5-10-'99

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FAX

TO: Steve Pullen

FROM: Jim Bonner

DATE: 10 May

RE:

Steve

Attached are:

- 8 pages of draft text for comments 22-33
- 2 exhibits
- 6 pages of lithologies
- 10 pages of a Groundwater Monitoring Suspension Request

second fax

This fax consists of this cover plus 16 additional pages

22. **Response**: These word changes will incorporated into revised document. — good

23.(a) **Response**: We have been unable to locate a copy of the approval. The text will be changed to reference ***Verbal Communication, Robert Sweeny - NMED, July 1994.*** — I'm not sure what the issue is here.

23.(b) **Response**: The paragraph at the top of page 3-12 will be changed to read:

A suite of three geophysical logs were run: 1) caliper, 2) gamma ray, and 3) dry thermal neutron. These logging techniques measure various chemical and physical characteristics of the subsurface stratigraphy. Used in conjunction with the logs of drill cuttings, these electric logs provide a valuable method of interpretation for the lithologic and saturation condtions of the proposed host sediments. Copies of all geophysical logs can be found in Volume II, Appendix D.

The following summaries briefly describe the interpretive value associated with each of the three log types used. For a more detailed explanation of these techniques, the U.S. Geological Survey has published *Borehole Geophysics Applied to Groundwater Investigations* by W. Scott Keys - Publication No. TWRI 2-E2 (1990). — Perhaps I should get this

1) Caliper logs - This is a physical measurement of the diameter of the borehole. A 4¾ inch bit was used to drill these boreholes and, for the most part, the caliper log reflects an approximate 5-inch diameter hole. As a general rule, the borehole diameter will increase in unconsolidated sands and gravels. This is due to a "caving in" effect. Likewise, there will be a slight decrease in the overall hole width in well-cemented sands and tightly compacted clays.

2) Gamma Ray logs - This is a measurement of natural radiation in the borehole. The radioisotopes of Thorium, Potassium and Bismuth account for most of the naturally occurring gamma radiation. From a lithologic perspective, finer grained sediments (clays) will have a stronger gamma response due to their higher concentration of potassium minerals. Sands, which are primarily composed of silica, will have a much lower gamma response. — Is this masked by the presence of uranium minerals? See Texas Report.

As a matter of geologic interest, there appears to be evidence of epigenetic (introduced) uranium mineralization within the sandy siltstone of the Upper Dockum. Several boreholes on the proposed site exhibit characteristic gamma "kicks" within the fluvial sediments that are consistent with "roll front" uranium deposits. These gamma anomalies occur where uranium precipitated in low-energy environments along the flanks of fluvial channels. Although they are of no economic significance, these gamma anomalies are found only in the basal fluvial unit of the Upper Dockum and assist in the correlation of this unit throughout the proposed site.

— What is the evidence of fluvial sediments here

- Check this!
- Perhaps with core samples.
- Quite a conundrum

3) Dry Thermal Neutron logs - This logging technique is considered to be a indicator of the presence of moisture. It utilizes a neutron-emitting source (1-3 curies of radioisotopes of Americium and Beryllium) and measures the time it takes for an emitted neutron to enter a formation and "bounce" back to a counter. These neutrons have an affinity for protons which will result in a relative rapid return rate. Should the neutron encounter large hydrogen ions (associated with water - H_2O), its return to the counter is significantly slowed. This results in a reduced count rate. Therefore, high count rates indicate dry conditions and these rates are reduced proportionally to the amount of moisture encountered. Neutron logging can be performed through steel casing without an appreciable decrease in count rates. Logging through plastic casing, however, will cause approximately a 30% decrease in count rate, due to the hydrogen in the plastic.

- How were these holes logged? op[en]
- why did I ask about casing?

For the purpose of interpreting lithologies, unsaturated sands will have the least amount of moisture and the highest count rate. Tightly compacted clays will contain some trapped moisture and will have a lower count rate. The presence of water will result in an order-of-magnitude reduction in the count rate.

