PDR

UC-576.5

KERR-McGEE
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

December 5, 1980

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. H. J. Miller, Section Leader
Uranium Recovery Licensing Branch
Division of Waste Management
US Nuclear Regulatory Commission
Washington, D. C. 20555

RE: NRC Docket No. 40-8768
SPRB "Q" Sand Project

Dear Mr. Miller:

Based on the October 24, 1980 telephone conversation between Ms. Terry Vandell of the NRC and Messrs. B. Campbell and M. Freeman of Kerr-McGee, we are submitting responses (10 copies) to questions on the referenced in-situ Research and Development license application.

Please let me know if you have any further questions.

Sincerely,

W. J. Shelley, Vice-President
Nuclear Licensing and Regulation
Environment and Health Management

WJS/pls

Enclosures

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NRC QUESTIONS - Q-SAND LICENSE APPLICATION
NRC DOCKET NO. 40-8768

Per the NRC telephone request of October 24, 1980, the following comments are provided on the referenced in-situ research and development license application. The question number designation has been revised to include only those questions requiring written responses.

Item 1:

a) What is maximum injection pressure?

b) At what pressure will the well casing tests be conducted?

Response:

a) The injection pressure at the well head is expected to be limited to 100 psig.

b) The casing integrity tests for the injection wells will be conducted at approximately 100 psig.

Item 2:

a) Estimate the leakage rates through the overlying and underlying shales under average operating conditions and with the maximum operating stress placed on the shale member.

b) Submit calculations used in determining the leakage rates for (a).

c) In the report submitted to NRC in 1977, it states that the "P" shale is as thin as five feet in places, however, the Q-sand pilot application indicates it is much thicker. Please comment on this.

Response:

a) The calculated rates of fluid movement from the overlying S-sand into the 49 foot overlying "R" shale under average operating conditions and under maximum stress are 3.3 inches per year and 1.2 inches per year, respectively. This fluid movement toward the Q-sand occurs because of the greater hydrostatic pressure in the S-sand. The calculated rates of fluid movment from the Q-sand into the underlying "P" shale for the average and maximum operating conditions are 7.3 inches per year and 8.7 inches per year, respectively.

b) The factors used in calculating the fluid movement into the shale members are included as page A-1 and A-2.

c) The 1977 report was addressing more of a regional aspect of the "P" shale as the area in which Kerr-McGee has obtained mining rights totals over 70,000 acres with the holdings extending about 18 miles in a north-south direction and some 14 miles in an east-west direction. There are some areas to the north of the Bill Smith mine where local channels have reduced the thickness of the "P" shale, however, a review of over 350 drill hole logs in the vicinity of the Q-sand pilot found that within 1000 feet of the pilot, the shale averaged slightly over 60 feet thick, and the minimum shale thickness noted was 41 feet.

Item 3:
Submit a table of the anticipated fluid compositions and flow rate that will be routed to the evaporation pond from the various process steps.

Response:
A list of the anticipated volumes and compositions of the fluids that will be routed to the evaporation pond from the various process steps is attached, page A-3.

Item 4:
Submit a more detailed map of the process plant layout including the locations of the offices, laboratory, safety showers, and major items of equipment.

Response:
A process plant layout drawing with requested information shown is included, page A-4.

Item 5:
For the evaporation pond, the following information is needed: (1) the approximate amount of earth to be moved, (2) pond capacity (3) anticipated

thickness of the liner, (4) designed freeboard, (5) anticipated water elevation above mean sea level, and (6) a preliminary soil stability analysis.

Response:

The pond design has been modified to include two lined cells so that if a leak in one of the cells is detected, that cell can be evacuated and repaired. Responses to the six specific requests are addressed respectively as follows: (1) The volume of earth to be removed during pond construction is estimated to be about 1500 cubic yards. (2) The capacity of each cell with two feet of freeboard is expected to be about 200,000 gallons for a total capacity of about 400,000 gallons. (3) The pond will be lined with a hypalon or similar type liner that will be 20 to 30 mils thick. (4) The pond design will include a minimum freeboard of two feet for normal operations. (5) The water elevation with two feet of freeboard is expected to be about 5515 feet above mean sea level, however, this will depend on the final site selection and the local terrain. (6) Chen and Associates, Inc., a soils and foundation engineering firm located in Casper, Wyoming, was requested to evaluate three proposed pond sites located to the north of the Bill Smith mine process building. The pond design evaluated included embankment heights of approximately 10 feet, a 3 to 1 horizontal to vertical interior slope, a 2½ to 1 horizontal to vertical exterior slope, two individual cells, and a hypalon or similar flexible liner.

