumping and Recovery at KAFB-7
Displacement (feet)
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
1000
2000
3000
4000
5000
6000
Elapsed Time (minutes)
KAFB-0507
KAFB-0508
KAFB-0523

Figure 3. Corrected Displacement in KAFB-7 During Pumping and Recovery

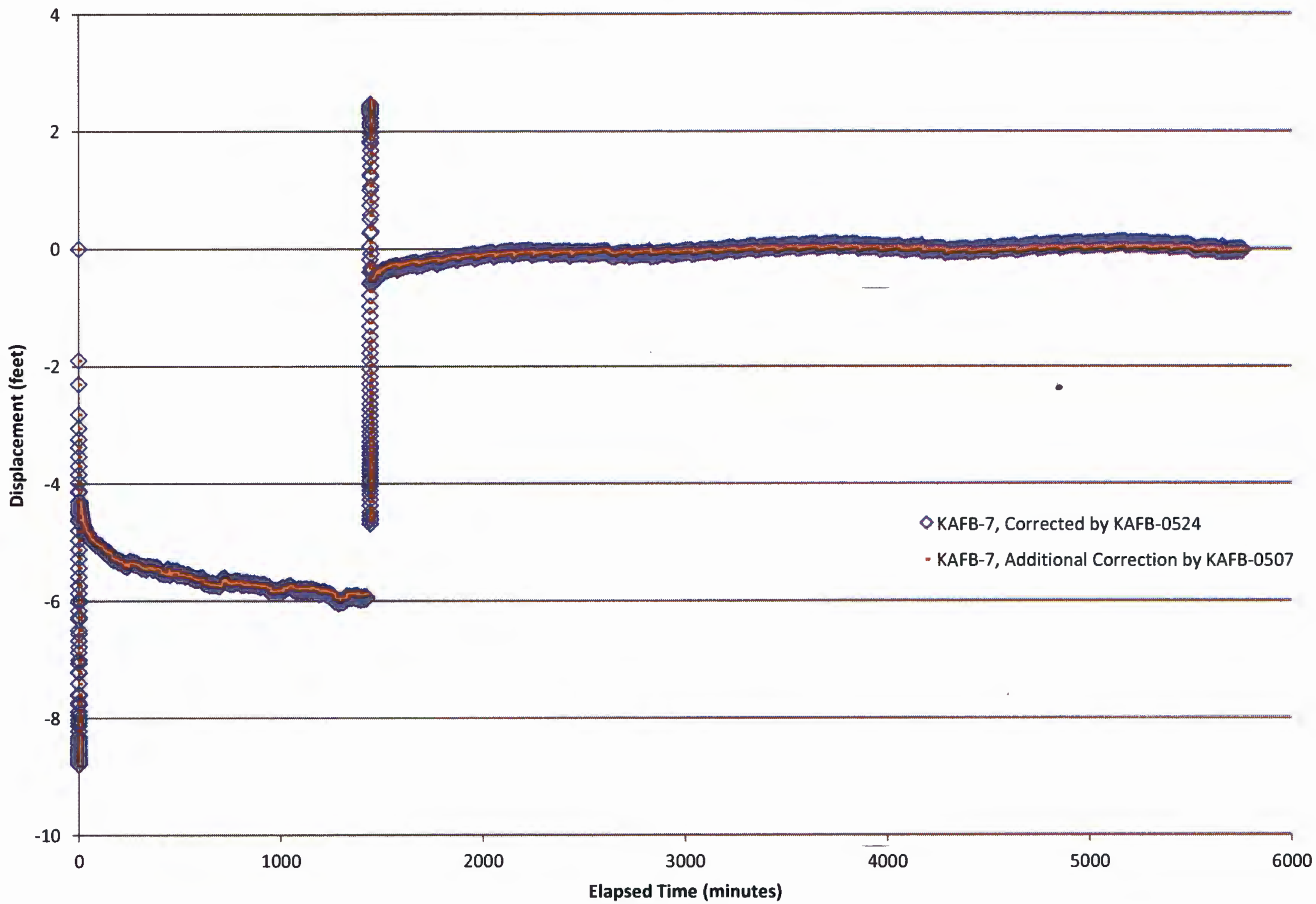
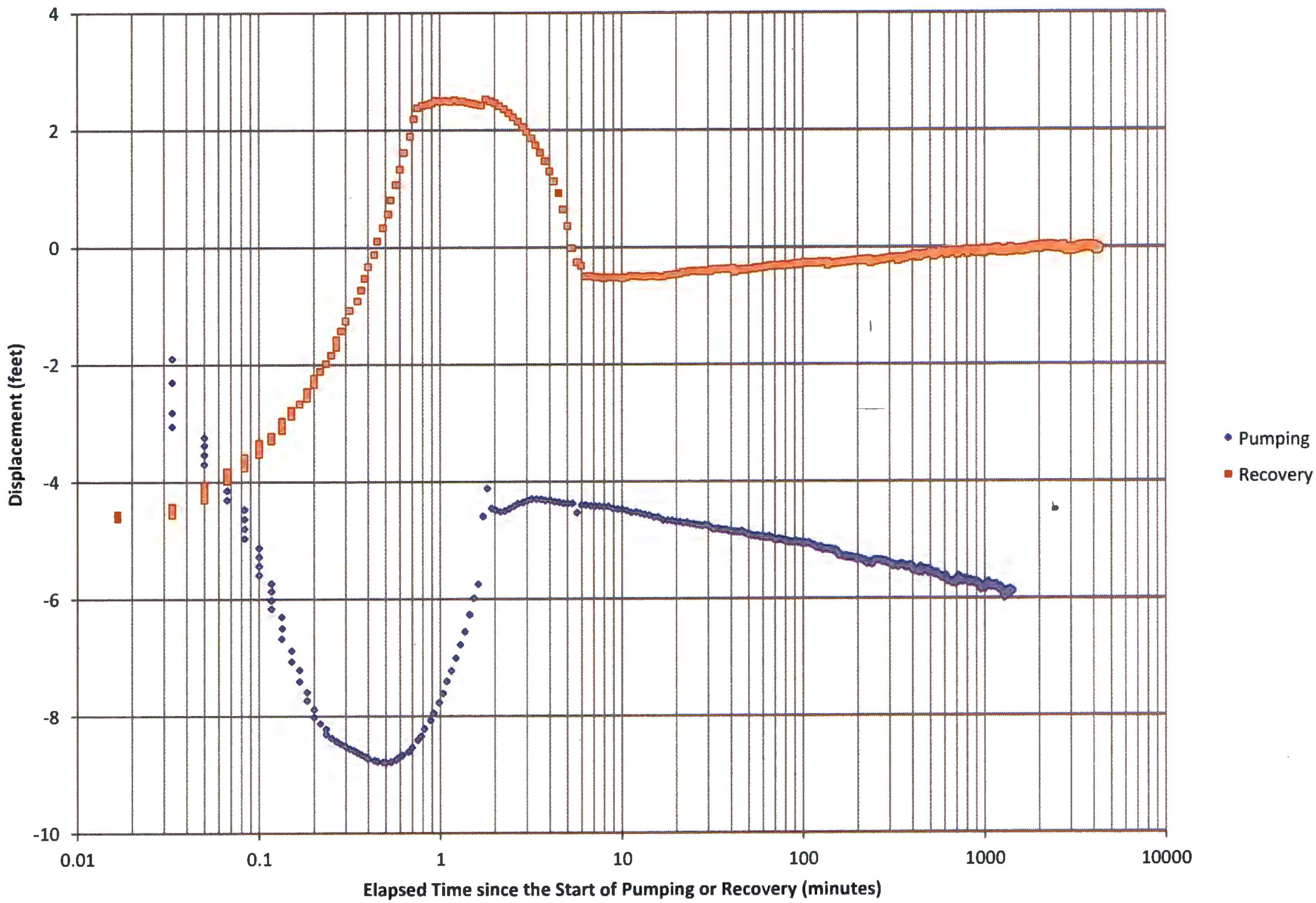


