7565

SOIL INVESTIGATION

OREM 52ND WARD CHAPEL

OREM, UTAH

JUNE 1975

ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS
1435 WEST 820 NORTH, PROVO, UTAH 84601

ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

1435 W. 820 N.
P.O. Box 711
Provo, Utah
84601

JUNE 18, 1975

THE ENVIRONMENTAL ASSOCIATES
303 TROLLEY SQUARE
SALT LAKE CITY, UTAH 84102

ATTENTION: ROBERT A. BOYLE

GENTLEMEN:

IN ACCORDANCE WITH YOUR REQUEST, WE HAVE COMPLETED A SOIL INVESTIGATION AT THE PROPOSED SITE OF THE 52ND WARD CHAPEL IN OREM, UTAH. THE PURPOSE OF THIS INVESTIGATION WAS TO DEFINE THE CHARACTERISTICS OF THE SUBSURFACE MATERIAL SO THAT ADEQUATE SUBSTRUCTURES COULD BE DESIGNED FOR THE PROPOSED FACILITY. THE RESULTS OF THE INVESTIGATION, ALONG WITH PERTINENT RECOMMENDATIONS RELATIVE TO THE FOUNDATION TYPES AND BEARING CAPACITIES ARE DISCUSSED BELOW.

1. GENERAL SITE CONDITIONS

THE PROPOSED CHAPEL IS LOCATED AT 4TH WEST AND CENTER STREET IN OREM, UTAH. THE PROPOSED SITE IS SITUATED ON DELTAIC DEPOSITS LAID DOWN WHEN THE PROVO RIVER DUMPED ITS SEDIMENTS INTO ANCIENT LAKE BONNEVILLE. THE DELTAIC DEPOSITS, WHICH CONSTITUTE THE OREM BENCH, ARE GENERALLY GRANULAR MATERIALS WITH COBBLES AND BOULDERS NEAR THE MOUTH OF PROVO CANYON AND FINER GRAINED SEDIMENTS TOWARDS THE SOUTH AND WEST AS THE DISTANCE FROM THE MOUTH OF THE CANYON INCREASES. SOME SILTS AND CLAYS ARE LOCATED ON THE EXTREME EDGES OF THE DELTA. THE FOUNDATION CONSIDERATIONS IN THE OREM AREA ARE GENERALLY GOOD. A SURFACE LAYER OF SILT, HOWEVER, OF VARYING THICKNESS COVERS THE GRANULAR DEPOSIT IN MANY LOCATIONS AND CONSTITUTES THE MOST UNCERTAIN PART OF THE SOIL PROFILE. SEVERAL MAJOR STRUCTURES ARE LOCATED EAST OF THE PROPOSED SITE AND INSOFAR AS WE CAN ASCERTAIN, THEIR FOUNDATION PERFORMANCE HAS BEEN ENTIRELY SATISFACTORY.

NO MANMADE FILL EXISTS THROUGHOUT THE AREA AND ALL SUBSURFACE MATERIALS APPEAR TO BE NATURAL DEPOSITS. THE TOPOGRAPHY IS GENERALLY FLAT WITH A SLIGHT SLOPE TOWARDS THE WEST.

2. Subsurface Soil Conditions

The characteristics of the subsurface material were investigated by excavating three test holes to depths of approximately 12 feet at locations as shown in Figure No. 1. The logs of the test holes are presented in Figures No. 2 and 3 and it will be noted that the subsurface material is all granular type soils with exception of a brown silt to silty sand which extends to a depth of 2 to 3 feet below ground surface.

During the subsurface investigation, the test holes were advanced to a depth of approximately 6 feet using a small rotary rig. Sufficient cobbles existed in the profile at that point and it became necessary to extend the test holes using a backhoe. In the upper portion of the test hole, standard penetration tests were performed at three-foot intervals, however, in the area excavated with the backhoe, in-place density tests were performed at three-foot intervals throughout the depth investigated.

