SOIL INVESTIGATION

FOR THE PROPOSED

KENSINGTON FIRE STATION

215 - 217 Arlington Avenue

Kensington, California

For

KENSINGTON FIRE DISTRICT

c/o Jeffries, Lyons, & Hill, Architects

1614 North Main Street

Walnut Creek, California

By

WOODWARD-CLYDE & ASSOCIATES
Consulting Soil Engineers and Geologists
Oakland, California

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May 28, 1969

Project S-11804

Kensington Fire District
c/o Jeffries, Lyons, & Hill, Architect
1614 North Main Street
Walnut Creek, California 94596

Attention: Mr. Sidney D. Lyons

Gentlemen:

In accordance with your request, we have investigated the site and soil conditions at the location of the proposed fire and police station. The site consists of two vacant lots at 215 - 217 Arlington Avenue in Kensington.

Our investigation indicates that the site is suitable for the construction of the proposed project. The accompanying report presents our conclusions and recommendations of the field investigation and laboratory tests upon which they are based.

Mr. Richard Bielefeld, Engineering Geologist, performed the geologic reconnaissance and fault study. The Staff Engineer assigned to this project was Mr. Donald Treadwell.

It has been a pleasure to be of service to you on this project. If additional consultation is required, please do not hesitate to contact us.

Very truly yours,

Robert S. Wright

Robert S. Wright
Project Engineer

RSW:al
cc: Milton Leong

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SCOPE

This report describes an investigation of the soil conditions at the site of the proposed structure. The purpose of this study is to determine the most satisfactory type and depth of foundation and the allowable soil pressures to be used in foundation design. Recommendations are also presented regarding site preparation and grading, lateral earth pressures and retaining wall construction, site drainage, and floor slab construction.

DESCRIPTION OF PROJECT

The proposed construction will consist of a two-story wood-frame stucco fire and police office and dormitory building with an attached one-story concrete or masonry-block apparatus room to house the fire-fighting equipment. Slab-on-grade construction will prevail throughout. Foundation and floor loadings are not presently known, but are assumed to be relatively light.

The steepness of the lot requires that retaining walls be constructed to accommodate the proposed structure and parking area. The location, layout, and dimensions of the proposed construction are shown on the Site Plan (Figure 1) and Section A-A (Figure 2).

FIELD INVESTIGATION AND LABORATORY TESTS

Five exploratory holes were machine-drilled at the locations shown on the Site Plan, Figure 1. Undisturbed (tube) and disturbed (sack) samples were recovered from these borings and returned to the laboratory for inspection and testing. The drilling was done on April 17, 1969, under the supervision of our Engineering Geologist who visually classified the cuttings and samples in the field. Boring logs were prepared from the field data and are presented as Figures 3 through 5. A description of our drilling and sampling techniques is given in the Appendix.

The water content, dry density, and unconfined compressive strength were determined for selected undisturbed samples in order to evaluate the strength characteristics of the underlying soils. The results of these tests are shown at the corresponding sample locations on the Logs of Borings. In addition, a representative disturbed sample of the near-surface soil was tested to determine its plasticity and gradation. These results are given on Figure 7.

GEOLOGIC RECONNAISSANCE AND FAULT STUDY

The site is in or near the Hayward Fault zone. Therefore, additional geologic studies of the site, using exploratory trenches and aerial photographs, were performed for the purpose of delineating traces of the Hayward Fualt that might traverse the site, and to provide more detailed knowledge of subsurface conditions. These studies were conducted by our Engineering Geologist, Mr. Richard Bielefeld.

Aerial photographic interpretation in conjunction with a visual reconnaissance of the general area places the nearest secondary trace of the Hayward Fault zone approximately 225 feet east of the site. Another, more pronounced, secondary trace lies about 250 feet to the west. Neither of these traces represent the main active zone of the Hayward Fault, which is generally placed approximately 1000 feet east of the site.

Three test trenches were excavated and geologically mapped on May 20, 1969 at the locations shown on the Site Plan. The trench exploration disclosed no evidence which would indicate the passage of a fault trace through the site. However, the underlying shale has been severely sheared as a result of stresses present within this portion of the Hayward Fault zone. Detailed geologic profiles of these trenches are presented on Figure 6.

SITE AND SOIL CONDITIONS

The site consists of two adjacent undeveloped lots in a residential area of Kensington. The existing ground surface slopes downward to Arlington Avenue at an average inclination of about 5 horizontal to 1 vertical. The site is clear, with some scattered growth of weeds and grasses.

The borings and trenches indicate that the surface soils consist of a medium stiff, dark brown silty clay to depths of from 6 to 7½ feet below grade. The clay is underlain by a layer of grey and brown, sheared and weathered shales having a thickness ranging from 3 to 10 feet. These shales become less weathered and sheared with depth. The brown, weathered shales are underlain by a dense, dark grey shale which was encountered to the limits of the borings.

Free groundwater was encountered in the borings and in the test trenches. In the trenches, groundwater levels ranged from about 8 feet below the surface at the rear of the lot to 4 feet below the surface near the front of the lot. Detailed descriptions of the soil conditions encountered are presented on the Logs of Borings and the Geologic Profiles of Trenches.

DISCUSSION

The surface soils (dark brown silty clays) at the site are moderate in shear strength and compressibility and are in the medium range of plasticity and potential expansibility. However, they are suitable for the support of shallow spread footings when designed and constructed in accordance with the recommendations presented herein.

A major problem in developing the site will be the design and construction of retaining walls. The retaining wall which will be the rear wall of the proposed structure may be constructed in a normal manner. However, it is probable that the excavation will penetrate the groundwater table with resultant problems of drainage and stability. Special consideration must be given to the design and construction techniques of the upper retaining wall because of the immediate proximity of the property above and the sewer line which parallels the rear property line. This condition presents problems of limited accessibility and work space, stability during construction and design criteria. Detailed recommendations for design and construction are presented in the following section.

Our geologic studies indicate that the site is not crossed by a fault trace. However, the site is in the Hayward Fault zone and has experienced deformation and stresses which have caused the sheared and slide-prone zones noted on the Geologic Profiles. It should be recognized that the site is located in an earthquake region and will doubtless be subjected to future earthquake shaking. However, provided the proposed structure is designed and constructed to withstand the shocks and vibrations as designated in the standard western engineering codes, the earthquake hazards within this site are considered to be not greater than in other localities in the San Francisco Bay region having similar foundation conditions.

RECOMMENDATIONS

Foundations - It is recommended that the proposed structures be founded on continuous or isolated spread footings bearing on undisturbed soil or select engineered fill at the depths recommended below.

Footings bearing on undisturbed soil should extend to a minimum depth of 2 feet below the existing grade or 2 feet below the lowest adjacent finished grade, whichever depth is lower. At the recommended depth, the allowable soil pressure should not exceed 1500 psf due to dead loads, 2250 psf due to combined dead plus live loads, and 3000 psf due to all loads, including wind or seismic.

Footings bearing on select engineered fill should extend to a minimum depth of 1½ feet below existing grade or lowest adjacent finished grade, whichever depth is lower. The select engineered fill should extend to a depth of at least 2 feet beneath the footings, and the limits of the fill layer should extend beyond the footing at least 2 feet on all sides. At the recommended depth, the allowable soil pressure should not exceed 2000 psf due to dead loads, 3000 psf due to combined dead plus live loads, and 4000 psf due to all loads, including wind or seismic.

If increased lateral restraint and allowable bearing pressures are desired, a foundation system consisting of end-bearing piers with interconnecting grade beams should be used. Drilled, cast-in-place, concrete piers should extend through the silty clay and brown shale and at least 1 foot into the dark grey shale. This will involve pier depths ranging from about 7 to 11 feet below existing grade (about 5½ to 7½ feet below finished floor elevation 517). Piers may be designed using maximum allowable soil bearing pressures of 3000 psf due to dead loads, 4000 psf due to combined dead plus live loads, and 5000 psf due to all loads, including wind or seismic. Piers may be either straight-shafted or belled to obtain the necessary bearing area. Because the piers will be end-bearing, it is important that the bottoms of the pier holes be clean and free from water, loose materials, rubble, and debris before they are filled with concrete. All pier shafts should have a minimum diameter of 30 inches to permit access for inspection and cleaning. It should be recognized that caving conditions in the weathered and fractured shale may require casing the shaft, and groundwater conditions may require pumping.

