ENGINEERING DIVISION
LIBRARY

July 8, 1987

Ms. Kebba Buckley
Maricopa County Flood Control District
3335 West Durango
Phoenix, AZ 85009

RE: Guadalupe Flood Retarding Structure

Dear Ms. Buckley:

Attached please find 2 copies of the summary of meetings, correspondence and engineering work completed to date regarding the above referenced flood control structure. To expedite and avoid duplication of effort, it is important to note that all requirements of the Maricopa County Flood Control District, Soil Conservation Service, and Arizona Department of Water Resources have been met, approved and the construction completed with the exception of the following:

1. Extension of the principal spillway pipe.
2. Removal of 1' of soil from top of the emergency spillway and installation of the concrete sill.

These two items have been designed and only await approval to begin construction. In order to facilitate your review, all items of concern have been addressed herein. Time is now of the essence regarding the planting season, i.e., in order to avoid a $400,000 reseed of the golf course, this matter must be resolved prior to July 15, 1987. To that end, my engineers and myself will be available to fly to Portland, if necessary, to address any items to insure each is complete and satisfactory within the seasonal time frame now dictated.

Thanking you in advance for understanding the urgency of these approvals and please advise if we can assist in any way.

Best regards,

GOSNELL BUILDERS

Robert A. Gosnell
President

RAG:taf
Attachments

cc: Dan Lawrence/ADWR (2 copies)
Ralph Arrington/SCS (2 copies)

GOSNELL BUILDERS
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008-1099 • (602) 956-4300

THE POINTE® RESORT @ SOUTH MOUNTAIN

REPORT

FOR

ALTERATIONS TO GUADALUPE FLOODWATER

RETARDING STRUCTURE

JUNE 29, 1987

TABLE OF CONTENTS

	Page
A. INTRODUCTION	1
Summary	2
Drainage Map	3
Aerial Photo	4
B. RESERVOIR	
1. Dam Stability	5
Mirafi 600X Certification	6
2. Stage-Storage and Sediment-Storage	7
Stage-Storage Curves and Calculations	8
Lake Volumes for Sediment Storage	17
3. Stage-Discharge	19
Stage-Discharge Curves	20
TR-20 for 50 Acre Site and Flow in Drainage Channel	22
TR-20 for PMP and 100 Year + 100 Year	38
4. Flows in Pima Wash and Downstream from Dam	61
Backwater Analysis and Calculations	62
Downstream Flow Rate Map	70
Downstream Cross-Section Plan	71
C. EMERGENCY AND PRINCIPAL SPILLWAYS	
1. Emergency Spillway	72
Concrete Sill	73
HEC-2 Assuming No Washout	75
HEC-2 with Washout	80
2. Principal Spillway	85
Hydraulics	86
Calculations for Pipe Strength	88
Collar Detail for Connection to Existing Pipe	90
Bedding Details	91
Specifications for Pressure Test	92
Details for Modifications to Inlet Structure	93
APPENDIX	
Soils Reports	
Geotechnical Report	
Grading and Drainage Plans (Sheets 1-5)	
Road Profile Over Dam	
Utility Plan - Water Line Over Dam, Plan and Profile	
Equestrian Facilities	
Landscape Plans and Planting Schedule	

THE POINTE® RESORT AT SOUTH MOUNTAIN

Alterations to the Guadalupe Floodwater Retarding Structure

June 29, 1987

A. INTRODUCTION

The development of The Pointe® Resort at South Mountain and the golf course has required several alterations to the existing Guadalupe Floodwater Retarding Structure. The attached drainage map shows the location of the retention structure with respect to the resort development. The alterations involved with the development are as follows:

- Construction of five buildings containing 65 resort suites along the north face of north dam no. 2.
- Regrading of the reservoir and the construction of golf course lakes within the reservoir.
- The removal of one foot of rock over the emergency spillway which will be replaced with top soil for the golf course fairway.
- The construction of Pointe® Parkway East roadway over the top of the dam which will involve the extension of the principal spillway.
- The rerouting of Pima Wash into the reservoir which will allow the removal of the existing baffle chute at the entrance to the reservoir.

This report separates the alterations into two groups: 1. Reservoir; and 2. Emergency and Principal Spillways. The items of concern generated by the proposed alterations are:

RESERVOIR

- What impact does the construction of the buildings on the face of the dam have on its stability. What affect will the lakes have on the stability of the dam, i.e., saturation of the foundation and seepage through the abutments due to long term standing water.
- How does the regrading affect the stage-storage and stage-discharge curves.
- Will sufficient sediment storage be provided.
- Will adequate protection against scouring be provided with the rerouting of Pima Wash and the removal of the baffle chute.
- Will floodwaters from Pima Wash be contained within the limits of hole no. 6.
- What will be the flooding depths downstream from the emergency spillway.

EMERGENCY AND PRINCIPAL SPILLWAYS

- With the removal of one foot of rock over the spillway, provide a means to maintain a spillway crest elevation of 1274.0 in case of washout.
- Show flood routing through the spillway and how the golf course mounding and the roadway over the dam affect the water surface elevations.
- Must maintain spillway width and length dimensions of 200 feet by 100 feet.
- Provide hydraulic calculations for the extension of the principal spillway pipe.

- Provide specifications and calculations for the pipe extension including testing specifications.
- Provide specifications and details for the pipe joint with the existing pipe.
- Provide bedding details and backfill specifications.
- Will the connection to the existing 24 inch outlet pipe increase flow to the Western Canal.

This report addresses all of these issues and contains design calculations, specifications and design details supporting the modifications.

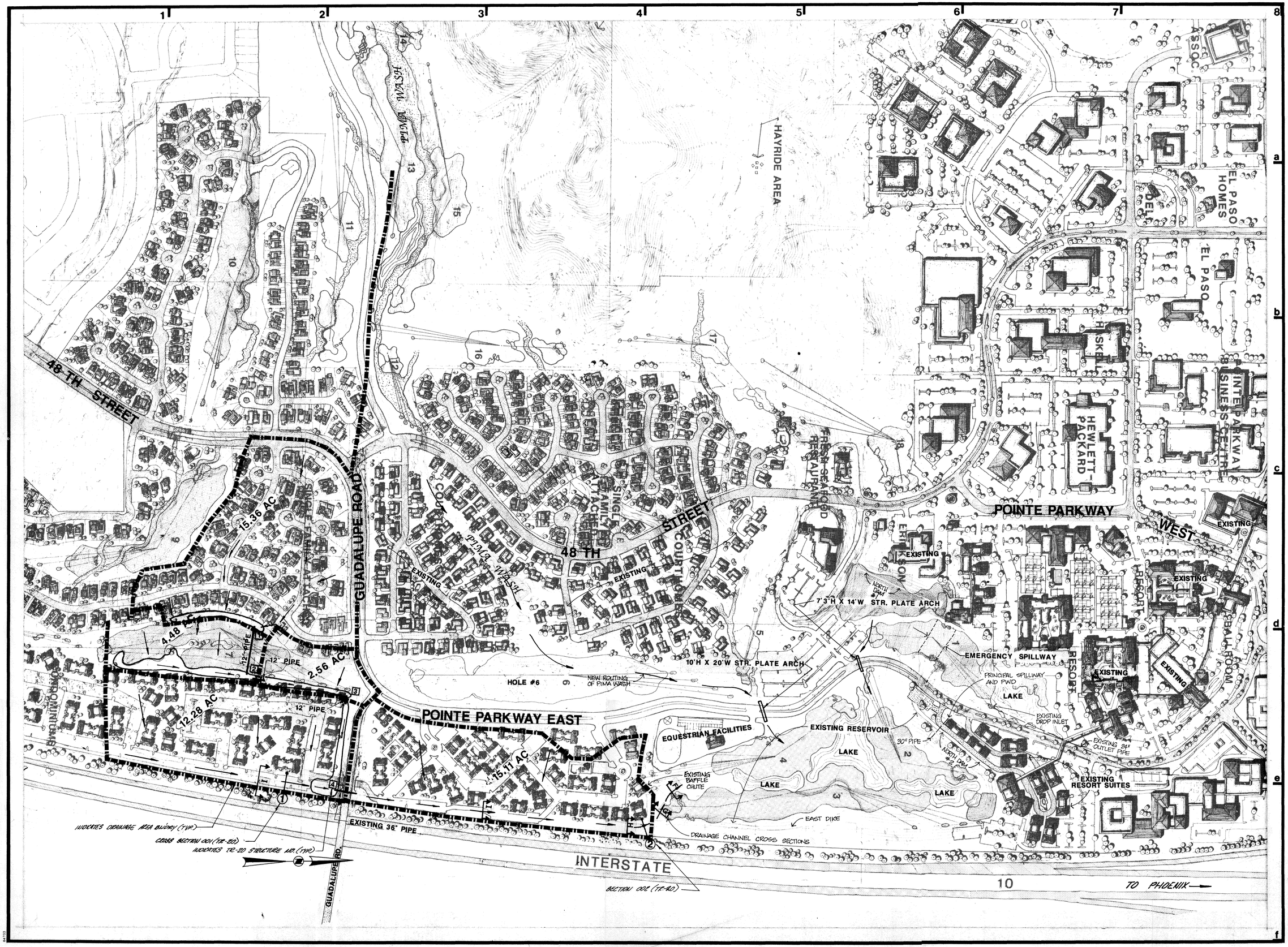
SUMMARY

During the course of design and review by Maricopa County Flood Control District, Soils Conservation Service, and Arizona Department of Water Resources, certain portions of the alterations to the GFRS have been approved and a license issued to construct these improvements. The items which have been approved are as follows:

- Construction of the five suite buildings on north dam no. 2.
- Grading for the golf course and construction of the lakes within the reservoir.
- Rerouting of Pima Wash into the reservoir and the installation of the 20' x 10' SPA and the removal of the baffle chute.
- Routing of PMP through the emergency spillway and routing downstream from the dam.

The aerial photo on page 4 shows the construction which has been completed as of June 19, 1987.

The only items for which a license has not been issued are the removal of 1 foot of rock off the top of the emergency spillway and the extension of the principal spillway. The concrete sill across the emergency spillway has been revised to meet all requirements by the local reviewing agencies. Likewise, the details and calculations for the extension of the principal spillway have been revised to incorporate all of the changes requested by these agencies.



Possessory rights of drawings and project design, as well as all rights in designs and specifications as instruments of service are the property of Gosnell Development Corporation and may not be utilized in any manner without written consent of the Gosnell Development Corporation.

Revisions		
By	Date	Description

		Phone
Architect	G.D.C.	956-4300
Planning	G.D.C.	956-4300
Engineer	G.D.C.	956-4300

Scale: 1" = 200'

Drawn by OLSEN Date 3/84

Ck'd by LEGGE Date 3/84

19__ COPYRIGHT © GOSNELL DEVELOPMENT CORP.

DRAINAGE MAP

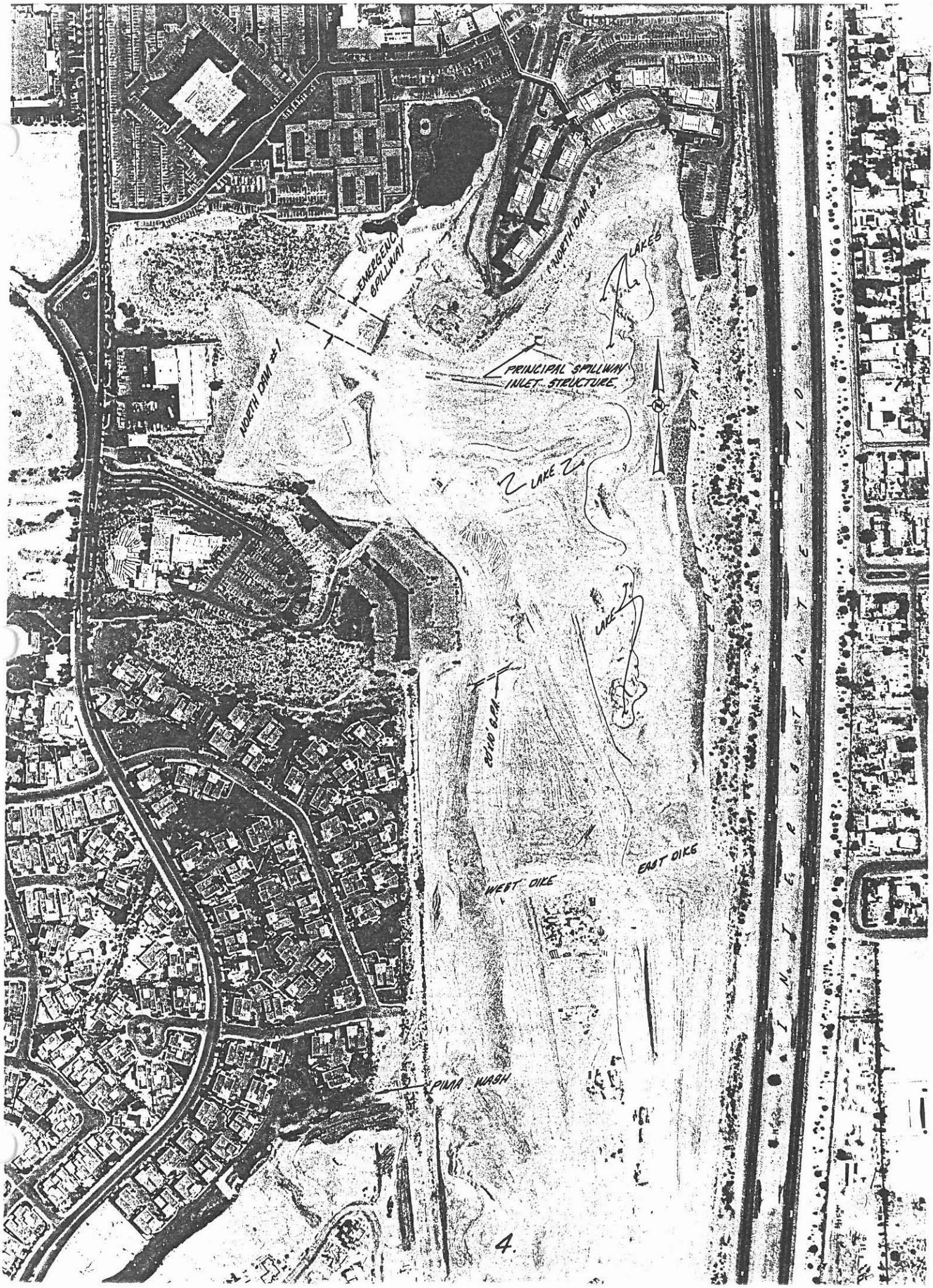
THE POINTE @ SO. MOUNTAIN

GOSNELL DEVELOPMENT CORPORATION

2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

SHEET

1 OF 1


EMERGENCY SPILLWAY
NORTH DAM #2
LAKES
PRINCIPAL SPILLWAY INLET STRUCTURE
NORTH DAM #1
LAKE 2
LAKE 1
EAST DIKE
WEST DIKE
PIMA WASH

B. RESERVOIR

1. Dam Stability

The soils report and supplements prepared by Thomas-Hartig Associates, Inc. and the geotechnical report prepared by Geological Consultants have been included in this report in the appendix. The reports show that with the addition of fill material and the construction of resort suites on the north face of north dam no. 2, the factor of safety for static loading conditions is greater than 1.5. The Maricopa County Flood Control District, Arizona Department of Water Resources, and Soils Conservation Service have reviewed and approved these reports and have issued a license to construct the resort suites and the golf course lakes. This construction has been completed as shown in the photo on page 4.

MIRAFI INC. P.O. BOX 240967/CHARLOTTE, N.C. 28224
PHONE (704) 523-7477 or (800) 438-1855/TELEX 216903 MRFI

MIRAFI 600X CERTIFICATION

February 10, 1987

Gosnell Development
2728 North 24th St.
Phoenix, AZ 85008
ATTN: Mike Mongelli

This is to certify that Mirafi 600X is a woven fabric of polypropylene filaments that meets or exceeds the following current typical property values.

PROPERTY/UNIT	VALUE	TEST METHOD
Grab Strength, lbs.	300	ASTM D-1682-64
Burst Strength, psi	600	ASTM D-3786-80
Puncture Strength, lbs.	130	ASTM D-3787-80
EOS, US Std Sieve	35 - 50	COE CW02215-77
Water Flow Rate, gpm/sf	40	CFMC GET-2

Ellen M. Suite
Notary Public

J. S. Freese
Manufacturing and
Technical Director

My commission expires August 1, 1988.

JSF/fda

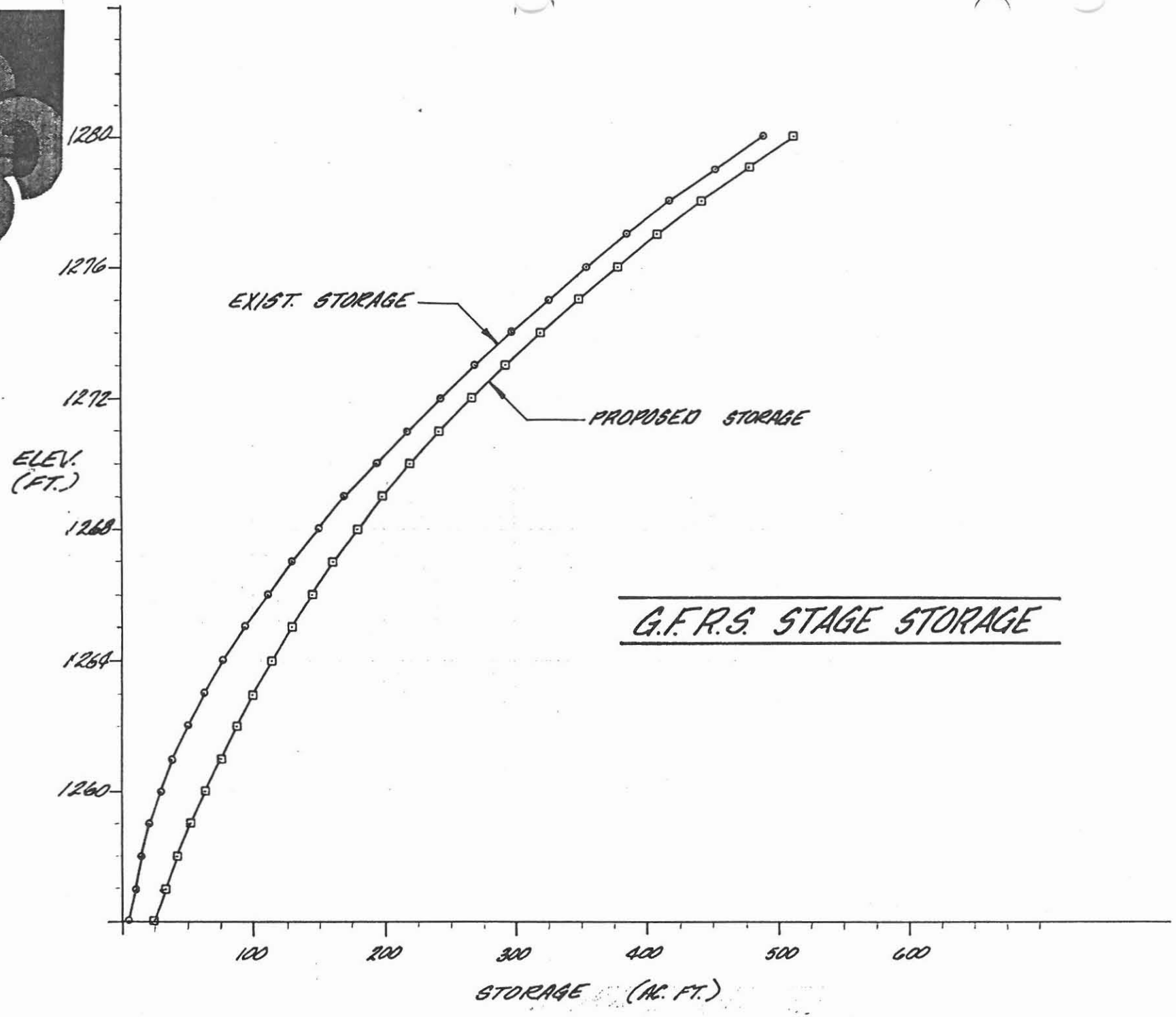
To the best of our knowledge, the information contained herein is accurate. However, MIRAFI INC. cannot assume any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material and whether there is any infringement of patents is the sole responsibility of the user.

Users of any substance should satisfy themselves by independent investigation that the material can be used safely. We may have described certain hazards, but we cannot guarantee that these are the only hazards which exist.

B. RESERVOIR

2. Stage-Storage and Sediment-Storage

The stage-storage data was compiled using the proposed contours shown on the grading plan for the golf course. The areas of the contours were computed using the CALCOMP 9100 digitizer. Except for contour 1281, only the even-elevation contours were digitized and the areas of the odd-elevation contours were interpolated. The volumes were computed using the average end area method. A comparison of the data shows that more storage is being provided at each stage for the proposed condition than for the existing condition. An additional 32 acre-feet of storage will be provided at the sediment pool elevation 1259.0 and 23 acre-feet at the emergency spillway elevation 1274.0. The calculations also show that nearly 18 acre-feet of additional storage is provided in the lakes for sediment. Routine maintenance will be done by golf course personnel on a storm by storm basis to prevent the build up of sediment.



G.F.R.S. STAGE STORAGE

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

8.

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE: ARIZONA | PROJECT: Quadalupe FRS

BY: Hann | DATE: 2/9/83 | CHECKED BY: | DATE: | JOB NO.:

SUBJECT: STAGE-STORAGE DATA Based on Recent Topo (CI = 1.0') By GOSNEL DEVELOPMENT CORP. Topo Map Based on Photography Dated 7/2/80.

SHEET ___ OF ___

Not data Surveyed Data

ELEV	END AREA (AC)	AVG. END AREA (AC)	INCREMENTAL STORAGE (AC-FT)	ACC STORAGE (AC-FT)
1250	0			0
		.035	.035	
1251	.07			0.1
		.145	.145	
1252	.18			0.2
		.375	.375	
1253	.57			0.6
		.940	.940	
1254	1.31			1.5
		1.605	1.605	
1255	1.90			3.1
		2.325	2.325	
1256	2.75			5.4
		3.390	3.390	
1257	4.03			8.8
		4.840	4.840	
1258	5.65			13.6
		6.385	6.385	
1259	7.12			20.0
		7.915	7.915	
1260	8.71			27.9
		9.480	9.480	
1261	10.25			37.4
		11.350	11.350	
1262	12.45			48.8
		13.305	13.305	
1263	14.16			62.1
		14.885	14.885	
1264	15.61			76.9
		16.315	16.315	
1265	17.02			93.3
		17.775	17.775	
1266	18.53			111.0
		19.080	19.080	
1267	19.63			130.1
		20.140	20.140	
1268	20.65			150.3

COMPUTATION SHEET

SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona | PROJECT Quadlupe Fcs

BY Hem | DATE 2/9/83 | CHECKED BY | DATE | JOB NO.

SUBJECT STAGE-STORAGE DATA (CONTINUED) | SHEET ____ OF ____

ELEV.	END AREA (AC)	AVG. END AREA (AC.)	INCREMENTAL STORAGE (AC-FT.)	ACC. STORAGE (AC-FT)
1268	20.65			150.3
		21.160	21.160	
1269	21.67			171.4
		22.290	22.290	
1270	22.91			193.7
		23.565	23.565	
1271	24.22			217.3
		24.835	24.835	
1272	25.45			245.1
		25.970	25.970	
1273	26.49			271.1
		27.180	27.180	
1274	27.87			298.3
		28.445	28.445	
1275	29.02			326.7
		29.630	29.630	
1276	30.24			356.3
		30.830	30.830	
1277	31.42			387.2
		32.135	32.135	
1278	32.85			419.3
		33.765	33.765	
1279	34.68			453.1
		35.495	35.495	
1280	36.31			488.6
		37.340	37.340	
1281	38.37			525.9

*** REVISED 6/25/86

GOSNELL DEVELOPMENT CORPORATION

RETENTION VOLUME CALCULATIONS

MADE BY	DATE	JOB NO.
	2/27/86	766-00
CHKD BY	DATE	SHEET NO.
P.S.		1 OF 1

PROJECT: GUADALUPE F.R.S. – PROPOSED STORAGE.

CONTOUR ELEV.	DEPTH/ DIST.	RETENTION END AREA AC.	AVG. END AREA AC.	INCREMENTAL VOLUME AC.-FT.	ACCUM. VOLUME AC.-FT.
***		↓			
1250	Ø	1.995	Ø	Ø	Ø
* 1251	1	2.326	2.160	2.160	2.160
** 1252	1	2.656	2.491	2.491	4.651
1253	1	4.079	3.368	3.368	8.019
1254	1	5.501	4.790	4.790	12.809
1255	1	6.542	6.022	6.022	18.831
1256	1	7.582	7.062	7.062	25.893
1257	1	8.556	8.069	8.069	33.962
1258	1	9.530	9.043	9.043	43.005
1259	1	10.295	9.913	9.913	52.918
1260	1	11.059	10.677	10.677	63.595
1261	1	12.130	11.595	11.595	75.190
1262	1	13.201	12.575	12.575	87.765
1263	1	13.846	13.524	13.524	101.289
1264	1	14.491	14.169	14.169	115.458
1265	1	15.976	15.234	15.234	130.692
1266	1	17.460	16.718	16.718	147.410
1267	1	18.506	17.983	17.983	165.393
1268	1	19.552	19.029	19.029	184.422
1269	1	21.078	20.315	20.315	204.737
1270	1	22.603	21.841	21.841	226.578
1271	1	24.234	23.419	23.419	249.997
1272	1	25.865	25.049	25.049	275.046
1273	1	26.910	26.388	26.388	301.434
1274	1	27.954	27.432	27.432	328.866
1275	1	29.545	28.750	28.750	357.616
1276	1	31.136	30.341	30.341	387.957
1277	1	33.084	32.110	32.110	420.067
1278	1	35.032	34.058	34.058	454.125
1279	1	36.056	35.544	35.544	489.669
1280	1	37.080	36.568	36.568	526.237
1281		37.913	37.497	37.497	563.734
		SUB TOTAL			

CONTOUR ELEV.	DEPTH/ DIST.	RETENTION END AREA AC.	AVG. END AREA AC.	INCREMENTAL VOLUME AC.-FT.	ACCUM. VOLUME AC.-FT.
		SUB TOTAL			

* THE "AREA VALUES" FOR "ODD-ELEVATION" CONTOURS WERE INTERPOLATED FROM DATA FOR "EVEN-ELEVATION" CONTOURS.

** SEE DATA SHEETS FOR "AREA VALUES" FOR "EVEN-ELEVATION" CONTOURS.

*** EST'D. ADJUSTMENT PER CURRENT GRADING PLANS (6-25-86)

GOSNELL DEVELOPMENT CORPORATION

RETENTION VOLUME CALCULATIONS

MADE BY	DATE	JOB NO.
CHKD BY	DATE	SHEET NO. 1 of 2

PROJECT: GUADALUPE F.R.S. — EXISTING STORAGE

CONTOUR ELEV.	DEPTH/ DIST.	RETENTION END AREA AC.	RETENTION AVG. END AREA AC.	RETENTION INCREMENTAL VOLUME AC.-FT.	RETENTION ACCUM. VOLUME AC.-FT.	CONTOUR ELEV.	DEPTH/ DIST.	RETENTION END AREA AC.	RETENTION AVG. END AREA AC.	RETENTION INCREMENTAL VOLUME AC.-FT.	RETENTION ACCUM. VOLUME AC.-FT.
* 1250				Ø	Ø						
1251					0.1						
1252					0.2						
1253					0.6						
1254					1.5						
1255					3.1						
1256					5.4						
1257					8.8						
1258					13.6						
1259					20.0						
1260					27.9						
1261					37.4						
1262					48.8						
1263					62.1						
1264					76.9						
1265					93.3						
1266					111.0						
1267					130.1						
1268					150.3						
1269					171.4						
1270					193.7						
1271					217.3						
1272					245.1						
1273					271.1						
1274					298.3						
1275					326.7						
1276					356.3						
1277					387.2						
1278					419.3						
1279					453.1						
1280					488.6						
1281					525.9						

* THE VALUES FOR EXISTING STORAGE (AS SHOWN ON THIS SHEET) WERE CALCULATED BY S.C.S. ON 2/9/83.

CONTOUR AREA DATA

02-26-1986 13:46:57

REVISED GFRS VOLUMES BY CONTOUR AREAS-2/26/86

CONTOUR EL.	AREA (S.F.)	AREA (AC.)	TOTAL AREA (AC.)
1250	84936.180	1.950	1.950
1252	115682.700	2.656	2.656
1254	207152.800	4.756	5.395
PLUS 1254	5216.023	0.120	
MINUS 1256	-545.426	-0.013	
PLUS 1254	125.066	0.003	
PLUS 1254	140.260	0.003	
PLUS 1254	21614.340	0.496	
1256	316696.000	7.270	7.292
PLUS 1256	2246.250	0.052	
MINUS 1258	-1425.002	-0.033	
PLUS 1256	113.073	0.003	
1258	428448.000	9.836	9.690
MINUS 1260	-1278.909	-0.029	
MINUS 1260	-5116.832	-0.117	
1260	495619.000	11.378	11.359
PLUS 1260	1491.919	0.034	
PLUS 1260	1011.920	0.023	
MINUS 1262	-623.651	-0.014	
MINUS 1262	[illegible]	-0.039	

CONTOUR EL.	AREA (S.F.)	AREA (AC.)	TOTAL AREA (AC.)
1262	551196.000	12.654	12.806
PLUS 1262	4468.940	0.103	
PLUS 1262	2894.205	0.066	
MINUS 1264	-755.501	-0.017	
1264	607244.300	13.940	14.496
PLUS 1264	8317.457	0.191	
PLUS 1264			
PLUS 1264	15890.100	0.365	
1266	688514.000	15.806	16.245
PLUS 1266	19954.480	0.458	
MINUS 1268	-816.908	-0.019	
1268	764988.300	17.562	18.123
PLUS 1268	24439.390	0.561	
1270	925180.500	21.239	22.542
PLUS 170	66488.600	1.526	
MINUS 1274	-2199.854	-0.051	
MINUS 1276	-7499.843	-0.172	

02-26-1986 15:54:24
REVISED GFRS VOLUMES BY CONTOUR AREAS-2/26/86

02-27-1986 06:54:53

REVISED GFRS VOLUMES BY CONTOUR AREAS-2/27/86

CONTOUR EL.	AREA (S.F.)	AREA (AC.)	TOTAL AREA (AC.)
1272	1025561.000	23.544	25.305
PLUS 1272	83860.150	1.925	
MINUS 1274	-2227.511	-0.051	
MINUS 1274	-1321.557	-0.030	
MINUS 1276	-3609.503	-0.083	
1274	1100037.000	25.253	27.545
PLUS 1274	102514.800	2.353	
PLUS 1274	520.818	0.012	
MINUS 1276	-1484.327	-0.034	
MINUS 1276	-1693.665	-0.039	
1276	1321413.000	30.335	30.335
1278	1505589.000	34.564	
MINUS 1280	-1597.117	-0.037	
MINUS 1284	-6571.810	-0.151	
MINUS 1284	-4140.202	-0.095	
MINUS 1282	-1812.351	-0.042	
MINUS 1282	-1005.073	-0.023	
MINUS 1282	-3699.125	-0.085	34.131

CONTOUR EL.	AREA (S.F.)	AREA (AC.)	TOTAL AREA (AC.)
1280	1597883.000	36.682	36.496
MINUS 1284	-2967.078	-0.068	
MINUS 1284	-1518.308	-0.035	
MINUS 1282	-834.064	-0.019	
MINUS 1282	-382.131	-0.009	
MINUS 1282	-901.760	-0.021	
MINUS 1282	-1480.959	-0.034	
1281	1652139.000	37.928	37.813
MINUS 1284	-1273.899	-0.029	
MINUS 1282	-732.303	-0.017	
MINUS 1284	-593.065	-0.014	
MINUS 1282	-379.369	-0.009	
MINUS 1282	-450.375	-0.010	
MINUS 1282	-203.441	-0.005	
MINUS 1282	-520.261	-0.012	
MINUS 1282	-842.456	-0.019	

GOSNELL DEVELOPMENT CORPORATION

RETENTION VOLUME CALCULATIONS

MADE BY	DATE	JOB NO.
DSO	12-7-82	26-[illegible]
CHKD BY	DATE	SHEET NO.
PS		1 OF 1

PROJECT: PSM - GFRS - LAKE VOLUMES

	CONTOUR ELEV.	DEPTH/ DIST.	RETENTION END AREA AC.	AVG. END AREA AC.	INCREMENTAL VOLUME AC.-FT.	ACCUM. VOLUME AC.-FT.
LAKE 1	1232				0	
	1232	2	0.033	0.062	0.124	0
	1234	2	0.091	0.135	0.270	0.124
	1236	2	0.179	0.237	0.474	0.394
	1238	2	0.295	0.386	0.772	0.868
	1240	2	0.476	0.587	1.174	1.640
	1242	2	0.698	0.823	1.646	2.814
	1244	2	0.947	1.103	2.206	4.460
	1246	2	1.260	1.398	2.796	6.666
	1248	2	1.535	1.675	3.350	9.462
	1250		1.815			12.812
LAKE 2	1242					
	1242	2	0.003	0.019	0.038	0
	1244	2	0.035	0.065	0.130	0.038
	1246	2	0.094	0.120	0.240	0.168
	1248	2	0.145	0.168	0.336	0.408
	1250	2	0.190			0.744
LAKE 3	1246					
	1246	2	0.006	0.049	0.098	0
	1248	2	0.091	0.152	0.304	0.098
	1250	2	0.212	0.265	0.530	0.402
	1252	2	0.317	0.376	0.752	0.932
	1254	2	0.435			1.684
LAKE 4	1248					
	1248	2	0.002	0.017	0.034	0
	1250	2	0.032	0.051	0.102	0.034
	1252	2	0.070	0.095	0.190	0.136
	1254	2	0.119			0.326
LAKE 5	1250					
	1250	2	0.005	0.013	0.026	0
	1252	2	0.021	0.029	0.058	0.026
	1254	2	0.037	0.046	0.092	0.084
	1256	2	0.055			0.176
			SUB TOTAL			

	CONTOUR ELEV.	DEPTH/ DIST.	RETENTION END AREA AC.	AVG. END AREA AC.	INCREMENTAL VOLUME AC.-FT.	ACCUM. VOLUME AC.-FT.
LAKE 6	1252					
	1252	2	0.007	0.017	0.034	0
	1254	2	0.027	0.045	0.090	0.034
	1256	2	0.063	0.083	0.166	0.124
	1258		0.102			0.290
LAKE 7	1248					
	1248	2	0.013	0.030	0.060	0
	1250	2	0.046	0.093	0.186	0.060
	1252	2	0.139	0.178	0.356	0.246
	1254	2	0.216	0.258	0.516	0.602
	1256	2	0.300	0.355	0.710	1.118
	1258		0.409			1.828
			SUB TOTAL			17.861 AC-FT.

PSK-GFRS-LAKE VOLUMES BY CONTOUR AREAS

1232			
	1448.425	0.033	
1234			
	3964.737	0.091	
1236			
	7780.052	0.179	
1238			
	12252.980	0.281	
PLUS 1238			
	621.246	0.014	LAKE 1
1240			
	20739.020	0.476	
1242			
	30403.230	0.698	
1244			
	41271.220	0.947	
1246			
	54896.500	1.260	
1248			
	66844.470	1.535	
1250			
	79067.630	1.815	
1242			
	111.331	0.003	
1244			
	1536.953	0.035	LAKE 2
1246			
	4111.313	0.094	
1248			
	6316.415	0.145	
1250			
	8260.920	0.190	
1246			
	259.841	0.006	
1248			
	1762.481	0.040	
PLUS 1248			
	2222.355	0.051	LAKE 3
1250			
	9236.135	0.212	
1252			
	13806.510	0.317	
1254			
	18955.090	0.435	
1248			
	100.915	0.002	
1250			
	1375.168	0.032	LAKE 4
1252			
	3028.933	0.070	
1254			
	5179.543	0.119	
1250			
	211.221	0.005	
1252			
	912.337	0.021	LAKE 5
1254			
	1607.034	0.037	
1256			
	2387.911	0.055	
1252			
	317.115	0.007	
1254			
	1127.634	0.026	
PLUS 1254			LAKE 6
	26.612	0.001	0.037
1256			
	2468.030	0.057	0.063
PLUS 1256			
	257.801	0.006	
1258			
	4456.762	0.102	
1248			
	548.646	0.013	
1250			
	1820.755	0.042	0.046
PLUS 1250			LAKE
	187.142	0.004	
1252			7
	6035.953	0.139	
1254			
	9412.807	0.216	
1256			
	13056.560	0.300	

B. RESERVOIR

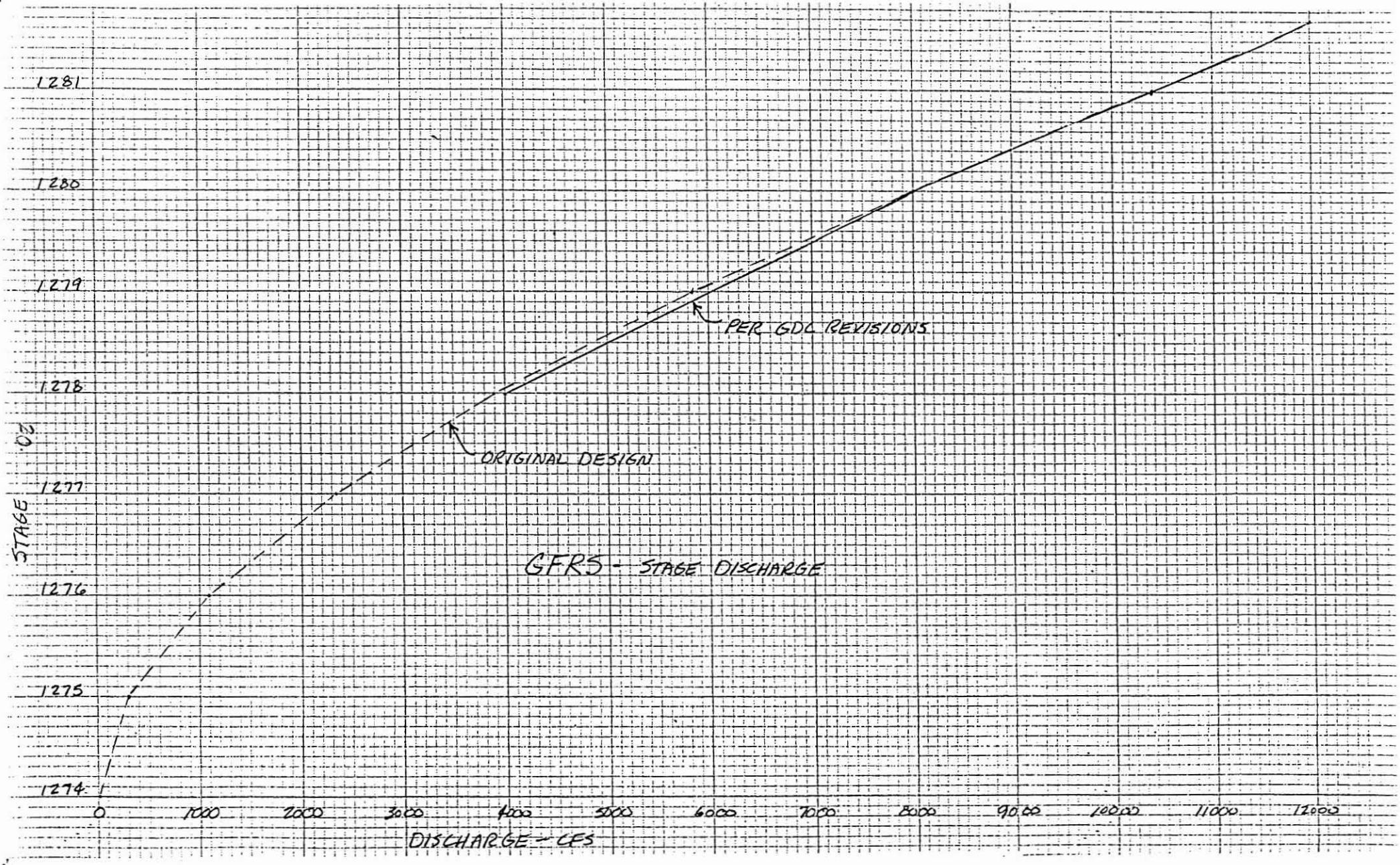
3. Stage-Discharge

With the proposed construction, water will enter the reservoir at two locations. The majority of the storm water draining to the reservoir comes from the Pima Wash and its tributary. This water will be intercepted by the golf course hole number 6 and drain to the proposed 10' x 20' structural plate arch where it enters the reservoir. See the drainage map on page 3. The other source of runoff is from the 35 acres south of Guadalupe Road and the 15 acres east of hole number 6. This runoff will be carried in a channel adjacent to the I-10 freeway where it will enter at the southeast corner of the reservoir. The runoff from this 50 acres is slight and will not require the existing baffle chute to dissipate the energy.

Two TR-20 computer analyses are included in this report. The first was run to determine the runoff from the 50 acre site and to size the drainage structures and channels accordingly. Assuming a developed condition, runoffs were computed for the 10, 50 and 100 year return frequencies. The 24 hour duration rainfall amounts were taken from "Estimated return period for short duration precipitation in Arizona, Phoenix WBO, latitude 33°26', longitude 112°01'." The second TR-20 run was made to determine what affect the proposed grading in the reservoir had on the discharge through the emergency spillway. This was done for the 6 hour PMP storm and for the 100 year on top of the 100 year condition. The rainfall distribution tables for the original design of the dam were used in this analysis.

The TR-20 run for the 50 acre site shows that the maximum flow in the proposed grassed channel at the location of the existing baffle chute is 45.1 cfs. The flow at cross-sections "I" and "H" is subcritical and the velocities will be less than 5 fps. Well maintained bermuda grass will withstand these velocities without any appreciable erosion. At cross-section "F", the flow is supercritical and a small jump will occur at the toe of the slope. Minor erosion may occur at this point, but will be routinely maintained by the golf course maintenance personnel.

The TR-20 run for the 6 hour PMP storm shows that the added storage in the reservoir has reduced the maximum discharge through the emergency spillway to 11812 cfs. The inflow rate of 16573 cfs compares closely with the original calculations of 16854 cfs.


1281
1280
1279
1278
1277
1276
1275
1274
STAGE
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
DISCHARGE – CFS
PER GDC REVISIONS
ORIGINAL DESIGN
GFRS - STAGE DISCHARGE

20.03

NOTE!! This is the STAGE - DISCHARGE DATA AS USED IN DESIGN AND WAS USED FOR THE SAFETY OF DAMS STUDY

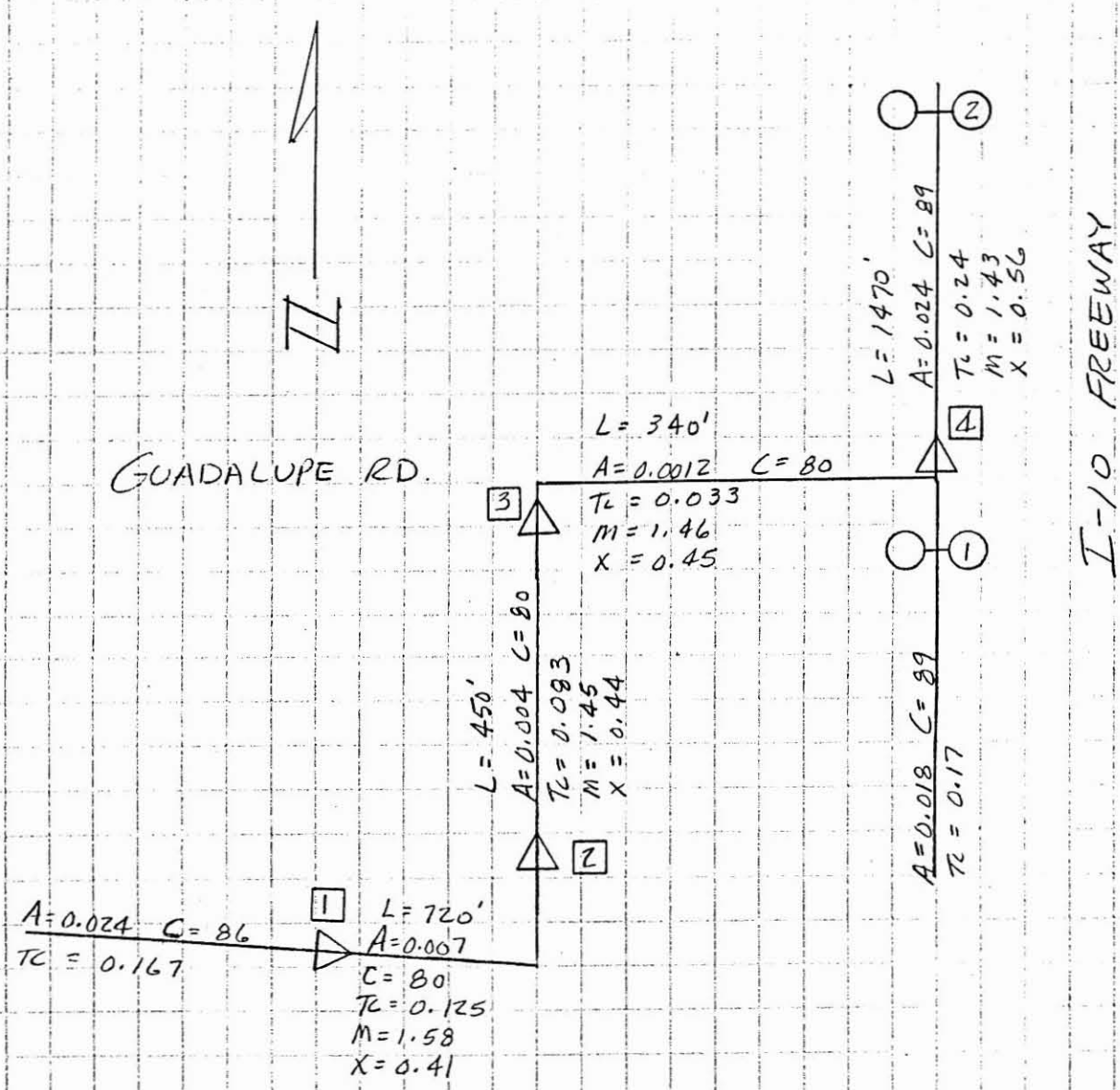
X

Arizona
Burton 12/20/72

Guadalupe

Elevation Discharge L = 100 ft., Emb = 4 14

Elevation	Discharge Principle Spillway	Emergency Spillway	Total C.F.S.	Total (in./day)
1259	0	0	0	0
1260	14	0	14	.2783
1262	15	0	15	.2981
1264	16	0	16	.3180
1266	17	0	17	.3379
1268	18	0	18	.3578
1270	18	0	18	.3578
1272	18	0	18	.3578
1274	19	0	19	.3777
1275	19	303	322	6.4012
1276	19	1110	1139	22.6427
1277	19	2350	2369	47.0946
1278	20	3900	3920	77.9277
1279	20	5850	5870	116.6928
1280	20	8000	8020	159.4338
1281	20	10400	10420	207.1447



GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

```
*******************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY*****************

JOB TR-20                                NOPRINT
TITLE 001 PSMGOLF
 5 RAINFL 3                  0.0208
 8          0.0              0.005        0.011        0.016        0.022
 8          0.028            0.035        0.041        0.048        0.056
 8          0.063            0.071        0.080        0.089        0.098
 8          0.109            0.120        0.133        0.147        0.163
 8          0.181            0.204        0.235        0.283        0.663
 8          0.735            0.772        0.799        0.820        0.838
 8          0.854            0.868        0.880        0.891        0.902
 8          0.912            0.921        0.929        0.937        0.945
 8          0.952            0.959        0.965        0.972        0.978
 8          0.984            0.989        0.995        1.000        1.000
 9 ENDTBL
 3            01
 8                         1294.0         0.00         0.00
 8                         1295.0         2.0          0.246
 8                         1295.5         4.0          0.418
 8                         1296.0        15.0          0.621
 8                         1296.3        26.0          0.753
 8                         1296.6        40.0          0.885
                           1297.0        61.0          1.061
 9 ENDTBL
 3            02
 8                         1284.5       000.00         0.0000
 8                         1286.0         4.0          0.250
 8                         1287.0         6.0          0.675
 8                         1288.0         7.0          1.282
 8                         1289.0        18.0          2.088
 8                         1289.5        38.0          2.571
 8                         1290.0        64.0          3.107
 9 ENDTBL
 3            03
 8                         1283.5         0.0          0.0
 8                         1285.0         4.0          0.122
 8                         1286.0         6.0          0.293
 8                         1287.0         7.0          0.522
 8                         1287.5        18.0          0.667
 8                         1288.0        38.0          0.800
 8                         1288.5        64.0          0.952
 9 ENDTBL
 3            04
                           1282.0         0.0          0.0
 8                         1283.5         1.0          0.551
 8                         1284.5         2.0          0.792
 8                         1285.0        17.0          1.369
```

```
**********************80-80 LIST OF INPUT DATA (CONTINUED)**********************
8                                  1285.5        41.0          1.708
8                                  1286.0        71.0          2.081
9 ENDTBL
2            001                     1.0
8                                  1285.5         0.0          0.0
8                                  1286.0         3.0          3.8
8                                  1286.5        20.0         15.0
8                                  1287.0        59.0         33.8
8                                  1287.25       89.0         45.9
8                                  1287.5       127.0         60.0
9 ENDTBL
2            002                     1.0
8                                  1278.0         0.0          0.0
8                                  1278.5        16.0          4.8
8                                  1279.0        55.0         11.0
8                                  1279.25       84.0         14.7
8                                  1279.5       118.0         18.8
8                                  1279.75      159.0         23.2
9 ENDTBL
          1     01       5            0.0240      86.0          0.1667 1          1
6         2     01 5     6          1294.0                            1          1
6         3     02 6     7           720.0          0.41         1.58  1          1
6         1     02       5            0.0070      80.0          0.125 1          1
6         4     02 7 5 6                                             1          1
6         2     02 6     7          1284.5                            1          1
6         3     03 7     5           450.0          0.44         1.45  1          1
6         1     03       6            0.0040      80.0          0.083 1          1
6         4     03 5 6 7                                             1          1
6         2     03 7     5          1283.5                            1          1
6         3     04 5     6           340.0          0.45         1.46  1          1
6         1 001          7            0.019       89.0          0.17  1          1
6         4     04 6 7 5                                             1          1
6         2     04 5     6          1283.5                            1          1
6         3 002    6     7          1470.0          0.56         1.43  1          1
6         1 002          5            0.024       89.0          0.240 1          1
6         4 002    7 5 6                                             1          1
  ENDATA
7 LIST
7 INCREM 6                  0.10
  COMPUT 7     01 002      0.0          2.53          24.0          3 2  01   01
  ENDCMP 1
7 COMPUT 7     01 002      0.0          3.57          24.0          3 2  01   02
  ENDCMP 1
7 COMPUT 7     01 002      0.0          4.04          24.0          3 2  01   03
  ENDCMP 1
  ENDJOB 2
```

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTI
IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALU
INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST
OINT.)

SECTION/ STRUCTURE RUNOFF ID	STANDARD CONTROL OPERATION	PEAK DISCHARGE DRAINAGE AREA	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM	PRECIPITATION BEGIN	AMOUNT	DURATION
AMOUNT (IN)	ELEVATION (FT)	TIME (SQ MI) (HR)	RATE (CFS)		RATE (HR) (CSM)	(HR)	(IN)	(HR)
ALTERNATE 1 STORM 1								
STRUCTURE 1 RUNOFF		0.02	3	2	0.10	0.0	2.53	24.00
1.26	---	11.97	19.60		816.7			
STRUCTURE 1 RESVOR		0.02	3	2	0.10	0.0	2.53	24.00
1.27	1295.80	12.14	10.50		437.7			
RUCTURE 2 REACH		0.02	3	2	0.10	0.0	2.53	24.00
1.27	1288.23	12.29	9.53		397.0			
STRUCTURE 2 RUNOFF		0.01	3	2	0.10	0.0	2.53	24.00
0.90	---	11.97	4.38		625.6			
STRUCTURE 2 ADDHYD		0.03	3	2	0.10	0.0	2.53	24.00
1.18	1288.32	12.28	10.47		337.8			
STRUCTURE 2 RESVOR		0.03	3	2	0.10	0.0	2.53	24.00
1.18	1286.36	12.87	4.71		152.0			
STRUCTURE 3 REACH		0.03	3	2	0.10	0.0	2.53	24.00
1.18	1285.35	13.04	4.71		151.8			
STRUCTURE 3 RUNOFF		0.00	3	2	0.10	0.0	2.53	24.00
0.90	---	11.96	2.59		648.3			
STRUCTURE 3 ADDHYD		0.03	3	2	0.10	0.0	2.53	24.00
1.15	1285.50	12.97	4.99		142.7			
STRUCTURE 3 RESVOR		0.03	3	2	0.10	0.0	2.53	24.00
1.15	1285.27	13.98	4.54		129.7			
STRUCTURE 4 REACH		0.03	3	2	0.10	0.0	2.53	24.00
1.15	1284.58	14.09	4.54		129.7			
XSECTION 1 RUNOFF		0.02	3	2	0.10	0.0	2.53	24.00
..48	---	11.96	17.71		932.1			
STRUCTURE 4 ADDHYD		0.05	3	2	0.10	0.0	2.53	24.00
1.27	1285.04	11.97	18.89		349.9			
STRUCTURE 4 RESVOR		0.05	3	2	0.10	0.0	2.53	24.00
'.35	1284.62	13.59	5.72		106.0			
.CTION 2 REACH		0.05	3	2	0.10	0.0	2.53	24.00
1.35	1278.18	13.90	5.68		105.3			
XSECTION 2 RUNOFF		0.02	3	2	0.10	0.0	2.53	24.00
1.48	---	11.98	21.00	25.	875.1			
XSECTION 2 ADDHYD		0.08	3	2	0.10	0.0	2.53	24.00
1.39	1278.57	11.99	21.66		277.7			

ALTERNATE 1 STORM 2

STRUCTURE	1	RUNOFF	0.02	3	2	0.10	0.0	3.57	24.00
2.15	---		11.96	32.72		1363.4			
STRUCTURE	1	RESVOR	0.02	3	2	0.10	0.0	3.57	24.00
2.16	1296.27		12.07	24.85		1035.4			
STRUCTURE	2	REACH	0.02	3	2	0.10	0.0	3.57	24.00
2.16	1289.15		12.19	24.18		1007.6			
STRUCTURE	2	RUNOFF	0.01	3	2	0.10	0.0	3.57	24.00
1.68	---		11.96	8.02		1145.4			
STRUCTURE	2	ADDHYD	0.03	3	2	0.10	0.0	3.57	24.00
2.05	1289.21		12.16	26.27		847.3			
STRUCTURE	2	RESVOR	0.03	3	2	0.10	0.0	3.57	24.00
2.05	1287.67		12.91	6.67		215.2			
STRUCTURE	3	REACH	0.03	3	2	0.10	0.0	3.57	24.00
2.05	1286.67		13.05	6.67		215.1			
STRUCTURE	3	RUNOFF	0.00	3	2	0.10	0.0	3.57	24.00
1.67	---		11.95	4.70		1174.3			
STRUCTURE	3	ADDHYD	0.03	3	2	0.10	0.0	3.57	24.00
2.01	1287.03		11.98	7.58		216.7			
STRUCTURE	3	RESVOR	0.03	3	2	0.10	0.0	3.57	24.00
2.01	1286.29		14.86	6.29		179.6			
STRUCTURE	4	REACH	0.03	3	2	0.10	0.0	3.57	24.00
2.01	1284.64		14.98	6.29		179.6			
XSECTION	1	RUNOFF	0.02	3	2	0.10	0.0	3.57	24.00
2.41	---		11.96	28.25		1486.9			
STRUCTURE	4	ADDHYD	0.05	3	2	0.10	0.0	3.57	24.00
2.15	1285.29		11.96	31.10		575.8			
STRUCTURE	4	RESVOR	0.05	3	2	0.10	0.0	3.57	24.00
2.22	1284.90		12.21	14.12		261.5			
XSECTION	2	REACH	0.05	3	2	0.10	0.0	3.57	24.00
2.21	1278.39		12.54	12.55		232.4			
XSECTION	2	RUNOFF	0.02	3	2	0.10	0.0	3.57	24.00
2.42	---		11.98	33.79		1407.9			
XSECTION	2	ADDHYD	0.08	3	2	0.10	0.0	3.57	24.00
2.28	1278.77		12.01	36.71		470.6			

ALTERNATE 1 STORM 3

STRUCTURE	1	RUNOFF	0.02	3	2	0.10	0.0	4.04	24.00
2.57	---		11.96	38.76		1615.2			
JCTURE	1	RESVOR	0.02	3	2	0.10	0.0	4.04	24.00
2.58	1296.42		12.05	31.67		1319.7			
STRUCTURE	2	REACH	0.02	3	2	0.10	0.0	4.04	24.00
2.58	1289.33		12.16	31.02		1292.5			
S JCTURE	2	RUNOFF	0.01	3	2	0.10	0.0	4.04	24.00
.05	---		11.96	9.75		1392.3			
STRUCTURE	2	ADDHYD	0.03	3	2	0.10	0.0	4.04	24.00
2.46	1289.40		12.12	33.91		1093.7			
STRUCTURE	2	RESVOR	0.03	3	2	0.10	0.0	4.04	24.00
2.46	1288.15		12.83	8.69		280.2			
STRUCTURE	3	REACH	0.03	3	2	0.10	0.0	4.04	24.00
2.46	1287.07		12.97	8.65		279.0			
STRUCTURE	3	RUNOFF	0.00	3	2	0.10	0.0	4.04	24.00
2.05	---		11.95	5.69		1423.1			
STRUCTURE	3	ADDHYD	0.03	3	2	0.10	0.0	4.04	24.00
2.41	1287.10		11.98	9.30		265.7			
STRUCTURE	3	RESVOR	0.03	3	2	0.10	0.0	4.04	24.00
2.42	1286.86		14.70*	6.86*		195.9			
STRUCTURE	4	REACH	0.03	3	2	0.10	0.0	4.04	24.00
2.42	1284.66		14.80*	6.86*		195.9			
XSECTION	1	RUNOFF	0.02	3	2	0.10	0.0	4.04	24.00
2.85	---		11.96	33.04		1739.0			
STRUCTURE	4	ADDHYD	0.05	3	2	0.10	0.0	4.04	24.00
57	1285.39		11.96	35.79		662.8			
STRUCTURE	4	RESVOR	0.05	3	2	0.10	0.0	4.04	24.00
2.63	1285.03		12.17	18.60		344.4			
XSECTION	2	REACH	0.05	3	2	0.10	0.0	4.04	24.00
2.62	1278.50		12.42	16.03		296.8			
XSECTION	2	RUNOFF	0.02	3	2	0.10	0.0	4.04	24.00
2.86	---		11.97	39.62		1650.7			
XSECTION	2	ADDHYD	0.08	3	2	0.10	0.0	4.04	24.00
2.70	1278.87		12.01	45.13		578.6			

SUMMARY TABLE 2 - SELECTED MODIFIED ATT-KIN REACH ROUTINGS IN ORDER OF STANDARI
EXECUTIVE CONTROL INSTRUCTIONS
(A STAR(*) AFTER VOLUME ABOVE BASE(IN) INDICATES A HYDROGRAPI
TRUNCATED AT A VALUE EXCEEDING BASE + 10% OF PEAK
A QUESTION MARK(?) AFTER COEFF.(C) INDICATES PARAMETERS OUT
DE ACCEPTABLE LIMITS, SEE PREVIOUS WARNINGS)

ROUTING PARAMETERS					HYDROGRAPH INFORMATION PEAK							
Q AND A			PEAK	S/Q	ATT-	OUTFLOW+ TRAVEL TIME			VOLUME	MAIN	ITE
XSEC REACH EQUATION		INFLOW LENGTH	RATIO	OUTFLOW @PEAK	KIN	INTERV. STOR-	AREA KINE-	BASE-	ABOVE	TIME	ATI
ID COEFF (X)	LENGTH POWER (FT) (M)	PEAK FACTOR (CFS) (K*)	TIME O/I (HR) (Q*)	PEAK (K) (CFS) (SEC)	TIME COEFF (HR) (C)	PEAK AGE (CFS) (HR)	TIME MATIC (HR) (HR)	FLOW (CFS)	BASE (IN)	INCR (HR)	#
ALTERNATE 1 STORM 1											
0.410720		10	12.1	10	12.3			0	1.27	0.10	
	1.58	0.018	0.926	341	0.69?	0.10	0210				
0.440450		5	12.9	5	13.0			0	1.18	0.10	
	1.45	0.005	0.990	338	0.70?	0.10	0300				
0.450340		5	14.0	5	14.1			0	1.15	0.10	
	1.46	0.003	1.000	250	0.84?	0.10	0200				
0.560470		6	13.6	6	13.9			0	1.35	0.10	
	1.43	0.011	0.993	912	0.33	0.20	0220				
ALTERNATE 1 STORM 2											
0.410720		25	12.1	24	12.2			0	2.16	0.10	
	1.58	0.018	0.983	247	0.84?	0.10	0202				
0.440450		7	12.9	7	13.0			0	2.05	0.10	
	1.45	0.003	0.999	303	0.74?	0.10	0200				
0.450340		6	14.9	6	15.0			0	2.01	0.10	
	1.46	0.002	1.000	225	0.89?	0.10	0200				
0.560470		14	12.2	13	12.5			0	2.22	0.10	
	1.43	0.014	0.887	696	0.41	0.30	0220				
ALTERNATE 1 STORM 3											
0.410720		31	12.0	30	12.2			0	2.58	0.10	
	1.58	0.017	0.986	228	0.88?	0.20	0206				
0.440450		9	12.8	9	13.0			0	2.46	0.10	
	1.45	0.003	0.996	280	0.78?	0.20	0300				
0.450340		7	14.7	7	14.8			0	2.42	0.10	
	1.46	0.001	1.000	219	0.90?	0.00	0200				
0.560470		18	12.2	16	12.4			0	2.63	0.10	
	1.43	0.014	0.867	641	0.44	0.40	0210				

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AN
ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2	3
STRUCTURE 4	0.05			
ALTERNATE 1		5.72	14.12	18.60
STRUCTURE 3	0.03			
ALTERNATE 1		4.54	6.29	6.86
RUCTURE 2	0.03			
ALTERNATE 1		4.71	6.67	8.69
STRUCTURE 1	0.02			
ALTERNATE 1		10.50	24.85	31.67
XSECTION 1	0.02			
ALTERNATE 1		17.71	28.25	33.04
XSECTION 2	0.08			
ALTERNATE 1		21.66	36.71	45.13

PROJECT: PSM GOLF
S/o Guadalupe Rd.

DESIGNER: _____

DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

STRUCTURE 1

12" PVC

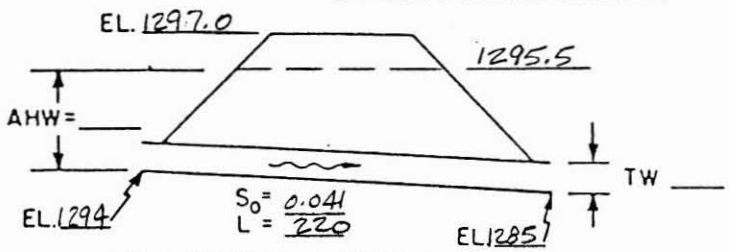
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q INLET	~~SIZE~~ Q OUTLET	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H + h_0 − LS_0: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS STORAGE AC-FT
1294.0	0	0			0.5					4.5	9.0					0
1295.0	2	6	1.0			5.5						1.0				0.246
1295.5	4	6	1.5			6.0						1.5				0.418
1296.0	5+10= 15	6	2.0			6.5						2.0				0.621
1296.3	5+21= 26	6	2.3			6.8						2.3				0.753
1296.6	6+34= 40	6	2.6			7.1						2.6				0.885
1297.0	6+55= 61	6	3.0			7.5						3.0				1.061

SUMMARY & RECOMMENDATIONS: Use $Q = CLH^{3/2}$ to determine overflow.
$L = 10'$ $C = 3.0$

Figure 7

PROJECT: PSM GOLF
S/O Guadalupe Rd.

DESIGNER: _____

DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

STRUCTURE 2

12" PVC

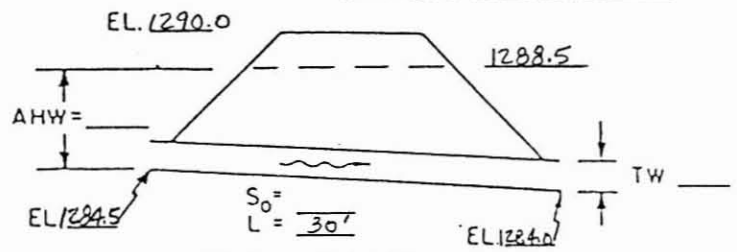
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS STORAGE AC-FT
1284.5	0		0													0
1286.0	4	4	1.5		0.5	1.0				1.0	0.5	1.5				0.250
1287.0	6	4	2.5			1.0				2.0		2.5				0.675
1288.0	7	4	3.5			1.0				3.0		3.5				1.282
1289.0	8+10= 18	15	4.5			1.5				3.5		4.5				2.088
1289.5	8+30= 38	36	5.0			2.0				3.5		5.0				2.571
1290.0	9+55= 64	62	5.5			2.5				3.5		5.5				3.107

SUMMARY & RECOMMENDATIONS: Use $Q = CLH^{3/2}$ to determine overflow
$L = 10'$ $C = 3.0$

Figure 7

PROJECT: PSM GOLF
S/o Guadalupe Rd.

DESIGNER: _____

DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

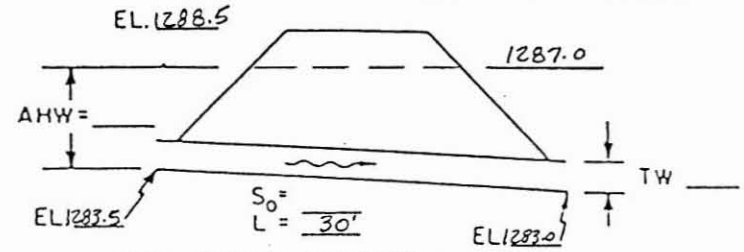
STRUCTURE 3
12" PVC

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS STORAGE AC-FT
1283.5	0		0													0
1285.0	4	4	1.5		0.5	1.0				1.0	0.5	1.5				0.122
1286.0	6	5	2.5			1.5				1.5		2.5				0.293
1287.0	7	6	3.5			2.3				1.7		3.5				0.522
1287.5	8+10 = 18	17	4.0			2.5				2.0		4.0				0.667
1288.0	8+30 = 38	38	4.5			2.5				2.5		4.5				0.800
1288.5	9+55 = 64	62	5.0			2.5				3.0		5.0				0.952

SUMMARY & RECOMMENDATIONS: Use $Q = CLH^{3/2}$ to determine overflow
$L = 10'$ $C = 3.0$

Figure 7

PROJECT: PSM GOLF
S/O Guadalupe Rd.

DESIGNER: _____

DATE: _____

HYDROLOGIC AND CHANNEL INFORMATION

STRUCTURE 4

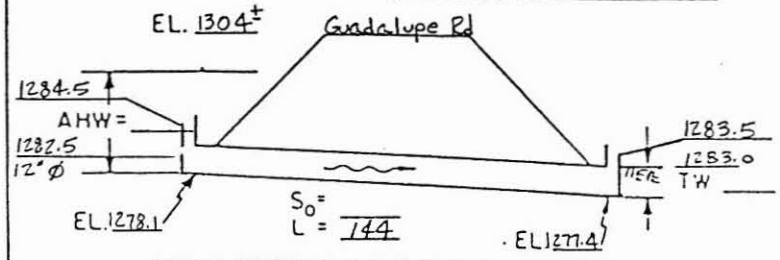
36" RCP with drop inlet structure at inlet and outlet.
12"Ø pipe at inlet

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	O inlet	~~SIZE~~ outlet	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS STORAGE AC-FT
1282.0	0	0	0			0										0
1283.5	0	0	0			0										0.551
1284.5	2	36	1.0			1.0										0.792
1285.0	4+13= 17	66	1.5			1.5										1.369
1285.5	5+36= 41	102	2.0			2.0										1.708
1286.0	5+66= 71	143	2.5			2.5										2.081

SUMMARY & RECOMMENDATIONS:

Use $Q = CLH^{3/2}$ to determine discharge into drop inlet.
L = 11' C = 3.29 for sharp crested weir.

Figure 7

DATE 10-22 1986
TIME A.M. ☐ P.M. ☐

GFRS
Drainage channel entering reservoir

The maximum discharge at cross-section 002 entering the reservoir is 45.1 cfs. A drainage channel will be constructed adjacent to the freeway to convey this runoff to the reservoir. See the attached drainage map. Part of the channel, section I, will eventually be paved with asphalt and serve as a driveway for the condominiums. The remainder of the channel, sections F and H, will be grassed. The channel has been revised to omit section G.

A. Section I

Critical depth: $\frac{Q^2}{g} = \frac{A^3}{b'}$ $\quad \frac{(45.1)^2}{32.2} = \frac{(15y_c^2)^3}{30y_c}$

by trial, $y_c = 0.89'$ $\quad V_c = 3.8$ fps

Normal depth: by Manning's, using $n = 0.035$ and $S = 0.0025'/'$
$y_n = 1.35'$ $\quad V_n = 1.6$ fps
$y_n > y_c$ ∴ subcritical flow

Assuming channel is paved, $n = 0.015$ $\quad y_n = 1.0$ $\quad V_n = 3$ fps
$y_n > y_c$ ∴ subcritical

B. Section H

Critical depth: $\frac{(45.1)^2}{32.2} = \frac{(10y_c + 3y_c^2)^3}{10 + 6y_c}$

by trial, $y_c = 0.79$ $\quad V_c = 4.6$ fps

Normal depth: by Mannings using $n = 0.035$ and $S = 0.020'/'$
$y_n = 0.80$ $\quad V_n = 4.5$ fps
$y_n > y_c$ ∴ subcritical flow

C. Section F

Critical depth: $\frac{(45.1)^2}{32.2} = \frac{(48y_c + 3y_c^2)^3}{48 + 6y_c}$

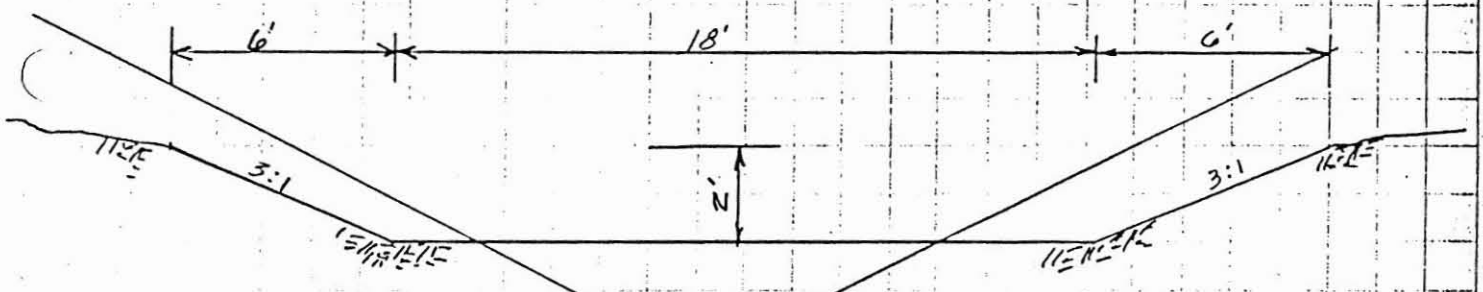
by trial, $y_c = 0.3$ $\quad V_c = 3.1$ fps

Normal depth: by Mannings using $n = 0.035$ and $S = 0.080'/'$
$y_n = 0.22'$ $\quad V_n = 4.3$ fps
$y_n < y_c$ ∴ Supercritical flow

A jump will occur at the toe of the slope at the bottom of the reservoir. Any scouring that might occur would be maintained by the golf course maintenance personnel.

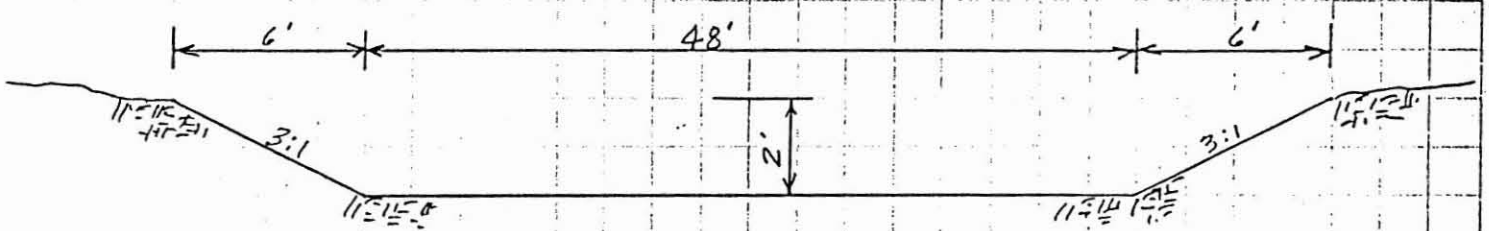
DATE 19

TIME A.M. ☐ P.M. ☐



SECTION "G"

d	A	P	$R^{2/3}$	S	$S^{1/2}$	n	V	Q
0.25	4.7	19.58	.386	0.04	0.2	.035	3.3	15
0.5	9.8	21.16	.597				5.1	49
0.75	15.2	22.74	.764				6.5	98
1.0	21	24.3	.907				7.7	162



SECTION "F"

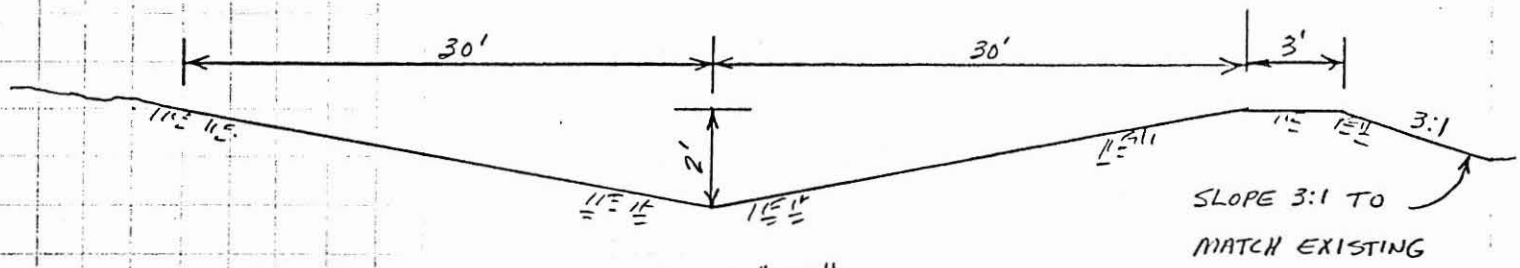
d	A	P	$R^{2/3}$	S	$S^{1/2}$	n	V	Q
0.15	7.3	48.95	.281	0.08	.283	.035	3.4	24
0.25	12.2	49.56	.392				4.7	57
0.5	24.8	51.16	.616				7.4	183

DATE 19

TIME A.M. ☐ P.M. ☐

FRS - TR-20

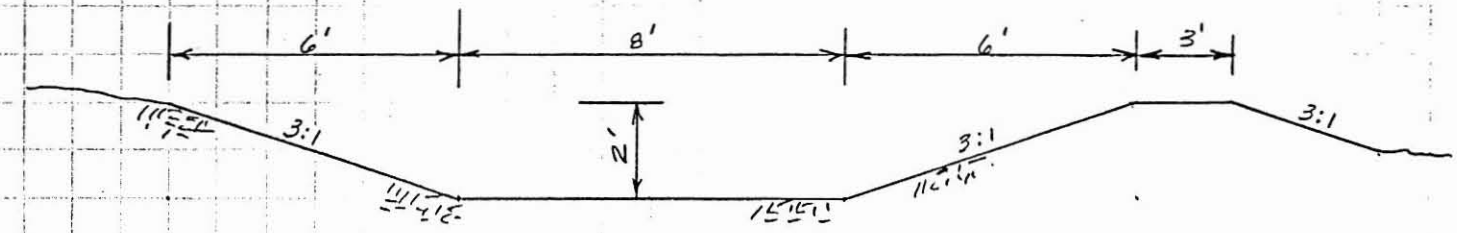
CROSS-SECTION 001



SECTION "I"

d	A	P	$R^{2/3}$	S	$S^{1/2}$	n	V	Q
0.5	3.8	15.03	.396	.0025	.05	.035	0.8	3
1.0	15	30.07	.629				1.3	20
1.5	33.8	45.1	.824				1.8	59
1.75	45.9	52.6	.913				1.9	89
2.0	60	60.1	.999				2.1	127

CROSS-SECTION 002



SECTION "H"

d	A	P	$R^{2/3}$	S	$S^{1/2}$	n	V	Q
0.5	4.8	11.16	.526	.02	.141	.035	3.4	16
1.0	11	14.32	.839				5	55
1.25	14.7	15.9	.948				5.7	84
1.5	18.8	17.49	1.047				6.3	118
1.75	23.2	19.07	1.139				6.8	159

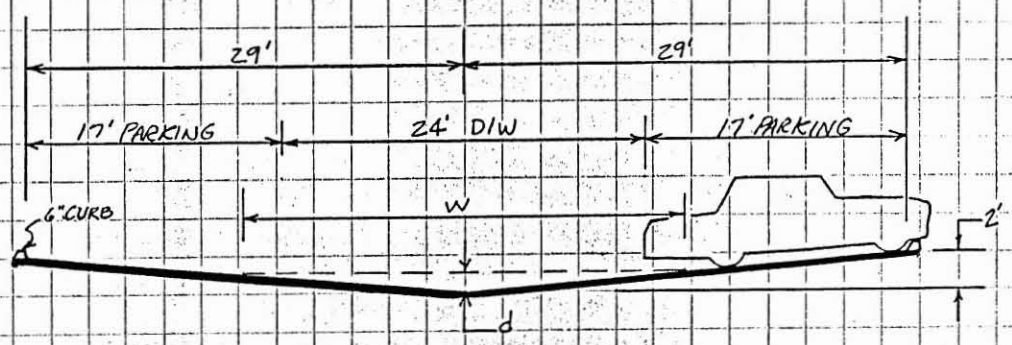
DATE 11-26 19 86

TIME A.M. ☐ P.M. ☐

GFRS

Drainage in proposed parking areas adjacent to the freeway

The calculations previously submitted for cross-section 001 and 002 show the Q_{100} to be 33 cfs and 45 cfs respectively. See page 21 of the initial report. It is intended to construct a channel adjacent to the freeway to convey this runoff to the reservoir. The calculations on page 26 of the report show that the depth of flow at section 001 will be about 1.2' and 1.35' at section 002. These channels will be constructed in approximately the same locations as the proposed parking areas for the future condominiums. Once developed, the runoff will be carried within the driveway. The driveway cross-section will be as follows:



1. Section 001, Q_{100} = 33 cfs

At d = 0.9', W = 26.1' $A = 11.75$ SF $P = 26.2$ $R = 0.449$ $R^{2/3} = 0.586$

$S = 0.0025$ $S^{1/2} = 0.05$ $n = 0.015$

$Q = 11.75 \times \frac{1.486}{.015} \times 0.586 \times 0.05 = 34.1$ cfs

$V = 2.9$ fps

Water will flow approximately 1.1' outside the limits of the driveway but will not be obstructed by the parked cars.

2. Section 002, Q_{100} = 45 cfs

At d = 1.0', W = 29' $A = 14.5$ SF $P = 29.1$ $R = 0.499$ $R^{2/3} = 0.629$

$S = 0.0025$ $S^{1/2} = 0.05$ $n = 0.015$

$Q = 14.5 \times \frac{1.486}{.015} \times 0.629 \times 0.05 = 45.2$ cfs

$V = 3.1$ fps

Water will flow approximately 2.5' outside the limits of the driveway but again will not be obstructed by the parked cars.

GOSNELL DEVELOPMENT CORPORATION

```
*****************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY*************

JOB TR-20                          FULLPRINT          SUMMARY
TITLE 002 GFRS GAR PMP
 5 RAINFL 7                  0.250
 8          0.0              0.11          0.22          0.36          0.50
 8          0.68             0.88          1.12          1.40          9.30
 8          11.10            11.90         12.60         13.17         13.60
 8          13.95            14.20         14.45         14.63         14.78
 8          14.90            14.97         14.98         14.99         15.0
 9 ENDTBL
 3 STRUCT       01
 8                           1251.0        0.0           0.0
 8                           1254.0        0.1           10.65
 8                           1256.0        0.2           23.73
 8                           1259.0        0.3           50.76
 8                           1260.0        14.0          61.44
 8                           1262.0        15.0          85.61
 8                           1264.0        16.0          113.30
 8                           1266.0        17.0          145.25
 8                           1268.0        18.0          182.26
 8                           1270.0        18.2          224.42
 8                           1272.0        18.4          272.89
 8                           1273.0        18.6          299.27
 8                           1274.0        19.0          326.71
 8                           1275.0        344.0         355.46
 8                           1276.0        1210.0        385.80
 8                           1277.0        2538.0        417.91
 8                           1278.0        4197.0        451.97
 8                           1279.0        6280.0        487.51
 8                           1280.0        8572.0        524.08
 8                           1281.0        11127.0       561.57
 9 ENDTBL
 6 RUNOFF 1     01       1 1.87          95.0          0.70          1 1 1       1
 6 RESVOR 2     01 1     2 1251.0                                    1 1 1 1     1
   ENDATA
 7 LIST
 7 INCREM 6                  0.10
 7 COMPUT 7     01     01 0.0                1.0           1.0       7 2  01   01
   ENDCMP 1
   ENDJOB 2

*****************************END OF 80-80 LIST*************************
```

```
TR20 XEQ 08-23-86  09:44          GFRS 6HR PMP
     REV PC 09/83(.2)


EXECUTIVE CONTROL OPERATION LIST


LISTING OF CURRENT DATA


                STRUCT NO.      ELEVATION    DISCHARGE      STORAGE
3 STRUCT            1

8                              1251.00          .00           .00
8                              1254.00          .10         10.65
8                              1256.00          .20         23.73
8                              1259.00          .30         50.76
8                              1260.00        14.00         61.44
8                              1262.00        15.00         85.61
8                              1264.00        16.00        113.30
8                              1266.00        17.00        145.25
8                              1268.00        18.00        182.26
8                              1270.00        18.20        224.42
8                              1272.00        18.40        272.89
8                              1273.00        18.60        299.27
8                              1274.00        19.00        326.71
8                              1275.00       344.00        355.46
8                              1276.00      1210.00        385.80
8                              1277.00      2538.00        417.91
8                              1278.00      4197.00        451.97
8                              1279.00      6280.00        487.51
8                              1280.00      8572.00        524.08
8                              1281.00     11127.00        561.57
9 ENDTBL

                     TIME INCREMENT
4 DIMHYD                   .0200

8                .0000      .0300      .1000      .1900      .3100
8                .4700      .6600      .8200      .9300      .9900
8               1.0000      .9900      .9300      .8600      .7800
8                .6800      .5600      .4600      .3900      .3300
8                .2800      .2410      .2070      .1740      .1470
8                .1260      .1070      .0910      .0770      .0660
8                .0550      .0470      .0400      .0340      .0290
8                .0250      .0210      .0180      .0150      .0130
8                .0110      .0090      .0080      .0070      .0060
8                .0050      .0040      .0030      .0020      .0010
8                .0000      .0000      .0000      .0000      .0000
```

```
TR20 XEQ 08-23-86  09:44          GFRS 6HR PMP
     REV PC 09/83(.2)

9 ENDTBL

  COMPUTED PEAK RATE FACTOR =  484.00

      TABLE NO.          TIME INCREMENT
5 RAINFL 1                        .5000

8                .0000        .0080        .0170        .0260        .0350
8                .0450        .0550        .0650        .0760        .0870
8                .0990        .1120        .1260        .1400        .1560
8                .1740        .1940        .2190        .2540        .3030
8                .5150        .5830        .6240        .6550        .6820
8                .7060        .7280        .7480        .7660        .7830
8                .7990        .8150        .8300        .8440        .8570
8                .8700        .8820        .8930        .9050        .9160
8                .9260        .9360        .9460        .9560        .9650
8                .9740        .9830        .9920       1.0000       1.0000
9 ENDTBL

      TABLE NO.          TIME INCREMENT
5 RAINFL 2                        .2500

8                .0000        .0020        .0050        .0080        .0110
8                .0140        .0170        .0200        .0230        .0260
8                .0290        .0320        .0350        .0380        .0410
8                .0440        .0480        .0520        .0560        .0600
8                .0640        .0680        .0720        .0760        .0800
8                .0850        .0900        .0950        .1000        .1050
8                .1100        .1150        .1200        .1260        .1330
8                .1400        .1470        .1550        .1630        .1720
8                .1810        .1910        .2030        .2180        .2360
8                .2570        .2830        .3870        .6630        .7070
8                .7350        .7580        .7760        .7910        .8040
8                .8150        .8250        .8340        .8420        .8490
8                .8560        .8630        .8690        .8750        .8810
8                .8870        .8930        .8980        .9030        .9080
8                .9130        .9180        .9220        .9260        .9300
8                .9340        .9380        .9420        .9460        .9500
8                .9530        .9560        .9590        .9620        .9650
8                .9680        .9710        .9740        .9770        .9800
8                .9830        .9860        .9890        .9920        .9950
8                .9980       1.0000       1.0000       1.0000       1.0000
9 ENDTBL
```

```
TR20 XEQ 08-23-86  09:44          GFRS 6HR PMP
     REV PC 09/83(.2)

     TABLE NO.          TIME INCREMENT
5 RAINFL 3                    .5000

8                  .0000      .0100      .0220      .0360      .0510
8                  .0670      .0830      .0990      .1160      .1350
8                  .1560      .1790      .2040      .2330      .2680
8                  .3100      .4250      .4800      .5200      .5500
8                  .5770      .6010      .6230      .6440      .6640
8                  .6830      .7010      .7190      .7360      .7530
8                  .7690      .7850      .8000      .8150      .8300
8                  .8440      .8580      .8710      .8840      .8960
8                  .9080      .9200      .9320      .9440      .9560
8                  .9670      .9780      .9890     1.0000     1.0000
9 ENDTBL

     TABLE NO.          TIME INCREMENT
5 RAINFL 4                    .5000

8                  .0000      .0040      .0080      .0120      .0160
8                  .0200      .0250      .0300      .0350      .0400
8                  .0450      .0500      .0550      .0600      .0650
8                  .0700      .0750      .0810      .0870      .0930
8                  .0990      .1050      .1110      .1180      .1250
8                  .1320      .1400      .1480      .1560      .1650
8                  .1740      .1840      .1950      .2070      .2200
8                  .2360      .2550      .2770      .3030      .4090
8                  .5150      .5490      .5830      .6050      .6240
8                  .6400      .6550      .6690      .6820      .6940
8                  .7050      .7160      .7270      .7380      .7480
8                  .7580      .7670      .7760      .7840      .7920
8                  .8000      .8080      .8160      .8230      .8300
8                  .8370      .8440      .8510      .8580      .8640
8                  .8700      .8760      .8820      .8880      .8940
8                  .9000      .9060      .9110      .9160      .9210
8                  .9260      .9310      .9360      .9410      .9460
8                  .9510      .9560      .9610      .9660      .9710
8                  .9760      .9800      .9840      .9880      .9920
8                  .9960     1.0000     1.0000     1.0000     1.0000
9 ENDTBL

     TABLE NO.          TIME INCREMENT
5 RAINFL 5                    .5000

8                  .0000      .0020      .0050      .0080      .0110
8                  .0140      .0170      .0200      .0230      .0260
```

```
TR20 XEQ 08-23-86  09:44          GFRS 6HR PMP
     REV PC 09/83(.2)

 8                .0290        .0320        .0350        .0380        .0410
 8                .0440        .0470        .0510        .0550        .0590
 8                .0630        .0670        .0710        .0750        .0790
 8                .0840        .0890        .0940        .0990        .1040
 8                .1090        .1140        .1200        .1260        .1330
 8                .1400        .1470        .1540        .1620        .1710
 8                .1810        .1920        .2040        .2170        .2330
 8                .2520        .2770        .3180        .6380        .6980
 8                .7290        .7520        .7700        .7850        .7980
 8                .8090        .8190        .8290        .8380        .8460
 8                .8540        .8610        .8680        .8740        .8800
 8                .8860        .8920        .8970        .9020        .9070
 8                .9120        .9170        .9210        .9250        .9290
 8                .9330        .9370        .9410        .9450        .9490
 8                .9530        .9570        .9600        .9630        .9660
 8                .9690        .9720        .9750        .9780        .9810
 8                .9840        .9870        .9900        .9930        .9960
 8                .9980       1.0000       1.0000       1.0000       1.0000
 9 ENDTBL

     TABLE NO.          TIME INCREMENT
 5 RAINFL 6                      .0200

 8                .0000        .0080        .0162        .0246        .0333
 8                .0425        .0524        .0630        .0743        .0863
 8                .0990        .1124        .1265        .1420        .1595
 8                .1800        .2050        .2550        .3450        .4370
 8                .5300        .6030        .6330        .6600        .6840
 8                .7050        .7240        .7420        .7590        .7750
 8                .7900        .8043        .8180        .8312        .8439
 8                .8561        .8678        .8790        .8898        .9002
 8                .9103        .9201        .9297        .9391        .9483
 8                .9573        .9661        .9747        .9832        .9916
 8               1.0000       1.0000       1.0000       1.0000       1.0000
 9 ENDTBL

     TABLE NO.          TIME INCREMENT
 5 RAINFL 7                      .2500

 8                .0000        .1100        .2200        .3600        .5000
 8                .6800        .8800       1.1200       1.4000       9.3000
 8              11.1000      11.9000      12.6000      13.1700      13.6000
 8              13.9500      14.2000      14.4500      14.6300      14.7800
 8              14.9000      14.9700      14.9800      14.9900      15.0000
 9 ENDTBL
```

```
TR20 XEQ 08-23-86  09:44          GFRS 6HR PMP
     REV PC 09/83(.2)

                    STANDARD CONTROL INSTRUCTIONS

 6 RUNOFF 1      1      1        1.8700      95.0000        .70001 1 1 1 0 1
 5 RESVOR 2      1 1    2     1251.0000                          1 1 1 1 0 1
   ENDATA

END OF LISTING
```

EXECUTIVE CONTROL OPERATION INCREM MAIN TIME INCREMENT = .10 HOURS RECORD ID

EXECUTIVE CONTROL OPERATION COMPUT FROM STRUCTURE 1 TO STRUCTURE 1 RECORD ID
STARTING TIME = .00 RAIN DEPTH = 1.00 RAIN DURATION= 1.00 RAIN TABLE NO.= 7 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF STRUCTURE 1
OUTPUT HYDROGRAPH= 1
AREA= 1.87 SQ MI INPUT RUNOFF CURVE= 95. TIME OF CONCENTRATION= .70 HOURS
INTERNAL HYDROGRAPH TIME INCREMENT= .0933 HOURS

PEAK TIME(HRS) 2.61 PEAK DISCHARGE(CFS) 16572.54 PEAK ELEVATION(FEET) (RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = 1.87 SQ.MI.

.00	DISCHG	.00	.00	.02	.39	2.69	9.93	26.10	53.82	93.19	141.44
.00	ELEV	1251.00	1251.00	1251.49	1259.01	1259.17	1259.70	1274.02	1274.11	1274.23	1274.38
1.00	DISCHG	194.31	249.37	306.61	367.72	432.32	498.49	566.05	634.90	706.79	782.23
1.00	ELEV	1274.54	1274.71	1274.88	1275.03	1275.10	1275.18	1275.26	1275.34	1275.42	1275.51
2.00	DISCHG	989.39	1829.29	4063.50	7900.12	12286.82	15476.94	16567.86	15744.63	13626.99	11124.76
2.00	ELEV	1275.75	1276.47	1277.92	1279.71	1281.45	1282.70	1283.13	1282.81	1281.98	1281.00
3.00	DISCHG	9069.32	7489.68	6267.28	5328.07	4598.49	4006.74	3515.93	3105.48	2757.59	2458.52
3.00	ELEV	1280.19	1279.53	1278.99	1278.54	1278.19	1277.89	1277.59	1277.34	1277.13	1276.94
4.00	DISCHG	2197.86	1966.65	1765.89	1596.09	1454.91	1337.97	1234.02	1134.75	1040.71	953.87
4.00	ELEV	1276.74	1276.57	1276.42	1276.29	1276.18	1276.10	1276.02	1275.91	1275.80	1275.70
5.00	DISCHG	874.55	799.59	725.77	648.79	566.44	478.39	387.66	303.90	233.92	179.26
5.00	ELEV	1275.61	1275.53	1275.44	1275.35	1275.26	1275.16	1275.05	1274.88	1274.66	1274.49
6.00	DISCHG	139.67	111.26	89.10	70.01	53.24	39.03	27.63	19.10	13.12	8.96
6.00	ELEV	1274.37	1274.28	1274.22	1274.16	1274.11	1274.06	1274.03	1274.00	1259.94	1259.63
7.00	DISCHG	6.04	4.06	2.67	1.73	1.10	.71	.47	.32	.20	.13
7.00	ELEV	1259.42	1259.27	1259.17	1259.10	1259.06	1259.03	1259.01	1259.00	1256.14	1254.52
8.00	DISCHG	.07	.03	.01	.00						
8.00	ELEV	1253.08	1251.89	1251.20	1251.01						

RUNOFF VOLUME ABOVE BASEFLOW = 14.40 WATERSHED INCHES, 17373.37 CFS-HRS. 1435.74 ACRE-FEET; BASEFLOW = .00 CFS

OPERATION RESVOR STRUCTURE 1
INPUT HYDROGRAPH= 1 OUTPUT HYDROGRAPH= 2
SURFACE ELEVATION= 1251.00

PEAK TIME(HRS) 2.89 PEAK DISCHARGE(CFS) 11812.39 PEAK ELEVATION(FEET) 1281.27

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = 1.87 SQ.MI.

.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.01	.01	.02
.00	ELEV	1251.00	1251.00	1251.00	1251.00	1251.00	1251.00	1251.00	1251.15	1251.33	1251.60

1.00	DISCHG	.03	.05	.07	.10	.12	.15	.19	.21	.23	.26
1.00	ELEV	1251.99	1252.51	1253.15	1253.94	1254.47	1255.06	1255.73	1256.36	1256.97	1257.55
2.00	DISCHG	.28	9.02	14.84	16.56	18.15	43.30	3863.87	8741.39	11353.80	11802.97
2.00	ELEV	1258.47	1259.64	1261.69	1265.12	1269.52	1274.07	1277.80	1280.07	1281.09	1281.26
3.00	DISCHG	11053.26	9834.27	8537.62	7410.36	6403.58	5577.88	4869.53	4261.68	3806.85	3405.13
3.00	ELEV	1280.97	1280.49	1279.98	1279.49	1279.05	1278.66	1278.32	1278.03	1277.76	1277.52
4.00	DISCHG	3044.25	2721.88	2448.42	2224.40	2020.38	1838.25	1677.04	1533.23	1403.18	1284.70
4.00	ELEV	1277.31	1277.11	1276.93	1276.76	1276.61	1276.47	1276.35	1276.24	1276.15	1276.06
5.00	DISCHG	1185.82	1112.23	1038.47	964.37	889.09	811.72	731.81	650.36	569.87	493.22
5.00	ELEV	1275.97	1275.89	1275.80	1275.72	1275.63	1275.54	1275.45	1275.35	1275.26	1275.17
6.00	DISCHG	422.79	360.05	327.60	305.46	283.69	262.49	242.04	222.52	204.10	186.86
6.00	ELEV	1275.09	1275.02	1274.95	1274.88	1274.81	1274.75	1274.69	1274.63	1274.57	1274.52
7.00	DISCHG	170.86	156.06	142.43	129.91	118.44	107.95	98.37	89.62	81.65	74.38
7.00	ELEV	1274.47	1274.42	1274.38	1274.34	1274.31	1274.27	1274.24	1274.22	1274.19	1274.17
8.00	DISCHG	67.75	61.70	56.20	51.18	46.61	42.45	38.66	35.21	32.07	29.21
8.00	ELEV	1274.15	1274.13	1274.11	1274.10	1274.08	1274.07	1274.06	1274.05	1274.04	1274.03
9.00	DISCHG	26.60	24.23	22.06	20.10	19.00	19.00	18.99	18.99	18.99	18.99
9.00	ELEV	1274.02	1274.02	1274.01	1274.00	1274.00	1273.99	1273.99	1273.98	1273.97	1273.97
10.00	DISCHG	18.99	18.98	18.98	18.98	18.98	18.97	18.97	18.97	18.97	18.96
10.00	ELEV	1273.96	1273.96	1273.95	1273.95	1273.94	1273.93	1273.93	1273.92	1273.92	1273.91
11.00	DISCHG	18.96	18.96	18.96	18.96	18.95	18.95	18.95	18.95	18.94	18.94
11.00	ELEV	1273.91	1273.90	1273.89	1273.89	1273.88	1273.88	1273.87	1273.87	1273.86	1273.85
12.00	DISCHG	18.94	18.94	18.94	18.93	18.93	18.93	18.93	18.92	18.92	18.92
12.00	ELEV	1273.85	1273.84	1273.84	1273.83	1273.83	1273.82	1273.81	1273.81	1273.80	1273.80
13.00	DISCHG	18.92	18.91	18.91	18.91	18.91	18.91	18.90	18.90	18.90	18.90
13.00	ELEV	1273.79	1273.79	1273.78	1273.78	1273.77	1273.76	1273.76	1273.75	1273.75	1273.74
14.00	DISCHG	18.89	18.89	18.89	18.89	18.88	18.88	18.88	18.88	18.88	18.87
14.00	ELEV	1273.74	1273.73	1273.72	1273.72	1273.71	1273.71	1273.70	1273.70	1273.69	1273.68
15.00	DISCHG	18.87	18.87	18.87	18.86	18.86	18.86	18.86	18.86	18.85	18.85
15.00	ELEV	1273.68	1273.67	1273.67	1273.66	1273.66	1273.65	1273.64	1273.64	1273.63	1273.63
16.00	DISCHG	18.85	18.85	18.84	18.84	18.84	18.84	18.83	18.83	18.83	18.83
16.00	ELEV	1273.62	1273.62	1273.61	1273.60	1273.60	1273.59	1273.59	1273.58	1273.58	1273.57
17.00	DISCHG	18.83	18.82	18.82	18.82	18.82	18.81	18.81	18.81	18.81	18.81
17.00	ELEV	1273.56	1273.56	1273.55	1273.55	1273.54	1273.54	1273.53	1273.53	1273.52	1273.51
18.00	DISCHG	18.80	18.80	18.80	18.80	18.79	18.79	18.79	18.79	18.79	18.78
18.00	ELEV	1273.51	1273.50	1273.50	1273.49	1273.49	1273.48	1273.47	1273.47	1273.46	1273.46
19.00	DISCHG	18.78	18.78	18.78	18.77	18.77	18.77	18.77	18.76	18.76	18.76
19.00	ELEV	1273.45	1273.45	1273.44	1273.43	1273.43	1273.42	1273.42	1273.41	1273.41	1273.40
20.00	DISCHG	18.76	18.76	18.75	18.75	18.75	18.75	18.74	18.74	18.74	18.74
20.00	ELEV	1273.39	1273.39	1273.38	1273.38	1273.37	1273.37	1273.36	1273.36	1273.35	1273.34
21.00	DISCHG	18.74	18.73	18.73	18.73	18.73	18.72	18.72	18.72	18.72	18.72
21.00	ELEV	1273.34	1273.33	1273.33	1273.32	1273.32	1273.31	1273.30	1273.30	1273.29	1273.29
22.00	DISCHG	18.71	18.71	18.71	18.71	18.70	18.70	18.70	18.70	18.69	18.69
22.00	ELEV	1273.28	1273.28	1273.27	1273.27	1273.26	1273.25	1273.25	1273.24	1273.24	1273.23
23.00	DISCHG	18.69	18.69	18.69	18.68	18.68	18.68	18.68	18.67	18.67	18.67
23.00	ELEV	1273.23	1273.22	1273.21	1273.21	1273.20	1273.20	1273.19	1273.19	1273.18	1273.18
24.00	DISCHG	18.67	18.67	18.66	18.66	18.66	18.66	18.65	18.65	18.65	18.65
24.00	ELEV	1273.17	1273.16	1273.16	1273.15	1273.15	1273.14	1273.14	1273.13	1273.12	1273.12
25.00	DISCHG	18.65	18.64	18.64	18.64	18.64	18.63	18.63	18.63	18.63	18.63

45.

25.00	ELEV	1273.11	1273.11	1273.10	1273.10	1273.09	1273.09	1273.08	1273.07	1273.07	1273.06
26.00	DISCHG	18.62	18.62	18.62	18.62	18.61	18.61	18.61	18.61	18.60	18.60
26.00	ELEV	1273.06	1273.05	1273.05	1273.04	1273.03	1273.03	1273.02	1273.02	1273.01	1273.01
27.00	DISCHG	18.60	18.60	18.60	18.60	18.60	18.59	18.59	18.59	18.59	18.59
27.00	ELEV	1273.00	1273.00	1272.99	1272.98	1272.98	1272.97	1272.97	1272.96	1272.95	1272.95
28.00	DISCHG	18.59	18.59	18.59	18.59	18.58	18.58	18.58	18.58	18.58	18.58
28.00	ELEV	1272.94	1272.94	1272.93	1272.93	1272.92	1272.91	1272.91	1272.90	1272.90	1272.89
29.00	DISCHG	18.58	18.58	18.57	18.57	18.57	18.57	18.57	18.57	18.57	18.57
29.00	ELEV	1272.88	1272.88	1272.87	1272.87	1272.86	1272.86	1272.85	1272.84	1272.84	1272.83

RUNOFF VOLUME ABOVE BASEFLOW = 11.43 WATERSHED INCHES, 13792.51 CFS-HRS, 1139.81 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP COMPUTATIONS COMPLETED FOR PASS 1 RECORD ID

EXECUTIVE CONTROL OPERATION ENDJOB RECORD ID

46.

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1													
STRUCTURE 1	RUNOFF	1.87	7	2	.10	.0	15.00	6.00	14.40	---	2.61	16572.54	8862.3
STRUCTURE 1	RESVOR	1.87	7	2	.10	.0	15.00	6.00	11.43	1281.27	2.89	11812.39	6316.8

47

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1
STRUCTURE 1	1.87	
ALTERNATE 1		11812.39

48.

```
*****************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY*************
JOB TR-20                          FULLPRINT          SUMMARY
TITLE 003 GFRS 100YR+100YR
 5 RAINFL 7                0.250
 8          0.0            0.11          0.22          0.36          0.50
 8          0.68           0.88          1.12          1.40          9.30
 8          11.10          11.90         12.60         13.17         13.60
 8          13.95          14.20         14.45         14.63         14.78
 8          14.90          14.97         14.98         14.99         15.0
 9 ENDTBL
 3 STRUCT       01
 8                         1251.0        0.0           0.0
 8                         1254.0        0.1           10.65
 8                         1256.0        0.2           23.73
 8                         1259.0        0.3           50.76
 8                         1260.0        14.0          61.44
 8                         1262.0        15.0          85.61
 8                         1264.0        16.0          113.30
 8                         1266.0        17.0          145.25
 8                         1268.0        18.0          182.26
 8                         1270.0        18.2          224.42
 8                         1272.0        18.4          272.89
 8                         1273.0        18.6          299.27
 8                         1274.0        19.0          326.71
 8                         1275.0        344.0         355.46
 8                         1276.0        1210.0        385.80
 8                         1277.0        2538.0        417.91
 8                         1278.0        4197.0        451.97
 8                         1279.0        6280.0        487.51
 8                         1280.0        8572.0        524.08
 8                         1281.0        11127.0       561.57
 9 ENDTBL
 6 RESVOR 2     01 1    2 1274.0                                  1 1 1 1   1
   ENDATA
 7 LIST
 7 INCREM 6                0.10
 7 READHD 8       1
 7 READHD 9 0.0            0.2           1.87          0.0
 8          0.0            0.0           0.0           0.0           0.0
 8          0.0            0.0           0.0           0.0           0.0
 8          0.0            0.0           0.0           0.0           0.0
 8          0.0            0.0           0.0           0.0           1.0
 8          2.0            4.0           6.0           8.0           10.0
 8          12.0           14.0          16.0          18.0          20.0
 8          22.0           24.0          27.0          31.0          34.0
 8          36.0           39.0          40.0          42.0          44.0
 8          46.0           48.0          53.0          60.0          67.0
```

```
*********************80-80 LIST OF INPUT DATA (CONTINUED)*****************

8          72.0        77.0        83.0        89.0        96.0
8         104.0       111.0       120.0       134.0       156.0
8         186.0       221.0       260.0       329.0       605.0
8        1415.0      2550.0      2383.0      1648.0      1061.0
8         737.0       542.0       418.0       340.0       284.0
8         243.0       213.0       192.0       175.0       159.0
8         146.0       138.0       133.0       127.0       120.0
8         115.0       114.0       113.0       112.0       109.0
8         103.0        98.0        96.0        95.0        94.0
8          92.0        86.0        80.0        78.0        76.0
8          76.0        75.0        75.0        75.0        75.0
8          73.0        67.0        62.0        59.0        58.0
8          57.0        57.0        56.0        56.0        56.0
8          56.0        56.0        56.0        56.0        56.0
8          56.0        56.0        56.0        56.0        56.0
8          54.0        46.0        30.0        16.0         8.0
8           4.0         4.0         4.0         4.0         4.0
9 ENDTBL
7 COMPUT 7     01     01 0.0            4.0          24.0     6 2  01   01
  ENDCMP 1
  ENDJOB 2

*****************************END OF 80-80 LIST*****************************
```

TR20 XEQ 08-26-86 09:21 GFRS 100YR+100YR
REV PC 09/83(.2)

EXECUTIVE CONTROL OPERATION LIST

LISTING OF CURRENT DATA

	STRUCT NO.	ELEVATION	DISCHARGE	STORAGE
3 STRUCT	1			
8		1251.00	.00	.00
8		1254.00	.10	10.65
8		1256.00	.20	23.73
8		1259.00	.30	50.76
8		1260.00	14.00	61.44
8		1262.00	15.00	85.61
8		1264.00	16.00	113.30
8		1266.00	17.00	145.25
8		1268.00	18.00	182.26
8		1270.00	18.20	224.42
8		1272.00	18.40	272.89
8		1273.00	18.60	299.27
8		1274.00	19.00	326.71
8		1275.00	344.00	355.46
8		1276.00	1210.00	385.80
8		1277.00	2538.00	417.91
8		1278.00	4197.00	451.97
8		1279.00	6280.00	487.51
8		1280.00	8572.00	524.08
8		1281.00	11127.00	561.57
9 ENDTBL				

	TIME INCREMENT				
4 DIMHYD		.0200			
8	.0000	.0300	.1000	.1900	.3100
8	.4700	.6600	.8200	.9300	.9900
8	1.0000	.9900	.9300	.8600	.7800
8	.6800	.5600	.4600	.3900	.3300
8	.2800	.2410	.2070	.1740	.1470
8	.1260	.1070	.0910	.0770	.0660
8	.0550	.0470	.0400	.0340	.0290
8	.0250	.0210	.0180	.0150	.0130
8	.0110	.0090	.0080	.0070	.0060
8	.0050	.0040	.0030	.0020	.0010
8	.0000	.0000	.0000	.0000	.0000

```
TR20 XEQ 08-26-86  09:21          GFRS 100YR+100YR
     REV PC 09/83(.2)

 9 ENDTBL

   COMPUTED PEAK RATE FACTOR =  484.00

      TABLE NO.          TIME INCREMENT
 5 RAINFL 1                      .5000

 8                .0000       .0080       .0170       .0260       .0350
 8                .0450       .0550       .0650       .0760       .0870
 8                .0990       .1120       .1260       .1400       .1560
 8                .1740       .1940       .2190       .2540       .3030
 8                .5150       .5830       .6240       .6550       .6820
 8                .7060       .7280       .7480       .7660       .7830
 8                .7990       .8150       .8300       .8440       .8570
 8                .8700       .8820       .8930       .9050       .9160
 8                .9260       .9360       .9460       .9560       .9650
 8                .9740       .9830       .9920      1.0000      1.0000
 9 ENDTBL

      TABLE NO.          TIME INCREMENT
 5 RAINFL 2                      .2500

 8                .0000       .0020       .0050       .0080       .0110
 8                .0140       .0170       .0200       .0230       .0260
 8                .0290       .0320       .0350       .0380       .0410
 8                .0440       .0480       .0520       .0560       .0600
 8                .0640       .0680       .0720       .0760       .0800
 8                .0850       .0900       .0950       .1000       .1050
 8                .1100       .1150       .1200       .1260       .1330
 8                .1400       .1470       .1550       .1630       .1720
 8                .1810       .1910       .2030       .2180       .2360
 8                .2570       .2830       .3870       .6630       .7070
 8                .7350       .7580       .7760       .7910       .8040
 8                .8150       .8250       .8340       .8420       .8490
 8                .8560       .8630       .8690       .8750       .8810
 8                .8870       .8930       .8980       .9030       .9080
 8                .9130       .9180       .9220       .9260       .9300
 8                .9340       .9380       .9420       .9460       .9500
 8                .9530       .9560       .9590       .9620       .9650
 8                .9680       .9710       .9740       .9770       .9800
 8                .9830       .9860       .9890       .9920       .9950
 8                .9980      1.0000      1.0000      1.0000      1.0000
 9 ENDTBL
```

```
TR20 XEQ 08-26-86  09:21          GFRS 100YR+100YR
     REV PC 09/83(.2)

     TABLE NO.          TIME INCREMENT
5 RAINFL 3                    .5000

8                  .0000      .0100      .0220      .0360      .0510
8                  .0670      .0830      .0990      .1160      .1350
8                  .1560      .1790      .2040      .2330      .2680
8                  .3100      .4250      .4800      .5200      .5500
8                  .5770      .6010      .6230      .6440      .6640
8                  .6830      .7010      .7190      .7360      .7530
8                  .7690      .7850      .8000      .8150      .8300
8                  .8440      .8580      .8710      .8840      .8960
8                  .9080      .9200      .9320      .9440      .9560
8                  .9670      .9780      .9890     1.0000     1.0000
9 ENDTBL

     TABLE NO.          TIME INCREMENT
5 RAINFL 4                    .5000

8                  .0000      .0040      .0080      .0120      .0160
8                  .0200      .0250      .0300      .0350      .0400
8                  .0450      .0500      .0550      .0600      .0650
8                  .0700      .0750      .0810      .0870      .0930
8                  .0990      .1050      .1110      .1180      .1250
8                  .1320      .1400      .1480      .1560      .1650
8                  .1740      .1840      .1950      .2070      .2200
8                  .2360      .2550      .2770      .3030      .4090
8                  .5150      .5490      .5830      .6050      .6240
8                  .6400      .6550      .6690      .6820      .6940
8                  .7050      .7160      .7270      .7380      .7480
8                  .7580      .7670      .7760      .7840      .7920
8                  .8000      .8080      .8160      .8230      .8300
8                  .8370      .8440      .8510      .8580      .8640
8                  .8700      .8760      .8820      .8880      .8940
8                  .9000      .9060      .9110      .9160      .9210
8                  .9260      .9310      .9360      .9410      .9460
8                  .9510      .9560      .9610      .9660      .9710
8                  .9760      .9800      .9840      .9880      .9920
8                  .9960     1.0000     1.0000     1.0000     1.0000
9 ENDTBL

     TABLE NO.          TIME INCREMENT
5 RAINFL 5                    .5000

8                  .0000      .0020      .0050      .0080      .0110
8                  .0140      .0170      .0200      .0230      .0260
```

```
TR20 XEQ 08-26-86  09:21          GFRS 100YR+100YR
     REV PC 09/83(.2)

8                .0290        .0320        .0350        .0380        .0410
8                .0440        .0470        .0510        .0550        .0590
8                .0630        .0670        .0710        .0750        .0790
8                .0840        .0890        .0940        .0990        .1040
8                .1090        .1140        .1200        .1260        .1330
8                .1400        .1470        .1540        .1620        .1710
8                .1810        .1920        .2040        .2170        .2330
8                .2520        .2770        .3180        .6380        .6980
8                .7290        .7520        .7700        .7850        .7980
8                .8090        .8190        .8290        .8380        .8460
8                .8540        .8610        .8680        .8740        .8800
8                .8860        .8920        .8970        .9020        .9070
8                .9120        .9170        .9210        .9250        .9290
8                .9330        .9370        .9410        .9450        .9490
8                .9530        .9570        .9600        .9630        .9660
8                .9690        .9720        .9750        .9780        .9810
8                .9840        .9870        .9900        .9930        .9960
8                .9980       1.0000       1.0000       1.0000       1.0000
9 ENDTBL

     TABLE NO.        TIME INCREMENT
5 RAINFL 6                   .0200

8                .0000        .0080        .0162        .0246        .0333
8                .0425        .0524        .0630        .0743        .0863
8                .0990        .1124        .1265        .1420        .1595
8                .1800        .2050        .2550        .3450        .4370
8                .5300        .6030        .6330        .6600        .6840
8                .7050        .7240        .7420        .7590        .7750
8                .7900        .8043        .8180        .8312        .8439
8                .8561        .8678        .8790        .8898        .9002
8                .9103        .9201        .9297        .9391        .9483
8                .9573        .9661        .9747        .9832        .9916
8               1.0000       1.0000       1.0000       1.0000       1.0000
9 ENDTBL

     TABLE NO.        TIME INCREMENT
5 RAINFL 7                   .2500

8                .0000        .1100        .2200        .3600        .5000
8                .6800        .8800       1.1200       1.4000       9.3000
8              11.1000      11.9000      12.6000      13.1700      13.6000
8              13.9500      14.2000      14.4500      14.6300      14.7800
8              14.9000      14.9700      14.9800      14.9900      15.0000
9 ENDTBL
```

```
TR20 XEQ 08-26-86  09:21          GFRS 100YR+100YR
     REV PC 09/83(.2)

                    STANDARD CONTROL INSTRUCTIONS

 C RESVOR 2      1 1    2     1274.0000                          1 1 1 1 0 1
   ENDATA

END OF LISTING
```

EXECUTIVE CONTROL OPERATION INCREM MAIN TIME INCREMENT = .10 HOURS RECORD ID

EXECUTIVE CONTROL OPERATION READHD DISCHARGE HYDROGRAPH, HYDROGRAPH LOCATION 1 RECORD ID

STARTING TIME= .00 TIME INCREMENT= .20 DRAINAGE AREA= 1.87 BASE FLOW= .00

8	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	1.00
8	2.00	4.00	6.00	8.00	10.00
8	12.00	14.00	16.00	18.00	20.00
8	22.00	24.00	27.00	31.00	34.00
8	36.00	39.00	40.00	42.00	44.00
8	46.00	48.00	53.00	60.00	67.00
8	72.00	77.00	83.00	89.00	96.00
8	104.00	111.00	120.00	134.00	156.00
8	186.00	221.00	260.00	329.00	605.00
8	1415.00	2550.00	2383.00	1648.00	1061.00
8	737.00	542.00	418.00	340.00	284.00
8	243.00	213.00	192.00	175.00	159.00
8	146.00	138.00	133.00	127.00	120.00
8	116.00	114.00	113.00	112.00	109.00
8	103.00	98.00	96.00	95.00	94.00
8	92.00	86.00	80.00	78.00	76.00
8	76.00	75.00	75.00	75.00	75.00
8	73.00	67.00	62.00	59.00	58.00
8	57.00	57.00	56.00	56.00	56.00
8	56.00	56.00	56.00	56.00	56.00
8	56.00	56.00	56.00	56.00	56.00
8	54.00	46.00	30.00	16.00	8.00
8	4.00	4.00	4.00	4.00	4.00

9 ENDTBL

EXECUTIVE CONTROL OPERATION COMPUT FROM STRUCTURE 1 TO STRUCTURE 1 RECORD ID
STARTING TIME = .00 RAIN DEPTH = 4.00 RAIN DURATION= 24.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RESVOR STRUCTURE 1
INPUT HYDROGRAPH= 1 OUTPUT HYDROGRAPH= 2
SURFACE ELEVATION= 1274.00

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
12.55	1835.08	1276.47

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = 1.97 SQ.MI.

.00	DISCHG	19.00	19.00	19.00	18.99	18.99	18.99	18.99	18.98	18.98	18.98
.00	ELEV	1274.00	1273.99	1273.99	1273.98	1273.98	1273.97	1273.97	1273.96	1273.95	1273.95
1.00	DISCHG	18.98	18.97	18.97	18.97	18.97	18.97	18.96	18.96	18.96	18.96
1.00	ELEV	1273.94	1273.94	1273.93	1273.93	1273.92	1273.91	1273.91	1273.90	1273.90	1273.89
2.00	DISCHG	18.95	18.95	18.95	18.95	18.95	18.94	18.94	18.94	18.94	18.93
2.00	ELEV	1273.89	1273.88	1273.87	1273.87	1273.86	1273.86	1273.85	1273.85	1273.84	1273.83
3.00	DISCHG	18.93	18.93	18.93	18.92	18.92	18.92	18.92	18.92	18.91	18.91
3.00	ELEV	1273.83	1273.82	1273.82	1273.81	1273.81	1273.80	1273.79	1273.79	1273.78	1273.78
4.00	DISCHG	18.91	18.91	18.91	18.90	18.90	18.90	18.90	18.90	18.90	18.90
4.00	ELEV	1273.77	1273.77	1273.76	1273.76	1273.75	1273.75	1273.75	1273.74	1273.74	1273.74
5.00	DISCHG	18.89	18.89	18.89	18.89	18.89	18.89	18.89	18.89	18.89	18.89
5.00	ELEV	1273.74	1273.74	1273.73	1273.73	1273.73	1273.73	1273.73	1273.73	1273.73	1273.73
6.00	DISCHG	18.89	18.89	18.89	18.89	18.90	18.90	18.90	18.90	18.90	18.90
6.00	ELEV	1273.73	1273.73	1273.73	1273.74	1273.74	1273.74	1273.74	1273.75	1273.75	1273.76
7.00	DISCHG	18.90	18.91	18.91	18.91	18.91	18.92	18.92	18.92	18.93	18.93
7.00	ELEV	1273.75	1273.77	1273.77	1273.78	1273.79	1273.79	1273.80	1273.81	1273.81	1273.82
8.00	DISCHG	18.93	18.93	18.94	18.94	18.95	18.95	18.95	18.96	18.97	18.97
8.00	ELEV	1273.83	1273.84	1273.85	1273.85	1273.86	1273.88	1273.89	1273.90	1273.91	1273.93
9.00	DISCHG	18.98	18.98	18.99	19.00	23.40	28.85	34.09	39.14	44.06	48.88
9.00	ELEV	1273.94	1273.96	1273.98	1274.00	1274.01	1274.03	1274.05	1274.06	1274.08	1274.09
10.00	DISCHG	53.62	58.27	62.82	67.32	71.82	76.44	81.26	86.46	92.18	98.54
10.00	ELEV	1274.11	1274.12	1274.13	1274.15	1274.16	1274.18	1274.19	1274.21	1274.23	1274.24
11.00	DISCHG	105.68	113.63	122.43	132.10	142.65	154.66	168.68	189.15	220.11	272.55
11.00	ELEV	1274.27	1274.29	1274.32	1274.35	1274.38	1274.42	1274.46	1274.52	1274.62	1274.78
12.00	DISCHG	373.43	653.10	993.49	1352.65	1665.60	1821.36	1824.37	1730.03	1577.56	1403.11
12.00	ELEV	1275.03	1275.36	1275.75	1276.11	1276.34	1276.46	1276.46	1276.39	1276.28	1276.15
13.00	DISCHG	1232.31	1111.32	1001.47	897.98	803.24	717.83	642.22	575.50	516.94	465.63
13.00	ELEV	1276.02	1275.89	1275.76	1275.64	1275.53	1275.43	1275.34	1275.27	1275.20	1275.14
14.00	DISCHG	420.81	381.71	347.69	333.07	320.95	309.06	297.47	286.18	275.19	264.53
14.00	ELEV	1275.09	1275.04	1275.00	1274.97	1274.93	1274.89	1274.86	1274.82	1274.79	1274.76
15.00	DISCHG	254.24	244.40	235.08	226.30	218.09	210.36	203.05	196.11	189.47	183.18
15.00	ELEV	1274.72	1274.69	1274.66	1274.64	1274.61	1274.59	1274.57	1274.54	1274.52	1274.51
16.00	DISCHG	177.27	171.76	166.65	161.93	157.58	153.58	149.89	146.44	143.17	139.98
16.00	ELEV	1274.49	1274.47	1274.45	1274.44	1274.43	1274.41	1274.40	1274.39	1274.38	1274.37
17.00	DISCHG	136.82	133.69	130.61	127.66	124.88	122.28	119.86	117.62	115.54	113.57
17.00	ELEV	1274.36	1274.35	1274.34	1274.33	1274.33	1274.32	1274.31	1274.30	1274.30	1274.29
18.00	DISCHG	111.69	109.80	107.81	105.73	103.56	101.42	99.37	97.42	95.55	93.81
18.00	ELEV	1274.29	1274.28	1274.27	1274.27	1274.26	1274.25	1274.25	1274.24	1274.24	1274.23
19.00	DISCHG	92.22	90.75	89.36	88.08	86.91	85.85	84.88	84.00	83.20	82.42
19.00	ELEV	1274.23	1274.22	1274.22	1274.21	1274.21	1274.21	1274.20	1274.20	1274.20	1274.20
20.00	DISCHG	81.62	80.72	79.63	78.39	77.04	75.63	74.21	72.83	71.53	70.30
20.00	ELEV	1274.19	1274.19	1274.19	1274.18	1274.18	1274.17	1274.17	1274.17	1274.16	1274.16
21.00	DISCHG	69.14	68.05	67.07	66.15	65.26	64.44	63.68	63.00	62.37	61.80
21.00	ELEV	1274.15	1274.15	1274.15	1274.15	1274.14	1274.14	1274.14	1274.14	1274.13	1274.13
22.00	DISCHG	61.29	60.81	60.38	59.99	59.64	59.31	59.02	58.75	58.50	58.28
22.00	ELEV	1274.13	1274.13	1274.13	1274.13	1274.13	1274.12	1274.12	1274.12	1274.12	1274.12
23.00	DISCHG	58.08	57.89	57.72	57.57	57.43	57.30	57.18	57.06	56.95	56.85

23.00	ELEV	1274.12	1274.12	1274.12	1274.12	1274.12	1274.12	1274.12	1274.12	1274.12	1274.12
24.00	DISCHG	56.64	56.23	55.49	54.29	52.48	50.16	47.42	44.44	41.36	38.33
24.00	ELEV	1274.12	1274.11	1274.11	1274.11	1274.10	1274.10	1274.09	1274.08	1274.07	1274.06
25.00	DISCHG	35.32	32.53	29.98	27.66	25.55	23.63	21.88	20.28	19.00	19.00
25.00	ELEV	1274.05	1274.04	1274.03	1274.03	1274.02	1274.01	1274.01	1274.00	1274.00	1273.99
26.00	DISCHG	18.99	18.99	18.99	18.99	18.99	18.98	18.98	18.98	18.98	18.97
26.00	ELEV	1273.99	1273.98	1273.98	1273.97	1273.96	1273.96	1273.95	1273.95	1273.94	1273.94
27.00	DISCHG	18.97	18.97	18.97	18.97	18.96	18.96	18.96	18.96	18.95	18.95
27.00	ELEV	1273.93	1273.92	1273.92	1273.91	1273.91	1273.90	1273.90	1273.89	1273.88	1273.88
28.00	DISCHG	18.95	18.95	18.94	18.94	18.94	18.94	18.94	18.93	18.93	18.93
28.00	ELEV	1273.87	1273.87	1273.86	1273.86	1273.85	1273.84	1273.84	1273.83	1273.83	1273.82
29.00	DISCHG	18.93	18.92	18.92	18.92	18.92	18.92	18.91	18.91	18.91	18.91
29.00	ELEV	1273.82	1273.81	1273.80	1273.80	1273.79	1273.79	1273.78	1273.78	1273.77	1273.75

RUNOFF VOLUME ABOVE BASEFLOW = 3.31 WATERSHED INCHES, 3991.41 CFS-HRS, 329.85 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP COMPUTATIONS COMPLETED FOR PASS 1 RECORD ID

EXECUTIVE CONTROL OPERATION ENDJOB RECORD ID

53.

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1													
STRUCTURE 1	RESVOR	1.87	6	2	.10	.0	.00	.00	3.31	1276.47	12.55	1835.08	981.3

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1
STRUCTURE 1	1.87	
ALTERNATE 1		1835.08

B. RESERVOIR

4. Flow in Pima Wash and Downstream from Dam
Stormwater from Pima Wash will be intercepted by golf course hole number 6. The grading for this hole will produce a channel approximately 200 feet wide and 10 feet deep. A standard step backwater curve analysis was prepared using a maximum flow of 16854 cfs. For the purpose of computing a backwater curve, a barrier was assumed along the east side of Pointe® Parkway East. The analysis shows that the water surface elevation from station 5+70 to 10+20 is about 3 feet below the proposed grades on the east side of the road. If a velocity head of 1 foot and a silting depth of 1 foot are considered, there would still be approximately 1 foot of freeboard. It should be noted that the use of 16854 cfs in the analysis is conservative in that this amount is the runoff from the total tributary area of 1.87 square miles. At station 10+20, the tributary area is about 1.5 square miles and the runoff is more in the range of 13500 cfs. At station 10+20, the water surface elevation would be about 2 feet lower.

The analysis of flows downstream from the emergency spillway was prepared assuming a fully developed condition to Baseline Road. Flows for the PMP, ½ PMP, and the 100 year on top of the 100 year were used in the analysis. The flow rates are as follows:
PMP = 11812 cfs ½ PMP = 5906 cfs 100 year = 1835 cfs.
Manning's formula was used to compute the velocities. An average slope of S = 0.015 and an "n" value of 0.025 were used for all sections. The attached plans show the routing of the three storms with the velocities and water surface elevations for each section.

DATE 19

TIME A.M. ☐ P.M. ☐

GFRS - PMP through Pima Wash (Hole No. 6)

Use Q = 16854 cfs

To establish a beginning water surface elevation for the backwater analysis, a cross-section was drawn at the entrance of the 10'x20' structural plate arch parallel to the road.

For an inlet condition and H.W = 20.0', the capacity of the culvert is about 2500 cfs. The remain flow, 14354 cfs, will overflow the roadway. The depth of flow over the road is computed assuming a weir condition, $Q = CLH^{3/2}$.

Using C = 3.0, L = 400' : $H = \frac{Q}{CL} = 5.2'$

The pavement elevation at the culvert crossing is 1276.0 and the water surface elevation would then be 1281.2

At station 10+20 a velocity head of $V^2/2g$ should be added to account for the change in direction of flow. Use V = 8 fps

$h = V^2/2g = 1'$

Also, sedimentation should be considered in the analysis. The Guadalupe Watershed Work Plan indicates that the estimated average annual sediment storage requirement for the Guadalupe FRS is 0.25 acre-feet or about 0.13 acre-feet per square mile of drainage area. If it is assumed that this amount was all deposited across hole number 6 starting at station 10+20, the depth of material deposited would be: $0.25 \text{ ac-ft} \times 43560 \frac{ft^2}{ac} = 10890 \text{ ft}^3$

Using a fairway width of 100' and assuming the sedimentation would occur within a 100' stretch of the golf course, $\frac{10890}{100' \times 100'} = 1.1$ ft depth.

P.G.M. GOLF COURSE ~ HOLE NO. 6.
BACKWATER CROSS SECTIONS
7-7-86

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

63.

N = 0.035

So = $Sf = \frac{(NVm)^2}{2.2082\ rm^{4/3}}$

PROJECT: PIMA WASH - Hole No. 6

BY:

DATE: 9-11-86

Assume barrier on east side of Pointe Parkway East.

JOB NO.

Station	Q CFS	Depth 'd' Ft.	Area 'A' Ft.2	Velo. $V=\frac{Q}{A}$ (r)sec	$\frac{V^2}{2g}$ Ft.	He $=d+\frac{V^2}{2g}$ Ft.	r $=\frac{A}{P}$ Ft.	Vm $=\frac{V1+V2}{2}$ Ft/sec	rm $=\frac{r1+r2}{2}$ Ft	$\frac{1}{2.2082rm^{4/3}}$	$(NVm)^2$	S_f	SfL fr	SoL fr	Down Stream $d1+\frac{V1^2}{2g}+SfL=He1+SfL$ fr	Up Stream $d2+\frac{V2^2}{2g}+SoL=He2+SoL$ fr	ELEVATIONS Bott.	ELEVATIONS W.S.
2+15	16854	20.1	1832	9.2	1.31	21.41	8.6										1261.1	1281.2
2+75		19.9	1949	8.6	1.16	21.06	8.5	8.9	8.6	.026	.097	.0025	.15	0.4	21.56	21.46	1261.5	1281.4
1+80		17.8	2497	6.7	.71	18.51	8.4	7.7	8.5	.027	.072	.0019	.20	2.7	21.26	21.21	1264.2	1282.0
3+40		15.5	2116	8.0	.98	16.48	7.7	7.3	8.1	.028	.066	.0018	.30	2.4	18.81	18.88	1266.6	1282.1
4+30		15.0	2099	8.0	1.0	16.0	7.8	8.0	7.8	.030	.079	.0023	.21	0.7	16.69	16.70	1267.3	1282.3
5+70		14.7	3012	5.6	.49	15.19	9.1	6.8	8.4	.027	.057	.0015	.21	1.0	16.21	16.19	1268.3	1283.0
6+55		14.1	1980	8.5	1.12	15.20	5.7	7.0	7.4	.032	.061	.0019	.16	0.6	15.35	15.32	1268.9	1283.0
7+60		13.8	2228	7.6	.89	14.69	7.2	8.0	6.5	.038	.079	.0030	.32	1.8	15.52	15.49	1269.7	1283.5
8+80		12.8	1580	10.7	1.77	14.57	6.7	9.1	7.0	.034	.101	.0035	.42	1.0	15.11	15.57	1270.7	1283.5
10+20		12.7	2005	8.4	1.1	13.80	9.2	9.6	8.0	.029	.112	.0032	.45	1.2	15.02	15.00	1271.9	1284.5

GOSNELL DEVELOPMENT CORPORATION
2720 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 954-4300

Standard Step Backwater Curve Calculations

Project/Subject: PSM 6th HOLE

Date: 9/5/86 19

STATION	ELEV	D	A	WP	R	STATION	ELEV	D	A	WP	R
0+75	64.0	2.5	51.5	30.4	1.50	1+80	66.0	1.75	56.88	65.1	0.87
	65.0	3.5	89.5	38.87	2.30		67.0	2.75	127.38	70.95	1.80
	66.0	4.5	127.5	43.34	2.94		68.0	3.75	197.88	76.8	2.58
	67.0	5.5	173.5	47.82	3.63		69.0	4.75			
	68.0	6.5	219.5	52.30	4.20		70.0	5.75	361.88	89.45	4.05
	69.0	7.5					71.0	6.75			
	70.0	8.5	327.5	61.24	5.35		72.0	7.75	549.88	102.1	5.39
	71.0	9.5					73.0	8.75			
	72.0	10.5	451.5	70.18	6.43		74.0	9.75	757.88	111.0	6.83
65.	73.0	11.5					75.0	10.75			
	74.0	12.5	580.5	78.24	7.52		76.0	11.75	978.88	120.8	8.10
	75.0	13.5				31,335 CFS	77.0	12.75	1096.38	126.2	8.69
	76.0	14.5	740.50	87.16	8.49						
11,925 CFS.	76.5	15.0	781.0	88.6	8.81						

AD 37 9/80

Project/Subject: PSM 6th HOLE

Date: 9/2/80 19

STATION	ELEV	D	A	WP	R	STATION	ELEV	D	A	WP	R
3+40	68.0	1.35	41.85	62.05	0.67	4+30	70.0	2.75	115.0	60.4	1.90
	69.0	2.35	113.85	72.25	1.58	S=0.07%	71.0	3.75	181.0	66.7	2.71
	70.0	3.35	185.85	82.45	2.25		72.0	4.75	247.0	73.0	3.38
	71.0	4.35	274.85	89.25	3.08		73.0	5.75	328.0	82.25	3.99
	72.0	5.35	362.85	96.05	3.78		74.0	6.75	409.0	91.5	4.47
	73.0						75.0	7.75			
	74.0	7.35	561.85	106.65	5.27		76.0	8.75	663.0	137.43	4.82
	75.0						77.0	9.75			
	76.0	9.35	783.85	116.95	6.70		78.0	10.75	953.0	156.43	6.09
	77.0					14,500 CFS @ 13 FPS	79.0	11.75	1126.0	163.22	6.90
(14,574 CFS 14.1 FPS)	78.0	11.35	1029.85	131.5	7.83						

AD 37 9/80

Project/Subject: PS.M. HOLE-6

Date: 9/4/80 19__

STATION	ELEV	D	A	WP	R	STATION	ELEV	D	A	WP	R
5+70	70.0	1.75	122.5	140.0	0.88	6+55	71.0	2.1	87.5	61.3	1.43
	71.0	2.75	272.5	150.2	1.81		72.0	3.1	167.5	72.2	2.04
S=.007	72.0	3.75	422.5	160.40	2.63	S=.00	73.0	4.1	226.0	81.7	2.77
	73.0	4.75	592.5	170.6	3.47		74.0	5.1	304.5	91.2	3.34
	74.0	5.75	762.5	180.8	4.22		75.0	6.1			
	75.0	6.75					76.0	7.1	500.5	113.95	4.39
	76.0	7.75	1144.5	202.75	5.64		77.0	8.1			
	77.0	8.75					78.0	9.1	737.5	137.75	5.35
	78.0	9.75	1566.5	220.30	7.11		79.0	10.1			
	79.0	10.75				(12,952 cfs)	80.0	11.1	1013.5	157.95	6.42
30,220 cfs @ 15 FPS	80.0	11.75	2022.5	236.3	8.56			12.1			
						(15,676 cfs)	82.0	13.1	1433.50	281.15	5.09

AD 37 9/80

Project/Subject: PSM Hole 6

Date: 9/2/86 19

STATION	ELEV	D	A	WP	R	STATION	ELEV	D	A	WP	R
7+60	72.0	2.3	144.1	82.4	1.75	8+80	74.0	3.3	127.5	78.3	1.63
	73.0	3.3	249.1	105.5	2.36		75.0	4.3	227.5	100.4	2.27
	74.0	4.3	354.1	128.6	2.75		76.0	5.3	327.5	122.5	2.67
	75.0	5.3	499.10	145.75	3.42		77.0	6.3	461.5	134.7	3.43
	76.0	6.3	644.1	162.9	3.95		78.0	7.3	595.5	146.9	4.05
	77.0	7.3					79.0	8.3			
	78.0	8.3	992.1	187.25	5.30		80.0	9.3	901.5	162.96	5.53
	79.0	9.3					81.0	10.3			
	80.0	10.3	1388.1	210.75	6.59		82.0	11.3	1249.5	190.36	6.56
	81.0	11.3					83.0	12.3			
(28,222 CFS)	82.0	12.3	1838.1	239.15	7.69	(25,630 CFS)	84.0	13.3	1649.5	208.56	7.87

68.

AD 37 9/80

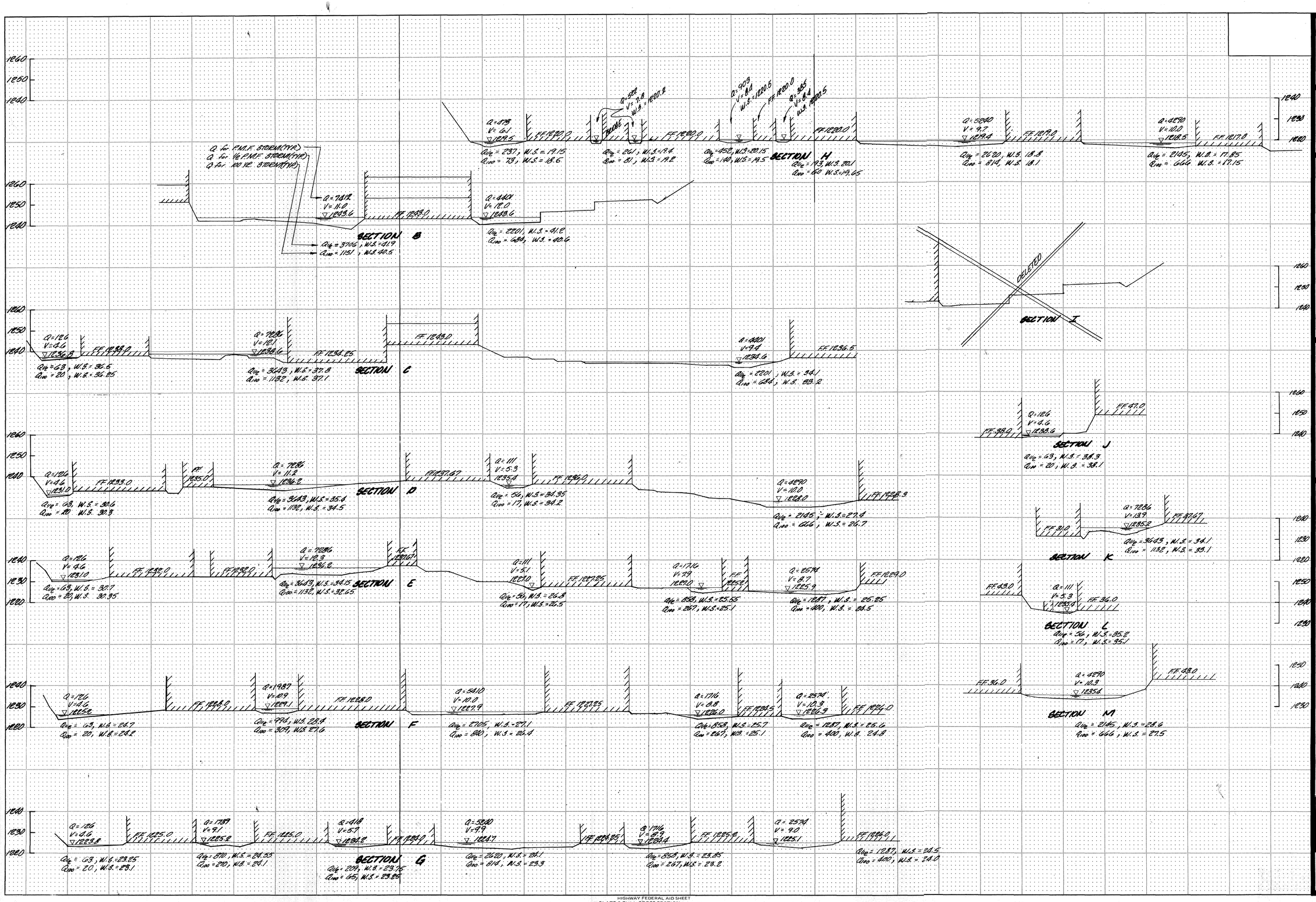
Project/Subject: PSM HOLE 6

Date: 9/4/86 19

STATION	ELEV	D	A	WP	R	STATION	ELEV	D	A	WP	R
10+20	74.0	2.1	140.8	120.1	1.13						
	75.0	3.1	276.8	138.25	2.02						
	76.0	4.1	416.8	152.40	2.73						
	77.0	5.1									
	78.0	6.1	740.8	173.4	4.27						
	79.0	7.1									
	80.0	8.1	1098.8	185.1	5.94						
	81.0	9.1									
	82.0	10.1	1480.8	196.8	7.52						
	83.0	11.1									
(31,942 cfs)	84.0	12.1	1891.8	213.35	8.87						
	85.0	13.1	2317	225	9.4						

AD 37 9/80

I-10
I-10
BASELINE
ROAD
BALL ROOM
RESORT
RESORT
ERICKSON
SECTION A
SECTION B
SECTION C
SECTION D
SECTION E
SECTION F
SECTION G
SECTION H
SECTION I
SECTION J
SECTION L
SECTION M
1
2
3



FINAL SURVEY — SURVEYED ___ PLOTTED ___ TEMPLATE ___ AREAS ___ AREAS CHECKED ___ NOTE BOOK NO. ___ BY ___ DATE ___

ORIGINAL SURVEY — SURVEYED ___ PLOTTED ___ TEMPLATE ___ AREAS ___ AREAS CHECKED ___ NOTE BOOK NO. ___ BY ___ DATE ___

Possessory rights of drawings: Ownership of all plans, drawings, designs and specifications are the property of Gosnell Development Corporation and may not be utilized in any way without obtaining the written consent of Gosnell Development Corporation.

Revisions		
By	Date	Description

Architect GONNELL BUDDEE Phone 955-4940
Planning " " "
Engineer " " "
Scale: 1" = 20'
Drawn by JCB Date 10-26-86
Ck'd by RB Date 10-26-86

P.M.F DOWNSTREAM ROUTING

Job#

THE POINTE RESORT @ SOUTH MOUNTAIN

GOSNELL DEVELOPMENT CORPORATION

2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

SHEET 1 OF 1

GAF Polytrace 033

HIGHWAY FEDERAL AID SHEET
PLATE 3-FULL CROSS SECTION-FULL DOT
W & S
PRINTED IN U.S.A.

C. EMERGENCY AND PRINCIPAL SPILLWAYS

1. Emergency Spillway

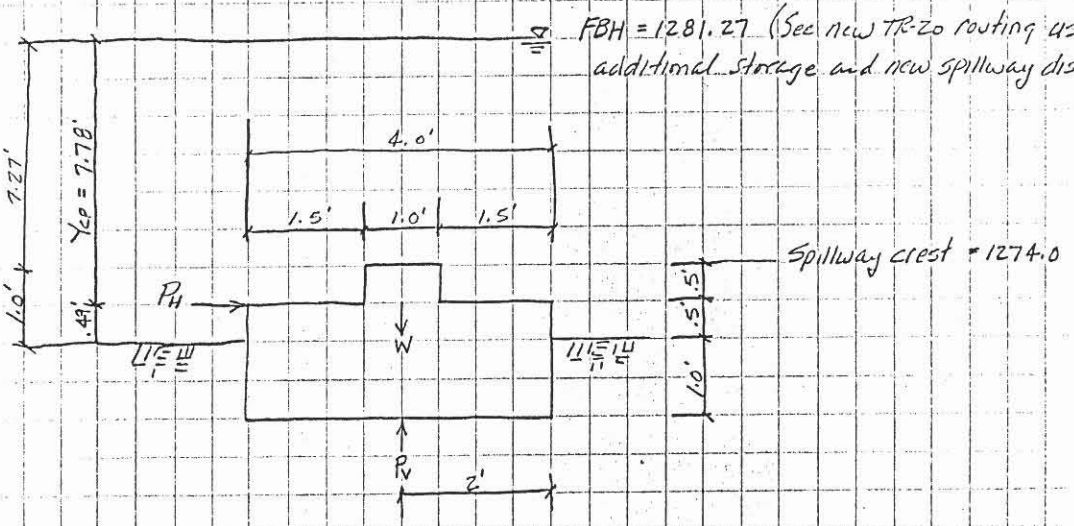
Modifications to the emergency spillway will involve the removal of 1 foot depth of rock off the top of the spillway and replacing it with top soil. To maintain a spillway crest elevation of 1274.0, a concrete sill will be constructed across the spillway and keyed into each abutment. See the details and reinforcement calculations on sheet 1 of the Grading and Drainage Plan in the appendix.

The grading for the golf course will involve the construction of some mounds near the entrance to the spillway. It was questioned whether the mounds, coupled with the proposed road going over the dam, might affect the discharge through the spillway. The HEC-2 program was run to show that the water surface elevation was not increased with these improvements. The program was run for two conditions; one with the top soil in place and the other assuming a washout condition. In both cases, the hydraulics of the spillway were not adversely affected.

DATE 9-11 1986
TIME A.M. ☐ P.M. ☐

GFRS

Concrete sill across emergency spillway



Assume a vertical upward pressure equal to the difference in static head.

$$Y_{cp} = \frac{I_{cg}}{Y_{cg} A} + Y_{cg} = \frac{1(1)^3/12}{7.77(1\times1)} + 7.77 = 7.78'$$

For a 1' section of sill, $P_H = 62.4(7.77) = 484.8$ lb
$W = 150(4\times1.5) + 150(1\times.5) = 975$ lb
$P_V = 62.4(3\times1.5) + 62.4(1\times2) = 405.6$ lb

Overturning moment: $484.8 \times 1.49 = 722.4$ ft-lb
Use factor of safety = 1.5 $M_o = 722.4 \times 1.5 = 1083.5$ ft-lb

Righting moment: $(975 - 405.6)2 = 1138.8$ ft-lb > 1083.5 ∴ ok

Resistence to sliding: Use friction factor = 0.7 (B.o.R. Pg 240 Design of Small Dams 1965)
Use F.S. = 1.5 $P_H = 484.8 \times 1.5 = 727.2$ lb
$R_f = (975 - 405.6)\,0.7 = 398.6$ lb
Assume key provides remaining resistence and that the force is resisted by only the lower 3 inches of the key.
Bearing pressure $= \frac{727.2 - 398.6}{0.25} = 1314.4$ psf

Key sill into rock abutments a minimum of 2 feet.

GOSNELL DEVELOPMENT CORPORATION

CONSTRUCT REINFORCED CONCRETE WALL (205 LF ±) SEE DWGS, SHEET 1.
CROSS-SECTION FOR HEC-2
REMOVE 1' ROCK MAT'L FROM TOP OF SPILLWAY & REPLACE WITH TOP SOIL (TO BE GRADED)
UTILITY TRENCH W/ CONC. COLUMNS - SEE DET. ABOVE.
SEE SHEET 3

```
1*****  ******  ****************************************
*  WATER SURFACE PROFILES                              *
*  VERSION OF NOVEMBER 1976                            *
*  UPDATED MAY 1984                                    *
*  IBM-PC-XT VERSION AUGUST 1985                       *
*  RUN DATE  05-05-87   TIME  09:02:35                 *
*****************************************************

*********  ******  *************
*  U.S. ARMY CORPS OF ENGINEERS
*  THE HYDROLOGIC ENGINEERING CENTE
*  609 SECOND STREET, SUITE D
*  DAVIS, CALIFORNIA 95616
*  (916) 440-2105 (FTS) 448-2105
*********************************

X     X  XXXXXXX   XXXXX              XXXXX
X     X  X         X     X            X     X
X     X  X         X                  X
XXXXXXX  XXXX      X          XXXXX    XXXXX
X     X  X         X                  X
X     X  X         X     X            X
X     X  XXXXXXX   XXXXX              XXXXXXX

1
05-05-87     09:02:36                                                                                PAGE     1

                                                                                THIS RUN EXECUTED 05-05-87
*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
*************************************************

T1 GFRS EMERGENCY SPILLWAY
T2 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS
T3 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS

J1  ICHECK     INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

      0.        2.        0.        0. -1.000000      .00       .0        0.   1266.000     .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

     1.000     .000    -1.000     .000      .000      .000     -1.000     .000      .000      .000

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

    38.000    43.000     1.000     2.000    25.000    26.000    21.000    22.000     4.000     5.000

     3.000      .000      .000      .000      .000      .000      .000      .000      .000      .000

J5  LPRNT     NUMSEC                    ********REQUESTED SECTION NUMBERS********

   -10.000   -10.000      .000      .000      .000      .000      .000      .000      .000      .000

NC      .030      .030      .030      .100      .300      .000      .000      .000      .000      .000
QT     4.000  4000.000  8000.000 12000.000 16854.400      .000      .000      .000      .000      .000
```

ET	.000	7.100	7.100	7.100	7.10	.000	810.000	1265.000	.000	.000
X1	1.000	28.000	810.000	1265.000	.0	.000	.000	.000	.000	.000
GR	70.000	810.000	1272.000	860.000	1274.0	896.000	1276.000	901.000	127 00	.000
GR	1274.000	914.000	1272.000	918.000	1270.000	924.000	1268.000	936.000	1266.000	996.000
GR	1264.000	1002.000	1263.500	1016.000	1264.000	1032.000	1265.000	1051.000	1264.000	1066.000
GR	1262.000	1072.000	1260.000	1083.000	1260.000	1106.000	1262.000	1112.000	1264.000	1120.000
GR	1266.000	1136.000	1268.000	1153.000	1270.000	1162.000	1272.000	1177.000	1274.000	1183.000
GR	1276.000	1189.000	1278.000	1196.000	1278.000	1265.000	.000	.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	877.000	1183.000	.000	.000
X1	2.000	9.000	877.000	1183.000	65.000	65.000	65.000	.000	.000	.000
GR	1285.000	877.000	1275.000	892.000	1274.000	897.000	1274.000	930.000	1274.000	1112.000
GR	1276.000	1157.000	1278.000	1168.000	1280.000	1177.000	1282.000	1183.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	871.000	1101.000	.000	.000
X1	3.000	4.000	871.000	1101.000	45.000	45.000	45.000	.000	.000	.000
GR	1285.000	871.000	1274.000	890.000	1274.000	1085.000	1283.000	1101.000	.000	.000

1

05-05-87 09:02:36 PAGE 2

ET	.000	7.100	7.100	7.100	7.100	.000	872.000	1150.000	.000	.000
X1	4.000	10.000	872.000	1150.000	54.000	45.000	50.000	.000	.000	.000
GR	1282.000	872.000	1280.000	879.000	1275.000	888.000	1274.000	890.000	1274.000	1084.000
GR	1275.000	1086.000	1278.000	1102.000	1278.000	1133.000	1280.000	1144.000	1282.000	1150.000
ET	.000	7.100	7.100	7.100	7.100	.000	838.000	1146.000	.000	.000
X1	5.000	13.000	838.000	1146.000	60.000	40.000	50.000	.000	.000	.000
GR	1282.000	838.000	1280.000	845.000	1275.000	860.000	1276.000	870.000	1278.000	875.000
GR	1280.000	885.000	1282.000	898.000	1282.000	908.000	1274.000	940.000	1273.000	958.000
GR	1273.000	1099.000	1274.000	1122.000	1282.000	1146.000	.000	.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	826.000	1140.000	.000	.000
X1	6.000	18.000	826.000	1140.000	74.000	46.000	60.000	.000	.000	.000
GR	1282.000	826.000	1270.000	861.000	1268.000	866.000	1268.000	882.000	1270.000	907.000
GR	1272.000	918.000	1274.000	926.000	1276.000	932.000	1276.000	943.000	1274.000	950.000
GR	1272.000	958.000	1271.000	1041.000	1272.000	1087.000	1274.000	1096.000	1274.000	1104.000
GR	1272.000	1110.000	1272.000	1115.000	1282.000	1140.000	.000	.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	814.000	1176.000	.000	.000
X1	7.000	18.000	814.000	1176.000	63.000	40.000	50.000	.000	.000	.000
GR	1282.000	814.000	1275.000	831.000	1265.000	865.000	1264.000	871.000	1266.000	890.000
GR	1276.000	923.000	1276.000	940.000	1270.000	965.000	1268.000	1000.000	1267.000	1028.000
GR	1268.000	1052.000	1270.000	1082.000	1274.000	1086.000	1274.000	1102.000	1272.000	1108.000
GR	1272.000	1113.000	1280.000	1132.000	1282.000	1176.000	.000	.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	785.000	1233.000	.000	.000
X1	8.000	22.000	785.000	1233.000	103.000	65.000	80.000	.000	.000	.000
GR	1282.000	785.000	1280.000	796.000	1278.000	805.000	1274.000	813.000	1265.000	840.000
GR	1264.000	845.000	1263.000	874.000	1263.000	918.000	1264.000	940.000	1263.000	962.000
GR	1264.000	982.000	1266.000	991.000	1268.000	1000.000	1268.000	1016.000	1266.000	1021.000
GR	1264.000	1070.000	1262.000	1083.000	1262.000	1096.000	1276.000	1126.000	1278.000	1138.000
GR	1280.000	1184.000	1282.000	1233.000	.000	.000	.000	.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	731.000	1295.000	.000	.000
X1	9.000	27.000	731.000	1295.000	127.000	57.000	80.000	.000	.000	.000
GR	1282.000	731.000	1280.000	738.000	1275.000	752.000	1270.000	779.000	1268.000	820.000
GR	1266.000	868.000	1264.000	892.000	1266.000	915.000	1274.000	944.000	1274.000	951.000
GR	1270.000	965.000	1268.000	986.000	1266.000	1002.000	1266.000	1017.000	1268.000	1026.000
GR	1268.000	1048.000	1266.000	1058.000	1264.000	1082.000	1262.000	1089.000	1261.000	1095.000
GR	1262.000	1100.000	1272.000	1125.000	1274.000	1130.000	1276.000	1163.000	1278.000	1198.000
GR	1280.000	1242.000	1282.000	1295.000	.000	.000	.000	.000	.000	.000

THIS RUN EXECUTED 05-05-87

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************

T1 GFRS EMERGENCY SPILLWAY
T2 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS
T3 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS

J1  ICHECK    INQ      NINV     IDIR     STRT      METRIC    HVINS     Q         WSEL      FQ

    -100.      3.       0.       0. -1.000000      .00       .0        0.   1267.300    .000

J2  NPROF    IPLOT    PRFVS    XSECV    XSECH     FN       ALLDC    IBW      CHNIM    ITRACE

     2.000    .000   -1.000    .000     .000     .000    -1.000    .000     .000     .000

1
 05-05-87     09:02:36                                                                    PAGE    4
```

THIS RUN EXECUTED 05-05-87

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************

T1 GFRS EMERGENCY SPILLWAY
T2 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS
T3 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS

J1  ICHECK    INQ      NINV     IDIR     STRT      METRIC    HVINS     Q         WSEL      FQ

    -100.      4.       0.       0. -1.000000      .00       .0        0.   1268.500    .000

J2  NPROF    IPLOT    PRFVS    XSECV    XSECH     FN       ALLDC    IBW      CHNIM    ITRACE

     3.000    .000   -1.000    .000     .000     .000    -1.000    .000     .000     .000

1
 05-05-87     09:02:36                                                                    PAGE    5
```

THIS RUN EXECUTED 05-05-87

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************
```

T1 GFRS EMERGENCY SPILLWAY
T2 S EMERGENCY SPILLWAY BACKWATER ANALYSIS
T3 S EMERG Y SPILLWAY BACKWATER ANALYSIS

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	-100.	5.	0.	0.	-1.000000	.00	.0	0.	1269.800	.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	15.000	.000	-1.000	.000	.000	.000	-1.000	.000	.000	.000

1

05-05-87 09:02:36 PAGE 6

THIS RUN EXECUTED 05-05-87

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************
```

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

EMERGENCY SPILLWAY BACKW

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	AREA	VCH	STCHL	STCHR	TOPWID	10K*S	EG
*	1.000	4000.00	1266.04	1266.04	411.67	9.72	810.00	1265.00	141.69	94.21	1267.51
*	1.000	8000.00	1267.92	1267.92	744.75	10.74	810.00	1265.00	213.83	90.04	1269.71
*	1.000	12000.00	1269.03	1269.03	992.62	12.09	810.00	1265.00	227.86	84.68	1271.30
*	1.000	16854.40	1270.30	1270.30	1289.69	13.07	810.00	1265.00	248.53	78.76	1272.95
*	2.000	4000.00	1276.09	1276.09	507.52	7.88	877.00	1183.00	267.14	107.85	1277.06
*	2.000	8000.00	1277.22	1277.22	814.66	9.82	877.00	1183.00	275.07	92.82	1278.72
*	2.000	12000.00	1278.16	1278.16	1075.49	11.16	877.00	1183.00	281.47	85.46	1280.09
*	2.000	16854.40	1279.16	1279.16	1359.96	12.39	877.00	1183.00	287.47	79.44	1281.55
	3.000	4000.00	1276.48	1276.33	493.38	8.11	871.00	1101.00	203.68	83.05	1277.50
*	3.000	8000.00	1277.69	1277.69	743.98	10.75	871.00	1101.00	207.94	87.20	1279.49
*	3.000	12000.00	1278.83	1278.83	981.87	12.22	871.00	1101.00	211.91	80.08	1281.15
*	3.000	16854.40	1280.03	1280.03	1239.84	13.59	871.00	1101.00	216.14	74.79	1282.90
	4.000	4000.00	1277.22	1276.35	653.99	6.12	872.00	1150.00	213.86	34.62	1277.80
	4.000	8000.00	1278.97	1277.65	1068.01	7.49	872.00	1150.00	257.47	34.64	1279.84
	4.000	12000.00	1280.44	1278.88	1454.09	8.25	872.00	1150.00	267.84	29.43	1281.50
	4.000	16854.40	1282.03	1279.92	1886.00	8.94	872.00	1150.00	278.00	25.70	1283.27
	5.000	4000.00	1277.62	1275.59	900.53	4.44	838.00	1146.00	229.23	13.11	1277.92
	5.000	8000.00	1279.43	1276.98	1340.22	5.97	838.00	1146.00	255.52	16.18	1279.99
	5.000	12000.00	1280.90	1278.10	1730.53	6.93	838.00	1146.00	279.24	17.52	1281.64
	5.000	16854.40	1282.50	1279.28	2203.00	7.65	838.00	1146.00	308.00	17.78	1283.41
	6.000	4000.00	1277.89	1273.15	1729.43	2.31	826.00	1140.00	291.73	2.08	1277.97
	6.000	8000.00	1279.88	1274.48	2320.18	3.45	826.00	1140.00	302.50	3.28	1280.06

78.

6.000	16854.40	1283.11	1276.55	3322.76	5.07	826.00	1140.00	314.00	4.72	1283.51
7.000	000.00	1277.93	1270.26	2300.72	4	814.00	1176.00	303.19	.85	1277.98
7.000	8000.00	1279.96	1271.80	2927.97	2.73	814.00	1176.00	312.97	1.60	1280.08
7.000	12000.00	1281.57	1273.05	3461.72	3.47	814.00	1176.00	351.54	2.40	1281.76
7.000	16854.40	1283.27	1274.39	4075.35	4.14	814.00	1176.00	362.00	2.91	1283.54

1

05-05-87 09:02:36 PAGE 7

SECNO	Q	CWSEL	CRIWS	AREA	VCH	STCHL	STCHR	TOPWID	10K*S	EG
8.000	4000.00	1277.97	1265.75	4065.36	.98	785.00	1233.00	332.78	.14	1277.99
8.000	8000.00	1280.05	1267.01	4814.81	1.66	785.00	1233.00	389.49	.40	1280.09
8.000	12000.00	1281.70	1268.11	5500.57	2.18	785.00	1233.00	439.14	.68	1281.78
8.000	16854.40	1283.45	1269.10	6283.10	2.68	785.00	1233.00	448.00	.90	1283.57
9.000	4000.00	1277.97	1267.92	4009.07	1.00	731.00	1295.00	453.93	.23	1277.99
9.000	8000.00	1280.06	1269.25	5007.52	1.60	731.00	1295.00	505.75	.50	1280.10
9.000	12000.00	1281.72	1270.38	5888.42	2.04	731.00	1295.00	555.55	.74	1281.79
9.000	16854.40	1283.48	1271.35	6878.78	2.45	731.00	1295.00	564.00	.90	1283.58

1

05-05-87 09:02:36 PAGE 8

SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION  SECNO=     1.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     1.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     1.000  PROFILE= 3  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     1.000  PROFILE= 4  CRITICAL DEPTH ASSUMED

CAUTION  SECNO=     2.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     2.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     2.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     2.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     2.000  PROFILE= 3  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     2.000  PROFILE= 3  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     2.000  PROFILE= 4  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     2.000  PROFILE= 4  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=     3.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     3.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     3.000  PROFILE= 3  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     3.000  PROFILE= 3  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     3.000  PROFILE= 4  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     3.000  PROFILE= 4  MINIMUM SPECIFIC ENERGY
```

1

05-05-87 09:03:35 PAGE 1

THIS RUN EXECUTED 05-05-87

```
*****************************************************
HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
ERROR CORR -  01,02,03,04,05,06
MODIFICATION -  50,51,52,53,54,55,56
```

```
1*****************************************************
 *  WATER SURFACE PROFILES                           *
 *  VERSION OF NOVEMBER 1976                         *
 *  UPDATED MAY 1984                                 *
 *  IBM-PC-XT VERSION AUGUST 1985                    *
 *  RUN DATE  05-05-87   TIME  08:36:57              *
 *****************************************************
```


```
*************************************
* U.S. ARMY CORPS OF ENGINEERS
* THE HYDROLOGIC ENGINEERING CENTE
* 609 SECOND STREET, SUITE D
* DAVIS, CALIFORNIA 95616
* (916) 440-2105 (FTS) 448-2105
*************************************
```


```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                  X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX              XXXXXXX
```

1

THIS RUN EXECUTED 05-05-87

```
*************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
*************************************************
```

T1 GFRS EMERGENCY SPILLWAY
T2 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS
T3 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	2.	0.	0.	-1.000000	.00	.0	0.	1266.000	.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1.000	.000	-1.000	.000	.000	.000	-1.000	.000	.000	.000

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

38.000	43.000	1.000	2.000	25.000	26.000	21.000	22.000	4.000	5.000
3.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

J5 LPRNT NUMSEC ********REQUESTED SECTION NUMBERS********

-10.000	-10.000	.000	.000	.000	.000	.000	.000	.000	.000

NC	.030	.030	.030	.100	.300	.000	.000	.000	.000	.000

ET	.000	7.100	7.100	7.100	7.1[illegible]	.000	810.000	1265.000	.000	.000
X1	1.000	28.000	810.000	1265.000	.0[illegible]	.000	.000	.000	[illegible]00	.000
GR	[illegible]70.000	810.000	1272.000	860.000	1274.00[illegible]	896.000	1276.000	901.000	127[illegible]	.000
GR	1274.000	914.000	1272.000	918.000	1270.000	924.000	1268.000	936.000	1266.000	996.000
GR	1264.000	1002.000	1263.500	1016.000	1264.000	1032.000	1265.000	1051.000	1264.000	1066.000
GR	1262.000	1072.000	1260.000	1083.000	1260.000	1106.000	1262.000	1112.000	1264.000	1120.000
GR	1266.000	1136.000	1268.000	1153.000	1270.000	1162.000	1272.000	1177.000	1274.000	1183.000
GR	1276.000	1189.000	1278.000	1196.000	1278.000	1265.000	.000	.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	877.000	1183.000	.000	.000
X1	2.000	9.000	877.000	1183.000	65.000	65.000	65.000	.000	.000	.000
GR	1285.000	877.000	1275.000	892.000	1273.000	897.000	1273.000	930.000	1273.000	1112.000
GR	1276.000	1157.000	1278.000	1168.000	1280.000	1177.000	1282.000	1183.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	871.000	1101.000	.000	.000
X1	3.000	4.000	871.000	1101.000	45.000	45.000	45.000	.000	.000	.000
GR	1285.000	871.000	1274.000	890.000	1274.000	1085.000	1283.000	1101.000	.000	.000

1

ET	.000	7.100	7.100	7.100	7.100	.000	872.000	1150.000	.000	.000
X1	4.000	10.000	872.000	1150.000	54.000	45.000	50.000	.000	.000	.000
GR	1282.000	872.000	1280.000	879.000	1275.000	888.000	1274.000	890.000	1274.000	1084.000
GR	1275.000	1086.000	1278.000	1102.000	1278.000	1133.000	1280.000	1144.000	1282.000	1150.000
ET	.000	7.100	7.100	7.100	7.100	.000	838.000	1146.000	.000	.000
X1	5.000	13.000	838.000	1146.000	60.000	40.000	50.000	.000	.000	.000
GR	1282.000	838.000	1280.000	845.000	1275.000	860.000	1276.000	870.000	1278.000	875.000
GR	1280.000	885.000	1282.000	898.000	1282.000	908.000	1274.000	940.000	1273.000	958.000
GR	1273.000	1099.000	1274.000	1122.000	1282.000	1146.000	.000	.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	826.000	1140.000	.000	.000
X1	6.000	18.000	826.000	1140.000	74.000	46.000	60.000	.000	.000	.000
GR	1282.000	826.000	1270.000	861.000	1268.000	866.000	1268.000	882.000	1270.000	907.000
GR	1272.000	918.000	1274.000	926.000	1276.000	932.000	1276.000	943.000	1274.000	950.000
GR	1272.000	958.000	1271.000	1041.000	1272.000	1087.000	1274.000	1096.000	1274.000	1104.000
GR	1272.000	1110.000	1272.000	1115.000	1282.000	1140.000	.000	.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	814.000	1176.000	.000	.000
X1	7.000	18.000	814.000	1176.000	63.000	40.000	50.000	.000	.000	.000
GR	1282.000	814.000	1275.000	831.000	1265.000	865.000	1264.000	871.000	1266.000	890.000
GR	1276.000	923.000	1276.000	940.000	1270.000	965.000	1268.000	1000.000	1267.000	1028.000
GR	1268.000	1052.000	1270.000	1082.000	1274.000	1086.000	1274.000	1102.000	1272.000	1108.000
GR	1272.000	1113.000	1280.000	1132.000	1282.000	1176.000	.000	.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	785.000	1233.000	.000	.000
X1	8.000	22.000	785.000	1233.000	103.000	65.000	80.000	.000	.000	.000
GR	1282.000	785.000	1280.000	796.000	1278.000	805.000	1274.000	813.000	1265.000	840.000
GR	1264.000	845.000	1263.000	874.000	1263.000	918.000	1264.000	940.000	1263.000	962.000
GR	1264.000	982.000	1266.000	991.000	1268.000	1000.000	1268.000	1016.000	1266.000	1021.000
GR	1264.000	1070.000	1262.000	1083.000	1262.000	1096.000	1276.000	1126.000	1278.000	1138.000
GR	1280.000	1184.000	1282.000	1233.000	.000	.000	.000	.000	.000	.000
ET	.000	7.100	7.100	7.100	7.100	.000	731.000	1295.000	.000	.000
X1	9.000	27.000	731.000	1295.000	127.000	57.000	80.000	.000	.000	.000
GR	1282.000	731.000	1280.000	738.000	1275.000	752.000	1270.000	779.000	1268.000	820.000
GR	1266.000	868.000	1264.000	892.000	1266.000	915.000	1274.000	944.000	1274.000	951.000
GR	1270.000	965.000	1268.000	986.000	1266.000	1002.000	1266.000	1017.000	1268.000	1026.000
GR	1268.000	1048.000	1266.000	1058.000	1264.000	1082.000	1262.000	1089.000	1261.000	1095.000
GR	1262.000	1100.000	1272.000	1125.000	1274.000	1130.000	1276.000	1163.000	1278.000	1198.000
GR	1280.000	1242.000	1282.000	1295.000	.000	.000	.000	.000	.000	.000

THIS RUN EXECUTED 05-05-87

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************

T1 GFRS EMERGENCY SPILLWAY
T2 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS
T3 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

    -100.      3.       0.       0. -1.000000     .00      .0       0.   1267.300   .000

J2  NPROF    IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE

      2.000    .000   -1.000    .000     .000     .000   -1.000    .000     .000     .000

1
 05-05-87     08:36:57                                                                    PAGE    4
```

THIS RUN EXECUTED 05-05-87

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************

T1 GFRS EMERGENCY SPILLWAY
T2 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS
T3 GFRS EMERGENCY SPILLWAY BACKWATER ANALYSIS

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

    -100.      4.       0.       0. -1.000000     .00      .0       0.   1268.500   .000

J2  NPROF    IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE

      3.000    .000   -1.000    .000     .000     .000   -1.000    .000     .000     .000

1
 05-05-87     08:36:57                                                                    PAGE    5
```

THIS RUN EXECUTED 05-05-87

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
```

T1 GPRS EMERGENCY SPILLWAY
T2 CORPS EMERGENCY SPILLWAY BACKWATER ANALYSIS
T3 CORPS EMERGENCY SPILLWAY BACKWATER ANALYSIS

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	-100.	5.	0.	0.	-1.000000	.00	.0	0.	1269.800	.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	15.000	.000	-1.000	.000	.000	.000	-1.000	.000	.000	.000

1
05-05-87 08:36:57 PAGE 6

THIS RUN EXECUTED 05-05-87

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************
```

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

EMERGENCY SPILLWAY BACKW

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	AREA	VCH	STCHL	STCHR	TOPWID	10K*S	EG
*	1.000	4000.00	1266.04	1266.04	411.67	9.72	810.00	1265.00	141.69	94.21	1267.51
*	1.000	8000.00	1267.92	1267.92	744.75	10.74	810.00	1265.00	213.83	90.04	1269.71
*	1.000	12000.00	1269.03	1269.03	992.62	12.09	810.00	1265.00	227.86	84.68	1271.30
*	1.000	16854.40	1270.30	1270.30	1289.69	13.07	810.00	1265.00	248.53	78.76	1272.95
*	2.000	4000.00	1275.13	1275.13	498.66	8.02	877.00	1183.00	252.21	105.96	1276.13
*	2.000	8000.00	1276.32	1276.32	808.02	9.90	877.00	1183.00	268.72	92.46	1277.84
*	2.000	12000.00	1277.29	1277.29	1072.67	11.19	877.00	1183.00	275.53	83.80	1279.23
*	2.000	16854.40	1278.28	1278.28	1349.41	12.49	877.00	1183.00	282.19	79.54	1280.70
*	3.000	4000.00	1276.33	1276.33	464.05	8.62	871.00	1101.00	203.17	101.48	1277.48
*	3.000	8000.00	1277.69	1277.69	742.92	10.77	871.00	1101.00	207.92	87.60	1279.49
*	3.000	12000.00	1278.82	1278.82	980.50	12.24	871.00	1101.00	211.89	80.44	1281.15
*	3.000	16854.40	1280.02	1280.02	1238.34	13.61	871.00	1101.00	216.11	75.08	1282.90
	4.000	4000.00	1277.24	1276.34	657.28	6.09	872.00	1150.00	213.97	34.07	1277.82
	4.000	8000.00	1278.97	1277.65	1068.35	7.49	872.00	1150.00	257.48	34.60	1279.84
	4.000	12000.00	1280.44	1278.88	1454.45	8.25	872.00	1150.00	267.85	29.41	1281.50
	4.000	16854.40	1282.03	1279.92	1886.30	8.94	872.00	1150.00	278.00	25.68	1283.27
	5.000	4000.00	1277.64	1275.59	905.29	4.42	838.00	1146.00	229.48	12.90	1277.94
	5.000	8000.00	1279.43	1276.98	1340.40	5.97	838.00	1146.00	255.53	16.17	1279.99
	5.000	12000.00	1280.90	1278.10	1730.94	6.93	838.00	1146.00	279.27	17.50	1281.64
	5.000	16854.40	1282.50	1279.28	2203.30	7.65	838.00	1146.00	308.00	17.77	1283.41
	6.000	4000.00	1277.91	1273.15	1734.52	2.31	826.00	1140.00	291.83	2.06	1277.99
	6.000	8000.00	1279.88	1274.48	2320.40	3.45	826.00	1140.00	302.51	3.28	1280.06

6.000	16854.40	1283.11	1276.55	3323.11	[illegible]	826.00	1140.00	314.00	4.72	1283.51
7.000	.000.00	1277.95	1270.26	2305.86	[illegible]	814.00	1176.00	303.27	.85	1278.00
7.000	8000.00	1279.96	1271.80	2928.20	2.73	814.00	1176.00	312.97	1.60	1280.08
7.000	12000.00	1281.57	1273.05	3462.07	3.47	814.00	1176.00	351.56	2.40	1281.76
7.000	16854.40	1283.27	1274.39	4075.84	4.14	814.00	1176.00	362.00	2.91	1283.54

SECNO	Q	CWSEL	CRIWS	AREA	VCH	STCHL	STCHR	TOPWID	10K*S	EG
8.000	4000.00	1277.99	1265.75	4070.96	.98	785.00	1233.00	332.92	.14	1278.00
8.000	8000.00	1280.05	1267.01	4815.10	1.66	785.00	1233.00	389.51	.40	1280.09
8.000	12000.00	1281.71	1268.10	5500.89	2.18	785.00	1233.00	439.17	.68	1281.78
8.000	16854.40	1283.46	1269.09	6283.54	2.68	785.00	1233.00	448.00	.90	1283.57
9.000	4000.00	1277.99	1267.92	4016.77	1.00	731.00	1295.00	454.27	.23	1278.01
9.000	8000.00	1280.06	1269.25	5007.89	1.60	731.00	1295.00	505.78	.50	1280.10
9.000	12000.00	1281.72	1270.38	5888.83	2.04	731.00	1295.00	555.58	.74	1281.79
9.000	16854.40	1283.48	1271.34	6879.26	2.45	731.00	1295.00	564.00	.90	1283.58

SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION  SECNO=     1.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     1.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     1.000  PROFILE= 3  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     1.000  PROFILE= 4  CRITICAL DEPTH ASSUMED

CAUTION  SECNO=     2.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     2.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     2.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     2.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     2.000  PROFILE= 3  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     2.000  PROFILE= 3  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     2.000  PROFILE= 4  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     2.000  PROFILE= 4  MINIMUM SPECIFIC ENERGY

CAUTION  SECNO=     3.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     3.000  PROFILE= 1  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     3.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     3.000  PROFILE= 2  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     3.000  PROFILE= 3  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     3.000  PROFILE= 3  MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     3.000  PROFILE= 4  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     3.000  PROFILE= 4  MINIMUM SPECIFIC ENERGY
```


THIS RUN EXECUTED 05-05-87

****

C. EMERGENCY AND PRINCIPAL SPILLWAYS

2. Principal Spillway

The construction of the proposed roadway over the dam will involve the extension of the principal spillway. This design proposes to remove the existing outlet structure and connect a 30" diameter pipe to the existing 30" pipe. The 30" pipe will extend across the roadway to a manhole. At this point, a 24" diameter pipe will extend parallel to the roadway where it will connect to the existing 24" pipe also at a new manhole. The hydraulic calculations show that the manhole lid at the connection to the existing 24" pipe will lift when the pressure head exceeds 1 foot above the top of the existing drop inlet structure (elevation 1274.81). This will allow water to flow overland and will not increase the flow to the Western Canal which, under the original design, was limited to approximately 20 cfs.

The 30" concrete pipe will be designed in accordance with AWWA C-302. Calculations provided by Ameron Concrete Pipe Company are included in this report. Details of the pipe joint to the existing pipe are likewise included. Pressure testing will be in accordance with the enclosed specifications for Method 2.

Plans and details have been included to show the proposed modifications to the principal spillway inlet structure.

DATE 19

TIME A.M. ☐ P.M. ☐

GFRS - Principal spillway extension Revised 7-1-86

The principal spillway will be extended for approximately 90 feet with a 30" RCP to a point on the west side of Pointe Parkway East. From here a 24" RCP will connect to the existing 24" pipe. Check depth of flow for maximum Q = 20 cfs.

	Length	D	H	n	K	Q_{Full}	d/D	d
Existing	210'	30"	.48	.012		21.3	.77	23.1
New	90'	30"	.21	.012		21.5	.83	24.9
New	170'	24"	2.37	.013	1.24	21.3	.67	16.1

$$K_{63°} = 1.25\left[1-\left(\frac{90-63}{90}\right)^2\right] = 1.14$$

$$K_{reduction} \quad \frac{D_2}{D_1} = \frac{24}{30} = 0.8 = .10$$

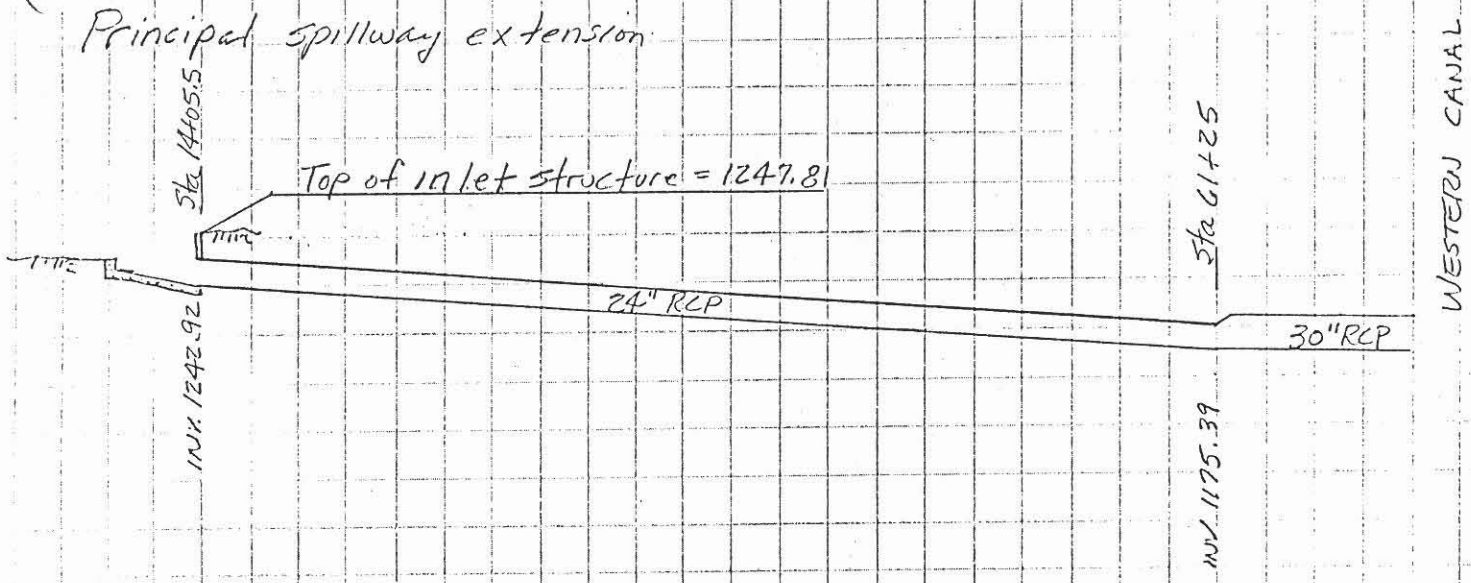
$$K = 1.24$$

$$H = \left(K + \frac{29 n^2 L}{R^{1.33}}\right)\frac{V^2}{2g}$$

DATE 10-22 19 86
TIME A.M. ☐ P.M. ☐

GFRS

Principal spillway extension



Under the existing conditions when the discharge in the principal spillway exceeded the capacity of the outlet pipe, water overflowed the drop structure at elevation 1247.81 and flowed overland. Using a head of 72.42' (1247.81 - 1175.39), the capacity of the 24" pipe is as follows: $H = \left(K + \frac{29\,n^2 L}{R^{1.33}}\right)\frac{V^2}{29}$ $K = 1.82$ (See previous submittal)

$n = 0.013$

$L = 4719.5$ (61+25 - 14+05.5)

For $H = 72.42'$, $V = 8.8$ fps $Q = 27.7$ cfs

It is planned to replace the drop inlet structure with a precast concrete manhole. The cover of the manhole is 24 inches in diameter and weighs about 200 pounds.

$\frac{200\text{ lb}}{144 \times 3.14} = 0.44$ psi which is equivalent to 1.02' head of water.

Therefore, once the head on the 24" pipe exceeds 73.44' (72.42' + 1.02') the manhole rim will lift and excess water will flow overland. The capacity in the 24" pipe due to the additional head will increase from 27.7 cfs to 27.9 cfs.

06/16/87 10:04:30

ULTIMATE STRENGTH NON-CYLINDER PIPE
90 DEG OLANDER BEDDING COEFFICIENTS

	PIPE		WATER		EARTH	
	Cfp	Cmp	Cfw	Cmw	Cfe	Cme
BOTTOM:	0.207	-0.122	-0.272	-0.122	0.324	-0.126
SIDE:	0.297	0.088	-0.062	0.088	0.539	0.089

UNIT WATER WT.= 62.4 LB/FT3 LOAD FACTOR = 1.80 PHI = 1.00
UNIT PIPE WT.= 150.0 LB/FT3

EARTH LOAD - ENTERED FROM SEPARATE CALCULATION

ID	T wall	Earth cover	Head
30.000	4.375	0.000	36.000

f'c	Earth Load	Weight Pipe	Weight Water
4500.0	11681.0	492.2	306.3

		M	F	Di	D'o	Fyo	As	As'
SIDE	(OUTER)	1589.66	3615.24	3.125	1.250	40000.0	0.177	
SIDE	(INNER)					Fyi 0.0		0.00

		M	F	Do	D'i	Fyi	As	As'
BOTTOM	(INNER)	-2247.58	995.20	3.125	1.250	40000.0	0.382	
BOTTOM	(OUTER)					Fyo 0.0		0.00

06/16/87 *** EXTERNAL LOAD CALCULATIONS ***

SAMPLE

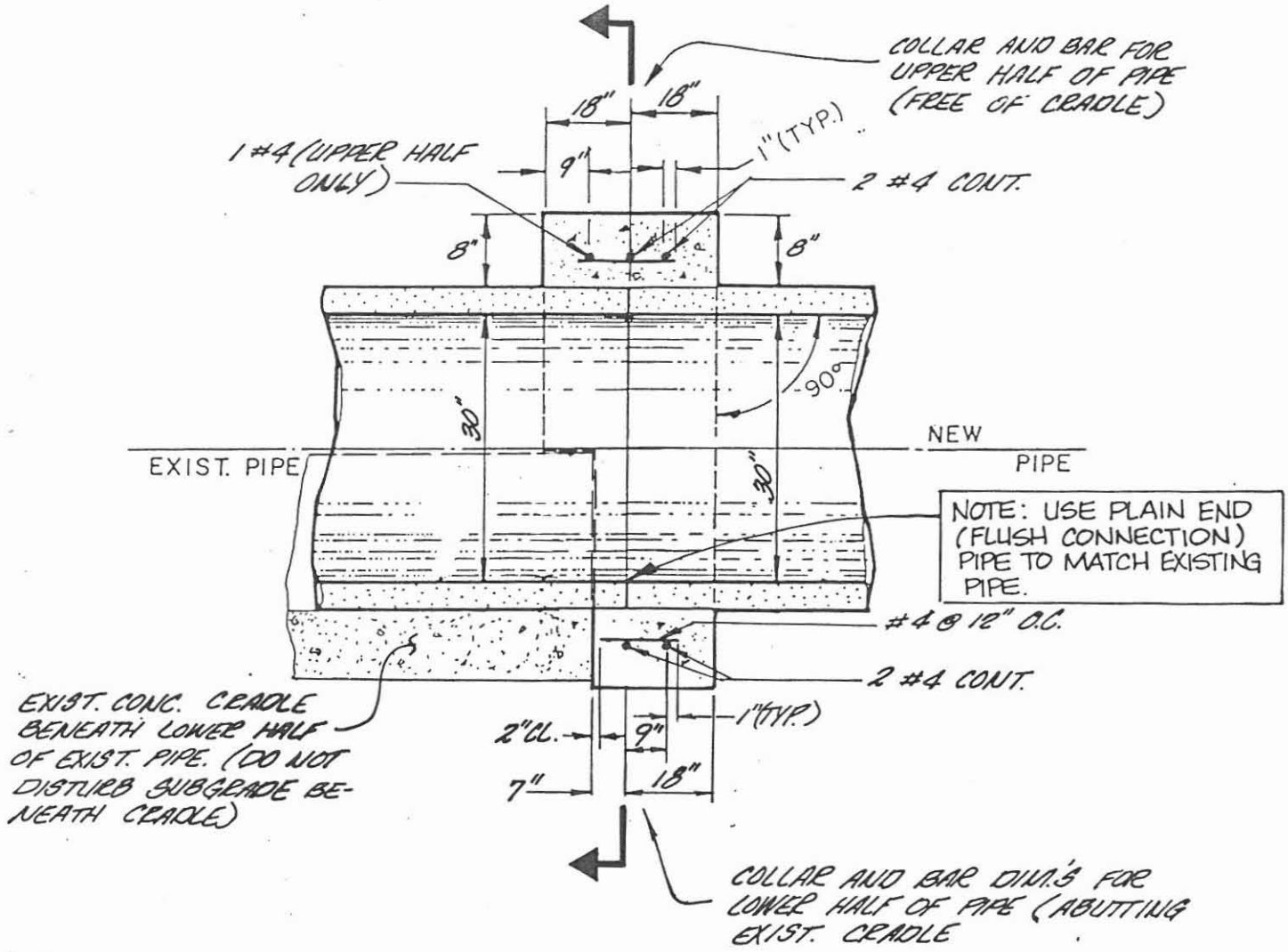
PIPE O.D. = 38.75" PIPE I.D. = 30.00"

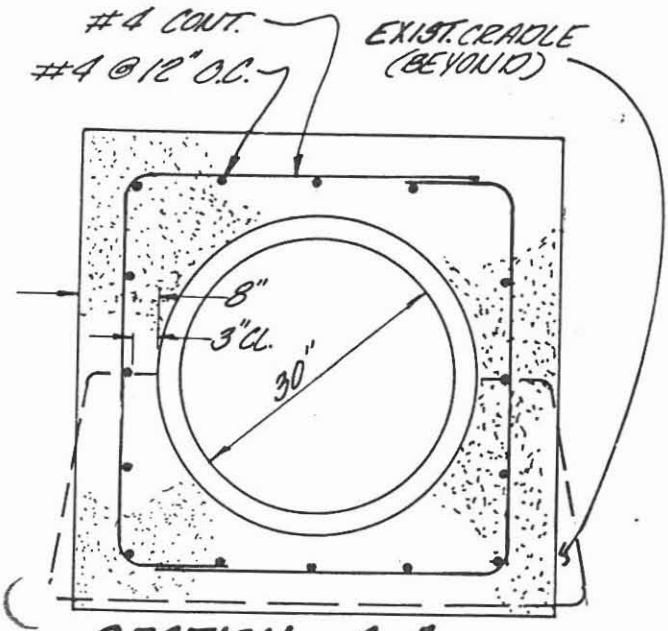
SOIL WEIGHT = 120.#/CF SOIL COEFFICIENT = 0.150

SETTLEMENT/PROJECTION RATIO(RSDP) = 0.50

POSITIVE PROJECTING CONDITION
(WIDE TRENCH)

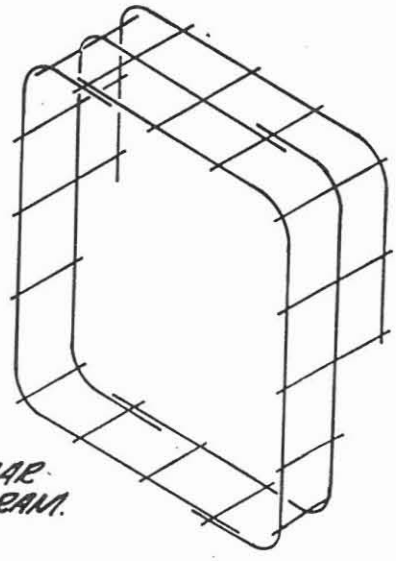
EARTH COVER (FT)	EARTH LOAD (#/FT)	LIVE LOAD (#/FT)	IMPACT FACTOR	TOTAL LOAD (#/FT)	HEIGHT OF EQUAL SETTLEMENT
21.00	11681.	0.	0.0	11681.	4.2824





SECTION A-A

NOTE: SANDBLAST ALL EXIST. SURFACES MAKING CONTACT WITH COLLAR



BAR DIAGRAM.

CONCRETE COLLAR

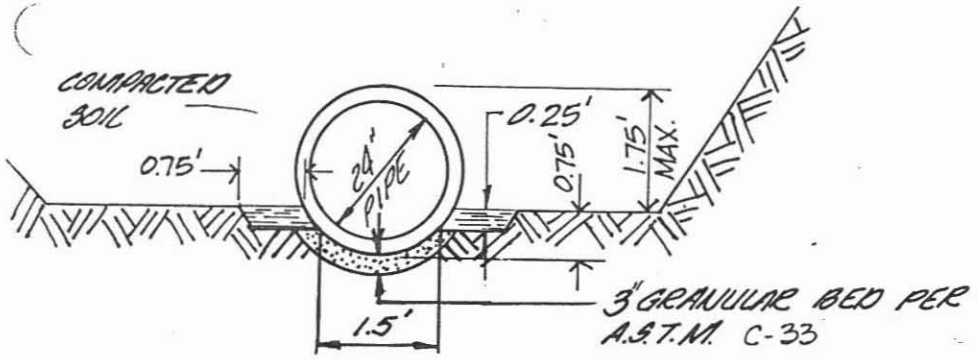
90.

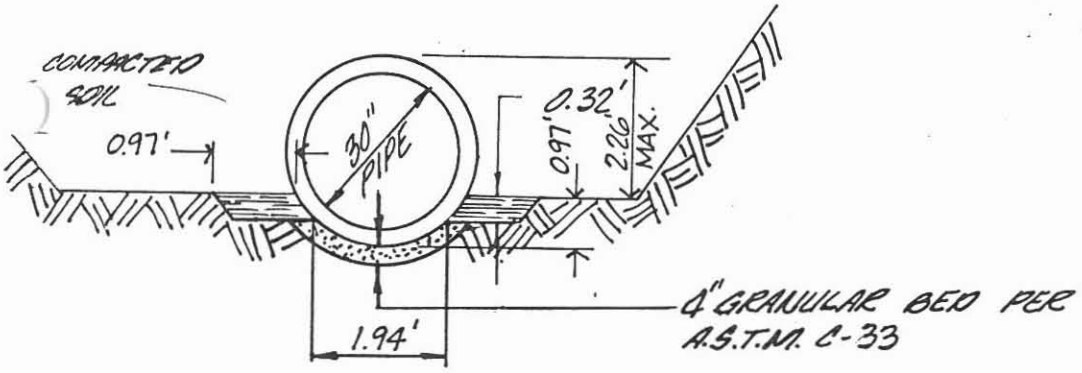
GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

BACKFILL AND COMPACTION TO BE IN ACCORDANCE WITH M.A.G. SPECIFICATION NO. 601. COMPACT TO 95%.

WHERE LEDGE ROCK, ROCKY OR GRAVELLY SOIL, HARD PAN OR OTHER UNYIELDING FOUNDATION MATERIAL IS ENCOUNTERED, THE HARD UNYIELDING MATERIAL SHOULD BE EXCAVATED BELOW THE BOTTOM OF THE PIPE OR PIPE BELL (CLASS B & C BEDDINGS) FOR A DEPTH OF AT LEAST 6 INCHES OR ½ INCH FOR EACH FOOT OF FILL OVER THE TOP OF THE PIPE, WHICHEVER IS GREATER, BUT NOT MORE THAN 3/4 THE NOMINAL DIAMETER OF THE PIPE.

BACKFILL MUST EXTEND A MINIMUM OF 2 FEET BEYOND ALL SIDES OF THE PIPE PRIOR TO ANY VEHICULAR CROSSING.





BEDDING DETAIL

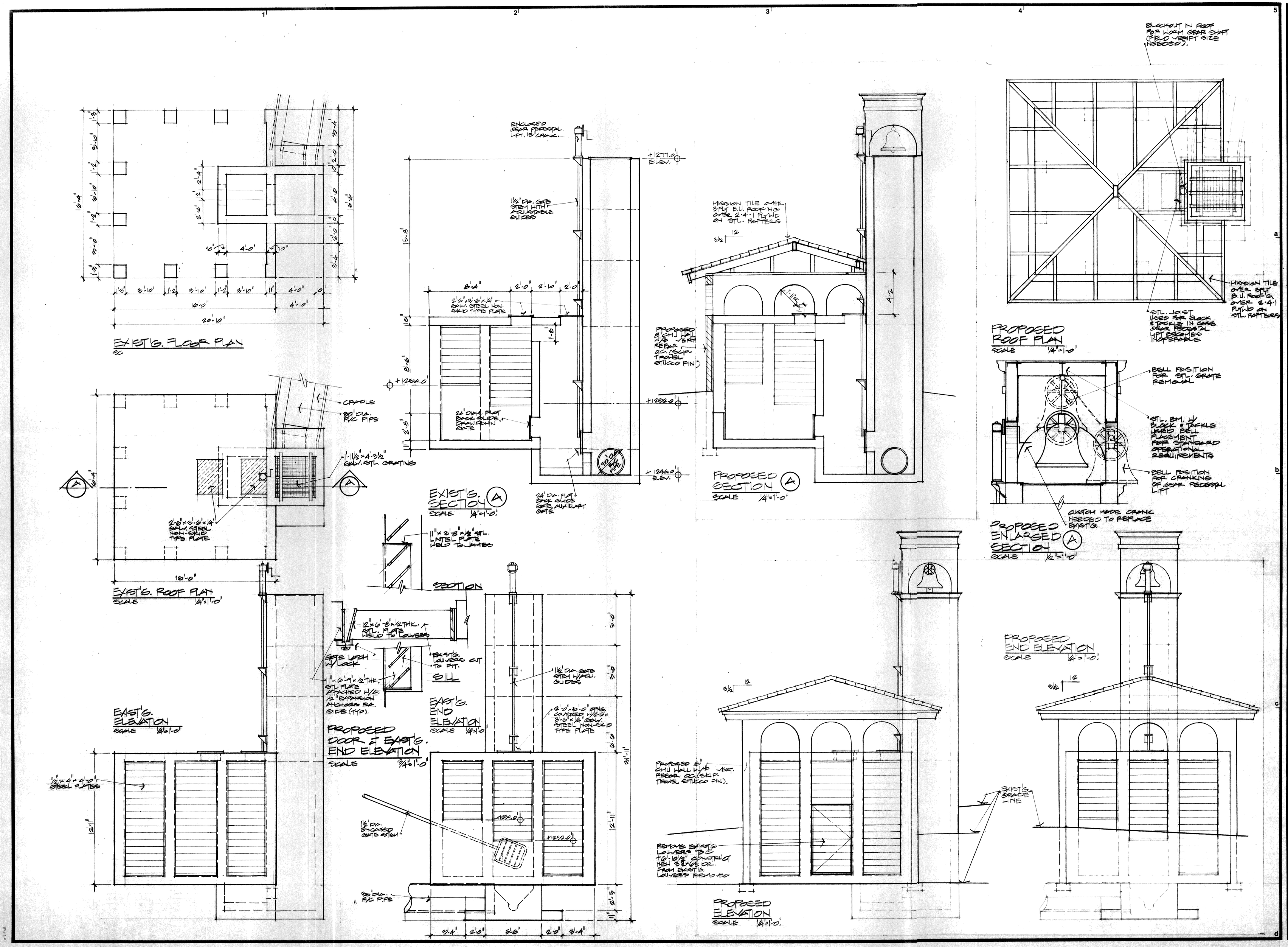
GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

PRESSURE TESTING

(Method 1) Pressure testing of the completed conduit will not be required.

(Method 2) Prior to the placement of any concrete or earth fill around the conduit or filling of the pipe joints, the conduit shall be tested for leaks in the following manner: The ends of the conduit shall be plugged and a standpipe with a minimum diameter of two (2) inches shall be attached to the upstream plug. The conduit shall be braced at each end to prevent slippage. The conduit and the standpipe shall be filled with water. The water level in the standpipe shall be maintained by continuous pumping a minimum of 10 feet above the invert of the upstream end of the conduit for a period of not less than two hours. Any leaks that occur during this period shall be repaired by a method satisfactory to the Engineer. After repair, the conduit shall be tested again as described above and the procedure shall be repeated until the conduit is accepted as watertight by the Engineer.

The pipe joints shall show no leakage. Damp spots developing on the surface of the pipe will not be considered as leakage.



Possessory rights of drawings and of work on all plans, drawings, designs and specifications as instruments of service are the property of Gosnell Development Corporation and may not be used in similar kind or form without the written consent of Gosnell Development Corporation.

Revisions		
By	Date	Description

19 87 COPYRIGHT © GOSNELL DEVELOPMENT CORP.

Architect: RICH ELECTRA METER Phone: 956-4400
Planning: CHEY, BULLEN Phone: 956-4400
Engineer:

Scale: AS NOTED
Drawn by: KEENER Date: =
Ck'd by: RCE Date:

PRINT SET
PRELIMINARY
CONSTRUCTION

WATER INTAKE STRUCTURE & PONTE SOUTH MOUNTAIN.

Job #

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

SHEET
1 OF 1

GEOLOGICAL CONSULTANTS

Kenneth M. Euge, R.G.

THE POINTE-SOUTH MOUNTAIN PROJECT

Response to Agency Concerns Related to Proposed Construction and the Guadalupe Flood Retarding Structure, Phoenix, Arizona

Submitted to:

Gosnell Development Corporation
2728 North 24th Street
Phoenix, Arizona 85008

Submitted by:

Geological Consultants
2822 West Northern Avenue, Suite B
Phoenix, Arizona 85051

REGISTERED GEOLOGIST
CERTIFICATE No.
10338
KENNETH M.
EUGE
Date Signed 2-12-86
ARIZONA, U.S.A.

Gosnell P.O. # 027997
Geological Consultants
Project No. 86-104

February 14, 1986

A

GEOLOGICAL CONSULTANTS

Kenneth M. Euge, R.G.

February 14, 1986

Mr. Hank Legge, P.E.
V.P. Engineering
Gosnell Development Corporation
2728 North 24th Street
Phoenix, Arizona 85008

Subject: The Pointe-South Mountain Project,
Response to Agency Concerns Related to
Proposed Construction and the Guadalupe Flood
Retarding Structure, Phoenix, Arizona
Gosnell P.O. No. 027997
Geological Consultants Project No. 86-104

Dear Mr. Legge:

This letter report presents the results of a geological evaluation of selected areas at the subject site to prepare responses to concerns raised by the Soil Conservation Service, the Arizona Department of Water Resources and the Maricopa County Flood Control District. Specifically the concerns addressed relate to the following:

- the condition of the rock exposed in cuts made for the construction of buildings on the downstream slope of the east abutment as the condition(s) affect the need, if any, for permeability testing, seepage analysis and/or grouting;
- the excavation of a proposed roadway through a portion of the west abutment near the emergency spillway to evaluate rock rippability, erodibility, and the need for slope and/or grade protection for the area excavated, and

NOT APPLICABLE

2822 West Northern Avenue, Suite B • Phoenix, Arizona 85021 • Telephone 602-864-1888

- modification to reservoir area resulting from the construction of a golf course and how the modification might affect the reservoir infiltration and embankment stability.

The evaluation was performed by Mr. Kenneth M. Euge, R.G. of Geological Consultants and the report was reviewed by Mr. Glen Copeland, P.E. of Thomas-Hartig and Associates. The requirements of this study were described in a Geological Consultants proposal dated January 9, 1986 and confirmed in a meeting at the Gosnell offices on January 20, 1986.

Scope of Work

To accomplish the objections of this study, Geological Consultants performed services that included:

- aquisition of published and unpublished reports, maps, and analyses prepared for the design of the South Mountain Development and the Guadalupe Flood Retarding Structure (FRS);
- meeting with Soil Conservaiton Services (SCS) representative, Mr. Aubry Sanders, SCS State Geologist and Mr. Harry Millsaps, Hydraulic Engineer, to discuss their concerns regarding the proposed development and the SCS geological study and hydraulic analysis made for the design of the FRS;
- a thorough review of the data obtained from various sources;

- a geological reconnaissance of the site to gather information pertaining to rock characteristics;
- analysis of the published and unpublished data, as well as the data obtained in the field; and,
- the preparation of this report presenting a summary of findings and conclusions.

Location

The Pointe-South Mountain site and Guadalupe FRS are located in the east half of Section 5, Township 1 South, Range 4 East at the east end of South Mountain. Access to the site is provided by a paved street south from Baseline Road about one-quarter mile west of the I-10 Freeway which parallels the east site property line. (Drawing No. 1)

Site Conditions

The bulk of the area originally included low, gently sloping hills to nearly flat-lying terrain. However, the site has been modified by extensive cut and fill grading for both the Pointe development and the FRS. Surface runoff from the site is retained by the FRS and released in a controlled manner from the principal spillway located in the center section of the FRS.

Geology

The site is underlain by the Tertiary-Age South Mountain Granodiorite, a light gray, medium to coarse crystalline granitic-type rock. The unit, well exposed in cuts at Building areas

6 & 7 (Drawing 2) and in the FRS emergency spillway, is generally massive and very strongly foliated (i.e. a type of lamination resulting in segregation of different minerals in response to imposed shear stresses) and closely jointed and fractured.

Joint frequency is about 3 to 4 joints per foot (12-13 joints per meter). There is no separation between the joints; however, the joints are locally filled with either clay gouge ranging in thickness from 0.005 inches to 0.25 iches, or caliche from 0.005 inches to 0.015 inches. In several areas the fractures have been recrystallized or mineralized with hematite, chalcopyrite, and chrysocolla.

Structurally, the foliation trend is in a northerly direction and dips to the east. Five joint systems are present based on the stereographic analysis of the data points obtained from three cut slopes at Building areas No. 6 and 7 (Drawing No. 3). The principal orientations are N52°W and N12°W dipping from 62° northeast to nearly vertical.

Analysis

A thorough review of the geological data available in the SCS (1972)[1] files indicate the geological information obtained for this evaluation is consistant with the earlier studies.

No design analysis of anticipated seepage rates or pressures through the foundations or the abutment areas was found in the SCS records. However, field laboratory permeability tests

1) Soil Conservation Service; 1972; Geologic Report, Guadalupe Watershed; 81 pages with plates

were performed to determine permeability coefficients for the site material (Table 1).

Table 1
Permeability Test Summary (SCS,1972)

Material Type	Test	Location	Permeability(K)
Soil @ 15.5	Open-hole	Foundation	0.56 feet/day
Bedrock @ 12.8-15.2	Packer	Near abutment	0.46 feet/day
Soil @ 20'	Open-hole	Foundation	0.50 feet/day

Hydrologic analyses (~~Appendix A~~) have been performed by the SCS to evaluate various flooding conditions that could result from modifications proposed in the reservoir area. The SCS, using topographic data provided by Gosnell Development Company, defined the Emergency Spillway flow conditions presented in Table 2.

Table 2
Summary of Results-Emergency Spillway Flood Routings

Storm Event	Main Water Surface elevation (feet)	Emergency Spillway Flow Duration (hrs.)	Max. Vel. (ft/sec)
6 hours	1276.93'	5.0	8.75
5-year	1267.04'	No flow	--
25-year	1271.16'	No flow	--
100-year	1274.14'	6.5	1.77
500-year	1274.81'	12.5	3.60

According to the SCS, the structure is designed to retain storage for a very short time period. If the reservoir is assumed to be filled to the emergency spillway elevation of 1274 feet due to a

major precipitation event, the system is designed to drain within five days.

The geologic investigation report (SCS,1972) reports a collapsible soil condition exists along portions of the FRS embankment.

Rock Cut Seepage: Potential seepage conditions possibly resulting from the cuts made into the downstream slope of the east abutment were evaluated using a method described by Hoek & Bray[2] (1974). This simplistic approach uses the joint/fracture distribution and spacing between cracks to determine the equivalent permeability of the jointed rock mass. This method assumes that the cracks are parallel and that the crack or fissures are open. Drawing No.4 shows a table from Hoek & Bray of permeability coefficient (K) for type of rocks and soil. As can be seen, the permeability for jointed rocks ranges from about 10^{-1} to 10^{-3} centimeters per second (3.3×10^{-3} to 3.3×10^{-5} feet per second) while clay-filled joints are about 10^{-4} to 10^{-6} centimeters per second (3.3×10^{-6} to $3.3\ 10^{-8}$ feet per second).

The discontinuity mapping performed at the site obtained over 190 orientations of joints and measurements of possible joint openings. (Drawing No. 5). It must be pointed out that no open fractures were found in undisturbed, intact rock. The joint and fractures were tightly filled with either clay gouge and caliche cementation or were recrystallized.

An estimate of rock permeability was made using joint spacing and assumed joint opening in the rock mass exposed in the building

2) E. Hoek and J.W. Bray; 1974; Rock Slope Engineering; Institution of Mining and Metallurgy, London pp. 112-116

pad cut slopes. For this analysis it is assumed, for the sake of conservatism, that the thickness of the filling in the joints is equivalent to a joint opening. Joint filling thickness ranged from 0 to about 0.64 centimeters (0 to 0.25 inches) with an average filling thickness of 0.015 centimeters (0.006 inches). Joint frequency is about 12 to 13 joints per meter (3 to 4 joints per foot) of slope face. The graph of joint opening to joint frequency (Drawing No. 4) indicates a conservatively high estimated permeability of about 1×10^{-3} centimeters per second (3.3×10^{-5} feet/sec). The fact that the joints are tightly filled should reduce the estimated permeabilty 1 to 2 orders of magnitude.

The packer-type test performed by the SCS during the original design studies indicated a rock permeability of about 1.6×10^{-4} centimeters per second (5.29×10^{-6} feet/sec). This value compares favorably with the estimated jointed rock permeability.

The majority of seepage losses will occur through the reservoir bottom rather that the embankment or abutments. The bottom surface area is about 12.6 million square feet while the perimeter area (sides are assumed to be vertical) with a height of 23' (equivalent to the maximum depth of the water) is about 290,000 square feet.

Movement of the water from the reservoir occurs in two ways, downward throughout the bedrock and by radial lateral outflow. The quantity of downflow can be estimated using Darcy's equation $q=kia$ where:

- q = discharge
- k = rock permeability = 3.3×10^{-5} ft/sec (Horizontal and vertical permeability is assumed equal).
- i = gradient acting across the bottom = (1)
- a = Area covered by the water

therefore:

$q=3.3 \times 10^{-5}$ ft/sec (1) (12.6×10^{-6} ft^2) =
416 ft^3/sec or 35.9×10^6 ft^3/day

A conservative estimate of lateral outflow is calculated in the same manner:

$q=3.3 \times 10^{-5}$ ft/sec (1) (2.9×10^5 ft^2) =
9.55 ft^3/sec or 8.25×10^5 ft^3/day

When $K_h = K_v$ the time required for outflow to equal downflow is about 43 days.

A better approximation of lateral outflow would be to calculate the seepage front movement in increments.

For the interval 0 to 70 feet from the edge of the assumed circular reservoir, the head (i) will range from ∞ at distance 0 feet to $\frac{23}{70} = 0.33$ which would yield a conservative average of about 0.5. Applying the Darcy equation:

$q=kia$ where $k= 3.3 \times 10^{-5}$ ft/sec
$i= 0.5$
$a = 1$ square foot

$q= (3.3 \times 10^{-5}$ ft/sec (60 sec/min)(.5)(1)=
9.0×10^{-4} feet per minute.

For the time (T) required for the front to move 70 feet:

$$\frac{70 \text{ feet}}{9.0 \times 10^{-4} \text{ ft/minute}} \times (1440 \text{ min/day}) = 54 \text{ days}$$

The seepage only has to fill the pore space; therefore applying a conservative rock porosity of 0.2:

0.2 x 54 days = 11 days for the seepage front to move out 70 feet from the reservoir edge.

Similar calculation for the intervals 70 to 140 feet and 140 feet to 350 feet yield time approximation of 20 days and 83 days respectively. These values compare favorably with the time estimated from the outflow/downflow calculations as the values are within the same order of magnitude.

The liklihood of the maximum water surface being sustained longer than a five day design period is extremely remote. Therefore, it is reasonable to assume that there will be insufficient time to develop a seepage zone where the phreatic surface intersects the cut areas in the east abutment.

Roadway Excavation in West Abutment ← NOT APPLICABLE

A review of the preliminary grading plan for the proposed roadway shows a cut to about elevation 1274 will be made in the abutment to accomodate the desired approach grades. A field inspection of the proposed site indicates the grade of the road cut as proposed will be in granitic-type bedrock similar to the rock exposed in the existing Emergency Spillway (Drawing 6) which was classified by the SCS (1972) as a rock spillway. The east edge of the Emergency Spillway is located about 120 feet from the centerline of the roadway. The spillway crest elevation is 1274 feet.

It is expected that excavations to the designed elevations can be accomplished in a manner similar to the rock cuts made in the building area. Erosion of the roadway at the crest elevation should be minimal. However, downstream from the crest where the approach embankment fills are constructed erosion will likely occur.

Golf Course Development

The preliminary design drawings of the proposed golf course show the reservoir capacities will not be significantly changed from the original SCS design[3] (SCS,1986). The greatest concern is the lakes proposed to parallel the upstream area adjacent to the main FRS embankment.

The geologic design report for the FRS shows the presence of collapsible soils beneath the embankment section. If the soils are saturated they will consolidate under the weight of the embankment that could cause differential settlement and cracking to occur in the structure. This potential condition can be effectively mitigated by lining the lakes with a relatively unpermeable membrane such as hypolon or high density polyethylene (HDPE).

Conclusion

1. Analysis of rock joints frequency and opening indicates the estimated permeability of the rock mass is similar to field permeability test results obtained by the SCS.

2. A simplified seepage analysis of flow from a full reservoir using very conservative input parameters indicate the development of a saturated zone resulting in seepage from the rock cuts in the east abutment would be required in excess of 40 days to develop if a full reservoir level were sustained for that period of time. The design time required to drain the FRS is five days, therefore seepage from the reservoir pool into the rock cut areas should not occur.

3) Soil Conservation Service, 1986; Personal communication with H. Millsaps, Hydrologic

NOT APPLICABLE

3. The road cut proposed through the west abutment is expected to be excavated in bedrock. Erosion of rock should not be problematic. The bedrock is likely to be excavatable based on prior experience at the Pointe-South Mountain site.

4. The proposed development within the reservoir area should not affect the foundation permeability characteristics of the FRS embankment if the proposed lakes are effectively lined to minimize saturation of foundation soils.

Recommendations

1. Based on the results of the study of the rock cut areas, it appears that a detailed field permeability testing program and seepage analysis of the east abutment area is not warranted. Grouting or sealing of the rock should not be required for controling seepage from the reservoir. However, surface runoff over the slope and resulting percolation from landscape watering, rainfall, and other sources must be controlled to enhance slope stability.

NOT APPLICABLE

2. The grade of the proposed roadway through the west abutment is about the same as the Emergency Spillway (1274 feet ±). A hydrologic analysis should be performed to assess the effects of the road cut relative to modification of the Emergency Spillway flow regime. If the analysis shows excessive flows through the road cut, downslope erosion control should be provided for the approach embankment fills and the toe areas of the FRS.

3. The lakes proposed for the golf course development must be effectively lined with a relative impervious membrane such as hypolon or HDPE. The lining will reduce the seepage losses from the lakes and minimize the saturation of FRS embankment foundation

soils.

The conclusions and opinions presented in this letter report were developed by Geological Consultants for Gosnell Development Corporation in accordance with generally accepted geological principles and practices. The data, conclusions and recommendations should be considered to relate only to the specific project and location. If changes are made in the project as outlined in this report the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions and recommendations of this report are modified or approved in writing by Geological Consultants.

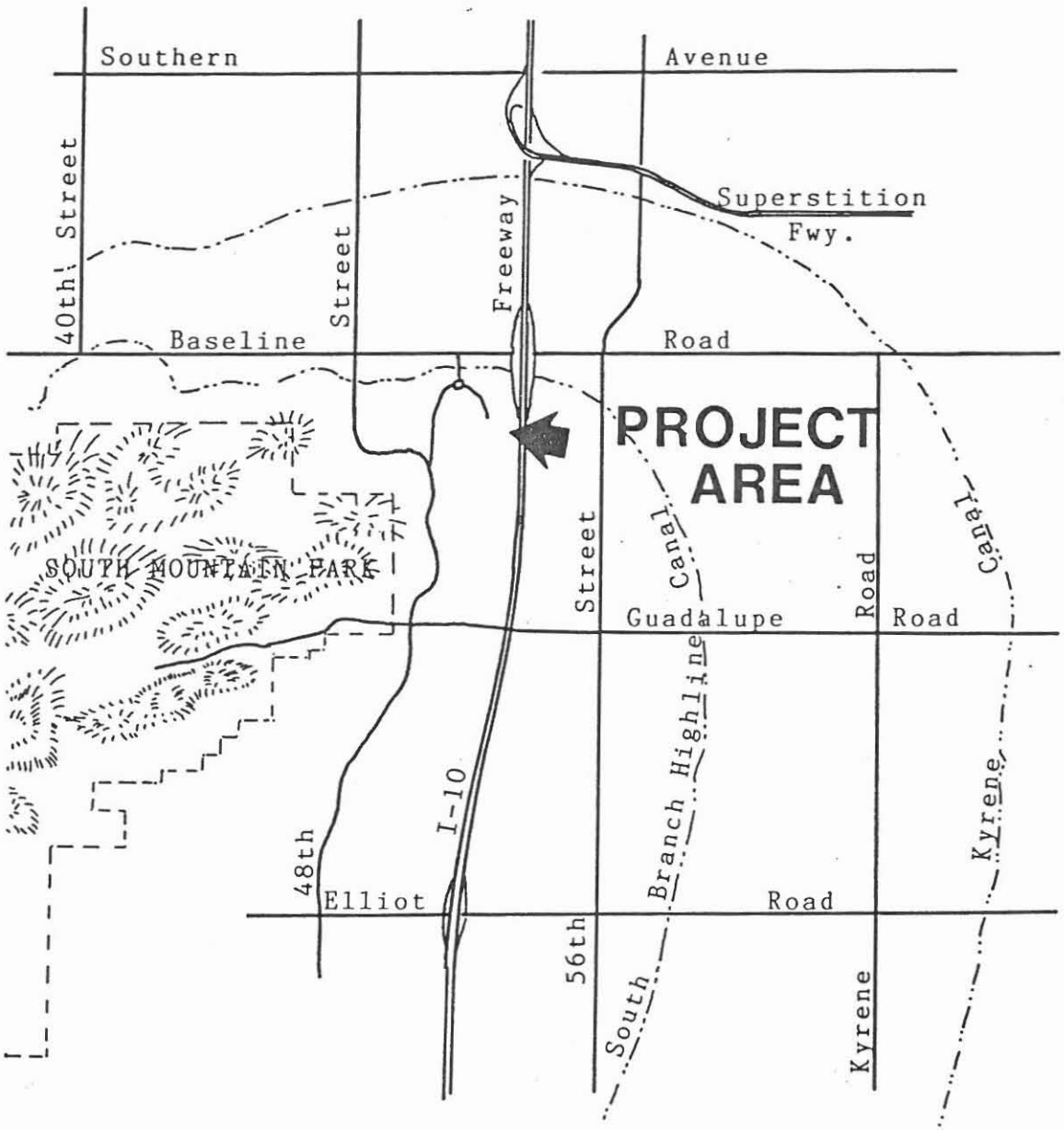
Thank you for this opportunity to be of service to you. If you have any questions regarding the content of this report please contact me.

Very truly yours,

REGISTERED GEOLOGIST
CERTIFICATE No.
10338
KENNETH M.
EUGE
Date Signed 2-14-86
ARIZONA, U.S.A.

Kenneth M. Euge, P.G.
Consulting Geologist

KME/jmw



Not to scale

North

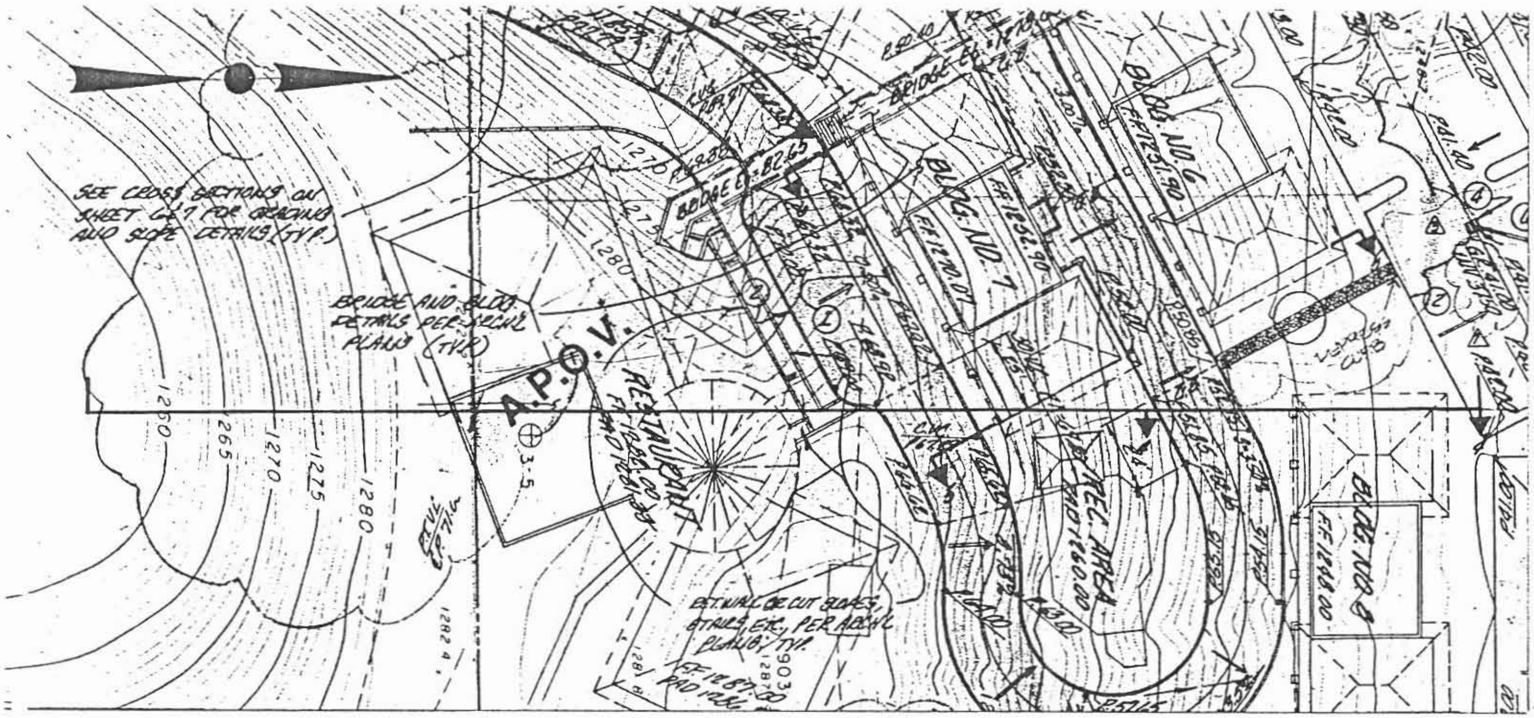
Geological Consultants
2822 West Northern Avenue, Suite B
Phoenix, Arizona 85051

SCALE:	APPROVED BY:	DRAWN BY
DATE: 2-14-86		REVISED

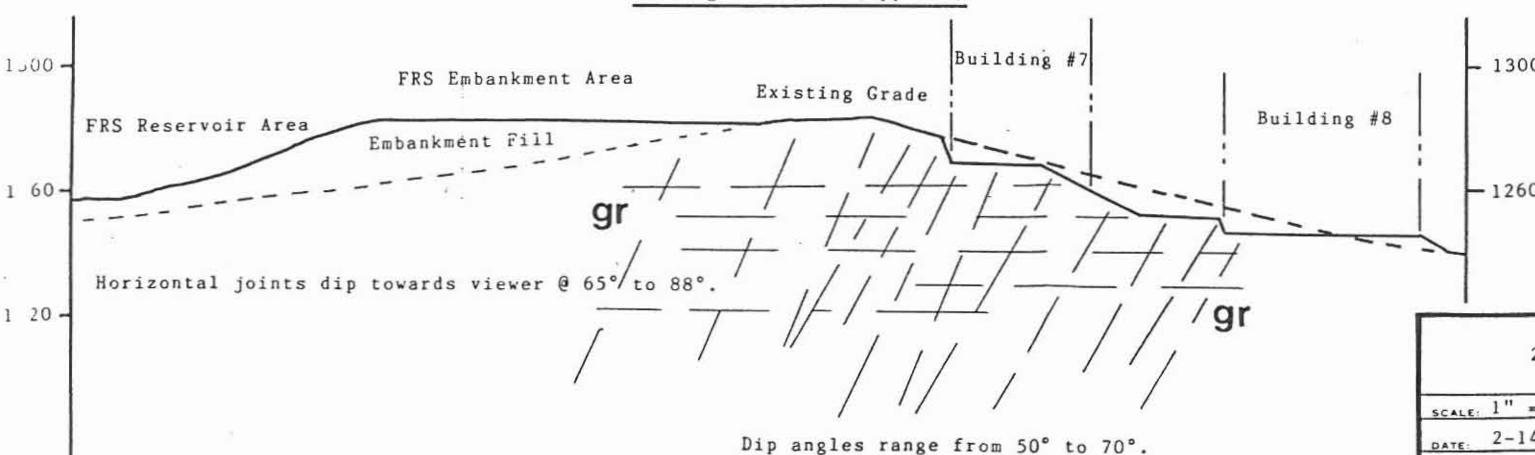
The Pointe-South Mountain Project
Phoenix, Arizona

Location Map	DRAWING NUMBER 1

86-104



Bearing Due North (approx.)



Base map from Grading and Drainage Plan prepared by Gosnell Development Corporation, Sheet CG&D 5/7, Rev. 5, 11-1-85.

86-104

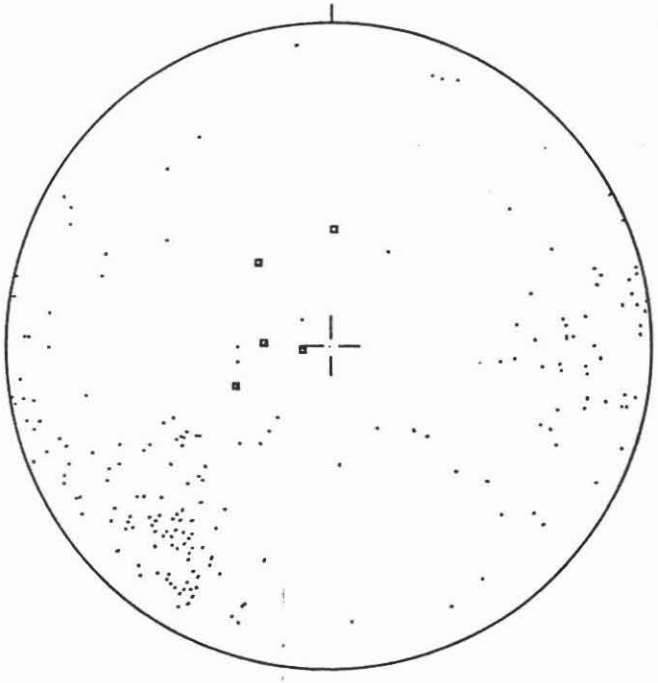
gr

South Mountain Granodiorite--light gray; medium to coarse crystalline; strongly foliated; closely jointed; locally mineralized.

Geological Consultants 2822 West Northern Avenue, Suite B Phoenix, Arizona 85051		
SCALE: 1" = 40' DATE: 2-14-86	APPROVED BY:	DRAWN BY REVISED
The Pointe-South Mountain Project Phoenix, Arizona		
East Abutment Building Pad Cut Areas Plan and Cross-section		DRAWING NUMBER 2

Relative Importance of Pole Concentrations

	Azimuth	Strike	Dip
A 25	038°	N 52 W	62NE
B 17	078°	N 12 W	90
C 10	058°	N 32 W	50NE
D 8	270°	N -- S	70W
E 4	260°	N 10 W	70SW
F 4	270°	N -- S	80W



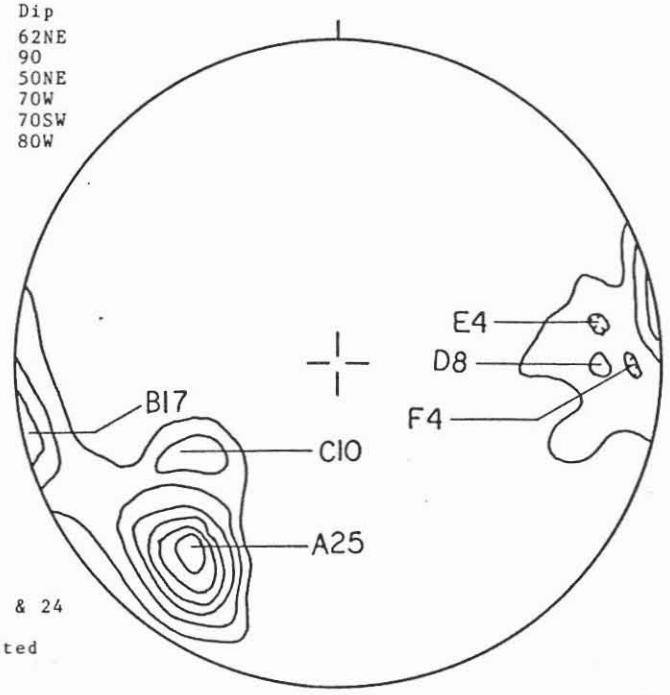
(a.) Pole Plot (192 points)

• Joint pole

▫ Foliation Pole

Contours @ 4, 8, 12, 16, 20, & 24

Highest concentration indicated in each concentration.



(b.) Polt Plot Concentration

86-104

Geological Consultants 2822 West Northern Avenue, Suite B Phoenix, Arizona 85051		
SCALE:	APPROVED BY: K.	DRAWN BY CE
DATE: 2-14-86		REVISED
The Pointe-South Mountain Project Phoenix, Arizona		
Stereographic Plot of Joint Data		DRAWING NUMBER 3

11 X 17 PRINTED ON NO. 1000H CLEARPRINT

	TABLE II - PERMEABILITY COEFFICIENTS FOR TYPICAL ROCKS AND SOILS			
	k - cm/sec	Intact rock	Fractured rock	Soil
practically impermeable	10^{-10}	Slate		Homogeneous clay below zone of weathering
	10^{-9}	Dolomite		
	10^{-8}	Granite		
	10^{-7}			
low discharge poor drainage	10^{-6}	Limestone — Sandstone		Very fine sands, organic and inorganic silts, mixtures of sand and clay, glacial till, stratified clay deposits
	10^{-5}		Clay-filled joints	
	10^{-4}			
	10^{-3}			
High discharge Free draining	10^{-2}		Jointed rock	Clean sand, clean sand and gravel mixtures
	10^{-1}			
	1.0		Open jointed rock	
	10^{1}			
	10^{2}		Heavily fractured rock	Clean gravel

(4a.)

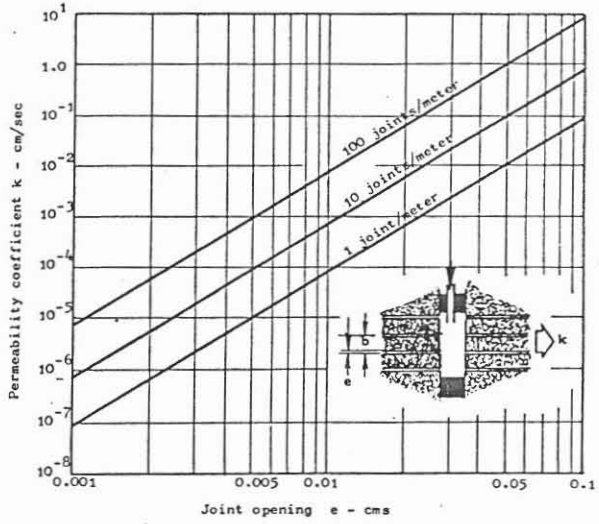


Figure 52 : Influence of joint opening e and joint spacing b on the permeability coefficient k in the direction of a set of smooth parallel joints in a rock mass.

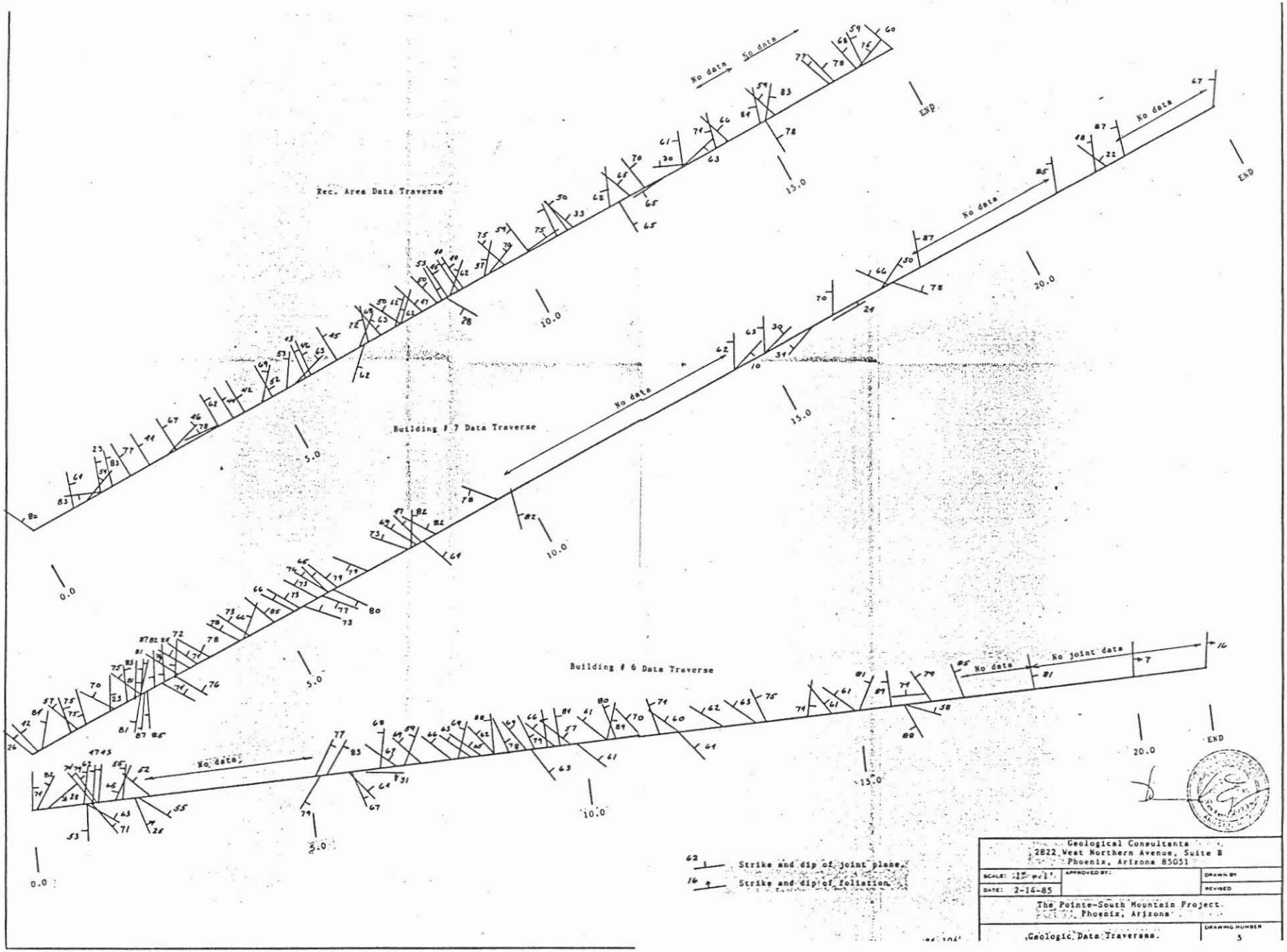
(4b.)

From E. Hoek and J. W. Bray; 1974; Rock Slope Engineering; Institution of Mining and Metallurgy, London; pp. 114 and 115.

86-104

Geological Consultants 2822 West Northern Avenue, Siute B Phoenix, Arizona 85051		
SCALE:	APPROVED BY: KE	DRAWN BY KE
DATE: 2-14-86		REVISED
The Pointe-South Mountain Project Phoenix, Arizona		
Effective Permeability Data Sources		DRAWING NUMBER 4

11 X 17 PRINTED ON NO. 1000H CLEARPRINT



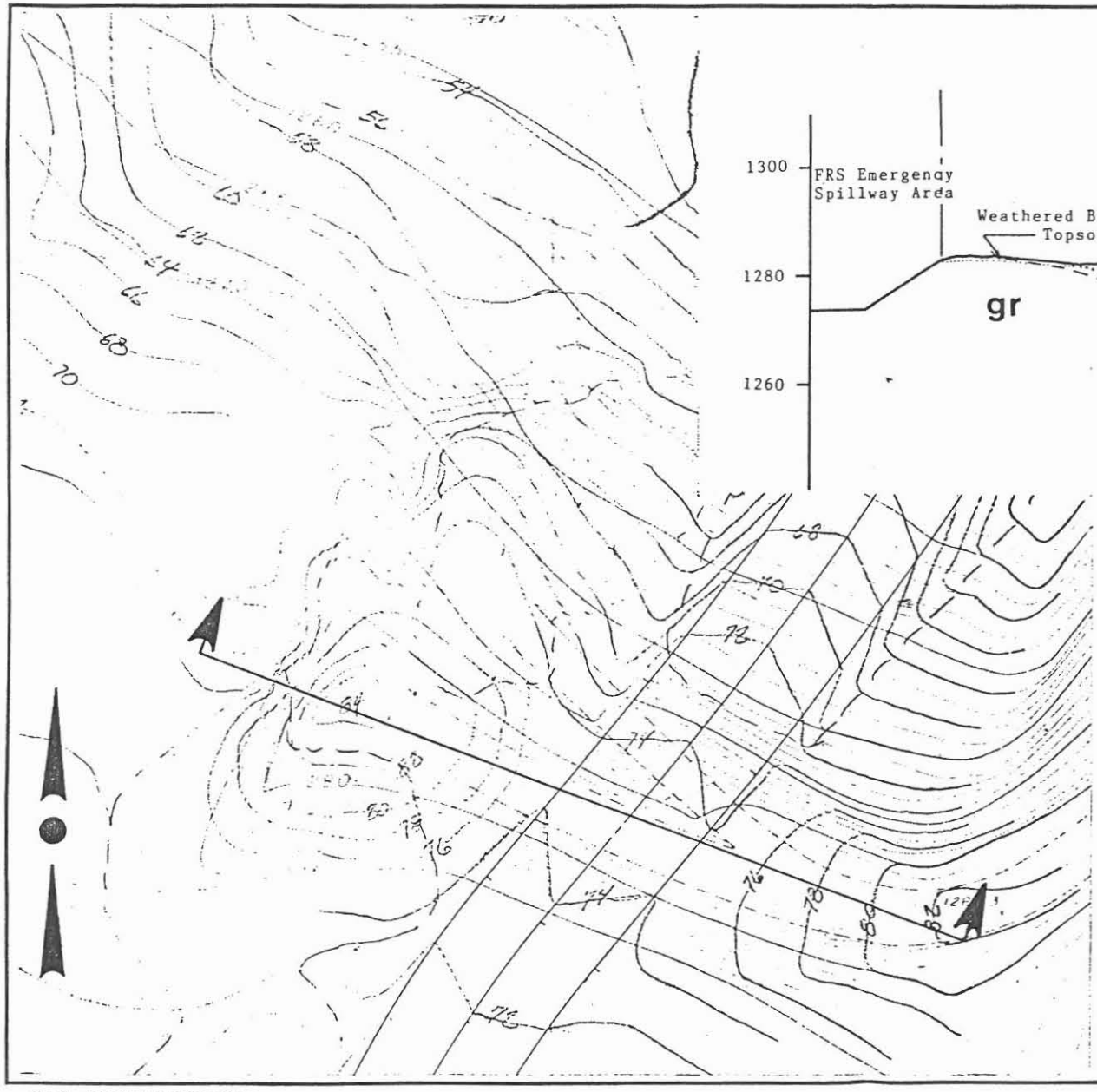
Geological Consultants
2822 West Northern Avenue, Suite B
Phoenix, Arizona 85051

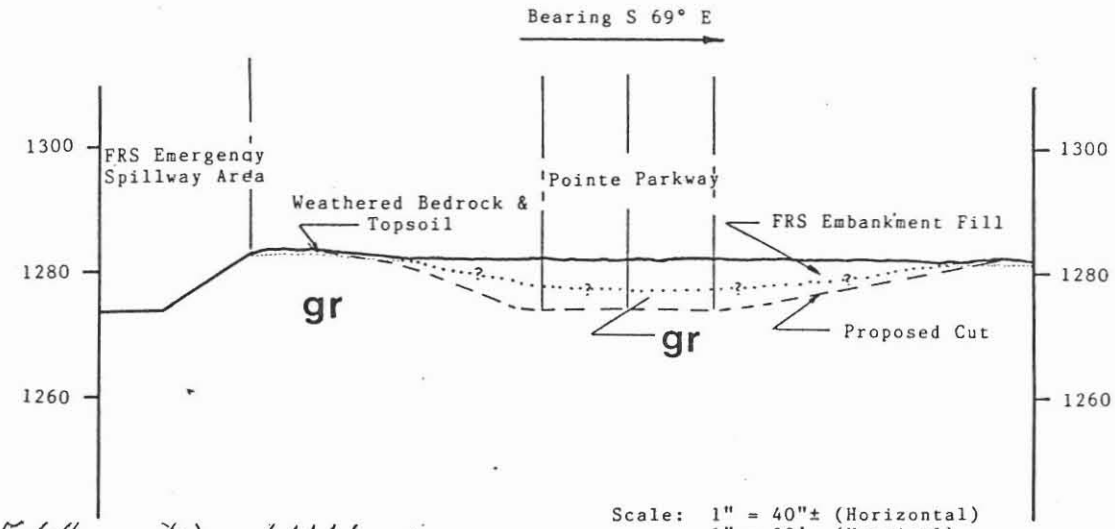
SCALE: 1" = 1'	APPROVED BY:	DRAWN BY
DATE: 2-14-85		REVISED

The Pointe-South Mountain Project
Phoenix, Arizona

Geologic Data Traverses.

DRAWING NUMBER 5





Scale: 1" = 40"± (Horizontal)
1" = 20' (Vertical)

gr South Mountain Granodiorite--light gray; medium to coarse crystalline; strongly foliated; closely jointed; locally mineralized.

Base map from untitles preliminary drawing prepared by Gosnell Development Corporation, undated.

86-104

Geological Consultants 2822 West Northern Avenue, Suite B Phoenix, Arizona 85051		
SCALE:	APPROVED BY:	DRAWN BY K. Z.
DATE: 2-14-86		REVISED
The Pointe-South Mountain Project Phoenix, Arizona		
Road Through West Abutment Plan & Cross-section		DRAWING NUMBER 6

11 X 17 PRINTED ON NO. 1000H CLEARPRINT

THOMAS-HARTIG & ASSOCIATES, INC.

TOM W. THOMAS, P.E. · HARRY E. HARTIG, P.E.
Soil and Foundation Engineering · Materials Testing
7031 West Oakland Street Chandler, Arizona 85226 602/961-1169

James R. Morrow
John P. Boyd, P.E.
Charles H. Atkinson, P.E.
Donald J. Spadola, P.E.

Glen K. Copeland, P.E.
James M. Willson, P.E.
Frank M. Guerra, P.E.

Roger A. Brewer, P.E.
Steven A. Haire, P.E.
Chet L. Pearson, P.E.
Kenneth L. Ricker, P.E.

Gosnell Development Corporation
2728 North 24th Street
Phoenix, Arizona 85036

3 February 1987

Attention: Mr. Bill Gordon

Project: Mountainside Suites
Pointe South Mountain
Phoenix, Arizona

Project No: 86-860

This report presents the conditions encountered at and beyond the toe of the downstream slope of the Guadalupe Flood Retention Dam No. 2, in the area of the proposed Mountainside Suites.

In this area, in order to comply with the Flood Control District's requirements, the overburden soils were removed until either hard cemented soils and/or bedrock were exposed. The depth to these materials varied from approximately six (6) feet below existing grade at the southwest end of the suites area (near the prinicipal spillway outlet conduit) to zero (0) feet at the northeast end of the suites area. After removal of the overburden soils, fills were placed at a minimum compaction of 100 percent of the maximum dry density determined by ASTM: D698 (Standard Proctor).

Please do not hesitate to call when we may be of further service to you.

Respectfully Submitted,
THOMAS-HARTIG AND ASSOCIATES, INC.

By: _____ Reviewed by: _____
Frank M. Guerra, P.E. Roger A. Brewer, P.E.

/srb
Copies to: Addressee (3)
Flood Control District/Grant Pickerton (2)

THOMAS-HARTIG & ASSOCIATES, INC.

TOM W. THOMAS, P.E. · HARRY E. HARTIG, P.E.
Soil and Foundation Engineering · Materials Testing
7031 West Oakland Street Chandler, Arizona 85226 602/961-1169

James R. Morrow
John P. Boyd, P.E.
Charles H. Atkinson, P.E.
Donald J. Spadola, P.E.

Glen K. Copeland, P.E.
James M. Willson, P.E.
Frank M. Guerra, P.E.

Roger A. Brewer, P.E.
Steven A. Haire, P.E.
Chet L. Pearson, P.E.
Kenneth L. Ricker, P.E.

Gosnell Development Corporation
2728 North 24th Street
Phoenix, Arizona 85008

23 October 1986

Attention: Hank Legge, P.E.

Project: Mountainside Suites
Pad Fill Placement
The Pointe Resort at South Mountain
Phoenix, Arizona

Project No: 86-743
Supplement No. 5

As requested, we have evaluated the use of Mirafi 600X filter fabric between existing embankment materials at Guadalupe Flood Control Structure North Dam 2 and your new fill pads for the proposed mountainside suites. Based on our evaluation, Mirafi 600X appears suitable for this use.

According to the manufacturer's specifications, a copy of which is attached, the average effective opening size (EOS) of Mirafi 600X is equivalent to U.S. Standard Sieve No. 20 to 45, or approximately 0.84 to 0.37 mm. According to the grain size distribution curves for the borrow material used to construct the embankments, a copy of which is also attached, the diameter corresponding to "85% passing," or 85% size of soil, varies from approximately 20 to 150 mm. Design criteria for filter fabric adjacent to granular soils presented by Cedergren (1977) indicates for effective soil retention:

$$\frac{\text{85\% size of soil}}{\text{opening size of EOS sieve}} \geq 1$$

By observation this criterion is met.

The other criterion is permeability; the fabric must not hinder flow. The specified permeability for Mirafi 600X is 3×10^{-3} cm/sec. Based on construction data and testing information provided to us by Soil Conservation Service, we

estimate the permeability of the embankment materials is at least one or more orders of magnitude less. Thus, the fabric should not hinder flow.

This supplement shall be attached to the original report and shall become a part thereof. Please do not hesitate to call when we may be of further service to you.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By: _____ Reviewed by: _____

Roger A. Brewer, P.E. Glen K. Copeland, P.E.

/cjf

Copies to: Addressee (7)

MIRAFI® TYPICAL PROPERTY VALUES*

PROPERTY	UNIT	TEST METHOD	140S	140N	100X	500X	600X	700X	900N
Weight	oz/sy	ASTM D-3776-79	4.0	4.5	2.5	4.0	6.0	6.5	4.0
Thickness	mils	ASTM D-1777-64	30	60	5	9.0	12	19	50
Grab Strength	lb	ASTM D-1682-64	125	120	100	200	300	520 x 310	115
Grab Elongation	%	ASTM D-1682-64	45	55	30	30 (max)	35 (max)	35 (max)	60
Modulus (10% Elongation)	lb	ASTM D-1682-64	N/A	N/A	N/A	115	140	N/A	N/A
Trapezoid Tear Strength	lb	ASTM D-1117-80	65	50	65	100	120	75	N/A
Mullen Brust Strength	psi	ASTM D-3786-80[1]	125	210	200	375	600	560	N/A
Puncture Strength	lb	ASTM D-3787-80[2]	55	70	N/A	85	130	145	N/A
Abrasion Resistance	lb	ASTM D-3884-80[3] & D-1682-64	N/A	N/A	N/A	50	100	155	N/A
Coef. of Permeability, k	cm/sec	CFMC-GET-2	0.1	0.2	0.0009	0.002	0.003	0.025	N/A
Water Flow Rate	gal/min/sf	CFMC-GET-2	350	225	40	35	50	120	N/A
Air Flow Rate	cf/min/sf	ASTM D-737	300	225	N/A	N/A	N/A	115	290
Equivalent Opening Size (EOS)	US Standard Sieve	COE CW 02215-77	100	100+	20	20-45	20-45	70	N/A
Open Area	%	COE Method	N/A	N/A	N/A	N/A	N/A	5.5	N/A
Retention Efficiency (Suspended Solids)	%	Virginia DOT VTM-51	N/A	N/A	75	N/A	N/A	N/A	N/A
Slurry Flow Rate	gal/min/sf	Virginia DOT VTM-51	N/A	N/A	1.0	N/A	N/A	N/A	N/A
Gradient Ratio	—	COE CW 02215-77	<3	<3	N/A	N/A	N/A	<3	N/A
Ultraviolet Radiation Stability	%	ASTM G-26/ D-1682-64[4]	0	0	90	30	90	90	0
Asphalt Retention	oz/sf	Texas DOT Item 3099	N/A	N/A	N/A	N/A	N/A	N/A	3.5
Shrinkage from Asphalt	%	Texas DOT Item 3099	N/A	N/A	N/A	N/A	N/A	N/A	<6

[1] Diaphragm Bursting Tester
[2] Tension Testing Machine with ring clamp, steel ball replaced with a 5/16 inch diameter solid steel cylinder (with hemispherical tip) centered within the ring clamp.
[3] ASTM D-1682 as above after abrasion as required by ASTM D-3884 Rotary Platform, Double Head Method, rubber-base abrasive wheels equal to CS-17 "Calibrase" by Taber Instrument Co.; 1kg load per wheel, 1,000 revolutions
[4] ASTM D-1682 as above after 250 cycles in Xenon-arc weatherometer (Type BH or Type C apparatus as described in ASTM G-26). One cycle consists of 102 minutes of light only followed by 18 minutes of light with water spray

THOMAS-HARTIG & ASSOCIATES, INC.
Project No: 86-743

LABORATORY NO A72033

MATERIALS TESTING REPORT

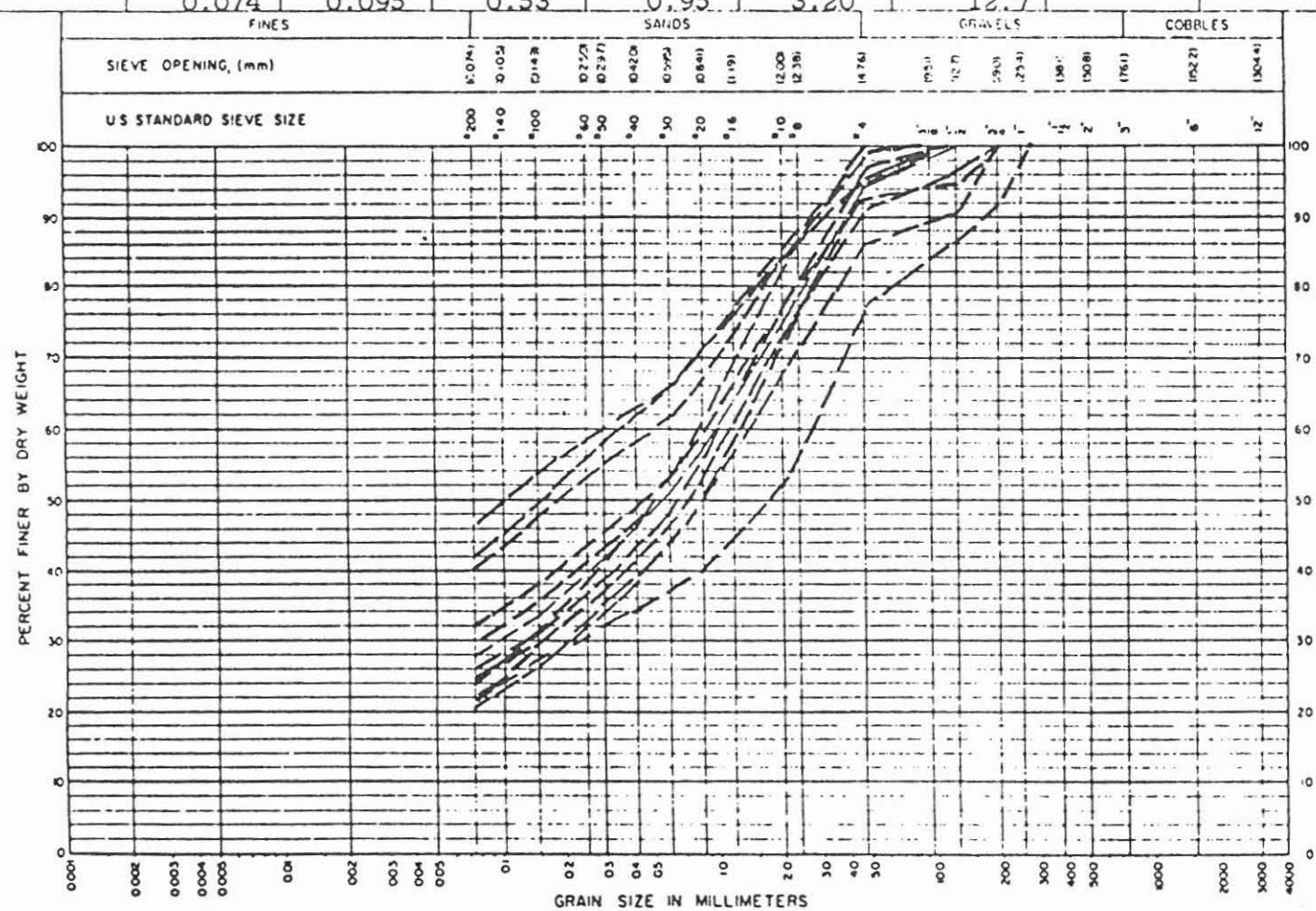
U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

PROJECT and STATE: Guadalupe WPP, Arizona
FIELD SAMPLE NO: 101 1
DEPTH: 0-5.0'
GEOLOGIC ORIGIN:
SAMPLE LOCATION: I-10 53+00 200' upstream
TYPE OF SAMPLE: Composite
TESTED AT: SCS field lab
APPROVED BY: [signature]
DATE: 10 Dec. 1971
SYMBOL: SM-1
DESCRIPTION: Coarse silty sands

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
	0.074	0.095	0.53	0.95	3.20	12.7		



SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI	%	%	%	g/cc pcf

REMARKS: Washed

Summary of grain size distribution curves for borrow pits 101 through 111, 2002 and 2005

THOMAS-HARTIG & ASSOCIATES, INC.

TOM W. THOMAS, P.E. · HARRY E. HARTIG, P.E.
Soil and Foundation Engineering · Materials Testing
7031 West Oakland Street Chandler, Arizona 85226 602/961-1169

James R. Morrow
John P. Boyd, P.E.
Charles H. Atkinson, P.E.
Donald J. Spadola, P.E.

Glen K. Copeland, P.E.
James M. Willson, P.E.
Frank M. Guerra, P.E.

Roger A. Brewer, P.E.
Steven A. Haire, P.E.
Chet L. Pearson, P.E.
Kenneth L. Ricker, P.E.

Gosnell Development Corporation
2728 North 24th Street
Phoenix, Arizona 85008

20 October 1986

Attention: Mr. Hank Legge, P.E.

Project: Pointe Parkway East
Spillway/Road Cut
The Pointe Resort at South Mountain
Phoenix, Arizona

Project No: 86-743
Supplement No. 4

In accordance with your request, we present recommended allowable bearing pressures and lateral design parameters to use for designing the concrete spillway chute at the cut for the new Pointe Parkway East. We understand the chute will be a concrete mat with short retaining walls on either side.

The cut will be approximately 80 feet wide and located just east of the existing 200-foot wide emergency spillway between North Dam 1 and North Dam 2 of the existing Guadalupe Flood Control Structure. The cut will serve as additional spillway capacity and match the elevation of the existing emergency spillway (Elevation 1274 feet±). The existing spillway surface is bedrock and, based on geological information provided for our review, it appears the new cut will also extend into bedrock. For this supplement, we provide recommendations for both soil and rock bearing conditions to cover both possibilities.

Soil Bearing: Continuous retaining wall footings should be founded a minimum depth of 1.5 feet below the lowest outside grade. The footings should bear on natural undisturbed soil or on engineered, structural fill which has been compacted to at least 95 percent of the ASTM D698 maximum dry density. A 1500 psf bearing pressure is recommended as an allowable maximum for dead plus design live loads and may be increased by one-third when considering lateral or overturning forces. The minimum recommended footing width is 2 feet.

Rock Bearing: Where clean, sound rock is encountered above base of footing level, it is permissible to waive the design footing depth recommended above provided the minimum footing width is maintained, lateral stability is achieved, and a scour protection is provided on exterior footing edges. To achieve lateral stability, steel reinforcing rods must be anchored in holes cored in the rock. Where hard, unjointed rock zones are encountered and the cored hole diameters are slightly less than the rod diameters, the rods can probably be driven into the holes to form a friction condition. We anticipate that cement grout would be necessary for bonding only if the rock is friable and jointed, or if tensile capacity is required.

Lateral Design Parameters: The following tabulation presents recommendations for lateral stability analyses:

[1]Foundation Toe Pressures----------1.33x allowable
[2]Lateral Backfill Pressures:
Unrestrained walls----------75 psf/ft.
Restrained walls----------90 psf/ft.
Lateral Passive Pressures:
Continuous walls/footings----------125 psf/ft.
Spread columns/footings----------175 psf/ft.
Coefficient of Base Friction:
Independent of passive resistance------0.40
In conjunction with passive resistance-0.30

[1]Increase in allowable foundation bearing pressure (previously tabulated) for foundation toe pressures due to eccentric or lateral loading. The entire footing bearing surface should remain in compression.

[2]Equivalent fluid pressures for vertical walls and horizontal backfill surfaces (maximum 12-foot height). Backfill surfaces which are not horizontal should be evaluated on a case-by-case basis. Pressures reported above include hydrostatic pressure caused by inundation. Pressures do not include temporary forces imposed during compaction of the backfill, swelling pressures developed by over-compacted clayey backfill, or surcharge loads. Walls should be suitably braced during backfilling to prevent damage and excessive deflection.

Compaction of the backfill soils against embedded footings or walls designed to provide passive resistance should be accomplished to a minimum 95 percent of the maximum ASTM D698 density to develop this resistance with low strains.

General: For footing design, the weight of a vertical column of saturated soil above the footing, and the vertical component of load from the retained soil (use 1/3 of the lateral active pressure) should be used. All continuous footings which descend slopes should be constructed on horizontal steps cut into the slopes. Scour protection has been assumed and must be provided. All footing excavations should be observed by a geotechnical engineer prior to steel placement. If the bearing conditions do not appear suitable for support, remedial measures such as over-excavation and recompaction, deepening and/or widening of footings, etc. will be required.

This supplement shall be attached to the original report and shall become a part thereof. Please do not hesitate to call if you have any questions or if we may be of further assistance.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By: _____ Reviewed by: _____

Roger A. Brewer, P.E. Glen K. Copeland, P.E.

/cmm

Copies to: Addressee (7)

THOMAS-HARTIG & ASSOCIATES, INC.

TOM W. THOMAS, P.E. · HARRY E. HARTIG, P.E.
Soil and Foundation Engineering · Materials Testing
7031 West Oakland Street Chandler, Arizona 85226 602/961-1169

James R. Morrow
John P. Boyd, P.E.
Charles H. Atkinson, P.E.
Donald J. Spadola, P.E.

Glen K. Copeland, P.E.
James M. Willson, P.E.
Frank M. Guerra, P.E.

Roger A. Brewer, P.E.
Steven A. Haire, P.E.
Chet L. Pearson, P.E.
Kenneth L. Ricker, P.E.

Gosnell Development Corporation
2728 North 24th Street
Phoenix, Arizona 85008

17 September 1986

Attention: Mr. Hank Legge, P.E.

Project: Slope Stability & Settlement Evaluation
Mountainside Suites
The Pointe Resort at South Mountain
Phoenix, Arizona

Project No: 86-743
Supplement No. 3

As requested, we submit with this supplement the results of additional stability analyses of the Guadalupe Flood Retention North Dam No. 2. These additional analyses are exactly the same as those presented in Supplement No. 2, except as follows:

1. We used a friction angle of 27.5 degrees for the embankment materials, rather than 35 degrees.

2. We used 125 pcf saturated unit weight for the embankment materials, rather than 135 pcf.

Using the computer program TSTAB and evaluating rapid drawdown on the upstream slope (as before) the results of the additional analyses are as follows:

Trial	Condition	Factor of Safety
1	Static; saturated foundation soils	1.5
2	Static; bouyant foundation soils	1.5
3	Pseudo-static (0.1g); bouyant foundation soils	1.1

As before, these minimum factors of safety generally correspond to "infinite slope" conditions, or surface raveling. Failure circles which extend deeper into the shoulder of the dam indicate higher factors of safety.

This supplement shall be attached to the original report and shall become a part thereof. Please do not hesitate to call when we may be of further service to you.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By: _____ Reviewed by: _____

Roger A. Brewer, P.E. Glen K. Copeland, P.E.

/cjf

Copies to: Addressees (7)

THOMAS-HARTIG & ASSOCIATES, INC.

TOM W. THOMAS, P.E. · HARRY E. HARTIG, P.E.
Soil and Foundation Engineering · Materials Testing
7031 West Oakland Street Chandler, Arizona 85226 602/961-1169

James R. Morrow
John P. Boyd, P.E.
Charles H. Atkinson, P.E.
Donald J. Spadola, P.E.

Glen K. Copeland, P.E.
James M. Willson, P.E.
Frank M. Guerra, P.E.

Roger A. Brewer, P.E.
Steven A. Haire, P.E.
Chet L. Pearson, P.E.
Kenneth L. Ricker, P.E.

Gosnell Development Corporation
2728 North 4th Street
Phoenix, Arizona 85008

15 September 1986

Attention: Mr. Hank Legge, P.E.

Project: Slope Stability & Settlement Evaluation
Mountainside Suites
The Pointe Resort at South Mountain
Phoenix, Arizona

Project No: 86-743
Supplement No. 2

In accordance with your request, we have performed additional stability analyses of the Guadalupe Flood Retention North Dam No. 2. These additional analysis were performed using the same assumed critical cross section as described in our original letter report dated 30 June 1986; however, we have substituted strength values requested by Soil Conservation Service (SCS) for the foundation soils. In addition, we have evaluated the effect of a "pseudo-static" horizontal acceleration of 0.1g, and we have evaluated the effect of buoyancy in the foundation soils. The assumed critical cross section and strength parameters are shown on the attached Figure 1. Using the same computer program (TSTAB) and evaluating rapid drawdown on the upstream slope (as before), the results of the additional stability analyses are as follows:

Trial	Condition	Factor of Safety
1	Static; saturated foundation soils	2.0
2	Static; bouyant foundation soils	2.0
3	Pseudo-static (0.1g); bouyant foundation soils	1.5

These minimum factors of safety generally correspond to "infinite slope" conditions, or surface raveling. Failure circles which extend deeper into the shoulder of the dam indicate higher factors of safety. Some representative failure circles, and their corresponding factors of safety, are included on Figure 1.

This supplement shall be attached to the original report and shall become a part thereof. Please do not hesitate to call when we may be of further service to you.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By: _____ Reviewed by: _____

Roger A. Brewer, P.E. Glen K. Copeland, P.E.

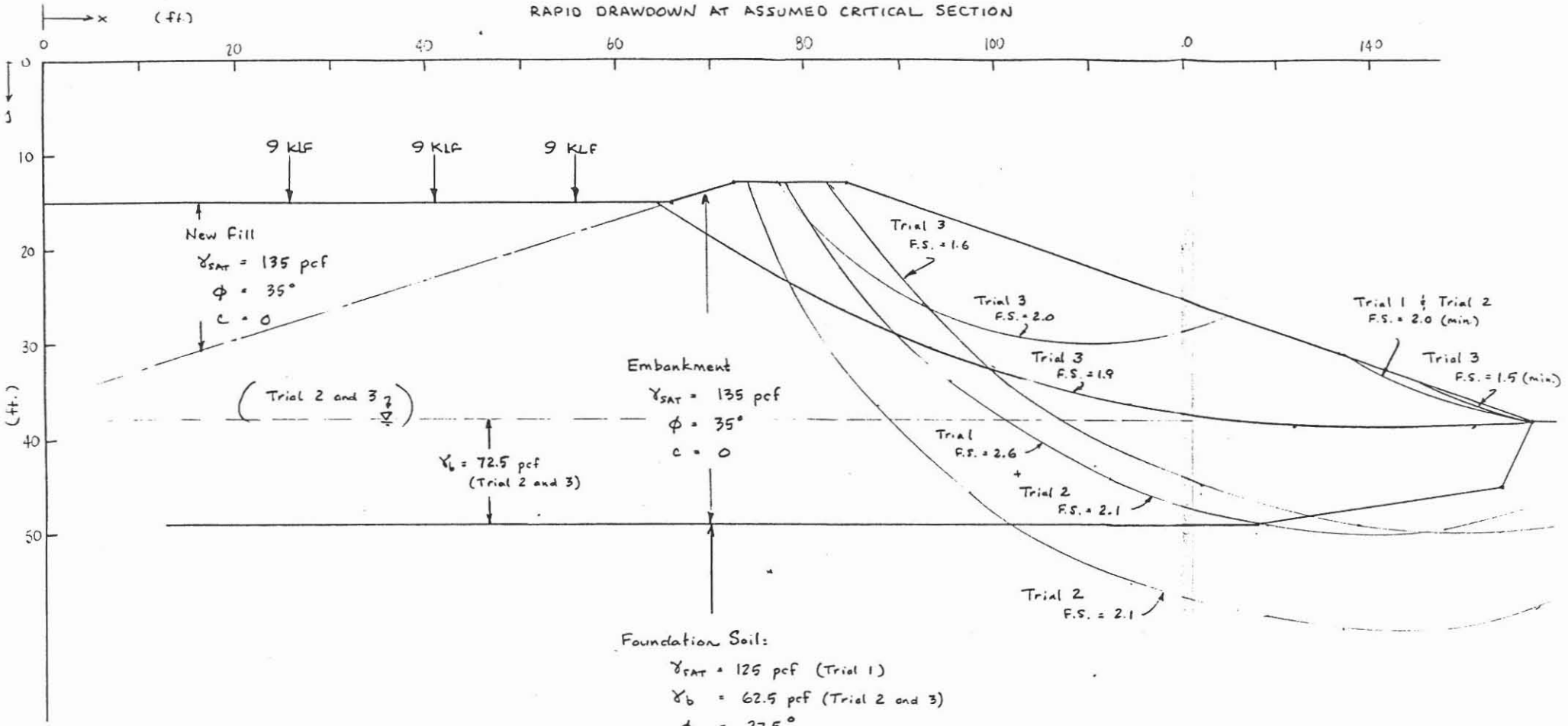
/cjf

Copies to: Addressee (7)

FIG. 1 SLOPE GEOMETRY AND TSTAB RESULTS (2nd SERIES)

NORTH DAM NO. 2 WITH FILL AND LINE LOADS

RAPID DRAWDOWN AT ASSUMED CRITICAL SECTION



Foundation Soil:

γ_{SAT} = 125 pcf (Trial 1)

γ_b = 62.5 pcf (Trial 2 and 3)

ϕ = 27.5°

c = 0

(Note: For Trial 3, add 0.1 g horizontal acceleration)

Thomas-Hartig & Associates

Project 86-743.2 9/15/86

THOMAS-HARTIG & ASSOCIATES, INC.

TOM W. THOMAS, P.E. · HARRY E. HARTIG, P.E.
Soil and Foundation Engineering · Materials Testing
7031 West Oakland Street Chandler, Arizona 85226 602/961-1169

James R. Morrow
John P. Boyd, P.E.
Charles H. Atkinson, P.E.
Donald J. Spadola, P.E.

Glen K. Copeland, P.E.
James M. Willson, P.E.
Frank M. Guerra, P.E.

Roger A. Brewer, P.E.
Steven A. Haire, P.E.
Chet L. Pearson, P.E.
Kenneth L. Ricker, P.E.

Gosnell Development Corporation
2728 N. 24th Street
Phoenix, Arizona 85008

20 August 1986

Attention: Mr. Hank Legge, P.E.

Project: Slope Stability & Settlement Evaluation
Mountainside Suites
The Pointe Resort at South Mountain
Phoenix, Arizona

Project No: 86-743
Supplement No. 1

Through discussions with Mr. Ralph Arrington of Soil Conservation Service (SCS), we understand SCS has two additional geotechnical-related concerns regarding your proposed construction on and near the Guadalupe Flood Retention North Dam No. 2. These concerns, and our responses, are as follows:

Concern No. 1: If the foundation bearing soils beneath the dam become saturated, would significant settlement occur? SCS is concerned that the proposed golf course lakes, located in the basin upstream from the dam, might leak through their linings, saturate the bearing soils, and cause the dam to settle significantly.

Response: Based on boring information and the conclusions presented in "Guadalupe Watershed, Geological Investigation", collapsible soil zones were encountered near ground surface (0 to 5 feet) at the Saddle Dike secton and in a silt (ML) layer at a 6.5 to 8.5-foot depth near Station 41 of the I-10 section. At greater depths, the borings indicated either dense granular soils, hard caliche, or bedrock. According to a file memorandum dated 13 May 1986 from K.M. Hussain of Arizona Department of Water Resources (ADWR), Mr. Arrington stated "We removed all the collapsible soils all the way down to the foundation level." The as-built drawings corroborate Mr. Arrington's statement, indicating that removals

varying up to approximately 8 feet occurred beneath some of the shoulders, and removals varying up to approximately 20 feet occurred beneath some of the keys. If these collapsible soils were removed, the addition of groundwater beneath the dam should not cause significant settlement.

In addition, we point out that the foundation soils will probably become saturated quickly when the reservoir fills because the foundation soils are predominantly granular. Therefore, we do not think the small golf course lakes will modify the service conditions of the dam.

Concern No. 2: The slope of the landscaping fill, which you (Gosnell) intend to place on the Saddle Dike section of the dam, appears steeper than the existing dam slope. Will this impact the stability of the dam?

Response: We have drawn to approximate scale the apparent critical section of the proposed landscaping fill and existing dam on the attached Figure 1. A location plan from sheet 2 of 11 of the Grading and Drainage Plans (dated 4/2/86) is shown on Figure 2. By inspection, the proposed slope is not significantly steeper than the existing embankment slopes, nor does it appear significantly different in geometry from the fill zone evaluated in our original report (Thomas-Hartig & Associates, Inc. Project No: 86-743, dated 30 June 1986). Thus, in our opinion, the proposed fill will not adversely affect the stability of the existing dam. However, to reduce slippage between the original dam slopes and the proposed fill, we recommend cutting benches into the dam slopes similar to those planned for the Mountainside Suites embankments.

We understand the fill will only be used for landscaping; thus, the surface of the fill will probably not be heavily compacted. Because of this, and because the fill surface will be watered, surface erosion and possibly minor raveling should be anticipated. Flatter slopes would reduce this tendency. We also do not recommend planting trees with large (or long) root systems anywhere on any earth dam because roots can provide flow channels after rotting.

This supplement shall be attached to the original report and shall become a part thereof. Please do not hesitate to call if you have any questions or if we may be of further assistance.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By: _____ Reviewed by: _____

Roger A. Brewer, P.E. Glen K. Copeland, P.E.

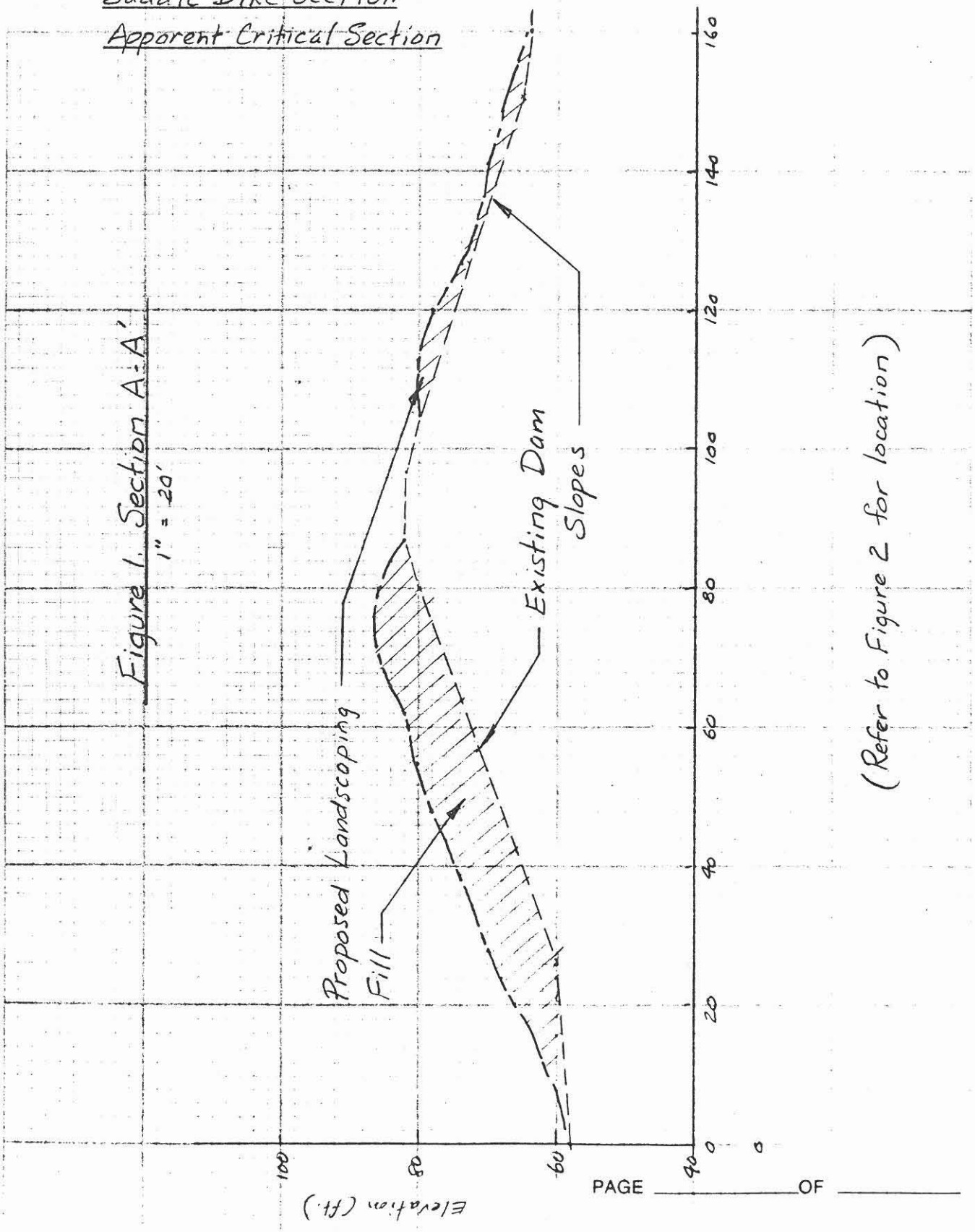
/cmm

Copies to: Addressee (7)

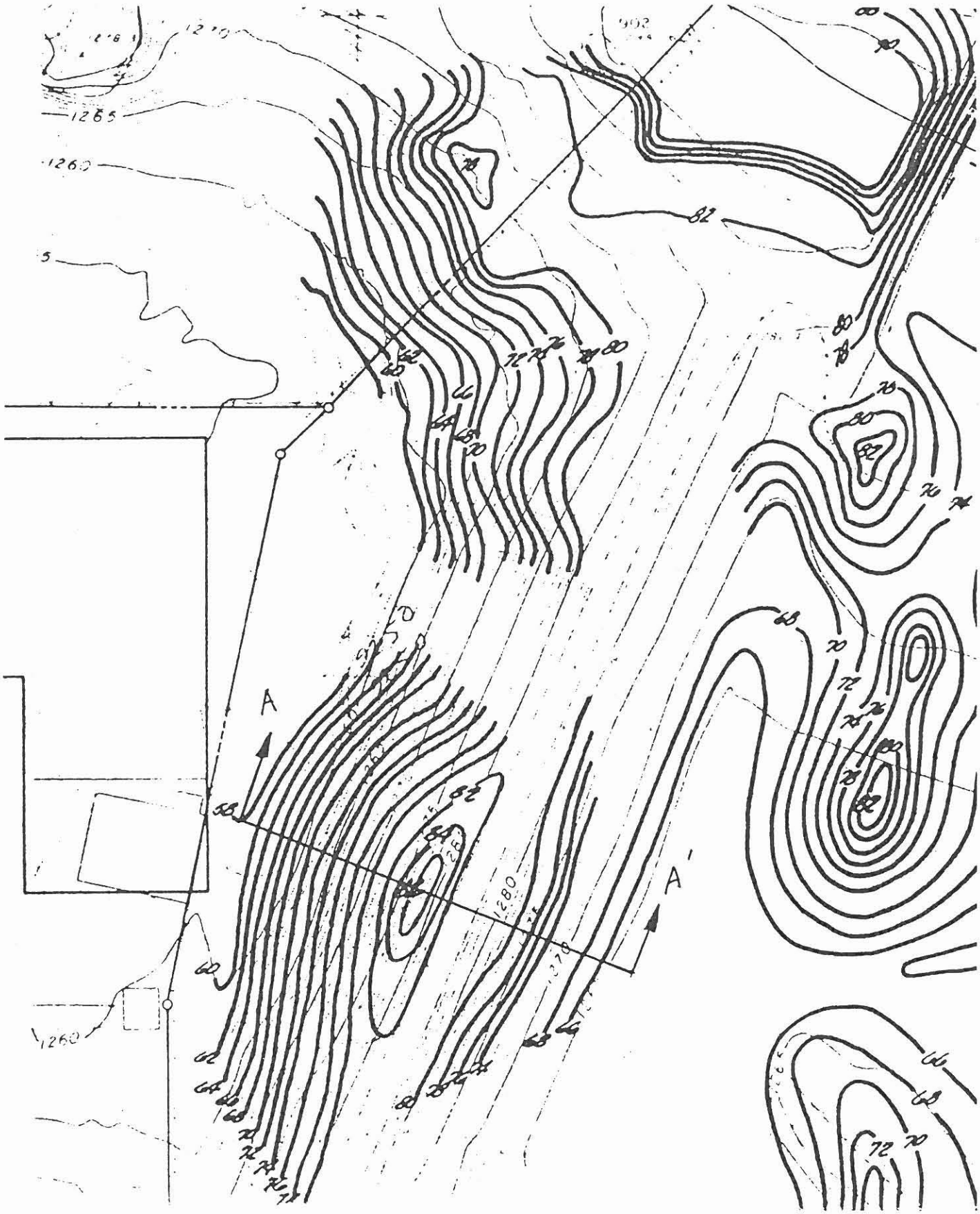
Thomas-Hartig & Assoc, Inc.
2720 S. Hardy Drive
Tempe, Arizona 85282

PROJECT NO. 86-743.1 COMPUTED BY RAB DATE 8/18/86

SUBJECT Landscaping Fill @ Sta. A-A' of Saddle Dike Section Apparent Critical Section CHECKED BY _____ DATE _____



PAGE _____ OF _____



SADDLE DIKE DESIGN

Location of Section A-A'

From: Grading and Drainage Plan, Sheet 2 of 11

THOMAS-HARTIG & ASSOCIATES, INC.

TOM W. THOMAS, P.E. · HARRY E. HARTIG, P.E.
Soil and Foundation Engineering · Materials Testing
7031 West Oakland Street Chandler, Arizona 85226 602/961-1169

James R. Morrow
John P. Boyd, P.E.
Charles H. Atkinson, P.E.
Donald J. Spadola, P.E.

Glen K. Copeland, P.E.
James M. Willson, P.E.
Frank M. Guerra, P.E.

Roger A. Brewer, P.E.
Steven A. Haire, P.E.
Chet L. Pearson, P.E.
Kenneth L. Ricker, P.E.

Gosnell Development Company
2728 N. 24th Street
Phoenix, Arizona

30 June 1986

Attention: Mr. Hank Legge, P.E.

Project: Slope Stability and Settlement Evaluation
Mountainside Suites
The Pointe Resort at South Mountain
Phoenix, Arizona

Project No: 86-743

The purpose of this letter is to present the results of slope stability and settlement evaluations for the existing Guadalupe Flood Retention North Dam No. 2 after construction of the proposed Mountainside Suites. Your current design is to construct some of the Mountainside Suites on compacted fill which extends out from the downstream slope of the dam. As requested, we have performed the evaluations assuming saturated conditions for both foundation material and embankments. Our design assumptions, methodology, and conclusions are presented herein.

DESIGN ASSUMPTIONS

Critical Section: The assumed critical cross-section for finished conditions is shown on the attached Figure 1. This section is based on:

1. The geometry of the compacted fill sections shown on your Grading and Drainage Plans, Revision 5, dated 11/1/85.

2. The "as-built" drawing, 7-E-22659, dated 5-75, provided by Soil Conservation Service (SCS). We selected "Station 15+00" because it is the approximate maximum section in the vicinity of the suites.

3. The "Plan and Profiles for Geologic Investigation, Guadalupe Flood Retaining Structure," also provided by SCS. The "Center Section" profile indicates the maximum thickness of foundation soil beneath the dam in the vicinity of the suites is 25 feet. We assume the underlying gneiss bedrock is incompressible and all failure surfaces pass above it.

Soil Conditions: The dam was constructed in 1974 and 1975 under observation and testing by SCS. According to their records, the dam is homogeneous, well-compacted, and consists of widely graded silty sands with gravels. The "Center Section" Profile indicates the foundation soil in the vicinity of the suites consists either of hard caliche (identified as "calcareous shale" in their legend) or dense silty sand and gravel. Based on these reported conditions, we have assumed the following soil parameters for both embankment and foundation materials:

Saturated Unit Weight (γ_s):	135 pcf
Dry Unit Weight (γ_d):	125 pcf
Friction Angle ($\emptyset$):	35°
Cohesion (c):	0
Compression Index (C_c):	0.01[1]

METHODOLOGY

Stability Evaluation: A typical method to increase the stability of a slope is to place a berm of fill on the toe. The surcharge weight of the fill increases the resisting stresses. Because this is, in effect, what is proposed for the downstream slope of North Dam No. 2, it is our opinion that the downstream slope will be more stable after the fill is placed than before. However, the upstream slope of North Dam No. 2 may experience a slight reduction in stability after the fill is placed. This is because the weight of the fill on the downstream slope could increase the driving stresses on the upstream slope.

In our opinion, the critical stability condition would be rapid-drawdown (i.e. saturated soil, no reservoir) on the upstream slope. We have evaluated this condition based on the assumptions described above and using the slope stability computer program TSTAB[2]. TSTAB computes factors of safety for circular slip failures using the simplified Bishop's method. It employs a search routine to find the circular failure center with the minimum factor of safety.

Settlement Evaluation: We predicted settlement of the dam due to fill placement and saturation using a Boussinesq elastic solution for stress distribution[3] and the assumed compression index shown above. We used a triangular distribution of load on the dam because the new fill will be approximately wedge-shaped, and evaluated points beneath both the upslope, thin portion of the fill and the downslope, thick portion. We also predicted settlement of the dam without fill placement. The assumed compression index was obtained from published data for "compact, very well graded sand, little gravel" presented by Hough (1969). We have assumed this compression index applies for both the dam materials and the foundation materials based on the test results performed during construction and the reported conditions of the natural foundation soils.

CONCLUSIONS

Stability Evaluation: The factor of safety against slope failure for the upstream slope after rapid-drawdown, prior to constructing the fill zone for the Mountainside Suites on the downstream slope, is approximately:

F.S. = 2.0

The factor of safety against slope failure for the upstream slope after rapid-drawdown, after constructing the fill zone for the Mountainside Suites on the downstream slope, is also approximately:

F.S. = 2.0

Based on the analyses employed, the addition of fill to the downstream slope of the dam will therefore not reduce the stability.

Settlement Evaluation: We estimate the fill zone on the downstream slope will cause the dam to settle approximately 1/8 to 1/4 inch at the crest, and

approximately 1/2 to 1 inch at the downstream toe. Approximately half of the settlement will probably occur during construction, with the remaining portion occurring only if the dam and underlying foundation materials become saturated.

We understand the dam and foundation materials have never been saturated. Thus, the dam will probably experience settlement after it becomes saturated even if fill is not placed on the downstream slope. In our opinion, if the dam becomes saturated, settlements on the order of 1 inch or more could occur at the crest, with lesser amounts expected beneath the upstream and downstream slopes. The addition of fill on the downstream slope will cause additional settlement to occur to the slope, but it would probably be similar in magnitude to the crest settlement because the thickness of fill on the slope will be similar to the thickness of the dam at the crest. Thus, the amount of differential settlement which will occur to the downstream slope, and conceivably cause cracking, appears small.

REFERENCES

[1]Hough, B.K., Basic Soils Engineering, Second Edition, 1969, The Ronald Press Company, New York, p.130.

[2]TSTAB, Slope Stability Analysis Computer Program by TAGA Engineering Software Services, Berkeley, California, MS-DOS Version by Design Professionals Management Systems, Kirkland, Washington.

[3]"Stresses and Deflections in Foundations and Pavements," Published by Department of Civil Engineering, University of California, Berkeley, California, Fall, 1965, p.47.

Please do not hesitate to call if there are any questions or if we may be of further assistance.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

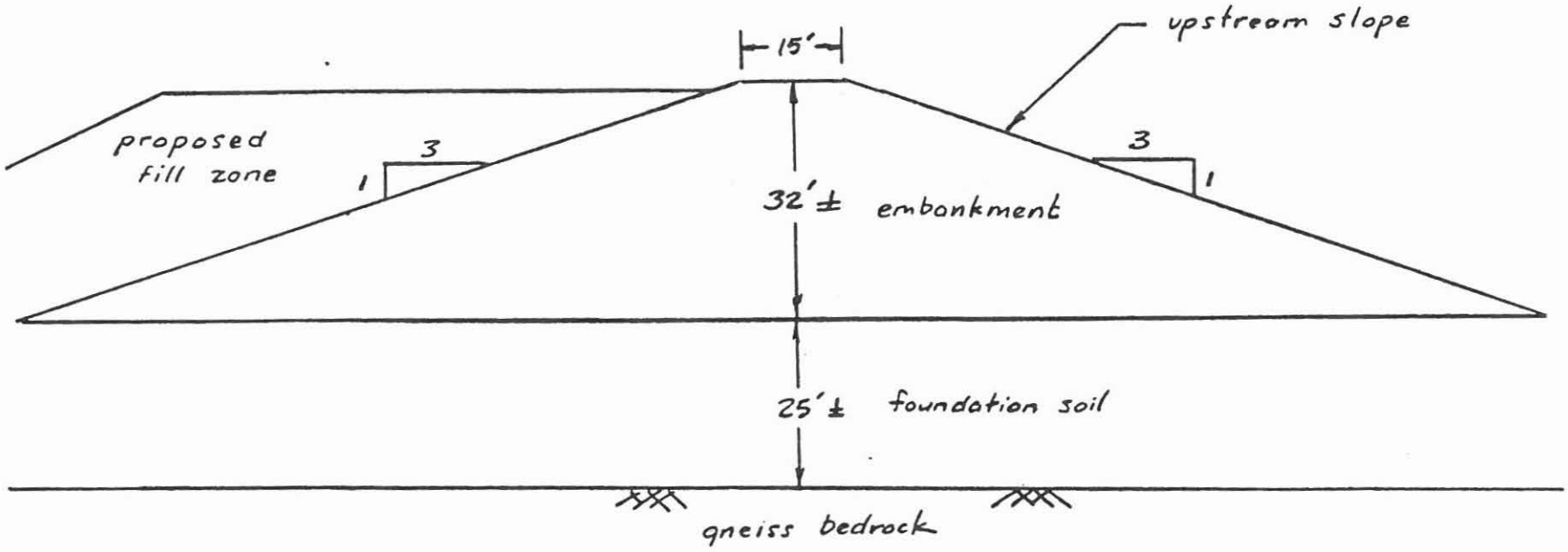
By: _____ Reviewed by: _____

Roger A. Brewer, P.E. Glen K. Copeland, P.E.

/cmm

Copies to: Addressee (7)

FIGURE 1 Assumed Critical Cross-Section
North Dam No. 2



Thomas-Hartig & Associates, Inc.

Project No: 86-743

THOMAS-HARTIG & ASSOCIATES, INC.

TOM W. THOMAS, P.E. · HARRY E. HARTIG, P.E.
Soil and Foundation Engineering · Materials Testing
7031 West Oakland Street Chandler, Arizona 85226 602/961-1169

James R. Morrow
John P. Boyd, P.E.
Charles H. Atkinson, P.E.
Donald J. Spadola, P.E.

Glen K. Copeland, P.E.
James M. Willson, P.E.
Frank M. Guerra, P.E.

Roger A. Brewer, P.E.
Steven A. Haire, P.E.
Chet L. Pearson, P.E.
Kenneth L. Ricker, P.E.

Gosnell Development Corporation
2728 North 24th Street
Phoenix, Arizona 85008

4 December 1986

Attention: Mr. Hank Legge, P.E.

Subject: Our report entitled: "Construction Data Review and Evaluation of Proposed Modifications to Guadalupe Flood Control Structure," dated 20 October 1986.

Project No: 86-743
Revised

In the subject report, we presented the results of stability analyses performed on selected cross-sections of the Guadalupe Flood Control Structure. Based on soil information provided by Soil Conservation Service (SCS), we concluded each of the three embankments, including your proposed modifications to them, has sufficient factors of safety for static loading conditions. We understand SCS has asked that we re-evaluate the cross-sections using the lowest correlated friction angle for the embankment material, rather than the average correlated friction angles, as were used in our analyses. We have re-evaluated the cross-sections using these lower correlated friction angles, and the results indicate there is still sufficient factors of safety for static loading conditions.

Our procedure for correlating field density to friction angle is presented in the subject report. Using the lowest values of field density, the new correlation is as follows:

Location	Lowest Dry Density (pcf)	*Estimated Relative Density Dr (%)	**Estimated Lowest Angle of Internal Friction
North Dam 1	116.4	74	36.5^{o}
North Dam 2	107.0	56	33.5^{o}
East Dam	108.9	60	34°

*Assumed minimum dry density = 86 pcf and assumed maximum dry density = 132.5 pcf (from Lambe and Whitman (1969)).

**Correlated from NAVFAC DM-7 (1971) Figure 3-7, p. 7-3-17.

These friction angles (with zero cohesion) were used in the analysis for the respective embankments. We also substituted the lowest densities as follows:

Location	Lowest Dry Density (pcf)	*Moisture Content (%)	Moist Density (pcf)	**Saturated Density (pcf)
North Dam 1	116.4	9.6	128	135
North Dam 2	107.0	14.4	122	129
East Dam	108.9	13.3	123	130

*As indicated with field density test result.

**Assuming G_s, specific gravity of solids, = 2.65.

All other aspects of the stability analyses, including the cross-section geometries, soil strengths for the new fill zones and natural materials, and the computer program (TSTAB), were the same as presented in the subject report.

Based on these lowest estimated friction angles for the embankments, the minimum factor of safety computed for failure circles which penetrate into the embankments is 2.1. For very shallow failure circles which would not affect overall stability, the minimum computed factor of safety is 1.4. In our opinion, these results indicate the embankments, including the modifications, have sufficient factors of safety for static loading conditions.

This letter shall be a supplement to the subject report and shall be attached thereto. Please do not hesitate to call if you have any questions or if we may be of further assistance.

Respectfully submitted,
THOMAS-HARTIG & ASSOCIATES, INC.

By: _____ Reviewed by: _____
12-4-86 Roger A. Brewer, P.E. 12-4-86 Kenneth L. Ricker, P.E.

/cmm

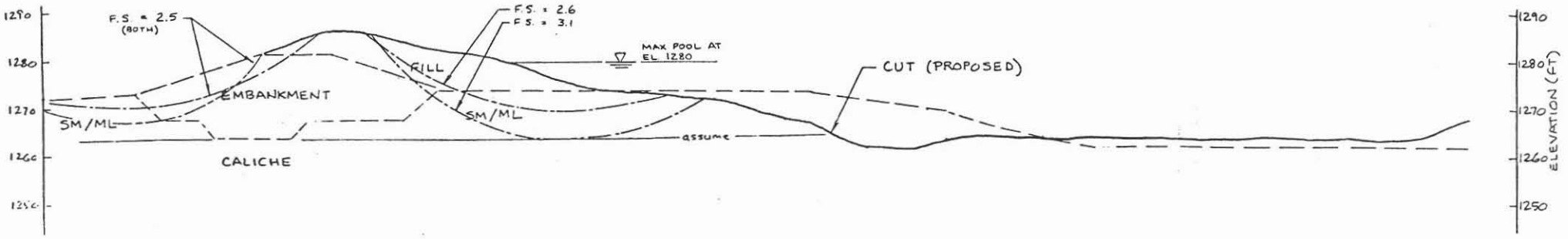
Copies to: Addressee (7)

EAST DAM
CROSS SECTIONS

Revised 4 December 1986

SECTION A-A

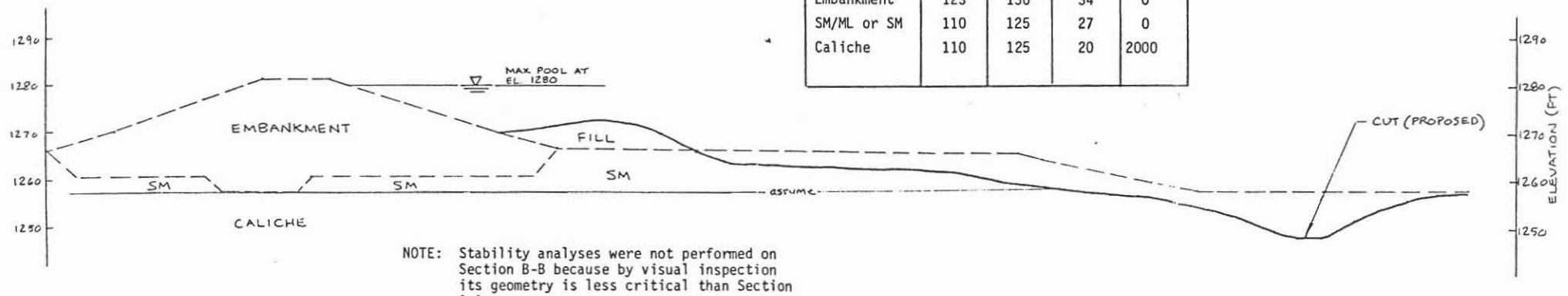
scale: 1" = 20'



Assumed Material Properties				
MATERIAL	Unit Weight		Shear Strength	
	γ_m, pcf	γ_{sat} pcf	ϕ deg	c psf
Fill	115	128	32	0
Embankment	123	130	34	0
SM/ML or SM	110	125	27	0
Caliche	110	125	20	2000

SECTION B-B

scale: 1" = 20'



NOTE: Stability analyses were not performed on Section B-B because by visual inspection its geometry is less critical than Section A-A.

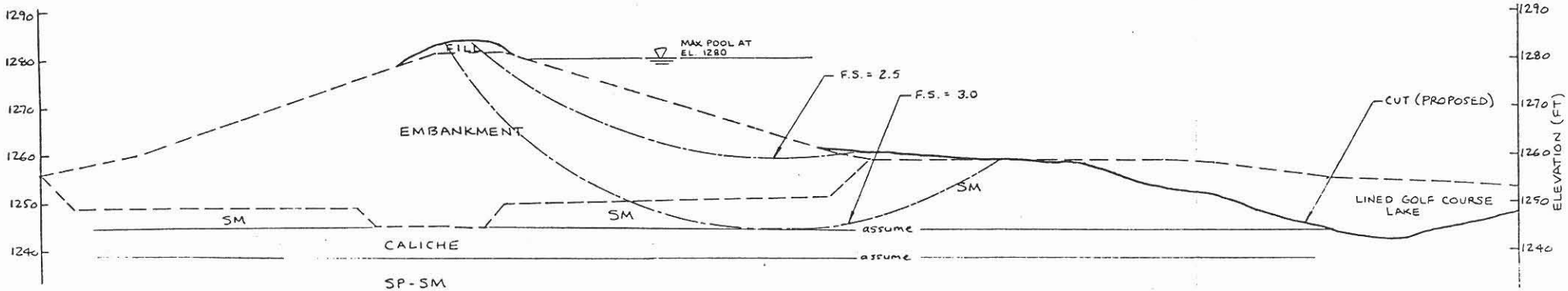
THOMAS-HARTIG & ASSOCIATES, INC.

Project No: 86-743

EAST DAM
CROSS SECTIONS

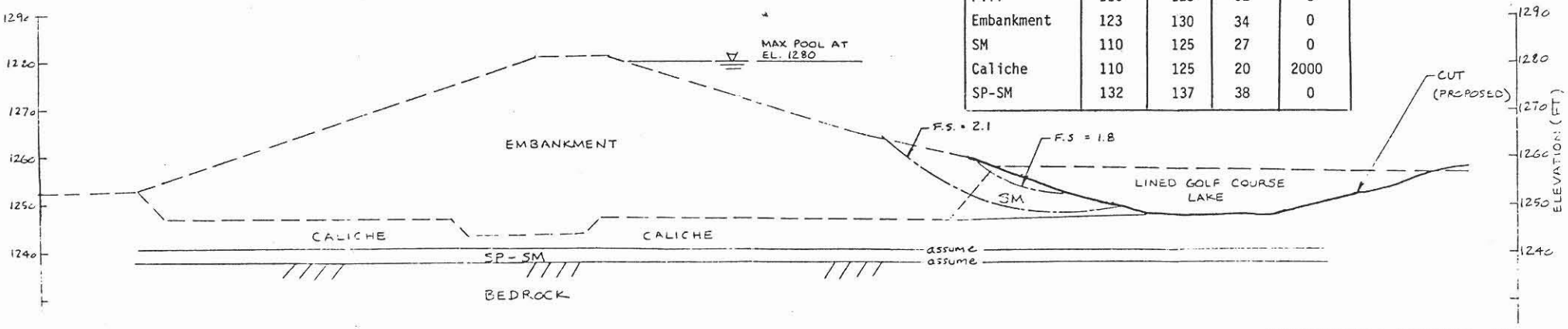
Revised 4 December 1986

SECTION C-C
scale: 1" = 20'



Assumed Material Properties				
MATERIAL	Unit Weight		Shear Strength	
	γ_m pcf	γ_{sat} pcf	ø deg	c psf
Fill	115	128	32	0
Embankment	123	130	34	0
SM	110	125	27	0
Caliche	110	125	20	2000
SP-SM	132	137	38	0

SECTION D-D
scale: 1" = 20'



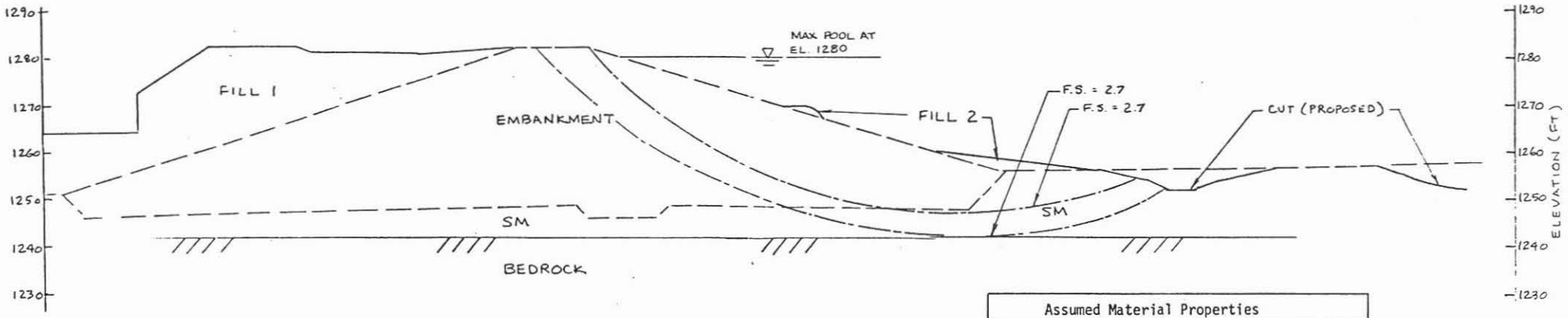
THOMAS-HARTIG & ASSOCIATES, INC.

Project No: 86-743

NORTH DAM 2
CROSS SECTIONS

Revised 4 December 1986

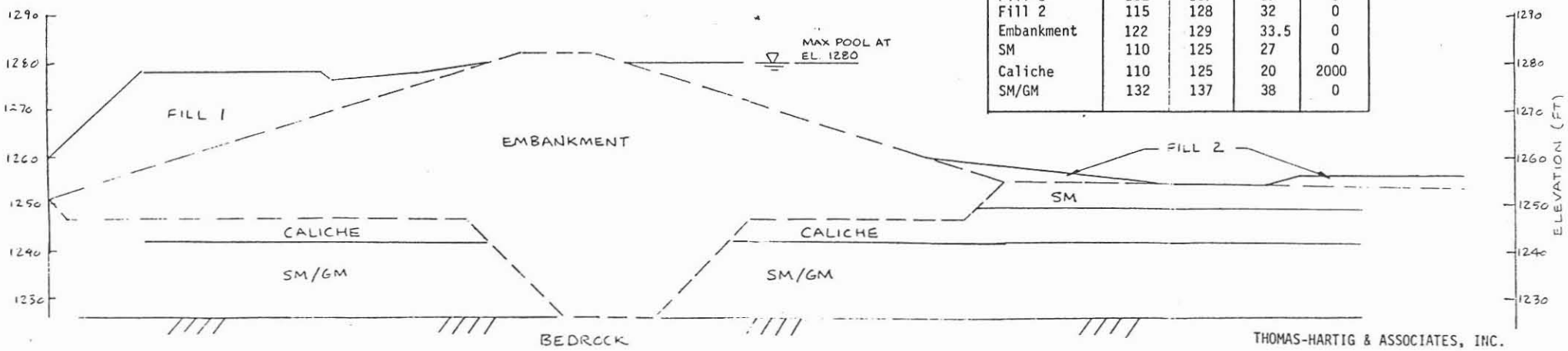
SECTION E-E
Scale: 1" = 20'



NOTE: Stability analyses were not performed on Section F-F because by visual inspection its geometry is less critical than Section E-E.

Assumed Material Properties				
	Unit Weight		Shear Strength	
MATERIAL	γ_m pcf	γ_{sat} pcf	ø deg	c psf
Fill 1	132	137	37	0
Fill 2	115	128	32	0
Embankment	122	129	33.5	0
SM	110	125	27	0
Caliche	110	125	20	2000
SM/GM	132	137	38	0

SECTION F-F
Scale: 1" = 20'

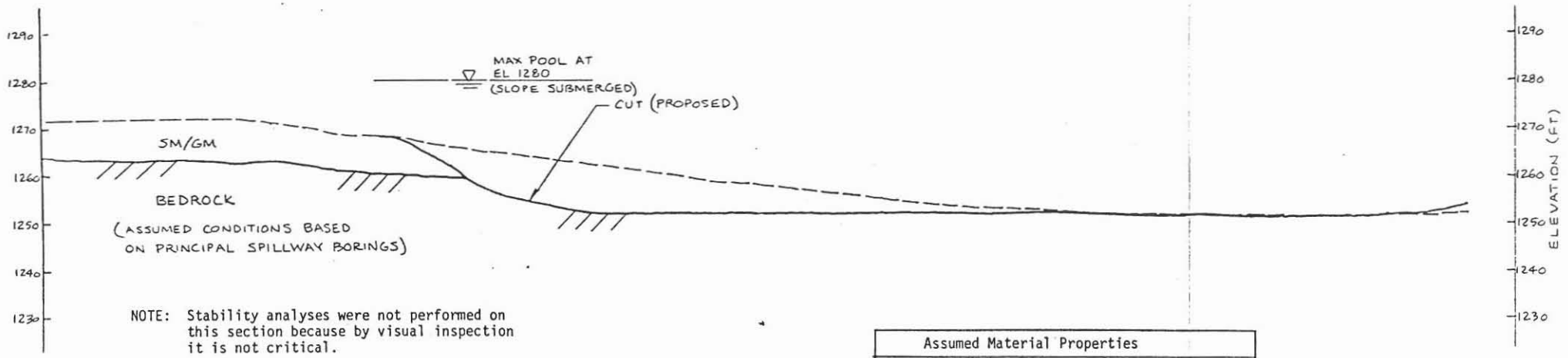


THOMAS-HARTIG & ASSOCIATES, INC.
Project No: 86-743

ABUTMENT CUT
CROSS SECTION

Revised 4 December 1986

SECTION G-G
scale. 1" = 20'



NOTE: Stability analyses were not performed on this section because by visual inspection it is not critical.

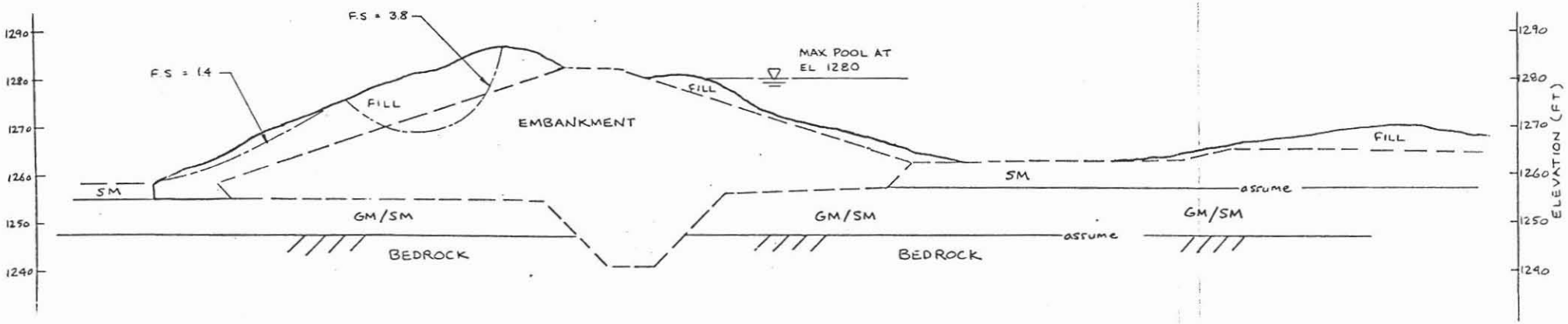
Assumed Material Properties				
	Unit Weight		Shear Strength	
MATERIAL	γ_m pcf	γ_{sat} pcf	ø deg	c psf
SM/GM	120	137	38	0

THOMAS-HARTIG & ASSOCIATES, INC.
Project No: 86-743

NORTH DAM 1
CROSS SECTION

Revised 4 December 1986

SECTION H-H
scale: 1" = 20'



Assumed Material Properties				
MATERIAL	Unit Weight		Shear Strength	
	γ_m pcf	γ_{sat} pcf	ϕ deg	c psf
Fill	120	128	32	0
Embankment	128	135	36.5	0
SM	110	125	27	0
SM/GM	120	137	38	0

THOMAS-HARTIG & ASSOCIATES, INC.

Project No: 86-743

CONSTRUCTION DATA REVIEW AND EVALUATION OF PROPOSED MODIFICATIONS TO GUADALUPE FLOOD CONTROL STRUCTURE

THE POINTE RESORT AT SOUTH MOUNTAIN
PHOENIX, ARIZONA

Submitted to:

Gosnell Development Corporation
2728 North 24th Street
Phoenix, Arizona

Submitted by:

THOMAS-HARTIG & ASSOCIATES, INC.
7031 W. Oakland Street
Chandler, Arizona
(602) 961-1169

Project No: 86-743

20 October 1986

By: _____ Reviewed by: _____

Roger A. Brewer, P.E. Glen K. Copeland, P.E.

/cmm

Copies to: Addressee (7)

TABLE OF CONTENTS

REPORT

1. Introduction
   - 1.1 Purpose.....1
   - 1.2 Scope.....1
   - 1.3 Authorization.....2
2. Executive Summary.....3
3. Site Description/Embankment Description.....4
4. Summary of Soil Strengths
   - 4.1 Compacted Materials:
     - 4.1.1 Existing Embankment Materials.....6
     - 4.1.2 New Fill Zones.....7
   - 4.2 Natural Materials:
     - 4.2.1 General.....8
     - 4.2.2 Shallow Collapsing Materials.....8
     - 4.2.3 Deeper Consolidated Materials.....9
     - 4.2.4 Direct Shear Test Result.....10
5. Stability Evaluation:
   - 5.1 General.....12
   - 5.2 Description of Computer Program.....12
   - 5.3 Results of Stability Analyses.....13
   - 5.4 Evaluation Results.....14
6. References.....15

FIGURES

Figure 1: Location Plan.....16
Figure 2: Site Plan (Sheet 1 of 2).....17
Figure 3: Site Plan (Sheet 2 of 2).....18
Figure 4: East Dam Cross-Section.....19
Figure 5: East Dam Cross-Sections.....20
Figure 6: North Dam 2 Cross-Sections.....21
Figure 7: Abutment Cut Cross-Section.....22
Figure 8: North Dam 1 Cross-Section.....23

10-20-86

APPENDIX

Summary of Field Density Tests - East Dam.....24
Summary of Field Density Tests - North Dam 1.....26
Summary of Field Density Tests - North Dam 2.....27
Summary of Average Densities.....28
Summary of Friction Angle Correlations.....30
Direct Shear Tests.....34
Grain Size Distribution Tests.....35

1. INTRODUCTION

1.1 Purpose

The purpose of this report is to present a review of existing construction data for the embankment sections of the Guadalupe Flood Control Structure, and to evaluate the effect of proposed modifications to the embankment sections by Gosnell Development Corporation.

1.2 Scope

The scope of the work performed by Thomas-Hartig & Associates, Inc. (THA) included the following:

A. Review of existing construction data provided to THA by the Soil Conservation Service (SCS), including:

   1. Logs of soil borings performed along the centerline of the embankment crests prior to construction, and logs of backhoe test pits performed at the borrow areas.

   2. Results of field density tests performed during construction, and results of laboratory density tests, compression tests, permeability tests, grain size distribution tests, and a direct shear test.

   3. As-built drawings by SCS indicating embankment geometrics and depths of soil over-excavation beneath the embankments.

   4. A report entitled "Guadalupe Watershed, Geological Investigation" (undated, unsigned).

B. Empirical evaluation of the shear strengths of the materials comprising the embankments and their foundations.

C. Performance of static stability analyses on predicted critical sections of the modified embankments using the Simplified Bishop circular arc method.

D. Presentation of results in this report.

1.3 Authorization

This report was authorized by Mr. Hank Legge of Gosnell Development Corporation on 23 September 1986.

2. EXECUTIVE SUMMARY

The three earth embankments, North Dam 1, North Dam 2, and East Dam, of the Guadalupe Flood Control Structure were designed by Soil Conservation Service and constructed in 1974 and 1975 under their observation and testing. The embankments are homogeneous and constructed of silty, widely-graded gravelly sand which was roller-compacted with control of both density and water content. Based on information provided by SCS, the natural foundation materials beneath the embankments generally consist of either hard caliche, dense silty sand and gravel, or bedrock. The upstream and downstream slopes of each embankment are approximately 3H:1V, and the maximum height above original grade is approximately 35 feet.

For this report, Thomas-Hartig & Associates, Inc. reviewed construction data provided by Soil Conservation Service and evaluated proposed modifications on and near the embankments by Gosnell Development Corporation for their new Pointe Resort at South Mountain project. Based on the information provided, stability analyses using the computer program TSTAB were performed on selected cross-sections using assumed material properties and incorporating the proposed modifications.

Based on the assumed material properties and new geometries, the minimum factor of safety computed for failure circles which penetrate into the existing embankment materials is 2.6. For very shallow failure circles which would not affect overall stability, the minimum computed factor of safety is 1.5. These safety factors are greater than, or equal to, the value of 1.5 which is required by the Corps of Engineers and which is generally accepted as the minimum factor of safety for static loading. Therefore; the results indicate the embankments, including the modifications, have sufficient factors of safety for static loading conditions.

3. SITE DESCRIPTION/EMBANKMENT DESCRIPTION

The Guadalupe Flood Control Structure is a floodwater retarding structure located west of the I-10 freeway between Guadalupe Road and Baseline Road in Phoenix, Arizona. It is comprised of three earth embankments identified as North Dam 1, North Dam 2, and East Dam. (NOTE: Some of the information provided for THA's review identifies North Dam 1, North Dam 2, and East Dam as Saddledike Section, Center Section, and I-10 Section, respectively. In this report, the first three names are used). A location plan is shown on Figure 1. Site plans indicating the locations of the embankments and the proposed modifications by Gosnell Development Corporation are shown on Figures 2 and 3.

The embankments were designed by SCS and constructed in 1974 and 1975 under their observation and testing. The upstream and downstream slopes of each embankment are approximately 3H:1V, and the crest elevations are approximately Elevation 1282 feet. The maximum height above original grade occurs near the center of North Dam 2, where the height is approximately 35 feet. Bedrock outcrops form abutments and separate each of the three embankments.

The embankments are homogeneous and constructed of silty, widely-graded gravelly sand which was borrowed from the basin upstream. The materials were compacted in layers with a roller, and with control of both density and water content. The field density data indicate approved densities equalled or exceeded 95 percent of the ASTM D698 maximum density at optimum water content ± 3 percent.

Collapsible surficial soils, which had been identified by lower recorded blow counts during drilling and by "effect of wetting" compression tests, were reportedly removed from embankment areas prior to construction. Based on as-built drawings, this depth of removal varied up to approximately 8 feet beneath the embankments. Information presented on the original boring logs indicates the natural materials beneath the collapsible surficial soils generally consist of either hard caliche (cemented calcareous clay, silt, and sand mixtures), dense silty sand and gravel, or gneiss bedrock.

A 30-inch diameter outlet conduit (principal spillway) extends through North Dam 2. The upstream inlet consists of an ungated stand pipe with a gated inlet at the bottom. An emergency overflow spillway, approximately 200 feet wide and with crest at Elevation 1274 feet, is located in the bedrock outcrop between North Dams 1 and 2.

To date, the embankments have not impounded more than approximately 5 feet of water. Reportedly, a full reservoir would drain out of the principal spillway in approximately one week.

4. SUMMARY OF SOIL STRENGTHS

4.1 Compacted Materials

4.1.1 Existing Embankment Materials

The results of the field density tests performed during construction of the three embankments, and a composite of grain size distribution curves from the borrow areas, are included in the Appendix. The averages of the field density test results are summarized as follows:

Location	Average Dry Density	Average Water Content	Average Moist Density	Average Saturated Density*
North Dam 1	124.0 pcf	10.0%	136.4 pcf	139.6 pcf
North Dam 2	119.3 pcf	10.9%	132.3 pcf	136.7 pcf
East Dam	122.8 pcf	9.3%	134.2 pcf	138.9 pcf

*Assuming G_S, specific gravity of solids = 2.65. These weights were used when evaluating upstream slope stability (i.e. rapid drawdown).

Using these average dry densities and the grain size distribution curves, we estimated approximate angles of internal friction, Ø, by a correlation presented in NAVFAC DM-7. Our procedure is summarized in the Appendix. The results are as follows:

Location	Average Dry Density (pcf)	*Estimated Relative Density Dr (%)	**Approximate Angle of Internal Friction
North Dam 1	124.0	87	38°
North Dam 2	119.3	80	37°
East Dam	122.8	85	37.5^{o}

*Assumed minimum dry density = 86 pcf and assumed maximum dry density = 132.5 pcf (from Lambe and Whitman (1969)).

**Correlated from NAVFAC DM-7 (1971) Figure 3-7, p. 7-3-17, assuming relative density, Dr, = 75%.

We assume the embankment materials have little or no cohesion because the fines fraction reportedly exhibit little to no plasticity.

4.1.2 New Fill Zones

As part of the new Pointe Resort at South Mountain development, the developer proposes to place new fill zones on and adjacent to the existing embankment materials, and to construct small, lined golf course lakes within the basin upstream. These are shown in plan view on Figures 2 and 3.

The proposed fill zones on the downstream shoulder of North Dam 2 will be used to support new two-story structures on shallow footings. We understand the fill will be predominantly granular materials borrowed on-site and the specified compacted density will be 100 percent of the ASTM D698 maximum dry density at optimum moisture content ± 3 percent. We also understand the preparation of the natural bearing materials is similar to that which was employed during construction of the embankments. Weak soils will be removed until hard or dense materials are encountered. The hard or dense materials will be proof-rolled, then the new fill will be placed by roller compacting in approximately 6-inch lifts.

In other areas, the fill will generally be used for landscaping. We understand these fill zones will also be predominantly granular materials borrowed on-site, but the specified compaction will be 90 percent (minimum) of the ASTM D698 maximum dry density because these fills will not be used for foundation support.

In our opinion, the following shear strength parameters and unit weights are suitable for the two categories of new fill:

Material	Dry Density	*Moist Density	Saturated Density	Friction Angle	Cohesion
Structural fill downstream from North Dam 2	120 pcf	132 pcf	137 pcf	37°	0
Landscaping fill	105 pcf	115 pcf	128 pcf	32°	0

*Assuming water content = 10%.

4.2 Natural Materials

4.2.1 General

The boring information and conclusions presented in "Guadalupe Watershed, Geological Investigation" indicate collapsible soil zones were encountered near ground surface (0 to 5 feet) at North Dam 1 and in a silt (ML) layer at a 6.5 to 8.5-foot depth near Station 41 at East Dam. At greater depths, the borings generally indicated either hard caliche (calcareous cemented soil), dense granular soils, or bedrock. Reportedly, all of the upper collapsible soils were removed from the embankment areas during construction. The as-built drawings indicate depths of removal (not including cut-off trenches) varied up to approximately 8 feet deep. Based on this information, the existing natural foundation materials beneath the embankments appears to be either hard caliche, dense granular soils, or bedrock.

4.2.2 Shallow Collapsing Materials

Based on the boring logs, the original natural materials (other than bedrock) near the ground surface (0 to 8.5-foot depth$\pm$) were highly variable and ranged from silty fine sand/sandy silt (SM/ML) to silty sands and gravels (SM/GM). They were randomly stratified and had SPT N-values (blow counts) ranging from approximately 4 blows/foot to 100 blows/foot. The results of six (6) compression tests indicated some of the lower blow count materials were susceptible to collapse (i.e. introduction of water into the test specimens caused additional compression under constant normal stress). NAVFAC defines collapse potential, CP, as:

$$CP = \frac{\Delta e \text{ at collapse}}{1 + e_{initial}}$$

Of the six (6) compression tests, the maximum CP was 4.3 percent under a constant normal stress of 4000 psf. The specimen was trimmed from an "undisturbed" sample obtained at 3-foot depth, 30 feet upstream from Station 2+50 (North Dam 1). NAVFAC qualitatively classifies this amount of collapse as "moderate trouble" (see Appendix). Reportedly, the collapsible soils were removed from the embankment areas prior to construction.

Based on this information, it appears that the only areas where natural foundation materials with low shear strength properties may still exist is at the edges of the embankment slopes (beyond the zone of removal) or possibly in a relatively thin layer beneath the embankments (if the depth of removal was not sufficient to remove all of these weaker materials). Using a correlation to SPT N-values presented by Lambe & Whitman and using the lowest recorded N-value of 4 blows/foot (borings 308 and 310 at depths between 3.0 and 4.5 feet), we estimate the lowest angle of internal friction for these materials would be approximately 27 degrees. Because some of these materials are granular, we assume zero (0) cohesion. The following table summarizes our assumed properties for these materials:

Material	Dry Density	*Moist Density	Saturated Density	Friction Angle	Cohesion
SM or SM/ML	100 pcf	110 pcf	125 pcf	27°	0

*Assuming water content = 10%.

4.2.3 Deeper Consolidated Materials

As previously discussed, the boring information indicates the materials at depths greater than approximately 8 feet below original grade at the embankment locations are either caliche, silty sand and gravel, or gneiss bedrock. The SPT N-values measured in these materials generally ranged from approximately 40 blows/foot to refusal (greater than 50 blows/6 inches). Based on empirical correlation to N-value (see Appendix), we estimate the following strength parameters for the soil materials:

Material	Dry Density	*Moist Density	Saturated Density	Friction Angle	Cohesion
Caliche	100 pcf	110 pcf	125 pcf	20°	2000 psf
Silty Sand & Gravel	120 pcf	132 pcf	137 pcf	38°	0

*Assuming water content = 10%.

The gneiss bedrock probably has a minimum compressive strength on the order of 5 ksi, which would correspond to an approximate cohesion of 360,000 psf. The bedrock would therefore be a lower bound through which no failure circle would pass.

4.2.4 Direct Shear Test Result

One direct shear test was performed on three (3) remolded test specimens from a sample of material identified as field sample 3.1, obtained from depths between 3 and 5 feet. The test result and a grain size distribution curve are included in the Appendix. Based on the grain size data, the material was fine to coarse sand with approximately 36 percent high plasticity silt (LL = 57, PI = 22), and approximately 20 percent gravel varying up to 3/4-inch diameter. Based on our experience with soils in the site vicinity, the presence of high plasticity silt probably indicates the material in its natural structure was cemented and calcareous (i.e. caliche). Remolded direct shear tests are typically performed on specimens of minus No. 4 material only; thus, the actual test specimens probably contained approximately 45 percent high plasticity silt and no gravel. These specimens therefore were not truly representative.

The specimens were remolded to a dry density of 100.1 pcf (void ratio, e = 0.706), which was 95 percent of the maximum dry density determined by ASTM D698. The specimens were sheared under water at normal stresses of 1500 psf, 3000 psf, and 6000 psf. The measured angle of internal friction, Ø, was 27.5 degrees and the measured cohesion, c, was 280 psf. The values of shear strength used to plot the shear envelope corresponded to 0.4-inch displacement, or approximately 17 percent strain, which was the strain at the end of the test. No "early" peak strength or strength reduction was indicated within this amount of strain.

A comprehensive interpretation of the test results is not possible because volume change (or vertical strain) data during shear was not presented, nor was the in-situ void ratio determined for comparison to the results. However, we would anticipate this soil would have significantly more cohesion in its natural structure due to cementation bonds and the overconsolidation effect of desiccation, both of which would have been eliminated by remolding. Regardless, the measured friction angle of 27.5 degrees is greater than the lowest friction of 27 degrees we have assumed for the shallow natural soils (Section 4.2.2). In our opinion, a friction angle of 27 degrees and zero cohesion represents the probable lower bound for shear strength of any of the weaker surficial soils present.

5. STABILITY EVALUATION

5.1 General

Eight (8) cross-sections identified as A-A through H-H are shown in plan view on Figures 2 and 3 and in profile on Figures 4 through 8. These cross-sections were selected for review because they generally have the steepest proposed cuts or fill surfaces, the thickest potential zones of weak surficial soils, and/or the closest proximity to the proposed lined golf course lakes. Figures 4 through 8 depict the existing geometries, proposed modifications, and the assumed soil and rock conditions based on the as-built drawings and boring information provided by SCS.

Stability analyses were performed on Sections A-A, C-C, D-D, E-E, and H-H using the computer program TSTAB. Sections B-B, F-F, and G-G were not analyzed because, by visual inspection, their geometries and soil conditions are less critical than the other sections. The method of analysis utilized by the computer program is described below.

5.2 Description of Computer Program

The stability analyses were performed using the computer program TSTAB, which was developed in 1983 by TAGA Engineering Software Services. The program was used to analyze circular failure surfaces through selected cross-sections using the simplified Bishop method of slices. The program has critical surface searching options which generate trial failure surfaces from specified origin points or specified horizontal tangents. The factor of safety (i.e. the ratio of available shear strength to the required shear strength) for each trial surface is calculated using limit equilibrium methods. The output results include factors of safety, circle centers, and radii for all trial failure surfaces. The trial failure surface with the lowest factor of safety for given input conditions is presented as the critical failure surface.

In the simplified Bishop method of slices, interslice forces are assumed to be horizontal (i.e. the vertical component of the interslice forces is assumed to be zero). With this assumption all conditions of force and moment equilibrium are generally not satisfied. The Bishop method solution satisfies vertical force equilibrium for each slice and overall moment equilibrium for the entire sliding mass.

The simplified Bishop method has been compared in the literature with more rigorous limit equilibrium methods such as the Spencer method and the Morgenstern and Price methods. In these methods both vertical and horizontal components of the interslice forces are considered. Assumptions are made for the inclination and line of thrust of the interslice forces, and a statically determinate solution which satisfies all equilibrium conditions is obtained. Although an infinite number of solutions are possible corresponding to different assumptions for the inclination and line of thrust of the interslice forces, it has been shown that the variation in values of the factor of safety for physically reasonable assumptions is insignificant.

Additionally, it has been shown that results from the simplified Bishop method are generally in close agreement with the results from the more rigorous methods and differences are generally on the conservative side. The difference has been found to vary from 0% to 6% for a wide variety of conditions of slope angle, shear strength, and pore pressure (Wright, et. al., 1973). In the Swedish method of slices used in the original analysis by Taylor, both the horizontal and vertical side forces are assumed to be zero. Results with this method have been found in some cases to vary from 10% to 60% lower (i.e. more conservative) than more rigorous methods (Lambe and Whitman, 1969).

5.3 Results of Stability Analyses

The results of the stability analyses are depicted on Figures 4 through 8 and summarized as follows:

Cross-Section	Static Factor of Safety: Upstream Slope[1]	Static Factor of Safety: Downstream Slope
A-A	2.6	2.7
C-C	2.8	---
D-D	1.8[2]	---
E-E	2.8	---
H-H	---	1.5[3]

NOTES: [1]Performed using saturated unit weights with no reservoir to simulate "rapid drawdown" conditions.

[2]Very shallow failure circle approaching "infinite slope" conditions. See Figure 5.

[3]The trial failure circle for this safety factor penetrated only the landscaping fill on the downstream slope, not the existing embankment. The lowest safety factor for a trial failure circle which penetrated the existing embankment was 3.9. See Figure 8.

5.4 Evaluation Results

Based on the assumed material properties and geometries, the minimum factor of safety computed for failure circles which penetrate into the existing embankment materials is 2.6. For very shallow failure circles which would not affect overall stability, the minimum computed factor of safety is 1.5. These safety factors are greater than, or equal to, the value of 1.5 which is required by the Corps of Engineers and which is generally accepted as the minimum factor of safety for static loading. The results, therefore, indicate the embankments with modifications have sufficient factors of safety for static loading conditions.

6. REFERENCES

Bowles, J.E., Foundation Analysis and Design, McGraw-Hill, New York, 1977, pp. 85, 86.

Lambe, T.W., and Whitman, R.V., Soil Mechanics, John Wiley and Sons, New York, 1969, pp. 31, 148, 364.

Wright, S.G., Kulhawy, F.H, and Duncan, J.M., "Accuracy of Equilibrium Slope Stability Analyses," Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 99, No. SM10, October, 1973, pp. 783-791.

NAVFAC DM-7 Design Manual "Soil Mechanics, Foundations, and Earth Structures," Department of the Navy, March 1971, Figure 3-7, p. 7-3-17. Also DM-7.1 (1982) Figure 6, p. 7.1-41.

User's Manual for TCON, TSLOPE, AND TSTAB, by Robert Pyke, TAGA Engineering Software Services, presented at a technical short course at Texas A & M University, August 1985.

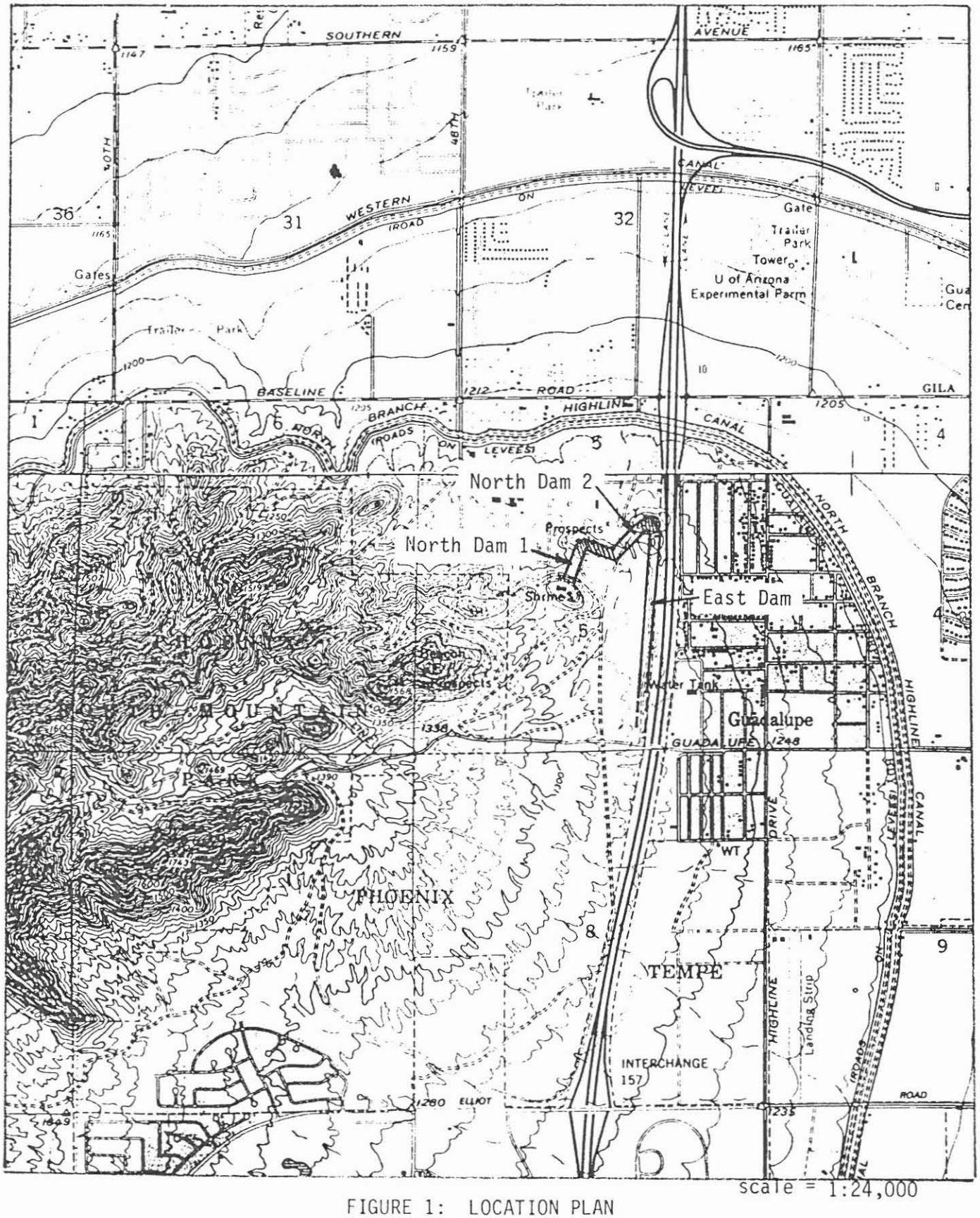
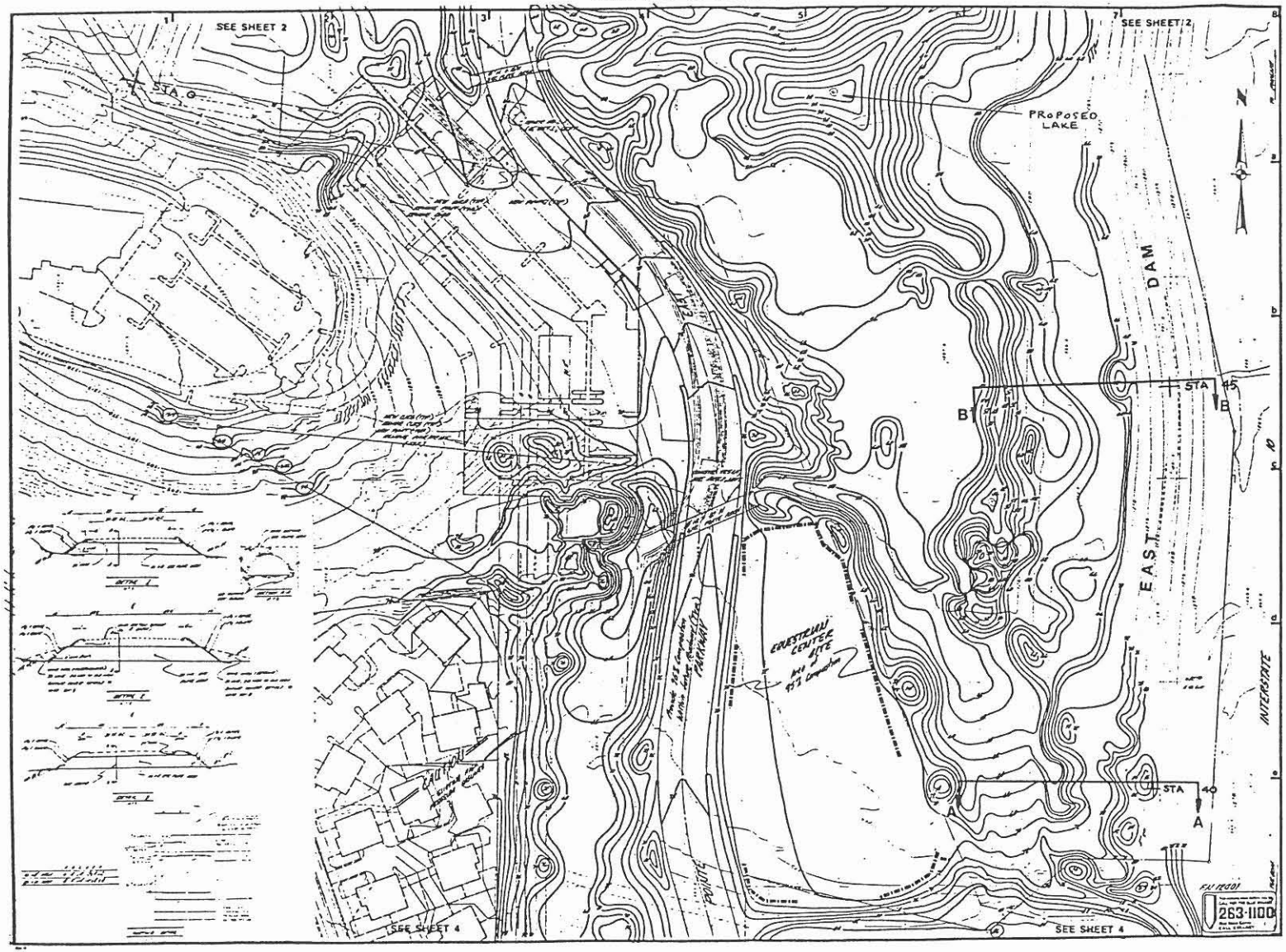


FIGURE 1: LOCATION PLAN
GUADALUPE FLOOD CONTROL STRUCTURE

From USGS topographic maps
(Guadalupe and Tempe Quadrangles)

THOMAS-HARTIG & ASSOCIATES, INC.
Project No: 86-743

MATCH LINE TO FIGURE 3



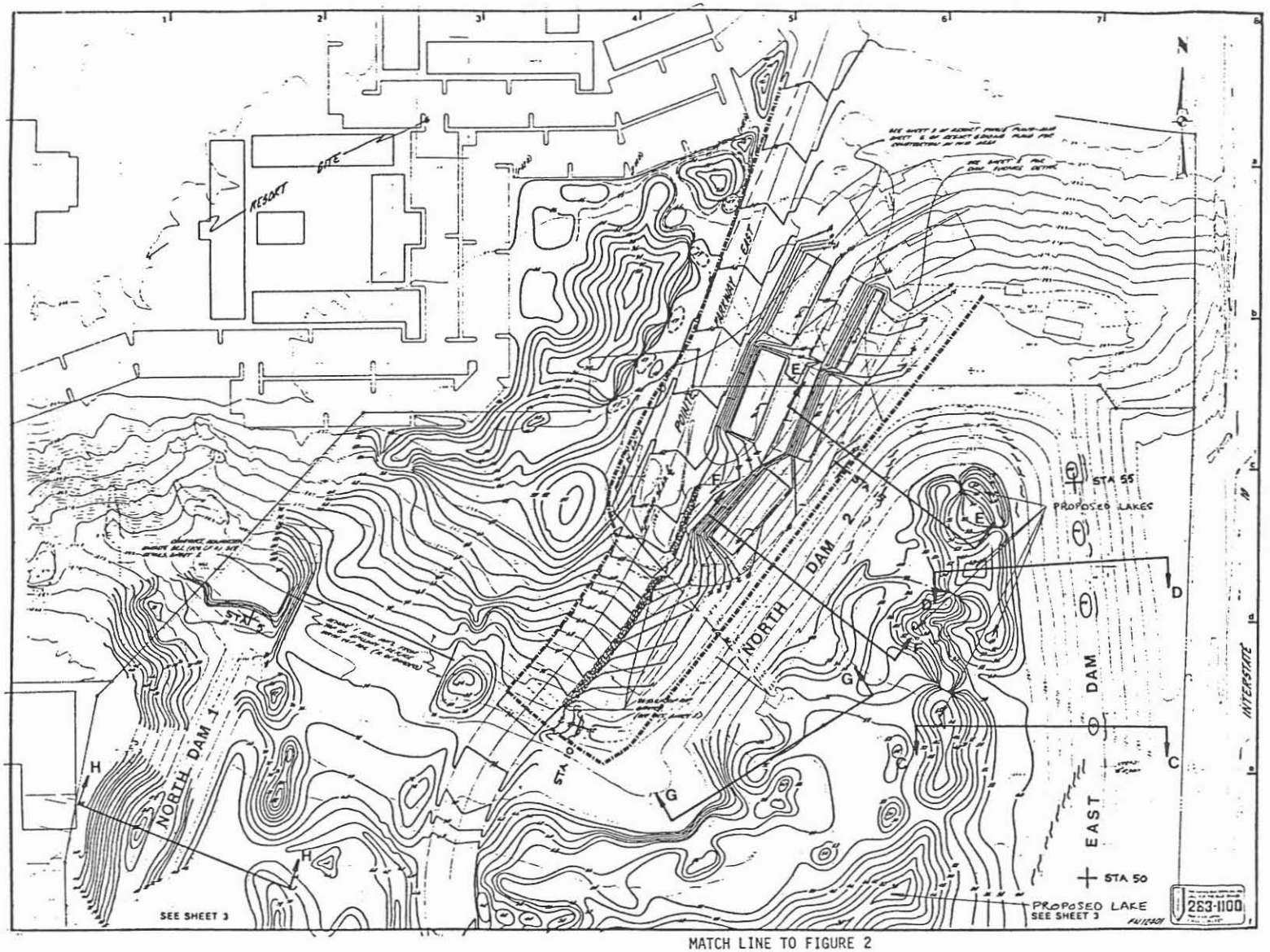
GUADALUPE FLOOD CONTROL STRUCTURE

FIGURE 2: SITE PLAN
(1 of 2)

0 100 200 300
Scale (ft.)

THOMAS-HARTIG & ASSOCIATES, INC.

Project No: 86-743



MATCH LINE TO FIGURE 2

GUADALUPE FLOOD CONTROL STRUCTURE

FIGURE 3: SITE PLAN
(2 of 2)

0 100 200 300
Scale (ft.)

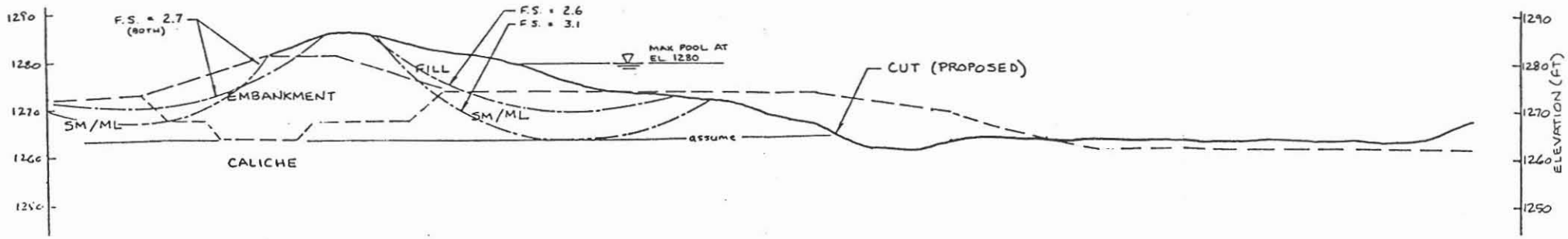
THOMAS-HARTIG & ASSOCIATES, INC.

Project No: 86-743

FIGURE 4: EAST DAM
CROSS SECTIONS

SECTION A-A

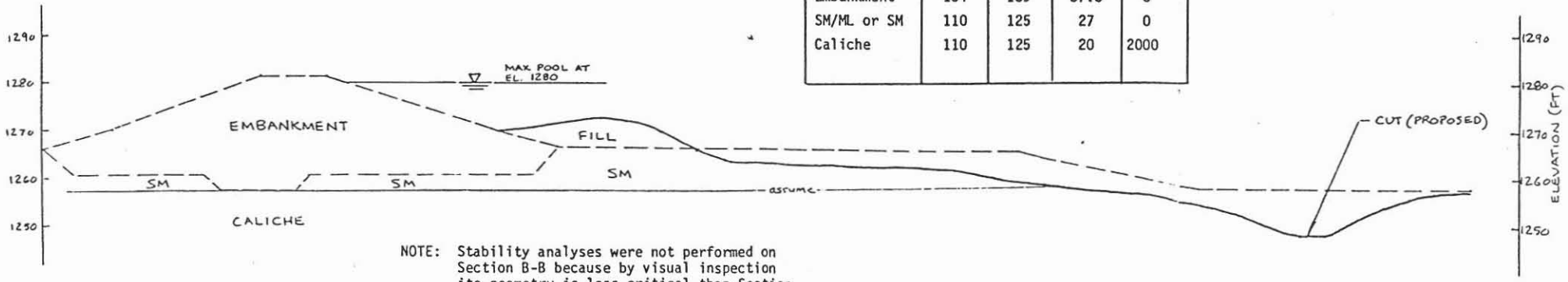
Scale: 1" = 20'



Assumed Material Properties				
MATERIAL	Unit Weight		Shear Strength	
	γ_m, pcf	γ_{sat} pcf	ø deg	c psf
Fill	115	128	32	0
Embankment	134	139	37.5	0
SM/ML or SM	110	125	27	0
Caliche	110	125	20	2000

SECTION B-B

Scale: 1" = 20'



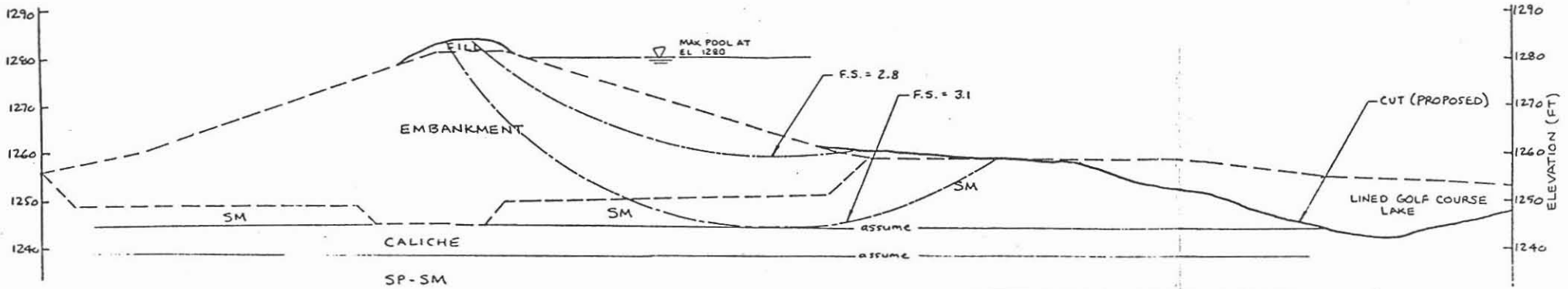
NOTE: Stability analyses were not performed on Section B-B because by visual inspection its geometry is less critical than Section A-A.

THOMAS-HARTIG & ASSOCIATES, INC.

Project No: 86-743

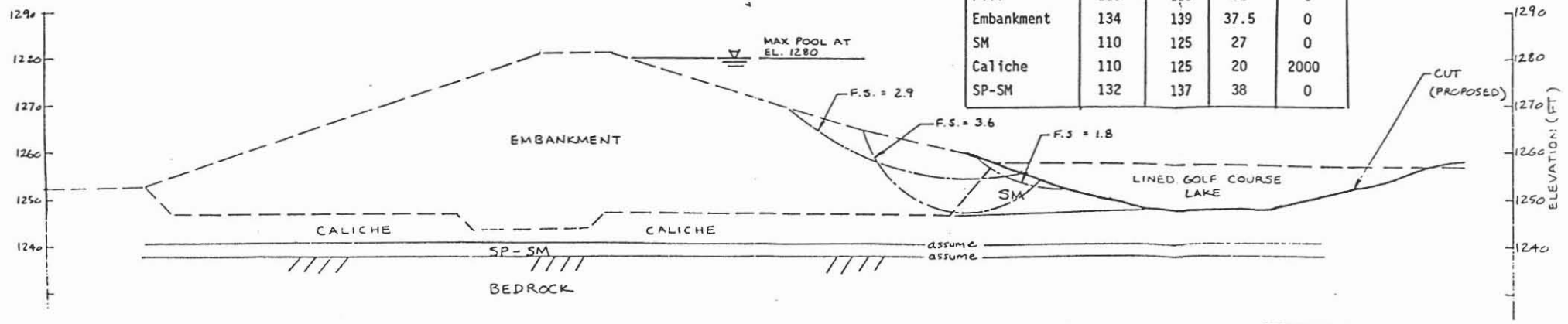
FIGURE 5: EAST DAM
CROSS SECTIONS

SECTION C-C
scale: 1" = 20'



Assumed Material Properties				
MATERIAL	Unit Weight		Shear Strength	
	γ_m pcf	γ_{sat} pcf	ϕ deg	c psf
Fill	115	128	32	0
Embankment	134	139	37.5	0
SM	110	125	27	0
Caliche	110	125	20	2000
SP-SM	132	137	38	0

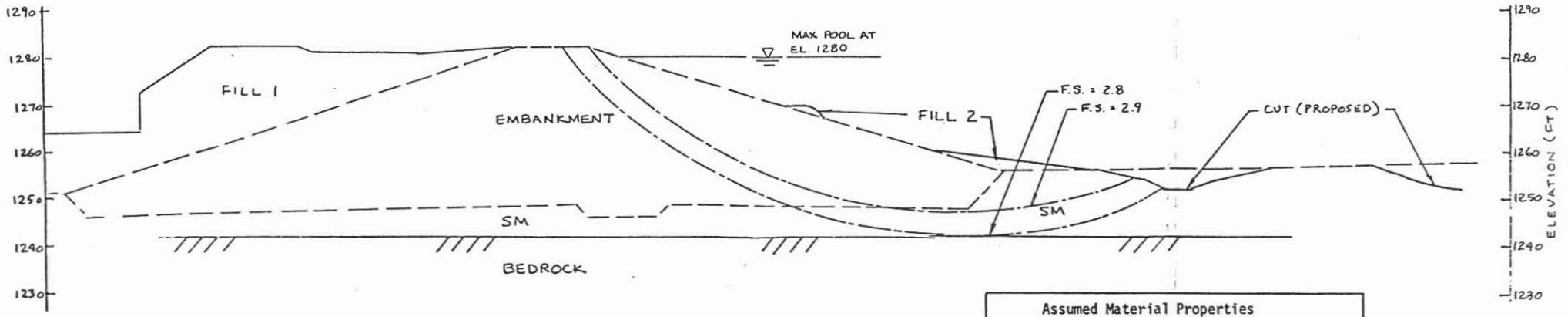
SECTION D-D
scale: 1" = 20'



THOMAS-HARTIG & ASSOCIATES, INC.
Project No: 86-743

FIGURE 6: NORTH DAM 2
CROSS SECTIONS

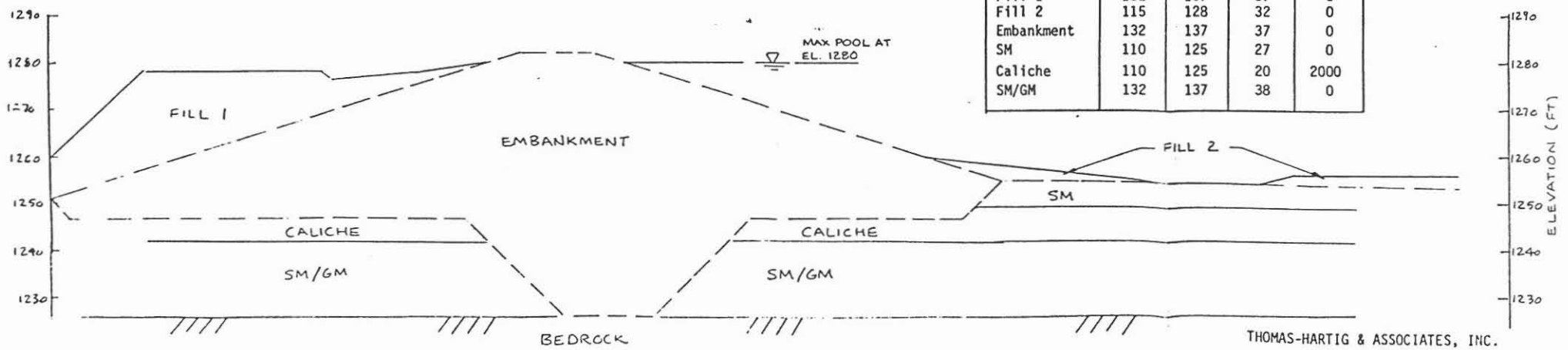
SECTION E-E
Scale: 1" = 20'



NOTE: Stability analyses were not performed on Section F-F because by visual inspection its geometry is less critical than Section E-E.

Assumed Material Properties				
	Unit Weight		Shear Strength	
MATERIAL	γ_m pcf	γ_{sat} pcf	ø deg	c psf
Fill 1	132	137	37	0
Fill 2	115	128	32	0
Embankment	132	137	37	0
SM	110	125	27	0
Caliche	110	125	20	2000
SM/GM	132	137	38	0

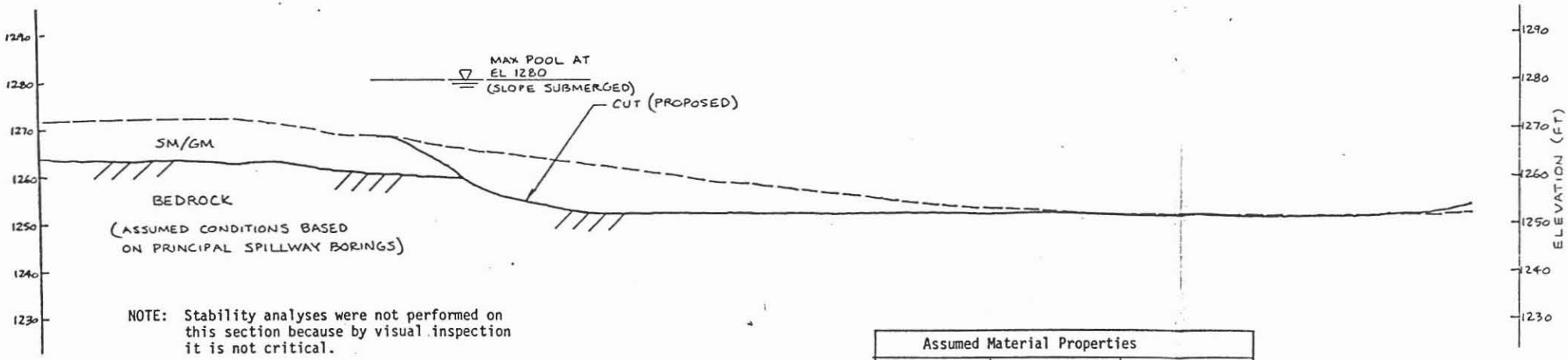
SECTION F-F
Scale: 1" = 20'



THOMAS-HARTIG & ASSOCIATES, INC.
Project No: 86-743

FIGURE 7: ABUTMENT CUT CROSS SECTION

SECTION G-G
scale. 1" = 20'



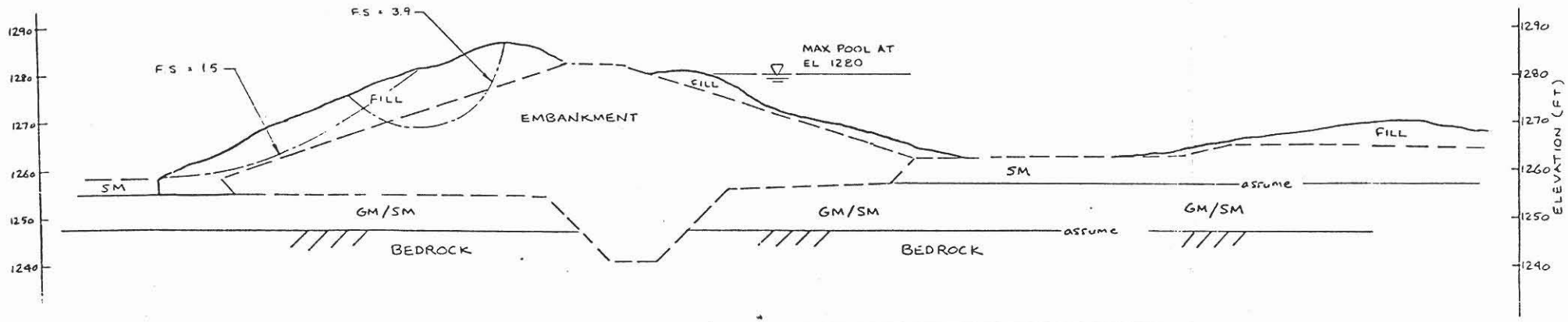
NOTE: Stability analyses were not performed on this section because by visual inspection it is not critical.

Assumed Material Properties				
	Unit Weight		Shear Strength	
MATERIAL	γ_m pcf	γ_{sat} pcf	ϕ deg	c psf
SM/GM	120	137	38	0

THOMAS-HARTIG & ASSOCIATES, INC.
Project No: 86-743

FIGURE 8: NORTH DAM 1
CROSS SECTION

SECTION H-H
scale: 1" = 20'



Assumed Material Properties				
	Unit Weight		Shear Strength	
MATERIAL	γ_m pcf	γ_{sat} pcf	ϕ deg.	c psf
Fill	120	128	32	0
Embankment	136	140	38	0
SM	110	125	27	0
SM/GM	120	137	38	0

THOMAS-HARTIG & ASSOCIATES, INC.

Project No: 86-743

Thomas-Hartig & Assoc, Inc.
2720 S. Hardy Drive
Tempe, Arizona 85282

PROJECT NO. 86-743 COMPUTED BY RAB DATE 10/1/86
SUBJECT CHECKED BY CLP DATE 10/17/86

Summary of Field Density Tests: (from SCS Data)

East Dam (I-10) Location

Test No.	γ_d (pcf)	w/c %
6	117.9	8.6
7	124.1	9.6
8	127.8	6.2
9	124.1	8.9
10	127.6	7.1
11	126.8	10.7
12	123.7	6.6
13	123.7	7.8
14	129.0	8.5
15	127.8	8.1
16	123.6	7.2
18	118.1	8.7
19	125.7	8.5
20	124.4	10.4
21	125.0	9.1
24	128.0	8.7
25	130.1	9.7
26	123.2	13.2
29	129.9	11.9
30	123.7	12.5
32	126.5	7.2
33	126.5	8.2
34	124.2	7.4
35	127.5	7.2
36	112.5	16.4
37	127.5	6.2
38	126.5	6.9
39	127.5	6.2
40	124.5	10.5
42	112.5	16.2
43	120.3	7.3
44	113.5	14.9
45	120.3	9.0
49	124.5	11.0
50	113.5	12.2
	Σ 4332.0	Σ 328.8

(cont. next page)

Thomas-Hartig & Assoc, Inc.
2720 S. Hardy Drive
Tempe, Arizona 85282

PROJECT NO. 86-743 COMPUTED BY RAB DATE 10/1/86
SUBJECT CHECKED BY CLP DATE 10/17/86

East Dam (I-10) Location (cont.)

Test No.	γ_d (pcf)	w/c (%)
52	130.5	6.7
54	122.6	5.9
55	122.6	5.8
56	124.1	10.6
57	114.5	11.8
59	108.9	13.3
60	113.9	11.8
61	117.1	11.4
62	118.5	9.5
63	111.1	11.3
65	126.8	11.2
66	123.4	9.4
68	126.1	10.9
69	124.7	8.0
72	113.8	12.2
73	121.1	10.1
74	124.7	9.8
75	128.7	9.1
76	115.1	9.2
77	125.1	9.1
78	119.6	7.3
81	129.1	7.4
151	119.9	8.7
152	127.5	10.2
153	125.7	6.3
154	123.3	6.4
165	125.3	7.7
166	123.2	7.3
	Σ 3406.9	Σ 258.4

$$\text{Avg } \gamma_d = \frac{4332 + 3406.9}{35 + 28} = 122.8 \text{ pcf}$$

$$\text{Avg } w/c = \frac{328.8 + 258.4}{35 + 28} = 9.3\%$$

Thomas-Hartig & Assoc, Inc.
2720 S. Hardy Drive
Tempe, Arizona 85282

PROJECT NO. 86-743 COMPUTED BY RAB DATE 10/1/86
SUBJECT CHECKED BY CLP DATE 10/17/86

North Dam No. 1

Test No.	γ_d (pcf)	w/c (%)
82	134.3	8.4
83	120.6	10.0
84	116.4	9.6
85	128.3	12.1
86	117.7	10.3
87	127.7	9.2
90	126.2	6.3
91	124.8	9.3
92	125.9	9.8
93	122.5	12.1
96	125.0	9.2
97	118.8	11.2
111	125.8	11.6
112	121.2	10.7
113	125.8	11.6
118	123.7	7.8
	Σ 1984.7	Σ 159.2

Avg w/c = 10.0 %

$$\text{Avg } \gamma_d = \frac{1984.7}{16} = 124.0 \text{ pcf}$$

Assume $G_s = 2.65$

$$e_{avg} = \frac{G\gamma_w}{\gamma_{d_{avg}}} - 1 \cong \frac{2.65(62.4)}{124.0} - 1 \cong 0.334$$

$$Gw = Se \therefore @\ S = 100\% \Rightarrow w_{SAT} = \frac{e}{G} = \frac{0.334}{2.65} \cong 12.6\%$$

$$\therefore \gamma_{SAT\ AVG} \cong (124 \text{ pcf})(1 + 0.126) = 139.6 \text{ pcf}$$

$$\gamma_{moist\ AVG} \cong (124 \text{ pcf})(1 + 0.10) = 136.4 \text{ pcf}$$

Thomas-Hartig & Assoc, Inc.
2720 S. Hardy Drive
Tempe, Arizona 85282

PROJECT NO. 86-743 COMPUTED BY RAB DATE 10/1/86
SUBJECT CHECKED BY CLP DATE 10/17/86

North Dam No. 2

Test No.	γ_d (pcf)	w/c (%)
105	125.1	8.5
106	128.6	8.9
107	111.0	12.4
108	118.6	8.5
109	117.0	8.3
121	114.5	10.1
122	112.5	13.6
174	109.4	12.2
176	126.8	9.1
177	129.0	11.1
178	131.9	8.1
179	129.1	9.6
181	127.0	9.8
182	123.6	9.1
183	120.6	11.0
184	107.0	14.4
185	118.1	13.2
186	113.7	18.1
187	128.1	10.1
188	111.3	10.8
189	122.5	14.9
190	112.0	12.1
191	126.7	8.7
192	128.2	7.2
193	121.1	8.7
194	111.4	12.0
195	111.9	13.2
196	118.7	10.0
197	117.1	12.9
198	113.3	15.2
199	119.5	9.1
200	110.8	12.1
201	120.8	8.2
	Σ 3936.9	Σ 361.2

Avg $\gamma_d = \frac{3936.9}{33} = 119.3$ pcf Avg w/c $= \frac{361.2}{33} = 10.9\%$

Thomas-Hartig & Assoc, Inc.
2720 S. Hardy Drive
Tempe, Arizona 85282

PROJECT NO. 86-743 COMPUTED BY RAB DATE 10/3/86
SUBJECT Density Estimates CHECKED BY CLP DATE 10/17/86

Summary of average densities:

Location	Avg γ_d (pcf)	Avg w/c (%)	Avg γ_t (pcf)	Avg γ_{SAT} (pcf)*
East Dam	122.8	9.3	134.2	138.9
North Dam 1	124.0	10.0	136.4	139.6
North Dam 2	119.3	10.9	132.3	136.7

* Assuming $G_s = 2.65$

East Dam

$$e_{avg} = \frac{G\gamma_w}{\gamma_d} - 1 = \frac{2.65(62.4)}{122.8} - 1 = 0.347$$

$$w_{SAT} = e/G = 0.347/2.65 = 13.1\%$$

North Dam 2

$$e_{avg} = \frac{(2.65)(62.4)}{119.3} - 1 = 0.386$$

$$w_{SAT} = \frac{e}{G} = \frac{0.386}{2.65} = 14.6\%$$

North Dam 1

(previously calculated on North Dam 1 summary sheet)

Thomas-Hartig & Assoc, Inc.
2720 S. Hardy Drive
Tempe, Arizona 85282

PROJECT NO. 86-743 COMPUTED BY RAB DATE 10/8/86
SUBJECT CHECKED BY CLP DATE 10/17/86

Using NAVFAC chart,[2] find ϕ for avg γ_d of embankment materials and D_r = 75%

Location	Avg γ_d (pcf)	ϕ
East Dam	122.8	37.5°
North Dam 1	124.0	38°
North Dam 2	119.3	37°

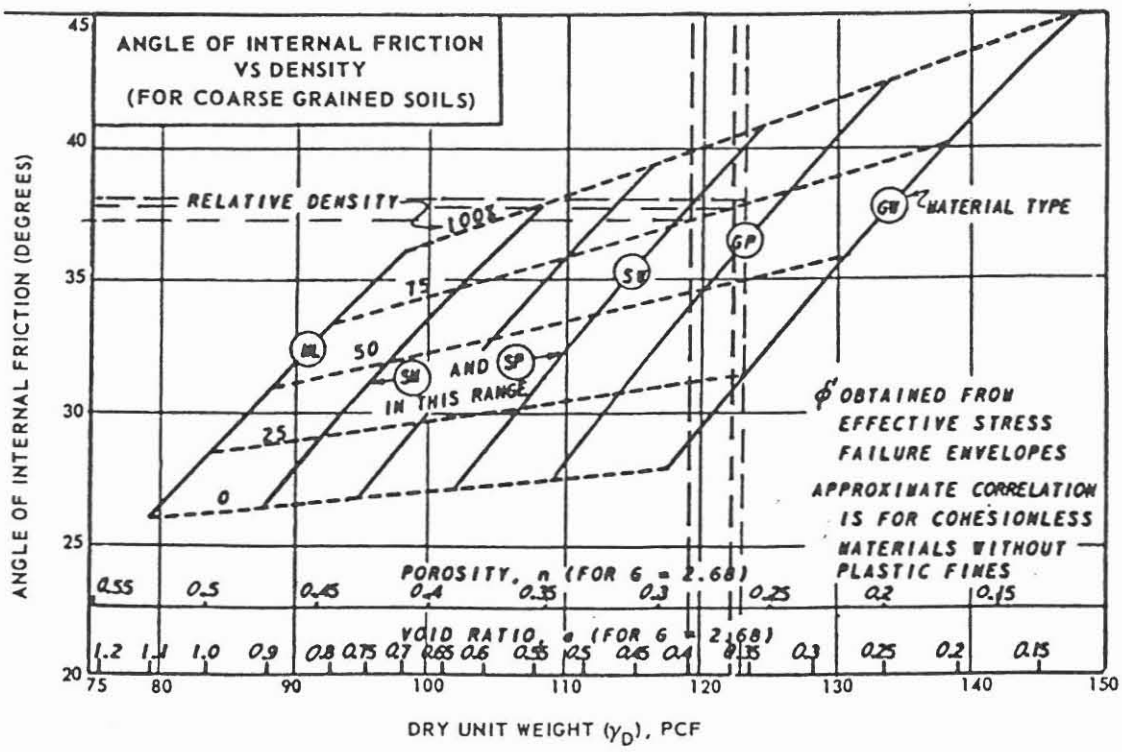


FIGURE 3-7
Correlations of Strength Characteristics

7-3-17

[2] NAVFAC DM-7 1971

Thomas-Hartig & Assoc, Inc.
2720 S. Hardy Drive
Tempe, Arizona 85282

PROJECT NO. 86-743 COMPUTED BY RAB DATE 10/8/86
SUBJECT CHECKED BY CLP DATE 10/17/86

Summary of friction angle correlations:

Need estimate of relative density, D_R, of embankment materials.

Lambe & Whitman[1] reports maximum dry unit weights for "silty sand" and "fine to coarse sand" as 127 pcf and 138 pcf, respectively.

Embankment material would be a combination of these two types ∴ assume max γ_d for embankment material $= \frac{127+138}{2} = \underline{\underline{132.5 \text{ pcf}}}$

Similarly, assume min $\gamma_d = \frac{87+85}{2} = \underline{\underline{86 \text{ pcf}}}$

$$D_r = \frac{\gamma_{d\,max}}{\gamma_d} \times \frac{\gamma_d - \gamma_{d\,min}}{\gamma_{d\,max} - \gamma_{d\,min}} \times 100\%$$

Therefore:

Location	Avg γ_d (pcf)	Dr
East Dam	122.8	85 %
North Dam 1	124.0	87 %
North Dam 2	119.3	80 %

Conclusion: Use $D_r = 75\%$ for NAVFAC correlation chart.

1 Lambe & Whitman, Soil Mechanics
John Wiley & Sons, 1969, p. 31

Table 3-3. Empirical values for ϕ, D_r, and unit weight of granular soils based on the standard penetration number with corrections for depth and for fine saturated sands

Description	Very loose	Loose	Medium	Dense	Very dense
Relative density D_r*	0 — 0.15	0.15 — 0.35	0.35 — 0.65	0.65 — 0.85	0.85 — 1.00
Standard penetration no. N	4	10	30	50	
Approx. angle of internal friction ϕ°†	25°–30°	27–32°	30–35°	35–40°	38–43°
Approx. range of moist unit weight, (γ) pcf (kN/m³)	70–100‡ (11–16)	90–115 (14–18)	110–130 (17–20)	110–140 (17–22)	130–150 (20–23)

* USBR [Gibbs and Holtz (1957)].

† After Meyerhof (1956). $\phi = 25 + 25D_r$ with more than 5 percent fines and $\phi = 30 + 25D_r$ with less than 5 percent fines. Use larger values for granular material with 5 percent or less fine sand and silt.

‡ It should be noted that excavated material or material dumped from a truck will weigh 70 to 90 pcf. Material must be quite dense and hard to weigh much over 130 pcf. Values of 105 to 115 pcf for nonsaturated soils are common.

Table 3-4. Empirical values for q_u* and consistency of cohesive soils based on the standard penetration number

Consistency	Very soft	Soft	Medium	Stiff	Very stiff	Hard
q_u, ksf	0 — 0.5	0.5 — 1.0	1.0 — 2.0	2.0 — 4.0	4.0 — 8.0	8.0
N, standard penetration resistance	0 — 2	2 — 4	4 — 8	8 — 16	16 — 32	32
$\gamma_{(sat)}$, pcf (kN/m³)	100–120 (16–19)		110–130 (17–20)	120–140 (19–22)		

* These values should be used as a guide only. Local cohesive samples should be tested, and the relationship between N and the unconfined compressive strength q_u established as $q_u = KN$.

FROM BOWLES (1977)

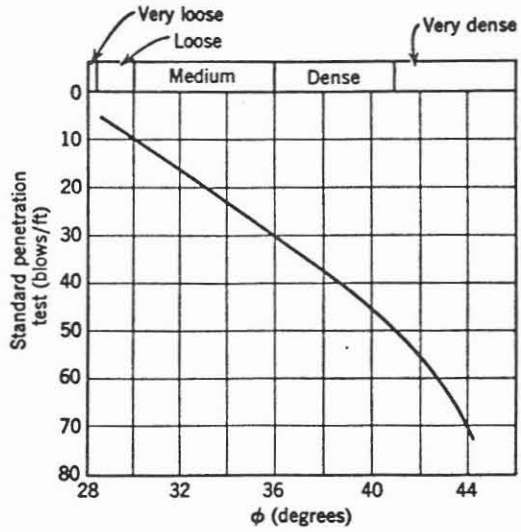


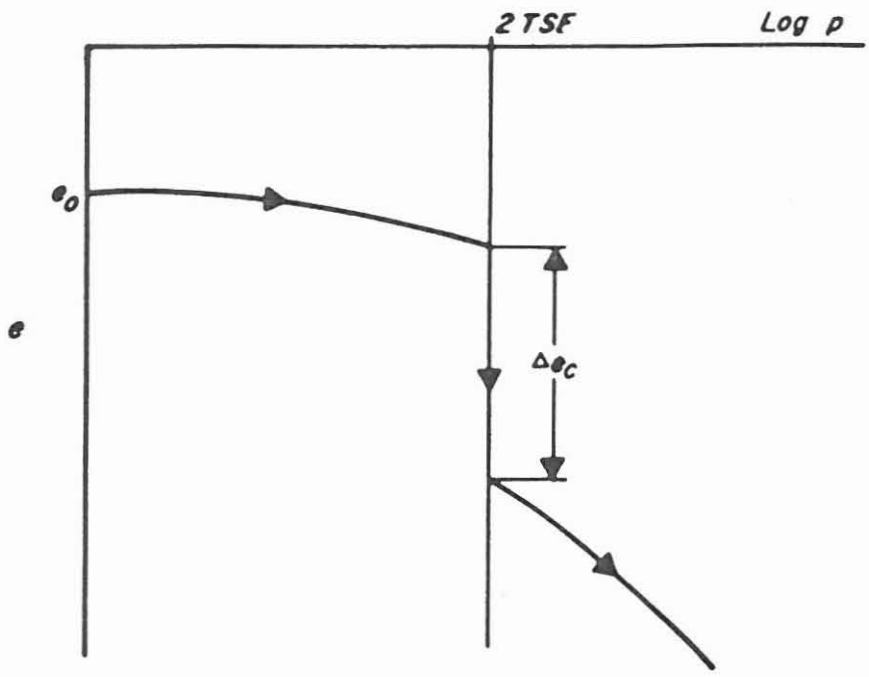
Fig. 11.14 Correlation between friction angle and penetration resistance (From Peck, Hanson, and Thornburn, 1953).

Table 3.2 Maximum and Minimum Densities for Granular Soils

Description	Void Ratio		Porosity (%)		Dry Unit Weight (pcf)	
	e_{max}	e_{min}	n_{max}	n_{min}	$\gamma_{d\,min}$	$\gamma_{d\,max}$
Uniform spheres	0.92	0.35	47.6	26.0	—	—
Standard Ottawa sand	0.80	0.50	44	33	92	110
Clean uniform sand	1.0	0.40	50	29	83	118
Uniform inorganic silt	1.1	0.40	52	29	80	118
Silty sand	0.90	0.30	47	23	87	127
Fine to coarse sand	0.95	0.20	49	17	85	138
Micaceous sand	1.2	0.40	55	29	76	120
Silty sand and gravel	0.85	0.14	46	12	89	146

B. K. Hough, *Basic Soils Engineering*. Copyright © 1957, The Ronald Press Company, New York.

FROM LAMBE AND WHITMAN (1969)



Collapse Potential (CP) is defined as:

$$CP = \frac{\Delta e_c}{1 + e_o} \quad \text{or} \quad CP = \frac{\Delta Hc}{Ho}$$

Δe_c = Change in void ratio upon wetting

e_o = Natural void ratio

ΔHc = Change in height upon wetting

Ho = Initial height

Collapse Potential Values

CP	Severity of Problem
0-1%	No problem
1-5%	Moderate trouble
5-10%	Trouble
10-20%	Severe Trouble
20%	Very Severe Trouble

FIGURE 6
Typical Collapse Potential Test Results

FROM NAVFAC DM-7.1 (1982)

LABORATORY NO 710001

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	DIRECT SHEAR TEST

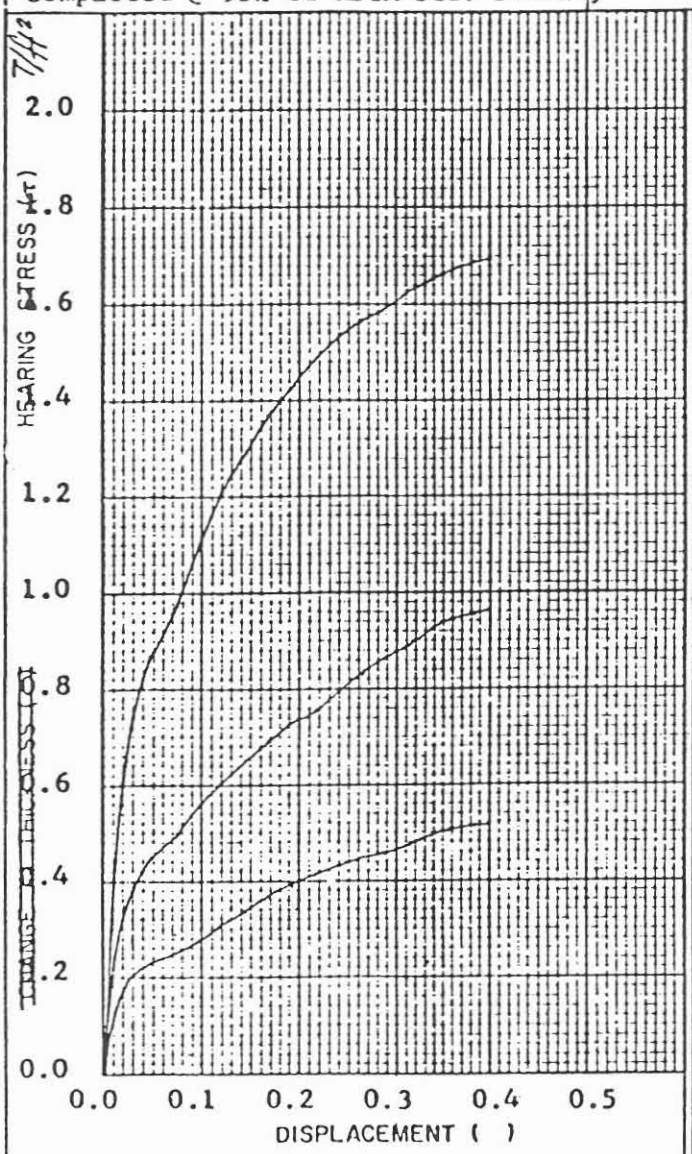
PROJECT and STATE: Guadalupe Wsh'd, Arizona			SAMPLE LOCATION: Guadalupe, ℄ FRS
FIELD SAMPLE NO: 3.1	DEPTH: 3.0 to 5.0 ft.	GEOLOGIC ORIGIN:	
TYPE OF SAMPLE: Disturbed	TESTED AT: Portland, Oregon	APPROVED BY: Donald E. Wallin	DATE: 7/31/70

CLASSIFICATION SM-1 LL 57 PI 22

TYPE OF TEST: Quick Consolidated Direct Shear		CONTROL: Strain	
RATE OF LOADING (in/min): 0.0080	MOISTURE CONDITION: 100.0% Saturated		
TYPE OF SPECIMEN: Compacted @ 95% of ASTM Ste. Density	AREA (sq in): 6.25	THICKNESS (in): 1.00	

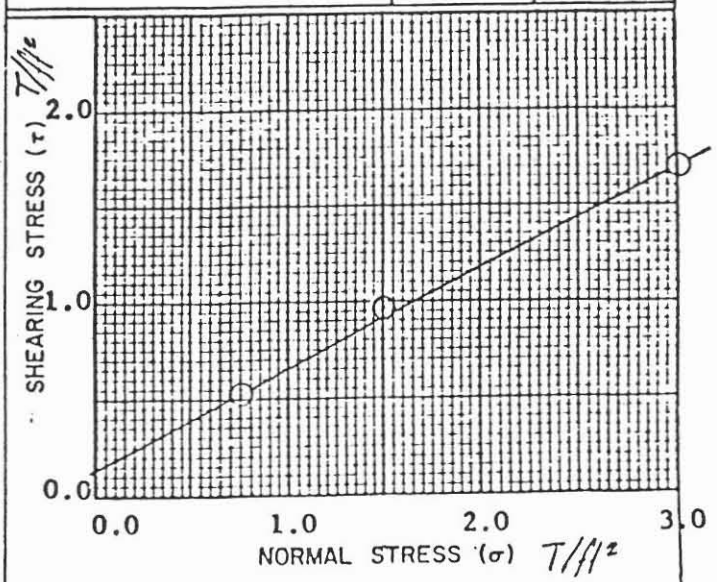
SPECIFIC GRAVITY

$G_s(-)$ #4	2.73
$G_s(+)$ #4	2.51
G_m(bulk)(+) #4	



TEST NO.	1	2	3	4
INIT. MOISTURE, %	17.2	17.2	17.2	
DRY DENSITY, ☐ g/cc ☒ pcf	100.1	100.1	100.1	
INIT. VOID RATIO	0.706	0.706	0.706	
TEST DURATION, (min)	50	50	50	
FINAL MOISTURE, %	28.4	25.8	25.6	
NORMAL STRESS T/ft²	3/4	1-1/2	3	
MAX. SHEAR STRESS T/ft²	0.5160	0.9622	1.6966	

SHEAR VALUES	∅	C
AT MAXIMUM STRESS	27°30'	0.14 T/ft²



REMARKS: Direct Shear test discussed in Section 4.2.4 of text.

THOMAS-HARTIG & ASSOCIATES, INC. Project No: 86-743

THOMAS-HARTIG & ASSOCIATES, INC.

Project No: 86-743

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 710001

PROJECT and STATE: Guadalupe Wsh'd., Arizona

SAMPLE LOCATION: Guadalupe, E FRS

FIELD SAMPLE NO: 3.1

DEPTH: 3.0 to 5.0 ft.

GEOLOGIC ORIGIN:

TYPE OF SAMPLE: Disturbed

TESTED AT: Portland, Oregon

APPROVED BY: Donald E. Wallin

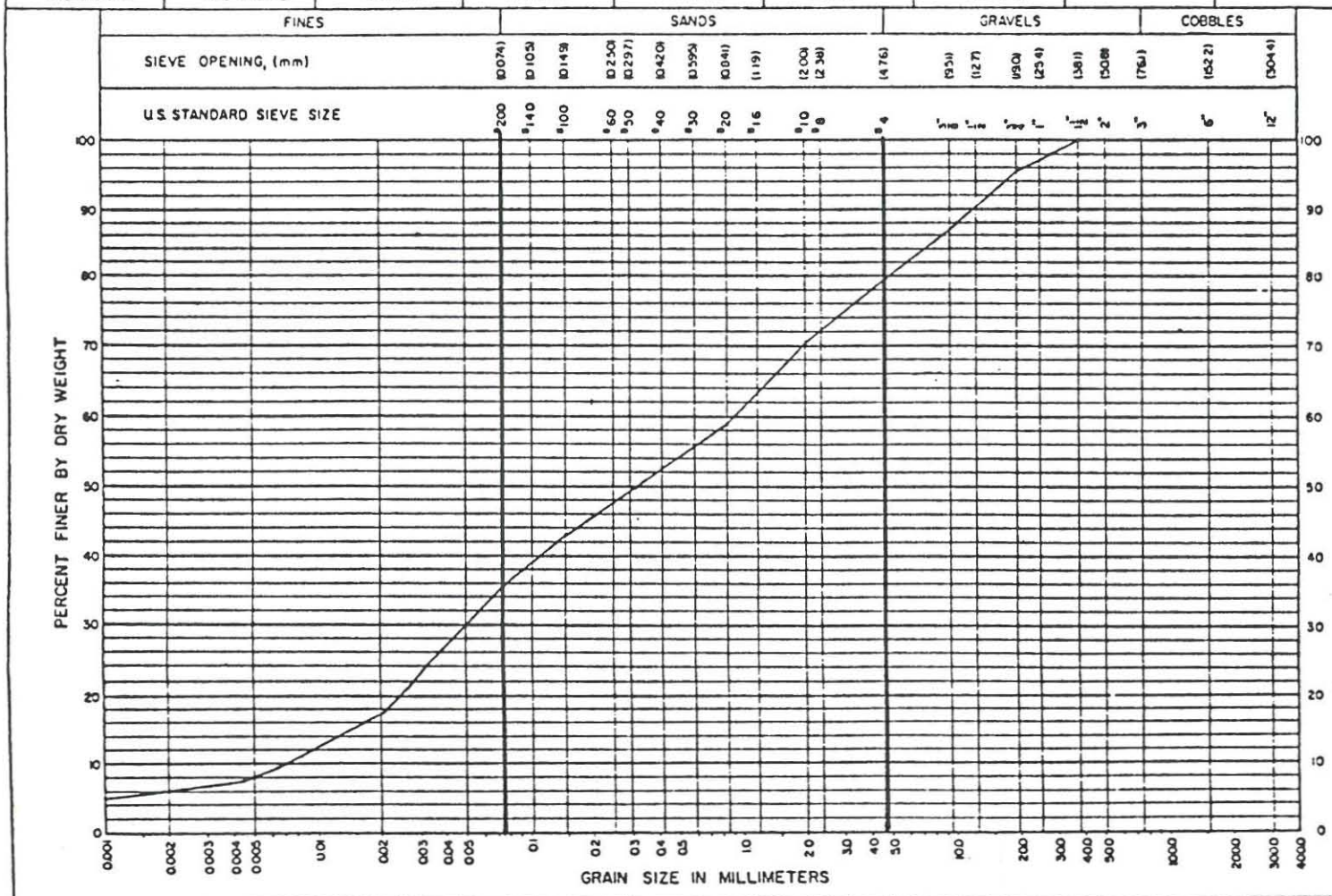
DATE: 7/31/70

SYMBOL: SM-1

DESCRIPTION: Pale brown, Gravelly Silty Clayey Sand

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
0.0070	0.0145	0.05	0.31	0.91	9.2	38.1		



SPECIFIC GRAVITY (G_S)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4 2.73	(+) #4 2.51	LL	PI	LL 57	PI 22	LL	PI	%	%	%	g/cc / pcf

REMARKS: Absorption = 3.31%

Grain size distribution results for direct shear test sample discussed in Section 4.2.4 of text.

THOMAS-HARTIG & ASSOCIATES, INC.
Project No: 86-743

Form SCS 353

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

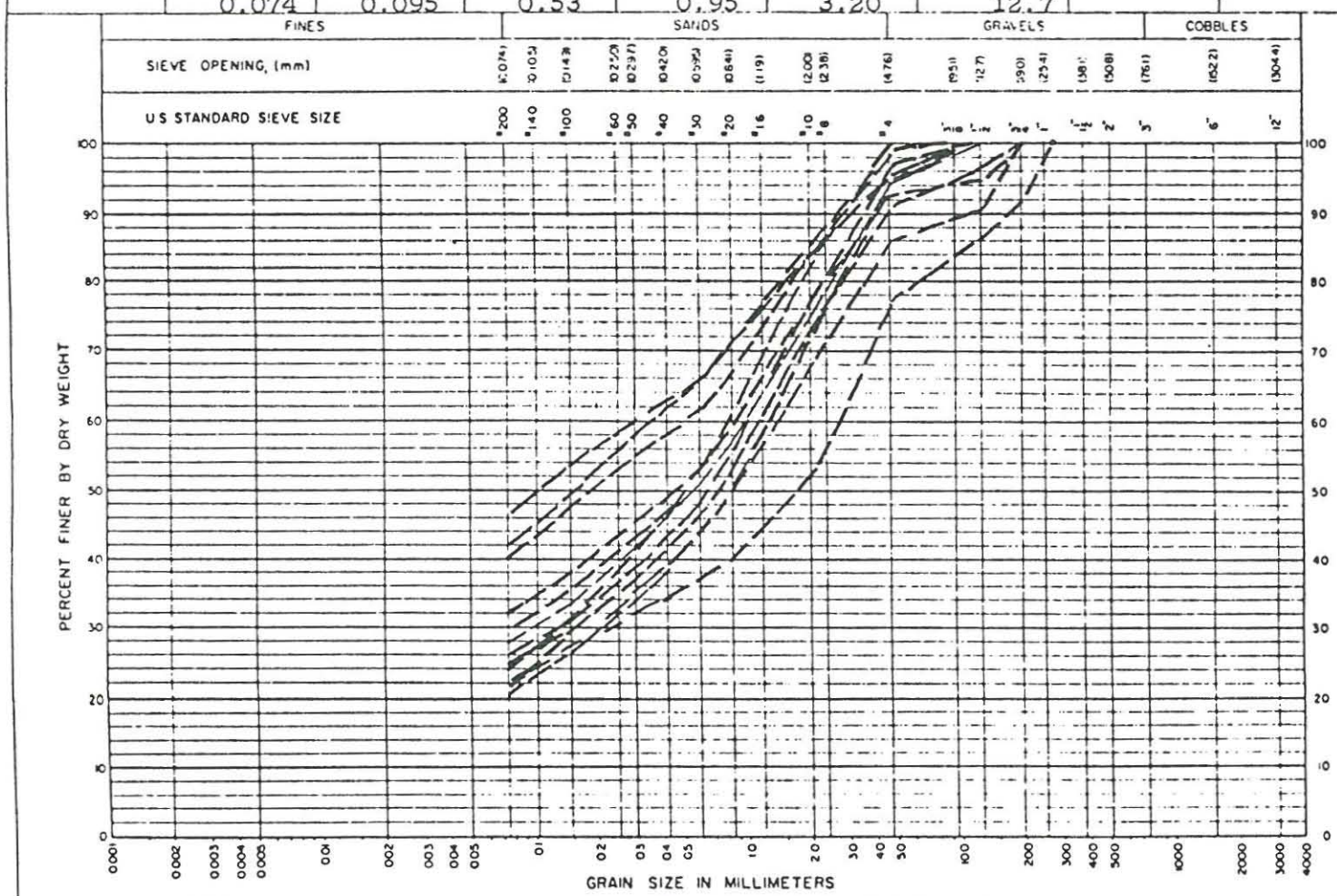
SOIL CLASSIFICATION

LABORATORY NO A72033

PROJECT and STATE: Guadalupe WPP			Arizona
FIELD SAMPLE NO: 101 1	DEPTH: 0-5.0'	GEOLOGIC ORIGIN	SAMPLE LOCATION: I-10 53+00 200' upstream
TYPE OF SAMPLE: Composite	TESTED AT: SCS field lab	APPROVED BY: [signature]	DATE: 10 Dec. 1971
SYMBOL: SM-1	DESCRIPTION: Coarse silty sands		

GRAIN SIZE DISTRIBUTION

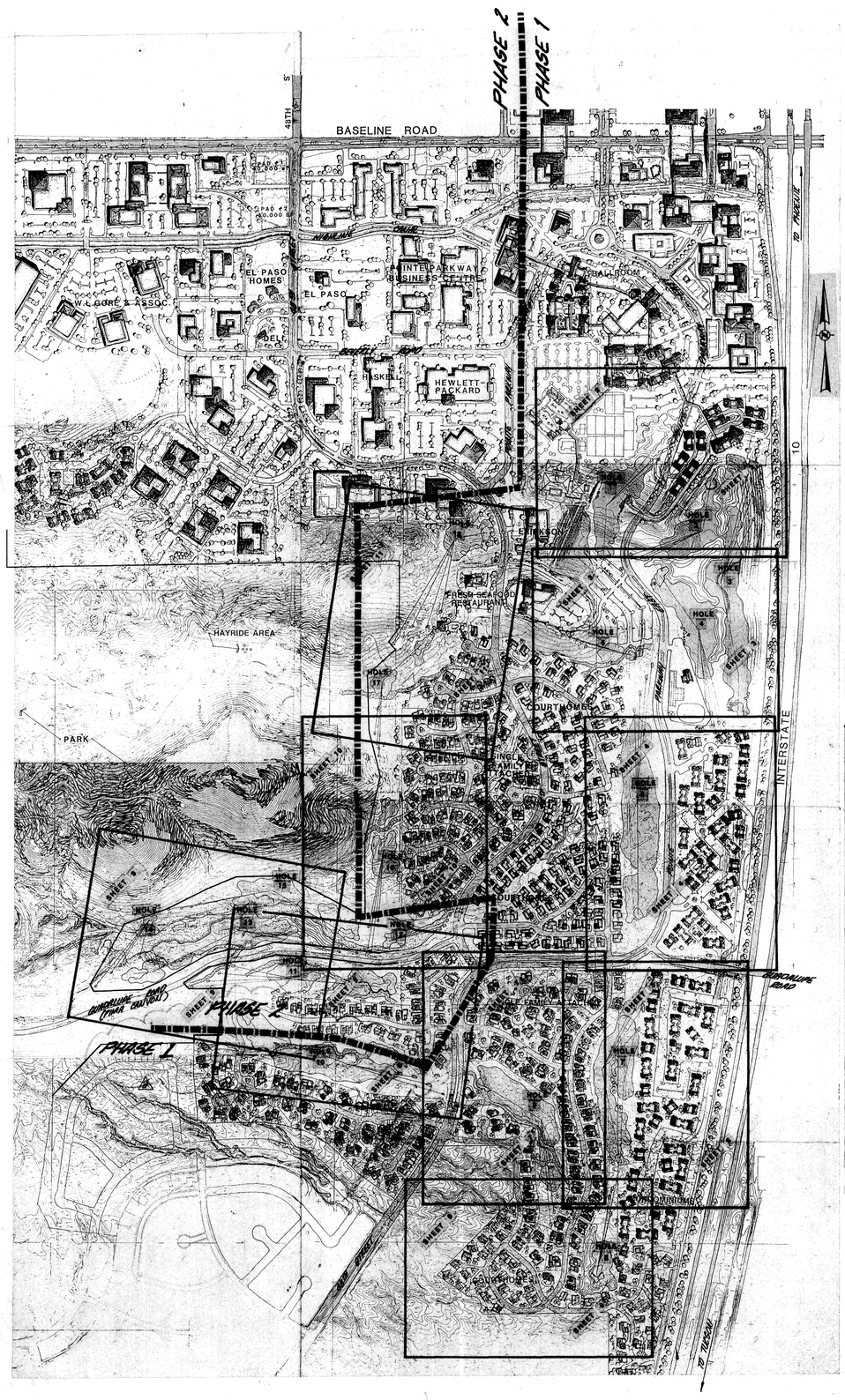
D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
	0.074	0.095	0.53	0.95	3.20	12.7		

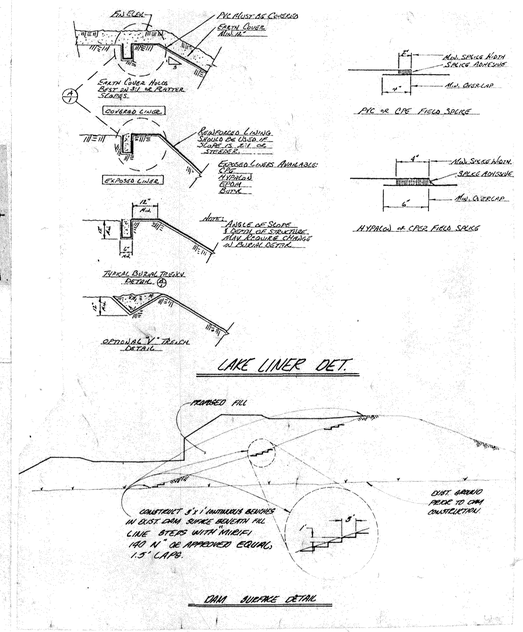


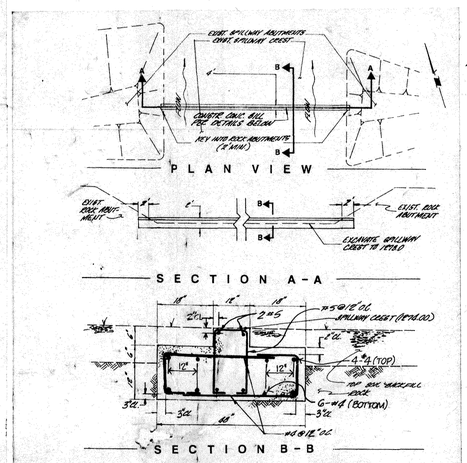
SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI	%	%	%	g/cc pcf

REMARKS: Washed

Summary of grain size distribution curves for borrow pits 101 through 111, 2002 and 2005







REINFORCED CONCRETE SILL DETAIL
N.T.S.

TEMPERATURE REQUIREMENT
MAX JOINT SPACING = 30'
A) FOR EXPOSED SURFACES, P = 0.002
28'x12" = 288 x 0.002 = 0.58 IN²
USE #5 = 0.62 IN²
B) FOR UNEXPOSED SURFACES, P = 0.001
18'x12" = 216 x 0.001 = 0.216 IN²
USE 5 x 4 = 1.0 IN²

NOTE: CONSTR. JOINTS SHALL NOT EXCEED 30'
CONC. SHALL BE CLASS 3000

LEGEND

(63.21)	INDICATES	EXISTING ELEVATION
T.C.	"	TOP OF CURB ELEVATION
P.	"	PAVEMENT ELEVATION
G.	"	GUTTER ELEVATION
F.F.	"	FINISH FLOOR ELEVATION
F.G.	"	FINISH GRADE
G.B.	"	GRADE BREAK
	"	FLOW LINE, OR DRAINAGE DIRECTION
	"	SHEET FLOW, OR CROSS-SLOPE
	"	CONCRETE
	"	PAVEMENT
1100	"	EXIST. CONTOUR
82	"	PROPOSED CONTOUR

GRADING AND DRAINAGE GENERAL NOTES

"A grading permit is required under Ordinance G-1177."

Excavating Contractor must give location for wasting excess excavation and a letter from owner giving permission for dumping prior to starting on-site construction.

"City Engineer's office shall be notified before any on-site construction begins, telephone 262-4960."

"Staking pad and/or finish floor elevations is the responsibility of the Developer and his Engineer." In non-critical areas: Developer's Engineer shall submit certification of constructed building pad elevations prior to request for final inspection. In critical drainage area: Substitute building floor elevation in above note.

"A separate permit is necessary for any off-site construction ."

A grading and drainage plan shall be on the job site at all times. Deviations from the plan must be preceded by an approved plan revision.

Drywells must be drilled a minimum of 5 feet into permeable porous strata or percolation tests will be required. The grading and drainage inspector must be present before backfill or wall pipes are placed within any drywells.

Grading and drainage plan approval includes: the construction of all surface improvements shown on the approved grading & drainage plan, including but not limited to, retention areas and/or other drainage facilities, drainage patterns, walls, curbs, asphalt pavement, and building floor elevations.

Contractor shall provide level bottom in all retention basins at elevations as shown on the plans. Retention basins side slopes shall not exceed 2:1 on private property unless noted otherwise on the plans.

Contractor is responsible for locating and confirming depths of all the existing utility lines within proposed retention basin areas. If the basin cannot be constructed as per plan because of conflict with underground utilities the contractor should request modification of basin configuration by plan revision.

All drainage protective devices such as swales, interceptor ditches, pipes protective berms, concrete channels or other measures designed to protect homes from storm runoff must be completed prior to any structure being built.

Soils compaction test results must be submitted to the City Engineer's Office for build-pads that have one(1) foot or more of fill material indicated. This information must be supplied prior to request for final inspection .

The design engineer shall locate and show all existing underground utilities within proposed retention areas. The basin should be designed to maintain a minimum 15" of cover over utility lines.

Clearance for occupation of any building is denied until grading & drainage improvement are completed.

PARKS DEPARTMENT IS TO BE NOTIFIED PRIOR TO ANY CONSTRUCTION WITHIN THE EXISTING MOUNTAIN PRESERVE.

PERMANENT CORNERS FOR THE NEW PRESERVE BOUNDARY AND TEMPORARY POST AT 50' INTERVALS ALONG THE BOUNDARY ARE TO BE SET PRIOR TO ANY CONSTRUCTION.

GUADALUPE ROAD IS TO REMAIN OPEN AT ALL TIMES DURING CONSTRUCTION.

A THROUGH ATTEMPT HAS BEEN MADE TO SHOW THE LOCATIONS OF ALL UNDERGROUND OBSTRUCTIONS AND UTILITY LINES IN THE WORK AREA. HOWEVER, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE TO OBSTRUCTIONS AND UTILITY LINES ENCOUNTERED DURING CONSTRUCTION AND SHALL DETERMINE THE EXACT LOCATION OF UTILITIES IN THE AREA.

TOTAL GRADING AREA = 96.6 ACRES

CITY OF PHOENIX
ENGINEERING DEPARTMENT
THIS SET OF PLANS HAS BEEN REVIEWED FOR
GRADING and DRAINAGE
REQUIREMENTS PRIOR TO ISSUANCE OF CONSTRUCTION PERMIT AND SHALL BE KEPT AT THE CONSTRUCTION SITE. SUCH REVIEW SHALL NOT PREVENT THE CITY ENGINEER FROM REQUIRING CORRECTION OF ERRORS IN THE PLANS WHERE SUCH ERRORS ARE SUBSEQUENTLY FOUND TO BE IN VIOLATION OF ANY LAW OR ORDINANCE.
DATE 5-22-86 BY CDW

REVISION APPROVALS:
FOR CITY ENGINEER — DATE 7/13/87

PHASE 1 APPROVAL
(SHEETS 1-4,9 HOLES 1-8,10 10,11 16,17,18)

CITY OF PHOENIX
ENGINEERING DEPARTMENT
THIS SET OF PLANS HAS BEEN REVIEWED FOR
GRADING and DRAINAGE
REQUIREMENTS PRIOR TO ISSUANCE OF CONSTRUCTION PERMIT AND SHALL BE KEPT AT THE CONSTRUCTION SITE. SUCH REVIEW SHALL NOT PREVENT THE CITY ENGINEER FROM REQUIRING CORRECTION OF ERRORS IN THE PLANS WHERE SUCH ERRORS ARE SUBSEQUENTLY FOUND TO BE IN VIOLATION OF ANY LAW OR ORDINANCE.
DATE _____ BY _____

PHASE 2 APPROVAL
(SHEETS 5-10, HOLES 2-15)

Phase 1 & Phase 2 Grading & Drainage Permits do not allow work to be performed on City or Park lands unless all other agencies have agreed to this action. These plans and Permits do not establish new Park boundaries. These plans and Permits only address the suitability of these actions if all other requirements are met and City Council approval is received.

SUBMITTED BY _____ 5-14-86
Registered Civil Engineer

EXPEDITED BY WITCHER & ASSOCIATES

NOTE:
CONTACT AMERICAN TELEPHONE & TELEGRAPH COMPANY 48 HOURS PRIOR TO ANY EXCAVATION. WORK CLOSELY WITH A.T.&T. PERSONNEL TO VERIFY LOCATION, EXCAVATE, SUPPORT, & BACKFILL CABLE. EXCAVATE BY HAND IN VICINITY OF CABLE.

F.N.12401

Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

Possessory rights of drawings, including designs, all plans, drawings, designs and specifications and all copies of plans are property of Gosnell Development Corporation and shall not be used for any similar kind or form without the consent of Gosnell Development Corporation.

Revisions		
By	Date	Description
	8-26-87	SEE SHEET 3
	8-26-87	SEE SHEET 4
	4-6-87	SEE SHEET 1-4 - REVISED PHASE LINE

	Firm	Phone
Architect	G.D.C. Block	956-4900
Planning	G.D.C.	956-4900
Engineer	G.D.C. Lagar	956-4900

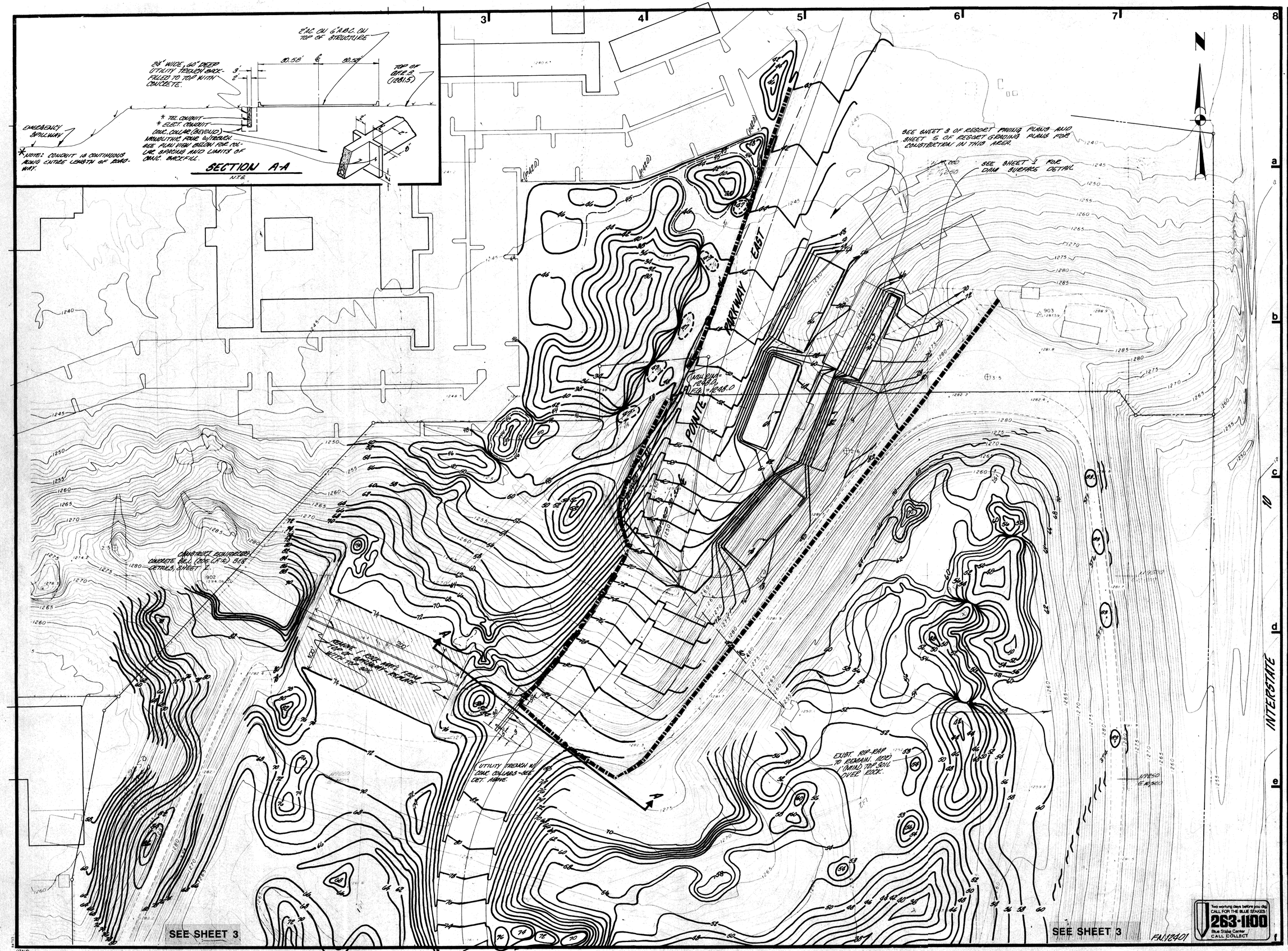
Scale: NS = NOTED
Drawn by _____ Date 4-3-86
Ck'd by _____ Date 4-3-86

19__ COPYRIGHT © GOSNELL DEVELOPMENT CORP.

GRADING & DRAINAGE PLAN
P.S.M. GOLF COURSE

THE POINTE - SOUTH MOUNTAIN
GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

SHEET 1 OF 11



Revisions

By	Date	Description

Architect S.D.C. Firm Phone
Planning S.D.C. 956-4300
Engineer S.D.C. Lopez 956-4820

Scale: 1" = 30'
Drawn by: Date 4-2-86
Ck'd by: Date 4-2-86

Possession rights of drawings and project design all plans, drawings, specifications, and other as instruments of service are property of Gosnell Development Corporation and may not be utilized in any way without consent. Out the written consent of Gosnell Development Corporation.

19__ COPYRIGHT © GOSNELL DEVELOPMENT CORP.

GRADING & DRAINAGE PLAN

P.S.M. GOLF COURSE

THE POINTE® - SOUTH MOUNTAIN

Job# -

GOSNELL DEVELOPMENT CORPORATION

2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

SHEET 2 OF 11

Possession rights of drawings and specifications or any part of all plans, drawings, designs and specifications are the property of Gosnell Development Corporation and shall not be used in any manner or form without the written consent of Gosnell Development Corporation.

Revisions		
By	Date	Description
J. Brady	12-21-87	Revise Fine Elevations
J. Brady	1-15-88	Add Trees, Set P. Pump Station

		Phone
Architect	G.D.C. Block	956-4320
Planning	G.D.C.	956-4800
Engineer	G.D.C. Lapp	956-4320

Scale: 1" = 50'
Drawn by Date 4-2-86
Ck'd by Date 4-2-86

19__ COPYRIGHT © GOSNELL DEVELOPMENT CORP.

GRADING & DRAINAGE PLAN
P.S.M. GOLF COURSE
THE POINTE® - SOUTH MOUNTAIN

Job#

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85006 • (602) 956-4300

SHEET 3 OF 11

Possessory rights of drawings, plans, designs and specifications are reserved by and are the property of Gosnell Development Corporation and may not be used in any similar kind or form without the written consent of Gosnell Development Corporation.

Revisions		
By	Date	Description

Architect G.D.C. Short 956-4300
Planning G.D.C. Lagge 956-4300
Engineer G.D.C. Lagge 956-4300

Scale: 1" = 50'
Drawn by Date 4-2-86
Ck'd by Date 4-2-86

19___ COPYRIGHT © GOSNELL DEVELOPMENT CORP.

GRADING & DRAINAGE PLAN
P.S.M. GOLF COURSE
THE POINTE® - SOUTH MOUNTAIN

Job#

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

SEE SHEET 7

SEE SHEET 7

SEE SHEET 6

SEE SHEET 6

SEE SHEET 4

SEE SHEET 4

CAUTION
EXIST. 24" SEWER (FORCE MAIN)

CAUTION
EXIST. HIGH PRESSURE GAS

CAUTION
PROPOSED GASLINE LOCATION

CAUTION
PROPOSED GASLINE LOCATION

CAUTION
EXIST. HIGH PRESSURE GAS

FUTURE CONDOMINIUM SITE #2

AREA OF 95% COMPACTION

22 L.F. 12" PVC.

25 L.F. 12" SCH. 40 PVC. OR ABS

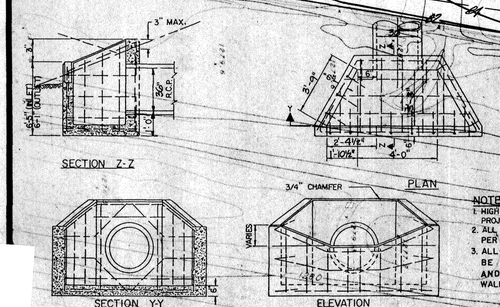
25 L.F. 12" PVC.

DROP INLET STRUCTURE PER M.A.G. 520-2, ATTACH TO EXIST. 36" C.M.P. PIPE. INV. = 78.61 T.W. (INLET EL.) = 84.15 SEE DET. LEFT.

INV. 18" PIPE 83.32

GUADALUPE ROAD

FN. 12401



NOTES:
1. HIGH POINT OF HEADWALL SHALL NOT PROJECT MORE THAN 3" ABOVE SLOPE.
2. ALL CONCRETE SHALL BE CLASS "A" PER SECT. 725.
3. ALL REINFORCING BARS SHALL BE NO. 4, 1'-0" O.C. TO C AND 3" CLEAR TO INSIDE OF WALLS AND FLOOR.

DROP INLET/DROP OUTLET DETAIL

NO WORKING DAYS BEFORE YOU DIG
CALL FOR THE BLUE STAKES
263-1100
Blue Stake Center
CALL COLLECT

Possessory rights of drawings and project design, as shown and given on all plans, drawings, and specifications, and as instruments of service are the property of Gosnell Development Corporation and may not be utilized in any way, nor copied in similar kind or form without written permission of Gosnell Development Corporation.

Revisions		
By	Date	Description

19__ COPYRIGHT © GOSNELL DEVELOPMENT CORP.

Firm	Phone
Architect G.D.C. Staff	956-4300
Planning G.D.C.	956-4300
Engineer G.D.C. Staff	956-4300

Scale: 1" = 50'
Drawn by Date
Ck'd by Date

GRADING & DRAINAGE PLAN

P.S.M. GOLF COURSE Job#

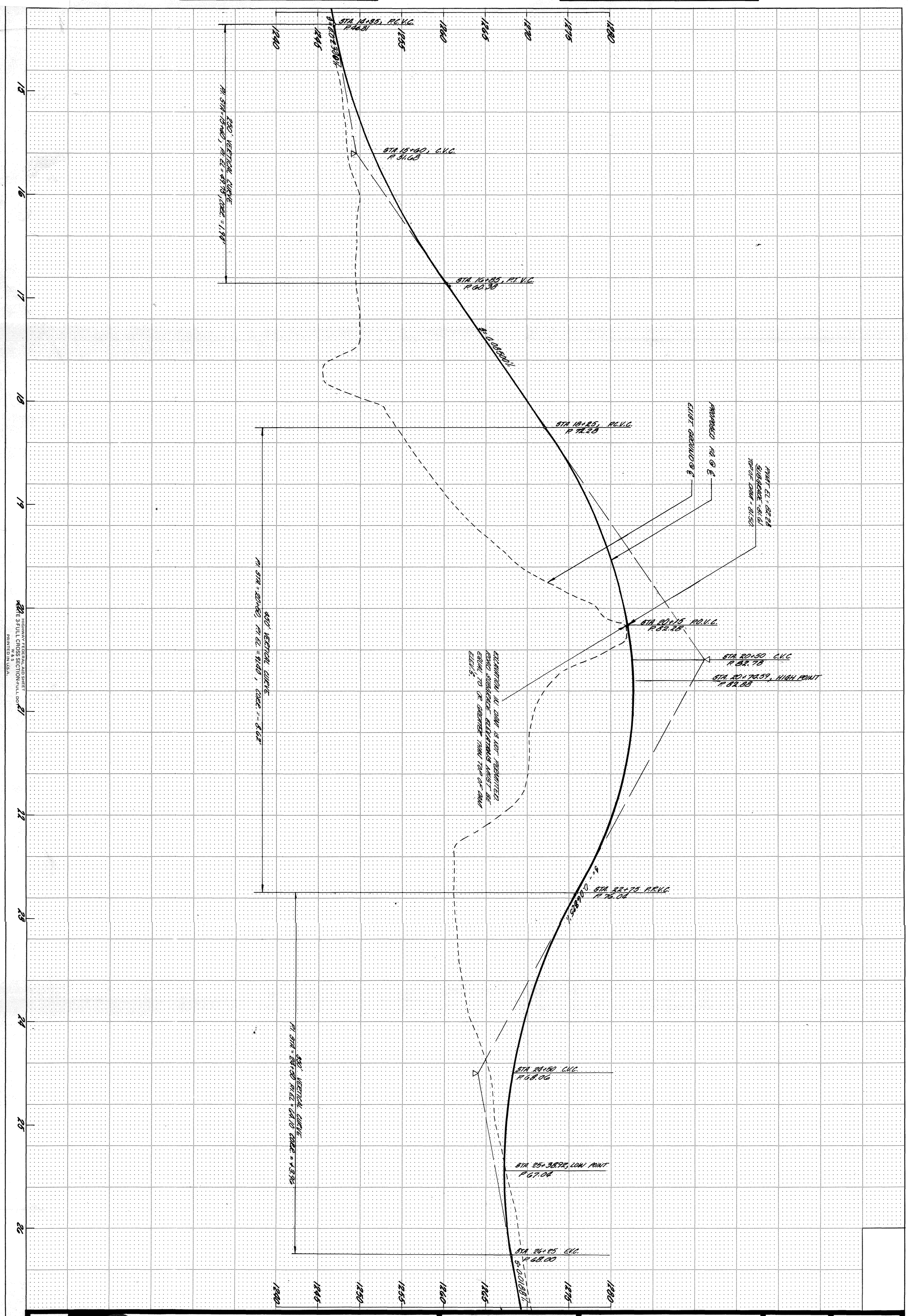
THE POINTE® - SOUTH MOUNTAIN

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

SHEET 5 OF 11

ORIGINAL SURVEY		BY	DATE
	SURVEYED		
	PLOTTED		
NOTE BOOK	TEMPLATE		
NO.	AREAS		
	AREAS CHECKED		

FINAL SURVEY		BY	DATE
	SURVEYED		
	PLOTTED		
NOTE BOOK	TEMPLATE		
NO.	AREAS		
	AREAS CHECKED		



SHEET 1 of 1

℄ PROFILE OF POINTE PARKWAY EAST
GUADALUPE FLOOD RETARDING STRUCTURE

THE POINTE @ 90 MOUNTAIN

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

	Firm	Phone
Architect	GOSNELL BUILDERS	956 - 4300
Planning	GOSNELL BUILDERS	956 - 4300
Engineer	GOSNELL BUILDERS	956 - 4300

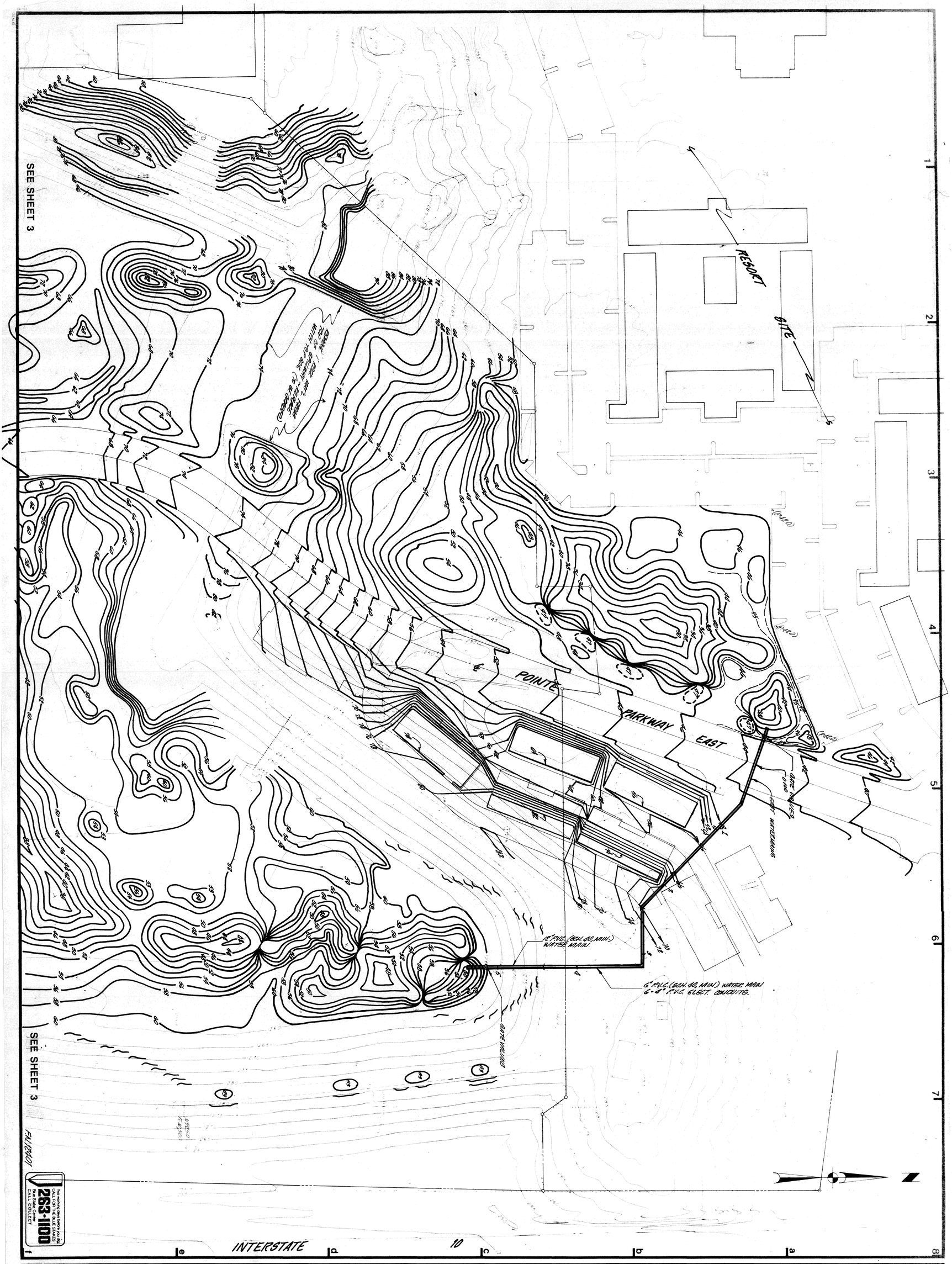
Scale: HORIZONTAL: 1" = 40'; VERTICAL: 1" = 5'
Drawn by OLSEN Date 2/87
Ck'd by SIDERS Date 2/87

Revisions

By	Date	Description

Possessory rights of drawings and project design: all plans, drawings, designs and specifications as instruments of service are the property of Gosnell Development Corporation and may not be utilized in similar kind or form without the written consent of Gosnell Development Corporation.

HIGHWAY FEDERAL AID SHEET
PLATE 3-FULL CROSS SECTION-FULL DO
W & S
PRINTED IN U.S.A.
GAF Polytrace 033



UTILITY PLAN

P.S.M. GOLF COURSE

THE POINTE - SOUTH MOUNTAIN

Job#

GOSNELL DEVELOPMENT CORPORATION

2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

SHEET 1

	Firm	Phone
Architect	G.D.C. Bisch	956-4300
Planning	G.D.C.	956-4300
Engineer	G.D.C. Legge	956-4300

Scale: 1" = 50'

Drawn by _____ Date 4-2-86

Ck'd by _____ Date 4-2-86

Revisions

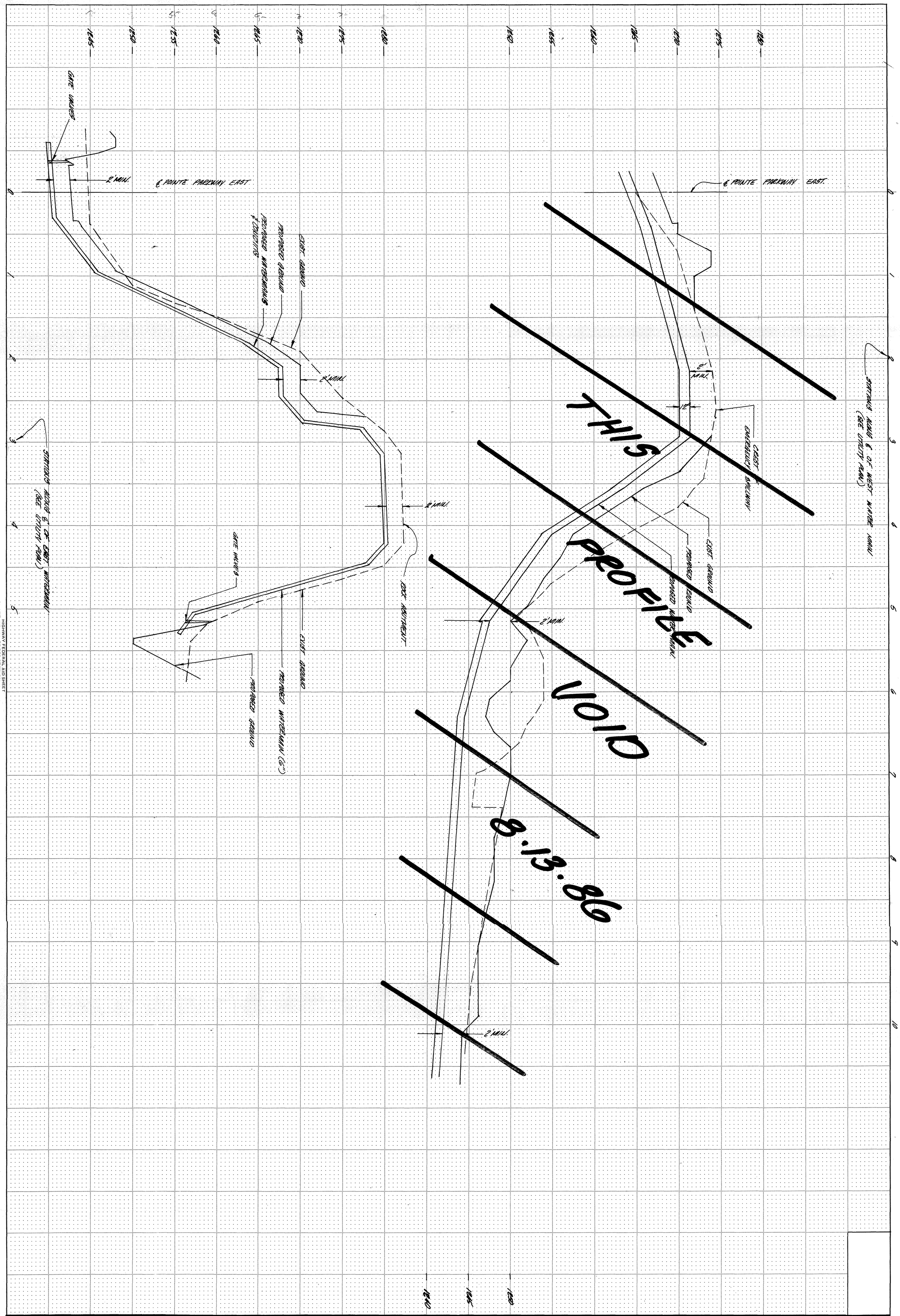
By	Date	Description

19__ COPYRIGHT © GOSNELL DEVELOPMENT CORP.

Possessory rights of drawings and project designs and plans, drawings, designs and specifications as instruments of service are the property of Gosnell Development Corporation and may not be utilized, submitted and or form without the written consent of Gosnell Development Corporation.

ORIGINAL SURVEY		BY	DATE
	SURVEYED		
	PLOTTED		
NOTE BOOK	TEMPLATE		
NO.	AREAS		
	AREAS CHECKED		

FINAL SURVEY		BY	DATE
	SURVEYED		
	PLOTTED		
NOTE BOOK	TEMPLATE		
NO.	AREAS		
	AREAS CHECKED		



HIGHWAY FEDERAL AID SHEET
PLATE 3-FULL CROSS SECTION-FULL DOT
W & S
PRINTED IN U.S.A.

SHEET 1

P.S.M. - G.F.R.S.

WATERMAIN PROFILE Job#

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

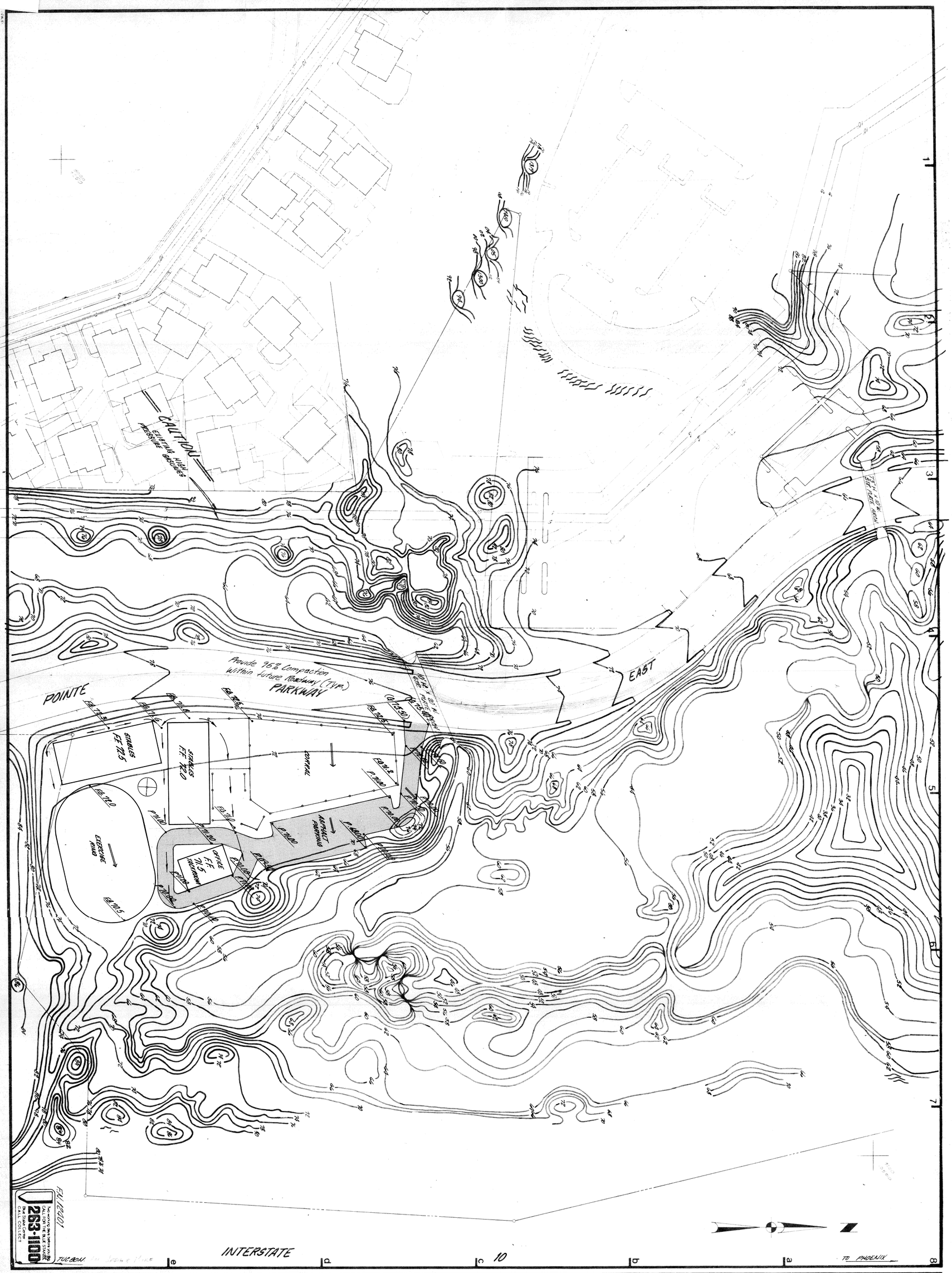
	Firm	Phone
Architect		
Planning		
Engineer		

Scale: 1" = 50' HORIZ. 5' VERT.
Drawn by DJD Date 7/2/86
Ck'd by Date

Revisions		
By	Date	Description

Possessory rights of drawings and project design: all plans, drawings, designs and specifications as instruments of service are the property of Gosnell Development Corporation and may not be utilized in similar kind or form without the written consent of Gosnell Development Corporation.

GAF Polytrace 033



GRADING & DRAINAGE PLAN

EQUESTRIAN FACILITY

THE POINTE - SOUTH MOUNTAIN

Job#

GOSNELL DEVELOPMENT CORPORATION

2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

SHEET 1

	Firm	Phone
Architect	G.D.C. Bisch	956-4300
Planning	G.D.C.	956-4300
Engineer	G.D.C. Legge	956-4300

Scale: 1" = 50'

Drawn by _____ Date 4-2-86

Ck'd by _____ Date 4-2-86

Revisions

By	Date	Description

19__ COPYRIGHT © GOSNELL DEVELOPMENT CORP.

Possessory rights of drawings and project design, as well as any drawings, designs, specifications, plans, or instruments of service are the property of Gosnell Development Corporation and may not be utilized in any way without the written consent of Gosnell Development Corporation.

SHEET GC 1.1

THE POINTE
SOUTH MOUNTAIN
GOLF COURSE

GOSNELL BUILDERS

2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

Job# 26600

	PRINT	SET	RAG
PRELIMINARY			SCB
CONSTRUCTION			CWB

	Firm	Phone
IRRIGATION:	PHILIPP MOLTE	
Planning		
Engineer		

Scale: 1" = 50'-0"
Drawn by JWC Date NOV 86
Ck'd by Date

Revisions

By	Date	Description
JWC	1 JUNE87	IRRIG. DESIGN
RCH	2 JUN 87	IRRIGATION AS BUILT

1986 COPYRIGHT © GOSNELL DEVELOPMENT CORP.

Possessory rights of drawings and project design: all plans, drawings, designs and specifications as instruments of service are the property of Gosnell Development Corporation and may not be utilized in similar kind or form without the written consent of Gosnell Development Corporation.

SHEET GC2.1

THE POINTE
SOUTH MOUNTAIN
GOLF COURSE

GOSNELL BUILDERS
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

	PRINT	SET	RAG	
PRELIMINARY			SCB	
CONSTRUCTION			CWB	

Job# 26600

	Firm	Phone
IRRIGATION:	PHILIPPI - HOLTE	
Planning		
Engineer		

Scale: 1" = 50'-0"
Drawn by JWC Date NOV 87
Ck'd by _____ Date _____

Revisions

By	Date	Description
JWC	1 JUNE 87	IRRIG DESIGN
RM	29 JUNE 87	IRRIGATION AS BUILT

1986 COPYRIGHT © GOSNELL DEVELOPMENT CORP.

Possessory rights of drawings and project design: all plans, drawings, designs and specifications as instruments of service are the property of Gosnell Development Corporation and may not be utilized in similar kind or form without the written consent of Gosnell Development Corporation.

PLANT SCHEDULE:

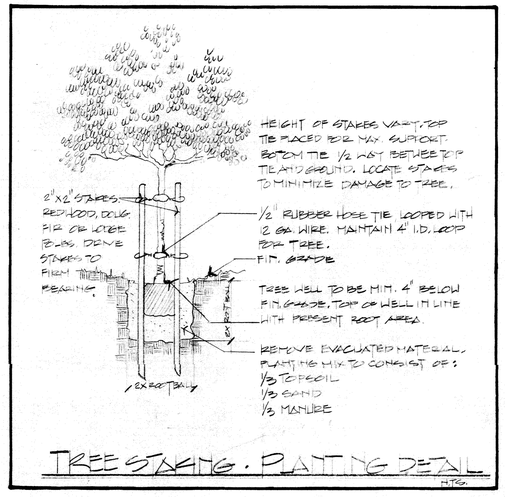
SYMBOL	MARK	QUANTITY	SIZE	BOTANICAL • COMMON NAME
SHRUBS	DOPP	71	1GAL	NERIUM OLEANDER • DWARF OLEANDER 'PETITE PINK'
	DOLR	59	1GAL.	NERIUM OLEANDER • DWARF OLEANDER 'LITTLE RED'
	CH	57	1GAL	TECOMARIA CAPENSIS • CAPE HONEYSUCKLE
	FC	175	1GAL	CASSIA ARTEMISIOIDES • FEATHERY CASSIA
	TS	4	1GAL.	LEUCOPHYLLUM FRUTESCENS • TEXAS SAGE
	AO	32	1GAL.	ACACIA FARNESIANA • ACACIA
	AG	40	1GAL.	AGAPANTHUS 'PETER PAN' • LILY OF THE NILE
	SC	18	1GAL.	JUNIPERUS C. 'SEA GREEN' • SEA GREEN JUNIPER
	B	111	1GAL.	BOUGAINVILLEA BUSH 'COMMON VARIEL'
	SG	18	5GAL.	JUNIPERUS C. 'SEA GREEN' • SEA GREEN JUNIPER
	CH	92	5GAL.	TECOMARIA CAPENSIS • CAPE HONEYSUCKLE
	DOP	25	5GAL.	NERIUM OLEANDER • DWARF OLEANDER 'PETITE PINK'
	FC	27	5GAL.	CASSIA ARTEMISIOIDES • FEATHERY CASSIA
	PC	6	5GAL.	COSTA DERIA SELLOANA • PAMPAS GRASS
	YO	18	5GAL.	TECOMA PERUVIANA • YELLOW OLEANDER
	TS	25	1GAL.	LEUCOPHYLLUM FRUTESCENS • TEXAS SAGE
	DOLR	9	5GAL.	NERIUM OLEANDER • DWARF OLEANDER 'LITTLE RED'
	UB	10	5GAL.	CYPERUS ALTERNAFLORA • UMBRELLA GRASS
	SG	28	5GAL.	JUNIPERUS C. 'SEA GREEN' • SEA GREEN JUNIPER
	FC	27	5GAL.	CASSIA ARTEMISIOIDES • FEATHERY CASSIA
TREES	ER	5	5GAL	EUCALYPTUS CAMALDULENSIS • ROSTRA
	EM	4	5GAL	EUCALYPTUS MICROTHECA • COOLIBAH TREE
	AS	10	5GAL	RHUS LANCEA • AFRICAN SUMAC
	FB	23	15GAL	FICUS BENJAMINA • WEEPING CHINESE BANYAN
	FB	1	36" BOX	FICUS BENJAMINA • WEEPING CHINESE BANYAN
	FM	1	22" BOX	FICUS MACROPHYLLA • MORETON BAY FIG
	AP	11	15GAL	PINUS HALEPENSIS • ALEPPO PINE
	ER	33	15GAL	EUCALYPTUS CAMALDULENSIS • ROSTRATA
	QP	3	15GAL.	COCOS PLUMOSA • QUEEN PALM
	BT	12	15GAL	STERCULIA DIVERSIFOLIA • AUST. BOTTLE TREE
	EG	6	15GAL	EUCALYPTUS SPATHULATA • SWAMP MALLEE
	CIP	4	15GAL	PINUS CANARIENSIS • CANARY ISLAND PINE
	CP	8	15GAL	SCHINUS MOLLE • CALIFORNIA PEPPER
	M	2	15GAL	PROSOPIS CHILENSIS • CHILEAN MESQUITE
	AA	4	15GAL	FRAXINUS VELUTINA • ARIZONA ASH
	EVE	6	15GAL	ULMUS PARVIFOLIA • EVERGREEN ELM
	WW	12	15GAL	SALIX BABYLONICA • WEEPING WILLOW
	RV	3	15GAL.	PARKINSONIA ACULEATA • MEX. PALO VERDE
	DW	2	15GAL.	CHILOPSIS LINEARIS • DESERT WILLOW
	SA	3	15GAL	ACACIA FARNESIANA • SWEET ACACIA
	EM	39	15GAL	EUCALYPTUS MICROTHECA • COOLIBAH TREE
	FN	2	15GAL	FICUS NITIDA • INDIAN LAUREL
	MED	3	15GAL	CHAMAEROPS HUMILIS • MED. FAN PALM
	MED	12	20' BOX	CHAMAEROPS HUMILIS • MED. FAN PALM
	QP	4	20' BOX	COCOS PLUMOSA • QUEEN PALM
	EVE	10	24" BOX	ULMUS PARVIFOLIA • EVERGREEN ELM
	FB	1	24" BOX	FICUS BENJAMINA • WEEPING CHINESE BANYAN
	FN	4	24" BOX	FICUS NITIDA • INDIAN LAUREL
	WW	3	24" BOX	SALIX BABYLONICA • WEEPING WILLOW
	M	4	24" BOX	PROSOPIS CHILENSIS • CHILEAN MESQUITE
	M	4	36" BOX	PROSOPIS CHILENSIS • CHILEAN MESQUITE
	FN	4	36" BOX	FICUS NITIDA • INDIAN LAUREL
PALMS	MFP	3	18' BTH	WASHINGTONIA ROBUSTA • MEX. FAN PALM
	MFP	4	20' BTH	WASHINGTONIA ROBUSTA • MEX. FAN PALM
	MFP	4	30' STM	WASHINGTONIA ROBUSTA • MEX. FAN PALM
	MED	2	20' BOX	CHAMAEROPS HUMILIS • MED. FAN PALM
GROUNDCOVER	VM	4000	6TH. FLT	VINCA MINOR • PERIWINKLE, MYRTLE
	TAD		6TH FLT.	OSTEOSPERMUM FRUTICOSUM • TRI. AFRICAN DAISY
	HH		6TH FLT.	LONICERA JAPONICA 'HALLIANA' • HALLS HONEYSUCKLE
	MYO		6TH FLT.	MYOPORUM PARVIFOLIUM 'PROSTRATUM' • MYOPORUM

NOTE:

PLANT SCHEDULE COUNTS REFLECT ENTIRE FRONT NINE HOLES OF COURSE. INCLUDED HERE FOR USE OF MARKS ONLY

THE POINTE @ SOUTH MOUNTAIN

GOLF COURSE



TREE STAKING • PLANTING DETAIL

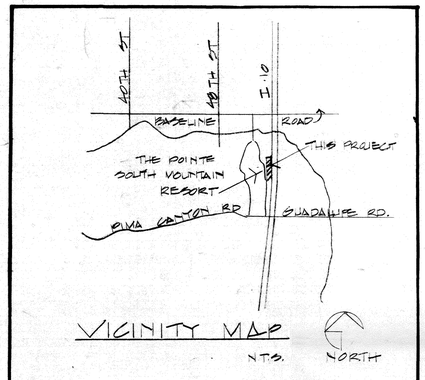
NTS.

GENERAL CONDITIONS

1. Contractor shall verify all site conditions prior to starting work.
2. Contractor shall remove all landscape/sprinkler rubble and excess landscape/sprinkler materials from site.
3. Contractor shall supply all materials and labor necessary to complete the work. No changes or extras will be accepted unless approved in writing prior to accomplishment by the Director of Landscaping and G.D.C. project manager.
4. Contractor shall be held responsible for acceptable repair and/or replacement of any damage to walls, walks, curbs, drives or any other surfaces during the course of work under this contract. Acceptability will be determined by Director of Landscaping.
5. Contractor shall be bound by stipulations set forth in G.D.C. 'instructions to bidder', which includes these instructions.
6. Contractor shall be furnished two sets of plans from G.D.C. office.
7. Prior to release of retention and within two weeks of project completion, contractor shall supply Director of Landscaping with one set of as-built drawings.
8. Director of Landscaping or his representative shall be given 48 hours notice of completion of all work specified on the drawings and prior to the start of the specified maintenance period.
9. Within 6 months of job completion, upon notification by Director of Landscaping, contractor shall return to project site, open palm trees and remove dead fronds.
10. Contractor shall notify Director of Landscaping of any major discrepancies in quantities of plant materials listed.
11. Contractor shall be responsible for determining from Director of Landscaping which walls, planters and walkways are to be installed as part of this bid.
12. Locations on drawings are diagrammatic and approximate only, and shall, as directed, be changed and adjusted to meet existing conditions.

LANDSCAPE INSTRUCTIONS

1. Ground cover, decomposed granite, river run rock, where applicable, shall extend under shrubs unless noted otherwise on plans.
2. Ground cover shall be installed 12" O.C.; seasonal color installed 6" O.C. 2" of mulch shall be worked into beds.
3. Decomposed granite, where applicable, shall be a min. of 2" in depth, unless noted otherwise on plans.
4. All lawn areas to be Bermuda, top dressed with steer manure.
5. Contractor shall furnish and install trees, shrubs and ground covers in accordance with landscape plan, all plant material shall conform in size and variety to the plant schedule material shall conform to, or surpass current standards of nursery stock. Director of Landscaping or his representative reserves the right to refuse any plant material that is deemed unacceptable. All containerized plant material brought on site shall be properly maintained by contractor while still in containers.
6. Tree staking, planting shall conform to typical detail this sheet. Bamboo stakes are not acceptable. Broken stakes shall be replaced by contractor at time of planting.
7. ~~Contractor~~ shall install 50 - 1 gal. Cats Claw and 50 1 gal. ~~Creeping~~ Fig around buttring(s) at locations indicated by ~~landscape~~ design department. NOTE: Plants ~~are not shown~~ on plans and are in addition to those shown. Plant Schedule count reflects these ~~numbers.~~
8. ~~50 - 5gl. Bougainvilles 'San Diego Red' and/or 5 gal. Pyracantha to be~~ planted at each ~~block wall unit. Plants not shown~~ on plans and are in addition to those shown. Field verify count with ~~landscape~~ superintendent.
9. ~~3-5 gal. Pampas Grass, or 3-1 gal Purple Fountain Grass at all C.V.S. units. Plants not shown on plans and are in addition to those shown. Field verify count with~~ landscape superintendent."
10. For installation of Palm trees 16' or taller, all holes shall be a minimum 4' deep by 4' wide. Contractor shall consult with landscape superintendent for hole sizes of palm trees under 16'
11. Landscape contractor shall bid top soil with a unit price. This price will include installation. Verify quantities with landscape superintendent.



VICINITY MAP

NTS.

Possession rights of drawings and project design and plans and specifications, as instruments of service are the property of Gosnell Development Corporation and shall not be used for similar kind or form without the express written consent of Gosnell Development Corporation.

Revisions

By	Date	Description

Revisions

By	Date	Description
WE	FEB 93	CHANGE PLANT COUNT

Firm LANDSCAPE ARCHITECT • PLANNER
Phone
Planning
Engineer

Scale: AS NOTED
Drawn by WEN Date 9/14/92
Ck'd by Date

THE POINTE @ SOUTH MOUNTAIN
GOLF COURSE

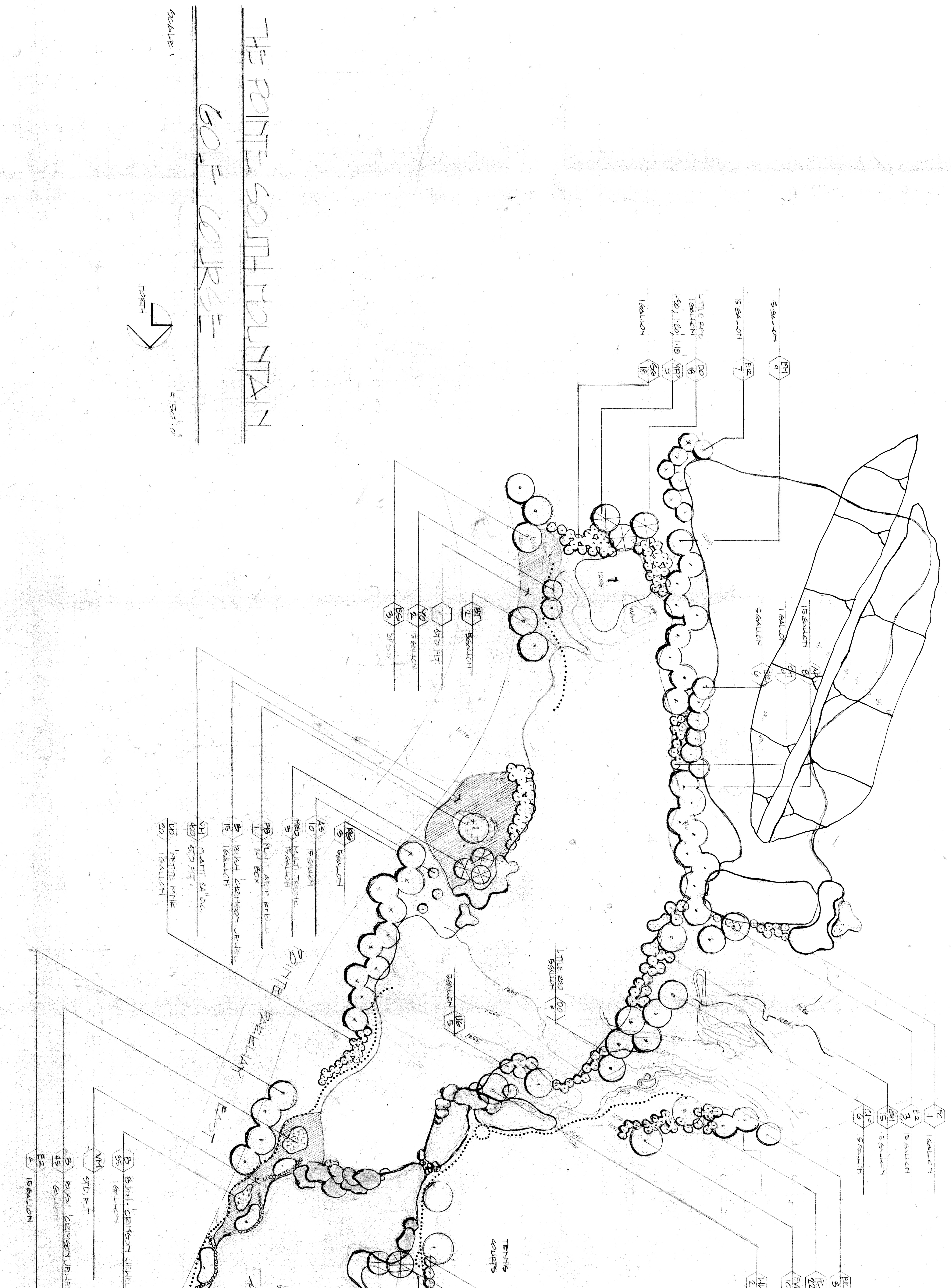
PRELIMINARY
CONSTRUCTION
PRINT SET

Job# 2660

SHEET

COPYRIGHT © '19 GOSNELL DEVELOPMENT CORPORATION

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300



OZALID 90658

SHEET L1

THE POINTE® SOUTH MOUNTAIN GOLF COURSE

	PRINT	SET
PRELIMINARY		
CONSTRUCTION		

Job# 26600

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

	Firm	Phone
Landscape	Phillips-Nolte	
Planning		
Engineer		

Scale: 1" = 50.0'
Drawn by RHH Date 24AUG85
Ck'd by ______ Date ______

Revisions

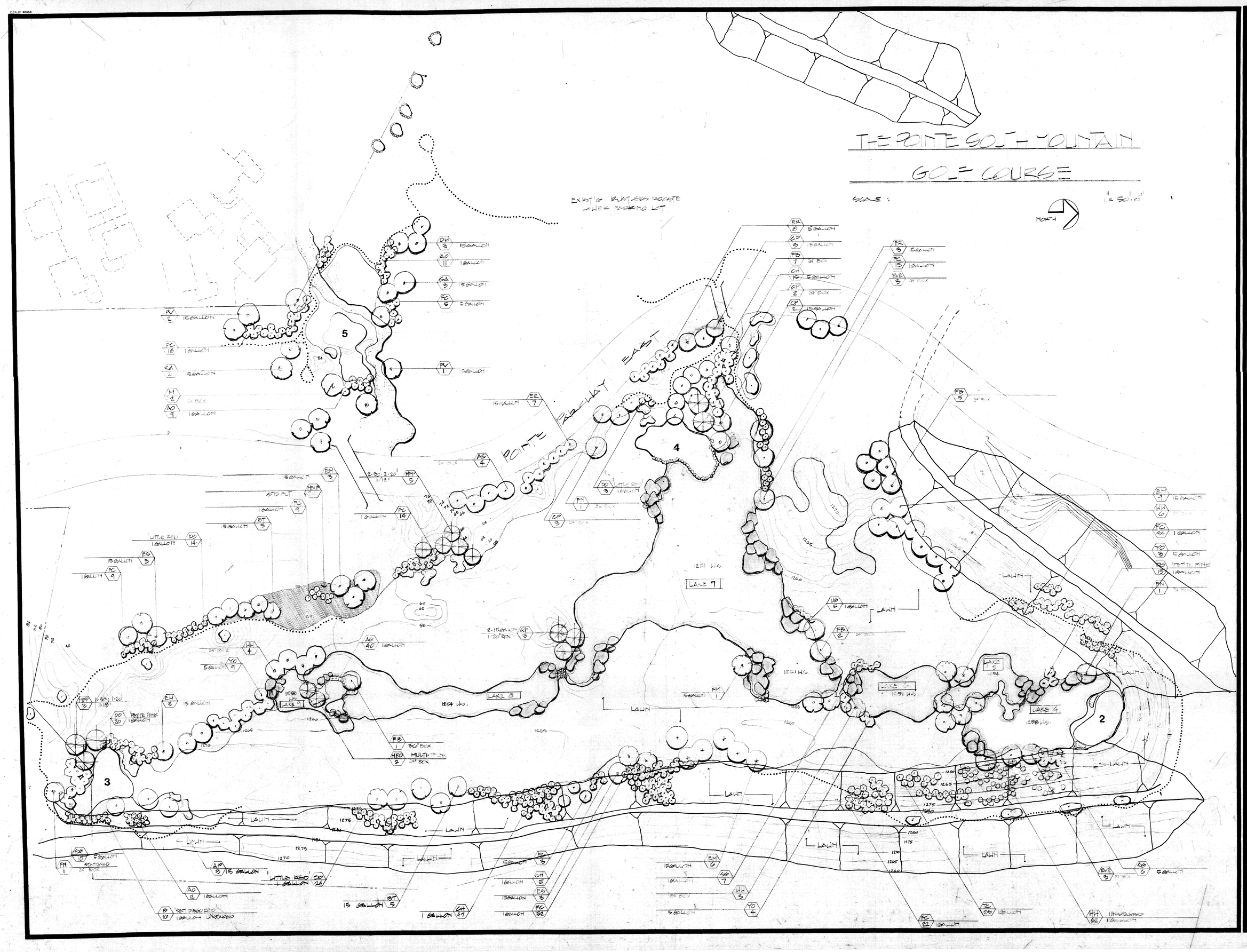
By	Date	Description
RHH	13NOV85	REVISE PLT. MATERIAL
RHH	29MAY86	REVISE PLT. MATERIAL

Revisions

By	Date	Description

COPYRIGHT © 1985 GOSNELL DEVELOPMENT CORPORATION

Possessory rights of drawings and project design: all plans, drawings, designs and specifications as instruments of service are the property of Gosnell Development Corporation and may not be utilized in similar kind or form without the written consent of Gosnell Development Corporation.



Firm Phone
LANDSCAPE ARCHITECT
Planning
Engineer
Scale: 1" = 50'-0"
Drawn by RJN Date 24 JUNE 85
Ck'd by Date

Revisions		
By	Date	Description
RJN	10-14-85	REVISE PLANT LAYOUT
RJN	8-14-85	REVISE PLANT LAYOUT
AE	7-31-85	REMOVE TREES FROM BERM

Revisions		
By	Date	Description

COPYRIGHT © 1985 GOSNELL DEVELOPMENT CORPORATION

Reproducing rights of drawings and project design all plans, drawings, specifications, and designs as instruments of service are the property of Gosnell Development Corporation and shall not be used in similar kind or form without the written consent of Gosnell Development Corporation.

PRELIMINARY | PRINT | SET
CONSTRUCTION

Job# 2600

THE POINTE SOUTH MOUNTAIN
GOLF COURSE

GOSNELL DEVELOPMENT CORPORATION
2728 NORTH 24TH STREET • PHOENIX, ARIZONA 85008 • (602) 956-4300

SHEET

12