+ important part here

The abrupt decrease in the dry neutron log response for boreholes PB-36 and PB-37 was due to a change in hole diameter. The bottom portion of these two boreholes were cored. The 4¾-inch drill bit was replaced by an NX (1⅞-inch) core barrel. This abrupt change in hole diameter can be seen in the caliper log. It causes a reduction in neutron counts due to a phenomenon called neutron flux. During the neutron emission process, neutrons are broadcast in a circular, "cloudlike" pattern (neutron flux). In a larger diameter hole, a certain amount of this neutron flux is present in the void between the source and the edge of the hole. The counter will detect some of this neutron flux. In a tight hole, when there is very little void space between the source and the edge, almost all of the neutrons are dispersed into the formation. In these situations, because there is no contribution from the neutron flux, the overall count rate is decreased.

- check this!

23.(b) **Response (cont)** On page 3-9, in addition to the headings *Upper Dockum* and *Lower Dockum* which are used to define Triassic sediments, a new heading *Contact between the Upper and Lower Dockum* will be added.

Contact between the Upper and Lower Dockum - This contact is a stratigraphic boundary and is not necessarily represented by a diagnostic geophysical log signature. The Upper Dockum consists of interbedded sequences of fine-grained fluvial sandstones/siltstones and mudstones. The lowermost occurrence of these fluvial sediments is recognized as the base of the Upper Dockum.

- Check if any geophysical log suggest if fluvial sediments exist below contact.
  - mod high clay (gamma)
  - [illegible]?

Where fluvial sediments are present, the contact between the Upper and Lower Dockum is easily recognizable. However, due to the low-energy depositional environment and abrupt facies changes within these fluvial sediments, there are areas where this contact must be inferred. Where Upper Dockum fluvial sediments have facied into mudstones, the contact is entirely within mudstone sequences. For this reason, the process of establishing this contact, whether mapped or inferred, is based on extensive subsurface correlation. This is accomplished with some degree of confidence since the maximum spacing between all 31 boreholes completed within the proposed project boundary is 1000 feet.

Need this [illegible] — need a contact surface map prepared.

What does this mean?

The basal fluvial unit (sandstones/siltstones) within the Upper Dockum has a maximum thickness of approximately 100 feet. Although the clastic (sandstone/siltstone) percentage of this 100-foot interval changes abruptly, through careful hole-by-hole correlation, the interval can be traced beneath the site. The gamma anomalies associated with the suspect uranium precipitation, actually act as marker beds to aid the correlation effort. WW-1 is an excellent example of how these anomalies help to identify the lower portion of the basal Upper Dockum. The log from this hole also illustrates the spatial relationship of this basal unit to the thick sequence of underlying Lower Dockum mudstones.

Uranium precipitate implies fluvial sediments.

The importance of recognizing the Upper and Lower Dockum boundary is to ensure that the base of the proposed landfill will be placed on the top of the Lower Dockum. The thick sequences of mudstones within this unit provide an excellent geologic barrier (another level of protection) to any potential downward migration. In those areas where there is an inferred contact, the lithologies are mudstones. Despite the inferred contact, the important consideration of establishing a permeability barrier has been accomplished..

Why?

The importance of this contact is more for its ability to collect H_2O & serve as a monitoring point!

23.(c) **Response:** The fluvial (or potential water-bearing) sediments within the Upper Dockum are fine-grained sandy siltstones with a relatively low permeability. As previously stated, the measured permeability of these sediments average 1.22 X 10^{-5} cm/s. Because of the low permeability of these sediments, when groundwater is encountered, it requires some time for this water to enter the borehole.

As an example, PB-1 (located approximately 1½ miles north of the proposed landfill) encountered damp sands at the base of theUpper Dockum at a depth of 158 feet. The hole was completed at a depth of 200 feet. Geophysical logs were run on PB-1 approximately two hours after the base of the Upper Dockum was penetrated. The log showed twenty feet of water (to a depth of 180 feet) in the bottom of the borehole. The lithology of this portion of the borehole (from both drill hole cuttings and geophysical profiles) corresponded to mudstones of the Lower Dockum unit. Apparently, water had been falling down the hole from the saturated sand at 158 feet. Two hours had not been enough time for the groundwater in the hole to equilibrate (reach the level of entry). Had more time elapsed between the drilling and the logging of the borehole, over forty feet of water would have been encountered.

- Uranium precipitation would imply a good lithologic source material as well as a reducing lithology below. Exactly what we are using as our monitoring zone. Perhaps we should confirm the presence of the uranium mineralization.

