Woodward-Clyde Consultants

GEOTECHNICAL EXPLORATION
NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
University of California
Richmond Field Station
Richmond, California

Prepared for

UNIVERSITY OF CALIFORNIA
Department of Facilities Management
2000 Carleton Street
Berkeley, California 94720

Three Embarcadero Center, Suite 700
San Francisco, California 94111
415-956-7070

Woodward-Clyde Consultants

April 23, 1980

Project: 14676A

University of California
Department of Facilities Management
2000 Carleton Street
Berkeley, California 94720

Attention: Ms. Norma Willer
Senior Architect

We are pleased to submit our report covering the geotechnical investigation of the subsurface conditions at the site of the proposed Northern Regional Library Compact Shelving Facility at the Richmond Field Station.

The accompanying report presents our conclusions and recommendations, as well as the results of the field exploration and laboratoyr tests upon which they are based. We have discussed our conclusions and recommendations with Mr. John Haag of Esherick Homsey Dodge and Davis, Architects and with Mr. Harold Davis of Rutherford and Chekene, Structural Engineers, prior to finalizing the report.

It has been a pleasure to be of service to you on this project. If we can be of any further assistance to you, please call us.

Sincerely yours,

Robert E. Johnston

Robert E. Johnston
Senior Project Engineer

sme

Enclosures

cc: Mr. John Haag - Esherick Homsey Dodge & Davis, Architects
Mr. Harold Davis - Rutherford and Chekene, Structural Engineers

TABLE OF CONTENTS

GEOTECHNICAL EXPLORATION
NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
University of California
Richmond Field Station
Richmond, California

SCOPE

This report covers our geotechnical exploration of the site of the Northern California Regional Library Compact Shelving Facility to be constructed at the University of California, Richmond Field Station. Our scope of services consisted of drilling and sampling exploratory borings, testing soil samples in the laboratory, and providing the following foundation engineering services:

a) Describe the soil and groundwater conditions in the area of the proposed facility.

b) Develop and present recommendations concerning the most suitable type and depth of foundations for the proposed structures and recommend soil bearing values for design.

c) Provide recommendations for support of both the heavily loaded shelving area floor slab and the more typical wing area floor slab. Recommend a modulus of subgrade reaction for design of floor slabs.

d) Make estimates of settlement and differential settlement.

e) Present recommendations for site preparation and grading.

f) Recommend lateral pressures and soil resistance for design of the truck-dock retaining walls.

g) Present pavement thickness designs; a heavy pavement section for truck traffic and a light pavement section for automobile parking areas.

Woodward-Clyde Consultants made a preliminary geotechnical exploration for the project in 1979. Preliminary foundations recommendations and a geologic hazards evaluation were presented in our report dated March 23, 1979.

PROPOSED CONSTRUCTION

The regional compact shelving facility will houses stacks of little-used library material on high shelving racks. The shelving building area will be approximately 159 feet by 125 feet in plan and about 38 feet high. The stacked materials will impose an average load of approximately 1150 psf. This average load will be transmitted as concentrated loads to the floor by movable shelving supports. These concentrated floor loads will be approximately 5 to 6 kips. In addition to the shelving loads, there will be building columns spaced on a grid of approximately 25 feet by 23 feet. Typical interior column loads will be approximately 45 kips dead plus 10 kips live load.

The shelving facility will have an adjoining single story wing, approximately 101 feet by 125 feet in plan. The wing will have lighter, more conventional floor loading. The wing will have typical interior column loads of 40 kips dead load and 10 kips live load. Slab-on-grade floors are planned for both building areas. It is assumed that the finished floor elevation will be about 1 foot above the existing ground surface.

A truck loading dock with a 3-to 4-foot hight retaining wall will be provided at one end of the single-story wing. Truck and automobile pavements for access roads and parking areas will be constructed at the site.

FIELD EXPLORATION AND LABORATORY TESTS

For the present exploration, five exploratory borings were drilled at the locations shown on the Site and Boring Location Plan, Figure 1. The depths of the borings varied from 31.5 to 61 feet. Representative samples were recovered from the borings and taken to our laboratory for testing and visual examination. The Logs of Borings are presented on Figures 2 through 6. Laboratory test results are shown on the Logs of Borings, at the corresponding sample locations, and on Figures 7 through 10. A description of the field exploration and laboratory testing programs is presented in Appendix A.

For the preliminary geotechnical investigation at the site in 1979, two other exploratory borings were drilled at the locations shown on Figure 1. A different building configuration was being considered at that time. Applicable data from the preliminary borings was utilized in the present study.

SITE AND SOIL CONDITIONS

The building site is located in the northwestern part of the Richmond Field Station property near Seaver Avenue as shown on Figure 1. The site is flat and covered with thick weeds and grass. The vacant site is part of an area that had once been planned as a subdivision. From an old aerial photograph of the site, it appears as though some street grading or stripping had once been done. However, at the time of the present study, we observed no signs of any prior construction.

The surface soils consist of 2 feet of soft dark gray silty clays. The underlying subsoils, to depths of 60 feet, consist of stiff and very stiff silty and sandy clays with occasional sand and gravel layers.

Free ground water was encountered at depths of 12 to 14 feet in the borings at the time of drilling. More detailed descriptions of the soil conditions are given on the attached Logs of Borings, Figures 2 through 6.

DISCUSSION AND RECOMMENDATIONS

General

The investigation indicates that the soils underlying the site have good strengths, and should be capable of supporting the heavy shelving and building loads without serious settlement. However, the surface soils to an average depth of about 2 feet are soft and weak, and also potentially expansive. Thus it will be necessary to remove the upper soft soils and to provide sufficient cover to prevent seasonal water content fluctuations in the soils below foundations and floor slabs. The cover should be a granular material capable of supporting the heavily loaded floor slab.

Settlement

The weight of the building and the proposed heavy shelving loads over the large (125 ft. by 159 ft.) shelving area will cause settlement due to consolidation of the clay subsoils. We estimate that the maximum ultimate settlement will be on the order of 2 to 3 inches with the maximum settlement occurring beneath the central portion of the shelving area. Differential settlements are not expected to exceed 3/4 inch between shelving area columns.

