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CERTIFIED MAIL - RETURN RECEIPT REQUESTED

February 17, 2012

Colonel John Kubinec
Base Commander
377 ABW/CC
2000Wyoming Blvd. SE
Kirtland AFB, NM 87117-5606

John Pike
Director, Environmental Management Services
377 MSG
2050 Wyoming Blvd. SE, Suite 116
Kirtland AFB, NM 87117-5270

RE: BOREHOLE GEOPHYSICAL LOGS, BULK FUELS FACILITY SPILL, SOLID WASTE MANAGEMENT UNITS ST-I06 AND SS-111, EMAIL OF DECEMBER 14, 2011 KIRTLAND AIR FORCE BASE, EPA ID# NM9570024423 HWB-KAFB-11-008

Dear Col. Kubinec and Mr. Pike:

NMED received an email on December 14, 2011 from Mr. Wayne Bitner with an attached document discussing the Permittee's responses to NMED's letter of September 28, 2011, in regard to the Permittee's submittal *Replacement Pages, Quarterly Pre-Remedy Monitoring and Site Investigation Report .for January-March 2011, Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111*, dated May 2011, with cover letter dated July 22, 2011. NMED has reviewed the information contained in the email and has assessed that the borehole geophysical logs, especially the induction logs generated by Jet West, are not calibrated and not useful.

NMED is still concerned that geophysical log calibration issues are unresolved. The Permittee's position, as discussed in the email attachment, is that the Colog logs may not be useful for quantitative purposes, that the Jet West logs can be used for quantitative purposes, and that a subset of Colog logged wells will be relogged by Jet West. However, in contrast, NMED finds that the existing Jet West induction logs are not useful for quantitative or qualitative purposes for the following reasons.

- There should be an order of magnitude difference in the electrical resistivity between the finer upper Unit A and coarser deeper Unit B (see explanation below for more information concerning Units A and B).
- Other boreholes in the area logged at other times by a variety of geophysical contractors exhibit the expected difference and clearly show the difference between Units A and B.
- The Jet West log for Borehole KAFB-10624 exhibited the expected difference in 2009, but not the log generated by the 2011 mobilization.
- The Jet West induction logs do not differentiate between Units A and B, nor do they differentiate between coarser units in Unit B.

Typically, finer units, such as clays and silts, exhibit electrical resistivities that are lower than coarser units, such as sands and gravels (see Table 1 enclosed with this letter). Differences of about an order of magnitude or so would not be uncommon. At the Bulk Fuels Facility site there is an upper finer unit, Unit A, typically one hundred or more feet thick, and a deeper coarser unit, Unit B, that are shown on geologic cross-sections in the *Quarterly Pre-Remedy Monitoring and Site Investigation Report for April – June 2011*). It would be expected that these two units would have notably different average electrical resistivities based upon the lithologies described in the geologic logs. This is not the case with the Jet West induction logs. In contrast with the Jet West induction logs, the logs of other boreholes in the same area (and similar geology) show the expected variations. For example, Figure 1 shows electric logs from the upper portion of the Ridgecrest 5 production well, and the Jet West and Colog deep induction logs for KAFB-10624. The Jet West log does not show the expected variation in resistivity.

KAFB-10624 was logged by Jet West in 2009 as an open hole, and was logged as a cased hole by Colog in 2010 and again by Jet West in 2011. Figure 2 shows the 2009 Jet West log submitted in the November 2009 Semiannual Report as well as a composite Colog, 2010, and Jet West, 2011, deep induction logs. Again, note the variation of an order of magnitude or so for the logs except that for the 2011 Jet West log. An attenuation of resistivity due to casing and well construction material is expected, but it should not have been enough to cause the Jet West log to lose most of its definition, an argument further supported by the Colog log which did not have such a problem.