Figure 4. Corrected Displacement in KAFB-7 During Pumping and Recovery in Log-Time



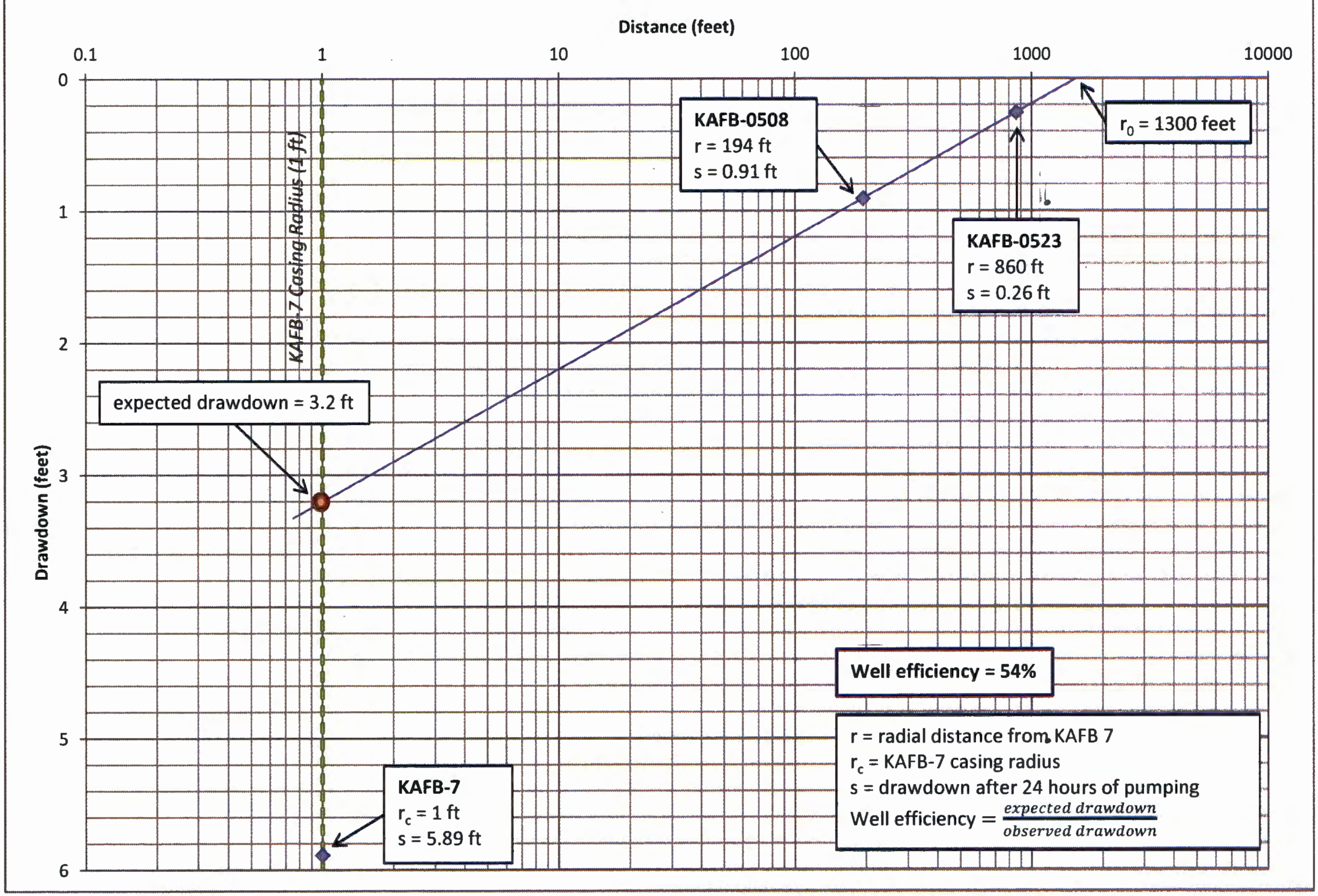


Figure 5. Well Efficiency Calculation after 24 Hours of Pumping at KAFB-7

TABLES

Table 1. KAFB-7 Pumping and Recovery Test Well Summary

Well ID	Screened Interval (feet bgs)	Depth to Groundwater (feet bgs)	Horizontal Distance From KAFB-7 (feet)	Observation Method[a]	Test Purpose	Transducer Log Setting
KAFB-7	448 to 856	491	0	Pressure Transducer attached to Airline	Extraction Well	True logarithmic with a maximum interval of 1 minute. Re-set at the start of recovery.
KAFB-0507	482.3 to 507	491	1,340	Pressure Transducer	Observation Well	Linear, 1-minute intervals
KAFB-0508	481 to 506	487	190	Pressure Transducer	Observation Well	Linear, 1-minute intervals
KAFB-0523	600 to 625	482	860	Pressure Transducer	Observation Well	Linear, 1-minute intervals
KAFB-0524	484 to 509	477	2,570	Pressure Transducer	Background Well	Linear, 1-minute intervals

[a]In-Situ Level TROLL® 700 pressure transducers were used.

bgs - below ground surface

ID - identification

Table 2. Draft Analytical Sample Results

				LOCATION CODE SAMPLE NO SAMPLE DATE SAMPLE PURPOSE	KAFB-7 RAPID-GW03 7-Oct-15 REG	
Chemical Class and Analytical Method [a]	**Parameter**	**EPA MCLs [b]**	**NMED BG [c]**	**NMED GWPS [d]**	**Result**	**LOQ**
Anions (mg/L) Method SW9056A	BROMIDE				ND	0.25
	CHLORIDE			250	10.3	0.5