Each sample obtained in the field was classified in the laboratory according to the Unified Soil Classification System. The results of the standard penetration tests, the in-place density tests and the classification tests according to the Unified Soil Classification System are presented on the boring logs. The significance of the Unified Soil Classification System is presented in Figure No. 4. Mechanical analysis was performed on representative samples obtained from Test Boring No. 1 and the results of these tests are presented in Table 1, Summary of Test Data. It will be noted that the amount of silt and clay size particles in the granular material was generally less than 4 percent with the gravel size particles predominating.

It will be noted from the boring logs that the granular material underlying the surface silt are in a medium-dense state and are capable of supporting relatively high load intensities.

No groundwater was encountered in any of the test borings at this site and none was expected. Groundwater is generally encountered on the lower tip of the deltaic deposit, but it does not usually exist within the zone of significant stress at this location in Orem.

3. Foundation Considerations

In making recommendations relative to the bearing capacities for the proposed facility, it has been assumed that the structure will be similar to other LDS chaples located throughout the area and that the column

loads will not likely exceed 75 to 80 kips and that wall loads will not likely exceed 3 to 4 kips per linal foot.

As indicated earlier in the report, the subsurface materials at this site are good, and relatively large bearing capacities can be used to proportion foundations in this area. In preparing recommended allowable soil bearing pressures, it has been assumed that the foundations will be located at a depth of between 2 and 2.5 feet below ground surface. It will be noted from the boring logs that this depth is generally sufficient to place the zone of significant stress within the dense granular material

In order to proportion the foundations for the proposed structure, a bearing capacity chart has been prepared as shown in Figure No. 5. In preparing the bearing capacity chart, consideration has been given to both shear failure and settlement. The lines sloping upward to the right define the bearing capacity with respect to shear failure, while the curve sloping downward to the right defines the bearing capacity such that the maximum settlement of any footing will not exceed one inch. Differential settlement should not exceed approximately one-half inch which should be tolerable for the proposed structure.

It is our understanding that the standard church plan assumes a bearing capacity of 1500 pounds per square foot. It is obvious that the allowable soil bearing pressure for the major column and wall loads can be defined with a substantially higher bearing capacity than this value, and we recommend that the major foundations for the chapel and the cultural hall be defined using the information presented in Figure No. 5. In a single-story portion of the proposed facility where the wall loads are relatively low, practical considerations may dictate the footing width and the bearing capacity chart shown in Figure No 5 may not be particularly useful.

Inasmuch as granular materials in a medium-dense state exist within the zone of significant stress, no problems associated with collapsible type soils or expansive type soils exist at this site.

4. Use of On-Site Material and Compacted Fill Requirements

It is not anticipated that any extensive grading operation will be required for the proposed facility. The area has been in crops during the past and a shallow root zone will exist over the area. We recommend that the site be stripped to a depth of at least six inches prior to

placing any portion of the building at this location. It is our opinion that stripping to this depth will eliminate most of the root zone in the surface zone.

No foundations should be placed on the surface silt to silty sand, and it is recommended that where fill is placed on this material, that the subsurface silts be scarified and recompacted prior to the placement of the fill. It is not anticipated that structural foundations will be located on any fill material for this structure. It is possible, however, that roadways, sidewalks and parking areas may either be located on the natural surface silt or on compacted fill. It is recommended that all compacted fill used to support facilities of the kind indicated above, be densified to a unit weight equal to 90 percent of the maximum laboratory density as determined by ASTM D 1557-70. Where roadways, parking areas or sidewalks are placed in the natural material, it is recommended that the natural material be scarified and compacted in accordance with the specifications indicated above.

We recommend that the flexible pavement design in all parking areas and driveways consist of a four-inch untreated granular base and a two-inch asphalt surface course. No asphalt material should be placed directly on the natural silts throughout the area.