Furthermore, Table 2 shows average electrical resistivities from two monitoring wells logged by Jet West (KAFB-106045 and KAFB-106081). It would be expected that the average electrical resistivity would change significantly in different portions of the well, and in particular, that electrical resistivities in the upper portion of the well (Unit A) would have been lower than those in the deeper part of the well (Unit B) where coarser units dominate the stratigraphy. However, this is not the case as the range in resistivity for KAFB-106045 and KAFB-106081 is only 9.2 to 10.7 and 8.4 to 10.4 ohmmeters, respectively. This same issue with the Jet West induction log is also readily apparent as shown graphically in Figure 1 of this letter, and is a pervasive problem with the Jet West logs prepared under the current characterization effort.

In conclusion, the Jet West induction logs are unreliable and are not useful. The Jet West induction logs fail to fulfill the work plan objective of collecting calibrated geophysical logs in all wells. Thus KAFB must repeat the geophysical logging of the wells. The newly-generated logs must be submitted to the NMED in both hard copy and electronic format by no later than May 17, 2012. The electronic version of the logs must be in a format useable by the NMED.

If you wish to discuss this matter, or have any questions, please contact Mr. Sid Brandwein of my staff at 505-222-9504.

Sincerely,

John E. Kieling
Acting Chief
Hazardous Waste Bureau

cc: J. Davis, NMED HWB
W. Moats, NMED HWB
W. McDonald, NMED HWB
S. Brandwein, NMED HWB
J. Schoeppner, NMED GWQB
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B. Gastian, ABCWUA
L. King, EPA-Region 6 (6PD-N)
File: KAFB 2012 and Reading

Typical electrical resistivity values for different soil and rock types

Material	Resistivity (0. m)
Clay *	3-30
Saturated organic clay or silt †	5-20
Sandy clay *	5-40
Saturated inorganic clay or silt †	10-50
Clayey sand *	30-100
Hard, partially saturated clays † and silts, saturated sands and gravels †	50-150
Shales, dry clays, silts †	100-500
Sand, gravel *	100-4000
Sandstone *	100-8000
Sandstones, dry sands and gravels †	200-1000
Crystalline rocks *	200-10000
Sound crystalline rocks †	1000-10000
Rocksalt, anhydrite *	>1100

* Values from Dohr (1975).
† Values from Sowers and Sowers (1970).

Resistivities of common rocks and ore minerals (ohm-metres)

Common rocks			
Topsoil	50–300	Greenstone	500–200 000
Loose sand	500–5000	Gabbro	1000–500 000
Gravel	100–6000	Granite	200–100 000
Clay	1–100	Basalt	50–200 000
Weathered bedrock	100–1000	Graphitic schist	10–500
Sandstone	200–8000	Slates	500–500 000
Limestone	500–10 000	Quartzite	500–800 000
Ore minerals			
Pyrite (ores)	100–0.01	Pyrrhotite	0.01–0.001
Chalcopyrite	0.1–0.005	Galena	100–0.001
Sphalerite	1 000 000–1000	Cassiterite	10 000–0.001
Magnetite	1000–0.01	Hematite	1 000 000–0.01

Table 1. Tables of typical electrical resistivities encountered in the field.
The upper table is from "Site Investigation" by C.R.I Clayton, M.C. Matthews and N.E.Simons, (http://www.geotechnique.info/SI/SI%20Book%20Chapter%204.pdf) and the lower table is from "Field Geophysics" by John Milsom, Geological Society of London Handbook.
Finer units (clays and silts) have markedly different resistivity values than coarser units (sands and gravels), not untypically an order of magnitude or more.