	NITRATE	10	4 *	10	4.32	0.25
	NITRITE	1	4 *		ND	0.25
	SULFATE			600	27.7	2.5
SM4500PE (mg/L)	O-PHOSPHATE (AS P)				ND	0.04
Alkalinity (mg/L) Method SM2320B	ALKALINITY, BICARBONATE				113	1
	ALKALINITY, CARBONATE				ND	1
	ALKALINITY, TOTAL				113	1
Alkalinity - Dissolved (mg/L) Method SM2320B	ALKALINITY, BICARBONATE, LAB FILTERED				100	1
	ALKALINITY, CARBONATE, LAB FILTERED				ND	1
	ALKALINITY, TOTAL, LAB FILTERED				100	1
TDS (mg/L) Method SM2540C	TOTAL DISSOLVED SOLIDS			1,000	225	20
Nitrogen (mg/L) Method EPA351.2	NITROGEN, KJELDAHL, TOTAL				ND	1.5
DOC/TOC (mg/L) Method SW9060A	DISSOLVED ORGANIC CARBON				ND	3
	TOTAL ORGANIC CARBON				ND	3
Metals (µg/L) Method SW6010B	SILICON				14,000	46
Metals (µg/L) Method SW6010C	ALUMINUM			5,000	80.7	50
	ARSENIC	10		100	ND	2.5
	BARIUM	2,000		1,000	106	10
	BORON			750	21.4	10
	CADMIUM	5		10	ND	1.25
	CALCIUM				36,600	1,250
	CHROMIUM	100		50	2.35	2.5
	COBALT			50	ND	3.12
	COPPER	1,300		1,000	43.7	2.5
	IRON			1,000	85	25
	LEAD	15	10	50	3.37	1.25
	MAGNESIUM				5,710	1,250
	MANGANESE			200	2.28	3.75
	MOLYBDENUM			1,000	ND	5
	NICKEL			200	ND	2.5
	POTASSIUM				1,750	1,250
	SELENIUM	50		50	0.824	2.5
	SODIUM				20,400	1,250
	STRONTIUM				250	1.5
	THALLIUM	2			ND	2
	TITANIUM				3.03	5
	VANADIUM				5.53	3.12
	ZINC			10,000	36.4	5
Metals (µg/L) Method SW6020A	URANIUM	30		30	1.4	0.1
Metals (µg/L) Method SW7470A	MERCURY	2		2	ND	0.2
Metals (µg/L) Method SW6010B	SILICON, DISSOLVED				14,000	46