Regardless of the foundation type chosen, the Soil Engineer should inspect all excavations prior to placement of reinforcing steel or concrete to verify the conditions forming the basis of these recommendations and to make supplemental recommendations if necessary. If piers are used, the Soil Engineer should continuously observe the drilling operation to determine that the holes extend into the recommended bearing material and are sufficiently cleaned.

Any utility installations adjacent to footing foundations should have the trench bottoms above a 1 to 1 plane extending downward from the bottom edge of the adjacent footing.

Floor Slabs - In order to reduce the likelihood of moisture passing upward through the floor slabs and to minimize the effects of volume change due to changes in soil moisture content, all floor slabs should be supported on a 1-foot thick layer of select, non-expansive engineered fill.

It is further recommended that a minimum of 4 inches of open-graded rock be placed under the floor slab to act as a capillary break. In areas where dampness of the floor slab would be undesirable or a moisture-susceptible floor covering is to be used, a waterproof membrane covered by 2 inches of sand should also be placed over the gravel to prevent moisture vapor migration into the floor slab. The sand will protect the membrane during construction. For your convenience, a copy of "Guide Specifications for Rock Under Floor Slabs" is enclosed. The recommended thickness of sand and gravel is in addition to the recommended thickness of select engineered fill.

Exterior sidewalk and lightly loaded slabs may be constructed on a nominal thickness of base rock. Subgrade preparation under exterior slabs should be equivalent to that recommended for interior slabs. Base rock thickness for this type of construction will depend on the service and loading requirements of the slab, but should be about 4 inches.

Retaining Walls - The site development includes construction of three levels of retaining walls. The north and east walls of the apparatus room and the first floor east and south walls of the office and dormitory building will be designed as retaining walls. Because of the restraint provided by the building structure, these walls should be designed for "at rest" earth pressures.

The retaining wall at the property line and the wall at the rear of the dormitory building, which retains the parking lot fill to form the lightwell behind the building, comprise the other retaining structures. These walls should be designed to resist "active" earth pressures.

The recommended lateral pressures, footing depths and bearing capacities are summarized below.

	Building Wall	Lightwell Wall	Rear Wall (at Property Line)
Design Lateral Pressure (Equivalent Fluid Pressure)[1]	75 pcf	40 pcf	100 pcf
Foundation Depth (min.) (below lowest adjacent finished grade)	3 ft	3 ft	3 ft
Allowable Bearing Pressure (maximum)	2000 psf	2000 psf	2000 psf

Note:
(1) These pressures are based on drained soil conditions and do not include hydrostatic pressures due to groundwater.

It is recommended that a subdrain be placed behind all walls. This drain should consist of a 4-inch minimum perforated pipe or drain tile placed at the bottom of all retaining walls in accordance with the enclosed "Guide Specifications for Subsurface Drains". The pipe should lead to a free-draining outlet. Weep holes through the wall, 3-inch diameter, at a maximum spacing of 10 feet may be used in lieu of perforated pipe where suitable drainage conditions prevail. In any case, the walls should be backfilled with a continuous blanket of filter drain material to permit rapid drainage of groundwater.

Where vehicular parking or other surcharge loading is anticipated on the backfill behind the wall, the wall should be designed to resist a uniform load equal to 1/3 the average vehicular or surcharge loading in addition ot the pressures recommended above. For purposes of computing slide resistance, a passive earth pressure equal to that of a fluid weighing 250 pcf acting over the depth of wall footing below the lowest adjacent finished grade may be used. The allowable passive pressure may be increased to 300 pcf acting on a key under the stem. In computing the passive resistance, any support provided by the upper 12 inches should be neglected unless the adjacent area is paved with concrete or asphalt. We should be consulted if this becomes critical and more detailed recommendations are desired. A factor of safety of 1.5 against sliding and against overturning should be used.

Drainage - Recommendations for subsurface drains behind retaining walls have been given in the previous section. It is further recommended that these drains be extended to positive outlets, either in the street or by discharging into storm sewer inlets. These drain extensions should be placed in trenches backfilled with drain rock. The upper foot of the trench should be backfilled with relatively impervious soil compacted to engineered fill requirements.

Surface drainage of paved areas can be handled by proper planning of finish grades and the use of gutters and/or catch basins.

Downspouts from the roof should not be allowed to discharge on the ground or on paved areas. Provisions should be made to collect this water in gutters or drains leading to positive outlets.

Site Preparation and Grading - It is recommended that all grading on the site be done under the observation of the Soil Engineer or his representative in the field. All grading should be done in accordance with the enclosed "Guide Specifications for Engineered Fill" and the recommendations presented below.

Site preparation should consist of stripping the area to a sufficient depth to remove all topsoil, brush, grass, organic matter, and debris. Any soft or loose soils should also be overexcavated.

The exposed surfaces to receive fill should then be scarified to a minimum depth of 6 inches and recompacted to the requirements for engineered fill. Engineered fill may then be placed to the desired grades in accordance with the attached "Guide Specifications".

On-site materials are suitable for use as engineered fill except where select fills are specified. Compactive effort should be sufficient to produce a minimum degree of compaction of 90 percent in all fills and backfills.

The exploratory trenches remaining from the investigation have been loosely backfilled. During the site grading operations, these trenches should be overexcavated and the backfill compacted to the requirements for engineered fill. The approximate limits of the trenches can be estimated from the trench logs, Figure 6.

Pavements - Paved areas will consist of the concrete-paved apparatus room floor and driveway and the asphalt-paved parking area and driveway. Recommended minimum sections for both areas are given below:

Apparatus Room Floor and Driveway

7" Portland Cement Concrete
6" Aggregate Base (Class 2)
12" Select Engineered Fill

Passenger Car Parking and Driveway

3" Asphaltic Concrete
7" Aggregate Base (Class 2)

Asphaltic pavements should be constructed in accordance with the enclosed "Guide Specifications for Pavement". Portland cement concrete paving slabs should be designed and constructed in accordance with the latest recommendations of the Portland Cement Association.

CONSTRUCTION

Excavation Shoring - During excavation of the exploratory trenches, caving and collapse of the trench sides occurred in several instances. This is to be expected in highly sheared and broken shaley materials, especially in the vicinity of the groundwater table.

In order to perform the necessary excavation at the property boundaries without disturbing the adjacent property shoring will be required. This is particularly important along the east boundary because of the uphill slope of the adjacent property and the presence of the sanitary sewer in the 5 foot easement immediately to the east of the property line.

A number of alternate shoring schemes for the excavation along the east boundary have been considered. In our opinion, the following scheme is preferred and we suggest that it be used.

1. A line of cast-in-place, reinforced concrete soldier piles should be installed along the property boundary. These soldier piles should have a diameter which is not

less than 12 inches and should extend to a minimum depth of 6 feet below the lowest level of retaining wall footing or other excavation. These piles would be constructed by boring holes at a maximum spacing of 4 feet center to center placing reinforcing steel and filling the holes with structural concrete. This will result in a maximum clear space of 3 feet between soldier piles. The piles should be designed to support a uniform lateral pressure of 300 psf.

2. To support the top ends of the soldier piles, a reinforced concrete waler should be constructed at the top of the piles. The pile reinforcing should extend up into the waler and be continuous with the waler reinforcing. The waler should be positioned so that it does not obstruct the placing of concrete in the finished wall. The waler should be supported horizontally either by buttresses which will become part of the finished wall or by tiebacks or other suitable system. The use of tiebacks would require permission from the adjacent property owners to drill and grout in the anchors. It is our understanding that the wall will be a buttressed wall and the buttresses can be utilized to support the soldier piles and waler.

3. After the soldier piles, waler and buttress system are in place, the excavation can be completed. It is our opinion that lagging will be unnecessary and that the soil will be supported by arching between the soldier piles.

4. When the excavation is complete, the subdrain pipes and filter drain material should be placed and the wall constructed. The soldier piles and waler system will remain in place and will become a permanent part of the wall.

In order to place the drain material, a crescent-shaped section should be cut into the soil between each pier to provide a space for drain rock. The wall forms to retain the drain material and the reinforcing steel may then be placed. These back wall panels will remain in place. Drain rock should be placed in the spaces provided as soon as possible after excavation.

