ES-376-78-204

PLAN FOR SOLID WASTE MANAGEMENT

Prepared in Compliance with Requirements
and Procedures 40 CFR 241 as Specified
in IAD 0510-35 as Applied to the
Rocky Flats Plant Sanitary Landfill

M. V. Werkema
C. R. Rose

December 1977

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1.0 INTRODUCTION

Planning for the current sanitary landfill was initiated in the early 70's. Subsequently the EPA defined the requirements for preparation of plans for landfills. The EPA document 40 CFR 241 specifies subjects which must be covered in the landfill plan. These subjects include design, acceptable materials, operating procedures, monitoring, and completion plans. It is also specified in 40 CFR 241 that the design of the landfill shall be approved by a professional engineer. This document is prepared retroactively to demonstrate compliance with the EPA requirements. The document covers the topics listed above and additionally discusses the distribution of responsibility.

2.0 DESIGN

Design of the sanitary landfill was based on subsurface studies. The documents associated with planning, designing, and supporting studies are included in Appendix B. Engineering drawings for landfill construction are included.

3.0 MATERIAL ACCEPTABILITY

3.1 Environmental Guidelines

The standard for deposit of materials in the landfill is as follows:

> Only nonradioactive, nonprocess, sanitary, solid wastes shall be deposited in the landfill. Natural soil, generated during construction and necessary maintenance operations, is allowed for deposit in the landfill, if it meets radioactivity guidelines

The policy that no radioactive materials shall be deposited in the landfill is interpreted within the limits of practicability. The practicable limit of detectability is used in controlling materials to be deposited in the landfill.

3.1.1 Materials Having Suspected Transuranic Radioactivity:

All sanitary materials to be sent to the landfill are subject to surveillance by means of the appropriate radiation monitoring probe. No solid materials, having man-made radioactivity detectable by calibrated FIDLER probe, shall be deposited in the landfill. Special consideration is given to soil to facilitate construction or any necessary maintenance. For soil, the limit of detectability shall be defined as those levels above ambient background as determined by Radiation Monitoring. Sludges and powders shall be deposited in the landfill only as nonroutine wastes. These materials shall be excluded from the landfill when the alpha emission rates are greater than 20 pCi/g. At present, sanitary waste treatment sludges are excluded from the landfill. Deposition of these sludges will require compliance with the State and local regulations and will be limited by the radioactivity guide determined to be most practicable.

3.1.2 Solid Gamma Emitters:

Materials suspected of containing gamma radioactivity undetected by routine surveillance must be submitted as nonroutine wastes. Only material whose gamma radioactivity is not greater than ambient background will be permitted for deposition in the landfill. Ambient background will be determined by Radiation Monitoring.[4]

3.1.3 Nonroutine Wastes:

Chemicals, beryllium, liquids and all nonroutine wastes shall be described in Form RF 46367 (see Figure 1). Ruling with regard to deposition shall be made by Environmental Sciences.

3.2 Radiation Monitoring Guidelines

3.2.1 All dumpsters carrying material to be deposited in the landfill shall be surveyed by Radiation Monitoring and be given an appropriate material transfer tag.[1]

3.2.2 The dumpsters in the collection areas will be monitored by Radiation Monitoring at least once a week[2]

3.2.3 The area of active waste disposal in the landfill will be monitored daily using a FIDLER type instrument. Other radiation detecting instruments will be used as needed.[3]

3.3 Operating Procedures

The operating procedures for the landfill are found in Appendix A.

3.4 Handling of Special Items

Special waste items are described in the Request Form RF 46367, Figure 1. Disposal of special items in the landfill will require the permission of the Environmental Sciences Manager. The Request Form RF 46367 must be submitted to and approved by the Manager of Environmental Sciences before the waste is deposited in the landfill.

Surveillance of the landfill is made by Radiation Monitoring approximately daily to spot check the type of waste received. If questionable items appear (e.g., recyclable scrap, possible nonline generated waste from a processing building, etc.) action is taken to determine the source of generation, return the material and advise the generator of the proper disposition method.

3.5 Responsibilities

The Plant Services Department has primary responsibility for the operation of the landfill. The planning for expansion is a responsibility of Plant Services with approvals by the Facilities Long Range Planning Committee (PLBL 2-001).

The Radiation Monitoring Department has responsibility for monitoring the dumpsters and the soil in the active areas of the landfill.

Environmental Sciences Department has responsibility for establishing guidelines for materials to be deposited

in the landfill. Environmental Sciences reviews requests for disposal of special items in the landfill. Environmental Sciences samples the ground water test holes at the landfill and records the concentrations of dissolved substances. Environmental Sciences samples drain water in the west holding pond and advises Waste Processing of the proper disposition of this water.

4.0 MONITORING

4.1 Ground Water

Drainage water from the landfill accumulates in the west holding pond. The water is either disposed by evaporation north of the landfill, or transferred to Waste Processing for evaporation, depending upon the chemical and/or radioactive content.

Three ground water wells are sampled once every five months for plutonium, gross alpha, electrical conductivity, pH, and nitrate. Monitoring locations and frequencies are reviewed annually The above schedule is subject to revisions which will be defined in the most current environmental monitoring catalog.

4.2 Soil

Landfill surveillance is done by FIDLER survey (see paragraph 3.2.3).

5.0 COMPLETION STATUS

At current filling rates, it is estimated that the existing landfill will be filled in three years. A budget request has been submitted for the FY 80 GPP budget for an expansion of the landfill. The proposal is to extend the existing legs of the "horseshoe" 250 feet to the east. It is proposed to use the same design for control of subsurface water as was utilized in the 1974 construction project. Existing drain tiles will be extended and the existing leachate detention ponds will be maintained. It is estimated that the proposed extension will have sufficient capacity for at least 10 to 15 years service. A contract for soil testing in the expansion area is to be completed in December, 1977. Alternatively, the use of a large clay pit near the west access road is being considered. Its capacity would be much greater than that of the proposed expansion.

Recommendations have been requested from the consultant regarding proper depth and types of material to utilize in capping the completed (filled) portions of the landfill and reseeding. It is planned to cap the completed areas with clay for sealing out storm water and to add top soil and reseed.

REFERENCES

1. HS&E Manual, HSE 21.04, page 4.
2. Radiation Monitoring Procedures and Techniques HS-RM-2.3, page 2.
3. Radiation Monitoring Procedures and Techniques HS-RM-12.4, page 2.
4. Radiation Monitoring Procedures and Techniques HS-RM-2.2, page 2.

Figure 1 PLEASE PRINT

WASTE PROCESSING REQUEST

Originator of Request: DATE: _____

NAME _____ ORGANIZATION _____

PHONE _____ BUILDING & ROOM NO. _____

Where applicable, please check the appropriate boxes, identify, and enter description information including toxic and fire hazards.

SOLID ☐ WEIGHT, Kg _____ LIQUID ☐ VOLUME, (LITRE) _____

ACID ☐ NEUTRAL ☐ BASE ☐ ANALYTICAL REQ. NO. _____
(Attach copy of results)

DESCRIPTION. (Attach sheet if additional space is required)

_____

_____

_____

SS Material Wt. Discarded; grams _____ element _____; grams _____ element _____

From Acct. No. _____ To Acct. No. _____ NMC Doc. No. _____

Equipment No. _____

==========

RADIATION MONITORING SURVEY RESULTS:

Direct _____ Smear _____ Gamma Radiation _____

Signature _____ Date _____

DISPOSITION.

A. RADIOACTIVE WASTE

Send to Building No. _____ Attention of _____

_____ _____
Approved by Waste Processing Date

B. NON-RADIOACTIVE, NON-ROUTINE WASTES

Send to Landfill ☐

_____ _____
Approved by Environmental Sciences Date

Distribution

White - Original - For Radioactive Wastes, Waste Processing; for Landfill Wastes, Environmental Sciences (see reverse side for notes on disposition)

Blue - Copy 2 - To accompany material or item when shipped

Yellow - Copy 3 - Originator (see reverse side for instructions)

RF 46367 (1/77) Destroy Previous Issues - Revised 12-9-77

Comments on Disposition

Signature _____ Date _____

Figure 1 (cont'd.)

Instructions for Completion of Form

This form must be completed and authorized by Radiation Monitoring and Waste Processing prior to the shipment of contaminated non-routine materials, items, or equipment to Waste Processing Routine pipeline liquid waste transfers to Building 374 and 774, normal white drums or crated waste production are exempt from using this form.

The form must be completed and authorized by Radiation Monitoring and Environmental Sciences prior to shipment of non-routine materials to the Sanitary Landfill Normal day-to-day uncontaminated waste sent to the Sanitary Landfill are exempt from using this form.

APPENDIX A

OPERATING PROCEDURES FOR THE LANDFILL

Atomics International Division
Rocky Flats Plant
P.O. Box 464
Golden, Colorado 80401
(303) 494-3511
Contractor to
Energy Research and Development
Administration

Rockwell International

SERVICES DEPARTMENT PROCEDURE

NO. GT&L-ADM-5 REV. 1 DATE: December 21, 1977

TITLE: DEMPSTER-DUMPSTER - LANDFILL

1. POLICY:

1.1 Dumpster boxes on Plant site are dumped on a demand basis.

1.2 The majority of the boxes are dumped in the landfill for burial.

1.3 Some buildings use open top boxes for metal to be salvaged.

2. SCOPE:

2.1 To define services responsibility plan for the prompt and efficient trash removal and disposal from the plant site.

3. RESPONSIBILITY:

3.1 The Supervisor, Garage, Trucking & Labor is responsible for truck operation, dumpster box assignment, and movement of the boxes on plant site.

4. GENERAL INFORMATION & INSTRUCTIONS:

4.1 Unlocked Dumpster Boxes

4.1.1 Buildings 111, 121, 122, 123, 112, 331, 441, 333, 334, 443, 551, 445, 664, 440, 439, 447, 991, 750, 995, 706, and 864 have boxes without locks.

4.1.2 Building 334 has six dumpster boxes, one for paper, one for sawdust, one for metal turnings and three for scrap metal. The three for scrap metal is not dumped in the landfill, but is deposited in an area in the salvage yard.

4.1.3 Buildings 111, 121, 122, 123, 112, 331, 441, 333, 443, 551, 445, 440, 439, 991, 750, 661, 995, 706, and 864 are basically used for general building waste such as paper, cans, cartons, trash, etc.

Buildings 112 and 445 have open top, 4 cu. yd. boxes and are used for cafeteria waste and carbon waste respectively. Open end boxes are used at the 444 Precision for metal turnings.

4.1.4 The above boxes are checked daily and are dumped at the landfill, if they are at least half full. The scrap metal boxes are monitored and dumped at an area designated by PU&D department, building 551. Scrap metal boxes are dumped approximately every month.

4.2 Locked Dumpster Boxes

4.2.1 Buildings 778, 776, 701, 777, 559, 779, 771, 774, 707, 883, 881, 865, 444 and 448 have dumpster boxes which are kept locked. The keys to these boxes are controlled by Custodial Supervision. Discarded material must be monitored before it is placed in the dumpster box.

4.2.2 Dumpster boxes in the above areas are called in to the trucking dispatcher by phone after it has been tagged and signed by Health Physics personnel. The dumpster driver is then contacted by radio and informed which box is ready to be dumped.

4.2.3 Dumpster driver checks green tag for Health Physics signature, removes tag and retains for Supervisors inspection.

4.2.4 The dumpster driver has no knowledge as to what the boxes contain until they are dumped.

4.2.5 After the boxes are dumped and any of the contents arouses suspicion, the driver calls supervision.

4.2.6 If supervision suspects contamination, Health Physics is called to monitor material.

4.3 Dumpster Boxes Used by Building Services Personnel

4.3.1 Open top or open end dumpster boxes are frequently used by the Labor Department. They are filled with dirt, rock, asphalt, concrete or a mixture of all to be disposed of at the landfill. The driver dumps these boxes on a demand basis at a spot determined by the dozer operator at the landfill.

4.3.2 If the material which goes into these boxes has been taken from an exclusion area, Health Physics

checks it before it is removed.

4.3.3 The remaining boxes utilized on plant site are used by contractors: Lummus office, Braun office, Lummus motor pool, Lummus warehouse, 371 building and 374 building. The trucking dispatcher is notified by phone and the dumpster driver is contacted by radio when the boxes are ready to be dumped.

4.4 Dumping Area

4.4.1 When dumpster boxes arrive at landfill, the dozer operator directs driver to dumping area.

4.4.2 When dumpster driver or any other driver arrives at the landfill with something other than the normal trash, the driver is questioned (when possible) by the dozer operator as to the origin of the material.

4.4.3 A full load of such material as duct, concrete, cinder blocks, pipe, roofing, etc., is placed in areas determined by the dozer operator.

4.4.4 If the operator sees anything unusual in the load, supervision is notified and steps are taken to determine what the material is and from where it came. When this information is received and is acceptable, the material is spread out for burial.

4.4.5 Before any now-routine material is placed in the landfill, approval of Environmental Sciences and Radiation Monitoring must be obtained utilizing Waste Processing Form RF 46367. The blue copy of this form will be filed in Building 331.

4.5 Contractor's Waste and Dirt

4.5.1 All trash from a construction area destined for the landfill is checked by the Guard as to type of trash and from where it originated. This information is recorded by the Guard and forwarded to trucking supervision where it is entered in a permanent record.

4.5.2 Upon arrival at landfill, the trash is disposed of in the same manner as that of Rockwell.

4.5.3 Dirt brought to the landfill is stock-piled and used for fill at the top of the lifts.

4.5.4 Dozer operator receives information (when possible)

from the driver as to the origin of the material or dirt and whether or not it has been checked by Health Physics.

4.5.5 If a Health Physics check has not been made, the material is set aside until it has been checked.

4.6 Fill and Compaction

4.6.1 All trash taken to the landfill is spread and compacted daily over an area approximately 100 feet by 45 feet. Health Physics monitor checks all material every day near the end of the shift. Four to six inches of dirt is then spread and that is compacted. This process continues to within three feet of the top of the lift. Dirt is then dozed onto the top three feet of the lift and compacted. A new lift is then started.

4.6.2 There are two lifts open at all times. As one is completed; a new one is started. There are approximately 9,000 square feet of open lifts at all times.

4.7 General Information

4.7.1 Boxes are not dumped on excessively windy days.

4.7.2 Open top boxes are held to a minimum in exclusion areas.

4.7.3 Occassionally a small amount of paper will blow. This is usually picked up the following day.

APPROVED: J. P. Waschal

J. P. Waschal, Manager
Garage, Trucking & Labor

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J. P. Waschal, Manager
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APPROVED: J. F. Paschal

J. P. Waschal, Manager
Garage, Trucking & Labor

APPENDIX B
ENGINEERING PLANS AND DRAWINGS

ZEFF, COGORNO AND SEALY, INC.

SUBSURFACE STUDIES

SANITARY LANDFILL RENOVATIONS, U.S. ATOMIC ENERGY COMMISSION'S ROCKY FLATS PLANT, GOLDEN, JEFFERSON COUNTY, COLORADO

PREPARED FOR:

UNITED STATES ATOMIC ENERGY COMMISSION

ROCKY FLATS AREA OFFICE

P.O. BOX 928

GOLDEN, COLORADO 80401

CONTRACT NO. AT (29-2) - 3442

PROJECT 13759 JUNE 26, 1974

consulting soil and geologic engineers
1020 w 1st ave / denver, colorado 80223/534-0882

ZEFF, COGORNO AND SEALY, INC.

June 26, 1974

United States Atomic Energy Commission
Rocky Flats Area Office
P.O Box 928
Golden, Colorado 80401

Attn Mr. Douglas Coe

Subject Report of Subsurface Studies
Proposed Sanitary Landfill Renovations
Rocky Flats Plant
Golden, Colorado
Project 13759
Contract No. AT (29-2) - 3442

Gentlemen

Zeff, Cogorno and Sealy, Inc. has completed the subsurface studies for the sanitary landfill renovations at the subject site. The attached report presents our findings and recommendations for the proposed project. The data collected in this study will be utilized to design the landfill ring and sampling structure.

If you have any questions after reviewing the contents of this report, please do not hesitate to contact our office

Respectfully submitted,

ZEFF, COGORNO AND SEALY, INC.
REGISTERED ENIGNEERS

By Richard C Edwards
Richard C. Edwards, Geologist

By Curtis O. Sealy
Curtis O Sealy, P.E.
Vice President

By Vukoslav E. Aguirre
Vukoslav E Aguirre, P.E.
Vice President

RCE, COS, VEA/sh

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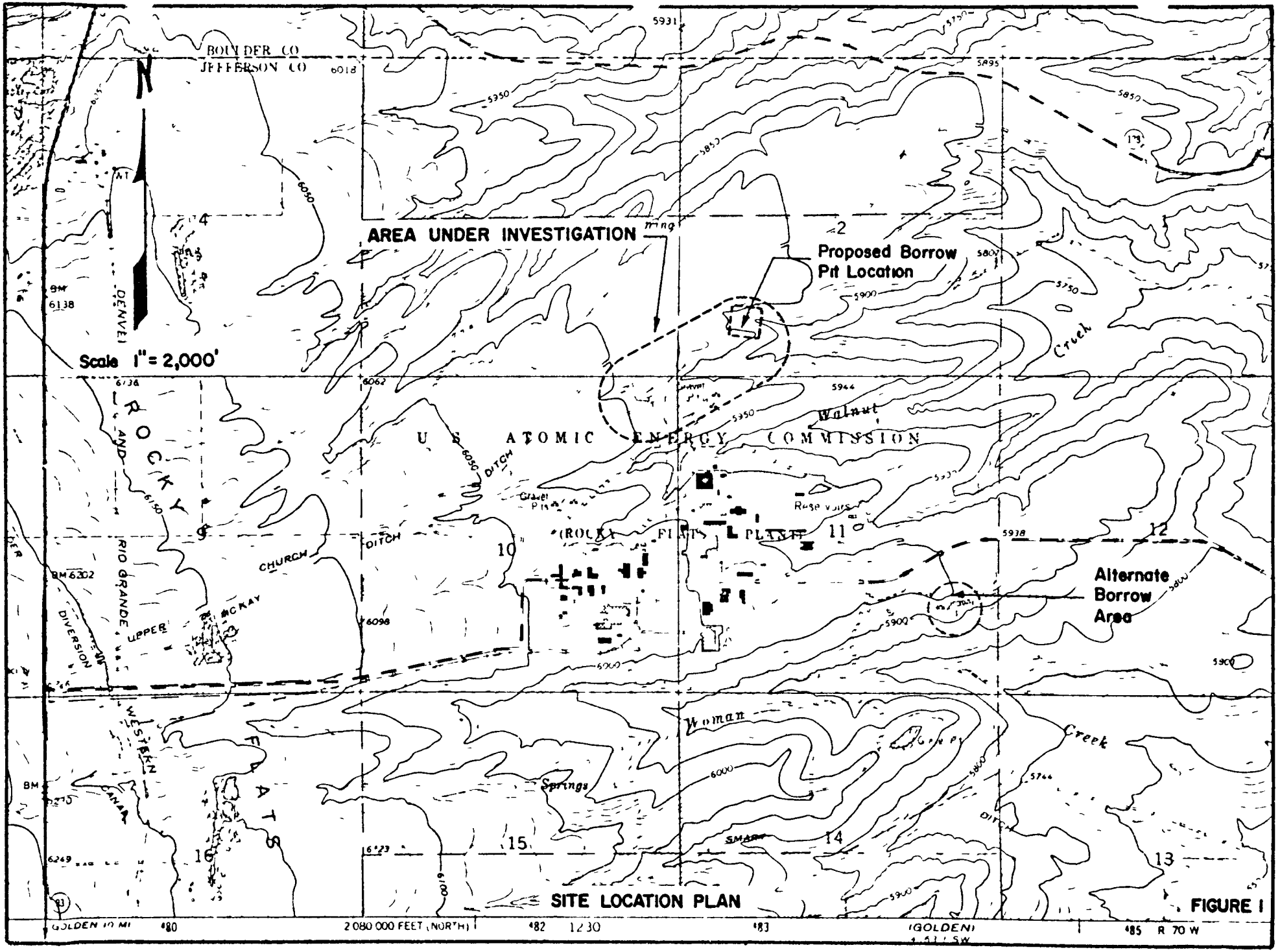
SCOPE OF SUBSURFACE STUDIES

THIS REPORT PRESENTS THE RESULTS OF SUBSURFACE STUDIES MADE AT THE SITE OF THE PROPOSED SANITARY LANDFILL RENOVATIONS AT THE U.S. ATOMIC ENERGY COMMISSION'S ROCKY FLATS PLANT, GOLDEN, JEFFERSON COUNTY, COLORADO.

THE PHYSICAL LIMITS OF THE PROJECT ARE SHOWN ON FIGURE 1. IT IS DESIRED TO CONSTRUCT AN IMPERVIOUS RING AROUND THE EXISTING SANITARY LANDFILL TO INTERCEPT AND DIRECT THE UNDERGROUND AND SURFACE WATER AWAY FROM THE SITE. THE INTENT OF THE RENOVATION IS TO ALSO CONSTRUCT A SAMPLING STRUCTURE DOWNSTREAM FROM THE LANDFILL. THE PURPOSE OF THE SAMPLING STRUCTURE WILL BE TO IMPOUND ALL DRAINAGE EFFLUENT FROM THE LANDFILL UNTIL PROPER MONITORING AND DISPOSITION OF THE EFFLUENT COULD BE UNDERTAKEN.

BOTH FIELD AND LABORATORY INVESTIGATIONS OF THE SUBSOIL CONDITIONS WERE MADE. THE FIELD WORK CONSISTED OF MAKING A SERIES OF EXPLORATORY TEST BORINGS AND TEST PITS. DISTURBED AND RELATIVELY UNDISTURBED SAMPLES WERE TAKEN FROM THE BORINGS. THE TEST PITS WERE INSPECTED BY A GEOLOGIST AND SAMPLES WERE COLLECTED FOR FURTHER STUDY. THE SAMPLES WERE SUBJECTED TO VISUAL INSPECTION AND LABORATORY TESTS IN ORDER TO EVALUATE THE PHYSICAL AND MECHANICAL PROPERTIES OF THE MATERIALS ENCOUNTERED. KNOWLEDGE OF THESE PROPERTIES WAS SUBSEQUENTLY UTILIZED, IN CONJUNCTION WITH RESULTS OF OBSERVATIONS MADE ON THE SITE AND PAST EXPERIENCE WITH SIMILAR SOIL CONDITIONS, IN REACHING THE CONCLUSIONS AND RECOMMENDATIONS PRESENTED IN THIS REPORT.



SITE LOCATION PLAN

FIGURE 1

GEOLOGIC CONSIDERATIONS

SETTING:

THE SITE IS SITUATED APPROXIMATELY 16 AIR MILES NORTHWEST OF DENVER, COLORADO AND 8 MILES SOUTH OF BOULDER, COLORADO IN AN AREA KNOWN AS ROCKY FLATS. LOCALLY, THE SITE LIES 2 MILES EAST OF COLORADO HIGHWAY 93 AND JUST NORTH OF THE U.S. ATOMIC ENERGY COMMISSION'S 'ROCKY FLATS PLANT'. THE SITE BOUNDARY IS WITHIN PORTIONS OF SECTIONS 2, 3, 10 AND 11, TOWNSHIP 2 SOUTH, RANGE 70 WEST OF THE SIXTH PRINCIPAL MERIDIAN, JEFFERSON COUNTY, COLORADO (SEE SITE LOCATION PLAN, FIGURE 1).

THE AREA SURROUNDING THE SITE IS COVERED WITH NATURAL GRASSES AND THE GROUND SURFACE IS TYPICAL OF PEDIMENTS FOUND IN MANY LOCATIONS ALONG THE FRONT RANGE OF THE SOUTHERN ROCKY MOUNTAINS. THESE BROAD FLAT PLAINS ARE FREQUENTLY INTERRUPTED BY EASTWARD TRENDING INTERMITTENT STREAMS. WITHIN THE AREA OF THE SITE THE SURFACE OF THE PEDIMENTS HAVE AN EASTERLY SLOPE OF ABOUT 2 PERCENT EXCEPT ON THE SIDE SLOPES OF THE DRAINAGE DEPRESSION WHERE SLOPES OF UP TO 22 DEGREES (APPROXIMATELY 40 PERCENT) AND MORE EXIST.

ALL OF THE DRAINAGE FEATURES IN THE VICINITY OF THE SITE ARE INTERMITTENT AND ONLY FLOW DURING TIMES OF LOCALIZED HEAVY RUNOFF. SURFACE RUNOFF FLOWS ACROSS THE PROJECT AREA IN SHEET FLOW AND SMALL EROSIONAL CHANNELS UNTIL IT REACHES THE MAJOR DRAINAGE FEATURES THESE FEATURES THEN TRANSMIT SURFACE WATER IN AN EASTERLY DIRECTION

OFF THE SITE. THE MAJORITY OF THE AVAILABLE SURFACE WATER IS COLLECTED IN RESERVOIRS LOCATED TO THE EAST OF THE PLANT AREA. THE REMAINDER OF THE SURFACE WATER EVENTUALLY JOINS THE SOUTH PLATTE RIVER WHICH IS LOCATED APPROXIMATELY 25 MILES EAST OF THE SITE.

THE RELATIVELY STEEP, NARROW AND 'V' SHAPED DEPRESSIONS PRESENT ALONG THE DRAINAGE FEATURES SUGGEST THAT FREQUENT EPISODES OF HEAVY RUNOFF HAVE OCCURRED IN THIS AREA. THESE EPISODES OF HEAVY RUNOFF ARE PROBABLY DUE TO THUNDER SHOWERS THAT FREQUENTLY OCCUR ALONG THE FRONT RANGE OF THE SOUTHERN ROCKY MOUNTAINS.

DUE TO THE STEEPENING OF THESE SLOPES BY EROSION AND OTHER FACTORS, FREQUENT OCCURRENCES OF MASS WASTING (SLOPE FAILURES) ARE PRESENT IN THIS AREA. THE CAUSES AND EFFECTS OF THESE EPISODES OF MASS WASTING ARE DISCUSSED IN DETAIL LATER IN THIS REPORT.

THE PEDIMENT ON WHICH THE SITE LIES WAS FORMED DURING THE PRE-WISCONSIN (PLEISTOCENE) WEATHERING OF THE FRONT RANGE. THIS DEPOSIT, KNOWN AS ROCKY FLATS ALLUVIUM, WAS DEPOSITED BY STREAMS ON A RELATIVELY FLAT EROSIONAL SURFACE OF CRETACEOUS AND OLDER SEDIMENTS. THE ALLUVIUM IS COMPOSED OF VARIOUS MIXTURES OF BOULDERS, COBBLES, GRAVELS AND SAND IN A CLAY MATRIX. COATINGS OF IRON OXIDE AND CALCIUM CARBONATE AND LOCAL CONCENTRATIONS OF CALICHE ARE PRESENT THROUGHOUT THIS DEPOSIT AND WERE NOTED DURING OUR INVESTIGATION.

THE ROCKY FLATS ALLUVIUM LIES UNCONFORMABLY ON SEDIMENTARY ROCKS

OF CRETACEOUS AGE. THE PRINCIPAL SEDIMENTARY ROCK THAT UNDERLIES THE SITE IS MAPPED BY THE U.S. GEOLOGICAL SURVEY AS THE LARAMIE FORMATION. HOWEVER, RECENT DATA INDICATES THAT THESE DEPOSITS ARE NOT PART OF THE LARAMIE FORMATION BUT ARE PART OF THE ARAPAHOE FORMATION.

THE STRUCTURAL FEATURES WITHIN THIS AREA ARE A COMPLEX ASSOCIATION OF FAULTS, FOLDS AND UPTURNED BEDS. A FEW MILES WEST OF THE SITE THE BEDS DIP 60 DEGREES AND MORE IN AN EASTERLY DIRECTION. WITHIN THE IMMEDIATE PROJECT AREA, THE BEDS PROBABLY DIP AT 10 DEGREES OR LESS IN AN EAST BY SOUTHEAST DIRECTION.

LOCATED TO THE NORTH OF THE SITE IS AN AREA MAPPED BY THE U.S. GEOLOGICAL SURVEY THAT SHOWS A COMPLEX ASSOCIATION OF BLOCK FAULTING. WITHIN THE IMMEDIATE AREA, INVESTIGATIONS BEING CONDUCTED BY THE U.S. GEOLOGICAL SURVEY HAVE DISCOVERED THE EXISTENCE OF ADDITIONAL FAULTS. THE FAULTS IN THIS AREA HAVE BEEN DATED TO THE LARAMIDE TIME. HOWEVER, THE PRESENT STUDIES HAVE SHOWN THAT AT LEAST A PORTION OF THESE FAULTS IS MUCH YOUNGER THAN LARAMIDE AGE. IT IS NOT ANTICIPATED THAT RECENT MOVEMENT HAS OCCURRED ALONG THESE ZONES OF WEAKNESS. HOWEVER, THE PRESENCE OF THESE FAULTS SHOULD BE RECOGNIZED WHEN BUILDING IN THIS AREA.

SEISMICITY:

THE PROJECT LIES WITHIN A ZONE 1 SEISMIC RISK AREA. THIS ZONE CORRESPONDS TO AN INTENSITY OF V AND VI OF THE MODIFIED MERCALLI INTENSITY SCALE OF 1931. GENERALLY, A ZONE 1 SEISMIC

RISK AREA MEANS THAT EARTHQUAKE PROBLEMS AND DAMAGE CAUSED BY EARTHQUAKES ARE MINOR. IT SHOULD BE NOTED, HOWEVER, THAT RECENT PUBLICATIONS HAVE STATED THAT THE DENVER METROPOLITAN AREA SHOULD REVISE IT'S SEISMIC RISK CLASSIFICATION UPWARD. (SOURCE: THE MOUNTAIN GEOLOGIST, OCTOBER 1973 VOL. 10, NO. 4).

NATURAL SLOPE STABILITY:

THERE IS A PROBLEM OF GENERAL SLOPE STABILITY ON AND IN THE VICINITY OF THIS SITE. THE AREAS WHERE SLOPE STABILITY PROBLEMS OCCUR ARE GENERALLY CONFINED TO THE RELATIVELY STEEP SIDE SLOPES PRESENT ALONG THE DRAINAGE FEATURES. THE FOLLOWING IS A SUMMARY OF THE SLOPE STABILITY CHARACTERISTICS PRESENT ON THE SITE.

A) WITHIN THE IMMEDIATE AREA OF THIS SITE IT WAS FOUND THAT THE NORTH (SOUTH FACING) SLOPES HAVE HAD MORE OCCURRENCE OF SLOPE FAILURE THAN THE SOUTH SLOPES. THIS PHENOMENON OF GREATER SLOPE FAILURE ON THE NORTH SLOPES IS PROBABLY DUE TO A COMBINATION OF THE FOLLOWING FACTORS. 1) OBSERVATIONS MADE IN TEST PITS DUG AT THE SITE SHOW AN INTERSECTING FRACTURE SYSTEM. THESE THREE MAJOR FRACTURE PATTERNS HAVE THE FOLLOWING ATTITUDES. STRIKE NORTH 20 DEGREES WEST, DIP 76 DEGREES WEST, STRIKE NORTH 70 DEGREES EAST, DIP 75 DEGREES SOUTH AND STRIKE EAST-WEST, DIP 1 TO 2 DEGREES SOUTH; 2) ACCORDING TO AVAILABLE INFORMATION AND OBSERVATIONS MADE IN THE FIELD, THE BEDROCK APPEARS TO HAVE A SOUTHEASTERLY DIP. THIS DIP APPROXIMATELY PARALLELS THE DIRECTION OF SLOPE OF THE SOUTH FACING SLOPES, AND 3) ALL SOUTH FACING SLOPES IN THIS AREA WILL BE MORE SUSCEPTIBLE TO FREQUENT EPISODES OF FREEZE-

THAW AND WETTING AND DRYING THAN THE NORTH FACING SLOPES. THESE EPISODES OF FREEZE-THAW AND WETTING AND DRYING WILL HAVE A TENDENCY TO WEAKEN THE BEDROCK STRUCTURE.

B) WITHIN THE IMMEDIATE AREA, THE ACTIVE AND OLD SLOPE FAILURE ZONES ARE ADJACENT TO SURFACE SLOPES OF AROUND 20 DEGREES OR MORE. WITHIN THE AREAS OF SLOPE FAILURE, EVIDENCE OF CONTINUED MOVEMENT WAS FOUND ON SLOPES OF LESS THAN 10 DEGREES.

C) NATURAL SLOPES OF ABOUT 12 DEGREES OR LESS HAVE NO EVIDENCE OF PAST FAILURES. IN ADDITION, THESE SLOPES SHOW NO EVIDENCE OF ANY MAJOR INSTABILITY.

D) NATURAL SLOPES BETWEEN 12 AND 20 DEGREES SHOW LINEATIONS (TENSION CRACKING AND LINEAR ALIGNMENT OF RODENT BURROWS) APPROXIMATELY PERPENDICULAR TO THE DIRECTION OF SURFACE SLOPES. THESE LINEATIONS ARE PROBABLY EVIDENCE OF A MARGINAL CONDITION ON THESE SLOPES.

DRYING CRACKS ARE PRESENT ALONG THE SIDE SLOPE OF THE DRAINAGE DEPRESSION, PROVIDING FOR A POTENTIAL INFLUX OF SURFACE WATER INTO THE DRYING CRACKS AND FRACTURE SYSTEM. THE INFLUX OF THIS WATER INTO THE CLAYSTONE BEDROCK WILL CAUSE A FURTHER WEAKENING OF THE BEDROCK STRUCTURE.

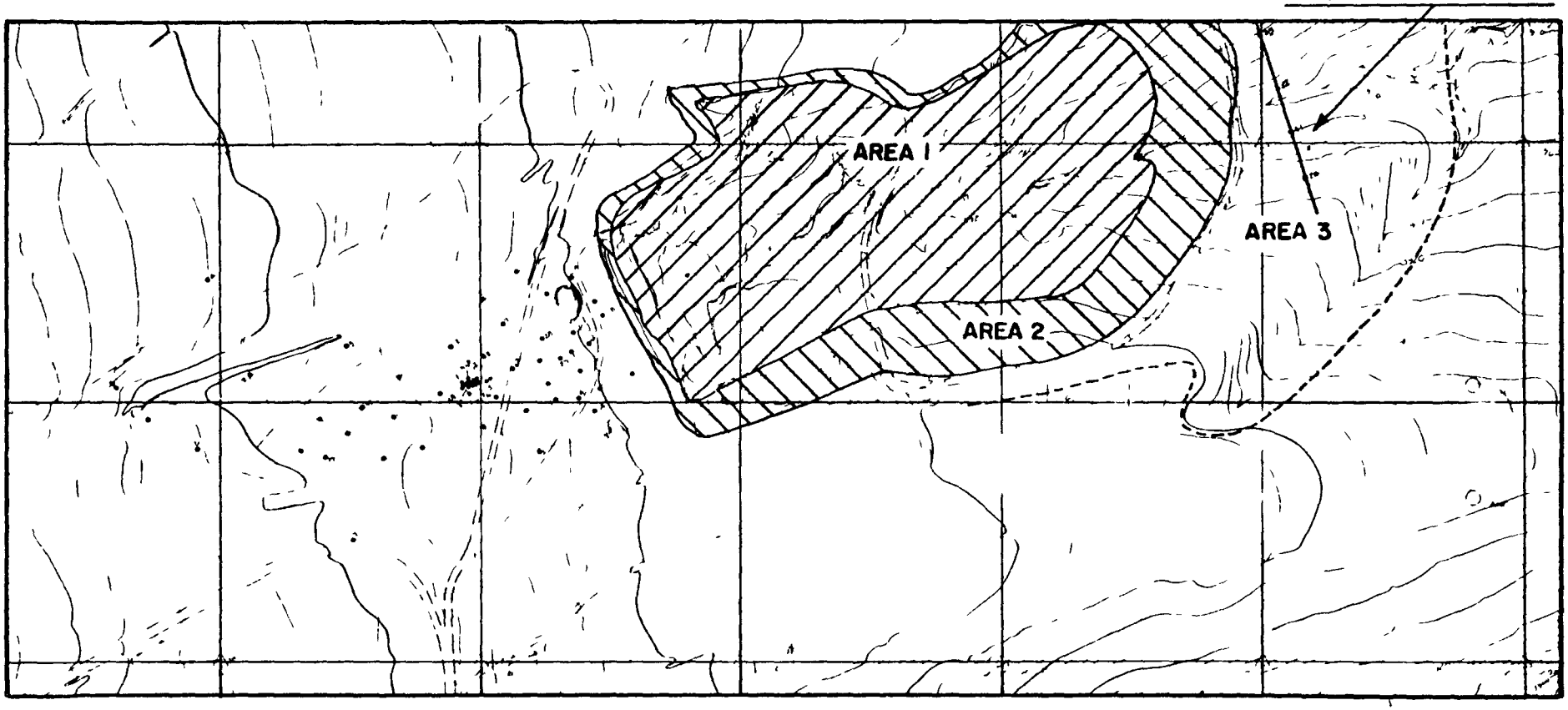
FIGURE 2 SHOWS THE AREAS ON THE SITE THAT HAVE ALREADY EXPERIENCED SLOPE FAILURE. ALSO SHOWN ON FIGURE 2 ARE THOSE AREAS WHERE, IN OUR OPINION, POTENTIAL SLOPE PROBLEMS MAY EXIST.

BASED ON THE ABOVE DATA, FIELD RECONNAISSANCE, LABORATORY DATA AND PAST EXPERIENCE, IT IS OUR OPINION THAT THE PROPOSED SAMPLING STRUCTURE SHOULD BE LOCATED AS SHOWN ON THE BORING PLAN IN APPENDIX 'A'. BY LOCATING THE STRUCTURE AT THIS LOCATION, THE FOLLOWING CONDITIONS WILL BE PRESENT:

1) THE STRUCTURE WILL NOT REST ON ANY ZONES OF PAST, ACTIVE OR POTENTIALLY ACTIVE SLOPE FAILURES, AND

2) THE REMOVAL OF LARGE QUANTITIES OF UNSTABLE SOILS (SLOPE FAILURE ZONES) WILL NOT BE REQUIRED.

IT SHOULD BE POINTED OUT THAT WITHOUT TOTAL RECONSTRUCTION OF EXISTING SLOPES UPSTREAM FROM THE SAMPLING STRUCTURE, FUTURE EPISODES OF MASS WASTING (SLOPE FAILURE) SHOULD BE ANTICIPATED. THE MOST CRITICAL SLOPE STABILITY CONDITION THAT MAY EXIST UPSTREAM FROM THE SAMPLING STRUCTURE WILL BE ENCOUNTERED DURING TIMES OF MAXIMUM SURFACE WATER RUNOFF. IF THE SAMPLING STRUCTURE BECOMES FULL OF WATER AND RAPID DRAWDOWN OF THIS WATER OCCURS, A POTENTIALLY UNSTABLE CONDITION MAY ARISE ALONG THE RESERVOIR WALLS. HOWEVER, IT IS OUR OPINION THAT IF MASS WASTING DOES OCCUR, IT'S MAGNITUDE WILL NOT BE SUFFICIENT TO CAUSE OVERTOPPING OF THE SAMPLING STRUCTURE.



AREA 1 - Area of active slope failure or potentially unstable conditions
AREA 2 - Marginal condition, possible slope problems
AREA 3 - Generally stable conditions

SCALE 1" = 300'

SLOPE MAP

(Areas of potential slope instability)

FIGURE 2

SUBSURFACE CONDITIONS

LANDFILL AREA:

BORINGS 101 THROUGH 109 WERE PLACED AROUND THE PERIMETER OF THE EXISTING LANDFILL. TEST BORING 105 PENETRATED THE EXISTING LANDFILL. THE BORINGS ENCOUNTERED OVERBURDEN SOILS (ROCKY FLATS ALLUVIUM) TO DEPTHS VARYING BETWEEN 11.5 TO 25.0 FEET BENEATH THE EXISTING GROUND SURFACE. THIS ALLUVIUM IS COMPOSED OF VARIOUS MIXTURES OF SANDS, GRAVELS, COBBLES AND BOULDERS IN A CLAY MATRIX. THESE MATERIALS WERE FOUND TO BE LIGHT BROWN, MEDIUM DENSE TO VERY DENSE, MEDIUM MOIST TO WET AND CALCAREOUS IN PLACES. ALTHOUGH THERE ARE ALLUVIUMS YOUNGER THAN THE ROCKY FLATS ALLUVIUM ON THE SITE, NO ATTEMPT WAS MADE TO DEFINE THEIR EXTENT OR LOCATION.

TYPICAL GRAIN-SIZE DISTRIBUTIONS OF THE MATERIALS, EXCLUSIVE OF THE COBBLES AND BOULDERS, ARE SHOWN IN APPENDIX 'B' OF THIS REPORT. THE CLAY CONTENT IS VARIABLE FROM LESS THAN 10 PERCENT TO MORE THAN 25 PERCENT BY WEIGHT IN THE MORE CLAYEY ZONES OF THE OVERBURDEN.

THE PERMEABILITY OF THE OVERBURDEN SOILS IS EXTREMELY VARIABLE AND IS DIFFICULT TO PREDICT. GRAIN-SIZE ANALYSIS PERFORMED ON THE SOILS INDICATE THAT THE AVERAGE PERMEABILITY VARIES FROM 10^{-4} TO 10^{-5} CENTIMETERS PER SECOND. HOWEVER, MORE CLEAN, SANDY ZONES INTERBEDDED WITHIN THE SUBSOILS HAVE PERMEABILITIES ON THE ORDER OF 10^{-2} CENTIMETERS PER SECOND. IT IS NOT KNOWN IF THESE LAYERS OF MEDIUM PERMEABILITY ARE CONTINUOUS OR IF THEY OCCUR RANDOMLY

THROUGHOUT THE SUBSURFACE STRATA. WE BELIEVE THAT AN AVERAGE VALUE OF 10^{-3} CENTIMETER PER SECOND IS REASONABLE TO ASSUME FOR SUBSURFACE PERMEABILITY RATES.

UNDERLYING THE SURFICIAL COVER IS CLAYSTONE BEDROCK OF THE ARAPAHOE FORMATION. THE UPPER PORTIONS OF THE CLAYSTONES HAVE WEATHERED INTO A VERY STIFF, PLASTIC CLAY. THE CLAYSTONE ITSELF IS A PLASTIC MATERIAL OF VARYING HARDNESS. PENETRATION RESISTANCE VALUES IN THE BEDROCK VARY FROM 50 BLOWS PER FOOT TO IN EXCESS OF 200 BLOWS PER FOOT. SOME MINOR FRACTURING AND STAINING WAS NOTED WITHIN SAMPLES EXTRACTED FROM THE BEDROCK STRATA.

THE CLAYSTONE BEDROCK HAS THREE MAJOR SYSTEMS OF FRACTURES. THE ATTITUDE OF THESE FRACTURES IS STRIKE NORTH 20 DEGREES WEST, DIP 76 DEGREES WEST, STRIKE NORTH 70 DEGREES EAST, DIP 75 DEGREES SOUTH AND STRIKE EAST-WEST, DIP 1 TO 2 DEGREES SOUTH. NO MEASURABLE BEDDING PLANES WERE FOUND IN SAMPLES FROM THE BORINGS OR TEST PITS. HOWEVER, FROM AVAILABLE DATA AND OBSERVATIONS MADE NEAR THE SITE, IT IS FELT THAT THE BEDROCK DIPS AT APPROXIMATELY 10 DEGREES OR LESS IN AN EAST BY SOUTHEAST DIRECTION.

AT THE BASE OF THE ARAPAHOE FORMATION, IT IS KNOWN THAT RELATIVELY PERMEABLE LAYERS OF SANDSTONE AND CONGLOMERATE EXIST. HOWEVER, NONE OF THESE BEDS WAS FOUND IN ANY OF OUR BORINGS OR TEST PITS.

SAMPLING STRUCTURE AREA:

FOUR (4) BORINGS WERE DRILLED AND SEVENTEEN (17) TEST PITS

WERE DUG IN THE VICINITY OF THE SAMPLING STRUCTURE. AT THE PROPOSED ABUTMENT OF THE SAMPLING STRUCTURE, DIRECTLY BENEATH A VENEER OF TOPSOIL, SEVERELY WEATHERED CLAYSTONE BEDROCK (CLAY) WAS FOUND. THESE CLAYS ARE VERY STIFF IN CONSISTENCY AND ARE HIGHLY PLASTIC. THESE MATERIALS EXTEND TO DEPTHS OF 4 TO 5 FEET WHERE WEATHERED CLAYSTONE BEDROCK OF VARIABLE HARDNESS WAS ENCOUNTERED. THE SEVERELY WEATHERED TO WEATHERED CLAYSTONES POSSESS A MOISTURE DEFICIENCY AND EXHIBIT LOW TO MODERATE SWELLING CHARACTERISTICS UPON WETTING (SEE SWELL CONSOLIDATION TEST RESULTS IN APPENDIX 'B' OF THIS REPORT).

IN THE BOTTOM OF THE RAVINE AN ALLUVIAL DEPOSIT OF CLAYS WITH GRAVELS AND COBBLES WAS FOUND TO OVERLIE THE SEVERELY WEATHERED TO WEATHERED CLAYSTONES. THIS DEPOSIT VARIES FROM LESS THAN 0.5 TO 4.0 FEET IN THICKNESS AND IS STIFF TO VERY STIFF.

BECAUSE OF THE NEARNESS TO THE SURFACE OF CLAYSTONE BEDROCK IN THE DRAINAGE FEATURE, SOME VERY LARGE DRYING CRACKS WERE FOUND. THE CRACKS ARE CAUSED BY THE LARGE VARIANCE IN VOLUME OF THE CLAYSTONE WHEN IT'S MOISTURE CONTENT IS CHANGED.

SOME OF THE TEST PITS WERE FOUND TO CONTAIN LENSES OF SUB-LIGNITE MATERIALS UP TO 6 INCHES THICK.

BORROW AREAS:

THE 400 SERIES TEST PITS WERE PLACED IN THE PROPOSED BORROW

AREAS. THE MATERIALS FROM TEST PIT 401 ARE PREDOMINANTLY SANDS AND GRAVELS AND COBBLES. THE MATERIALS FROM TEST PIT 402 ARE ALSO GRANULAR BUT ARE MORE CLAYEY. THE SOIL FROM THESE TEST PITS, TO APPROXIMATE DEPTHS OF 7 TO 9 FEET, MAY BE USED IN ZONE 2 OF THE SAMPLING STRUCTURE EMBANKMENT. IN ADDITION, THE MATERIALS FROM THE EXCAVATION OF THE SAMPLING STRUCTURE MAY BE USED IN THE ZONE 2 PART OF THE EMBANKMENT.

THE SEVERELY WEATHERED CLAYSTONES (PLASTIC CLAYS) TO DEPTHS OF APPROXIMATELY 4 FEET FROM TEST PITS 403 AND 404 MAY BE USED IN ZONE 1 OF THE EMBANKMENT. BELOW DEPTHS OF 4 FEET, THE MATERIALS BECOME HARD AND EXHIBIT A BLOCKY STRUCTURE UPON EXCAVATION. THESE HARD MATERIALS ARE DIFFICULT TO WET AND BREAK DOWN WITH CONSTRUCTION EQUIPMENT BUT MAY WEATHER INTO PLASTIC CLAYS OVER A PERIOD OF TIME. IF PLACED IN THE EMBANKMENT, THE IN-PLACE WEATHERING COULD BE DETRIMENTAL TO THE INTEGRITY OF THE EMBANKMENT. CLOSE CONTROL OF EXCAVATION OF THE BORROW MATERIALS BY THE SOILS ENGINEER WILL BE REQUIRED TO ELIMINATE THE USE OF THESE MATERIALS.

THE BORROW SOILS HAVE MOISTURE DEFICIENCIES IN THEIR NATURAL STATE, THUS WATER MUST BE ADDED TO ACHIEVE THE DESIRED WATER CONTENT AND COMPACTION IN THE EMBANKMENT. THE COMPACTION CHARACTERISTICS OF THE TYPICAL BORROW MATERIALS, INCLUDING THEIR MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, ARE SHOWN IN APPENDIX 'B' OF THIS REPORT.

THE MATERIALS FROM TEST PITS 405 AND 406 ARE FROM THE OLD GRAVEL

PIT USED BY THE AEC. THE PIT IS LOCATED TO THE SOUTHEAST OF THE ROCKY FLATS BOUNDARY AND IS SHOWN ON FIGURE 1.

IT IS NOT BELIEVED THAT THESE MATERIALS WILL NEED TO BE USED IN CONSTRUCTION OF THE EMBANKMENT BUT ARE SUITABLE IF THE NEED ARISES.

GROUNDWATER:

GROUNDWATER TABLES ARE SHOWN ON THE LOGS OF EXPLORATORY BORINGS AND TEST PITS IN APPENDIX 'A' OF THIS REPORT.

BASED ON OBSERVATIONS MADE IN THE FIELD, TWO TYPES OF GROUNDWATER FLOW ARE PROBABLY PRESENT AT THE SITE. THE FIRST AND PROBABLY THE DOMINANT IS THE FLOW THROUGH THE ALLUVIUM ABOVE THE BEDROCK SURFACE. THE SECOND TYPE OF FLOW IS WITHIN THE FRACTURE ZONES OF THE CLAYSTONE BEDROCK.

THE FLOW OF GROUNDWATER IN THE CLAYSTONE BEDROCK WILL PROBABLY BE OF MINOR CONCERN EXCEPT DURING TIMES OF HEAVY RUNOFF. AS PREVIOUSLY MENTIONED, LARGE DRYING CRACKS ARE PRESENT ON THE SURFACE OF THE MAJOR DRAINAGE DEPRESSION. SURFACE WATER MAY ENTER THESE CRACKS AND BE CARRIED THORUGH THE FRACTURE SYSTEM. THE TOTAL AMOUNT OF THIS TYPE OF GROUNDWATER FLOWS IS ANTICIPATED TO BE EXTREMELY SMALL.

DESIGN CONSIDERATIONS

SANITARY LANDFILL RING:

AS SHOWN ON THE LOGS OF EXPLORATORY BORINGS IN APPENDIX 'A', THE DEPTH TO CLAYSTONE BEDROCK VARIES FROM 11.5 TO 25.0 FEET BELOW THE EXISTING GROUND SURFACE. THE OVERBURDEN MATERIALS CAN READILY BE EXCAVATED WITH CONVENTIONAL CONSTRUCTION EQUIPMENT. ONCE DEWATERED, THE MATERIALS WILL STAND ON A SLOPE OF 2 (HORIZONTAL) TO 1 (VERTICAL). HOWEVER, LOCALIZED SLIPPAGE MAY OCCUR ON THE SLOPES. THUS, MINOR PERIODIC MAINTENANCE WILL PROBABLY BE REQUIRED UNTIL THE TRENCH IS FILLED WITH LANDFILL MATERIALS.

BECAUSE THE WATER TABLE IS SHALLOW AROUND THE LANDFILL, EXTENSIVE DEWATERING WILL BE REQUIRED DURING CONSTRUCTION. IT IS ADVISABLE THAT CONSTRUCTION PROCEED FROM THE DOWNSTREAM PORTION OF THE RING AND THAT DRAINS BE INSTALLED AS WORK PROGRESSES.

THE DRAINS IN THE RING WILL BE A PERMANENT SYSTEM TO DIVERT GROUND AND SURFACE WATER AROUND THE SANITARY LANDFILL. THE DRAINS WILL BE DESIGNED IN CONJUNCTION WITH DRAINAGE BLANKETS TO INTERCEPT WATER SEEPAGE.

THE DRAIN PIPE AND DRAINAGE BLANKET SYSTEM CONSTRUCTED AROUND THE SANITARY LANDFILL SHOULD BE PROTECTED AGAINST CLOGGING. THE CRITICAL CONDITIONS ARE PROTECTION FROM THE ALLUVIAL SOILS PENETRATING THE GRAVEL DRAINAGE BLANKET AND KEEPING THE FILTER

MATERIALS FROM CLOGGING THE DRAINAGE PIPES. FOR EASE OF CONSTRUCTION, THE DRAINAGE BLANKET AND FILTER AROUND THE DRAIN PIPES SHOULD BE THE SAME MATERIALS. BECAUSE OF THE COHESION OF THE PLASTIC CLAYSTONES AND CLAYS, NO SIGNIFICANT MOVEMENT OF THESE MATERIALS INTO THE GRAVEL BLANKET AND FILTER MATERIALS SHOULD OCCUR.

STANDARD CRITERIA HAVE BEEN DEVELOPED FOR DRAINAGE FILTER DESIGNS AND ARE SUMMARIZED AS FOLLOWS:

1) TO AVOID HEAD LOSS IN THE FILTER MATERIAL:

$$\frac{D_{15} \text{ OF THE FILTER}}{D_{15} \text{ OF THE SOIL}} \text{ IS 5 OR GREATER}$$

2) TO AVOID MOVEMENT OF PARTICLES FROM THE ALLUVIUM:

$$\frac{D_{15} \text{ OF THE FILTER}}{D_{85} \text{ OF THE SOIL}} \text{ IS 5 OR LESS; AND}$$

$$\frac{D_{50} \text{ OF THE FILTER}}{D_{50} \text{ OF THE SOIL}} \text{ IS LESS THAN 25}$$

3) TO AVOID MOVEMENT OF FILTER INTO DRAIN PIPE PERFORATIONS:

$$\frac{D_{85} \text{ OF THE FILTER}}{\text{SLOT WIDTH OF PERFORATIONS}} \text{ IS GREATER THAN 1.2}$$

4) TO AVOID SEGREGATION, THE FILTER SHOULD CONTAIN NO SIZES LARGER THAN 3 INCHES.

5) TO AVOID INTERNAL MOVEMENT OF FINES, THE FILTER MATERIAL SHOULD HAVE NO MORE THAN 5 PERCENT PASSING THE NO. 200 SIEVE.

IN THE FOREGOING DISCUSSION, D_{15} IS THE PARTICLE SIZE AT WHICH 15 PERCENT OF THE TOTAL SOIL PARTICLES IS SMALLER. THE D_{85} SIZE IS THAT AT WHICH 85 PERCENT OF THE TOTAL SOIL PARTICLES IS SMALLER AND D_{50} IS THAT SIZE AT WHICH 50 PERCENT OF THE TOTAL SOIL PARTICLES IS SMALLER.

USING THE ABOVE DESIGN CRITERIA, WE RECOMMEND THE USE OF A STANDARD CONCRETE GRAVEL MEETING THE REQUIREMENTS OF ASTM C-33 GRADING OF 3/4 INCH TO NO. 4. THIS MATERIAL SHOULD SERVE AS A DRAINAGE BLANKET AND ALSO AS A FILTER MATERIAL AROUND SLOTTED DRAIN PIPES. THE DRAIN PIPES SHOULD HAVE A SLOT WIDTH OF 1/8 INCH.

SAMPLING STRUCTURE:

BASED ON THE RESULTS OF OUR SUBSURFACE INVESTIGATION AND GEOLOGIC STUDIES, WE RECOMMEND THE SAMPLING STRUCTURE BE FOUNDED AT THE LOCATION SHOWN ON THE BORING PLAN IN APPENDIX 'A' OF THIS REPORT.

THIS LOCATION WAS CHOSEN PRIMARILY BECAUSE OF NATURAL SLOPE STABILITY IN THE DRAINAGE CHANNEL AS DISCUSSED IN THE GEOLOGIC SECTION OF THIS REPORT.

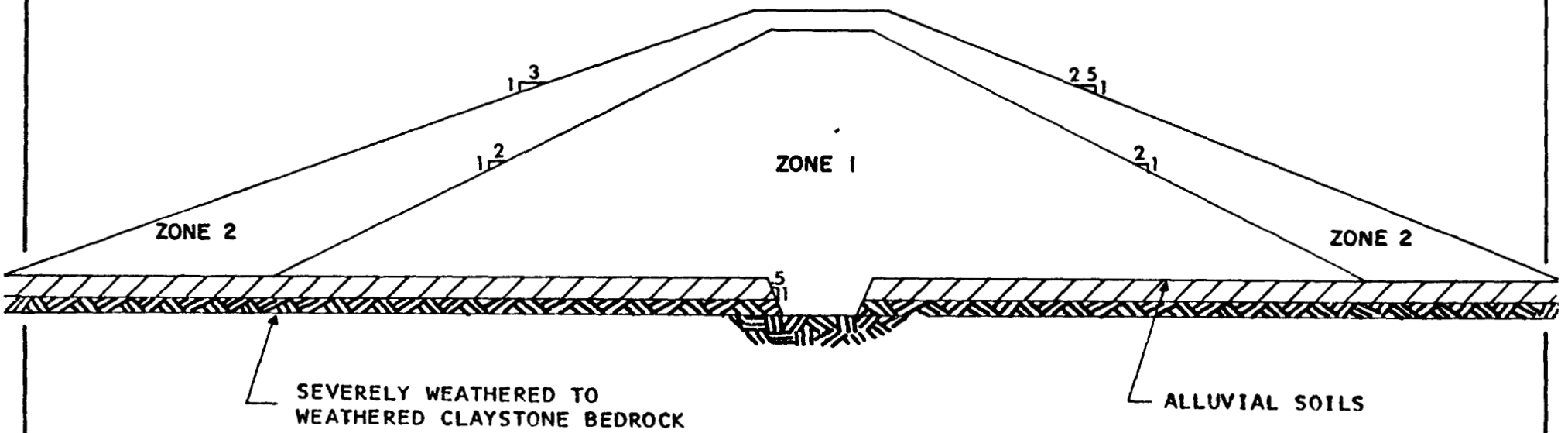
A SUGGESTED TYPICAL CROSS-SECTION OF THE SAMPLING STRUCTURE IS SHOWN ON FIGURE 3. THE CENTER OF THE SAMPLING STRUCTURE SHOULD BE CONSTRUCTED OF CLAYS AND SEVERELY WEATHERED CLAYSTONES FROM THE BORROW AREA DELINEATED ON FIGURE 1. IT IS RECOMMENDED THAT THE OUTER SHELL OF THE STRUCTURE BE COMPOSED OF THE CLAYEY SANDS AND GRAVELS AND COBBLES FROM THE BORROW AREA AND FROM THE MATERIAL TAKEN FROM THE CONSTRUCTION OF THE SANITARY LANDFILL RING.

THE CLAYS AND SEVERELY WEATHERED CLAYS (CLAYSTONES) SHOULD BE COMPACTED TO AT LEAST 95 PERCENT OF THE STANDARD PROCTOR DRY DENSITY (PER ASTM D-698) AND AT, OR ABOVE, THE OPTIMUM MOISTURE CONTENT. BECAUSE THE FOUNDATION SOILS WILL EXPAND UPON WETTING, STRAINS WILL BE INDUCED INTO THE EMBANKMENT. CONSEQUENTLY, A HIGH WATER CONTENT WILL BE REQUIRED TO PREVENT BRITTLENESS WITHIN THE EMBANKMENT, THUS PROHIBITING CRACKING.

