Spook Hill ADMP Update

Flood Control District of Maricopa County

Appendix A
Volume 5

Design Alternative Analysis
Level II
Channel & Culvert Calcs & Costs

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Registered Professional Engineer (Civil)
CERTIFICATE NO.
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RICHARD L.
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Date Signed 9-20-07
ARIZONA U.S.A.

Spook Hill Area Drainage Master Plan Update

Flood Control District of Maricopa County

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Appendix A

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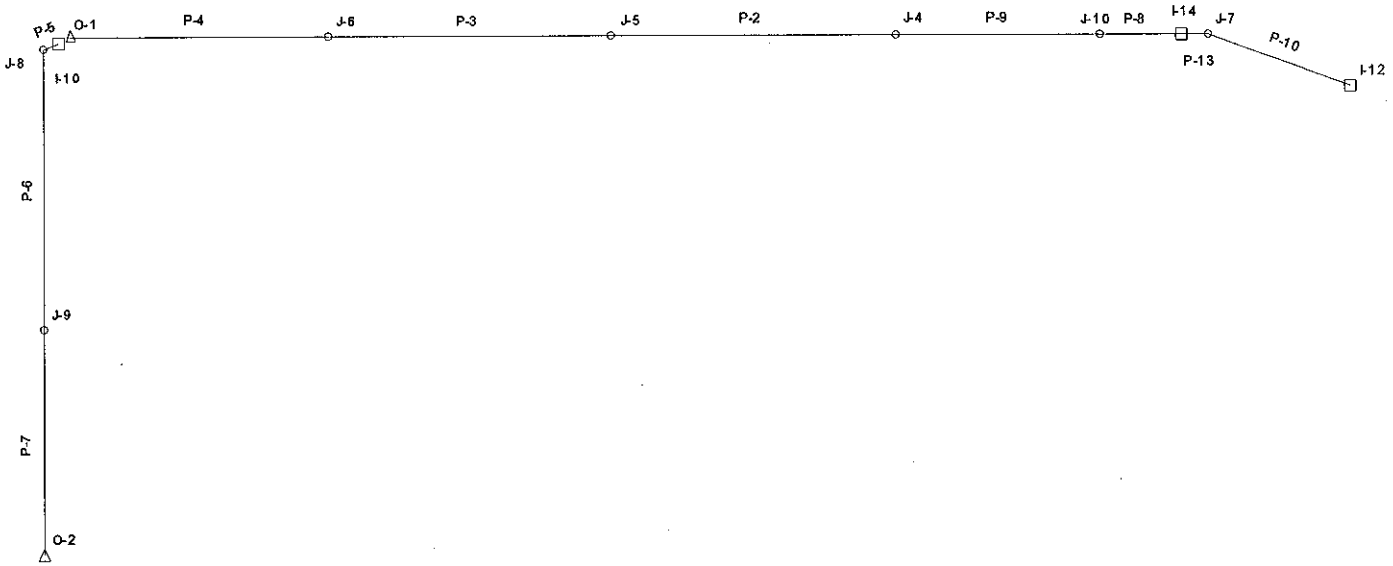
Alternative location for the 88th Street Detention Basin

Due to the rapid development in the project area, it seemed possible that the 88th Street and McDowell location may be developed prior to the District's ability to purchase the land and reserve it for a detention basin. Given this possibility, the District requested that an alternative location for this basin be identified and some preliminary analysis be done to determine the viability of the site and its ability to integrate with the other elements in the Recommended Drainage Alternative.

An alternative site was identified at the northeast corner of the intersection of Hawes Road and Culver Street (see conceptual drawing on accompanying pages). The basin would be located in the southwest corner of a privately owned parcel approximately 40 acres in size (a very small portion of the parcel in the northeast corner is owned by the City of Mesa but is not required).

Preliminary evaluation of the topography, contours, and Hydrology in the area indicate that this is a viable alternative location for the 88th Street Detention Basin. Please refer to the attached documentation for additional information including a StormCAD model of the revised storm drain alignments.

Scenario: Base



Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Number of Sections	Section Size	Mannings n	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
P-10	I-12	J-7	800.00	270.00	0.015556	2	78 inch	0.023	12.05	1,815.20	1,811.00	1,823.85	1,818.93
P-13	J-7	I-14	800.00	47.00	0.010638	2	78 inch	0.023	12.05	1,811.00	1,810.50	1,818.70	1,817.84
P-8	I-14	J-10	1,046.00	140.00	0.025000	2	78 inch	0.023	15.95	1,810.50	1,807.00	1,817.46	1,813.12
P-9	J-10	J-4	1,046.00	360.00	0.033333	2	78 inch	0.023	16.32	1,807.00	1,795.00	1,812.91	1,801.13
P-2	J-4	J-5	1,046.00	500.00	0.025000	2	84 inch	0.023	14.29	1,795.00	1,782.50	1,800.95	1,789.73
P-3	J-5	J-6	1,046.00	500.00	0.021000	2	84 inch	0.023	13.59	1,782.50	1,772.00	1,789.58	1,779.09
P-4	J-6	O-1	1,046.00	451.00	0.024390	2	84 inch	0.023	13.60	1,772.00	1,761.00	1,778.95	1,769.50
P-5	I-10	J-8	844.00	28.00	0.035714	2	84 inch	0.023	12.31	1,760.00	1,759.00	1,765.41	1,765.43
P-6	J-8	J-9	844.00	494.00	0.012146	2	84 inch	0.023	12.45	1,759.00	1,753.00	1,765.22	1,758.41
P-7	J-9	O-2	844.00	398.00	0.017588	2	84 inch	0.023	13.63	1,753.00	1,746.00	1,758.41	1,751.10

Spook Hill ADMP Level II Alternative Summary - Model Elements

HEC-1	Land Use Condition		Return Period			Rainfall Duration			Pass Mountain		Non-Jurisdictional				McDowell Road				McKellips Road			
File Name	Existing	Future	100-year	10-year	SPS	24-hour	6-hour	7-hour	PM4R	PM4E	SH Channel	SH FRS	Off-line Basin	SB FRS 4xFlow	MD2E	MD2P	MD3E	MD3P	MK1C	MK1P	MK2E	MK2P
EC24BASE.DAT	X		X			X						X										
EC24B_R.DAT	X		X			X					X											
EC24_NJ6.DAT	X		X			X			X		X		X	X								
EC24_NJ4.DAT	X		X			X					X		X									
EC24NJ4Q.DAT	X		X			X					X		X*	X								
EC24PM4R.DAT	X		X			X			X			X		X								
EC24PM4E.DAT	X		X			X				X		X		X								
EC24MD2E.DAT	X		X			X						X			X							
EC24MD2P.DAT	X		X			X						X				X						
EC24MD3E.DAT	X		X			X						X					X					
EC24MD3P.DAT	X		X			X						X						X				
EC24MK1C.DAT	X		X			X						X							X			
EC24MK1P.DAT	X		X			X						X								X		
EC24MK2E.DAT	X		X			X						X									X	
EC24MK2P.DAT	X		X			X						X										X
MD2EPM4R.DAT	X		X			X			X			X		X	X							
MD3EPM4R.DAT	X		X			X			X			X		X			X					
MD2PMMK2.DAT	X		X			X			X			X		X	X						X	
MD2PMMK1.DAT	X		X			X			X			X		X	X				X			
MD3PMMK2.DAT	X		X			X			X			X		X			X				X	
MD3PMMK1.DAT	X		X			X			X			X		X			X		X			
MK2ENJ4Q.DAT	X		X			X					X		X*	X								
MD2ENJ4Q.DAT	X		X			X					X		X*	X								
MD2EMK2E.DAT	X		X			X						X			X						X	
MD2MK2NJ.DAT	X		X			X					X		X*	X	X						X	
EC24PM_R.DAT	X		X			X			X		X			X								
EF24_NJ6.DAT	X			50-Yr		X					X		X	X								
ET24_NJ6.DAT	X			X		X					X		X	X								
ESPSBASE.DAT	X				X			X				X										
ESPS_CHL.DAT	X				X			X			X											
ESPS_GCL.DAT	X				X			50-hr			X											

* - Divert flow into offline basin "SS380" before combining with flow from "380".

Spook Hill ADMP Level II Alternative Summary - Peak Flows I

HEC-1	Inflow to Apache Junction FRS			Outflow of Apache Junction FRS			Inflow to Signal Butte FRS (east)			Inflow to Signal Butte FRS (north)			Total Inflow to Signal Butte FRS			Outflow of Signal Butte FRS			Inflow to Spook Hill FRS			Outflow of Spook Hill FRS		
File Name	"C60" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"S60" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"C180" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"RR200" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"CC180" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"S180" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"CC455" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"S440" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)
EC24BASE.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	7116	12.37	1404	242	18.33	881
EC24B_R.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	13.37	190	7306	12.30	1053	113	15.63	524	3996	13.63	1357	N/A		
EC24_NJ6.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1785	13.37	345	7306	12.30	1214	449	15.63	916	2140	13.63	1595	N/A		
EC24_NJ4.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	2282	13.60	1339	N/A		
EC24NJ4Q.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	398	14.97	780	2754	13.73	1613	N/A		
EC24PM4R.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6518	12.40	1630	362	26.10	1131
EC24PM4E.DAT	Same as	EC24PM4R																						
EC24MD2E.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	6744	12.37	1404	225	23.93	882
EC24MD2P.DAT	Same as	EC24MD2E																						
EC24MD3E.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	6722	12.37	1404	225	23.53	882
EC24MD3P.DAT	Same as	EC24MD3E																						
EC24MK1C.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	7091	12.37	1416	242	18.53	892
EC24MK1P.DAT	Same as	EC24MK1C																						
EC24MK2E.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	6940	12.37	1416	229	22.13	890
EC24MK2P.DAT	Same as	EC24MK2E																						
MD2EPM4R.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6100	12.33	1672	363	26.43	1172
MD3EPM4R.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6166	12.33	1672	363	26.44	1172
MD2PMMK2.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6428	12.27	1672	364	26.47	1172
MD2PMMK1.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6428	12.27	1672	364	26.47	1172
MD3PMMK2.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6397	12.30	1672	364	26.47	1172
MD3PMMK1.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6397	12.30	1672	364	26.47	1172
MK2ENJ4Q.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	13.37	190	7306	12.30	1053	398	14.97	780	2337	13.73	1619	N/A		
MD2ENJ4Q.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	13.37	190	7306	12.30	1053	398	14.97	780	2411	13.73	1613	N/A		
MD2EMK2E.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	13.37	190	7306	12.30	1053	113	29.07	524	6774	12.37	1416	226	24.00	886
MD2MK2NJ.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	13.37	190	7306	12.30	1053	398	14.97	780	2327	13.67	1617	N/A		
EC24PM_R.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	2140	13.63	1630	N/A		
EF24_NJ6.DAT	7224	12.37	577	482	13.70	577	9866	12.30	1196	2635	13.33	336	9866	12.30	1732	554	16.03	1392	3709	12.37	2374	N/A		
ET24_NJ6.DAT	2512	12.40	196	108	13.97	196	3542	12.30	411	502	14.00	95	3542	12.30	512	117	22.80	315	713	12.33	685	N/A		
ESPSBASE.DAT	N/A			N/A			N/A			N/A			N/A			113	29.07	524	23577	5.47	3201	4151	6.63	2666
ESPS_CHL.DAT	N/A			N/A			N/A			N/A			N/A			113	29.07	524	17099	6.07	3195	N/A		
ESPS_GCL.DAT	N/A			N/A			N/A			N/A			N/A			113	29.07	524	9708	48.37	3428	N/A		

Spook Hill ADMP Level II Alternative Summary - Peak Flows II

HEC-1	Spook Hill FRS												McDowell Road						McKellips Road				Total Outflow	
File Name	"C320" Q100 (cfs)	Tp (hr)	"C340" Q100 (cfs)	Tp (hr)	"C360" Q100 (cfs)	Tp (hr)	"C380/A" Q100 (cfs)	Tp (hr)	"CC400/B" Q100 (cfs)	Tp (hr)	"C420/A" Q100 (cfs)	Tp (hr)	"C370/A" Q100 (cfs)	Tp (hr)	"C390" Q100 (cfs)	Tp (hr)	"C415/C_A" Q100 (cfs)	Tp (hr)	"CC340B/340" Q100 (cfs)	Tp (hr)	"CC380B/380" Q100 (cfs)	Tp (hr)	"C500" Q100 (cfs)	Tp (hr)
EC24BASE.DAT	2546	12.30	3733	12.33	4484	12.33	4667	12.37	5262	12.37	5884	12.37	1046	12.23	478	12.03	1540	12.27	1534	12.17	627	12.27	2475	12.33
EC24B_R.DAT	2546	12.30	3025	12.53	4079	12.70	4597	12.87	4253	13.13	4082	13.40	1046	12.23	478	12.03	1540	12.27	1534	12.17	627	12.27	4332	14.23
EC24_NJ6.DAT	2277	12.27	2756	12.53	3025	12.67	3382	12.83	2018	13.27	2036	13.47	838	12.10	478	12.03	1434	12.27	1581	12.17	627	12.27	2320	12.23
EC24_NJ4.DAT	2546	12.30	3025	12.53	4079	12.70	4597	12.87	2047	13.13	2125	13.40	1046	12.23	478	12.03	1540	12.27	1534	12.17	627	12.27	2424	14.40
EC24NJ4Q.DAT	2559	12.30	3051	12.53	4106	12.70	2715	12.83	2652	13.20	2660	13.53	1046	12.23	478	12.03	1540	12.27	1534	12.17	627	12.27	2964	14.40
EC24PM4R.DAT	2277	12.27	3564	12.30	3921	12.37	4306	12.40	4902	12.40	5409	12.40	838	12.10	478	12.03	1434	12.27	1581	12.17	627	12.27	2475	12.33
EC24PM4E.DAT	Same as	EC24PM4R																						
EC24MD2E.DAT	2546	12.30	3733	12.33	4484	12.33	4405	12.33	4788	12.37	5497	12.37	1046	12.23	810	12.03	2035	12.20	1534	12.17	627	12.27	2475	12.33
EC24MD2P.DAT	Same as	EC24MD2E																						
EC24MD3E.DAT	2546	12.30	3733	12.33	4484	12.33	4405	12.33	4788	12.37	5167	12.37	1046	12.23	620	12.03	1973	12.23	1534	12.17	627	12.27	2475	12.33
EC24MD3P.DAT	Same as	EC24MD3E																						
EC24MK1C.DAT	2546	12.30	3667	12.27	4279	12.33	4513	12.33	5234	12.37	5857	12.37	1046	12.23	478	12.03	1540	12.27	394	12.13	913	12.57	2475	12.33
EC24MK1P.DAT	Same as	EC24MK1C																						
EC24MK2E.DAT	2546	12.30	3667	12.27	4279	12.33	4513	12.33	5081	12.37	5705	12.37	1046	12.23	478	12.03	1540	12.27	394	12.13	913	12.57	2475	12.33
EC24MK2P.DAT	Same as	EC24MK2E																						
MD2EPM4R.DAT	2277	12.27	3564	12.30	3921	12.37	3921	12.37	4250	12.37	4562	12.37	838	12.10	814	12.03	2063	12.20	1581	12.17	627	12.27	2475	12.33
MD3EPM4R.DAT	2277	12.27	3564	12.30	3921	12.31	3921	12.37	4250	12.37	4562	12.37	838	12.10	622	12.03	2002	12.23	1581	12.17	627	12.27	2475	12.33
MD2PMMK2.DAT	2277	12.27	3432	12.27	3690	12.37	3922	12.37	4334	12.27	4746	12.27	838	12.10	814	12.03	2063	12.20	394	12.13	156	12.80	2475	12.33
MD2PMMK1.DAT	2277	12.27	3432	12.27	3690	12.37	3922	12.37	4334	12.27	4746	12.27	838	12.10	814	12.03	2063	12.20	394	12.13	156	12.80	2475	12.33
MD3PMMK2.DAT	2277	12.27	3432	12.27	3690	12.37	3922	12.37	4334	12.27	4746	12.27	838	12.10	622	12.03	2002	12.23	394	12.13	156	12.80	2475	12.33
MD3PMMK1.DAT	2277	12.27	3432	12.27	3690	12.37	3922	12.37	4334	12.27	4746	12.27	838	12.10	622	12.03	2002	12.23	394	12.13	156	12.80	2475	12.33
MK2ENJ4Q.DAT	2559	12.30	2883	12.53	3951	12.70	2006	13.00	2150	13.27	2203	13.57	1046	12.23	478	12.03	1540	12.27	394	12.13	913	12.57	2647	12.30
MD2ENJ4Q.DAT	2559	12.30	3051	12.53	4106	12.70	2194	12.90	2198	13.23	2221	13.53	1046	12.23	810	12.03	2035	12.20	1534	12.17	627	12.27	2665	12.30
MD2EMK2E.DAT	2546	12.30	3667	12.27	4279	12.33	4513	12.33	4824	12.33	5196	12.37	1046	12.23	810	12.03	2035	12.20	394	12.13	156	12.80	2475	12.33
MD2MK2NJ.DAT	2559	12.30	2883	12.53	3951	12.70	2006	13.00	2090	13.30	2121	13.57	1046	12.23	810	12.03	2035	12.20	394	12.17	156	12.80	2669	12.30
EC24PM_R.DAT	2277	12.27	2756	12.53	3025	12.67	3382	12.83	2018	13.27	2036	13.34	838	12.10	478	12.03	1434	12.27	1581	12.17	627	12.27	2320	12.33
EF24_NJ6.DAT	3133	12.23	4005	12.47	4553	12.60	5353	12.70	2714	13.40	2697	13.67	1126	12.10	629	12.03	2253	12.20	2165	12.17	889	12.27	3578	12.33
ET24_NJ6.DAT	1058	12.30	818	12.80	725	13.10	644	13.47	515	13.90	498	14.30	417	12.10	256	12.03	734	12.27	772	12.20	273	12.27	1185	12.27
ESPSBASE.DAT	6600	5.53	9174	5.50	12385	5.53	15413	5.53	16908	5.53	18404	5.53	1956	5.33	743	5.07	4092	5.40	3083	5.33	1504	5.47	6577	5.40
ESPS_CHL.DAT	6600	5.53	8300	5.70	11367	5.73	13851	5.77	14613	5.90	15427	6.00	1956	5.33	743	5.07	4092	5.40	3083	5.33	1504	5.47	18679	6.50
ESPS_GCL.DAT	3328	47.73	4353	47.90	6138	48.03	7562	48.10	8060	48.23	8533	48.37	1005	47.70	337	47.50	2004	47.70	1534	47.63	768	47.73	10861	49.03

Wood, Patel & Associates, Inc.

Flow Exhibits for OPTIONS
LEVEL II
7/19/01

Spook Hill ADMP Level II Alternative Summary - Model Elements

10-Sim 100 %

HEC-1	Land Use Condition		Return Period			Rainfall Duration			Pass Mountain		Non-Jurisdictional				McDowell Road				McKellips Road			
File Name	Existing	Future	100-year	10-year	SPS	24-hour	6-hour	7-hour	PM4R	PM4E	SH Channel	SH FRS	Off-line Basin	SB FRS 4xFlow	MD2E	MD2P	MD3E	MD3P	MK1C	MK1P	MK2E	MK2P
EC24BASE.DAT	X		X			X						X										
EC24B_R.DAT	X		X			X					X											
EC24_NJ6.DAT	X		X			X			X		X		X	X								
EC24_NJ4.DAT	X		X			X					X		X									
EC24NJ4Q.DAT	X		X			X					X		X*	X								
EC24PM4R.DAT	X		X			X			X			X		X								
EC24PM4E.DAT	X		X			X				X		X		X								
EC24MD2E.DAT	X		X			X						X			X							
EC24MD2P.DAT	X		X			X						X				X						
EC24MD3E.DAT	X		X			X						X					X					
EC24MD3P.DAT	X		X			X						X						X				
EC24MK1C.DAT	X		X			X						X							X			
EC24MK1P.DAT	X		X			X						X								X		
EC24MK2E.DAT	X		X			X						X									X	
EC24MK2P.DAT	X		X			X						X										X
MD2PM4R.DAT	X		X			X			X			X		X	X							
MD3PM4R.DAT	X		X			X			X			X		X			X					
MD2PMMK2.DAT	X		X			X			X			X		X	X						X	
MD2PMMK1.DAT	X		X			X			X			X		X	X				X			
MD3PMMK2.DAT	X		X			X			X			X		X			X				X	
MD3PMMK1.DAT	X		X			X			X			X		X			X		X			
MDPMMKNJ.DAT	X		X			X			X		X		X*	X	X						X	
MK2ENJ4Q.DAT	X		X			X					X		X*	X							X	
MD2ENJ4Q.DAT	X		X			X					X		X*	X	X							
MD2EMK2E.DAT	X		X			X						X			X						X	
MD2MK2NJ.DAT	X		X			X					X		X*	X	X						X	
EC24PM_R.DAT	X		X			X			X		X			X								
EF24_NJ6.DAT	X			500-Yr		X			X		X		X	X								
ET24_NJ6.DAT	X			X		X			X		X		X	X								
ESPSBASE.DAT	X				X			X				X										
ESPS_CHL.DAT	X				X			X			X											
ESPS_GCL.DAT	X				X			50-hr			X											

* - Divert flow into offline basin "SS380" before combining with flow from "380".

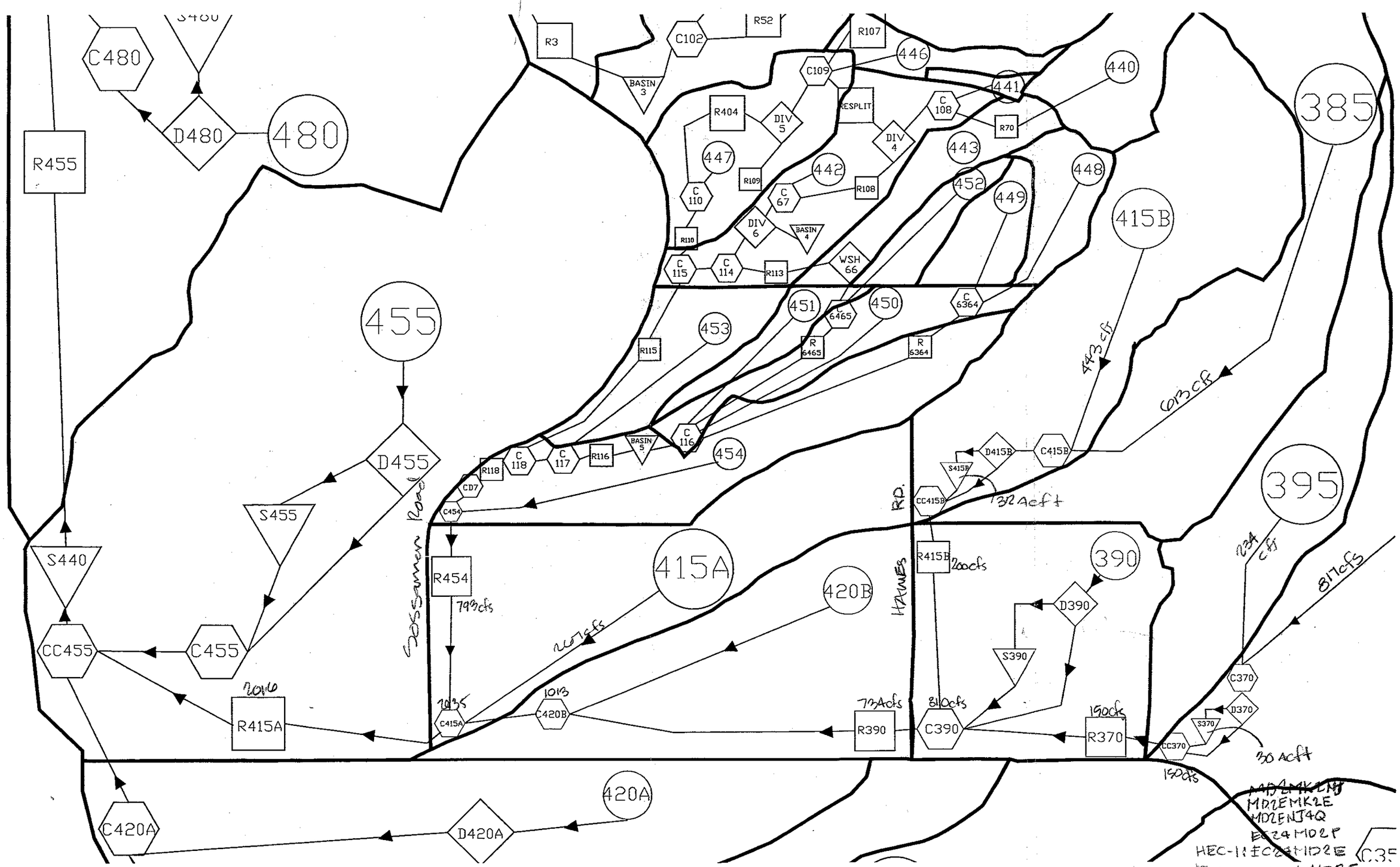
Spook Hill Level II

Spook Hill ADMP Level II Alternative Summary - Peak Flows I

HEC-1	Inflow to Apache Junction FRS			Outflow of Apache Junction FRS			Inflow to Signal Butte FRS (east)			Inflow to Signal Butte FRS (north)			Total Inflow to Signal Butte FRS			Outflow of Signal Butte FRS			Inflow to Spook Hill FRS			Outflow of Spook Hill FRS		
File Name	"C60" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"S60" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"C180" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"RR200" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"CC180" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"S180" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"CC455" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"S440" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)
EC24BASE.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	7116	12.37	1404	242	18.33	881
EC24B_R.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	13.37	190	7306	12.30	1053	113	15.63	524	3996	13.63	1357	N/A		
EC24_NJ6.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1785	13.37	345	7306	12.30	1214	449	15.63	916	2140	13.63	1595	N/A		
EC24_NJ4.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	2282	13.60	1339	N/A		
EC24NJ4Q.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	398	14.97	780	2754	13.73	1613	N/A		
EC24PM4R.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6518	12.40	1630	362	26.10	1131
EC24PM4E.DAT	Same as	EC24PM4R																						
EC24MD2E.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	6744	12.37	1404	225	23.93	882
EC24MD2P.DAT	Same as	EC24MD2E																						
EC24MD3E.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	6722	12.37	1404	225	23.53	882
EC24MD3P.DAT	Same as	EC24MD3E																						
EC24MK1C.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	7091	12.37	1416	242	18.53	892
EC24MK1P.DAT	Same as	EC24MK1C																						
EC24MK2E.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	12.83	190	7306	12.30	1053	113	29.07	524	6940	12.37	1416	229	22.13	890
EC24MK2P.DAT	Same as	EC24MK2E																						
MD2EPM4R.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6100	12.33	1672	363	26.43	1172
MD3EPM4R.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6166	12.33	1672	363	26.44	1172
MD2PMMK2.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6428	12.27	1672	364	26.47	1172
MD2PMMK1.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6428	12.27	1672	364	26.47	1172
D3PMMK2.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6397	12.30	1672	364	26.47	1172
MD3PMMK1.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	6397	12.30	1672	364	26.47	1172
MDPMMKNJ.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	2121	13.67	1637	N/A		
MK2ENJ4Q.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	13.37	190	7306	12.30	1053	398	14.97	780	2337	13.73	1619	N/A		
MD2ENJ4Q.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	13.37	190	7306	12.30	1053	398	14.97	780	2411	13.73	1613	N/A		
MD2EMK2E.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	13.37	190	7306	12.30	1053	113	29.07	524	6774	12.37	1416	226	24.00	886
MD2MK2NJ.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1330	13.37	190	7306	12.30	1053	398	14.97	780	2327	13.67	1617	N/A		
EC24PM_R.DAT	5371	12.37	417	118	14.27	417	7306	12.30	869	1784	13.37	345	7306	12.30	1214	449	15.63	916	2140	13.63	1630	N/A		
EF24_NJ6.DAT	7224	12.37	577	482	13.70	577	9866	12.30	1196	2635	13.33	336	9866	12.30	1732	554	16.03	1392	3709	12.37	2374	N/A		
ET24_NJ6.DAT	2512	12.40	196	108	13.97	196	3542	12.30	411	502	14.00	95	3542	12.30	512	117	22.80	315	713	12.33	685	N/A		
ESPSBASE.DAT	N/A			N/A			N/A			N/A			N/A			113	29.07	524	23577	5.47	3201	4151	6.63	2666
ESPS_CHL.DAT	N/A			N/A			N/A			N/A			N/A			113	29.07	524	17099	6.07	3195	N/A		
ESPS_GCL.DAT	N/A			N/A			N/A			N/A			N/A			113	29.07	524	9708	48.37	3428	N/A		