Field procedures were to log a borehole within 1-2 hours after it had been completed. If the boreholes were not logged immediately, there was a risk that it may cave-in and no log would be obtained. The question has arisen that, due to the low permeability of the fluvial sediments and small quantities of groundwater, perhaps geophysical logging took place too soon after drilling to detect the presence of groundwater. There are three types of supporting evidence to suggest that the groundwater characterization was accurate.

1) In the southwestern portion of the proposed site, ten boreholes were temporarily cased with plastic tubing in order to see if groundwater would accumulate in the holes after drilling (see page 3-17). On a weekly basis for a six-week period of time, these holes were monitored and no groundwater entered the holes.

- Do cuttings or E-logs suggest H_2O?

2) Core samples were taken from five separate boreholes. This procedure involved a change of drilling operations, from rapid rotary bit drilling to a slow core barrel operation. Instead of requiring a few hours to complete, these holes would be open for 10-12 hours. During this time, no groundwater entered the holes. Coring was conducted using air and any water entering the hole would have interfered with the operations.

- Possibly!

3) Even in the above cited example of PB-1, the rapid logging of the borehole <u>did</u> encounter the groundwater. It underestimated the amount, but the groundwater did not go undiscovered.

24. Response: Any mention of interpreted information will be written as "inferred'.

good.

25. Response:

- will need to check this.

Of the 37 shallow boreholes (PB-1 through PB-36) and two deep boreholes (WW-1 and WW-2), all but two have been plugged. The only remaining open boreholes are PB-14 and WW-1. These have been kept open by inserting 3" plastic tubing into the open hole.

All boreholes were manually plugged using the original drill cuttings and/or bentonite. A cement cap was placed at the top of each hole to prevent surface waters from entering the borehole. In the time since the holes were plugged, the eolian sands of the surface Quaternary sediments have been redistributed to the point where the original borehole locations are no longer visible.

- Possible problem these will act as conduits

PB-14 and WW-1 have been kept open for the purpose of possibly obtaining additional geological, geophysical or hydrological information. Once it has been determined that there is no more value to these boreholes, they will also be plugged. A cement plug will be placed in WW-1 between the Upper and Lower Dockum units to ensure that there is no mixing of formational fluids. PB-14 will be plugged using bentonite and a surface cement cap.

- ?
- require cement here.

They were not drilled v. deep!

26. Response

There is no existing groundwater monitoring data for the proposed site. All boreholes completed within the site boundary were unsaturated. Water levels were taken in 1994 from three boreholes outside of the proposed boundary. These boreholes were PB-14 (500 feet west), WW-1 (3000 feet northeast) and WW-2 (5000 feet south). The results of these water level measurements are contained in Sections 3.6.2.2 and 3.6.2.3.

At the request of RPMP, water levels were again taken in April 1999. WW-2 had been plugged, but a static water level (using an electronic water detector) of 202 feet was recorded for WW-1 and a static water level of 37 feet was recorded for PB-14.

WW-1 - The recent water level of 202 feet for WW-1 compared to a static water level of 155 feet in 1994. We believe this decrease of 47 feet is not an indication of changing groundwater conditions, but a reflection of the manner in which this borehole was cased.

The insertion of plastic tubing into the borehole shortly after it was drilled was never an attempt to complete it as a well. Instead, this temporary casing was placed for the purpose of keeping the borehole accesible, so that additional geological, geophysical or hydrological information might be obtained. The only perorations are at the bottom of the temporary casing.

It appears that over the past five years, the mudstones between the Upper and Lower Dockum have "caved in" around the outside of the tubing. This has apparently sealed off any communication between these two aquifers. There is no way for Upper Dockum water to enter the tubing. Consequently, the water level inside the tubing is dropping. At the present time, this water level is 20 feet below the bottom of the Upper Dockum. — So static H_2O in Lower Dockum rises to within 20' of Upper Dockum. Is this consistent elsewhere?

It is reasonable to infer that there is still saturation within the lower portion of the Upper Dockum in WW-1. This water could still be present in the borehole outside of the tubing and not contribute to the existing static water level. This conservative assumption would be consistent with the groundwater conditions as presented in Sections 3.6.2.2 and 3.6.2.3 and the inferred interface between saturated and unsaturated conditions (as indicated in Figure 3-12) would still exist east of the facility boundary.

PB-14 - The recent static water level measured in PB-14 was 37 feet. This compares quite well to the 1994 measured water levels of 42 feet. Relook at this.