The site recommended by the consultant is located about 500 feet northwest of the Bill Smith mine office building. The soils in this area are medium stiff to stiff, slightly sandy to very sandy clay with minor clayey sand lenses to the depth investigated, 15 feet. The consistency of the sandy clay was determined by the Standard Penetration Test. Test results are presented in Figure 1, page A-5. Gradations for typical samples of the sandy clay are presented in Figure 2 through 4, pages A-7 to A-9. No free water was encountered in the exploratory holes at the time of drilling.

The consultant stated Site #2 "is the most suitable location from a soil point of view for the proposed evaporation pond. The soils in this area are most uniform. Based on standard engineering index properties, we believe these soils would have the lowest remolded coefficient of permeability of the on site soils. The sandy clay soils are suitable for use in the construction of the embankments and in the construction of the layer beneath the artificial liner. We believe the sandy clays would have a remolded coefficient of permeability of less than 0.1 foot per year (10^{-7} cm/sec) when compacted to at least 95% Standard Proctor Density."

Item 6:
What is the approximate area to be occupied by the evaporation pond?

Response:
The change in design to include two cells in the pond will increase the surface area occupied by the pond to about 0.65 acres. This is based on the preferred site, however, these dimensions could change if a different final site is selected. This increased area for the evaporation pond is partially offset by the fact that the process plant will now be located in an existing building which was constructed for the Bill Smith mine.

Item 7:
What is the Wyoming DEQ License number for this project and when was it approved?

Response:
The Wyoming DEQ assigned Research and Development License No. 5RD to the project and approval was granted August 28, 1980.

Item 8:
The report submitted to NRC in 1977 states that there is communication between the Wasatch and the Fort Union formations (pages 2-87 and 2-88),

however, the Q-sand project application state there is no communication. Please comment on this apparent difference.

Response:
The 1977 report was addressing the regional nature of the geology and indicated that in some areas, communication between the formations should be expected over long periods (geological) of time. The Q-sand application, however, is addressing site-specific conditions where the intervening shales are uniformly developed and provide effective barriers to the vertical movement of fluids. At the test site, the degree of isolation is well demonstrated by the differences in piezometric surfaces for the different formations and by the the hydrological pump test conducted in the Q-sand.

R SHALE LEAKAGE CALCULATION
Q SAND IN SITU LEACH PILOT PROJECT
CONVERSE COUNTY, WYOMING

Shale Permeability = 2.1×10^{-4} gpd/ft^2 [1]

Shale Thickness = 49 feet [2]

Static Fluid Level for Q Sand = 5172 feet above MSL [3]

Static Fluid Level for S Sand = 5239 feet above MSL [3]

Leach Zone Area = 50.000 Square feet [4]

Pressure Across Shale, average = -67 feet of water [5]

Additional Stress for Maximum Conditions = +40 feet of water [6]

$$\text{Leakage Calculation} = \frac{(\text{Permeability})(\text{Area})(\Delta\ \text{Pressure})}{\text{Thickness}}$$

$$\text{Under Average Conditions; Leakage} = \frac{(2.1\times10^{-4}\ \text{gpd/ft}^2)(5\times10^{4}\ \text{ft}^2)(-67\ \text{ft})}{49\ \text{feet}}$$

= 14.3 gpd fluid movement toward the Q sand

Assuming 5% connected porosity in the shale, S-sand water would move into the 49 foot shale member at a rate of about 3.3 inches per year.

$$\text{Under Stress Conditions; Leakage} = \frac{(2.1\times10^{-4}\ \text{gpd/ft}^2)(5\times10^{4}\ \text{ft}^2)(-67+40\ \text{ft})}{49\ \text{feet}}$$

= 5.8 gpd fluid movement toward the Q sand

Assuming 5% connected porosity in the shale, S sand water would move into the 49 foot shale member at a rate of about 1.2 inches per year.

[1] Permeability tests on plugs taken from cored sections of the shale members indicated permeabilities of less than 1×10^{-5} gpd/ft^2, however, a more conservative value of 2.1×10^{-4} is used in the calculation.

[2] Average thickness from logs for the 25 operating wells (minimum thickness was 41 ft).

[3] Hydraulic report - Table 1

[4] Area bounded by the outer ring of operating wells

[5] Q sand static fluid level minus S sand static fluid level

[6] Calculated maximum stress obtained by terminating production but continuing injection at a rate of 100 gpm until the pregnant and barren leach solution storage tanks were empty (about 3 hours).