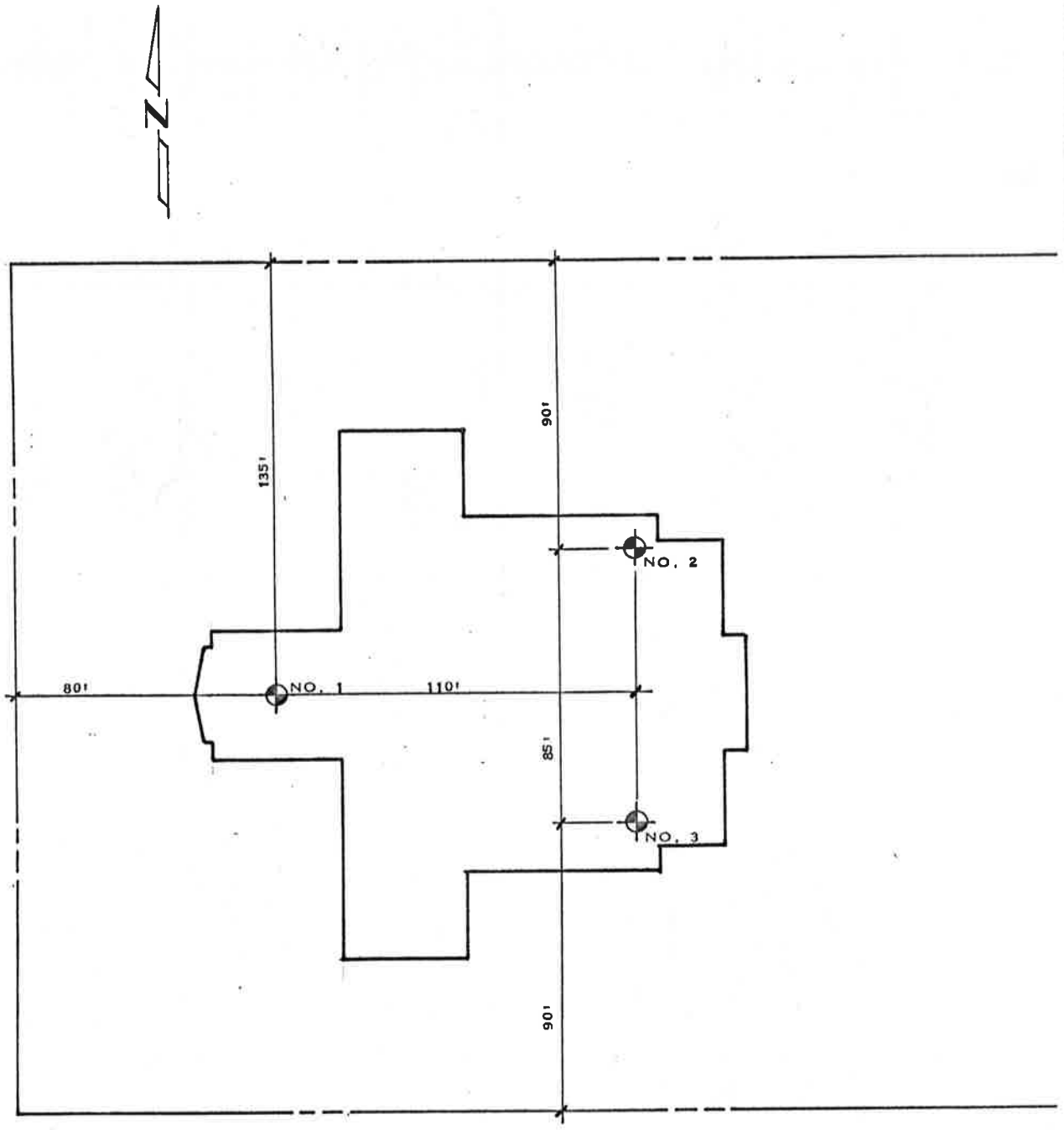
The conclusions and recommendations presented in this report are based upon the field and laboratory investigations. If there are any questions relative to the information contained herein, please advise us.

Yours truly,

ROLLINS, BROWN AND GUNNELL, INC.

