

Project #1937



01396708

KEOTA ERF RECLAMATION PROJECT

MAY 2004

## REPORT FOR PHASE II SOIL AMENDMENTS TASK



**URS**

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May 17, 2004

Mr. Randall Ferguson  
State of Colorado  
Oil and Gas Conservation Commission  
1120 Lincoln Street, Suite 801  
Denver, CO 80203

**Subject: Keota ERF – Reclamation Project  
Report for 2003 Phase II Soil Amendments Task  
Weld County, Colorado**

Dear Mr. Ferguson,

URS is pleased to submit this letter report to the Colorado Oil and Gas Conservation Commission (COGCC) to document field activities associated with the recommended 2003 Phase II Soil Amendments task for the Keota ERF Reclamation project. The Keota site is located near the town of Grover, in Weld County, Colorado.

The field activities completed at the Keota site were based on the reclamation plan prepared for the site as outlined in the May 13, 2003 Site Investigation and Reclamation Plan Development Report prepared by URS and Soil Analytical Inc.

URS teamed with Fred Marick, of Marick Custom Services (Marick) to complete this phase of the Keota project for the COGCC.

## **BACKGROUND**

The Keota reclamation project involves four general areas of impacted soil approximating a total of 8.5 acres. The approximate size of each of the four areas, as calculated by the COGCC, is as follows:

- Area 1 – 4.1 acres
- Area 2 – 3.0 acres
- Area 3 – 0.6 acres
- Area 4 – 0.8 acres

The specific cause of impact to the soils at the Keota project area is associated with the historic discharge of “brine-based” produced oil and gas waters. This discharge of produced water may have occurred over a 30-year period starting from as early as the 1950's.

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The project site is located in Weld County Colorado in Sections 4 and 9 of Township 9 North, Range 61 West. The project area is primarily classified as rangeland and is owned by local rancher, Mr. Phil McKinley.

### **Previous Site Investigation**

URS conducted a site investigation at the subject property in February of 2003. During this phase of the investigation, URS collected a total of 27 soil samples from all of the four areas. The soil samples were analysed per USDA Agriculture Handbook 60 including the following list of parameters and analytical methods:

1. Cation Exchange Capacity (CEC), Method 19
2. Exchangeable Sodium Potential (ESP), Method 20
3. pH, Method 21A
4. Saturated paste moisture, Method 3A
5. Electrical conductivity (EC), Method 4B
6. SAR – Calculated
7. SP Soluble Cations
8. Exchangeable Cations
9. Effervescence – Observation

### **Summary of Site Conditions**

The results of the investigation and laboratory analysis indicate that the existing soil type at the site is predominantly a clay loam. Further it was determined that the basic limitation of the soil was an excessive exchangeable sodium level. Salts were also elevated, classifying the soils at the site as saline-sodic. The soils were not devoid of structure, owing to a high natural organic matter content and solid phase calcium.

In some instances soil reactions were approaching the strongly alkaline range and resulted in a black soil water extract created by dissolution of the soil organic matter. This condition would be expected to worsen as chloride salts are leached out and untreated sodic soil approaches a sodium bicarbonate/carbonate buffer.

### **Summary of Reclamation Plan (Soil Amendment Phase)**

Based on the results of the investigation, a site-specific reclamation plan was developed by URS and Dr. Lloyd Deuel. The proposed reclamation plan outlined a two-phase process as presented in the May 13, 2003 Site Investigation and Reclamation Plan Development Report. The first Phase (called 2003 Phase II in the reclamation plan) made the specific recommendation to reclaim the Keota project soils utilizing both gypsum and sulfur to abate a very strong alkaline reaction and sodic soil condition. A specific proposal and cost estimate (dated October 24, 2003) was prepared and submitted to the COGCC

to address this first phase of the reclamation plan. The second phase (called 2004 Phase III in the reclamation plan) outlines the revegetation aspects of the reclamation plan.

Additional details of the previous site investigation and proposed reclamation plan can be found in the May 13, 2003 Site Investigation and Reclamation Plan Development Report. This letter report is intended to document the completion of the first phase of the Reclamation Plan outlined in the May 13, 2003 report.

## **SCOPE OF WORK**

The Scope of Work for this project consisted of implementing the first phase (addition of soil amendments) of the May 13, 2004 Reclamation Plan for the Keota site and preparation of this report. In general, the activities associated with this phase of the project included the addition of approximately 68 tons of gypsum and 12 tons of sulfur to the four project areas.

