ADEQ

A R K A N S A S
Department of Environmental Quality

June 4, 2008

Mike Zinser
Environmental Solutions and Services, Inc.
5 Raymond Road
Morrilton, AR 72110

RE: AFIN No. 15-00533, Permit No. 4919-WR-1
        Authorization for the Land Application of Drilling Fluids
        Moore Site

Dear Mr. Zinser:

The laboratory analyses for the representative samples of soil and reserve pit drilling fluids have been received and evaluated. Attached is the "Technical Evaluation and Calculations for the Land Application of Drilling and Production Fluids" sheet showing the approved volume, area, application rate, and application depth for the current land application event. The Department hereby grants authorization to land apply drilling fluids according to the attached "Technical Evaluation and Calculations for the Land Application of Drilling and Production Fluids" sheet as follows:

Date of request:	06/04/08	
Volume to be applied:	50,121	bbl
	2105097	gal
Application area:	150	acres
Maximum application rate:	40,724	gpm
	14,034	gal/acre
Maximum application depth:	.518	inches

You must comply with all conditions of your permit including the waste management plan as approved by the Department. As a reminder, Permit Condition No. 22 states that drilling fluids shall not be applied to soils that are saturated. Alterations of the system or method of operation is prohibited without prior approval. For subsequent land application events, the volume, soil analysis, drilling fluids analysis (if the source has changed), and acreage must be submitted prior to land application. Future land application may be authorized after evaluation of required information.

Sincerely,

Mo Shafii
Assistant Chief
Water Division

MS:mt

Enclosure

cc: Greg Kremers, ADEQ District Field Inspector
        Marcus J. Tilley, ADEQ Engineer
        Permit File (AFIN No. 15-00533, Permit No. 4919-WR-1)

Technical Evaluation and Calculations
for the Land Application of Drilling and Production Fluids

Permittee Name:	Environmental Solutions and Services, Inc. (Moore Site)		
Authorization Date:	6/4/2008	**Permit No.:**	4919-WR-1
Engineer:	Marcus Tilley	**AFIN No.:**	15-00533

Approved Application Requirements

Volume to be applied:	50,121	bbl
Application area:	150	ac
Maximum application rate:	40,724	gpm
	271	gpm/ac
	14,034	gal/ac
Maximum application depth:	0.518	in

These are the approved application requirements for this land application event. Fluids must be distributed over the entire application area. For subsequent land application events, the volume, soil analysis, drilling fluids analysis (if the source has changed), and acreage must be submitted prior to land application. A new Authorization will be issued for each land application event.

Design and Analysis Values (Enter values from design drawings, WMP, and lab analysis)

Drilling Fluids Volume:	50,121	bbl	→	Volume Equivalents		
Available Acreage:	150	ac		Volume:	2,105,097	gal
Soil Permeability:	0.60	in/hr		Volume:	281,411	ft^3

Drilling Fluids Analysis Data			Soil Analysis Data		
TDS	6000	mg/l	CEC	6.56	meq/100g
pH	7.5		ESP	2.08	% Na sat.
Conductance	7600	µmho/cm	Conductivity	568.00	µmho/cm
Volatile solids	1300	mg/l	pH	6.38	
Total solids	6400	mg/l	Arsenic	N/A	mg/kg
TPH-DRO	1.0	mg/l	Barium	N/A	mg/kg
Arsenic	0.05	mg/l	Cadmium	N/A	mg/kg
Barium	6.0	mg/l	Calcium	N/A	mg/kg
Cadmium	0.004	mg/l	Chlorides	338.00	mg/kg
Calcium	84	mg/l	Chromium	N/A	mg/kg
Chlorides	2000	mg/l	Copper	N/A	mg/kg
Chromium	0.086	mg/l	Iron	N/A	mg/kg
Copper	0.027	mg/l	Lead	N/A	mg/kg
Iron	11	mg/l	Magnesium	N/A	mg/kg
Lead	0.05	mg/l	Manganese	N/A	mg/kg
Magnesium	14.0	mg/l	Mercury	N/A	mg/kg
Manganese	0.9	mg/l	Nickel	N/A	mg/kg
Mercury	0.00021	mg/l	Nitrate + Nitrite Nitrogen	N/A	mg/kg
Molybdenum	0.008	mg/l	Phosphorus	N/A	mg/kg
Nickel	0.029	mg/l	Potassium	N/A	mg/kg
Selenium	0.070	mg/l	Selenium	N/A	mg/kg
Sulfate	21	mg/l	Sodium	N/A	mg/kg
Sodium	1900	mg/l	Sulfate	N/A	mg/kg
Zinc	0.047	mg/l	Zinc	N/A	mg/kg
Total Phosphorus	3.9	mg/l	TPH-DRO	N/A	mg/kg
Potassium	120	mg/l			
Ammonia Nitrogen	2.9	mg/l			
Total Kjeldahl Nitrogen	24	mg/l			
Nitrate + Nitrite Nitrogen	1.6	mg/l			