Table 2. Draft Analytical Sample Results

				LOCATION CODE	KAFB-7	
				SAMPLE NO	RAPID-GW03	
				SAMPLE DATE	7-Oct-15	
				SAMPLE PURPOSE	REG	
Chemical Class and Analytical Method [a]	Parameter	EPA MCLs [b]	NMED BG [c]	NMED GWPS [d]	Result	LOQ
Metals (µg/L) Method SW6010C	ALUMINUM, DISSOLVED			5,000	75.7	50
	ARSENIC, DISSOLVED	10		100	0.961	2.5
	BARIUM, DISSOLVED	2,000		1,000	112	10
	BORON, DISSOLVED			750	22.5	10
	CADMIUM, DISSOLVED	5		10	ND	1.25
	CALCIUM, DISSOLVED				38,400	1,250
	CHROMIUM, DISSOLVED	100		50	2.77	2.5
	COBALT, DISSOLVED			50	ND	3.12
	COPPER, DISSOLVED	1,300		1,000	2.11	2.5
	IRON, DISSOLVED			1,000	ND	25
	LEAD, DISSOLVED	15	10	50	ND	1.25
	MAGNESIUM, DISSOLVED				5,910	1,250
	MANGANESE, DISSOLVED			200	0.988	3.75
	MOLYBDENUM, DISSOLVED			1,000	ND	5
	NICKEL, DISSOLVED			200	ND	2.5
	POTASSIUM, DISSOLVED				1,810	1,250
	SELENIUM, DISSOLVED	50		50	0.978	2.5
	SODIUM, DISSOLVED				21,300	1,250
	STRONTIUM, DISSOLVED				262	1.5
	THALLIUM, DISSOLVED	2			ND	2
	TITANIUM, DISSOLVED				2.99	5
	VANADIUM, DISSOLVED				5.85	3.12
	ZINC, DISSOLVED			10,000	7.6	5
Metals (µg/L) Method SW6020A	URANIUM, DISSOLVED	30		30	1.3	0.1
Metals (µg/L) Method SW7470A	MERCURY, DISSOLVED	2		2	ND	0.2

* = The Value is the combination of Nitrate/Nitrite as Nitrogen

[a] = EPA analytical methods listed are for the most recent sampling event.

[b] = EPA Maximum Contaminant Levels (MCLs) are from the EPA RSL Table, dated June 2015.

[c] = New Mexico Environmental Department-HWB Approved Background Concentrations, SNL/Kirtland AFB, Chemical Constituents in Ground Water.

[d] = New Mexico Environmental Department Ground Water Protection Standards (Sec. 20.6.2.3103)

EPA = Environmental Protection Agency

KAFB = Kirtland Air Force Base

LOQ = Limit of Quantitation

µg/L = microgram per liter

mg/L = milligram per liter

ND = Not detected.

RSL = Regional Screening Level.

Shading indicates the analyte was detected.

Table 3. Aquifer Properties Analysis Results

Well ID	Pumping or Recovery	Transmissivity ($feet^2$/day)	Hydraulic Conductivity (feet/day)	Hydraulic Conductivity (gpd/$foot^2$)	Specific Yield (dimensionless)	Specific Storage (per foot)	Storativity (dimensionless)
KAFB-7	Pumping	35,000	100	750	0.001	3.84E-10	1.40E-07
	Recovery	38,000	100	750	0.0026	1.40E-08	5.00E-06
KAFB-0508	Pumping	54,000	150	1,100	0.0079	2.49E-05	1.70E-02
	Recovery	28,000	80	600	0.038	2.11E-05	7.70E-03
KAFB-0523	Pumping[a]	110,000	300	2,200	0.033	2.74E-06	1.00E-03
	Recovery	21,000	60	450	0.066	8.30E-07	3.00E-04
Geometric Mean of Results[b]	Pumping and Recovery	34,000	90	670	0.027	7.6E-06	3.4E-03

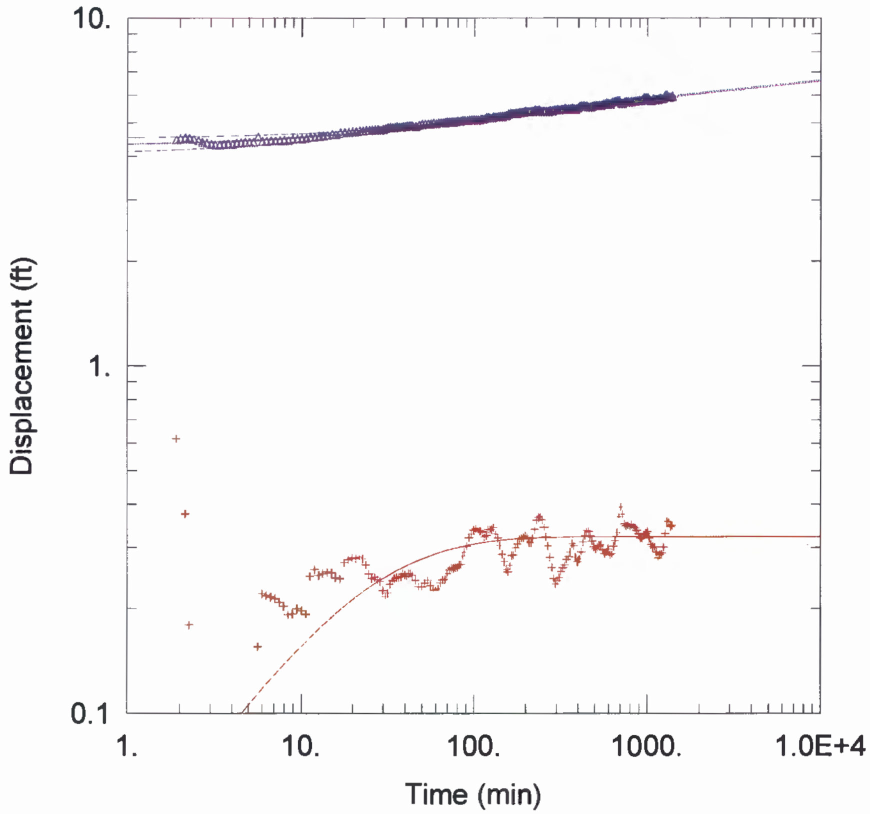
[a]The pumping results for KAFB-0523 were not used to calculate the geometric mean of results. During the recovery period, a separate analysis of the first 24 hours of recovery in KAFB-0523 yielded results consistent with the pumping period. However, the shape of the recovery curve continued to change after that point, and the analysis of the entire recovery curve yielded results more consistent with those determined in KAFB-7 and KAFB-0508 during pumping and recovery.