Ralph L. Rollins

lg
enclosures

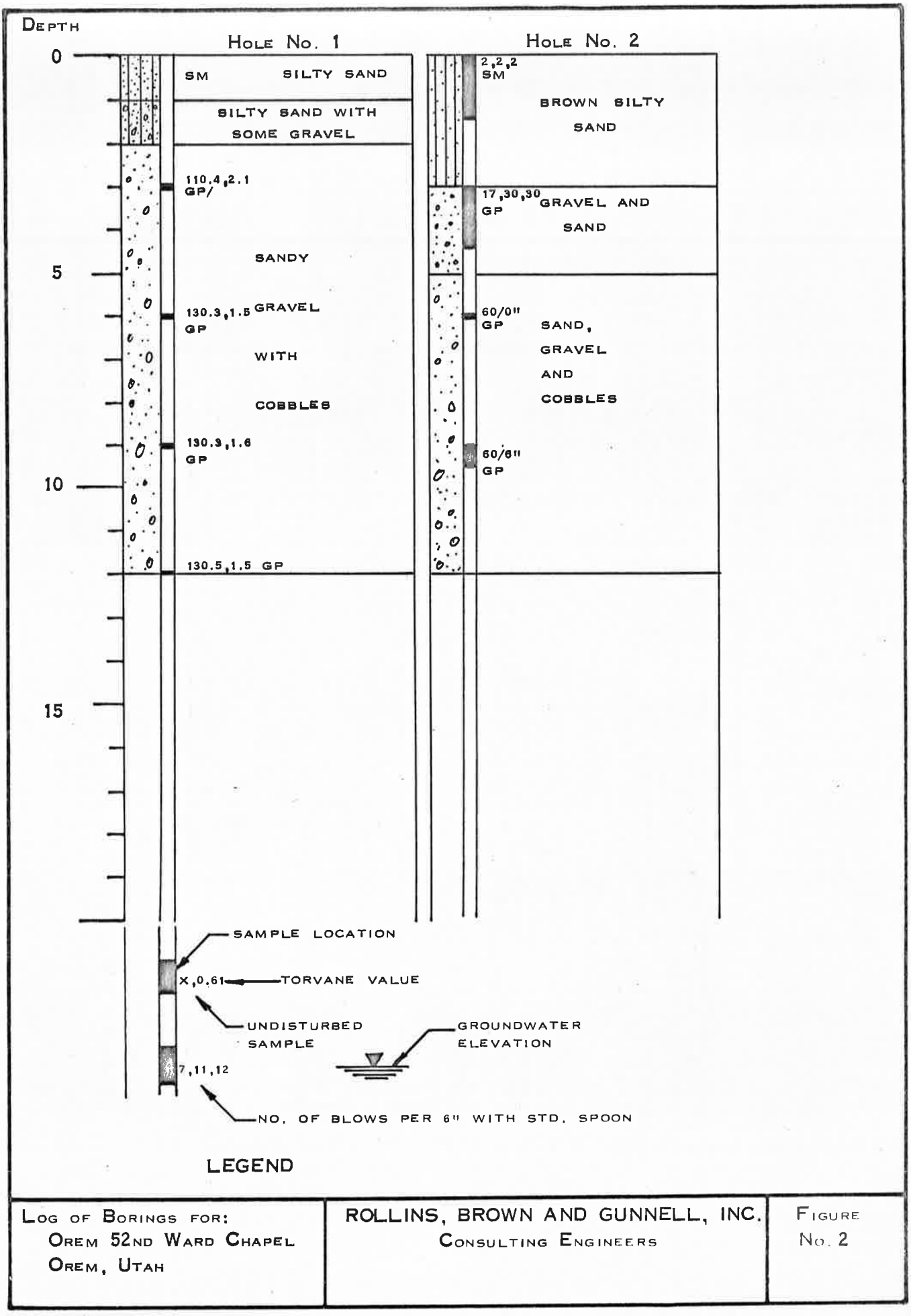


LOCATION OF TEST HOLES

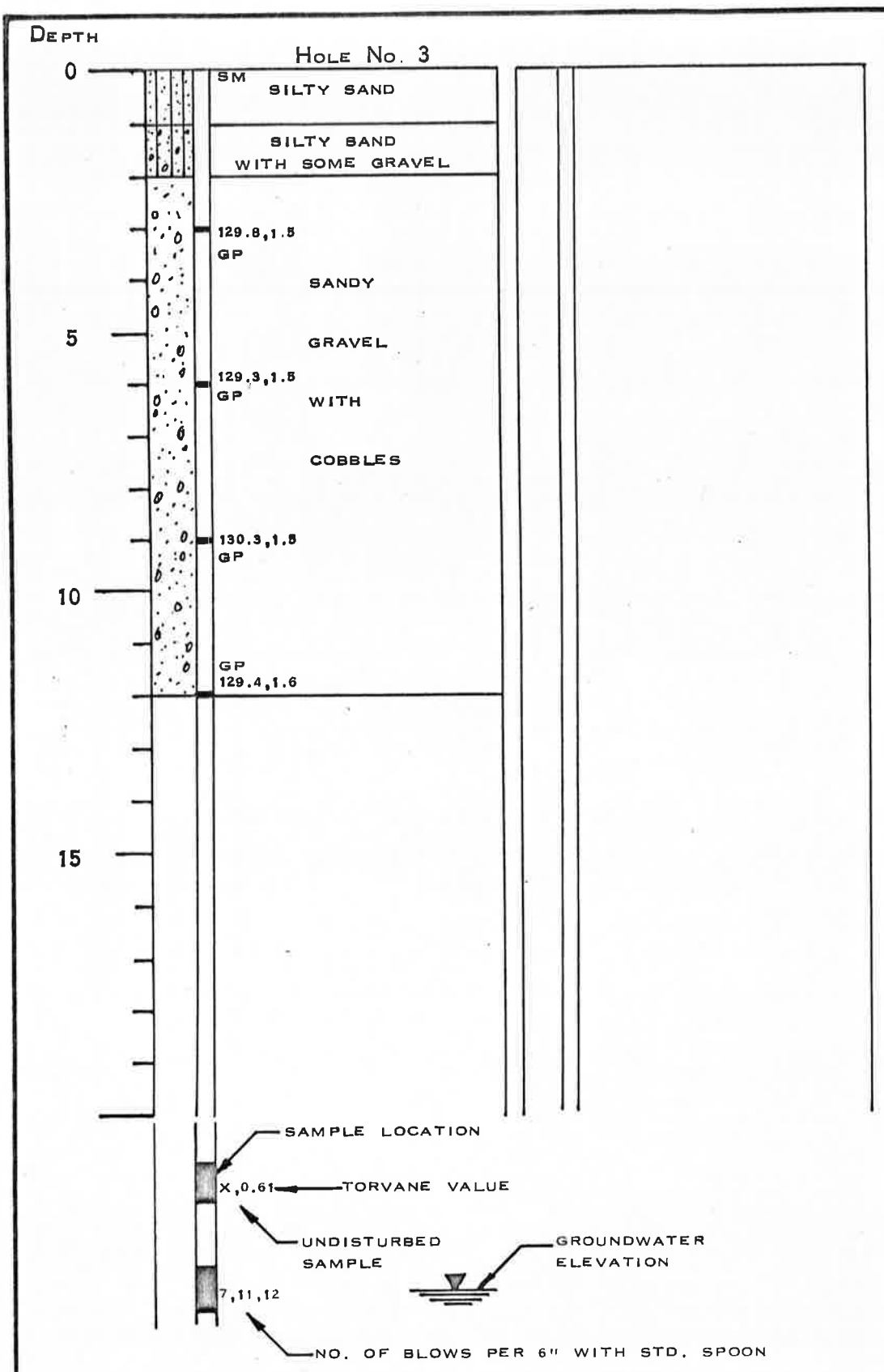
SCALE: 1" = 50'

ROLLINS, BROWN & GUNNELL, INC. **CONSULTING ENGINEERS**	LOCATION OF TEST HOLES FOR OREM 52ND WARD CHAPEL OREM, UTAH	FIGURE NO. 1

Bruning "500"