Evaluation and Calculations

1.a. Acreage Necessary for Disposal Based on Conductivity (EC)

Is the soil conductivity less than 1000 μmho/cm? _____ yes _____

$A_C =$ __149.900__ ac $A_C = \dfrac{1.7 \times 10^{-4}(EC_{dm})(V)}{1000 - EC_S}$

1.b. Acreage Necessary for Disposal Based on Exchangeable Sodium Percent (ESP)

Is the ESP less than 10%? _____ yes _____

$A_{ESP} =$ __135.637__ ac $A_{ESP} = \dfrac{7.4 \times 10^{-7}(Na)(V)}{(0.1 - ESP_S)(CEC)}$

1.c. Minimum Acreage Required

$A =$ __149.900__ ac   A - maximum of A_C or A_{ESP}

Is the minimum acreage required less than the available acreage?   _____ yes _____

2. pH of the Drilling Fluids

Is the pH of drilling fluids between 6.0 and 9.0?   _____ yes _____

3. Loading Rate for Disposal Based on Heavy Metals

$$L = \frac{(V)(Metal)_F}{A} \times 3.5 \times 10^{-4} + 2 \times (Metal)_S$$

Element	Calculated Value		Allowable Value	Is calculated value less than allowable value?
Arsenic:	$L_{Ar} =$	N/A lbs/ac	37 lbs/ac	N/A
Barium:	$L_{Ba} =$	N/A lbs/ac	1000 lbs/ac	N/A
Cadmium:	$L_{Cd} -$	N/A lbs/ac	35 lbs/ac	N/A
Copper:	$L_{Cu} =$	N/A lbs/ac	1350 lbs/ac	N/A
Chromium	$L_{Cr} =$	N/A lbs/ac	1351 lbs/ac	N/A
Lead:	$L_{Pb} =$	N/A lbs/ac	270 lbs/ac	N/A
Mercury:	$L_{Hg} -$	N/A lbs/ac	15 lbs/ac	N/A
Nickel:	$L_{Ni} =$	N/A lbs/ac	378 lbs/ac	N/A
Selenium:	$L_{Se} -$	N/A lbs/ac	90 lbs/ac	N/A
Zinc:	$L_{Zn} =$	N/A lbs/ac	2520 lbs/ac	N/A

4. Maximum Application Rate Based on the Soil Permeability

The allowable application rate of the drilling fluids is calculated based on the soil permeability.   This value is the maximum rate at which drilling fluids can be applied over the entire application area without runoff.

GPM = __40,724__ gpm $GPM = \dfrac{(K_S)(A)}{2.21 \times 10^{-3}}$

AR = __271__ gpm/ac $AR = \dfrac{GPM}{A}$

5. Maximum Application Depth

$D_{max} =$ __0.518__ in $D_{max} = \left(\dfrac{V}{A}\right)(1.55 \times 10^{-3})$

A_C - area based on EC, ac $(Metal)_F$ = Conc. of Zn, Cr, Pb, etc in the drilling fluid, mg/L

EC_{dm} = EC of drilling fluid, μmho/cm $(Metal)_S$ = Conc. of Zn, Cr, Pb, etc in the soil, mg/kg

V = volume of pit, bbl   A = maximum of A_C or A_{ESP}, ac

EC_S = EC soil, μmho/cm   GPM = drilling fluid flow rate, gpm

A_{ESP} = area based on ESP, ac   L = loading rate, lbs/ac

Na = Sodium conc. of the drilling fluid, mg/l D_{max} = max application depth, in

ESP_S = ESP of soil, expressed as a percent K_S = soil permeability, in/hr

C_{metal} = Concentration of metal in drilling fluid, mg/kg   AR = application rate of drilling fluid, gpm/ac

CEC - cation exchange capacity, meq/100g   Parameters marked "N/A" are tested quarterly.