Due to the "dishing" effect of deep seated settlement, the settlement pattern could extend beyond the heavily loaded shelving area into the adjacent first bay of the 1-story wing. Differential settlements in the area of the 1-story wing are not expected to exceed 1/2 inch between columns. The remainder of the 1-story wing should have even less differential settlement.

Consolidation of clay soils is a time-dependent process. We estimate that about one-half of the above settlements will occur within the first several years of shelving loading and the balance of the settlement will occur gradually over a period of 10 to 20 years.

Foundations

The columns and walls of the shelving area and the 1-story wing may be supported on spread footing foundations bearing in newly compacted fill placed as recommended herein or on underlying undisturbed soil. The footings should extend to a minimum depth of 2 feet below the lowest adjacent finished grade. Recommended maximum design bearing pressure are 2500 psf for dead loads, 3500 psf for combined dead and live loads, and 4500 psf for all loads including wind or code-seismic.

Concrete Floor Slabs

It is recommended that the concrete floor slabs for both the shelving area and the 1-story wing be supported on a 2 ft. minimum thickness of aggregate subbase material (select fill). The purposes are (1) to replace the weak and potentially expansive surface soils with a strong subgrade to support the heavy floor loads, and (2) to provide protection against slab heaving. The aggregate subbase (select fill) requirements are specified in the Guide Specifications for Earthwork, Appendix B.

For design of the floor slab, we recommend a modulus of subgrade reaction, k, of about 250 pounds per cubic inch for the aggregate subbase. This modulus is based on typical plate load tests in granular soils; no plate load tests were performed at the site. Plate load tests can be made on the completed aggregate subbase at the site if a more precise modulus value is desired.

In areas where moisture transmission would be undersirable such as in the shelving area and in areas where moisture susceptible mastic or asphalt tile is used, the slab should be directly underlain by a minimum 4-inch thickness of open-graded gravel to provide a capillary break. The requirements for this gravel are defined in Appendix C. The gravel should be covered with a moistureproof membrane to minimize moisture vapor transmission. Two inches of sand should be placed above the membrane to protect it during construction. The sand should be moistened immediately prior to placing concrete. The 2 inches of sand, membrane, and 4 inches of rock can be substituted for the top 6 inches of the aggregate subbase.

Retaining Walls

The retaining walls that support the sides of the truck loading dock must resist the lateral soil loads and the surcharge of adjacent loads on the dock floor.

The expansive native soils, both in cut or as backfill, could exert excessive lateral pressures on the walls. For this reason we recommend that the native soils be excavated back from the back face of the walls a minimum horizontal distance equal to one-half the wall height, and backfilled with compacted select fill.

It is recommended that the walls be designed to withstand an equivalent fluid pressure of 35 pcf plus a uniform horizontal pressure of one-third the average floor load applied within a distance equal to the height of the wall. This horizontal pressure, in any case, should be at least 50 psf.

Lateral forces on the walls may be resisted by friction between the footing and the supporting soil. A friction coefficient of 0.4 may be used in design. A factor of safety of 1.5 should be provided against sliding. Additional lateral resistance may be derived from

passive pressure acting against the face of the footing. An equivalent fluid pressure of 250 pcf may be used in design. Retaining wall footings should be designed in accordance with the recommendations given above under "Foundations".

Site Preparation and Grading

It is recommended that all earthwork be performed under the direct observation of the Geotechnical Engineers' representative in accordance with the attached Guide Specifications for Earthwork, Appendix B.

Prior to any cutting or filling, the site should be stripped to remove all weeds and vegetation. The strippings may be stockpiled for later use such as topsoil for landscaping, but should not be used in any compacted fill.

After stripping, the building area should be excavated to a minimum depth of 2 feet below the present ground surface to remove the soft soils. The excavation should extend deeper wherever soft or weak soils are encountered in the field. The excavated on-site soil, in general, may be reused later if applicable, as compacted fill, but only below the recommended 2-foot thick select fill zone. However, based on the assumed finished floor elevation, it is expected that much of the on-site soil will be excess and have to be removed from the site. The excavated surface should be scarified and recompacted to a minimum relative compaction of 90 percent (California test method 216F-70) at a moisture content above optimum.

After the above site preparation is completed and approved, all fill material (on-site and select fill) should be placed in thin lifts and compacted as required in the Guide Specifications for Earthwork.

Pavement Structural Sections

The pavement thickness designs given below are based on an assumed resistance (R) value of 5 for the plastic clay subgrade soils at the site. It is assumed that the traffic will consist of occasional

heavy trucks and automobile parking. The following pavement sections were designed by the procedures of the California Department of Transportation.

Pavement Component	THICKNESS, INCHES Truck Access, Turns and Parking	Automobile Parking
Asphalt Concrete	3	2
Aggregate Base	8	6
Aggregate Subbase	6	4
Total	17	12

It is recommended that the pavement materials and construction conform to the requirements given in the Standars Specifications of the State of California, Department of Transportation, January 1978 Edition. Subgrade preparation should be done in accordance with the requirements set forth in Section 19 of the Standard Specifications. The requirements for asphalt concrete and aggregate base are outlined below:

Asphalts

(1) Asphalt for prime coat shall be liquid asphalt, grade MC-70, conforming to the provision of Section 93 of the Standard Specifications.

(2) Paint binder (tack coat) shall be Slow-Setting Type emulsion, Grade SS-1, conforming to the provisions of Section 94 of the Standard Specifications.

(3) Paving asphalt to be mixed with aggregate shall be steam refined paving asphalt conforming to Section 92, grade AR 4000 or AR 8000.

Mineral Aggregate for Asphalt Concrete - Type B Aggregate as specified in the Standard Specifications, Section 39, 3/4-inch maximum size, medium grading.