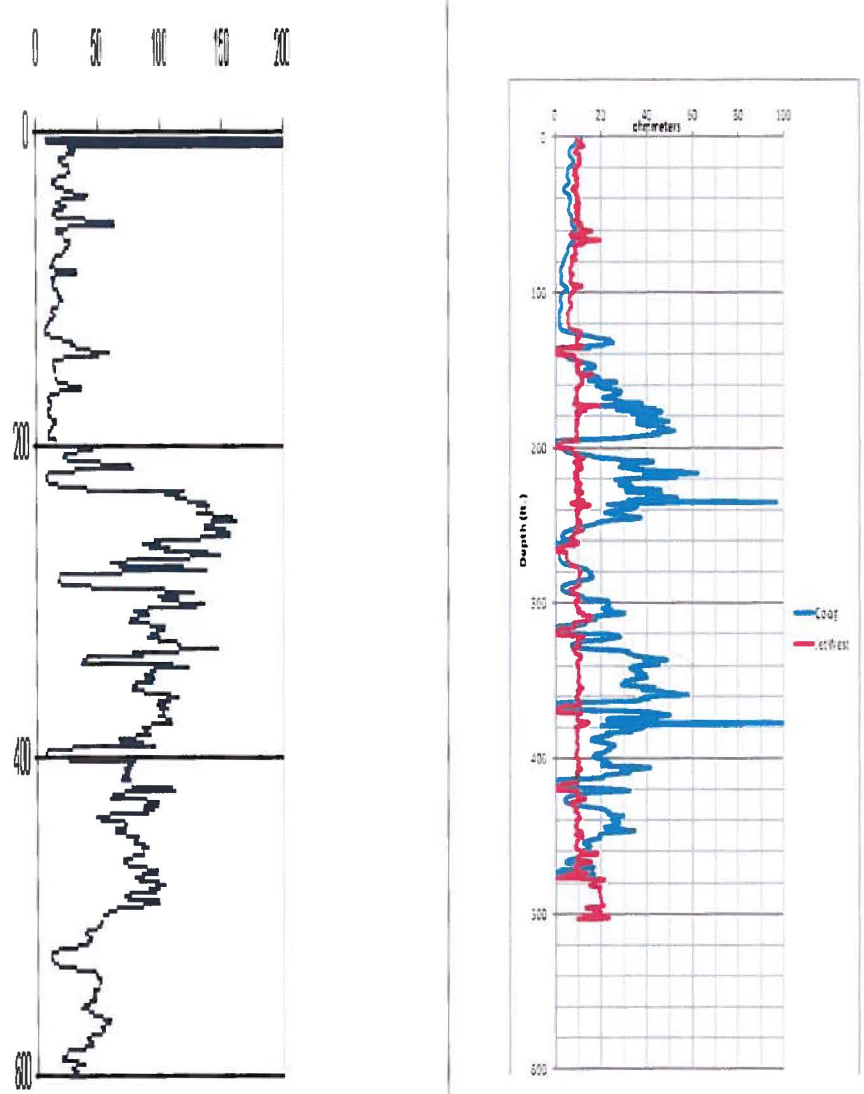

Figure 1. Electrical logs from area wells

Left - Production Well Ridgecrest 5

Right – Composite of Colog, 2010, Long Induction Resistivity, in blue, and Jet West, 2011, Deep Dual Induction, in red, from KAFB-10624. Note: the Jet West log does not show the expected order of magnitude difference in resistivity values between finer and coarser units.