THE FACTOR OF SAFETY FOR A RAPID DRAWDOWN CONDITION OF THE UPSTREAM SLOPE WAS FOUND TO BE IN EXCESS OF 1.5 WHICH IS THE MOST CRITICAL STABILITY CONDITION FOR THE SAMPLING STRUCTURE.

WE ESTIMATE THAT LONG-TERM SETTLEMENTS OF THE EMBANKMENT WILL APPROACH 9 INCHES. CONSEQUENTLY, ENOUGH CAMBER SHOULD BE PLACED ON THE STRUCTURE TO ALLOW FOR THIS SETTLEMENT.

SUGGESTED TYPICAL CROSS SECTION
PROPOSED SAMPLING STRUCTURE
SANITARY LANDFILL RENOVATIONS
ROCKY FLATS PLANT



SCALE: 1" = 20'

FIGURE 3

SEEPAGE THROUGH THE EMBANKMENT WILL BE NEGLIGIBLE. CONSIDERING THE PERMEABILITY OF THE SOILS, THE RELATIVE SMALL HEIGHT OF THE STRUCTURE AND THE QUANTITY OF IMPOUNDED WATER, WE DO NOT BELIEVE A TOE DRAIN FOR THE STRUCTURE IS WARRANTED. THE OUTER MORE GRANULAR SHELL SHOULD BE ADEQUATE TO CONTROL ANY SEEPAGE THAT MIGHT OCCUR.

THE AVERAGE EVAPORATION RATE FOR THE ROCKY FLATS AREA IS ABOUT 0.2 GAL/FT^2/DAY WHICH EXCEEDS ANY SEEPAGE QUANTITIES THAT MAY OCCUR THROUGH THE STRUCTURE.

CONSIDERATION WAS GIVEN TO PLACING RIPRAP ON THE UPSTREAM FACE OF THE STRUCTURE. WHILE WIND VELOCITIES OFTEN EXCEED 100 MILES PER HOUR IN THE AREA, THE FETCH OF THE RESERVOIR IS ONLY ABOUT 800 FEET. ALSO, THE SAMPLING STRUCTURE IS LOCATED IN A TOPOGRAPHIC LOW AREA WHICH WILL OFFER SOME PROTECTION FROM THE PREVAILING WINDS.

IT IS DOUBTFUL THAT WATER STORAGE IN THE RESERVOIR WILL EXCEED 6 ACRE FEET. THE WAVE HEIGHT SHOULD NOT EXCEED 6 INCHES EVEN IN THE MOST SEVERE WIND CONDITION, THUS THE OUTER SHELL OF THE STRUCTURE SHOULD AFFORD ENOUGH PROTECTION UNDER THESE CONDITIONS. CONSEQUENTLY, WE DO NOT BELIEVE THAT PROTECTION OF THE UPSTREAM FACE OF THE STRUCTURE WITH RIPRAP IS NECESSARY.

WE RECOMMEND THAT THE SAMPLING STRUCTURE BE FOUNDED DIRECTLY ON THE SEVERELY WEATHERED CLAYSTONE (CLAYS) AND ON THE EXISTING ALLUVIAL SOILS. THE MINIMUM FACTOR OF SAFETY FOR THE EMBANKMENT SLIDING ON THE FOUNDATION MATERIALS IS COMPUTED TO BE IN EXCESS

OF 3.5. THIS FACTOR OF SAFETY ASSUMES COMPLETE SATURATION ALONG THE INTERFACE OF THE EMBANKMENT AND FOUNDATION SOILS. THE PROBABILITY OF EXPERIENCING A PLASTIC FOUNDATION FAILURE IS, FOR PRACTICAL PURPOSES, NON-EXISTENT.

A CUT-OFF TRENCH SHOULD BE LOCATED BENEATH THE CENTER OF THE SAMPLING STRUCTURE AND SHOULD PENETRATE INTO THE SEVERELY WEATHERED TO WEATHERED CLAYSTONE BEDROCK. THE TRENCH SHOULD CONTINUE UP TO THE ABUTMENT ABOVE MAXIMUM POOL ELEVATION. THIS IS TO ELIMINATE ANY SEEPAGE THROUGH THE MORE PERMEABLE ALLUVIAL SOILS IN THE BOTTOM OF THE EXISTING GULLY. A PENETRATION OF 2 FEET INTO THESE MATERIALS SHOULD BE MORE THAN ADEQUATE. HOWEVER, LESS COMPETENT ZONES OF MATERIALS MAY BE EXPOSED WHEN THE CUT-OFF TRENCH IS EXCAVATED. IN THIS CASE, THE SOILS ENGINEER SHOULD MAKE THE DETERMINATION WHERE CERTAIN PORTIONS OF THE CUT-OFF TRENCH WILL NEED TO PENETRATE FURTHER INTO THE CLAYSTONES.

THE WIDTH OF THE CUT-OFF TRENCH WILL BE CONTROLLED BY THE TYPE OF EXCAVATION EQUIPMENT USED IN THE CONSTRUCTION. FOR PRACTICAL PURPOSES, A BOTTOM WIDTH OF 10 OR 12 FEET SHOULD SUFFICE. THE SIDE SLOPES OF THE CUT-OFF TRENCH WILL STAND IN A VERTICAL POSITION FOR A SHORT PERIOD OF TIME. IT IS BELIEVED THAT THE TRENCH CAN BE EXCAVATED AND COMPACTED WITH IMPERVIOUS SOILS IN LESS THAN A WEEK. GROUNDWATER SHOULD NOT BE A PROBLEM DURING CONSTRUCTION. HOWEVER, IF SOME SEEPAGE OCCURS ON THE TRENCH, LOCALIZED PUMPING FROM SUMPS WILL CONTROL THE WATER SEEPAGE.

PREPARATION OF THE FOUNDATION AND ABUTMENT AREAS OF THE STRUCTURE WILL REQUIRE THAT THE EXISTING GRASSES AND TOPSOIL BE REMOVED. WE FORESEE NO OTHER SPECIAL PREPARATION OF THESE AREAS PRIOR TO CONSTRUCTION OF THE EMBANKMENT.

EMERGENCY SPILLWAY:

OUR GEOLOGICAL AND SUBSURFACE STUDIES INDICATE THE SPILLWAY WOULD BE IN A MORE STABLE POSITION NEAR THE SOUTH ABUTMENT OF THE SAMPLING STRUCTURE. IT WOULD BE PLACED INTO THE SEVERELY WEATHERED TO WEATHERED CLAYSTONES AND EMPTY INTO THE NATURAL DRAINAGE GULLY AS SHOWN ON THE BORING PLAN IN APPENDIX 'A'.

CUTS FOR THE SPILLWAY MAY BE CONSTRUCTED ON A 2-1/2 (HORIZONTAL) TO 1 (VERTICAL) SLOPE. HOWEVER, IT SHOULD BE RECOGNIZED THAT LOCALIZED SLIPPAGE OF THE CLAYSTONES WILL OCCUR, THUS REQUIRING SOME MAINTENANCE. HOWEVER, WE BELIEVE IT WOULD BE IMPRACTICAL TO CONSTRUCT THE CUTS ON FLATTER SLOPES. THE DEGREE OF SLOPE SLIPPAGE WILL BE LARGELY DEPENDENT UPON THE FREQUENCY OF SPILLWAY USE.

ZEFF, COGORNO AND SEALY, INC.
REGISTERED ENGINEERS

BY _____
RICHARD C. EDWARDS,
GEOLOGIST

BY _____
CURTIS O. SEALY, P.E.
VICE PRESIDENT

RCE, COS, VEA/SH
20 COPIES SENT

BY _____
VUKOSLAV E. AGUIRRE, P.E.
VICE PRESIDENT

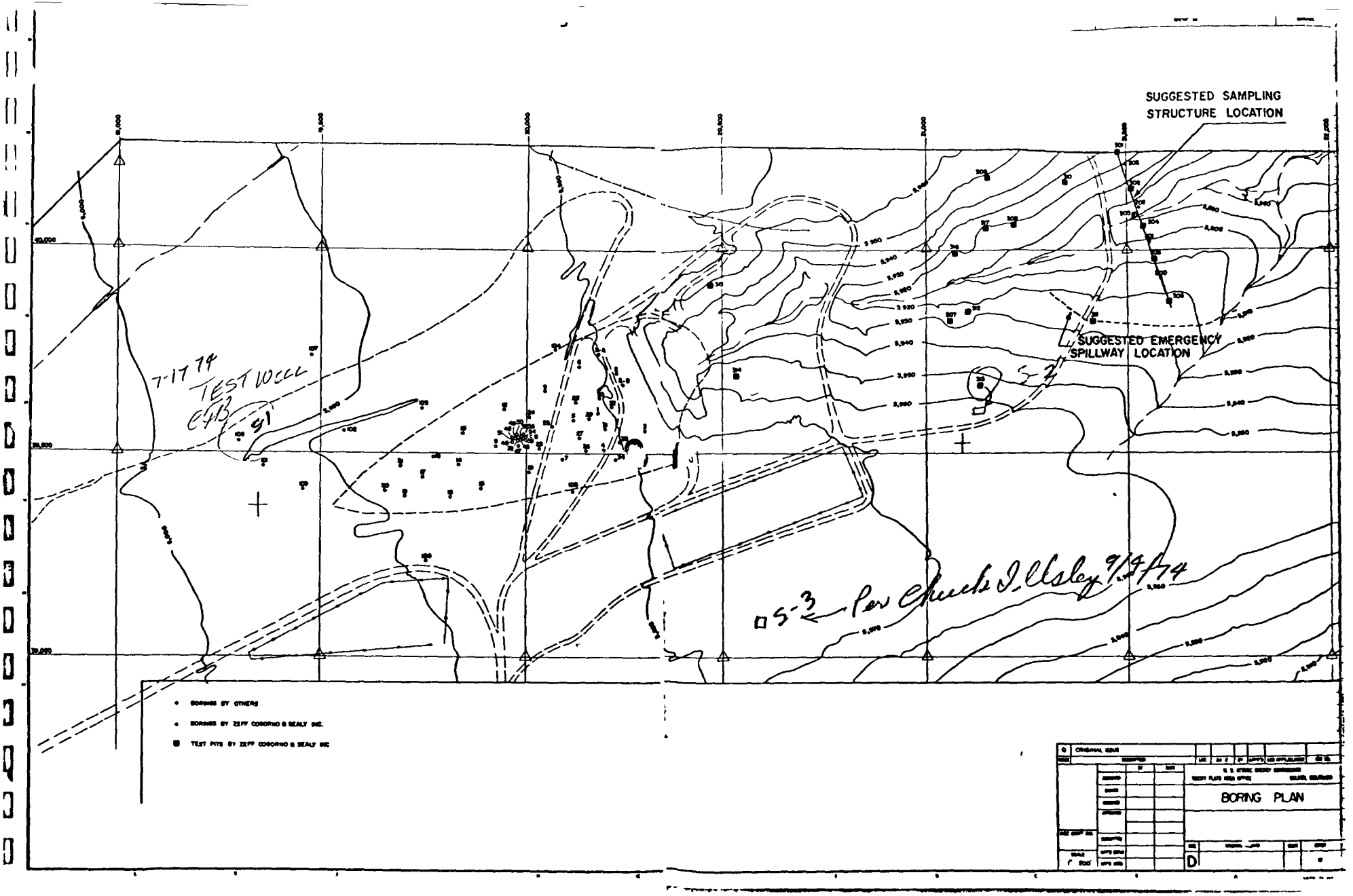
APPENDIX A

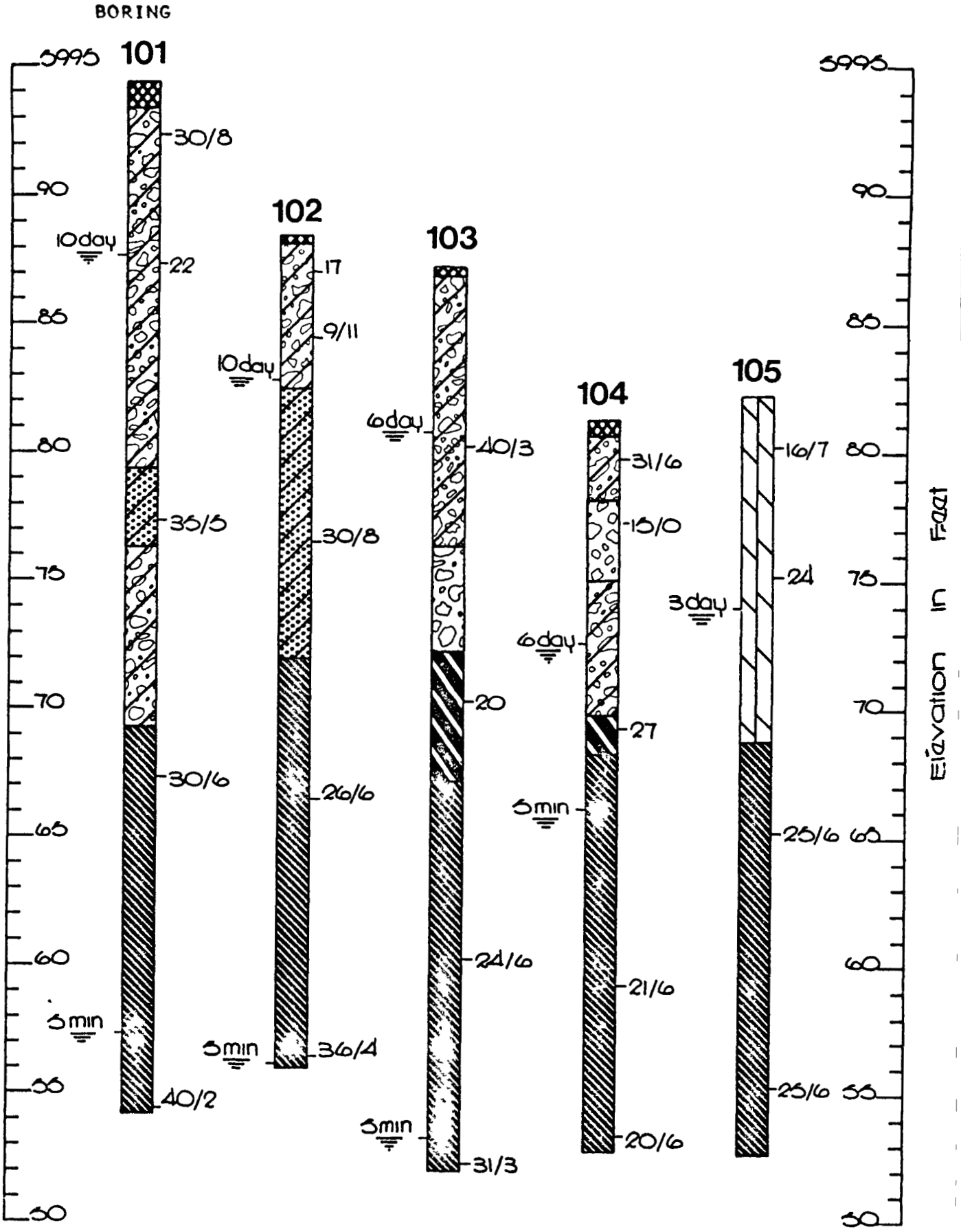
FIELD INVESTIGATIONS

THIRTEEN (13) EXPLORATORY TEST BORINGS WERE DRILLED AT THE SITE AT LOCATIONS SHOWN ON THE BORING PLAN IN APPENDIX A. THE HOLES WERE DRILLED WITH A 4 OR 6 INCH DIAMETER, CONTINUOUS FLIGHT, POWER AUGER WITH A CME-55 DRILLING RIG.

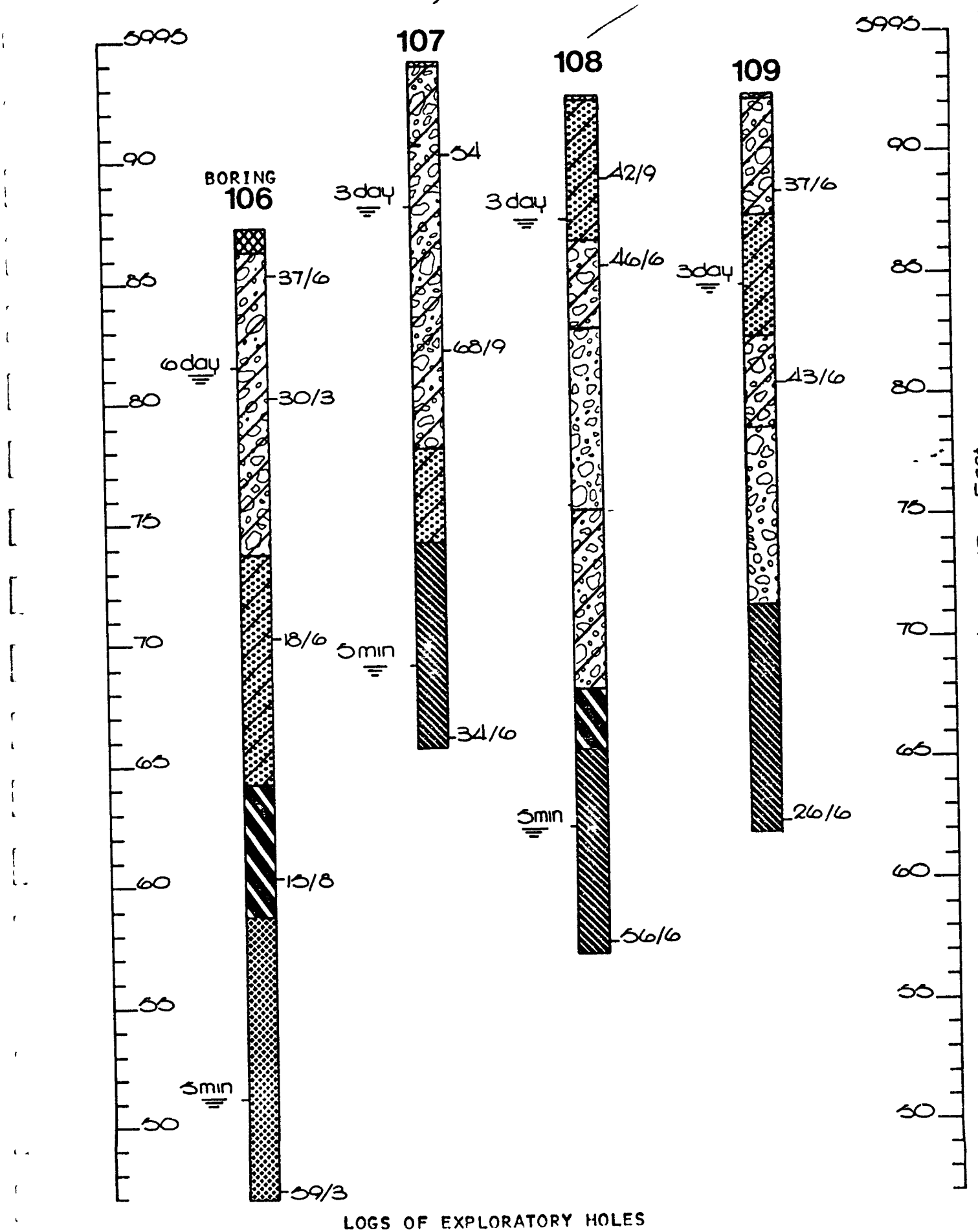
AT VARIOUS INTERVALS, THE DRILLING TOOLS WERE REMOVED FROM THE HOLES AND SOIL SAMPLES WERE OBTAINED WITH A 2 INCH I.D. SPOON SAMPLER. THE SAMPLER WAS DRIVEN INTO THE VARIOUS SUBSOIL STRATA WITH BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES. THE NUMBER OF HAMMER BLOWS REQUIRED TO DRIVE THE SAMPLER ONE FOOT, OR A FRACTION THEREOF, CONSTITUTES THE PENETRATION TEST. THIS FIELD TEST IS SIMILAR TO THE STANDARD PENETRATION TEST DESCRIBED BY ASTM METHOD D-1586. PENETRATION RESISTANCE VALUES, WHEN PROPERLY EVALUATED, ARE AN INDEX TO THE SOIL STRENGTH AND DENSITY. THE DEPTHS AT WHICH THE SAMPLES WERE TAKEN AND THE PENETRATION RESISTANCE VALUES ARE SHOWN ON THE LOGS OF THE EXPLORATORY HOLES IN THE FOLLOWING PAGES.

THE UPPER SOIL PROFILE WAS STUDIED BY OUR GEOLOGIST BY INSPECTING TEST PITS THAT WERE DUG WITH A BACKHOE AT THE LOCATIONS SHOWN ON THE BORING PLAN. THE SOILS WERE CLASSIFIED AND THE DIFFICULTY TO EXCAVATING WAS DETERMINED. REPRESENTATIVE SAMPLES WERE COLLECTED FROM THE TEST PITS FOR APPROPRIATE LABORATORY TESTING.

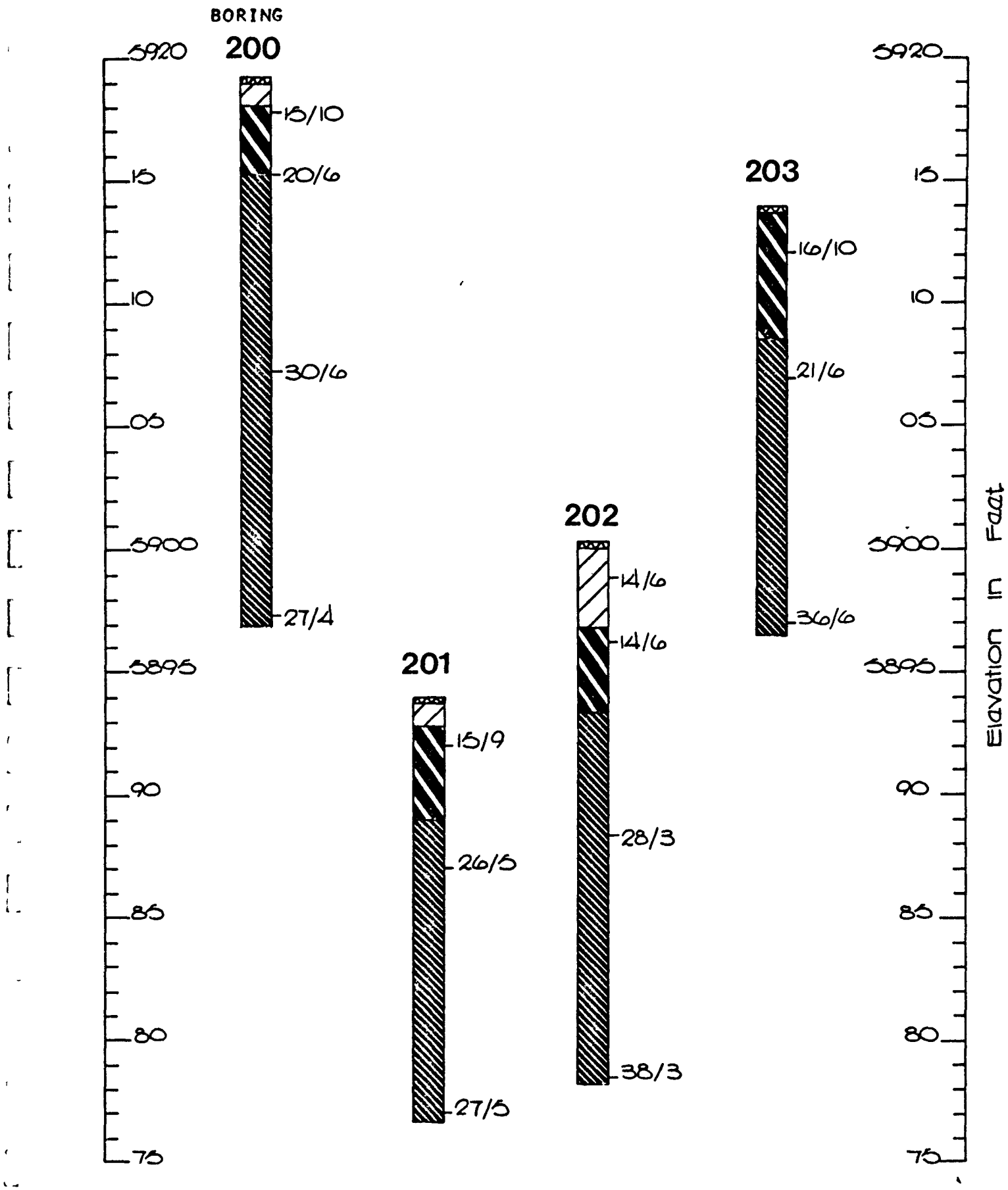

SUGGESTED SAMPLING STRUCTURE LOCATION
SUGGESTED EMERGENCY SPILLWAY LOCATION
7-17-74
TEST HOLE
C-13
S-1
S-2
S-3
S-3 Per Charles I. Ulsley 9/4/74
BORING PLAN
D



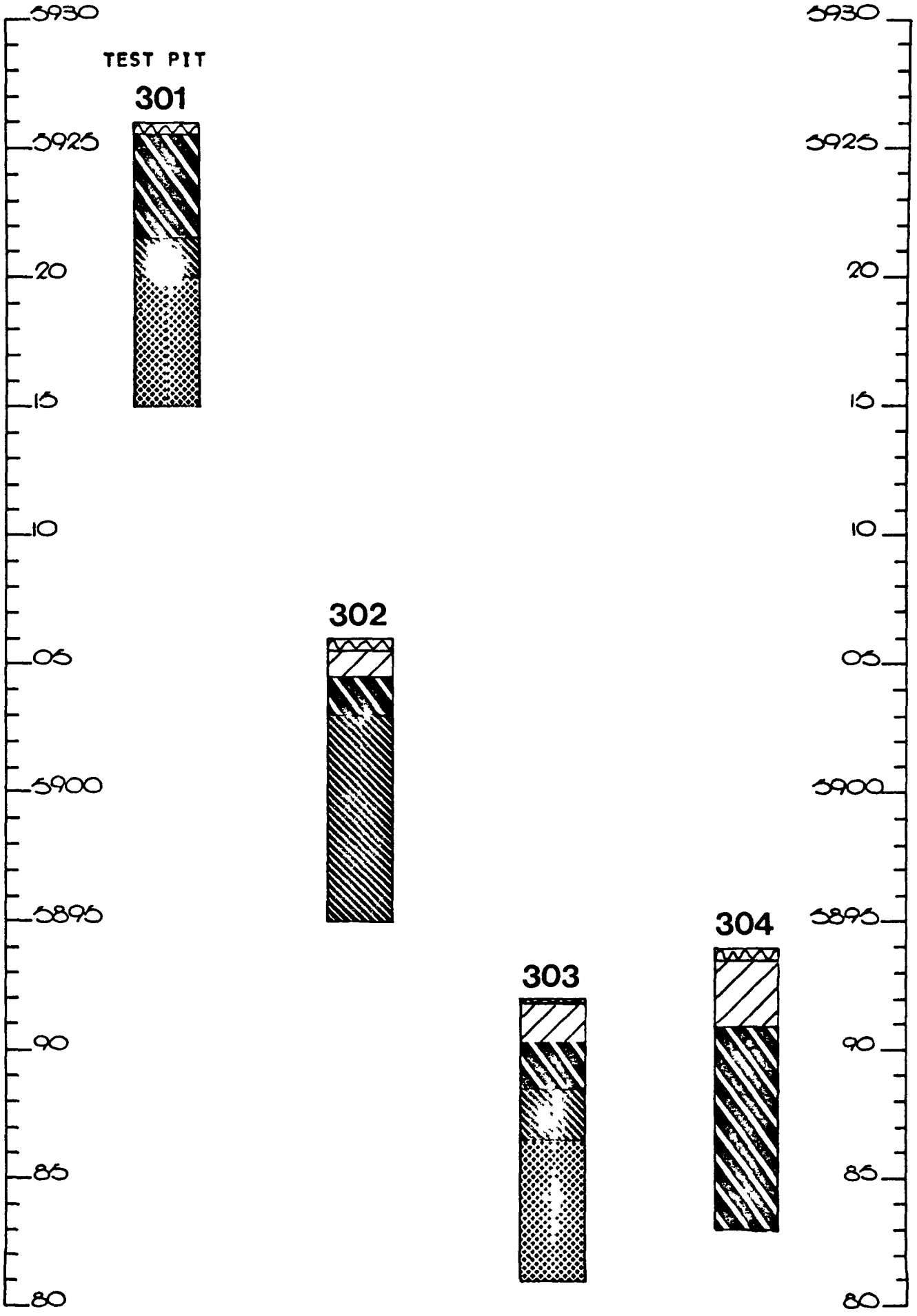
LOGS OF EXPLORATORY HOLES



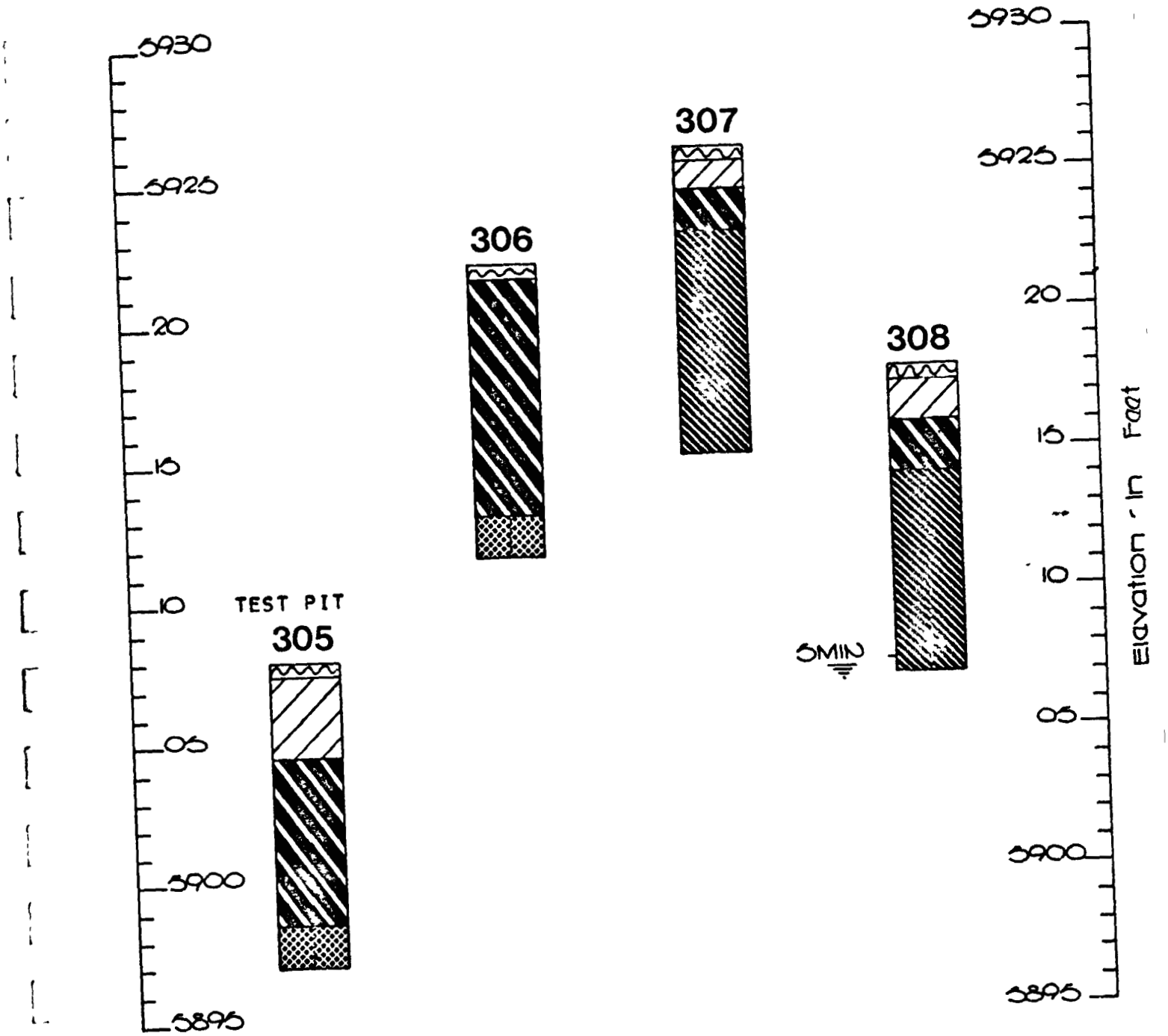
LOGS OF EXPLORATORY HOLES



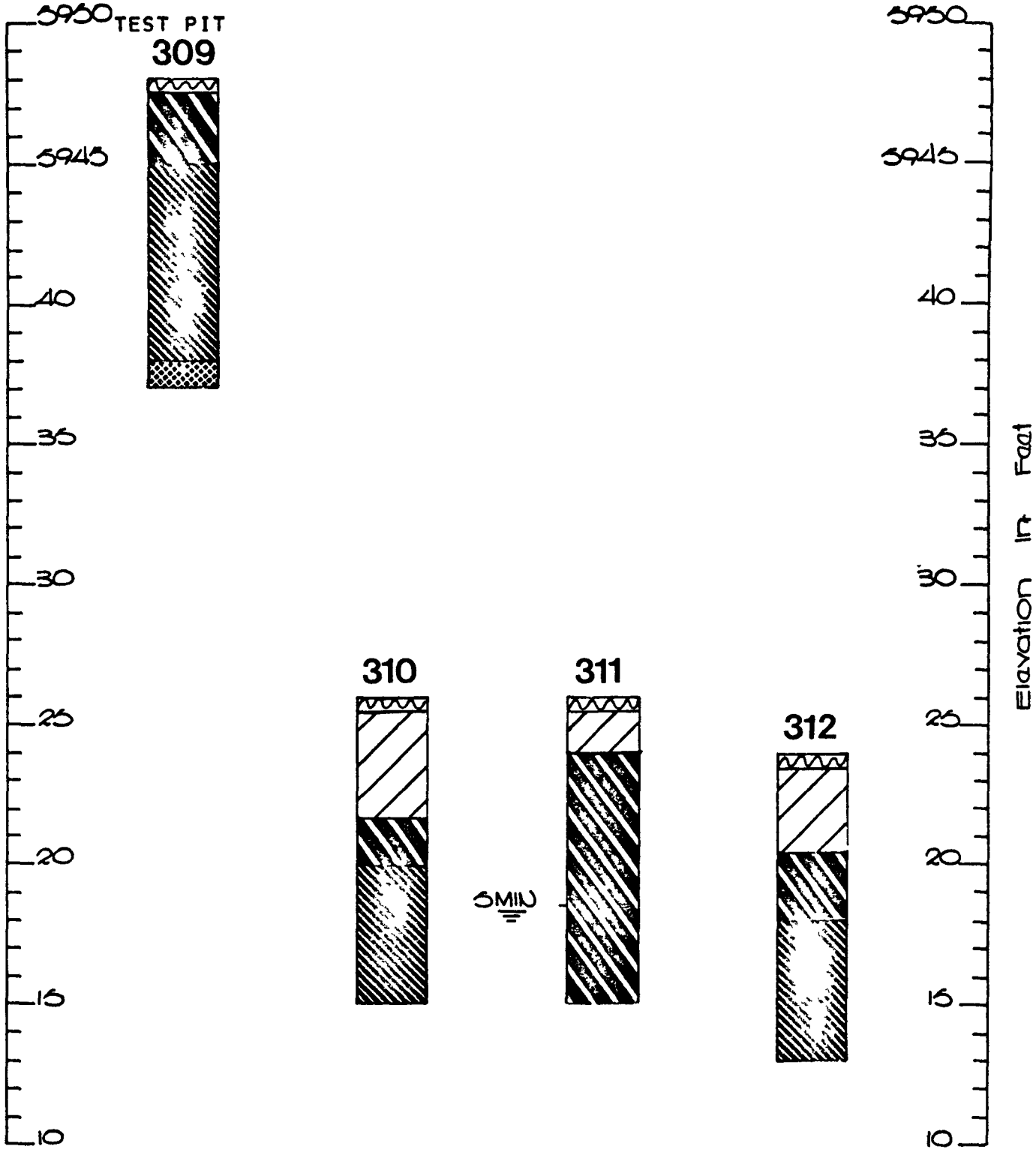
LOGS OF EXPLORATORY HOLES



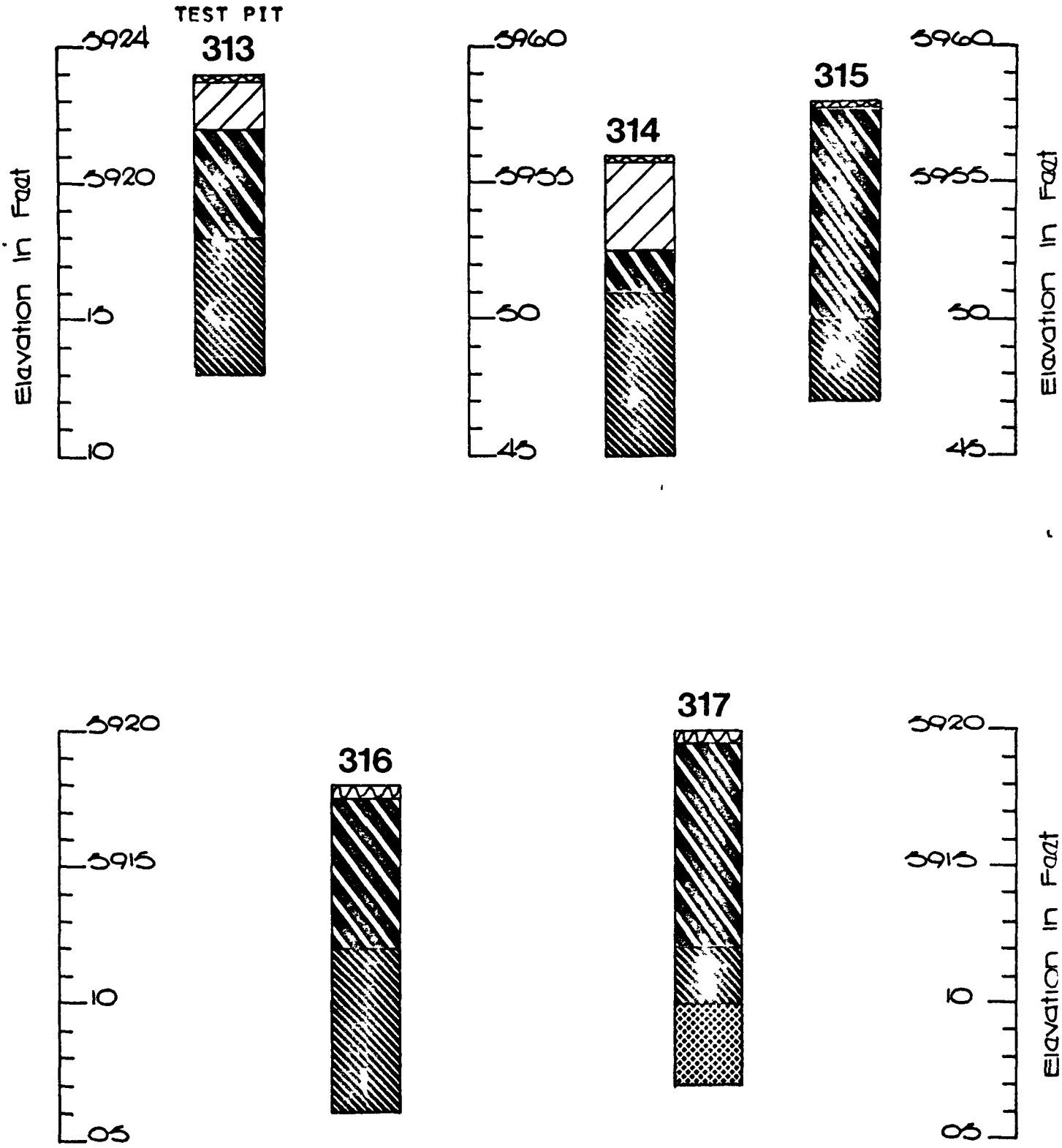
LOGS OF TEST PITS



LOGS OF TEST PITS



LOGS OF TEST PITS



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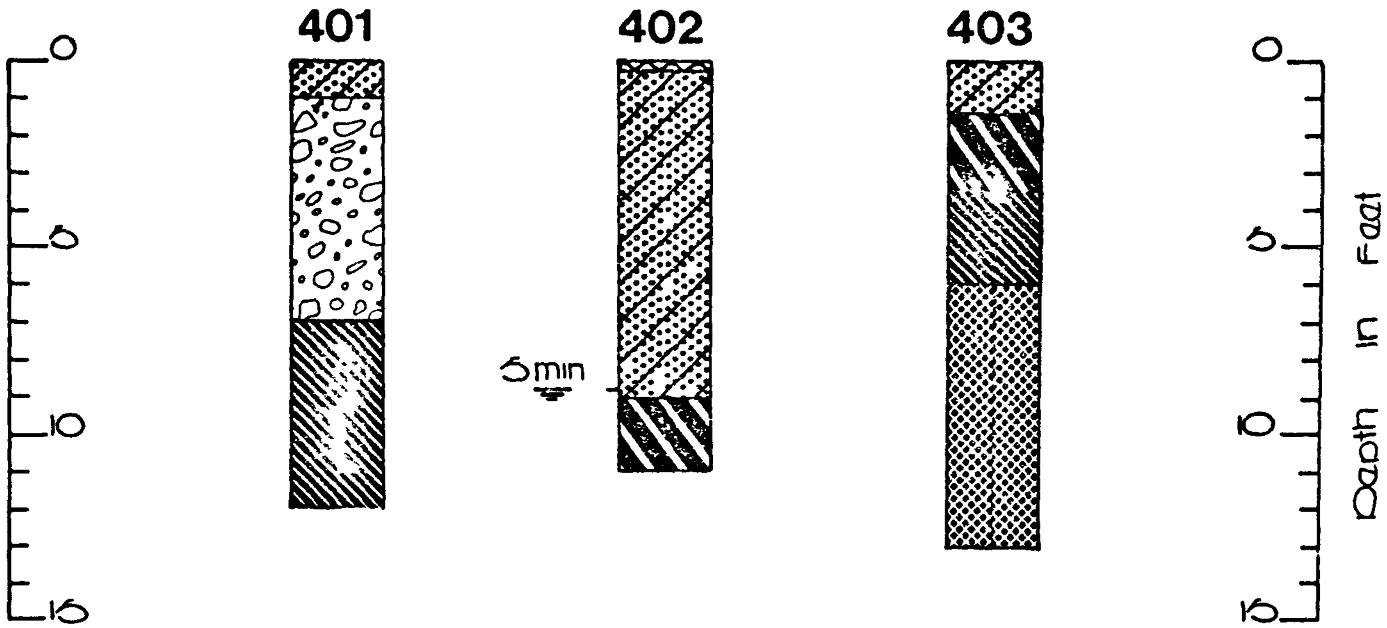
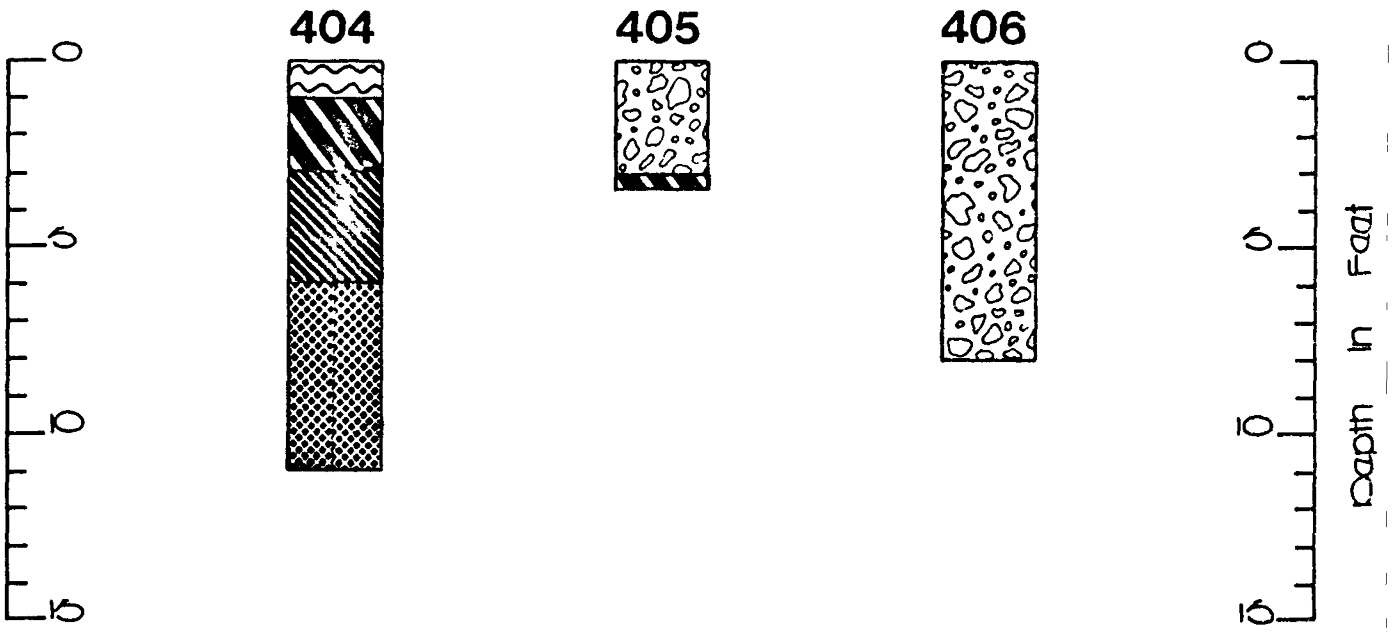

401
402
403
5 min
0
5
10
15
Depth In Feet


404
405
406
0
5
10
15
Depth In Feet

TOPSOIL

FILL - CLAY, SANDY WITH GRAVELS AND COBBLES

SANITARY LANDFILL

ALLUVIUM CONSISTING OF MIXTURES OF CLAYS, SANDS AND GRAVELS WITH RANDOM AMOUNTS OF COBBLES AND BOULDERS

CLAY, SANDY TO VERY SANDY, SILTY, VERY STIFF, MEDIUM MOIST TO MOIST, BROWN, GRAVEL

SAND, CLAYEY WITH CLAY LAYERS, MEDIUM DENSE TO DENSE, MEDIUM MOIST TO WET, RANDOM GRAVELS AND COBBLES

SAND AND GRAVEL, DENSE TO VERY DENSE, MEDIUM MOIST TO WET, SOME COBBLES AND BOULDERS

SAND AND GRAVEL, SLIGHTLY CLAYEY TO CLAYEY, DENSE TO VERY DENSE, SOME COBBLES AND BOULDERS

CLAY (SEVERELY WEATHERED CLAYSTONE), VERY STIFF, MOIST

CLAYSTONE BEDROCK (SHALE), WEATHERED, MEDIUM HARD TO VERY HARD, MOIST, VARICOLORED, YELLOW, BROWN AND GRAY

CLAYSTONE BEDROCK (SHALE), WEATHERED, HARD TO VERY HARD, MOIST, YELLOW AND GRAY

WATER TABLE, TIME AFTER DRILLING

NOTES:

(1) THE HOLES WERE DRILLED MAY 28 THROUGH JUNE 3, 1974, WITH A 4" DIAMETER, CONTINUOUS FLIGHT, POWER AUGER.

(2) THE TEST PITS WERE DUG MAY 30 AND 31, 1974 WITH A BACKHOE.

(3) 30 INDICATES THAT 30 BLOWS OF A 140-LB. HAMMER FALLING 30" WERE REQUIRED TO DRIVE THE SAMPLER 8".

(4) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

(5) THE BORING LOGS SHOW SUBSURFACE CONDITIONS AT THE DATES AND LOCATIONS INDICATED, AND IT IS NOT WARRANTED THAT THEY ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

LEGEND AND NOTES

APPENDIX B

LABORATORY TESTS

SOIL CLASSIFICATION

SOIL CLASSIFICATIONS PROVIDE A GENERAL GUIDE TO THE ENGINEERING PROPERTIES OF VARIOUS SOIL TYPES AND ENABLE THE ENGINEER TO APPLY HIS PAST EXPERIENCE TO CURRENT PROBLEMS. IN OUR INVESTIGATION, SAMPLES OBTAINED DURING DRILLING OPERATIONS ARE EXAMINED IN OUR LABORATORY AND VISUALLY CLASSIFIED BY AN ENGINEER. THE SOILS ARE CLASSIFIED ACCORDING TO SOIL TYPE AND CONSISTENCY (BASED ON NUMBER OF BLOWS FROM STANDARD PENETRATION TESTS). THESE CLASSIFICATION DESCRIPTIONS ARE INCLUDED ON OUR TEST BORING RECORDS.

THE CLASSIFICATION SYSTEM DISCUSSED ABOVE IS PRIMARILY QUALITATIVE AND FOR DETAILED SOIL CLASSIFICATION TWO LABORATORY TESTS ARE NECESSARY· GRAIN SIZE TESTS AND ATTERBERG LIMITS TESTS. USING THESE TEST RESULTS THE SOIL CAN BE CLASSIFIED ACCORDING TO THE AASHO OR UNIFIED CLASSIFICATION SYSTEMS. EACH OF THESE CLASSIFICATION SYSTEMS AND THE IN-PLACE PHYSICAL SOIL PROPERTIES PROVIDES AN INDEX FOR ESTIMATING THE SOILS BEHAVIOR FOR ENGINEERING PURPOSES. THE SOIL CLASSIFICATIONS AND PHYSICAL PROPERTIES OBTAINED ARE PRESENTED ON THE FOLLOWING SHEETS.

MOISTURE CONTENT AND UNIT WEIGHT

IN THE LABORATORY, SEVERAL UNDISTURBED SAMPLES STILL IN THEIR STEEL TUBES WERE WEIGHED AND TOTAL UNIT WEIGHTS WERE CALCULATED. THEN PORTIONS OF THE SOIL WERE REMOVED FOR MOISTURE CONTENT

DETERMINATIONS. MOISTURE CONTENTS WERE DETERMINED BY DRYING THE SOIL AT 105°C FOR 24 HOURS AND MEASURING THE LOSS OF MOISTURE DURING THE DRYING PROCESS. FROM THESE DATA, DRY UNIT WEIGHTS OF THE IN-PLACE SOILS WERE COMPUTED AND ARE PRESENTED ON THE ATTACHED SUMMARY OF LABORATORY TEST RESULTS.

ATTERBERG LIMITS

REPRESENTATIVE SAMPLES OF THE SOILS WERE SELECTED FOR ATTERBERG LIMITS TESTING TO DETERMINE THE SOIL PLASTICITY CHARACTERISTICS AND ITS UNIFIED CLASSIFICATION. THE SOILS PLASTICITY INDEX (PI) IS REPRESENTATIVE OF THIS CHARACTERISTIC AND IS THE NUMERICAL DIFFERENCE BETWEEN THE LIQUID LIMIT (LL) AND THE PLASTIC LIMIT (PL). THE LL IS THE MOISTURE CONTENT AT WHICH THE SOIL WILL FLOW AS A HEAVY VISCOUS FLUID AND IS DETERMINED IN ACCORDANCE WITH ASTM TEST D-423. THE PL IS THE MOISTURE CONTENT AT WHICH THE SOIL TENDS TO LOSE ITS PLASTICITY AND IS DETERMINED IN ACCORDANCE WITH ASTM TEST D-424. THE DATA OBTAINED ARE PRESENTED ON THE ATTACHED SUMMARY OF LABORATORY TEST RESULTS.

GRAIN SIZE ANALYSIS

GRAIN SIZE TESTS WERE PERFORMED TO DETERMINE THE PARTICLE SIZE DISTRIBUTION OF THE SAMPLES TESTED. THE GRAIN SIZE DISTRIBUTION OF SOILS COARSER THAN A NUMBER 200 SIEVE WAS DETERMINED BY PASSING THE SAMPLES THROUGH A STANDARD SET OF NESTED SIEVES. MATERIALS PASSING THE NUMBER 200 SIEVE WERE SUSPENDED IN WATER AND THE GRAIN SIZE DISTRIBUTION MEASURED BY THE RATE OF SETTLE-

MENT. THESE TESTS ARE SIMILAR TO THOSE DESCRIBED BY ASTM TESTS D-421 AND D-422. THE RESULTS ARE PRESENTED ON THE ATTACHED GRADATION ANALYSES SHEETS

COMPACTION TESTS

SEVERAL REPRESENTATIVE SOIL SAMPLES WERE OBTAINED FOR LABORATORY COMPACTION TESTS. SIMILAR SOIL TYPES WERE COMPOSITED PRIOR TO TESTING. A STANDARD PROCTOR COMPACTION TEST ASTM D-698 WAS PERFORMED ON THESE SOILS TO DETERMINE THEIR COMPACTION CHARACTERISTICS, INCLUDING THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT. THE TEST RESULTS ARE PRESENTED ON THE ATTACHED COMPACTION TEST SHEETS.

TRIAXIAL SHEAR TESTS

SPECIMENS OF THE SOILS WERE REMOLDED TO SIMULATE THE IN-PLACE DRY DENSITY OF THE MATERIALS ON THE SITE. ONE SAMPLE WAS PARTIALLY SATURATED AND ANOTHER WAS COMPLETELY SATURATED. EACH SPECIMEN WAS THEN PLACED IN A COMPRESSION CHAMBER AND CONFINED BY ALL-AROUND AIR PRESSURE. AN AXIAL LOAD WAS THEN APPLIED UNTIL THE SAMPLE FAILED IN SHEAR. UNCONSOLIDATED QUICK (TRIAXIAL) TESTS WERE PERFORMED. THE UNCONSOLIDATED QUICK TEST SIMULATES THE CONDITION OF RAPID SHEARING BEFORE CONSOLIDATION TAKES PLACE. THE TEST RESULTS ARE PRESENTED IN THE FORM OF MOHR DIAGRAMS ON THE ACCOMPANYING TRIAXIAL SHEAR TEST SHEET.

CONSOLIDATION TESTS

THE PROCEDURE FOR THESE TESTS WAS ESSENTIALLY CONDUCTED IN ACCORDANCE WITH TEST DESIGNATION E-15 OF THE U.S. BUREAU OF RECLAMATION.

A SINGLE SECTION OF AN UNDISTURBED SAMPLE WAS EXTRUDED FROM ITS SAMPLING TUBE FOR CONSOLIDATION TESTING. THE DISC WAS CONFINED IN A BRASS STEEL RING, SANDWICHED BETWEEN POROUS PLATES, AND SATURATED. IT WAS THEN SUBJECTED TO INCREMENTALLY INCREASING VERTICAL LOADS AT 12 HOURS PER INCREMENT AND THE RESULTING DEFORMATIONS MEASURED WITH A MICROMETER DIAL GAUGE.

THE TEST RESULTS ARE PRESENTED IN THE FORM OF A PRESSURE VERSUS VOID RATIO CURVE ON THE ACCOMPANYING CONSOLIDATION TEST SHEETS.

SWELL CONSOLIDATION TESTS

RANDOM SWELL CONSOLIDATION TESTS WERE PERFORMED ON THE SAMPLES RECOVERED FROM THE SITE. THIS TEST IS COMMONLY EMPLOYED IN SEMI-ARID CLIMATES WHERE THE SOILS POSSESS A SWELL POTENTIAL UPON WETTING. THE SAMPLES WERE EXTRUDED FROM THE SAMPLING TUBES INTO 1 INCH THICK CONFINING RINGER. A LOADING WAS APPLIED TO THE SAMPLE AND THEN THE SAMPLE WAS INUNDATED WITH WATER. AS SATURATION PROGRESSED, THE PERCENT LINEAR SWELL WAS RECORDED. WHEN THE SAMPLE HAD COMPLETELY STOPPED SWELLING, LOADINGS WERE APPLIED TO CONSOLIDATE THE SOIL. THE RESULTS OF THESE TESTS ARE SHOWN ON THE ATTACHED SWELL CONSOLIDATION SHEETS.

JOB NO 13759

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS			SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
101	2.0	9.4								SAND & GRAVEL, CLAYEY
101	12.0	7.2								SAND & GRAVEL, CLAYEY
101	21.0	26.9	97	77	51					CLAYSTONE BEDROCK
102	17.0	23.5		59	41					CLAYSTONE BEDROCK
102	22.0	15.1	117	34	18					CLAYSTONE BEDROCK
103	12.0	3.6								GRAVEL, SANDY, SLIGHTLY CLAYEY
103	22.0	27.6		51	34					CLAYSTONE BEDROCK
103	27.0	22.1	104	89	66					CLAYSTONE BEDROCK
104	4.0	2.1								GRAVEL, SANDY, SLIGHTLY CLAYEY
104	17.0	22.0		53	35					CLAYSTONE BEDROCK
106	12.0	18.5								SAND & GRAVEL, CLAYEY

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TABLE I - PAGE 2

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS			SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
106	17.0	12.3	123	42	20					SAND, CLAYEY, GRAVELLY
107	12.0	5.0								SAND & GRAVEL, SLIGHTLY CLAYEY
107	25.0	22.9		61	43					CLAYSTONE BEDROCK
108	12.0	2.3								SAND & GRAVEL, SLIGHTLY CLAYEY
108	17.0	7.8								SAND & GRAVEL, CLAYEY
109	9.0	5.2								SAND & GRAVEL, CLAYEY
200	2.0	17.5	108			13,385				CLAY (SEVERELY WEATHERED CLAYSTONE)
200	4.0	12.9	113	55	33					CLAYSTONE BEDROCK
201	2.0	16.9	108			17,734				CLAY (SEVERELY WEATHERED CLAYSTONE)

JOB NO 13759

TABLE I - PAGE 3

SUMMARY OF LABORATORY TEST RESULTS

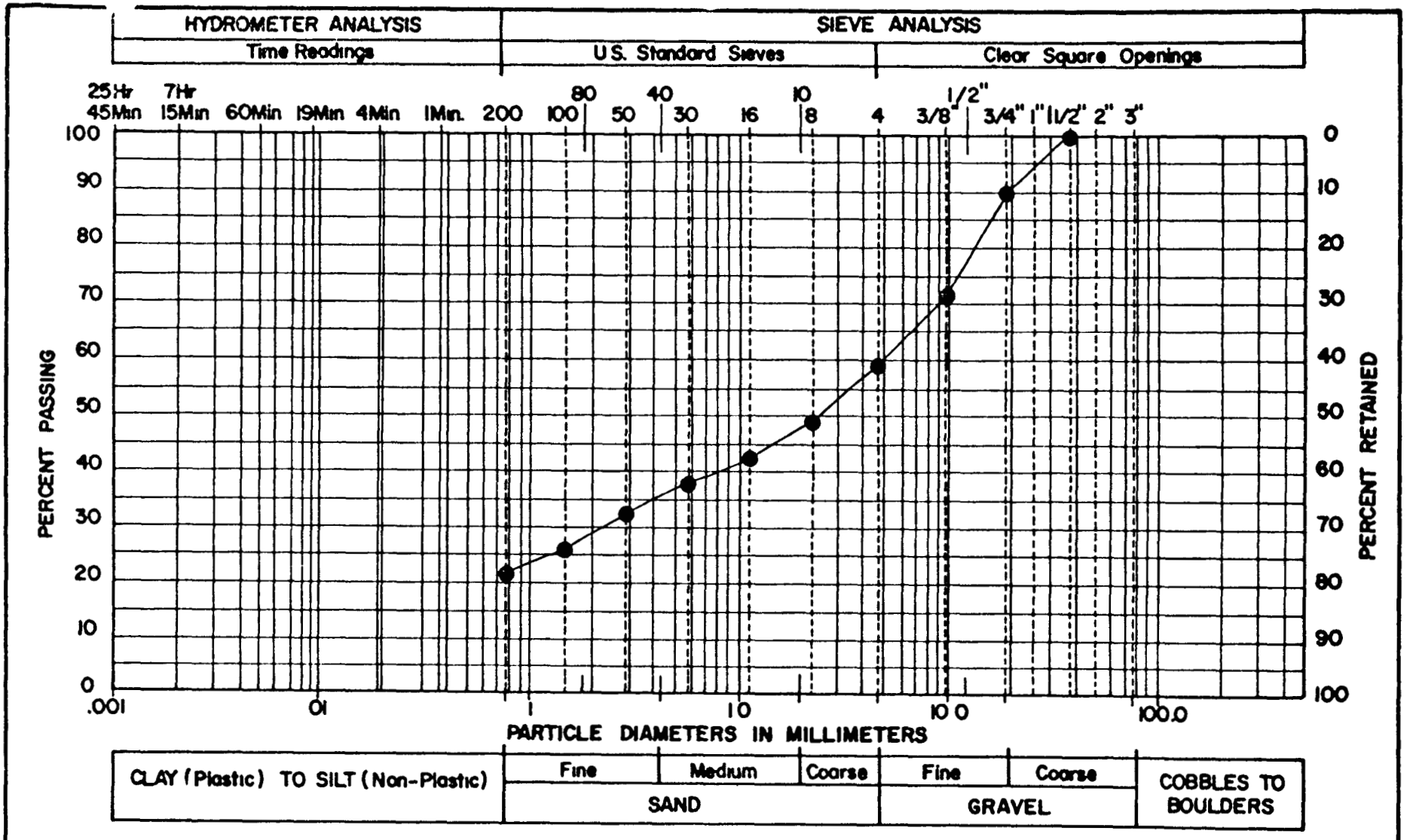
HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS			SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
201	7.0			47	27					CLAYSTONE BEDROCK
202	4.0			57	37					CLAY (SEVERELY WEATHERED BEDROCK)
203	7.0	16.3	109							CLAYSTONE BEDROCK
TEST PITS										
304	2.0	22.5	98							CLAY, SANDY
304	3.5	19.0	106			4,784				CLAY (SEVERELY WEATHERED CLAYSTONE)
310	2.0	6.6								SAND & GRAVEL, CLAYEY
311	6.0	19.9	106	51	34	2,952				CLAY (SEVERELY WEATHERED CLAYSTONE)

JOB NO 13759

TABLE I - PAGE 4

SUMMARY OF LABORATORY TEST RESULTS

HOLE	DEPTH (FEET)	NATURAL MOISTURE (%)	NATURAL DRY DENSITY (PCF)	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	TRIAXIAL SHEAR TESTS			SOIL TYPE
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		DEVIATOR STRESS (PSF)	CONFINING PRESSURE (PSF)		
TEST PITS										
313	3.5	15.8	110	44	28	4,950				CLAY (SEVERELY WEATHERED CLAYSTONE)
317	4.5	21.6	101			1,310				CLAY (SEVERELY WEATHERED CLAYSTONE)

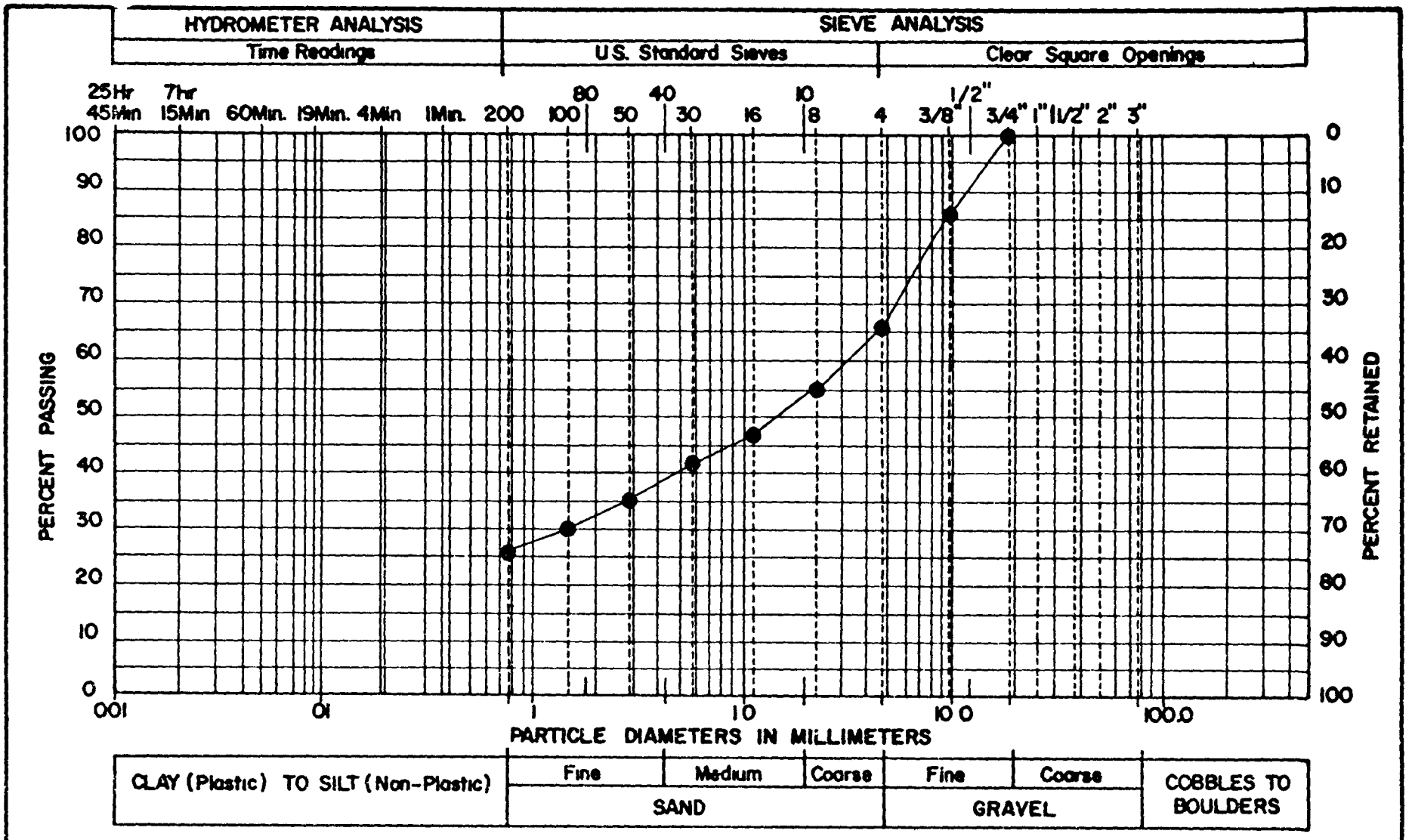


Boring Or Sample No.	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
101	2.0	9.4	--	--	-	SAND & GRAVEL, CLAYEY .

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

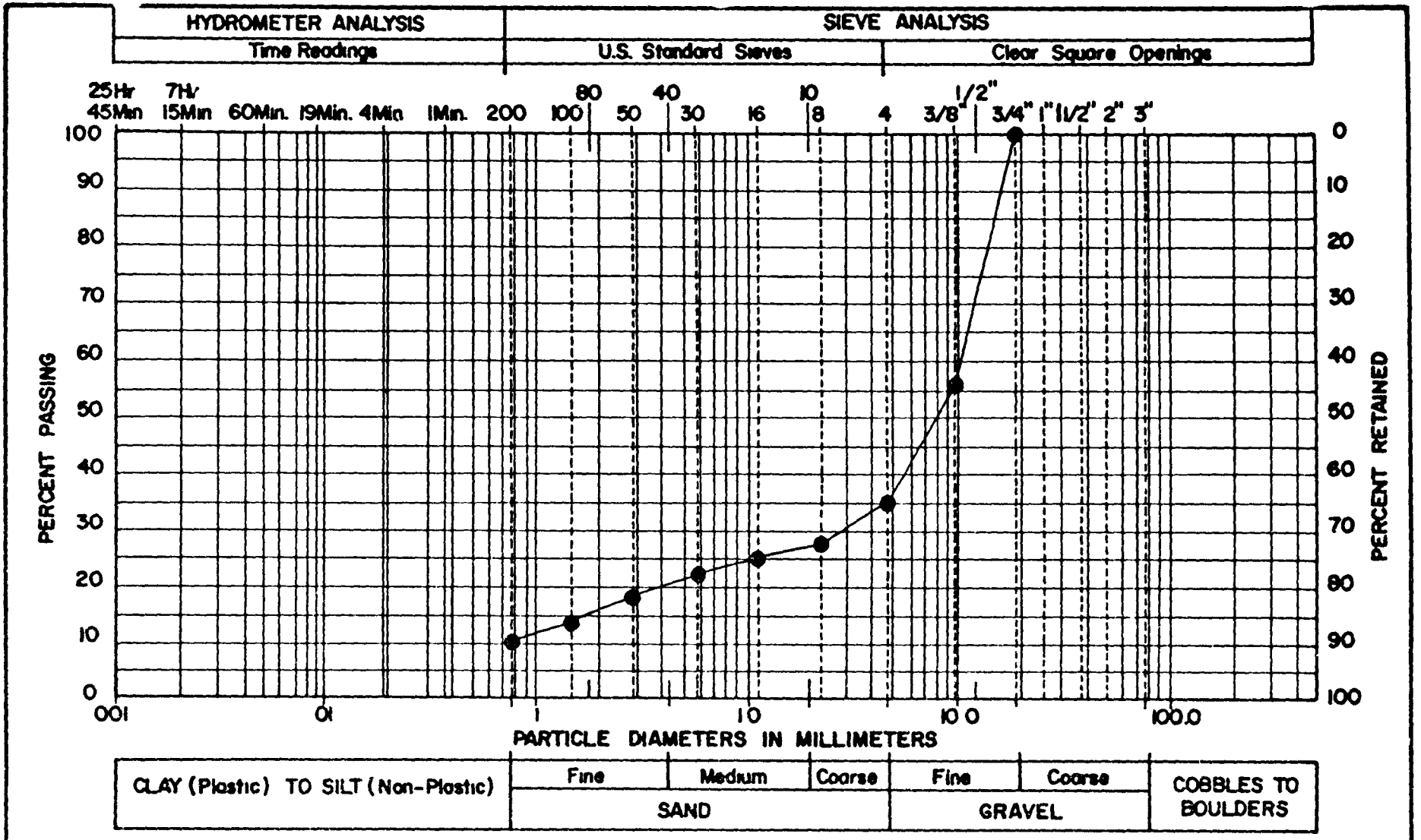


Boring Or Sample No.	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
101	12.0	7.2	--	--	-	SAND & GRAVEL, CLAYEY

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO. 13759

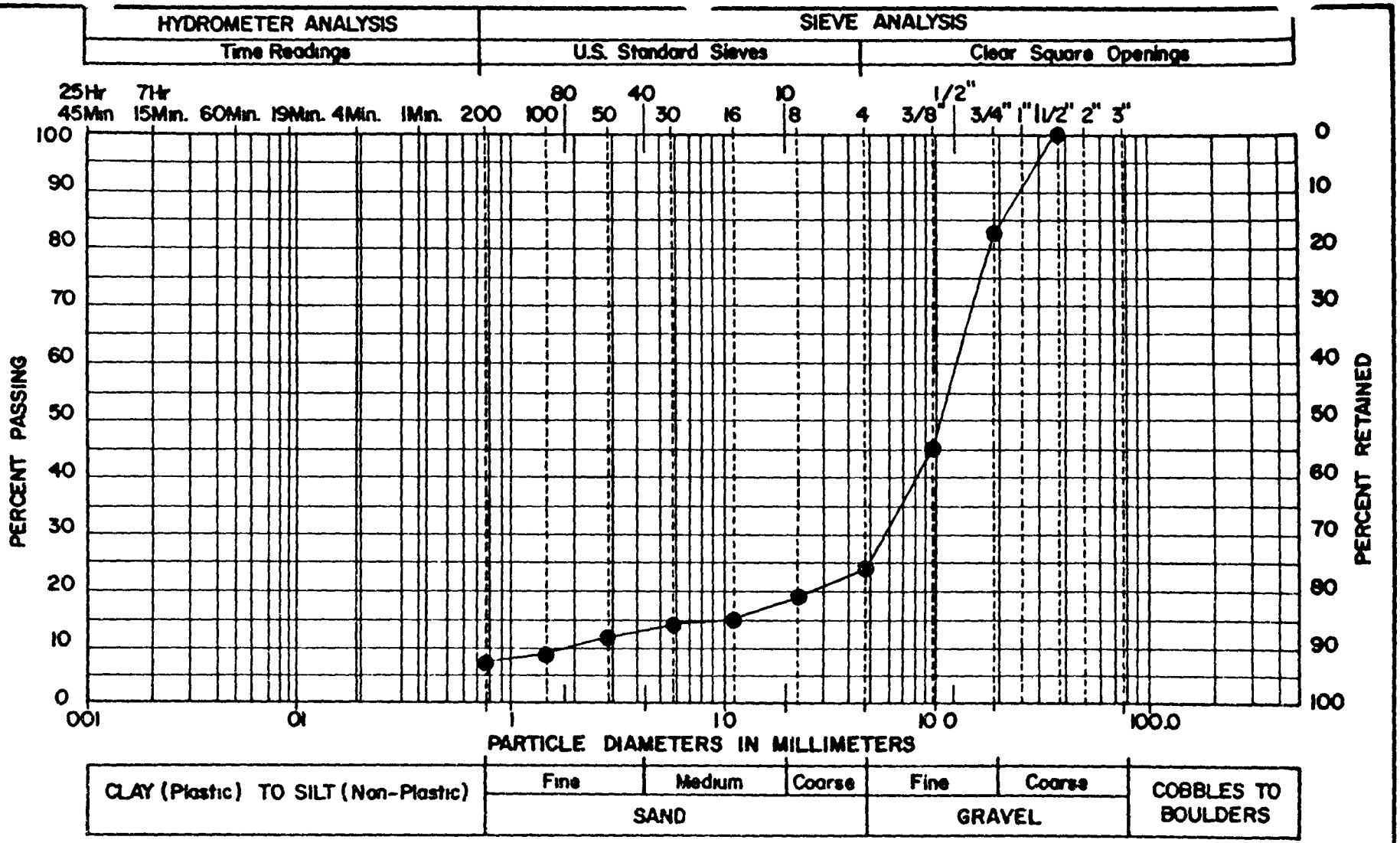


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
103	12.0	3.6	--	--	-	GRAVEL, SANDY, SLIGHTLY CLAYEY

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

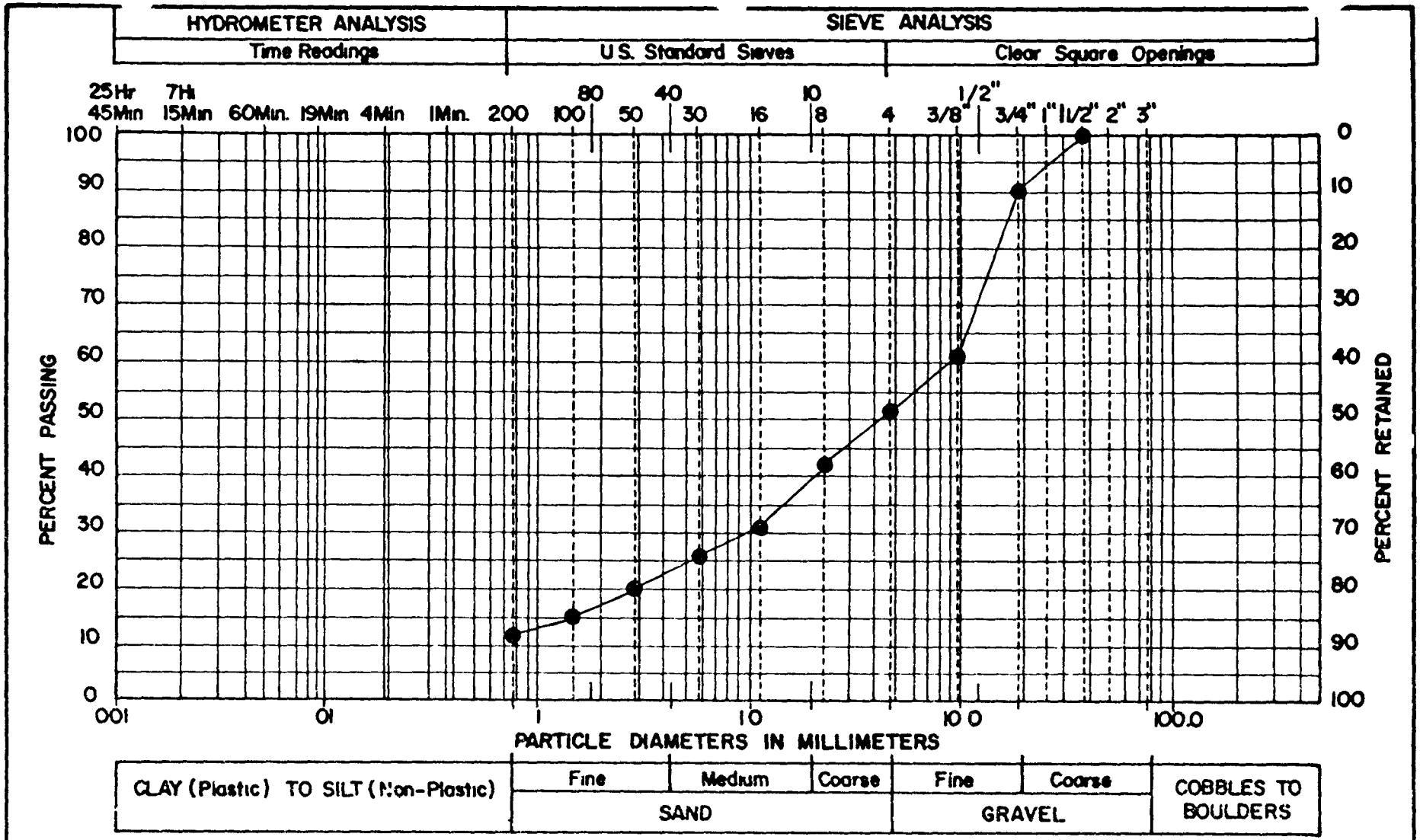


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
104	4.0	2.1	--	--	-	GRAVEL, SANDY, SLIGHTLY CLAYEY

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

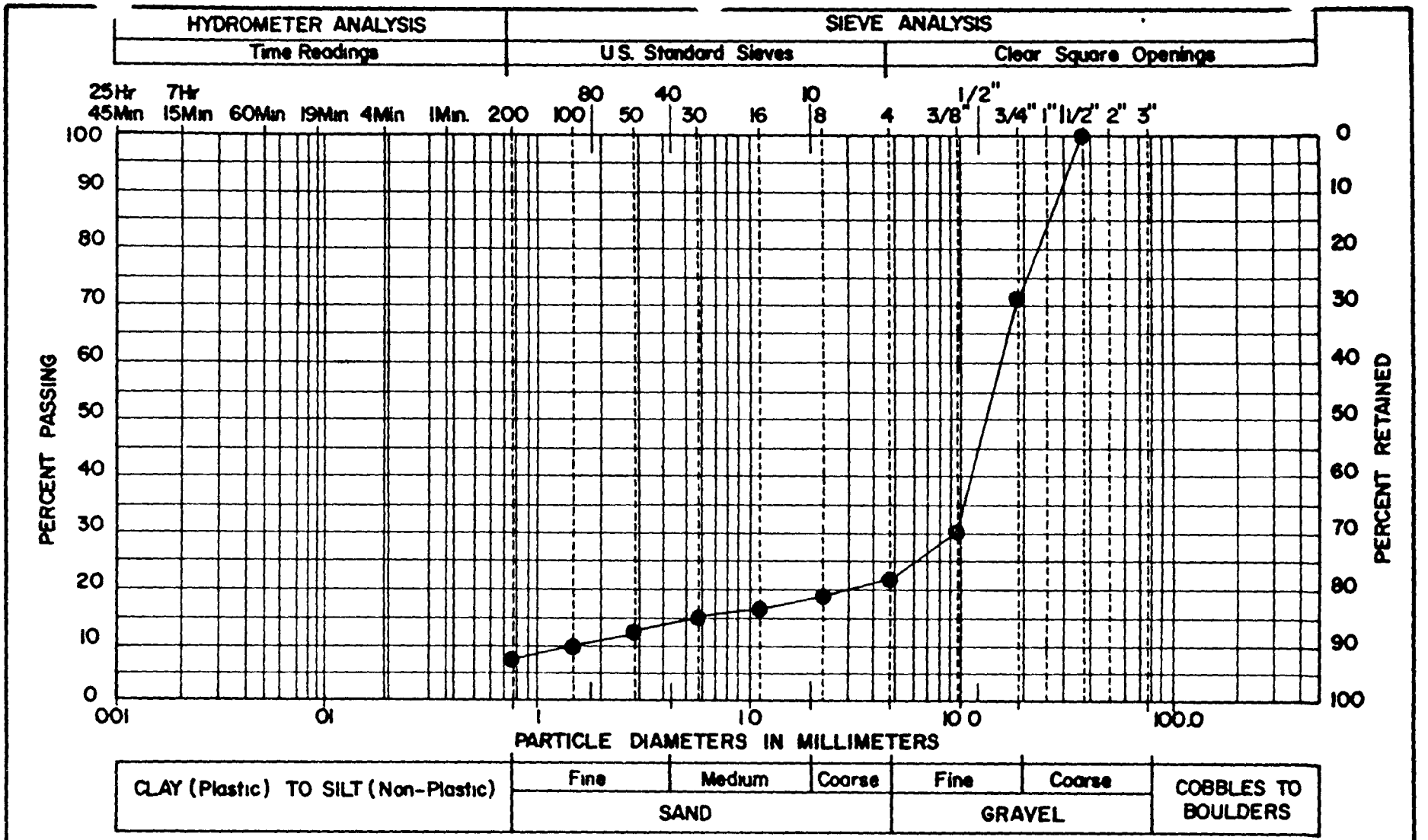


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
107	12.0	5.0	--	--	-	SAND & GRAVEL, SLIGHTLY CLAYEY

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

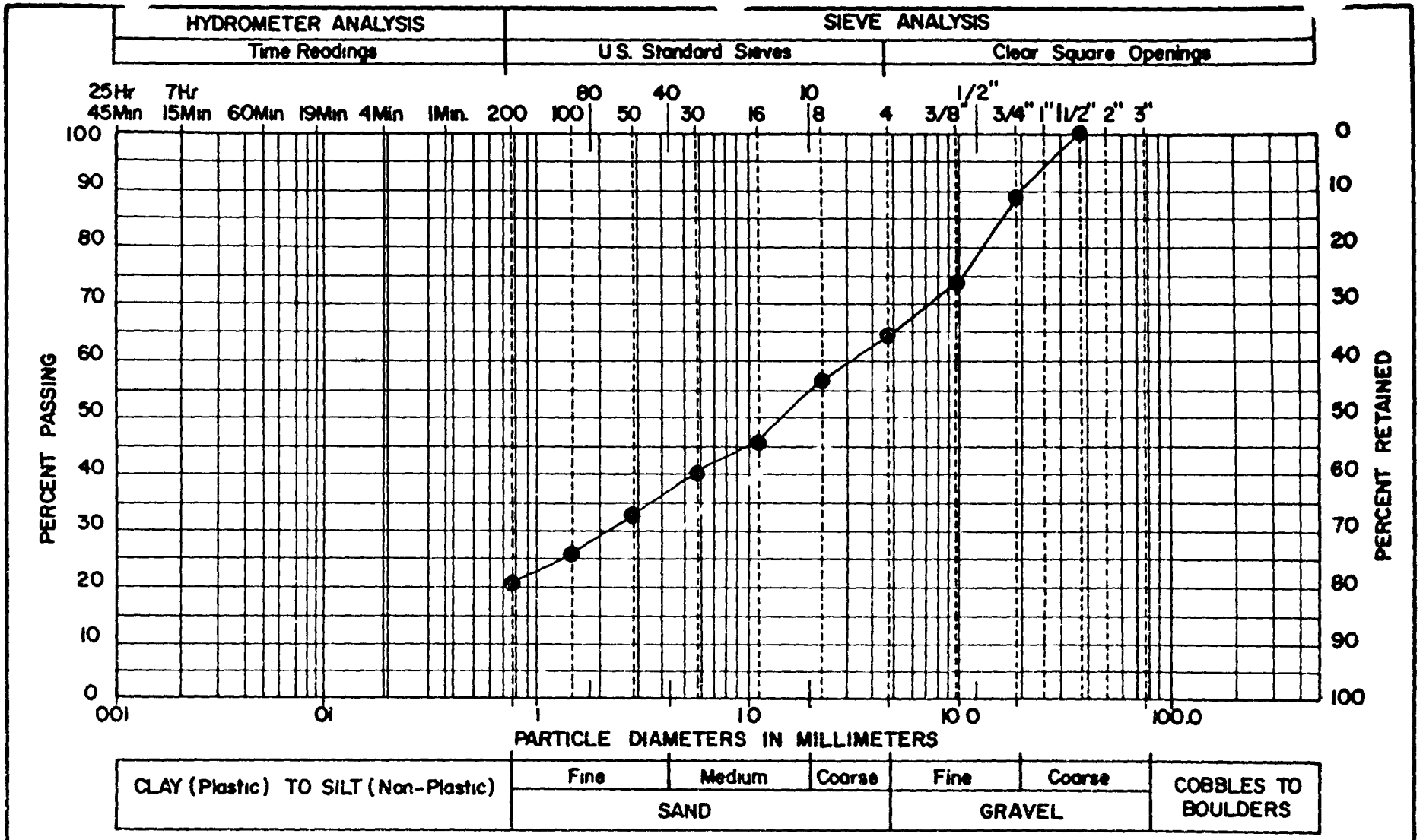


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
108	12.0	2.3	--	--	-	GRAVEL, SANDY, SLIGHTLY CLAYEY

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

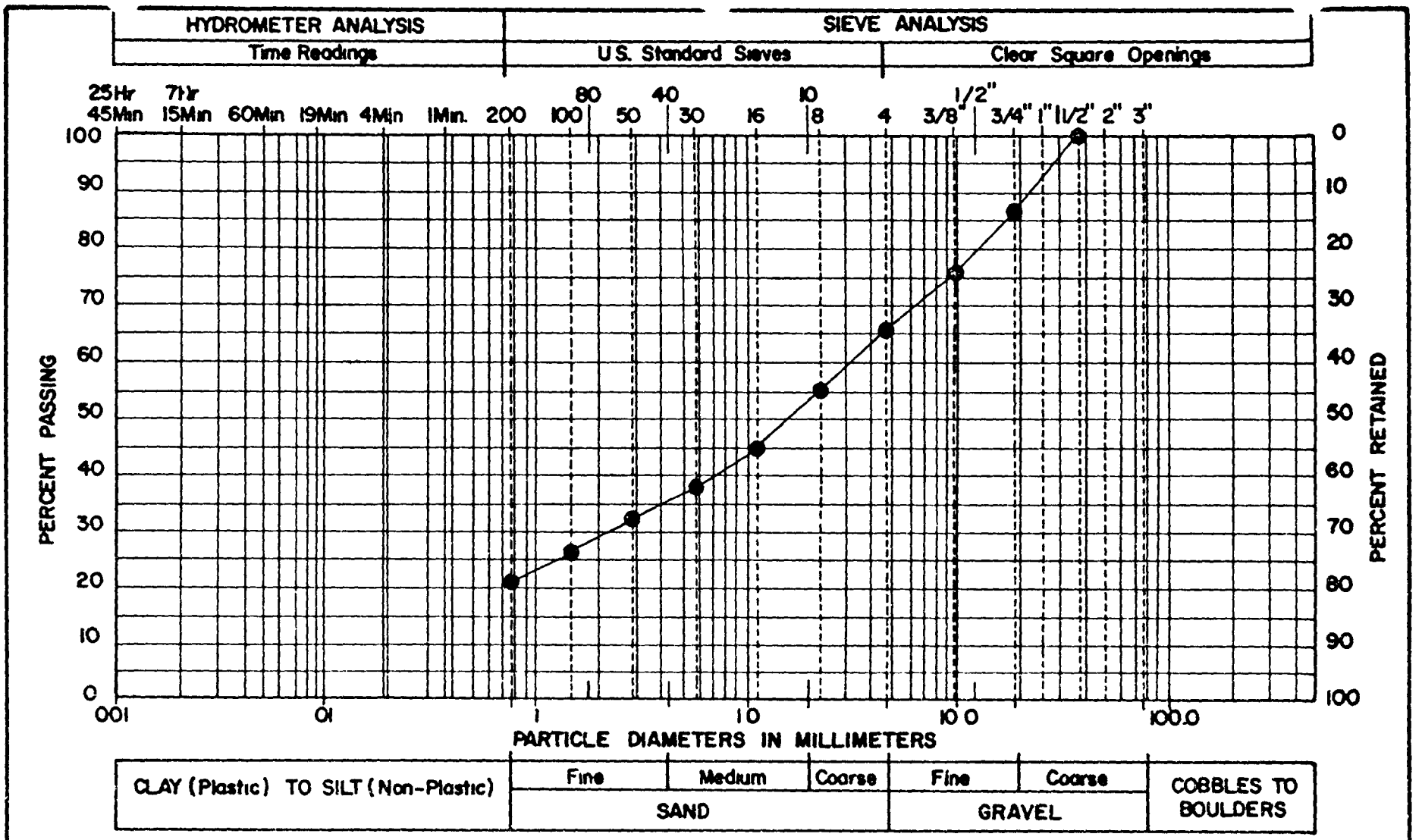


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
108	17.0	7.8	--	--	-	SAND & GRAVEL, CLAYEY

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

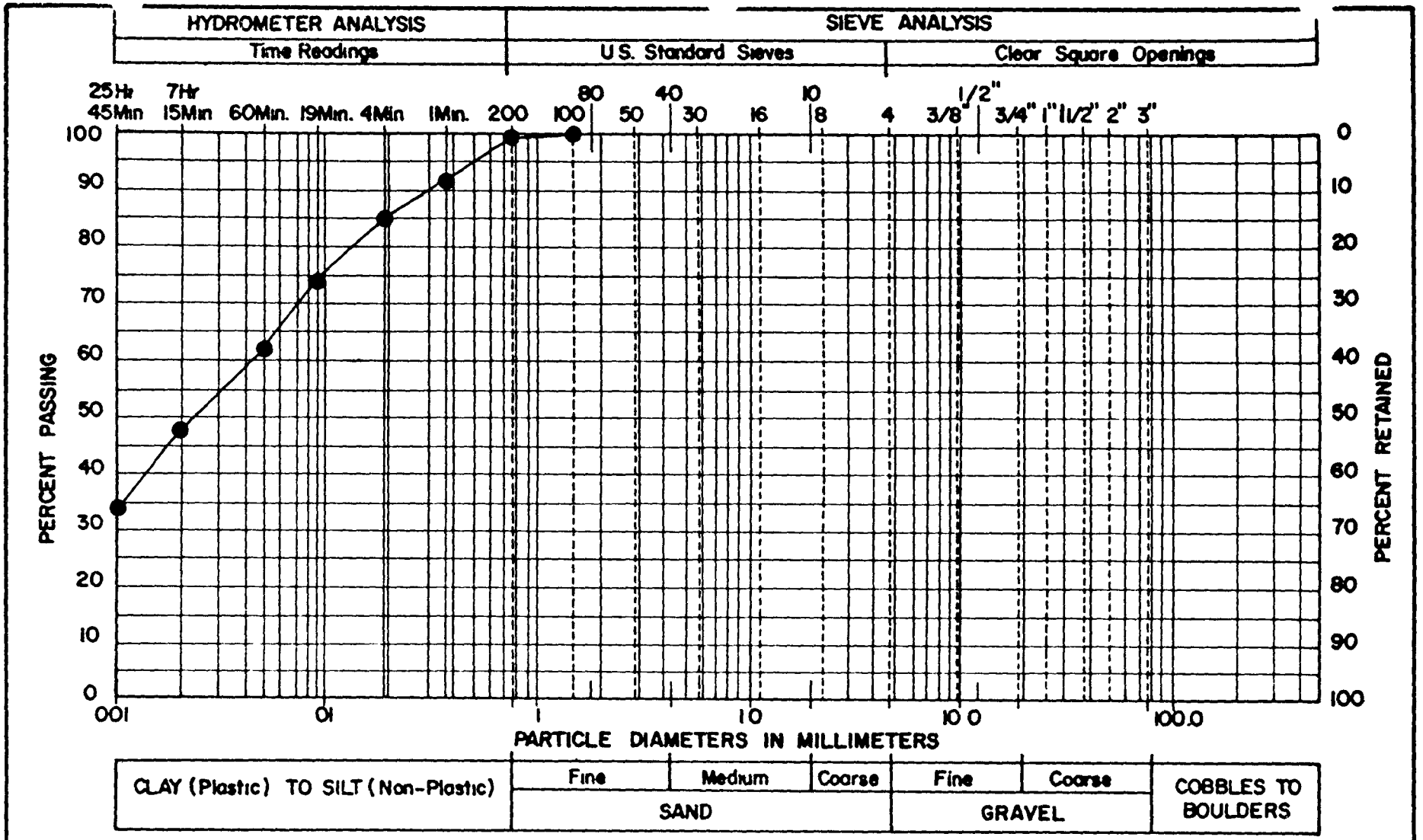


Boring Or Sample No.	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
109	9.0	5.2	--	--	-	SAND & GRAVEL, CLAYEY

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

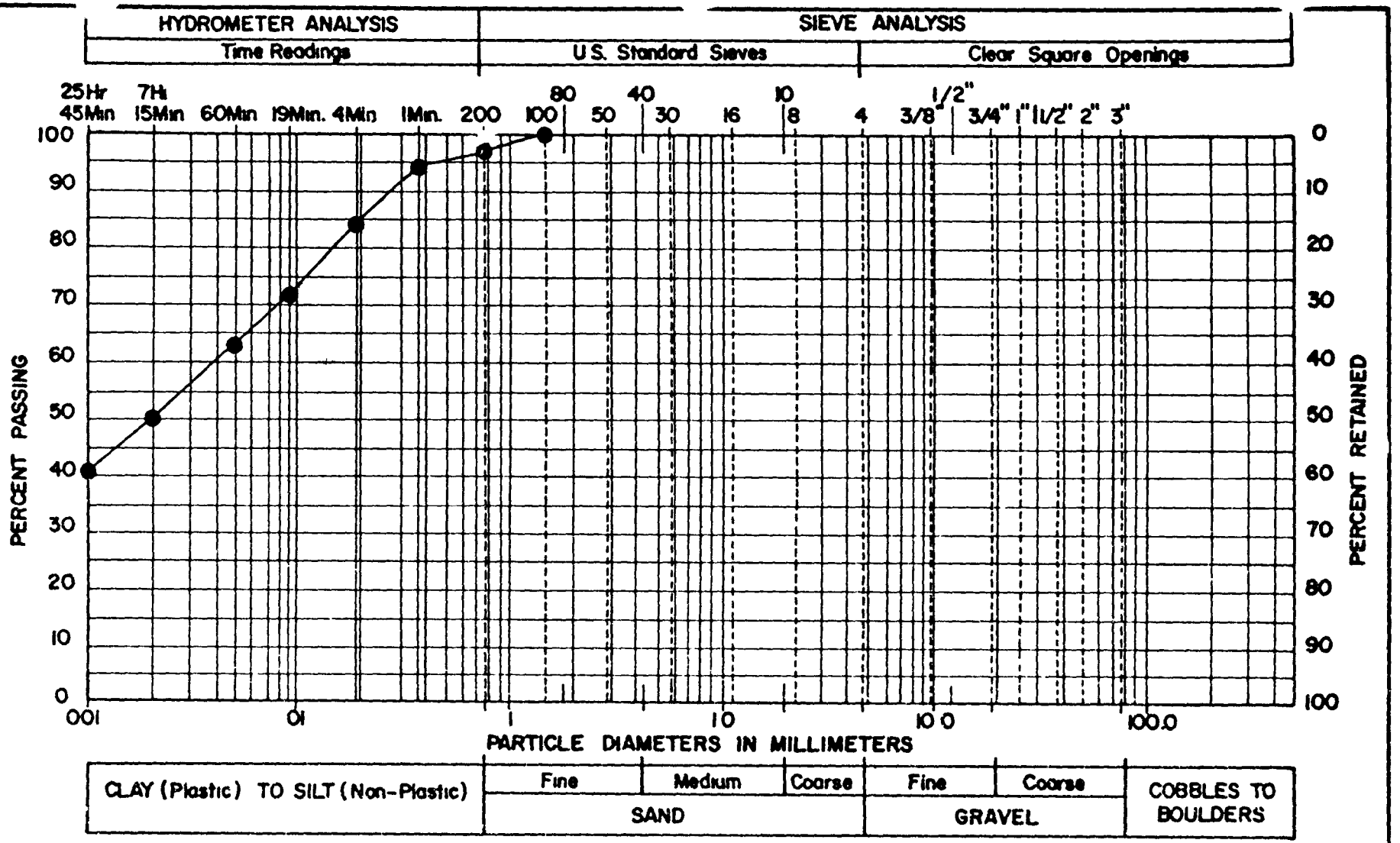


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
201	7.0	---	47	20	27	CLAYSTONE BEDROCK

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

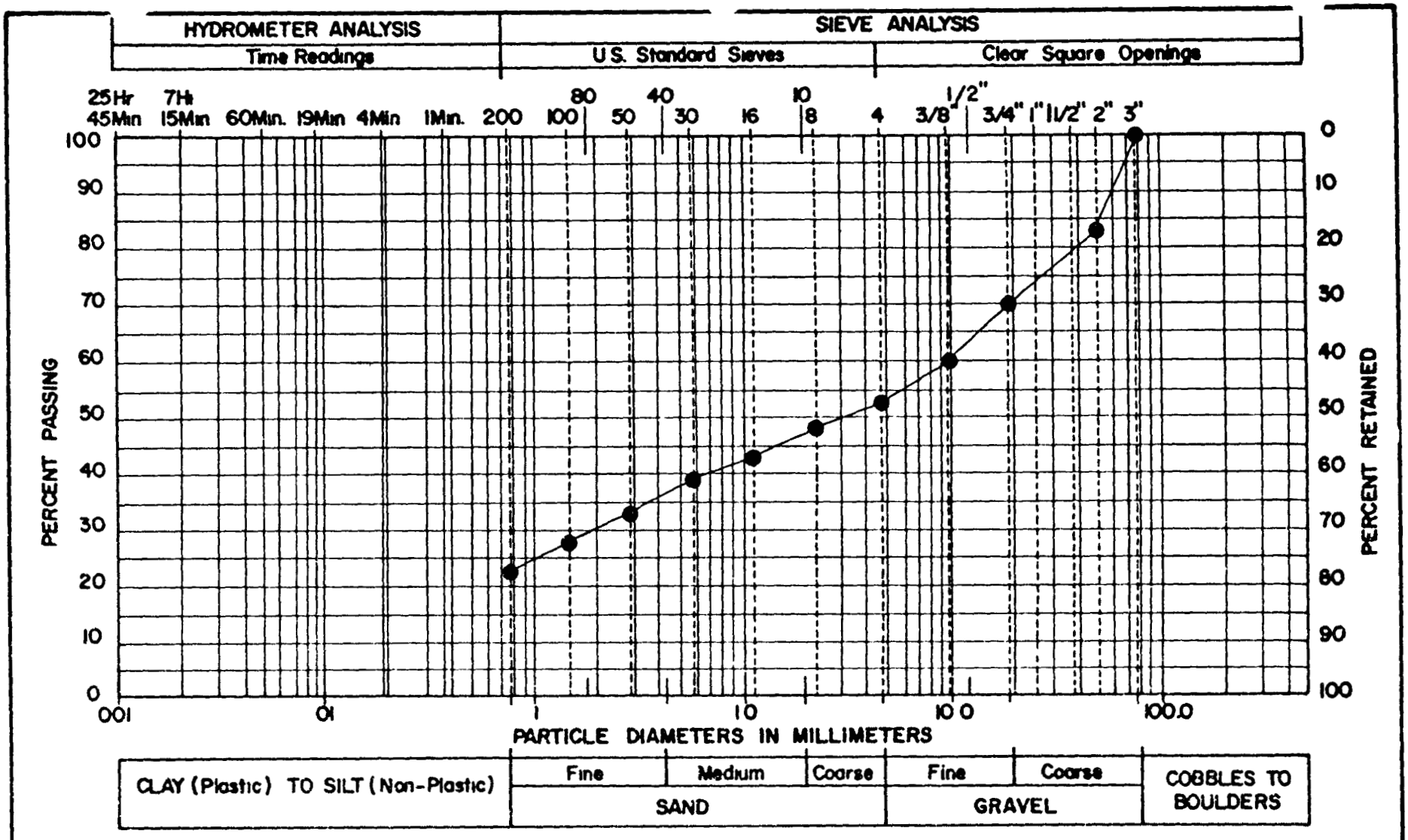


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
202	4.0	---	57	20	37	CLAY, SILTY (SEVEPELY WEATHERED CLAYSTONE)

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

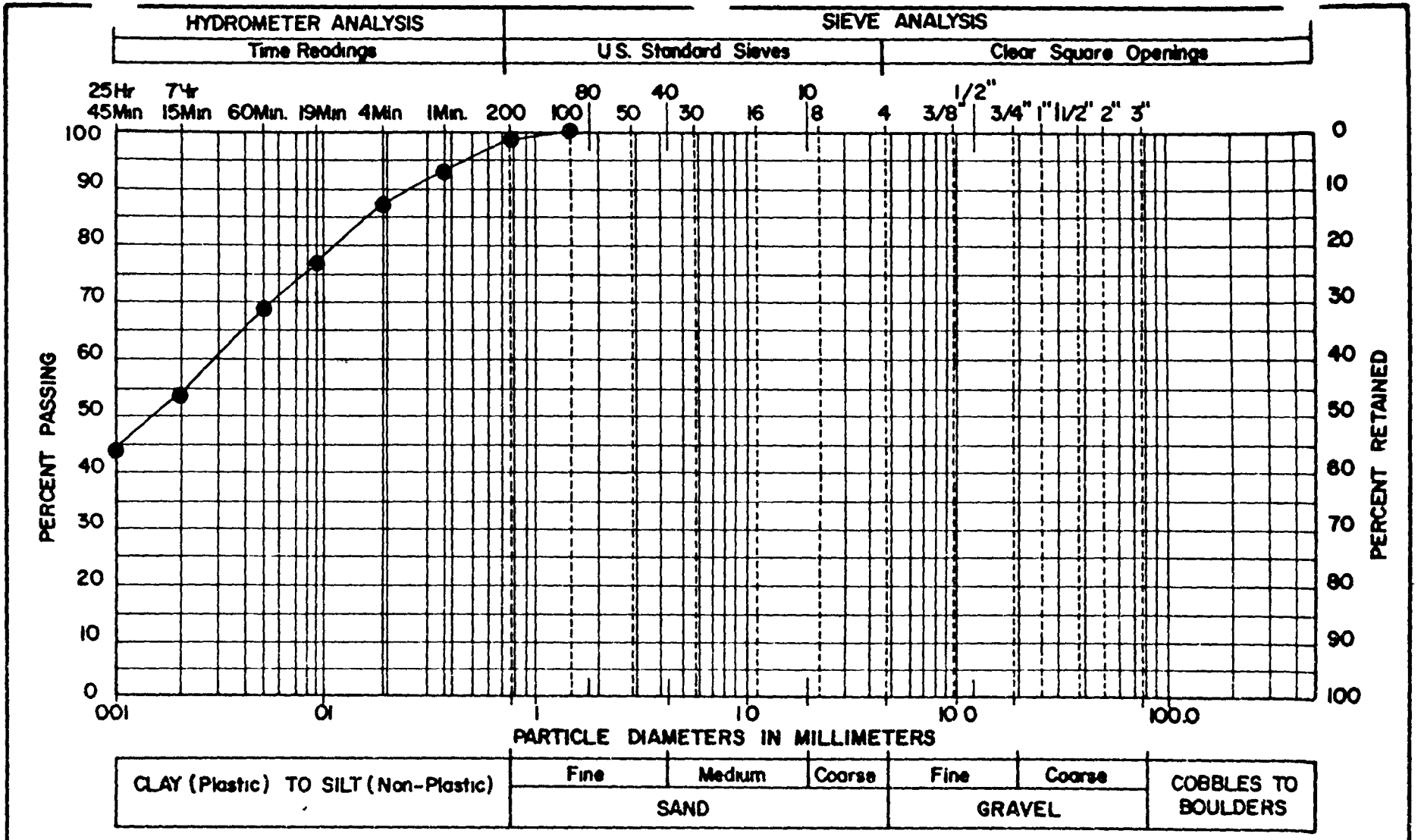


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
310	2.0	6.6	--	--	-	SAND & GRAVEL, CLAYEY

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

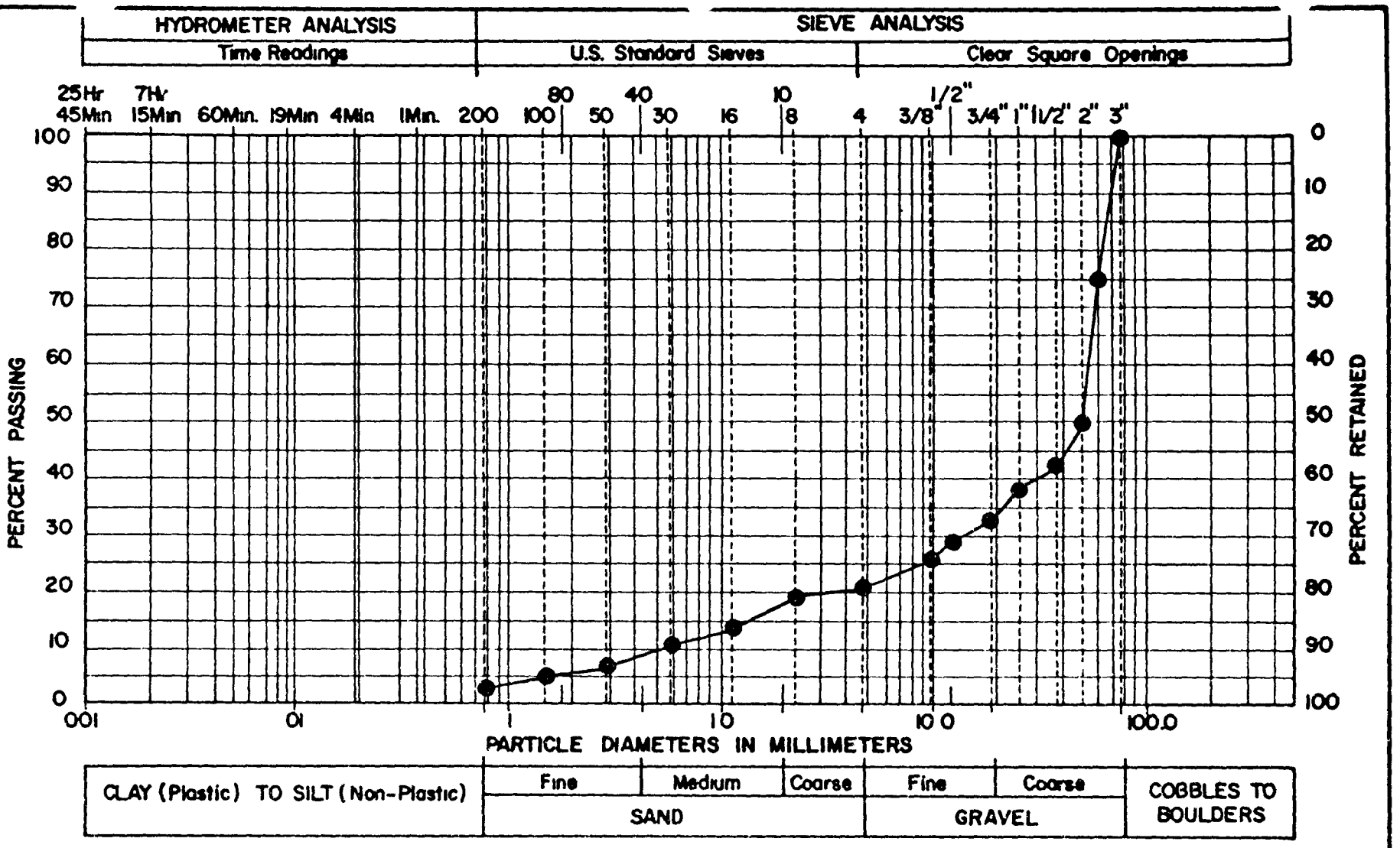


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
312	5.5 - 6.0	---	55	20	35	CLAY (SEVERELY WEATHERED CLAYSTONE)

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

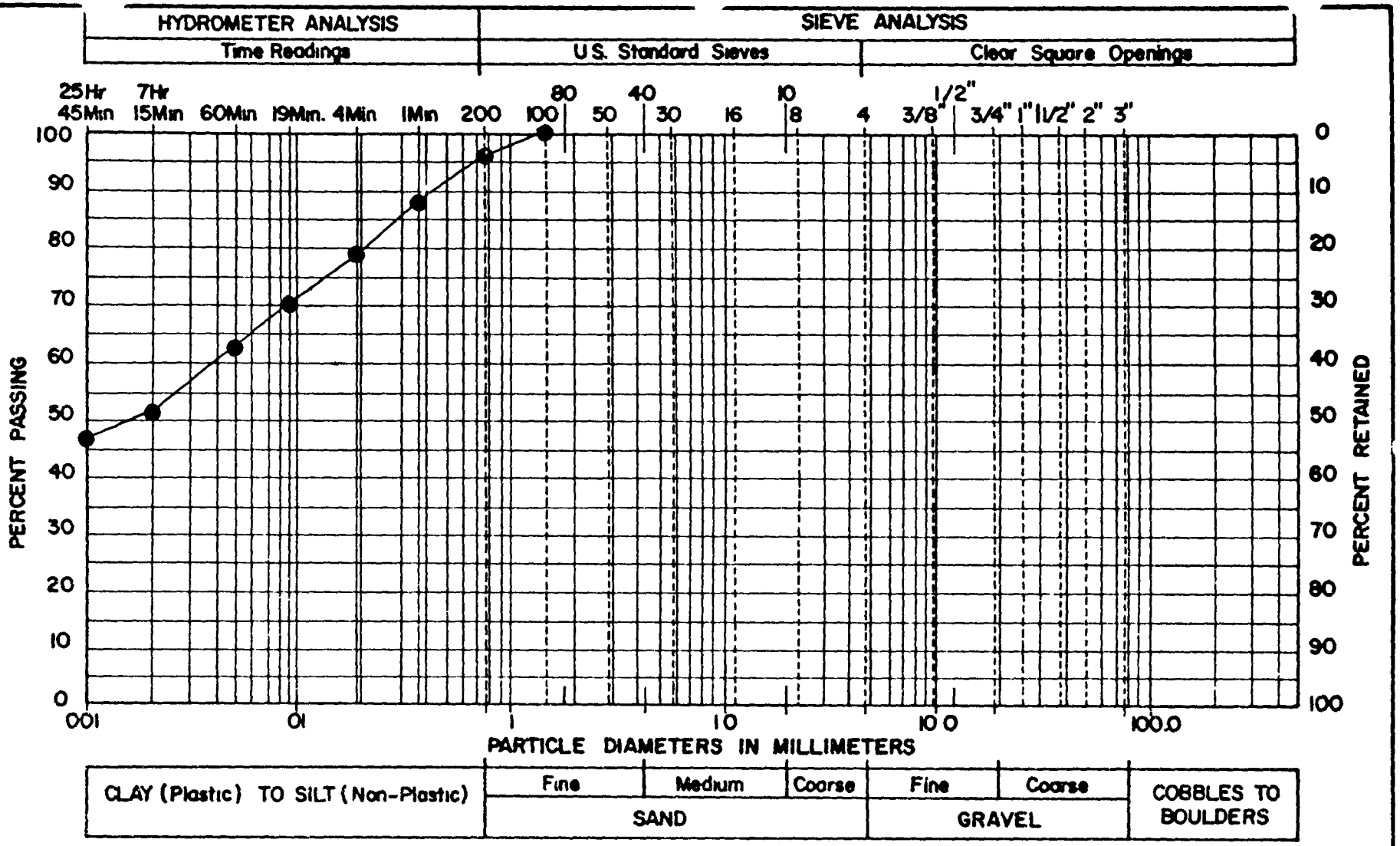


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
401	6.0					GRAVEL, SANDY

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759

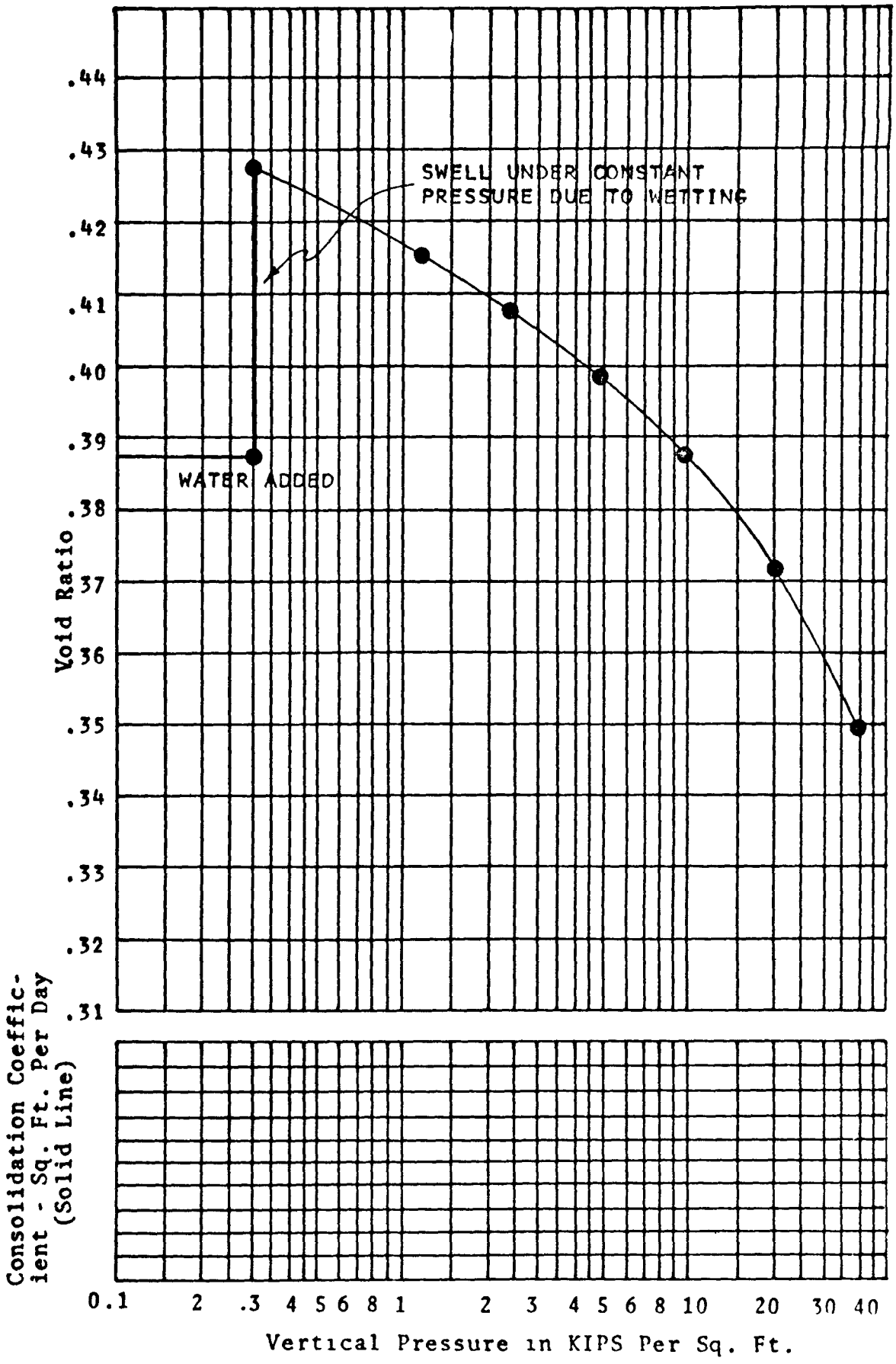


Boring Or Sample No	Elevation Or Depth	NAT WC	LL	PL	PI	DESCRIPTION OR CLASSIFICATION
403	1.2 - 2.5	--	58	20	38	CLAY (SEVERELY WEATHERED CLAYSTONE)

GRADATION ANALYSIS

ZEFF, COGORNO, AND SEALY INC

JOB NO 13759



Compression Index _____

Unit Weight 120 PCF

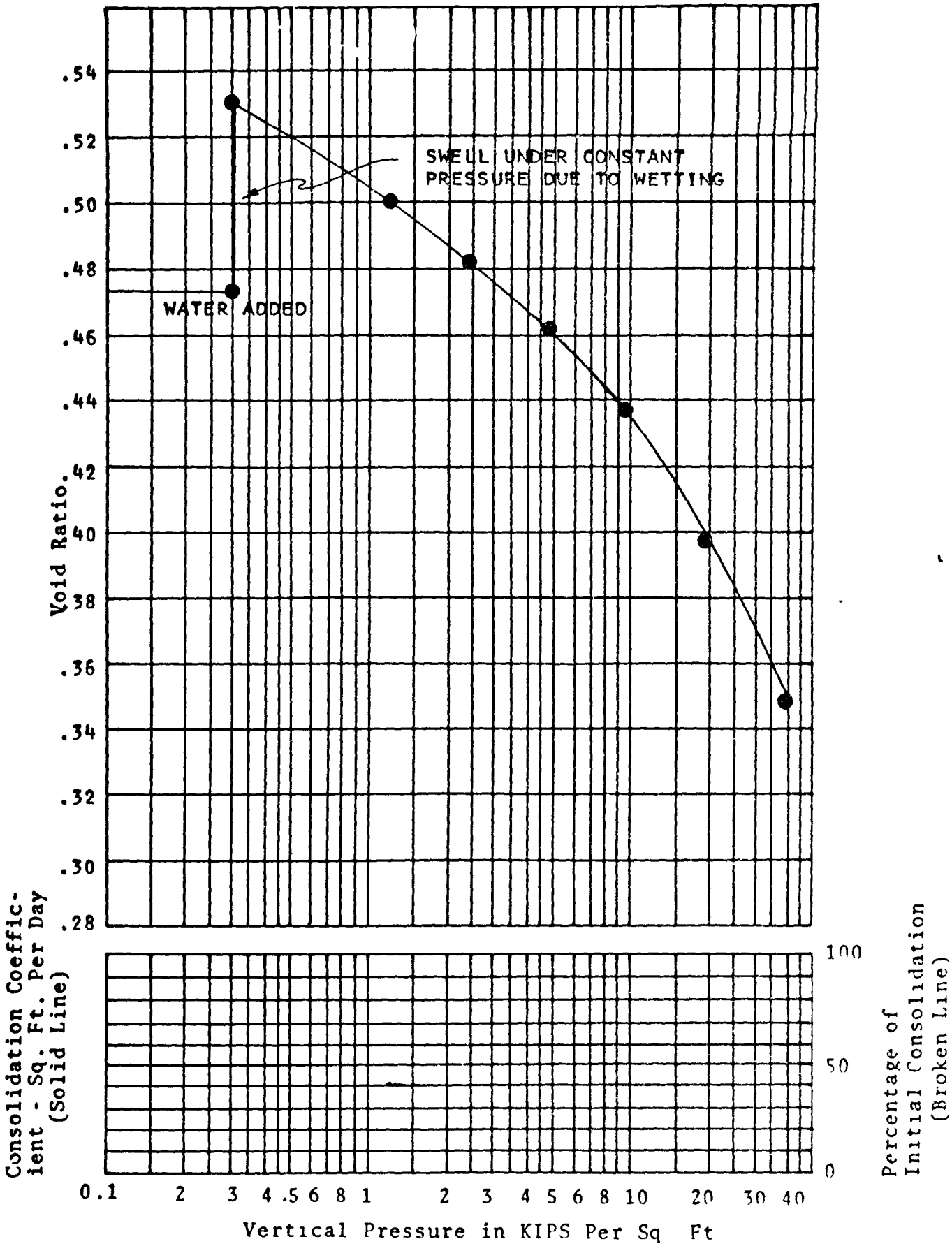
Water Content 14.7

Saturation _____

CONSOLIDATION TEST

Boring No. 201 Sample No. _____

Elev. or Depth 7.0 Fig. No. _____



Compression Index _____

Unit Weight 114 PCF

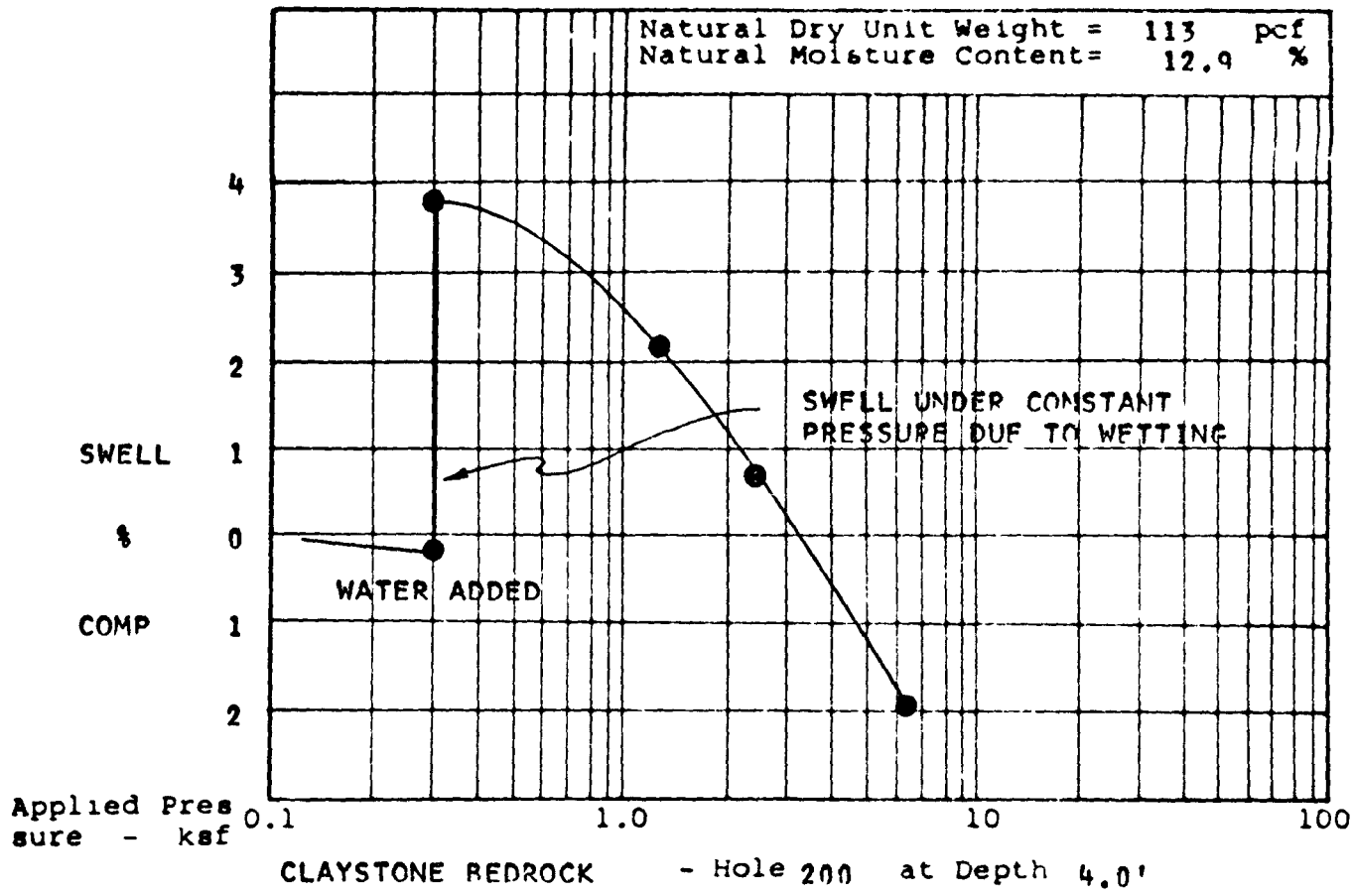
Water Content 15.3

Saturation _____

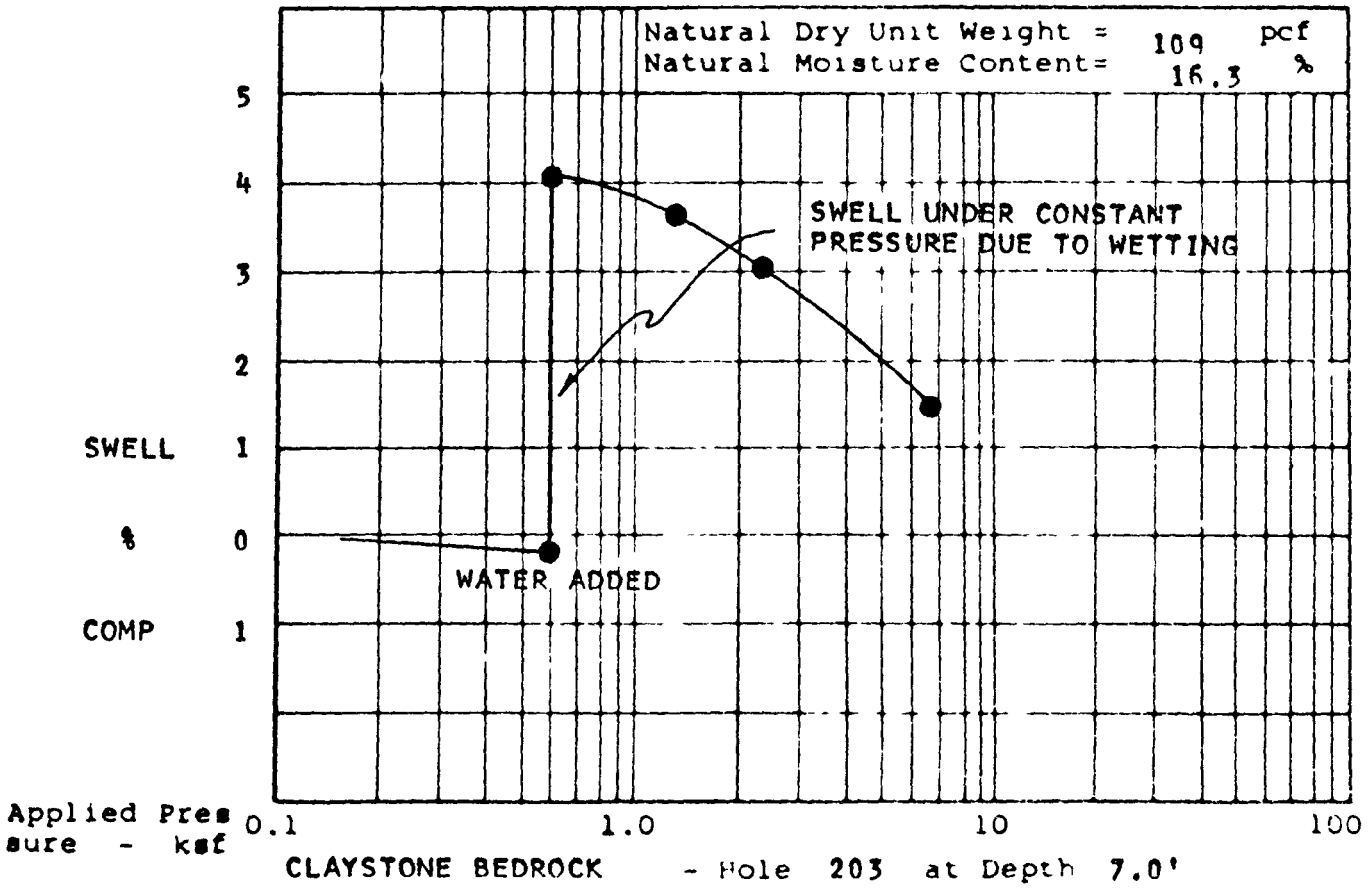
CONSOLIDATION TEST

Boring No. 202 Sample No. _____

Elev or Depth 4.0 Fig. No _____



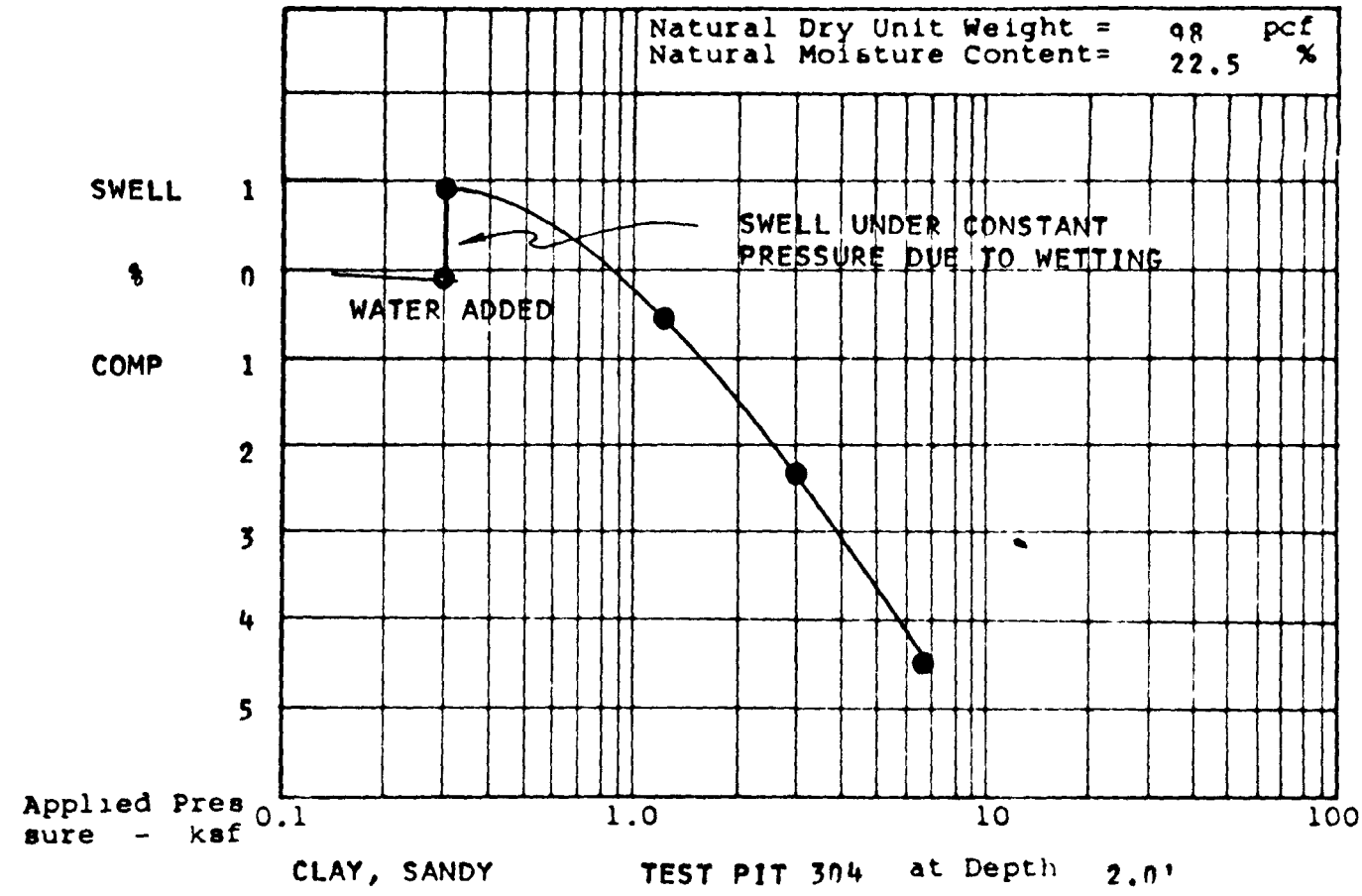
CLAYSTONE BEDROCK - Hole 200 at Depth 4.0'

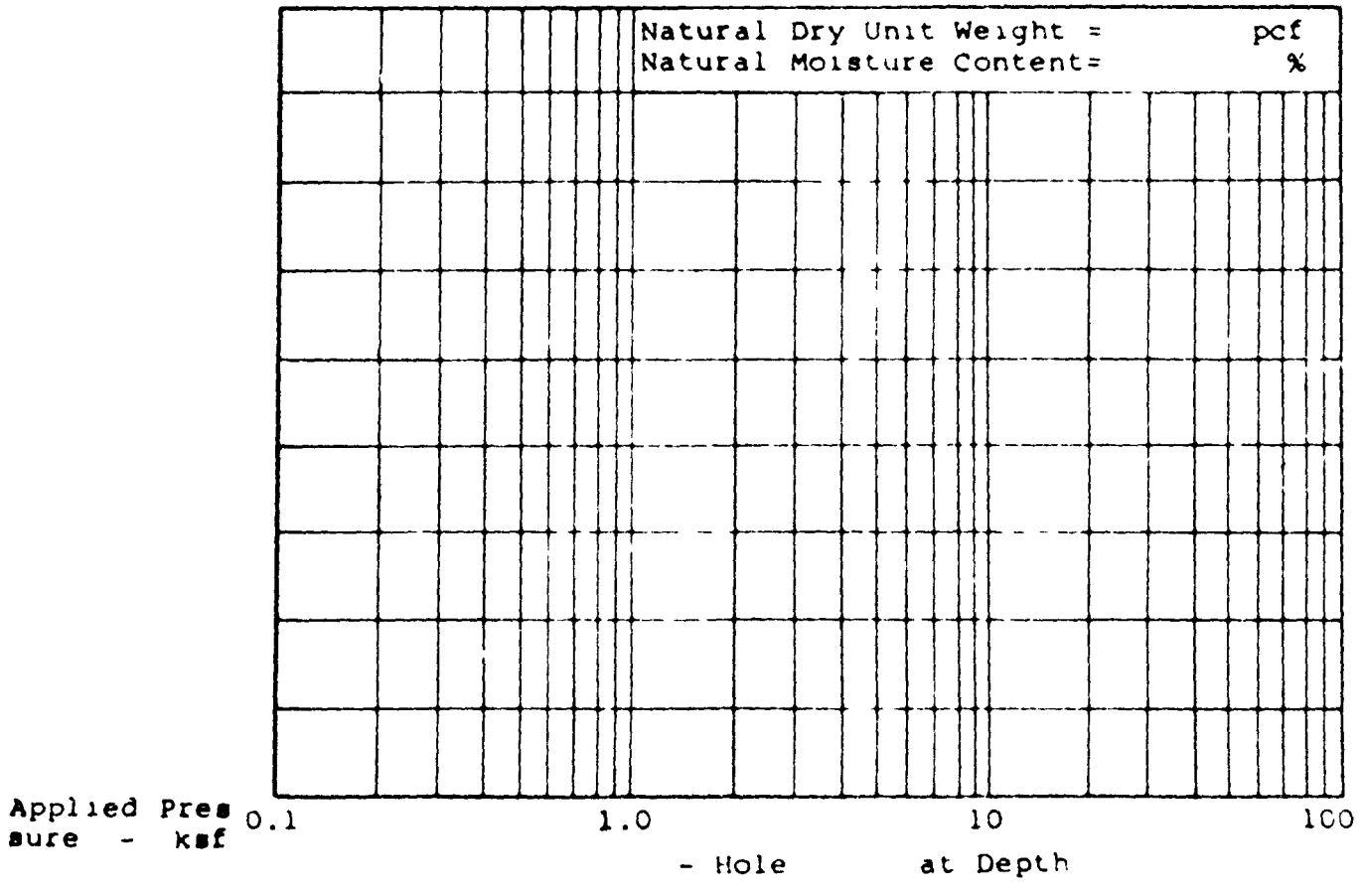


CLAYSTONE BEDROCK - Hole 203 at Depth 7.0'

SWELL CONSOLIDATION TEST RESULTS

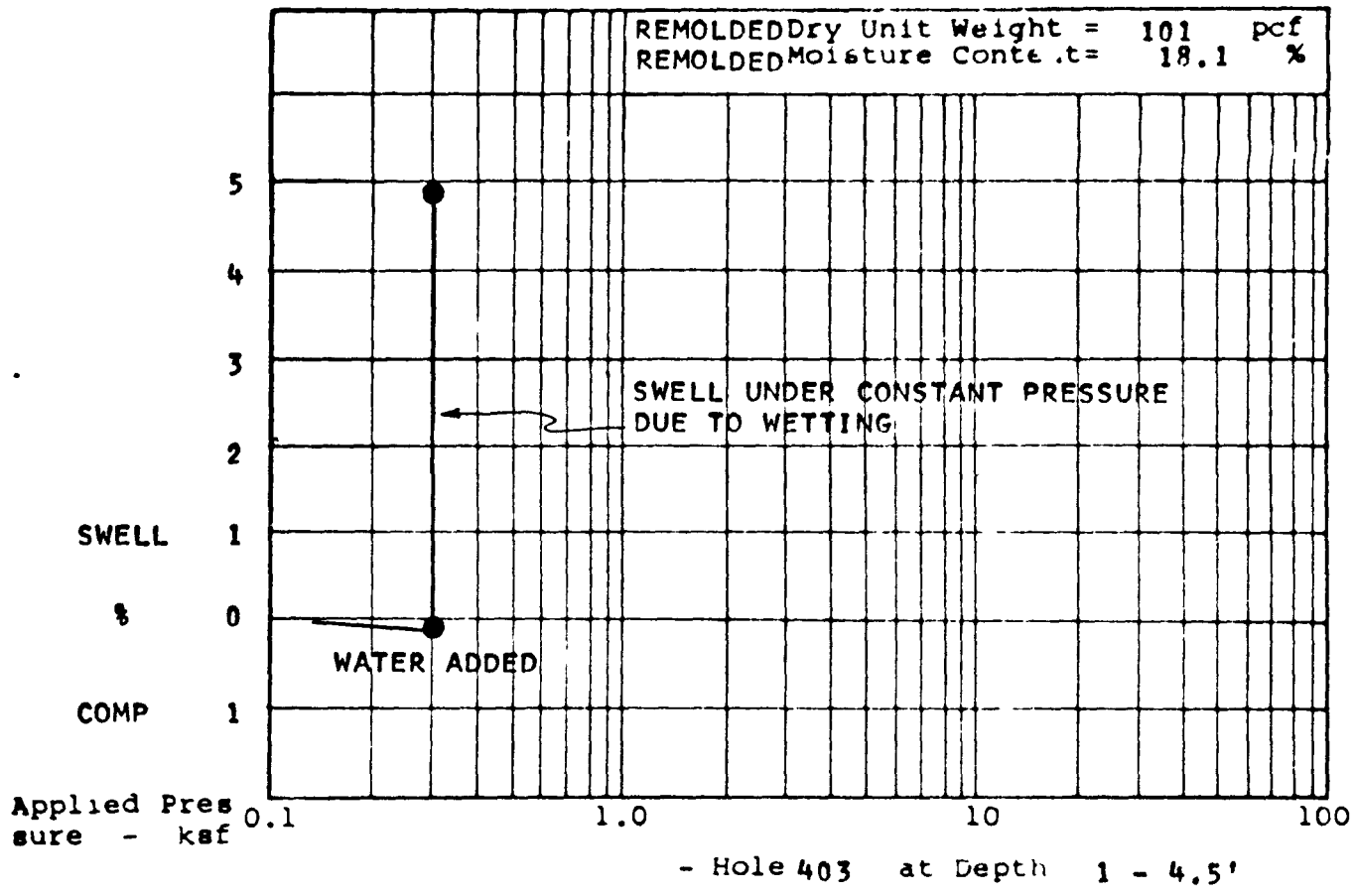
Figure



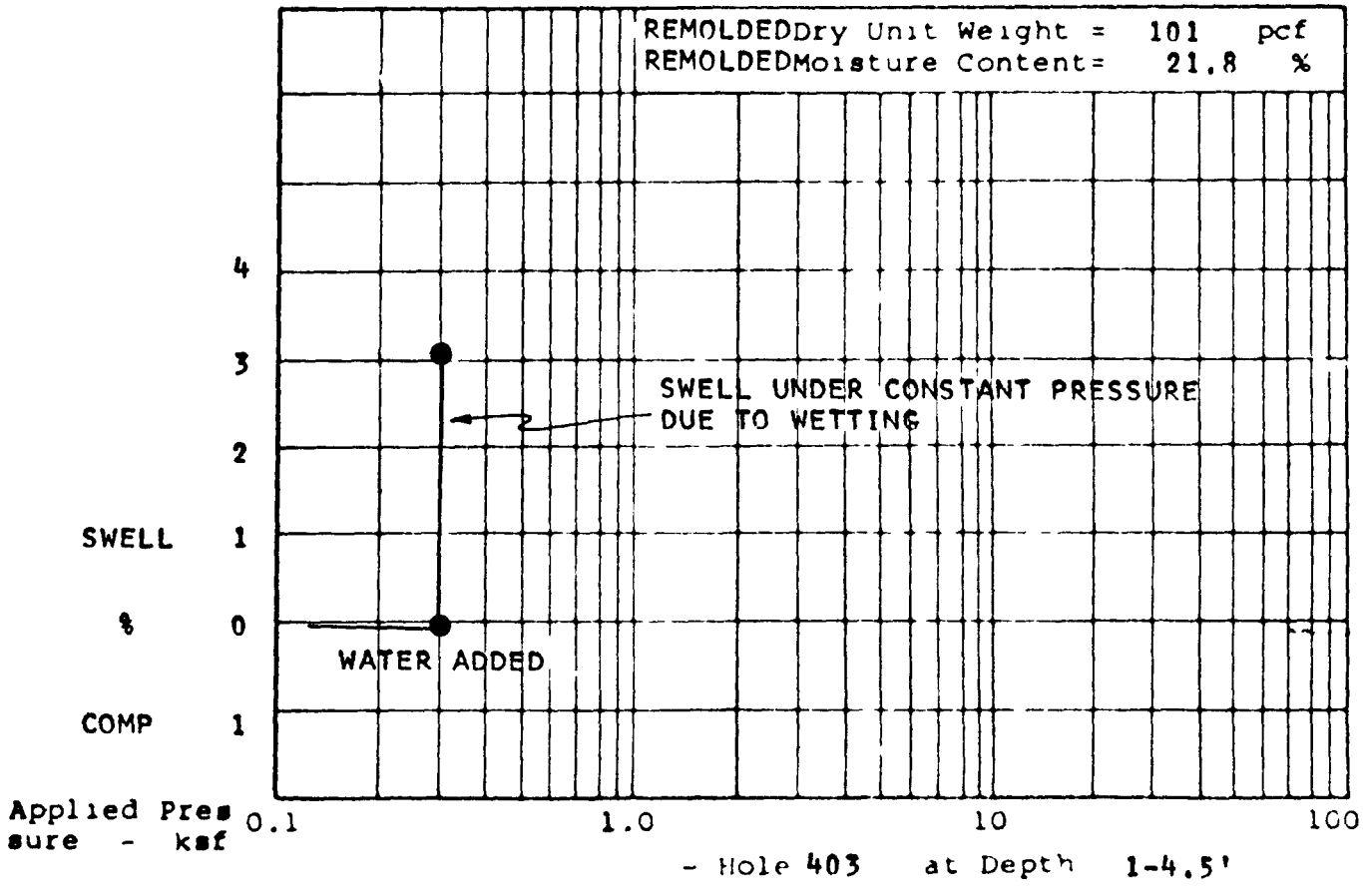


SWELL CONSOLIDATION TEST RESULTS

Figure



- Hole 403 at Depth 1 - 4.5'



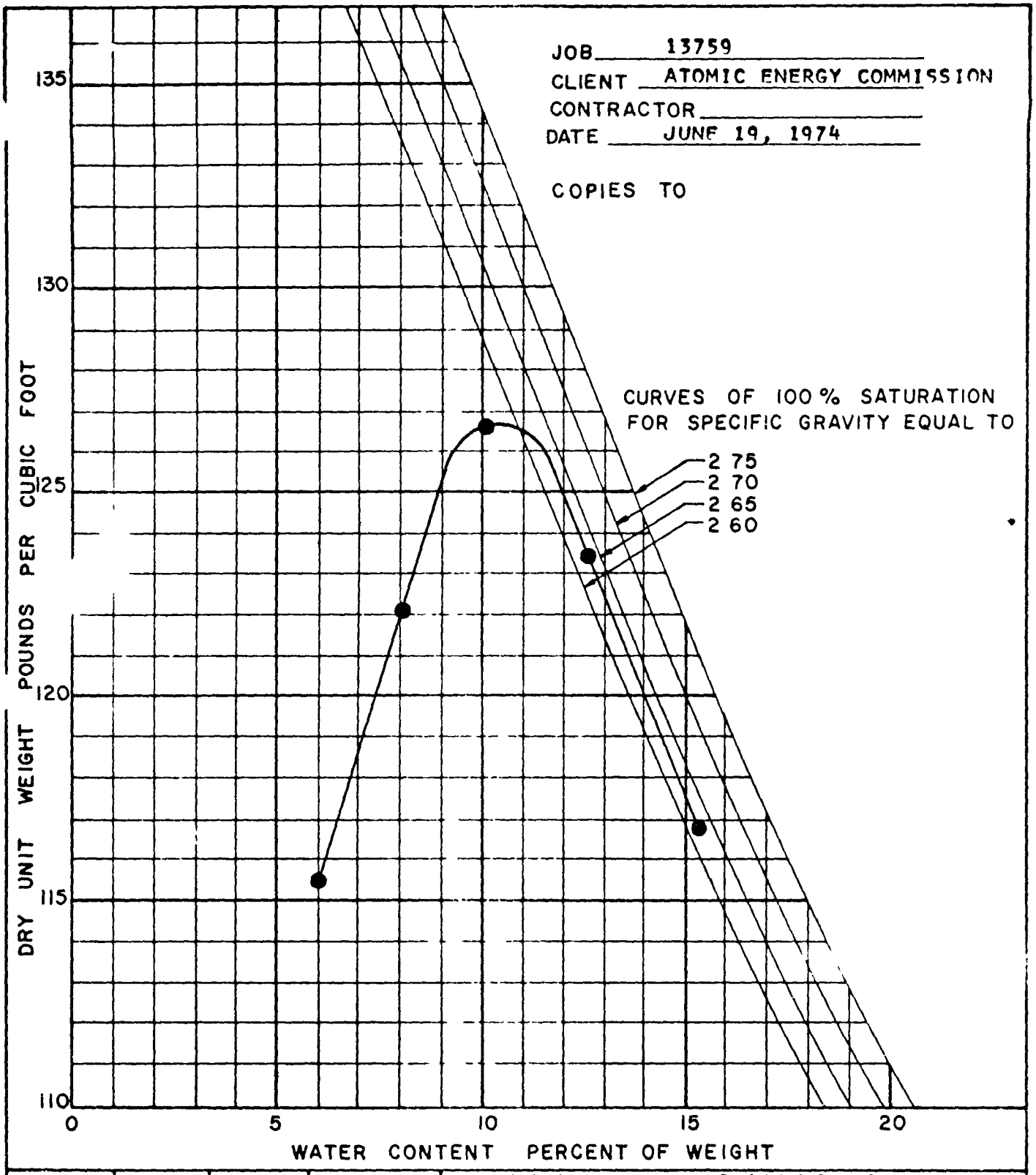
- Hole 403 at Depth 1-4.5'

SWELL CONSOLIDATION TEST RESULTS

Figure

JOB 13759
CLIENT ATOMIC ENERGY COMMISSION
CONTRACTOR
DATE JUNE 19, 1974

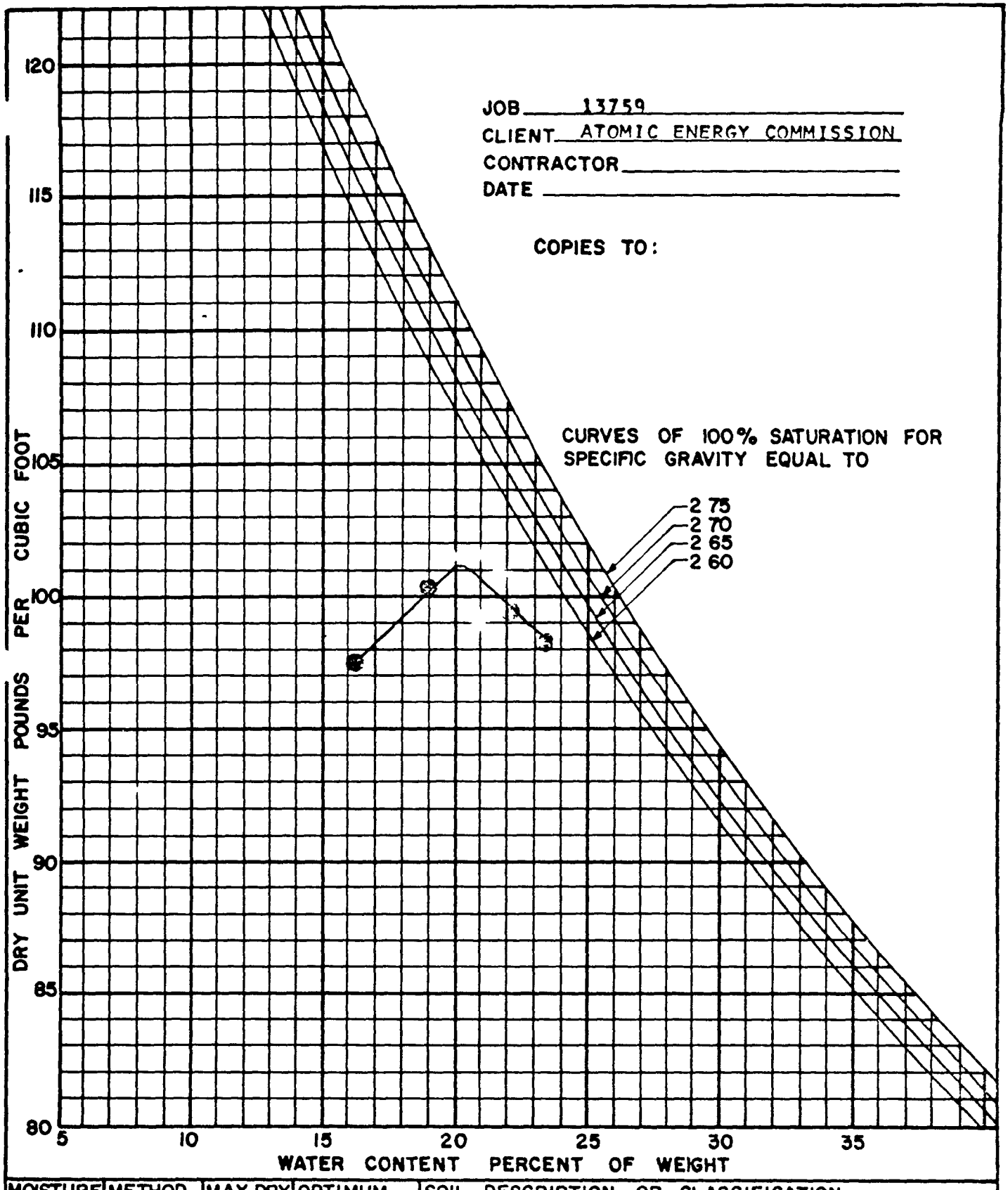
COPIES TO



MOISTURE DENSITY RELATION	METHOD OF TEST	MAX DRY DENSITY PCF	OPTIMUM MOISTURE CONTENT %	SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION
109	ASTM D-698 METHOD 'C'	126.7	10.4	SAND, GRAVEL, CLAYEY

KAL ZEFF & ASSOC BY Kenneth R Cuik

FIG



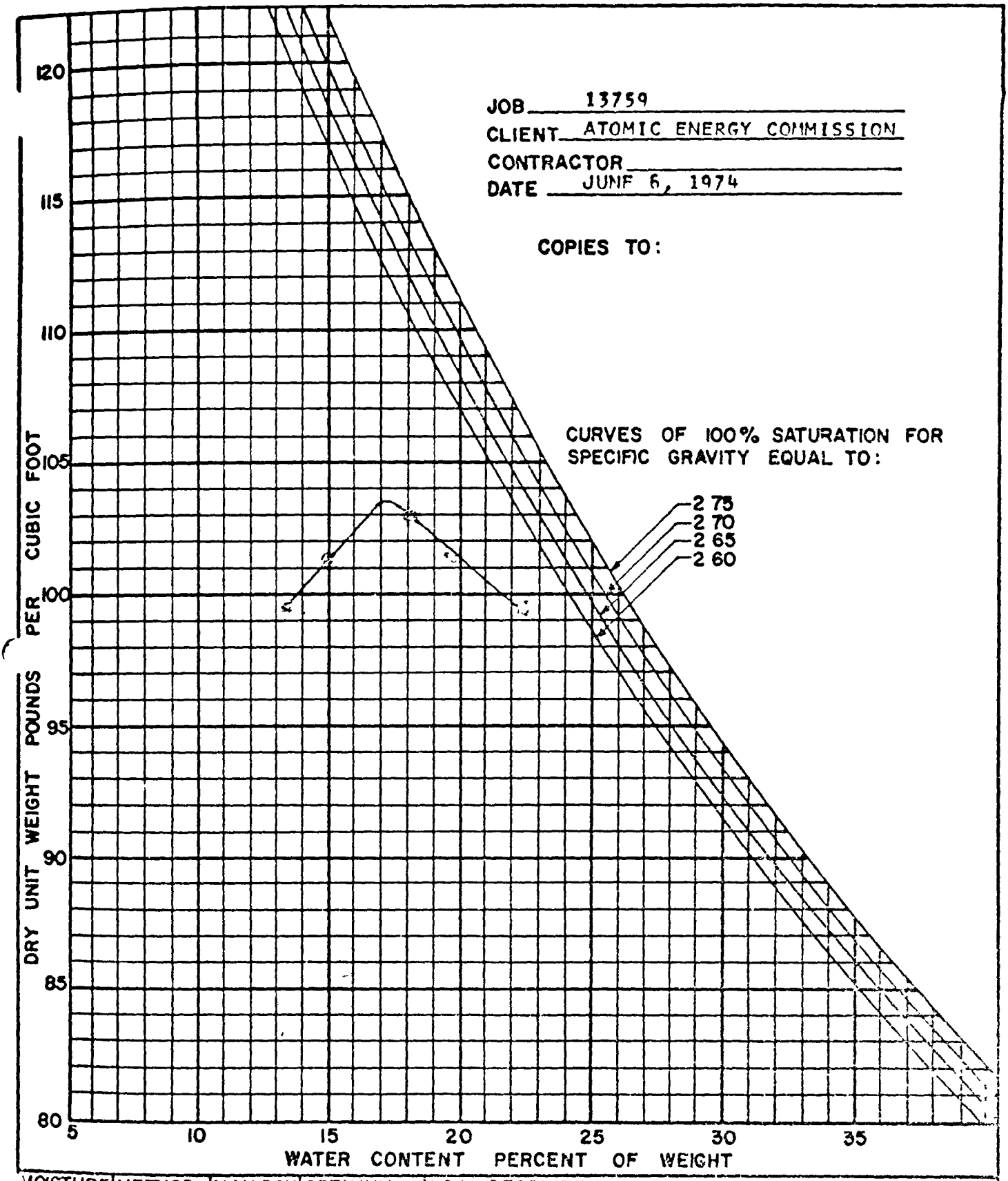
MOISTURE DENSITY RELATION	METHOD OF TEST	MAX DRY DENSITY PCF	OPTIMUM MOISTURE CONTENT %	SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION
403	ASTM D-698 METHOD 'A'	101.1	20.2	CLAY (SEVERELY WEATHERED CLAYSTONE)

KAL ZEFF & ASSOCIATES BY

FIGURE

JOB 13759
CLIENT ATOMIC ENERGY COMMISSION
CONTRACTOR
DATE JUNE 6, 1974

COPIES TO:

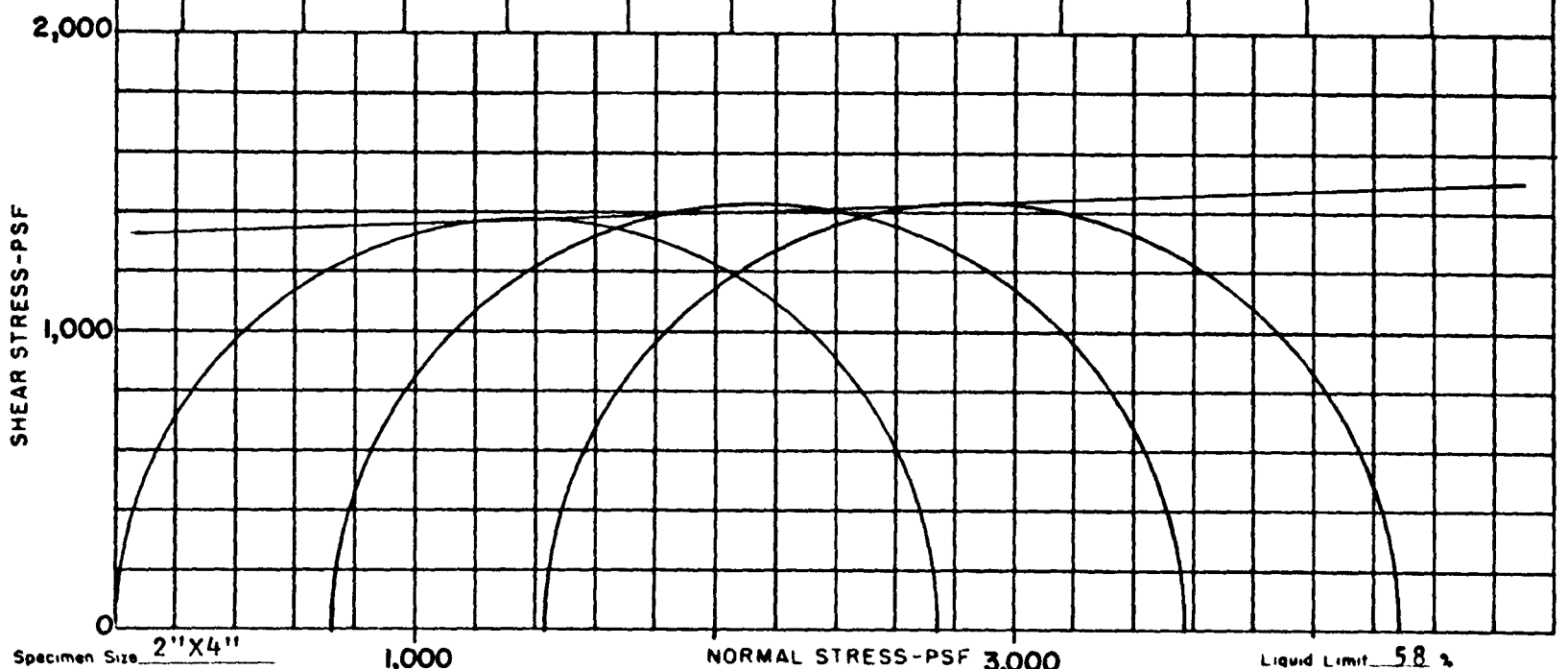


MOISTURE DENSITY RELATION	METHOD OF TEST	MAX DRY DENSITY PCF	OPTIMUM MOISTURE CONTENT %	SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION
404	ASTM D-698 METHOD 'A'	103.5	17.2	CLAY (SEVERELY WEATHERED CLAYSTONE)

KAI ZEE & ASSOCIATES BY

ZEFF, COGORNO & SEALY, INC
CONSULTING SOIL ENGINEERS

Specimen No	Initial Specimen Data: As prepared — Dry Density (pcf)	Moisture Content (%)	Degree of Saturation (%)	Wetted — Dry Density (pcf)	Moisture Content (%)	Degree of Saturation (%)	Test Values at Failure: Applied Lateral Pressure (psi)	Effective Lateral Pressure (psi)	Volume Change % or or Initial	Deviator Stress (psi)	Shear Values Corrected for Pore Pressure: Tan φ	Cohesion (PSF)
1	96.6	26.2	95				0					1,390
2	95.9	26.1	96				5				2^0	1,440
3	96.7	26.2	96				10					1,430



Specimen Size 2"X4"
Sealed Test ☐
Unconsolidated Undrained ☐
Drained ☒

Classification Symbol CH
Undisturbed ☐
Re molded ☒

Liquid Limit 58 %
Plasticity Index 38 %
Sp G 2.70

LABORATORY SAMPLE NO 13759 EXCAVATION NO BORROW SOILS DEPTH 1.2' - 2.5'

TRIAXIAL SHEAR
CONSTANT APPLIED LATERAL PRESSURE

FIGURE NO

CRITERIA CHANGE NO. 1

TO

CONTRACT AT(29-2)-3442

SANITARY LANDFILL RENOVATIONS

ROCKY FLATS PLANT
GOLDEN, COLORADO

The following revisions shall be incorporated into the Criteria

1. Include provisions for three (3) lined water quality sampling wells numbered S-1, S-2, and S-3, per Section III-42 of the Engineering Sciences, Inc. Water Study Report dated June 1, 1974. An existing test bore hole is to be used for one of the wells.

2. Provide two (2) approximately 36" x 36" photographic negatives of the aerial survey. The original negatives, approximately 8" x 8", are to remain the property of the Government upon contract completion.

3. The Sanitary Landfill will be a part of "Facility No. 219". This facility designation shall be added only in the title block of the Title Sheet, Drawing D-27317-0.

END OF CRITERIA CHANGE

DESIGN CRITERIA
FOR
SANITARY LANDFILL RENOVATIONS

ROCKY FLATS PLANT
GOLDEN, COLORADO

VOLUME 2

Prepared by
Engineering and Construction Department
Dow Chemical U.S.A.
Rocky Flats Division
Dow Authorization 440555

May 1974

TABLE OF CONTENTS

1. SCOPE

1.1 PURPOSE OF PROJECT

This project consists of two parts Part 1 covers Preliminary Landfill Studies and the design and construction of an impervious ring and water diversion facility around the existing sanitary landfill to intercept and direct the underground and surface water away from the site This is required to prevent leaching of contaminates from the landfill into the existing surface drainage or the underground water table. Part 2 comprises Preliminary Site Investigations and the design and construction of a sampling structure downstream from the landfill. This structure will impound all drainage effluent from the landfill until proper monitoring and disposition of the effluent may be accomplished

1.2 LOCATION

This project will be constructed at the United States Atomic Energy Commission's Rocky Flats Plant in Jefferson County, Colorado

1.3 DESIGN CRITERIA

The criteria contained in this document represent Volume 2 as described in Volume 1, Design Criteria for Engineering and Architectural Services As such it provides the specific criteria pertaining solely to this project.

1.4 SAFETY

This project has been reviewed and approved by the appropriate Rocky Flats Health, Safety, Energy, Fire Protection, and Environmental Control personnel

2. DESCRIPTION OF PROJECT

2.1 Part 1 - This portion of the project consists of the preliminary geological investigation, landfill studies, and the design and construction of an impervious clay and gravel water barrier ring (or open-ended horseshoe) around the existing sanitary landfill shown on Drawings 27296-2 and -4

2.1.1 The Architect-Engineer (A-E) shall present a summary report prior to Title I engineering design covering the following

a Test hole analysis from new test holes performed in the area around the existing landfill

b. Evaluation of geological factors and the principle of the water barrier ring and drainage system for adequacy and concurrence with the theory of design

c Project capacities of

(1) The existing landfill area not using the mounding technique

(2) The existing landfill area using mounding technique

(3) Stored excavated fill required for use in the landfill.

(4) Spoilage from the water barrier ring excavation

d. Recommended spoilage storage area(s).

e. Recommended actions required to continue landfill operations during construction

f Recommended local sites for obtaining clay, gravel, and riprap (see Part 2)

2.1.2 The A-E shall design an impervious clay and gravel water barrier ring around the existing sanitary landfill area. This ring shall be constructed using approximately 12 inches of compacted clay over approximately 12 inches of coarse gravel sized from 1-1/2 to 3 inches with fines as necessary to keep out the clay layer. This water barrier shall begin at the existing landfill grade level and extend down to impervious claystone bedrock on a 2 1 slope (2 feet horizontal to 1 foot vertical) Underdrains consisting of perforated pipe or open joint clay tile shall be installed in gravel layers to drain underground water downstream from the landfill area and to drain water from the landfill basin.

"Vee" type diversion ditches about 3 feet deep by 10 feet wide, with a total approximate length of 2,300 feet, will be installed on each side of the landfill area to divert surface runoff around the site See Drawing D-27296-4 for details.

Dow Chemical U S A Drawings D-27239-1 and -2, available for reference upon the request of the Architect-Engineer (A-E), show the locations of a series of test holes that have been made in the sanitary landfill area. Test hole data on these drawings shows the depth of bedrock and underground water This information will be required for the design of the landfill ring Additional test holes shall be drilled around the existing landfill to accurately determine depths for the ditches and drain systems

2.2 Part 2 - This portion of the project consists of the design and construction of a sampling structure approximately 700 feet downstream and east of the eastern edge of the existing landfill The sampling structure shall include an emergency spillway, an overflow drain, and surface water diversion ditches. The require retention capacity of this facility shall be about 2,000,000 gallons The location of the structure, dimension, and features shown on Drawing D-27296-3, are only approximate

The approximate dimensions of the sampling structure are shown on Section A-A on the above drawing to show the magnitude of the work involved The Architect-Engineer shall design the structure and shall determine its final location, configuration, and size

A cut-off trench shall be cut to the claystone bedrock formation and backfilled with compacted clay to minimize seepage. All soil under the sampling structure shall be stripped in accordance with Paragraph 3 4 The core of the structure shall consist of impermeable

clay with a 2 1 maximum slope The core shall be covered with a shell consisting of a mixture of gravel, sand, and clay Riprap shall be used on the upstream face of the structure

Freeboard between the high water line and the top of the sampling structure shall be 3 feet, minimum

An overflow consisting of an 18-inch diameter galvanized corrugated metal pipe, with the exterior surface asphalt coated, shall be installed with the inlet at the high water line per Section A-A, Drawing D-27296-3 The emergency spillway, sized in accordance with Section B-B, shall be constructed on the north end of the structure. A 10-inch ductile iron drain line with cut-off collars shall be installed approximately as illustrated on Section A-A. The gate valve located on the upstream face of the structure shall be operated by an extension located on top of the structure. A blind flange and sample valve shall be installed on the downstream end of the drain line.

The existing small drainage barrier located approximately 450 feet east of the existing landfill shall be removed after the construction of the new sampling structure

3. DESIGN REQUIREMENTS

3.1 GENERAL

The latest edition of the codes, standards, and specifications referred to in these criteria shall be followed.

3.2 DESIGN

Design shall conform to the applicable sections of "Design Criteria for Engineering and Architectural Services, Volume 1", U S Atomic Energy Commission's Rocky Flats Plant, operated by Dow Chemical U.S A , Rocky Flats Division, with specific requirements and/or exceptions provided herein.

3.3 CODES

3.3.1 The Occupational Safety and Health Administration (OSHA) Standards 29 CFR Part 1910

3.3 2 Dow Chemical U S A Rocky Flats Standard for Service Piping including Underground Water, SP-105.

3.3.3 Dow Chemical U.S.A. Rocky Flats Standard for Pipe Systems Testing Procedure, SP-301

3.3 4 Plans and Specifications for the Construction of Reservoir Dams, Division of Water Resources, Office of the State Engineer of Colorado

3.3.5 American Association of State Highway Officials (AASHO) Standards

3 3.6 Design of Small Dams, United States Bureau of Reclamation, United States Government Printing Office, Washington, D C

3.4 SITE DEVELOPMENT

3.4.1 All soil under the sampling structure shall be stripped to a depth sufficiently below the existing grade to remove the top soil and provide a base consisting of natural, undisturbed soil A minimum stripping of 18 inches shall be required

3.4.2 Vegetation and top soil within the retention basin shall remain undisturbed where possible Grasses shall be restored to disturbed areas after areas have been reshaped to natural contours The downstream side of the sampling structure shall also be reseeded with natural grasses.

3 5 MECHANICAL

3.5.1 Drain piping shall be installed and tested in accordance with Dow Chemical U S A Standards SP-105 and 301

3.5 2 The overflow pipe shall consist of fabricated corrugated steel pipe in accordance with AASHO Standard Specification M-136.

3.6 CIVIL

3.6.1 Clay and gravel for the new landfill ring and sampling structure will be available locally from sites within 1/2 mile of the project construction area. The Architect-Engineer shall determine the most suitable sites for obtaining

these materials by core drilling or other geological investigation. Materials shall meet all Colorado state requirements per Plans and Specifications for Construction of Reservoir Dams, Division of Water Resources, Office of the State Engineer of Colorado.

3.6.2 Suitable crossings shall be constructed and maintained during the construction period over the existing and new surface water diversion ditches to permit access to the construction site and to the landfill itself.

3.6.3 Arrangement shall be made to permit uninterrupted normal use of the landfill by existing Rocky Flats Plant users

3.6.4 All material used for the embankment shall be free from organic soils, vegetation and other deleterious materials.

3.6.5 The shell shall consist of material no larger than 8 inches in size.

3.6.6 The riprap shall consist of field stone or rough, unhewn quarry stone having a specific gravity of at least 2.25, and shall be resistant to the action of air and water. Riprap shall be placed on a layer of bedding material consisting of pit run gravel and sand

4. SPECIAL CONSIDERATIONS

4.1 SAFETY REQUIREMENTS

4.1.1 General

The design and construction of this project shall conform to the standards of the Occupational Safety and Health Administration (OSHA)

A high degree of control is maintained over physical safety and fire protection throughout the Rocky Flats Plant. All visitors and construction personnel are required to adhere to all regulations which pertain to them. Indoctrinations will be given to such personnel as needed

4.1.2 Standard Safety Practices

The Architect-Engineer and the Construction Contractor shall be knowledgeable of and shall follow the "Standard Safety Practices" published and enforced by the Rocky Flats Division. A copy of these safety practices will be issued under separate cover

4.2 DISPOSAL OF REMOVED MATERIAL

Spoilage from the Landfill Ring shall be stored in areas approximately as shown on Drawing D-27296-2

All vegetation, top soil, and material from the existing barrier removed from this area shall be deposited in the existing landfill or be disposed of as directed by the Contracting Officer

4.3 CONSTRUCTION QUALITY ASSURANCE

This project requires a level of quality indicating that normal design, procurement, construction and inspection practices, procedures, and codes will be followed

Design reviews shall assure the adequacy of specification and the inclusion of appropriate inspection criteria Title III inspection shall be fully documented and shall assure that specifications are met Exceptions to specifications shall be properly approved and documented

5. EQUIPMENT AND SERVICES BY OTHERS

5.1 MATERIALS AND EQUIPMENT

All materials, equipment and services required for this project shall be provided by the Construction Contractor.

APPENDIX 6 1

CRITERIA DRAWINGS

The following attached drawings are a part of these Criteria

Number	Title
D-27296-1	Cover Sheet
D-27296-2	Area Plot Plan
D-27296-3	Sampling Structure Details
D-27296-4	Landfill Ring and Water Diversion Details

APPENDIX 6 2

STANDARDS

The following Dow Chemical U S A. Rocky Flats Standards are part of this Criteria and may be obtained from the Engineering and Construction Department Building 441

Number	Title
SP-105	Standard for Service Piping Including Underground Water
SP-301	Standard for Pipe Systems Testing Procedure

APPENDIX 6.3

REFERENCE DRAWINGS AND DOCUMENTS

The following Dow Chemical U S A drawings and documents are a part of this criteria and may be obtained from the Engineering and Construction Department, Building 441

Number	Title
D-27239-1	Sanitary Landfill Test Holes (Sheet 1)
D-27239-2	Sanitary Landfill Test Holes (Sheet 2)

APPENDIX B

OPERATING PROCEDURES FOR THE LANDFILL

NOTE· Appendices available upon request.

Atomics International Division
Rocky Flats Plant
P O Box 464
Golden Colorado 80401
(303) 494 3311
Contractor to
Energy Research and Development
Administration

Rockwell
International

SERVICES DEPARTMENT PROCEDURE

NO. GT&L-ADM-5 REV. 0 DATE: April 27, 1976

TITLE: DEMPSTER-DUMPSTER - LANDFILL

1. POLICY:

1.1 Dumpster boxes on Plant site are dumped on a demand basis.

1.2 The majority of the boxes are dumped in the landfill for burial.

1.3 Some buildings use open top boxes for metal to be salvaged.

2. SCOPE.

2.1 To define services responsibility plan for the prompt and efficient trash removal and disposal from the plant site.

3. RESPONSIBILITY:

3.1 The Supervisor, Garage, Trucking & Labor is responsible for truck operation, dumpster box assignment, and movement of the boxes on plant site.

4. GENERAL INFORMATION & INSTRUCTIONS:

4.1 Unlocked Dumpster Boxes

4.1.1 Buildings 111, 121, 122, 123, 112, 331, 441, 333, 334, 443, 551, 445, 664, 440, 439, 147, 991, 750, 995, 706, and 864 have boxes without locks.

4.1.2 Building 334 has six dumpster boxes, one for paper, one for sawdust, one for metal turnings and three for scrap metal. The three for scrap metal is not dumped in the landfill, but is deposited in an area in the salvage yard.

4.1.3 Buildings 111, 121, 122, 123, 112, 331, 441, 333, 443, 551, 445, 440, 439, 991, 750, 664, 995, 706, and 864 are basically used for general building waste such as paper, cans, cartons, trash, etc.

Buildings 112 and 145 have open top, 4 cu. yd. boxes and are used for cafeteria waste and carbon waste respectively. Open end boxes are used at the 444 Precision for metal turnings.

4.1.4 The above boxes are checked daily and are dumped at the landfill, if they are at least half full. The scrap metal boxes are monitored and dumped at an area designated by PU&D department, building 551 Scrap metal boxes are dumped approximately every month

4.2 Locked Dumpster Boxes

4.2.1 Buildings 778, 776, 701, 777, 559, 779, 771, 774, 707, 883, 881, 865, 444 and 448 have dumpster boxes which are kept locked. The keys to these boxes are controlled by Custodial Supervision. Discarded material must be monitored before it is placed in the dumpster box.

4.2.2 Dumpster boxes in the above areas are called in to the trucking dispatcher by phone after it has been tagged and signed by Health Physics personnel. The dumpster driver is then contacted by radio and informed which box is ready to be dumped

4.2.3 Dumpster driver checks green tag for Health Physics signature, removes tag and retains for Supervisors inspection.

4.2.4 The dumpster driver has no knowledge as to what the boxes contain until they are dumped.

4.2.5 After the boxes are dumped and any of the contents arouses suspicion, the driver calls supervision.

4.2.6 If supervision suspects contamination, Health Physics is called to monitor material.

4.3 Dumpster Boxes Used by Building Services Personnel

4.3.1 Open top or open end dumpster boxes are frequently used by the Labor Department They are filled with dirt, rock, asphalt, concrete or a mixture of all to be disposed of at the landfill. The driver dumps these boxes on a demand basis at a spot determined by the dozer operator at the landfill.

4.3.2 If the material which goes into these boxes has been taken from an exclusion area, Health Physics

checks it before it is removed

4.3.3 The remaining boxes utilized on plant site are used by contractors Lab's office, Braun office, Cummins motor pool, Lab's warehouse, 371 building and 374 building. The trucking dispatcher is notified by phone and the dumpster driver is contacted by radio when the boxes are ready to be dumped.

4.4 Dumping Area

4.4.1 When dumpster boxes arrive at landfill, the dozer operator directs driver to dumping area.

4.4.2 When dumpster driver or any other driver arrives at the landfill with something other than the normal trash, the driver is questioned (when possible) by the dozer operator as to the origin of the material.

4.4 3 A full load of such material as duct, concrete, cinder blocks, pipe, roofing, etc , is placed in areas determined by the dozer operator.

4.4.4 If the operator sees anything unusual in the load, supervision is notified and steps are taken to determine what the material is and from where it came When this information is received and is acceptable, the material is spread out for burial

4.4.5 Permission is obtained from Waste Management before any liquid or chemical is dumped or buried at the landfill.

4.5 Contractor's Waste and Dirt

4.5.1 All trash from a construction area destined for the landfill is checked by the Guard as to type of trash and from where it originated. This information is recorded by the Guard and forwarded to trucking supervision where it is entered in a permanent record.

4.5.2 Upon arrival at landfill, the trash is disposed of in the same manner as that of Rockwell.

4.5.3 Dirt brought to the landfill is stock-piled and used for fill at the top of the lifts.

4.5.4 Dozer operator receives information (when possible)

from the driver as to the origin of the material or dirt and whether or not it has been checked by Health Physics.

4.5.5 If a Health Physics check has not been made, the material is set aside until it has been checked.

4.6 Fill and Compaction

4.6.1 All trash taken to the landfill is spread and compacted daily over an area approximately 100 feet by 45 feet. Health Physics monitor checks all material every day near the end of the shift. Four to six inches of dirt is then spread and that is compacted This process continues to within three feet of the top of the lift. Dirt is then dozed onto the top three feet of the lift and compacted. A new lift is then started.

4.6.2 There are two lifts open at all times. As one is completed; a new one is started. There are approximately 9,000 square feet of open lifts at all times.

4.7 General Information

4.7.1 Boxes are not dumped on excessively windy days.

4.7.2 Open top boxes are held to a minimum in exclusion areas.

4.7.3 Occassionally a small amount of paper will blow. This is usually picked up the following day

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