Spook Hill ADMP Level II Alternative Summary - Peak Flows II

HEC-1	Spook Hill FRS												McDowell Road						McKellips Road				Total Outflow	
File Name	"C320" Q100 (cfs)	Tp (hr)	"C340" Q100 (cfs)	Tp (hr)	"C360" Q100 (cfs)	Tp (hr)	"C380/A" Q100 (cfs)	Tp (hr)	"CC400/B" Q100 (cfs)	Tp (hr)	"C420/A" Q100 (cfs)	Tp (hr)	"C370/A" Q100 (cfs)	Tp (hr)	"C390" Q100 (cfs)	Tp (hr)	"C415/C_A" Q100 (cfs)	Tp (hr)	"CC340B/340" Q100 (cfs)	Tp (hr)	"CC380B/380" Q100 (cfs)	Tp (hr)	"C500" Q100 (cfs)	Tp (hr)
EC24BASE.DAT	2546	12.30	3733	12.33	4484	12.33	4667	12.37	5262	12.37	5884	12.37	1046	12.23	478	12.03	1540	12.27	1534	12.17	627	12.27	2475	12.33
EC24B_R.DAT	2546	12.30	3025	12.53	4079	12.70	4597	12.87	4253	13.13	4082	13.40	1046	12.23	478	12.03	1540	12.27	1534	12.17	627	12.27	4332	14.23
EC24_NJ6.DAT	2277	12.27	2756	12.53	3025	12.67	3382	12.83	2018	13.27	2036	13.47	838	12.10	478	12.03	1434	12.27	1581	12.17	627	12.27	2320	12.23
EC24_NJ4.DAT	2546	12.30	3025	12.53	4079	12.70	4597	12.87	2047	13.13	2125	13.40	1046	12.23	478	12.03	1540	12.27	1534	12.17	627	12.27	2424	14.40
EC24NJ4Q.DAT	2559	12.30	3051	12.53	4106	12.70	2715	12.83	2652	13.20	2660	13.53	1046	12.23	478	12.03	1540	12.27	1534	12.17	627	12.27	2964	14.40
EC24PM4R.DAT	2277	12.27	3564	12.30	3921	12.37	4306	12.40	4902	12.40	5409	12.40	838	12.10	478	12.03	1434	12.27	1581	12.17	627	12.27	2475	12.33
EC24PM4E.DAT	Same as	EC24PM4R																						
EC24MD2E.DAT	2546	12.30	3733	12.33	4484	12.33	4405	12.33	4788	12.37	5497	12.37	1046	12.23	810	12.03	2035	12.20	1534	12.17	627	12.27	2475	12.33
EC24MD2P.DAT	Same as	EC24MD2E																						
EC24MD3E.DAT	2546	12.30	3733	12.33	4484	12.33	4405	12.33	4788	12.37	5167	12.37	1046	12.23	620	12.03	1973	12.23	1534	12.17	627	12.27	2475	12.33
EC24MD3P.DAT	Same as	EC24MD3E																						
EC24MK1C.DAT	2546	12.30	3667	12.27	4279	12.33	4513	12.33	5234	12.37	5857	12.37	1046	12.23	478	12.03	1540	12.27	394	12.13	913	12.57	2475	12.33
EC24MK1P.DAT	Same as	EC24MK1C																						
EC24MK2E.DAT	2546	12.30	3667	12.27	4279	12.33	4513	12.33	5081	12.37	5705	12.37	1046	12.23	478	12.03	1540	12.27	394	12.13	913	12.57	2475	12.33
EC24MK2P.DAT	Same as	EC24MK2E																						
MD2EPM4R.DAT	2277	12.27	3564	12.30	3921	12.37	3921	12.37	4250	12.37	4562	12.37	838	12.10	814	12.03	2063	12.20	1581	12.17	627	12.27	2475	12.33
MD3EPM4R.DAT	2277	12.27	3564	12.30	3921	12.31	3921	12.37	4250	12.37	4562	12.37	838	12.10	622	12.03	2002	12.23	1581	12.17	627	12.27	2475	12.33
MD2PMMK2.DAT	2277	12.27	3432	12.27	3690	12.37	3922	12.37	4334	12.27	4746	12.27	838	12.10	814	12.03	2063	12.20	394	12.13	156	12.80	2475	12.33
MD2PMMK1.DAT	2277	12.27	3432	12.27	3690	12.37	3922	12.37	4334	12.27	4746	12.27	838	12.10	814	12.03	2063	12.20	394	12.13	156	12.80	2475	12.33
MD3PMMK2.DAT	2277	12.27	3432	12.27	3690	12.37	3922	12.37	4334	12.27	4746	12.27	838	12.10	622	12.03	2002	12.23	394	12.13	156	12.80	2475	12.33
MD3PMMK1.DAT	2277	12.27	3432	12.27	3690	12.37	3922	12.37	4334	12.27	4746	12.27	838	12.10	622	12.03	2002	12.23	394	12.13	156	12.80	2475	12.33
MDPMMKNJ.DAT	2277	12.27	2575	12.53	2838	12.70	1991	12.97	1980	13.07	2062	13.47	838	12.10	814	12.03	2063	12.20	394	12.17	156	12.80	2657	12.30
MK2ENJ4Q.DAT	2559	12.30	2883	12.53	3951	12.70	2006	13.00	2150	13.27	2203	13.57	1046	12.23	478	12.03	1540	12.27	394	12.13	913	12.57	2647	12.30
MD2ENJ4Q.DAT	2559	12.30	3051	12.53	4106	12.70	2194	12.90	2198	13.23	2221	13.53	1046	12.23	810	12.03	2035	12.20	1534	12.17	627	12.27	2665	12.30
MD2EMK2E.DAT	2546	12.30	3667	12.27	4279	12.33	4513	12.33	4824	12.33	5196	12.37	1046	12.23	810	12.03	2035	12.20	394	12.13	156	12.80	2475	12.33
MD2MK2NJ.DAT	2559	12.30	2883	12.53	3951	12.70	2006	13.00	2090	13.30	2121	13.57	1046	12.23	810	12.03	2035	12.20	394	12.17	156	12.80	2669	12.30
EC24PM_R.DAT	2277	12.27	2756	12.53	3025	12.67	3382	12.83	2018	13.27	2036	13.34	838	12.10	478	12.03	1434	12.27	1581	12.17	627	12.27	2320	12.33
EF24_NJ6.DAT	3133	12.23	4005	12.47	4553	12.60	5353	12.70	2714	13.40	2697	13.67	1126	12.10	629	12.03	2253	12.20	2165	12.17	889	12.27	3578	12.33
ET24_NJ6.DAT	1058	12.30	818	12.80	725	13.10	644	13.47	515	13.90	498	14.30	417	12.10	256	12.03	734	12.27	772	12.20	273	12.27	1185	12.27
ESPSBASE.DAT	6600	5.53	9174	5.50	12385	5.53	15413	5.53	16908	5.53	18404	5.53	1956	5.33	743	5.07	4092	5.40	3083	5.33	1504	5.47	6577	5.40
ESPS_CHL.DAT	6600	5.53	8300	5.70	11367	5.73	13851	5.77	14613	5.90	15427	6.00	1956	5.33	743	5.07	4092	5.40	3083	5.33	1504	5.47	18679	6.50
ESPS_GCL.DAT	3328	47.73	4353	47.90	6138	48.03	7562	48.10	8060	48.23	8533	48.37	1005	47.70	337	47.50	2004	47.70	1534	47.63	768	47.73	10861	49.03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C 108
R70
DIV 4
443
447
R109
442
R108
452
449
448
C 110
C 67
DIV 6
BASIN 4
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R110
C 115
C 114
R113
WSH 66
455
451
450
C 6364
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C 6465
R 6465
R 6364
R115
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C 117
C 118
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CD7
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Haines
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C455
S390
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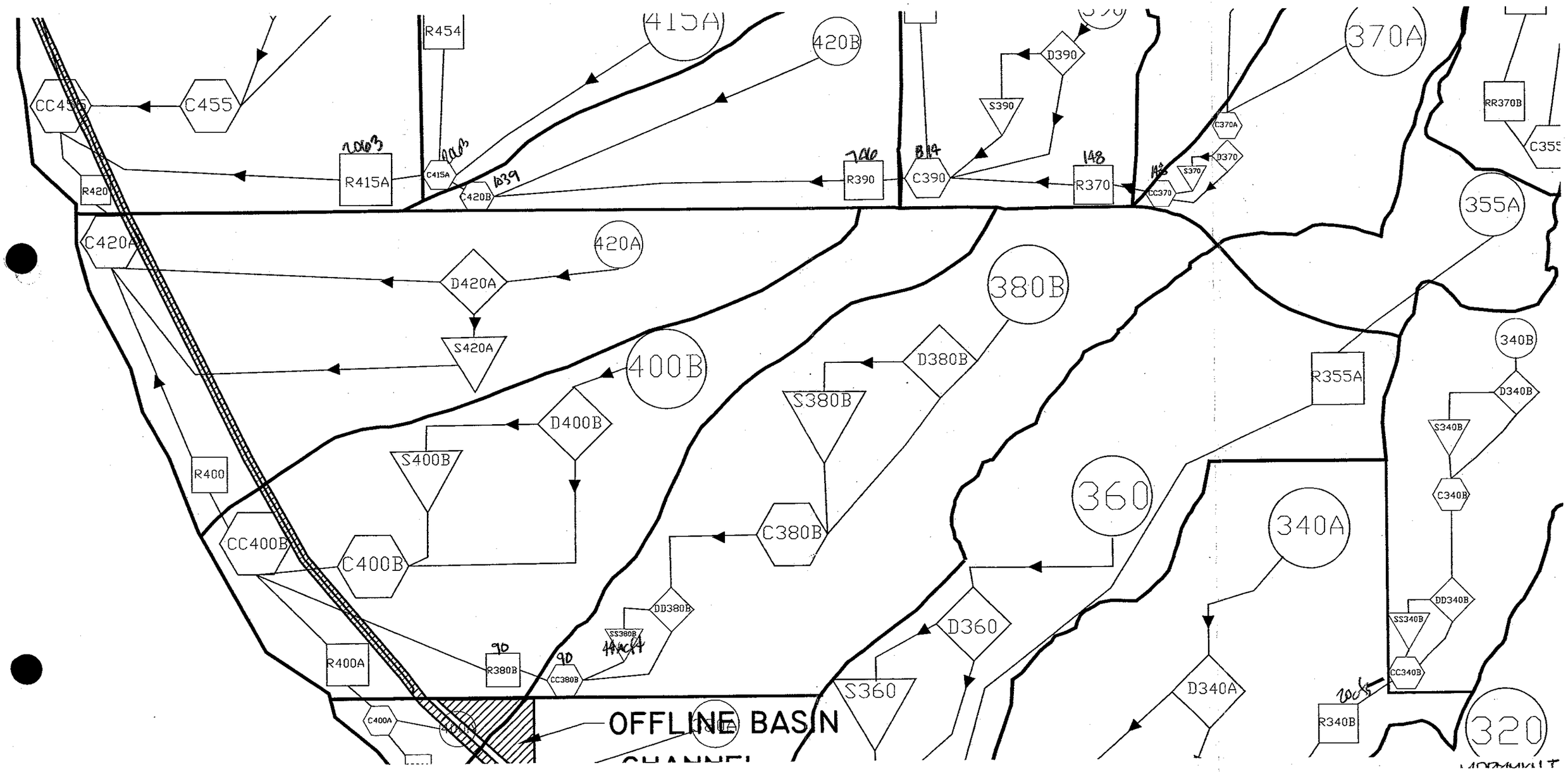
C35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R370
355A
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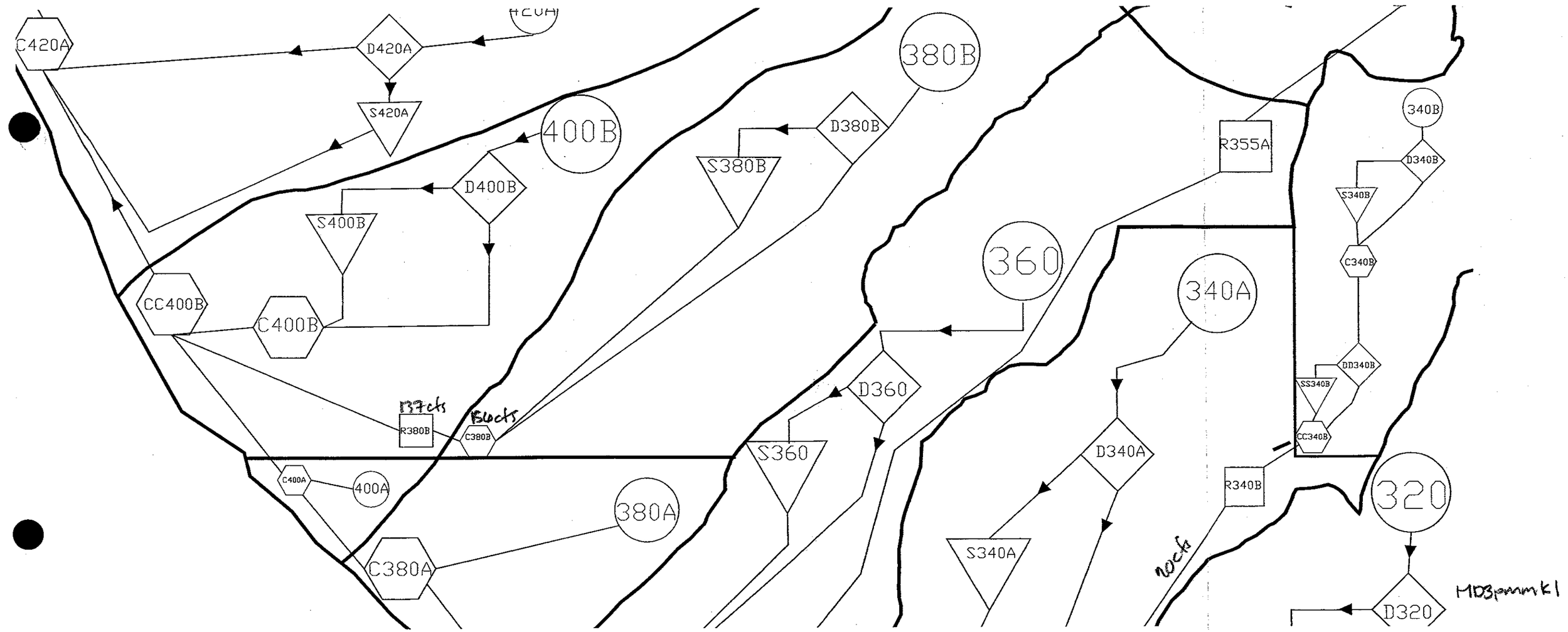
OFFLINE BASIN
320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380B
D380B
S380B
360
D360
S360
340A
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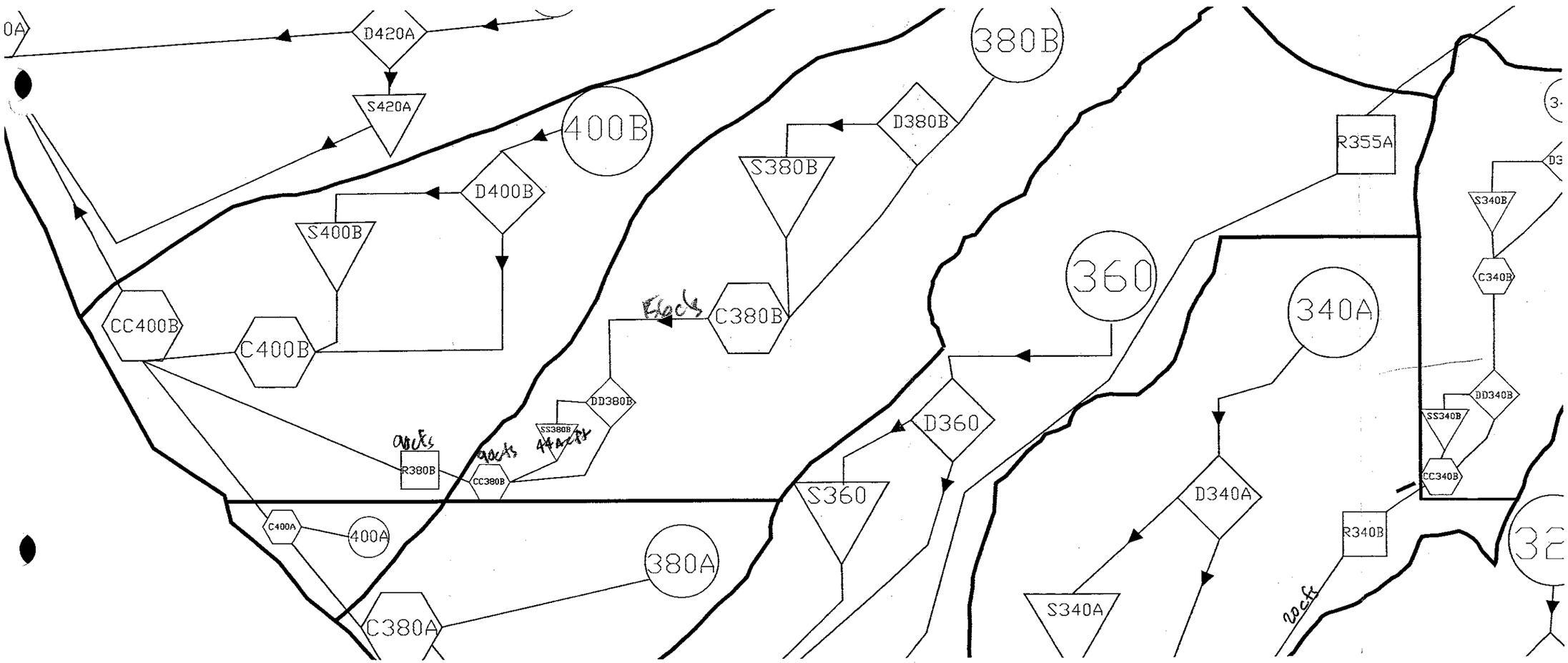
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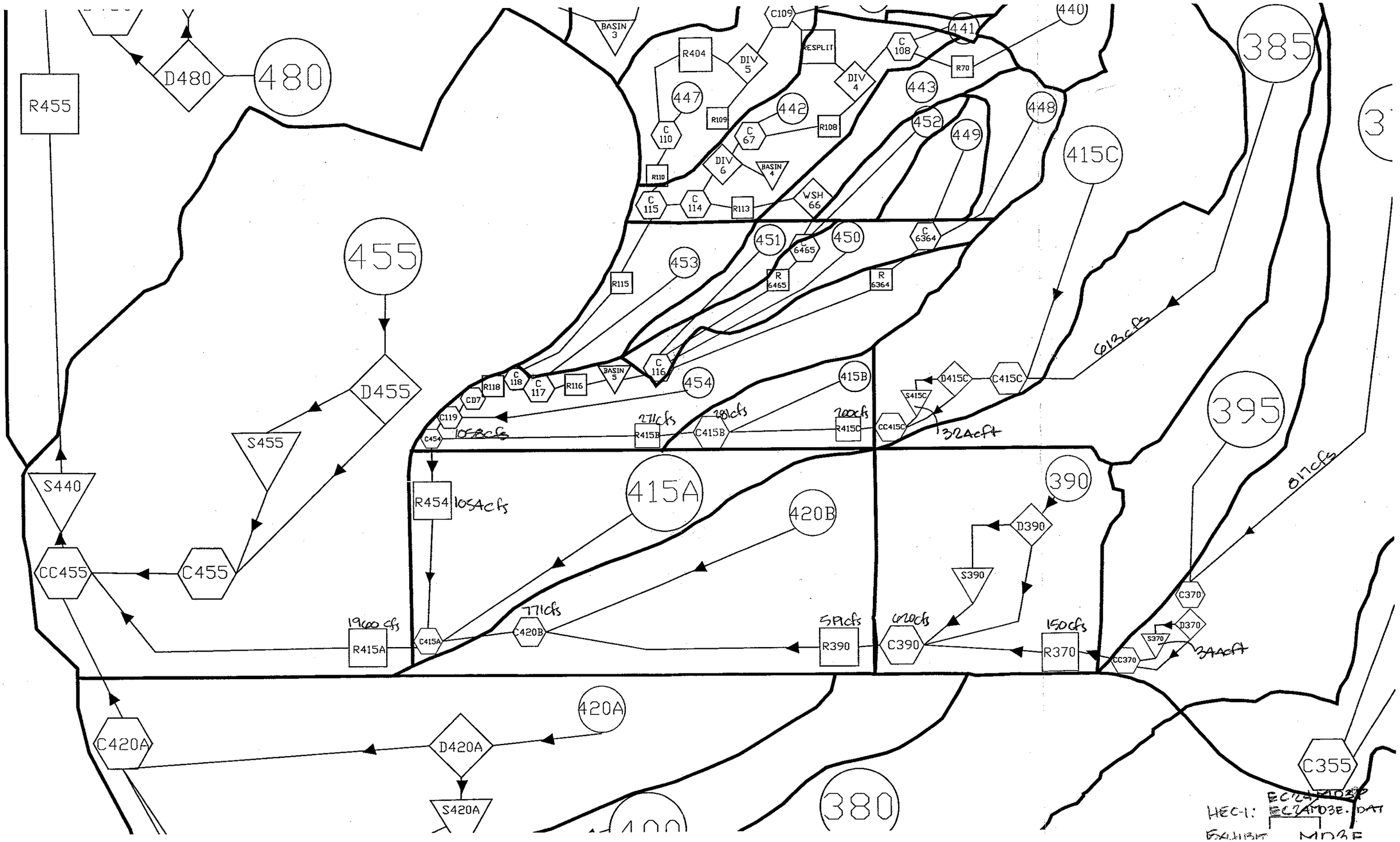
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C 67
R108
443
452
449
448
C 110
DIV 6
BASIN 4
R110
C 115
C 114
R113
WSH 66
415C
455
451
C 6465
450
C 6364
453
R115
R 6465
R 6364
D455
C 118
C 117
R118
CD7
R116
BASIN 5
C 116
454
415B
C119
C454
105.8cfs
271cfs
281cfs
200cfs
R415B
C415B
R415C
CC415C
S415C
D415C
C415C
613cfs
32Acft
395
S455
S440
R454
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415A
420B
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D390
S390
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CC455
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C420B
591cfs
R390
620cfs
C390
150cfs
R370
C370
D370
S370
CC370
34Acft
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D420A
S420A
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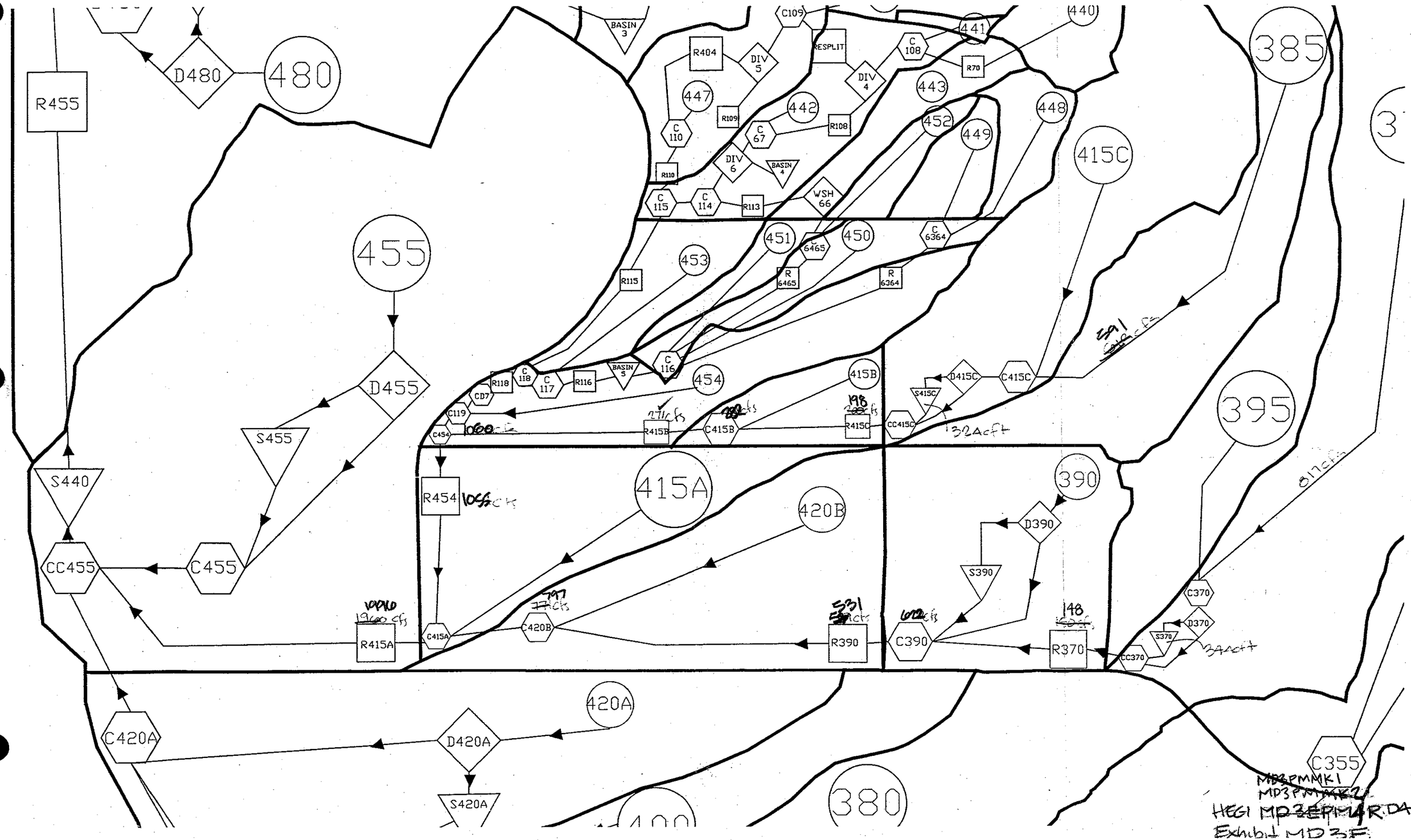
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448
R109
C 110
C 67
R108
452
449
415C
DIV 6
BASIN 4
R110
C 115
C 114
R113
WSH 66
455
451
6465
450
C 6364
453
R115
R 6465
R 6364
D455
C 116
BASIN 5
R118
C 118
C 117
R116
454
415B
CD7
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C454
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C415C
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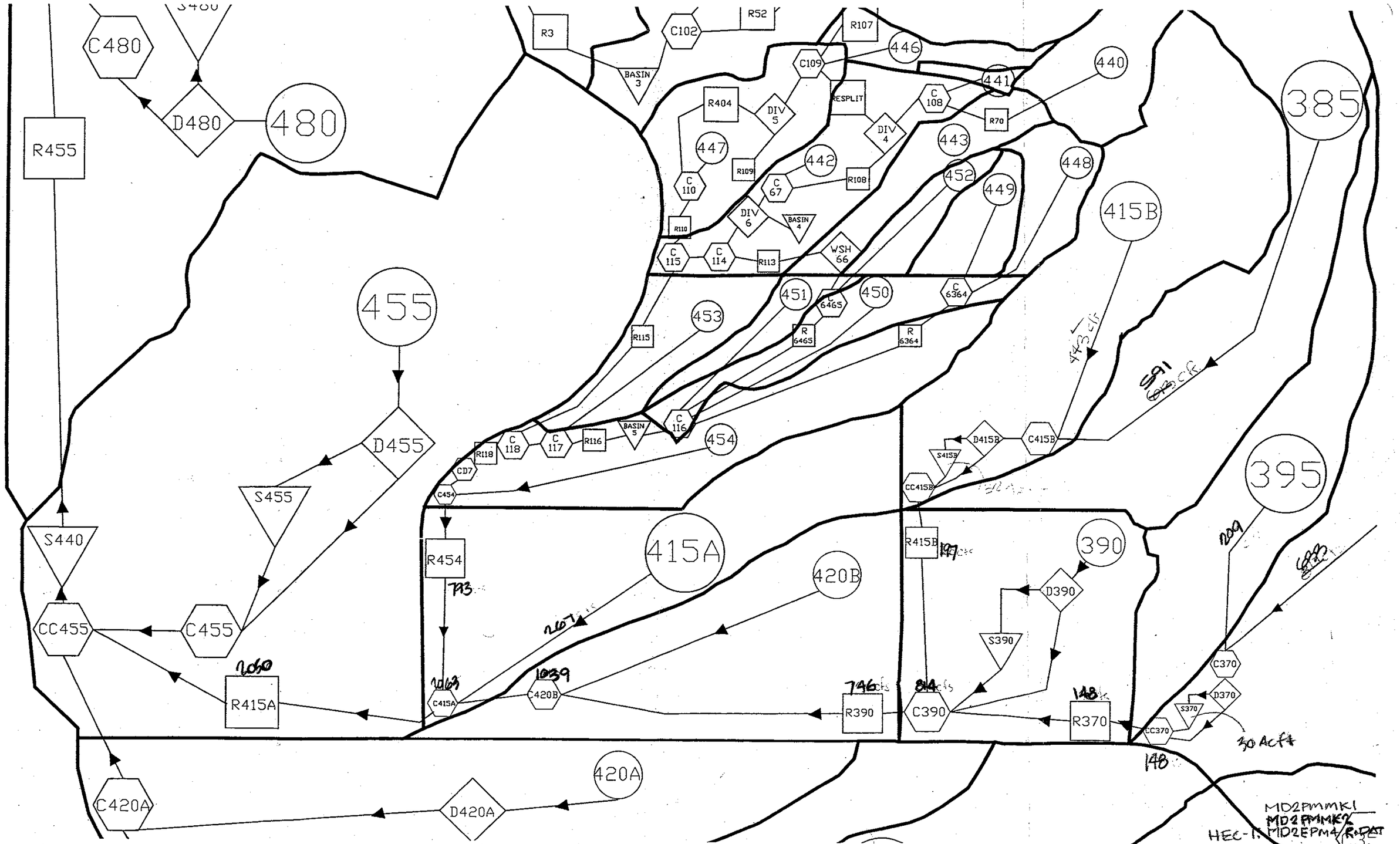
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R70
385
DIV 4
443
447
R109
442
R108
452
448
C 110
C 67
449
415B
DIV 6
BASIN 4
R110
C 115
C 114
R113
WSH 66
455
451
450
C 6364
453
C 6465
R115
R 6465
R 6364
D455
C 116
BASIN 5
454
R118
C 118
C 117
R116
CD7
C454
D415B
C415B
S415B
CC415B
395
S455
S440
R454
415A
420B
R415B
390
D390
S390
CC455
C455
R415A
C415A
C420B
R390
C390
R370
C370
D370
S370
CC370
30 Ac ft
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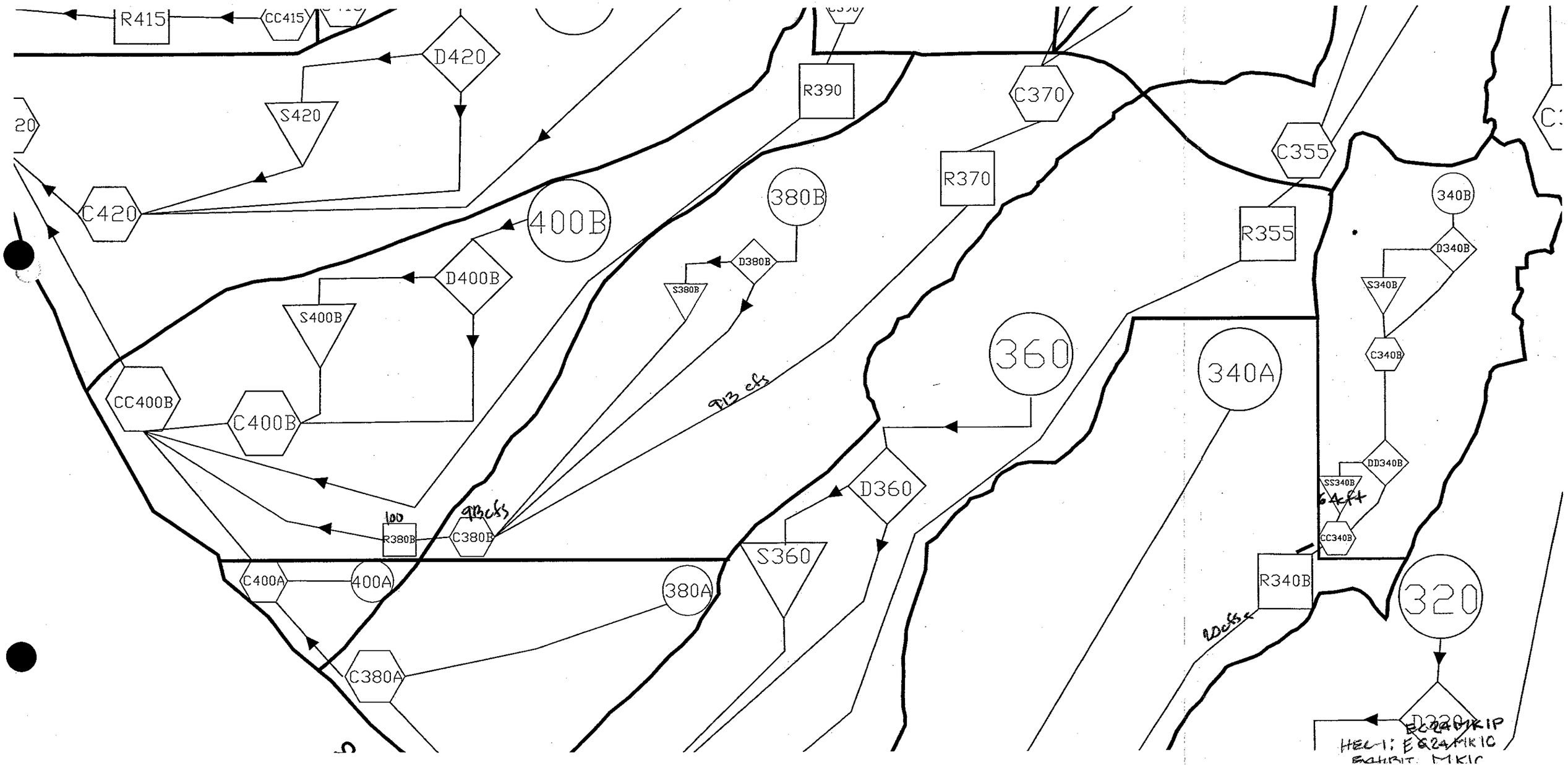
MD2PMMK2
MD2EPM4
HEC-1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CC415
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S420
20
C420
400B
D400B
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CC400B
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R390
C370
R370
380B
D380B
S380B
C355
R355
340B
D340B
S340B
C340B
DD340B
SS340B
CC340B
R340B
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340A
D360
S360
R380B
C380B
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C380A
320
D320
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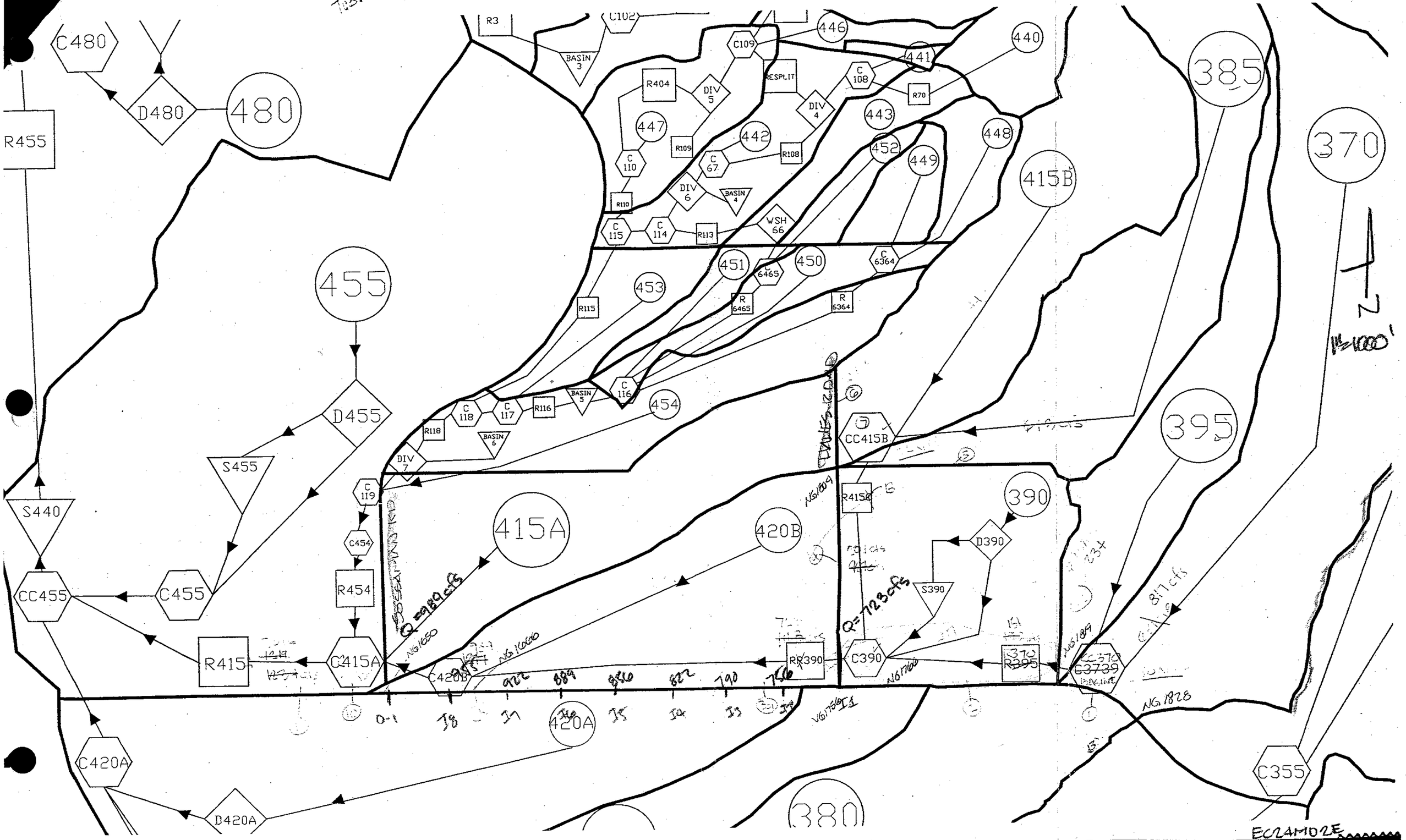
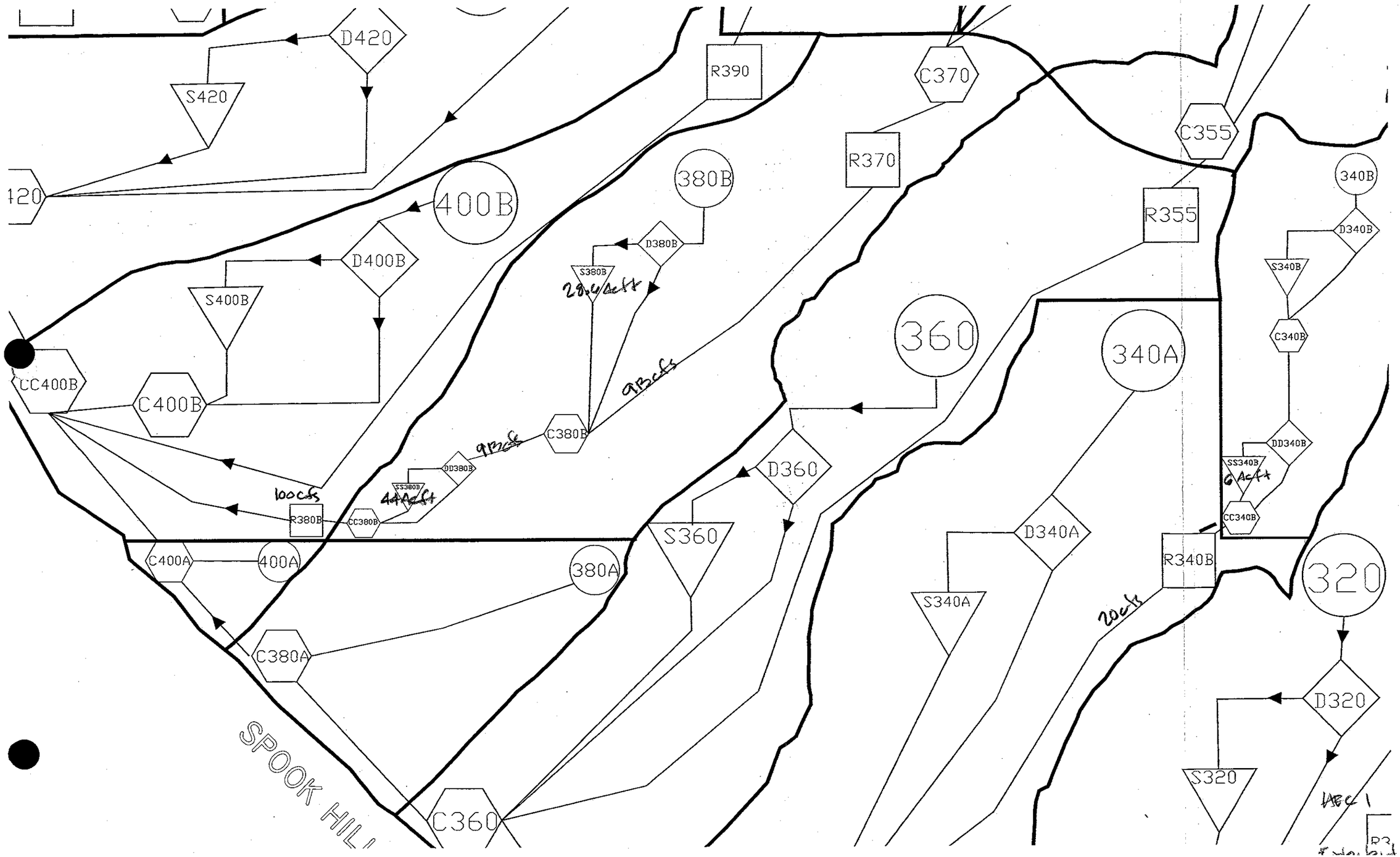
EXHIBIT MKIC