Prior to pouring concrete, weep hole pipes should be installed which penetrate the formwork and extend into the drain rock between each pier location. A drain should be installed in front of the wall which will collect and carry off the water derived from the weep holes and any plant watering.

Other schemes including soldier piles and lagging present complications during removal and backfill operations.

It is possible that temporary construction slopes of 1 to 1 can be made without shoring. However, it must be recognized that in this sheared and broken material the use of unsupported excavation slopes may result in local failures depending on the orientation of fractures and old slide planes. It is our opinion that all cuts should be braced to minimize disturbance of adjacent materials, and to prevent unexpected failures of the sides of the excavations.

It is recommended that the Soil Engineer review the planned site excavation and shoring schemes before excavation is begun.

LIMITATIONS

The opinions and recommendations presented in this report are based on the assumption that the soil conditions do not deviate appreciably from those disclosed in the borings and trenches, and that the correlations between observed and estimated soil properties and site conditions are valid. If any variations or undesirable conditions are encountered during construction of if the proposed construction or building locations will differ from that planned at the present time, the Soil Engineer should be notified so that supplemental recommendations can be made. It is recommended that the Soil Engineer review the foundation and grading plans and specifications prior to construction, and observe the earthwork and foundation construction to verify the conditions assumed and to present supplemental recommendations if required.

ENGINEERED FILL

A. GENERAL CONDITIONS

1. Definition of Terms

FILL.....is all soil material placed to raise the natural grade of the site or to backfill excavations.

ON-SITE MATERIAL.....is that which is obtained from the required excavation on the site.

IMPORT MATERIAL.....is hauled in from off-site borrow areas.

ENGINEERED FILL.....is a fill which the Soil Engineer has made sufficient tests and observations to enable him to issue a written statement that in his opinion the fill has been placed and compacted in accordance with the specification requirements.

SELECT MATERIAL.....is a soil material meeting the requirements set forth in C (2) below.

STANDARD SPECIFICATIONS.....are the 1964, or later, edition of the Standard Specifications of the State of California, Department of Public Works, Division of Highways.

MATERIALS MANUAL.....is that of the State of California, Department of Public Works, Division of Highways, latest revision.

DEGREE OF COMPACTION.....is the ratio, expressed as a percentage, of the dry density of the fill material as compacted in the field, to the maximum dry density of the same material determined by AASHO Test Designation T180-57, "Moisture-Density Relations of Soils Using a 10-lb Hammer and an 18 inch Drop."

OPTIMUM MOISTURE CONTENT.....is the moisture content which occurs at the maximum dry density as determined by AASHO Test Designation T180-57.

ENGINEERED FILL

2. Duties of Soil Engineer

The Soil Engineer shall be the owner's representative to observe the grading operations both during preparation of the site and the compaction of any engineered fill. He shall make enough visits to the site to familiarize himself generally with the progress and quality of the work. He shall make a sufficient number of field observations and tests to enable him to form an opinion regarding the adequacy of the site preparation, the acceptability of the fill material, and the extent to which the degree of compaction of the fill, as placed, meets the specification requirements. Any fill that does not meet the specification requirements shall be removed and/or recompacted until the requirements are satisfied.

3. Soil Conditions

A soil investigation has been performed for this site. The contractor shall familiarize himself with the soil conditions at the site, whether covered in the report or not, and shall thoroughly understand all recommendations associated with grading.

B. SITE PREPARATION

1. Excavation

All excavations shall be carefully made true to the grades and elevations shown on the plans. The excavated surfaces shall be properly graded to provide good drainage during construction and prevent ponding of water.

2. Preparation for Filling

All topsoil shall be stripped to a minimum depth of 4 in. or to such greater depth as the Soil Engineer in the field may consider as being advisable to remove material, which, in his opinion, is unsatisfactory. This material shall either be removed from the site or stockpiled for reuse later as topsoil, but none of this stripped material may be used for engineered fill. Any soft zones or soil with shrinkage cracks exposed during stripping shall also be excavated.

ENGINEERED FILL

After the site is stripped and the unsuitable soils excavated, the exposed surfaces shall be scarified to a minimum depth of 6 in. and compacted at a moisture content that will permit proper compaction as hereinafter specified for fill. All native soils beneath floor slabs or in pavement areas shall be compacted at a moisture content from 1 to 3% above the optimum moisture content as defined in A (1) above. All debris or otherwise unsuitable material shall be removed before compaction. Before placing fill, the contractor shall obtain the soil engineer's approval of the site preparation in the area to be filled. The requirements of this section may be omitted only when approved in writing by the Soil Engineer.

C. MATERIAL USED FOR FILL

1. General Requirements for Fill Material

All fill material must be approved by the Soil Engineer. The material shall be a soil or soil-rock mixture which is free from organic matter or other deleterious substances. The fill material shall not contain rocks or lumps over 6 in. in greatest dimension, and not more that 15% larger than 2-1/2 in. Materials from the site, but below the topsoil layer, are suitable for use in fills. The native soils do not meet the requirements of select material.

2. Requirements for Select Fill Material

In addition to the requirements of C (1) above, select material must conform to the following requirements:

	Minimum Requirements
Minimum "R" Value	25
Maximum Expansion Pressure	150
Maximum Plasticity Index	15

*Values at an exudation pressure of 300 psi as determined by Test Method No. 301-F of the Materials Manual.

ENGINEERED FILL

3. Requirements for Import Material

All import material shall meet the requirements of select fill material as given in C (2) above.

D. PLACING AND COMPACTING FILL MATERIAL

All fill material shall be compacted as specified below, or by other methods, if approved by the Soil Engineer, so as to produce a minimum degree of compaction of 90%. Fill material shall be spread in uniform lifts not exceeding 8 in. in uncompacted thickness. Before compaction begins, the fill shall be brought to a water content that will permit proper compaction by either: (1) aerating the material if it is too wet; or (2) spraying the material with water if it is too dry. Each lift shall be thoroughly mixed before compaction to ensure a uniform distribution of water content. All native soils placed within 3 ft of the finished grade shall be compacted at a moisture content of 1 to 3% above optimum.

E. TREATMENT AFTER COMPLETION OF GRADING

After the grading is completed and the Soil Engineer has finished his observation of the work, no further excavation on filling shall be done except with the approval of and under the observation of the Soil Engineer.

It shall be the responsibility of the grading contractor to prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

ROCK UNDER FLOOR SLABS

A. DESCRIPTION

Graded gravel or crushed rock for use under floor slabs shall consist of a minimum thickness of 4 inches of mineral aggregate placed in accordance with these specifications and in conformity with the dimensions shown on the plans.

B. MATERIALS

The mineral aggregate for use under floor slabs shall consist of broken stone, crushed or uncrushed gravel, clean quarry waste or a combination thereof. The aggregate shall be free from adobe, vegetable matter, loam, volcanic tuff, and other deleterious substances. It shall be of such quality that the absorption of water in a saturated surface dry condition does not exceed 3 percent of the oven dry weight of the sample.

C. GRADATION

The mineral aggregate shall be of such size that the percentage composition by dry weight as determined by laboratory sieves (U.S. Series), will conform to the following grading:

Sieve Size	Percentage Passing Sieve
1"	100
3/4"	90 - 100
No. 4	0 - 10

SUBSURFACE DRAINS

A. DESCRIPTION

Underdrains consisting of perforated vitrified clay pipe, or perforated asbestos cement pipe shall be installed as shown on the plans and in accordance with these specifications, unless otherwise specified by the Engineer.

B. MANUFACTURE

Underdrains shall be manufactured in accordance with the following requirements:

1. Perforated vitrified clay pipe shall conform to the specifications for extra-strength perforated clay pipe of AASHO Designation M65.

2. Perforated asbestos cement pipe shall conform to the specifications of AASHO Designation M189.

C. FILTER MATERIAL

Filter material for use in backfilling excavations around and over underdrains shall consist of clean coarse sand and gravel or crushed stone conforming to the following grading requirements.