LOG OF BORINGS FOR: OREM 52ND WARD CHAPEL OREM, UTAH	ROLLINS, BROWN AND GUNNELL, INC. CONSULTING ENGINEERS	FIGURE NO. 2



LEGEND

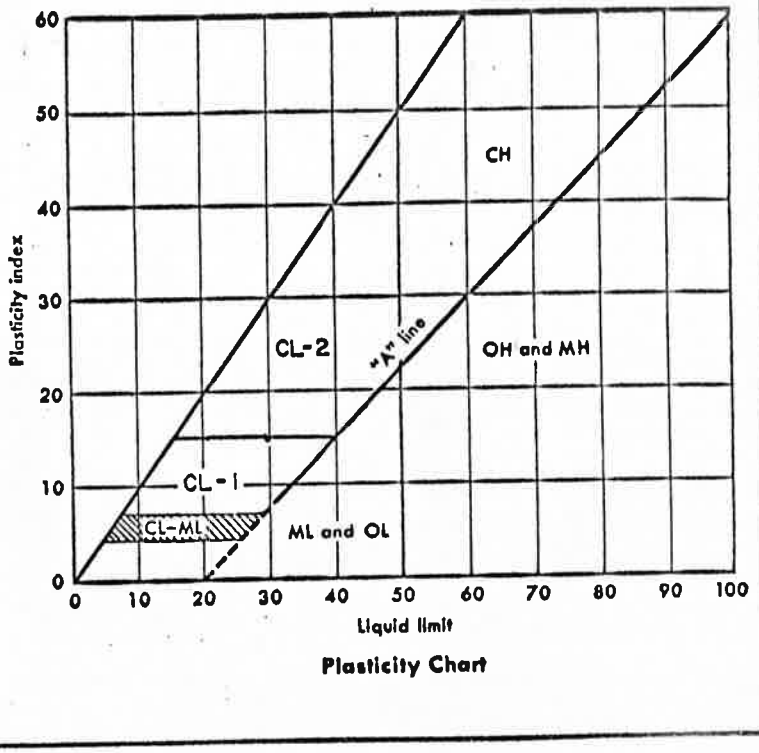
LOG OF BORINGS FOR: OREM 52ND WARD CHAPEL OREM, UTAH	ROLLINS, BROWN AND GUNNELL, INC. CONSULTING ENGINEERS	FIGURE NO. 3

Unified Soil Classification System

FIGURE No. 4

Major divisions			Group symbols	Typical names	Laboratory classification criteria
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW
		Gravels with fines (Appreciable amount of fines)	GM* d / u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM* d / u	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line with P.I. less than 7
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	
			CL 1 / 2	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity, organic silts	
	Highly organic soils		Pt	Peat and other highly organic soils	