27. Response

Gandy-Marley anticipates using vadose monitoring for the proposed facility. To support this, a Groundwater Monitoring Equivalency Demonstration (GMED) has previously been submitted to RPMP. This GMED will be added to the Application. As additional support for this GMED, a copy of a Groundwater Monitoring Suspension Report prepared for a solid waste landfill in Lea County, New Mexico is attached. This report addresses unsaturated Chile Formation sediments in southeastern New Mexico and was approved by NMED's Solid Waste Bureau. With this in mind, is it necessary to undergo the cost of acquiring and analyzing "various ground waters adjacent to and below the proposed Facility?"

– yes. I want to know the chemistry of the existing waters.

28. Response

Lithologic logs for WW-1 and WW-2 are attached.

29. Response

Elevations for all shallow boreholes were surveyed by a licensed professional land surveyor. These elevations are written on the lithologic logs for each borehole in Volume II of the Application. The following is listing of these elevations.

— This info should be in application.

Borehole No.	Elevation	Borehole No.	Elevation
PB-1	4152	PB-21	4148
PB-2	4150	PB-22	4143
PB-3	4135	PB-23	4151
PB-4	4139	PB-24	4154
PB-5	4142	PB-25	4144
PB-6	4120	PB-26	4183
PB-7	4118	PB-27	4144
PB-8	4117	PB-28	4159
PB-9	4138	PB-29	4129
PB-10	4131	PB-30	4152
PB-11	4119	PB-31	4115
PB-12	4132	PB-32	4108
PB-13	4119	PB-33	4134
PB-14	4116	PB-34	4100
PB-14o	4118	PB-35	4124
PB-15	4129	PB-36	4146
PB-16	4161	PB-37	4160
PB-17	4141	PB-38	4182
PB-18	4142		
PB-19	4152	WW-1 estimated elevation is 4154	
PB-20	4157	WW-2 estimated elevation is 4110	

30. Response

A subsurface contour map of the contact of the Upper/Lower Dockum within the proposed Facility boundary is enclosed. *– Need to post w Application*

31. (a) Response

Gandy-Marley is prepared to install six vadose zone monitoring wells (VZMWs) at the proposed facility. While the primary vadose monitors would still be located beneath the sumps in the Landfill and the Evaporation Pond, these VZDWs would provide a more visible secondary method of vadose zone monitoring. These wells (as shown on Exhibit No. 1) would be located along the eastern boundary of the proposed facility at the Point of Compliance and provide valuable confirmation of the unsaturated conditions underlying the facility.

31. (b) Response

Exhibit No. 2 is a structure contour map of the Upper/Lower Dockum contact as requested in Comment No. 30. The proposed VZDWs are shown along the eastern boundary of the facility. The lowest identified elevation of this contact is 4039 feet and is located in a hydrologic trap west of the site boundary (PB-14). The lowest identified elevation of this contact east of the site is 4046 feet (PB-38). It is proposed that all VZMWs be completed to an elevation of a least 4020, which would ensure the contact between the Upper and Lower Dockum had been penetrated. Exhibit No. 2 also shows the depths of these proposed wells.

⇐ IS THIS A GOOD [illegible]

– Any other construction details?
– Length of screen?
– Sump in bottom

31. (c) Response

Once agreement is reached on the GMED, submitted in a November 1998 letter to the RPMP, it will be incorporated into Section 3.7.2 - Vadoze Zone Monitoring Requirements. There has been no formal response to this letter from RPMP.

– The question is can we decide whether GMED is appropriate with the given info.

31. (d) Response

The certification form will be signed and included in Section 3.7.2. Who from the Gandy Marley team do you suggest signs this certification form?

– Anyone who meets the specified qualifications.
– Should this be in the Application or the request for GMED.

31. (c,f,g) Response

To be addressed by Montgomery Watson

– Look at the water balance equations in the GMED proposal.

–

– I probably need to respond to the GMED letter, formally. – Considering it came in draft form.

32. Response

The three "drill holes" shown on the USGS 7½ Minute Quadrangle basemap refer to three oil well tests. The logs for these dry wells are on file with the New Mexico Oil Conservation Division. Gandy Marley obtained copies of these logs. In fact, the three-point problem, shown in the Application, to determine the regional dip of the Triassic sediments used one of these "drill holes". — we need to see these logs.

33. Response

The boreholes labeled PB-4 and WW-4 shown on Figure 3-14 in Section 8, T11S, R31E are mislabeled. PB-4 should be PB-1 and WW-4 should be WW-1. In addition, the other following labeling changed will be made: PB-14-C will be changed to PB-14o, PB-36 will be changed to PB-36-C and PB-37 will be changed to PB-37-C.

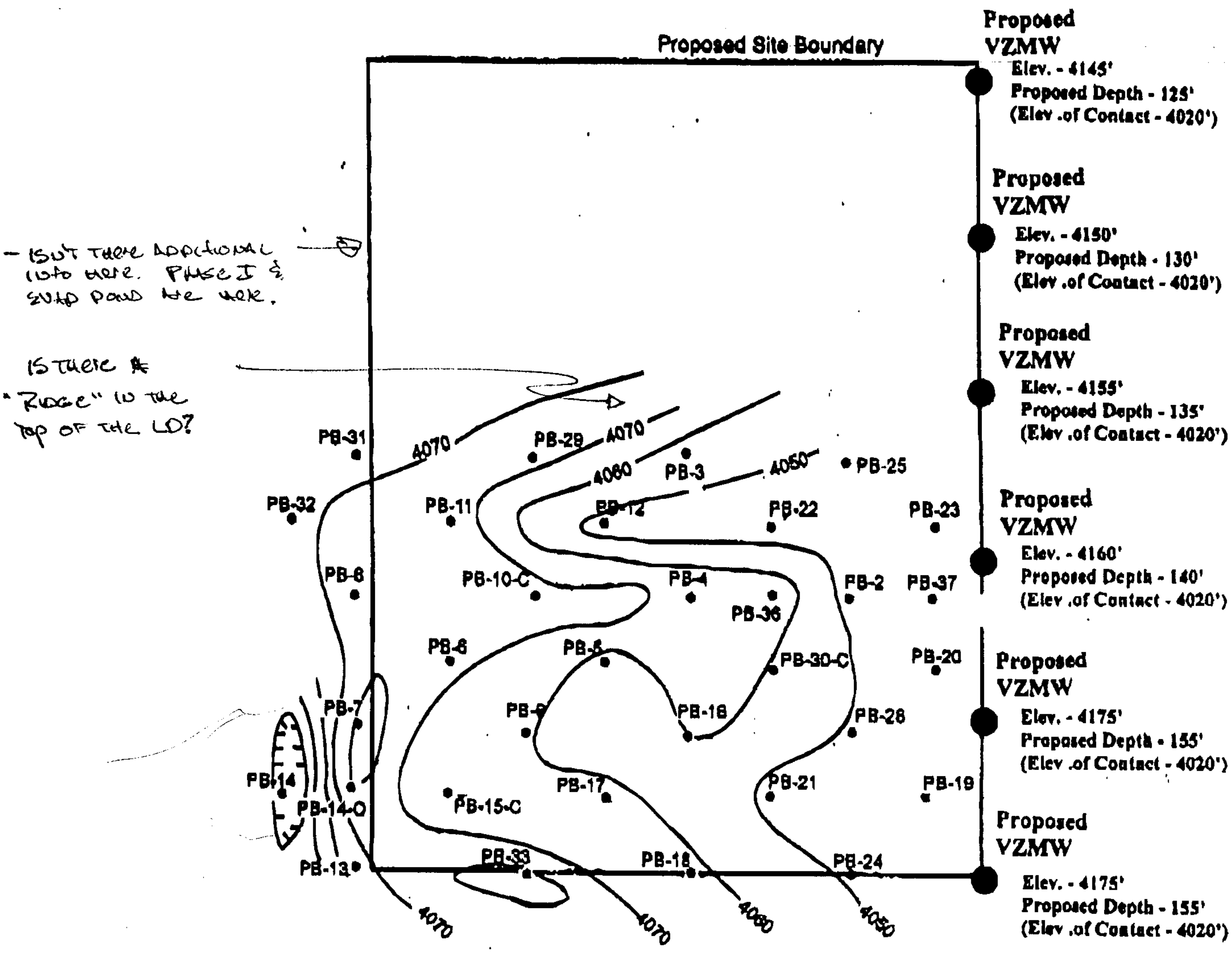


EXHIBIT No. 2

STRUCTURE CONTOUR OF UPPER/LOWER DOCKUM CONTACT

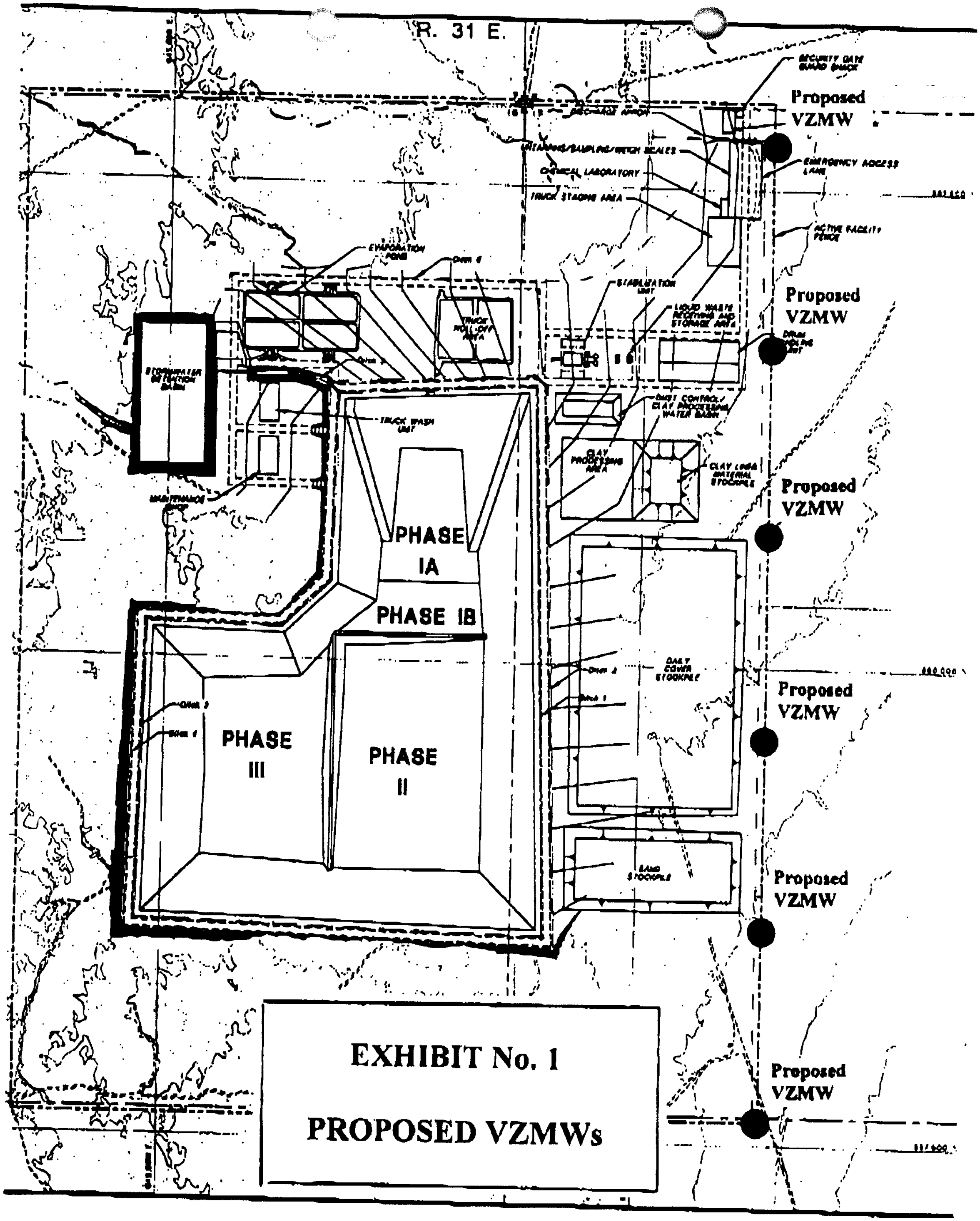


EXHIBIT No. 1

PROPOSED VZMWs

S.M. Stoller Corporation

LITHOLOGY LOG

Hole No. WW-1 Section NW SE 8 T 11 S R 31 E

Project Gandy Marley Elevation 4154

Driller Larry JAB Date 07/26/93

Comments

GSA Color	Lith	Depth	Description
			lt gray [illegible] ss
			red clay
			purple clay
		50'	lt gray fn ss
			red clay (damp @ 50-52')
		100'	red gray siltstone
			lt gray siltstone
		150'	lt gray siltstone & fn ss
			dk red clay
		200'	lt gray clay @ 203-205'
			dk red clay
		250'	
			dk purple clay
		300'	