Sieve Size	Percentage Passing Sieves
2"	100
3/4"	70-100
3/8"	40-100
No. 4	25-50
No. 8	15-35
No. 30	5-18
No 50	0-10
No. 200	0-3

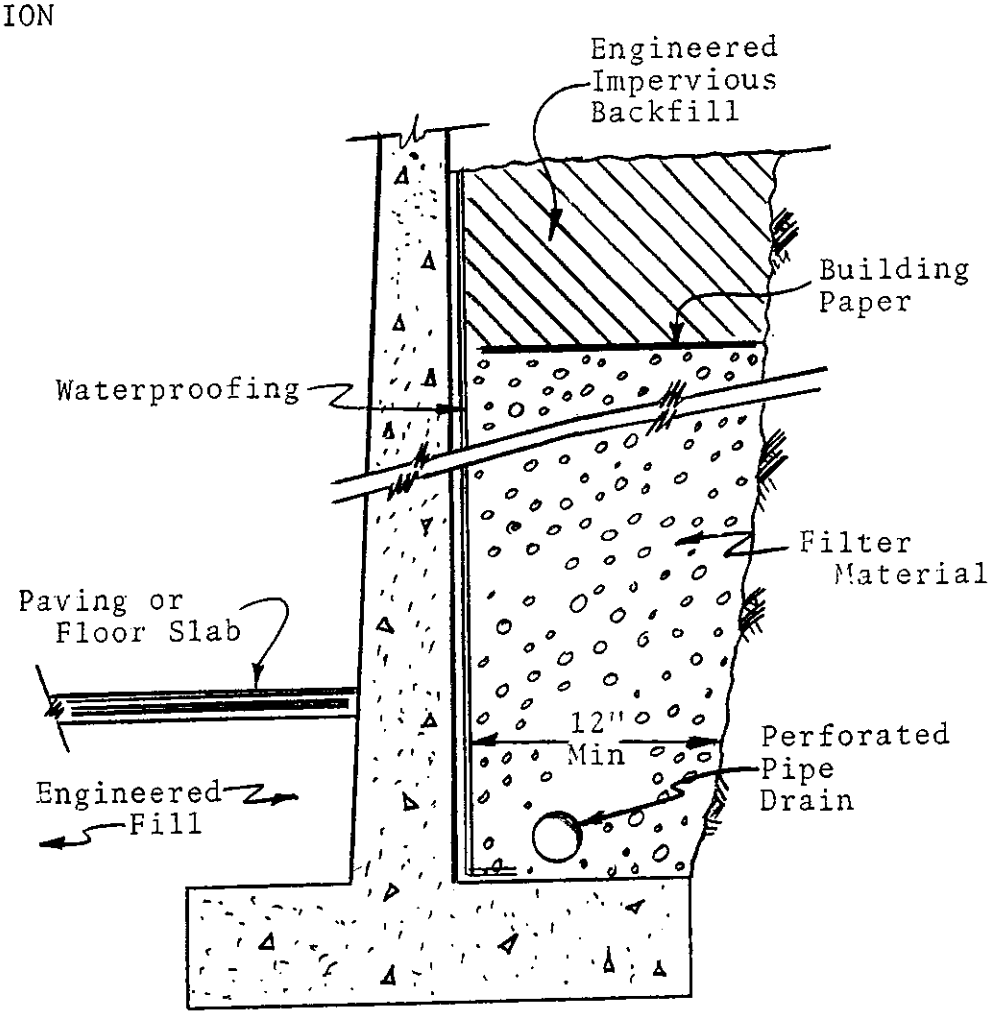
D. PLACING

The perforated pipe drain shall be placed at the base of the wall. The pipe shall be placed with the perforations down on a minimum thickness of 4 inches of compacted filter material to the elevations and grades shown on the plans or as directed by the Engineer. The pipe shall be laid with lightly caulked joints to prevent intrusion of the filter material into the pipe.

SUBSURFACE DRAINS

After the pipe has been placed, the wall shall be backfilled with filter material to the elevations shown on the plans, or as directed the Engineer. The filter material shall be compacted by vibration or by other means approved by the Engineer to the relative compaction requirements of engineered fill. The filter material shall be protected against contamination. The upper surface of the filter rock adjacent to the wall shall be covered with a layer of building paper or plastic. The upper portion of the excavation shall then be backfilled with an impervious soil which shall be compacted to the requirements of engineered fill.

E. TYPICAL SECTION



PAVEMENT

A. DEFINITIONS

The term pavement shall include asphalt concrete surfacing and aggregate base. The term subgrade is that portion of the area on which surfacing and base is to be placed.

The term "Standard Specifications" hereinafter referred to is the Standard Specifications, July, 1964, and the "Materials Manual" is the Materials Manual of Testing and Control Procedures State of California, Department of Public Works, Division of Highways. The term degrees of compaction refers to the ratio of the field density to laboratory density as defined in the Guide Specifications for Engineered Fill.

B. SCOPE OF WORK

This portion of the work shall include all labor, materials, tools and equipment necessary for and incidential to the completion of the pavement shown on the plans and as herein specified, except work specifically noted as "Work Not Included".

C. PREPARATION OF THE SUBGRADE

The contractor shall prepare the surface of subgrade receiving subsequent pavement courses to the lines, grades, and dimensions given on the plans. The upper 12 in of material forming the subgrade beneath the aggregate base shall conform to the requirements set forth for select fill under section C (2) in the Guide Specifications for Engineered Fill and in addition be compacted to a minimum degree of compaction of 95%. The finished subgrade shall be tested and approved by the Soil Engineer prior to the placement of additional pavement courses.

D. AGGREGATE BASE

The aggregate base shall be spread and compacted on the prepared select material in conformance with the lines, grades, and dimensions shown on the plans as specified in Section 26 of the Standard Specifications and the following provisions:

The base material shall be 1-1/2 or 3/4 in maximum Class 2 aggregate base and conform to the requirements outlined in Section 26-1.02B. The R-value requirement will not be waived regardless of the aggregate gradation and sand equivalent. The aggregate base may be placed in one lift.

E. ASPHALT CONCRETE SURFACING

Asphalt concrete surfacing shall consist of a mixture of mineral aggregate and asphalt binder mixed at a central mixing plant and spread and compacted on the prepared base in conformance with the lines, grades, and dimensions shown on the plans, and as specified in Section 39 of the Standard Specifications and the following provisions:

The asphalt binder to be mixed with the mineral aggregate shall be steam refined paving asphalt conforming to the provisions of Section 92 and shall have a penetration range of 60-70 or 85-100.

The aggregate to be mixed with the asphalt binder shall conform to the requirements for Type B mineral aggregate with ½ in maximum size and medium grading.

The asphalt concrete shall be placed and compacted in two lifts of approximately equal thickness.

