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# WIPP Conceptual Design Report

Addendum I: Soils and Foundation Investigation for Proposed Waste Isolation Pilot Plant, Eddy County, New Mexico, By Richard R. Pettigrew and Associates, Consulting Engineers.

Prepared by Sandia Laboratories, Albuquerque, New Mexico 87115
and Livermore, California 94550 for the United States Energy Research
and Development Administration under Contract AT(29–1)-789

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# SOILS AND FOUNDATION INVESTIGATION FOR PROPOSED WASTE ISOLATION PILOT PLANT EDDY COUNTY, NEW MEXICO



951 0842

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PREPARED FOR:

SANDIA LABORATORIES
KIRTLAND AIR FORCE BASE EAST
ALBUQUERQUE, NEW MEXICO
87115

# SOILS & FOUNDATION

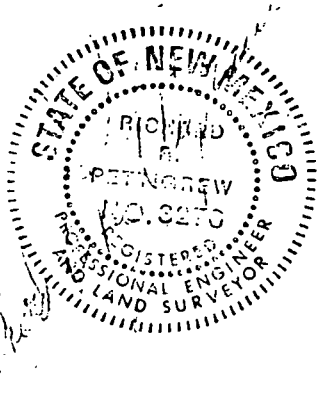
# INVESTIGATION

FOR

PROPOSED

WASTE ISOLATION PILOT PLANT

EDDY COUNTY, NEW MEXICO




PREPARED FOR:

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ALBUQUERQUE, NEW MEXICO 87115

LAB NO. 6L-6263

DATE: DECEMBER, 1976

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# PART I

# REPORT

## SCOPE

This Report presents the results of a Soils and Foundation investigation for the Proposed Waste Isolation Pilot Plant (WIPP) located in Section 21, Township 22 South, Range 31 East, N.M.P.M., Eddy County, New Mexico. The purpose of this investigation was to determine the physical characteristics of the subsoils in order to provide foundation design recommendations. The investigation was performed and the report prepared in accordance with the requirements received from John West Engineering Company and Mr. Bill Wowak, Sandia Laboratories. These were:

1. Statement of work for WIPP Soils Investigation Program, and
2. WIPP Soil Investigation revised drill hole location.

## INVESTIGATION

Eight (8) test borings were made on the site under dates of November 16, 17, 18 & 19, 1976. The location of the test holes is presented on the Site Plan (See Page 21 of this Report).

A rotary drill rig, using air, was employed to make the borings. During the test drilling, the soils encountered were continuously examined, visually classified, and where applicable, sampled.

Standard penetration tests were performed and cores were taken at varying depths as presented in the Log of Borings. Penetration resistance was measured by driving a standard 2 inch split-tube sampler having a 30 inch free-fall drop hammer weighing 140 pounds. Cores were taken utilizing a 1 inch inside diameter diamond core bit. The cores were removed from the sampler in the field, logged, and sealed to maintain "in-situ" conditions while being transported to the Laboratory.

Mechanical analysis and soils constant determinations were made on the soils to establish classification and identification of each soil type.

Unconfined compression tests were performed on certain soils. A combination of the Field and Laboratory Tests were performed to determine both the bearing capacity and to give an indication of the swell and settlement characteristics of the soils encountered.

## DISCUSSION

The proposed site is located in range land with no visual evidence of prior structures or deep site disturbance which would influence the performance of the footings of the proposed construction.

The ground surface is very sandy and although the drill unit was able to negotiate the terrain, mobilization problems could occur.

Because of variations in the elevations of the subsoils an on-site determination was made to drill all eight test holes rather than the six sighted in the Statement of Work. A more accurate soil profile was the result of this decision.

No groundwater was encountered during the investigation.

Maximum frost line action in this locale is generally considered to be approximately 18 inches depending upon the soils. However, the sands encountered should be relatively "frost free".

Since neither the site grading plan or the proposed loadings on the foundations was available to the Soils Engineers this Report by necessity can present only generalizations. The Structural Engineers must make the final determination for type and depth of foundations.

## CONCLUSIONS

Sight grading, structural locations, and foundation loadings are the governing factors in the site development. Generally, under embankments, the existing ground should be scarified, moistened and compacted to such a degree that the sands

will present a uniform bearing capacity.

In moistened and compacted sands, excavation could probably be made to a maximum depth of 4' without lateral support. Deeper excavation will require bracing or slopes laid back on a minumum of 1-1/2 to 1.

The surface sands encountered will provide excellent 'on-site' building fill. If these sands are used for building fill, a moisture barrier between the building fill and the concrete floor slabs on grade will not be required.

## RECOMMENDATIONS

I. Site Development

A. The natural sands under embankments should be scarified and compacted at approximately optinum moisture to a minimum of 90% and a maximum of 95% of Laboratory Densities as determined by ASTM D-698. The depth of this preparation will vary over the site area, but as a minimum should be to the depth where N=20, as presented in the Log of Borings.

B. Embankments - The sands utilized in embankments should be moistened and compacted to the relative density as described in No. I above.

C. A Prime Consideration of the Site Grading should be that the footings or foundations rest upon soils of comparable bearing value in order that excessive differential settlement cannot occur.

II Basis of Foundation Design

A. Conceivably, footings or foundations, can

rest upon five distinct soil formations as follows:

1. Sand - Soil Classification - SM-SP, or
2. Sand Clay Mixtures - Soil Classification - SC, or,
3. Caliche - Soil Classification - SM - Caliche is a formation consisting of calcium carbonate and silica and a form of clays, sand and gravel cemented into a conglomerate by calcium carbonate, or,
4. Sandstone, or
5. Stratified Sandstone and Clay (consolidated).

B. Footings on Sand

1. For vertical loads see Design Chart (page 6) of this Report
2. For lateral loads (unconsolidated materials)
   a. In Place unit weight of material $\gamma$ = 100 p.c.f.
   b. Angle of internal friction $\phi$ = 33°
   c. Total pressure per unit width $P = 1/2\ K\ \gamma\ H^2$ applied 2/3 H below the ground-surface and inclined at the angle $\delta$ with the horizontal.