P SHALE LEAKAGE CALCULATION
Q SAND IN SITU LEACH PILOT PROJECT
CONVERSE COUNTY, WYOMING

Shale Permeability = 2.1×10^{-4} gpd/ft^2 [1]

Shale Thickness = 64 feet [2]

Static Fluid Level for Q Sand = 5172 feet above MSL [3]

Top of O Sand = 4982 feet above MSL

Leach Zone Area = 50,000 square feet [4]

Pressure Across Shale, average = +190 feet of water [5]

Additional Stress for Maximum Conditions = +40 feet of water [6]

$$\text{Leakage Rate Calculation} = \frac{(\text{Permeability})(\text{Area})(\Delta\ \text{Pressure})}{\text{Thickness}}$$

$$\text{Under Avg. Condition; Leakage} = \frac{(2.1 \times 10^{-4}\ \text{gpd/ft}^2)(5 \times 10^4\ \text{ft}^2)(190\ \text{ft})}{64\ \text{feet}}$$

$$= 31.2\ \text{gpd movement into the P shale}$$

Assuming 5% connected porosity in the shale, the leach solution front would move into the 64 foot shale member at a rate of about 7.3 inches per year.

$$\text{Under Stress Condition; Leakage} = \frac{(2.1 \times 10^{-4}\ \text{gpd/ft}^2(5 \times 10^4\ \text{sq ft})(190+40\ \text{ft})}{64\ \text{feet}}$$

$$= 37.7\ \text{gpd movement into the P shale}$$

Assuming 5% connected porosity in the shale, the leach solution front would move into the 64 foot shale member at a rate of about 8.7 inches per year.

[1] Permeability tests on plugs taken from cored sections of the shale members indicated permeabilities of less than 1×10^{-5} gpd/ft^2, however a more conservative value of 2.1×10^{-4} is used in the calculation.

[2] Thickness in QMO-1; average of 350 drill holes in local vicinity was 62 feet

[3] Hydraulic report - Table 1

[4] Area bounded by the outer ring of operating wells

[5] Q sand static fluid level minus top of O sand

[6] Calculated maximum stress obtained by terminating production but continuing injection at a rate of 100 gpm until the pregnant and barren leach solution storage tanks were empty (about 3 hours).

EXPECTED SOURCES OF WASTE LIQUIDS
ROUTED TO THE EVAPORATION PONDS
KERR-McGEE Q SAND IN SITU R&D PROJECT
CONVERSE COUNTY, WYOMING

The anticipated waste water volumes that will result from the various process steps and the expected range of concentrations of the major ions or ions of concern in each of these streams are as follow:

Process Step	Volume	Ion	Concentration	
IX Resin Rinse	200 GPD*	Na	15,000-25,000	ppm
		NH_4	500- 1,000	ppm
		Cl	30,000-40,000	ppm
		HCO_3	8,000-12,000	ppm
		U	5-10	ppm
		Ra 226	50-100	pCi/l
Excess Eluant	20 GPD	Na	1,500- 2,500	ppm
		NH_4	20,000 30,000	ppm
		Cl	50,000-60,000	ppm
		HCO_3	200-300	ppm
		U	10-20	ppm
		Ra 226	50-100	pCi/l
Yellowcake Wash	40 GPD	Na	600-1000	ppm
		NH_4	5,000-10,000	ppm
		Cl	15,000-20,000	ppm
		HCO_3	200-300	ppm
		U	5-10	ppm
		Ra 226	30-40	pCi/l
Sump Liquids	50 GPD	Na	2,000- 3,000	ppm
		NH_4	3,000- 4,000	ppm
		Cl	6,000- 8,000	ppm
		HCO_3	1,000- 2,000	ppm
		U	5-10	ppm
		Ra 226	20-30	pCi/l