APPENDIX

FIELD INVESTIGATION

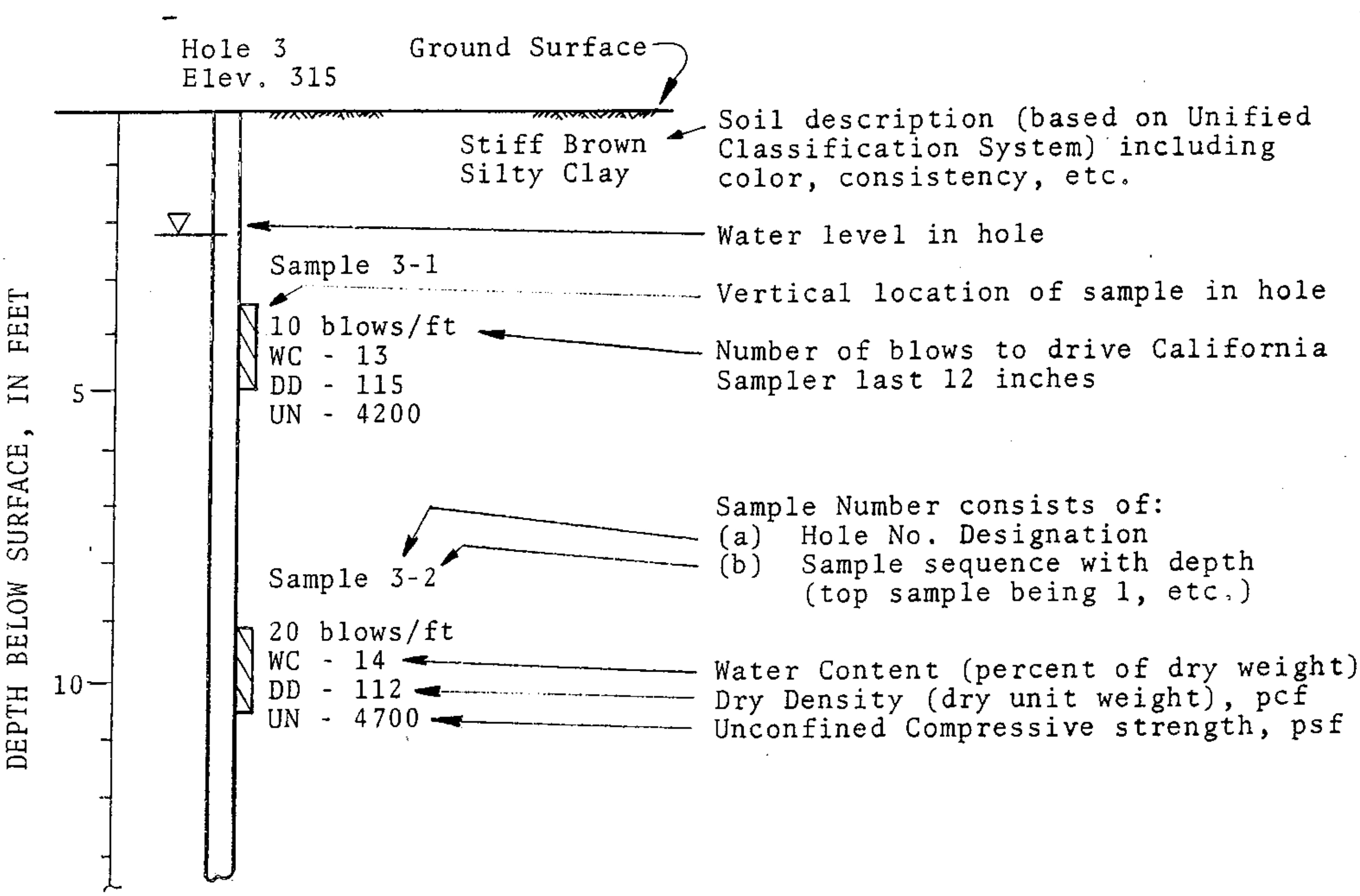
Five borings were drilled at the approximate locations shown on the Site Plan, Fig. 1. Borings were advanced with a 6-in. diameter continuous-flight power auger. The drilling was done on April 17, 1969, under the direct supervision of our Engineering Geologist.

Samples of the underlying soils were obtained with a 2-in. inside diameter modified California drive sampler. The sampler has thin brass liners. The sampler was driven 18 in. into the soil at the bottom of the hole with a 140-lb hammer falling 30 in. When the sampler was withdrawn from the test hole, the brass tubes containing the soil samples were removed, carefully sealed to preserve the natural moisture content, and returned to the laboratory for testing. Classifications are made in the field by our engineering geologist and are verified by an examination by the staff engineer and by test results. Boring logs were prepared from the field data, and are presented as Figures 3 through 5.

To further delineate the soil profile, three trenches were excavated by a crawler-mounted backhoe at the locations shown on the Site Plan. This work was done under the direct supervision of our Engineering Geologist, who evaluated and geologically mapped the materials exposed by the excavation. Geologic profiles of the trenches are presented on Figure 6.

APPENDIX

KEY TO BORING LOGS



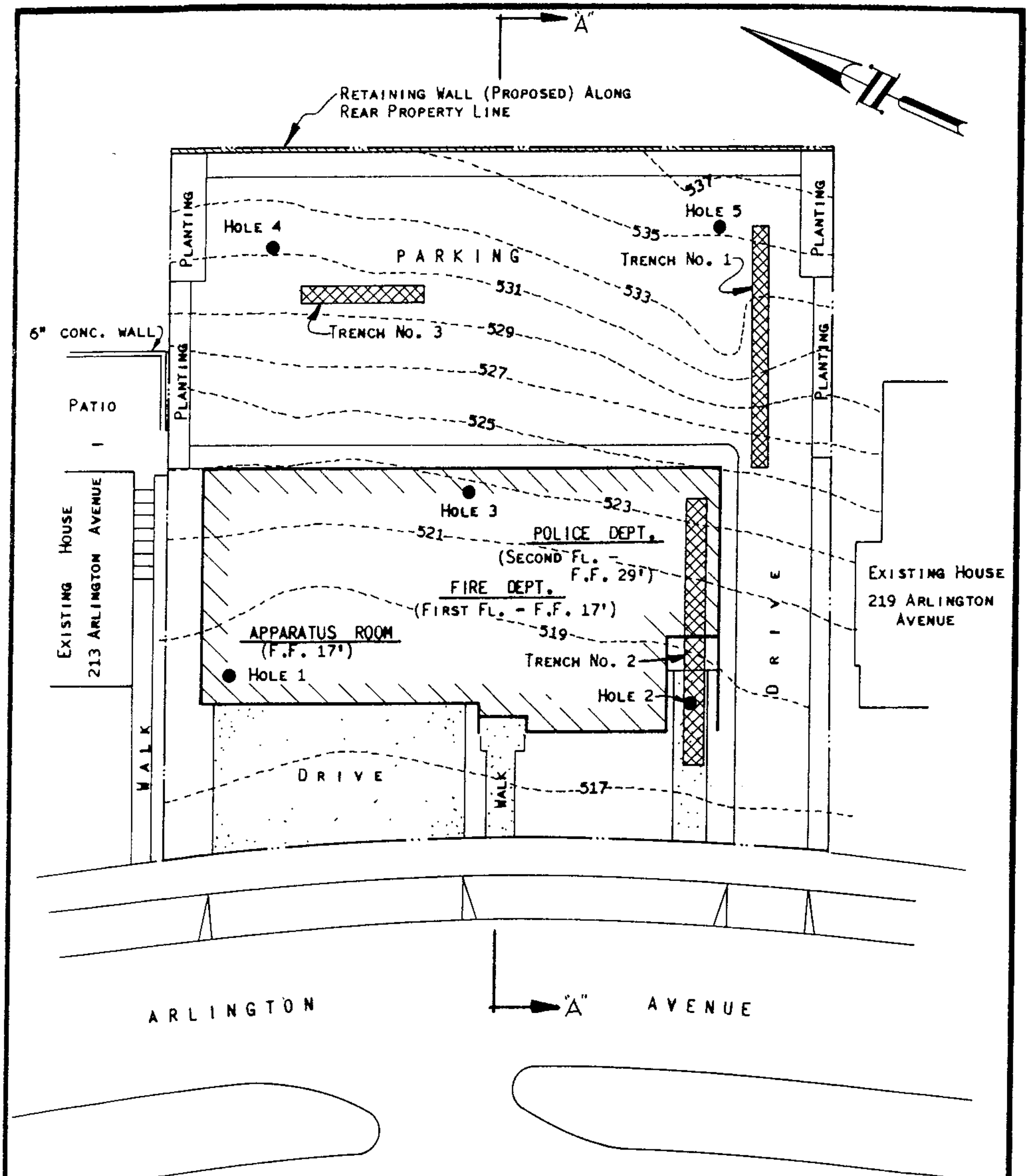
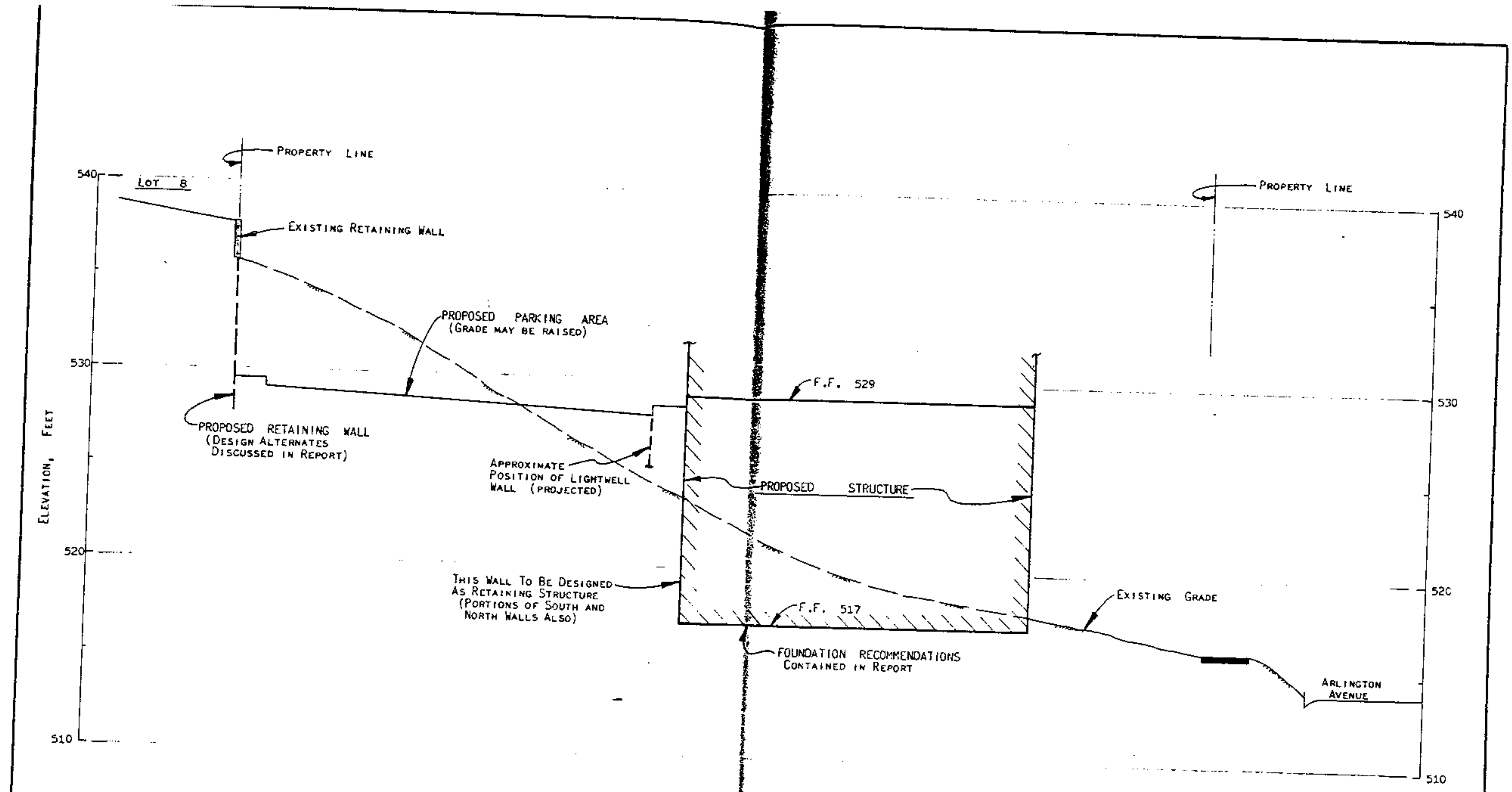