      WHERE:

      H = depth of the bottom of footing below the groundline

      K = the coefficient of earth pressure as follows:

      Active Pressure - $K_a$=0.29
      Passive Pressure- $K_p$=3.39
      At Rest - $K_o$=0.45

   d. Friction factor to be used for footings,

basement walls, retaining walls, and slabs on grade is = 0.3

e. The minimum recommended safety factor to be applied is 3.

C. For subsoils other than sand

1. Caliche

a. Allowable soil bearing capacity - 6,000 p.s.f.

b. Allowable passive pressure - 6,000 p.s.f.

c. Angle of internal friction - $\phi = 38°$

2. Sandstone and/or stratified sandstone and clay

a. Allowable soil bearing capacity should be calculated as follows:

$$q = \frac{2.85\ q_u\ (1+0.3\frac{B}{L})}{(S.F.)}$$ where:

q = allowable soil bearing capacity

$q_u$ = unconfined compression

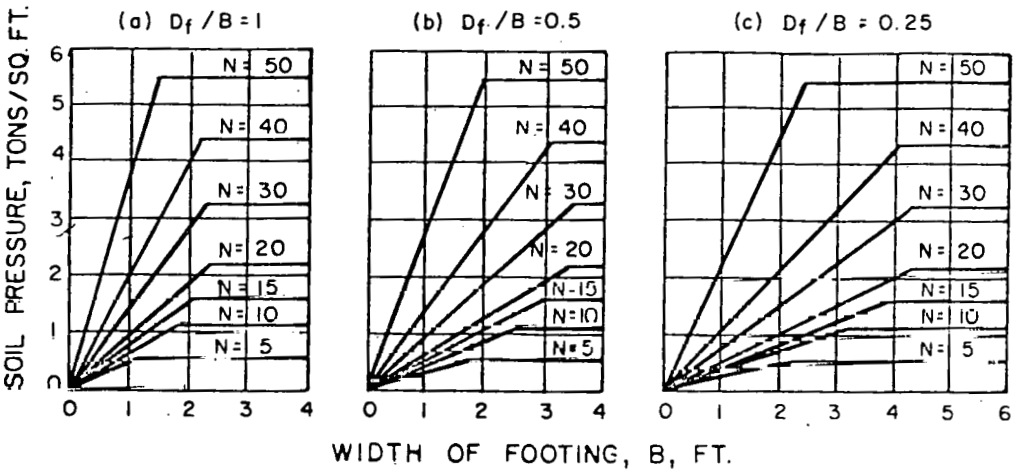
B = width of the footing

L = length of the footing

S.F. = safety factor (minimum recommended safety factor of 3

b. Allowable passive pressure - 6,000 p.s.f.

## DESIGN CHART FOR PROPORTIONING SHALLOW FOOTINGS ON SAND[1]




NOTES:

1. $D_f$ = the depth of footing below the ground surface
2. B = a) The width of a long, continuous footing, or
   b) Side of a square footing, or
   c) The smaller dimension of a rectangular footing, or
   d) Diameter of a circular footing.
3. Uncorrected N values may be used at depths of 10-25 feet, or when the effective overburden pressure is between 0.8 and 1.2 tons per sq. ft.
4. For conditions other than those presented above, a correction factor should be multiplied by the field N values as follows:

   $C_N = 0.77 \log_{10} \frac{20}{\bar{p}}$, where $\bar{p}$ is the effective vertical overburden pressure in tons per square foot at the elevation of the penetration test. This equation is valid for $\bar{p} \geq 0.25$ tons per sq. ft. If $\bar{p} < 0.25$ tons per sq. ft. use $C_N = 2.0$.
5. Charts are based upon a maximum settlement of 1".
6. Charts are based on unit weight of material approximately 100 pounds per cubic ft.

[1] Foundation Engineering, 2nd Edition, John Wiley & Sons, Inc.

# PART II

# LABORATORY ANALYSIS

LABORATORY TEST REPORTS

RICHARD R. PETTIGREW AND ASSOCIATES

P. O. DRAWER 807
CLOVIS, NEW MEXICO 88101
505 762-3716

TO: SANDIA LAB

TYPE OF TEST:

SOIL ANAYLSIS & CLASSIFICATION

PROJECT: WASTE ISOLATION PILOT PLANT

DATE OF TEST: November, 1976

| COMBINED HOLE NO. | DEPTH REPRESENTED |
|---|---|
| 1 | 0" - 7'7" |
| 2 | 0' - 2' |
| 3 | 0' - 5'9" |
| 4 | 0' - 2'6" & 4'1" - 6'6" |
| 5 | 0' - 5'5" |
| 6 | 0' - 1'9" |
| 7 | 0' - 7'1" |
| 8 | 0' - 4'6" |

| SEIVE SIZE | % PASSING |
|---|---|
| #4 | 100 |
| #10 | 100 |
| #30 | 99.7 |
| #40 | 98.1 |
| #60 | 56.0 |
| #100 | 26.1 |
| #200 | 10.4 |
| Sandy Non Plastic | |
| Volumetric Shrinkage | 0. |
| SOIL CLASSIFICATION | SM-SP - Silty Sands, Sand-silt Mixtures, Poorly Graded Sands, Gravelly Sands, little or no Fines |

LAB. No. 6L-6263

RICHARD R. PETTIGREW AND ASSOCIATES

BY

LABORATORY TEST REPORTS

RICHARD R. PETTIGREW AND ASSOCIATES

P. O. DRAWER 807
CLOVIS, NEW MEXICO 88101
505 762-3716

TO: SANDIA LAB

TYPE OF TEST:

SOIL ANAYLSIS & CLASSIFICATION

PROJECT: WASTE ISOLATION PILOT PLANT

DATE OF TEST: November, 1976

| HOLE NO. | COMBINED DEPTH REPRESENTED |
|---|---|
| 1 | 7'7" - 10' |
| 2 | 4'1" - 7'9" |
| 3 | 5'9" - 6'10" |
| 4 | 6'6" - 8'10" |
| 5 | 5'5" - 10'4" |
| 6 | 1'9" - 9'6" |
| 7 | 8'3" - 13'6" |
| 8 | 4'6" - 8'1" |

| SEIVE SIZE | % PASSING |
|---|---|
| 1/2" | 100 |
| 1" | 95.8 |
| 1/2" | 94.6 |
| #4 | 87.9 |
| #10 | 74.4 |
| #30 | 61.9 |
| #40 | 59.1 |
| #60 | 44.6 |
| #100 | 29.0 |
| #200 | 19.8 |
| Liquid Limit | 23.5 |
| Plastic Limit | 22.7 |
| Plasticity Index | 0.8 |
| Linear Shrinkage | 1.09 |
| Shrinkage Limit | 21.47 |
| Shrinkage Ratio | 1.65 |
| Volumetric Shrinkage | 3.35 |
| Specific Gravity | 2.56 |
| SOIL CLASSIFICATION | SM - Silty Sands, Sand-Silt Mixtures |

LAB. No. 6L-6263

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BY

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P. O. DRAWER 807
CLOVIS, NEW MEXICO 88101
505 762-3716

TO: SANDIA LAB

TYPE OF TEST:

SOIL ANAYLSIS & CLASSIFICATION

PROJECT: WASTE ISOLATION PILOT PLANT

DATE OF TEST: November, 1976

COMBINED

| HOLE NO. | DEPTH REPRESENTED |
|---|---|
| 2 | 2' - 4'1" |
| 4 | 2'6" - 4'1" |
| 7 | 7'1" - 8'3" |

| SEIVE SIZE | % PASSING |
|---|---|
| #4 | 100 |
| #10 | 100 |
| #30 | 99.6 |
| #40 | 97.9 |
| #60 | 69.0 |
| #100 | 38.5 |
| #200 | 23.9 |
| Liquid Limit | 25.6 |
| Plastic Limit | 17.4 |
| Plasticity Index | 8.2 |
| Linear Shrinkage | 4.98 |
| Shrinkage Limit | 16.19 |
| Shrinkage Ratio | 1.76 |
| Volumetric Shrinkage | 16.56 |
| Specific Gravity | 2.46 |
| SOIL CLASSIFICATION | SC - Clayey Sands, Sand-Clay Mixtures |

LAB. NO. 6L-6263

RICHARD R. PETTIGREW AND ASSOCIATES

BY _____

LABORATORY TEST REPORTS

RICHARD R. PETTIGREW AND ASSOCIATES

P. O. DRAWER 807
CLOVIS, NEW MEXICO 88101
505 762-3716

TO: SANDIA LAB

TYPE OF TEST:

SOIL ANAYLSIS & CLASSIFICATION

PROJECT: WASTE ISOLATION PILOT PLANT

DATE OF TEST: November, 1976

| HOLE NO. | COMBINED DEPTH REPRESENTED |
|---|---|
| 6 | 18' - 31'6", 62' - 64' & 71' - 75' |
| 7 | 20' - 23'6" |

| SEIVE SIZE | % PASSING |
|---|---|
| 1/2" | 100 |
| #4 | 99.7 |
| #10 | 99.5 |
| #30 | 98.8 |
| #40 | 98.7 |
| #60 | 98.3 |
| #100 | 97.7 |
| #200 | 95.7 |
| Liquid Limit | 35.7 |
| Plastic Limit | 22.6 |
| Plasticity Index | 13.1 |
| Linear Shrinkage | 9.79 |
| Shrinkage Limit | 1.80 |
| Shrinkage Ratio | 15.58 |
| Volumetric Shrinkage | 36.22 |

SOIL CLASSIFICATION — CL - Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays

LAB. NO. 6L-6263

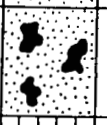
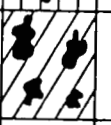
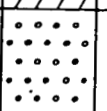
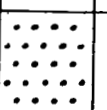
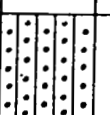
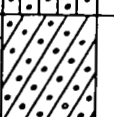
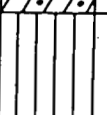
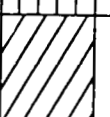
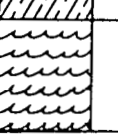
RICHARD R. PETTIGREW AND ASSOCIATES

BY

# PART III

# LOG OF BORINGS

# KEY TO CLASSIFICATION USED ON LOGS

| MAJOR DIVISIONS | | | GROUP SYMBOLS | | DESCRIPTIONS |
|---|---|---|---|---|---|
| COARSE-GRAINED SOILS<br>More Than Half of Material is LARGER Than No. 200 Sieve Size. | GRAVELS<br>More Than Half of Coarse Fraction is LARGER Than No. 4 Sieve Size. | Clean Gravels (Little or no Fines) | GW |  | Well-Graded Gravels, Gravel-Sand Mixtures, Little or no Fines. |
| | | | GP |  | Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or no Fines. |
| | | Gravels With Fines (Appreciable Amount of Fines) | GM |  | Silty Gravels, Gravel-Sand-Silt Mixtures. |
| | | | GC |  | Clayey Gravels, Gravel-Sand-Clay Mixtures. |
| | SANDS<br>More Than Half of Coarse Fraction is SMALLER Than No. 4 Sieve Size. | Clean Sands (Little or no Fines) | SW |  | Well-Graded Sands, Gravelly Sands, Little or no Fines. |
| | | | SP |  | Poorly-Graded Sands, Gravelly Sands, Little or no Fines. |
| | | Sands With Fines (Appreciable Amount of Fines) | SM |  | Silty Sands, Sand-Silt Mixtures. |
| | | | SC |  | Clayey Sands, Sand-Clay Mixtures. |
| FINE-GRAINED SOILS<br>More Than Half of Material is SMALLER Than No. 200 Sieve Size. | SILTS and CLAYS<br>Liquid Limit Less Than 50 | | ML |  | Inorganic Silts & Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity. |
| | | | CL |  | Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays. |
| | | | OL |  | Organic Silts & Organic Silty Clays of Low Plasticity. |
| | SILTS and CLAYS<br>Liquid Limit Greater Than 50 | | MH |  | Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils, Elastic Silts. |
| | | | CH |  | Inorganic Clays of High Plasticity, Fat Clays. |
| | | | OH |  | Organic Clays of Medium to High Plasticity, Organic Silts. |
| Highly Organic Soils | | | Pt |  | Peat & Other Highly Organic Soils |

Ref. (Unified Soil Classification System) Corps of Engineers, U.S. ARMY, T.M. NO. 3-357