Aggregate Base Course - Conform to the requirements of Standard Specifications, Section 26, for Class 2 Aggregate Base, 1-1/2-inch or 3/4 inch maximum size, except that the R-value requirement will not be waived, regardless of the grading or sand equivalent value.

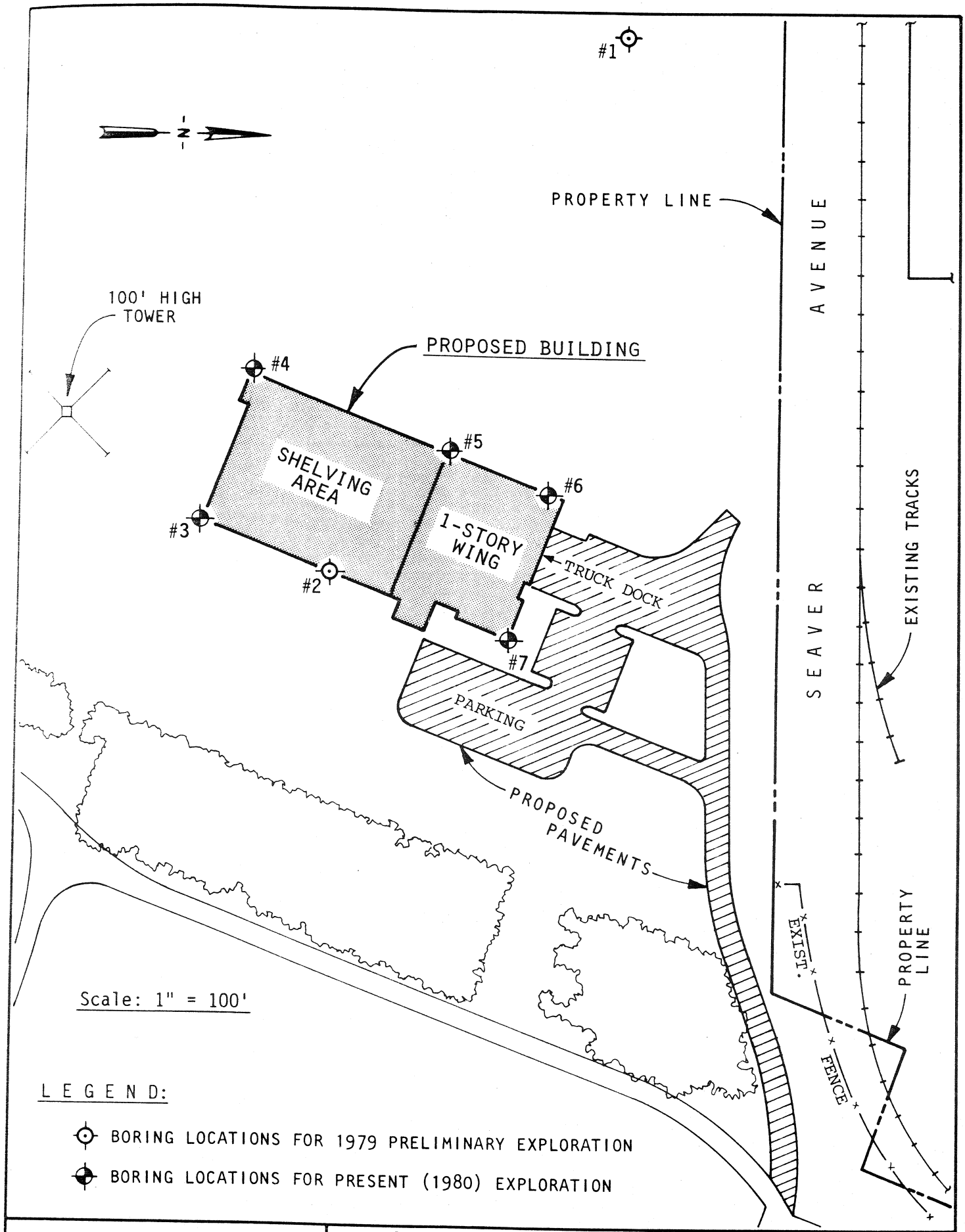
Aggregate Subbase Course - Conform to the requirements of Standards Specifications Section 25 for Class 2 Aggregate Subbase.

All pavement areas should be designed for a minimum surface gradient of at least one percent, and all flow lines should have gradients of 1-1/2 percent in order to minimize water percolation through the pavement and subsequent saturation of the subgrade. It would be desirable to locate the flow lines away from high traffic areas. In addition, a fog seal coat (Section 37 of the Standard Specifications) should be applied to all pavement areas to decrease the permeability of the asphalt-concrete surface.

LIMITATIONS

The recommendations contained in this report are based on the assumption that soil conditions do not deviate appriciably from those disclosed in the borings. If any unanticipated variations or undesirable conditions are encountered during construction, or if the proposed construction is modified or relocated from that planned at this time, the Soil Engineer should be notified so that supplemental recommendations can be made.

The recommendations in the report are intended to provide stable foundation support for the structures when subjected to the dead, live, wind and seismic loadings specified by the applicable Uniform Building Code. Dynamic analysis to develop loading and design criteria beyond these code requirements are not within the scope of this study. If dynamic analyses for the structures and the soils at this site are desired, we would be pleased to assist you.