*Gallons Per Day

Attachment 4

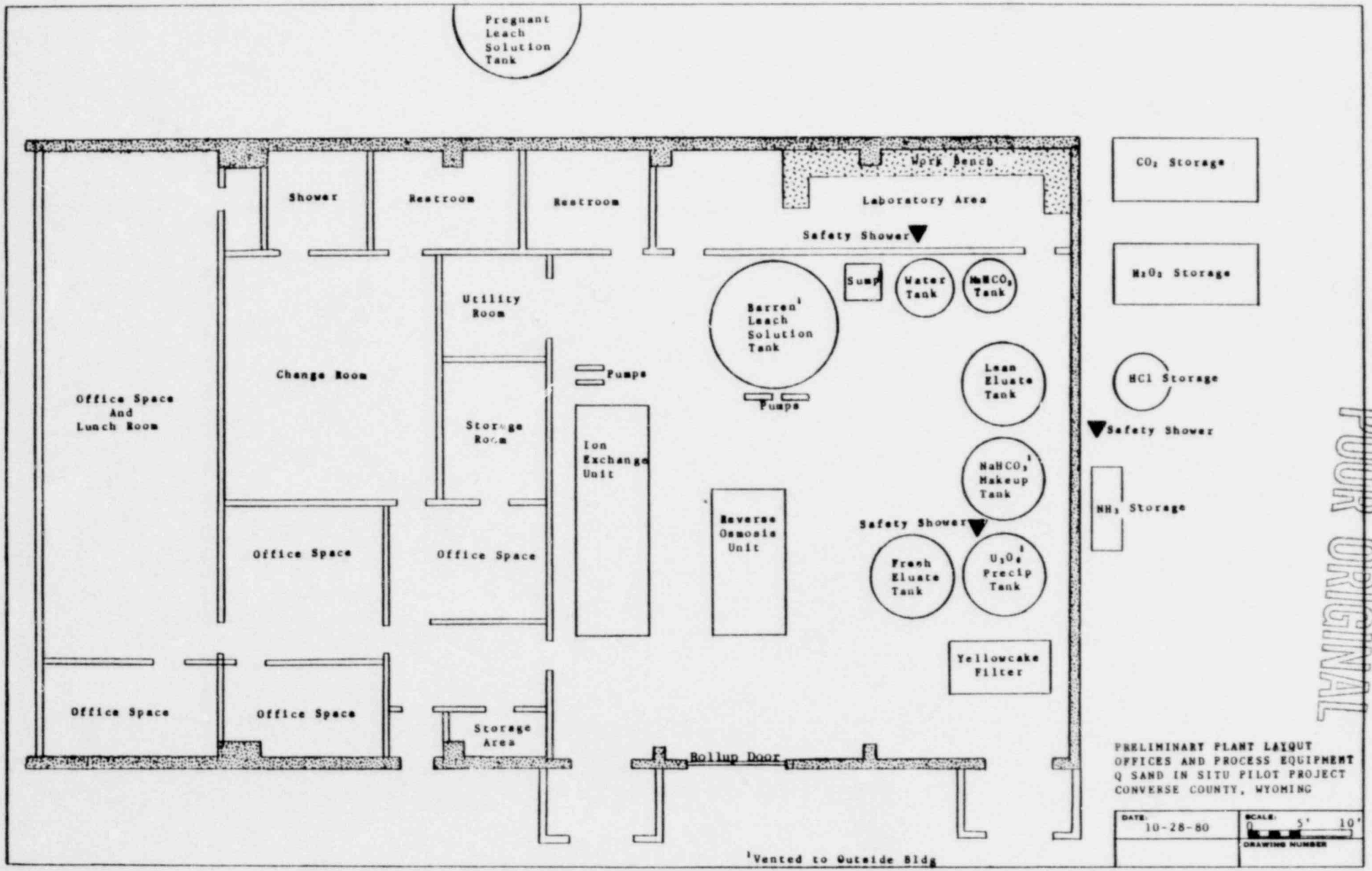
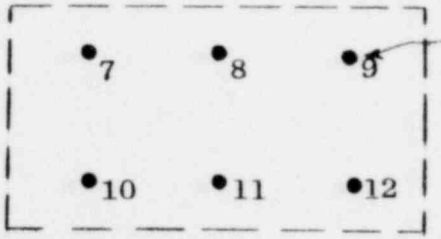


Figure 1

LOGS OF EXPLORATORY HOLES
POND SITE #2



General Hole Locations
Within Proposed Pond Site

Hole 10 EL=84.6 | Hole 11 EL=85.5 | Hole 12 EL=86.7 | Hole 7 EL=88.7 | Hole 8 EL=89.7 | Hole 9 EL=89.6

LEGEND:

Fill, sand, very silty and clayey to clay, very sandy, loose to medium dense and medium stiff, interlayered, brown to grey, moist.

Clay (CL), slightly sandy to very sandy, medium stiff to stiff, minor clayey sand lenses, brown to grey, moist.

Sand (SP), clean, loose to medium dense, brown, moist.

Sand (SC-SM), clayey to silty, intergraded, loose to medium dense, brown, moist.

Claystone Bedrock, firm grey, moist.

20/12 Undisturbed drive sample. The symbol 20/12 indicates that 20 blows of a 140 lb. hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates depth interval from which disturbed soil sample was obtained from auger cuttings.

NOTES:

(1) Test holes were drilled October 6, 1980 with a 4-inch diameter continuous flight power auger.

(2) No free water was encountered in the exploratory holes at the time of drilling.

