City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

August 26, 1999

Douglas Andrews, P.E.
Smith Engineering Company
6400 Uptown Blvd. NE, Suite 500E
Albuqueque, New Mexico 87110

RE: BOSQUE DEL RIO, PHASE 3 (D13-D8). GRADING AND DRAINAGE PLAN CERTIFICATION FOF RELEASE OF FINANCIAL GUARANTEES. ENGINEER'S STAMP DATED AUGUST 25, 1999.

Dear Mr. Andrews:

Based on the information provided on your August 26, 1999 submittal, the above referenced plan is adequqte to satisfy the requirement for Subdivision Certification for release of Financial Guarantees per the Infrastructure List dated February 25, 1997, and last revised January 14, 1998.

If I can be of further assistance, please feel free to contact me at 924-3984.

Sincerely,

John P. Murray, P.E.
Hydrology

c: Terri Martin, City Project No. 5406.82
File

THE CITY OF ALBUQUERQUE IS AN EQUAL OPPORTUNITY/REASONABLE ACCOMMODATION EMPLOYER

CITY OF
Albuquerque

July 31, 1998

Douglas Andrews, P.E.
Smith Engineering Company
6400 Uptown Blvd. NE, Suite 500E
Albuquerque, New Mexico 87110

RE: Grading and Drainage Certification for Bosque Del Rio Subdivision, Phase 2 (D13/D8) Submitted for Release of Financial Guarantees, Certification Stamp Dated 7/20/98.

Dear Mr.Andrews:

Based on the information provided in the submittal of July 22, 1998, the above referenced plan is adequate to satisfy the requirement for Subdivision Certification for release of financial guarantees for Unit 2, per the Infrastructure List dated April 16, 1996, last amended on December 2, 1997.

If you have any questions, or if I may be of further assistance to you, please call me at 924-3982.

Sincerely,

Susan Calongne

Susan M. Calongne, P.E.
City/County Floodplain Administrator

c: Terri Martin, DRB-94-578
Ted Garrett, Garrett Group Inc.
File

CITY OF
Albuquerque

Public Works Department

March 27, 1997

Martin J. Chávez, Mayor

Robert E. Gurulé, Director

Clifford Anderson, P.E.
Smith Engineering Company
6400 Uptown Blvd. NE, Suite 500E
Albuquerque, New Mexico 87111

RE: Grading and Drainage Certification for Bosque Del Rio Subdivision, Phase I (D13/D8) Submitted for Release of Financial Guarantees, Certification Date 3/27/97.

Dear Mr. Anderson:

Based on the information provided in the submittal of March 27, 1997, the above referenced plan is adequate to satisfy the requirement for Subdivision Certification for release of financial guarantees for Unit 1, per the Infrastructure List dated April 16, 1996.

If you should have any questions, or if I may be of further assistance to you, please contact me at 924-3982.

Sincerely,

Susan Calongne

Susan M. Calongne, P.E.
City/County Floodplain Administrator

c: Terri Martin
Ted Garrett, Garrett Group Inc.
File

CITY OF
Albuquerque

Martin J. Chávez, Mayor

July 25, 1996

Clifford Anderson, P.E.
Smith Engineering Company
6400 Uptown Blvd. NE, Suite 500E
Albuquerque, New Mexico 87111

RE: REVISED GRADING PLAN FOR BOSQUE DEL RIO SUBDIVISION (D13/D8) SUBMITTED FOR FINAL PLAT APPROVAL, ENGINEER'S STAMP DATED 6/25/96.

Dear Mr. Anderson:

Based on the information provided in the submittal of July 2, 1996, the above referenced plan is approved for Final Plat action. The Final Plat must reference the recorded drainage covenants.

As you are aware, the Grading Certification for the subdivision and for Coors Trail will be required prior to release of financial guarantees per the approved Infrastructure List.

If you should have any questions, or if I may be of further assistance to you, please call me at 768-2666.

Sincerely,

Susan Calongne

Susan M. Calongne, P.E.
City/County Floodplain Administrator

c: Fred Aguirre, DRB-94-578
Ted Garrett, Owner
File

GARRETT GROUP, INC.

BOSQUE DEL RIO

DRAINAGE REPORT
FOR THE
PRELIMINARY PLAT

DRB-94-578

MARCH 1996

REVISED JUNE 25, 1996

CLIFFORD E. ANDERSON
NEW MEXICO
6472
LAND SURVEYOR
REGISTERED PROFESSIONAL ENGINEER

6/25/96

Prepared by

SMITH ENGINEERING COMPANY
6400 UPTOWN BOULEVARD NE SUITE 500E
ALBUQUERQUE, NM 87110

SEC No. 194156-01

1.

INTRODUCTION

Smith Engineering Company has been retained by the Garrett Group, Inc. to develop the drainage and grading plan for Bosque del Rio. Bosque del Rio is a planned community comprising 114 lots on a 50 acre parcel. The parcel is located on the northwest side of Albuquerque, New Mexico in the former floodplain of the Rio Grande. A vicinity map is shown in Figure 1. Existing offsite flow from the north is diverted east to the Corrales Riverside Drain. Developed onsite flow will be ponded onsite in retention ponds.

2.

SITE LOCATION AND DESCRIPTION

The project area is located in Bernalillo County on the northwest side of the city of Albuquerque, New Mexico. The local climate is considered semi-desert and is hot and dry. Albuquerque receives less than 8 inches of rain per year. The project area is located on the valley floor in the former floodplain of the Rio Grande. The area is protected by levees that contain the 100 year runoff of the Rio Grande. The majority of the floods that effect the area come from thunderstorms that occur in the months of July, August, and September. The summer thunderstorms originate from the Gulf of Mexico. Less intense winter rainfall comes from frontal activity that originates in the Pacific Ocean.

A. Existing Conditions - Onsite

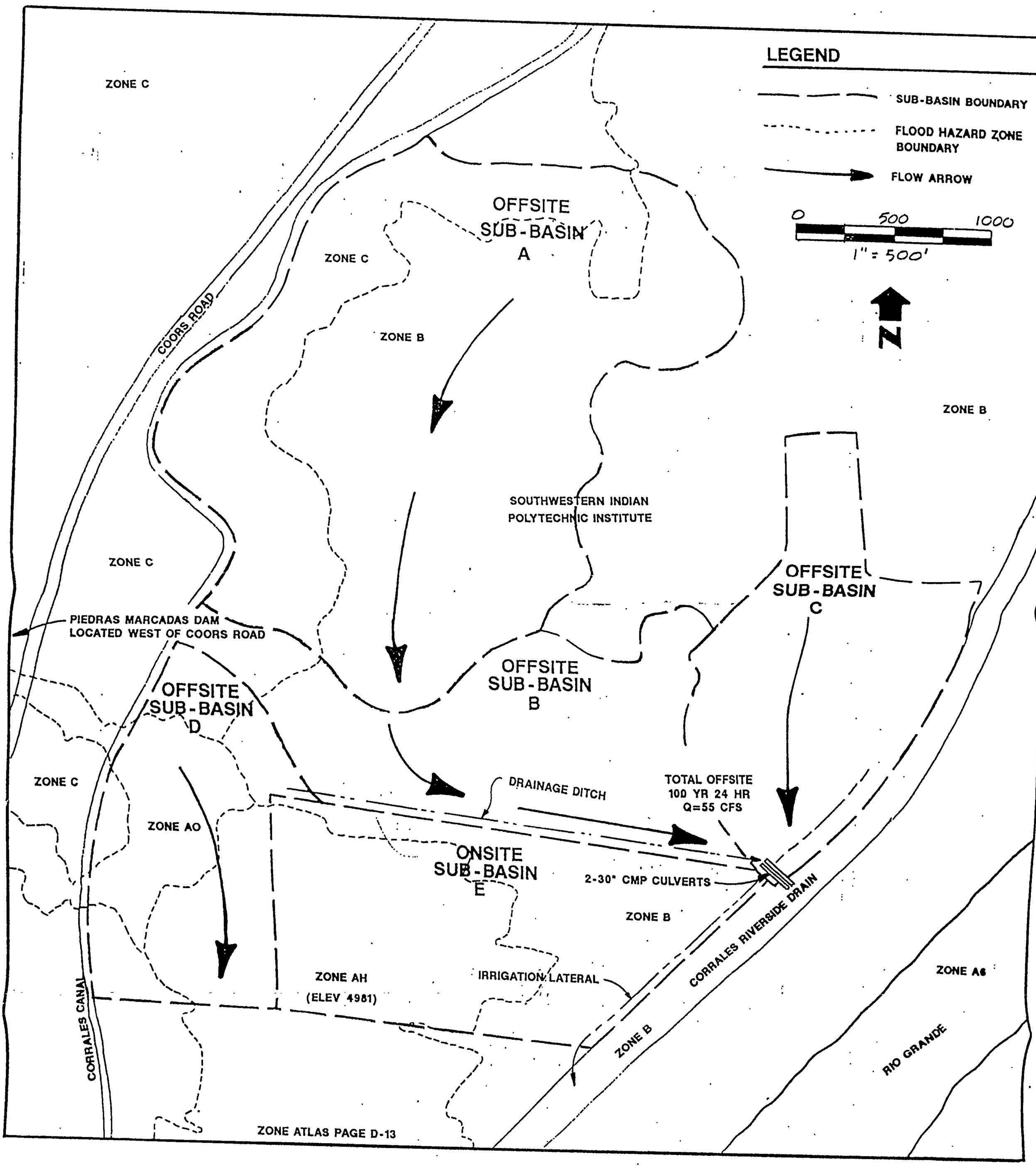
Bosque del Rio will be located on 50 acres of existing farm fields. The project site is zoned SU-1 for Planned Residential Development. The property is bordered on the north by the Southwestern Indian Polytechnic Institute (SIPI). An old river meander borders the property on the west and more farm fields form the southern boundary. On the east the property boundary is formed by an irrigation lateral (and further east is located the Corrales Riverside Drain). The average slope of the existing grade is about 0.2% from northeast to southwest. Three concrete lined irrigation ditches convey irrigation water from irrigation lateral to the fields. The lined ditches run east to west at the north, center, and south ends of the property. The ground water table is about 5 to 7 feet below the ground surface.

The Flood Insurance Rate Map (FIRM) for the area delineates the western two-thirds of the property as zone AH (shallow flooding with ponding up to elevation 4981 ft) and the eastern one-third as zone B (area protected by levee from the base flood). Due to the construction of the Piedras Marcadas Dam the zone AH will be removed from the area (including the project site). The flood hazards for the onsite and offsite sub-basins are shown in Figure 2.

B. Existing Conditions - Offsite

Existing offsite flow from the north (sub-basins A, B, and C in Figure 2) is diverted by an existing drainage ditch along the northern boundary of the project site. The ditch ranges from a top width of 6 feet and a depth of 2 feet (at the west end of the project site) to a top width of 15 feet and a depth of 6 feet (at the east end of the project site). The ditch conveys flow to two 30 inch CMP culverts. The culverts convey flow to the Corrales Riverside Drain. Between the ditch and the northern boundary of the project site lies an earthen berm about one foot high. This also prevents offsite flow from the north from entering the project site. Offsite flow from the west (sub-basin D) will flow around the project site to the south.

The average slope of the northern offsite sub-basins is about 0.2 %. The SIPI campus and farm fields form these northern sub-basins. An old river meander forms the western offsite sub-basin. It has a slope of 0.6%. The soils of the offsite and onsite sub-basins are shown in Figure 3.

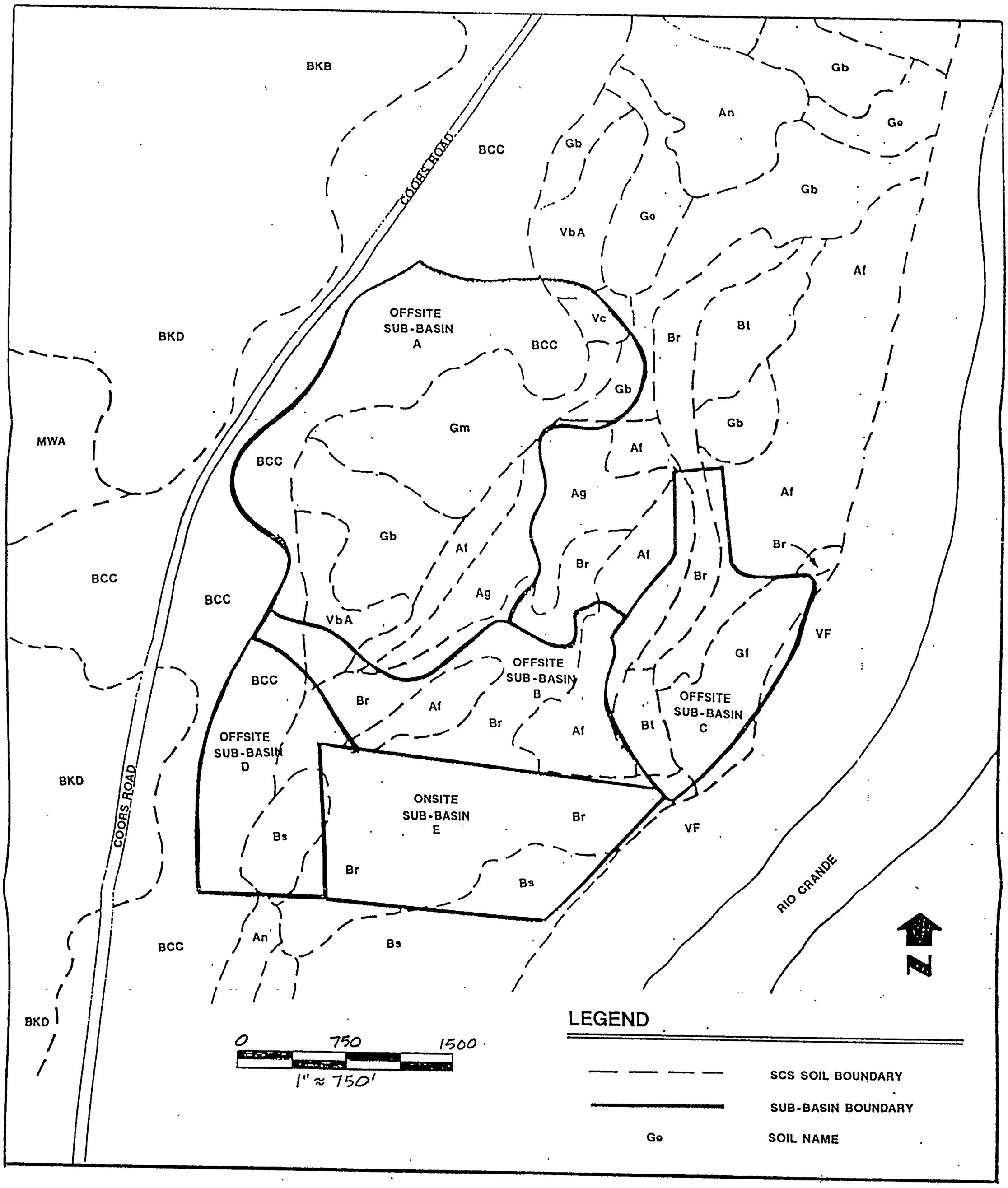


BOSQUE DEL RIO

FIGURE 2

FLOOD HAZARDS FOR ONSITE AND OFFSITE SUB-BASINS

(SOURCE: FIRM 350002 0008C, OCTOBER 14, 1983)



BOSQUE DEL RIO

FIGURE 3

SOILS OF OFFSITE AND ONSITE SUB-BASINS

(Br= BRAZITO FINE SANDY LOAM· Bs= BRAZITO SILTY CLAY LOAMY

In the past runoff from the Piedras Marcadas Arroyo flowed onto the project site. Today the Piedras Marcadas Dam contains the 100 year runoff from the west mesa. The operation plan for the dam does not allow the release of the dam's waters until the storm event has passed. Then the dam's floodwater is released to the Corrales Canal (Molzen-Corbin, 1993, p. 10). The Corrales Canal is located about 1000 feet west of the project site. The canal has been redesigned in recent years to convey the 100 year event as shown in the Albuquerque Metropolitan Arroyo Flood Control Authority's (AMAFCA) "North Coors - La Orria Outlet Plans". It forms a drainage divide, preventing local runoff from the west from entering the project site. On the east of the project site is the Corrales Riverside Drain. This drain conveys the 100 year discharge without flooding the adjacent property as shown on the FIRM (zone B).

C. Developed Conditions - Onsite

The developed project site will include a planned community consisting of 114 lots on 50 acres. The lots will be made up of 13 one acre lots while the remaining 101 lots will be 1/4 acre in size or slightly larger. The layout of the subdivision is shown in Sheets D1, D2, D3 and D4 of the enclosed plan sheets. As mentioned in a previous section, the onsite runoff will be ponded in shallow retention ponds adjacent to each home.

Also discussed previously, the zone AH flood hazard is in the process of being removed by AMAFCA due to the construction of the Piedras Marcadas Dam. Once this area is removed from zone AH it is anticipated that it will be designated zone B. This will not require any flood insurance. Until the floodplain revision occurs the homeowner's may have to buy flood insurance. A copy of the letter from the City of Albuquerque to the Federal Emergency Management Agency discussing the change in the FIRM is found in Appendix A. Other offsite flow from the north will continue to flow to the east to the Corrales Riverside Drain and never enter the proposed subdivision.

3.

HYDROLOGIC ANALYSIS

A. Pre-Design Conference

Smith Engineering met with Fred Aguirre of the City of Albuquerque's (COA) Hydrology Department on January 11, 1995 to determine the criteria for handling onsite and offsite flow for the Bosque del Rio project. The COA determined that due to the mild slopes of the existing project site, the COA's "Flat Grading Scheme" should be used. This criteria incorporates onsite retention ponds to control runoff. Shallow ponds adjacent to raised pads will insure at least one foot of freeboard between the 100 year 10 day pond elevation and the top of pad. Estate streets with a width of 28 feet and 4 foot shoulders will also be raised above the 100 year 10 day pond elevation. These private streets will drain to the adjacent lots. The entrance road to the subdivision will consist of 2 paved lanes. The 100 year 10 day runoff from the road will be ponded adjacent to the road in linear retention ponds within the roadway right-of-way while maintaining one open lane in each direction. The locations and configurations of these necessary roadside ponds are shown on sheets D10, D11 and D12 of the enclosed plan sheets. A perimeter wall will be constructed along Coors Trail while an earth berm will surround the remainder of the property. The perimeter wall and earth berm necessary for drainage purposes are shown in Sheets D2, D3 and D4 of the enclosed plan sheets. The perimeter wall and earth berm will insure that onsite flow will not flood adjacent property. The result is that the Bosque del Rio subdivision will have no adverse impact on downstream drainage systems. The pad elevations for the lots and the private interior roads are also shown in Sheets D2, D3 and D4 of the enclosed plan sheets. The entrance road to the subdivision is shown in Sheets D6, D7, D8 and D9 of the enclosed plan sheets. Unforturnately, no pre-design conference form was obtained from the City. However, this report as well as the grading and drainage plan address the issues discussed at this conference. The runoff calculations for the entrance road are shown in Appendix B.

B. Offsite Hydrologic Analysis

The 100 year 24 hour storm event was modeled with AHYMO (version 1/94) for the northern and western offsite sub-basins. The 100 year 24 hour rainfall depth is 2.63 inches. The time to peak was computed using the Soil Conservation Upland Method. The total flow from the north is 55 cfs. It is conveyed through a drainage ditch to two 30 inch CMP culverts. The culverts convey the flow to the Corrales Riverside Drain. Capacity of the drainage ditch is 66 cfs and the capacity of the two 30 inch culverts is about 120 cfs (assuming inlet control). Therefore, the existing drainage ditch and culverts can convey the runoff from the northern offsite basins to the Corrales Riverside Drain, and no offsite runoff reaches the project site. Table 1 shows the runoff parameters used in the hydrologic model. Table 2 summarizes the peak discharge and runoff volume for the sub-basins. The AHYMO output is shown in Appendix C. The ditch and culvert capacity calculations are shown in Appendix D.

C. Onsite Hydrologic Analysis

The 100 year 10 day storm event was used to model runoff for the developed onsite conditions and the entrance road. The 100 year 10 day rainfall is 3.57 inches. The COA's

DPM 22.2 was used to determine the volume of runoff and the peak discharge generated for the typical lots. The 1 and 1/4 acre lots produced 0.12 and 0.054 ac-ft of runoff, respectively. The hydrologic parameters used to compute the runoff are shown in Table 1. A summary of the peak discharge and runoff volume is shown in Table 2. The runoff calculations for the typical lots are shown in Appendix E. The existing onsite flow was modeled using AHYMO for the 100 year 24 hour event. The results are also displayed in Table 2. The peak discharge and runoff volume are 14 cfs and 1.9 ac-ft, respectively.

TABLE 1
SUMMARY OF BASIN PARAMETERS

Basin	Area (ac)	Length (ft)	Slope (ft/ft)	K	tp (hrs)	Surface Treatment in Percent			
						A	B	C	D
Existing Conditions - Offsite and Onsite - 100 Year 24 Hour									
A	117	3440	0.002	2.05	0.69	80	11	5	4
B	42	3400	0.0024	2.04	0.64	90	4	5	1
C	41	2380	0.0013	1.79	0.69	80	14	5	1
D	43	1900	0.0055	1.65	0.29	70	3	25	2
E	50	2600	0.0013	1.86	0.73	100	0	0	0
Developed Conditions - Onsite Typical Lots - 100 Year 10 Day									
Lot 1	0.30	N/A	N/A	N/A	0.133	8	15	20	57
Lot 2	1.13	N/A	N/A	N/A	0.133	10	52	15	23

Notes: The Lot 1 and 2 areas include right-of-way.

TABLE 2
SUMMARY OF PEAK DISCHARGE AND RUNOFF VOLUME

Sub-basin	Peak Discharge (cfs)	Runoff Volume (ac-ft)
Existing Conditions - Offsite and Onsite - 100 Year 24 Hour		
A	47	5.6
B	15	1.8
C	14	1.8
D	39	2.2
E	14	1.9
Developed Conditions - Onsite Typical Lots - 100 Year 10 Day		
Lot 1	1.0	0.054
Lot 2	3.0	0.12

D. Onsite Retention Pond Performance

Each lot drains to its own retention pond. A summary of the pond data is shown in Table 3. The depth of ponding for the 100 year 10 day event for the 1 and 1/4 acre lots is 0.18 and 0.90 feet, respectively. The freeboard (difference between the 100 year 10 day water surface elevation and the top of pad elevation) for both types of lots is 1 foot. The runoff from the developed conditions will not generate any significant sediment as each lot is composed of impervious and landscaped areas. The specific details on the pond schematic for these individual lot ponds are shown in sheet D15 of the enclosed plan sheets. An NPDES Storm Water Pollution Prevention Plan will be developed for the subdivision prior to construction. A copy of the drainage covenant required by the COA is shown in Appendix F. The soils investigation report is found in Appendix G.

TABLE 3

SUMMARY OF POND DATA - TYPICAL LOTS

Sub-basin	Retention Pond Depth of Ponding (ft)	Retention Pond Volume (acft)	Freeboard (ft)
Lot 1 (1/4 acre)	0.90	0.054	1.0
Lot 2 (1 acre)	0.18	0.12	1.0

4.

CONCLUSIONS

Smith Engineering Company has developed a drainage and grading plan, which is outlined in the enclosed plan sheets, for the Bosque del Rio Planned Community. The onsite flow from the 100 year 10 day event will be stored in retention ponds located on each lot. The depth of ponding for the 1 and 1/4 acre lots is 0.18 and 0.90 feet, respectively. The freeboard from the pond water surface elevation to the top of pad will be 1 foot. The interior private roads will also be raised above the pond water surface elevation. The paved 2 lane entrance road will pond the 100 year 10 day storm in retention ponds located along the sides of the road (within the right-of-way).

Existing offsite flow from the north is conveyed through a drainage ditch and culverts to the Corrales Riverside Drain. Existing offsite flow from the west mesa is controlled by the Piedras Marcadas Dam and the Corrales Canal. A small offsite sub-basin on the western border of the project site drains to the south. The Piedras Maracas Dam has removed the source of flooding that produced the zone AH classification for the project site. AMAFCA is presently working to formally remove the project site from the 100 year floodplain.

City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

RECEIVED
FEB 15 1996
AMAFCA

February 13, 1996

Frank Pagano, Branch Chief
Federal Emergency Management Agency
Region VI, Federal Center
800 North Loop 288
Denton, Texas 76201-3698

RE: REQUEST FOR LETTER OF MAP REVISION FOR THE PIEDRAS MARCADAS DETENTION DAM, CITY OF ALBUQUERQUE, BERNALILLO COUNTY, NEW MEXICO, COMMUNITY PANEL NO. 350002-0008.

Dear Mr. Pagano:

The purpose of this letter is to request a Letter of Map Revision for the above referenced project. The request consists of the elimination of the floodplain downstream of the Piedras Marcadas Detention Dam which was constructed by the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA). No request was sent to FEMA for a Conditional Letter of Map Revision for this project.

Enclosed with this letter are the application and certification forms for requesting revisions to the National Flood Insurance Program (NFIP) maps. Along with the forms are a detailed technical analysis, As-Built plans and NFIP-related information presented in an organized fashion to facilitate an efficient review. Since this project was sponsored by a public agency, no fees are applicable.

My office has reviewed and approved the hydrology and floodplain revision proposed with this project. Our Community would greatly appreciate your expeditious cursory review and the forwarding of this document to Headquarters for their technical review. If you have any questions regarding this submittal, please do not hesitate to call me at (505) 768-2666.

Sincerely,

Susan Calongne

Susan M. Calongne, P.E.
City/County Floodplain Administrator

c: Michael K. Buckley, Chief, Hazard Identification Branch, FEMA
John Kelly, AMAFCA
Craig Hoover, Bohannan-Huston
File

THE CITY OF ALBUQUERQUE IS AN EQUAL OPPORTUNITY/REASONABLE ACCOMMODATION EMPLOYER

PROJECT Bosque del Rio SHEET NO. 1 OF 5

SUBJECT Roadway Drainage PROJECT NO. 194156-01

BY C. Olsen DATE 4/2/96 CHECKED BY _____ DATE / /

Drainage for Entrance Road - Road Section varies at 40' (F to F), 28' (F to F) and 24' (F to F); All roads 2-LANE (40' WITH PAVED MEDIAN).

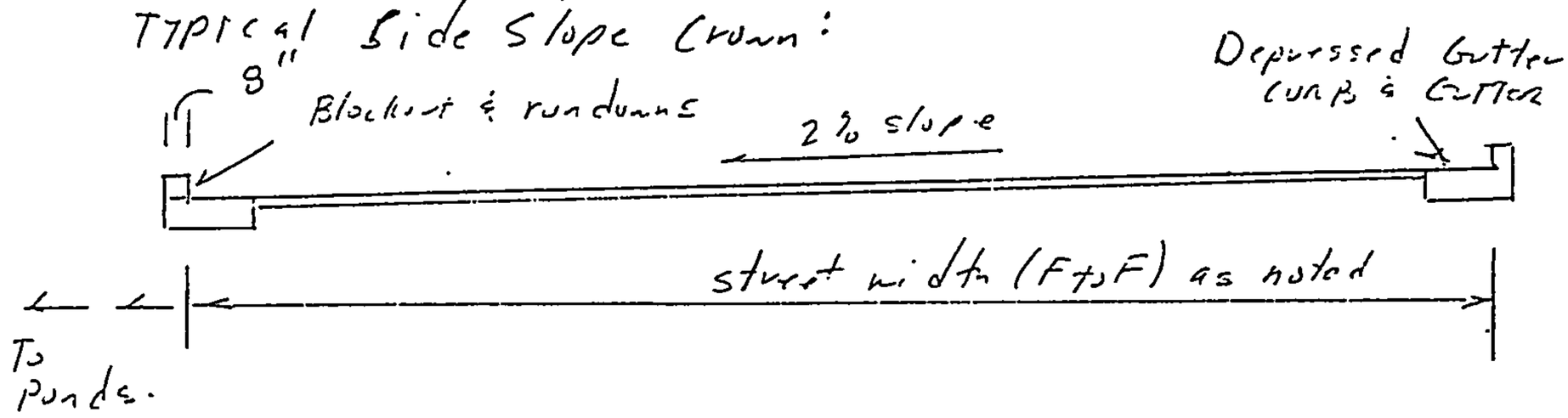
FOR 40' (F. TO F.) Section (60' Typical Row)

FOR 28' (F to F) & 24' (F to F) Section (50' Typical Row)

28' & 24' sect - Side Slope Crown, GUTTER ON one side with rundown curb blockouts @ pond areas.

40' Sect - Normal crown section, with rundown curb blockouts @ pond areas.

Typical Side Slope Crown:



Compute runoff volume per 100 linear ft of road for 40' (F to F) Section - (60' Typical Row)

Impervious Area =

$= 100' \times 41.33' = 4133$ SQFT (LAND TREATMENT D)

PERVIOUS AREA =

$= 100'(18.67') = 1867$ SQFT (Land Treatment C)

FROM DPM 22.2 - LOCATION ZONE 1

$P_{360} = 2.2^{in}$ $P_{1440} = 2.66^{in}$ $P_{10\,days} = 3.67^{in}$

$V_{360} = (0.99 * 1867 + 1.97 * 4133)/12 = 833$ cu ft

$V_{10\text{-}day} = 833$ cu ft $+$ Imp $(\Delta$ 10 day - 6 hr$)/12$ in/ft

$= 833 + 4133(3.67 - 2.20)^{in}/12 = 1389$ cu ft per 100' street

PROJECT Bosque del Rio SHEET NO. 2 OF 5

SUBJECT Roadway Drainage PROJECT NO. 194156-01

BY C. Olsen DATE 4/2/96 CHECKED BY _____ DATE / /

Note: Most of 40' (F.to.F) section will have normal crown with drainage to each side.

TOTAL drainage volume per 100' street =

$V_{10\text{-}day}$ = 1389 cu ft per 100 ft street

1/2 OF drainage to each side with normal crown.

For Normal crown starts with ponds on BOTH sides:

WIDTH - CURB TO ROW = 9.33 FT - (Normal crown)

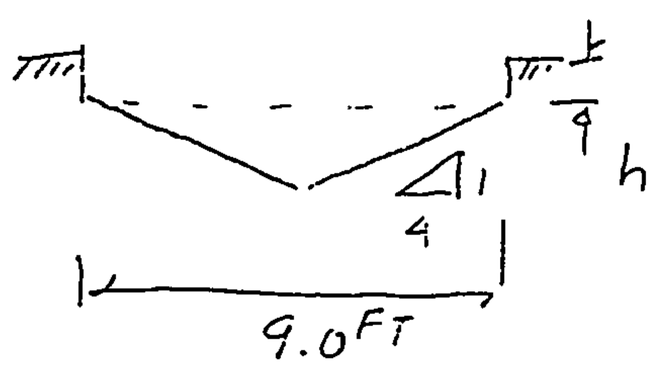
STA 5+15 to 11+00 - 585' STREET

LENGTH OF POND AVAILABLE = 600 FT

- VOLUME REQUIRED PER LENGTH OF POND

= 13.89 * 585 / 600 = 13.54 CU FT/FT

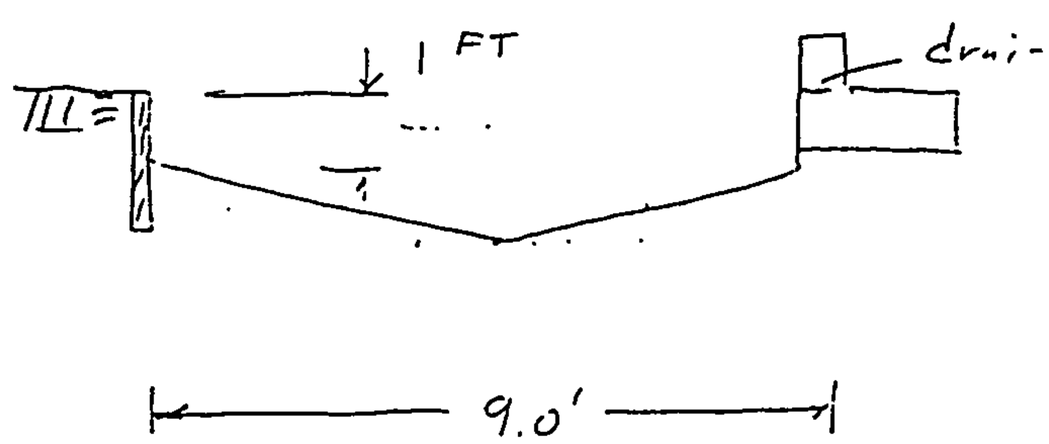
TYPICAL SIDE POND:



$h = [13.54 - (1/2 * 9 * 1.125')] / 9$

= 0.94 FT = Use 1.0 FT

Typical side pond configuration - (STORAGE)



Note: Additional pond width available sta 9+00 to 11+00

PROJECT Bosque del Rio SHEET NO. 3 OF 5

SUBJECT Roadway Drainage PROJECT NO. 194156-01

BY C Oliver DATE 4/2/96 CHECKED BY _____ DATE / /

compute runoff volume per 100 linear-ft of road for 28' (F. TO F.) Section.

Impervious Area =

$100' \times 29.33' = 2933$ SQFT (LAND TREATMENT D)

Pervious Area =

$100'(20.67') = 2067$ SQFT (LAND TREATMENT C)

$V_{360} = (0.99 * 2067 + 1.97 * 2933)/12 = 652$ cu ft

$V_{10\text{-}day} = 652 + 2933(3.67-2.20)/12 = 1011$ cu ft

Per 100' STREET

WIDTH - CURB TO ROW = 20 FT

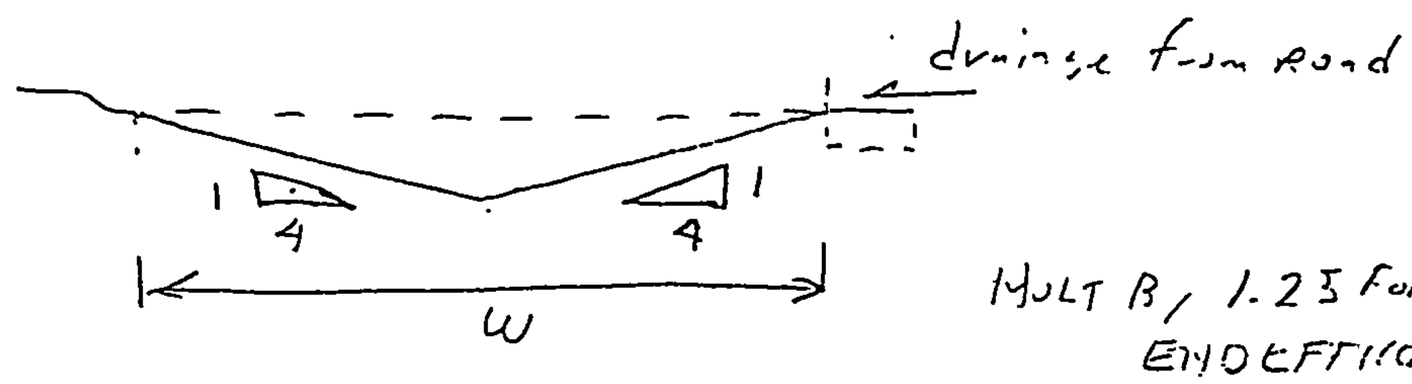
STATION 11+00 TO 22+00 - 1100 FT STREET

LENGTH OF POND AVAILABLE = 900 FT

VOLUME REQUIRED PER LENGTH OF POND

$= 10.11 * 1100/900 = 12.36$ cu ft/ft

TYPICAL SIDE POND



MULT BY 1.25 FOR END EFFECTS OF POND

$1.25 * 12.36 = [w * (w/2)/4]\ 1/2$

$w = 15.72$ FT USE $w = 17$ FT

PROJECT Bosque del Rio SHEET NO. 4 OF 5

SUBJECT Roadway Drainage PROJECT NO. 194156-01

BY C. Allen DATE 4/2/96 CHECKED BY _____ DATE / /

Compute runoff volume per 100 linear ft of road for 24 Ft (F. to F) Section

Impervious Area

$= 100 * 25.33' = 2533$ SQFT (LAND TREATMENT D)

PERVIOUS Area

$= 100 * 24.67' = 2467$ SQFT (LAND TREATMENT C)

$V_{360} = (0.99 * 2467 + 1.97 * 2533)/12 = 620$ cu ft

$V_{10\text{-}day} = 620 + 2533(3.67 - 2.20)/12 = 930$ cu ft

WIDTH - CURB TO ROW = 22 FT

STATION 22+00 to 30+59 - 859 FT ROAD

LENGTH OF POND AVAILABLE = 700 FT

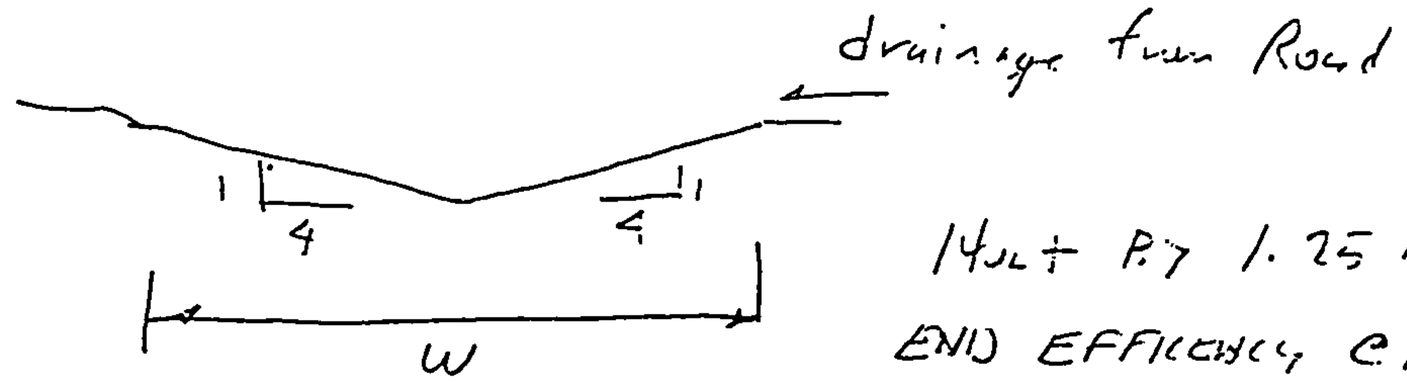
REDUCE BY 100 FT TO ALLOW FOR FUTURE DRIVES

NET LENGTH = 600 FT

VOLUME REQUIRED PER LENGTH OF POND

$= 9.3 * 859^{FT}/600 = 13.31$ cu ft/ft

Typical side pond



14 ac + P.7 1.25 FOR END EFFICIENCY @ PONDS

$1.25 * 13.31 = [W * (W/2)/4]^{1/2}$

$W = 16.32^{FT} \Rightarrow$ USE $W = 17^{FT}$

PROJECT Bosque del Rio SHEET NO. 5 OF 5*
SUBJECT Roadway Drainage PROJECT NO. 194156-01
BY C. Olsen DATE 4/2/96 CHECKED BY _____ DATE / /

COMPUTE PEAK FLOW FOR POND ENTRANCE

FOR 40' (F to F.) Section.

FLOW RATE PER 100' linear foot - ROAD

$Q_{100} = 4.37$ cfs/Ac - LAND TREATMENT D

(ONLY STREETS DRAIN TO PONDS THROUGH BLOCKOUT INLETS)

$Q_{100} = 4.37 * 41.33' * 100' / 43560$ SQFT/Ac $= 0.42$ cfs per 100 FT

FOR STATION 5+15 TO 11+00 - 6 ponds @ 100 FT

PEAK FLOW PER POND

$Q_{100} = 5.85 * 0.42 / 6 = 0.41$ cfs/pond

FOR WEIR FLOW SIDE CHANNEL INLET

@ depth flow = 0.2 FT MAX - 12 IN WIDE BOTTOM

$Q_{weir} = CLH^{3/2} = 2.44 * 0.5 (0.2)^{3/2}$

$= 0.22$ cfs

PROVIDE MIN 2 SIDE CHANNEL INLETS/POND (MIN)

FOR 29' (F to F) Section

FLOW RATE per 100 linear Ft ROAD

$Q_{100} = 4.37 * 29.33' * 100 / 43560$ SQFT/Ac $= 0.30$ cfs/100 ft Road

FOR STATION 11+00 to 22+00 - 9 ponds

Peak flow per pond

$Q_{100} = (1100/100) * 0.30 / 9 = 0.37$ cfs/pond

∴ ok FOR WEIR FLOW @ L = 12" H = 0.2 ft $Q_{weir} = 0.22$ cfs

use 2 inlets per pond / Also use @ 24' section. Road

PROJECT Bosque del Rio SHEET NO. 1 OF 7

SUBJECT Coors Trail - Ret. Ponds PROJECT NO. 194156-01

BY [illegible] DATE 6/25/96 CHECKED BY C. [illegible] DATE 6/25/96

POND #1

STA 6+50 → 7+50

RUNOFF LENGTH = 235ft × 40' Imp

RUNOFF VOL. =

$235 \times 40(1.97 + 1.47)/12 + 100 \times 20(0.99/12) = 2860$

DIST. FROM FACE OF CURB TO EASEMENT @ 6+50 = 25' → LOSS = 3' DUE TO GUARDRAIL

DIST FROM FACE OF CURB TO EASEMENT @ 7+50 = 15'

$\Delta elev = 2.42'$

$2860\ ft^3 / 100ft = 28.60\ ft^3/ft$

2.5:1 → on deep

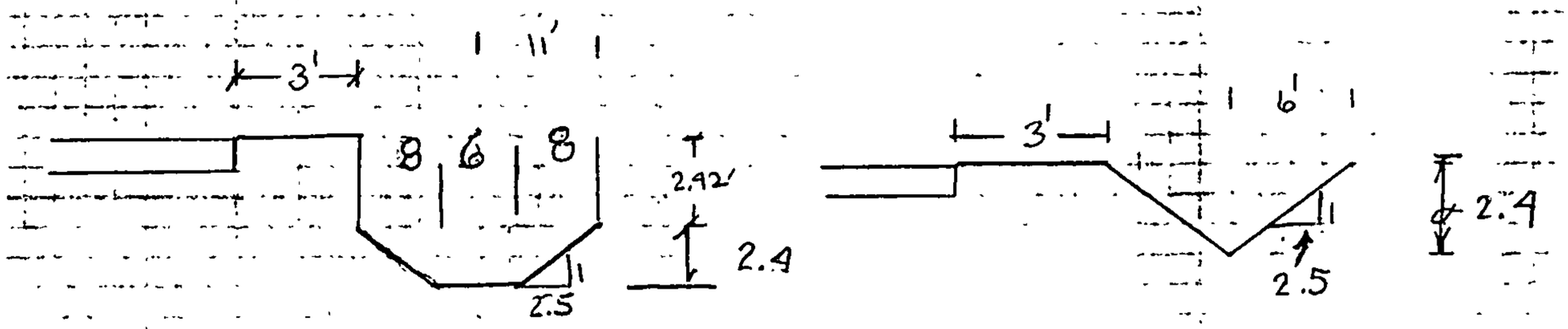
1.5:1 → on shallow

Slope	Deep End	Shallow End	Avg Area
4:1	30.25	9.0	19.625
3:1	40.33	12.0	26.165
2.5:1	48.9	14.4	31.65
2:1	60.5	18	39.25 > 34.725
1:1.5	80.67	24	52.33

Avg Area = 36.2 → ga

Details Begin STA 6+50 End STA 7+50

Front 3' From Face of Curb Back @ Easement



DEEP END SHALLOW END

ESTIMATED CAPACITY $\frac{[\frac{1}{2}(3.2)16 + 3.2(6)]100 + \frac{1}{2}(2.4)(12)(100)}{2} = 2960\ ft^3$

2960 > 2860 → (3% more than Runoff Volume)

PROJECT Bosque del Rio SHEET NO. 2 OF 7*

SUBJECT Coors Trail - Ret. Ponds PROJECT NO. 194156-01

BY [illegible] DATE 6/25/96 CHECKED BY C. Chelsen DATE 6/25/96

* LEAVE STA 7+50 TO STA 8+75 Open For Future Access

Pond #2 STA 8+75 → 9+50

RUNOFF LENGTH = 157'

RUNOFF VOL =

$= 157 \times 40 (1.97 + 1.47)/12 + 120 \times 25 (0.99/12) = 2048 \text{ ft}^3$

DIST. FROM FACE OF CURB TO EASEMENT @ 8+75 = 17' → LOSS = 3' DUE TO GUARDRAIL

BUILD DEEP END 20' FROM EASEMENT ALONG WITH DRAINAGE SWALE

$\Delta elev = (100 \times .0119) = 1.19'$

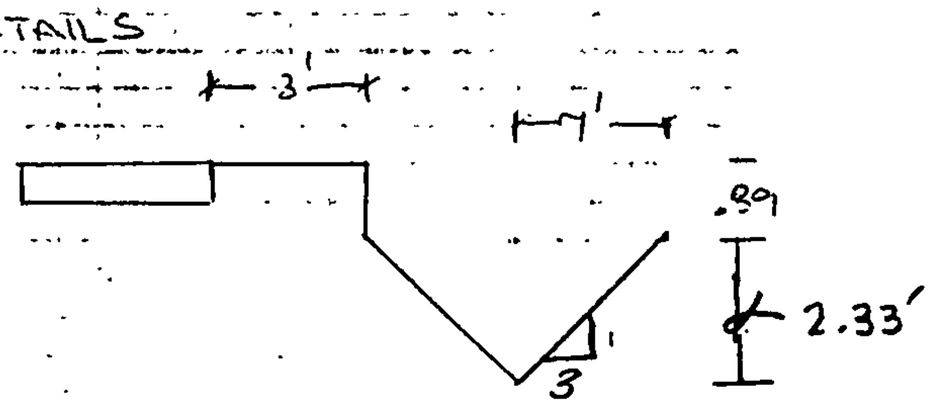
$2048/100 = 20.48 \text{ ft}^2/\text{ft}$

SLOPE	DEED END AREA	D.E. HEIGHT	SHALLOW END AREA	S.E. HEIGHT
5:1				
4:1	12.25	1.75	30.5	2.75
3.5:1			34.57	3.14
3:1	16.33	2.33	40.33	3.66
2.5:1	19.6	2.8	48.4	4.4
2:1	24.5	3.5		5
1.5:1	32.67	4.67		

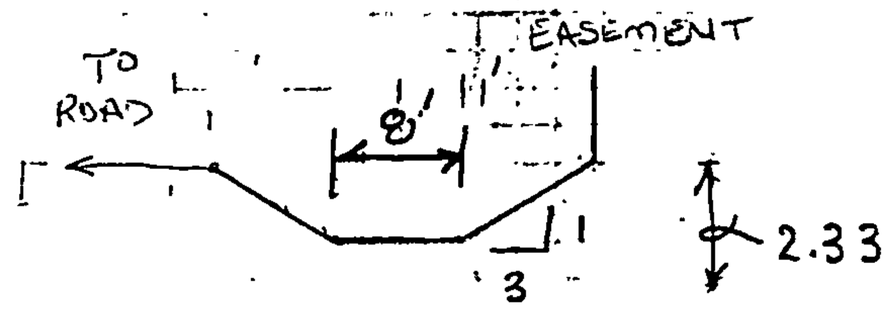
Area Avg $29.54 \text{ ft}^2 > 27.78$

* DEED END MUST BE DEEPER THAN SHALLOW END

DETAILS



DEED END



SHALLOW END

Estimated Capacity $= \dfrac{(2.33/2)\,14(100) + (2.33/2 * (9 + 2.33 * 8))(100)}{2} = 2563'$

$2563 > 2048 \rightarrow$ (25% greater than runoff volume)

* NEED DRAINAGE SWALE @ 9+50

Smith Engineering Company

6400 Uptown Boulevard, N.E. Suite 500E Albuquerque, New Mexico 87110 505/884-0700

PROJECT Bosque del Rio SHEET NO. 3 OF 7

SUBJECT Cours Trail - Ret. Ponds PROJECT NO. 199156-01

BY [illegible] DATE 6/25/96 CHECKED BY [illegible] DATE 6/25/96

POND #3 STA 10+30 → 11+00

RUNOFF LENGTH = 175' @ 15' wide

RUNOFF VOLUME =

$175 * 15 (1.97 + 1.47)/12 + 120(30)(0.99)/12 = 1{,}050\ ft^3$

DIST. FROM FACE OF CURB TO EASEMENT @ 10+25 = 23' → LOSS = 3' DUE TO GUARDRAIL

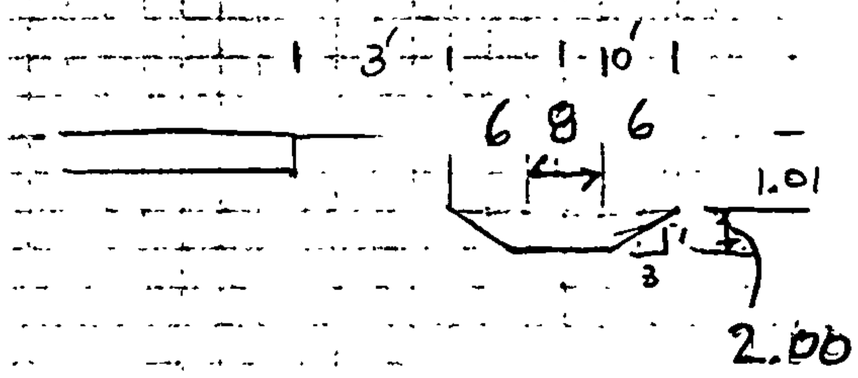
DIST. FROM FACE OF CURB TO EASEMENT @ 11+00 = 11'

$\Delta elev = .89'$

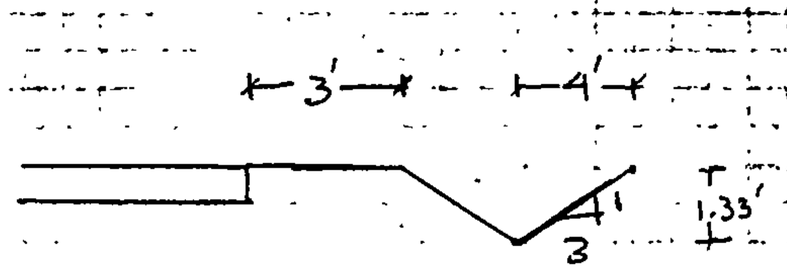
$\frac{105.0\ ft^3}{70} = 1.500\ ft^3/ft$

SLOPE	DEEP END AREA	SHALLOW END AREA	AVG AREA
4:1	25	4	14.5
3:1	33.33	5.33	19.33

DETAILS



DEEP END



SHALLOW END

Estimated Capacity $= \frac{[(2.00/2) * 12 + 2.00(8)]\ 70 + (1.33/2)\ 8(70)}{2} = 1166\ ft^3$

$1166\ ft^3 > 1050$ → (.11% greater than runoff volume)

Smith Engineering Company

6400 Uptown Boulevard, N.E. Suite 500E Albuquerque, New Mexico 87110 505/884-0700

PROJECT Bosque del Rio SHEET NO. 4 OF 7

SUBJECT Coors Trail - Ret. Ponds PROJECT NO. 194156-01

BY C. Olsen DATE 6/25/96 CHECKED BY _____ DATE / /

Pond No 4

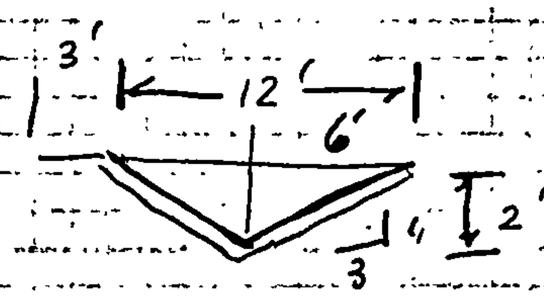
POND Length = 100 ft

Drainage Area = 260' x 17' (PNED)

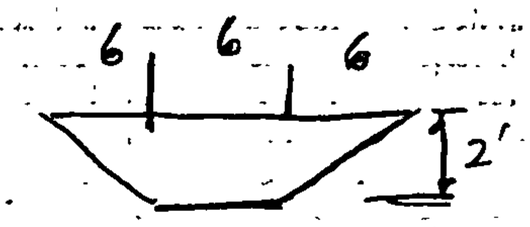
Runoff Volume = 2.75*17(1.97+1.47)/12 + 150(18)(.99)/12
= 1563 cuft

TYPICAL SECTIONS:

TOP END



BOTTOM END



$$\text{Volume} = \frac{\tfrac{1}{2}(2)(12) * 100 + \left(\tfrac{1}{2}(2)(12) + 2(6)\right) 100}{2} = 1800\ ft^3$$

$1800\ ft^3 > 1563\ ft^3 \Rightarrow$ (15% greater than runoff volume)

PROJECT Bosque del Rio SHEET NO. 5 OF 7

SUBJECT Coors Trail - Ret. Ponds PROJECT NO. 194156-01

BY [illegible] DATE 6/25/96 CHECKED BY C. Olsen DATE 6/25/96

POND # 5 STA 12+25 → STA 13+50

RUNOFF LENGTH = 230' @ 30' WIDTH

RUNOFF VOLUME =

$= 230 \times 30 (1.97 * 1.47)/12 + 135 (20') (.99)/12 = 2200$

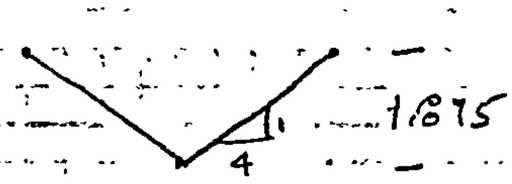
Δelev = 1.49'

DIST. FROM FACE OF CURB TO EASEMENT @ 12+00 = 1.9'

DIST FROM FACE OF CURB TO EASEMENT @ 13+25 = 1.9'

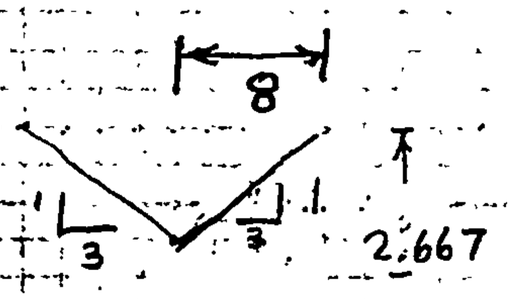
$\frac{2200}{100} = 22.00 \ ft^3/ft$

@4:1



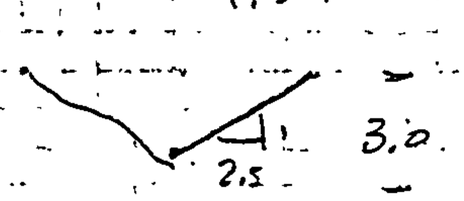
Area - 14.06 ft^2

@3:1



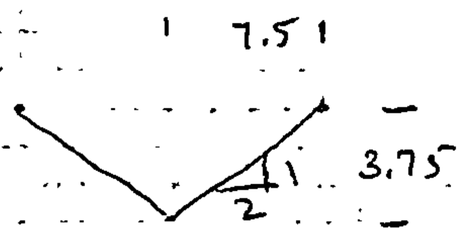
Area = 21.33 ft^3 @ L = 125' V = 2667'

@2.5:1



Area - 22.5 ft^3

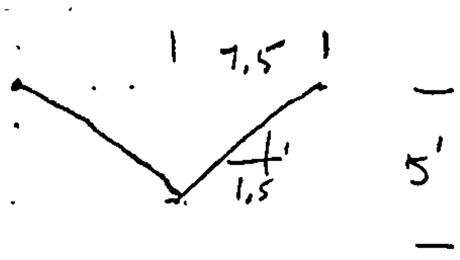
@2:1



Area - 28.125 ft

USE 3:1 for design

@1.5:1



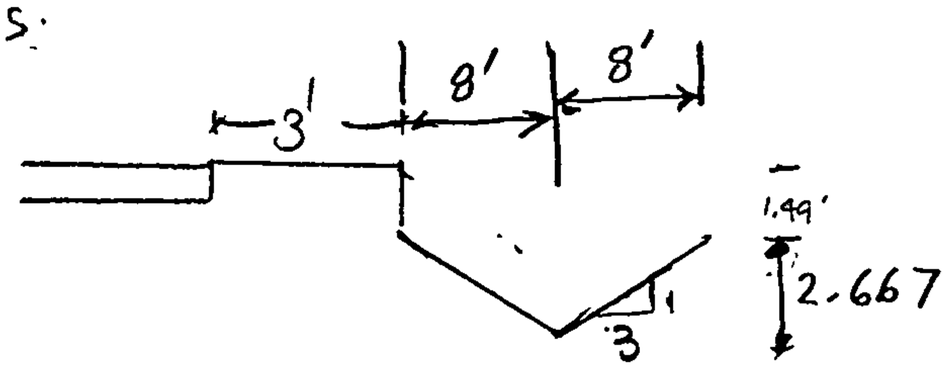
Area - 37.5 ft^2

* Estimated Capacity

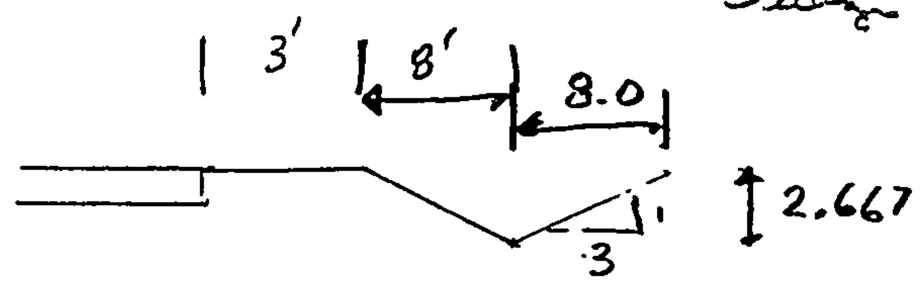
$(8)(2.667)(125) =$
$= 2667 \ ft^3$

$2667 \ ft^3 > 2200 = 20\%$ greater than Design

DETAILS:



DEED END



SHALLOW END

PROJECT Bosque del Rio SHEET NO. 6 OF 7

SUBJECT Coors Trail - Ret. Ponds PROJECT NO. 199156-01

BY [illegible] DATE 6/25/96 CHECKED BY [illegible] DATE 6/25/96

Pond #6 Sta 13+75 → 15+00

Runoff Length = 150' Road Width Ratio = 30'

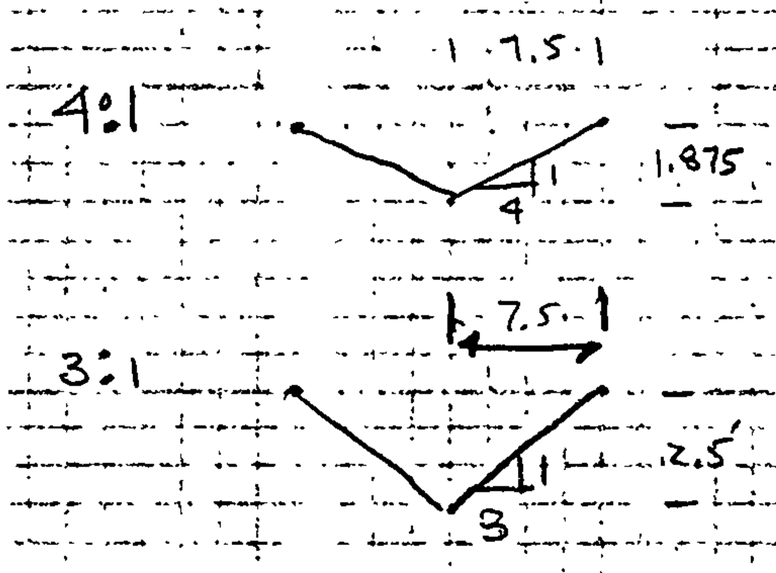
Runoff Volume = 150 * 30 (1.97 + 1.47)/12 + 20 * (150) .99/12
= 1537 ft³

Δelev = .85'

$\frac{1537 \text{ ft}^3}{100 \text{ ft}} = 15.37 \text{ ft}^3/\text{ft}$

Dist from face of curb to easement @ 13+75 = 18'

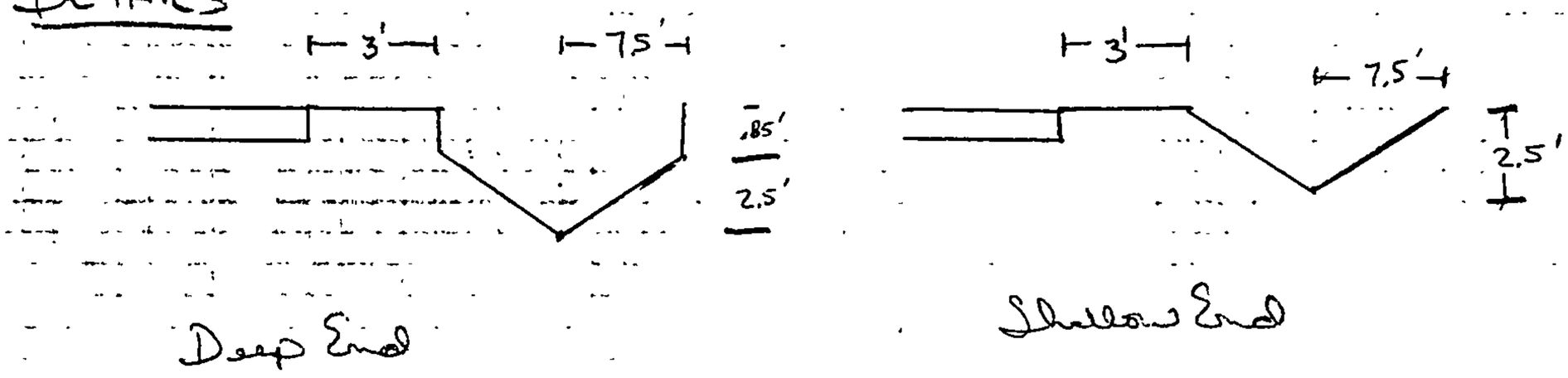
Dist from face of curb to easement @ 15+00 = 18'



Area = 7.5 × 1.875 = 14.0625

Area = 18.75 ft² ← USE

Details



Pond volume 18.75 * 100 = 1875 cu ft

1875 ft³ > 1537 ft³ (22% Greater than runoff volume)

PROJECT Bosque del Rio SHEET NO. 7 OF 7

SUBJECT Coors Trail - Ret. Ponds PROJECT NO. 194156-01

BY [illegible] DATE 6/25/96 CHECKED BY C. [illegible] DATE 6/25/96

REMAINING PONDS → ALL WILL HOLD SAME VOLUME

Q = 100' S = 20' RUNOFF LENGTH = 120'

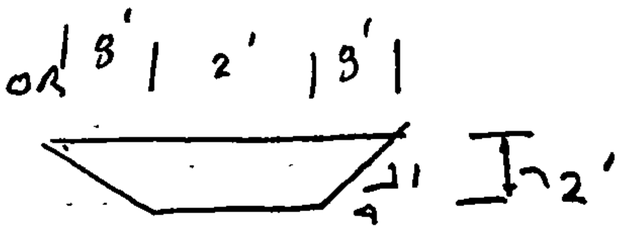
RUNOFF VOLUME = 120 * 30'(1.97 + 1.97)/12 + 20' * 120' * .99/12
= 1230 ft³

AREA = 1230/100 = 12.30 ft²

DIST FROM FACE OF CURB TO EASEMENT = 20' (SAME FOR ALL)

** NO GUARDRAIL SO NO LOSS. **

SLOPE	AREA
6:1	@ 20' WIDTH = 16.67 FT
5:1	18.25 ft² > 16.67 ft² → good
3:1	15' WIDTH = 18.75 ft² ∴ OK
4:1	15' WIDTH = 14.06 ft² ∴ OK

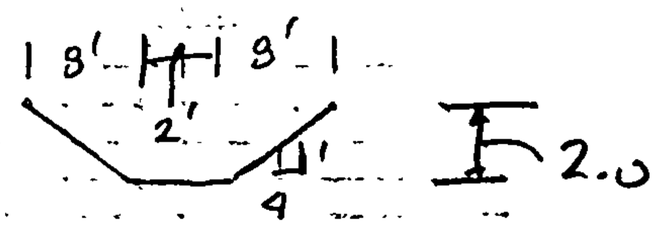


VOL = 22 ft³/ft ∴ OK

POND #6 STA 15+20 to 16+20 → 3:1 slopes all around
— 15' WIDTH TOP

POND #7 STA 16+40 to 17+40 → sinted slopes to avoid
vertical drop — 4:1 SIDE SLOPES — 18' WIDTH TOP
MAX DEPTH 2.0 ft

STA 16+40



POND #8 - 15 - SAME SECTION AS #7

AT AREA BELOW POND #15 - POND WIDTH = 15 FT USE 4:1 SLOPE

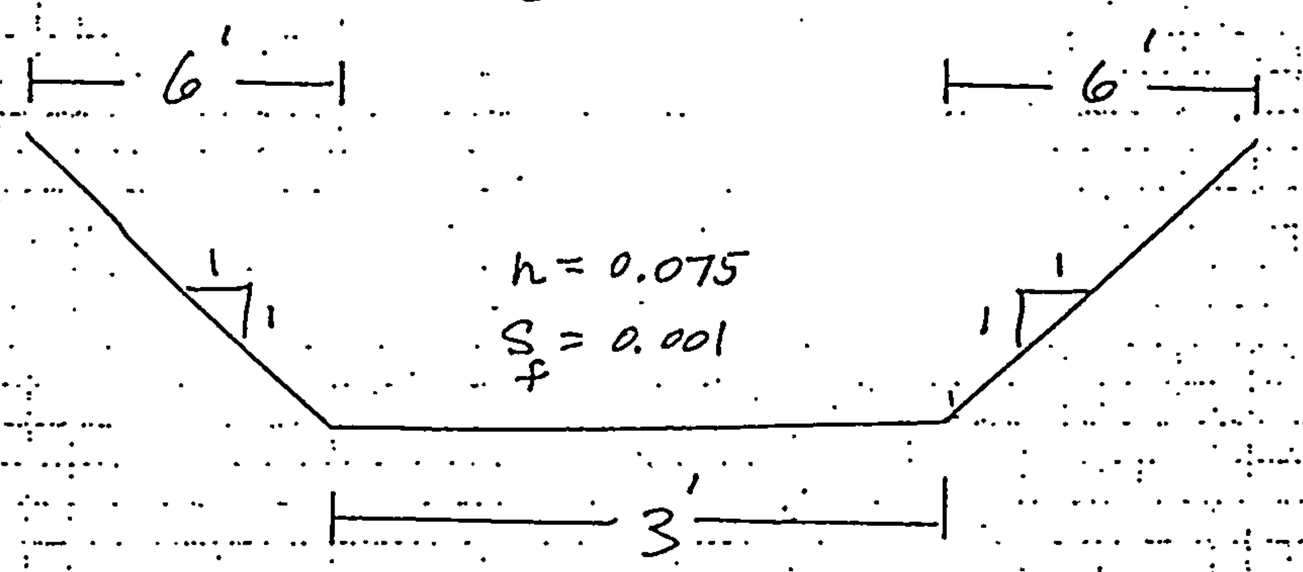
POND #16 - 18 - USE 4:1 SIDE SLOPES - 15' TOP WIDTH

PROJECT Bosque del Rio SHEET NO. 1 OF 2

SUBJECT NORTH DITCH CAPACITY CALCS. PROJECT NO. 194156-01

BY SPK DATE 1/20/95 CHECKED BY _____ DATE / /

Avg. Channel Section



MANNINGS EQ.

$$Q_{cap.} = \frac{1.49}{n} A R^{2/3} S_f^{1/2}$$

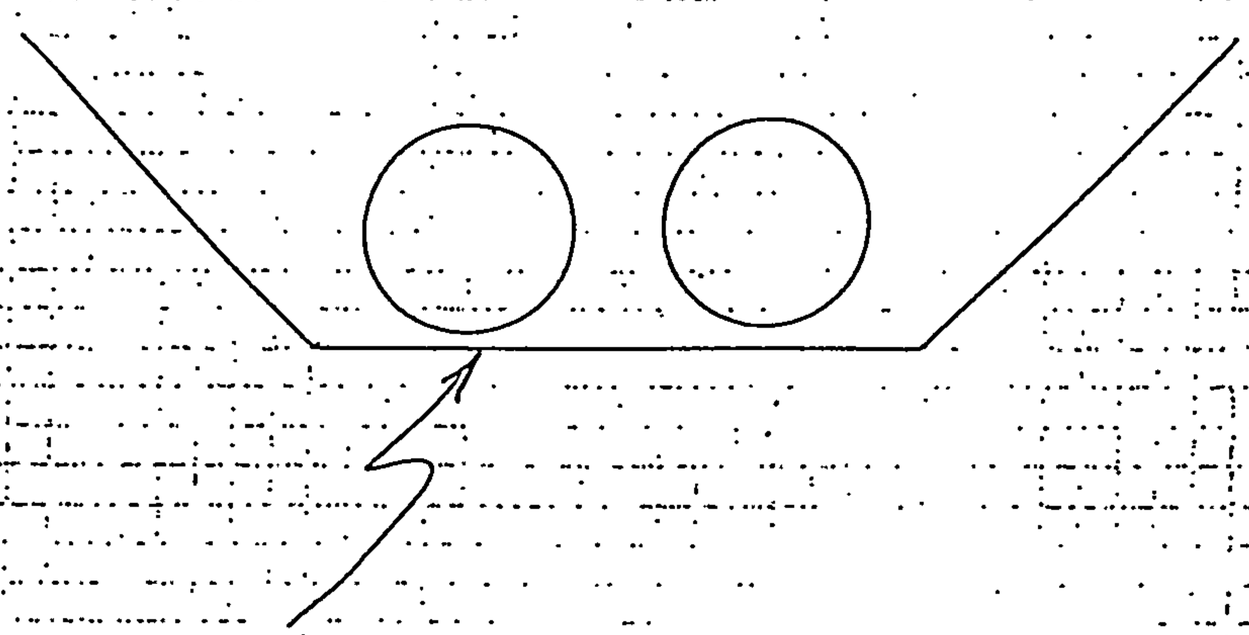
$$= \frac{1.49}{0.075}(54)(2.7)^{2/3}(0.001)^{1/2}$$

$$= \underline{\underline{66}} \text{ CFS}$$

PROJECT Bosque del Rio SHEET NO. 2 OF 2

SUBJECT 2-30" CULVERT CAPACITY CALCS. PROJECT NO. 194156-01

BY SPK DATE 1/20/95 CHECKED BY _____ DATE / /



2-30" CMP CULVERTS

ORIFICE EQ. (ASSUME INLET CONTROL)

$$Q_{cap.} = CA\sqrt{2gH}$$

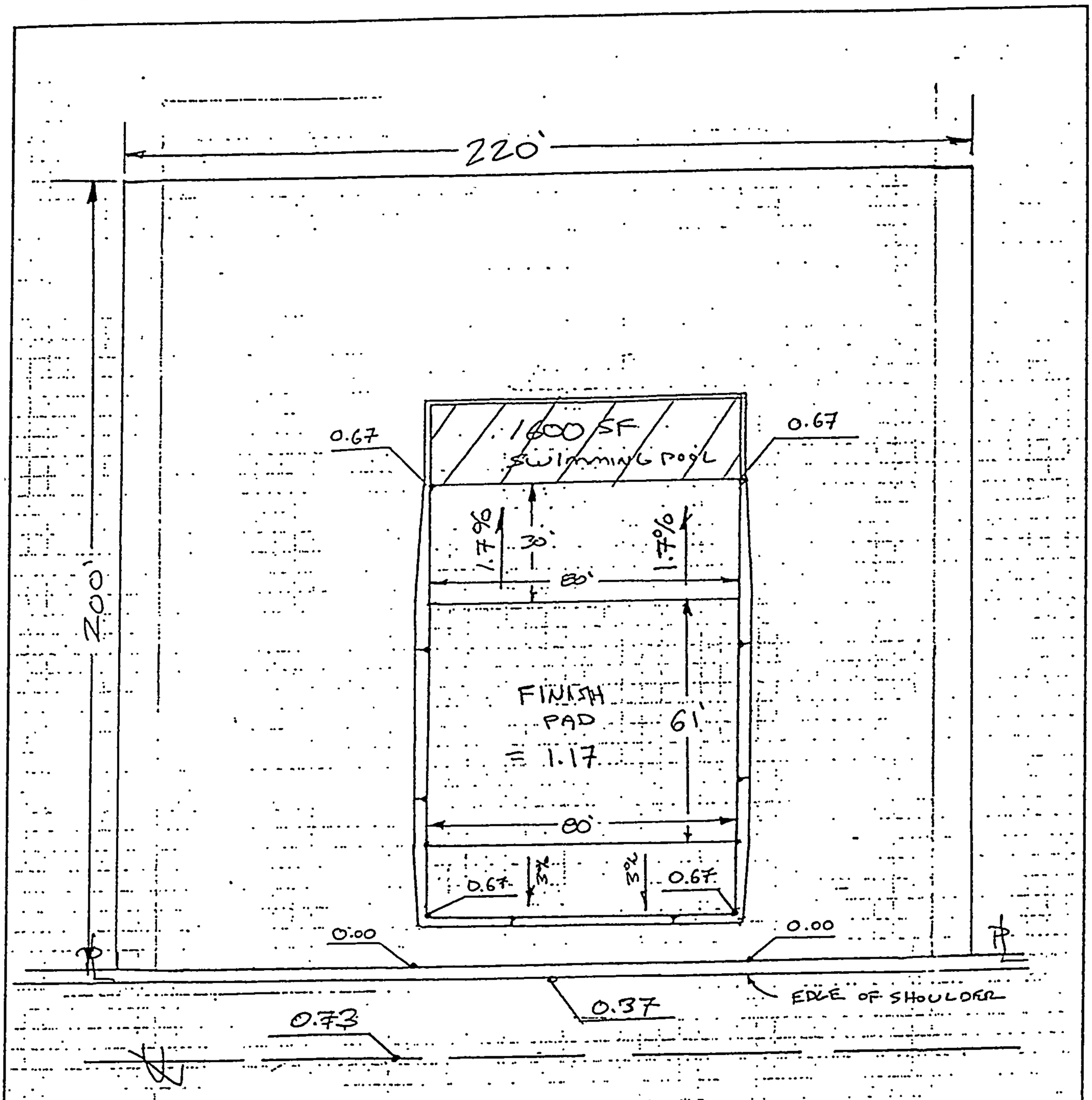
$$= (0.7)(4.91)\sqrt{2(32.2)(4.75)}\,(2\text{ culverts})$$

$$= \underline{120}\text{ CFS}$$

PROJECT BOSQUE DEL RIO SHEET NO. 1 OF 6

SUBJECT LARGE LOT (1 ACRE) PROJECT NO. 194156-01

BY TVD DATE 1/3/95 CHECKED BY C. Ann DATE 1/27/95



DEPTH OF PONDING

80(75) + 85(10) + 220(45) + 220(65) = 30,200 SF

WE STORE 0.1218 AC-FT = 5306 CF

$\frac{5306}{30,200} = \boxed{0.176}$

PROJECT BOSQUE DEL RIO SHEET NO. 2 OF 6

SUBJECT HYDROLOGY - (1-ACRE LOTS) PROJECT NO.

BY TVD DATE 12/22/94 CHECKED BY C. Adam DATE 1/27/95

TOTAL SIZE = 220' WIDE BY 200' LONG

= 44,000 SF + 5060 SF = 49,060 SF

= 1.126 AC.

ROAD

% D = HOUSE/GARAGE = 4900 SF

ROAD = 23' (220) = 5,060 SF

PATIO = 300 SF

DRIVEWAY = 30' $\left(\frac{30' + 16}{2}\right)$ = 690 SF

LENGTH AVG WIDTH

MISC. = 50 SF

11,000 SF OR 23%

% A = LANDSCAPING = 10%

% C = GRAVEL/ROCK PLASTIC LANDSCAPING = 15%

% B = GRASS = 52%

FLOW = A (1.29) (1.126) (0.10) = 0.145

B (2.03) (1.126) (0.52) = 1.189

TABLE A-9 ⇒ C (2.87) (1.126) (0.15) = 0.485

D (4.37) (1.126) (0.23) = 1.132

Q_{100} = 2.95 CFS

PROJECT BOSQUE DEL RIO SHEET NO. 3 OF 6

SUBJECT 1 ACRE LOT – V10 DAY PROJECT NO.

BY TVD DATE / / CHECKED BY C. Alden DATE 1/22/95

VOLUME TABLE A-8

E (6-HR STORM)

A = 0.44
B = 0.67
C = 0.99
D = 1.97

EQ A-5

WEIGTED E = $\frac{.44(.1116)+.67(.5803)+.99(.1674)+1.97(.2567)}{1.116}$

= 0.9940

A-6 → $V_{360} = \frac{.9940\,(1.126)}{12} = 0.0933$ AC-FT/LOT

A-9 → $V_{10\ DAYS} = V_{360} + A_D * (P_{10\text{-}DAYS} - P_{360})/12$ = ac-ft

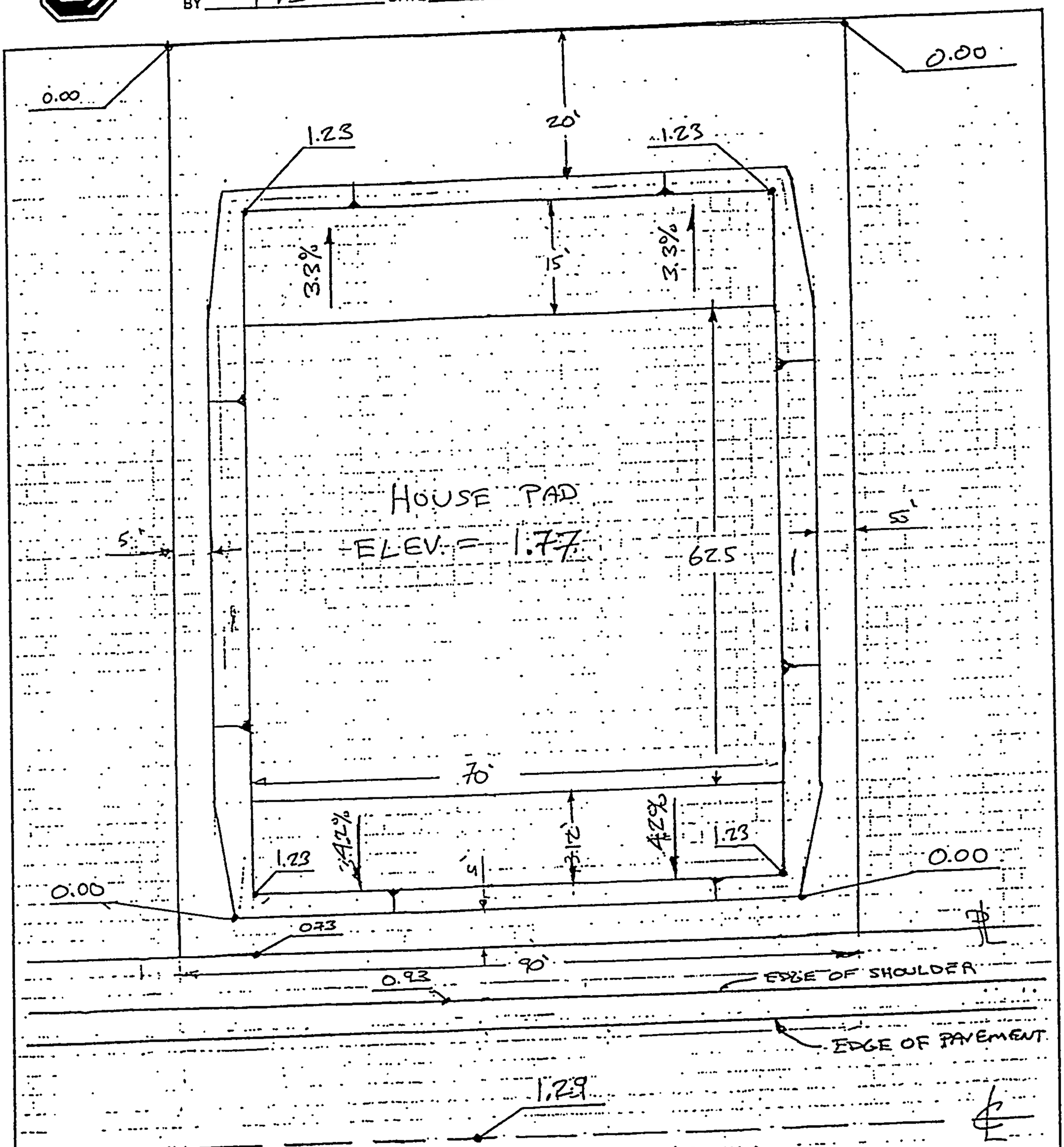
NOAA ATLAS { $P_{10\text{-}DAY} = 3.57''$, $P_{360} = 2.25''$ } $A_D = .259$ AC

$V_{10\text{-}DAYS} = 0.0933 + .259 \cdot (3.57 - 2.25)/12 = \boxed{0.1218 \text{ AC-FT}}$

PROJECT BOSQUE DEL RIO SHEET NO. 4 OF 6

SUBJECT SMALL LOT (1/4 ACRE) PROJECT NO. 194156-01

BY TVD DATE 1/4/95 CHECKED BY C. Olsen DATE 1/27/95



DEPTH OF PONDING

AREA = 5 (62.5) * 2 + 5(75) + 6.5(15) * 2 + 6.5(18) * 2 + 20(90)

= 3229 SF

VOL NEEDED = 0.0573 AC-FT = 2497 CF

2497 / 3229 = 0.77

1" = 20'

PROJECT BOSQUE DEL RIO SHEET NO. 5 OF 6

SUBJECT HYDROLOGY - (1/4 AC LOTS) PROJECT NO. 194156-01

BY TVD DATE 1/3/95 CHECKED BY C. Clem DATE 1/27/95

TOTAL SIZE = 90' WIDE X 120' LONG

= 10,800 SF + 2250 SF = 13,050 SF

= 0.300 AC

% D = HOUSE/GARAGE = .75(4200) + .25(4900) = 4375 SF

ROAD = 25(90) = 2250 SF

PATIO = 300 SF

DRIVEWAY = 690 SF

MISC = 385 SF

3000 SF OR 61%

% A = LANDSCAPING = 10%

% C = GRAVEL/ROCK PLASTIC LANDSCAPING = 15%

% B = GRASS = 14%

FLOW = A (1.29)(.30)(.1) = 0.39

B (2.03)(.30)(.14) = 0.085

TABLE A-9 ⇒ C (2.87)(.30)(.15) = 0.129

D (4.37)(.30)(.61) = 0.800

Q_{100} = 1.053 CFS

PROJECT BOSQUE DEL RIO SHEET NO. 6 OF 6

SUBJECT 1/4 ACRE LOT - V10 DAYS PROJECT NO. 194156-01

BY TVD DATE 1/3/95 CHECKED BY C. [illegible] DATE 1/27/95

VOLUME TABLE A-8

E (6-HR STORM)

A = 0.44

B = 0.67

C = 0.99

D = 1.97

EQ A-5

WEIGHTED E = .44(0.03) + .67(.042) + .99(0.045) + 1.97(0.183)

0.300

= 1.488"

EQ-A-6 $V_{360} = \frac{1.488(.300)}{12} = 0.0372$ AC-FT/LOT

EQ-A-9 $V_{10\text{-DAYS}} = V_{360} + A_D * (P_{10\text{-DAYS}} - P_{360})/12$ = AC-FT

NOAA ATLAS

$P_{10\text{-DAYS}} = 3.57"$

$P_{360} = 2.25"$

$A_D = 0.183$ AC

$V_{10\text{-DAYS}} = 0.0372 + .183(3.57 - 2.25)/12$

$= \boxed{0.0573 \text{ AC-FT}}$

PROJECT Bosque Del Rio SHEET NO. 1 OF 4

SUBJECT Hydrology (1/4 Ac Lots) - Rev PROJECT NO. 194156-01

BY C. Chen DATE 6/24/96 CHECKED BY _____ DATE / /

Update of Computation of ponding for 1/4 Acre lots for 6:1 slopes at house pads.

TOTAL Area in lots plus adjacent street

$90' \times 120' + 90' \times 23' = 12\,870$ SQFT $= 0.2955$ Ac.

Area Treatment D:

		SQFT
HOUSE:	$70' \times 65'$ =	4550
ROAD:	$90' \times 14.13$ =	1272
DRIVEWAY:	$20' \times (27'+9')$ =	720 (AVE SETBACK @ 27')
PATIO:	$15' \times 30'$ =	450
MISC =	$5' \times 60'$ =	300
TOTAL		7292 SQFT

PORTION OF LOT IN TREATMENT A, B or C = 4960 SQFT

LOT AREA IN TREATMENT A: (Landscaping)

$0.20 \times 4960 = 992$ SQFT

LOT AREA IN TREATMENT B: (GRASS)

$0.40 \times 4960 = 1984$ SQFT

LOT AREA IN TREATMENT C: (Gravel or Rock & Plastic)

$0.40 \times 4960 = 1984$ SQFT

ROAD AREA AT TREATMENT C

$= 90' - 23' - 90' \times 14.13 - 20' \times 9 = 618$ SQFT

TOTAL LAND TREATMENTS (LOT & STREET)

TYPE	SQ FT	AC	PERCENT
Treatment D	7292	0.1674	56.66
Treatment C	2602	0.0597	20.22
Treatment B	1984	0.0455	15.41
Treatment A	992	0.0278	7.71
TOTAL	12 870	0.2954	100.00

PROJECT Bosque del Rio SHEET NO. 2 OF ***

SUBJECT Hydrology (1/4 Acre Lots) - Rev PROJECT NO. 199156-01

BY C. Chan DATE 6/29/96 CHECKED BY _____ DATE / /

PEAK FLOW PER LOT (with Adjacent Street)

Q_{100} =

TYPE	cfs/Ac	Area	cfs
A	1.29	.2954 * .0771	0.029
B	2.03	.2954 * .1541	0.092
C	2.87	.2954 * .2022	0.171
D	4.37	.2954 * .5666	0.731

Q_{100} = 1.023 cfs

Volume Runoff - 6-Hour Storm

TREATMENT TYPE	IN/Ac	Area	AC-INCHES
A	0.44	.2954 * .0771	0.0100
B	0.67	.2954 * .1541	0.0305
C	0.99	0.2954 * .2022	0.0591
D	1.97	0.2954 * .5666	0.3297

TOTAL Ac-in = 0.4293

FROM DPM Eq a-5 $E = \frac{0.4293}{.2954} = 1.453^{IN}$

FROM DPM EQ a-6

$$V_{360} = \frac{1.453^{IN} * (0.2954)}{12}$$

$$= 0.03577 \text{ Ac-FT/Lot}$$

$$= 1558 \text{ cuft/Lot}$$

FOR 100-year - 10 day Storm - USE DPM eq a-9

$$V_{10\text{-days}} = V_{360} + A_D (P_{10\text{-days}} - P_{360})/12$$

$$= 0.03577 + 0.1674(3.57 - 2.25)/12$$

$$V_{10\,days} = 0.0542 \text{ AC-FT/LOT} = 2360 \text{ cuft/LOT}$$

PROJECT Bosque Del Rio SHEET NO. 3 OF

SUBJECT Hydrology (¼ Acre lots) Rev. PROJECT NO. 194156-01

BY C. Chaim DATE 6/25/96 CHECKED BY DATE / /

Check of original design with pad @ 81.20 and pond @ 79.95 with 3:1 slopes

Area Pond Bottom = 90×120 − 4550 − 20*27 − 15*40
LOT AREA, HOUSE, DRIVEWAY, PATIO

− 3×100 − 90*(0.75*4) − 140×1.75*3
MISC, ROAD SLOPE, HOUSESIDE slopes

− 130*1.75*3 − 30*1.5*3 − 2*27*1.5*3 − 20*1.75*3
HOUSE FRONT/BACK SLP, PATIO SIDES SLP, DRIVEWAY slopes, MISC slopes

$= 10800^{ft^2} - 8160^{ft^2} = 2640^{ft^2}$

Area Pond @ 0.75' up from Bottom (to Elev 80.70 w/3:1ss)

= 90*120 − 4550 − 20*27 − 15*40 − 3*100
LOT AREA, HOUSE, DRIVEWAY, PATIO, MISC

− 90*0*9 − 140*1.0*3 − 130*10*3 − 30*0.75*3
ROAD SLOPE, HOUSE SIDE SLOPES, HOUSE FRONT/BACK SLP, PATIO SIDE SLP

− 2*27*0.75*3 − 20*1.0*3
DRIVEWAY SLOPES, MISC SLOPES

$= 10800^{ft^2} - 7049^{ft^2} = 3751^{ft^2}$

VOLUME OF POND TO DEPTH = 0.75^{ft} w/ 3:1 SIDESLOPES

$= \frac{1}{3}(0.75)(2640 + 3751 + \sqrt{2640*3751}) = 2385$ cu ft

$2385 \approx V_{10\ days}$ ∴ depth = 0.75^{ft} @ 3:1 Slopes

Check for revised design with Building Pad @ 81.40 and pond @ 79.95 with 6:1 slopes (FIN FL @ 81.90 min)

Area Pond Bottom = 90*120 − 4550 − 20*27 − 15*40
LOT AREA, HOUSE, DRIVEWAY, PATIO

− 3*100 − 90*0.75*4 − 140*1.45*6 − (130−20)*1.45*6
MISC, ROAD SLOPE, HOUSE SIDE SLOPES, HOUSE FRONT/BK SLP

− 30*1.2*6 − 2*27*1.2*6 − 2*1.45*6
PATIO SIDE SLOPES, DRIVEWAY SIDE SLOPES, MISC SLOPES

$= 10800^{ft^2} - 9214^{ft^2} = 1586$ SQ FT

PROJECT Bosque del Rio SHEET NO. 4 OF 4

SUBJECT Hydrology (1/4 Ac Lots) Rev. PROJECT NO. 199156-01

BY C. Chaem DATE 6/24/96 CHECKED BY _____ DATE / /

Area Pond @ 0.90' up From Bottom (To Elev 80.85 w/6:1 ss)

$= 90 * 120 - 4550 - 20 * 27 - 15 * 40 - 3 * 100$

LOT AREA HOUSE DRIVEWAY PATIO MISC

$- 90 * 0 * 4 - 140 * 0.55 * 6 - (130 - 20) * 0.55 * 6$

ROAD SLOPE HOUSE SIDE SLOPES HOUSE FRONT/BK SLP

$- 30 * 0.55 * 6 - 2 * 27 * 0.30 * 6 - 20 * 0.55 * 6$

PATIO SIDE SLOPES DRIVEWAY SIDE SLOPES MISC SLOPES

$= 10800^{SQFT} - 7032^{SQFT} = 3768^{SQFT}$

$V_{OLUME} = 1/3\,(0.90)\left(1586 + 3768 + \sqrt{1586 * 3768}\right)$

$= 2340$ cu ft

For $V_{10\text{-}day} = 2360$ cu ft - difference = 20 cu ft

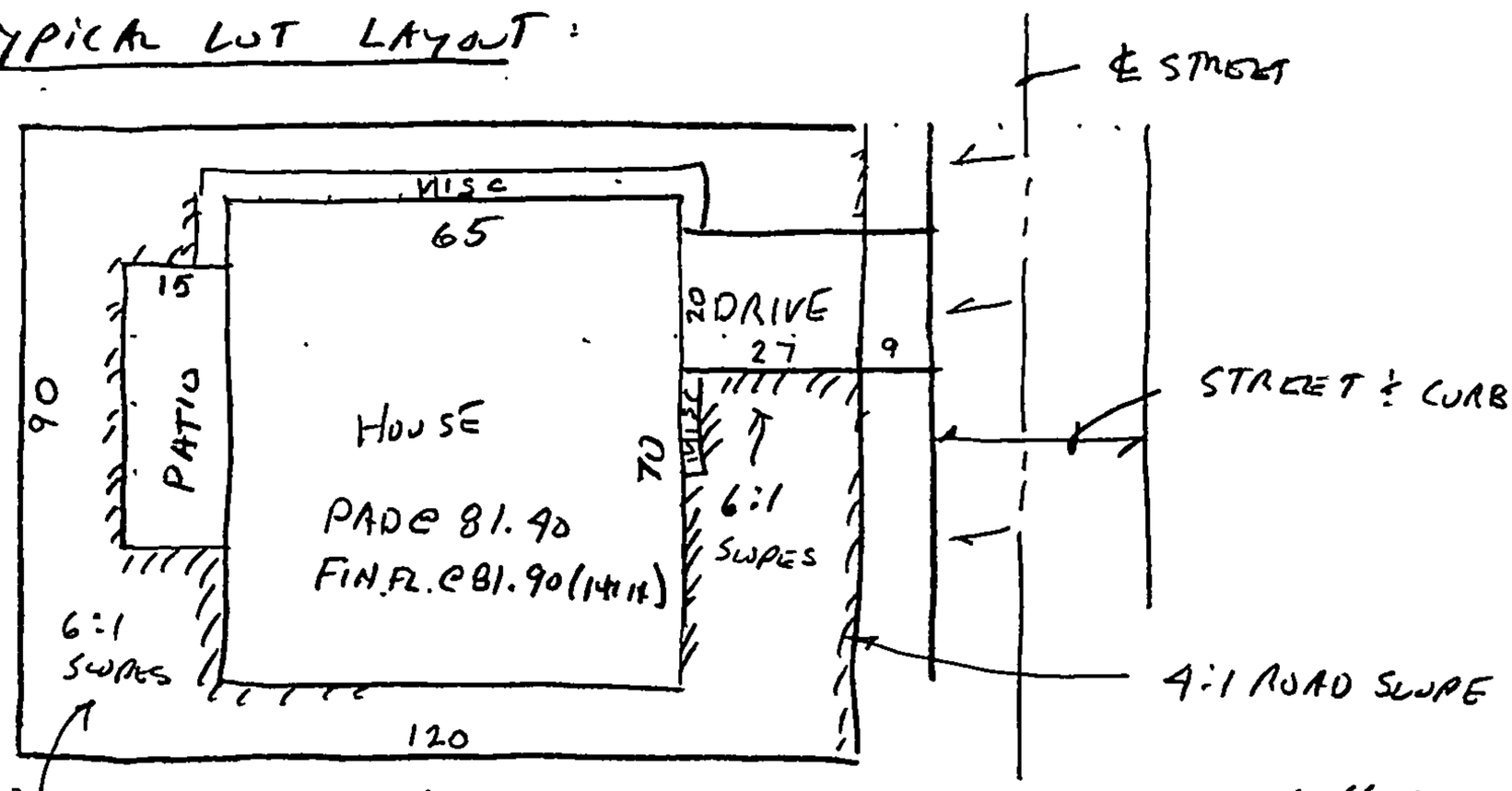
@ SURFACE AREA = 3768^{SQFT}

$\Delta h \approx \frac{20}{3768} = 0.0053^{FT}$

depth to $V_{10\text{-}day}$ @ 2360 $\approx 0.9053^{FT}$

USE 0.90 for plan dimension

TYPICAL LOT LAYOUT:



BOTTOM POND @ 79.95

Actual Dimensions May Vary with 1/4 Ac Lots.

Smith Engineering Company

6400 Uptown Boulevard, N.E. Suite 500E Albuquerque, New Mexico 87110 505/884-0700

DRAINAGE COVENANT

The approved grading and drainage plan details the designed grades for this subdivision. Alterations of the grades within the properties of this subdivision that change the volume of the drainage ponds on each lot will not be allowed. Any alteration of the grades within the properties that does not affect the pond volume must comply with the approved grading and drainage plan in order to gain approval.

* NOTE *

This is only the preliminary language of the drainage convenant. The final wording of the convenant will be completed upon preliminary plat approval. At that time, the drainage covenant application located within the DPM will also be finalized.

199156-0
Doc...

Vinyard & Associates, Inc.

4415-D Hawkins, NE
Albuquerque, New Mexico 87109
(505) 345-1937

Geotechnical Engineering • Materials Testing • Environmental Engineering

GEOTECHNICAL INVESTIGATION
MULTI-FAMILY HOUSING PROJECT
NEAR COORS ROAD AND
EAGLE RANCH ROAD

Prepared for:

Garrett Group, Inc.

Project No.: 94-1-273

February 15, 1995

V & A

TABLE OF CONTENTS

1.0	INTRODUCTION	Page 1
2.0	PROPOSED CONSTRUCTION	2
3.0	SITE CONDITIONS	3
4.0	SITE SUBSURFACE CONDITIONS	3
5.0	LABORATORY TESTING	4
6.0	FOUNDATIONS	6
7.0	CONCRETE SLABS ON GRADE	9
8.0	RETAINING WALLS	10
9.0	EARTHWORK	
	9.1 GENERAL	12
	9.2 CLEARING AND GRUBBING	12
	9.3 EXCAVATION	13
	9.4 NATURAL GROUND PREPARATION	13
	9.5 FILL PLACEMENT AND COMPACTION	14
	9.6 OBSERVATION AND TESTING	14
10.0	SITE GRADING AND DRAINAGE	15
11.0	LANDSCAPING	15
12.0	UTILITIES	16
13.0	TRENCHES AND EXCAVATIONS	17
14.0	CLOSURE	17

V & A

TABLE OF CONTENTS CONTINUED

SITE PLAN	Figure	1
LOGS OF TEST HOLES		2-17
NOTES - LOGS OF TEST HOLES		18
CONSOLIDATION TEST RESULTS		19-22
SUMMARY OF LABORATORY TEST DATA	Table	1
APPENDIX		
EARTHWORK PROCEDURES	Page	A-1

V & A

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation for the proposed multi-family housing project to be located near the intersection of Coors Road and Eagle Ranch Road.

The investigation was performed to determine site subsurface conditions and based upon the conditions observed in the test holes to develop geotechnical recommendations for:

Foundation Design;

Slabs on Grade;

Lateral Earth Pressures;

Site Grading; and

Earthwork Construction.

The conclusions and recommendations presented are based on information provided to us regarding the proposed development, on subsurface conditions disclosed by the test holes, on laboratory testing, and upon the local standards of our profession at the time this report was prepared.

This investigation was not performed to determine the presence of potentially hazardous waste or radon gas. Determination of the presence of potentially hazardous materials was beyond the scope of

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this investigation and requires the use of exploration techniques and analytic testing which were not appropriate for this investigation. If desired, Vinyard & Associates, Inc. will perform an environmental audit of the site.

2.0 PROPOSED CONSTRUCTION

Based upon information obtained from personnel with the Garrett Group and Smith Engineering, we anticipate the site will be developed with a multi-family housing project. The proposed buildings will be one and two stories in height and will be constructed utilizing conventional wood frame construction. The ground floor will be a conventional concrete slab on grade. No basements or below grade structures are anticipated. The maximum column and bearing wall loads (dead plus live) are not anticipated to exceed ten kips and two kips per linear foot, respectively. If structure loads or configuration differ from those indicated in this report, this office should be notified.

Final site grading plans were not available during preparation of this report. We anticipate that limited cut/fill earthwork will be required to develop the site. Approximately one to two feet of fill is anticipated in each building area.

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3.0 SITE CONDITIONS

The site is bounded on the north by a concrete lined irrigation ditch and the Southwest Indian Polytechnic Institute Facilities and on the east by the Corrales Riverside Drain. To the south the site is bounded by single family residences with some farm buildings and the west is bounded by a graveled road and vacant land.

The site has no apparent slope. Vegetation on site consists of pasture grasses.

4.0 SITE SUBSURFACE CONDITIONS

To explore the site subsurface conditions, sixteen test holes were drilled at the approximate locations shown on the Site Plan, Figure 1. As shown on the Logs of Test Holes, Figures 2 through 17 the site soil profile is relatively uniform. The soil profile typically consisted of a surficial layer of silty fine to medium-grained sand. The surficial silty sands were loose to medium dense. At greater depths, the test holes encountered clean to slightly silty sands. These soils were typically loose to medium dense above the water table and loose below the water table. Several of the test holes encountered a thin surficial layer of sandy clay. The sandy clay was firm and very moist.

Flowing groundwater was encountered in the test holes at depths ranging from 4′ to 7-1/2′. However groundwater conditions will change with time due to fluctuations in the Rio Grande, the Riverside Drain, variations in groundwater level, seepage from ponding areas or leaking utilities. Further evaluation of the groundwater table and determination of the magnitude of seasonal fluctuation would require installation of piezometers and monitoring over time which was beyond the scope of this investigation.

The soils encountered in the test holes exhibit a limited consolidation potential under the anticipated structural loads. Limited consolidation (collapse) occurs when site soils increase in moisture content. Refer to Figures 19 through 22.

The test holes allow observation of a very small portion of the soils below the site. Significant variations in subsurface conditions may occur across the site which were not disclosed by the test holes.

5.0 LABORATORY TESTING

A laboratory testing program was performed on samples obtained during the field investigation which appeared representative of the soils encountered in the test holes. The laboratory testing

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program was structured to determine the physical properties of the soils encountered in the test holes necessary for development of geotechnical recommendations.

The laboratory testing program included:

- o Moisture Content;
- o Dry Density;
- o Sieve Analysis;
- o Atterberg Limits; and
- o Consolidation/Collapse.

Moisture Content and Dry Density tests were performed to evaluate the in-place soil density and moisture content. Test results help to evaluate settlement potential. Test results indicate the soils encountered in the test holes are loose to medium dense with an average dry density of approximately 101 pcf. Natural moisture content of the soils above the water table averaged approximately four percent. Test results are presented on the Logs of Test Holes, Figures 2 through 17 and are summarized on Table 1.

Sieve Analysis and Atterberg Limits tests were performed to confirm field soil classifications and to provide information on general physical soil properties. Test results are presented on Table 1.

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Consolidation/Collapse tests were performed to evaluate structure settlement and to determine the effect of water on site soils. The tests indicate the soils encountered in the test holes are slightly compressible under anticipated loads. Limited additional settlement occurs if the site soils are allowed to increase in moisture content. Test results are presented on Figures 19 through 22.

6.0 FOUNDATIONS

If the recommendations presented in this report are implemented particularly those regarding site grading and drainage, the proposed structures may be supported on conventional spread and strip footings. Foundations may be designed for an allowable bearing pressure of 1500 pounds per square foot. This value may be increased by one-third for short term loads due to wind and earthquakes. If it is not feasible to implement the site grading, drainage and landscaping recommendations presented herein an alternate foundation system may be required. This office should be contacted for additional recommendations.

Exterior footings should be embedded a minimum of eighteen inches below lowest adjacent grade. Interior footings should be embedded a minimum of twelve inches below finish pad grade. Spread and strip footings should be a minimum of twenty-four and eighteen

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inches wide, respectively. However, local building codes may require greater dimensions.

Lateral foundation loads will be resisted by a combination of passive soil pressure against the sides of footings and friction along the base. A passive soil resistance of 300 pounds per cubic foot may be utilized for design. Frictional resistance may be determined by multiplying foundation dead load by a coefficient of friction of 0.40.

In areas where sandy clay is present at the ground surface the clay should be removed from the building area. If clay is encountered in footing excavations the clay should be removed and replaced with granular structural fill.

Prior to fill placement and following footing excavation, the natural soils should be scarified to a depth of eight inches and moistened to a near optimum moisture content (±3%). The exposed soils should then be compacted to a minimum of 95% of maximum density as determined by ASTM D-1557 with a minimum of twenty passes of a minimum twenty ton vibratory compactor. If vibratory compaction will endanger existing structures a fully loaded scraper may be utilized. All fill below structures should be placed and compacted as detailed in the attached Appendix. Prior to pouring concrete footing excavations should be cleaned of any slough, loose soil or debris. Footing excavations should be compacted as

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detailed in the attached Appendix.

Foundations designed and constructed as described herein are not anticipated to settle more than one inch. Differential settlement between adjacent column footings should not exceed one-half of the above value. The above settlement estimates are based on the assumption the site soils will not be allowed to increase in moisture content and that the site grading, drainage, earthwork, and landscaping recommendations presented in this report will be fully implemented. Under seismic loading conditions additional settlement may occur. Evaluation of dynamic consolidation was beyond the scope of this investigation.

The site soils are slightly collapsible if allowed to increase in moisture content. If the soils supporting footings are allowed to increase in moisture content, additional settlement of 1/8 inch per foot of wetted soil could occur.

To reduce the affect of settlement on the structure, we suggest that all stucco be fiberglass reinforced. Periodic control joints should be utilized in the stucco particularly at window and door corners. Periodic control joints should also be utilized in masonry walls.

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7.0 CONCRETE SLABS-ON-GRADE

Concrete slabs-on-grade may be utilized. Slabs should be isolated from all foundations, stem walls, elevator pits and utility lines. Frequent joints should be scored or cut in slabs to control the location of cracks.

Thickened slabs may be utilized to support interior partitions. Thickened slabs should be a minimum of twelve inches in width and should be designed to exert a maximum earth pressure of 500 pounds per square foot. Wall loads on thickened slabs should not exceed 800 pounds per linear foot. The thickness and reinforcement should be determined by a qualified structural engineer.

The slab should be underlain by a moisture barrier to prevent "damp slab". The moisture barrier may consist of a 6 mil polyethylene film or equivalent. The barrier may be overlain with one or two inches of clean sand to provide a working surface and reduce shrinkage cracking.

In areas where sandy clay is present the clay should be removed from the building area.

Prior to placing slabs or structural fill, the natural soils

should be stripped of vegetation, scarified to a depth of eight inches, and moistened to a near optimum (±3%) moisture content. The exposed soils should then be compacted to a minimum of 95% of maximum density as determined by ASTM D-1557 with a minimum of twenty passes of a minimum twenty ton vibratory compactor. If vibratory compaction will endanger existing structures a fully loaded scraper may be utilized. All fill below slabs should be placed and compacted as detailed in the attached Appendix.

8.0 RETAINING WALLS

Retaining walls constructed in conjunction with this project are not anticipated to exceed three feet in height. If higher walls or unusual loading conditions such as sloping backfill, slopes below retaining wall footings or surcharges are anticipated, this office should be contacted for supplemental recommendations.

Foundations for retaining walls may be designed for a maximum toe bearing pressure of 1500 pounds per square foot. Retaining wall footings should be embedded a minimum of eighteen inches below lowest adjacent grade. Prior to placing footings, the exposed soils should be scarified to a depth of eight inches, moisture conditioned to a near optimum (±3%) moisture content and compacted to a minimum of 95% of maximum density as determined by ASTM D-1557.

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We recommend that the following equivalent fluid pressures be utilized for design of retaining walls:

Loading Condition	Equivalent Fluid Pressure*
Active Earth Pressure	32 pcf
Passive Earth Pressure	
Undisturbed Natural Soils	300 pcf
Structural Fill	400 pcf
Earth Pressure at Rest	60 pcf

* Does not include a factor of safety or hydrostatic pressure.

The above earth pressures do not include a factor of safety or hydrostatic pressure. If retaining walls are restrained against rotation (corners of basements, upper floors, etc.) the earth pressure at rest should be utilized for design.

Lateral retaining wall loads will be resisted by passive earth pressure at the toe and friction along the base of the wall. A coefficient of friction between soil and concrete of 0.4 may be used for design.

Backfill adjacent to retaining walls should be placed and compacted as detailed in the attached Appendix. Backfill adjacent to walls should be compacted with relatively light, hand operated equipment to prevent over stressing the wall and excessive lateral

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deflections.

To prevent staining of concrete, the back of retaining walls should be waterproofed prior to backfilling. Weep holes should be constructed near the base of exterior walls. Perimeter drains may be necessary around interior walls.

9.0 EARTHWORK

9.1 General

The recommendations presented in this report are based upon the assumption that site earthwork will be performed as recommended in this report and the attached Appendix. Presented below is a summary of the site earthwork recommendations. Detailed earthwork procedures are presented in the attached Appendix.

9.2 Clearing and Grubbing

Prior to placing structural fill, all borrow and fill areas should be stripped of vegetation and deleterious materials. All strippings should be hauled offsite or utilized in landscaped areas.

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All existing utilities, leach fields, and disturbed soil should be removed from below the proposed structure. The resulting excavations should be backfilled with compacted fill as detailed in the attached Appendix.

9.3 Excavation

We anticipate that on site soils can be excavated with conventional earthwork equipment. Occasional cobbles or boulders may be encountered during excavation. Cobbles and boulders should be disposed of off site or utilized for landscaping. Cobbles and boulders should not be placed within structural fills.

9.4 Natural Ground Preparation

Prior to placing structural fill and subsequent to final grading in cut areas, the exposed soils should be scarified to a depth of eight inches and moisture conditioned to a near optimum (±3%) moisture content. The exposed soils should then be compacted to a minimum of 95% of maximum density as determined by ASTM D-1557 with a minimum of twenty passes of a minimum twenty ton vibratory compactor. If vibratory compaction poses a threat to nearby structures, static compaction should be utilized.

Vibratory compaction may "pump up" groundwater to the surface.

It may be necessary to perform a portion of the twenty passes and then allow time for the water to dissipate before continuing.

9.5 Fill Placement and Compaction

Structural fill should be placed in horizontal lifts a maximum of eight inches in loose thickness, moisture conditioned to a near optimum moisture content and mechanically compacted. Fill below footings and slabs should be compacted to a minimum of 95% of maximum dry density as determined by ASTM D-1557. On site native soils with the exception of sandy clay appear suitable for re-use as engineered fill.

9.6 Observation and Testing

Placement and compaction of structural fill should be observed and tested by a qualified Geotechnical Engineer or his representative. The purpose of the observation and testing is to confirm that the recommendations presented herein are followed and to provide supplemental recommendations if subsurface conditions differ from those anticipated.

Foundation excavations should be observed by a qualified geotechnical engineer or his representative prior to placement of reinforcement or concrete. The purpose of the observation is to

determine if the exposed soils are similar to those anticipated.

10.0 SITE GRADING AND DRAINAGE

The site soils are slightly to moderately collapsible if allowed to increase in moisture content. To reduce the risk of structure settlement the site should be graded to rapidly drain away from structures. We suggest a minimum four percent gradient within at least the first ten feet away from structures in areas not protected by sidewalks and pavement. Splash blocks should be utilized below down spouts and canales.

If ponding areas are required, they should be located as far away from structures as possible, a minimum of ten feet. If this criteria cannot be met, this office should be contacted for supplemental recommendations.

11.0 LANDSCAPING

Landscaping adjacent to structures should be desigr constructed to minimize the potential for wetting of supporting the proposed facilities. If soils supporting the proposed facilities are allowed to increase in moisture content, significant localized settlement could occur.

Trees and shrubs within five feet of structures should be hand watered or watered using controlled drip irrigation. If drip irrigation is used, emitters should discharge no more than one gallon per hour. If grass must be planted within five feet of structures, watering should be carefully controlled to prevent overwatering. Grassed areas adjacent to structures should be sloped so that excess irrigation water will run off promptly. Sprinkler lines and drip irrigation mains should be located a minimum of five feet away from foundations.

Mowing strips, planters and sidewalks should not "dam" water adjacent to structures. If necessary, mowing strips should be perforated to allow water to flow away from structures.

All interior planters should be closed bottom and watertight.

12.0 UTILITIES

The site soils are slightly collapsible if allowed to increase in moisture content. If post construction water or sewer line leaks occur, localized settlement may result. Following installation, all water and sewer lines should be pressure checked for leaks. Any leaks found should be repaired. Backfill in utility line trenches below slabs and pavement should be compacted to a minimum of 90% of maximum density as determined by ASTM D-

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1557. To reduce the possibility of breaking utility lines with compaction equipment, heavy compactors should not be utilized.

13.0 TRENCHES AND EXCAVATIONS

All trenches greater than four feet in depth must be sloped, shored or braced or otherwise supported according to OSHA Construction and Safety Standards. Material excavated from the trench or spoil must be placed a minimum of two feet from the edge of the excavation. The spoil should be retained in an effective manner such that no loose material can fall into the excavation.

Temporary construction excavations above the water table should be sloped no steeper than 1-1/2:1 (horizontal:vertical). If deeper excavations are required, this office should be contacted for supplemental recommendations. Limited raveling of slopes will occur particularly as the exposed soils dry out. Heavy equipment and material stockpiles should be located a minimum of five feet from the top of slope.

14.0 CLOSURE

The recommendations presented in this report are based upon the subsurface conditions disclosed by the test holes. Soil and groundwater conditions may vary between test holes and with time.

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This report reflects our interpretation of the site subsurface conditions. We strongly recommend that prior to bidding all contractors perform their own subsurface investigation to form their own opinion of the site soil, rock and groundwater conditions. Should contractors elect to use this report for construction, bidding or estimating purposes, they do so at their own risk.

In a southwest climate it is particularly important to protect the soils supporting the proposed structure from an increase in moisture content. If soils supporting the structure increase in moisture content due to any cause such as poor site drainage, ponding areas, or leaking utility lines, significant structural settlement and distress may occur.

If conditions are encountered during construction which differ from those presented herein, this office should be contacted for supplemental recommendations. The staff of Vinyard & Associates, Inc. is available for supplemental consultation as necessary.

This office would be pleased to review site grading and drainage plans to evaluate conformance with the recommendations presented herein. All site earthwork should be observed by a qualified geotechnical engineer or his representative. Vinyard &

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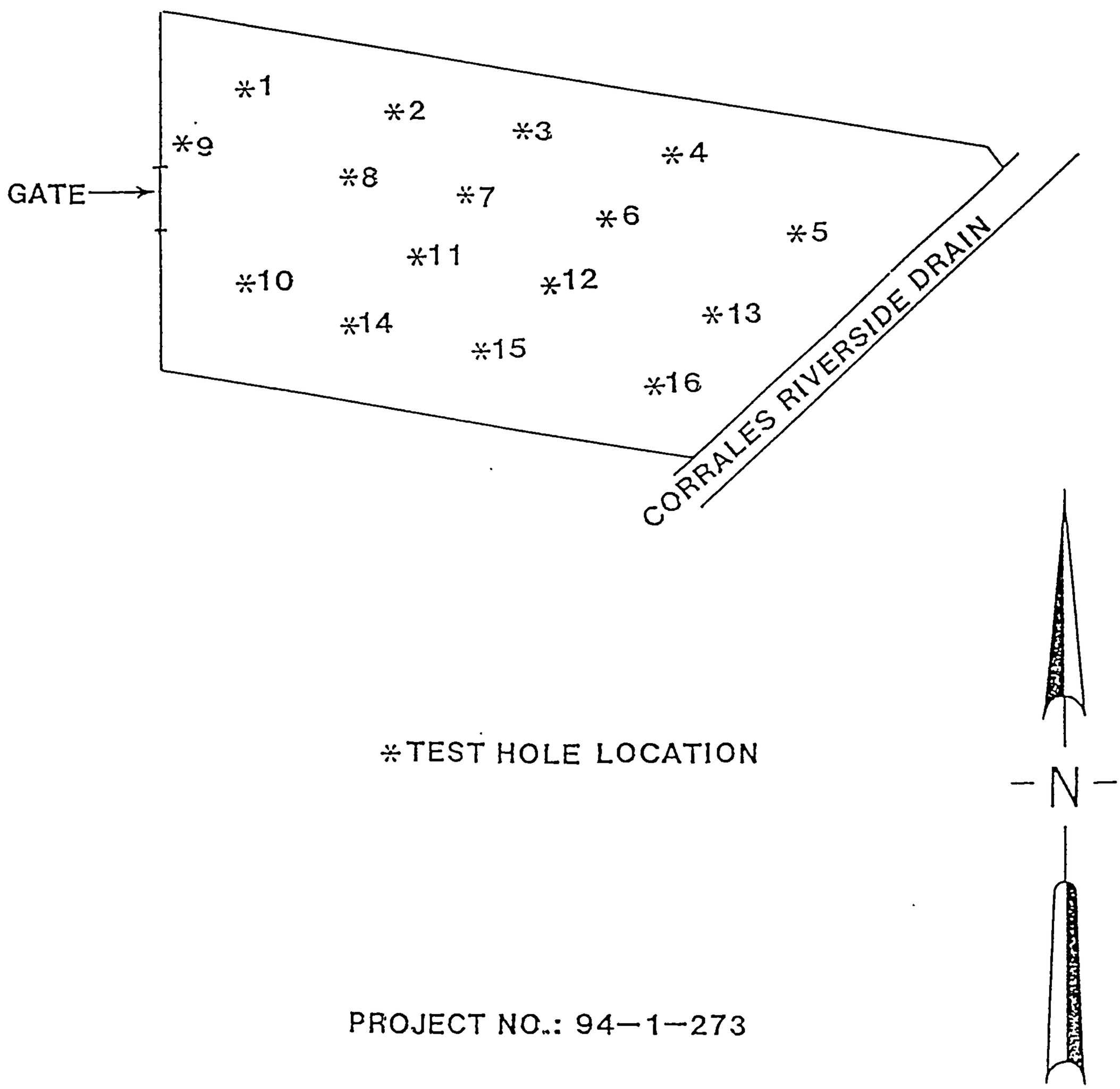
Associates, Inc. would be pleased to provide these services.

Vinyard & Associates, Inc.

Martin D. Vinyard, P. E.

SITE PLAN



*TEST HOLE LOCATION

PROJECT NO.: 94-1-273

FIGURE 1.

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LOG OF TEST HOLE NO. 1

Project: Coors and Eagle Ranch Road — Project No.: 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/11/95

Depth to Groundwater: +7.5' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SM	SAND, silty, fine to medium-grained, poorly graded, medium dense, very moist, brown
	15	R	103	2.2	1,2,5	SP-SM	SAND, slightly silty, fine to medium-grained, poorly graded, medium dense, moist, brown
5	6	R		2.2	1		Fine to coarse-grained, loose
							Wet
10	4	S					Slight fine gravel
15	9	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

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LOG OF TEST HOLE NO. 2

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/11/95

Depth to Groundwater: ±7.5' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density, pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SM	SAND, silty, fine to medium-grained, poorly graded, medium dense, moist, brown
	10	R	85	33.0	1,2,5	CL	CLAY, slightly sandy, firm, moist, brown
						SP-SM	SAND, slightly silty, fine to medium-grained, medium dense, moist, brown
5	13	R	119	3.1			Fine to coarse-grained, slight fine to coarse gravel, grey
10							Wet
	2	S					Very loose
15	5	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

Figure 3

V & A

LOG OF TEST HOLE NO. 3

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/11/95

Depth to Groundwater: ±7.5' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SM	SAND, silty, fine to medium-grained, poorly graded, loose, moist, brown
	8	R	103	1.5	1	SP-SM	SAND, slightly silty, fine to medium-grained, loose to medium dense, moist, brown
5							
	9	R	103	15.2			Fine to coarse-grained, tan
							Wet, grey
10							
	8	S					
15							
	10	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

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LOG OF TEST HOLE NO. 4

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/11/95

Depth to Groundwater: ± 5.5' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
		B		21.5	1,2	CL	CLAY, very sandy, fine-grained, moist, brown
	8	R	99	4.9	1,2,5	SP-SM	SAND, silty, fine to medium-grained, poorly graded, loose, moist, light brown Silty to slightly silty
5	9	R					Fine to coarse-grained, wet, grey
10	6	S					
15	7	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

V & A

LOG OF TEST HOLE NO. 5

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/11/95

Depth to Groundwater: ± 5' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SM	SAND, silty, fine to medium-grained, poorly graded, loose, moist, brown
	10	R	98	2.4	1	SP-SM	SAND, slightly silty, fine to medium-grained, loose, moist, brown
5							
	7	R		13.1	1		Fine to coarse-grained, wet
10							
	5	S					
15							
	7	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

V & A

LOG OF TEST HOLE NO. 6

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/11/95

Depth to Groundwater: ± 5.5' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SM	SAND, silty, fine to medium-grained, poorly graded, loose, moist, brown
	7	R	97	1.7		SP-SM	SAND, slightly silty, fine to medium-grained, poorly graded, loose, moist, grey
5							Fine to coarse-grained
	10	R					Wet
10							
	7	S					
15							
	4	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

V & A

LOG OF TEST HOLE NO. 7

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/12/95

Depth to Groundwater: ± 5' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SM	6" very sandy clay surface layer SAND, silty, fine to medium-grained, loose, moist, brown
	10	R	101	2.9	1,2,5		
5							
	8 NR	R					
						SP	SAND, fine to coarse-grained, trace gravel, trace to slightly silty, very loose, wet, brown
10							
	3	S		8.6	1		
15							
	7	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

V & A

LOG OF TEST HOLE NO. 8

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/12/95

Depth to Groundwater: ± 6' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SM	SAND, fine to medium-grained, silty to slightly silty, medium dense, moist, brown
	11	R	95	2.5	1		
5	6	S		27.2	1		Loose, silty Wet
						SP	SAND, fine to coarse-grained, trace gravel, trace silt, loose, wet, brown
10	4	S					
15	5	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

V & A

LOG OF TEST HOLE NO. 9

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation · Top of Test Hole: n/a — Date Drilled: 1/12/94

Depth to Groundwater: ± 7' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SP-SM	SAND, fine to medium-grained, slightly silty, loose, slightly moist, brown
	7	R		3.6	1,2		
5	8	S		4.6	1		Fine to coarse-grained
							Wet
10	3	S				SP	SAND, fine to coarse-grained, trace silt, trace gravel, very loose, wet, brown
15	8	S					Loose
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

Figure 10

V & A

LOG OF TEST HOLE NO. 10

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/12/95

Depth to Groundwater: ± 7' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SP-SM	SAND, fine to medium-grained, slightly silty, loose, medium moist, brown
	6	R		1.9	1,2		
5	6	S		13.5	1		Moist, trace gravel
							Wet
10						SP-SM	SAND, fine to coarse-grained, slightly silty to trace silt, trace gravel, loose, wet, brown
	8	S					
15	4	S					
							Clay lense
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

V & A

LOG OF TEST HOLE NO. 11

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/12/95

Depth to Groundwater: ± 6' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
	11	R	97	1.9	1,2,5	SM	6" clay, very sandy, moist, surface layer SAND, fine to medium-grained, silty, medium dense, moist, brown
5	4	S		15.0	1	SP	SAND, fine to coarse-grained, trace silt, trace gravel, loose, very moist, brown Wet
10	5	S					Trace to slightly silty
15	9	S					
20							Bottom of hole at 16-1/2'
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

Figure 12

V & A

LOG OF TEST HOLE NO. 12

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/12/95

Depth to Groundwater: ± 6' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SP	SAND, fine to medium-grained, trace silt, loose, moist, brown
	5	R	100	4.5	1,2,5		
5							Fine to coarse-grained, silty to slightly silty
	6	S		19.5	1		Wet
10						SP	SAND, fine to coarse-grained, slightly gravelly, trace silt, loose, wet, brown
	6	S					
15							
	7	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

V & A

LOG OF TEST HOLE NO. 13

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/12/94

Depth to Groundwater: ± 4' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
	7	R	97	9.3	1	SP-SM	SAND, fine to medium-grained, slightly silty, trace gravel, loose, moist, brown
5	4	S		12.1	1	SP	SAND, fine to coarse-grained, trace silt to slightly silty, trace gravel, loose, wet, brown
10	3	S					
15	6	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

V & A

LOG OF TEST HOLE NO. 14

Project: Coors and Eagle Ranch Road — Project No.: 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/12/95

Depth to Groundwater: + 6' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						CL	CLAY, very sandy, moist, brown
	9	R	100	2.7	1,2,5	SP-SM	SAND, fine to medium-grained, slightly silty, loose, slightly moist, tan
5	6	S		10.4	1		
							Wet, fine to coarse-grained, trace gravel
10	6	S					
15	3	S					Very loose
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

Figure 15

V & A

LOG OF TEST HOLE NO. 15

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation · Top of Test Hole: n/a — Date Drilled: 1/12/95

Depth to Groundwater: ± 5' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SP-SM	SAND, fine to medium-grained, slightly silty, loose, moist, brown
	8	R	103	7.2	1		
5							
	5	S		12.9			Fine to coarse-grained, trace gravel, slightly silty to trace silt, wet
10							
	4	S					
15							
	10	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

V & A

LOG OF TEST HOLE NO. 16

Project: Coors and Eagle Ranch Road — Project No. 94-1-273

Elevation - Top of Test Hole: n/a — Date Drilled: 1/12/95

Depth to Groundwater: ± 4' — Drilling Method: 6" H.S.A.

Depth, feet	Blows/Foot	Sample Type	Dry Density pcf	Water Content, %	Additional Testing	Unified Classification	Material Description
						SM	6" clay, very sandy, moist, surface layer SAND, fine to medium-grained, silty to slightly silty, loose, medium moist, brown
	10	R	93	4.3	1,2,5	SP-SM	SAND, slightly silty, fine to medium-grained, medium dense, moist, brown
5						SP-SM	SAND, fine to coarse-grained, trace gravel, slightly silty, very loose, wet, brown
	3	S		18.1			
							Slightly silty to trace silt
10							
	6	S					Loose
15							
	8	S					
							Bottom of hole at 16-1/2'
20							
25							
30							

ADDITIONAL TESTS: 1 = Sieve Analysis 2 = Atterberg Limits 3 = Direct Shear 4 = R-Value 5 = Other

Figure 17

V & A

NOTES - LOGS OF TEST HOLES

Test hole locations were determined by compass bearing and pacing distances from known topographic points.

"Drilling Method" refers to the equipment utilized to advance the test hole. Six inch outside diameter, continuous flight, hollowstem auger was utilized.

"S" under "Sample Type" indicates a Standard Penetration test (ASTM D-1586). The Standard Penetration sampler is 2 inches in outside diameter and 1 3/8 inches inside diameter.

"R" under "Sample Type" indicates a 3 inch outside diameter by 2.5 inch inside diameter sampler. The sampler is lined with 1 inch high brass rings.

"B" under "Sample Type" indicates a bulk sample.

"Blows Per Foot" indicates the number of blows of a 140 pound hammer falling 30 inches required to drive the indicated sampler 12 inches.

"NR" under "Blows/Foot" indicates that no sample was recovered.

"Dry Density PCF" indicates the laboratory determined soil dry density in pounds per cubic foot.

"Water Content %" indicates the laboratory determined soil moisture content in percent (ASTM D-2216).

"Unified Classification" indicates the field soil classification as per ASTM D-2488. When appropriate, the field classification is modified based upon subsequent laboratory tests.

Variations in soil profile, consistency, and moisture content may occur between test holes. Subsurface conditions may also vary between test holes and with time.

Figure No.: 18

V & A

	Minimum Compaction ASTM D-1557
Foundation Support	95%
Slab Support	95%
Below Slab Utility Trenches	90%
General Site Grading	90%
Pavement Support	
Upper 8" of Subgrade	95%
All other fill below pavement	90%

Aggregate Base Course shall be compacted to a minimum of 95% of maximum density as determined by ASTM D-1557.

Asphaltic concrete shall be compacted to a minimum of 96% of maximum Marshall Density (75 Blows).

Compaction by flooding and jetting is specifically prohibited unless authorized in advance by the Owner or his representative and the Geotechnical Engineer.

Observation and Testing

The Geotechnical Engineer or his representative shall perform field density tests with a frequency and at the locations he feels appropriate. The Geotechnical Engineer or his representative will perform Proctor tests on representative samples of all fill material. To minimize delays the Earthwork Contractor is encouraged to submit soil samples prior to use for proctor testing.

V & A

Foundation, Slab and Pavement Subgrade Preparation

Prior to placing reinforcement, footings, slabs, or pavement the supporting soils shall be prepared, moisture conditioned and compacted as described herein.

Fill Material

Fill material shall be non expansive soil which may be gravel, sand, silt or clay or a combination there of.

Sieve Size	Percent Passing By Weight
1"	100
No. 4	70 - 100
No. 200	10 - 40

Fill material shall exhibit a plasticity index of twenty or less. No organic or decomposable material shall be utilized. Material larger than six inches shall not be placed in the fill without prior approval of the Owner or his representative and the Geotechnical Engineer. Material larger than four inches shall not be placed within twelve inches of footings or slabs. All fill material shall be approved by the Geotechnical Engineer.

Fill Placement

Fill material shall be blended as necessary to produce a homogeneous material. Fill material shall be spread in horizontal lifts no greater than eight inches in uncompacted thickness but in no case thicker than can be properly compacted with the equipment to be utilized. If fill is to be placed on slopes steeper than 5:1 (horizontal:vertical) the natural ground shall be benched with minimum three foot wide benches at maximum two foot vertical intervals.

Moisture Conditioning

Fill material shall be dried or moistened as necessary, prior to compacting, to within ± three percent of optimum moisture content as determined by ASTM D-1557. Moisture shall be distributed uniformly throughout each lift.

Compaction

Structural fill shall be mechanically compacted to the following:

V & A

Appendix

EARTHWORK PROCEDURES

General

The Geotechnical Engineer shall be the Owner's representative to observe and evaluate the earthwork operations. The Contractor shall cooperate with the Geotechnical Engineer in the performance of the Engineer's duties.

Clearing and Grubbing

Prior to placing structural fill all borrow areas and areas to receive structural fill shall be stripped of vegetation and deleterious materials. Strippings shall be hauled offsite or stockpiled for subsequent use in landscaped areas or non structural fill areas as designated by the Owner or his representative and approved by the Geotechnical Engineer.

Site Preparation - Fill Areas

Prior to placing structural fill the areas to be filled shall be scarified to a depth of eight inches and moisture conditioned as described below. The area to be filled shall then be compacted to a minimum of 95 percent of maximum density as determined by ASTM D-1557 with a minimum of twenty passes of a vibratory compactor. The vibratory compactor shall exert a minimum dynamic force of twenty tons. If vibratory compaction techniques pose a threat to the structural integrity of near by facilities a fully loaded scraper shall be used. Any soft or "spongy" areas shall be removed as directed by the Geotechnical Engineer and replaced with structural fill as described herein.

Site Preparation - Cut Areas

Following excavation to rough grade all building and pavement areas shall be scarified to a depth of eight inches and moisture conditioned as described below. All building and paved areas shall be compacted to a minimum of 95 percent of maximum density as determined by ASTM D-1557 with a minimum of twenty passes of a vibratory compactor. The vibratory compactor shall exert a minimum dynamic force of twenty tons. If vibratory compaction techniques pose a threat to the structural integrity of near by facilities a fully loaded scraper shall be used. Any soft or "spongy" areas shall be removed as directed by the Geotechnical Engineer and replaced with structural fill as described herein.

V & A

SUMMARY OF LABORATORY TEST DATA

Test Hole No.	Depth (Feet)	Unified Classification	Natural Dry Density (pcf)	Natural Moisture Content (%)	Atterberg Limits		SIEVE ANALYSIS % PASSING BY WEIGHT										DESCRIPTION
					LL	PI	1½"	3/4"	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200	
11	5	SP	-	15.0	-	-	-	100	92	86	77	65	45	20	3	0.8	SAND, trace silt, gravelly
12	2	SP	100	4.5	NV	NP	-	-	100	99	98	97	94	65	7	1.3	SAND, trace silt
12	5	SP	-	19.5	-	-	-	100	91	86	82	76	62	42	9	1.8	SAND, trace silt, gravelly
13	2	SP	97	9.3	-	-	-	100	98	97	96	94	83	38	5	1.0	SAND, trace silt, trace gravel
13	5	SP	-	12.1	-	-	100	89	81	69	58	49	32	12	3	1.0	SAND, trace silt, very gravelly
14	2	SP	100	2.7	NV	NP	-	100	99	98	97	93	75	29	3	0.8	SAND, trace silt, trace gravel
14	5	SP	-	10.4	-	-	100	84	73	63	54	42	28	13	5	2.0	SAND, trace silt, very gravelly
15	2	SP	103	7.2	-	-	-	100	98	97	95	93	83	47	9	0.9	SAND, trace silt, trace gravel
15	5	-	-	12.9	-	-	-	-	-	-	-	-	-	-	-	-	
16	2	SP	93	4.3	NV	NP	-	-	100	99	98	97	82	24	4	0.7	SAND, trace silt, trace gravel
16	5	SP	-	18.1	-	-	-	100	95	92	86	75	60	33	10	2.9	SAND, trace silt, sli. gravelly

****

NV - indicates no value
NP - indicates non-plastic

Project No. 94-1-273
Table 1

SUMMARY OF LABORATORY TEST DATA

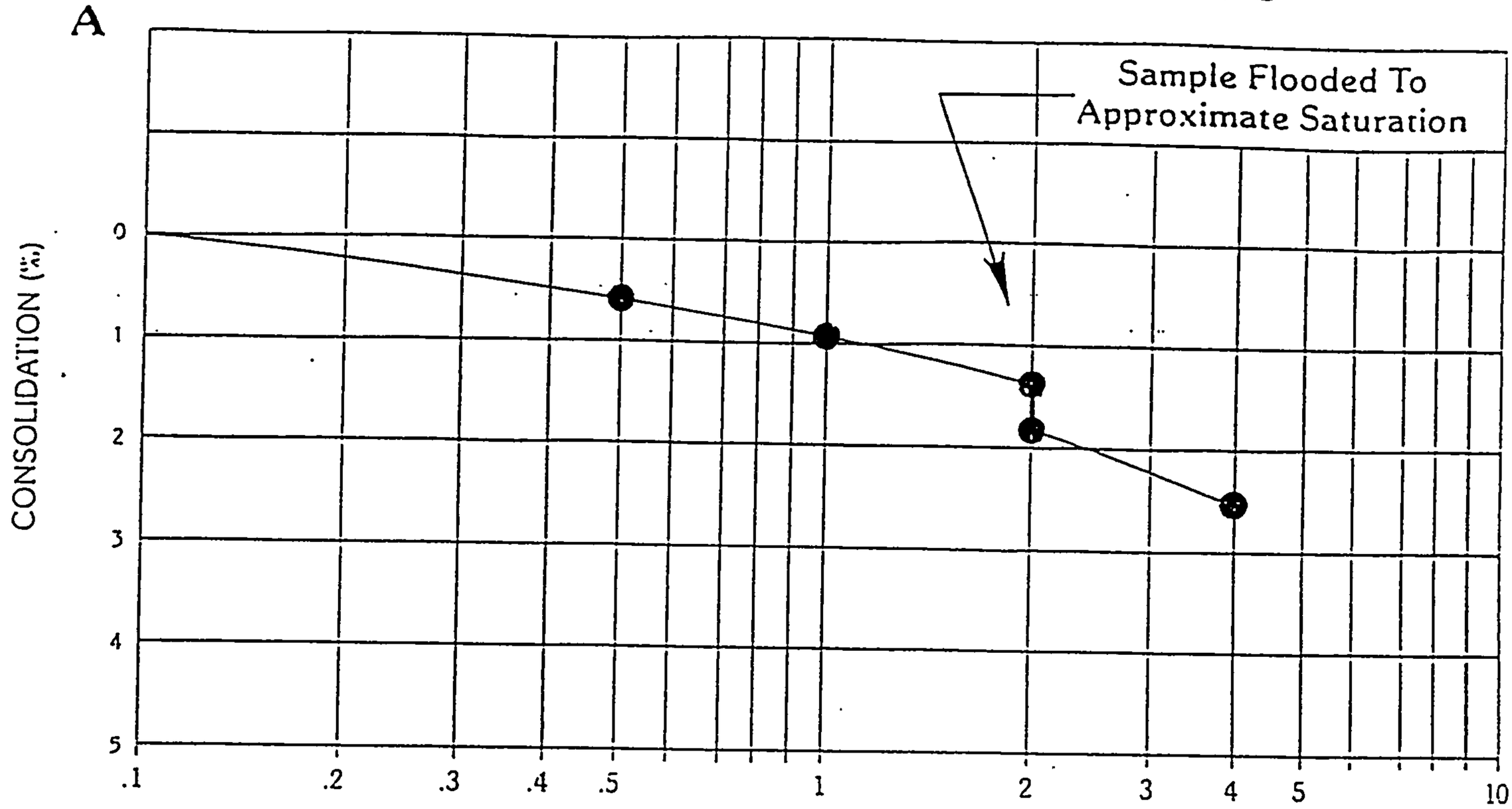
Depth (Feet)	Unified Classification	Natural Dry Density (pcf)	Natural Moisture Content (%)	Atterberg Limits		SIEVE ANALYSIS % PASSING BY WEIGHT										DESCRIPTION
				LL	PI	1½"	3/4"	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200	
2	SP-SM	103	2.2	NV	NP	-	-	-	100	99	98	97	79	32	5.2	SAND, sli. silty
5	SP	-	2.2	-	-	-	100	98	97	91	79	56	27	11	3.3	SAND, trace silt, trace gravel
2	CL	85	33.0	46	22	-	-	-	-	-	100	99	98	96	93.1	CLAY, slightly sandy
5	-	119	3.1	-	-	-	-	-	-	-	-	-	-	-	-	
2	SP	103	1.5	-	-	-	-	100	98	95	87	66	40	8	1.1	SAND, trace silt, trace gravel
5	-	103	15.2	-	-	-	-	-	-	-	-	-	-	-	-	
1/2	CL	-	21.5	40	22	-	-	-	-	100	99	98	93	85	74.4	CLAY, sandy
.2	SP	99	4.9	NV	NP	-	-	-	-	-	100	98	74	15	2.4	SAND, trace silt
2	SP	98	2.4	-	-	-	-	-	-	100	99	98	76	15	1.9	SAND, trace silt
5	SP	-	13.1	-	-	-	-	100	97	88	77	63	33	7	2.4	SAND, trace silt, trace gravel
2	-	97	1.7	-	-	-	-	-	-	-	-	-	-	-	-	
2	SP	101	2.9	NV	NP	-	-	100	99	96	89	73	36	7	1.8	SAND, trace silt, trace gravel
10	SP	-	8.6	-	-	-	100	93	72	49	31	15	4	1	0.3	SAND, trace silt, gravelly
2	SP	95	2.5	-	-	-	-	-	100	99	98	95	74	33	3.3	SAND, trace silt
5	SP	-	27.2	-	-	-	-	-	-	100	98	93	80	26	4.0	SAND, trace silt
2	SP-SM	-	3.6	NV	NP	-	-	-	100	99	98	95	69	28	9.1	SAND, sli. silty
5	SP	-	4.6	-	-	-	100	94	85	77	67	53	27	5	1.7	SAND, trace silt, gravelly
2	SP-SM	-	1.9	NV	NP	-	-	-	-	100	99	98	79	34	8.5	SAND, sli. silty
5	SP	-	13.5	-	-	-	-	-	100	99	98	97	58	8	1.1	SAND, trace silt
2	SP	97	1.9	NV	NP	-	-	-	100	99	97	92	65	15	1.5	SAND, trace silt

- indicates no value
- indicates non-plastic

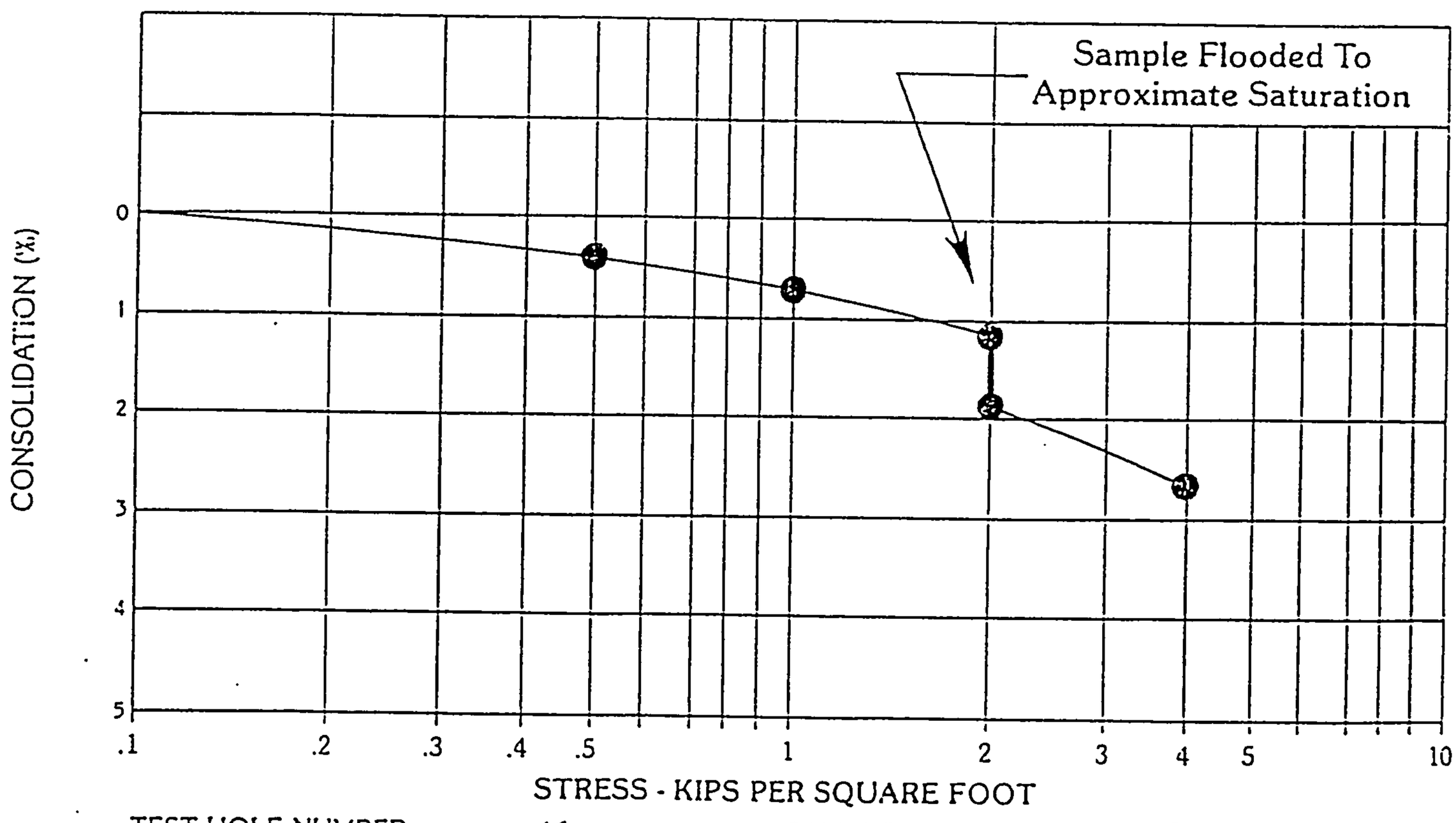
Project No. 94-1-273
Table 1

V & A

CONSOLIDATION TEST RESULTS



TEST HOLE NUMBER 14 SAMPLE DEPTH 2 FEET
SOIL CLASSIFICATION SP SOIL DESCRIPTION SAND, tr. silt, trace gravel
MOISTURE CONTENT (%) 2.7 DRY DENSITY (PCF) 100

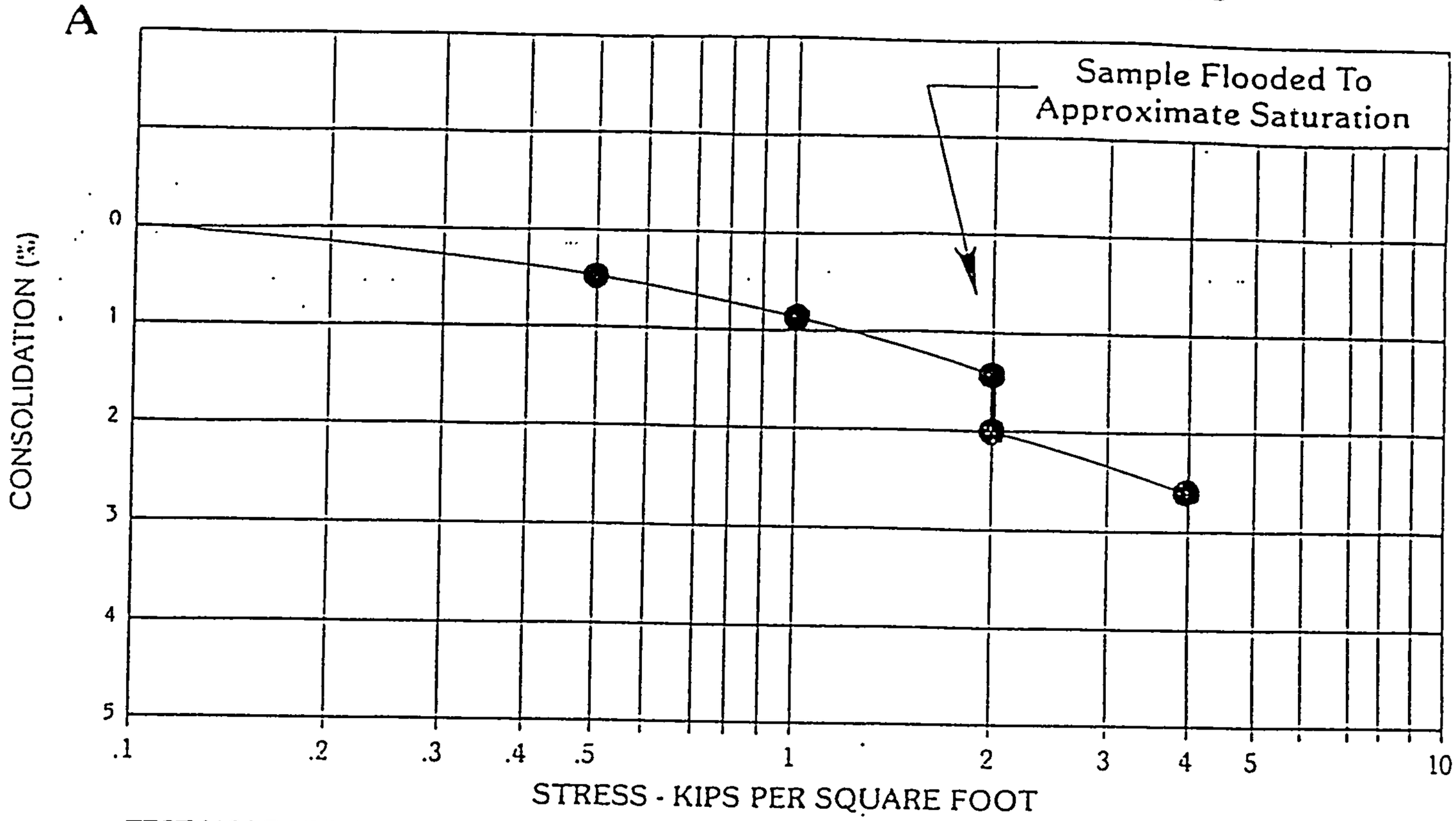


TEST HOLE NUMBER 16 SAMPLE DEPTH 2 FEET
SOIL CLASSIFICATION SP SOIL DESCRIPTION SAND, tr. silt, tr. gravel
MOISTURE CONTENT (%) 4.3 DRY DENSITY (PCF) 93

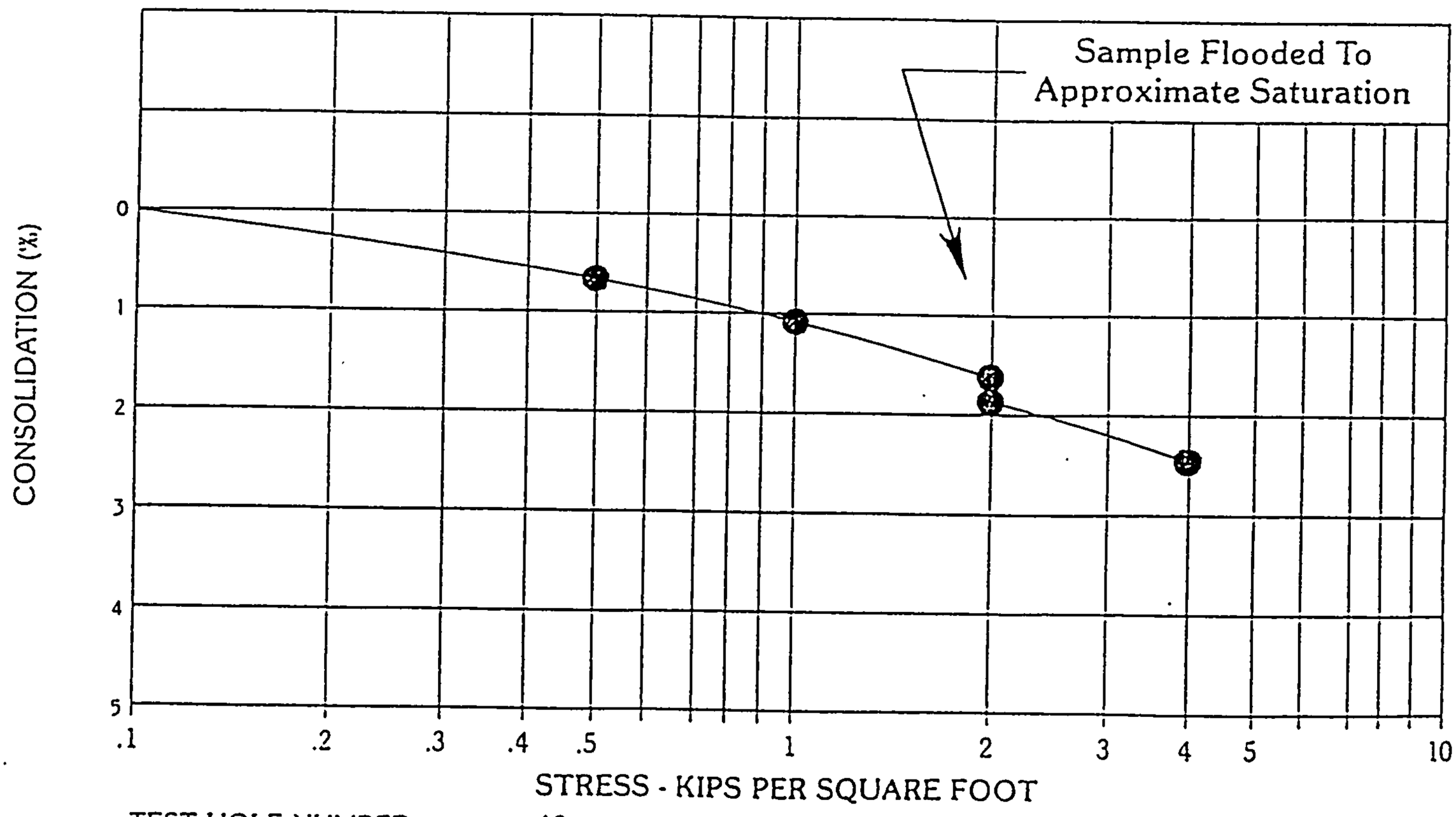
Project No. 94-1-273
Figure 22

V & A

CONSOLIDATION TEST RESULTS



TEST HOLE NUMBER 11 SAMPLE DEPTH 2 FEET
SOIL CLASSIFICATION SP SOIL DESCRIPTION SAND, trace silt
MOISTURE CONTENT (%) 1.9 DRY DENSITY (PCF) 97

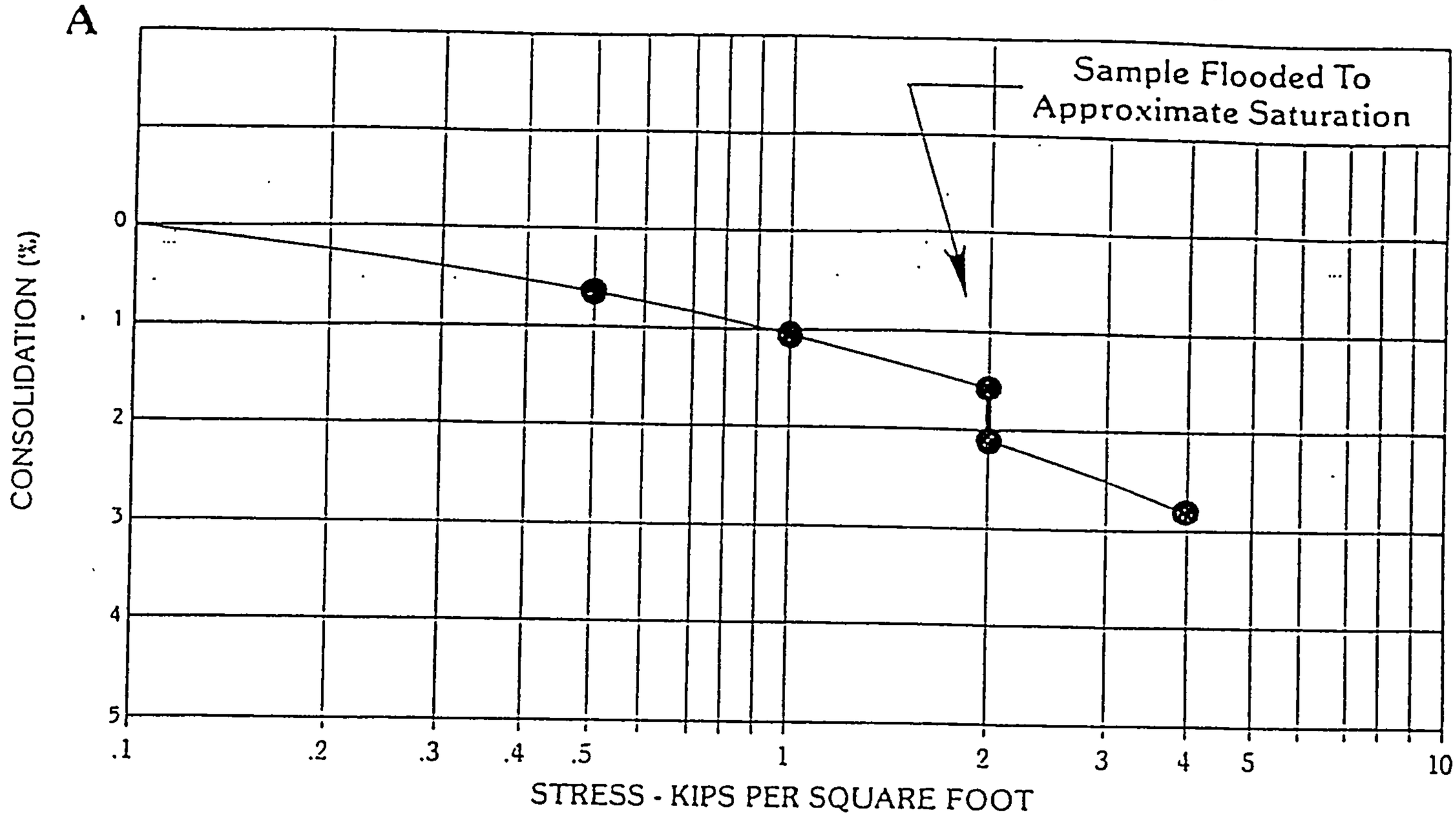


TEST HOLE NUMBER 12 SAMPLE DEPTH 2 FEET
SOIL CLASSIFICATION SP SOIL DESCRIPTION SAND, trace silt
MOISTURE CONTENT (%) 4.5 DRY DENSITY (PCF) 100

Project No. 94-1-273

V & A

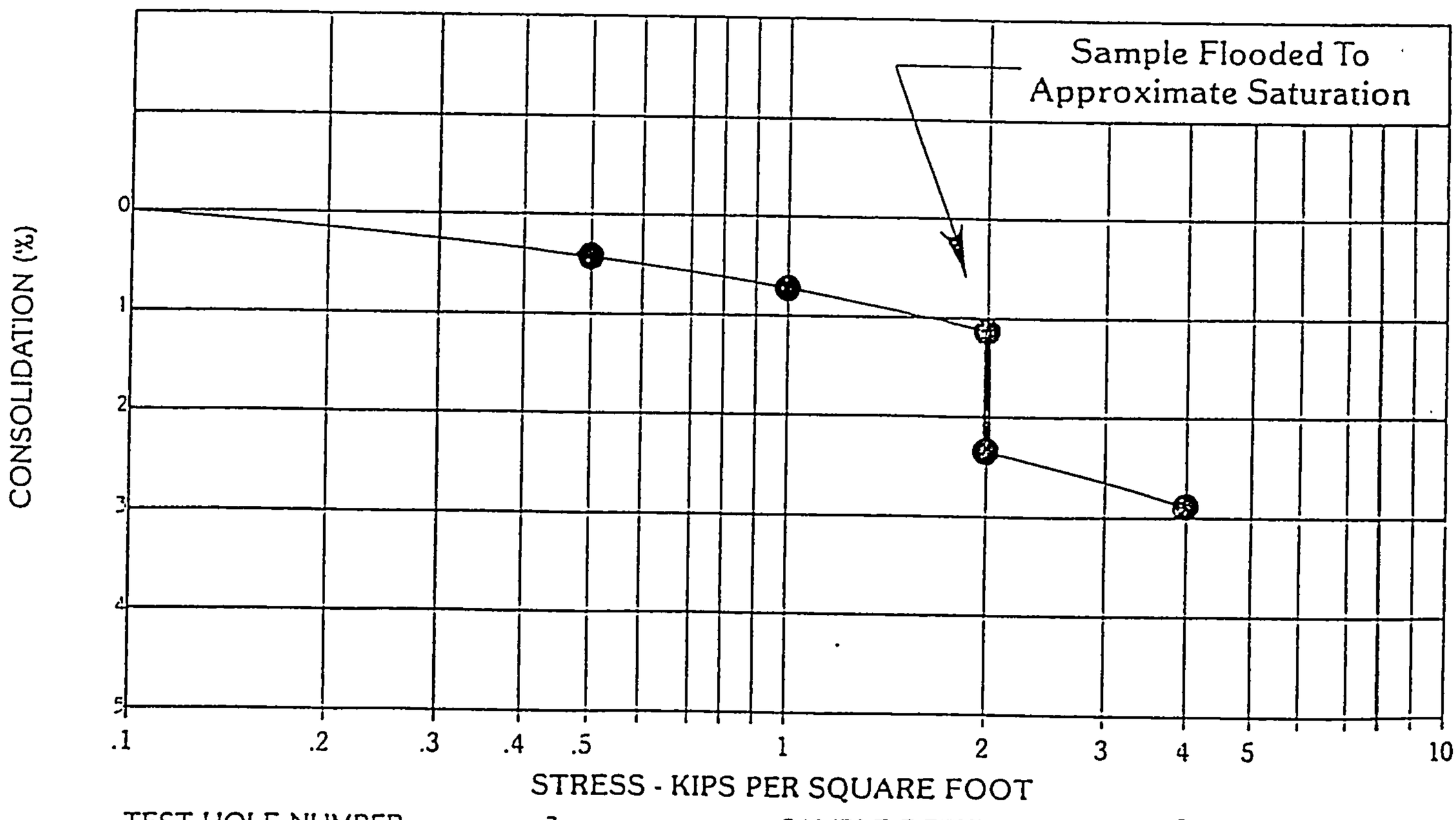
CONSOLIDATION TEST RESULTS



TEST HOLE NUMBER 4 SAMPLE DEPTH 2 FEET

SOIL CLASSIFICATION SP SOIL DESCRIPTION SAND, trace silt

MOISTURE CONTENT (%) 4.9 DRY DENSITY (PCF) 99



TEST HOLE NUMBER 7 SAMPLE DEPTH 2 FEET

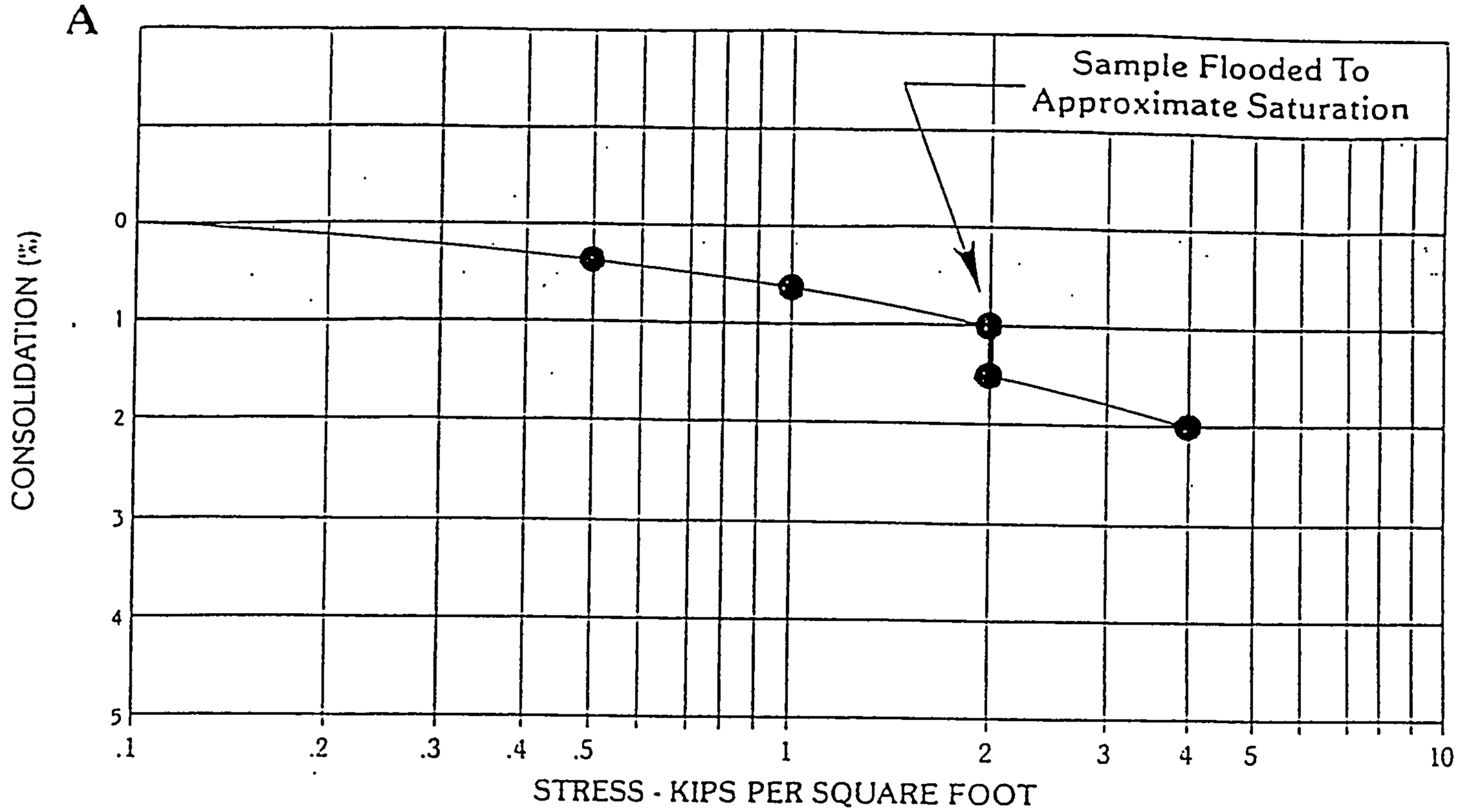
SOIL CLASSIFICATION SP SOIL DESCRIPTION SAND, trace silt, tr. gravel

MOISTURE CONTENT (%) 2.9 DRY DENSITY (PCF) 101

Project No. 94-1-273

V & A

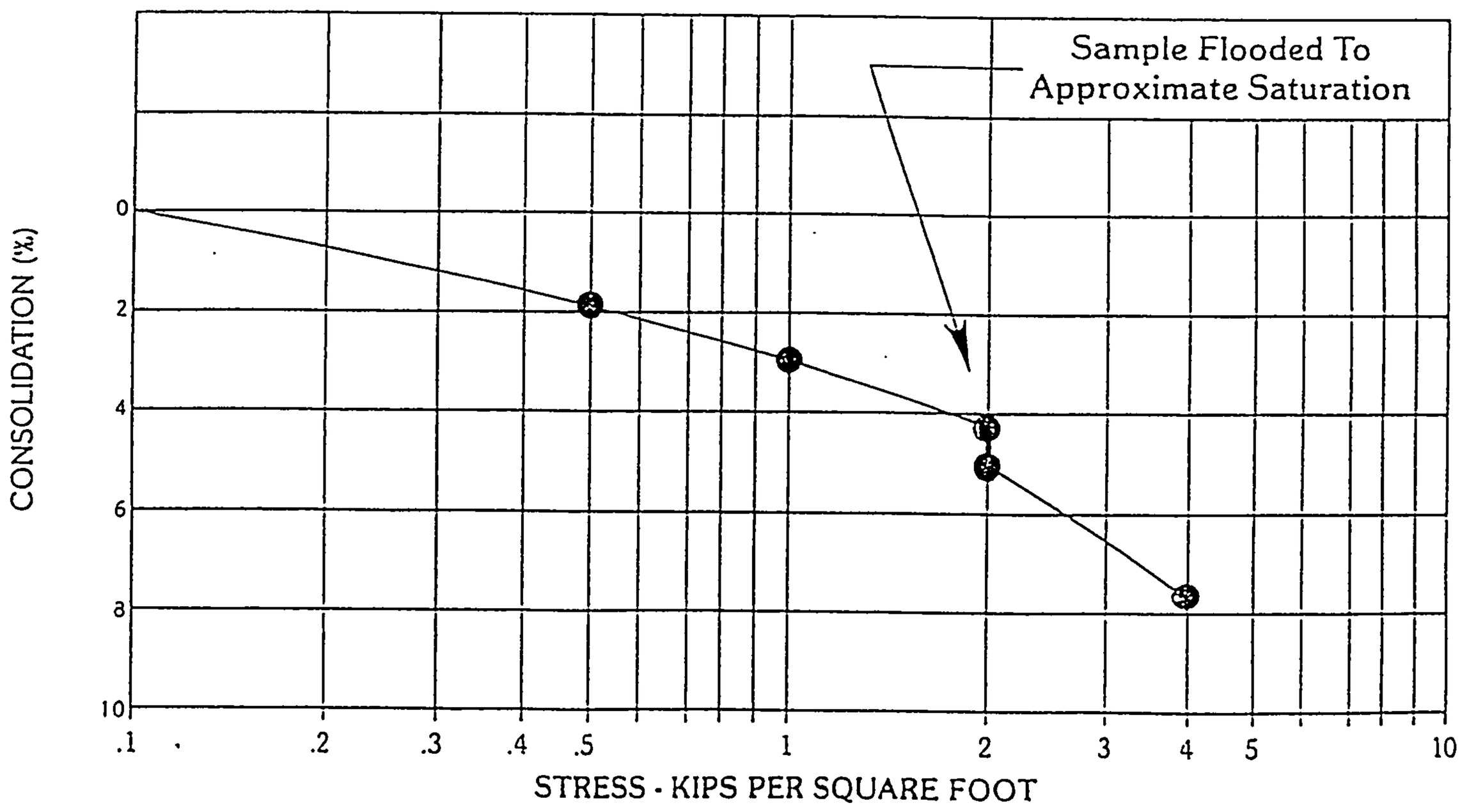
CONSOLIDATION TEST RESULTS



TEST HOLE NUMBER 1 SAMPLE DEPTH 2 FEET

SOIL CLASSIFICATION SP-SM SOIL DESCRIPTION SAND, sli. silty

MOISTURE CONTENT (%) 2.2 DRY DENSITY (PCF) 103



TEST HOLE NUMBER 2 SAMPLE DEPTH 2 FEET

SOIL CLASSIFICATION CL SOIL DESCRIPTION CLAY, sli. sandy

MOISTURE CONTENT (%) 33.0 DRY DENSITY (PCF) 85

Project No. 94-1-273