### **Project Preparation**

Project preparation/planning activities for this phase of the Keota project included the following activities:

- Completion of Purchase Order OE PHA 040000000026 With the State of Colorado, COGCC.
- Project planning and coordination of field activities with Randall Ferguson at the COGCC.
- Preparation of a Health and Safety Plan.
- Sub-contracting and planning activities with Marick Custom Services (sub-contractor used to complete the contracting/field aspects of the project.
- Completion of a "utility locate".

The COGCC directly contracted with FEC Cooperative in Pine Bluffs Wyoming for the purchase and delivery of gypsum and sulfur to the Keota site.

### **Field Activities**

Field activities associated with the Keota Reclamation Plan were conducted on March 23, 2004. URS employee Stuart Francone arrived at the site at approximately 8:30 AM. Approximately 68 tons of gypsum and 6 tons of sulfur (half of the sulfur purchase) had already been delivered to the site. Weather conditions were sunny to partly cloudy with expected temperatures in the mid 70's. A slight breeze out of the northeast was noted.

The gypsum was initially delivered in bulk to the Marick Custom Services Shop near Grover, Colorado. This was done so that the material could be weighed on a unit basis (weight per front-end loader bucket) to ensure that the proper tonnage could be measured and applied to each of the four impacted areas. The gypsum was then delivered in bulk to the project site. The sulfur was delivered directly to the project



site in two separate loads, utilizing trailer-mounted dry fertilizer spreaders. These spreaders were equipped with adjustable rate distribution gates and rotary blades to facilitate proper distribution.

Fred Marick and a crew of two laborers from Marick Custom Services were also present on-site with the following equipment to complete the soil amendment activities:

- One, CASE front-end loader (to load gypsum at a rate of 3 tons per bucket)
- One, Mohrlang manure spreader with “diaper” (to distribute gypsum)
- Two, 8-ton dry fertilizer spreaders (to distribute sulfur)
- Two, 250 horsepower, 4690 John Deere Tractors, one equipped with a Case International Sub-Soiler, the other with a John Deere disk (to incorporate gypsum and sulfur)

Soil amendments were applied to each of the four sites as specified in the proposed reclamation plan. Specific activities included the following:

1. Agricultural grade gypsum was applied at the recommended rates utilizing the manure spreader. Total application for all four sites was approximately 68 tons with an average break down for each area as follows:
  - Area 1 = 32.9 tons
  - Area 2 = 20.1 tons
  - Area 3 = 5.3 tons
  - Area 4 = 10 tons
2. Each of the four areas was chiseled using the sub-soiler to a depth of 14-16 inches to break up the soil and distribute some of the gypsum deeper in the profile.
3. Agricultural grade sulfur was applied at the recommended rates utilizing the dry fertilizer spreaders. Total application for all four sites was approximately 12 tons with an average break down for each area as follows:
  - Area 1 = 5.8 tons
  - Area 2 = 3.4 tons
  - Area 3 = 0.9 tons
  - Area 4 = 1.8 tons
4. Each of the four sites was tilled using a disk to mechanically blend the gypsum and sulfur applications in to the upper foot of soil. Sloped locations within areas 1 and 2 were tilled along the contour to help prevent erosion.

Field activities were completed by approximately 7:30 P.M. on March 23, 2004. On March 30, 2004, Stuart Francone (URS), Randall Ferguson and Ed DiMatteo (COGCC) returned to the Keota project site to inspect the final work product. Observations made during these two site visits indicate that all field activities were implemented as outlined in the proposed reclamation plan and as proposed to the COGCC.

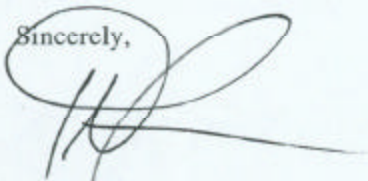
A site vicinity map and general site map have been attached to this letter report. A photographic log documenting the field activities is also attached.