LOG OF BORING

PROJECT: WASTE ISOLATION PILOT PLANT — BORING NO.: 1

CLIENT: SANDIA LABORATORIES — LOCATION: Site Plan

DATE: November 18, 1976 — GROUND ELEVATION: 3435.4

LEGEND: ● CORE ▬ SAMPLE • PENETRATION ▲ WATER

| DEPTH, FEET | SYMBOL | SAMPLE | DESCRIPTION OF STRATUM |
|---|---|---|---|
| | | | SAND |
| | | | Moisture Content 5.3% N = 1 |
| | | | Moisture Content 3.9% N = 14 |
| 5 | | | Moisture Content 2.7% N = 27 |
| | | | CALICHE |
| | | | Moisture Content 8.3% N = 40 (Penetration - 4") |
| 10 | | | SANDSTONE |
| | | | Moisture Content 7.7% $q_u$ = 2036 psi |
| 15 | | | STRATIFIED SANDSTONE & CLAY |
| | | | Moisture Content 7.2% $q_u$ = 1700 psi |
| 20 | | | Moisture Content 4.9% |
| | | | TOTAL DEPTH OF HOLE - 20' |

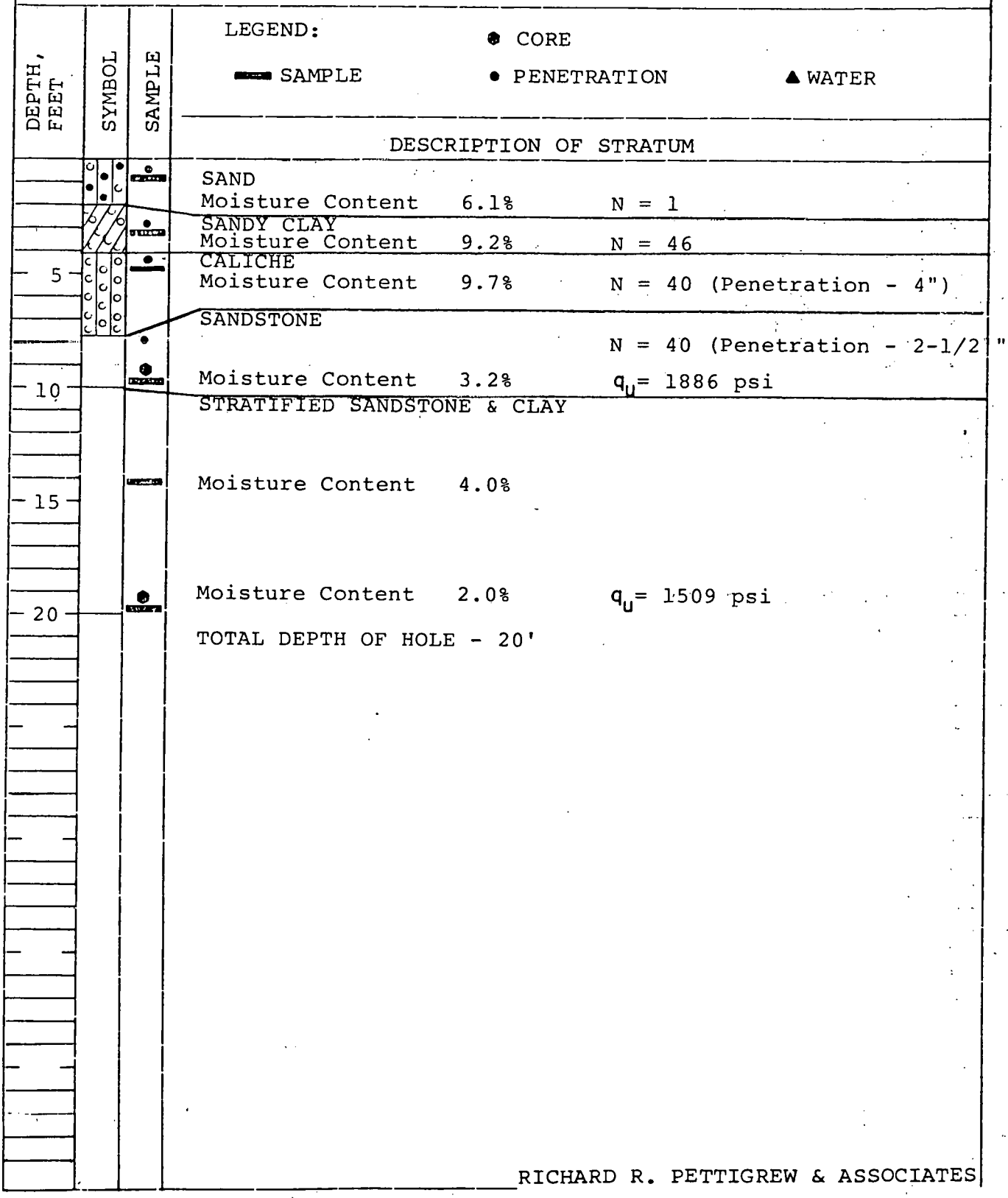
RICHARD R. PETTIGREW & ASSOCIATES

## LOG OF BORING

PROJECT: WASTE ISOLATION PILOT PLANT — BORING NO.: 2

CLIENT: SANDIA LABORATORIES — LOCATION: Site Plan

DATE: November 18, 1976 — GROUND ELEVATION: 3444.5




LEGEND: ● CORE — SAMPLE — • PENETRATION — ▲ WATER

DESCRIPTION OF STRATUM

SAND
Moisture Content 6.1% N = 1

SANDY CLAY
Moisture Content 9.2% N = 46

CALICHE
Moisture Content 9.7% N = 40 (Penetration - 4")

SANDSTONE
N = 40 (Penetration - 2-1/2")
Moisture Content 3.2% $q_u$ = 1886 psi

STRATIFIED SANDSTONE & CLAY
Moisture Content 4.0%

Moisture Content 2.0% $q_u$ = 1509 psi

TOTAL DEPTH OF HOLE - 20'

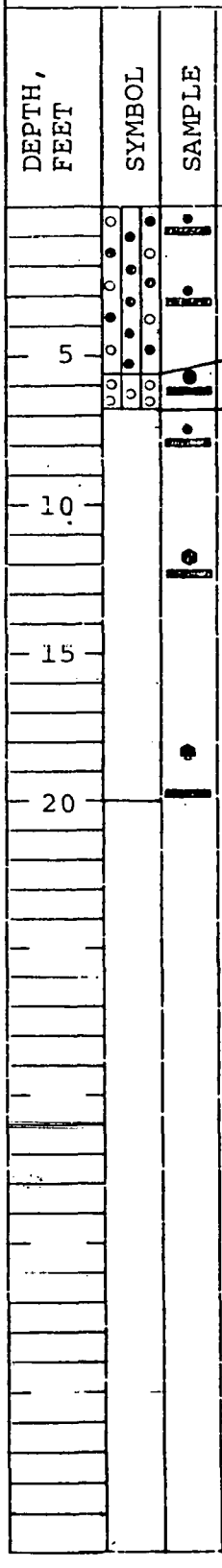
RICHARD R. PETTIGREW & ASSOCIATES

## LOG OF BORING

PROJECT: WASTE ISOLATION PILOT PLANT — BORING NO.: 3

CLIENT: SANDIA LABORATORIES — LOCATION: Site Plan

DATE: November 19, 1976 — GROUND ELEVATION: 3461.1




LEGEND: ● CORE ▬ SAMPLE • PENETRATION ▲ WATER

| DESCRIPTION OF STRATUM | | |
|---|---|---|
| SAND | | |
| Moisture Content | 4.9% | N = 1 |
| Moisture Content | 5.2% | N = 36 |
| CALICHE | | |
| Moisture Content | 9.0% | N = 40 (Penetration - 10") |
| SANDSTONE | | |
| Moisture Content | 4.2% | N = 40 (Penetration - 5-1/2") |
| Moisture Content | 5.7% | $q_u$ = 1894 psi |
| Moisture Content | 0.8% | $q_u$ = 1894 psi |
| TOTAL DEPTH OF HOLE - 20' | | |

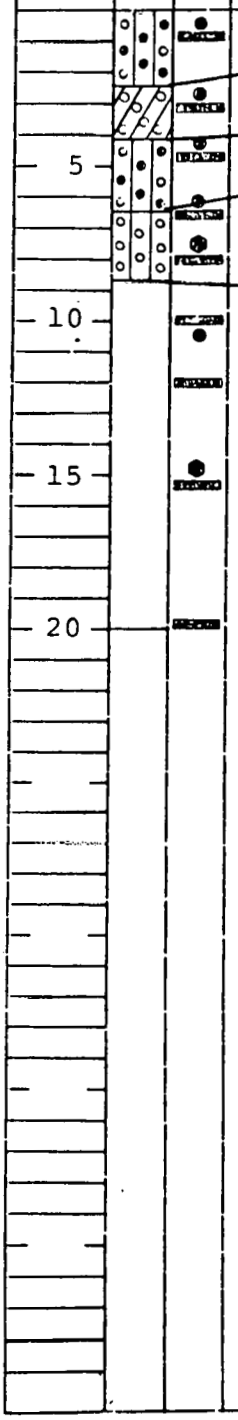
RICHARD R. PETTIGREW & ASSOCIATES

LOG OF BORING

PROJECT: WASTE ISOLATION PILOT PLANT — BORING NO.: 4

CLIENT: SANDIA LABORATORIES — LOCATION: Site Plan

DATE: November 18, 1976 — GROUND ELEVATION: 3452.2




LEGEND:

▬ SAMPLE ● CORE ● PENETRATION ▲ WATER

DESCRIPTION OF STRATUM

| | | |
|---|---|---|
| SAND | | |
| Moisture Content | 5.3% | N = 1 |
| SANDY CLAY | | |
| Moisture Content | 8.0% | N = 14 |
| SAND | | |
| Moisture Content | 1.4% | N = 23 |
| CALICHE | | |
| Moisture Content | 9.3% | N = 40 (Penetration - 2-1/2 ") |
| Moisture Content | 5.6% | = 1326 psi |
| STRATIFIED SANDSTONE & CLAY | | |
| Moisture Content | 7.8% | N = 40 (Penetration - 2-1/2 ") |
| Moisture Content | 5.2% | |
| Moisture Content | 2.8% | $q_u$ = 1509 psi |

TOTAL DEPTH OF HOLE - 20'

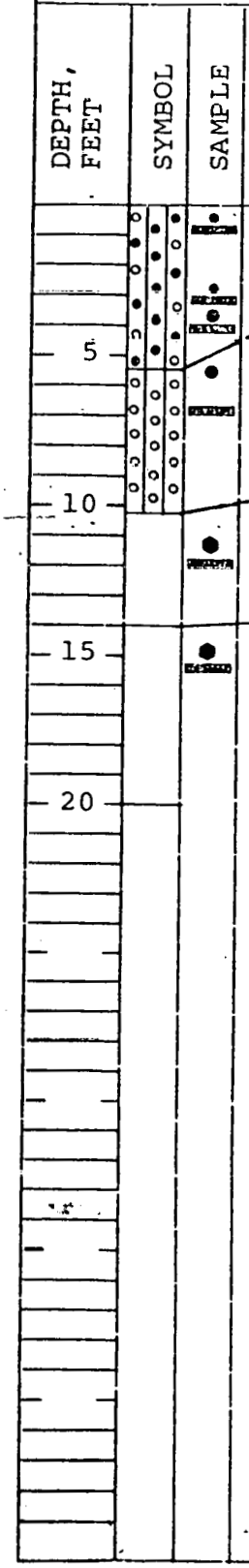
RICHARD R. PETTIGREW & ASSOCIATES

## LOG OF BORING

PROJECT: WASTE ISOLATION PILOT PLANT — BORING NO.: 5

CLIENT: SANDIA LABORATORIES — LOCATION: Site Plan

DATE: November 17, 1976 — GROUND ELEVATION: 3451.7




LEGEND:

▬ SAMPLE ● CORE ● PENETRATION ▲ WATER

| DESCRIPTION OF STRATUM | | |
|---|---|---|
| SAND | | |
| Moisture Content | 4.4% | N = 1 |
| Moisture Content | 3.7% | N = 11 |
| Moisture Content | 6.8% | N = 35 |
| CALICHE | | |
| | | N = 40 (Penetration - 2") |
| Moisture Content | 7.0% | |
| SANDSTONE | | |
| Moisture Content | 8.8% | $q_u$ = 3018 psi |
| STRATIFIED SANDSTONE & CLAY | | |
| Moisture Content | 1.9% | $q_u$ = 2084 psi |
| TOTAL DEPTH OF HOLE - 20' | | |

RICHARD R. PETTIGREW & ASSOCIATES

LOG OF BORING

Page I

PROJECT: WASTE ISOLATION PILOT PLANT BORING NO.: 6

CLIENT: SANDIA LABORATORIES LOCATION: Site Plan

DATE: November 16, 1976 GROUND ELEVATION: 3465.3

LEGEND: ● CORE ▬ SAMPLE • PENETRATION ▲ WATER

| DEPTH, FEET | SYMBOL | SAMPLE | DESCRIPTION OF STRATUM | | |
|---|---|---|---|---|---|
| | | | SAND | | |
| | | | Moisture Content | 6.3% | N = 1 |
| | | | CALICHE | | |
| | | | Moisture Content | 8.5% | N = 40 (Penetration - 2") |
| 5 | | | Moisture Content | 3.7% | |
| | | | STRATIFIED SANDSTONE & CLAY | | |
| 10 | | | Moisture Content | 8.6% | N = 40 (Penetration - 3") |
| | | | Moisture Content | 3.0% | N = 40 (Penetration - 5") |
| 15 | | | Moisture Content | 2.2% | $q_u$ = 1263 psi |
| | | | Moisture Content | 0.3% | $q_u$ = 1579 psi |
| | | | RED CLAY | | |
| 20 | | | Moisture Content | 9.7% | $q_u$ = 1200 psi |
| 25 | | | | | |
| 30 | | | Moisture Content | 7.9% | $q_u$ = 1389 psi |
| | | | SANDSTONE | | |
| | | | Moisture Content | 2.1% | |
| 35 | | | Moisture Content | 2.4% | $q_u$ = 2178 psi |
| 40 | | | | | |
| | | | STRATIFIED SANDSTONE & CLAY | | |
| | | | Moisture Content | 2.5% | $q_u$ = 1342 psi |
| 45 | | | | | |

RICHARD R. PETTIGREW & ASSOCIATES

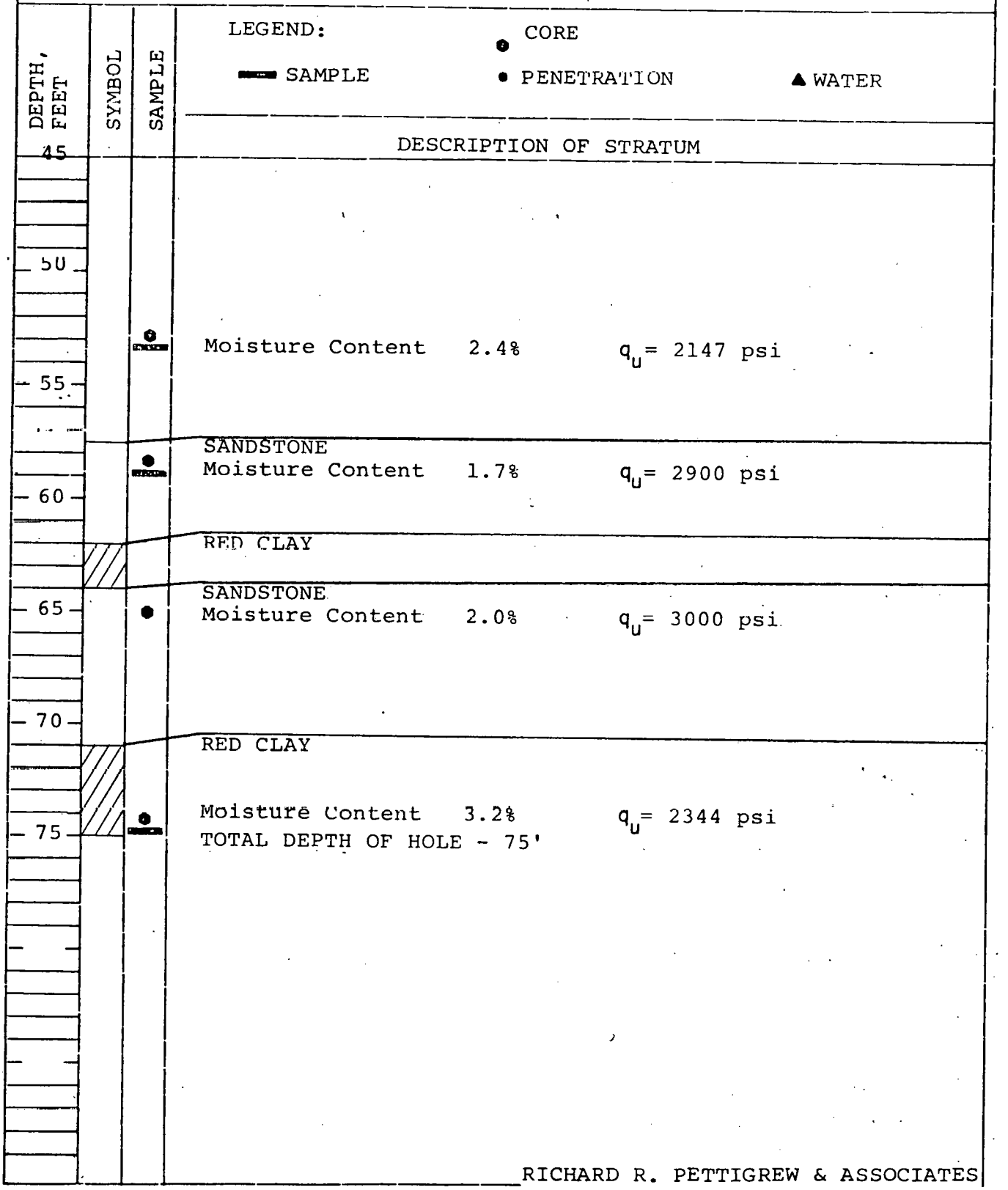
LOG OF BORING

Page II

PROJECT: WASTE ISOLATION PILOT PLANT — BORING NO.: 6

CLIENT: SANDIA LABORATORIES — LOCATION: Site Plan

DATE: November 17, 1976 — GROUND ELEVATION: 3465.3



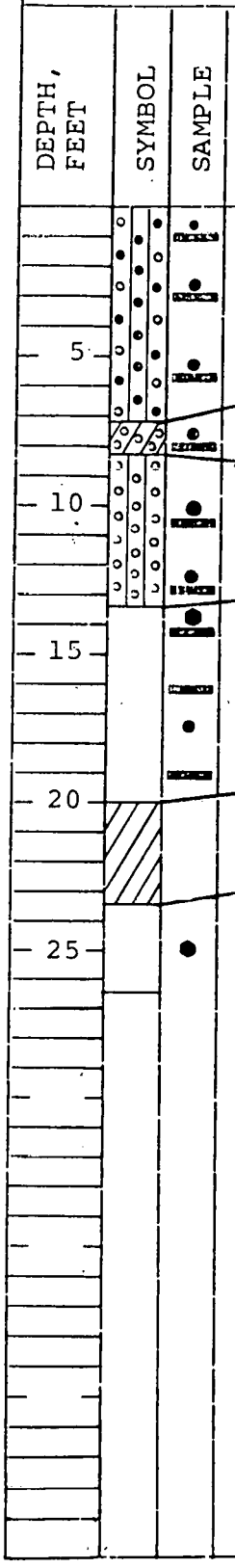

RICHARD R. PETTIGREW & ASSOCIATES

LOG OF BORING

PROJECT: WASTE ISOLATION PILOT PLANT BORING NO.: 7

CLIENT: SANDIA LABORATORIES LOCATION: Site Plan

DATE: November 19, 1976 GROUND ELEVATION: 3445.8




LEGEND:

SAMPLE ● CORE ● PENETRATION ▲ WATER

DESCRIPTION OF STRATUM

SAND

Moisture Content 4.5% N = 2

Moisture Content 2.2% N = 6

Moisture Content 1.8% N = 28

SANDY CLAY

Moisture Content 7.5% N = 50

CALICHE

Moisture Content 4.4% N = 40 (Penetration - 4")

Moisture Content 6.5% N = 40 (Penetration - 3")

STRATIFIED SANDSTONE & CLAY

Moisture Content 6.1% $q_u$ = 2036 psi

Moisture Content 6.5%

N = 40 (Penetration - 2")

Moisture Content 3.1%

RED CLAY

SANDSTONE

$q_u$ = 3018 psi

TOTAL DEPTH OF HOLE - 26-1/2'

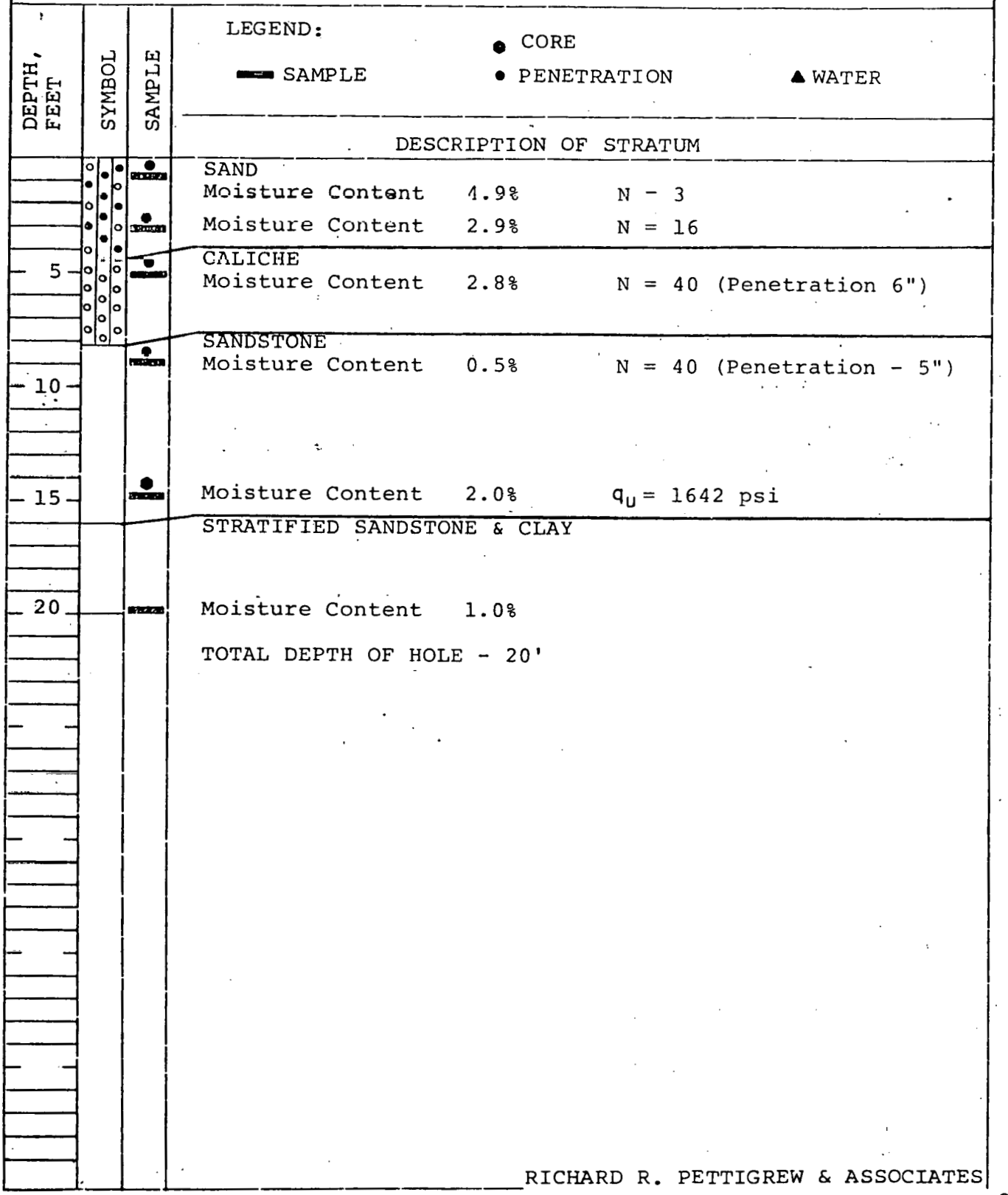
RICHARD R. PETTIGREW & ASSOCIATES

LOG OF BORING

PROJECT: WASTE ISOLATION PILOT PLANT — BORING NO.: 8

CLIENT: SANDIA LABORATORIES — LOCATION: Site Plan

DATE: November 19, 1976 — GROUND ELEVATION: 3453.1




DESCRIPTION OF STRATUM

SAND
Moisture Content 4.9% N - 3
Moisture Content 2.9% N = 16

CALICHE
Moisture Content 2.8% N = 40 (Penetration 6")

SANDSTONE
Moisture Content 0.5% N = 40 (Penetration - 5")

Moisture Content 2.0% $q_u$ = 1642 psi

STRATIFIED SANDSTONE & CLAY

Moisture Content 1.0%

TOTAL DEPTH OF HOLE - 20'

RICHARD R. PETTIGREW & ASSOCIATES

# PART IV

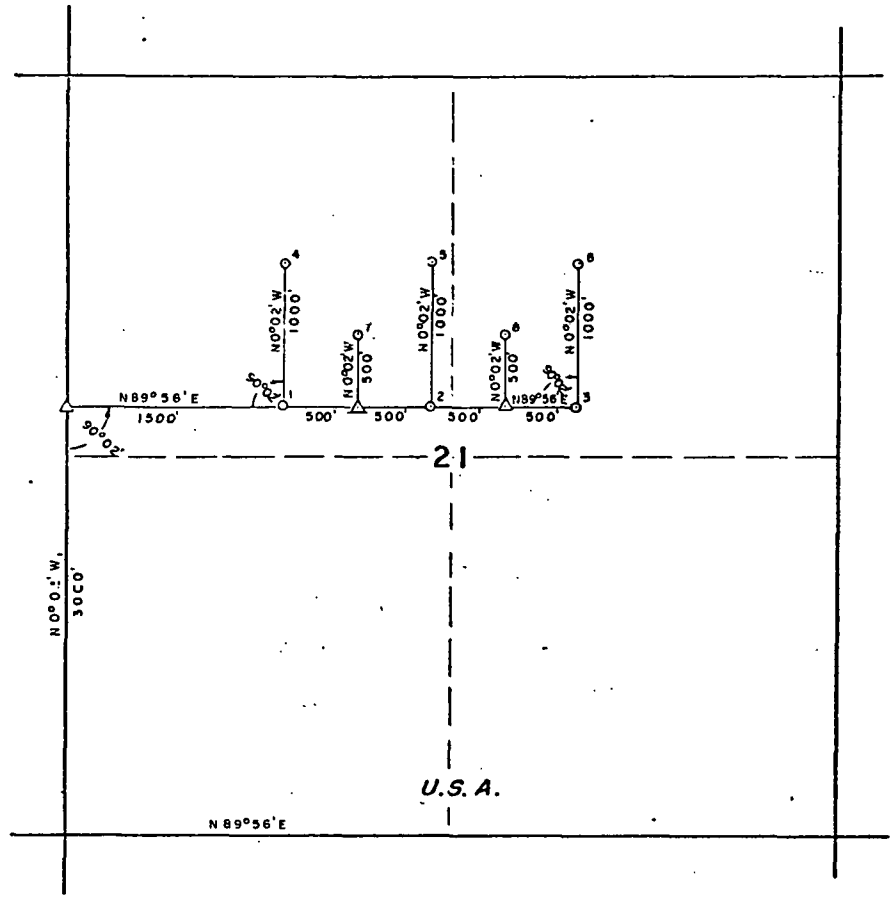
# SITE PLAN

# WIPP SOIL INVESTIGATION

## REVISED DRILL HOLE LOCATIONS

SEC. 21, T22S, R31E, N.M.P.M.,

EDDY COUNTY, NEW MEXICO




O INDICATES DRILL HOLE MARKED BY 5/8" IRON ROD
△ INDICATES TURNING HUB MARED BY IRON NAIL

Surveyed: Oct. 6, 1976
Weather : Warm and clear

P. C. : N. King
Chain : B. Thompson
A. Mussett

Elevations

| | |
|---|---|
| No. 1 | 3435.42 |
| No. 2 | 3444.49 |
| No. 3 | 3461.06 |
| No. 4 | 3452.21 |
| No. 5 | 3451.68 |
| No. 6 | 3465.25 |
| No. 7 | 3445.76 |
| No. 8 | 3453.09 |

I HEREBY CERTIFY THAT THIS PLAT WAS MADE FROM NOTES TAKEN IN THE FIELD IN A BONA FIDE SURVEY MADE UNDER MY SUPERVISION, AND THAT THE SAME IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

John W. West

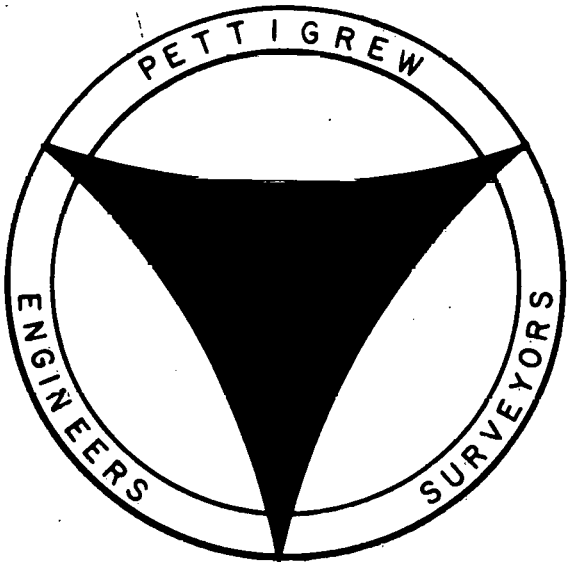
JOHN W. WEST, N.M. P.E. & L.S. NO.676
TEXAS R.P.S. NO. 1138

SANDIA, CORP.

Rivised drill hole locations for WIPP Soil Investigation, Section 21, Township 22 South, Range 31 East, N. M. P. M., Eddy County, New Mexico.

JOHN W. WEST ENGINEERING COMPANY
CONSULTING ENGINEERS HOBBS, NEW MEXICO

| | |
|---|---|
| Scale 1" = 1000' | Drawn by chb |
| Date Oct. 14, 1976 | Sheet 1 of 1 Sheets |




*RICHARD R. PETTIGREW*
*AND ASSOCIATES*
**CONSULTING ENGINEERS**

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