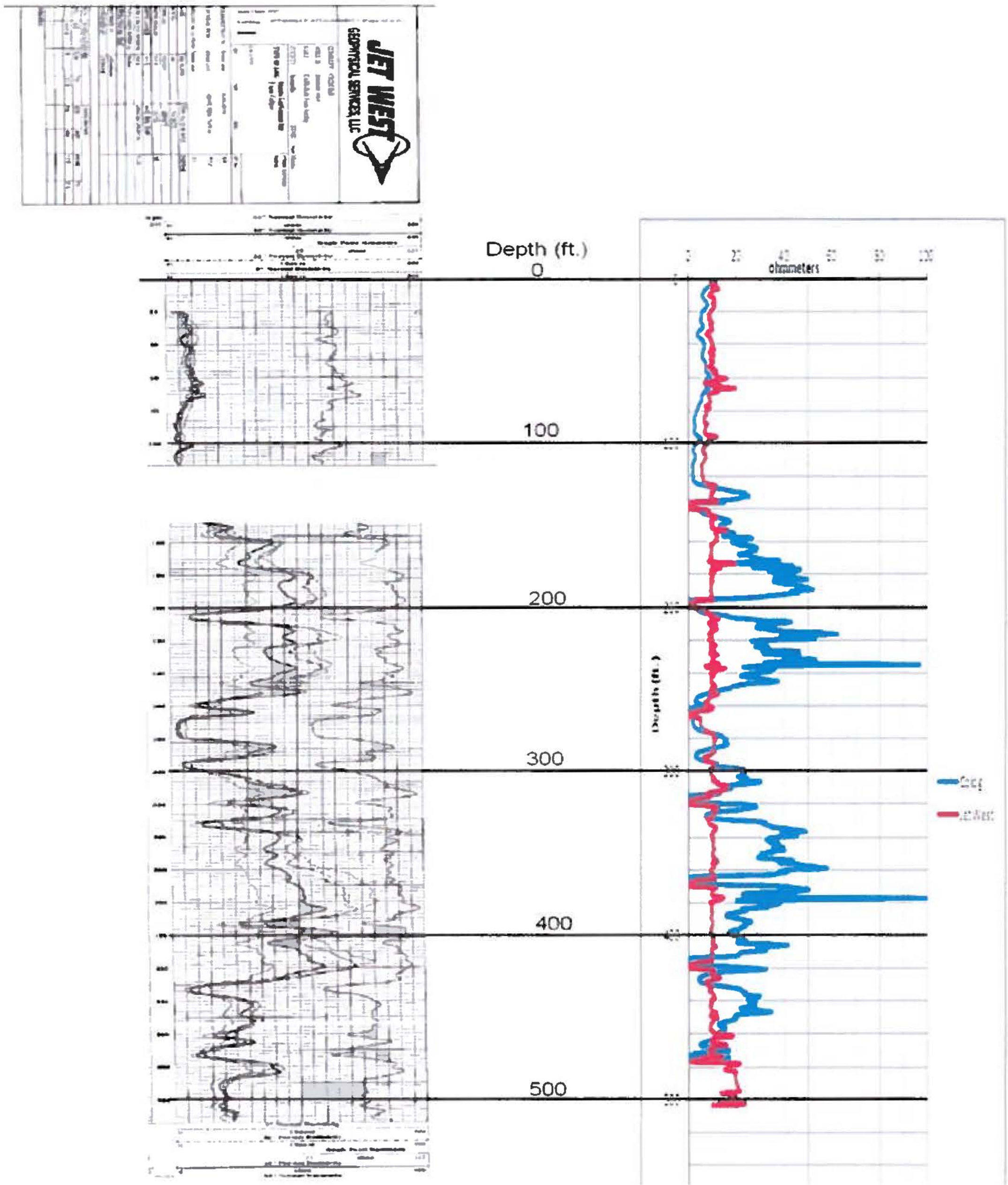

Figure 2. Comparison of electric logs at KAFB-10624.
Left – Jet West, 2009, Normal Resistivity and single point in open hole.
Right – Composite of Colog, 2010, Long Induction Resistivity, in blue, and Jet West, 2011, Deep Dual Induction, in red, in cased hole.
Note: the Jet West log from 2011 does not show the expected order of magnitude difference in resistivity values between finer and coarser units.

KAFB-106045	Long Induction		KAFB-106081	Long Induction
depth range	average resistivity		depth range	average resistivity
(ft.)	(ohmmeters)		(ft.)	(ohmmeters)
5-99.9	10.7		5-99.9	10.4
100-199.9	9.2		100-199.9	8.7
200-299.9	9.3		200-299.9	8.4
300-399.9	9.6		300-399.9	9.4
400-499.9	9.9		400-499.9	10.5
500-545	10.6		500-590	10.1
5-545	9.8		5-590	9.6

Table 2. Average electrical resisitivity by depth for Jet West logs for KAFB-106045 and KAFB 106081. Note: average electrical resistivities vary by only 1-2 ohmmeters, rendering the logs unusable for characterizing geology in each borehole.