Future activities proposed in the reclamation plan for the Keota site include the following activities:

1. Allow a minimum of 6-8 weeks for a reaction period after the first-phase soil amendment activities are completed.
2. Collect five to six confirmation samples to verify the effectiveness of the soil amendments and to determine the amount, if any, of fertilizer that is needed to establish plant growth. Analysis should include pH, electrical conductivity, and standard agricultural nutrient testing.
3. Apply fertilizer as needed.
4. Prepare soil and plant appropriate seed mixture. Plant at appropriate time of year (spring or fall). Recommended rate and species includes a total of 15 lbs. / acre of the following mixtures.
  - **Dry land pasture mix** (10 lbs. / acre of Intermediate Wheat, Smooth Brome, Crested Wheat, Pubescent Wheat, Orchard Grass and Perennial Rye).
  - **Short grass mix** (5 lbs. / acre of Buffalo, Blue Grama and Side Oats Grama Grass).
5. Mulch surface with 4-5 tons / acre straw (crimp vertically to hold).

We appreciate this opportunity to work with the COGCC on this important remediation project. Should you have any questions regarding this report, please feel free to contact me at 303-740-3965.

Sincerely,



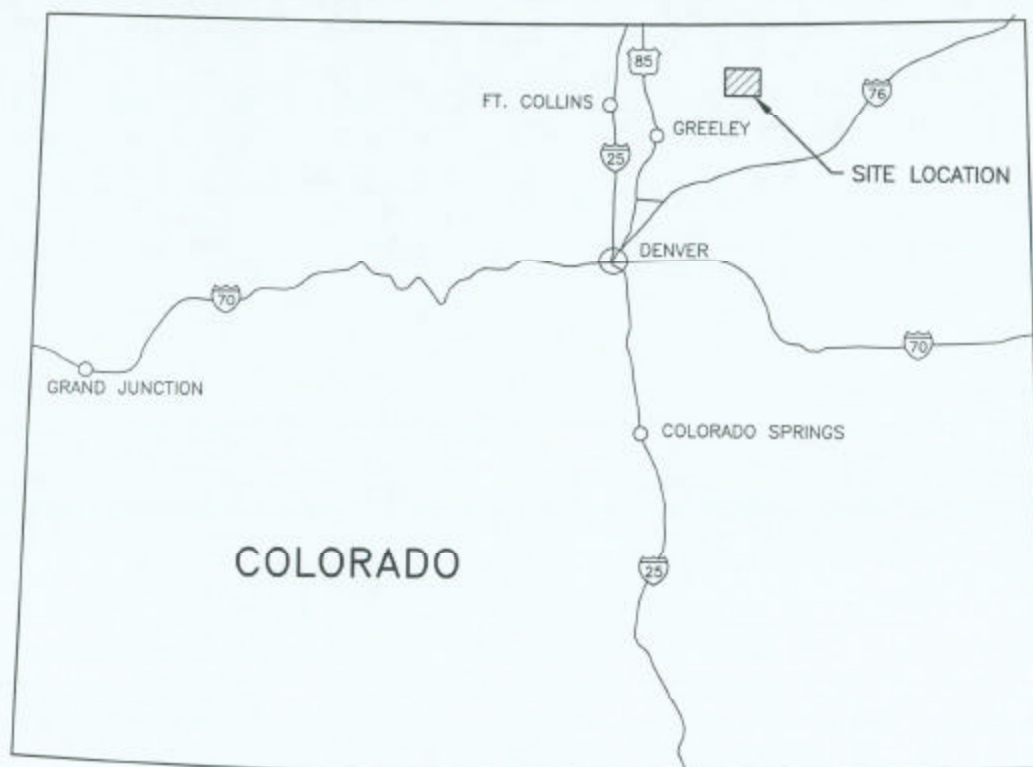
Stuart Francone, CES  
Regional Director, Oil and Gas Services