Project No. 14676A **Woodward-Clyde Consultants**	SITE AND BORING LOCATION PLAN NORTHERN REGIONAL LIBRARY COMPACT SHELVING FACILITY Univ. of Calif. - Richmond Field Station	Figure 1

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. 3

Date Drilled: February 26, 1980
Type of Boring: 6" Auger
Hammer Weight: 140 lbs.
Remarks: See LEGEND on Figure 2b

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
	1	7	SILTY CLAY (CL) Soft, dark gray	24	104	1200
5	2	37	SILTY CLAY (CH) Stiff, light gray Very stiff, tan	17	113	6060
10	3	42	CLAYEY SAND & GRAVEL (GP) Medium dense, brown ATD	-	-	-
15	4	23	SANDY CLAY (CL) Stiff to very stiff, brown	21	103	3030
20	5	17	Grading to Silty Clay	23	102	1580
25	6	26		22	103	5040
30	7	43	CLAYEY SILT (ML) Medium dense, brown Grading to Sandy Silt	23	103	1880
35	8	70	SAND & GRAVEL (GW) Dense, brown, to 1" max. size	-	-	-
			SANDY CLAY (CL) Very stiff, blue-gray			

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 2a

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. 3 (Continued)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
40	9	37	S A N D Y C L A Y (CL).....Cont'd } Silty Clay	-	-	-
45	10	70	S I L T Y C L A Y (CL) Hard, blue-gray	18	111	8840
50	11	60	S A N D Y C L A Y (CL) Very stiff, brown	-	-	-
55	12	58		16	115	4760
60	13	52		-	-	-
			BOTTOM OF BORING @ 61.0'			
65						
70						
75						
80						

LEGEND FOR ALL BORINGS:

- 2" I.D. MODIFIED CALIFORNIA SAMPLER
- 2½" I.D. MODIFIED CALIFORNIA SAMPLER
- ATD — WATER LEVEL AT TIME OF DRILLING

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. 4

Date Drilled: February 23, 1980
Type of Boring: 6" Auger
Hammer Weight: 140 lbs.

Remarks: See LEGEND on Figure 2b

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation:			
			SILTY CLAY (CH) Soft, dark gray			
	1	9	SILTY CLAY (CH) Medium stiff, light gray	31	88	980
5	2	41	SILTY CLAY (CH) Hard, light gray, with lime	15	110	8420
			SILTY CLAY (CL) Very stiff, brown CONSOL. TEST, See Figure 8	24	101	4960
10	3	29	ATD Stiff			
15	4	27		25	102	3390
20	5	19	SANDY CLAY (CL) Stiff to very stiff, brown Gravelly	17	114	3230
25	6	22	SILTY CLAY (CL) Stiff, brown	28	95	3560
30	7	22		25	99	2940
			SANDY CLAY (CL) Stiff, brown			
35	8	50	SAND & GRAVEL (GW) Dense, brown	-	-	-
			SILTY CLAY (CL) Very stiff, blue-gray			

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 3a

Log of Boring No. 4 (Continued)

MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
LTY CLAY (CL) CONSOL. TEST, See Figure 9 .....Cont'd	21	105	4620
Hard	22	106	8550
Very stiff	21	108	6230
LTY CLAY (CL) Very stiff, brown	25	100	4540
	-	-	-
BOTTOM OF BORING @ 61.0'			

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. 5

Date Drilled: February 23 & 25, 1980
Type of Boring: 6" Auger
Hammer Weight: 140 lbs.
Remarks: See LEGEND on Figure 2b

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation:	LABORATORY TESTS		
	1	8	SILTY CLAY (CL) Soft, dark gray —Stiff	26	94	480
	2	16	SILTY CLAY (CL): Very stiff, gray-brown	26	95	2080
5			SANDY CLAY (CL) Stiff, brown			
	3	53	SAND (SW) Very dense, tan	-	-	-
10			SANDY CLAY (CL)			
	4	17	ATD Stiff, brown	27	97	2290
15						
	5	23	CONSOL. TEST, See Figure 10	-	-	-
20			SAND & GRAVEL (GP): Medium dense, brown			
	6	42	SANDY CLAY (CL) Very stiff, brown	23	104	5220
25						
			SAND & GRAVEL (GP)			
30	7	56	Dense, brown, to 2" max. size	-	-	-
35						
	8	72	SANDY CLAY (CL) Very stiff, brown	No Recovery		
			SANDY CLAY (CL) Very stiff, blue-gray			

Proj. No. 14676A | Woodward-Clyde Consultants | Figure 4a

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHLEVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. 5 (Continued)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
40	9	45	Grading to Silty Clay	21	106	7460
45	10	95		22	105	6320
			} Sand and gravel lense			
50	11	43	S I L T Y C L A Y (CL) Very stiff, brown	20	108	7680
			S A N D & G R A V E L (GP) Medium dense			
55	12	27	S I L T Y C L A Y (CL) Stiff to very stiff, brown	22	-	-
60	13	75		-	-	-
			S A N D (SW): Dense, brown			
			BOTTOM OF BORING @ 61.0'			
65						
70						
75						
80						

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 4b

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. 6

Date Drilled: February 25, 1980
Type of Boring: 6" Auger
Hammer Weight: 140 lbs.

Remarks: See LEGEND on Figure 2b

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation:			
	1	13	SILTY CLAY (CH) Soft, dark gray Stiff	21	104	3180
5	2	48	SILTY CLAY (CL) Very stiff, brown Gravelly	8	133	7060
10	3	50	SAND (SP) Medium dense to dense, brown	-	-	-
			ATD CLAYEY SAND & GRAVEL (GP) Dense, brown			
15	4	29	SILTY CLAY (CL) Very stiff, light gray	19	107	6980
20	5	35	SANDY CLAY (CL) Very stiff, brown	17	115	4010
25	6	32	SILTY CLAY (CL) Very stiff, brown	24	99	5580
30	7	33		-	-	-
			BOTTOM OF BORING @ 31.5'			
35						

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 5

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

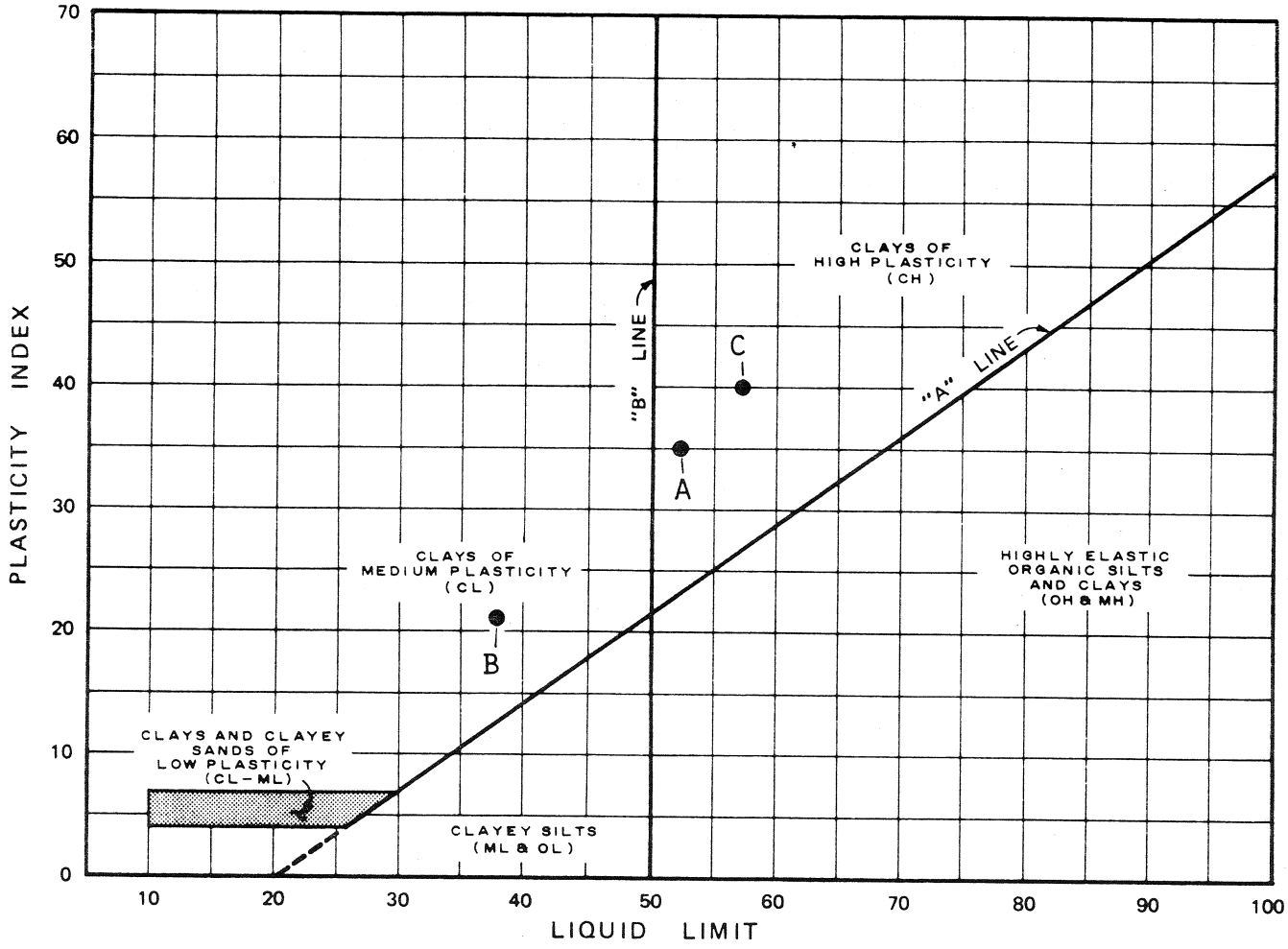
Log of Boring No. 7

Date Drilled: February 25, 1980
Type of Boring: 6" Auger
Hammer Weight: 140 lbs.
Remarks: See LEGEND on Figure 2b

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation:			
			SILTY CLAY (CH) Soft, dark gray -- Medium stiff			
5	1	32	SILTY CLAY (CL) Stiff, gray-brown -- Very stiff	21	105	5240
10	2	45/10½"	CLAYEY SAND (SC) Dense, brown Grading to a Sandy Clay (CL) With fine gravel			
15	3	17	ATD SANDY CLAY (CL) Stiff, brown	19	107	2460
20	4	27		22	104	3800
25	5	30	SANDY CLAY (CL) Very stiff, brown	-	-	-
30	6	30		25	100	3920
35			BOTTOM OF BORING @ 31.5'			

LABORATORY TESTS

Proj. No. 14676A | Woodward-Clyde Consultants | Figure 6

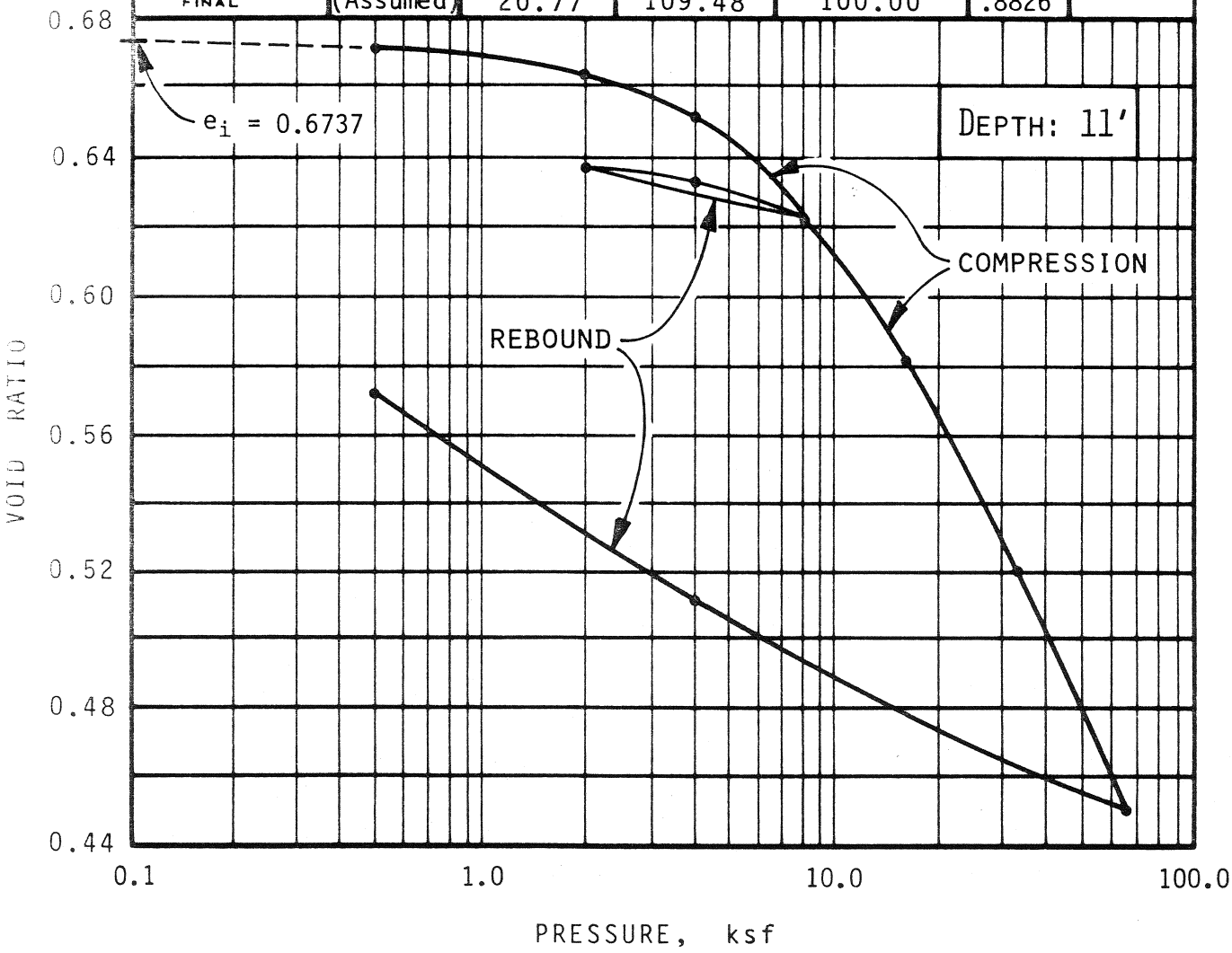


CLASSIFICATION TEST RESULTS

SAMPLE IDENTIFICATION				ATTERBERG LIMITS			GRAIN SIZES - % DRY WEIGHT			
LETTER DESIG'N	BORING NO.	SAMPLE NO.	DEPTH, FT.	LIQUID LIMIT	PLASTICITY INDEX	PLASTIC LIMIT	SAND	SILT	CLAY	COLLOIDAL
A	3	1	2.0'	52	35	16	—	—	—	—
B	5	1	1.0'	38	21	17	—	—	—	—
C	6	1	2.5'	57	40	16	—	—	—	—

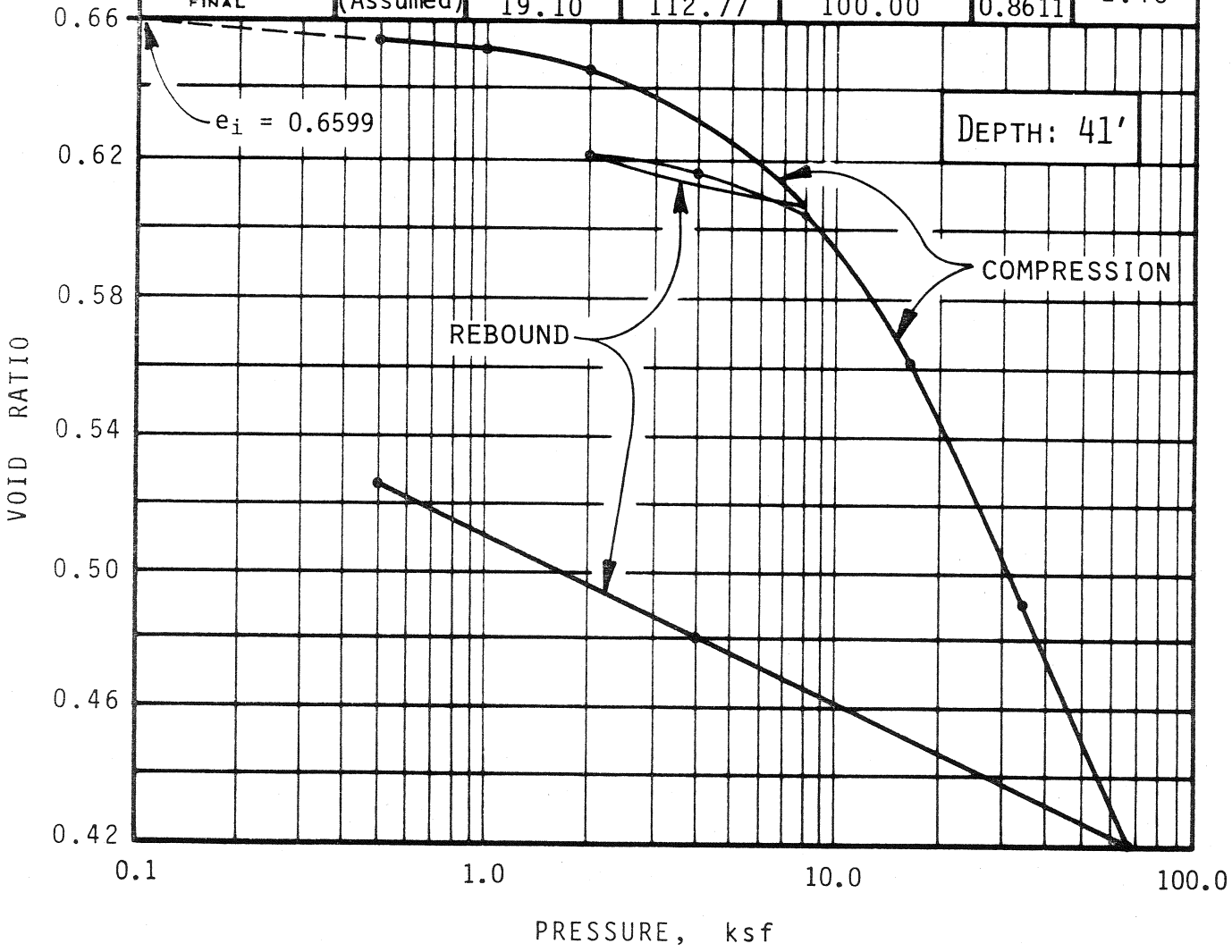
Project No. 14676A **Woodward-Clyde Consultants**	PLASTICITY CLASSIFICATION U.C. - NORTHERN REGIONAL LIBRARY	Figure 7

SAMPLE NO.	SUMMARY OF TEST RESULTS					
4 - 3	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	2.76	23.18	102.90	94.98	.9390	2.43
FINAL	(Assumed)	20.77	109.48	100.00	.8826	



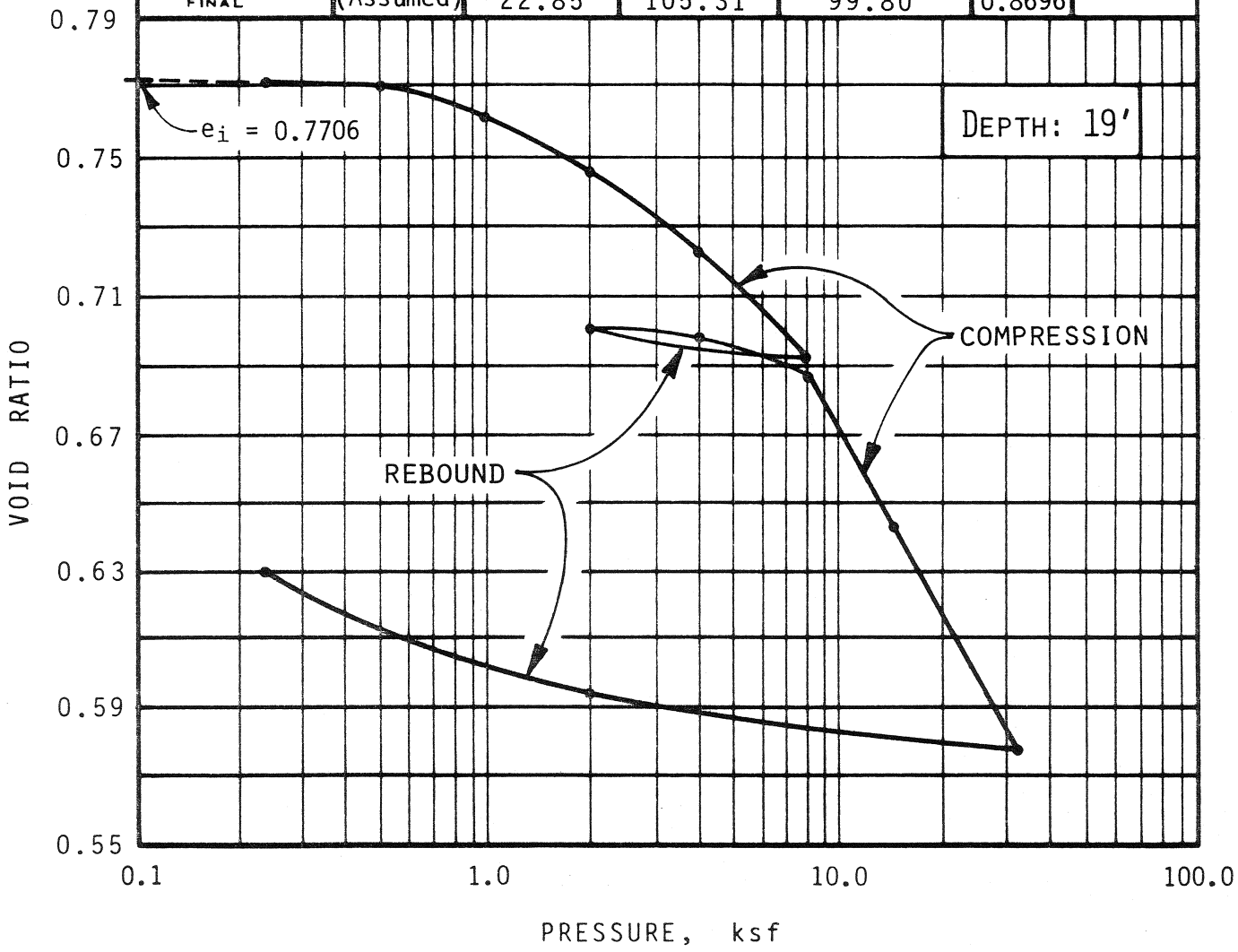
Project No. 14676A **Woodward-Clyde Consultants**	CONSOLIDATION TEST RESULTS U.C. - NORTHERN REGIONAL LIBRARY	Figure 8

SAMPLE NO.	SUMMARY OF TEST RESULTS					
4 - 9	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	2.76 (Assumed)	22.91	103.75	95.79	0.9360	2.43
FINAL		19.10	112.77	100.00	0.8611	



Project No. 14676A **Woodward-Clyde Consultants**	CONSOLIDATION TEST RESULTS U.C. - NORTHERN REGIONAL LIBRARY	Figure 9

SAMPLE NO.	SUMMARY OF TEST RESULTS					
5 - 5	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	2.74 (Assumed)	27.88	96.92	99.48	0.9449	2.43
FINAL		22.85	105.31	99.80	0.8696	



Project No. 14676A **Woodward-Clyde Consultants**	CONSOLIDATION TEST RESULTS U.C. - NORTHERN REGIONAL LIBRARY	Figure 10

APPENDICES

APPENDIX A

FIELD EXPLORATION AND LABORATORY TESTS

Northern Regional Library - Compact Shelving Facility

FIELD EXPLORATION

Five exploratory borings were drilled for the present (1980) exploration at the locations shown on the power auger. Depths of borings varied from 31.5 feet to 61 feet. The borings were left open for intervals ranging from 1 to 24 hours in order to observe free groundwater levels. The drilling was accomplished on February 23 through 26, 1980, by the AAA Drilling Company under the supervision of Mr. Robert Leahy of our firm.