[b]Specific yield, specific storage, and storativity calculated using KAFB-7 data were not used to calculate the geometric mean of results, as storage parameters are more accurate when calculated using both pumping and observation wells.

gpd - gallons per day

ID - identification

ATTACHMENT 1



WELL TEST ANALYSIS

Data Set: N:\...\WW7_pump_Moench.aqt
Date: 10/21/15 Time: 14:03:04

PROJECT INFORMATION

Company: CB&I Federal Services LLC
Location: Kirtland AFB
Test Well: KAFB-7
Test Date: 10/6/15

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 3.529E+4 ft^2/day
S = 1.414E-7
Sy = 0.001
ß = 5.277E-7
Sw = 0.08751
r(w) = 1. ft
r(c) = 0.5 ft
alpha = 1.0E+30 min^{-1}

AQUIFER DATA

Saturated Thickness: 370. ft

Anisotropy Ratio (Kz/Kr): 0.07225

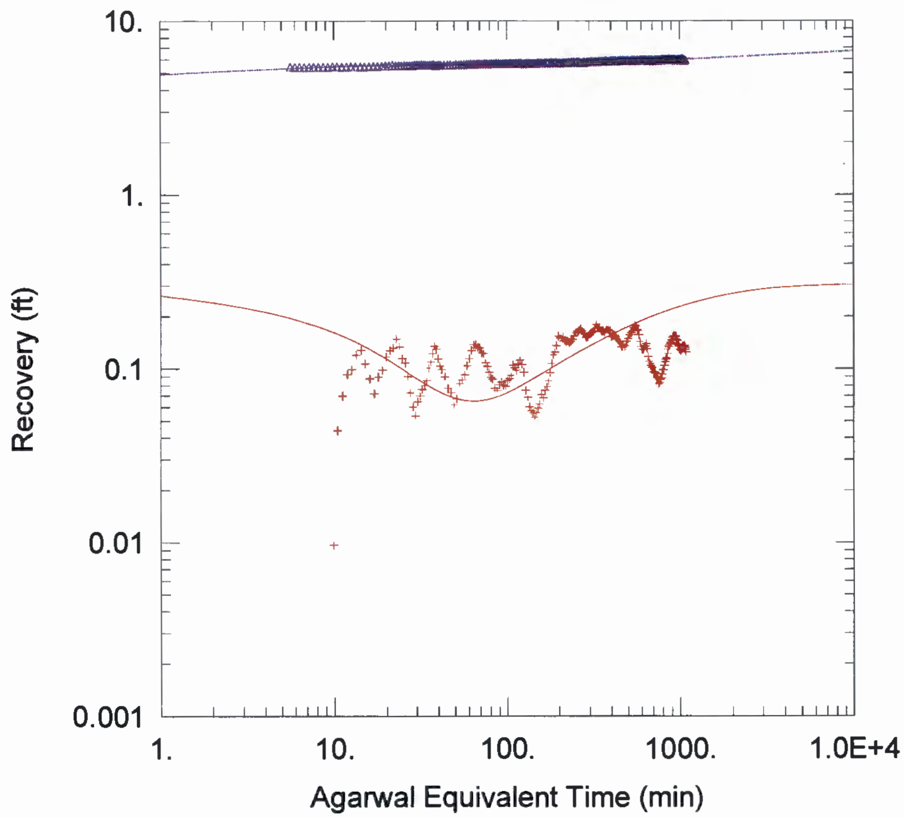
WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
KAFB-7	1544731	1470756

Observation Wells

Well Name	X (ft)	Y (ft)
▵ KAFB-7	1544731	1470756



WELL TEST ANALYSIS

Data Set: N:\...\WW7_recovery_Moench.aqt
Date: 10/21/15 Time: 14:03:42

PROJECT INFORMATION

Company: CB&I Federal Services LLC
Location: Kirtland AFB
Test Well: KAFB-7
Test Date: 10/6/15

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 3.758E+4 ft^2/day
S = 5.044E-6
Sy = 0.0002618
ß = 3.707E-9
Sw = 0.09
r(w) = 1. ft
r(c) = 0.5 ft
alpha = 1.0E+30 min^{-1}