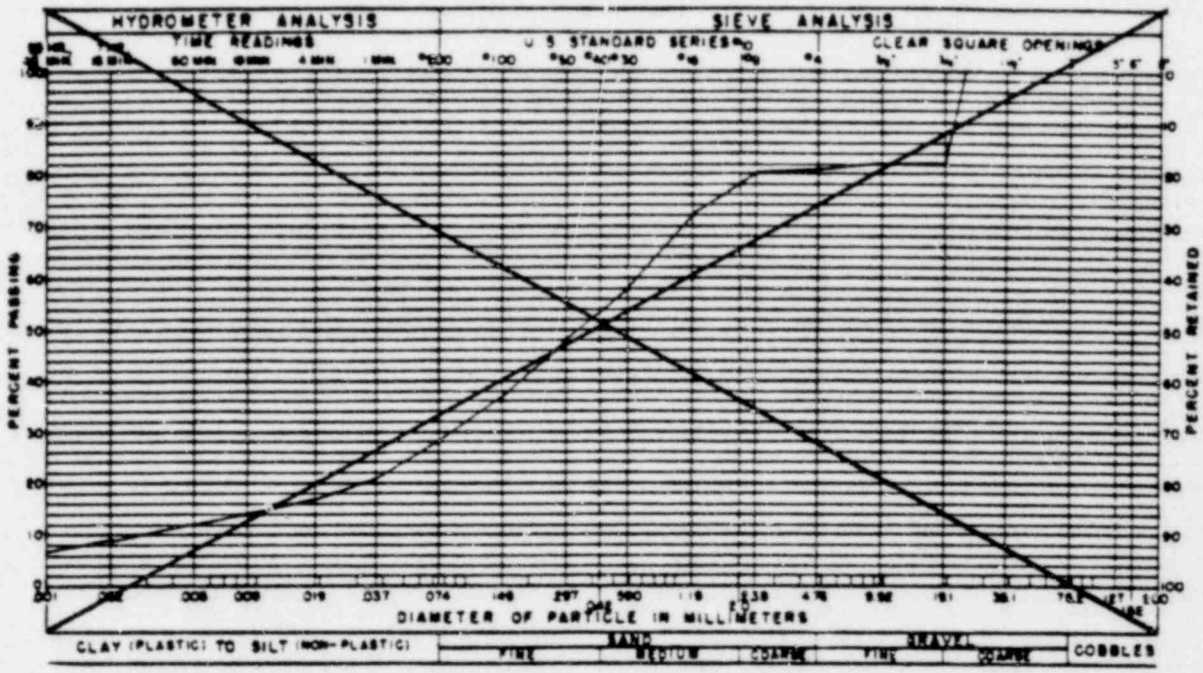
(3) Elevations of test holes refer to finished floor level of existing office building at locations shown in Fig. 1. EL=100.0' (assumed)

(4) WC = Water Content (%)
DD = Dry Density (pcf)
LL = Liquid Limit (%)
PI = Plasticity Index (%)
-200 = Passing No. 200 Sieve (%)

Figure 2

CHEN AND ASSOCIATES

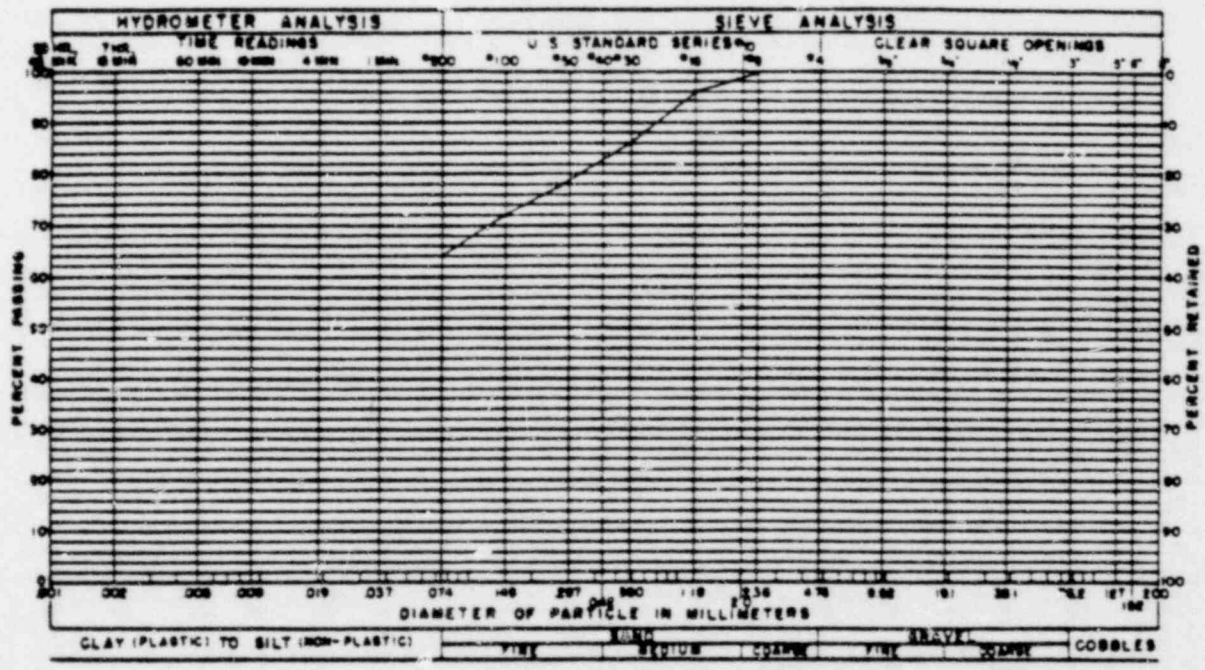
Consulting Soil and Foundation Engineers



GRAVEL 19 % SAND 53% SILT AND CLAY 28 %

LIQUID LIMIT 26 % PLASTICITY INDEX 8 %

SAMPLE OF Clayey Sand FROM Hole 6 at depth 9'-0"



GRAVEL 0 % SAND 36% SILT AND CLAY 64 %

LIQUID LIMIT 31 % PLASTICITY INDEX 13 %

SAMPLE OF Very Sandy Clay FROM Hole 7 at depth 2'-0"

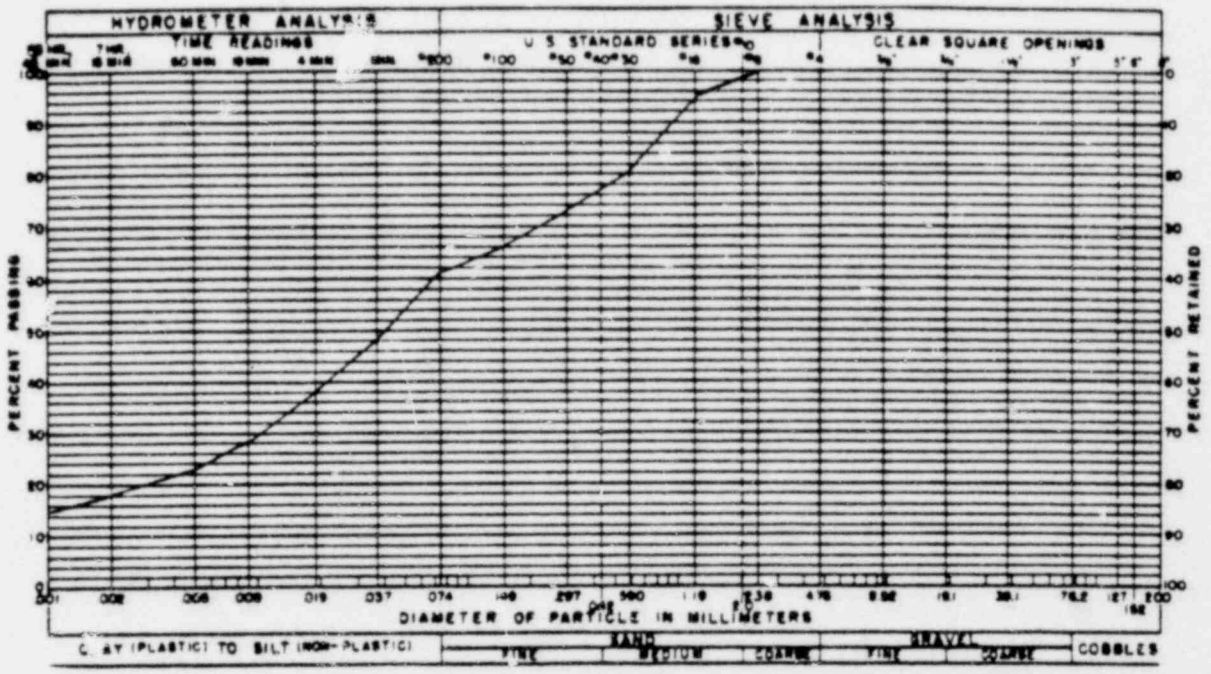
GRADATION TEST RESULTS

#6386W

Figure 3

CHEN AND ASSOCIATES

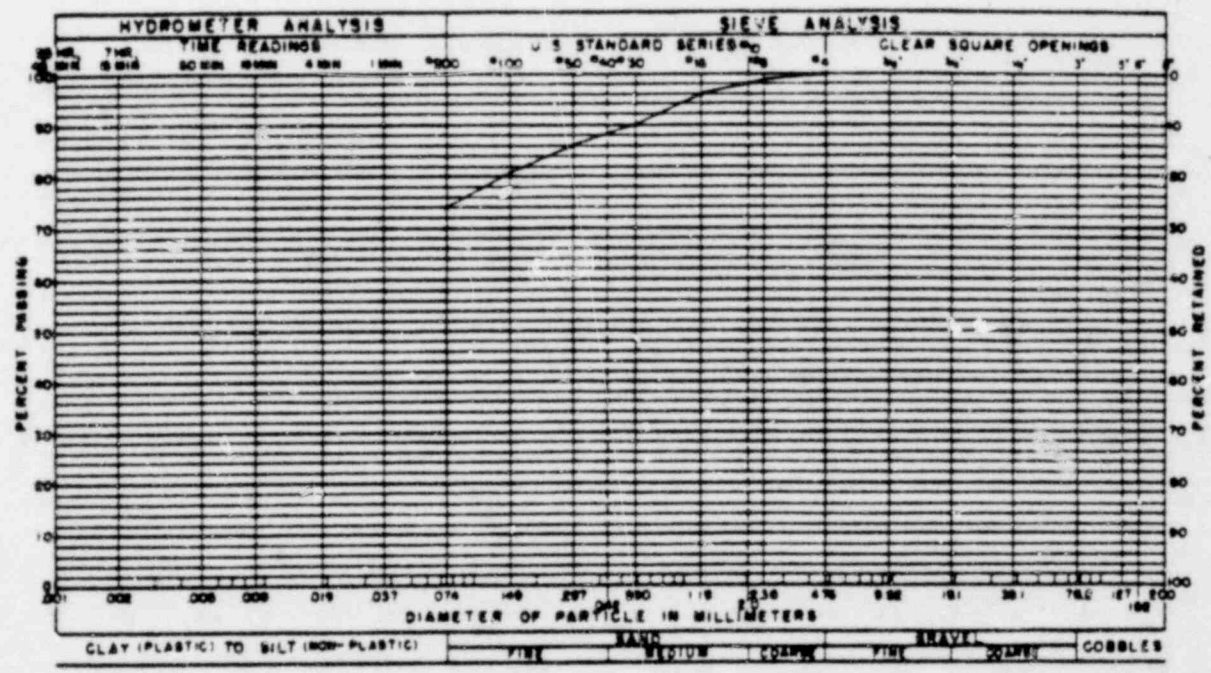
Consulting Soil and Foundation Engineers



GRAVEL 0 % SAND 39% SILT AND CLAY 61 %

LIQUID LIMIT 28 % PLASTICITY INDEX 9 %

SAMPLE OF Very Sandy Clay FROM Hole 9 at depth 4'-0"



GRAVEL 0 % SAND 26% SILT AND CLAY 74 %

LIQUID LIMIT 38 % PLASTICITY INDEX 16 %

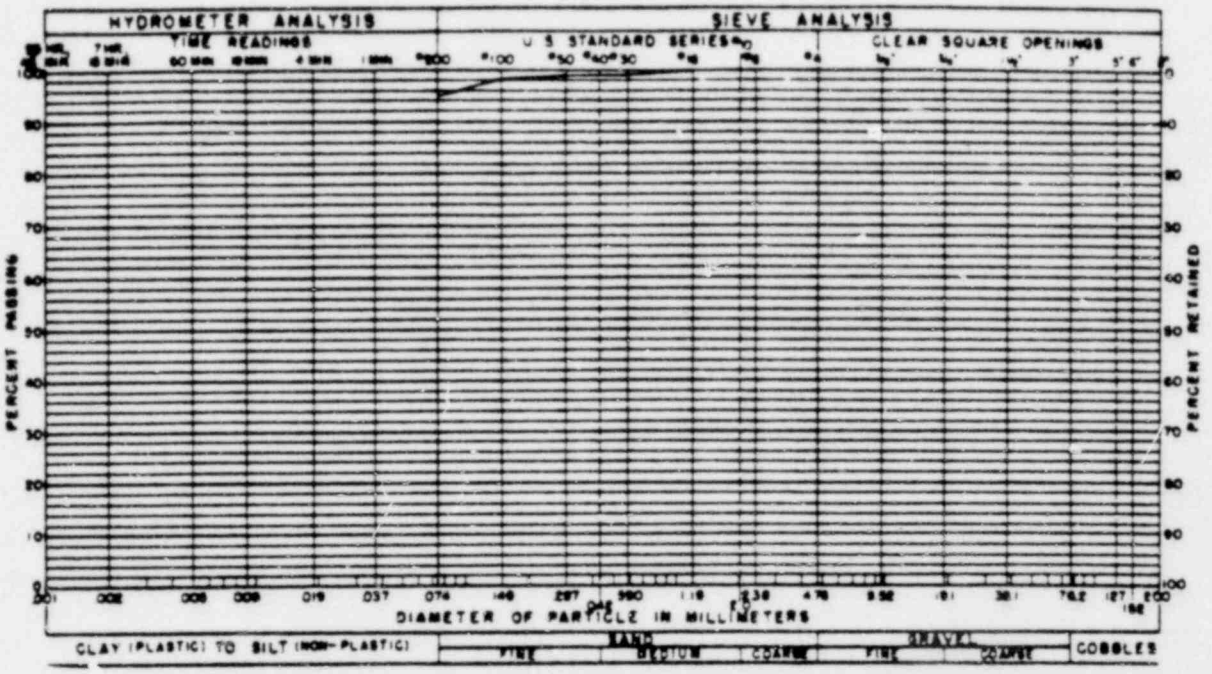
SAMPLE OF Sandy Clay FROM Hole 11 at depth 2'-0"