MIKE USNEU II
EC24MD2E FLOWS

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400B
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S380B
28.4Acft
9Bcfs
C380B
9Bcfs
DD380B
SS380B
44Acft
100cfs
R380B
CC380B
360
340A
340B
D340B
S340B
C340B
DD340B
SS340B
6Acft
CC340B
D360
S360
C400A
400A
380A
C380A
C360
D340A
S340A
R340B
20cfs
320
D320
S320
SPOOK HILL
MKZENJAQ
ECZAMKUP
ECZAMKZE
MKZE

Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

June 14, 2001
W/P # 99989

McKellips Road Alignment
Option MD2PMMK2
Landscaped Earthen Channel Option (APPROXIMATED)

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Excavation	$4.00	CY	4,944	$19,777
2	Drop Structures	$310	CY	341	$105,847
3	Splitter Structures	$60,000	EA	1	$60,000
4	Culverts	$310	CY	46	$14,384
5	Baisn Excavation	$4	CY	177,467	$709,867
		SUBTOTAL MAJOR ELEMENTS			$909,874
		CONTINGENCIES:			
		Construction		35%	$318,456
		Engineering		7%	$63,691
		Construction Admin		6%	$54,592
		TOTAL MAJOR ELEMENTS			**$1,346,614**

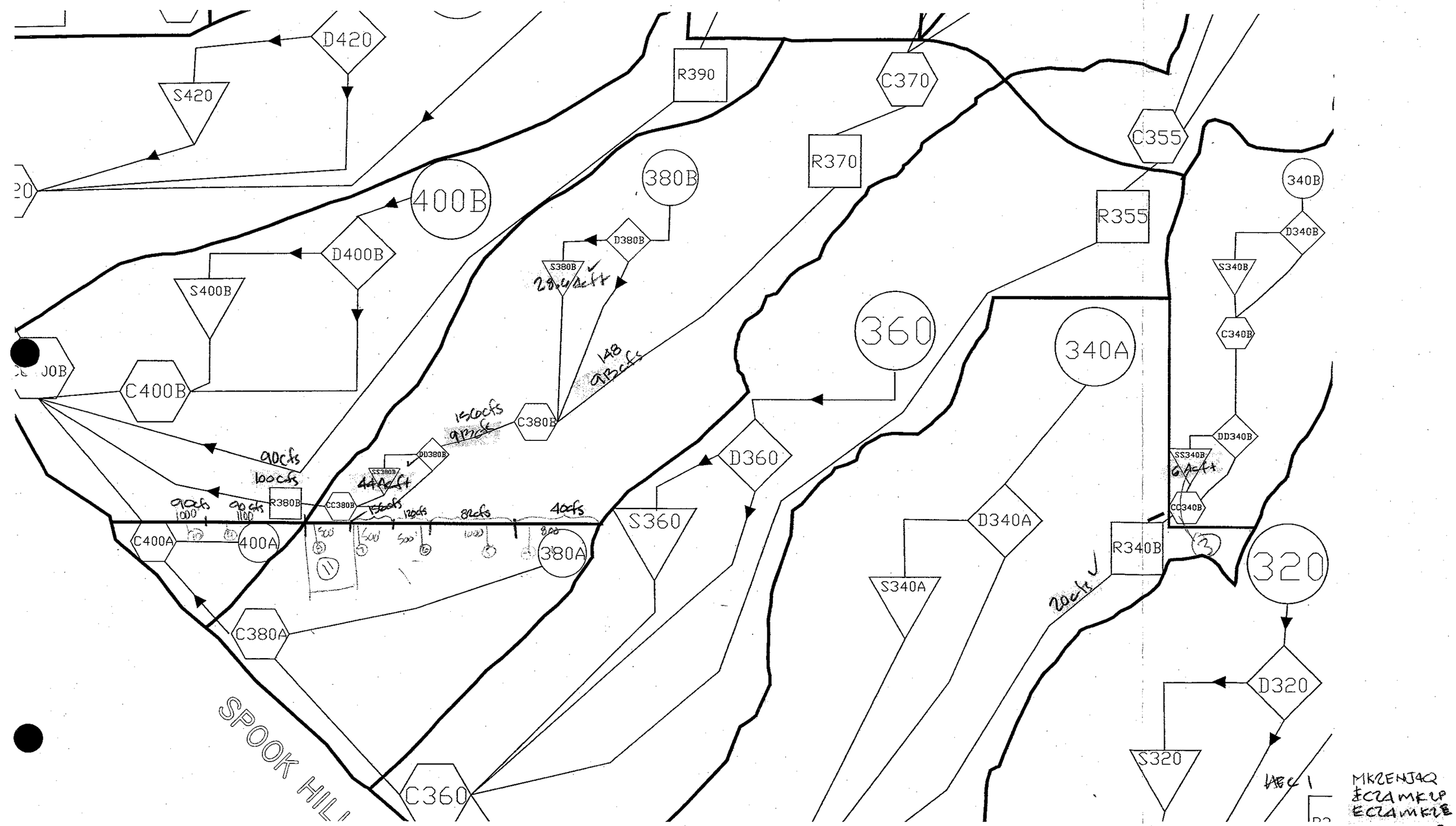
ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping (Channel & Basins)	$1.10	SF	492,296	$541,526
2	Fence	$12	LF	14,800	$177,600
3	Utility Relocations (W & S)	$8,000	EA	0	$0
		SUBTOTAL ADDITIONAL ELEMENTS			$719,126
		CONTINGENCIES:			
		Construction		35%	$251,694
		Engineering		7%	$50,339
		Construction Admin		6%	$43,148
		TOTAL ADDITIONAL ELEMENTS			**$1,064,306**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$16,000	AC	1.9	$30,848
2	Basin Land Acquisition	$14,300	AC	10.0	$143,000
		SUBTOTAL LAND ACQUISITION			$173,848
		CONTINGENCIES :		25%	$43,462
		TOTAL LAND ACQUISITION			**$217,310**
				TOTAL	***$2,628,230***

Note: Flow for this option (with Mcdowell and Pass Mt Diversion in place) flows are about 20% of existing flows. For approximation, estimated quantities have been reduced to 20% of existing .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S320
SPOOK HILL
90cfs
100cfs
90cfs
90cfs
1000
100
R380B
CC380B
150cfs
120cfs
82cfs
40cfs
1000
800
500
500
500
1000
800
1
148
93cfs
150cfs
93cfs
44cfs
20cfs
6cfs
3
MK2ENJ4Q
EC2AMK1P
EC2AMK2E
MD2PMMK2

Spook Hill ADMS Update August 1, 2001
Flood Control District of Maricopa County W/P # 99989
FCD 99-43

Alternative to Pass Mountain
Option EC2MD2E
Landscaped Earthen Channel Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Excavation	$4.00	CY	297,402	$1,189,608
2	Drop Structures	$310	CY	21,059	$6,528,303
3	Splitter Structures	$60,000	EA	4	$240,000
4	Culverts	$310	CY	2,663	$825,530
5	Basin Excavation	$4	CY	250,067	$1,000,267
		SUBTOTAL MAJOR ELEMENTS			$9,783,707
		CONTINGENCIES:			
		Construction		35%	$3,424,298
		Engineering		7%	$684,860
		Construction Admin		6%	$587,022
		TOTAL MAJOR ELEMENTS			**$14,479,887**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping (Channel & Basins	$1.10	SF	3,005,734	$3,306,307
2	Fence	$12	LF	67,580	$810,960
3	Utility Relocations (W & S)	$8,000	EA	2	$16,000
		SUBTOTAL ADDITIONAL ELEMENTS			$4,133,267
		CONTINGENCIES:			
		Construction		35%	$1,446,644
		Engineering		7%	$289,329
		Construction Admin		6%	$247,996
		TOTAL ADDITIONAL ELEMENTS			**$6,117,236**

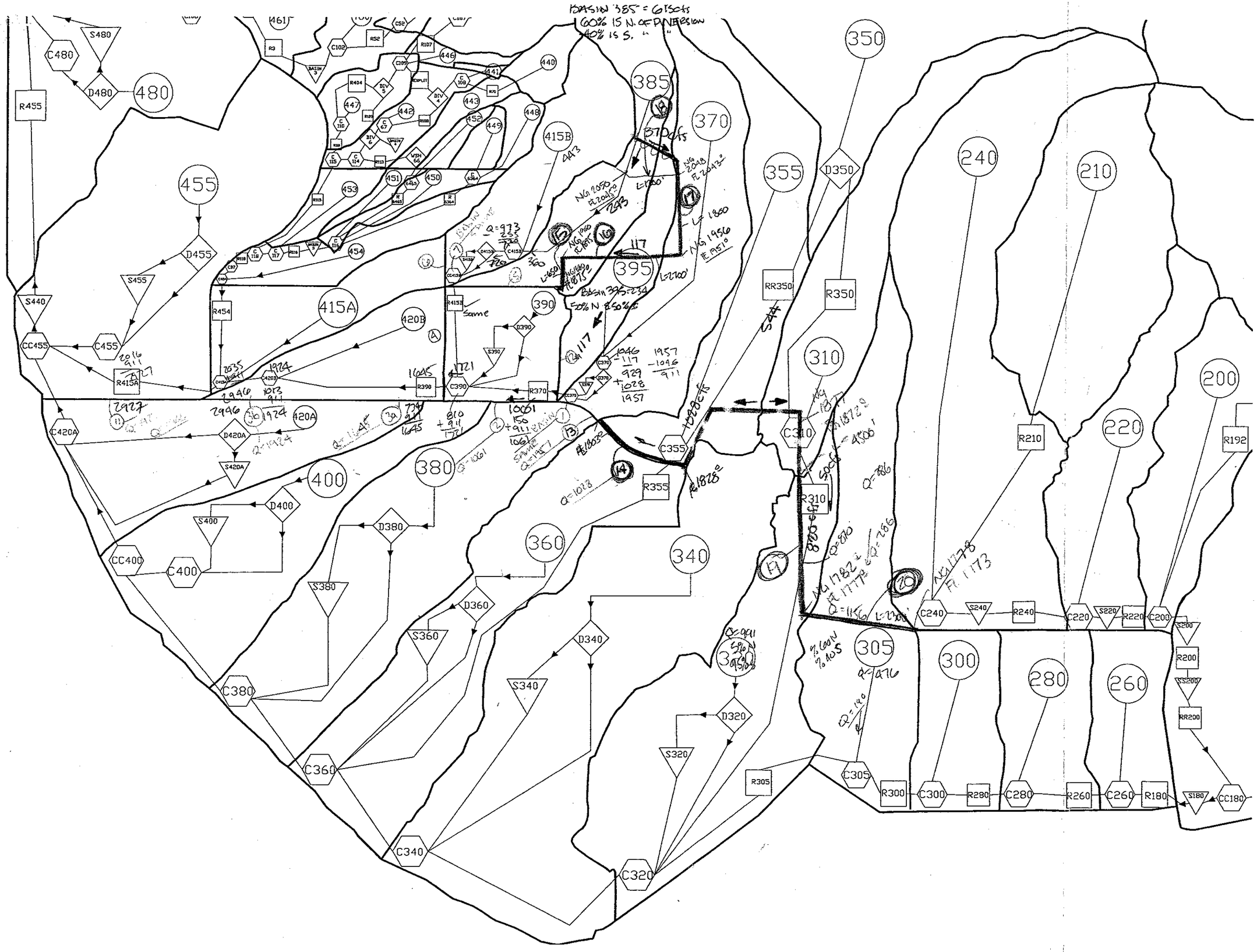
LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$88,774	AC	78.53	$6,971,422
2	Basin Land Acquisition	$24,200	AC	18.62	$450,604
		SUBTOTAL LAND ACQUISITION			$7,422,026
		CONTINGENCIES :		25%	$1,855,507
		TOTAL LAND ACQUISITION			**$9,277,533**
				TOTAL	***$29,874,655***

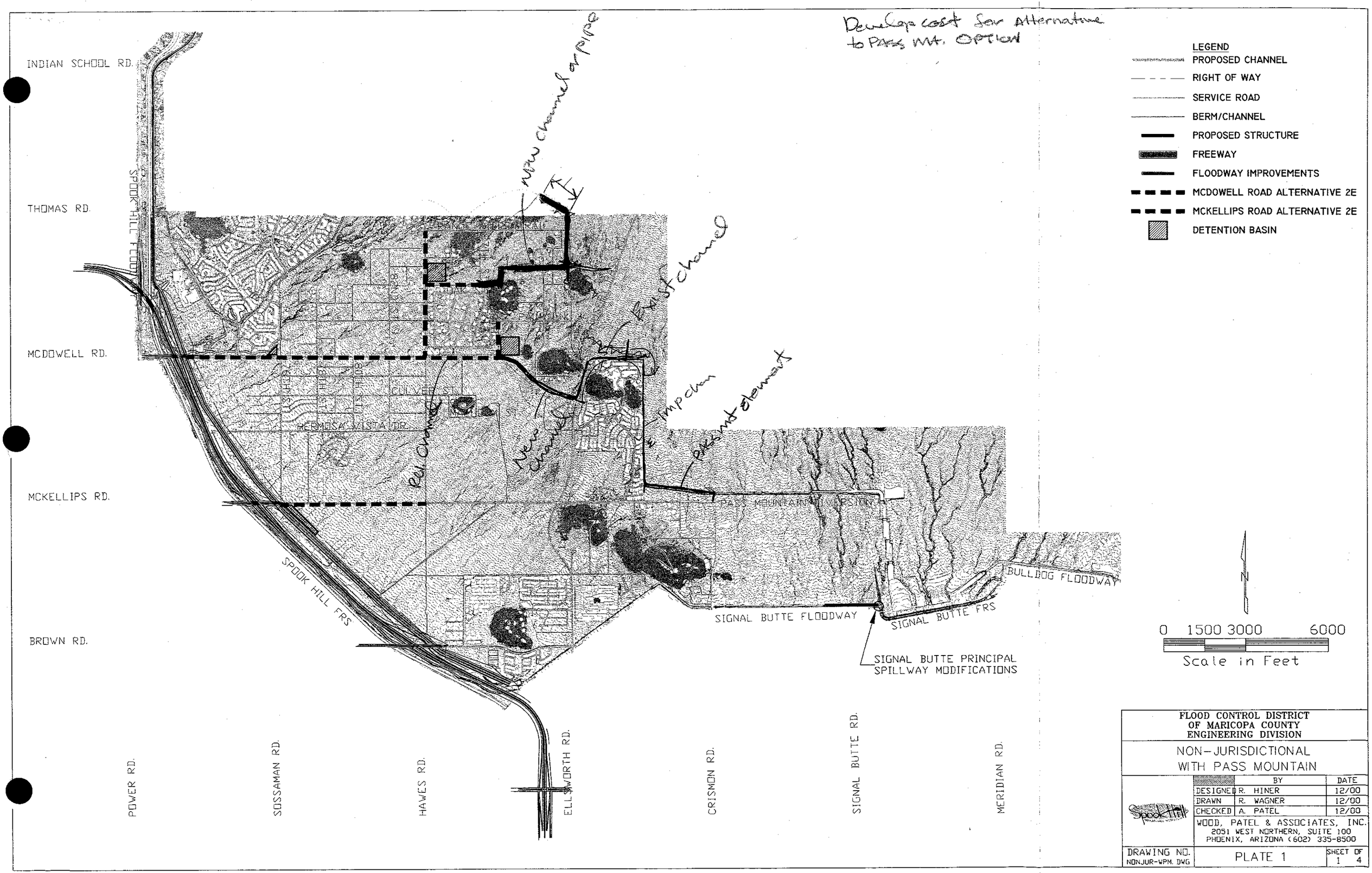
Land Takes
Alternative to Pass Mountain
Level II