AQUIFER DATA

Saturated Thickness: 370. ft

Anisotropy Ratio (Kz/Kr): 0.0005075

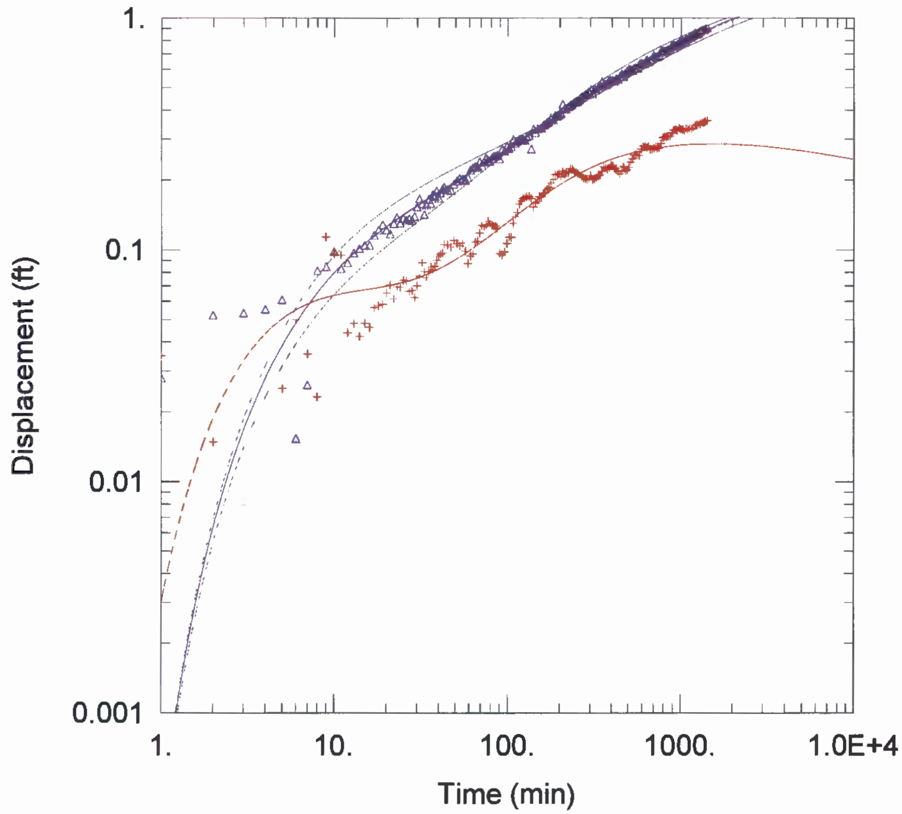
WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
KAFB-7	1544731	1470756

Observation Wells

Well Name	X (ft)	Y (ft)
▵ KAFB-7	1544731	1470756



WELL TEST ANALYSIS

Data Set: N:\...\KAFB0508_Pump_Moench.aqt
Date: 10/21/15 Time: 13:58:48

PROJECT INFORMATION

Company: CB&I Federal Services LLC
Location: Kirtland AFB
Test Well: KAFB-7
Test Date: 10/6/15

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 5.427E+4 ft^2/day
S = 0.01681
Sy = 0.007905
ß = 0.001592
Sw = 0.1
r(w) = 1. ft
r(c) = 0.5 ft
alpha = 1.0E+30 min^{-1}

AQUIFER DATA

Saturated Thickness: 370. ft

Anisotropy Ratio (Kz/Kr): 0.005795

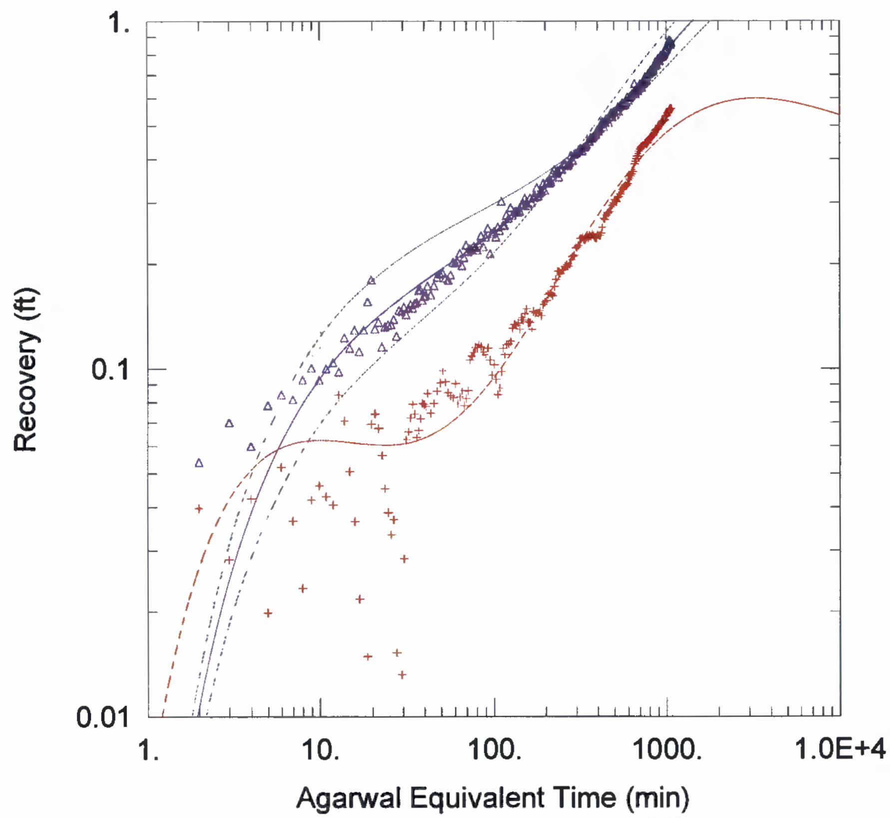
WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
KAFB-7	1544731	1470756

Observation Wells

Well Name	X (ft)	Y (ft)
△ KAFB-0508	1544798	1470574



WELL TEST ANALYSIS

Data Set: N:\...\KAFB0508_Recovery_Moench.aqt
Date: 10/21/15 Time: 13:59:32

PROJECT INFORMATION

Company: CB&I Federal Services LLC
Location: Kirtland AFB
Test Well: KAFB-7
Test Date: 10/6/15

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 2.809E+4 ft^2/day
S = 0.007731
Sy = 0.03775
ß = 0.006857
Sw = 0.
r(w) = 1. ft
r(c) = 0.5 ft
alpha = 1.0E+30 min^{-1}

AQUIFER DATA

Saturated Thickness: 370. ft

Anisotropy Ratio (Kz/Kr): 0.02496

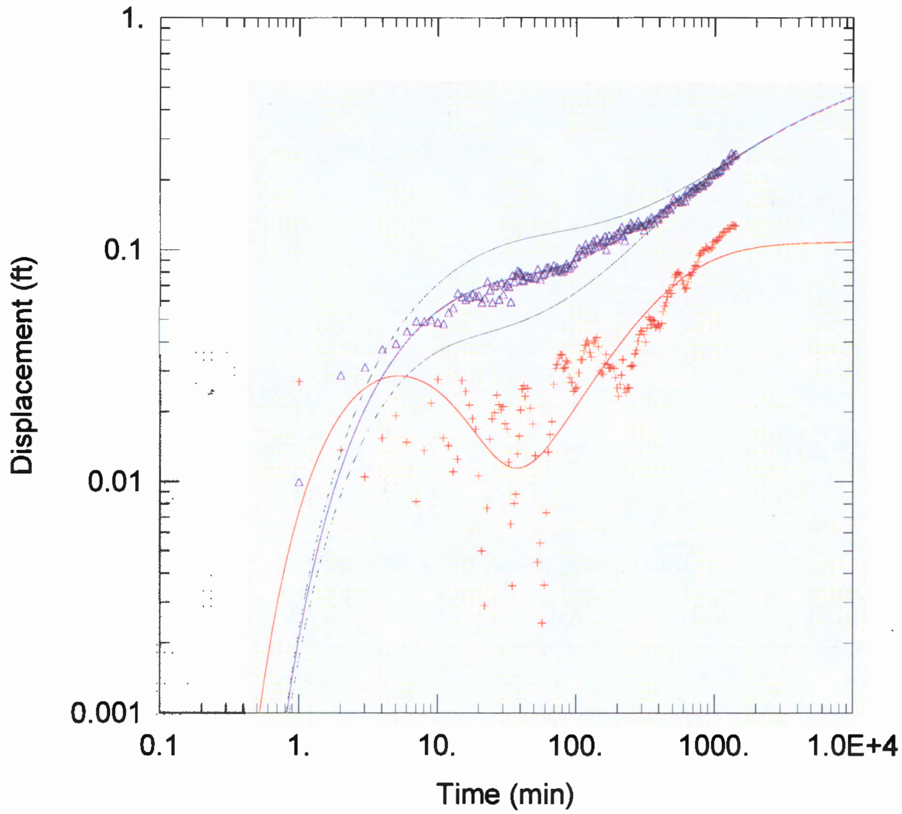
WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
KAFB-7	1544731	1470756

Observation Wells

Well Name	X (ft)	Y (ft)
△ KAFB-0508	1544798	1470574



WELL TEST ANALYSIS

Data Set: N:\...\KAFB0523_Pump_Moench.aqt
Date: 10/21/15 Time: 14:00:19

PROJECT INFORMATION

Company: CB&I Federal Services LLC
Location: Kirtland AFB
Test Well: KAFB-7
Test Date: 10/6/15

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 1.054E+5 ft^2/day
S = 0.001014
Sy = 0.03295
ß = 0.3567
Sw = 0.55
r(w) = 1. ft
r(c) = 0.5 ft
alpha = 1.0E+30 min^{-1}

AQUIFER DATA

Saturated Thickness: 370. ft

Anisotropy Ratio (Kz/Kr): 0.06599

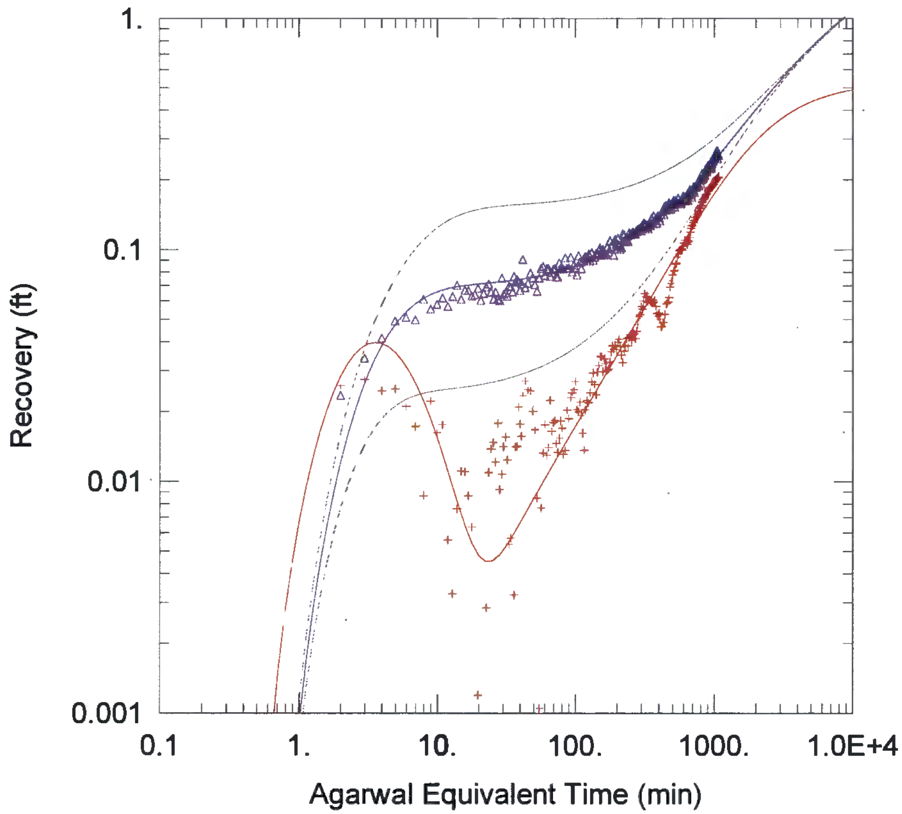
WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
KAFB-7	1544731	1470756