Fig. 1 - Site Plan

scale: 1" = 20'

KENSINGTON FIRE STATION
215 - 217 Arlington Avenue

Kensington, Calif.



Horiz. Scale: 1" = 10'

Vert. Scale: 1" = 5'

WOODWARD - CLYDE & ASSOCIATES CONSULTING SOIL ENGINEERS AND GEOLOGISTS 2730 ADELINE STREET OAKLAND, CALIFORNIA 94607			
Fig. 2 - Section "A - A" KENSINGTON FIRE STATION			
DESIGNED BY:	APPROVED BY:	SCALE: NOTED	DATE: 5-26-69
CHECKED BY: D. T.			

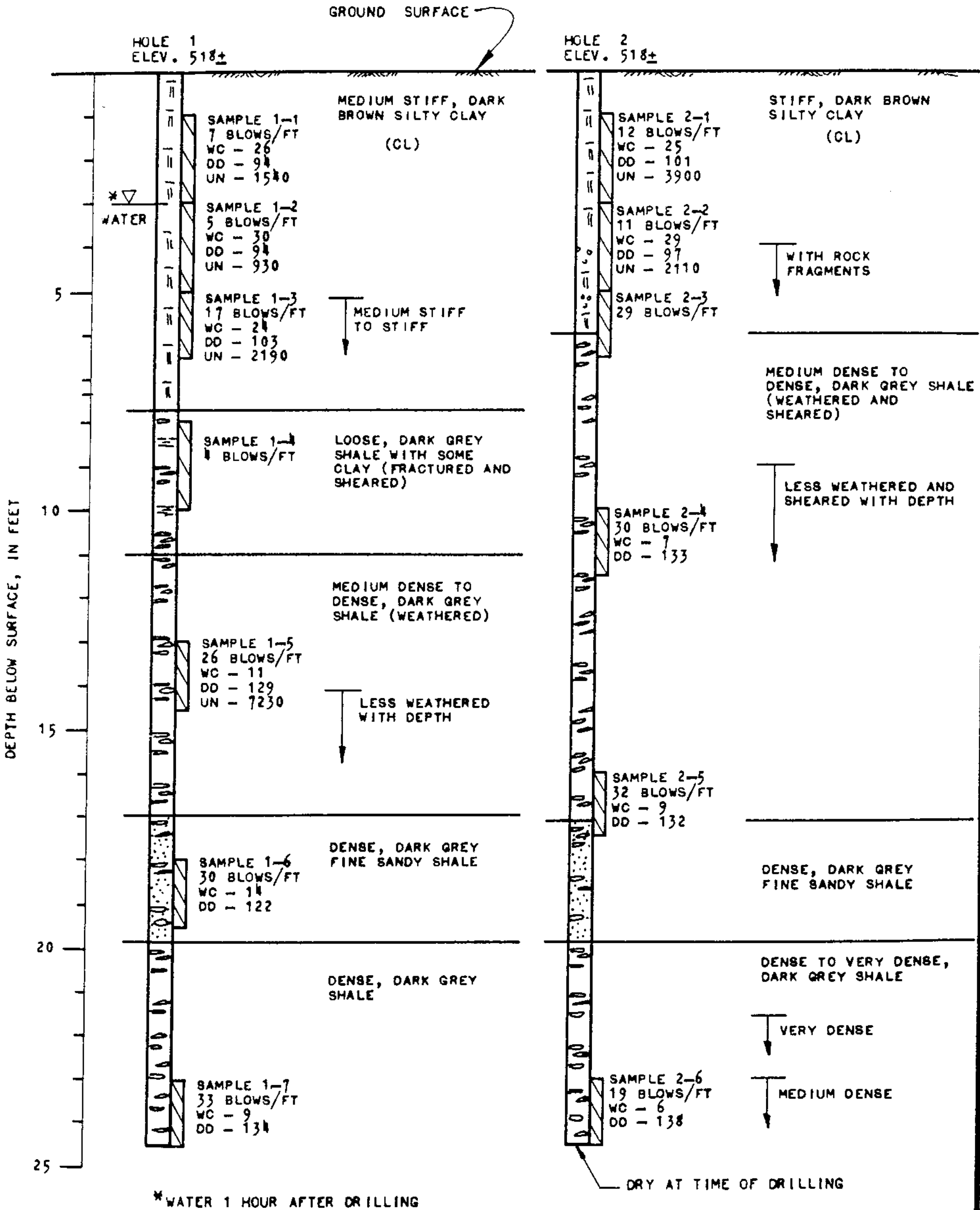


FIG. 3 – LOGS OF BORINGS

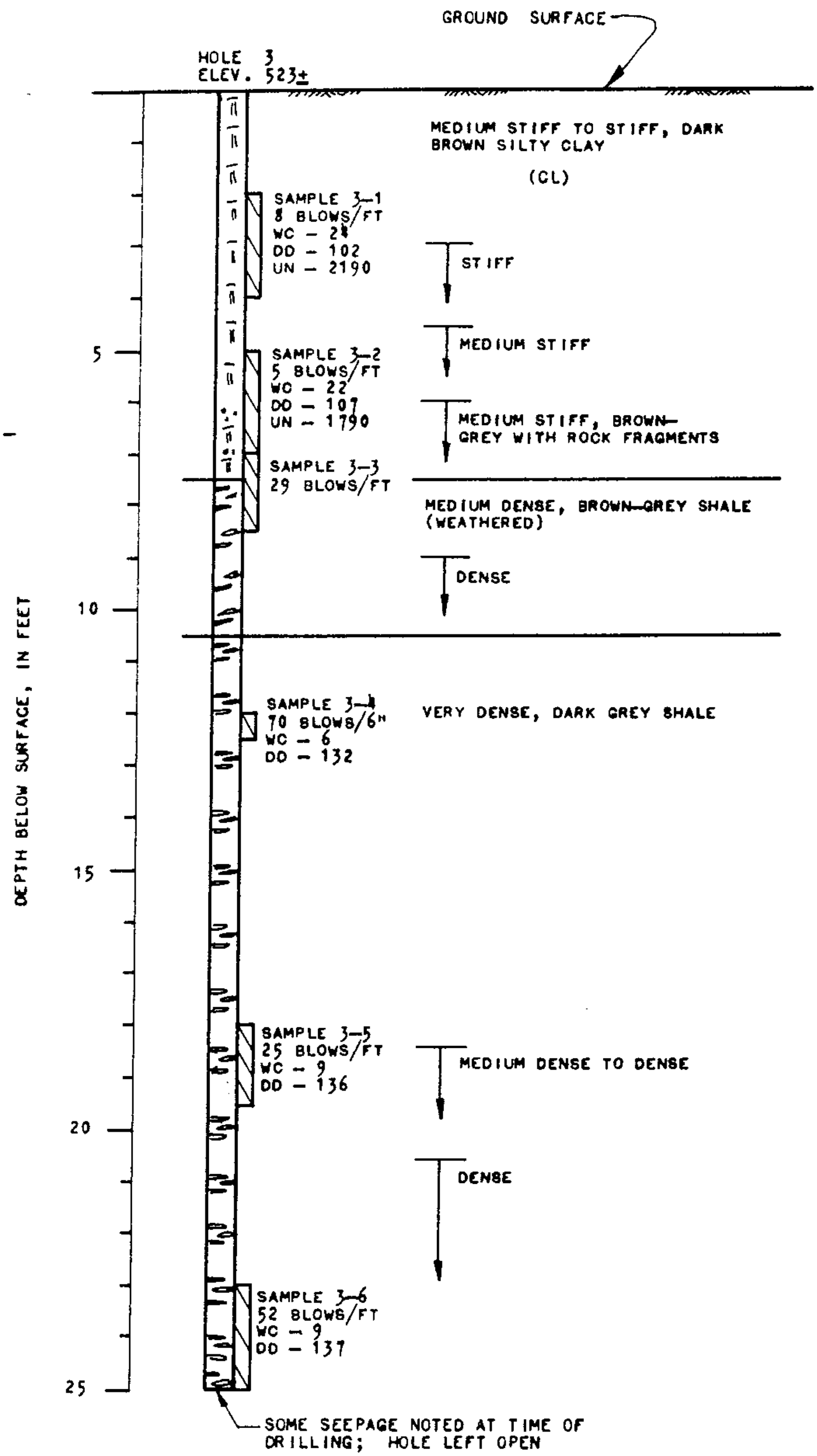


FIG. 4 – LOG OF BORINGS

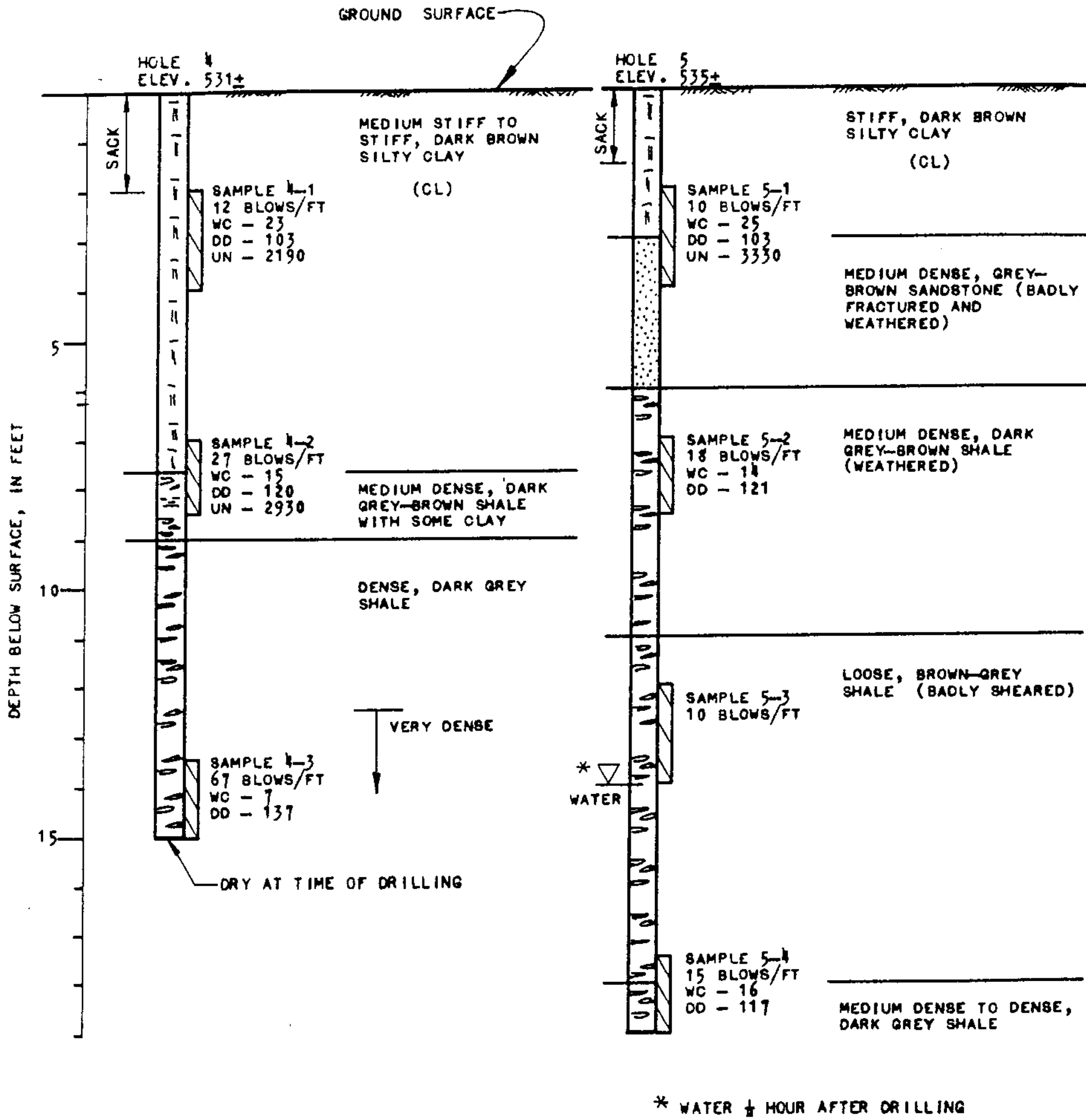
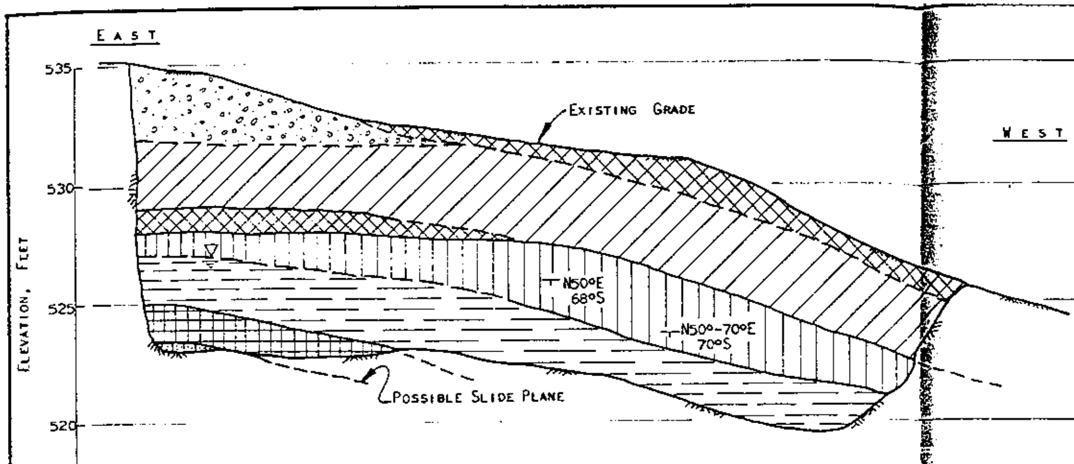
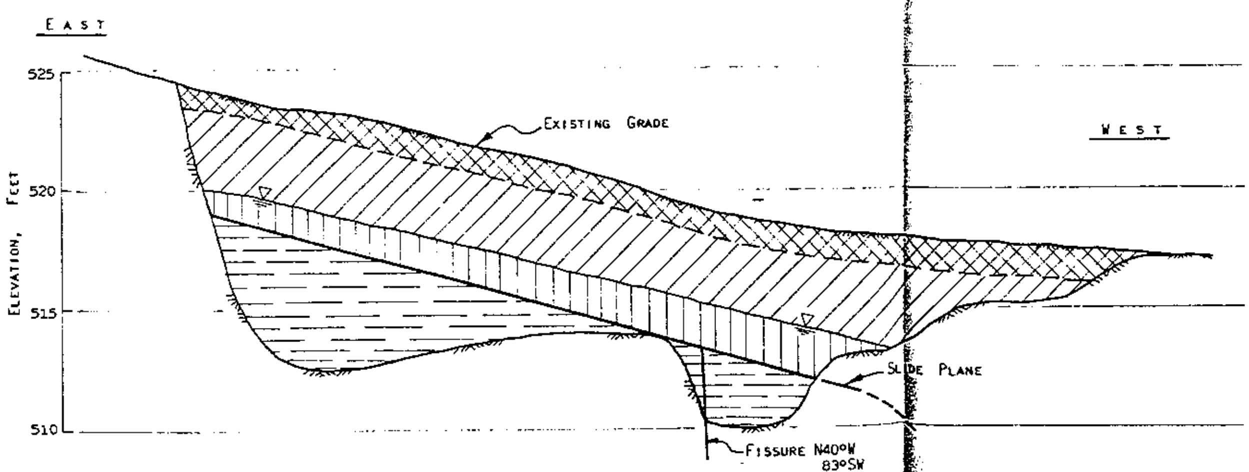