GRADATION TEST RESULTS

Figure 4

CHEN AND ASSOCIATES

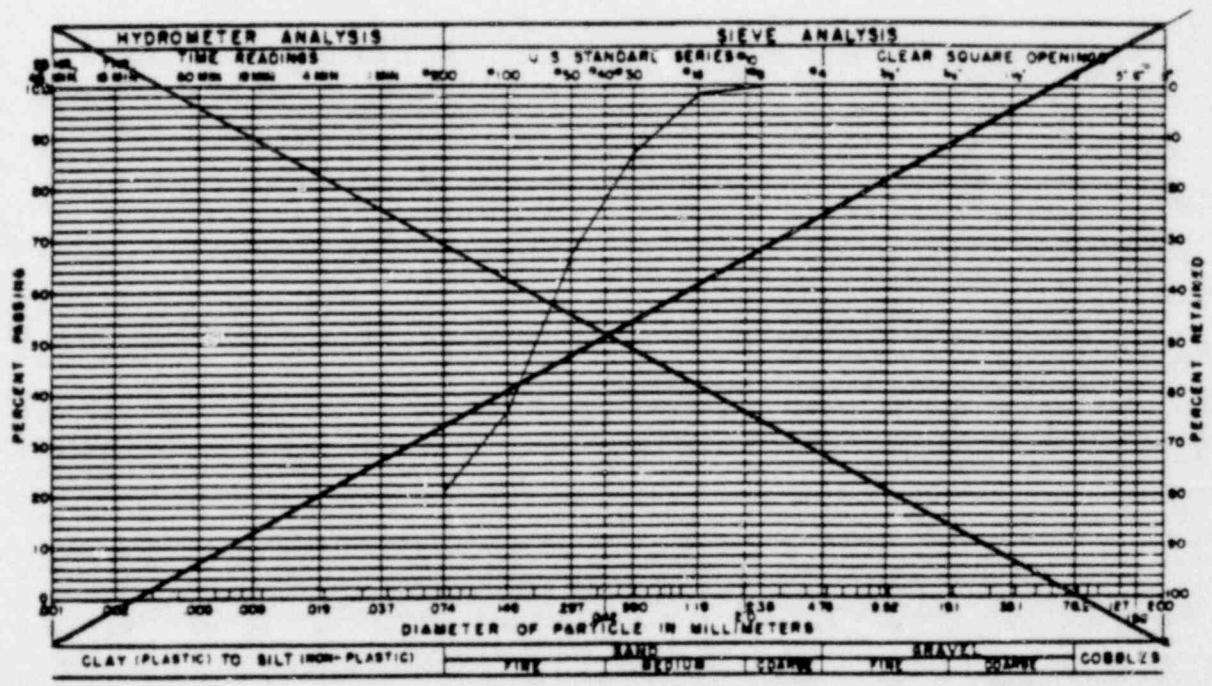
Consulting Soil and Foundation Engineers



GRAVEL 0 % SAND 5 % SILT AND CLAY 95 %

LIQUID LIMIT 47 % PLASTICITY INDEX 26 %

SAMPLE OF Slightly Sandy Clay FROM Hole 11 at depth 9'-0"



GRAVEL 0 % SAND 79 % SILT AND CLAY 21 %

LIQUID LIMIT % PLASTICITY INDEX NP %

SAMPLE OF Silty Sand FROM Hole 13 at depth 4'-0"

GRADATION TEST RESULTS

#6386W