Observation Wells

Well Name	X (ft)	Y (ft)
KAFB-0523	1543890	1470575



WELL TEST ANALYSIS

Data Set: N:\...\KAFB0523_Recovery_Moench.aqt
Date: 10/21/15 Time: 14:01:49

PROJECT INFORMATION

Company: CB&I Federal Services LLC
Location: Kirtland AFB
Test Well: KAFB-7
Test Date: 10/6/15

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 2.128E+4 ft^2/day
S = 0.0003043
Sy = 0.06617
ß = 1.859
Sw = 0.
r(w) = 1. ft
r(c) = 0.5 ft
alpha = 1.0E+30 min^{-1}

AQUIFER DATA

Saturated Thickness: 370. ft

Anisotropy Ratio (Kz/Kr): 0.3439

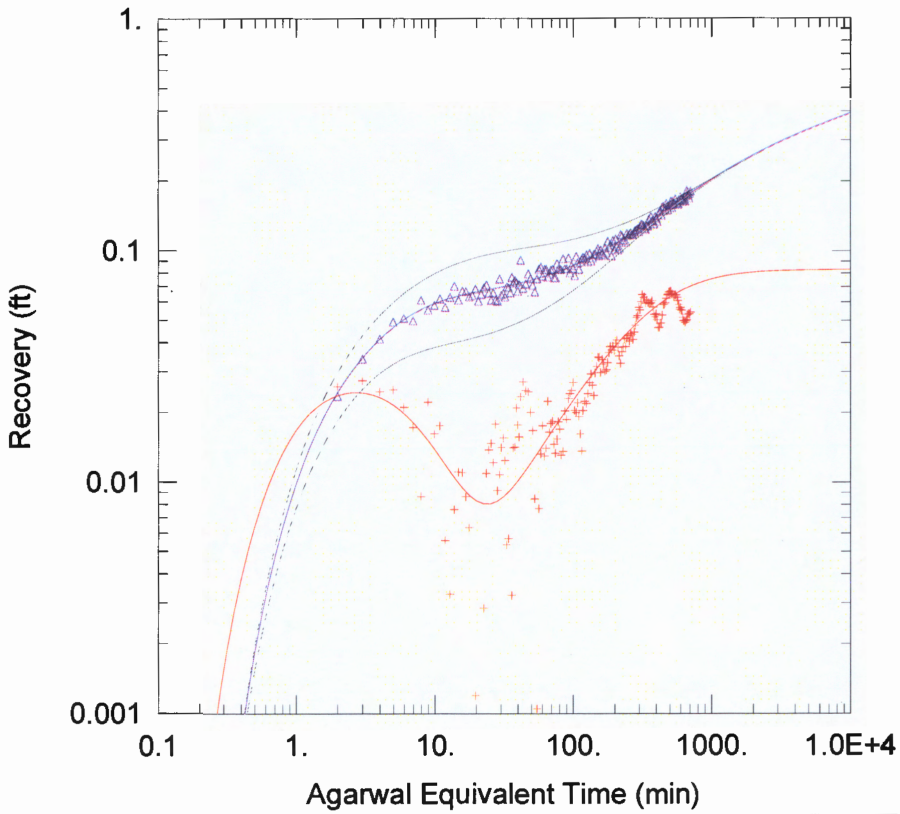
WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
KAFB-7	1544731	1470756

Observation Wells

Well Name	X (ft)	Y (ft)
△ KAFB-0523	1543890	1470575



WELL TEST ANALYSIS

Data Set: N:\...\KAFB0523_Recovery_2880_Moench.aqt
Date: 10/21/15 Time: 14:00:59

PROJECT INFORMATION

Company: CB&I Federal Services LLC
Location: Kirtland AFB
Test Well: KAFB-7
Test Date: 10/6/15

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 1.375E+5 ft^2/day
S = 0.0006358
Sy = 0.02628
ß = 0.285
Sw = 0.55
r(w) = 1. ft
r(c) = 0.5 ft
alpha = 1.0E+30 min^{-1}

AQUIFER DATA

Saturated Thickness: 370. ft

Anisotropy Ratio (Kz/Kr): 0.05272

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
KAFB-7	1544731	1470756

Observation Wells

Well Name	X (ft)	Y (ft)
KAFB-0523	1543890	1470575

Note: This analysis includes only the first 24 hours of recovery data.