Samples of the underlying soils were obtained from each boring with modified California drive samplers having thin brass liners. Two sampler sizes were used: 2-inch inside diameter, 2-1/2-inch outside diameter; and 2-1/2-inch inside diameter, 3-inch outside diameter; as indicated on the Logs of Borings, Figures 2 through 6.

The samplers were driven into the soil at the bottom of the hole with a 140-lb hammer falling 30 inches. When the sampler was withdrawn from the test hole, the tubes containing the soil samples were removed, carefully sealed to preserve the natural moisture content of the soil and returned to the laboratory for testing. Soil classifications were made in the field and verified by an examination of the samples and by the test results. Boring logs were prepared from the field and laboratory data and are presented as Figures 2 through 6.

Test borings were located in the field with the aid of a site plan furnished us. The locations indicated are only approximate and they were not surveyed in.

LABORATORY TESTS

The water contents, dry density and unconfined compressive strength were determined for selected samples in order to evaluate the strength, denseness, and compressibility of the soils. The results of these tests are shown at the corresponding sample locations on the Logs of Borings, Figures 2 through 6, together with the resistance to penetration of the soil sampler.

The liquid and plastic limits were determined for typical samples of the near surface soils in order to classify the soils and evaluate their potential for swelling. The results of these tests are shown on Figure 7.

Three consolidation tests were performed on representative samples of the clay soils which underlie the site. The results of the consolidatin tests are given in graphical form on Figures 8, 9 and 10.

APPENDIX B

GUIDE SPECIFICATIONS FOR EARTHWORK

Northern Regional Library - Compact Shelving Facility

1. GENERAL CONDITIONS

1.1 DEFINITION OF TERMS

(A) FILL - all soil and aggregate material placed to raise the grade of the site or to backfill excavations.

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

(C) IMPORT MATERIAL - that which is hauled in from off-site sources.

(D) COMPACTED FILL - fill upon which the Geotechnical 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.

(E) SELECT MATERIAL - Class 2 aggregate subbase as specified in Section 25 of the Standard Specifications.

(F) STANDARD SPECIFICATIONS - State of California, Department of Transportation, January 1978.

(G) MATERIALS MANUAL - State of California, Department of Transporation, latest revision.

(H) RELATIVE COMPACTION - the ratio, expressed as a percentage, of dry density of the fill material as compacted in the field, to the maximum dry density of the same material determined by California Test Method 216F-70. Field density shall be determined in accordance with ASTM Test Methods D-1556 and D-2922-71.

1.2 DUTIES OF GEOTECHNICAL ENGINEER

The Geotechnical Engineer will be thw Owner's representative to observe the grading operations both during preparation of the site and the compaction of materials. He will make enough visits to the site to familiarize himself generally with the progress and quality of the work. He will 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 and base materials and the extend to which the percent compaction as placed, meets the specifications requirements. He will require any fill that does not meet the specification requirements be removed and/or recompacted until the requirements are satisfied.

1.3 SOIL CONDITIONS

A soil investigation has been performed for this site by Woodward-Clyde Consultants as described in their report for Project No. 14676A. The contractor shall familiarize himself with the soil conditions at the site, and shall thoroughly study all recommendations associated with grading.

2. PREPARATION FOR FILLING

2.1 Stripping

Prior to any cutting or filling, the site shall be stripped to a sufficient depth to remove all weeds, roots and organic matter, as determined by the Geotechnical Engineer. The strippings may be stockpiled for later use as topsoil but shall be used in any compacted fills.

2.2 Excavation

After stripping, the building area shall be excavated to the elevations required to remove the upper 2 feet of surface soil and to provide the reommended thickness of aggregate subbase beneath floor slabs. All soft or weak zones exposed in the excavated surface shall also be excavated. The excavations shall extend 3 feet beyond the exterior foundation edges.

2.3 Preparation for Filling

When the excavation has been completed, the exposed subgrade shall be scarified to a depth of 6 inches and brought to a water content at least 3 percent over optimum before recompaction, unless this requirement is specifically waived by the Geotechnical Engineer at the time of grading.

Before placing fill, the Contractor shall obtain the Geotechnical Engineer's approval of the site preparation in the areas to be filled.

3. MATERIALS USED FOR FILL

3.1 GENERAL REQUIREMENTS FOR FILL MATERIAL

All fill material must be approved by the Geotechncial Engineer. The material shall be a soil or soil-rock mixture which is free from deleterious substance. The fill material shall not contain rocks or lumps over 6 inches in greatest dimension and not more than 15 percent larger than 2-1/2 inches. Approved excavated soils from the site may be used as fill beneath the specified select fill. Any imported soil fill shall meet the additional requirements in Section 3.2.

3.2 REQUIREMENTS FOR SELECT FILL MATERIAL

Select material must conform to the requirements of Class 2 Aggregate Subbase as specified in Section 25 of the Standard Specifications.

4. PLACING AND COMPACTING FILL MATERIAL

All fill material shall be compacted as specified below or by other methods if approved by the Geotechnical Engineer, so as to produce a minimum relative compaction of 90 percent, except for that materials with less than 8 percent passing the #200 sieve shall be compacted to at least 95 percent relative compaction.

Fill material shall be spread in uniform lifts not exceeding 8 inches in uncompacted thickness. Before compaction begins, the fill shall be brought to a water contention will permit proper compaction by either: aerating the material if it is too wet; or spraying the material with water if it is too dry. Each lift shall be thoroughly mixed before to provide a uniform distribution of water content. On-site soils shall be compacted at a moisture content at least 3 percent above optimum.

For pavement areas, the upper 6 inches of subgrade, the aggregate base, and the aggregate subbase shall be compacted to at least 95 percent relative compaction.

5. TREATMENT AFTER COMPLETION OF GRADING

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

APPENDIX C

GUIDE SPECIFICATIONS FOR ROCK UNDER FLOOR SLABS

A. DESCRIPTION

Graded pea gravel for use under floor slabs shall consist 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 rounded, uncrushed gravel. It 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 2 percent of the oven dry weight of the sample.

C. GRADATION

The gravel 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