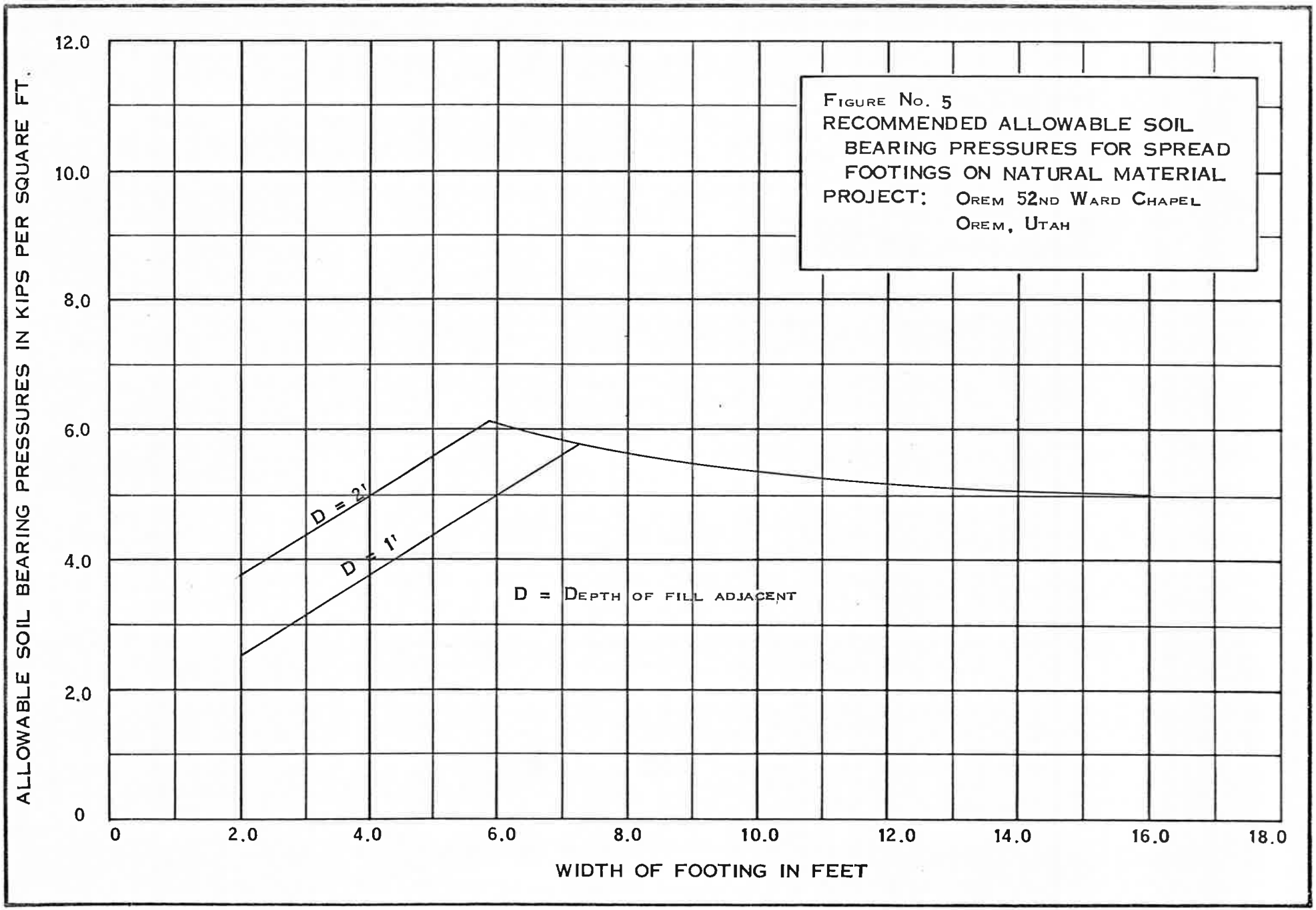
Determine percentages of sand and gravel from grain-size curve.
Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:
Less than 5 per cent.....GW, GP, SW, SP
More than 12 per cent.....GM, GC, SM, SC
5 to 12 per cent.....Borderline cases requiring dual symbols**



Plasticity Chart

*Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

**Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.



ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

TABLE 1 SUMMARY OF TEST DATA

PROJECT 52ND WARD CHAPEL FEATURE FOUNDATIONS LOCATION 400 WEST 100 NORTH, OREM, UTAH

HOLE NO.	DEPTH BELOW GROUND SURFACE	STANDARD PENETRA. BLOWS PER FT.	IN-PLACE			UNCONFINED COMPRESSIVE STRENGTH LB/FT³	FRICTION ANGLE ϕ	CONSISTENCY LIMITS			MECHANICAL ANALYSIS			SOIL CLASSIFICATION UNIFIED SYSTEM
			UNIT WEIGHT LB/FT³	MOISTURE PERCENT	VOID RATIO			L.L. %	P.L. %	P.I. %	% GRAVEL	% SAND	% SILT & CLAY	
1	0-1.5'	7									8.7	61.8	29.5	SM
	3-4'		110.4	2.1							69.3	29.2	1.5	GP
	6-7'		130.3	1.5							60.3	36.1	3.6	GP
	9-10'		130.3	1.6							67.6	29.5	2.8	GP
	12-13'		130.5	1.5							64.2	31.5	4.3	GP

ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS