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COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
☆ GPO: 1972—460-109

STATE Arizona		PROJECT Spook Hill F.R.S. Buckhorn Mesa		
BY	DATE	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Index				SHEET ____ OF ____

Subject	Page
DESIGN REPORT	
ALIGNMENT	
Alignment & dam & floodway	1.
HYDRAULIC DESIGN	
Principal Spillway	2-11
Emergency & Auxilliary Spillway	12-29
Floodway	30-51
Junction Structures	52-55
Existing Highway Culvert	56-57
EMBANKMENT & FOUNDATION DESIGN	
Soil Properties	58-59
Embankment and Foundation Design	60-64
Earth Fill Proportions	65-67
STRUCTURAL DESIGN	
Emergency Spillway	68-73
Auxilliary Spillway	74-78
COST ESTIMATE	
Summary of Costs	79
Cost Calculations	80-81
Quantities	82-85
PLAN PROFILES	
Plan Profile of Dam	86-90
Plan Profile of Floodway	91-93

DESIGN REPORT

Job: Spook Hill Dam and Floodway
Project: Buckhorn-Mesa WPP
Location: Maricopa County, Arizona
Authority: PL 566
Phase: Preliminary Design

Summary: The preliminary design is in accordance with the project measure plan, with the following deviations or additions:

1. The emergency spillway will consist of a concrete drop spillway with an adjacent soil cement auxiliary spillway set at the emergency spillway design storm elevation.

2. The embankment will be a zoned fill instead of homogenous fill and will have side slopes of 3:1 upstream and 2:1 downstream.

3. An open drop inlet to a 7.5'x7' box culvert will be used for the principal spillway.

4. Some modification was made in the hydrologic design, but resulting changes in the structure were minor.

Description of Job

The job consists of an earthfill dam, with a concrete drop emergency spillway, a soil cement auxiliary spillway, a concrete box culvert principal spillway, and an excavated floodway outleting to a natural channel flowing to the Salt River.

Alignment

Although minor changes have been made, the project follows closely the work plan supplement alignment. For most of the length, the project parallels the Bureau of Reclamation's Central Arizona Project Salt-Gila Aqueduct.

Hydrology

The hydrologic design has been reworked since the work plan was completed. This rerun has been reviewed in Portland. Additional emergency spillway routings have been made in the modification of the spillway system.

Hydraulic Design

1. An open drop inlet riser will be used with a 7.5'x7' box culvert principal spillway. The design Q = 808 cfs.

2. The floodway has been designed using uniform flow criteria. A water surface profile will be run in final design.

3. The natural channel outlet will be designed for a 10-year frequency storm. This will be a temporary outlet system.

4. Hydraulic Design Criteria

   (a) NEH, Section 5
   (b) Technical Release 25
   (c) Manning's "n"
      Concrete box culvert 0.012
      Earth channel 0.030
      Natural channel 0.035

Structural Design

1. The emergency spillway is a Type "C" drop structure. It is designed for a Q = 2500 cfs, which is the emergency spillway peak design discharge.

2. An auxiliary spillway is designed to carry the freeboard storm. It is a gravity soil cement section adjacent to the concrete spillway, and on both sides of it.

3. A rock riprap section will be used at the outlet of the principal spillway conduit.

4. Design Criteria

   (a) NEH, Section 6
   (b) NEH, Section 11
   (c) NEH, Section 14
   (d) f_c = 4000 psi
   (e) f_s = 20,000 psi

Embankment and Foundation Design

1. The dam will be a zoned earth fill with sideslopes of 3:1 upstream, and 2:1 downstream. The infinite slope method of stability analysis was used in design.

2. The cutoff trench will be down to siltstone or keyed one foot into caliche. The layer of loose material will be removed in foundation excavation.

   Approximate limits of foundation and cutoff are shown on the plan profile sheets.

Submitted by _____ Date _____

Approved by _____ Date _____

SCS-347a 5-57
Tabular Computations

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SOIL CONSERVATION SERVICE

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Buckhorn Mesa WPP

Spook Hill FRS. & Floodway — Alignment

	Station		Bearing		dist.		Δ	R	D	T	L		Grid		Coordinates		
	87 +	00±	S 79°	30' 00.3"W	930.09												
P.C.	96 +	30.09															
P.I #1	97 +	30.09					36°01'30"	307.54	18°37'49"	100.00'	193.37		N 884,	797.987	E 583,	958.968	
P.T.	98 +	23.46	N 64° 28' 29.7W		1,293.12												
P.C.	109 +	16.58															
P.I. #2	110 +	16.58					2°29'30"	4,598.27	1°14'46"	100.00	199.97		N 885,	355.102	E 582,	792.061	
P.T	111 +	16.55	N 61° 58' 59.7W		3,028.36												
P.C.	132 +	35.68															
P.I #3	140 +	44.91					16°26'47"	5,599.61	1°01'24"	809.23	1,607.33		N 886,	777.613	E 580,	118.594	
P.T.	148 +	43.01	N 45° 32' 08.6W		8,355.78												
P.C.	216 +	71.29															
P.I #4	223 +	89.56					22°01'54"	3,689.74	1°33'10.2"	718.27	1418.80		N 892,	630.54	E 574,	155.180	
P.T.	230 +	90.09	N 23° 30' 11.8"W		5,979.20												
P.C.	276 +	51.02															
P.I #5	283 +	51.02					23°24'50"	3,378.11	1°41'46"	700.00'	1,380.46		N 898,	113.69	E 571,	770.67	
P.T.	290 +	31.48	N 0° 05' 14.3"W		1,450.10												
P.C.	296 +	31.58															
P.I. #6	297 +	31.58					45°00'00"	362.13	15°49'18"	150.00	284.42		N 899,	563.79	E 571,	768.46	
P.T	299 +	16.00	N 44° 54' 44.7'E		150.00												
℄																	
P.I #7	102 +	30					90°00'00"						N 899	670.02	E 571,	874.37	
P.C.	103 +	43.14	N 45° 05' 15.3"W		262.14												
P.I. #8	104 +	93.14					45°00'00"	362.13	15°49'18"	150.00	284.42		N 899.8	955.80	E 571,	688.01	
P.T	106 +	27.56	N 00° 05' 14.3"W		7970.00												
P.C.	181 +	47.56															
P.I #9	184 +	47.56					55°59'40"	564.28	10°37'13.4"	300.00	551.47		N 907.8	25.80	E 571,	675.84	
P.T.	186 +	99.03	N 55° 54' 25.7"E		1898.48												
P.C	196 +	97.51															
P.I #10	202 +	97.51					49°44'05"	1294.52	4°25'37"	600.00	1123.69		N 908.8	90.00	E 573,	248.00	
PT	208 +	21.20	N 06° 10' 20.7"E														

Principal Spillway Routing

2

```
TITLE1    SITE SPOOK HILL SITE NO. 4  STRUCTURE CLASS C                    PAGE NO.    1
TITLE2    BUCKHORN MESA W/S  ARIZONA  02-24-75

HYDRO          69.00      1.19      0.00      3.81      6.40     13.57

PS INFO        11.500  1568.000     0.000   125.000     0.012     2.000

GENERAL         0.0       0.0      0.000      0.0      0.000      0.0

HIGH WEIR    1577.50     27.00      0.00

CONDUIT         9.00      6.00

STAGE-CFS    1577.50      0.00      0.00

STAGE-CFS    1578.00     63.00      0.00

STAGE-CFS    1580.00    408.90      0.00

STAGE-CFS    1582.00    856.30      0.00

STAGE-CFS    1584.00   1402.70      0.00

STAGE-CFS    1586.00   2045.10      0.00

STAGE-CFS    1588.00   2777.20      0.00

STAGE-CFS    1590.00   3597.70      0.00

STAGE-CFS    1592.00   4499.60      0.00

STAGE-CFS    1594.00   5484.80      0.00

END TABLE
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PRINCIPAL SPILLWAY ROUTING PAGE NO. 2

SITE SPOOK HILL SITE NO. 4 STRUCTURE CLASS C
BUCKHORN MESA W/S ARIZONA 02-24-75

UNCONTROLLED AREA HYDROGRAPH

TC= 1.19 BASE FLOW = 156.0 CFS CN 10 DAY= 50.8 10 DAY RAIN= 6.40 Q 10DAY= 1.40
CN 1 DAY = 69.0 1 DAY RAIN= 3.81 Q 1DAY= 1.14
10 DAY HYDROGRAPH VOLUME = 1019.3 AC FT

TIME	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
0.00	156.	158.	160.	160.	160.	160.	160.	160.	160.	160.
10.00	161.	161.	161.	161.	161.	161.	161.	161.	161.	161.
20.00	161.	161.	161.	161.	161.	161.	161.	161.	161.	161.
30.00	162.	162.	162.	162.	162.	162.	162.	162.	162.	162.
40.00	162.	162.	162.	162.	163.	163.	163.	163.	163.	163.
50.00	163.	163.	163.	163.	163.	164.	164.	164.	164.	164.
60.00	164.	164.	164.	165.	165.	165.	165.	165.	165.	166.
70.00	166.	166.	166.	166.	166.	167.	167.	167.	167.	168.
80.00	168.	168.	169.	169.	169.	169.	170.	170.	171.	171.
90.00	172.	172.	173.	173.	174.	174.	175.	176.	177.	177.
100.00	178.	180.	181.	182.	183.	185.	187.	189.	191.	194.
110.00	197.	201.	206.	212.	220.	230.	245.	267.	307.	401.
120.00	4798.	3014.	852.	392.	284.	254.	236.	224.	215.	209.
130.00	203.	199.	195.	192.	190.	188.	186.	184.	183.	181.
140.00	180.	179.	178.	177.	176.	175.	175.	174.	173.	173.
150.00	172.	172.	171.	171.	170.	170.	170.	169.	169.	169.
160.00	168.	168.	168.	168.	167.	167.	167.	167.	166.	166.
170.00	166.	166.	166.	165.	165.	165.	165.	165.	165.	164.
180.00	164.	164.	164.	164.	164.	164.	164.	163.	163.	163.
190.00	163.	163.	163.	163.	163.	163.	163.	163.	162.	162.
200.00	162.	162.	162.	162.	162.	162.	162.	162.	162.	162.
210.00	162.	162.	161.	161.	161.	161.	161.	161.	161.	161.
220.00	161.	161.	161.	161.	161.	161.	161.	161.	161.	161.
230.00	161.	161.	161.	160.	160.	160.	160.	160.	160.	160.
240.00	160.	157.	156.	156.	156.	156.	156.	156.	156.	156.
250.00	156.	156.	156.	156.	156.	156.	156.	156.	156.	156.
260.00	156.	156.	156.	156.	156.	156.	156.	156.	156.	156.
270.00	156.	156.	156.	156.	156.	156.	156.	156.	156.	156.
280.00	156.	156.	156.	156.	156.	156.	156.	156.	156.	156.
290.00	156.	156.	156.	156.	156.	156.	156.	156.	156.	156.

SITE SPOOK HILL SITE NO. 4 STRUCTURE CLASS C

BUCKHORN MESA W/S ARIZONA 02-24-75

ELEVATION	STORAGE	DISCHARGE
1577.50	0.00	0.00
1578.00	63.00	29.59
1578.50	149.47	83.70
1579.00	235.95	153.76
1579.50	322.42	236.73
1580.00	408.90	330.85
1580.50	520.75	434.91
1581.00	632.59	548.05
1581.50	744.44	669.59
1582.00	856.30	798.99
1582.50	992.90	935.79
1582.69	1046.25	989.85
1583.00	1129.50	1002.66
1583.84	1360.61	1037.40
1584.69	1624.93	1071.01
1585.53	1896.65	1103.60
1586.38	2185.58	1135.26
1587.22	2495.24	1166.05
1588.07	2808.24	1196.06
1588.92	3155.29	1225.33
1589.76	3502.34	1253.91
1590.61	3874.36	1281.86
1591.45	4255.84	1309.21
1592.30	4650.04	1336.00
1593.15	5066.76	1362.27
1593.99	5483.47	1388.04

SITE SPOOK HILL SITE NO. 4 STRUCTURE CLASS C
BUCKHORN MESA W/S ARIZONA 02-24-75

BOX CONDUIT DIMENSIONS ARE 9.00 BY 6.00 FEET

	TIME	INFLOW	AVE IN	OUTFLOW	ELEV.	STORAGE
	6.00	160.87	160.85	34.40	1578.04	70.69
	12.00	161.11	161.09	68.18	1578.35	124.67
	18.00	161.38	161.36	95.53	1578.58	164.07
	24.00	161.68	161.65	117.37	1578.74	191.04
	30.00	162.02	161.99	132.10	1578.84	209.21
	36.00	162.40	162.37	142.06	1578.91	221.51
	42.00	162.84	162.80	148.87	1578.96	229.91
	48.00	163.35	163.30	153.58	1578.99	235.72
	54.00	163.94	163.89	157.38	1579.02	239.71
	60.00	164.65	164.58	160.00	1579.03	242.45
	66.00	165.50	165.42	161.93	1579.04	244.46
	72.00	166.56	166.46	163.49	1579.05	246.09
	78.00	167.89	167.77	164.91	1579.06	247.57
	84.00	169.64	169.48	166.38	1579.07	249.10
	90.00	172.04	171.81	168.08	1579.08	250.87
	96.00	175.54	175.19	170.25	1579.09	253.13
	102.00	181.17	180.58	173.31	1579.11	256.32
	108.00	191.79	190.60	178.21	1579.14	261.42
	114.00	220.29	216.43	188.09	1579.20	271.72
	120.00	4798.04	2599.58	407.45	1580.36	491.23
PEAK	122.00	852.16	1933.12	808.63	1582.03	865.92
	MAXIMUM STORAGE OBTAINED. DRAW-DOWN BEGINS.					
	1.00	156.05	156.05	238.69	1579.51	324.21
	2.00	156.05	156.05	168.32	1579.08	251.12
	3.00	156.05	156.05	157.88	1579.02	240.23
	4.00	156.05	156.05	156.32	1579.01	238.61
	5.00	156.05	156.05	156.09	1579.01	238.37
	6.00	156.05	156.05	156.06	1579.01	238.34
	7.00	156.05	156.05	156.05	1579.01	238.33
	7.62	156.05	156.05	156.05	1579.01	238.33
	OUTFLOW = INFLOW-ROUTING COMPLETE					

← USE

MAXIMUM STORAGE IS 865.9 ACRE FEET (1.196 INCHES) AT ELEV. 1582.03 (CREST, EMER. SPW.).

NET DETENTION STORAGE REQUIRED IS 866.0 ACRE FEET (1.196 INCHES).

GROSS STORAGE REMAINING AFTER 10 DAYS IS 238.3 ACRE FEET (0.329 INCHES)
AT ELEV. 1579.01 (START EMER. SPW. AND FREEBOARD ROUTINGS).

NET REMAINING STORAGE IS 238.4 ACRE FEET (0.329 INCHES).

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

6

GPO : 1958 O—470868

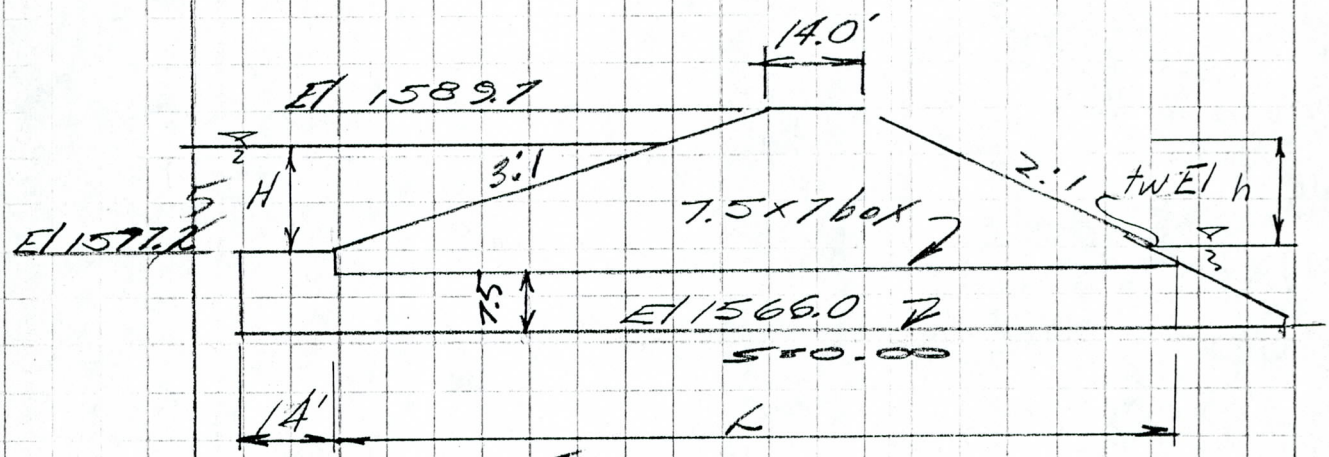
STATE	PROJECT		
Ariz	Buck Horn Mesa WP Spook Hill F.R.S.		
BY PJM	DATE 5-29-75	CHECKED BY	DATE	JOB NO.

SUBJECT Hydraulics

SHEET 1 OF 6

Principal Spillway

Given:



$L = 3(12.5) + 14.0 + 2(16.2) = 83'$

Find: A rating curve for the spillway

Solution

a) Weir Flow

$$Q = 3.1 L H^{3/2}$$
$$= 3.1(35.0) H^{3/2}$$
$$= 108.50 H^{3/2}$$

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 7

GPO : 1958 O—470868

STATE: Ariz
PROJECT: Buckhorn Mesa WPP Spook Hill FRS.
BY: RJM
DATE: 3-29-75
CHECKED BY:
DATE:
JOB NO.:
SUBJECT: Hydraulics
SHEET 2 OF 6

Elev	H	$Q = 1085 H^{3/2}$
1577.5	0	0
1578.0	0.5	38
1579.0	1.5	200
1580.0	2.5	429
1582.0	4.5	1036
1584.0	6.5	1798
1586.0	8.5	—
1588.0	10.5	—
1590.0	12.5	—

b) Orifice Flow

$$Q = 0.67 a \sqrt{2gh}$$
$$= 0.67(7.5)(7)\sqrt{64.4h}$$
$$= 282.3\sqrt{h}$$

Elev	h	$Q = 282.3\sqrt{h}$	
1577.5	7.75	~~730~~	785.9
1578.0	8.25	~~753~~	810.8
1579.0	9.25	~~798~~	858.6
1580.0	10.25	~~840~~	903.8
1582.0	12.25	~~918~~	988.1
1584.0	14.25	~~990~~	1065.6
1586.0	16.25	~~1057~~	1138.0
1588.0	18.25	~~1121~~	1206.0
1590.0	20.25	~~1180~~	1270.4

COMPUTATION SHEET
SCS-522 REV 5-58

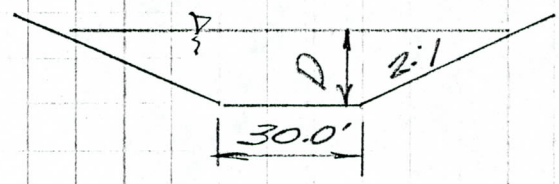
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 8

GPO : 1958 O—470868

STATE Ariz	PROJECT Buckhorn Mesa WPP Spook Hill FRS		
BY RJM DATE 5-29-75	CHECKED BY	DATE	JOB NO.
SUBJECT Hydraulics			SHEET 3 OF 6

c) Channel Rating Curve

Given:

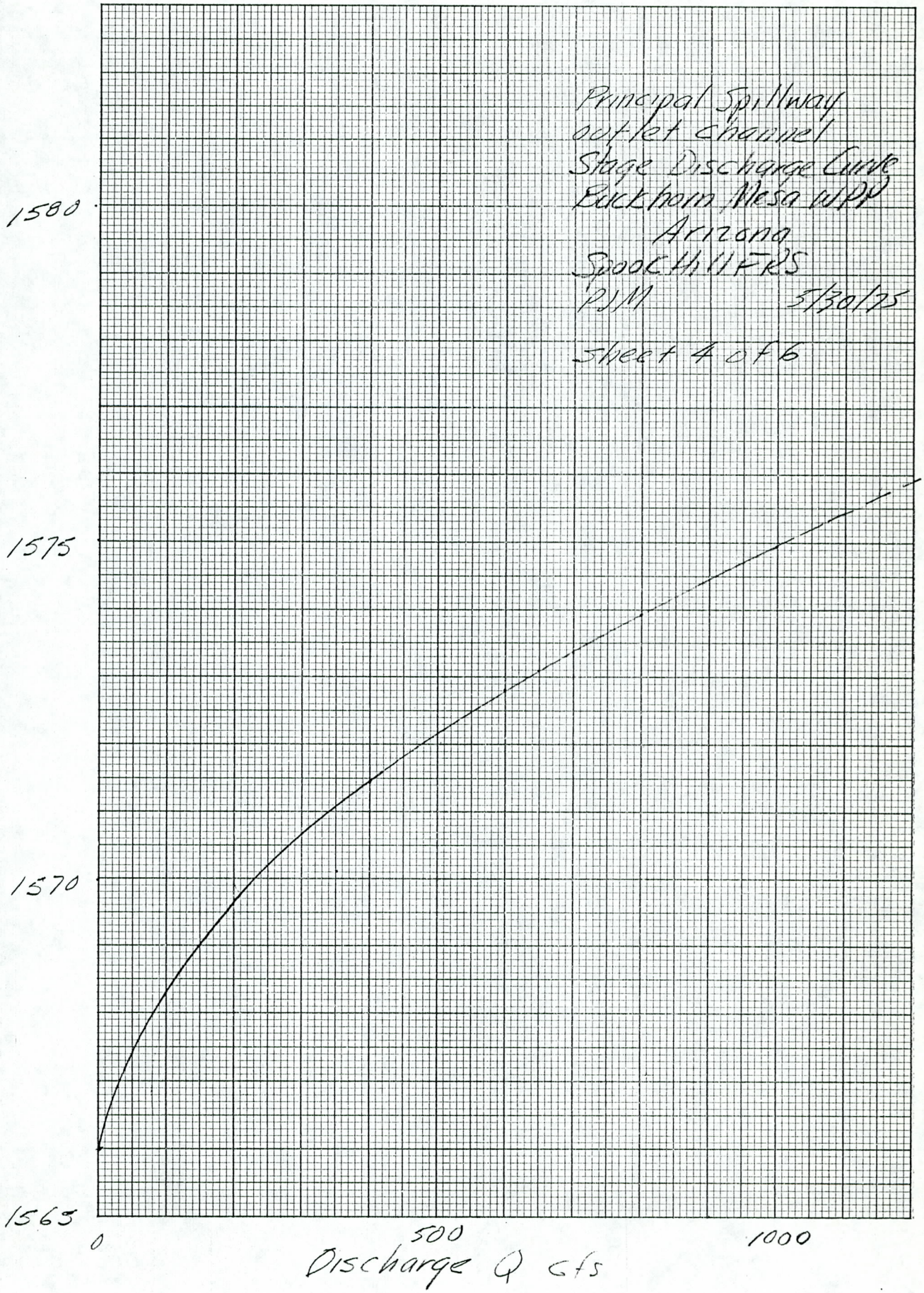


$n = 0.030$
$S = 0.00020$

$$K' = \frac{Qn}{b^{8/3} S^{1/2}} = \frac{0.030}{(30)^{8/3}(0.00020)^{1/2}} Q$$

$$= 0.000244\, Q$$

Q	K' = .000244 Q	D/b	D 30(D/b)	Elev
0			0	1566.0
200	0.0488	0.1231	3.69	1569.69
400	0.0976	0.1816	5.45	1571.45
600	0.1465	0.227	6.81	1572.81
800	0.1953	0.264	7.92	1573.92
1000	0.244	0.298	8.94	1574.94



K&E 10 X 10 TO ½ INCH 46 1432
6 X 9 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 10

GPO : 1958 O—470868

STATE	PROJECT		
Ariz	Buckhorn Mesa WPP Spook Hill FRS		
BY RJM / DATE 5-30-75	CHECKED BY	DATE	JOB NO.

SUBJECT Hydraulics

SHEET 5 OF 6

d/Pipe Flow

$$Q = a\sqrt{\frac{2gh}{1+K_e+K_b+K_cL}}$$

where: $a = 52.5$ sq.ft.

$K_e + K_b = 1$

$$K_c = \frac{29.16\,n^2}{r^{4/3}} =$$

$$= \frac{29.16\,(0.014)^2}{\left[\frac{(7.5)(7)}{15+14}\right]^{4/3}}$$

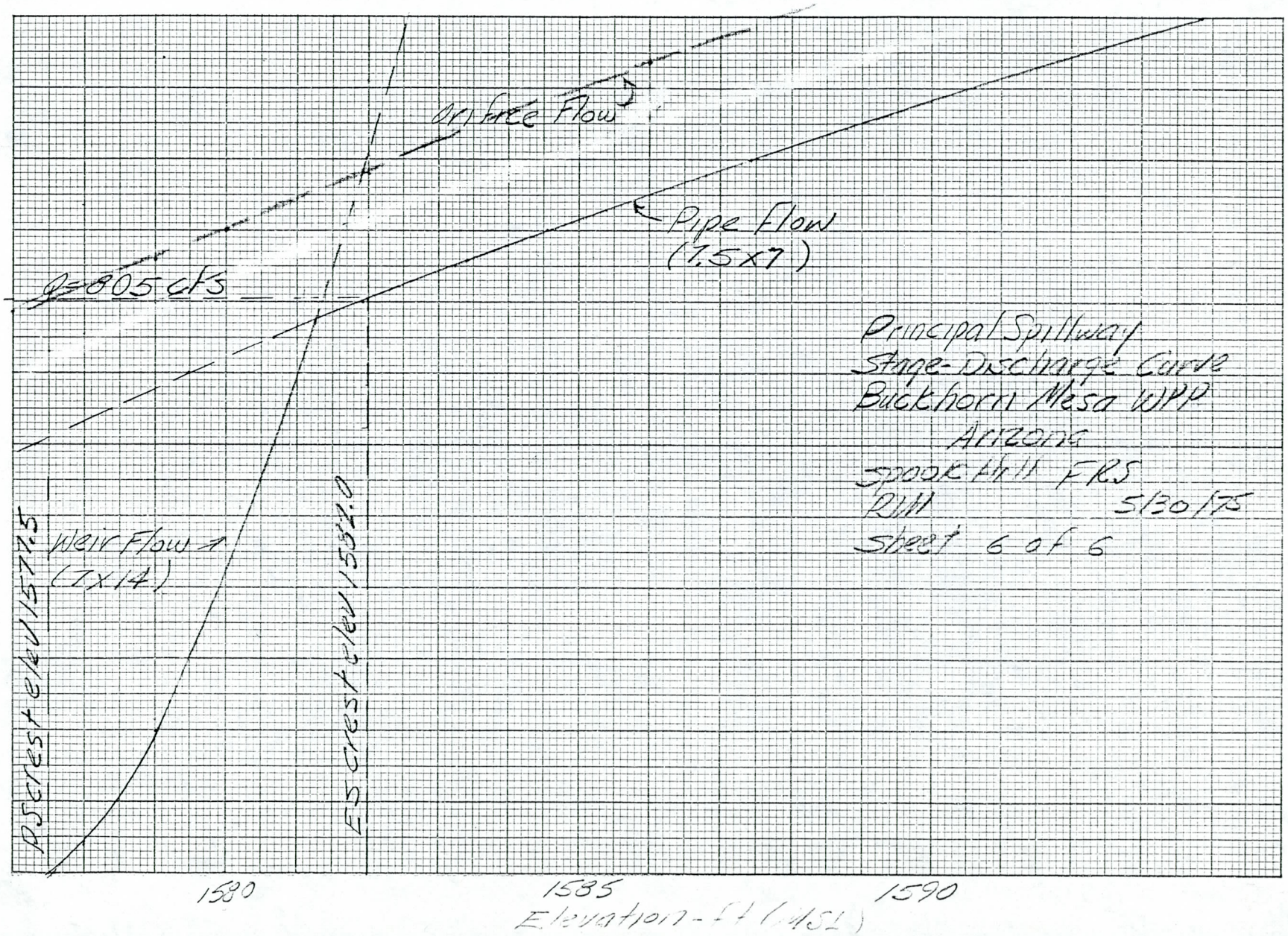
$$= 0.00259$$

$$\therefore h = \frac{[1+1+(0.00259)(83)]}{(64.4)(52.5)^2}\,Q^2$$

$$= 0.00001247\,Q^2$$

Q	h	twElev	wSElev = tw + h
600	4.49	1572.81	1577.30
650	5.27	1573.09	1578.36
700	6.11	1573.37	1579.48
750	7.02	1573.64	1580.66
800	7.99	1573.92	1581.91
850	9.02	1574.20	1583.22
900	10.11	1574.43	1584.54
1000	12.48	1574.93	1587.41
1200	17.97	1575.90	1593.87

10 X 10 TO ½ INCH 46 1432
6 X 9 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



11

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 12

* GPO: 1972 —460-109

STATE	PROJECT		
Arizona	Buckhorn Mesa WFP - Spook Hill F.R.S.		
BY Burton	DATE 6/2/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design - Spillway Alternates			SHEET 1 OF 2

Summary of Analysis:

1. Based on Resource Sites Program Analysis, it was determined that an excavated emergency spillway of 700 ft. width would have velocities greater than the 6.0 fps. allowed in Engr. Memo 27.

2. The cost of an excavated emergency spillway of 500 ft. width or more was found to be considerably greater than the cost of a concrete spillway.

3. Consideration was then given to use of a concrete emergency spillway with an auxiliary spillway to handle freeboard flows. Both excavated and soil cement auxiliary spillways were considered.

4. Analysis of various alternates considered:
   (a) The cost of the concrete spillway.
   (b) The cost of the auxiliary spillway.
   (c) The cost of the earth fill.

5. Large excavation quantities made an earth auxiliary spillway uneconomical.

6. Various widths of concrete emergency spillways and soil cement auxiliary spillways were considered. Flood routings for each spillway combination were made and cost estimates were prepared.

7. The following curves of Cost vs. Concrete Spillway Width for various auxiliary spillway width were prepared. From these curves the selection of the best alternate was made.

SUMMARY DATA FOR POTENTIAL UPSTREAM RESERVOIR SITES

SPOOK HILL SITE 4 — BUCKHORN MESA WPP

BENEFICIAL POOL							EMERGENCY SPILLWAY					DESIGN HIGH WATER		DAM			SAFE YIELD AT 95 PERCENT CHANCE
ELEV (MSL)	STORAGE AC FT	IN	COST PER AC FT ($)	AREA (AC)	COST/ SURF AC ($)	DEPTH AT DAM (FT)	CREST ELEV + TYPE (MSL)	STORAGE AT CREST AC FT	IN	COST PER AC FT ($)	ELEV (MSL)	AREA (AC)	TOP ELEV (MSL)	HGT FT	FILL VOL (1000 CY)	(MGD)
SITE 4			DA= 13.57 SQ MI = 8685 AC				CONCRETE EMERGENCY SPILLWAY ALT 2									
SITE 4							100-YR PRIN SPWY DESIGN STORM RUNOFF = 6.72 IN, PEAK FLOW = 4798 CFS									
1574.1	0	0.0		85		8.1	1578.1 D	742	1.0	2410	1581.5	250	1586.8	21	703	*****

****THIS SITE LACKS SUFFICIENT STORAGE FOR BENEFICIAL WATER.****

NOTES - (1) COSTS ARE BASED ON 1971 S.C.S. DESIGN CRITERIA AND COST DATA.
(2) EMERGENCY SPILLWAY STORAGE AND COSTS ARE BASED ON TOTAL STORAGE, INCLUDING BENEFICIAL POOL.
(3) EMERGENCY SPILLWAY TYPE CODE- C=CONCRETE CHUTE, D=CONCRETE DROP, E=EXCAVATED, T= TWO SPILLWAYS, N= NONE
(4) TABULAR DATA ARE BASED ON PRELIMINARY INFORMATION. FIGURES SHOWN ARE PRIMARILY FOR COMPARISON PURPOSES.
(5) ELEVATIONS ARE SHOWN TO THE NEAREST 0.1 FOOT TO SHOW VARIATION BETWEEN DEVELOPMENTS ONLY, AND ARE NOT TO BE CONSIDERED ACCURATE TO THAT DEGREE.

** DO NOT USE FOR FINAL SITE SELECTION OR LAND ACQUISITION. **

DETAILED DESIGN/COST TABLE NO. 1
SPILLWAYS COST DATA

TITLE- BUCKHORN MESA SITE 4
TITLE- SPOOK HILL
Combination Concrete + Earth Spillway

LEVEL OF DEV. AF	PRINCIPAL SPILLWAY SYSTEM TYPE	SIZE-FT.	DISCH CFS	COST $	CONC. EMER. SPIL. SYS. TYPE	SIZE-FT.	DISCH CFS	COST $	EXCAV. EMER. SPIL. SYS. WIDTH FT.	CREST MSL	DISCH CFS	COST $
SD	NO DESIGN POSSIBLE FOR THIS LEVEL OF DEVELOPMENT WITHIN GIVEN CONSTRAINTS. *											

NOTES- (1) THE CONCRETE SPILLWAY DISCHARGES OCCUR AT THE PEAK OF THE FREEBOARD STORM AND ARE THE BASIS FOR THE RESPECTIVE COST ESTIMATES.
(2) THE EXCAVATED SPILLWAY DISCHARGE OCCURS DURING THE PEAK OF THE FREEBOARD STORM.
(3) THE CONC. EMER. SPIL. CREST, IF THERE IS ONE, IS DEFINED TO BE THE EMER. SPIL. CREST (SEE TABLE NO. 3). THEREFORE, THE EXCAV. EMER. SPIL. CREST IS SET EQUAL TO OR ABOVE THE EMER. SPIL. CREST, DEPENDING UPON THE ANALYSIS. IF THERE IS NO CONC. EMER. SPIL., THE EXCAV. EMER. SPIL. IS DEFINED TO BE THE EMER. SPIL.
(4) BOX INLET DIMENSIONS ARE GIVEN - THROAT WIDTH BY UPSTREAM PROJECTION
(5) MONOLITH DIMENSIONS ARE GIVEN - WIDTH BY HEIGHT. SINGLE BARREL, W=0.75*H. DOUBLE BARREL, W=1.5*H.

* Spillway width limit is too low for allowable velocity

Width of Spillway required would be uneconomical and would not fit the site

Use: Concrete Emergency Spillway

DETAILED DESIGN/COST TABLE NO. 2
SPILLWAYS DISCHARGE DATA

TITLE- BUCKHORN MESA SITE 4
TITLE- SPOOK HILL

LEVEL OF DEV. AF	DISCHARGES - CFS													EXIT VEL.-FPS	
	PRINCIPAL SPILLWAY SYSTEM					CONC. EMER. SPIL. SYS.				EXCAV. EMER. SPIL. SYS.					
	RC	CESC	XESC	DHW	TOD	XESC	DHW	TOD	DHW	TOD	ESHY	FBHY			
SD	NO DESIGN POSSIBLE FOR THIS LEVEL OF DEVELOPMENT WITHIN GIVEN CONSTRAINTS.														

NOTES- (1) RESPECTIVE DISCHARGES OCCUR WHEN WATER SURFACE IS AT DESIGNATED COLUMN HEADING ELEVATIONS.
(2) DEFINITION OF COLUMN HEADINGS

RC - RISER CREST
CESC - CONCRETE EMERGENCY SPILLWAY CREST
XESC - EXCAVATED EMERGENCY SPILLWAY CREST
DHW - DESIGN HIGH WATER
TOD - TOP OF DAM
ESHY - EMERGENCY SPILLWAY HYDROGRAPH
FBHY - FREEBOARD HYDROGRAPH

DETAILED DESIGN/COST TABLE NO.3
KEY SITE DATA

TITLE- BUCKHORN MESA SITE 4
TITLE- SPOOK HILL

STATE - ARIZONA REGION - BUCKHORN MESA SITE NAME - SITE 4

```
                    ************************************************************************
REMARKS * BUCKHORN MESA WPP                                                          * REMARKS
REMARKS * SITE 4                                                                     * REMARKS
REMARKS * COMBINATION CONCRETE AND EARTH EMERGENCY SPILLWAY                          * REMARKS
                    ************************************************************************
```

WATER-IMPOUNDING STRUCTURE DESIGN AND COST TABLE

```
*****************************************************************************************************************************
*****************************************************************************************************************************
        ELEVATION            *HGT *        STORAGE        *  SURFACE * FILL*     INSTALLATION COST     *   UNIT COST
          MSL                *DAM *        AC-FT          *   AREA   *(1000*          $1000            *  $ PER UNIT
                             *FT  *                       *    AC.   * YD.)*                           *
*****************************************************************************************************************************
 NORM    EMER    DSGN    TOP   *MAX * BEN  NORM  TEMP  TOTAL* NORM DSGN* VOL *CONST ENGR L/R PROJ TOTAL* PER   PER   PER
 POOL    SPWY    HIGH    OF    *HGT * USE  POOL  FLOOD EMER * POOL HIGH*     *                 ADM       *AC-FT ACRE AC-FT
         CREST   WATER   DAM   *    *                    SPWY *      WTR *     *                         *TOTAL NORM BEN
                               *    *                    CREST*          *     *                         *STORE SURF STORE
*****************************************************************************************************************************
                               *    *                         *          *     *                         *
DRAINAGE AREA -   13.57 SQ.MI.     ELEVATION BOTTOM C/L PROFILE - 1566.10 MSL
                               *    *                         *          *     *                         *
                                                   SINGLE DEVELOPMENT ONLY
1574.1  NO DESIGN POSSIBLE FOR THIS LEVEL OF DEVELOPMENT WITHIN GIVEN CONSTRAINTS. SEE DESIGN MESSAGE(S)-3,
*****************************************************************************************************************************
*****************************************************************************************************************************
NOTES- (1) TABLE VALUES WERE DEVELOPED TO ASSIST THE ENGINEER TO COMPARE-
                 (A) ALTERNATE DEVELOPMENTS WITHIN THIS SITE LOCATION
                 (B) ALTERNATE LOCATIONS THIS SITE
                 (C) ALTERNATE SITES FOR SIMILAR DEVELOPMENTS
       (2) TABLE VALUES ARE NOT MEANT TO BE USED AS A SUBSITUTE FOR FINAL DESIGN. USE THE TABLE FOR THE FINAL SELECTION,
           THEN MAKE AN INDEPENDENT ANALYSIS TO VERIFY SELECTION.
```

DETAILED DESIGN/COST TABLE NO. 1
SPILLWAYS COST DATA

TITLE- BUCKHORN MESA
TITLE- SPOOK HILL SITE 4
Earth Spillway

LEVEL OF DEV. AF	PRINCIPAL SPILLWAY SYSTEM TYPE	SIZE-FT.	DISCH CFS	COST $	CONC. EMER. SPIL. SYS. TYPE	SIZE-FT.	DISCH CFS	COST $	EXCAV. EMER. SPIL. SYS. WIDTH FT.	CREST MSL	DISCH CFS	COST $
SD	NO DESIGN POSSIBLE FOR THIS LEVEL OF DEVELOPMENT WITHIN GIVEN CONSTRAINTS. *											

NOTES- (1) THE CONCRETE SPILLWAY DISCHARGES OCCUR AT THE PEAK OF THE FREEBOARD STORM AND ARE THE BASIS FOR THE RESPECTIVE COST ESTIMATES.
(2) THE EXCAVATED SPILLWAY DISCHARGE OCCURS DURING THE PEAK OF THE FREEBOARD STORM.
(3) THE CONC. EMER. SPIL. CREST, IF THERE IS ONE, IS DEFINED TO BE THE EMER. SPIL. CREST (SEE TABLE NO. 3). THEREFORE, THE EXCAV. EMER. SPIL. CREST IS SET EQUAL TO OR ABOVE THE EMER. SPIL. CREST, DEPENDING UPON THE ANALYSIS. IF THERE IS NO CONC. EMER. SPIL., THE EXCAV. EMER. SPIL. IS DEFINED TO BE THE EMER. SPIL.
(4) BOX INLET DIMENSIONS ARE GIVEN - THROAT WIDTH BY UPSTREAM PROJECTION
(5) MONOLITH DIMENSIONS ARE GIVEN - WIDTH BY HEIGHT. SINGLE BARREL, W=0.75*H. DOUBLE BARREL, W=1.5*H.

* Spillway width limit is too low, for velocity allowed.

Width of spillway required would be uneconomical and would not fit the site.

Use: Concrete Emergency Spillway

DETAILED DESIGN/COST TABLE NO. 2
SPILLWAY DISCHARGE DATA

TITLE- BUCKHORN MESA
TITLE- SPOOK HILL SITE 4

LEVEL OF DEV. AF	DISCHARGES - CFS												EXIT VEL.-FPS	
	PRINCIPAL SPILLWAY SYSTEM					CONC. EMER. SPIL. SYS.			EXCAV. EMER. SPIL. SYS.					
	RC	CESC	XESC	DHW	TOD	XESC	DHW	TOD	DHW	TOD	ESHY	FBHY		
SD	NO DESIGN POSSIBLE FOR THIS LEVEL OF DEVELOPMENT WITHIN GIVEN CONSTRAINTS.													

NOTES- (1) RESPECTIVE DISCHARGES OCCUR WHEN WATER SURFACE IS AT DESIGNATED COLUMN HEADING ELEVATIONS.
(2) DEFINITION OF COLUMN HEADINGS

RC - RISER CREST
CESC - CONCRETE EMERGENCY SPILLWAY CREST
XESC - EXCAVATED EMERGENCY SPILLWAY CREST
DHW - DESIGN HIGH WATER
TOD - TOP OF DAM
ESHY - EMERGENCY SPILLWAY HYDROGRAPH
FBHY - FREEBOARD HYDROGRAPH

DETAILED DESIGN/COST TABLE NO.3
KEY SITE DATA

TITLE- BUCKHORN MESA
TITLE- SPOOK HILL SITE 4

STATE - ARIZONA REGION - BUCKHORN MESA SITE NAME - SITE 4

```
                    ************************************************************************
REMARKS * BUCKHORN MESA WPP.                                                                 * REMARKS
REMARKS * SITE 4                                                                             * REMARKS
REMARKS * EXCAVATED EMERGENCY SPILLWAY ALT 3                                                 * REMARKS
                    ************************************************************************
```

WATER-IMPOUNDING STRUCTURE DESIGN AND COST TABLE

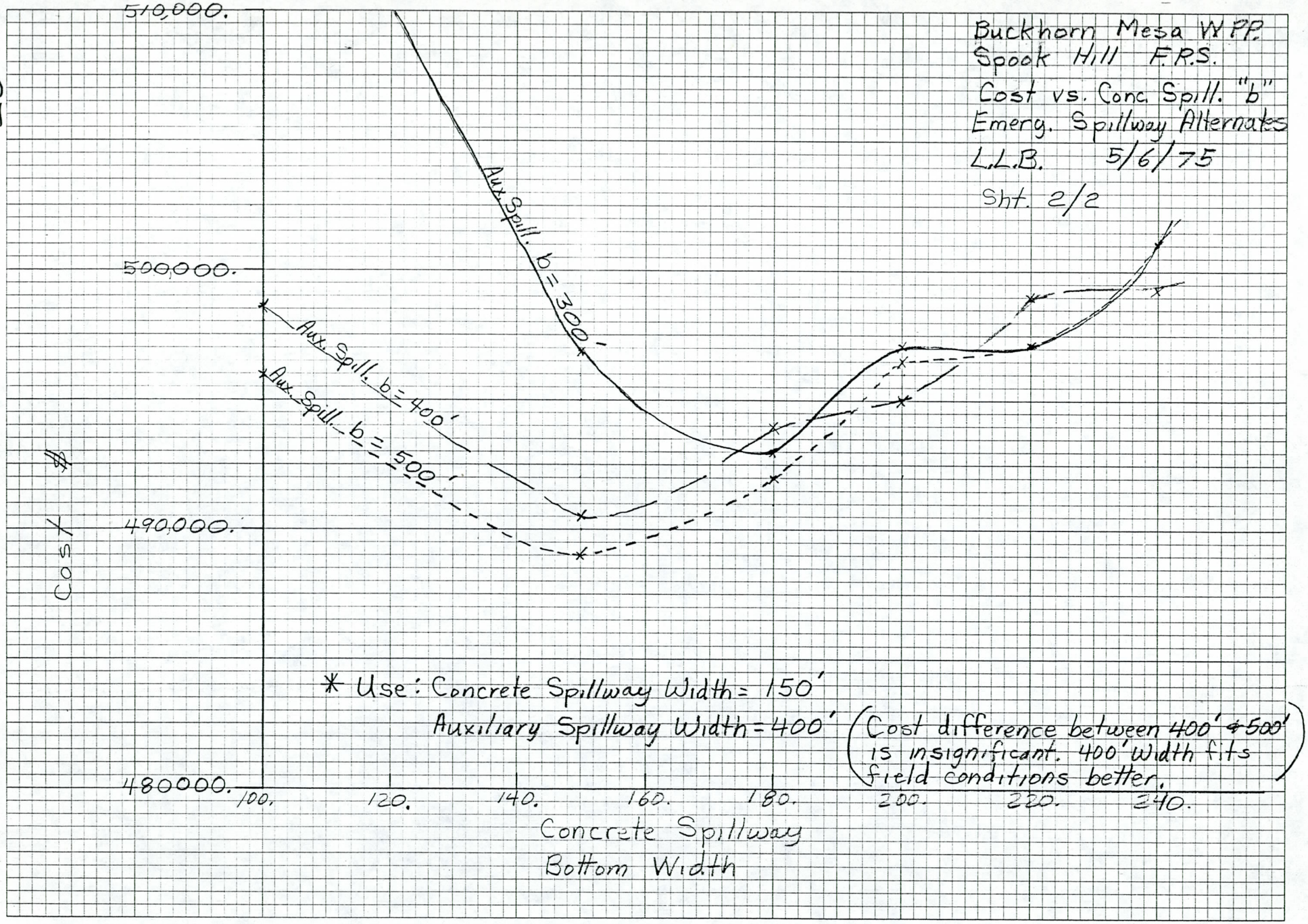
ELEVATION MSL				*HGT *DAM *FT *	STORAGE AC-FT	SURFACE AREA AC.	FILL *(1000* YD.)*	INSTALLATION COST $1000	UNIT COST $ PER UNIT
NORM POOL	EMER SPWY CREST	DSGN HIGH WATER	TOP OF DAM	*MAX HGT	BEN USE	NORM POOL	TEMP FLOOD	TOTAL EMER SPWY CREST	NORM DSGN HIGH WTR	VOL	CONST ENGR ADM	L/R PROJ	TOTAL	PER AC-FT TOTAL STORE	PER ACRE NORM SURF	PER AC-FT BEN STORE

DRAINAGE AREA - 13.57 SQ.MI. ELEVATION BOTTOM C/L PROFILE - 1566.10 MSL

SINGLE DEVELOPMENT ONLY

1574.1 NO DESIGN POSSIBLE FOR THIS LEVEL OF DEVELOPMENT WITHIN GIVEN CONSTRAINTS. SEE DESIGN MESSAGE(S)-3,

NOTES- (1) TABLE VALUES WERE DEVELOPED TO ASSIST THE ENGINEER TO COMPARE-
(A) ALTERNATE DEVELOPMENTS WITHIN THIS SITE LOCATION
(B) ALTERNATE LOCATIONS THIS SITE
(C) ALTERNATE SITES FOR SIMILAR DEVELOPMENTS
(2) TABLE VALUES ARE NOT MEANT TO BE USED AS A SUBSITUTE FOR FINAL DESIGN. USE THE TABLE FOR THE FINAL SELECTION, THEN MAKE AN INDEPENDENT ANALYSIS TO VERIFY SELECTION.



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SPOOK HILL SITE NO. 4
BUCKHORN MESA W.P.P. STRUCTURE CLASS C 05-08-75

EMER. SPW. UNCONTROLLED AREA HYDROGRAPH.

RUNOFF = 3.38 IN., VOL. = 2450. AC.FT.

TIME	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75
0.00	0.00	0.00	0.00	0.00	0.00	2.51	36.68	181.53
2.00	606.73	1844.14	4857.75	8809.55	11588.89	11998.59	10745.02	9259.07
4.00	8010.53	7004.01	6186.30	5564.86	5044.01	4598.75	4226.48	3877.63
6.00	3557.12	3254.70	2803.54	2122.18	1438.75	925.57	585.70	363.76
8.00	228.46	142.10	85.97	49.87	28.22	15.00	6.19	1.31
10.00	0.00							

Emergency Spillway Routing

```
TITLE      SPOOK HILL SITE  NO. 4                                                    PAGE NO.    1
TITLE      BUCKHORN MESA W.P.P.  STRUCTURE CLASS C  05-08-75

HYDRO      CURVE= 79.  TC= 1.18  DURATION= 6.00  ES RAIN= 5.66  FB RAIN=13.00  AREA= 13.56

SPILLWAY   CREST=1582.0  CASE= 0.  PRINT OPTION=0.  SIDE SLOPES= 1.000  EXIT CHANNEL SLOPE = 0.00

GENERAL    ROUTE=0.  PLOT CODE=0.  VELOCITY= 0.00  LENGTH=    0.  'C'=0.000  CODE=0.

SPW.SIZE   1ST BO= 150., E. LNGTH=   0.

STAGE-CFS   ELEV=1577.50  STORAGE=  238.4  1ST DISCH=     0.

STAGE-CFS   ELEV=1579.01  STORAGE=  238.5  1ST DISCH=   156.

STAGE-CFS   ELEV=1580.00  STORAGE=  408.9  1ST DISCH=   400.

STAGE-CFS   ELEV=1581.00  STORAGE=  632.6  1ST DISCH=   568.

STAGE-CFS   ELEV=1582.00  STORAGE=  856.3  1ST DISCH=   808.

STAGE-CFS   ELEV=1582.50  STORAGE=  992.9  1ST DISCH=   945.

STAGE-CFS   ELEV=1583.00  STORAGE= 1129.5  1ST DISCH=  1196.

STAGE-CFS   ELEV=1583.50  STORAGE= 1223.0  1ST DISCH=  1520.

STAGE-CFS   ELEV=1584.00  STORAGE= 1402.7  1ST DISCH=  1904.

STAGE-CFS   ELEV=1585.00  STORAGE= 1673.0  1ST DISCH=  2822.

STAGE-CFS   ELEV=1585.20  STORAGE= 1747.0  1ST DISCH=  2990.

STAGE-CFS   ELEV=1586.00  STORAGE= 2045.1  1ST DISCH=  4795.

STAGE-CFS   ELEV=1587.00  STORAGE= 2404.0  1ST DISCH=  8135.

STAGE-CFS   ELEV=1588.00  STORAGE= 2779.0  1ST DISCH= 12313.

STAGE-CFS   ELEV=1589.00  STORAGE= 3204.0  1ST DISCH= 17170.

STAGE-CFS   ELEV=1590.00  STORAGE= 3604.0  1ST DISCH= 22616.

STAGE-CFS   ELEV=1591.00  STORAGE= 4054.0  1ST DISCH= 28591.

END TABLE
```

SPOOK HILL SITE NO. 4
BUCKHORN MESA W.P.P. STRUCTURE CLASS C 05-08-75

EMER.SPW. ROUTING BOTTOM WIDTH= 150.0 ENTRANCE LENGTH= 0.0

TIME	INFLOW	AVE INFLOW	OUTFLOW	STORAGE	ELEVATION
0.25	0.00	0.00	0.00	238.40	1577.50
0.50	0.00	0.00	0.00	238.40	1577.50
0.75	0.00	0.00	0.00	238.40	1577.50
1.00	0.00	0.00	0.00	238.40	1577.50
1.25	2.51	1.25	2.36	238.40	1577.52
1.50	36.68	19.60	34.82	238.42	1577.83
1.75	181.53	109.11	156.33	238.70	1579.01
2.00	606.73	394.13	163.27	243.54	1579.03
2.25	1844.14	1225.44	194.23	265.16	1579.16
2.50	4857.75	3350.94	286.24	329.43	1579.53
2.75	8809.55	6833.65	440.81	463.10	1580.24
3.00	11588.89	10199.22	601.13	663.06	1581.13
3.25	11998.59	11793.74	844.22	891.78	1582.13
3.50	10745.02	11371.81	1153.27	1106.09	1582.91
3.75	9259.07	10002.05	1650.52	1283.77	1583.66
4.00	8010.53	8634.80	1979.40	1424.67	1584.08
4.25	7004.01	7507.27	2353.95	1535.00	1584.48
4.50	6186.30	6595.16	2641.31	1619.66	1584.80
4.75	5564.86	5875.58	2848.09	1684.34	1585.03
5.00	5044.01	5304.43	2960.86	1733.93	1585.16
5.25	4598.75	4821.38	3133.75	1770.58	1585.26
5.50	4226.48	4412.61	3284.36	1795.44	1585.33
5.75	3877.63	4052.06	3374.77	1810.37	1585.37
6.00	3557.12	3717.38	3415.12	1817.03	1585.38
6.25	3254.70	3405.91	3414.03	1816.85	1585.38

← USE

VOLUME CHECK AT HP= 0.08. COMPUTED HP= 3.38 AT ELEV.1585.38 (STORAGE IS 1817.0 AC.FT.= 2.51 IN.)
TIME= 6.00 HOURS CRITICAL VELOCITY= 8.19 CRITICAL DEPTH= 2.09 CRITICAL SLOPE= 1.82.

Freeboard Routing

```
TITLE      SPOOK HILL SITE NO.4                                                    PAGE NO.    1
TITLE      BUCKHORN MESA W.P.P.  STRUCTURE CLASS C  05-15-75

HYDRO      CURVE= 79.  TC= 1.18  DURATION= 6.00  ES RAIN= 0.00  FB RAIN=13.00  AREA= 13.56

SPILLWAY   CREST=1582.0  CASE= 0.  PRINT OPTION=0.  SIDE SLOPES= 1.000  EXIT CHANNEL SLOPE = 0.00

GENERAL    ROUTE=0.  PLOT CODE=0.  VELOCITY= 0.00  LENGTH=    0.  'C'=0.000  CODE=0.

SPW.SIZE   1ST BO= 150., E. LNGTH=   1.

STAGE-CFS   ELEV=1577.50  STORAGE=  238.4  1ST DISCH=     0.

STAGE-CFS   ELEV=1579.01  STORAGE=  238.5  1ST DISCH=   156.

STAGE-CFS   ELEV=1580.00  STORAGE=  408.9  1ST DISCH=   400.

STAGE-CFS   ELEV=1581.00  STORAGE=  632.6  1ST DISCH=   568.

STAGE-CFS   ELEV=1582.00  STORAGE=  856.3  1ST DISCH=   808.

STAGE-CFS   ELEV=1582.50  STORAGE=  992.9  1ST DISCH=   945.

STAGE-CFS   ELEV=1583.00  STORAGE= 1129.5  1ST DISCH=  1196.

STAGE-CFS   ELEV=1583.50  STORAGE= 1223.0  1ST DISCH=  1520.

STAGE-CFS   ELEV=1584.00  STORAGE= 1402.7  1ST DISCH=  1904.

STAGE-CFS   ELEV=1585.00  STORAGE= 1673.0  1ST DISCH=  2822.

STAGE-CFS   ELEV=1585.40  STORAGE= 1821.8  1ST DISCH=  3237.

STAGE-CFS   ELEV=1586.00  STORAGE= 2045.1  1ST DISCH=  4484.

STAGE-CFS   ELEV=1587.00  STORAGE= 2404.0  1ST DISCH=  7650.

STAGE-CFS   ELEV=1588.00  STORAGE= 2779.0  1ST DISCH= 11702.

STAGE-CFS   ELEV=1589.00  STORAGE= 3204.0  1ST DISCH= 16455.

STAGE-CFS   ELEV=1590.00  STORAGE= 3604.0  1ST DISCH= 21810.

STAGE-CFS   ELEV=1591.00  STORAGE= 4054.0  1ST DISCH= 27703.

END TABLE
```

SPOOK HILL SITE NO.4
BUCKHORN MESA W.P.P. STRUCTURE CLASS C 05-15-75

FREEBOARD UNCONTROLLED AREA HYDROGRAPH.

RUNOFF =10.27 IN., VOL. = 7437. AC.FT.

TIME	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75
0.00	0.00	0.00	0.00	10.98	94.59	466.48	1369.44	2875.78
2.00	5245.06	9997.13	19607.26	30919.07	37657.92	37115.53	32114.86	26917.14
4.00	22716.23	19426.99	16842.93	14917.32	13343.74	12033.40	10957.66	9976.00
6.00	9091.64	8278.50	7110.47	5374.94	3641.91	2342.11	1481.57	919.81
8.00	577.48	359.00	217.09	125.85	71.18	37.81	15.60	3.31
10.00	0.00							

SPOOK HILL SITE NO.4 PAGE NO. 3

BUCKHORN MESA W.P.P. STRUCTURE CLASS C 05-15-75

FREEBOARD ROUTING BOTTOM WIDTH= 150.0 ENTRANCE LENGTH= 1.0

TIME	INFLOW	AVE INFLOW	OUTFLOW	STORAGE	ELEVATION
0.25	0.00	0.00	0.00	238.40	1577.50
0.50	0.00	0.00	0.00	238.40	1577.50
0.75	10.98	5.49	10.34	238.40	1577.59
1.00	94.59	52.78	90.27	238.45	1578.37
1.25	466.48	280.53	160.57	241.66	1579.02
1.50	1369.44	917.96	182.65	257.08	1579.11
1.75	2875.78	2122.61	239.20	296.57	1579.34
2.00	5245.06	4060.42	350.58	374.37	1579.79
2.25	9997.13	7621.09	486.04	523.18	1580.51
2.50	19607.26	14802.19	765.43	816.06	1581.82
2.75	30919.07	25263.17	1711.75	1312.41	1583.74
3.00	37657.92	34288.50	4019.24	1961.61	1585.77
3.25	37115.53	37386.72	9687.88	2592.42	1587.50
3.50	32114.86	34615.20	14787.70	3054.74	1588.64
3.75	26917.14	29516.00	18077.96	3325.04	1589.30
4.00	22716.23	24816.69	19715.54	3447.35	1589.60
4.25	19426.99	21071.61	20045.08	3471.96	1589.67 ← USE
4.50	16842.93	18134.96	19580.90	3437.29	1589.58

VOLUME CHECK AT HP= 0.18. COMPUTED HP= 7.67 AT ELEV.1589.67 (STORAGE IS 3471.9 AC.FT.= 4.79 IN.)
TIME= 4.25 HOURS CRITICAL VELOCITY= 15.76 CRITICAL DEPTH= 7.72 CRITICAL SLOPE= 1.17.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 30
☆ GPO: 1972—460-109

STATE Arizona		PROJECT Buckhorn Mesa W.P.P. - Spook Hill Fldw.	
BY Burton	DATE 5/30/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design Summary			SHEET 1 OF 1

Station	Q	b	dn	S	V	V_A
102+70	Begin Floodway					
	808.	30	7.97	0.00020	2.2	6.5
133+00						
	808.	30	7.97	0.00020	2.2	11.3
159+50						
	808.	30	3.09	0.00610	7.2	8.7
178+50						
	1614.	30	4.58	0.00610	9.0	10.0
189+50						
	1614.	30	8.93	0.000519	3.8	11.5
195+00						
	2136.	30	10.33	0.000519	4.1	11.7
207+25	End Floodway					

Additional Design Considerations

1. Floodway stability checked by allowable velocity procedure. Soils in channel bottom were used for this analysis.
2. Some rock rip rap may be required to protect channel side slopes in a few areas consisting of weaker soils.
3. Weirs with rock rip rap protection will be used for side inlets with low flows.
4. Junction channel sections will be designed for major side drainages.
5. Channel side slopes are 2:1 in all sections.

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill Fldw.		
BY Burton	DATE 5/27/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design - Allowable Velocity				SHEET 1 OF 20

Assume the following soil types:

1. Sta 102+30 to Sta 133+00
   Bottom soils are caliche
   Side soils are mostly caliche with some SM + ML material.

   The distribution as estimated by the Gelogist (Don Clarke) would range from ML size up to about 8" Max with a D_{75} size of 3 to 4 inches

   Use: D_{75} = 3.0 inches for design

2. Sta 133+00 to Sta 208+00

   Materials are nearly all weathered and fractured Granite.
   Geology report estimates D_{50} size = 6"
   Size distribution as estimated by Don Clarke would range from 3 m.m. to about 12 inches. The D_{75} size would be about 8 to 9 inches.

   Use: D_{75} = 8.0 inches for design

Allowable Tractive Force: $\left(\begin{array}{l} T_{Lb} = 0.4\ D_{75} \\ T_{LS} = (0.4)(K)(D_{75}) \end{array} \right)$

1. Caliche Material:

$T_{LB} = (0.4)(3.0) = 1.2$

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill Fldw.		
BY Burton	DATE 5/27/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design - Allowable Velocity				SHEET 2 OF 20

$T_{Ls} = 0.4\,K\,D_{75}$

ES 141 Sht. 3: For very angular material & $D_{75} = 3.0$ inches $\phi_R = 40.5°$

ES 141 Sht 4: For $\phi_R = 40.5$ & $z = 2.0$

$T_{Ls}/T_{Lb} = 0.72$

$\therefore T_{Ls} = (0.72)(1.2) = \underline{0.864}$

2. Granite Material:

$T_{Lb} = (0.4)(8.0) = \underline{3.2}$

$T_{Ls} = K\,T_{Lb}$

ES 141 Sht 3: For very angular material & $D_{75} = 8.0$ inches $\phi_R = 41°$

ES 141 Sht 4: For $\phi_R = 41°$ & $z = 2.0$

$T_{Ls}/T_{Lb} = K = 0.72$

$\therefore T_{Ls} = (0.72)(3.2) = \underline{2.304}$

STATE Arizona	PROJECT Buckhorn Mesa WPP - Spook Hill Fldw.		
BY Burton	DATE 5/27/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design - Allowable Velocity			SHEET 3 OF 20

Section between Sta. 162+50 & Sta. 189+00 appears to be the most critical area, as the channel grade needs to be kept as steep as possible in order to avoid excess excavation. (D_{75} = 8.0 inches)

Try: b = 30 ft
z = 2.0
S = 19.0/2550 = 0.00745
Q = 808 cfs for Sta. 162+50 to Sta. 178+00.
Q = 1614 cfs. for Sta 178+00 to Sta 189+00.

30.0000	b
2.0000	z
0.00745	S
0.0300	n
808.0000	Q
3.0000	
848.3073	
2.9180	
808.4287	
2.9171	d
807.9999	Q
7.7296	V
104.5324	A

30.0000	b
2.0000	z
0.0074	S
0.0300	n
1614.0000	Q
5.0000	
2091.1803	
4.3656	
1640.4912	
4.3260	
1614.0984	
4.3259	d
1613.9999	Q
9.6528	V
167.2038	A

For Q = 808 cfs:

$$n_t = \frac{(8.0)^{1/6}}{39} = 0.0363$$

$$S_t = \frac{S_e (n_t)^2}{n^2} = \frac{(0.00745)(.0363)^2}{(0.03)^2} = 0.0109$$

$$T_\infty = \gamma_w d S_t = \gamma_w d S_t = (62.4)(2.917)(.0109)$$
$$= 1.984$$

STATE Arizona	PROJECT Buckhorn Mesa WPP - Spook Hill Fldw.		
BY Burton / DATE 5/27/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design - Allowable Velocity			SHEET 4 OF 20

From E.S. 140, Sht. # 5

$b/d = 30/2.917 = 10.28$; $z = 2.0$

$T_B/T_\infty = 0.99$

$T_B = (0.99)(1.984) = 1.964 < 3.20$ O.K.

From E.S. 140, Sht # 6

$T_S/T_\infty = 0.78$

$T_S = (0.78)(1.984) = 1.548 < 2.304$ O.K.

For Q = 1614 cfs:

$n_t = 0.0363$ $S_t = 0.0109$

$T_\infty = (62.4)(4.326)(.0109) = 2.94$

From E.S. 140, sht. # 5

$b/d = 30/4.326 = 6.935$; $z = 2$

$T_B/T_\infty = 0.98$

$T_B = (0.98)(2.94) = 2.88 < 3.20$ O.K.

F.S. = 3.20/2.88 = 1.11

From E.S. 140, sht. # 6

$T_S/T_\infty = 0.78$

$T_S = (0.78)(2.94) = 2.29 < 2.304$ O.K.

F.S. = 1.0

STATE Arizona	PROJECT Buckhorn Mesa W.P.P. - Spook Hill Fldw.		
BY Burton	DATE 5/28/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design - Allowable Velocity			SHEET 5 OF 20

Check by Allowable Velocity Procedure:

Use Fig 6.1 — TR 25

Use Curve #1 & D_{75} = 8.0 inches

$V = 13.0$ f.p.s.

$D = 1.07$ (for $d = 4.33$ ft.)

$B = 0.72$ (for $z = 2$)

$A = 1.0$

Then: $V_A = (13.0)(1.07)(0.72)$

$V_A = 10.02$ fps > 9.653 f.p.s. O.K.

Set grade between Sta 162+50 & Sta 189+00 as proposed.
Establish design grades on remainder of channel and check stability.

STATE Arizona		PROJECT Buckhorn Mesa W.P.P. - Spook Hill Fldw.		
BY Burton	DATE 5/28/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design				SHEET 6 OF 20

Determine design for section between Sta. 102+50 & Sta. 162+50.

Assume invert elevations as follows

Station 102+50 Elev = 1568.0

Station 162+50 Elev = 1567.0

$\therefore S = 1.0/6000 = 0.0001667$

Q = 808 cf.s.

Z = 2.0

n = 0.030

Try b = 30 ft.

```
   30.0000 b
    2.0000 Z
    0.0001667 S
    0.0300 n
  808.0000 Q
    5.0000
  312.8102
    9.4006
 1009.0329
    8.4250
  818.7193
    8.3668
  808.0359
    8.3666
  807.9999
    8.3666 d
  808.0000 Q
    2.0664 V
  391.0001 A
```

STATE Arizona	PROJECT Buckhorn Mesa WPP - Spook Hill Fldw.		
BY Burton	DATE 5/28/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design			SHEET 7 OF 20

If channel invert elev = 1568.0

Then tailwater elevation = 1568.0 + 8.4 = 1576.4

Assume 9x6 Box Culvert principal spillway and determine discharge curve.

Full Pipe Flow:

$$Q = a\sqrt{\frac{2gh}{1 + K_e + K_b + K_c L}}$$

$$K_e + K_b = 1.0$$

$$K_c = \frac{29.16\, n^2}{r^{4/3}}$$

$$n = 0.014$$

$$r = \frac{(9)(6)}{2(9+6)} = 1.800$$

$$K_c = \frac{29.16\,(0.014)^2}{(1.80)^{4/3}} = 0.00261$$

$$Q = (9)(6)\sqrt{\frac{64.4\,h}{1+1+(0.00261)(82)}} = 291.2\sqrt{h}$$

Elev	h	Q
1577.5	1.1	304.41
1578.0	1.6	368.34
1579.	2.6	469.54
1580.	3.6	552.51
1582.	5.6	689.1
1584.	7.6	802.78
1586.	9.6	902.25
1588.	11.6	991.79
1590.	13.6	1073.89

STATE Arizona		PROJECT Buckhorn Mesa W.P.P. - Spook Hill Fldw.		
BY Burton	DATE 5/28/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design				SHEET 8 OF 20

Try b = 40 ft.

40.0000	b
2.0000	Z.
0.0001667	S
0.0300	n
808.0000	Q
6.0000	
557.8636	
7.5083	
835.3212	
7.3732	
808.2191	
7.3721	d
807.9999	Q
2.0020	V
403.5797	A

Then: Tailwater Elevation = 1575.4

Assume 9'x6' Box Culvert

Elev	h	Q $= 291.2\sqrt{h}$
1577.5	2.1	
1578.	2.6	469.54
1579.	3.6	552.51
1580.	4.6	624.55
1582.	6.6	748.10
1584.	8.6	853.96
1586.	10.6	948.07
1588.	12.6	1037.75
1590.	14.6	1112.67

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP - Spook Hill Fldw.			
BY Burton	DATE 5/28/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design				SHEET 9 OF 20

Try: b = 50 ft.

50.0000	b
2.0000	Z
0.0001667	S
0.0300	n
808.0000	Q
6.0000	
631.5157	
6.6339	
813.4971	
6.6086	
808.0079	
6.6085	
807.9999	
6.6085	d
807.9999	Q
1.9340	V
417.7769	A

Then: Tailwater Elevation = 1568.0 + 6.61
= 1574.61

Assume 9'x6' Box Culvert:

Elev	h	Q $=291.2\sqrt{h}$
1577.5	2.9	495.89
1578.0	3.4	536.94
1579.0	4.4	610.82
1580.0	5.4	676.68
1582.0	7.4	792.14
1584.0	9.4	892.80
1586.0	11.4	983.20
1588.0	13.4	1065.96
1590.0	15.4	1142.75

STATE Arizona	PROJECT Buckhorn Mesa W.P.P. - Spook Hill F.R.S.		
BY Burton / DATE 5/29/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design			SHEET 10 OF 20

Use b = 30 ft.
Lower invert elevation to El 1566 at principal spillway outlet.

Increase slope to s = 0.00020

```
  30.000000 b
   2.000000 z
   0.000200 S
   0.030000 n
 808.000000 Q
   8.000000
 813.205672
   7.972814
 808.008075
   7.972772 d
 807.999998 Q
   2.205761 V
 366.313351 A
```

Then Tailwater Elevation = 1566 + 8.0 = 1574.0

Elev.	h	Q $= 291.2\sqrt{h}$
1577.5	3.5	544.78
1578.0	4.0	582.40
1579.0	5.0	651.14
1580.0	6.0	713.29
1582.0	8.0	823.63
1584.0	10.0	920.85
1586.0	12.0	1008.74
1588.0	14.0	1089.57
1590.0	16.0	1164.80

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 41
☆ GPO: 1972 —460-109

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill FRS.		
BY Burton	DATE 5/29/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design				SHEET 11 OF 20

Determine design for section between Sta. 188+00 & Sta 207+25±

Elev @ Sta 188+00 = 1548.0

Elev @ Sta 207+25 = 1547.0

S = 0.000519

Station 188+00 to Sta 195+00

Q = 1614 cfs

```
   30.000000 b
    2.000000 z
    0.000519 S
    0.030000 n
 1614.000000 Q
   10.000000
 2005.634952
    8.990515
 1634.645348
    8.931049
 1614.067316
    8.930854 d
 1613.999991 Q
    3.775916 V
  427.445934 A
```

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill FRS	
BY Burton	DATE 5/29/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design			SHEET 12 OF 20

Station 195+00 to Sta 207+25±

Q = 2136 cfs.

30.000000	b
2.000000	z
0.000519	S
0.030000	n
2136.000000	Q
10.000000	
2005.634952	
10.336030	
2138.345352	
10.330194	
2136.000384	
10.330193	d
2135.999999	Q
4.081542	V
523.331584	A

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill		
BY Burton	DATE 5/29/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design				SHEET 13 OF 20

Check Allowable Velocity for channel sections

Station 102+70 to Station 133+00:

D_{75} size = 3.0 inches

Using allowable velocity procedure

From Fig 6-1, TR-25

For $D_{75} = 3.0$ & Curve #1

$V = 7.5$ fps.

$B = 0.72$ (for $z = 2$)

$D = 1.205$ (for $d = 8$ ft)

$\therefore V_A = (7.5)(0.72)(1.205) = \underline{6.51 \text{ fps.}}$

Station 133+00 to Station 165+00:

D_{75} size = 8.0 inches

Using allowable velocity procedure

From Fig 6-1, TR-25

For $D_{75} = 8.0$ & Curve #1

$V = 13.0$ fps

$B = 0.72$

$D = 1.205$

$\therefore V_A = (13.0)(0.72)(1.205) = \underline{11.28 \text{ fps.}}$

STATE Arizona		PROJECT Buckhorn Mesa W.P.P. - Spook Hill FRS.		
BY Burton	DATE 5/29/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design				SHEET 14 OF 20

Station 165+00 to Station 178+50:

D_{75} = 8.0 inches

Use Allowable Velocity Procedure

From Fig 6-1, TR-25

V = 13.0 fps.

B = 0.72

D = 0.93

$V_A = (13.0)(.72)(.93) =$ 8.70 fps.

Station 178+50 to Station 189+00:

$V_A =$ 10.02 fps. (from calculations, pg 5/)

Station 190+00 to Station 195+00:

D_{75} = 8.0 inches

From Fig 6-1, TR-25

V = 13.0

B = 0.72

D = 1.225 (for d = 8.9 ft.)

$V_A = (13.0)(0.72)(1.225) =$ 11.47 fps

STATE Arizona		PROJECT Buckhorn Mesa WRP - Spook Hill FRS.	
BY Burton	DATE 5/29/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design			SHEET 15 OF 20

Station 195+00 to Station 207+25±

D_{75} = 8.0 inches

From Fig 6-1, TR-25

V = 13.0 fps

B = 0.72

D = 1.25 (for d = 10.33 ft.)

$V_A = (13.0)(0.72)(1.25) = \underline{11.7 \text{ f.p.s.}}$

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill Fldw		
BY Burton	DATE 5/30/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design				SHEET 16 OF 20

Check Critical Slope of channel sections:

Station 178+50 to Station 195+00

30.0000	b
2.0000	z
808.0000	Q
2268.0000	
1023.5607	
817.5906	
808.0231	
807.9999	
807.9999	
2.6559	d_c
93.7877	A_c
8.6151	V_c
0.0300	n
0.0103	S_c

$0.7\ S_c = 0.00721$

$1.3\ S_c = 0.01339$

For critical section: s = 0.00745 - This is in the unstable zone.

Other slopes are out of unstable zone

∴ OK.

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill Fldw.		
BY Burton	DATE 5/30/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design				SHEET 17 OF 20

Station 178+50 to Station 195+00

30.0000	b
2.0000	z
1614.0000	Q
2268.0000	
1657.2995	
1614.2512	
1614.0000	
4.0731	d_c
155.3761	A_c
10.3876	V_c
0.0300	n
0.0092	S_c

$0.7\ S_c = 0.00614$

$1.3\ S_c = 0.01339$

For critical section: s = 0.00745 - This is in the unstable zone.

Other slopes out of critical zones

∴ OK.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 48
☆ GPO: 1972 —460-109

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill Fldw.		
BY Burton	DATE 5/30/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design				SHEET 18 OF 20

Station 195+00 to Station 207+25

30.0000	b
2.0000	z
2136.0000	Q
3086.6471	
2205.3656	
2136.5005	
2136.0000	
4.8238	d_c
191.2557	A_c
11.1682	V_c
0.0300	n
0.0088	S_c

$0.7\ S_c = 0.0061$

$1.3\ S_c = 0.0114$

All design slopes outside of critical zone

STATE Arizona	PROJECT Buckhorn Mesa WPP - Spook Hill Fldw.		
BY Burton	DATE 5/30/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design			SHEET 19 OF 20

Modify slope in steep section to avoid unstable zone.

Flatten slope and make grade change at Station 159+50.

$\therefore$ S = 0.00610 < 0.0064 O.K.

Redesign channel section between Sta 159+50 & Station 189+00.

Sta. 159+50 to Sta. 178+50

Q = 808 cfs.
b = 30 ft.
z = 2.0

30.0000	b
2.0000	z
0.0061	S
0.0300	n
808.0000	Q
2.5000	
559.8439	
3.1428	
832.3627	
3.0900	
808.1590	
3.0897	d
807.9999	Q
7.2281	V
111.7847	A

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 50

☆ GPO: 1972 —460-109

STATE	PROJECT			
Arizona	Buckhorn Mesa WVPP - Spook Hill Fldw.			
BY Burton	DATE 5/30/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design				SHEET 20 OF 20

Station 178+50 to Station 189+50
Q = 1614 cfs

30.0000	b
2.0000	z
0.0061	S
0.0300	n
1614.0000	Q
4.5000	
1566.8004	
4.5760	
1614.3503	
4.5754	d
1613.9999	Q
9.0100	V
179.1723	A

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 51
☆ GPO: 1972 —460-109

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill Floodway	
BY Burton	DATE 6/3/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Freeboard Requirements			SHEET 1 OF 1

Pg. 5-3
TR-25

Freeboard for subcritical flow ≥ 20% of the design depth but not less than 1.0 ft.

Station	Design Depth	0.2 d	Freeboard
102+70			
	7.97	1.59	1.60
159+50			
	3.09	0.61	1.00
178+50			
	4.58	0.91	1.00
189+00			
	8.93	1.78	1.80
195+00			
	10.33	2.06	2.10
207+75			

STATE Arizona	PROJECT Buckhorn Mesa WPP – Spook Hill		
BY Burton / DATE 4/5/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Junction Structure #1			SHEET 1 OF 3

Determine required θ for channel design:

Use equation on Fig 5-1 TR 25 for analysis

$$\frac{Q_3^2}{gA_3}\cos\alpha_3 + \left(\frac{b_3}{2}+\frac{zd_3}{3}\right)\left(d_3^2\right)\cos^2\alpha_3 = \frac{Q_1^2}{gA_1}\cos\alpha_1 + \frac{Q_2^2}{gA_2}\cos\alpha_2\cos\theta$$

$$+\left(\frac{b_1}{2}+\frac{zd_1}{3}\right)\left(d_1^2\right)\cos^2\alpha_1 + A_a h - \frac{P_a l n^2 V_a^2}{2.21\, R_a^{1/3}}$$

Assume side channel inflow is maximum

Use:

$Q_1 = 533$ cfs $\quad Q_2 = 1081$ cfs $\quad Q_3 = 1614$ cfs

$b_1 = 50'$ $\quad b_2 = 30'$ $\quad b_3 = 50'$

$z_1 = 2$ $\quad z_2 = 2$ $\quad z_3 = 2$

$d_1 = 3.63'$ $\quad d_2 = 3.57$ $\quad d_3 = 3.63$

$A_1 = 208.14$ $\quad A_2 = 132.42$ $\quad A_3 = 207.99$

$\alpha_1 = 0.0332$ $\quad \alpha_2 = 0.5156°$ $\quad \alpha_3 = 0.3053°$

$\cos\alpha_1 = 1.00000$ $\quad \cos\alpha_2 = 0.99996$ $\quad \cos\alpha_3 = 0.99999$

Try $\theta = 18°$

$A_a = 170.33$ $\quad P_a = 56.10$ $\quad V_a = 5.36$ $\quad R_a = 3.04$

$l = 92.33$ $\quad n = 0.035$ $\quad h = 0.49'$

From above equation:

$388.96 + 361.30 = 42.39 + 260.63 + 361.31 + 83.46 - 57.15$

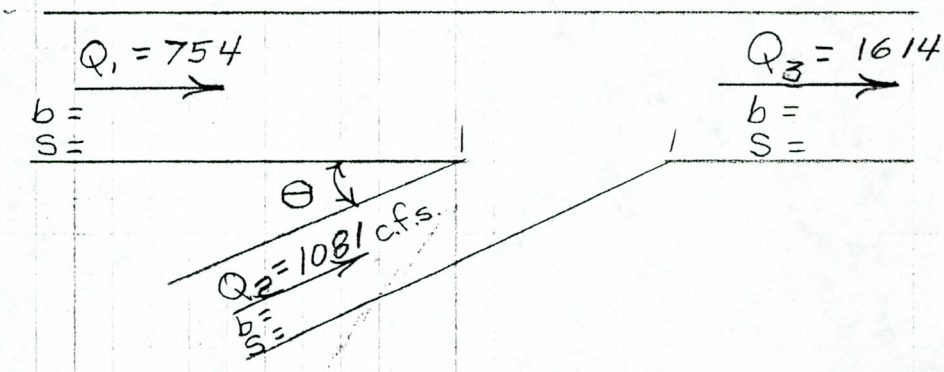
$750.26 \neq 690.64 \rightarrow$ More refinement needed

Decrease $\theta \rightarrow$ Try $15°$

Then: $\cos\theta = 0.9659$

$l = 111.96'$

STATE Arizona		PROJECT Buckhorn Mesa - Spook Hill	
BY Burton	DATE 4/4/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Junction Structure #1			SHEET 2 OF 3



Design side channel for max Q = 1081 cf.s.

Assume: S = 0.009
n = 0.035
z = 2

Try b = 30

30.0000	b
2.0000	z
0.0090	S
0.0350	n
1081.0000	Q
3.5000	
1046.0158	
3.5667	
1081.2772	
3.5662	d
1080.2999	Q
8.1652	V
132.4255	A

Critical Slope

30.0000	b
2.0000	z
1081.0000	Q
981.9605	
1083.0887	
1081.0008	
1080.9999	
3.1844	d_c
115.8152	A_c
9.3338	V_c
0.0350	n
0.0133	S_c

$0.7\ S_c = 0.0093$

$S = 0.0090 < 0.0093$ O.K.

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill		
BY Burton	DATE 4/5/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Junction Structure #1				SHEET 3 OF 3

$720.26 = 42.39 + 264.70 + 361.31 + 101.07 - 69.30$

$720.26 \neq 700.17$

Decrease $\theta \rightarrow$ Try $12°$

Then $\cos\theta = 0.9781$

$l = 141.14$

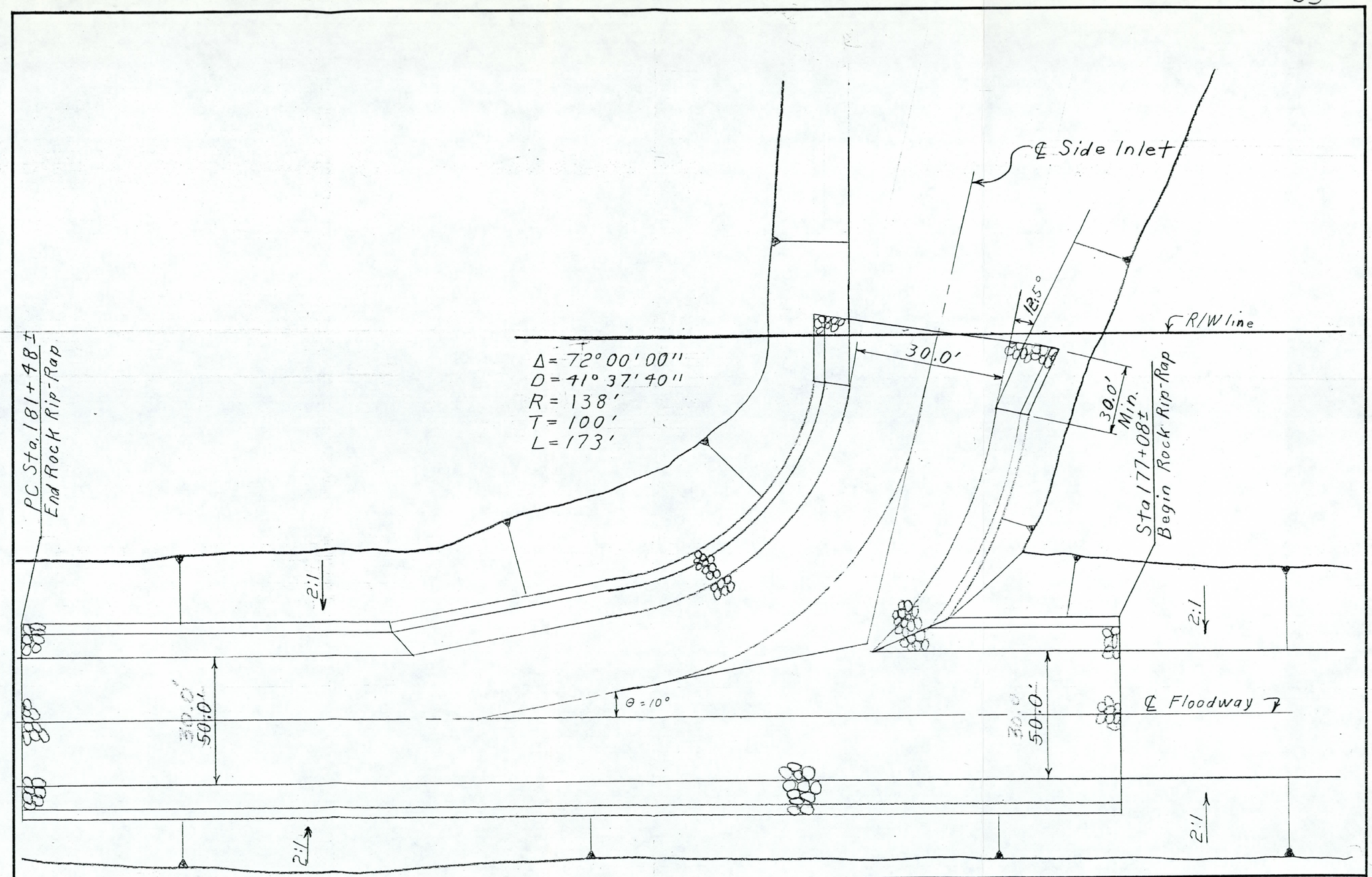
$h = 0.75$

$720.26 = 42.39 + 268.05 + 361.31 + 127.75 - 87.37$

$720.26 \neq 712.13$

θ should be reduced slightly

Use: $\theta = 10°$ for design



50 0 50 100
SCALE IN FEET

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DESIGNED BY L.L.B	APPROVED BY
CHECKED BY	DRAWING NO.
DATE: 4-5-75	SHEET 1 OF 1

Form SCS-313A (March 1957)

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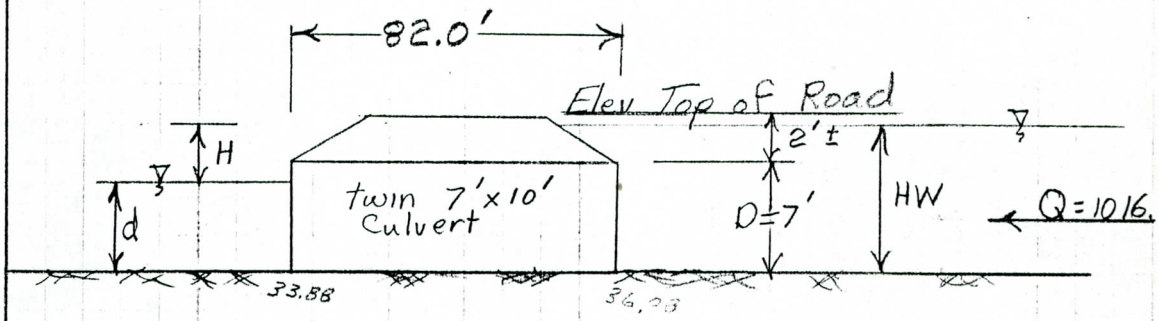
STATE Arizona	PROJECT Buckhorn Mesa WPP - Spook Hill Floodway		
BY Burton / DATE 5/20/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulics - Highway Culvert			SHEET 1 OF 2

Given:



Criteria:

1. Design Q for Culvert = 1016 cfs. Based on 10 Yr.-24 hr. storm
2. Outlet is temporary. The Floodway flow will be diverted to the proposed Orme Dam by the Bureau of Reclamation in 5-10 Years.
3. Assume $d = 2/3\,D = 2/3(7) = 4.7$ ft.
4. Use Bureau of Public Roads Nomograph for culverts with Inlet + Outlet Control

Design:

$Q = 1016$ cfs.

$A = 2[10 \times 7] = 140\ ft^2$

$V = Q/A = 1016/140 = 7.25$ fps

$D = 7.0$

$\therefore d = 2/3\,D = 2/3(7.0) = 4.7$ ft.

STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill Floodway		
BY Burton	DATE 5/20/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulics - Highway Culvert				SHEET 2 OF 2

Assume Outlet Control:

From B.P.R. Nomograph - Chart # 12

$K_e = 0.70$

$n = 0.12$

Required $H = 1.4$ ft.

Available $H = (7 - 4.7) + 2.0 = 4.3$ ft.

∴ Design Q can pass through culvert

Assume Inlet Control:

From B.P.R. Nomograph - Chart # 6

$Q/B = 1016/20 = 50.8$

$HW/D = 0.89$

$HW = (0.89)(7.0) = 6.23$ ft.

Available $HW = 9.0$ ft.

∴ Design Q can pass through culvert.

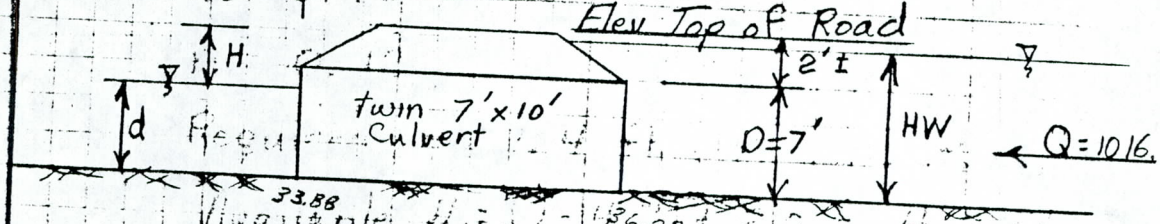
Summary:

10 Yr 24 hr Storm Q = 1016 cfs can be passed through the existing highway culvert.

Arizona	PROJECT Buckhorn Mesa WPP - Spook Hill Floodway		
DATE 5/20/75	CHECKED BY	DATE	JOB NO. 2005
Hydraulics - Highway Culvert			SHEET 1 OF 2

Given: Assume Outlet Control:

From BPR Nomograph - Chart #12



Criteria: Design Q can pass through culvert

1. Design Q for Culvert = 1016 cfs. Based on 10 Yr. - 24 hr. storm

Assume Inlet Control:

2. Outlet is temporary. The Floodway flow will be diverted to the proposed Orme Dam by the Bureau of Reclamation in 5-10 Years.

3. Assume = d = 2/3 D = 2/3 (7) = 4.7 ft.

4. Use = Bureau of Public Roads Nomograph for culverts with Inlet & Outlet Control

Available HW = 9.0 ft.

Design: ∴ Design Q can pass through culvert

Q = 1016 cfs.

A = 2 [10 x 7] = 140 ft²

V = Q/A = 1016/140 = 7.25 fps

Summary: D = 7.0 hr. Storm Q = 1016 cfs can be passed through the existing highway culvert

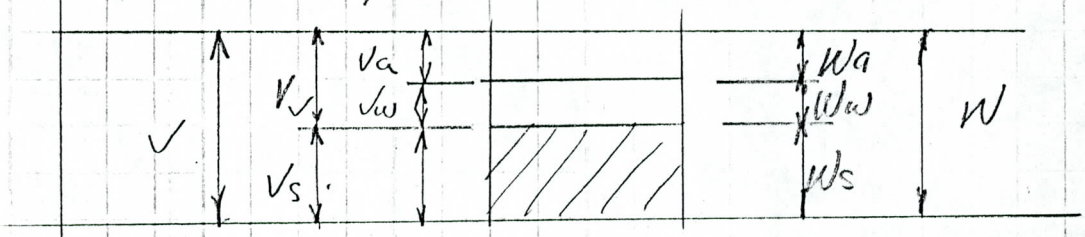
d = 2/3 D = 2/3 (7.0) = 4.7 ft.

Ariz
RM 6-8-75

Buckhorn Mesa WPP Spookhill FKS.

Foundation and Embankment Design 1 2

Soil Properties



$$.95\,\gamma d = \frac{130.6 + 127.7 + 128.2 + 122.2}{4}(.95)$$

$$= 120.8\,pcf = W_s$$

For Gs Use weighted Ave of Gs of Samples 750296-297, 302 and 305

750296	Gs-4	Gs+4	%-4	%+4
	2.71	2.59	85.5	14.5

$$G_s = \frac{2.71(85.5) + 2.59(14.5)}{100}$$

$$= 2.69$$

750297	2.74	2.52	87.9	12.1

$$G_s = \frac{2.74(87.9) + 2.52(12.1)}{100}$$

$$= 2.71$$

Arr2 Backhorn Mesa WPP Spook Hill F.R.S.
RJM 5-8-75
Embankment & Foundation Design 2 2

	Gs-4	Gs+4	% -4	% +4
750302	2.67	2.61	82.5	17.5

$$G_s = \frac{2.67(82.5) + 2.52(17.5)}{100}$$

$$= 2.64$$

750305	2.75	2.58	81.4	18.6

$$G_s = \frac{2.75(81.4) + 2.58(18.6)}{100}$$

$$= 2.72$$

$$G_{s\,ave} = \frac{2.69 + 2.71 + 2.64 + 2.72}{4}$$

$$= \underline{\underline{2.69}}$$

$$V_s = W_s / \gamma_w G_s$$

$$= 120.8 / (62.4)(2.69)$$
$$= 0.720 \text{ cf}$$

$$V_v = 1.00 - 0.720 = 0.280 \text{ cf}$$

Sat

$$W_w = 62.4(0.280) = 17.47 \text{ lbs}$$

$$\gamma_{sat} = (W_s + W_{w\,sat})/V$$

$$= (120.8 + 17.5)/1 = \underline{\underline{138.3}} \text{ pcf}$$

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

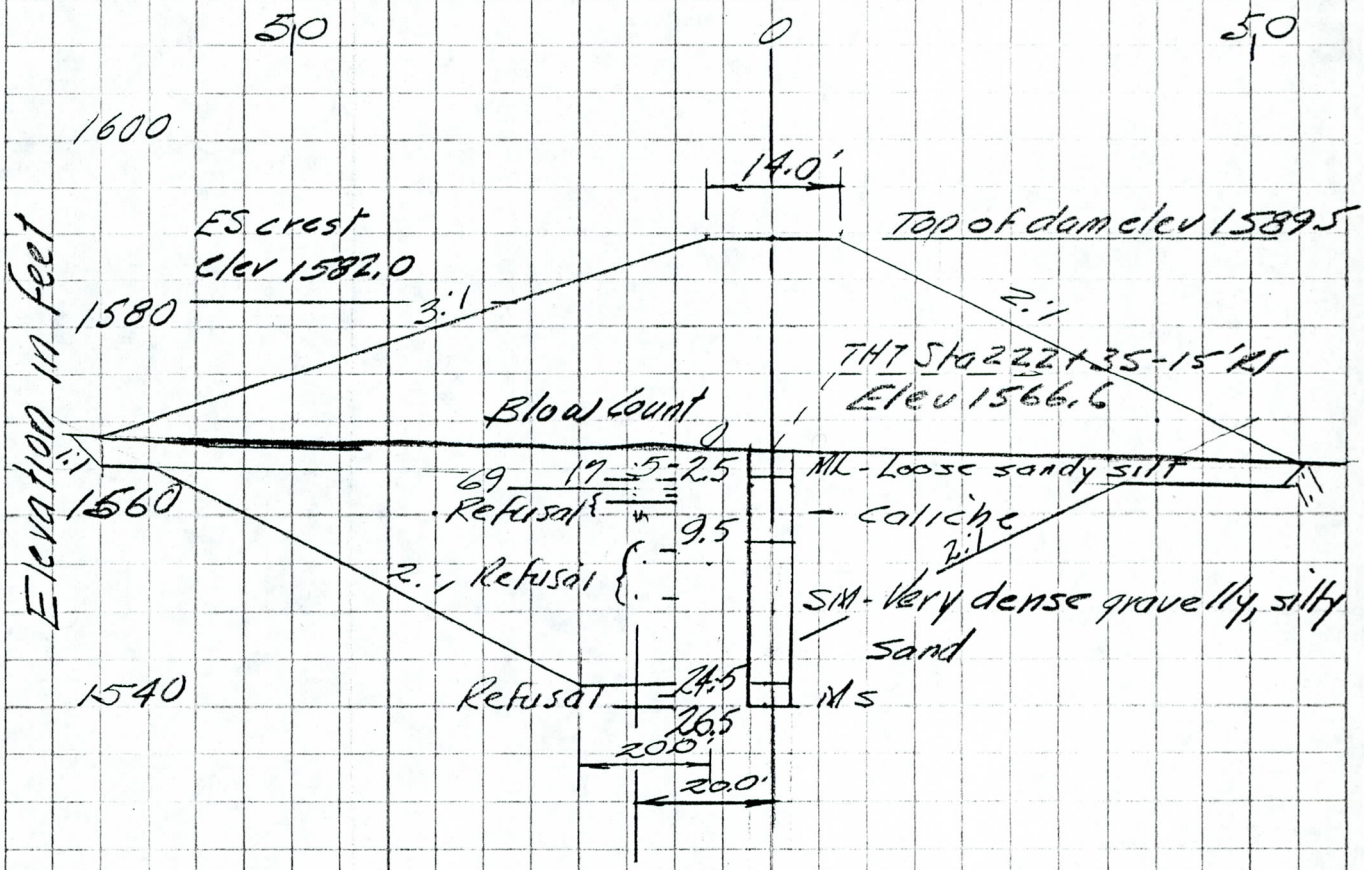
60

GPO : 1958 O—470868

STATE	PROJECT			
Ariz	Buckhorn Mesa WPP & Spook Hill PRS			
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	5-7-75			

SUBJECT
Embankment and Foundation Design

SHEET 1 OF 5



Foundation

MTS No	Field No	Depth	Unif Class	Att Lim	G_s
750294	7.1	9.5-25.0	SW-SM	NP NP	2.71

Blow counts indicate extremely strong material 9.5'-25'. Foundation will be considered strong for analysis. Material 0-2.5' dp not tested. Logs indicate material is very loose. It will be removed and recompacted.

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE: Ariz
PROJECT: Buckhorn Mesa WPP Spook Hill F.R.S
BY: PSM
DATE: 5-8-75
CHECKED BY:
DATE:
JOB NO.:
SUBJECT: Foundation and Embankment Design
SHEET 2 OF 5

Embankment (Borrow)

NTS No.	Field No	Unit Class	Att Limits LL	Att Limits PI	Mech Analy Grav.	Mech Analy Sand	Mech Analy Fines	Compact. γ_d	Compact. Opt M	Direct Shear ϕ	Direct Shear C	Depth
750296	2107.1	SC-SM	23	7	14.5	57.7	27.8	130.6	8.9	32 1/4	0	1.5-5.0
750297	2108.1	SM-1	NP	NP	12.1	45.0	42.9	127.7	8.5	35	0	1.0-2.0
750302	2112.1	SM-1	NP	NP	17.5	58.8	23.7	128.2	8.8	33 1/2	0	1.0-5.0
750305	2116.1	SC	36	16	18.6	56.8	24.6	122.2	10.9	32	0	1.0-3.0

Preliminary Design -

Ref: TM SM series No 3

SM-1 Behavior group III } Emb.
SC " " II

From Table 6

1. Site type A
2. Foundation type 1a

Embankment Design - Table 7

Homogeneous Section Type 1 Fig 3
w/ positive c/o

Route courser materials to the d.s.
portion of the fill

STATE	PROJECT		
Ariz	Buckhorn Mesa WPP Spook Hill F.R.S.		
BY PJM / DATE 5-6-75	CHECKED BY	DATE	JOB NO.

SUBJECT Embankment and Foundation Design

SHEET 3 OF 5

Stability Analysis

w/ Strong Foundation use Infinite slope method of analysis for embankment design

Use min. test value for strength

ϕ	c
32°	0

vs Slope — Rapid Drawdown Cond.

$$F.S. = \frac{\gamma_b \tan\phi}{\gamma_{sat} \tan\theta}$$

where

$$\gamma_b = \gamma_{sat} - \gamma_w$$
$$= 138.3 - 62.4 = 75.9 \text{ pcf}$$

$$\gamma_{sat} = 138.3 \text{ pcf}$$

$$\phi = 32°$$

$$\theta = \text{slope} = \tan^{-1} 1/z$$

$$F.S. = \frac{75.9 \tan 32°}{138.3 (1/z)}$$

$$= 0.343 z$$

STATE	PROJECT		
Ariz	Buckhorn Mesa WPP Spook Hill FRS		
BY RJM	DATE 5-8-75	CHECKED BY	DATE	JOB NO.

SUBJECT Embankment and Foundation Design

SHEET 4 OF 5

Z	.0343 Z
1	.343
2	.686
2.5	.858
2.75	.943
3	1.029
3.25	1.115
3.5	1.20

Reqd FS = 1.20

Require **Z = 3.5**

DS slope dry condition

F.S. = tan ϕ / tan θ
= 0.625 Z

For Z = 2

F.S. = 0.625 (2) = 1.25 OK

USE **Z = 2**

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE	PROJECT		
Ariz	Buckhorn Mesa WPP Spook Hill FRS		
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	5-8-75			

SUBJECT Embankment and Foundation Design

SHEET 5 OF 5

Modify Embankment by using zoned fill

Core SC, ML
Shell SM-1 $\phi = 35°$ $\gamma_d = 127.7$
$G_s = 2.71$

$.95\gamma_d = .95(127.7) = 121.3 = W_s$

$V_s = W_s / \gamma_w G_s$
$= 121.3 / 62.4(2.71)$
$= 0.717$ cf

$V_v = 1.00 - 0.717 = 0.283$ cf

$W_w = 62.4(0.283) = 17.7$ #

$\gamma_{sat} = (W_s + W_{w\,sat}) / V$
$= (121.3 + 17.7) / 1$
$= 139.0$ pcf

$\gamma_b = 139.0 - 62.4 = 76.6$ pcf

$FS = \dfrac{76.6 \tan 35° (z)}{139.0}$

$= 0.386\,z$

$z = 3$

$FS = .386(3) = \underline{1.16 \text{ OK}}$

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE	PROJECT		
Ariz	Buckhorn Mesq C/PP Spook Hill FRS		
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	5-9-75			

SUBJECT Embankment & Foundation Design

SHEET 1 OF 2

Estimate proportions of core & shell mat'l

Core SC & ML
Shell SM-1

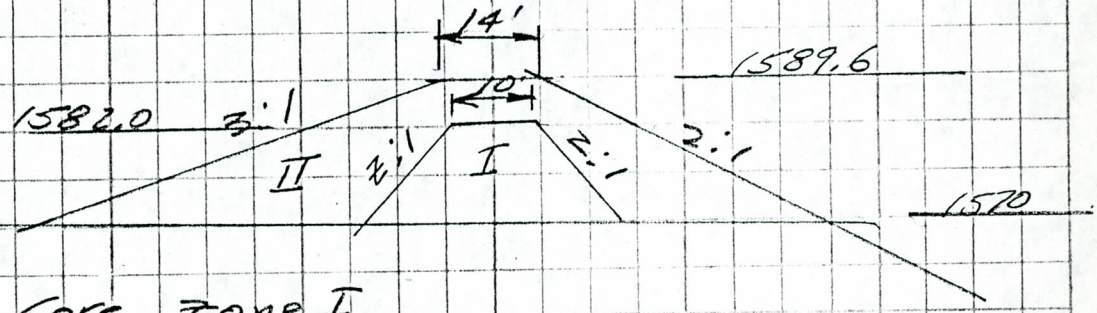
USE
1. Soils Profile on ℄ dam
2. Depths 500' c.c
3. Percentage of total depth of mat'l to ~~total~~ Σ depths

Program for Compucorp 324G

Enterd

↓+(1)
↓+(2)
st/st

Core: 110' 42 sta 56 %
Shell 87.7 42 sta 44 %



Core zone I

$A_I/(A_I+A_{II}) = .56$

STATE	PROJECT		
Ariz	Buckhorn Mesa WPP Spook Hill FRS		
BY RJM	DATE 5-9-75	CHECKED BY	DATE	JOB NO.

SUBJECT Embankment & Foundation Design

SHEET 2 OF 2

$A_I = 10(1582-1570) + z(1582-1570)^2$
$= 120 + 144z$

$A_I + A_2 = 14(1589.6-1570) + 25(1589.6-1570)^2$
$= 1234$ sf

$120 + 144z = 0.56(1234)$
$z = 3.96$

Change top of Zone I to elev 1585.4

$A_I = 10(1585.4-1570) + z(1585.4-1570)^2$
$= 154 + 237.2z$

$154 + 237.2z = 0.56(1234)$
$z = 2.26$

Change top of Zone I to top of Dam

$A_I = 14(19.6) + z(19.6)^2$
$= 274 + 384.2z$

$274 + 384.2z = 0.56(1234)$
$z = 1.08$

USE 1:1

COMPUTATION SHEET
SCS-522 REV 5-58

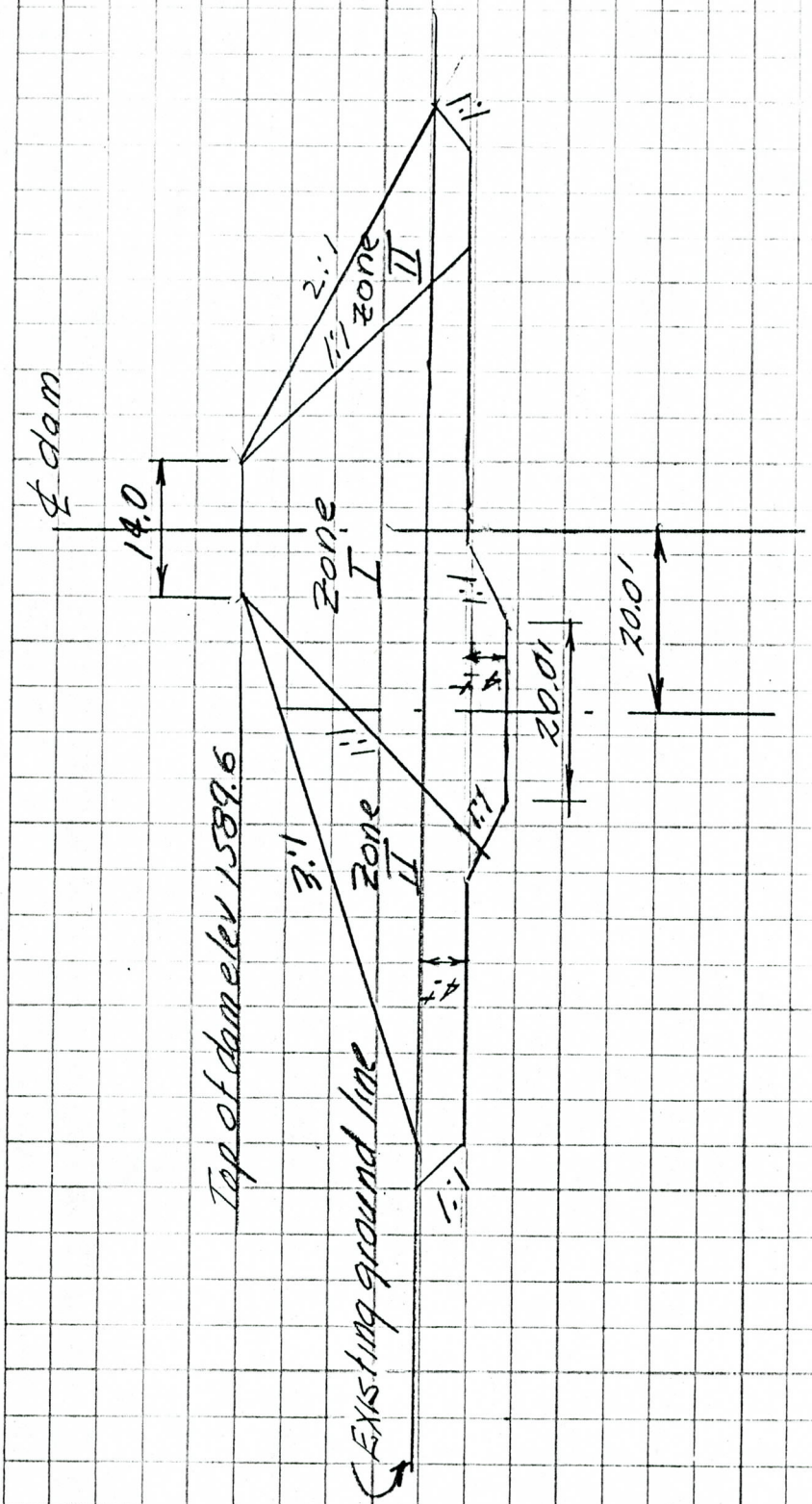
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO : 1958 O—470868

STATE	PROJECT			
Ariz.	Buckhorn Mesa W/PP Spook Hill F.R.S.			
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	5-9-75			

SUBJECT

SHEET 1 OF 1



TYPICAL CROSS SECTION OF DAM

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 69

GPO : 1958 O—470868

STATE Ariz	PROJECT Buckhorn Mesa W/PV - Spook Hill F.R.S		
BY RJM	DATE 5-9-75	CHECKED BY	DATE	JOB NO.

SUBJECT Structural Design

SHEET 1 OF 5

Proportion a type c drop spillway for the emergency spillway

$Q_E = 3415$ cfs $\quad Q_P = 930$ cfs

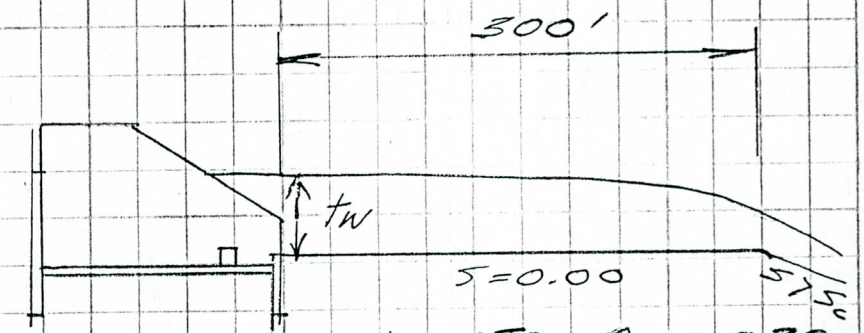
$Q_d = 2485$ cfs say 2500 cfs

$b = 150'$

$h = 3.5$

$F = 12'$

$\therefore h/F = 3.5/12 = 0.29 > 0.1$
< 1.43 OK

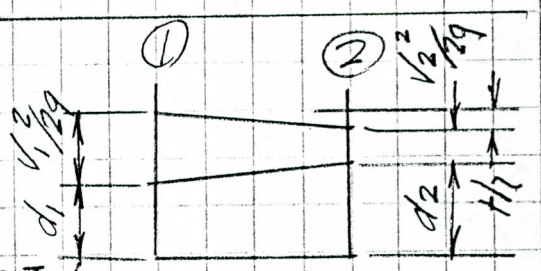


$b = 150 \quad n = 0.030$

$Z = 2$

1. Find tw

1. Solution



① $A = bd + Zd^2$

② $P = b + 2d\sqrt{Z^2+1}$

③ $R_{ave} = [A_1/P_1 + A_2/P_2]/2$

④ $V = Q/A$

⑤ $S_f = \dfrac{n^2 V^2}{2.2083 R^{4/3}}$

⑥ $He_1 = He_2 + S_f l$

EWP-8
2-57
PORTLAND, ORE.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WATER SURFACE PROFILE CALCULATION SHEET

Project: Buckhorn Mesa W.S. Spook Hill ~~Floodway~~ Emergency Spillway Location: Maricopa County, Arizona

Date: 5-12-75 By: D. Toerpe Sheet 1 of 1 Appropriation: 508-2005

Q = 2500 cfs b = 150' z = 2 n = 0.030 n^2 = 0.0009

Station	Depth, D	Bottom Width, b	Area, A $bd+zd^2$	Velocity, $V=\frac{Q}{A}$	Velocity Head $h_v=V^2/2g$	$\frac{D}{b}$	c(table 97 King)	Hydraulic Radius $R=cD$	$\frac{1}{2.2083R^{4/3}}$ (table 107, King)	V^2	n^2V^2	Friction Slope $S_f=\frac{n^2V^2}{2.2083R^{4/3}}$	Invert Slope S_i ft./ft.	Energy Head $H_e=D+h_v$	$H_e''-H_e'$	S_f-S_i	$l=\frac{H_e''-H_e'}{S_f-S_i}$	Remarks
3+00	2.033	150'	313.22	7.98	0.989	0.0135	0.970	1.972	0.174	60.53	0.0545	0.00948	0	3.022	0.07	0.00948	7.38'	too short
	2.200	150'	330.00	7.78 / 7.58	0.892	0.147	0.968	2.051 / 2.130	0.139	45.83	0.0412	0.00573	0	3.092	0.458	0.00573	79.93	too long
	3.000	150'	450.00	6.77 / 5.56	0.480	0.020	0.955	2.418 / 2.865	0.147	48.44	0.0436	0.00640	0	3.480	0.328	0.00640	51.25	Close Enough
2+48.75	2.800	150'	420.00	6.96 / 5.95	0.550	0.0187	0.962	2.333 / 2.694	0.119	34.22	0.0308	0.00366	0	3.350	0.063	0.00366	17.21	too short
	2.9	150'	435	5.85 / 5.75	0.513	0.0193	0.956	2.733 / 2.772	0.115	32.49	0.0292	0.00336	0	3.413	0.163	0.00336	48.51	Close Enough
2+00.24	3.05	150'	457.5	5.70 / 5.46	0.463	0.020	0.955	2.804 / 2.913	0.107	28.94	0.0260	0.00278	0	3.513	0.172	0.00278	61.87	Too long
	3.15	150'	472.5	5.38 / 5.29	0.435	0.021	0.953	2.958 / 3.002	0.108	29.38	0.0264	0.00285	0	3.549	0.136	0.00285	47.72	Close Enough
1+52.52	3.10	150'	465.0	5.42 / 5.38	0.449	0.021	0.953	2.934 / 2.954	0.104	27.67	0.0249	0.00258	0	3.659	0.147	0.00250	58.80	Close Enough
93.72	3.30	150'	495.0	5.22 / 5.05	0.396	0.022	0.951	3.046 / 3.138	0.0976	25.10	0.0226	0.00220	0	3.735	0.076	0.00220	34.55	Too Short
	3.35	150'	502.5	5.01 / 4.98	0.385	0.022	0.951	3.162 / 3.186	0.972	25.00	0.0225	0.00218	0	3.750	0.091	0.00218	41.74	Close Enough
0+51.98	3.37	150'	505.5	5.00 / 4.95	0.380	0.022	0.951	3.172 / 3.205	0.0935	23.62	0.0213	0.00198	0	3.852	0.102	0.00198	51.52	Close Enough
0+00.46	3.50	150'	525.0	4.86 / 4.76	0.352	0.023	0.949	3.264 / 3.322										

USDA-SCS-PORTLAND, OREG. 1957 M-1231

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 71
☆ GPO: 1972 —460-109

STATE	PROJECT			
Arizona	Spook Hill F.R.S. - Buckhorn Mesa W.P.P.			
BY J.E.B.	DATE 13 May 1975	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydraulic Design Type c Drop spillway				SHEET 3 OF 5

Q = 2500 c.f.s. , b = 150', Z = 2 , n = 0.030

find critical depth 300ft down stream as shown in sketch

b =	150.0000
Z =	2.0000
Q =	2500.0000
	2816.8438
	2506.2440
	2500.0026
	2499.9999
Q =	2499.9999
Dc =	2.0333
Ac =	313.2653
Vc =	7.9804
n =	0.0300
Sc =	0.0105

Critical Depth (D_c) = 2.0333 ft.
Area (A_c) = 313.265 sq.ft.
Velocity (V_c) = 7.98 fps
(n) = 0.03
Slope (S_c) = 0.0105 ft./ft.

d	hv	sf.
2.0333	0.9904	0.0105
2.1	0.9269	0.0094
2.2	0.8424	0.0080
2.3	0.7687	0.0069
2.4	0.7042	0.0060
2.5	0.6473	0.0052
2.6	0.5969	0.0046
2.7	0.5521	0.0040
2.8	0.5120	0.0036
2.9	0.4761	0.0032
3.0	0.4437	0.0028
3.1	0.4145	0.0025
3.2	0.3880	0.0023
3.3	0.3639	0.0020
3.4	0.3419	0.0018
3.5	0.3219	0.0017
3.6	0.3035	0.0015
3.7	0.2865	0.0014
3.8	0.2710	0.0012
3.9	0.2566	0.0011
4.0	0.2433	0.0010

find tail water depth at 300ft = 3.5 ft.+

Required Tailwater depth (2.03)(1.75) = 3.558ft.

Tailwater depth 3.6ft is at 329.35ft, 3.5ft is 278.35ft R

COMPUTATION SHEET
SCS–ENG–523 Rev. 8–69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 72
☆ GPO: 1972 —460-109

STATE	PROJECT			
Arizona	Spook Hill F.R.S. - Buckhorn Mesa W.P.P.			
BY J.E.B	DATE 13 May 75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydra. Design Type C Drop spillway				SHEET 4 OF 5

Find the length of stilling basin apron L_B

Tailwater depth (t) = 3.56 ft.
drop from spwy crest to sill (F) = 12.00 ft.
head over crest (h) = 3.5 ft. from Design notes
$h = D_c\ 1.5 = (2.05)(1.5) = 3.08$ ft for using ES 111

cfs width $\frac{2500}{150} = 16.67$

$q = 16.67$

ES 111
Sheet 3
$2.05' = D_c$

$h/F = 3.08\text{ft} / 12.0\text{ ft} = 0.2563$

$h/t = 3.075 / 3.6 = 0.8542$

Use ES-111 page 5-21

$L_B/F = 1.3$

$L_B = (F)(1.3) = (12)(1.3) = \underline{\underline{15.6\text{ ft.}}}$

Location of Floor Blocks L_f, ES-111 page 5-22

$L_f/F = 1.$

$L_f = (F)(1) = (12)(1) = \underline{\underline{12\text{ ft.}}}$

The minimum distance between the floor block & the transverse sill $L_B - L_F = 1.75\ D_c$

$15.6 - 12 = (1.75)(2.05)$

$\underline{\underline{3.6' = 3.59'}}$

Height of Floor Blocks

$(0.8)(D_c) = (0.8)(2.05) = \underline{\underline{1.64\text{ ft.}}}$

Solve for Dc

b	150.0000
Z	0.0000
Q	2500.0000
	2405.5772
	2500.6150
	2500.0000
Q	2499.9999
Dc	2.0519
	307.7998
Vc	8.1221

STATE Arizona		PROJECT Spook Hill FRS - Buckhorn Mesa W.P.P.		
BY J.E.B.	DATE 13 May 75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydr. Design Type C Drop Spillway				SHEET 5 OF 5

Width of Floor Blocks

$(0.4)(D_c) = (0.4)(2.05) = \underline{\underline{0.82 \text{ ft.}}}$

Length of Floor Blocks

$(0.4)(D_c) = (0.4)(2.05) = \underline{\underline{0.82 \text{ ft.}}}$

Spacing of Floor Blocks

50 to 60% of the transverse length of stilling basin

use spacing $(0.4)(D_c) = 0.82$ ft.

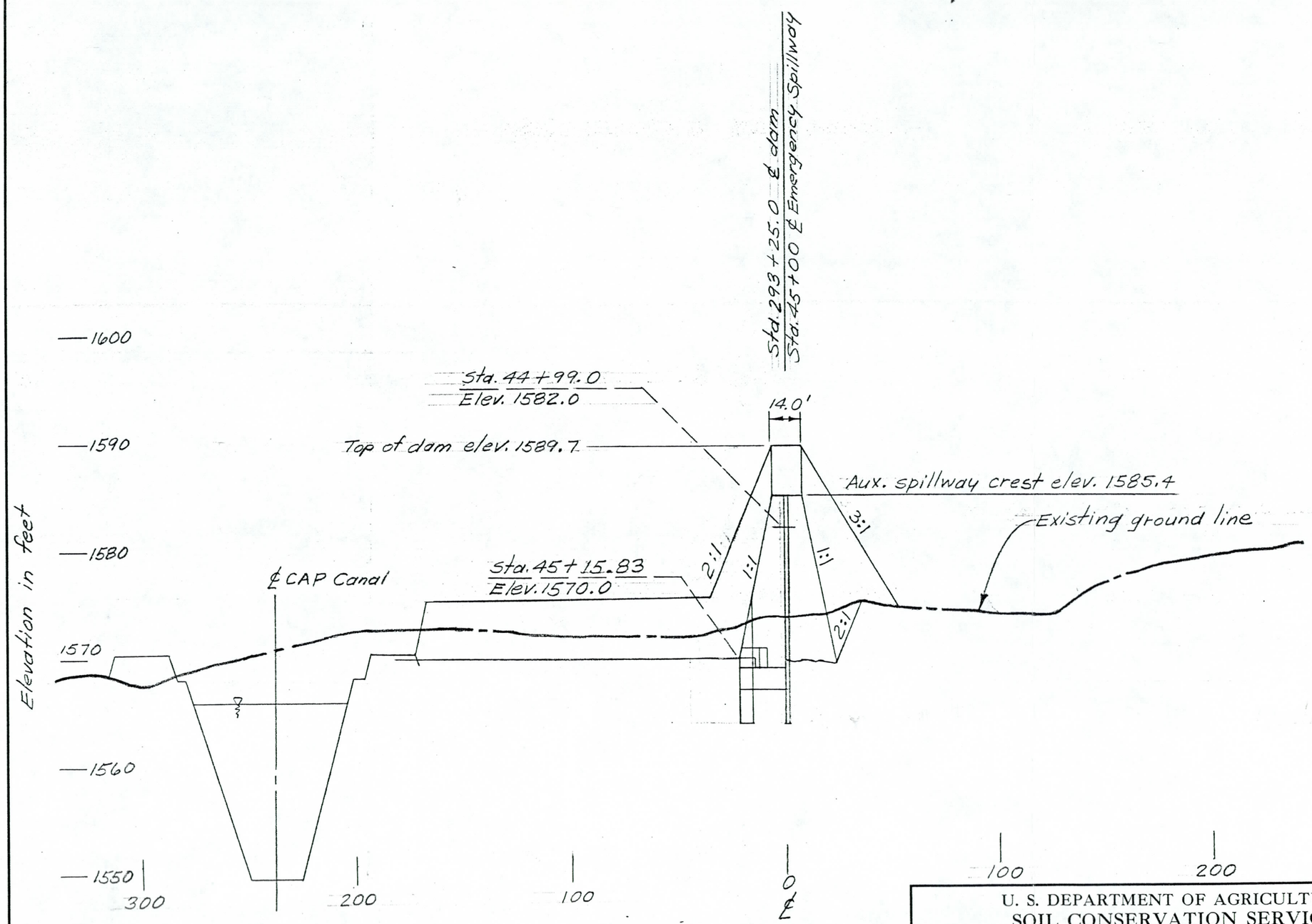
a half space $(0.2\,D_c) = 0.41$ ft. shall be allowed adjacent to the sidewalls - no floor block will be placed adjacent to the sidewalls.

Transverse sill Height

$(0.4)(D_c) = (0.4)(2.05) = \underline{\underline{0.82 \text{ ft.}}}$

side wall Height

$t + 0.85\,D_c = 3.6 + (0.85)(2.05) = \underline{\underline{5.34 \text{ ft.}}}$

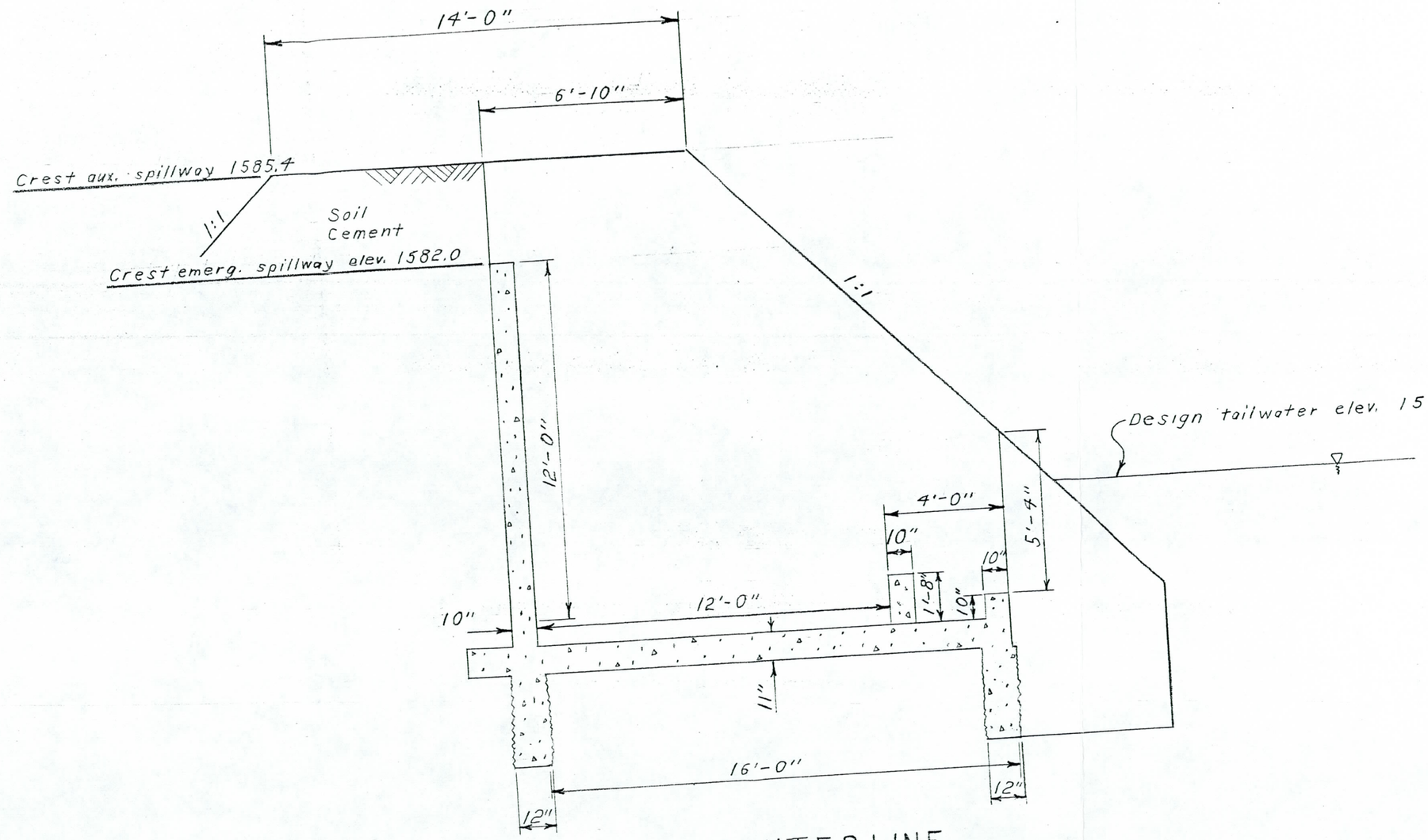


Cross Section
Sta 293+25.0 ℄ dam

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
DESIGNED BY PJM	APPROVED BY
CHECKED BY	DRAWING NO.
DATE: 5-20-75	SHEET 1 OF 1

SCS-ENG-313A (Rev. 8-70)

U.S. GOVERNMENT PRINTING OFFICE : 1970 O—401-772



SECTION ON CENTER LINE

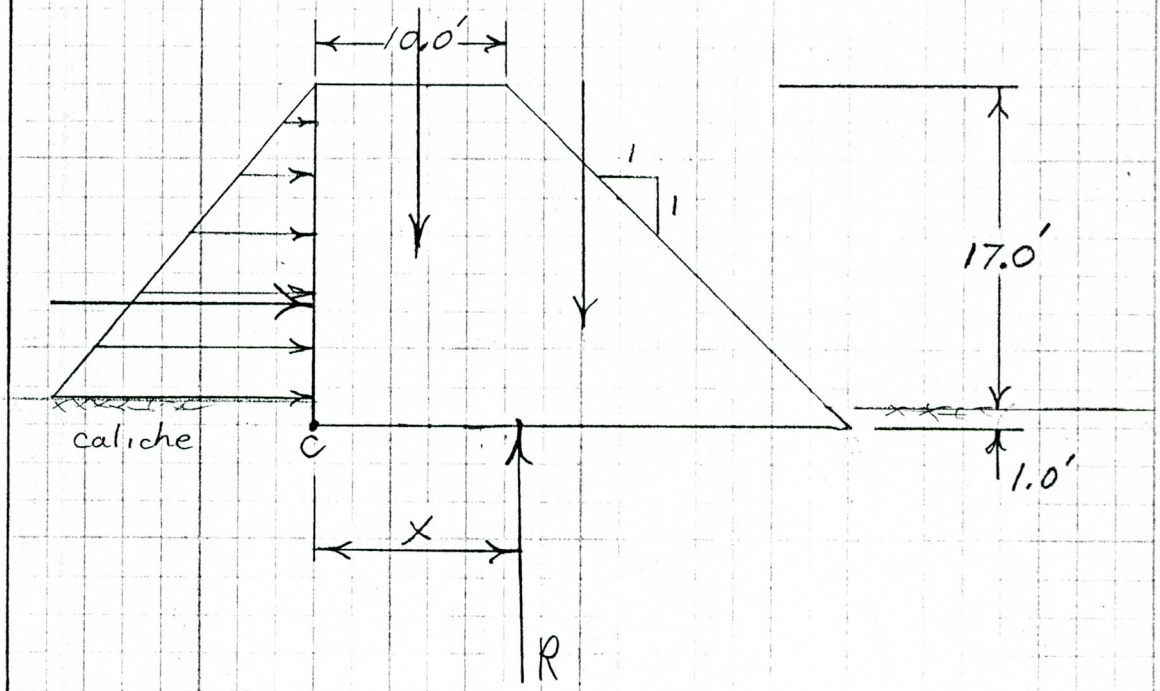
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
DESIGNED BY JEB	APPROVED BY
CHECKED BY PJM	DRAWING NO.
DATE: 5-16-75	SHEET 1 OF 1

SCS-ENG-313A (Rev. 8-70)

STATE Arizona	PROJECT Buckhorn Mesa WPP - Spook Hill F.R.S.		
BY Burton / DATE 5/16/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Auxiliary Spillway - Structure Proportioning			SHEET 1 OF 2

Assume:

1. Section as shown below
2. No flow condition, water at crest of spillway.
3. Soil cement section down to caliche layer ≈ 3.0 ft. below ground surface
4. With structure tied to caliche layer, uplift will be ignored.
5. Assume water load behind structure.
6. Weight of soil cement = 100 pcf.



STATE Arizona		PROJECT Buckhorn Mesa WPP - Spook Hill F.R.S.		
BY Burton	DATE 5/16/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Auxiliary Spillway - Structure Proportioning				SHEET 2 OF 2

$$\Sigma M_c = \frac{62.4(17^2)}{2}\left(\frac{17}{3}\right) + 100(10)(17)(5)$$

$$+ 100(17)(17/2)(5 + 17/3) - (17000 + 14450)X = 0$$

$$X = \frac{51095.2 + 85000 + 154{,}037}{31450}$$

$$X = \underline{\underline{9.22 \text{ ft.}}}$$

Middle 1/3 between 9.0' & 18.0'

∴ 9.22 ft within middle 1/3 <u>O.K.</u>

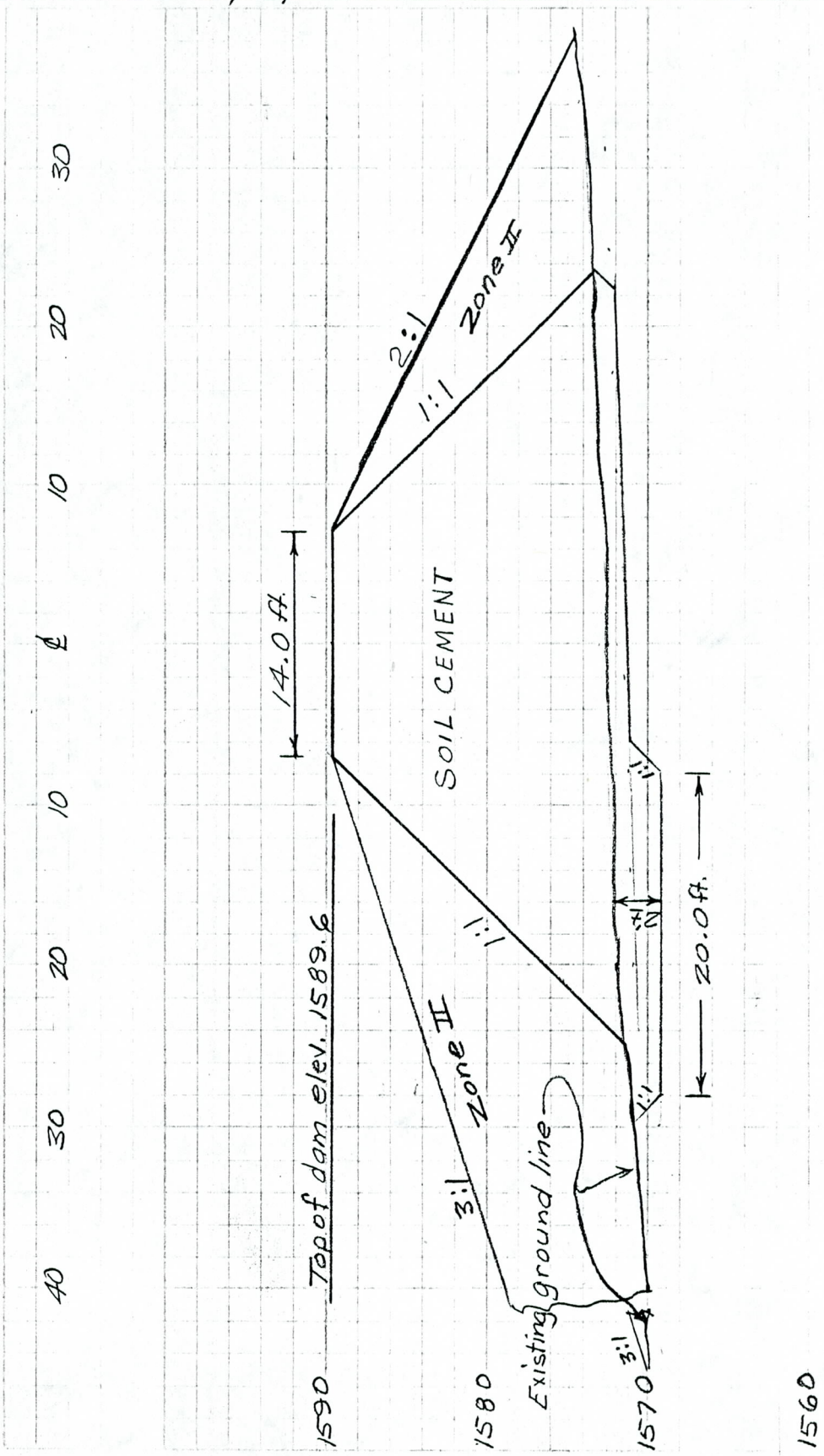
<u>6/2/75</u> L.L.B.

Use 1:1 slopes upstream & downstream. with a 14.0 ft. top width for easier construction.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 77
☆ GPO: 1972 —460-109

STATE		PROJECT		
Arizona		Spook Hill F.R.S. - Buckhorn Mesa W.P.P.		
BY J.E.B.	DATE 5/21/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Auxillary Spillway + Sections				SHEET 1 OF 2



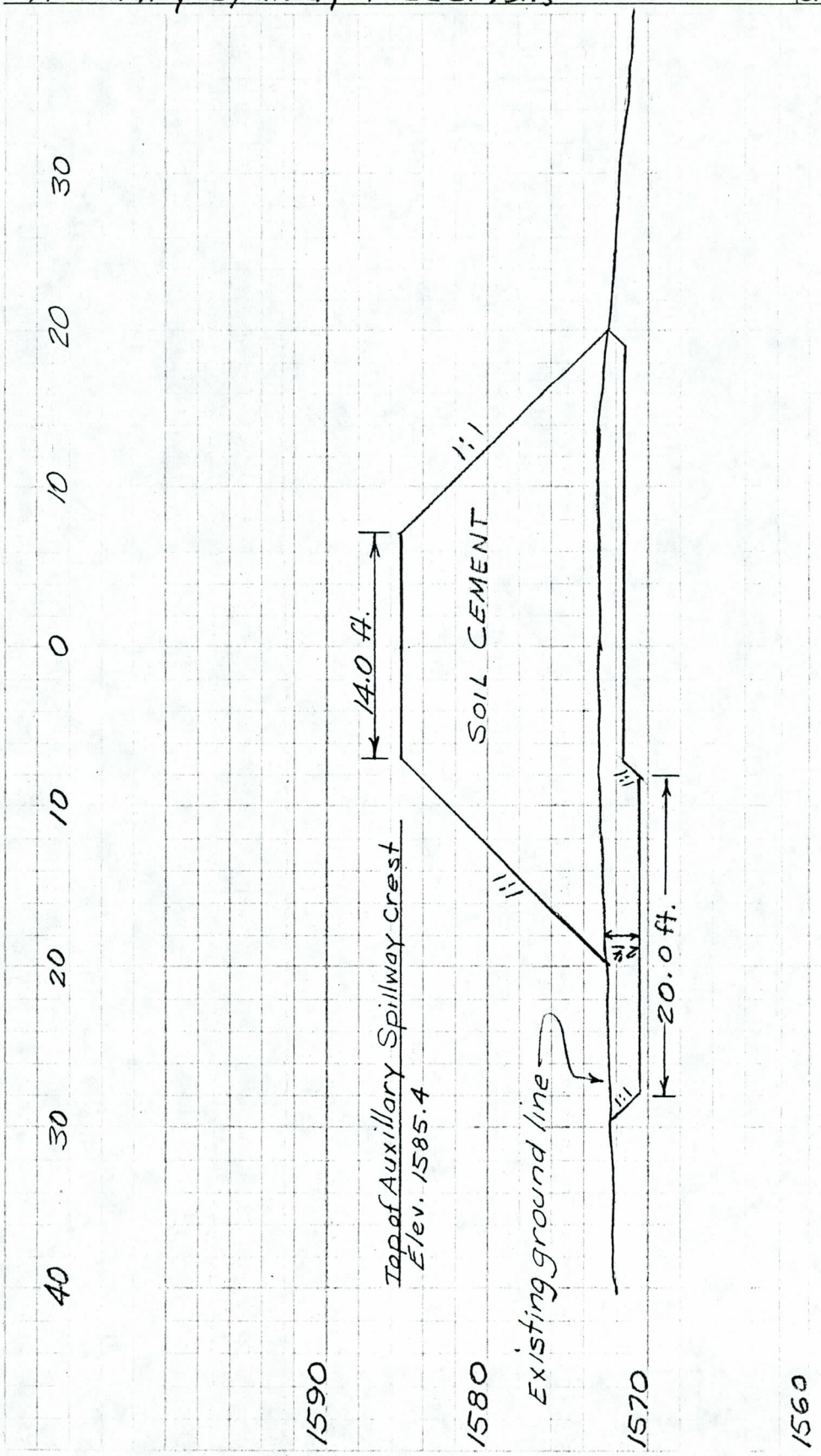
Cross section Auxilliary Spillway Sta. 290 + 25 ±

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

☆ GPO: 1972 —460-109

STATE Arizona		PROJECT Spook Hill F.R.S. - Buckhorn Mesa W.P.P.		
BY J.E.B.	DATE 5/21/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Auxillary spillway + sections				SHEET 2 OF 2



Cross Section Auxillary Spillway Sta. 29+00 ±

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

☆ GPO: 1972 —460-109

STATE Arizona		PROJECT Buckhorn Mesa W.P.P. - Spook Hill F.R.S.		
BY Burton	DATE 6/3/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Cost Summary				SHEET ____ OF ____

Item	Cost
Excavation	669,061.
Earth fill	596,080.
Concrete	102,870.
Soil Cement	87,000.
Rock Riprap	20,000.
Contingency	368,750.
Total =	1,843,750.

Use: $ 2,000,000. for rough estimate

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 80
☆ GPO: 1972 —460-109

STATE Arizona	PROJECT Buckhorn Mesa WPP-Spook Hill F.R.S.		
BY Burton / DATE 6/3/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Preliminary Cost Estimate			SHEET 1 OF 2

Concrete

Emergency Spillway:

Total Volume = 330 Yd^3

Cost @ \$225./Cu Yd = \$74,250.

Principal Spillway Box Culvert:

Volume = (1.2 Yd^3/Lin Ft.)(83 ft) = 99.6 Yd^3

Cost @ \$225./Cu Yd. = \$22,410.

Inlet Structure: 14' x 7' x 16' High

Volume = (1.9 Yd^3/ft)(16 ft.) − 2.83 = 27.6 Yd^3

Cost @ \$225./Cu Yd = \$6210.

Soil Cement

Auxiliary Spillway:

(14.5 Yd^3/Lin Ft)(400 ft.) = 5800 Yd^3

Cost @ \$15.00/Cu.Yd = \$87,000.

Rock Riprap

Floodway:

(5 Yd^3/Ft)(200) = 1000 Yd^3

Cost @ \$20./Cu Yd = \$20,000.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 81
* GPO: 1972 —460-109

STATE Arizona	PROJECT Buckhorn Mesa WPP - Spook Hill F.R.S.		
BY Burton / DATE 6/3/75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Preliminary Cost Estimate			SHEET 2 OF 2

Excavation

Foundation:

$(16\ Yd^3/Lin\ Ft)(21385) = 342,160\ Yd^3$

Cost @ $0.40/Yd^3 = $136,864.

Floodway:

Total Volume = 429,549 Yd^3

Cost @ $1.00 = $429,549.

Low Flow Channel Excavation:

$(12\ Yd^3/Lin\ Ft)(21385) = 256,620\ Yd^3$

Cost @ $0.40/$Yd^3$ = $102,648

Earth Fill

Dam:

Total Fill above ground = 850,000 Yd^3

Cost @ $0.50/$Yd^3$ = $425,000.

Foundation:

Total fill required = 342,160 Yd^3

Cost @ $0.50/$Yd^3$ = $171,080

TOTAL COST = $1,475,000.

+ 25% contingency = $368,750

Total = $1,843,750. Use $2,000,000.

Arizona Spookhill Buckhorn - Mesa

U.S.A 4-15-75

Fill Quantity Estimate

Deterimine Height @ 500 intervalls Estimate end areas using

$$A = 14 \times H + 2.5H^2$$

Station	H Depth	Area	Average Area	Length	AL/27 Volume	Acc. Volume
87+40	0.0	0.0				0
			32.25	261	311.75	
90+00	3.0	64.50				311.75
			278.07	500	5,149.44	
95+00	11.5	491.63				5461.19
			751.13	500	13,909.81	
100+00	17.5	1,010.63				19,371.00
			1,089.57	500	20,177.22	
105+00	19.0	1,168.50				39,371.00
			1,099.77	500	20,366.11	
110+00	17.7	1,031.03				59,914.33
			1,036.17	500	19188.33	
115+00	17.8	1,041.30				79,102.66
			906.90	500	16,794.44	
120+00	15.0	772.50				95,897.10
			818.25	500	15,152.78	
125+00	16.0	864.00				111,049.88
			937.32	500	17,357.78	
130+00	17.5	1,010.63				128,407.66
			1,089.57	500	20,177.22	
135+00	19.0	1,168.50				148,584.88
			1,168.50	500	21,638.89	
140+00	19.0	1,168.50				170,223.77
			1,218.57	500	22,566.11	
145+00	19.9	1,268.63				192,789.88
			1,274.32	500	23,598.52	
150+00	20.0	1,280.00				216,388.40
			1,274.32	500	23,598.52	
155+00	19.9	1,268.63				239,986.92
			1,246.13	500	23,076.48	
160+00	19.5	1,223.63				263,063.40
			1,223.63	500	22,659.81	

Arizona SPOOKHILL BUCKHORN-MESA

V.S.A 4-15-75

Fill Quantity Estimate

Station	H Depth	Area	Average Area	Length	AL/27 Volume	Acc. Volume
						285,723.21
165+00	19.5	1,223.63				
			1,207.02	500	22,352.2	
170+00	19.2	1,190.40				308,075.43
			1,152.52	500	21,342.96	
175+00	18.5	1,114.63				329,418.39
			1,077.97	500	19,962.41	
180+00	17.8	1,041.30				349,380.80
			1,062.10	500	19,668.52	
185+00	18.2	1,082.90				369,049.32
			1,125.70	500	20,846.30	
190+00	19.0	1,168.50				389,895.62
			1,212.90	500	22,461.11	
195+00	19.8	1,257.30				412,356.73
			1,268.65	500	23,493.52	
200+00	20.0	1,280.00				435,850.25
			1,280.00	500	23,703.70	
205+00	20.0	1,280.00				459,553.95
			1,308.82	500	24,237.41	
210+00	20.5	1,337.63				483,791.36
			1,253.07	500	23,205.00	
215+00	19.0	1,168.50				506,996.36
			1,330.90	500	24,646.30	
220+00	21.8	1,493.30				531,642.66
			1530.65	500	28,345.37	
225+00	22.4	1,568.00				559,988.03
			1482.25	500	27,449.07	
230+00	21.0	1,396.50				587,437.10
			1,338.25	500	24,782.41	
235+00	20.0	1280.00				612,219.51
			1,171.00	500	21,685.19	
240+00	18.0	1062.00				633,904.70
			1,036.32	500	19,191.11	
245+00	17.5	1,010.63				653,095.81
			937.32	500	17,357.78	

Arizona
J.S. △ 5/16/75

Buckhorn Mesa WPP - Spook Hill FRS

3 of 3

Fill Quantity Estimate

Station	Depth	Area	Average Area	Length	AL/27 Volume	Acc. Volume
250+00	16.0	864.00				670,453.59
			864.00	500	16,000.00	
255+00	16.0	864.00				686,453.59
			963.00	500	17,833.33	
260+00	18.0	1,062.00				704,286.92
			1,062.00	500	19,666.67	
265+00	18.0	1,062.00				723,953.59
			1,011.25	500	18,726.85	
270+00	17.0	960.50				742,680.44
			1,086.50	500	20,120.37	
275+00	19.4	1,212.50				762,800.81
			1,152.97	500	21,351.30	
280+00	18.3	1,093.43				784,152.11
			1,114.73	500	20,643.15	
285+00	18.7	1,136.03				804,795.26
			1,196.67	500	22,160.56	
290+00	19.8	1,257.30				826,955.82
			892.65	500	16,530.56	
295+00	12.0	528.00				843,486.38
			296.25	500	5,486.11	
300+00	3.0	64.50				848,972.49
			32.25	125	149.30	
301+25	0.0	0.0				849,121.79

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

85

☆ GPO: 1972 —460-109

STATE Arizona | PROJECT Buckhorn Mesa WPP - Spook Hill Floodway

BY Burton | DATE 6/3/25 | CHECKED BY | DATE | JOB NO. 2005

SUBJECT Preliminary Excavation Quantities | SHEET 1 OF 1

Station	Cut	Area	Avg. Area	Length	Volume	Acc. Volume
102+70	14.0	812.0				0
			770.0	230.	6559.	
105+00	13.0	728.0				6559.
			748.75	500.	13866.	
110+00	13.5	769.5				20425.
			769.5	500.	14250.	
115+00	13.5	769.5				34675.
			769.5	500.	14250	
120+00	13.5	769.5				48925.
			634.75	500.	11755	
125+00	10.0	500.0				60680.
			500.	500.	9259	
130+00	10.0	500.				69939.
			634.75	500.	11755	
135+00	13.5	769.5				81694.
			1112.5	500.	20602	
140+00	20.5	1455.5				102296.
			1512.5	500.	28009	
145+00	21.5	1569.5				130305.
			1720.75	500.	31866.	
150+00	24.0	1872.0				162171.
			1810.0	500.	33518.5	
155+00	23.0	1748.0				195690.
			1520.0	500.	28148	
160+00	19.0	1292.0				223838.
			1346.0	500.	24926	
165+00	20.0	1400.0				248764.
			1196.	500.	22148	
170+00	16.0	992.0				270912.
			800.75	500.	14829	
175+00	11.5	609.5				285740.
			458.75	1000.	16991	
185+00	7.0	308.0				302731.
			1090.0	1000.	40370	
195+00	24.0	1872.0				343101.
			2520.	500.	46667.	
200+00	33.0	3168.0				389767.
			1948.	500.	36074.	
205+00	13.0	728.0				425841.
			364.	275.	3707.	
207+75	0	0				429549.

USE

DETAILED DESIGN/COST TABLE NO. 1
SPILLWAYS COST DATA

TITLE- BUCKHORN MESA
TITLE- SPOOK HILL SITE 4
Concrete Spillway

LEVEL OF DEV. AF	PRINCIPAL SPILLWAY SYSTEM TYPE	SIZE-FT.	DISCH CFS	COST $	CONC. EMER. SPIL. SYS. TYPE	SIZE-FT.	DISCH CFS	COST $	EXCAV. EMER. SPIL. SYS. WIDTH FT.	CREST MSL	DISCH CFS	COST $
SD	MONOLITH	8.3 X 5.6	1221.	43822.	DROP-STR	240.	18608.	195489.	NONE			

NOTES- (1) THE CONCRETE SPILLWAY DISCHARGES OCCUR AT THE PEAK OF THE FREEBOARD STORM AND ARE THE BASIS FOR THE RESPECTIVE COST ESTIMATES.
(2) THE EXCAVATED SPILLWAY DISCHARGE OCCURS DURING THE PEAK OF THE FREEBOARD STORM.
(3) THE CONC. EMER. SPIL. CREST, IF THERE IS ONE, IS DEFINED TO BE THE EMER. SPIL. CREST (SEE TABLE NO. 3). THEREFORE, THE EXCAV. EMER. SPIL. CREST IS SET EQUAL TO OR ABOVE THE EMER. SPIL. CREST, DEPENDING UPON THE ANALYSIS. IF THERE IS NO CONC. EMER. SPIL., THE EXCAV. EMER. SPIL. IS DEFINED TO BE THE EMER. SPIL.
(4) BOX INLET DIMENSIONS ARE GIVEN - THROAT WIDTH BY UPSTREAM PROJECTION
(5) MONOLITH DIMENSIONS ARE GIVEN - WIDTH BY HEIGHT. SINGLE BARREL, W=0.75*H. DOUBLE BARREL, W=1.5*H.

DETAILED DESIGN/COST TABLE NO. 2
SPILLWAYS DISCHARGE DATA

TITLE- BUCKHORN MESA
TITLE- SPOOK HILL SITE 4

LEVEL OF DEV. AF	DISCHARGES - CFS: PRINCIPAL SPILLWAY SYSTEM RC	CESC	XESC	DHW	TOD	CONC. EMER. SPIL. SYS. XESC	DHW	TOD	EXCAV. EMER. SPIL. SYS. DHW	TOD	ESHY	FBHY	EXIT VEL.-FPS
SD		899.		1033.	1221.		4334.	18608.	NONE				

NOTES- (1) RESPECTIVE DISCHARGES OCCUR WHEN WATER SURFACE IS AT DESIGNATED COLUMN HEADING ELEVATIONS.
(2) DEFINITION OF COLUMN HEADINGS

RC - RISER CREST
CESC - CONCRETE EMERGENCY SPILLWAY CREST
XESC - EXCAVATED EMERGENCY SPILLWAY CREST
DHW - DESIGN HIGH WATER
TOD - TOP OF DAM
ESHY - EMERGENCY SPILLWAY HYDROGRAPH
FBHY - FREEBOARD HYDROGRAPH

DETAILED DESIGN/COST TABLE NO.3
KEY SITE DATA

TITLE- BUCKHORN MESA
TITLE- SPOOK HILL SITE 4

STATE - ARIZONA REGION - BUCKHORN MESA SITE NAME - SITE 4

```
                    ************************************************************************
REMARKS * BUCKHORN MESA WPP                                                          * REMARKS
REMARKS * SITE 4                                                                     * REMARKS
REMARKS * CONCRETE EMERGENCY SPILLWAY ALT 2                                          * REMARKS
                    ************************************************************************
```

WATER-IMPOUNDING STRUCTURE DESIGN AND COST TABLE

ELEVATION MSL				*HGT *DAM *FT *	STORAGE AC-FT					SURFACE AREA AC.	FILL *(1000* YD.)*	INSTALLATION COST $1000				UNIT COST $ PER UNIT		
NORM POOL	EMER SPWY CREST	DSGN HIGH WATER	TOP OF DAM	*MAX HGT *	BEN USE	NORM POOL	TEMP FLOOD	TOTAL EMER SPWY CREST	NORM POOL	DSGN HIGH WTR	VOL	CONST	ENGR	L/R ADM	PROJ	TOTAL	PER *AC-FT *TOTAL *STORE	PER ACRE NORM SURF	PER AC-FT BEN STORE
DRAINAGE AREA - 13.57 SQ.MI.					ELEVATION BOTTOM C/L PROFILE - 1566.10 MSL													
					SINGLE DEVELOPMENT ONLY													
1574.1	1578.1	1581.5	1586.8	21	0	217	525	742	85	250	703	1051	105	473	158	1787	2406	20999

NOTES- (1) TABLE VALUES WERE DEVELOPED TO ASSIST THE ENGINEER TO COMPARE-
(A) ALTERNATE DEVELOPMENTS WITHIN THIS SITE LOCATION
(B) ALTERNATE LOCATIONS THIS SITE
(C) ALTERNATE SITES FOR SIMILAR DEVELOPMENTS
(2) TABLE VALUES ARE NOT MEANT TO BE USED AS A SUBSITUTE FOR FINAL DESIGN. USE THE TABLE FOR THE FINAL SELECTION, THEN MAKE AN INDEPENDENT ANALYSIS TO VERIFY SELECTION.

SPOOK HILL SITE NO. 4
BUCKHORN MESA W.P.P. STRUCTURE CLASS C 05-08-75

EMER.SPW. ROUTING BOTTOM WIDTH= 150.0 ENTRANCE LENGTH= 0.0

TIME	INFLOW	AVE INFLOW	OUTFLOW	STORAGE	ELEVATION
0.25	0.00	0.00	0.00	238.40	1577.50
0.50	0.00	0.00	0.00	238.40	1577.50
0.75	0.00	0.00	0.00	238.40	1577.50
1.00	0.00	0.00	0.00	238.40	1577.50
1.25	2.51	1.25	2.36	238.40	1577.52
1.50	36.68	19.60	34.82	238.42	1577.83
1.75	181.53	109.11	156.33	238.70	1579.01
2.00	606.73	394.13	163.27	243.54	1579.03
2.25	1844.14	1225.44	194.23	265.16	1579.16
2.50	4857.75	3350.94	286.24	329.43	1579.53
2.75	8809.55	6833.65	440.81	463.10	1580.24
3.00	11588.89	10199.22	601.13	663.06	1581.13
3.25	11998.59	11793.74	844.22	891.78	1582.13
3.50	10745.02	11371.81	1153.27	1106.09	1582.91
3.75	9259.07	10002.05	1650.52	1283.77	1583.66
4.00	8010.53	8634.80	1979.40	1424.67	1584.08
4.25	7004.01	7507.27	2353.95	1535.00	1584.48
4.50	6186.30	6595.16	2641.31	1619.66	1584.80
4.75	5564.86	5875.58	2848.09	1684.34	1585.03
5.00	5044.01	5304.43	2960.86	1733.93	1585.16
5.25	4598.75	4821.38	3133.75	1770.58	1585.26
5.50	4226.48	4412.61	3284.36	1795.44	1585.33
5.75	3877.63	4052.06	3374.77	1810.37	1585.37
6.00	3557.12	3717.38	3415.12	1817.03	1585.38
6.25	3254.70	3405.91	3414.03	1816.85	1585.38

← USE

VOLUME CHECK AT HP= 0.08. COMPUTED HP= 3.38 AT ELEV.1585.38 (STORAGE IS 1817.0 AC.FT.= 2.51 IN.)
TIME= 6.00 HOURS CRITICAL VELOCITY= 8.19 CRITICAL DEPTH= 2.09 CRITICAL SLOPE= 1.82.

SPOOK HILL SITE NO. 4
BUCKHORN MESA W.P.P. STRUCTURE CLASS C 05-08-75

EMER. SPW. UNCONTROLLED AREA HYDROGRAPH.

RUNOFF = 3.38 IN., VOL. = 2450. AC.FT.

TIME	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75
0.00	0.00	0.00	0.00	0.00	0.00	2.51	36.68	181.53
2.00	606.73	1844.14	4857.75	8809.55	11588.89	11998.59	10745.02	9259.07
4.00	8010.53	7004.01	6186.30	5564.86	5044.01	4598.75	4226.48	3877.63
6.00	3557.12	3254.70	2803.54	2122.18	1438.75	925.57	585.70	363.76
8.00	228.46	142.10	85.97	49.87	28.22	15.00	6.19	1.31
10.00	0.00							

```
TITLE      SPOOK HILL SITE NO.4
TITLE      BUCKHORN MESA W.P.P.  STRUCTURE CLASS C  05-15-75                                  PAGE NO.   1
HYDRO      CURVE= 79.  TC= 1.18  DURATION= 6.00  ES RAIN= 0.00  FB RAIN=13.00  AREA= 13.56
SPILLWAY   CREST=1582.0  CASE= 0.  PRINT OPTION=0.  SIDE SLOPES= 1.000  EXIT CHANNEL SLOPE = 0.00
GENERAL    ROUTE=0.  PLOT CODE=0.  VELOCITY= 0.00  LENGTH=    0.  'C'=0.000  CODE=0.
SPW.SIZE   1ST BO= 150., E. LNGTH=   1.
STAGE-CFS   ELEV=1577.50  STORAGE=  238.4  1ST DISCH=     0.
STAGE-CFS   ELEV=1579.01  STORAGE=  238.5  1ST DISCH=   156.
STAGE-CFS   ELEV=1580.00  STORAGE=  408.9  1ST DISCH=   400.
STAGE-CFS   ELEV=1581.00  STORAGE=  632.6  1ST DISCH=   568.
STAGE-CFS   ELEV=1582.00  STORAGE=  856.3  1ST DISCH=   808.
STAGE-CFS   ELEV=1582.50  STORAGE=  992.9  1ST DISCH=   945.
STAGE-CFS   ELEV=1583.00  STORAGE= 1129.5  1ST DISCH=  1196.
STAGE-CFS   ELEV=1583.50  STORAGE= 1223.0  1ST DISCH=  1520.
STAGE-CFS   ELEV=1584.00  STORAGE= 1402.7  1ST DISCH=  1904.
STAGE-CFS   ELEV=1585.00  STORAGE= 1673.0  1ST DISCH=  2822.
STAGE-CFS   ELEV=1585.40  STORAGE= 1821.8  1ST DISCH=  3237.
STAGE-CFS   ELEV=1586.00  STORAGE= 2045.1  1ST DISCH=  4484.
STAGE-CFS   ELEV=1587.00  STORAGE= 2404.0  1ST DISCH=  7650.
STAGE-CFS   ELEV=1588.00  STORAGE= 2779.0  1ST DISCH= 11702.
STAGE-CFS   ELEV=1589.00  STORAGE= 3204.0  1ST DISCH= 16455.
STAGE-CFS   ELEV=1590.00  STORAGE= 3604.0  1ST DISCH= 21810.
STAGE-CFS   ELEV=1591.00  STORAGE= 4054.0  1ST DISCH= 27703.
END TABLE
```

FREEBOARD UNCONTROLLED AREA HYDROGRAPH.

RUNOFF =10.27 IN., VOL. = 7437. AC.FT.

TIME	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75
0.00	0.00	0.00	0.00	10.98	94.59	466.48	1369.44	2875.78
2.00	5245.06	9997.13	19607.26	30919.07	37657.92	37115.53	32114.86	26917.14
4.00	22716.23	19426.99	16842.93	14917.32	13343.74	12033.40	10957.66	9976.00
6.00	9091.64	8278.50	7110.47	5374.94	3641.91	2342.11	1481.57	919.81
8.00	577.48	359.00	217.09	125.85	71.18	37.81	15.60	3.31
10.00	0.00							

SPOOK HILL SITE NO.4
BUCKHORN MESA W.P.P. STRUCTURE CLASS C 05-15-75

FREEBOARD ROUTING BOTTOM WIDTH= 150.0 ENTRANCE LENGTH= 1.0

TIME	INFLOW	AVE INFLOW	OUTFLOW	STORAGE	ELEVATION
0.25	0.00	0.00	0.00	238.40	1577.50
0.50	0.00	0.00	0.00	238.40	1577.50
0.75	10.98	5.49	10.34	238.40	1577.59
1.00	94.59	52.78	90.27	238.45	1578.37
1.25	466.48	280.53	160.57	241.66	1579.02
1.50	1369.44	917.96	182.65	257.08	1579.11
1.75	2875.78	2122.61	239.20	296.57	1579.34
2.00	5245.06	4060.42	350.58	374.37	1579.79
2.25	9997.13	7621.09	486.04	523.18	1580.51
2.50	19607.26	14802.19	765.43	816.06	1581.82
2.75	30919.07	25263.17	1711.75	1312.41	1583.74
3.00	37657.92	34288.50	4019.24	1961.61	1585.77
3.25	37115.53	37386.72	9687.88	2592.42	1587.50
3.50	32114.86	34615.20	14787.70	3054.74	1588.64
3.75	26917.14	29516.00	18077.96	3325.04	1589.30
4.00	22716.23	24816.69	19715.54	3447.35	1589.60
4.25	19426.99	21071.61	20045.08	3471.96	1589.67
4.50	16842.93	18134.96	19580.90	3437.29	1589.58

← USE

VOLUME CHECK AT HP= 0.18. COMPUTED HP= 7.67 AT ELEV.1589.67 (STORAGE IS 3471.9 AC.FT.= 4.79 IN.)
TIME= 4.25 HOURS CRITICAL VELOCITY= 15.76 CRITICAL DEPTH= 7.72 CRITICAL SLOPE= 1.17.

```
TITLE      SPOOK HILL SITE  NO. 4
TITLE      BUCKHORN MESA W.P.P.  STRUCTURE CLASS C  05-08-75

HYDRC      CURVE= 79.  TC= 1.18  DURATION= 6.00  ES RAIN= 5.66  FB RAIN=13.00  AREA= 13.56

SPILLWAY   CREST=1582.0  CASE= 0.  PRINT OPTION=0.  SIDE SLOPES= 1.000  EXIT CHANNEL SLOPE = 0.00

GENERAL    ROUTE=0.  PLOT CODE=0.  VELOCITY= 0.00  LENGTH=    0.  'C'=0.000  CODE=0.

SPW.SIZE   1ST BO= 150., E. LNGTH=   0.

STAGE-CFS   ELEV=1577.50  STORAGE=  238.4  1ST DISCH=    0.

STAGE-CFS   ELEV=1579.01  STORAGE=  238.5  1ST DISCH=  156.

STAGE-CFS   ELEV=1580.00  STORAGE=  408.9  1ST DISCH=  400.

STAGE-CFS   ELEV=1581.00  STORAGE=  632.6  1ST DISCH=  568.

STAGE-CFS   ELEV=1582.00  STORAGE=  856.3  1ST DISCH=  808.

STAGE-CFS   ELEV=1582.50  STORAGE=  992.9  1ST DISCH=  945.

STAGE-CFS   ELEV=1583.00  STORAGE= 1129.5  1ST DISCH= 1196.

STAGE-CFS   ELEV=1583.50  STORAGE= 1223.0  1ST DISCH= 1520.

STAGE-CFS   ELEV=1584.00  STORAGE= 1402.7  1ST DISCH= 1904.

STAGE-CFS   ELEV=1585.00  STORAGE= 1673.0  1ST DISCH= 2822.

STAGE-CFS   ELEV=1585.20  STORAGE= 1747.0  1ST DISCH= 2990.

STAGE-CFS   ELEV=1586.00  STORAGE= 2045.1  1ST DISCH= 4795.

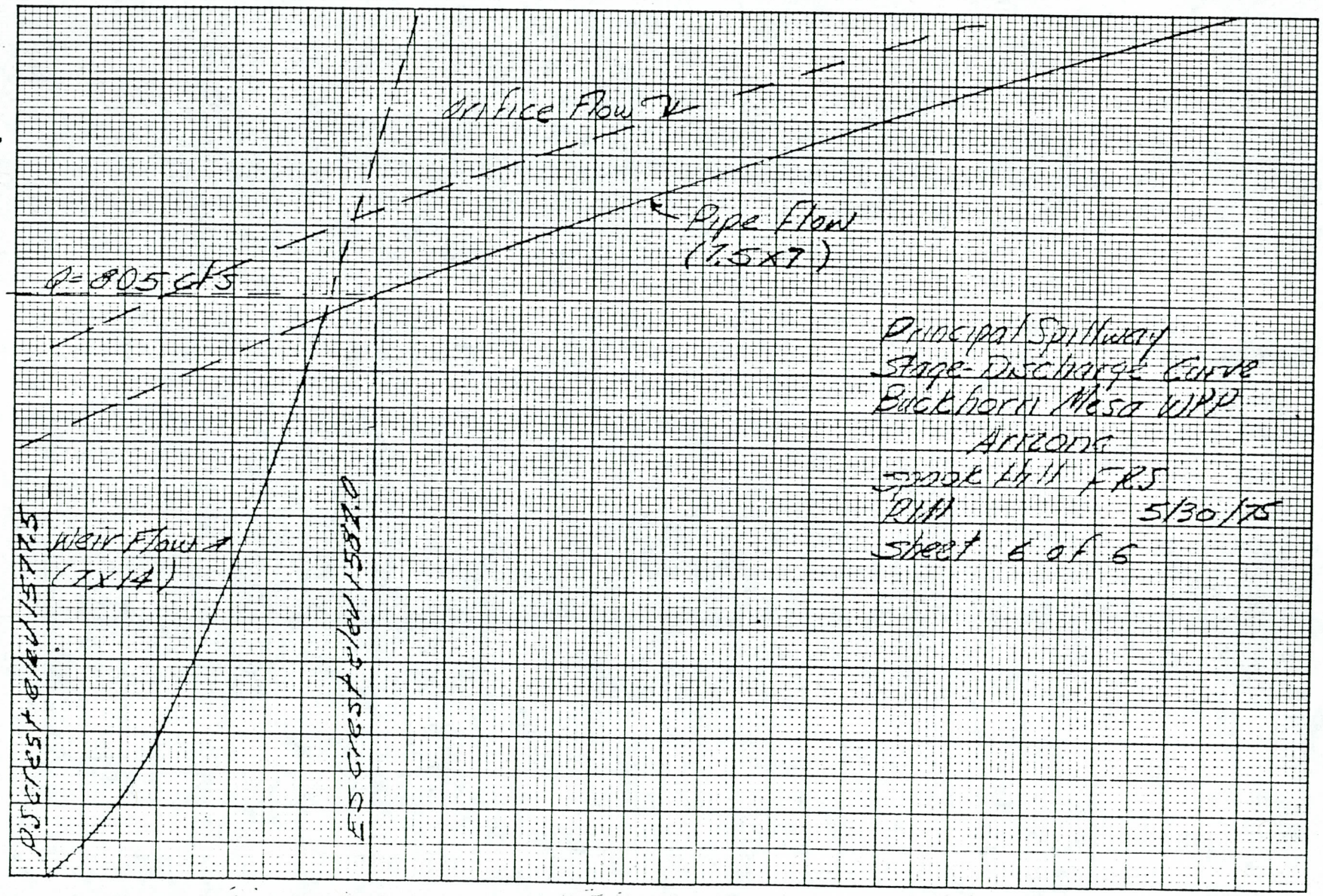
STAGE-CFS   ELEV=1587.00  STORAGE= 2404.0  1ST DISCH= 8135.

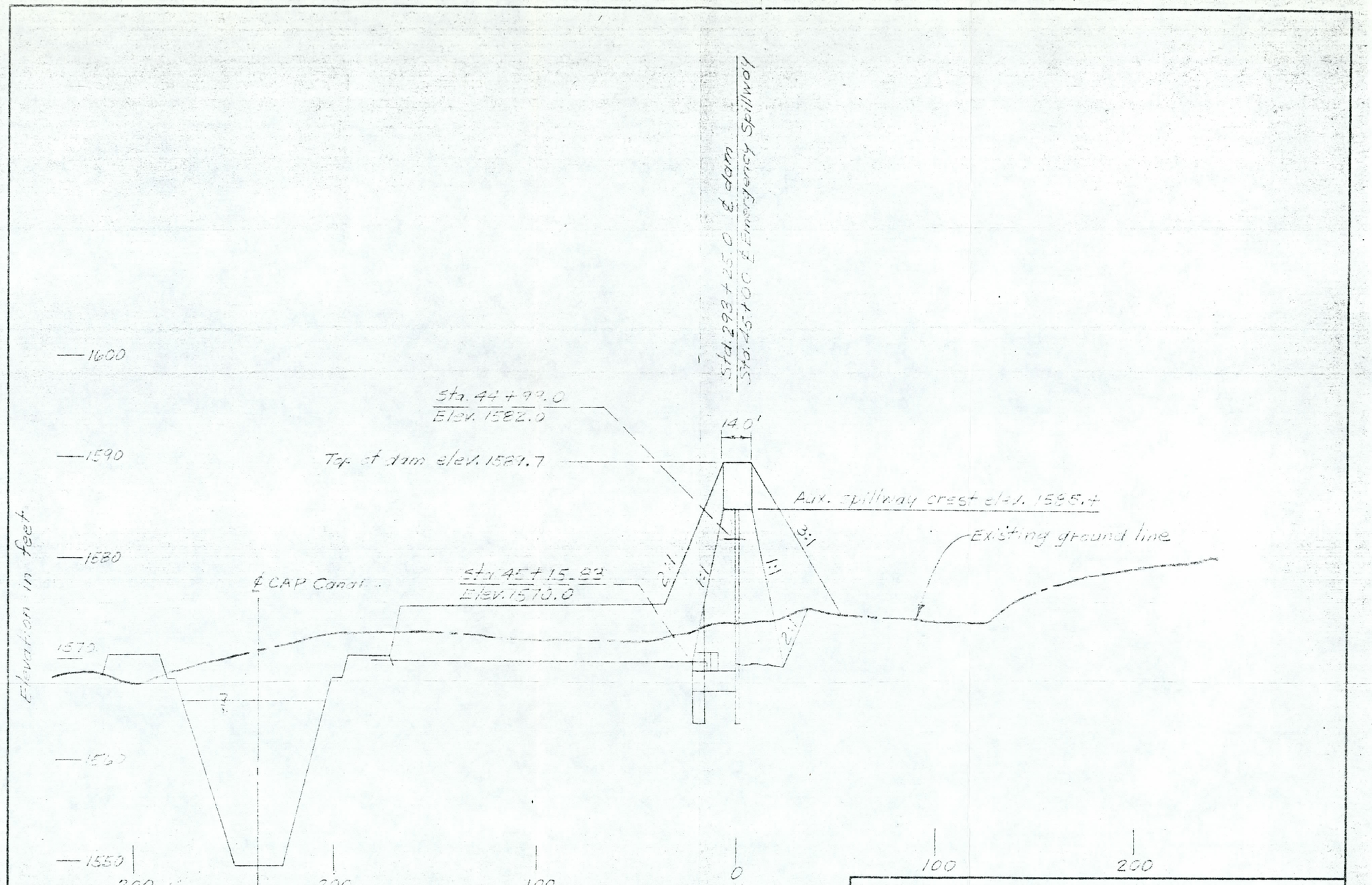
STAGE-CFS   ELEV=1588.00  STORAGE= 2779.0  1ST DISCH= 12313.

STAGE-CFS   ELEV=1589.00  STORAGE= 3204.0  1ST DISCH= 17170.

STAGE-CFS   ELEV=1590.00  STORAGE= 3604.0  1ST DISCH= 22616.

            ELEV=1591.00  STORAGE= 4054.0  1ST DISCH= 28591.
```


Discharge Q - cfs
100
50
Orifice Flow
Pipe Flow
(1.5x7)
Q=805 cfs
Weir Flow
(7x14)
Pipe crest elev 1577.5
ES crest elev 1582.0
Principal Spillway
Stage-Discharge Curve
Buckhorn Mesa WRP
Arizona
Foote Hill FRS
RJM
5/30/75
Sheet 6 of 6



Cross Section
Sta 293+25.0 ℄ dam

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
DESIGNED BY PJM	APPROVED BY
CHECKED BY	DRAWING NO.
DATE: 5-20-75	SHEET 1 OF 1

SCS-ENG-313A (Rev. 8-70)

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470866

STATE		PROJECT		
Ariz		Buckhorn Mesa WPP - Spook Hill F. R. 5		
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	3-9-75			

SUBJECT
Structural Design

SHEET 1 OF 5

Proportion a type c drop spillway for the emergency spillway

$Q_E = 3415$ cfs $\quad Q_P = 930$ cfs

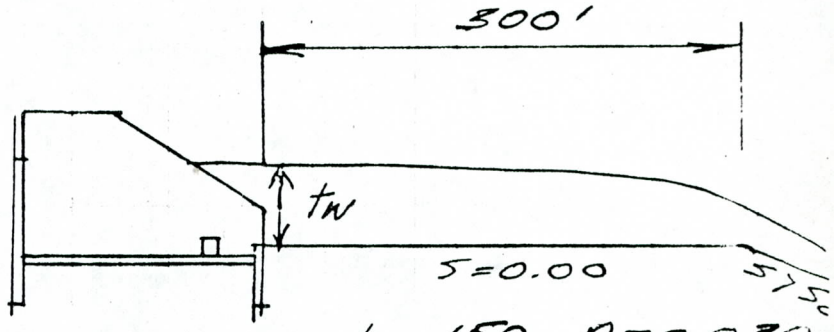
$Q_d = 2485$ cfs say 2500 cfs

$b = 150'$

$h = 3.5$

$F = 12'$

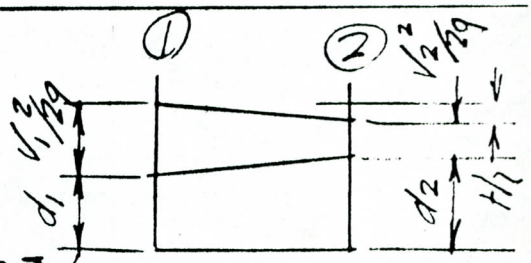
$\therefore h/F = 3.5/12 = 0.29 > 0.1$
< 1.43 OK



$b = 150 \quad n = 0.030$
$Z = 2$

1. Find tw

1. Solution



① $A = bd + Zd^2$

② $P = b + 2d\sqrt{Z^2+1}$

③ $R_{ave} = [A_1/P_1 + A_2/P_2]/2$

④ $V = Q/A$

⑤ $S_f = \dfrac{n^2 V^2}{2.2083 R^{4/3}}$

⑥ $He_1 = He_2 + S_f l$

EWP-8
2-57
PORTLAND, ORE.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WATER SURFACE PROFILE CALCULATION SHEET

Project: Buckhorn Mesa W.S. Spook Hill ~~Floodway~~ Emergency Spillway Location: Maricopa County, Arizona

Date: 5-12-75 By: D. Toerpe Sheet 1 of 1 Appropriation: 508-2005

Q = 2500 cfs b = 150' z = 2 n = 0.030 n^2 = 0.0009

Station	Depth, D	Bottom Width, b	Area, A $bd+zd^2$	Velocity, $V=\frac{Q}{A}$	Velocity Head $h_v = V^2/2g$	$\frac{D}{b}$	α (table 97 King)	Hydraulic Radius R = αD	$\frac{1}{2.2083R^{4/3}}$ (table 107, King)	V^2	n^2V^2	Friction Slope $S_f = \frac{n^2V^2}{2.2083R^{4/3}}$	Invert Slope S_i ft./ft.	Energy Head $H_e = D + h_v$	$H_e'' - H_e'$	$S_f - S_i$	$l = \frac{H_e'' - H_e'}{S_f - S_i}$	Remarks
3+00	2.033	150'	313.22	7.98	0.989	0.0135	0.970	1.972	0.174	60.53	0.0545	0.00948	0	3.022	0.07	0.00948	7.38'	too short
	2.200	150'	330.00	7.78 / 7.58	0.892	0.147	0.968	2.051 / 2.130	0.139	45.83	0.0412	0.00573	0	3.092	0.458	0.00573	79.93	too long
	3.000	150'	450.00	6.77 / 5.56	0.480	0.020	0.955	2.418 / 2.865	0.147	48.44	0.0436	0.00640	0	3.480	0.328	0.00640	51.25	Close Enough
2+48.75	2.800	150'	420.00	6.96 / 5.95	0.550	0.0187	0.962	2.333 / 2.694	0.119	34.22	0.0308	0.00366	0	3.350	0.063	0.00366	17.21	too short
	2.9	150'	435	5.85 / 5.75	0.513	0.0193	0.956	2.733 / 2.772	0.115	32.49	0.0292	0.00336	0	3.413	0.163	0.00336	48.51	Close Enough
2+22.24	3.05	150'	457.5	5.70 / 5.46	0.463	0.020	0.955	2.804 / 2.913	0.107	28.94	0.0260	0.00278	0	3.513	0.172	0.00278	61.87	Too long
	3.15	150'	472.5	5.38 / 5.29	0.435	0.021	0.953	2.958 / 3.002	0.108	29.38	0.0264	0.00285	0	3.549	0.136	0.00285	47.72	Close Enough
1+52.52	3.10	150'	465.0	5.42 / 5.38	0.449	0.021	0.953	2.934 / 2.957	0.104	27.67	0.0249	0.00258	0	3.659	0.147	0.00250	58.80	Close Enough
93.72	3.30	150'	495.0	5.22 / 5.05	0.396	0.022	0.951	3.076 / 3.138	0.0976	25.10	0.0226	0.00230	0	3.735	0.076	0.00220	34.55	Too Short
	3.35	150'	502.5	5.01 / 4.98	0.335	0.022	0.951	3.162 / 3.136	0.0972	25.00	0.0225	0.00218	0	3.750	0.091	0.00218	41.74	Close Enough
0+51.93	3.37	150'	505.5	5.00 / 4.95	0.380	0.022	0.951	3.172 / 3.205	0.0935	23.62	0.0213	0.00198	0	3.852	0.102	0.00198	51.52	Close Enough
0+00.46	3.50	150'	52[illegible]	4.86 / 4.75	0.352	0.023	0.947	3.2[illegible] / 3.323										

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO: 1972 -460-109

STATE	PROJECT		
Arizona	Spook Hill F.R.S - Buckhorn Mesa		
BY J.E.B.	DATE 13 May 1975	CHECKED BY	DATE	JOB NO. 2025
SUBJECT Hydraulic Design Type c Drop spillway			SHEET 3 OF 5

Q = 2500 c.f.s. , b = 150', Z = 2 , n = 0.030

find critical depth 300ft down stream as shown in sketch

b = 150.0000
Z = 2.0000
Q = 2500.0000
2816.8438
2506.2440
2500.0026
2499.9999
Q = 2499.9995
Dc = 2.0333
Ac = 313.2653
Vc = 7.9804
n = 0.0300
Sc = 0.0105

Critical Depth (D_c) = 2.0333 ft.
Area (A_c) = 313.265 sq.ft.
Velocity (V_c) = 7.98 fps
(n) = 0.03
Slope (S_c) = 0.0105 ft./ft.

d	hv	sf.
2.0333	0.9904	0.0105
2.1	0.9269	0.0094
2.2	0.8424	0.0080
2.3	0.7687	0.0069
2.4	0.7042	0.0060
2.5	0.6473	0.0052
2.6	0.5969	0.0046
2.7	0.5521	0.0040
2.8	0.5120	0.0036
2.9	0.4761	0.0032
3.0	0.4437	0.0028
3.1	0.4145	0.0025
3.2	0.3880	0.0023
3.3	0.3639	0.0020
3.4	0.3419	0.0018
3.5	0.3219	0.0017
3.6	0.3035	0.0015
3.7	0.2865	0.0014
3.8	0.2710	0.0012
3.9	0.2566	0.0011
4.0	0.2433	0.0010

find tail water depth at 300ft = 3.5 ft.+

Required Tailwater depth (2.03)(1.75) = 3.558ft.

Tailwater depth 3.6ft is at 329.35ft, 3.5ft is 278.35ftR

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

* GPO: 1972 —460-109

STATE		PROJECT		
Arizona		Spook Hill F.R.S. - Buckhorn Mesa W.F.P.		
BY J.E.B	DATE 13 May 75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydra. Design Type C Drop spillway				SHEET 4 OF 5

Find the length of stilling basin apron L_B

Tailwater depth (t) = 3.56 ft.
drop from spwy crest to sill (F) = 12.00 ft.
head over crest (h) = 3.5 ft. from Design note
$h = D_c\ 1.5 = (2.05)(1.5) = 3.08$ ft for using ES 111

cfs/ft $\frac{2500}{150} = 16.67$

$q = 16.67$

ES 111
Sheet 3
$2.05' = D_c$

$h/F = 3.08\text{ ft} / 12.0\text{ ft} = 0.2563$

$h/t = 3.075 / 3.6 = 0.8542$

use ES-111 page 5-21

$L_B/F = 1.3$

$L_B = (F)(1.3) = (12)(1.3) = \underline{\underline{15.6\text{ ft.}}}$

Location of Floor Blocks L_f. ES-111 page 5-22

$L_f/F = 1.$

$L_f = (F)(1) = (12)(1) = \underline{\underline{12\text{ ft.}}}$

Solve for Dc

	150.0000
Z	0.0000
Q	2500.0000
	2405.5772
	2500.6150
	2500.0000
Q	2499.9999
Dc	2.0519
	307.7998
Vc	8.1221

The minimum distance between the floor block + the transverse sill $L_B - L_F = 1.75\ D_c$

$15.6 - 12 = (1.75)(2.05)$

$\underline{\underline{3.6' = 3.59'}}$

Height of Floor Blocks

$(0.8)(D_c) = (0.8)(2.05) = \underline{\underline{1.64\text{ ft.}}}$

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

☆ GPO: 1972 -460-109

STATE	PROJECT			
Arizona	Spook Hill FRS - Buckhorn Mesa W.P.P.			
BY J.E.B.	DATE 13 May 75	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Hydr. Design Type C Drop Spillway				SHEET 5 OF 5

Width of Floor Blocks

$(0.4)(D_c) = (0.4)(2.05) = \underline{0.82 \text{ ft.}}$

Length of Floor Blocks

$(0.4)(D_c) = (0.4)(2.05) = \underline{0.82 \text{ ft.}}$

Spacing of Floor Blocks

50 to 60% of the transverse length of stilling basin

use spacing $(0.4)(D_c) = 0.82$ ft.

a half space $(0.2\ D_c) = 0.41$ ft. shall be allowed adjacent to the sidewalls - no floor block will be placed adjacent to the sidewalls.

Transverse sill Height

$(0.4)(D_c) = (0.4)(2.05) = \underline{0.82 \text{ ft.}}$

side wall Height

$t + 0.85\ D_c = 3.6 + (0.85)(2.05) = \underline{5.34 \text{ ft.}}$

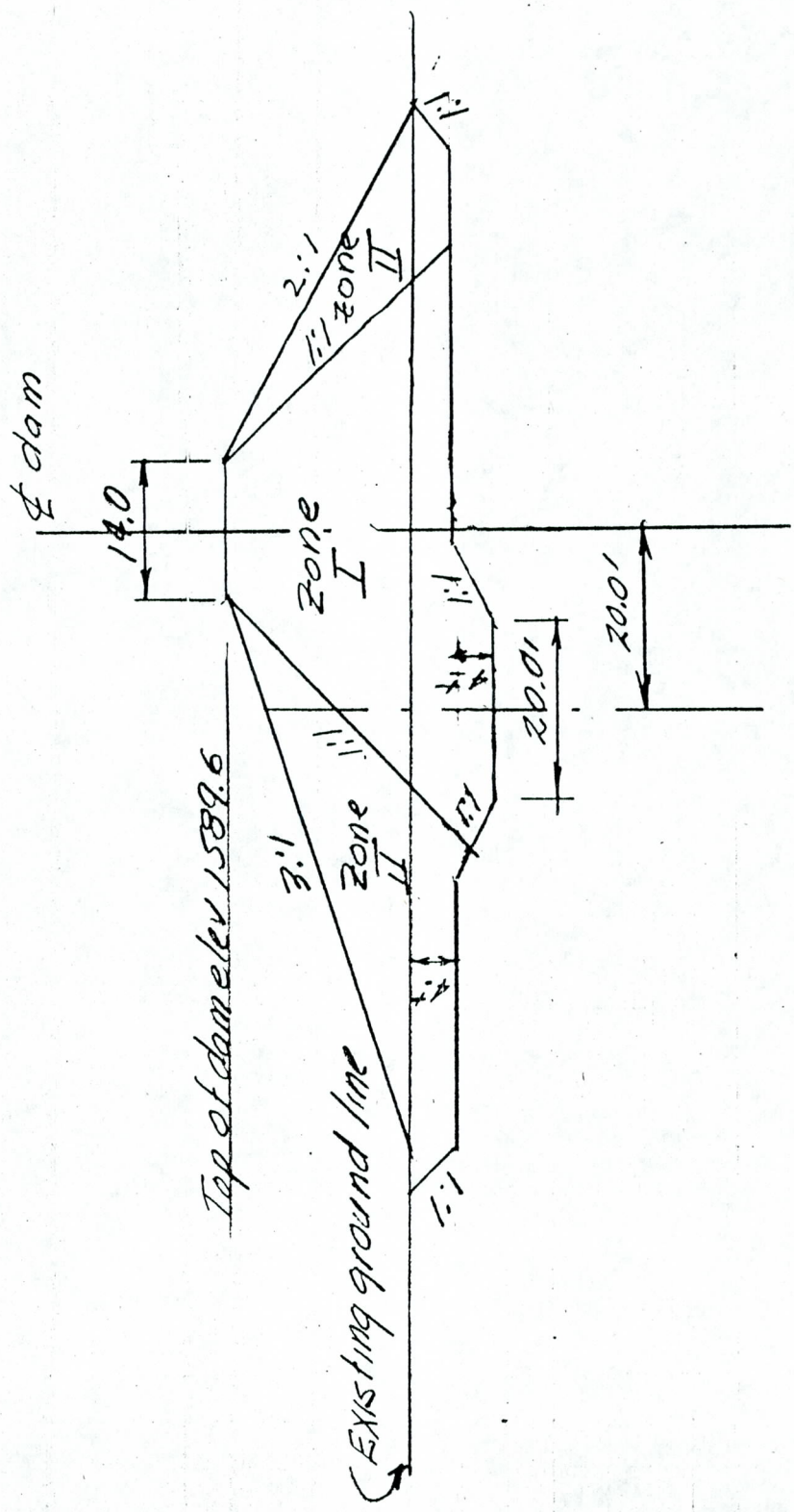
COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

67

GPO 1958 O - 470868

STATE		PROJECT		
Ariz.		Buckhorn Mesa WPP Spoon Hill F.R.S.		
BY	DATE	CHECKED BY	DATE	JOB NO.
RJM	5-9-75			
SUBJECT				SHEET 1 OF 1

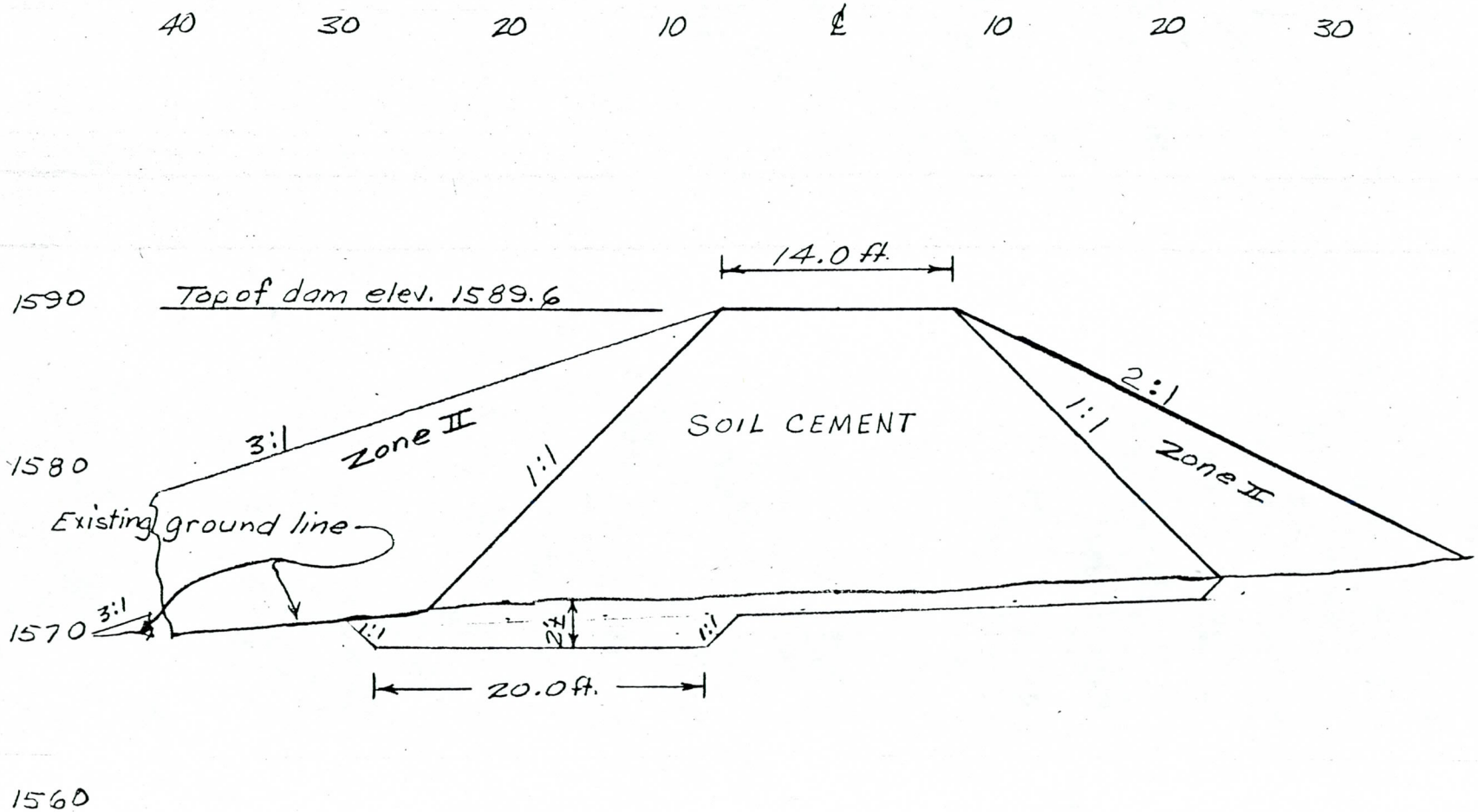


TYPICAL CROSS SECTION OF DAM

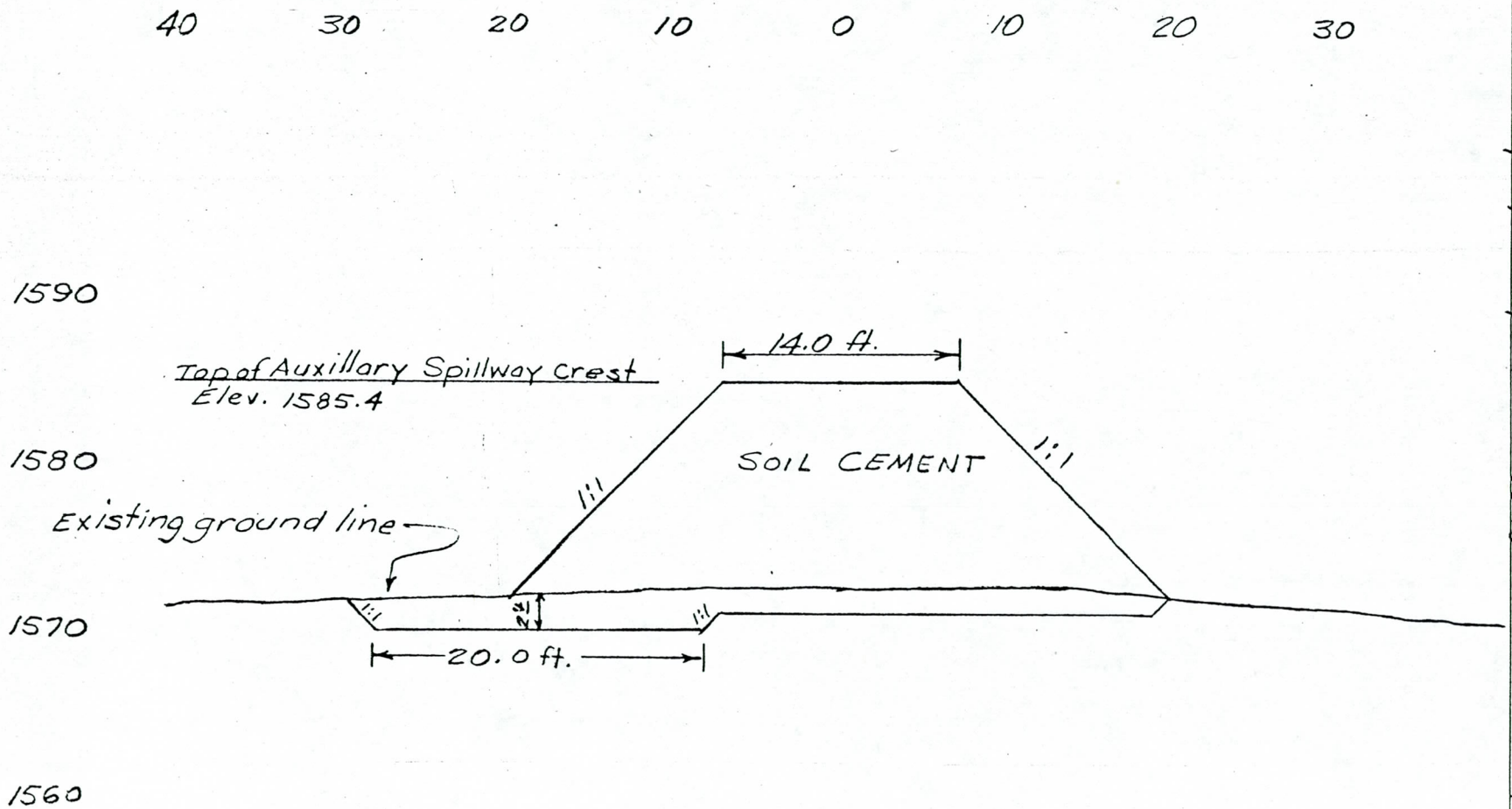
COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 77
GPO: 1972 —450-109

STATE Arizona		PROJECT Spook Hill F.R.S. - Buckhorn Mesa W.P.P.	
BY J.E.B.	DATE 5/21/75	CHECKED BY	DATE
SUBJECT Auxillary Spillway + Sections			JOB NO. 2005
			SHEET 1 OF 2



Cross section Auxilliary Spillway Sta. 290 + 25 ±

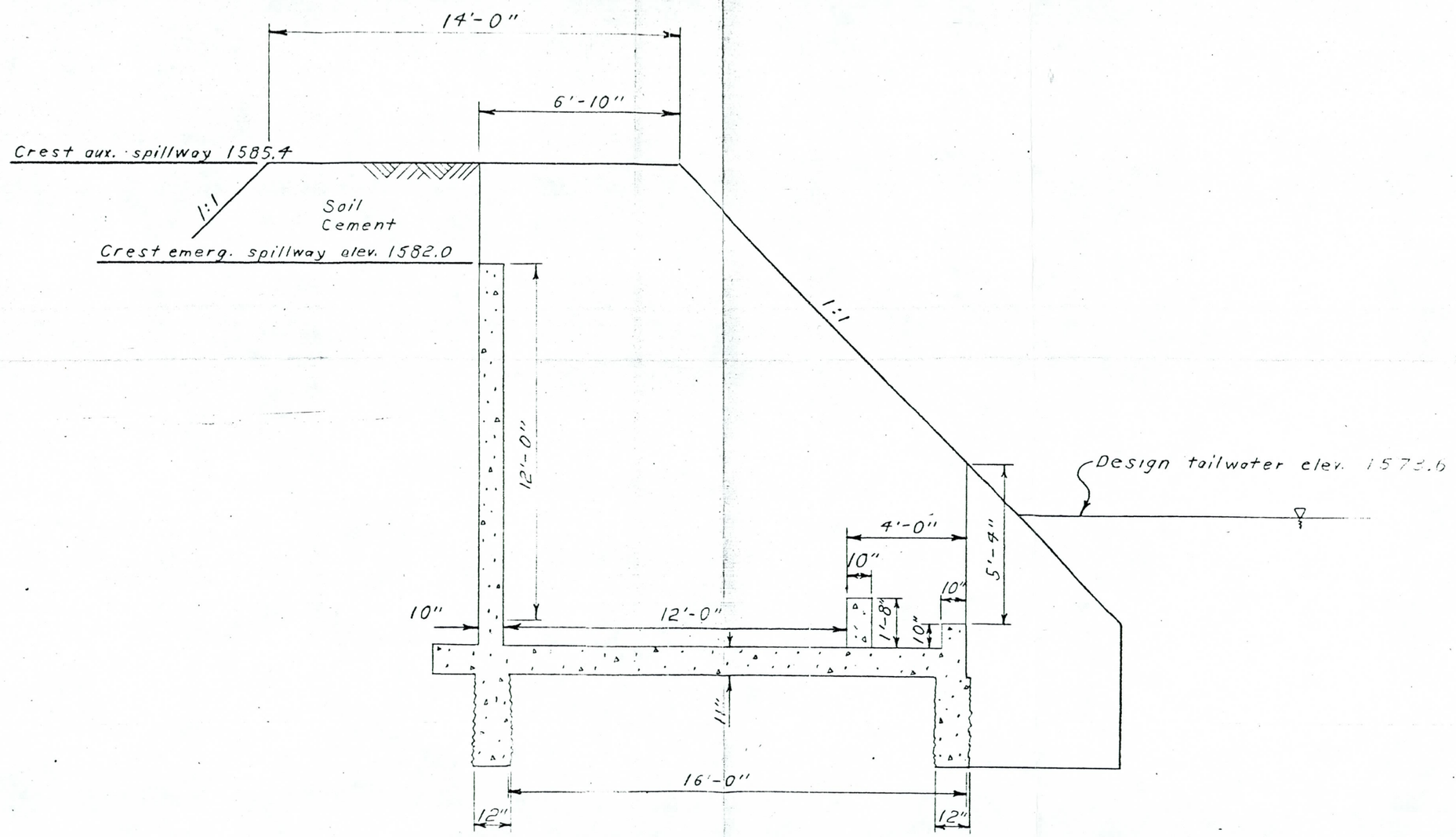


Cross Section Auxillary Spillway Sta 251+00 ±

STATE Arizona
BY J.E.B.
DATE 5/21/75
PROJECT Spook Hill F.R.S. - Buckhorn Mesa W.R.P.
CHECKED BY
DATE
SUBJECT Auxillary Spillway + sections
JOB NO. 2005
SHEET 2 OF 2

SCS-ENG-523 Rev. 11-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 78



SECTION ON CENTER LINE

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
DESIGNED BY JEB	APPROVED BY
CHECKED BY PJM	DRAWING NO.
DATE: 5-16-75	SHEET 1 OF 1

U. S. GOVERNMENT PRINTING OFFICE : 1970 O—401-172

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE Room 6029 Federal Bldg., Phoeni. AZ 85025

SUBJECT: ENG - Design PL566 Buckhorn-Mesa WPP
Arizona - Spook Hill FRS

DATE: February 11, 1976

TO: Ralph M. Arrington
State Conservation Engineer

In response to a request from Mr. Herb Donald, Chief Engineer and General Manager of the Flood Control District of Maricopa County, in his letter to Mr. Rockenbaugh dated January 8, 1976 (attached) the relocation of the ramps at McKellips and McDowell Roads has been studied. The study shows that a total cost increase of $110,276.00 will result from the relocations.

The relocation was introduced in a meeting with the Flood Control District, Bureau of Reclamation and SCS on January 7, 1976. A copy of the memo to Ralph Arrington from Paul Monville dated January 9, 1976 describing the meeting is attached. Adopted for study was the alternative described by the Bureau of Reclamation which would move the ramp into the reservoir area and reduce the height of fill over the Salt-Gila Aqueduct. Details of this alternative are included in the attached copy of the letter to Mr. Rockenbaugh from Mr. Pugh, Projects Manager, Bureau of Reclamation, Arizona Projects Office, dated January 13, 1976. The Bureau's details were modified to permit passage of the freeboard hydrograph without increasing the backwater. Extensive hydraulic calculations were not made at this time. Instead, the area between the top of the dam and the C/L of the roadway was maintained in the revision. In order to maintain equality, excavation in the reservoir area was necessary.

Attached is the following information:

1. Cost comparison

2. Cost estimate McKellips Road Ramp original alinement C/L dam, Sta. 193+00 to Station 223+00.

3. Cost estimate McKellips Road Ramp, new alinement C/L Dam, Sta. 193+00 to Sta. 223+00.

4. Profile McKellips Road Ramp.

5. Plan McKellips Road Ramp.

6. Cost estimate McDowell Road Ramp, original alinement C/L dam, Sta. 260+00 to Sta. 280+00.

7. Cost estimate McDowell Road Ramp, new alinement, C/L dam, Sta. 260+00 to Sta. 280+00.

8. Profile McDowell Road Ramp.

9. Plan McDowell Road Ramp.

Paul J. Monville
Design Engineer

Attachments

Paul's copy

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE Room 6029 Federal Bldg., Phoenix, AZ 85025

SUBJECT: ENG - Design - PL 566
Buckhorn-Mesa WPP, Arizona
Spook Hill FRS

DATE: January 9, 1976

TO: Ralph M. Arrington
State Conservation Engineer

A meeting was held in the Federal Building on January 7, 1976 between members of the Flood Control District, Bureau of Reclamation, and the SCS. The list of persons in attendance is attached.

The purpose of the meeting was to discuss alternative design approaches to the McKellips and McDowell Road Ramps.that would relieve rights-of-way problems. With the current design, costly severences of property west of the dam and adjacent to the roadways are expected.

The Flood Control District presented two (2) proposals which were as follows:

1. Do not disturb the existing roadways. Extend the dam adjacent to the roadways and connect the separated pools with conduit.

2. Move the ramps upstream as far as possible and use steeper side slopes by applying gunnite concrete or other stabilizing materials.

The SCS pointed out the following:

1. Alternative No. 1 would create separate dams that would require separate emergency spillways.

2. Alternative No. 2 would require an excavated ramp across the road to convey waters to the spillways. Additional removal and replacement of pavement would be required.

The Bureau of Reclamation offered another alternative. The ramp would be moved upstream by moving that portion of the dam crossing the roadways upstream. They claimed that the benefit due to this change would be to decrease the bridge costs from about $800,000 each to about $400,000 each. This type of treatment is in effect in the Granite Reef Aqueduct, Reach 11.

The Flood Control District was requested to submit their proposals in writing to Mr. Rockenbaugh and the analysis would be given top priority.

Paul Monville
Design Engineer

cc- John Peterson

Attachment

PJM:ks

Meeting at SCS Office Jan 7 1976

Attendance

Paul Thomwells	SCS
John Peterson	SCS
S. D BRASE	F. C.
JACK LEAVITT	F.C.D.
BILL JOLLY	F.C.D.
Lowell Heaton	U.S.B.R.
E. H. DIETMANN	U.S B.R.
M. C. Thomas	USBR
H. F. HOBBS	USBR
John Sullivan	SCS
Bob Bond	USBR

FLOOD CONTROL DISTRICT of Maricopa County

3325 West Durango Street • Phoenix, Arizona 85009 • Telephone (602) 262-3630/262-3639

MARICOPA COUNTY ARIZONA

January 8, 1976

United States Department of Agriculture
Soil Conservation Service
Room 6029, Federal Building
Phoenix, Arizona 85025

ATTENTION: Mr. Thomas G. Rockenbaugh,
State Conservationist

RE: McDowell Road and McKellips Road Ramps - Spook Hill Retarding Structure

Dear Mr. Rockenbaugh:

As per our discussion with members of your staff at your office on January 7, 1976, we are herewith requesting that a study be made to consider relocation and redesign of the roadway ramps crossing the Spook Hill Retarding Structure at McKellips Road and McDowell Road. It is intended to relocate the ramps east of the present location consequently reducing the height of the ramps and the roadway crossing the Central Arizona Project aqueduct at existing grade.

We feel the aforesaid can be accomplished and will minimize a traffic hazard at the intersection of Bush Highway and McDowell Road. In addition there will be a substantial savings in construction costs for bridge structures over the C.A.P. aqueduct and ramp construction.

Should you require additional information please contact Sid Brase of my staff.

Sincerely,

Herbert P. Donald, P. E.
Chief Engineer and General Manager

HPD/SHB/det

cc: Mr. C. A. Pugh, Projects Manager
Bureau of Reclamation

Arrington
RC
PAUL

United States Department of the Interior

cyc to R&P

BUREAU OF RECLAMATION

ARIZONA PROJECTS OFFICE
SUITE 2200 VALLEY CENTER
201 NORTH CENTRAL AVENUE
PHOENIX, ARIZONA 85073

IN REPLY
REFER TO: 330-212
520.

JAN 13 1976

Department of Agriculture
Soil Conservation Service
Room 6029, Federal Building
Phoenix, Arizona 85025

Attention: Mr. Thomas Rockenbaugh, State Conservationist

Gentlemen:

We have reviewed the preliminary drawings and design information of the Spook Hill Floodwater Retarding Structure and Floodway and offer the following recommendations for consideration:

1. The earth dam at McKellips, McDowell and Brown Roads should parallel both sides of and cross the above roads approximately 600 feet upstream of the proposed Salt-Gila Aqueduct to permit construction of the proposed bridges at existing grade as shown on the enclosed sketches.

2. Allow sufficient space between the dam spurs paralleling McKellips, McDowell and Brown Roads for possible future expansion of the existing road to four lanes.

3. Earth plugs, 300 feet wide, should be left in the canal prism at the above bridge sites to provide crossings of the aqueduct during the period following excavation of the prism and prior to construction of the bridges.

4. Alinement of the dam should be sinuous rather than straight to provide a more pleasing and aesthetically acceptable appearance. The existing vegetation in the pocket areas, between the toe of the dam and the left maintenance road, created by the sinuous alinement should be preserved.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

5. Topsoil should be stripped, stockpiled and replaced on the slopes of the dam in a roughened form to facilitate natural revegetation.

6. Vegetative growth located in wash or drainage areas within the borrow area should be preserved to create green belt areas and to further promote growth of native vegetation.

7. Landscaping of the downstream slopes of the dam should consist of native trees and shrubs compatible to the area and capable of panoramic blending within a brief time span.

8. Ramp grades at points of dam crossings on McKellips, McDowell and Brown Roads should not exceed 6 percent.

9. An area from the outside toe of the dam to the beginning of the borrow area should be left undisturbed to provide stability to the dam and enhance the environmental aspect of the feature.

10. Excavation of the canal prism should be limited to within six inches of final excavation lines as shown on the enclosed typical canal section.

The bridge at Brown Road was requested by Maricopa County Highway Department officials in lieu of a bridge at Usery Pass Road.

We appreciate the opportunity of reviewing and commenting on the subject plans.

Should you have questions or require additional information regarding the above, please contact Mr. E. H. Diekmann at 261-3757.

Sincerely,

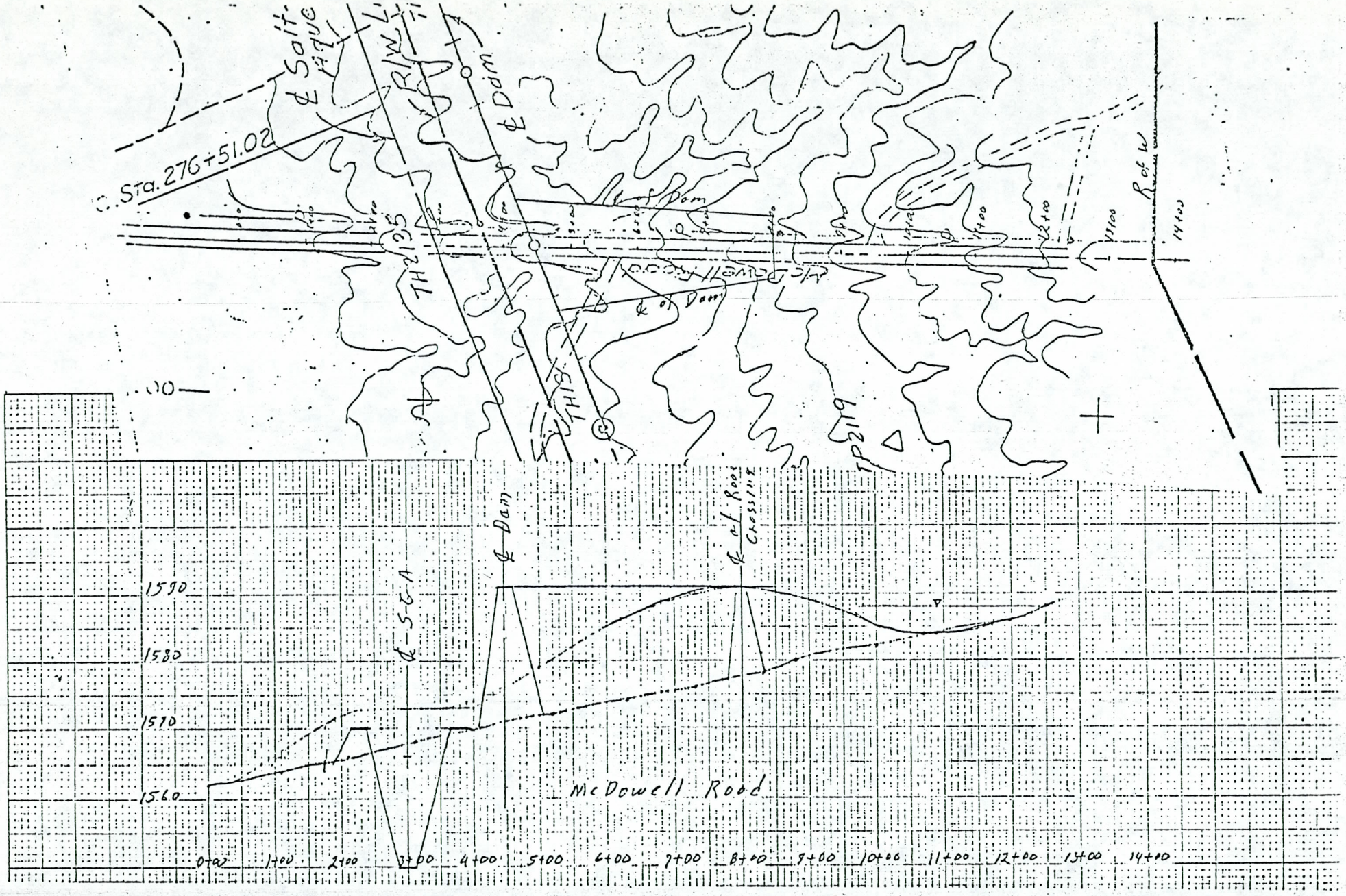
C. A. Pugh
Projects Manager

In duplicate

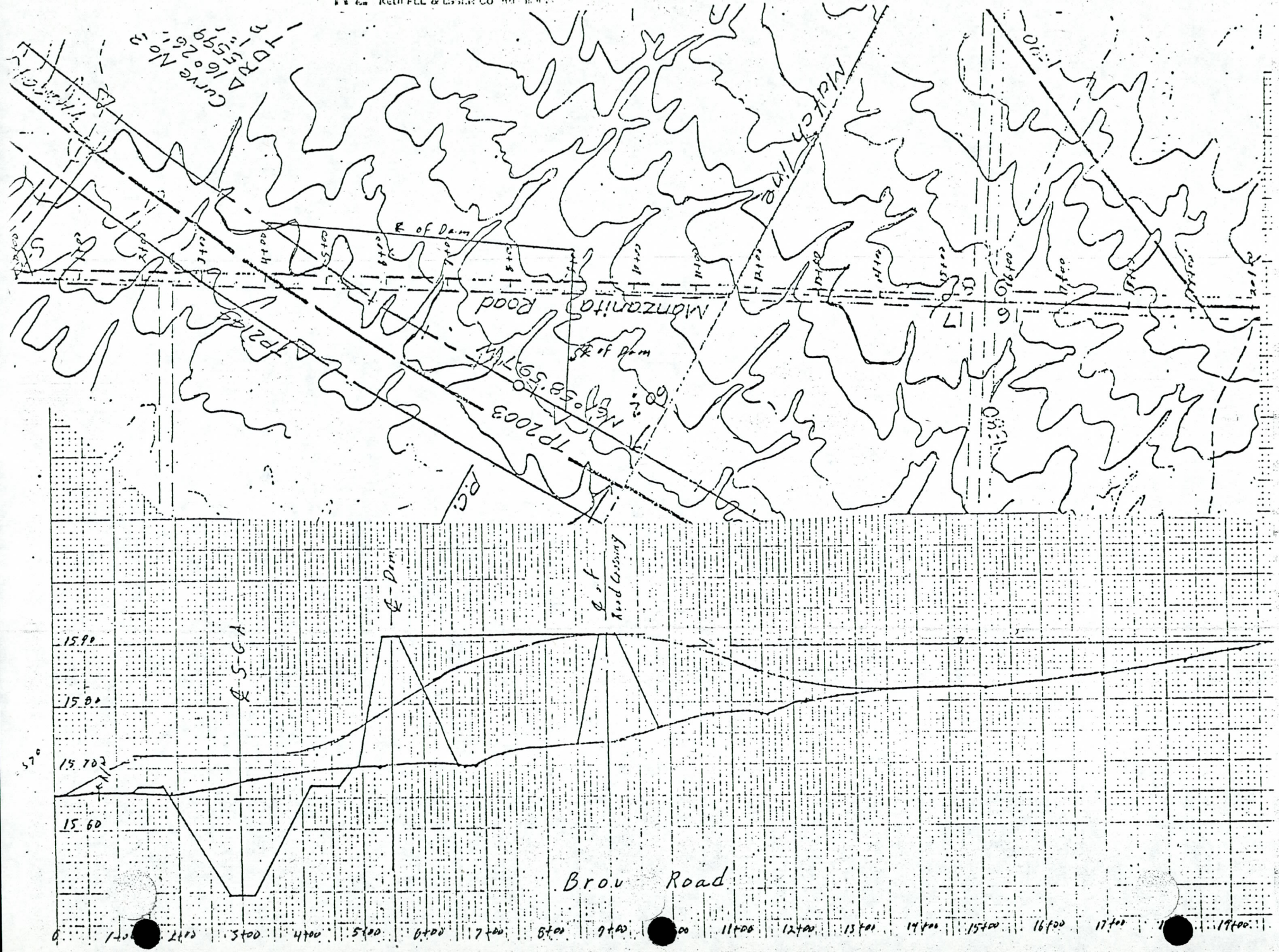
Enclosures (4)

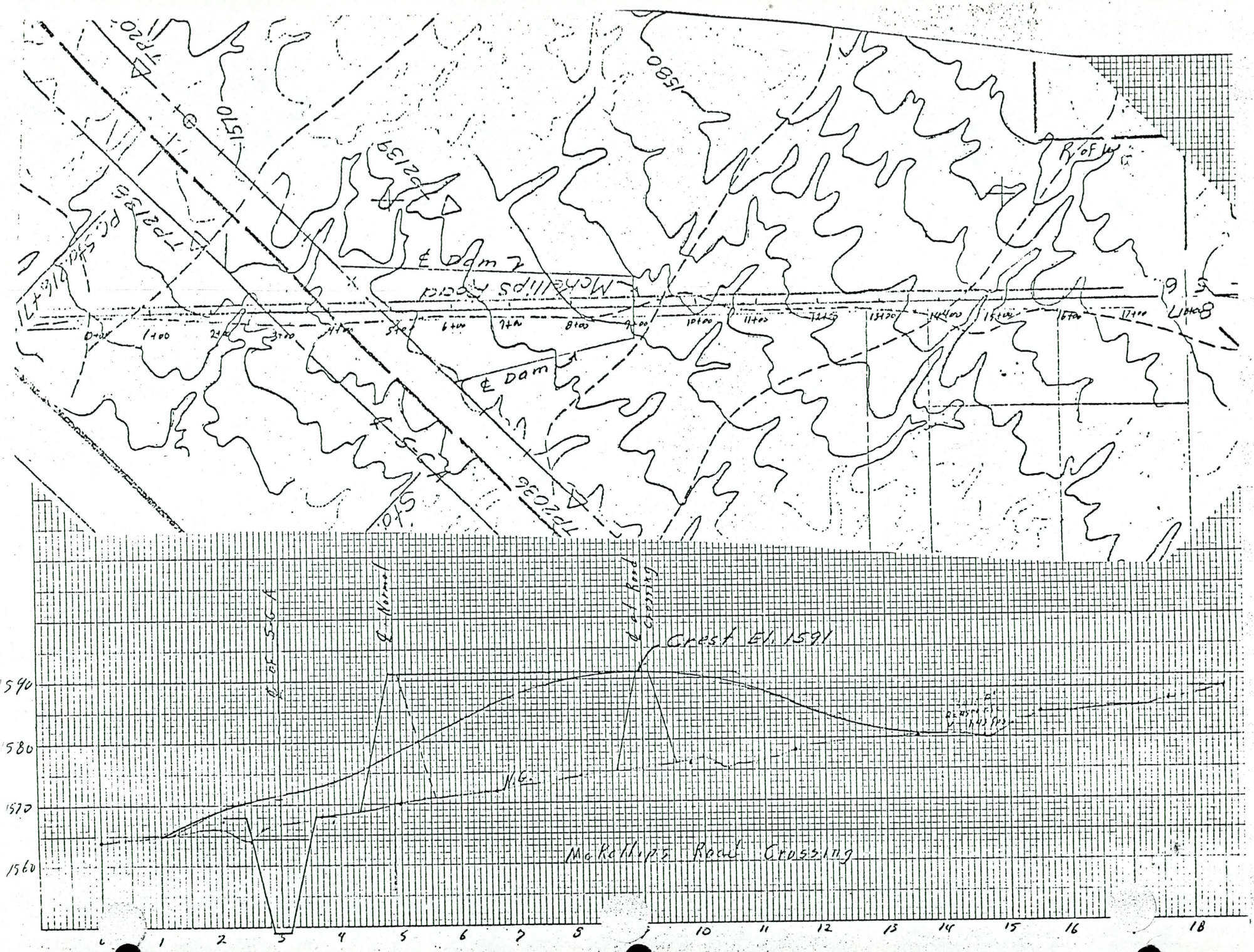
(cc's on following page)

cc:
Maricopa County Highway Department, 3325 W. Durango Street, Phoenix, Arizona 85009
Maricopa County Flood Control District, 3325 W. Durango Street, Phoenix, Arizona 85009
(w/enclosures to each)


Sta. 276+51.02
℄ Salt River
℄ Dam
TH 125
TH 124
TP 119
℄ of Dam
℄ of Dam
R of W
℄ S-6-A
℄ of Road Crossing
1590
1580
1570
1560
McDowell Road
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00
11+00
12+00
13+00
14+00

10 X 10 TO ½ INCH
KEUFFEL & ESSER CO.




McPhillips Road
℄ Dam
℄ Dam
℄ Normal
℄ Rail Road Crossing
Crest El. 1591
M.G.
McPhillips Road Crossing
1590
1580
1570
1560
0
1
2
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COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO . 1958 O—470868

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP Spookhill Dam			
BY D. Riddle	DATE 2-5-76	CHECKED BY	DATE	JOB NO. 2005

SUBJECT Cost Analysis of Ramps Summary

SHEET 1 OF 1

Item	SCS Cost	FCDMC Cost	CAP Cost	Total Cost
McKellips Road				
Existing Design	173,204.00	432,587.00	432,424.00	1,038,215.00
Proposed Change	366,615.00	422,985.00	285,250.00	1,074,850.00
Change in Cost	(+) 193,411.00	(-) 9,602.00	(-) 147,174.00	(+) 36,635.00
McDowell Road				
Existing Design	153,315.00	374,461.00	403,717.00	931,493.00
Proposed Change	363,252.00	410,547.00	231,335.00	1,005,134.00
Change in Cost	(+) 209,937.00	(+) 36,086.00	(-) 172,382.00	(+) 73,641.00
Total Change in Cost	(+) 403,348.00	(+) 26,484.00	(-) 319,556.00	+110,276

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP Spookhill Dam			
BY D Riddle	DATE 1-19-76	CHECKED BY JLS	DATE 2-10-76	JOB NO. 2005
SUBJECT Total Cost Est. Mikelliqua Rd (Ortiz Alignment)				SHEET 1 OF 3

Item No	Item	SCS Cost	FCD Cost	CAP Cost	Total Cost
1	Clearing	$4,140.00	$540.00		$4,680.00
3	Foundation Exc.	$22,035.00	$3,389.00		$25,424.00
4	Channel Excav	$9,000.00			$9,000.00
5	Str. Excav.		$2,640.00		$2,640.00
6	Zone I Fill	$51,528.00	$29,800.00		$81,328.00
7	Zone II Fill	$51,860.00			$51,860.00
8	Str. Backfill		$6,670.00		$6,670.00
13	108" dia C.P.X.M.		$51,694.00		$51,694.00
14	Pav. Removal & Replace		$59,072.00		$59,072.00
15	Loose Rock Riprap		$4,560.00		$4,560.00
—	CAP Bridge			292,875.00	292,875.00
—	Total Const. Cost	$138,563.00	$158,365.00	$292,875.00	$589,803.00
—	R/W Cost	—	$213,300.00	$60,300.00	$273,600.00
Total Cost (Const. + R/W)		$138,563.00	$371,665.00	$353,175.00	$863,403.00
10% Admin. Service (const. + R/W)		$13,856.30	$37,167.30	$35,318.00	$86,340.00
15% Engineering (const.)		$20,785.00	$23,755.00	$43,931.00	$88,471.00
Total		$173,204.00	$432,587.00	$432,424.00	$1,038,215

from Sta 193+00 to Sta 223+00

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP Spookhill Dam			
BY D Riddle	DATE 1-19-75	CHECKED BY J.L.S	DATE 2-6-76	JOB NO. 2005
SUBJECT Cost of McKallips Rd Ramp orig alinmt				SHEET 2 OF 3

Sta 1.93+00 to Sta 223+00

Item #1 Clearing

Dam Gov Cost

(300)(3,000) ÷ 43,560 = 20.7 Ac

(20.7 Ac) $200.00 per Ac = $4,140.00

Span Cost Ramp

[(89)(620) + (89)(680)] ÷ 43,560 = 2.7 Ac

(2.7)($200.00 per Ac = $540.00

Total Cost $4,680.00

Item #3 Foundation Excavation

Dam Gov Cost

44,070 cu. yd @ $0.50 = $22,035.00

Ramp

(61)(1,500)(2.0) ÷ 27 = 6,778 cu. yd

6,778 cu. yd @ $0.50 per yd = $3,389.00

Total = $25,424.00

Item #4 Channel Excavation

(3,000)(6)(27) ÷ 27 = 18,000 cu. yd

(18,000 cu. yd)($0.50) = $9,000.00

All Gov. Cost

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		Buckhorn Mesa WPP Spook Hill Dam		
BY D. Riddle	DATE 1-19-76	CHECKED BY JLJ	DATE 2-6-76	JOB NO. 2005
SUBJECT Cost of Dam & Mckellaps Rd sta 195+00 to 220+00				SHEET 3 OF 3

Item #5
Structure Excavation
Pipe 660 cu. yd @ $4.00 = $2,640.00
All Sponsers Cost

Item #6
Embankment Fill Zone I
Dam (100,475)(0.58768) @ $0.50 = $29,493.00 Dam
+ $22,035.00 Core
$51,528.00 Total
Ramp Spon. Cost
59,600 cu. yd @ $0.50 = $29,800.00
Total Cost = $81,328.00 81,328

Item #7
Embankment Fill zone II
Dam = 41,488 cu yd @ $1.25 = $51,860.00
All Gov. Cost

Item #8
Structure Backfill
Ramp = 667 cu yd @ $10.00 = $6,670.00

Item #13
108" dia C. M. Pipe
301' @ $171.74 = $51,694.00

Item #14
Pavement Removal & Replacement
5,680 S.Y. @ $10.40 = $59,072.00

Item #15
Loose Rock Riprap
456 cu. yd. @ $10.00 = $4,560.00

United States Department of the Interior

BUREAU OF RECLAMATION

ARIZONA PROJECTS OFFICE
SUITE 2200 VALLEY CENTER
201 NORTH CENTRAL AVENUE
PHOENIX, ARIZONA 85073

IN REPLY
REFER TO: 330-212
520.

FEB 2 1976

Department of Agriculture
Soil Conservation Service
Room 6029, Federal Building
Phoenix, Arizona 85025

Attention: Mr. Paul Monville

Gentlemen:

In response to Mr. Monville's verbal request, we are enclosing copies of our comparative cost summaries for the McKellips and McDowell Road bridges crossing Reach 1 of the Salt-Gila Aqueduct. The comparative costs, providing bridges at existing grade versus earth ramp crossings, have been developed for both a 32-foot wide bridge to accommodate the existing roadway widths and an 80-foot wide bridge to allow for future expansion of the existing roads to four lanes.

The 80-foot bridge width is an obligation of the Bureau of Reclamation to Maricopa County under the Water Resource Development Act of 1974 requiring the use of current standards. Therefore, in the best interest of all agencies concerned, we request that your plans for the Spook Hill Floodway Retarding Structure allow sufficient space for possible future expansion of the existing McKellips, McDowell and Brown Roads to four lanes.

Sincerely,

C. A. Pugh
Projects Manager

In duplicate

Enclosures

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

7-1654 (7-73)
Bureau of Reclamation

COMPUTATION SHEET

BY	DATE	PROJECT	SHEET ___ OF ___
FES	1/22/75	CAP	
CHKD BY	DATE	FEATURE	
		Salt-Gila Aqueduct Reach 1 - Bridges	

DETAILS Summary of Comparative Costs - SCS Ramps vs Exist. Grade

	Mc Kellips Rd.		Mc Dowell Rd.	
	w/ Ramps	w/o Ramps	w/ Ramps	w/o Ramps
Mc Kellips Rd.				
Compacted Embankment:				
Ramps - 44,000 yds³ @ $.50/yd³	$22,000			
w/o Ramps - 94,172 yds³ @ $.50/yd³		$47,086		
Bridge:				
Ramps - L = 275' @ $985.00/l.f.	$270,875			
w/o Ramps - L = 130' @ $985/l.f.		$128,050		
Mc Dowell Rd.				
Compacted Embankment:				
with Ramps - 32,918 yds³ @ $.50			$16,459	
w/o Ramps - 42,756 yds³ @ $.50				$21,378
Bridge:				
w/Ramp L = 275' @ $985/l.f.			$270,875	
w/o Ramp. L = 130' @ $985/l.f.				$128,050
Totals	$292,875	$175,136	$287,334	$149,428

Note: Costs based on 32 ft. bridge width to conform with existing pavement widths of 28 ft. at above locations.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP Spookhill Dam			
BY D Ridalla	DATE 1-20-76	CHECKED BY JLS	DATE 2-10-76	JOB NO. 2005
SUBJECT Cost Est. Mekellips Rd Area (New Alignment)				SHEET 1 OF 4

Item No	Item	S.C.S Cost	F.C.D. Cost	C.A.P. Cost	Total Cost
1	Clearing	$9,420.00	$460.00		$9,880.00
3	Foundation Excav.	$24,172.00	$4,444.00		$28,616.00
4	Channel Excav.	$146,284.00			$146,284.00
5	Str. Excav		$3,512.00		$3,512.00
6	Zone I Fill	$56,526.00	$17,913.00		$74,439.00
7	Zone II Fill	$56,890.00			$56,890.00
8	Str Backfill		$5,200.00		$5,200.00
13	108" dia C.M.P.		$26,104.00		$26,104.00
14	Pav. Remov. & Replace		$73,611.00		$73,611.00
15	Rock Riprap		$3,600.00		$3,600.00
—	C.A.P. Bridge			$175,136.00	$175,136.00
—	Total Const. Cost	$293,292.00	$134,844.00	$175,136.00	$603,272.00
—	R/W Cost	—	231,300.00	$60,300.00	$291,600.00
Total Const + R/W Cost		$293,292.00	$366,144.00	$235,436.00	$894,872.00
10% Admin. Service (Const + R/W)		$29,329.00	$36,614.00	23,544.00	89,487.00
15% Engineering (const)		$43,994.00	20,227.00	26,270.00	90,491.00
Total		$366,615.00	$422,985.00	285,250.00	1,074,850.00

+ 9 Ac. @ $4500.00 per Ac.

from Sta 193+00 to Sta 222+00

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona	PROJECT Buckhorn Mesa WPP-Spookhill Dam			
BY D Riddle	DATE 1-20-76	CHECKED BY JLS	DATE 2-6-76	JOB NO. 2005
SUBJECT Cost Est Mckellips Rd Area New Alignment				SHEET 2 OF 4

Sta 193+00 to Sta 223+00

Item #1 Dam Gov Cost

193+00	300		
		1,000	6.9 Ac
203+00	300		
		200	1.5 Ac
205+00	350		
		400	4.8 Ac
209+00	700		
		1,400	16.1 Ac
223+00	300		

? $\left(\frac{1,100 + 1875}{2}\right)(520) \div 43,560 =$ 17.8 Ac

47.1 Ac

47.1 Ac @ $200. = $9,420.00 Gov Cost

Ramp $\frac{[(740)(124) + (75)(120)]}{43560} =$ 2.3 Ac

2.3 Ac @ $200.00 = $460.00

Total Cost = $9,880.00

Item #3

Foundation Excavation

$\frac{3290}{3000} = 1.097 \times 44,070 =$ 48,344 cu. yd Dam

48,344 cu. yd @ $0.50 = $24,172.00 Gov. Cost

Ramp

700	(48)(2)		19+90	(152)(2)	
300		1,200 CY	360		2,667 CY
1000	(60)(2)		23+50	(48)(2)	
400		1,926 CY			
14+00	(70)(2)				
440		3,096 CY	Total = 8,888 cu. y		
18+40	120(2)		@ $0.50 = $4,444.00		

Total of $28,616.00

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP Spillway Dam			
BY D Riddle	DATE 1-20-76	CHECKED BY J.L.S.	DATE 2-6-76	JOB NO. 2005
SUBJECT Cost Est Mckallips Rd Area New Alignment				SHEET 3 OF 4

Item #4 Channel Excavation

$[(1,100)(4)+(750)(2.0)]540 \div 27 = 118,000$ cu. yd

$[(1,150)(27)(6.0)+(\frac{13+6}{2})(35.75)(1,700)] \div 27 = 28,284$ cu. yd

Total = 146,284 cu. yd. @ \$1.00 = \$146,284

Item #5 Structure Excavation

$(12)(13)(152)/27 = 878$ cu. yd @ \$4.00 = \$3,512.00

Item #6 Zone I Fill

Dam Govi Cost $(100,475)(1.097)(0.58708) = 64,709$

$64,709 + 48,344 = 113,053$ @ \$0.50 = \$56,526 cu. yd

Spon Cost Ramp

35,826 cu. yd @ \$0.50 = \$17,913.00

Total of = \$74,439.00

Item #7 Zone II Fill

$(100,475)(1.097)(0.41292) = 45,512$ cu. yd

45,512 cy @ \$1.25 = \$56,890.00

Item #8 Structure Backfill

$878 - (152)\pi(4.5)^2/27 = 520$ cu. yd

520 cu. yd @ \$10.00 = \$5,200.00

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	Burkhorn Mesa WPP Spook hill Dam		
BY D Ridolla / DATE 1-20-75	CHECKED BY JLS / DATE 2-6-76		JOB NO. 2005
SUBJECT Cost Est. McKellipo Rd Area New Alignment			SHEET 4 OF 4

Item #13

108" dia C.M.P.

152 ft. @ $171.74 = $26,104.00

Item #14

Pavement Removal & Replacement

(2,275 Lin. ft)(28) ÷ 9 = 7,078 S.Y.

(7,078)($10.40) = $73,611.00

Item #15

Loose Rock Riprap

360 cu. yd @ $10.00 = $3,600.00

4.0 Ac Required upstream of R/W

4.0 Ac @ $2,000.00 = $8,000.00 Spon. Cost

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP Spoot hill Dam			
BY: D Riddle	DATE: 1-14-76	CHECKED BY: JLS	DATE: 2-10-76	JOB NO. 2005
SUBJECT: Total Cost Est. McDowell Rd Ramp (Orig. Lic.)				SHEET 1 OF 3

Item No	Item	S.C.S. Cost	FCD. Cost	CAP Cost	Item Total cost
1	Clearing & Grub.	$2,760.00	$460		$3,220.00
3	Foundation Excav.	$18,905.00	5,120.00		$24,025.00
4	Channel Excav.	$12,000.00			$12,000.00
5	Structure Excav		$1,828.00		$1,828.00
6	Zone I Fill	$44,312.00	23,983.00		$68,295.00
7	Zone II Fill	$44,675.00			$44,675.00
8	Structure Backfill		$4,000.00		$4,000.00
13	108" dia C.M. Pipe		$38,642.00		$38,642.00
14	Pav. Rem. & Replace		$42,380.00		$42,380.00
15	Rock Riprap		$4,560.00		$4,560.00
—	C.A.P. Bridge			$287,334.00	$287,334.00
—	Total Const. Cost	$122,652	120,973.00	$287,334.00	$530,959.00
—	R/W Cost	—	$202,950.00	$40,508.00	$243,450.00
Total Cost (const + R/W)		$122,652.00	$323,923.00	$327,834.00	$774,409.00
10% Admin. Service (const + R/W)		$12,265.00	32,392.00	32,783.00	77,440.00
15% Engineering (const.)		$18,398.00	18,146.00	43,100.00	79,644.00
Total		$153,315.00	$374,461.00	403,717.00	931,493.00

from Sta 260+00 to Sta 280+00

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		Burkham-Mesa WPP Stockhill Dam		
BY D Riddle	DATE 1-14-75	CHECKED BY J.L.J	DATE 2-6-76	JOB NO. 2005
SUBJECT Total Cost Eval McDowell Rd Ramp (avig)				SHEET 2 OF 3

(1) Clearing & Grubbing (Gov. Cost)

Dam

Sta 260+00 to 280+00

70' D.S & 230 up.S. = 300'

2,000 X 300 ÷ 4356 = 13.8 AC

13.8 ac @ 200.00 per Ac. = $2,760.00

Ramp (Sponsrs. Cost)

$\left[\frac{135+80}{2}(750) + 70 \times 250\right] \div 4356 = 2.3$ ac

2.3 ac @ $200.00 = $460

Total Cost = $3,220.00

---

3 Foundation Excavation Sta 260+00 to 280+00

Dam Gov Cost

$[(3.58)(112.58) + (4.58)(23.45)]2,000 \div 27 = 37,810$ cu yd

Gov Cost = 37,810 cy @ $0.50 = $18,905.00

Spon Cost Ramp 10,240 cu yd @ .504 = $5,120.00

Total Cost = $24,025.00

---

4 Channel Excavation Sta 260+00 to 280+00

$(6)(27)(2,000) \div 27 = 12,000$ cu. yd

12,000 cu yd @ 1.00 = $12,000.00

all Gov Cost

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		Buckhorn Mesa WPP Spook Hill Dam		
BY D Riddle	DATE 1-14-75	CHECKED BY J.L.S	DATE 2-6-76	JOB NO. 2005
SUBJECT Total Cost Est McDowell Rd Ramp (Orig. Alin)				SHEET 3 OF 3

5 Structure Excavation

Pipe 457 cu. yd @ 4.00 = $1,828.00

(All Spon. Cost)

---

6 Embankment Fill Zone I

Dam (14)(49)(2,000) ÷ 27 = 50,815 cu. y

Core = 37,810 cu. yd.

Total Dam = 88,625 cu. yd.

Gov Cost = 88,625 @ $0.50 = $44,312

Spon Cost Ramp = 47,967 cu. yd = $23,983

Total Cost = $68,295

---

7 Embankment Fill Zone II

[(19)(61.5) - (14)(49)] 2,000 ÷ 27 = 35,740 cu. yd.

Gov Cost = 35,740 @ 1.25 = $44,675.00

---

8 Structure Backfill

Spon Cost Ramp = 400 cu. yd @ $10.00 = $4,000.00

---

13 108" dia C.M. Pipe

225 Lin ft @ $171.74 per ft. = $38,642.00
Spon Cost

---

15 Loose Rock Riprap

456 cu. yd @ $10.00 = $4,560.00

---

14 Pavement Removal & Replacement

4,075 S.Y. @ $10.40 per S.Y. = $42,380.00

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP Spook Hill Dam			
BY D Ridolle	DATE 1-15-76	CHECKED BY J.L.S.	DATE 2-6-76	JOB NO. 2005
SUBJECT Cost to Remove Asphalt @ McDowell Rd				SHEET 1 OF 5

1,310 Lin. ft. of Pavement Removal

min of 350 cu yd to be hauled off

13 mi one way haul to Nerest Land Fill

350 ÷ 12 cu. yd per Load = 30 Loads

@ 1 hr per Load 3 Trucks 10 hr

	Blade 10 hr @ $26.31 =		$263.10
2hrs. O.T	operator 10 hr @ $13.86 =		$152.46
	Loader 10 hr @ 26.31 =		$263.10
2hrs. O.T.	operator 10 hr @ 13.86 =		$152.46
	3 Dump Trucks 30 hr @ $27.94 =		$838.20
	3 Drivers 30 hr @ $10.63 =		$350.79
2hrs. O.T.	Formon 10 hr @ $14.36 =		$157.96
	Pickup 10 hr @ $4.00 =		$40.00

Total Cost $2,218.07

Cost to Dump Loads 30 Lods @ 5.00 = $150.00

Total Cost = $2,368.07

Admin. & Profit 15% = $355.21

$2,723.28

4,076 SY ∴ $0.67 per S.Y.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		Buckhorn Mesa WPP Spook Hill Dam		
BY	DATE	CHECKED BY	DATE	JOB NO.
D Riddle	1-15-76	J.L.S	2-6-76	2005
SUBJECT				SHEET 2 OF 5
Cost of ABC @ McDowell Road Ramp				

ABC -10" Thick (Material only)

one S.Y. = 7.497 s.f @ 10" Thick

(7.497)(150#) ÷ 2,000 = 0.56 Ton/S.Y.

($2.76 Per Ton)(0.56) = $1.55 S.Y. (FOB) delivered

Placement of A.B.C.

(1,310)(28)(0.833) ÷ 27 = 1,132 cu. Yd.

@ 12 cu Yd per Load = 95 Loads

1 hr per Load 95 hr to Accomp

4 Trucks delivered in 3 days @ 8 hr per day

Blade 24 hr @ $26.31	=	$631.44
operator 24 hr @ $13.86	=	$332.64
Water Truck 24 hr @ $55.50	=	$1,332.00
operator 24 hr @ 13.86	=	332.64
Roller 24 hr @ $26.31	=	$631.44
operator 24 hr @ $12.15	=	$291.60
Forman 24 hr @ $14.36	=	$344.64
Pickup 24 hr @ $4.00	=	$96.00
Const Cost Total	=	$3,992.40
Water Cost $33.33 per Day	=	100.00
Total Cost		$4,092.40
Admin & Profit 15%		$613.86
Total		$4,706.26

@ 4,076 S.Y. = $1.15 Su. Yd.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT		
Arizona	Buckhorn Mesa WPP Spook Hill Dam		
BY D Riddle / DATE 1-16-75	CHECKED BY J.L.S / DATE 2-6-76	JOB NO. 2005	
SUBJECT Cost of Placing 6" of Bituminous		SHEET 3 OF 5	

6" Bituminous (Material)

(9)(0.5)(154.5)(÷2,000 = 0.347625 Ton/S.Y.

($11.00 Per Ton)(0.347625) = $3.82 S.Y. (F.O.B.) delivered

Placing 6" Bituminous

[(1,310)(0.5)(28)]÷27 = 680 cu. Yd

@ 12 c.y Loads = 57 Loads

1 hr Per Load = 57 hr Hauling

4 Trucks 2 days work

Paver 16 hr @ $50.00	=	$800.00
operator 16 hr @ $13.86	=	$221.76
3 Laborers 48 hr @ $10.64		$510.72
Roller 16 hr @ $19.81	=	$317.00
operator 16 hr @ $12.15	=	$194.40
Foreman 16 hr @ $14.36	=	$229.76
Pickup 16 hr @ $4.00	=	$64.00
Total Cost		$2,337.64
Admin. & Profit 15%	=	$350.65
		$2,688.29
@ 4,076 S.Y.	=	$0.66 per S.Y.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		Buckhorn Mesa WPP Spook Hill Dam		
BY D Riddle	DATE 1-16-75	CHECKED BY J.L.S	DATE 2-6-76	JOB NO. 2005
SUBJECT Cost of Pavemen @ Mc Dowell Road Ramp				SHEET 4 OF 5

Pavement 2" (Material)
Pavement

(9)(0.17)(142.80) ÷ 2,000 = 0.11 Ton/S.Y.

(12.00)(0.11 = $1.32

Tack coat $0.50 S.Y.

Total = $1.82 S.Y

Placing 2" Pavement

(1,310)(0.17)(28) ÷ 27 = 231 cu.yd

@ 12 cu.y. Per Load = 20 Loads

1 hr Per Load 20 hr hauling

=6.67 hr

3 trucks 1 days

Use 1

Broom 8 hr @ $17.56	=	$140.48
operator 8 hr @ $12.15	=	$57.20
Water Truck 8 hr @ $43.05	=	$344.40
Driver 8 hr @ $13.86		$110.88
Tack Truck 8 hr @ $35.00	=	$280.00
Driver 8 hr @ $13.86	=	110.88
Paver 8 hr @ $50.00	=	$400.00
operator 8 hr @ $13.86	=	$110.88
3 Laborers 24 hr @ $10.64	=	$255.36
Roller 8 hr @ $19.81	=	$158.50
operator 8 hr @ $12.15	=	$97.20
Foreman 8 hr @ $14.36	=	$114.88
Pickup 8 hr @ 4.00	=	$32.00
Toto Cost		$2,247.66
Admin & Profet		$337.15
	total =	$2,584.81

4,076 S.Y = $0.63 S.Y.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		Buckhorn Mesa WFP Spook Hill Dam		
BY D Riddle	DATE 1-16-76	CHECKED BY JLS	DATE 2-10-76	JOB NO. 2005
SUBJECT Cost on McDowell Road Ramp Pavement				SHEET 5 OF 5

Sanding for finishing

Sand

2 loads of Sand @ $20.00 ... $40.00

Broom 8 hr @ 17.56 = 140.48
operator 8 hr @ 12.15 = 97.20

Total Cost = $277.20

Admin & Profit 15% = 41.58

Total = 318.78

4,076 SY = $0.08 S.Y.

Total Job = $10.38 S.Y.

Rounded to $10.40

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—470868

STATE	PROJECT			
Arizona	Burkhorn Mesa WPP Spookhill Dam			
BY D R. dA.	DATE 2-10-76	CHECKED BY	DATE	JOB NO. 2005
SUBJECT Check Average Cost against Estom 2-2-76				SHEET 5A OF 5

Item #19 Pavement Replacement

Wickenburg Quan 1,125 S.Y.

Jackson $7.00

Sunt $11.00

Hunter $7.00

Tiffany $15.00

New Pueblo $9.00

Dullon $15.00

Anderson $20.00

P.K. S. $7.00

$11.375 Average

COMPUTATION SHEET
SCS–ENG–523 Rev. 8–69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		Buckhorn Mesa WPP-Spookhill Dam		
BY D Ridelle	DATE 1-14-76	CHECKED BY J.L.S	DATE 2-6-76	JOB NO. 2005
SUBJECT Design C.M. Pipe @ McDowell Rd 8 ft of Fill				SHEET ___ OF ___

See HandBook of Steel Drainage & Hwy Const. Products Page 47 through 52

Dead Load = (100#/ft)(8ft) = 800#

Live Load = 100#/ft (Highway H-20 Loading)

Ring Compression

$C = (P)(\frac{S}{2}) = (900\#)\frac{9}{2} = 4{,}050\ \#/ft$

FS_R = Factor of Safety = 4

Seam Strength Required = 4,050 × 4 = 16,200 #/ft

12 Ga 3/8" Single Rivets = 23,400 #/ft. OK

Buckling of Wall

Ultimate buckling stress fb = 33,000 PSI

$FS_B = 2$ ∴ Allowable fc = 16,500 PSI

$f_c = \frac{C}{12 \times A} = \frac{4{,}050}{12 \times 0.13} = 2{,}596\ PSI < 16{,}500\ PSI$

OK

Deflection

W_c = Load on Pipe $= \frac{(P)(S)}{12} = \frac{(900)(9)}{12} = 675\ \#/in$

$\Delta_x = \frac{D_1 \times K \times W_c \times R^3}{(E \times I) + 0.061 \times E' \times R^3}$

Could Use D_1 of 1.25 Backfill will be Compacted to 95% or better

$\Delta_x = \frac{1.5 \times 0.10 \times 675 \times 54^3}{(30 \times 10^6 \times 0.0604) + (0.061 \times 700 \times 54^3)}$

$\Delta_x \frac{15{,}943{,}230}{1{,}812{,}000 + 1{,}763{,}596.8 \quad 6{,}723{,}712.8} = 1.87$ in

Allowable = 108" × 0.05 = 5.40 in > 1.87 OK

Answer

No 12 gage Meets all requirements

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT Buckhorn Mesa WRP Site & Hill Dam		
BY O Dodd	DATE 1-15-76	CHECKED BY JLS	DATE 2-6-76	JOB NO. 2005
SUBJECT Cost of C.M.P. for Ramps				SHEET ____ OF ____

1-15-76

Called Armco Steel Corp for Cost (278-6234)
on 108" dia C.M. Pipe 12 Gage, Anular
Rings & O ring-Gaskets
$104.09 pipe $10.40 coating 25% discount
to Contractors $85.87 Cost

1-15-76

Called Ariz Culvert & MFG. Co (839-3485)
Said he would Drop of information
in PM Today $85.87 same

1-15-76
Called Unruled Metro for Prices
ABC $2.76 per ton F.O.B.
Bituminous 11.00 per ton F.O.B
Paving 12.00 per ton F.O.B
Tack 0.50 per Sq yd

SCS-ENG-523 Rev. 8-69

SOIL CONSERVATION SERVICE

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP Spook Hill Dam			
BY D Riddle	DATE 1-19-76	CHECKED BY JLS	DATE 2-10-76	JOB NO. 2005
SUBJECT Cost Est McDowell Rd New Alinment				SHEET 1 OF 3

Item No	Item	S.C.S. Cost	F.C.R. Cost	C.A.P. Cost	Total Cost
1	Clearing & Grubbing	$8,280.00	$300.00		$8,580.00
3	Found. Excav.	28,358.00	3,478.00		$31,836.00
4	Channel Excav.	$120,483.00			$120,483.00
5	Str. Excav		$4,228.00		$4,228.00
6	Zone I Fill	$66,469.00	$16,456.00		$82,925.00
7	Zone II Fill	$67,012.00			$67,012.00
8	Str. Backfill		$6,710.00		$6,710.00
13	108" dia C.M.P.		$28,~~159~~ 165.00		$28,~~159~~ 165.00
14	Pavi. Rem. & Rep		$65,520.10		$65,520.10
15	Rock Riprap		$3,600.00		$3,600.00
—	CAP Bridge			$149,428.00	$149,428.00
—	Total Const Cost	$290,602.00	$128,457.00	$149,428.00	$568,487.00
—	R/W Cost	—	$227,250.00	$40,500.00	$267,750.00
Total Cost (Const + R/W)		$290,602.00	$355,707	$189,928.00	$836,237.00
10% Admin Service (Const + R/W)		$29,060.00	$35,571.00	18,993.00	$83,624.00
15% Engineering (Const.)		$43,590.00	$19,269.00	22,414.00	$85,273.00
Total		$363,252.00	$410,547.00	$231,335.00	$1,005,134.00

+ 5.4 Ac. @ $4500 per Ac.

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE	PROJECT			
Arizona	Buckhorn Mesa WPP Spookhill Dam			
BY O Riddle	DATE 1-19-75	CHECKED BY JLS	DATE 2-6-76	JOB NO. 2006
SUBJECT Cost Est McDowell Rd New Alignment				SHEET 2 OF 3

Item #1
Clearing & Grubbing

260+00 to Sta 280+00

260+00 - 300'				
		570	9.8 Ac	
265+70	1,200			41.4
		680	18.7 Ac	
272+50	1,200.			
		750	12.9	
280+00	300			

41.4 Ac @ $200 = $8,280.00 Gov Cost

Spon. Cost. (810)(80) ÷ 43560 = 1.5 Ac @ $200.00 = $300.00

Total = $8,580.00

Item #3
Foundation Excav

Note: Length was increased 50%

(37,810)(1.5) = 56,715 cu. yd in Dam

(56,715 cu. yd)($0.50) = $28,358.00 Gov Cost

[(1,070)(82)(2) + 140(44)2] / 27 = 6,956 cu. yd.

(6,956 cu. yd)(0.50) = $3,478.00 spon. Cost.

∴ Total = $31,836.00

Item #4
Channel Excavation

[(700)(700)(4) + (650)(700)8] / 27 = 207,400 cu. yd.
1325 100,000

((14.5 + 6.0)/2)(2,350)(37.625) / 27 = 33,566 cu. yd
10.25

240,966 cu. yd.

240,966 cu. yd @ $0.50 = $120,483

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
Arizona		Buckhorn Mesa WPP-Spackhill Dam		
BY D Riddle	DATE 1-19-76	CHECKED BY JLS	DATE 2-6-76	JOB NO. 2005
SUBJECT Cost Est McDowell Rd. New Alignment				SHEET 3 OF 3

Item #5
Structure Excav.

$(12)(14.5)(164)/27$ 1,057 cu.yd

1,057 cu.yd @ $4.00 = $4,228 cu.yd.

Sponsors Cost.

Item #6
Embankment Fill Zone I

Earthfill was increase 50% by the increase in distance

$(88,625 \text{ cu.yd})1\frac{1}{2} = 132,938$ cu.yd

132,938 cu.yd @ $0.50 = $66,469.00 Gov Cost

Spon Cost Ramp 32,912 cu.yd @ $0.50 = $16,456.00

* Total = $82,925.00

Item #7
Embankment Fill zone II

$(35,740)(1.5) = 53,610$ cu.yd

53,610 cu.yd @ $1.25 = $67,012.00 Gov Cost

Item #8
Structure Backfill

? $1,057 - [164\pi(4.5)^2/27] = 671$ cu.yd

671 cu.yd @ $10.00 = $6,710.00 Spon. Cost.

Item #13
108" dia. C.M.P. 164' @ $171.74 = $28,~~159.00~~ 165.00

Item #14
Pavement Removal & Replacement

$[(2,025)(28) \div 9]$ $10.40 = $65,520.00 Spon Cost

Item #15
Loose Rock Riprap

360 cu.yd at $10.00 = $3,600.00 Spon Cost