S.M. Stoller Corporation

LITHOLOGY LOG

Hole No. WW-1 Section NW SE 8 T 11 S R 31 E

Project Gnome Marley Elevation 4154

Driller Larry JMS Date 04/26/93

Comments

GSA Color	Lith	Description
		dk red clay
		red clay
	350'	dk red clay
		lt gray clay
	400	reddish purple clay
		red clay
		dk reddish-purple clay
	450'	blue clay
		purple clay w/ trace lt gray @ 475'-480'
	500	purple clay
	550'	red clay
		lt gray clay 570-575
	600'	dk red clay

S.M. Stoller Corporation

LITHOLOGY LOG

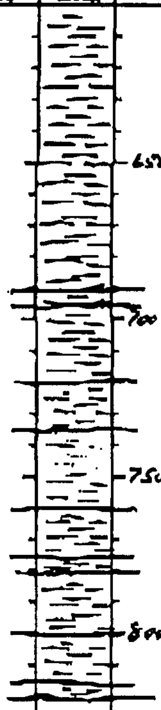
Hole No. WW-1 Section NW SE 8 T 11 S R 31 E

Project Grady Marley Elevation 4154

Driller Larry DAB Date 09/26/93

Comments

GSA Color	Lith	Depth	Description
			red - dk red clay
		650'	
		700'	lt red - tan clay
			red clay
			gray - lt gray clay
		750'	dk red clay
			red clay
			gray clay
		800'	red clay
			gray to dk gray clay
			red-tan clay
	TD		



S.M. Stoller Corporation

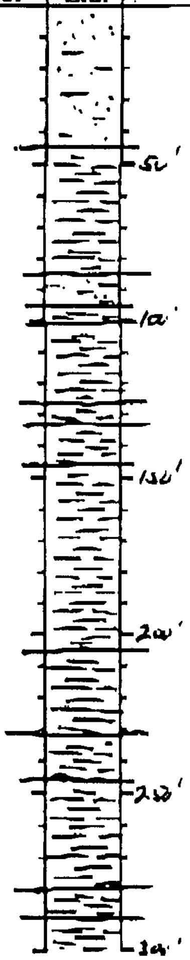
LITHOLOGY LOG

Hole No. WW-2 Section SW SE 19 T 11S R 31E

Project Gandy Marley Elevation 4110

Driller Larry DAB Date 02/28/95

Comments

GSA Color	Lith	Description
		lt gray - yell brn surface sl wet lt brn silt red clay red-brn silt gray clay red-brn clay red clay reddish purple clay purple clay red clay purple clay red clay lt gray clay purple clay

S.M. Stoller Corporation

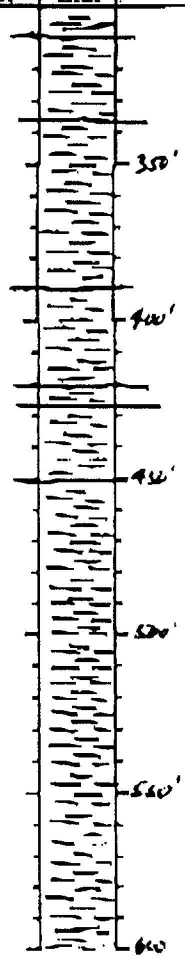
LITHOLOGY LOG

Hole No. WW-2 Section SWSE 19 T 11S R 31E

Project Grady Marley Elevation 4110

Driller Gary JAB Date 07/28/93

Comments

GSA Color	Lith	Description
		purple clay red clay purple clay w/ lt gray @ 365' reddish purple clay red clay purple clay red clay

S.M. Stoller Corporation

LITHOLOGY LOG

Hole No. *WW-2* Section *SW SE 19* T *11 S* R *31 E*

Project *Gandy Marley* Elevation *4110*

Driller *Larry* *DAB* Date *07/28/93*

Comments

GSA Color	Lith	Depth	Description
	(clay pattern)		red clay
	no return	650'	circulation lost @ 624' - no sample return 624-740
		700'	
	TD		