Segment	Feature	Parcel	Take (T, P, or N)	Parcel Area (acres)	Parcel Width (ft)	Depth of Take (ft)	Take Area (acres)	Take Area (%)	Land Value ($)	Cost ($)		
2	Channel	219-24-048	P	1.50	110	30	1.50	100.00%	$232,000	$232,000		
2	Channel	219-24-049	P	1.50	260	30	1.50	100.00%	$279,500	$279,500		
2	Channel	219-24-050	P	1.00	180	30	1.00	100.00%	$62,000	$62,000		
2	Channel	219-24-051	P	1.00	180	30	1.00	100.00%	$62,000	$62,000		
2	Channel	219-24-052	P	1.00	180	30	1.00	100.00%	$62,000	$62,000		
2	Channel	219-24-053	P	1.00	180	30	1.00	100.00%	$254,500	$254,500		
2	Channel	219-24-054	P	1.00	180	30	1.00	100.00%	$62,000	$62,000		
2	Channel	219-24-055	P	1.00	180	30	1.00	100.00%	$62,000	$62,000		
2	Channel	219-24-056	P	1.00	180	72	1.00	100.00%	$65,000	$65,000		
2	Channel	219-24-057	P	1.00	180	72	1.00	100.00%	$264,000	$264,000		
2	Channel	219-24-058	P	1.00	180	72	1.00	100.00%	$268,500	$268,500		
2	Channel	219-24-059	P	1.00	180	72	1.00	100.00%	$62,000	$62,000		
2	Channel	219-24-060	P	1.00	180	72	1.00	100.00%	$305,000	$305,000	$2,040,500	
3a	Channel	219-23-025G	T				0.99	100.00%	$138,000	$138,000		
3a	Channel	219-23-026E	P	4.70	330	107	0.81	17.25%	$439,109	$75,733		
3a	Channel	219-23-027G	T				1.09	100.00%	$180,500	$180,500		
3a	Channel	219-23-027D	T				1.14	100.00%	$154,000	$154,000		
3a	Channel	219-23-027B	P	4.70	330	107	0.81	17.25%	$187,500	$32,338		
3a	Channel	219-23-028L	T				0.90	100.00%	$180,500	$180,500		
3a	Channel	219-23-028N	T				0.88	100.00%	$208,690	$208,690		
3a	Channel	219-23-028E	T				1.17	100.00%	$179,000	$179,000		
3a	Channel	219-23-028J	T				1.31	100.00%	$179,000	$179,000		
3a	Channel	219-23-029B	P	2.82	198	107	0.49	17.25%	$158,500	$27,336		
3a	Channel	219-23-029C	P	1.88	132	107	0.32	17.25%	$64,500	$11,124		
3a	Channel	219-23-030A	P	2.34	165	107	0.41	17.32%	$172,500	$29,878		
3a	Channel	219-23-031A	P	2.35	165	107	0.41	17.25%	$134,500	$23,197	$1,419,297	
3b	Channel	219-22-012C	P	2.35	165	120	0.45	19.34%	$70,200	$13,578		
3b	Channel	219-22-012B	P	2.35	165	120	0.45	19.34%	$150,000	$29,014		
3b	Channel	219-22-023C	T				0.87	100.00%	$127,000	$127,000		
3b	Channel	219-22-023E	T				1.33	100.00%	$156,500	$156,500		
3b	Channel	219-22-022G	P	2.03	305	120	0.84	41.39%	$104,500	$43,253		
3b	Channel	219-22-021A	P	4.20	330	120	0.91	21.65%	$111,500	$24,134		
3b	Channel	219-22-020C	P	4.48	420	120	1.16	25.83%	$89,560	$23,130		
3b	Channel	219-22-019H	P	1.81	190	120	0.52	28.92%	$63,000	$18,218		
3b	Channel	219-22-018Q	T				0.93	100.00%	$122,500	$122,500		
3b	Channel	219-22-018L	T				0.8	100.00%	$124,500	$124,500		
3b	Channel	219-22-024B	T				0.8	100.00%	$61,000	$61,000		
3b	Channel	219-22-024D	P	1.89	130	120	0.36	18.95%	$216,000	$40,929	$783,756	
1	Basin	219-33-027A	P	19.28	609	660	9.23	47.86%	$385,600	$184,545	$184,545	
10	Basin	219-19-8K	P	32.56	660	330	0.00	0.00%	$1,418,300	$0	$0	
12	Channel	219-33-027A	P	19.28	1246	43	1.23	6.38%	$385,600	$24,600	$24,600	
13	Channel	219-31-004E	T				0.24	100.00%	$16,000	$16,000		
13	Channel	219-31-004F	T				1.21	100.00%	$148,500	$148,500		
13	Channel	219-31-004C	P	7.81	660	87	1.32	16.88%	$169,000	$28,524	$193,024	
6	Channel	219-24-003M	P	4.70	330	45	0.34	7.25%	$322,000	$23,356		
6	Channel	219-24-003P	T				2.20	100.00%	$193,500	$193,500		
6	Channel	219-24-001H	P	37.90	635	45	0.66	1.73%	$720,000	$12,462		
6	Channel	219-24-001Q	P	8.90	625	45	0.65	7.25%	$258,500	$18,608	$247,926	
7	Basin	219-24-003N	T	9.39	620	660	9.39	100.00%	$266,000	$266,000	$266,000	
5	Channel	219-24-003R	P	5.00	330	82	0.62	12.42%	$191,000	$23,730		
5	Channel	219-24-003V	T				1.1	100.00%	$170,500	$170,500		
5	Channel	219-24-003U	T				1.1	100.00%	$193,500	$193,500		
5	Channel	219-24-004G	P	10.00	659.68	82	1.24	12.42%	$200,000	$24,836		
5	Channel	219-24-004F	T				1.3	100.00%	$25,980	$25,980		
5	Channel	219-24-004D	T				3.7	100.00%	$74,020	$74,020	$512,567	
14	Channel		P				4.6			$1,001,880		
15	Channel		P				1.1			$35,937		
16	Channel		P				4.2			$137,214		
17	Channel		P				2.6			$84,942		
18	Channel		P				1.6			$52,272		
19	Channel		P				8.4			$274,428		
20	Channel		P				5			$163,350	$1,750,023	
						Total (ac)	97.15				$7,422,238	76398.34
						Basin (ac)	18.62				$450,545	24195.28
						Channel (ac)	78.53				$6,971,692	88773.88

			I.D.	Design Q100 (cfs)	Comp. Capacity (cfs)	Downstream Invert Elevation (ft)	Upstream Invert Elevation (ft)	Length (ft.)	Computed Invert Slope (ft./ft.)	Design Invert Slope (ft./ft.)	Total Vertical Drop (ft.)	No. of Drops	Vertical Drop (ft.)	Material Type	Manning's "n" Value	Bottom Width, W (ft.)	Depth of Flow(ft.)	Sideslope (H:1) Left (H:1)	Sideslope (H:1) Right (H:1)	Area (sf)	Perimeter (ft.)	Flow Top Width (ft)	Hydraulic Depth (ft)	Froude Number	Type of Flow	Velocity (fps)	Freeboard (ft.)	Channel Design Freeboard (ft)	Channel Topwidth Including Freeboard(ft)	Channel Width Plus 10' Access Road	Excavated Volume (cy)	Unit Cost ($/cy)	Excavation Cost	Concrete Volume (cy)	Unit Cost ($/cy)	Concrete Cost	Fence Length (ft.)	Unit Cost ($/lf)	Fence Cost	Drop Structures (No.)	Drop Structure Size (CY)	Unit Cost ($/cy)	Drop Structures Cost	No. of Utility Crossings	Unit Cost ($ per crossing)	Utilities Cost	Channel Length (ft)	Landscape Width Required (ft.)	Landscape Area Required (s.)	Landscaping Unit Cost ($/sf)	Total Landscape Cost	Land Acquisition (Channel & Maint. Road)(Ac.)	Zoning	Unit Cost ($/sf)	Channel Land Acquisition Cost	Total Construction Cost	Total Contingencies Cost	Total Construction, Land, Landscape, and Contingencies Costs
McDowell-partial pass mt			12a	117	123	1828.0	1840.0	660	0.0182	0.0045	9.0	3	3.0	e	0.0250	8.0	1.8	4	4	27.4	22.8	22.4	1.2	0.72	Sub	4.5	1.0	2.8	30.4	46.4	1,314	$4	$5,257	0	$310	$0	1,320	$12	$15,840	3	47.7	$310	$44,377	0	$3,000	$0	660	30	20064	$1.10	$22,070.4	0.7	Res. N.	$1.00	$30,624	$65,842	$25,020	$143,556
			12b	26	26	1816.0	1828.0	660	0.0182	0.0045	9.0	3	3.0	e	0.0250	8.0	0.8	4	4	9.0	14.6	14.4	0.6	0.64	Sub	2.9	1.0	1.8	22.4	38.4	669	$4	$2,675	0	$310	$0	1,320	$12	$15,840	3	35.2	$310	$32,699	0	$3,000	$0	660	22	14784	$1.10	$16,262.4	0.6	Res. N.	$1.00	$26,344	$51,486	$19,565	$112,656
			2a	1061	1035	1763.0	1816.0	2140	0.0248	0.0065	39.0	13	3.0	e	0.0250	20.0	3.5	4	4	119.0	48.9	48.0	2.5	0.97	Trans	8.7	2.0	5.5	61.0	80.0	18,309	$4	$73,236	0	$310	$0	4,280	$12	$51,360	13	100.2	$310	$403,539	0	$3,000	$0	2140	64	136960	$1.10	########	3.9	Res. N.	$1.00	$171,200	$531,489	$201,966	########
			2b	1721	1687	1762.0	1763.0	500	0.0200	0.0013	9.4	3	3.1	e	0.0250	45.0	5.0	4	4	325.0	86.2	85.0	3.8	0.47	Sub	5.2	1.4	6.4	85.8	111.8	8,267	$4	$33,147	0	$310	$0	1,000	$12	$12,000	3	155.4	$310	$144,476	0	$3,000	$0	500	96	47918	$1.10	$52,710.2	1.3	Res. N.	$1.00	$55,918	$191,206	$72,658	$372,493
			3a	1645	1650	1661.0	1751.0	4280	0.0210	0.0015	83.6	27	3.1	e	0.0250	40.0	5.0	4	4	300.0	81.2	80.0	3.8	0.50	Sub	5.5	1.4	6.4	80.9	106.9	66,082	$4	$264,330	0	$310	$0	8,560	$12	$102,720	27	146.5	$310	########	0	$3,000	$0	4280	91	389221	$1.10	########	10.5	Res. N.	$1.00	$457,701	########	$610,268	########
			3b	1924	1912	1645.0	1661.0	1000	0.0160	0.0012	14.8	5	3.0	e	0.0250	50.0	5.2	4	4	370.0	90.0	91.8	4.0	0.45	Sub	5.2	1.4	6.6	103.0	119.0	18,785	$4	$75,140	0	$310	$0	2,000	$12	$24,000	5	159.2	$310	$246,819	0	$3,000	$0	1000	103	103030	$1.10	########	2.7	Res. N.	$1.00	$119,090	$347,668	$132,121	$712,171
			11	2927	1900	1580.0	1642.0	1550	0.0400	0.0011	60.3	20	3.0	e	0.0250	60.0	4.9	4	4	390.0	100.4	99.2	3.9	0.43	Sub	4.9	1.3	6.2	109.7	125.7	30,290	$4	$121,161	0	$310	$0	3,100	$12	$37,200	20	172.5	$310	########	0	$3,000	$0	1550	110	170092	$1.10	########	4.5	Res. N.	$1.00	$194,692	########	$470,009	########
			4	201	151	1739.0	1753.0	2640	0.0053	0.0053	0.0	0	0.0	e	0.0250	8.0	1.9	4	4	29.9	23.8	23.3	1.3	0.78	Sub	5.0	1.0	2.9	31.3	47.3	5,588	$4	$22,353	0	$310	$0	5,280	$12	$63,360	0	0.0	$310	$0		$3,000	$0	2640	31	82579	$1.10	$90,837.1	2.9	$1	$1.00	$124,819	$85,718	$32,571	
			5	750	746	1799.0	1875.0	2640	0.0288	0.0015	72.0	24	3.0	e	0.0250	20.0	4.3	4	4	160.0	55.5	54.4	2.9	0.48	Sub	4.7	1.2	5.5	63.7	79.7	22,334	$4	$89,335	0	$310	$0	5,280	$12	$63,360	24	99.7	$310	$741,707	0	$3,000	$0	2640	64	168104	$1.10	########	4.8	Res. N.	$1.00	$210,344	$900,408	$342,155	########
			6	100	106	1801.0	1828.0	1320	0.0189	0.0065	16.4	6	2.7	e	0.0250	10.0	1.4	4	4	21.8	21.5	21.2	1.0	0.64	Sub	4.8	1.0	2.4	29.2	45.2	2,300	$4	$9,199	0	$310	$0	2,640	$12	$31,680	6	42.0	$310	$78,102	0	$3,000	$0	1320	29	38544	$1.10	$42,398.4	1.4	Res. N.	$1.00	$69,664	$119,032	$45,232	$266,326
			13	1028	1014	1816.0	1825.0	1000	0.0090	0.0015	7.5	3	2.5	e	0.0250	20.0	5.0	4	4	200.0	61.2	60.0	3.3	0.49	Sub	5.1	1.3	6.3	70.9	86.8	10,677	$4	$42,707	0	$310	$0	2,000	$12	$24,000	3	93.7	$310	$87,179	0	$3,000	$0	1000	71	70798	$1.10	$77,877.4	2.0	Res. N.	$1.00	$96,796	$153,257	$58,238	$376,169
			14	1028	1014	1803.0	1828.0	2300	0.0109	0.0015	21.6	7	3.1	e	0.0250	20.0	5.0	4	4	200.0	61.2	60.0	3.3	0.49	Sub	5.1	1.3	6.3	70.8	86.8	24,556	$4	$98,225	0	$310	$0	4,600	$12	$55,200	7	113.5	$310	$246,216	0	$3,000	$0	2300	71	162635	$1.10	########	4.6	Res. N.	$1.00	$199,635	$402,112	$152,803	$833,668
			15	500	500	1875.0	1895.0	700	0.0286	0.0020	16.6	6	3.1	e	0.0250	15.0	3.6	4	4	105.8	44.7	43.8	2.4	0.54	Sub	4.7	1.0	4.6	51.8	67.8	3,963	$4	$15,933	0	$310	$0	1,400	$12	$16,800	6	83.6	$310	$155,406	0	$3,000	$0	700	52	36260	$1.10	$39,886.0	1.1	Res. N.	$1.00	$47,460	$189,780	$72,117	$349,243
			16	487	500	1895.0	1951.0	2700	0.0207	0.0020	50.6	17	3.0	e	0.0250	15.0	3.6	4	4	105.8	44.7	43.8	2.4	0.54	Sub	4.7	1.0	4.6	51.8	67.8	15,364	$4	$61,456	0	$310	$0	5,400	$12	$64,800	17	80.5	$310	$424,080	0	$3,000	$0	2700	52	139860	$1.10	########	4.2	Res. N.	$1.00	$183,060	$553,492	$210,327	########
			17	370	370	1951.0	2043.0	1800	0.0511	0.0020	88.4	30	2.9	e	0.0250	15.0	3.1	4	4	84.9	40.6	39.8	2.1	0.52	Sub	4.4	1.0	4.1	47.8	63.8	8,583	$4	$34,331	0	$310	$0	3,600	$12	$43,200	30	73.6	$310	$684,207	0	$3,000	$0	1800	48	86040	$1.10	$94,644.0	2.6	Res. N.	$1.00	$114,840	$766,290	$291,190	########
			18	370	370	2043.0	2045.0	1100	0.0018	0.0020	-0.2	0	0.0	e	0.0250	15.0	3.1	4	4	84.9	40.6	39.8	2.1	0.52	Sub	4.4	1.0	4.1	47.8	63.8	5,245	$4	$20,980	0	$310	$0	2,200	$12	$26,400	0	0.0	$310	$0	0	$3,000	$0	1100	48	52580	$1.10	$57,838.0	1.6	Res. N.	$1.00	$70,180	$47,360	$18,004	$193,402
			19	870	859	1777.0	1872.0	4500	0.0211	0.0016	88.3	29	3.0	e	0.0250	15.0	5.0	4	4	175.0	56.2	55.0	3.2	0.46	Sub	4.9	1.3	6.3	65.7	81.7	42,685	$4	$170,741	0	$310	$0	9,000	$12	$108,000	29	104.2	$310	$937,187	0	$3,000	$0	4500	66	295865	$1.10	########	8.4	Res. N.	$1.00	$367,865	########	$465,313	########
			20	1160	1217	1773.0	1777.0	2300	0.0017	0.0016	0.3	1	0.3	e	0.0250	30.0	4.7	4	4	229.4	68.8	67.6	3.4	0.51	Sub	5.3	1.3	6.0	77.9	93.9	27,496	$4	$109,985	0	$310	$0	4,600	$12	$55,200	1	21.4	$310	$6,625	0	$3,000	$0	2300	78	179113	$1.10	########	5.0	Res. N.	$1.00	$215,913	$169,247	$84,314	$468,487


BASIN 385 = 615cfs
60% IS N. OF DIVERSION
40% IS S. " "
N
1"=200'
480
455
415A
415B
420B
420A
400
380
360
340
385
370
395
390
350
355
310
305
300
280
260
240
210
220
200
S480
C480
D480
R455
D455
S455
S440
CC455
C455
R415A
R454
C420A
D420A
S420A
D400
S400
CC400
C400
D380
S380
C380
D360
S360
C360
D340
S340
C340
D320
S320
C320
R390
C390
R370
C355
R355
RR350
R350
D350
C310
R310
C240
S240
R240
C220
S220
R220
C200
S200
R200
SS200
RR200
R210
R192
R305
C305
R300
C300
R280
C280
R260
C260
R180
S180
CC180

Develop cost for Alternative to Pass Mt. OPTION



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY ENGINEERING DIVISION		
NON-JURISDICTIONAL WITH PASS MOUNTAIN		
	BY	DATE
DESIGNED	R. HINER	12/00
DRAWN	R. WAGNER	12/00
CHECKED	A. PATEL	12/00
WOOD, PATEL & ASSOCIATES, INC. 2051 WEST NORTHERN, SUITE 100 PHOENIX, ARIZONA (602) 335-8500		
DRAWING NO. NONJUR-WPM. DWG	PLATE 1	SHEET OF 1 4

Spook Hill ADMS Update May 7, 2001
Flood Control District of Maricopa County W/P # 99989
FCD 99-43

Spook Hill Floodway Channel Design
File: New_Geo
Revised Incised Concrete Channel with Gabion Outlet

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Concrete Channel	$310	CY	14,300	$4,433,000
2	Channel Excavation	$4	CY	68,000	$272,000
3	Gabion Channel Lining	$75	CY	14,600	$1,095,000
4	Concrete Bridge	$60	SF	6,400	$384,000
		SUBTOTAL MAJOR ELEMENTS			$6,184,000
		CONTINGENCIES:			
		Construction		35%	$2,164,400
		Engineering		7%	$432,880
		Construction Admin		6%	$371,040
		TOTAL MAJOR ELEMENTS			**$9,152,320**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Box Culvert Removal (Thomas Rd)	$100,000	Job	1	$100,000
2	Utility Relocations (W & S)	$8,000	EA	0	$0
		SUBTOTAL ADDITIONAL ELEMENTS			$100,000
		CONTINGENCIES:			
		Construction		35%	$35,000
		Engineering		7%	$7,000
		Construction Admin		6%	$6,000
		TOTAL ADDITIONAL ELEMENTS			**$148,000**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$0	AC	0.00	$0
2	Basin Land Acquisition	$0	AC	0.00	$0
		SUBTOTAL LAND ACQUISITION			$0
		CONTINGENCIES :		25%	$0
		TOTAL LAND ACQUISITION			**$0**

TOTAL ***$9,300,320***

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS

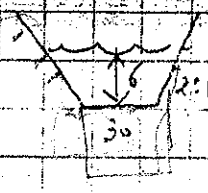
PROJECT Spankhill Floodway

PROJECT NO. _____ SHEET NO. _____ OF _____

CALCULATED BY Acp DATE 10/22/96 CHECKED BY _____ DATE _____

Potential Upgrade

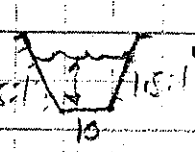
Source: SCS- As-built plans



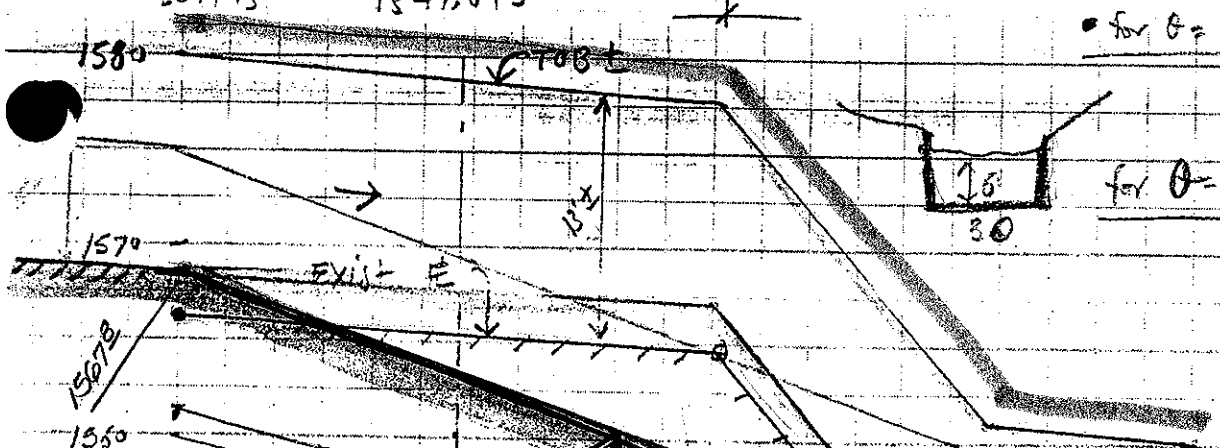
- n = .03 d = 6
  S = .0017 ft/ft, Q = 14 cfs
- n = .018 Q = 23 cfs
- n = .014 Q = 3 cfs

Sta.	Elev.	slope	
103+23	1566.00		
145+00	1565.16	.0002	.002
		.0002	
159+50	1564.87		
		.00609	.00609
187+00	1548.13		
		.000524	.000524
190+00	1547.37		
		.000524	
207+75	1547.04		

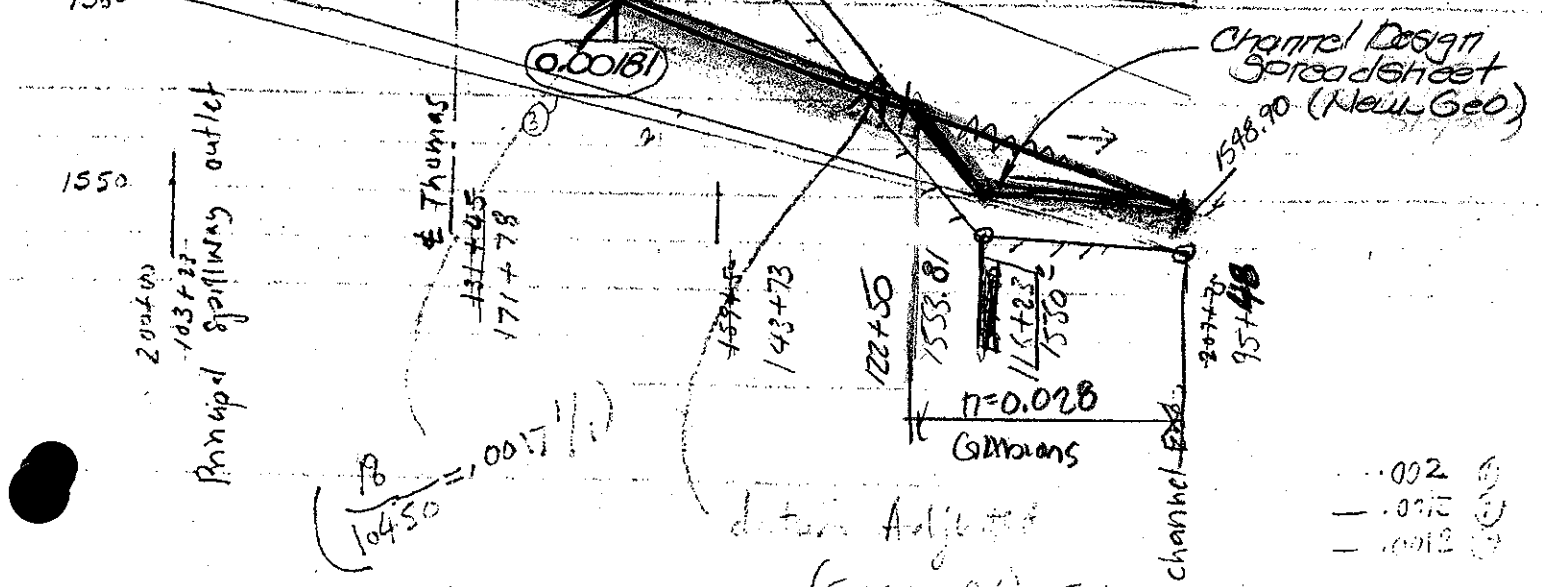
10450'



- n = .012, d = 6
  Q = 14 cfs B = 10'
- for Q = 3 cfs, B = 28'



for Q = 3 cfs B = 36' Fr = 1



Spook Hill FRS Channel Design - New_Geo

Concrete and channel excavation Quantities based on HEC RAS Model: W:\1999 Projects\99989-Spook Hill ADMP Update\Hydraulics\sh_nj6\new_geo.prj
Outlet Sta 95+48 to 122+50 - Existing channel profile to be used. Channel to be gabion lined from Sta 95+48 to Sta 122+50
Channel will have an incised Concrete U channel from Sta 122+50 to Sta 200+00. Channel will be lined to the Freeboard Elevation which is 2' above WSEL.

Gabion Thickness	Ret Wall Thickness	Channel Thickness	Chan Slab Thickness	Concrete h/v (l)	Concrete h/v (r)	Gabion h/v (l)	Conc S(R) h/v (r)
2	1	0.50	1.00	2.0	2.0	2.0	2.0

Concrete and Excavation

Location	Station	Exist Chl Inv El	Exist Chl Slope ft/ft	Design Inv El	Design Slope ft/ft	Cut or Fill ft	Design WSEL	Top of Lining El	Top of Ret Wall El	Ret Wall Volume cy/lf	Channel Lining Vol cy/lf	otal Conc Volume cy/lf	Conc Volume cy	Ex Within Channel cy	Sub-Total Excavation cy	Bottom Width ft	Top Width ft	Q Total (cfs)
Outlet	95+48	1548.90	0.00053	1548.90	0.00053	0.00	1554.04	1556.04	1548.90							30	70	2300
	100+00	1549.14	0.00053	1549.14	0.00053	-0.00	1556.46	1558.46	1549.14							30	70	2300
	105+00	1549.40	0.00053	1549.40	0.00053	-0.00	1557.18	1559.18	1549.40							30	70	2300
	110+00	1549.66	0.00053	1549.67	0.00053	-0.01	1557.74	1559.74	1549.67							30	70	2300
	116+23	1549.99	0.00053	1550.00	0.00053	-0.01	1558.41	1560.41	1550.00							30	70	2300
	120+00	1552.28	0.00609	1552.29	0.00607	-0.00	1558.51	1560.51	1552.29							30	70	2300
Rectangular Starts	122+50	1553.81	0.00609	1553.81	0.00607	0.00	1559.03	1561.03	1553.81	1.19	0.65	1.84				30	70	2300
	126+00	1555.94	0.00609	1554.44	0.00181	1.50	1558.98	1560.98	1555.94	1.30	0.47	1.77	631.4	291.2	922.7	30	70	2300
	130+00	1558.37	0.00609	1555.17	0.00181	3.21	1560.31	1562.31	1558.37	1.42	0.38	1.80	714.7	1,045.1	1,759.8	30	70	2300
	135+00	1561.42	0.00609	1556.07	0.00181	5.34	1561.70	1563.70	1561.42	1.58	0.24	1.83	907.5	2,374.7	3,282.2	30	70	2300
	140+00	1564.46	0.00609	1556.98	0.00181	7.48	1562.60	1564.60	1564.46	1.74	0.07	1.81	908.0	3,561.7	4,469.7	30	70	2300
	143+73	1566.73	0.00609	1557.66	0.00181	9.07	1563.32	1565.32	1566.73	1.86	0.17	2.03	715.4	3,430.1	4,145.5	30	70	2300
	150+00	1566.86	0.00020	1558.79	0.00181	8.06	1564.41	1566.41	1566.86	1.78	0.09	1.87	1,224.1	5,968.8	7,192.8	30	70	2300
	155+00	1566.96	0.00020	1559.70	0.00181	7.26	1565.32	1567.32	1566.96	1.72	0.09	1.81	920.8	4,254.8	5,175.6	30	70	2300
	160+00	1567.06	0.00020	1560.61	0.00181	6.45	1566.21	1568.21	1567.06	1.66	0.15	1.81	905.5	3,806.8	4,712.3	30	70	2300
	165+00	1567.16	0.00020	1561.52	0.00181	5.64	1567.12	1569.12	1567.16	1.60	0.22	1.82	908.8	3,358.7	4,267.5	30	70	2300
	170+00	1567.26	0.00020	1562.42	0.00181	4.84	1567.99	1569.99	1567.26	1.54	0.28	1.83	911.6	2,910.7	3,822.3	30	70	2300
	175+00	1567.36	0.00020	1563.33	0.00181	4.03	1568.96	1570.96	1567.36	1.48	0.35	1.84	915.7	2,462.6	3,378.3	30	70	2300
	180+00	1567.46	0.00020	1564.24	0.00181	3.22	1569.83	1571.83	1567.46	1.42	0.42	1.84	919.7	2,014.6	2,934.3	30	70	2300
	185+00	1567.56	0.00020	1565.14	0.00181	2.42	1570.71	1572.71	1567.56	1.36	0.48	1.85	921.9	1,566.5	2,488.4	30	70	2300
	190+00	1567.66	0.00020	1566.05	0.00181	1.61	1571.48	1573.48	1567.66	1.30	0.54	1.84	922.1	1,118.4	2,040.5	30	70	2300
	195+00	1567.76	0.00020	1566.96	0.00181	0.80	1572.33	1574.33	1567.76	1.24	0.60	1.84	921.6	670.4	1,592.0	30	70	2300
Principal Spillway	200+00	1567.86	0.00020	1567.86	0.00181	-0.00	1573.68	1575.68	1567.86	1.18	0.70	1.89	933.1	222.3	1,155.4	30	70	2150

Gabion and Excavation

Sub-total 14,282.0 39,057.4 53,339.4

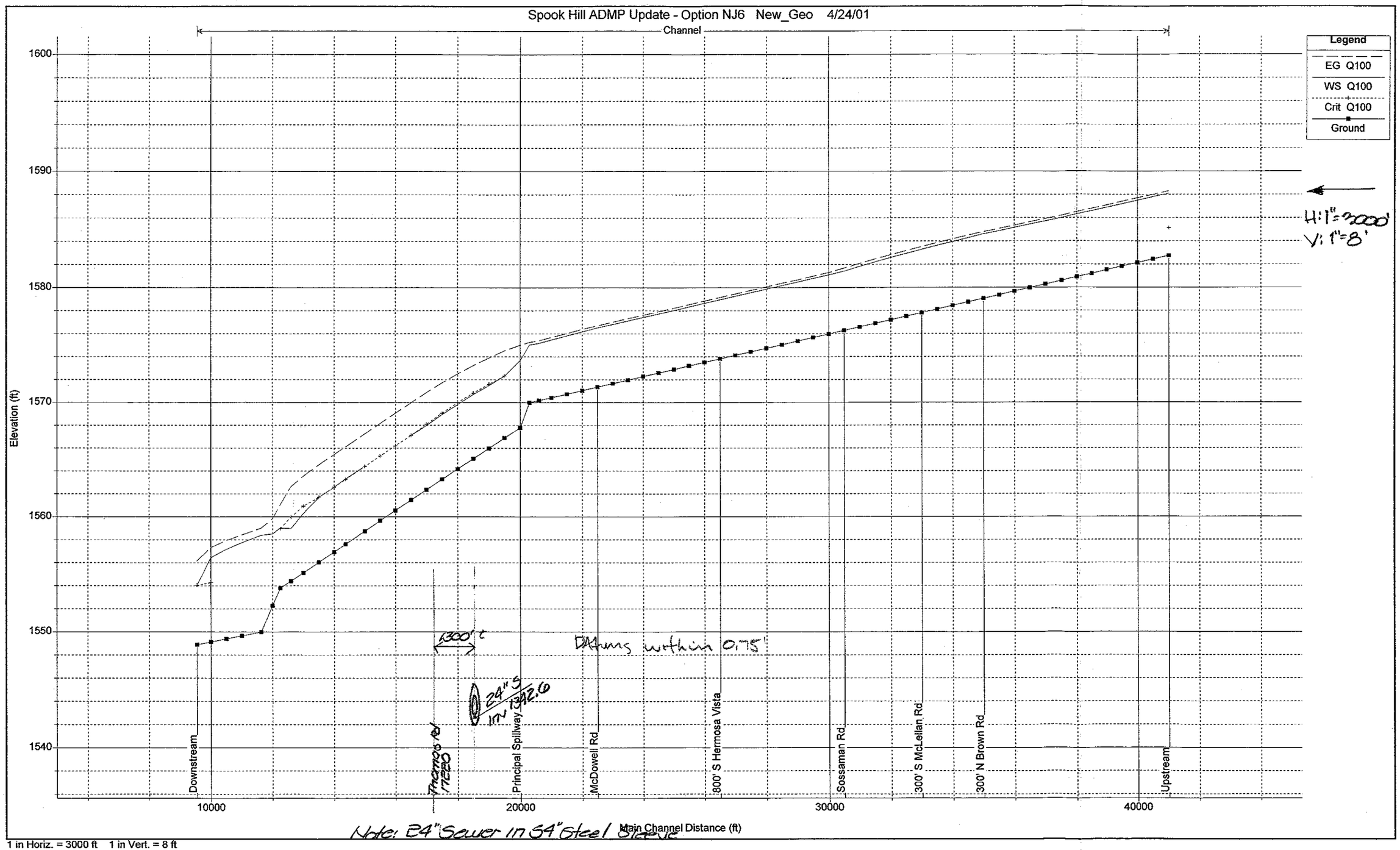
	Station	Exist Chl Inv El	Exist Chl Slope ft/ft	Design Inv El	Design Slope ft/ft	Cut or Fill ft	Design WSEL	Top of Lining El			Gabion Volume cy/lf		Gabion Volume cy		Sub-Total Excavation cy	Bottom Width ft	Top Width ft	Q Total (cfs)
Outlet	95+48	1548.90	0.00053	1548.90	0.00053	0.00	1554.04	1556.04			4.66					30	70	2300
	100+00	1549.14	0.00053	1549.14	0.00053	0.00	1556.46	1558.46			5.38		2,270.3		2,270.3	30	70	2300
	105+00	1549.40	0.00053	1549.40	0.00053	0.00	1557.18	1559.18			5.53		2,729.6		2,729.6	30	70	2300
	110+00	1549.66	0.00053	1549.67	0.00053	-0.01	1557.74	1559.74			5.63		2,791.7		2,791.7	30	70	2300
	116+23	1549.99	0.00053	1550.00	0.00053	-0.01	1558.41	1560.41			5.74		3,544.0		3,544.0	30	70	2300
	120+00	1552.28	0.00609	1552.29	0.00607	0.00	1558.51	1560.51			5.02		2,029.2		2,029.2	30	70	2300
Rectangular Starts	122+50	1553.81	0.00609	1553.81	0.00607	0.00	1559.03	1561.03			4.69		1,213.7		1,213.7	30	70	2300

Quantity Summary

Sub-total 14,578.5 14,578.5

Total Excavation 67,918 CY
Total Concrete 14,282 CY
Total Gabions 14,578 CY

5/7/01



1 in Horiz. = 3000 ft 1 in Vert. = 8 ft

5/7/01

HEC-RAS Plan: New_Geo River: Spook Hill Reach: Channel

W:\1999 project\99189-Spook Hill ADMP Update\Hydraulics\SH_NJO\NEW GEO

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Max Ch Dpth (ft)	Mann Wtd Total
Channel	41000 *	2800.00	1582.75	1588.11	1585.14	1588.32	0.000607	3.74	782.79	162.15	0.28	5.36	0.030
Channel	40500 *	2800.00	1582.44	1587.81		1588.01	0.000604	3.73	784.04	162.20	0.28	5.37	0.030
Channel	40000 *	2800.00	1582.14	1587.50		1587.71	0.000605	3.73	783.58	162.18	0.28	5.36	0.030
Channel	39500 *	2800.00	1581.83	1587.20		1587.41	0.000602	3.73	784.99	162.23	0.28	5.37	0.030
Channel	39000 *	2800.00	1581.52	1586.90		1587.11	0.000598	3.72	786.71	162.30	0.28	5.38	0.030
Channel	38500 *	2800.00	1581.21	1586.61		1586.81	0.000593	3.71	788.83	162.38	0.28	5.40	0.030
Channel	38000 *	2800.00	1580.91	1586.31		1586.51	0.000591	3.71	789.50	162.40	0.28	5.40	0.030
Channel	37500 *	2800.00	1580.60	1586.02		1586.22	0.000585	3.70	792.24	162.50	0.28	5.42	0.030
Channel	37000 *	2800.00	1580.29	1585.73		1585.93	0.000577	3.68	795.59	162.63	0.28	5.44	0.030
Channel	36500 *	2800.00	1579.98	1585.44		1585.64	0.000568	3.66	799.69	162.78	0.28	5.46	0.030
Channel	36000 *	2800.00	1579.68	1585.16		1585.36	0.000562	3.65	802.71	162.89	0.27	5.48	0.030
Channel	35500 *	2800.00	1579.37	1584.89		1585.08	0.000549	3.62	808.28	163.09	0.27	5.52	0.030
Channel	35000	2800.00	1579.06	1584.62		1584.81	0.000536	3.60	814.95	163.34	0.27	5.56	0.030
Channel	34500	3050.00	1578.75	1584.28		1584.51	0.000646	3.94	810.61	163.18	0.30	5.53	0.030
Channel	34000 *	3050.00	1578.44	1583.95		1584.18	0.000653	3.95	807.96	163.08	0.30	5.51	0.030
Channel	33500 *	3050.00	1578.13	1583.62		1583.86	0.000661	3.97	804.58	162.96	0.30	5.49	0.030
Channel	33000	3050.00	1577.82	1583.29		1583.52	0.000672	3.99	800.34	162.80	0.30	5.47	0.030
Channel	32500 *	3050.00	1577.51	1582.94		1583.18	0.000687	4.01	794.92	162.60	0.30	5.43	0.030
Channel	32000 *	3050.00	1577.20	1582.59		1582.83	0.000706	4.05	788.00	162.35	0.31	5.39	0.030
Channel	31500 *	3050.00	1576.90	1582.22		1582.47	0.000738	4.10	776.91	161.94	0.31	5.32	0.030
Channel	31000 *	3050.00	1576.59	1581.84		1582.09	0.000776	4.17	764.44	161.47	0.32	5.25	0.030
Channel	30500	3050.00	1576.28	1581.42		1581.69	0.000832	4.26	747.58	160.84	0.33	5.14	0.030
Channel	30000 *	2050.00	1575.98	1581.10		1581.30	0.000617	3.66	591.26	130.75	0.28	5.12	0.030
Channel	29500 *	2050.00	1575.67	1580.80		1580.99	0.000617	3.66	591.47	130.76	0.28	5.13	0.030
Channel	29000 *	2050.00	1575.36	1580.49		1580.68	0.000616	3.66	591.76	130.77	0.28	5.13	0.030
Channel	28500 *	2050.00	1575.05	1580.18		1580.38	0.000615	3.65	592.10	130.79	0.28	5.13	0.030
Channel	28000 *	2050.00	1574.74	1579.87		1580.07	0.000613	3.65	592.53	130.81	0.28	5.13	0.030
Channel	27500 *	2050.00	1574.43	1579.57		1579.76	0.000612	3.65	593.05	130.83	0.28	5.14	0.030
Channel	27000 *	2050.00	1574.13	1579.26		1579.46	0.000615	3.65	592.10	130.79	0.28	5.13	0.030
Channel	26500 *	2050.00	1573.82	1578.95		1579.15	0.000613	3.65	592.53	130.81	0.28	5.13	0.030
Channel	26000 *	2050.00	1573.51	1578.65		1578.84	0.000612	3.65	593.04	130.83	0.28	5.14	0.030
Channel	25500 *	2050.00	1573.20	1578.34		1578.54	0.000610	3.64	593.71	130.86	0.28	5.14	0.030
Channel	25000 *	2050.00	1572.90	1578.04		1578.23	0.000612	3.65	592.91	130.82	0.28	5.14	0.030
Channel	24500 *	2050.00	1572.59	1577.73		1577.93	0.000610	3.64	593.55	130.85	0.28	5.14	0.030
Channel	24000 *	2050.00	1572.28	1577.43		1577.62	0.000608	3.64	594.33	130.89	0.28	5.15	0.030
Channel	23500 *	2050.00	1571.97	1577.13		1577.32	0.000604	3.63	595.34	130.94	0.28	5.16	0.030
Channel	23000 *	2050.00	1571.67	1576.82		1577.02	0.000606	3.64	594.95	130.92	0.28	5.15	0.030
Channel	22500	2050.00	1571.36	1576.52		1576.72	0.000602	3.63	596.11	130.97	0.28	5.16	0.030
Channel	22000 *	2150.00	1571.05	1576.18		1576.39	0.000678	3.83	591.62	130.76	0.30	5.13	0.030
Channel	21500 *	2150.00	1570.74	1575.83		1576.05	0.000695	3.86	586.77	130.54	0.30	5.09	0.030
Channel	21000	2150.00	1570.43	1575.47		1575.70	0.000719	3.91	580.40	130.25	0.31	5.04	0.030
Channel	20500 *	2150.00	1570.18	1575.17		1575.40	0.000744	3.95	574.19	129.96	0.31	4.99	0.030

HEC-RAS Plan: New_Geo River: Spook Hill Reach: Channel (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Max Ch Dpth (ft)	Mann Wtd Total
Channel	21300	2150.00	1570.00	1575.04		1575.26	0.000321	3.91	579.76	130.22	0.31	5.04	0.020
Channel	20000	2150.00	1567.80	1573.69		1575.02	0.000602	9.90	245.83	53.54	0.72	5.89	0.012
Channel	19500	2300.00	1566.90	1572.33	1572.33	1574.53	0.001145	12.44	203.74	48.10	0.94	5.43	0.012
Channel	19000	2300.00	1565.99	1571.48	1571.61	1573.90	0.001287	12.87	193.37	45.13	0.97	5.49	0.012
Channel	18500	2300.00	1565.09	1570.71	1570.83	1573.23	0.001356	13.00	187.83	42.43	0.97	5.62	0.012
Channel	18000	2300.00	1564.18	1569.82	1569.99	1572.50	0.001495	13.28	179.99	39.28	0.99	5.64	0.012
Channel	17500	2300.00	1563.28	1568.95	1569.07	1571.72	0.001603	13.41	174.93	36.20	0.99	5.67	0.012
Channel	17000	2300.00	1562.37	1568.00	1568.09	1570.87	0.001763	13.61	169.78	32.79	1.01	5.63	0.012
Channel	16500	2300.00	1561.47	1567.10	1567.13	1569.98	0.001851	13.63	168.76	30.00	1.01	5.63	0.012
Channel	16000	2300.00	1560.56	1566.17	1566.22	1569.07	0.001867	13.67	168.29	30.00	1.02	5.61	0.012
Channel	15500	2300.00	1559.66	1565.24	1565.32	1568.17	0.001900	13.75	167.29	30.00	1.03	5.58	0.012
Channel	15000	2300.00	1558.75	1564.29	1564.41	1567.26	0.001941	13.85	166.09	30.00	1.04	5.54	0.012
Channel	14373	2300.00	1557.62	1563.20	1563.28	1566.13	0.001900	13.75	167.29	30.00	1.03	5.58	0.012
Channel	14000	2300.00	1556.94	1562.49	1562.61	1565.45	0.001930	13.82	166.42	30.00	1.03	5.55	0.012
Channel	13500	2300.00	1556.04	1561.62	1561.71	1564.55	0.001874	13.75	167.36	30.86	1.03	5.58	0.012
Channel	13000	2300.00	1555.13	1560.31	1560.94	1563.56	0.002002	14.55	162.87	37.66	1.13	5.18	0.012
Channel	12600	2300.00	1554.41	1558.98	1559.98	1562.64	0.002413	15.73	156.12	42.32	1.30	4.57	0.012
Channel	12250	2300.00	1553.81	1559.17	1558.96	1561.09	0.005299	11.83	218.31	51.48	0.90	5.36	0.028
Channel	12000	2300.00	1552.28	1558.78		1559.98	0.002590	9.41	279.43	55.94	0.65	6.50	0.028
Channel	11623	2300.00	1549.99	1558.71		1559.27	0.000853	6.57	413.42	64.84	0.39	8.72	0.028
Channel	11000	2300.00	1549.66	1558.08		1558.69	0.000979	6.87	393.38	63.52	0.42	8.42	0.028
Channel	10500	2300.00	1549.40	1557.48		1558.16	0.001142	7.22	372.79	62.31	0.45	8.08	0.028
Channel	10000	2300.00	1549.14	1556.69		1557.50	0.001467	7.82	341.54	60.38	0.50	7.55	0.028
Channel	9548	2300.00	1548.90	1554.05	1554.05	1556.17	0.006130	12.39	207.62	50.61	0.96	5.15	0.028

WOOD/PATEL

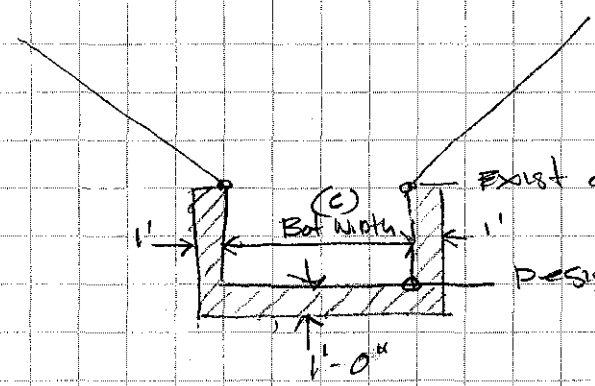
CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT Spook Hill NO.

CALC'D BY JST CHK'D BY

SHEET OF DATE 5/3/01

Retaining wall

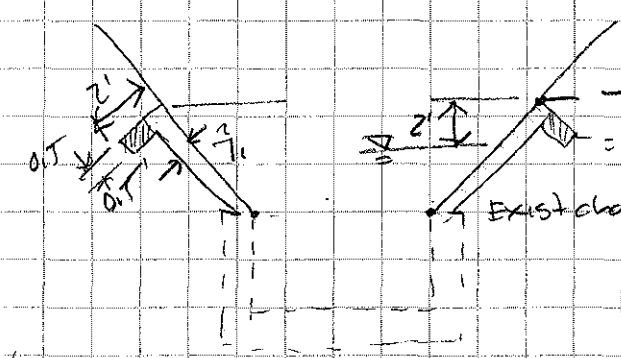


Exist chan bottom = Top Ret wall (A)

Design invert (B)

Ret wall volume = $(C + 2' \times 0.67) + (A - B \times 1' \times 2)$ = SF/LF

Channel lining



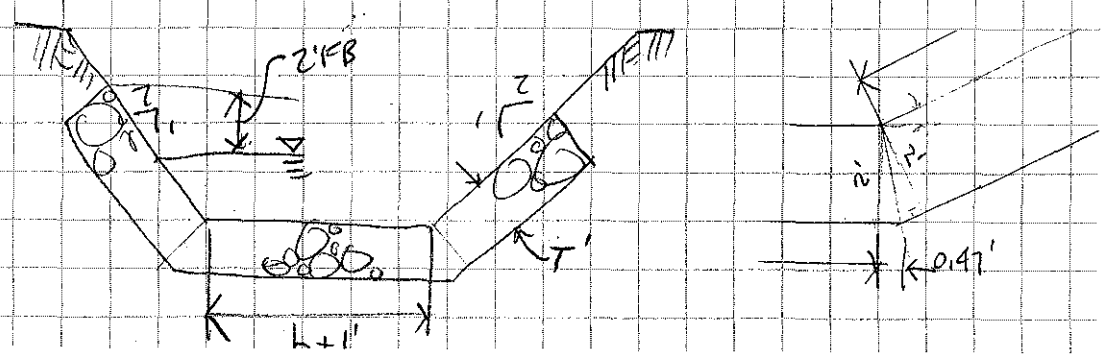
Top Lining = WSEL + 2' FB (B) 1561.03

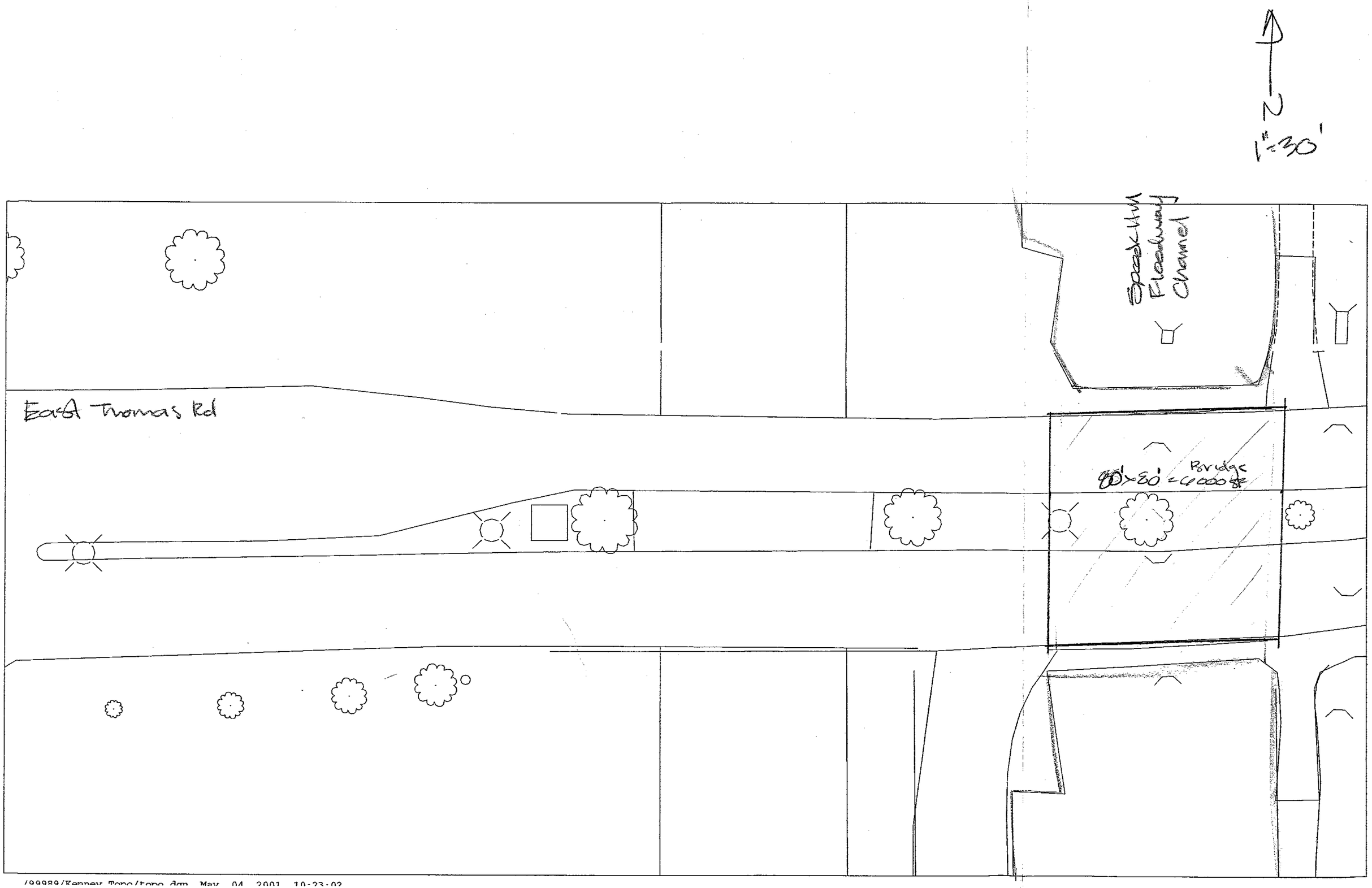
= 1.5 · 0.5 = 0.75 7.22'

Exist chan bottom = Top wall (A) 1553.81

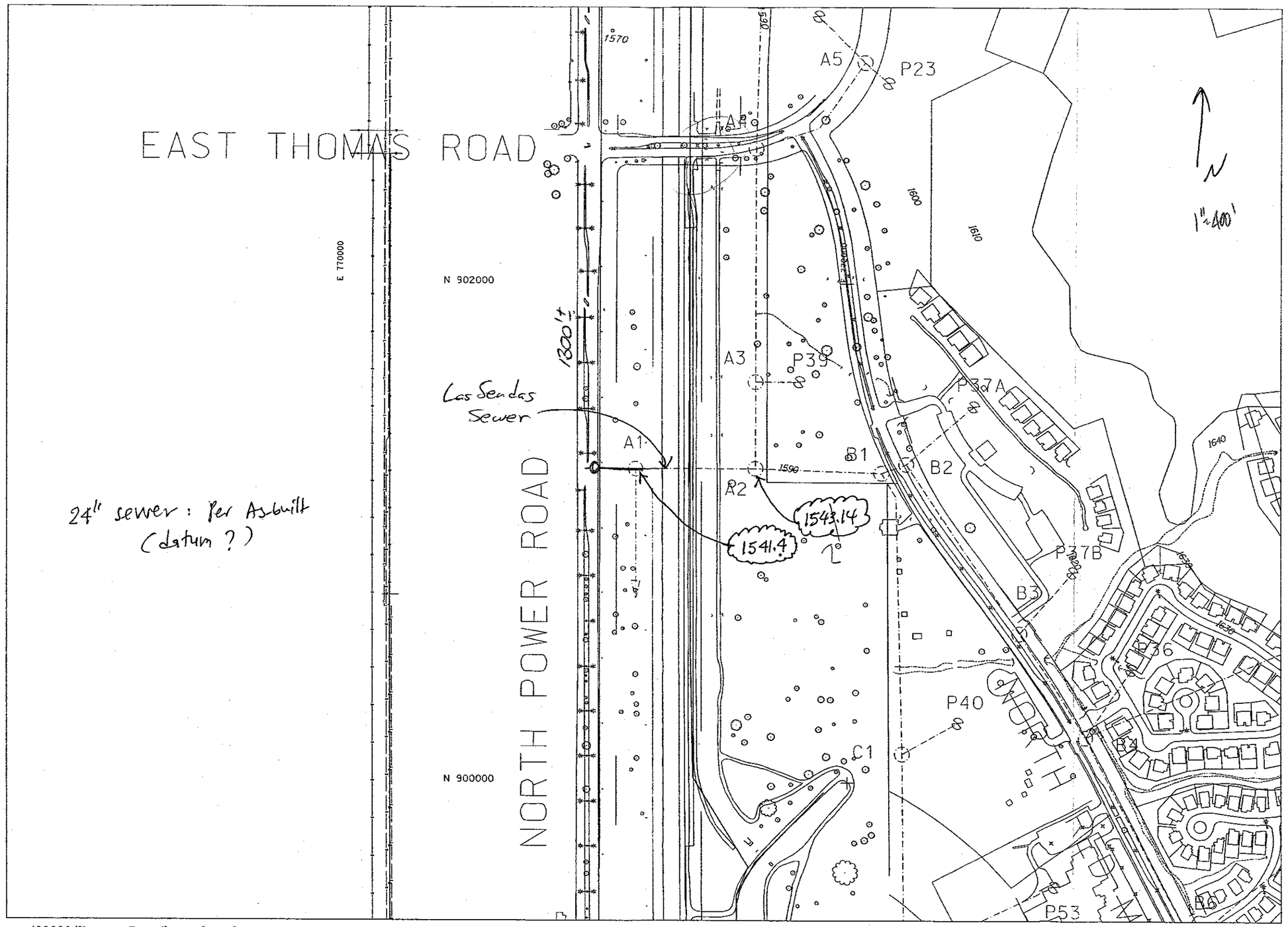
Lining Volume = $\left(\text{sqrt}\left[(B-A)^2 + 2\cdot(B-A)^2\right]\cdot 0.5 + 0.75\right) \times 2$

RipRap 2' thick





/99989/Kenney Topo/topo.dgn May 04 2001 10:23:02



.../99989/Kenney Topo/baseplan.dgn 10/23/00 12:52:22 PM

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS

PROJECT Spookhill Floodway

PROJECT NO. _____ SHEET NO. _____ OF _____

CALCULATED BY Acp DATE 10/22/98 CHECKED BY _____ DATE _____

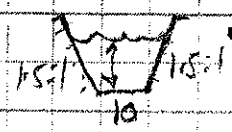
Potential Upgrade

Source: SCS- As-built plans

- $n = .03$ $d = 6$ $S = .0017'/'$ $Q = 14$ cfs
- $n = .018$ $Q = 23$ cfs
- $n = .014$ $Q = 3$ cfs

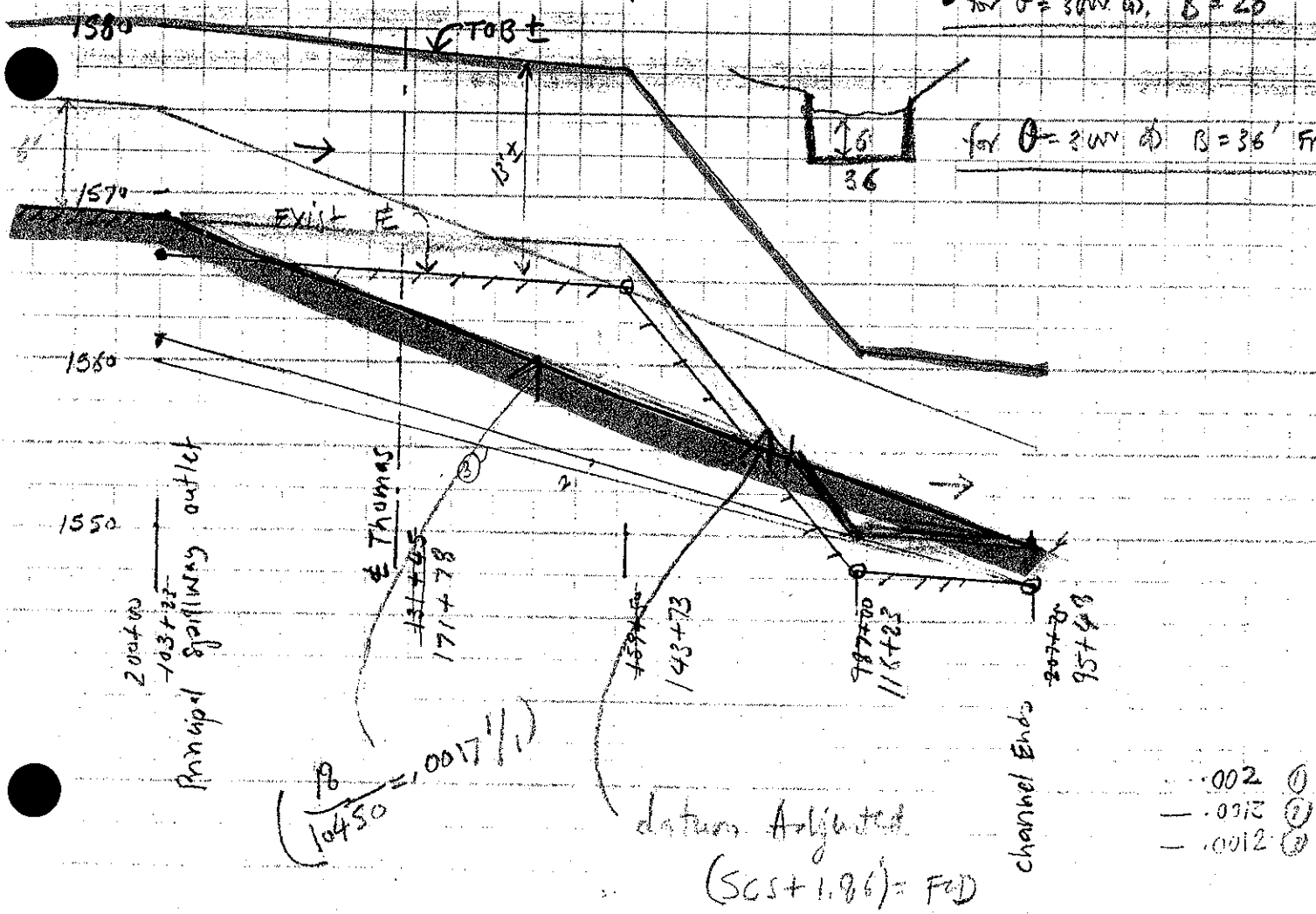
Sta.	Elev.	slope	
103+23	1566.00		
145+00	1565.16	.0002	.002
		.0002	
159+50	1564.87	.00609	.00609
187+00	1548.13		
190+00	1547.97	.000524	.000524
207+75	1547.04	.000524	

10450'



- $n = .012$, $d = 6$ $Q = 14$ cfs $B = 10'$
- for $Q = 3$ cfs, $B = 23'$

for $Q = 3$ cfs $B = 36'$ $Fr = 1$



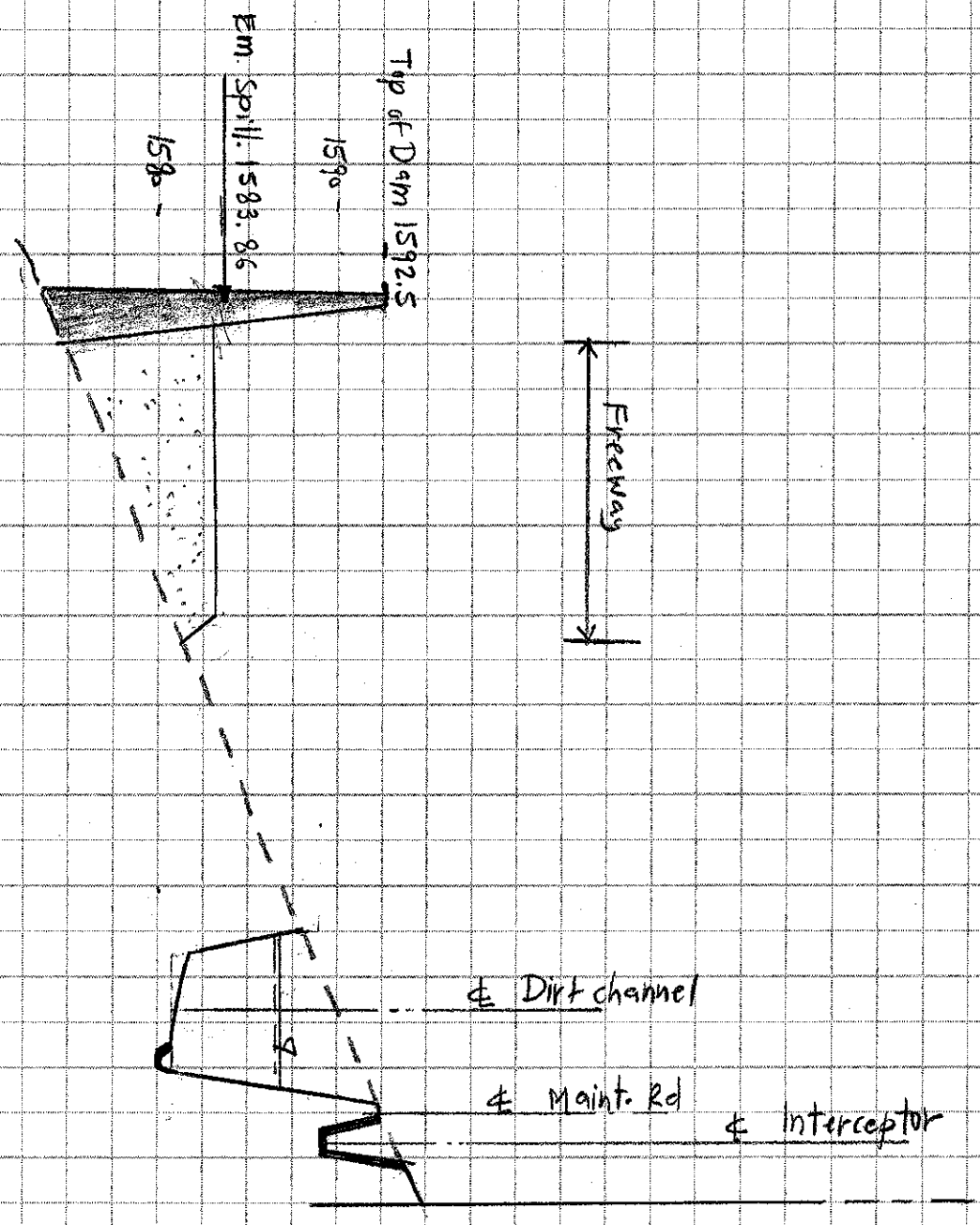
WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS

PROJECT Spook Hill ADMP

PROJECT NO. _____ SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____ CHECKED BY _____ DATE 4/2/2001



SPOOK HILL FRS & DIVERSION

H: 1"=200' V: 1"=10'

Spook Hill FRS Channel Design

Location	Station	Exist Chl Inv	Exist Chl Slope	Design Inv	Design Slope	Cut or Fill	LOB Existing Elev (ft)	LOB-EX (ft)	Design LOB	Design ROB	Depth (L) (ft)	Depth (R) (ft)	Elev(ML)	Elev(MR)	Sta (LOB)	Sta(ML)	Sta (BL)	Sta (C)	Sta (BR)	Sta(MR)	Sta (ROB)	Bottom Width	Top Width	S (L)	S(R)	Q Total (cfs)	"n"-value
Outlet	95+48	1548.90	0.00053	1548.90	0.00181	0.00	1558.0	0.90	1558.9	1558.9	10.00	10.00	1553.9	1553.9	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	100+00	1549.14	0.00053	1549.72	0.00181	-0.58	1558.2	1.48	1559.7	1559.7	10.00	10.00	1554.7	1554.7	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	105+00	1549.40	0.00053	1550.62	0.00181	-1.22	1558.5	2.12	1560.6	1560.6	10.00	10.00	1555.6	1555.6	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	110+00	1549.66	0.00053	1551.53	0.00181	-1.86	1558.8	2.76	1561.5	1561.5	10.00	10.00	1556.5	1556.5	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	116+23	1549.99	0.00053	1552.65	0.00181	-2.66	1559.1	3.56	1562.7	1562.7	10.00	10.00	1557.7	1557.7	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	120+00	1552.28	0.00609	1553.33	0.00181	-1.05	1561.4	1.95	1563.3	1563.3	10.00	10.00	1558.3	1558.3	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
Rectangular Starts	122+50	1553.81	0.00609	1553.79	0.00181	0.02	1562.9	0.88	1563.8	1563.8	10.00	10.00	1558.8	1558.8	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	126+00	1555.94	0.00609	1554.42	0.00181	1.52	1565.9	-1.52	1564.4	1564.4	10.00	10.00	1555.9	1555.9	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	130+00	1558.37	0.00609	1555.14	0.00181	3.23	1568.4	-3.23	1565.1	1565.1	10.00	10.00	1558.4	1558.4	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	135+00	1561.42	0.00609	1556.05	0.00181	5.37	1571.4	-5.37	1566.0	1566.0	10.00	10.00	1561.4	1561.4	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	140+00	1564.46	0.00609	1556.95	0.00181	7.51	1574.5	-7.51	1567.0	1567.0	10.00	10.00	1564.5	1564.5	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	143+73	1566.73	0.00609	1557.62	0.00181	9.11	1576.7	-9.11	1567.6	1567.6	10.00	10.00	1566.7	1566.7	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	150+00	1566.86	0.00020	1558.76	0.00181	8.10	1576.9	-8.10	1568.8	1568.8	10.00	10.00	1566.9	1566.9	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	155+00	1566.96	0.00020	1559.66	0.00181	7.29	1577.0	-7.29	1569.7	1569.7	10.00	10.00	1567.0	1567.0	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	160+00	1567.06	0.00020	1560.57	0.00181	6.49	1577.1	-6.49	1570.6	1570.6	10.00	10.00	1567.1	1567.1	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	165+00	1567.16	0.00020	1561.47	0.00181	5.69	1577.2	-5.69	1571.5	1571.5	10.00	10.00	1567.2	1567.2	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	170+00	1567.26	0.00020	1562.38	0.00181	4.88	1577.3	-4.88	1572.4	1572.4	10.00	10.00	1567.3	1567.3	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	175+00	1567.36	0.00020	1563.28	0.00181	4.08	1577.4	-4.08	1573.3	1573.3	10.00	10.00	1567.4	1567.4	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	180+00	1567.46	0.00020	1564.18	0.00181	3.28	1577.5	-3.28	1574.2	1574.2	10.00	10.00	1567.5	1567.5	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	185+00	1567.56	0.00020	1565.09	0.00181	2.47	1577.6	-2.47	1575.1	1575.1	10.00	10.00	1567.6	1567.6	165.00	185.00	185.00	200	225.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	190+00	1567.66	0.00020	1565.99	0.00181	1.67	1577.7	-1.67	1576.0	1576.0	10.00	10.00	1571.0	1571.0	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
	195+00	1567.76	0.00020	1566.90	0.00181	0.86	1577.8	-0.86	1576.9	1576.9	10.00	10.00	1571.9	1571.9	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2300	0.012
Principal Spillway	200+00	1567.86	0.00020	1567.80	0.00181	0.06	1577.9	-0.06	1577.8	1577.8	10.00	10.00	1572.8	1572.8	165.00	175.00	185.00	200	215.00	225.00	235.00	30	70	2.0	2.0	2150	0.012
Transition Ends	203+00	1580.00	0.00062	1570.00	0.00730	10.00	1580.0	0.00	1580.0	1580.0	10.00	10.00	1575.0	1575.0	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2150	0.02
	206+00	1580.18	0.00062	1570.18	0.00062	10.00	1580.2	0.00	1580.2	1580.2	10.00	10.00	1575.2	1575.2	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2150	0.03
	210+00	1580.43	0.00062	1570.43	0.00062	10.00	1580.4	0.00	1580.4	1580.4	10.00	10.00	1575.4	1575.4	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2150	0.03
	215+00	1580.74	0.00062	1570.74	0.00062	10.00	1580.7	0.00	1580.7	1580.7	10.00	10.00	1575.7	1575.7	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2150	0.03
	220+00	1581.05	0.00062	1571.05	0.00062	10.00	1581.0	0.00	1581.0	1581.0	10.00	10.00	1576.0	1576.0	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2150	0.03
McDowell Rd	225+00	1581.36	0.00062	1571.36	0.00062	10.00	1581.4	0.00	1581.4	1581.4	10.00	10.00	1576.4	1576.4	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	230+00	1581.66	0.00062	1571.66	0.00062	10.00	1581.7	0.00	1581.7	1581.7	10.00	10.00	1576.7	1576.7	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	235+00	1581.97	0.00062	1571.97	0.00062	10.00	1582.0	0.00	1582.0	1582.0	10.00	10.00	1577.0	1577.0	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	240+00	1582.28	0.00062	1572.28	0.00062	10.00	1582.3	0.00	1582.3	1582.3	10.00	10.00	1577.3	1577.3	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	245+00	1582.59	0.00062	1572.59	0.00062	10.00	1582.6	0.00	1582.6	1582.6	10.00	10.00	1577.6	1577.6	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	250+00	1582.90	0.00062	1572.90	0.00062	10.00	1582.9	0.00	1582.9	1582.9	10.00	10.00	1577.9	1577.9	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	255+00	1583.20	0.00062	1573.20	0.00062	10.00	1583.2	0.00	1583.2	1583.2	10.00	10.00	1578.2	1578.2	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	260+00	1583.51	0.00062	1573.51	0.00062	10.00	1583.5	0.00	1583.5	1583.5	10.00	10.00	1578.5	1578.5	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
800' S. Hermosa Vista	265+00	1583.82	0.00062	1573.82	0.00062	10.00	1583.8	0.00	1583.8	1583.8	10.00	10.00	1578.8	1578.8	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	270+00	1584.13	0.00062	1574.13	0.00062	10.00	1584.1	0.00	1584.1	1584.1	10.00	10.00	1579.1	1579.1	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	275+00	1584.44	0.00062	1574.44	0.00062	10.00	1584.4	0.00	1584.4	1584.4	10.00	10.00	1579.4	1579.4	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	280+00	1584.74	0.00062	1574.74	0.00062	10.00	1584.7	0.00	1584.7	1584.7	10.00	10.00	1579.7	1579.7	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	285+00	1585.05	0.00062	1575.05	0.00062	10.00	1585.1	0.00	1585.1	1585.1	10.00	10.00	1580.1	1580.1	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	290+00	1585.36	0.00062	1575.36	0.00062	10.00	1585.4	0.00	1585.4	1585.4	10.00	10.00	1580.4	1580.4	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	295+00	1585.67	0.00062	1575.67	0.00062	10.00	1585.7	0.00	1585.7	1585.7	10.00	10.00	1580.7	1580.7	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
	300+00	1585.98	0.00062	1575.98	0.00062	10.00	1586.0	0.00	1586.0	1586.0	10.00	10.00	1581.0	1581.0	120.00	135.00	150.00	200	250.00	265.00	280.00	100	160	3.0	3.0	2050	0.03
Sossaman Rd	305+00	1586.28	0.00062	1576.28	0.00062	10.00	1586.3	0.00	1586.3	1586.3	10.00	10.00	1581.3	1581.3	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	310+00	1586.59	0.00062	1576.59	0.00062	10.00	1586.6	0.00	1586.6	1586.6	10.00	10.00	1581.6	1581.6	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	315+00	1586.90	0.00062	1576.90	0.00062	10.00	1586.9	0.00	1586.9	1586.9	10.00	10.00	1581.9	1581.9	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	320+00	1587.21	0.00062	1577.21	0.00062	10.00	1587.2	0.00	1587.2	1587.2	10.00	10.00	1582.2	1582.2	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	325+00	1587.52	0.00062	1577.52	0.00062	10.00	1587.5	0.00	1587.5	1587.5	10.00	10.00	1582.5	1582.5	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
300' S. McLellan	330+00	1587.82	0.00062	1577.82	0.00062	10.00	1587.8	0.00	1587.8	1587.8	10.00	10.00	1582.8	1582.8	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	335+00	1588.13	0.00062	1578.13	0.00062	10.00	1588.1	0.00	1588.1	1588.1	10.00	10.00	1583.1	1583.1	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	340+00	1588.44	0.00062	1578.44	0.00062	10.00	1588.4	0.00	1588.4	1588.4	10.00	10.00	1583.4	1583.4	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
	345+00	1588.75	0.00062	1578.75	0.00062	10.00	1588.7	0.00	1588.7	1588.7	10.00	10.00	1583.7	1583.7	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	3050	0.03
300' N. Brown Rd	350+00	1589.06	0.00062	1579.06	0.00062	10.00	1589.1	0.00	1589.1	1589.1	10.00	10.00	1584.1	1584.1	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	355+00	1589.36	0.00062	1579.36	0.00062	10.00	1589.4	0.00	1589.4	1589.4	10.00	10.00	1584.4	1584.4	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	360+00	1589.67	0.00062	1579.67	0.00062	10.00	1589.7	0.00	1589.7	1589.7	10.00	10.00	1584.7	1584.7	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	365+00	1589.98	0.00062	1579.98	0.00062	10.00	1590.0	0.00	1590.0	1590.0	10.00	10.00	1585.0	1585.0	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	370+00	1590.29	0.00062	1580.29	0.00062	10.00	1590.3	0.00	1590.3	1590.3	10.00	10.00	1585.3	1585.3	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	375+00	1590.60	0.00062	1580.60	0.00062	10.00	1590.6	0.00	1590.6	1590.6	10.00	10.00	1585.6	1585.6	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	380+00	1590.90	0.00062	1580.90	0.00062	10.00	1590.9	0.00	1590.9	1590.9	10.00	10.00	1585.9	1585.9	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	385+00	1591.21	0.00062	1581.21	0.00062	10.00	1591.2	0.00	1591.2	1591.2	10.00	10.00	1586.2	1586.2	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	390+00	1591.52	0.00062	1581.52	0.00062	10.00	1591.5	0.00	1591.5	1591.5	10.00	10.00	1586.5	1586.5	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	395+00	1591.83	0.00062	1581.83	0.00062	10.00	1591.8	0.00	1591.8	1591.8	10.00	10.00	1586.8	1586.8	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	400+00	1592.14	0.00062	1582.14	0.00062	10.00	1592.1	0.00	1592.1	1592.1	10.00	10.00	1587.1	1587.1	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
	405+00	1592.44	0.00062	1582.44	0.00062	10.00	1592.4	0.00	1592.4	1592.4	10.00	10.00	1587.4	1587.4	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03
Upstream End	410+00	1592.75	0.00062	1582.75	0.00062	10.00	1592.8	0.00	1592.8	1592.8	10.00	10.00	1587.8	1587.8	105.00	120.00	135.00	200	265.00	280.00	295.00	130	190	3.0	3.0	2800	0.03

Spook Hill ADMP Level II Alternative Summary - Peak Flows

HEC-1	Inflow to Apache Junction FRS			Outflow of Apache Junction FRS			Inflow to Signal Butte FRS (east)			Inflow to Signal Butte FRS (north)			Total Inflow to Signal Butte FRS			Outflow of Signal Butte FRS			Inflow to Spook Hill FRS			Outflow of Spook Hill FRS		
File Name	"C60" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"S60" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"C180" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"RR200" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"CC180" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"S180" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"CC455" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)	"S440" Q100 (cfs)	Tp (hr)	Volume (Ac-Ft)
EC24BASE.DAT	5371	12.37	417	118	14.27	417	7306	12.3	869	1330	12.83	190	7306	12.3	1053	113	29.07	524	6968	12.37	1404	238	18.63	881
EC24B_R.DAT	5371	12.37	417	118	14.27	417	7306	12.3	869	1330	13.37	190	7306	12.3	1053	113	15.63	524	4013	13.63	1357	N/A		
EC24_NJ6.DAT	5371	12.37	417	118	14.27	417	7306	12.3	869	1785	13.37	345	7306	12.3	1214	449	15.63	916	2145	13.63	1595	N/A		
EC24_NJ4.DAT	5371	12.37	417	118	14.27	417	7306	12.3	869	1330	12.83	190	7306	12.3	1053	113	29.07	524	2274	13.63	1339	N/A		
EC24PM4R.DAT	5371	12.37	417	118	14.27	417	7306	12.3	869	1784	13.37	345	7306	12.3	1214	449	15.63	916	6578	12.4	1630	359	26.2	1131
EC24PM4E.DAT	Same as	EC24PM4R																						
EC24MD2E.DAT	5371	12.37	417	118	14.27	417	7306	12.3	869	1330	12.83	190	7306	12.3	1053	113	29.07	524	6356	12.37	1404	226	24.1	882
EC24MD2P.DAT	Same as	EC24MD2E																						
EC24MD3E.DAT	5371	12.37	417	118	14.27	417	7306	12.3	869	1330	12.83	190	7306	12.3	1053	113	29.07	524	6352	12.37	1404	227	24.07	882
EC24MD3P.DAT	Same as	EC24MD3E																						
EC24MK1C.DAT																								
EC24MK1P.DAT																								
EC24MK2E.DAT																								
EC24MK2P.DAT																								
ESPSBASE.DAT	N/A			N/A			N/A			N/A			N/A			113	29.07	524	22798	5.5	3201	3980	6.7	2666
ESPS_CHL.DAT	N/A			N/A			N/A			N/A			N/A			113	29.07	524	16783	6.1	3195	N/A		
ESPS_GCL.DAT	N/A			N/A			N/A			N/A			N/A			113	29.07	524	9000			N/A		

Spook Hill ADMP Alternative Summary - Level II

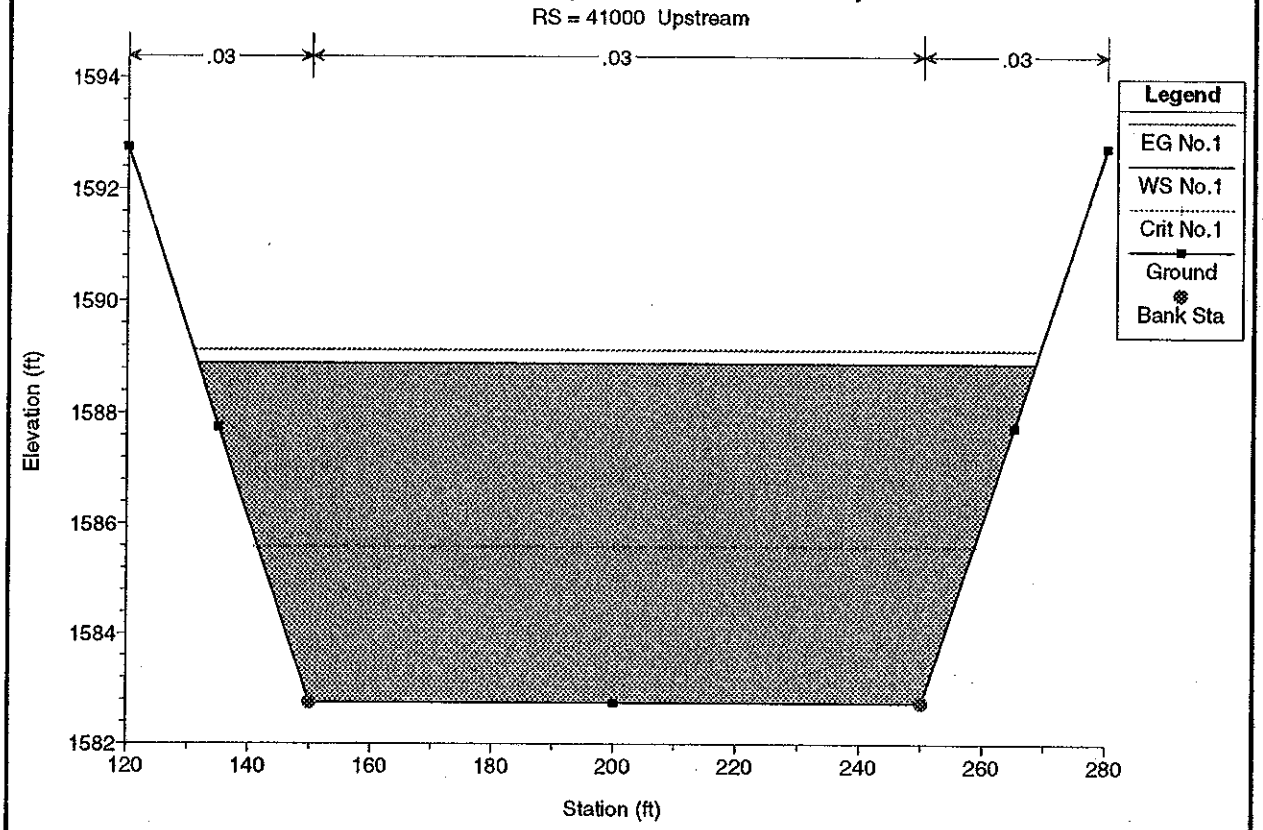
HEC-1	Land Use Condition		Return Period			Rainfall Duration			Pass Mountain		Non-Jurisdictional				McDowell Road				McKellips Road			
File Name	Existing	Future	100-year	10-year	SPS	24-hour	6-hour	7-hour	PM4R	PM4E	SH Channel	SH FRS	Off-line Basin	SB FRS 4xFlow	MD2E	MD2P	MD3E	MD3P	MK1C	MK1P	MK2E	MK2P
EC24BASE.DAT	X		X			X						X										
EC24B_R.DAT	X		X			X					X											
EC24_NJ6.DAT	X		X			X			X		X		X	X								
EC24_NJ4.DAT	X		X			X					X		X									
EC24PM4R.DAT	X		X			X			X			X		X								
EC24PM4E.DAT	X		X			X				X		X		X								
EC24MD2E.DAT	X		X			X						X			X							
EC24MD2P.DAT	X		X			X						X				X						
EC24MD3E.DAT	X		X			X						X					X					
EC24MD3P.DAT	X		X			X						X						X				
EC24MK1C.DAT	X		X			X						X							X			
EC24MK1P.DAT	X		X			X						X								X		
EC24MK2E.DAT	X		X			X						X									X	
EC24MK2P.DAT	X		X			X						X										X
ESPSBASE.DAT	X				X			X				X										
ESPS_CHL.DAT	X				X			X			X											
ESPS_GCL.DAT	X				X			50-hr			X											

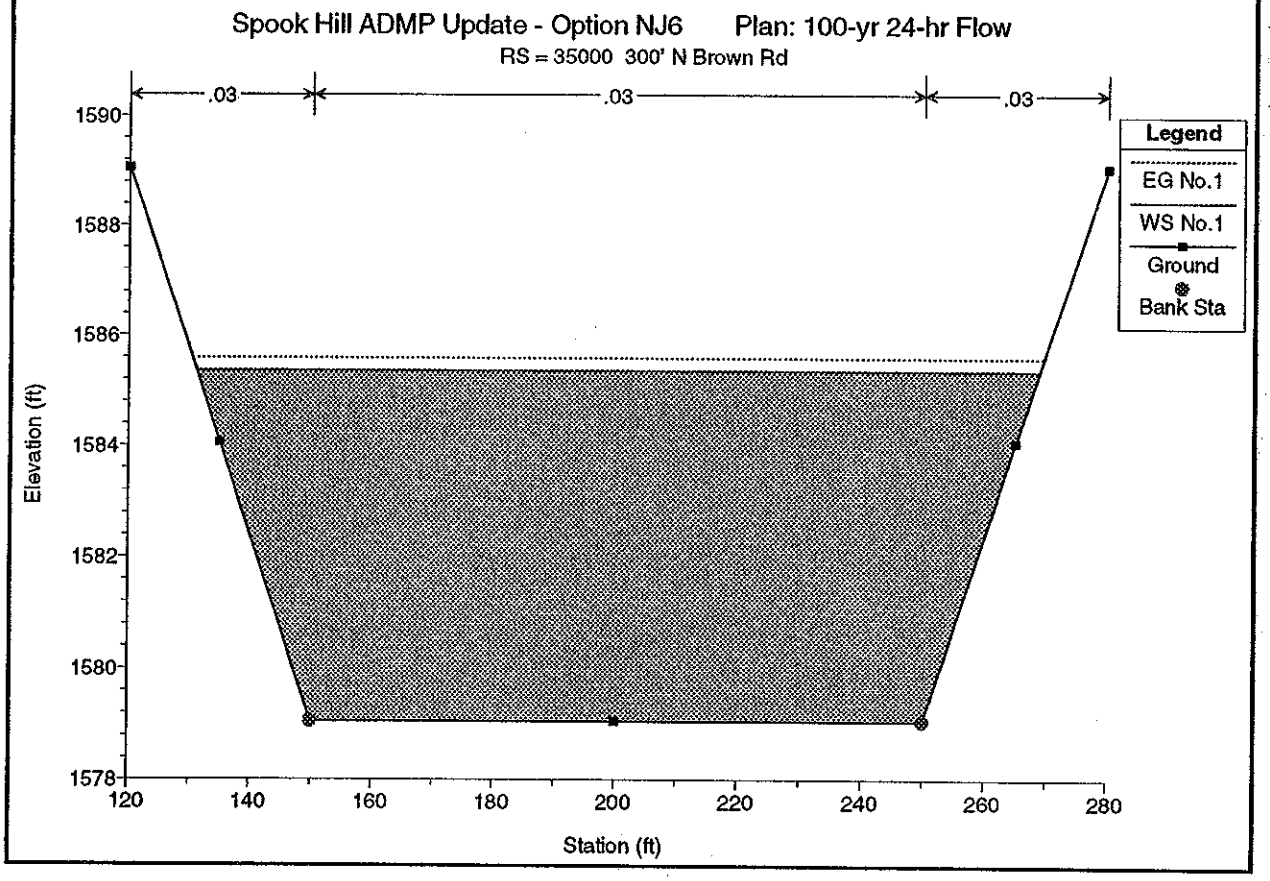
HEC-RAS Plan: 100-yr Flow River: Spook Hill Reach: Channel Profile: No.1

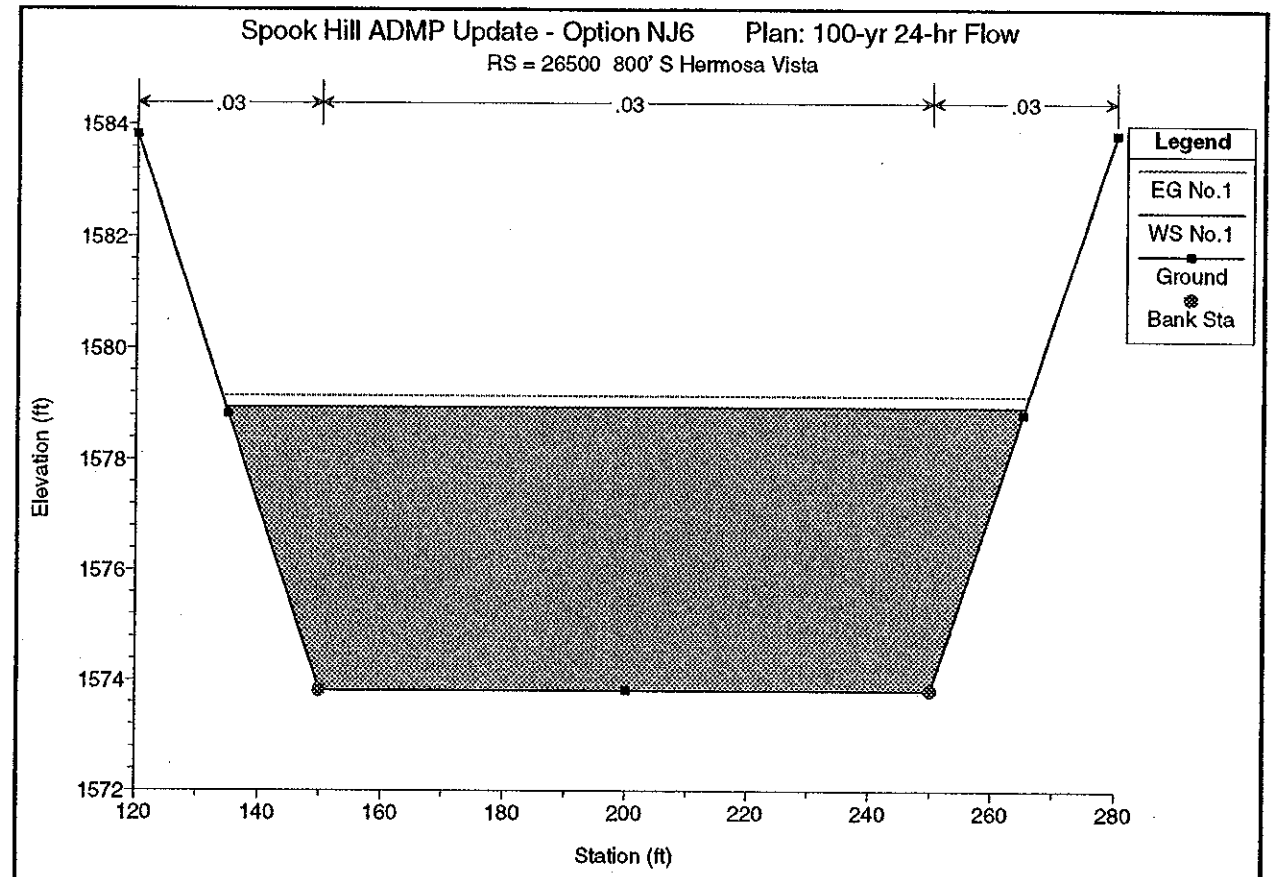
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	41000	2800.00	1582.75	1588.89	1585.58	1589.13	0.000611	4.10	726.73	136.82	0.29	6.14
Channel	40500.*	2800.00	1582.44	1588.58		1588.83	0.000608	4.10	727.62	136.86	0.29	6.14
Channel	40000.*	2800.00	1582.14	1588.28		1588.53	0.000610	4.10	727.12	136.84	0.29	6.14
Channel	39500.*	2800.00	1581.83	1587.98		1588.22	0.000606	4.09	728.37	136.90	0.29	6.15
Channel	39000.*	2800.00	1581.52	1587.68		1587.92	0.000603	4.09	729.61	136.95	0.29	6.16
Channel	38500.*	2800.00	1581.21	1587.38		1587.62	0.000599	4.08	731.18	137.02	0.29	6.17
Channel	38000.*	2800.00	1580.91	1587.08		1587.32	0.000599	4.08	731.36	137.03	0.29	6.17
Channel	37500.*	2800.00	1580.60	1586.79		1587.03	0.000594	4.07	733.25	137.11	0.29	6.18
Channel	37000.*	2800.00	1580.29	1586.49		1586.73	0.000589	4.06	735.53	137.21	0.29	6.20
Channel	36500.*	2800.00	1579.98	1586.20		1586.44	0.000582	4.04	738.25	137.33	0.29	6.22
Channel	36000.*	2800.00	1579.68	1585.91		1586.15	0.000578	4.03	739.94	137.40	0.28	6.23
Channel	35500.*	2800.00	1579.37	1585.63		1585.86	0.000569	4.01	743.58	137.56	0.28	6.26
Channel	35000	2800.00	1579.06	1585.35		1585.58	0.000560	3.99	747.75	137.74	0.28	6.29
Channel	34500	3050.00	1578.75	1584.99		1585.27	0.000684	4.39	740.58	137.43	0.31	6.24
Channel	34000.*	3050.00	1578.44	1584.64		1584.92	0.000700	4.42	734.83	137.18	0.31	6.20
Channel	33500.*	3050.00	1578.13	1584.27		1584.56	0.000722	4.46	727.55	136.86	0.32	6.14
Channel	33000	3050.00	1577.82	1583.90		1584.20	0.000750	4.52	718.59	136.47	0.32	6.08
Channel	32500.*	3050.00	1577.51	1583.50		1583.81	0.000788	4.59	707.00	135.96	0.33	5.99
Channel	32000.*	3050.00	1577.20	1583.08		1583.40	0.000843	4.68	691.81	135.28	0.34	5.88
Channel	31500.*	3050.00	1576.90	1582.61		1582.96	0.000932	4.83	669.40	134.29	0.36	5.71
Channel	31000.*	3050.00	1576.59	1582.08		1582.45	0.001074	5.05	639.32	132.94	0.38	5.49
Channel	30500	3050.00	1576.28	1581.41		1581.84	0.001363	5.44	591.79	130.77	0.42	5.13
Channel	30000	2050.00	1575.98	1581.10		1581.30	0.000620	3.66	590.36	130.71	0.29	5.12
Channel	29500.*	2050.00	1575.67	1580.79		1580.99	0.000620	3.66	590.53	130.71	0.29	5.12
Channel	29000.*	2050.00	1575.36	1580.48		1580.68	0.000619	3.66	590.72	130.72	0.29	5.12
Channel	28500.*	2050.00	1575.05	1580.18		1580.37	0.000617	3.66	591.23	130.75	0.28	5.12
Channel	28000.*	2050.00	1574.74	1579.87		1580.07	0.000616	3.66	591.76	130.77	0.28	5.13
Channel	27500.*	2050.00	1574.43	1579.56		1579.76	0.000614	3.65	592.27	130.79	0.28	5.13
Channel	27000.*	2050.00	1574.13	1579.26		1579.45	0.000617	3.66	591.49	130.76	0.28	5.13
Channel	26500	2050.00	1573.82	1578.95		1579.15	0.000615	3.65	592.02	130.78	0.28	5.13
Channel	26000.*	2050.00	1573.51	1578.64		1578.84	0.000613	3.65	592.53	130.81	0.28	5.13
Channel	25500.*	2050.00	1573.20	1578.34		1578.53	0.000612	3.65	593.05	130.83	0.28	5.14
Channel	25000.*	2050.00	1572.90	1578.03		1578.23	0.000614	3.65	592.25	130.79	0.28	5.13
Channel	24500.*	2050.00	1572.59	1577.73		1577.92	0.000611	3.65	593.10	130.83	0.28	5.14
Channel	24000.*	2050.00	1572.28	1577.43		1577.62	0.000609	3.64	593.93	130.87	0.28	5.15
Channel	23500.*	2050.00	1571.97	1577.12		1577.32	0.000605	3.64	595.13	130.93	0.28	5.15
Channel	23000.*	2050.00	1571.67	1576.82		1577.02	0.000605	3.64	595.00	130.92	0.28	5.15
Channel	22500	2050.00	1571.36	1576.52		1576.72	0.000602	3.63	596.20	130.97	0.28	5.16

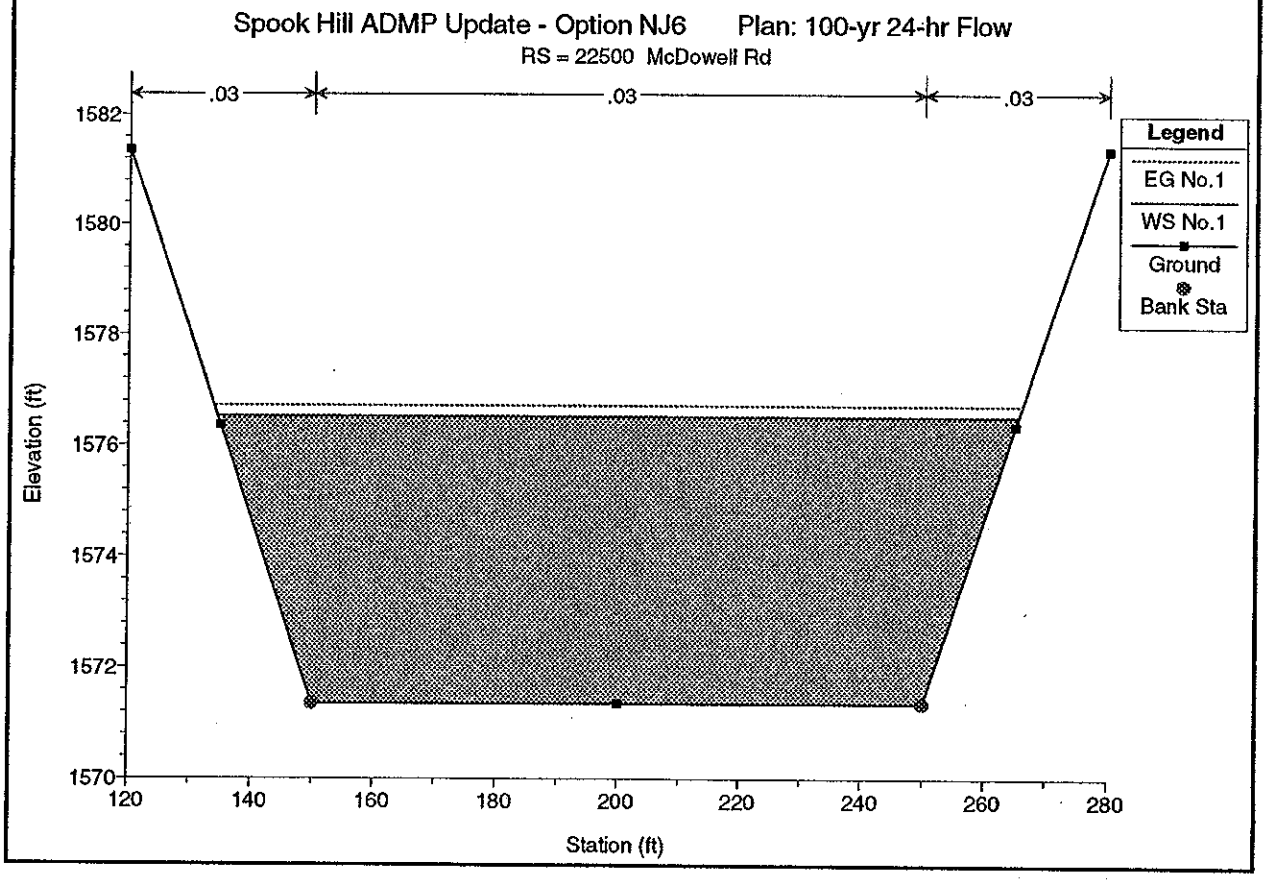
HEC-RAS Plan: 100-yr Flow River: Spook Hill Reach: Channel Profile: No.1 (Continued)

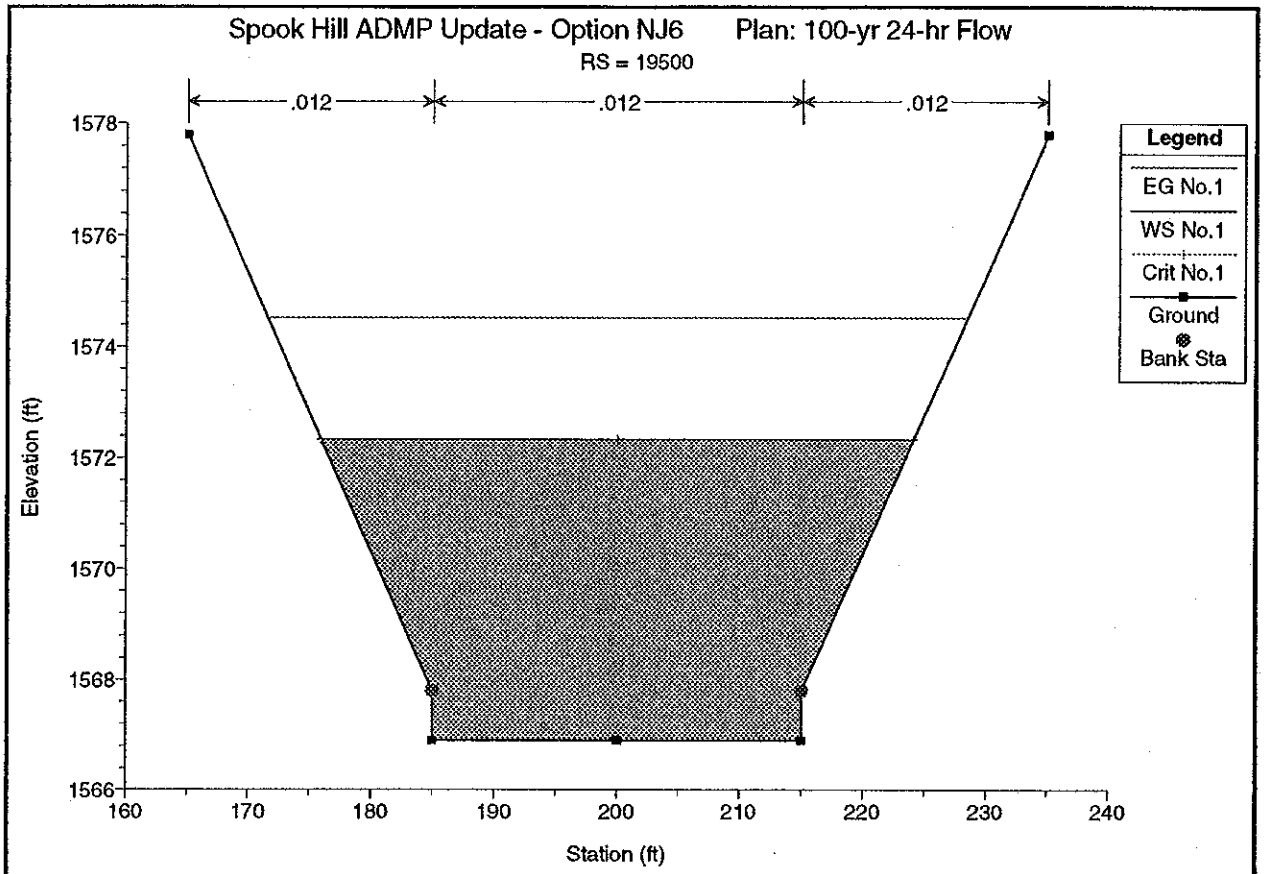
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	22000	2150.00	1571.05	1576.18		1576.39	0.000678	3.83	591.54	130.76	0.30	5.13
Channel	21500.*	2150.00	1570.74	1575.83		1576.05	0.000696	3.87	586.51	130.53	0.30	5.09
Channel	21000	2150.00	1570.43	1575.47		1575.69	0.000720	3.91	580.10	130.24	0.31	5.04
Channel	20600	2150.00	1570.18	1575.17		1575.40	0.000744	3.95	574.10	129.96	0.31	4.99
Channel	20300	2150.00	1570.00	1575.04		1575.26	0.000321	3.91	579.67	130.22	0.31	5.04
Channel	20000	2150.00	1567.80	1573.68		1575.02	0.000603	9.91	245.72	53.53	0.72	5.88
Channel	19500	2300.00	1566.90	1572.33	1572.33	1574.53	0.001143	12.44	203.82	48.11	0.94	5.43
Channel	19000.*	2300.00	1565.99	1571.48	1571.61	1573.90	0.001286	12.86	193.39	45.13	0.97	5.49
Channel	18500.*	2300.00	1565.09	1570.71	1570.83	1573.23	0.001358	13.00	187.74	42.42	0.97	5.62
Channel	18000.*	2300.00	1564.18	1569.83	1569.99	1572.50	0.001486	13.25	180.37	39.32	0.98	5.65
Channel	17500.*	2300.00	1563.28	1568.96	1569.08	1571.72	0.001598	13.40	175.10	36.22	0.99	5.68
Channel	17000.*	2300.00	1562.37	1568.00	1568.10	1570.87	0.001765	13.62	169.72	32.78	1.01	5.63
Channel	16500.*	2300.00	1561.47	1567.12	1567.12	1569.98	0.001826	13.57	169.54	30.00	1.01	5.65
Channel	16000.*	2300.00	1560.56	1566.21	1566.22	1569.07	0.001826	13.56	169.56	30.00	1.01	5.65
Channel	15500.*	2300.00	1559.66	1565.32	1565.32	1568.17	0.001821	13.55	169.69	30.00	1.00	5.66
Channel	15000.*	2300.00	1558.75	1564.41	1564.41	1567.26	0.001821	13.55	169.70	30.00	1.00	5.66
Channel	14373	2300.00	1557.62	1563.32	1563.28	1566.13	0.001780	13.45	171.03	30.00	0.99	5.70
Channel	14000.*	2300.00	1556.94	1562.60	1562.60	1565.45	0.001821	13.55	169.71	30.00	1.00	5.66
Channel	13500.*	2300.00	1556.04	1561.70	1561.71	1564.55	0.001786	13.55	169.88	31.19	1.00	5.66
Channel	13000	2300.00	1555.13	1560.31	1560.94	1563.56	0.002014	14.58	162.53	37.62	1.13	5.18
Channel	12600	2300.00	1554.41	1558.98	1559.98	1562.64	0.002415	15.73	156.08	42.32	1.30	4.57
Channel	12250	2300.00	1553.78	1557.76	1558.92	1561.69	0.002870	16.67	151.18	45.93	1.47	3.98
Channel	12000	2300.00	1553.33	1557.69	1558.47	1560.86	0.002071	15.04	168.74	47.43	1.27	4.36
Channel	11623	2300.00	1552.65	1557.25	1557.79	1560.04	0.001700	14.13	180.40	48.41	1.16	4.60
Channel	11000.*	2300.00	1551.52	1556.06	1556.66	1558.94	0.001789	14.36	177.31	48.15	1.19	4.54
Channel	10500.*	2300.00	1550.62	1555.16	1555.76	1558.04	0.001789	14.36	177.31	48.15	1.19	4.54
Channel	10000	2300.00	1549.72	1554.26	1554.86	1557.14	0.001789	14.36	177.31	48.15	1.19	4.54
Channel	9548	2300.00	1548.90	1553.43	1554.04	1556.33	0.001806	14.40	176.76	48.10	1.19	4.53

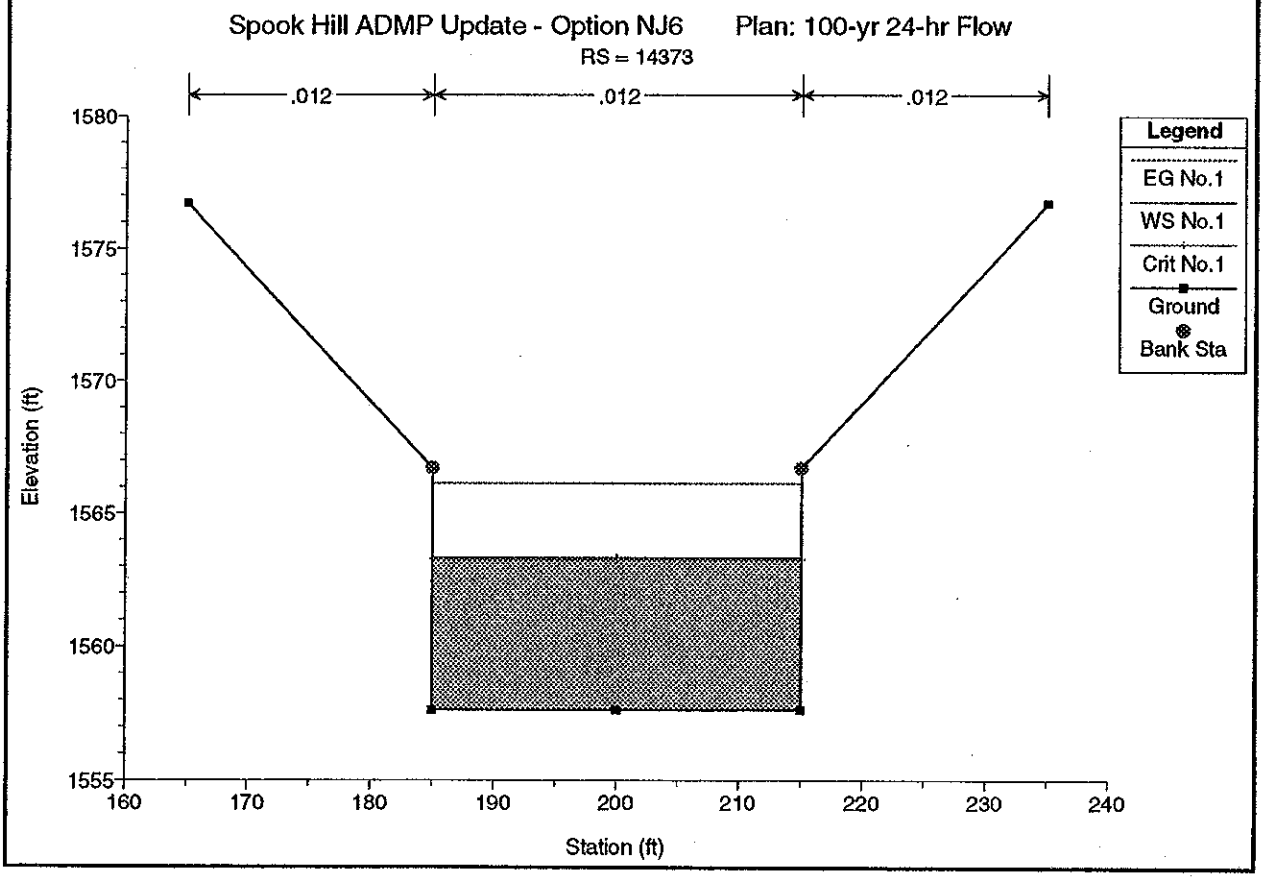

Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
RS = 41000 Upstream
.03
.03
.03
Legend
EG No.1
WS No.1
Crit No.1
Ground
Bank Sta
Elevation (ft)
1594
1592
1590
1588
1586
1584
1582
120
140
160
180
200
220
240
260
280
Station (ft)