Attachment

# Figures



URS



Job No. : 22235895

Prepared by : SLF

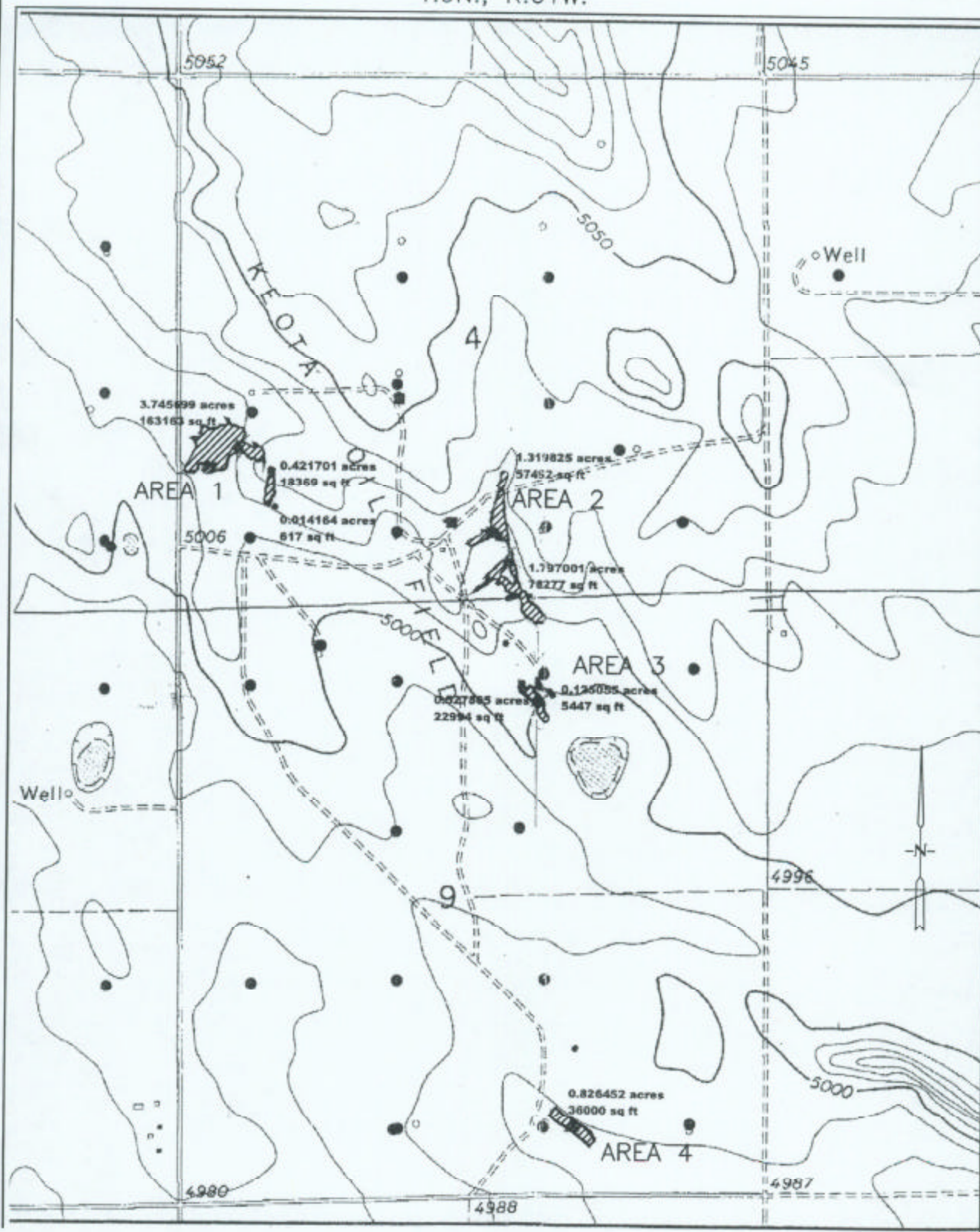
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VICINITY MAP  
COGCC  
KEOTA RECLAMATION PROJECT

FIG. 1



T.9N., R.61W.



Job No. : 22235895

Prepared by : SLF

Date : 3/3/03

# SITE MAP

COGCC  
KEOTA RECLAMATION PROJECT

FIG. 2

# **Photographic Log**

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01 – Agricultural grade Gypsum delivered in bulk to the project site. CASE front-end loader used to load and weigh (3 tons/bucket) gypsum. Manure spreader to right used to distribute gypsum.



02 – Manure spreader used to distribute gypsum.





03 – Manure Spreader used to distribute gypsum. Area 1 looking northwest.



04 – Distribution of gypsum.





05 – John Deere tractor chiseling soil with sub-soiler after gypsum application.



06 – Chiseling of soil with sub-soiler after gypsum was applied. Area 4 looking southwest.





07 – Depth of sub-soiler penetration



08 – Dry fertilizer spreader used to distribute sulfur.





09 – Dry fertilizer spreader showing adjustable gate and rotary spreader.



10 – Distribution of sulfur.





11 – John Deere tractor and disk used to incorporate gypsum and sulfur into the upper-foot of soil.



12 – Disking soil after gypsum and sulfur application. Area 3 looking southeast.





13 – Typical photo of completed work product after gypsum application, chiseling, sulfur application and disking. Area 4 looking northwest.