FIG. 5 - LOGS OF BORINGS



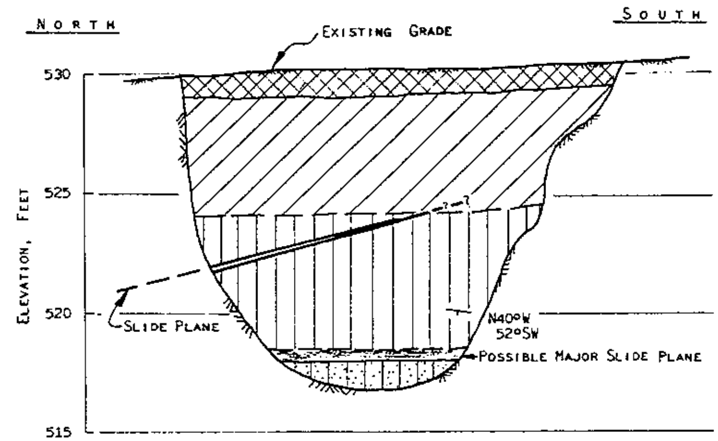
Geologic Profile Of Trench No. 1 Looking South

Scale: 1" = 5' Horiz. & Vert.



Geologic Profile Of Trench No. 2 Looking South

Scale: 1" = 5' Horiz. & Vert.



Geologic Profile Of Trench No. 3 Looking East

Scale: 1" = 5' Horiz. & Vert.

Legend:

- Fill: Sandy clay (CL)
- Topsoil: Medium stiff, dark reddish brown, sandy clay (CL - CH)
- Residual Soil: Very stiff, light reddish brown, clay (CH)
- Decomposed Shale: Soft, olive brown, highly weathered and fissured
- Shale: Hard, olive brown, partially weathered
- Shaly Clay: Very stiff, blue, sheared (CH)
- Shale: Hard, massive, blue-grey

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Fig. 6 - Geologic Profile Of Trenches

KENSINGTON FIRE STATION

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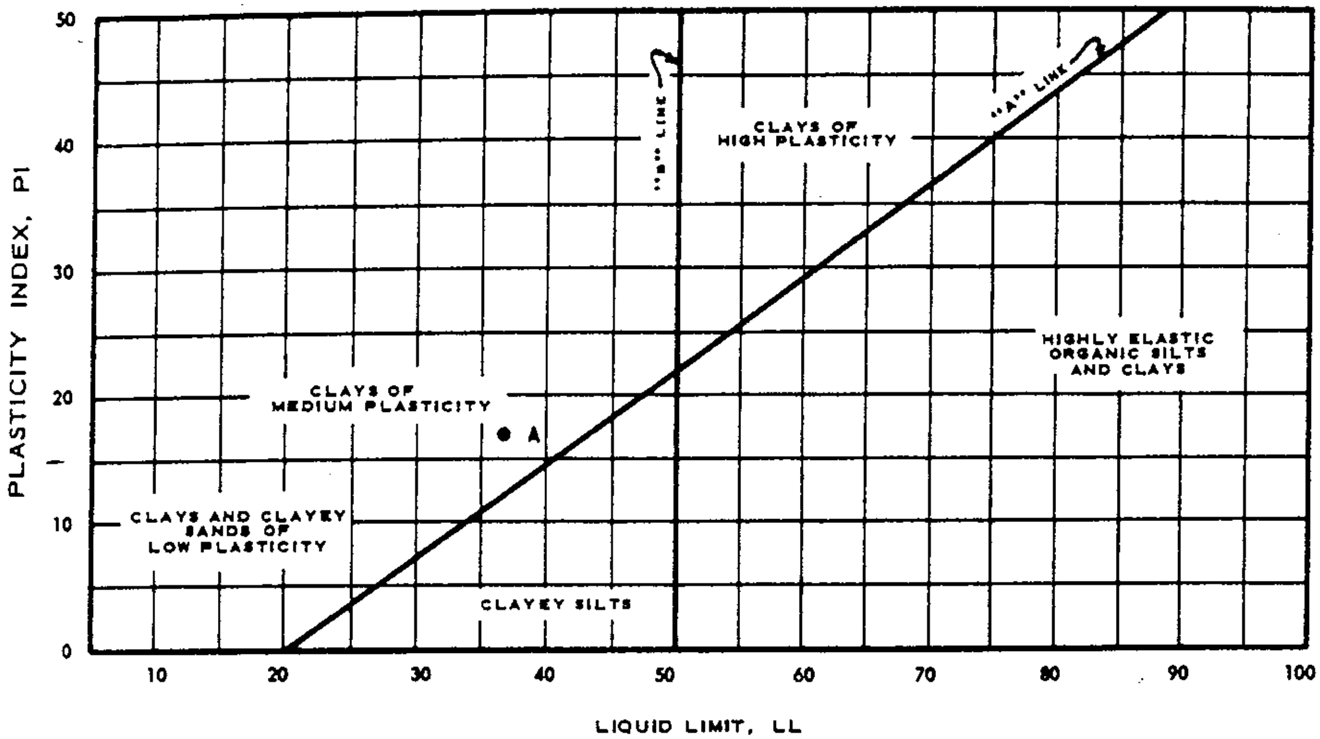
CHECKED BY: D.T.		DWG. NO.	
DRAWN BY: D.O.F.	R. E. NO.	S - 11804 - 6	



CLASSIFICATION TEST RESULTS								
SAMPLE IDENTIFICATION		ATTERBERG LIMITS			GRAIN SIZES – % DRY WEIGHT			
SAMPLE NO.	LETTER DESIGNATION	LIQUID LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	SAND	SILT	CLAY	COLLOIDAL
SACK (HOLE 4 0 – 2')	A	37	17	–	15	36	49	(30)

FIG. 7 – PLASTICITY CLASSIFICATION