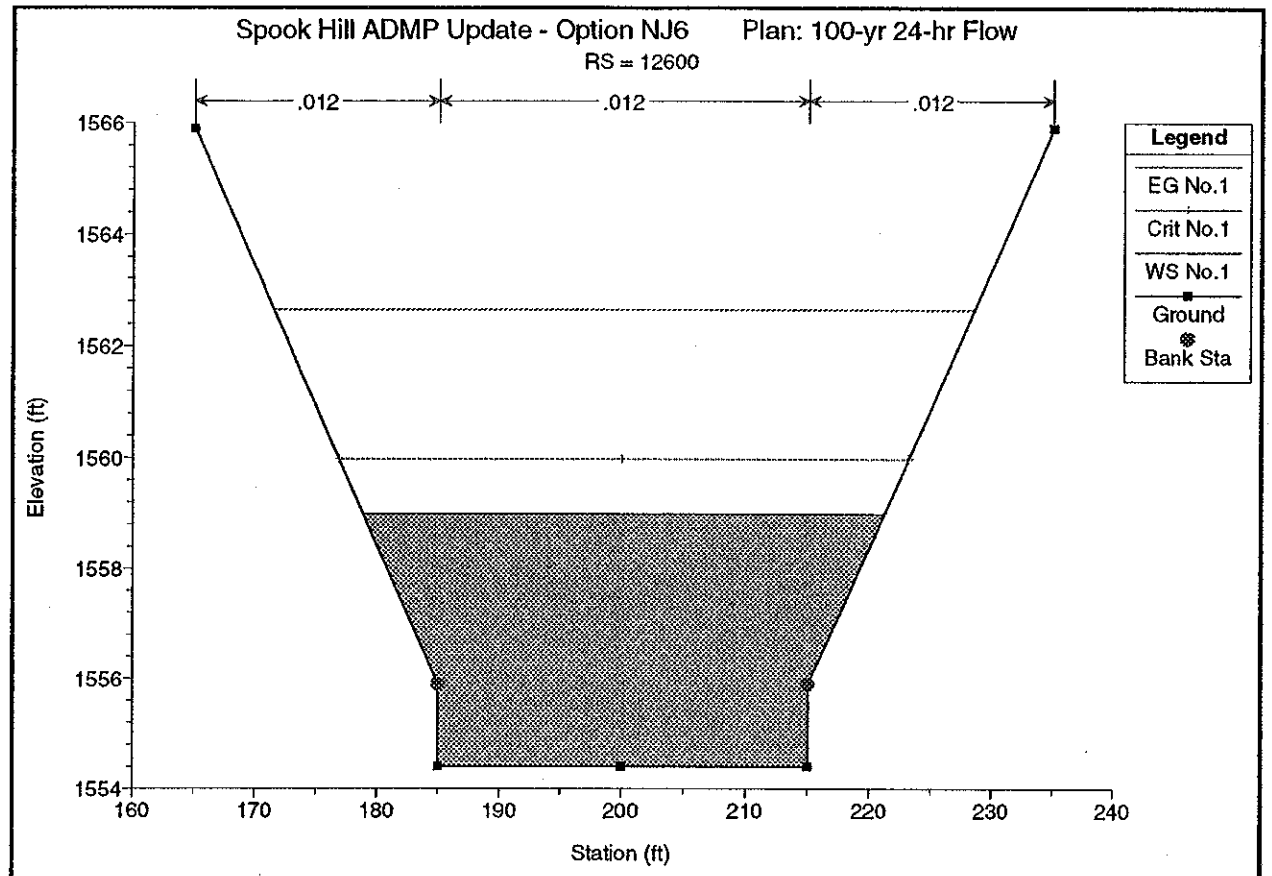

Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
RS = 35000 300' N Brown Rd
.03
.03
.03
Legend
EG No.1
WS No.1
Ground
Bank Sta
Elevation (ft)
1590
1588
1586
1584
1582
1580
1578
120
140
160
180
200
220
240
260
280
Station (ft)

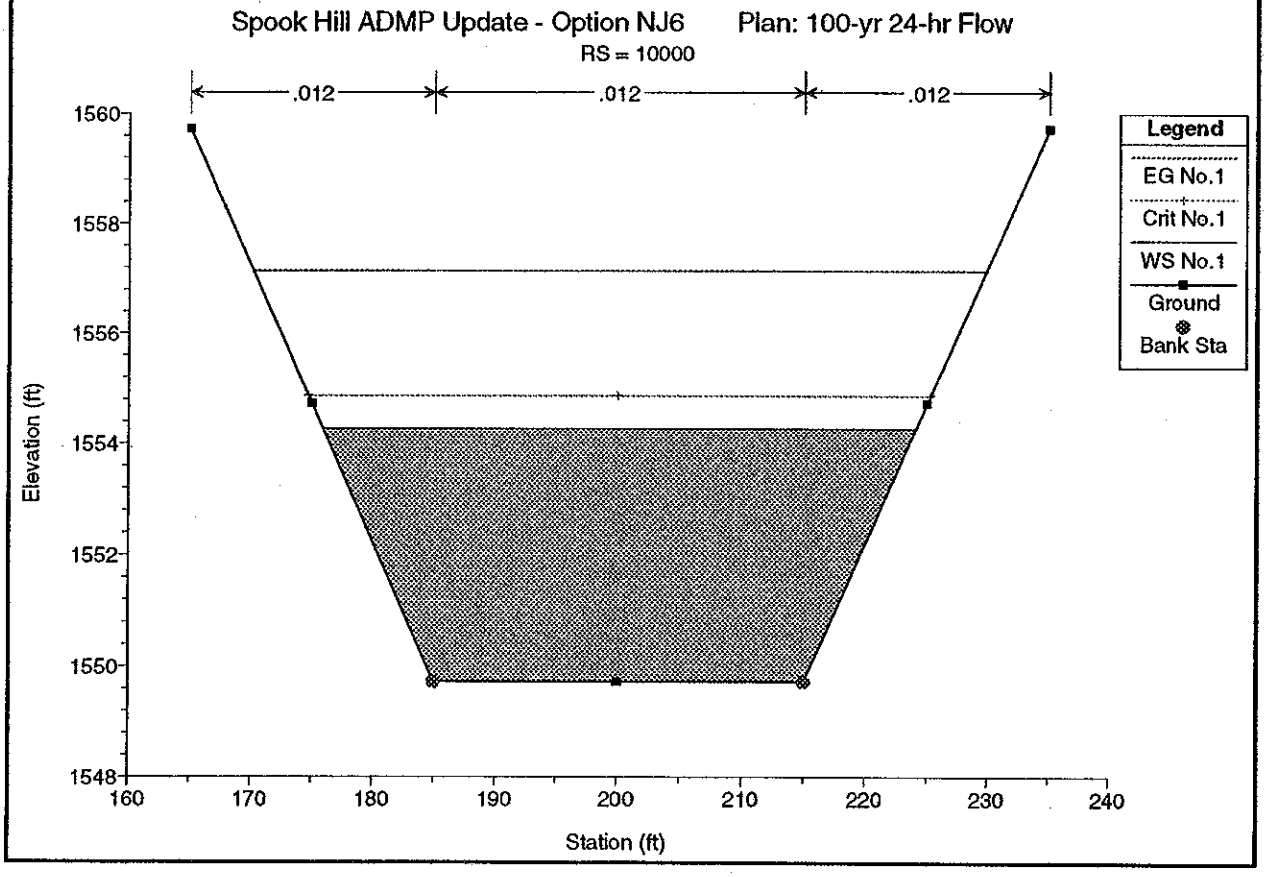

Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
RS = 26500 800' S Hermosa Vista
.03
.03
.03
Legend
EG No.1
WS No.1
Ground
Bank Sta
Elevation (ft)
1584
1582
1580
1578
1576
1574
1572
120
140
160
180
200
220
240
260
280
Station (ft)

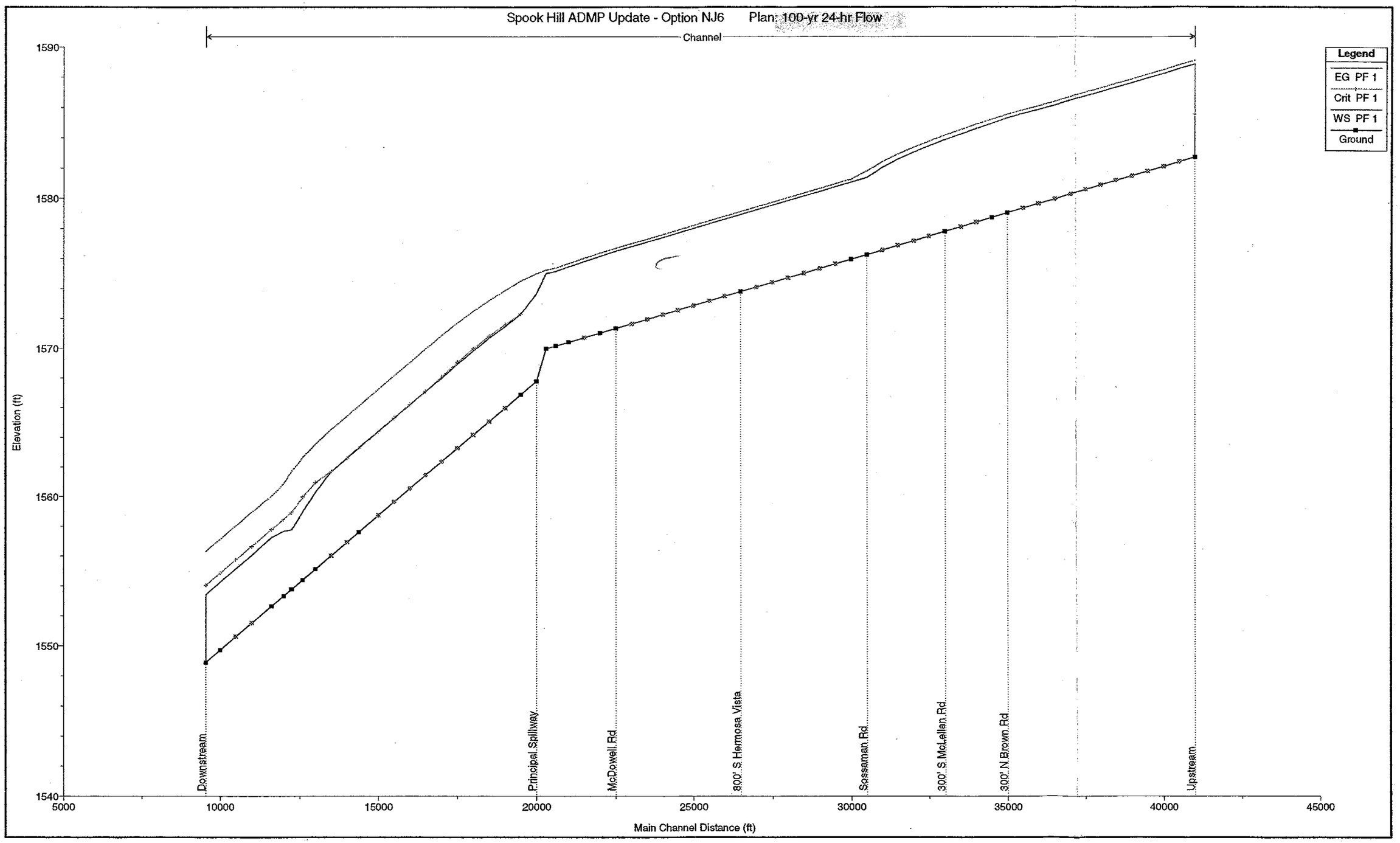

Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
RS = 22500 McDowell Rd
.03
.03
.03
Legend
EG No.1
WS No.1
Ground
Bank Sta
Elevation (ft)
1582
1580
1578
1576
1574
1572
1570
120
140
160
180
200
220
240
260
280
Station (ft)


Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
RS = 19500
.012
.012
.012
Legend
EG No.1
WS No.1
Crit No.1
Ground
Bank Sta
Elevation (ft)
1578
1576
1574
1572
1570
1568
1566
160
170
180
190
200
210
220
230
240
Station (ft)


Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
RS = 14373
.012
.012
.012
Legend
EG No.1
WS No.1
Crit No.1
Ground
Bank Sta
Elevation (ft)
1580
1575
1570
1565
1560
1555
160
170
180
190
200
210
220
230
240
Station (ft)


Spook Hill ADMP Update - Option NJ6
Plan: 100-yr 24-hr Flow
RS = 12600
.012
.012
.012
Legend
EG No.1
Crit No.1
WS No.1
Ground
Bank Sta
Elevation (ft)
1566
1564
1562
1560
1558
1556
1554
160
170
180
190
200
210
220
230
240
Station (ft)


Spook Hill ADMP Update - Option NJ6
Plan: 100-yr 24-hr Flow
RS = 10000
.012
.012
.012
Legend
EG No.1
Crit No.1
WS No.1
Ground
Bank Sta
Elevation (ft)
1560
1558
1556
1554
1552
1550
1548
160
170
180
190
200
210
220
230
240
Station (ft)


Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
Channel
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Elevation (ft)
1590
1580
1570
1560
1550
1540
5000
10000
15000
20000
25000
30000
35000
40000
45000
Main Channel Distance (ft)
Downstream
Principal Spillway
McDowell Rd
800' S Hermosa Vista
Sossaman Rd
300' S McLellan Rd
300' N Brown Rd
Upstream

HEC-RAS Plan: Q120 River: Spook Hill Reach: Channel Profile: No.1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	41000	3360.00	1582.75	1589.55	1585.93	1589.83	0.000611	4.40	818.80	140.80	0.30	6.80
Channel	40500.*	3360.00	1582.44	1589.25		1589.53	0.000609	4.39	819.88	140.85	0.30	6.81
Channel	40000.*	3360.00	1582.14	1588.95		1589.22	0.000610	4.39	819.53	140.83	0.30	6.81
Channel	39500.*	3360.00	1581.83	1588.64		1588.92	0.000607	4.39	820.62	140.88	0.30	6.81
Channel	39000.*	3360.00	1581.52	1588.34		1588.62	0.000604	4.38	822.11	140.94	0.30	6.82
Channel	38500.*	3360.00	1581.21	1588.05		1588.32	0.000600	4.37	823.63	141.01	0.29	6.83
Channel	38000.*	3360.00	1580.91	1587.75		1588.02	0.000599	4.37	824.06	141.03	0.29	6.84
Channel	37500.*	3360.00	1580.60	1587.45		1587.73	0.000595	4.36	825.92	141.11	0.29	6.85
Channel	37000.*	3360.00	1580.29	1587.16		1587.43	0.000591	4.35	828.11	141.20	0.29	6.87
Channel	36500.*	3360.00	1579.98	1586.87		1587.14	0.000585	4.34	830.69	141.31	0.29	6.88
Channel	36000.*	3360.00	1579.68	1586.58		1586.85	0.000582	4.33	832.14	141.37	0.29	6.90
Channel	35500.*	3360.00	1579.37	1586.29		1586.56	0.000575	4.31	835.51	141.51	0.29	6.92
Channel	35000	3360.00	1579.06	1586.01		1586.27	0.000567	4.29	839.36	141.68	0.29	6.95
Channel	34500	3660.00	1578.75	1585.63		1585.95	0.000696	4.73	829.88	141.27	0.32	6.88
Channel	34000.*	3660.00	1578.44	1585.27		1585.60	0.000714	4.77	822.87	140.98	0.32	6.83
Channel	33500.*	3660.00	1578.13	1584.90		1585.23	0.000737	4.81	814.38	140.62	0.33	6.77
Channel	33000	3660.00	1577.82	1584.51		1584.86	0.000767	4.87	803.77	140.16	0.33	6.69
Channel	32500.*	3660.00	1577.51	1584.11		1584.46	0.000808	4.95	790.32	139.58	0.34	6.60
Channel	32000.*	3660.00	1577.20	1583.67		1584.04	0.000864	5.06	772.90	138.83	0.35	6.47
Channel	31500.*	3660.00	1576.90	1583.19		1583.59	0.000956	5.22	747.80	137.74	0.37	6.29
Channel	31000.*	3660.00	1576.59	1582.64		1583.07	0.001098	5.45	714.61	136.29	0.39	6.05
Channel	30500	3660.00	1576.28	1581.95		1582.45	0.001379	5.85	663.53	134.02	0.43	5.67
Channel	30000	2460.00	1575.98	1581.66		1581.89	0.000618	3.92	665.24	134.10	0.29	5.68
Channel	29500.*	2460.00	1575.67	1581.36		1581.58	0.000617	3.92	665.65	134.12	0.29	5.69
Channel	29000.*	2460.00	1575.36	1581.05		1581.27	0.000616	3.92	666.07	134.14	0.29	5.69
Channel	28500.*	2460.00	1575.05	1580.75		1580.97	0.000614	3.91	666.86	134.17	0.29	5.70
Channel	28000.*	2460.00	1574.74	1580.44		1580.67	0.000611	3.91	667.66	134.21	0.29	5.70
Channel	27500.*	2460.00	1574.43	1580.14		1580.36	0.000609	3.90	668.45	134.24	0.29	5.71
Channel	27000.*	2460.00	1574.13	1579.83		1580.06	0.000611	3.91	667.91	134.22	0.29	5.70
Channel	26500	2460.00	1573.82	1579.53		1579.75	0.000607	3.90	669.07	134.27	0.29	5.71
Channel	26000.*	2460.00	1573.51	1579.23		1579.45	0.000604	3.89	670.22	134.32	0.29	5.72
Channel	25500.*	2460.00	1573.20	1578.93		1579.15	0.000600	3.89	671.71	134.39	0.29	5.73
Channel	25000.*	2460.00	1572.90	1578.63		1578.85	0.000600	3.88	671.84	134.40	0.29	5.73
Channel	24500.*	2460.00	1572.59	1578.34		1578.56	0.000595	3.87	673.66	134.48	0.28	5.75
Channel	24000.*	2460.00	1572.28	1578.04		1578.26	0.000589	3.86	675.86	134.57	0.28	5.76
Channel	23500.*	2460.00	1571.97	1577.75		1577.97	0.000582	3.85	678.51	134.69	0.28	5.78
Channel	23000.*	2460.00	1571.67	1577.46		1577.68	0.000577	3.84	680.14	134.77	0.28	5.79
Channel	22500	2460.00	1571.36	1577.18		1577.39	0.000569	3.82	683.53	134.92	0.28	5.82

HEC-RAS Plan: Q120 River: Spook Hill Reach: Channel Profile: No.1 (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	22000	2580.00	1571.05	1576.86		1577.09	0.000630	4.02	681.86	134.84	0.29	5.81
Channel	21500.*	2580.00	1570.74	1576.54		1576.78	0.000633	4.02	680.83	134.80	0.29	5.80
Channel	21000	2580.00	1570.43	1576.22		1576.46	0.000636	4.03	679.78	134.75	0.30	5.79
Channel	20600	2580.00	1570.18	1575.97		1576.20	0.000638	4.03	679.07	134.72	0.30	5.79
Channel	20300	2580.00	1570.00	1575.85		1576.08	0.000273	3.98	687.76	135.10	0.29	5.85
Channel	20000	2580.00	1567.80	1574.40		1575.84	0.000565	10.36	285.28	56.41	0.71	6.60
Channel	19500	2760.00	1566.90	1572.96	1572.96	1575.36	0.001096	13.10	234.81	50.62	0.94	6.06
Channel	19000.*	2760.00	1565.99	1572.14	1572.27	1574.76	0.001216	13.49	224.07	47.77	0.96	6.15
Channel	18500.*	2760.00	1565.09	1571.39	1571.53	1574.13	0.001281	13.64	217.85	45.17	0.96	6.30
Channel	18000.*	2760.00	1564.18	1570.56	1570.74	1573.45	0.001384	13.87	210.09	42.24	0.97	6.38
Channel	17500.*	2760.00	1563.28	1569.71	1569.88	1572.72	0.001484	14.03	203.67	39.25	0.98	6.43
Channel	17000.*	2760.00	1562.37	1568.77	1568.92	1571.92	0.001641	14.30	196.18	35.86	1.00	6.40
Channel	16500.*	2760.00	1561.47	1567.86	1567.92	1571.07	0.001750	14.38	192.66	32.65	1.00	6.39
Channel	16000.*	2760.00	1560.56	1566.93	1566.96	1570.17	0.001850	14.45	190.98	30.00	1.01	6.37
Channel	15500.*	2760.00	1559.66	1566.05	1566.05	1569.27	0.001832	14.40	191.63	30.00	1.00	6.39
Channel	15000.*	2760.00	1558.75	1565.18	1565.14	1568.36	0.001795	14.30	192.96	30.00	0.99	6.43
Channel	14373	2760.00	1557.62	1564.10	1564.01	1567.23	0.001760	14.21	194.25	30.00	0.98	6.47
Channel	14000.*	2760.00	1556.94	1563.33	1563.33	1566.55	0.001831	14.40	191.65	30.00	1.00	6.39
Channel	13500.*	2760.00	1556.04	1562.33	1562.54	1565.63	0.001797	14.59	190.53	33.73	1.03	6.29
Channel	13000	2760.00	1555.13	1560.79	1561.68	1564.61	0.002114	15.86	181.21	39.56	1.17	5.66
Channel	12600	2760.00	1554.41	1559.41	1560.64	1563.65	0.002502	17.01	174.80	44.05	1.34	5.00
Channel	12250	2760.00	1553.78	1558.16	1559.52	1562.68	0.002926	17.94	169.83	47.52	1.51	4.38
Channel	12000	2760.00	1553.33	1558.06	1559.07	1561.82	0.002212	16.41	186.73	48.93	1.33	4.73
Channel	11623	2760.00	1552.65	1557.68	1558.39	1560.92	0.001772	15.30	201.42	50.11	1.20	5.03
Channel	11000.*	2760.00	1551.52	1556.53	1557.26	1559.80	0.001801	15.38	200.27	50.02	1.21	5.01
Channel	10500.*	2760.00	1550.62	1555.63	1556.36	1558.90	0.001801	15.38	200.27	50.02	1.21	5.01
Channel	10000	2760.00	1549.72	1554.73	1555.46	1558.00	0.001801	15.38	200.27	50.02	1.21	5.01
Channel	9548	2760.00	1548.90	1553.90	1554.65	1557.19	0.001809	15.40	199.98	50.00	1.21	5.00

HEC-RAS Plan: Q140 River: Spook Hill Reach: Channel Profile: No.1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	41000	3920.00	1582.75	1590.17	1586.27	1590.48	0.000611	4.66	906.51	144.49	0.30	7.42
Channel	40500.*	3920.00	1582.44	1589.86		1590.17	0.000609	4.65	907.58	144.54	0.30	7.42
Channel	40000.*	3920.00	1582.14	1589.56		1589.87	0.000610	4.65	907.19	144.52	0.30	7.42
Channel	39500.*	3920.00	1581.83	1589.26		1589.57	0.000608	4.65	908.27	144.57	0.30	7.43
Channel	39000.*	3920.00	1581.52	1588.96		1589.27	0.000605	4.64	909.72	144.63	0.30	7.44
Channel	38500.*	3920.00	1581.21	1588.66		1588.97	0.000602	4.63	911.18	144.69	0.30	7.45
Channel	38000.*	3920.00	1580.91	1588.36		1588.67	0.000601	4.63	911.50	144.70	0.30	7.45
Channel	37500.*	3920.00	1580.60	1588.06		1588.37	0.000598	4.62	913.28	144.77	0.30	7.46
Channel	37000.*	3920.00	1580.29	1587.77		1588.07	0.000593	4.61	915.41	144.86	0.30	7.48
Channel	36500.*	3920.00	1579.98	1587.48		1587.78	0.000588	4.60	918.06	144.97	0.30	7.50
Channel	36000.*	3920.00	1579.68	1587.18		1587.49	0.000586	4.60	919.25	145.02	0.30	7.50
Channel	35500.*	3920.00	1579.37	1586.90		1587.20	0.000580	4.58	922.31	145.15	0.29	7.52
Channel	35000	3920.00	1579.06	1586.61		1586.91	0.000574	4.56	925.78	145.29	0.29	7.55
Channel	34500	4270.00	1578.75	1586.22		1586.58	0.000707	5.03	914.20	144.81	0.32	7.47
Channel	34000.*	4270.00	1578.44	1585.85		1586.22	0.000726	5.07	906.01	144.47	0.33	7.41
Channel	33500.*	4270.00	1578.13	1585.47		1585.85	0.000751	5.13	896.22	144.06	0.33	7.34
Channel	33000	4270.00	1577.82	1585.08		1585.47	0.000782	5.19	884.11	143.56	0.34	7.26
Channel	32500.*	4270.00	1577.51	1584.66		1585.07	0.000824	5.28	868.89	142.92	0.35	7.15
Channel	32000.*	4270.00	1577.20	1584.22		1584.64	0.000883	5.39	849.46	142.10	0.36	7.02
Channel	31500.*	4270.00	1576.90	1583.72		1584.17	0.000976	5.57	821.94	140.94	0.38	6.82
Channel	31000.*	4270.00	1576.59	1583.16		1583.64	0.001118	5.81	785.94	139.40	0.40	6.57
Channel	30500	4270.00	1576.28	1582.45		1583.02	0.001390	6.22	731.80	137.05	0.44	6.17
Channel	30000	2870.00	1575.98	1582.19		1582.44	0.000615	4.15	736.89	137.27	0.29	6.21
Channel	29500.*	2870.00	1575.67	1581.89		1582.14	0.000613	4.15	737.46	137.29	0.29	6.22
Channel	29000.*	2870.00	1575.36	1581.58		1581.83	0.000611	4.14	738.38	137.33	0.29	6.22
Channel	28500.*	2870.00	1575.05	1581.28		1581.53	0.000609	4.14	739.29	137.37	0.29	6.23
Channel	28000.*	2870.00	1574.74	1580.98		1581.23	0.000605	4.13	740.61	137.43	0.29	6.24
Channel	27500.*	2870.00	1574.43	1580.68		1580.93	0.000602	4.12	741.92	137.49	0.29	6.25
Channel	27000.*	2870.00	1574.13	1580.38		1580.63	0.000602	4.12	742.20	137.50	0.29	6.25
Channel	26500	2870.00	1573.82	1580.08		1580.33	0.000597	4.11	743.87	137.57	0.29	6.26
Channel	26000.*	2870.00	1573.51	1579.79		1580.03	0.000593	4.10	745.85	137.66	0.29	6.28
Channel	25500.*	2870.00	1573.20	1579.49		1579.74	0.000587	4.09	748.22	137.76	0.29	6.29
Channel	25000.*	2870.00	1572.90	1579.20		1579.45	0.000584	4.08	749.51	137.82	0.29	6.30
Channel	24500.*	2870.00	1572.59	1578.92		1579.16	0.000576	4.07	752.73	137.96	0.28	6.33
Channel	24000.*	2870.00	1572.28	1578.63		1578.87	0.000567	4.05	756.55	138.13	0.28	6.35
Channel	23500.*	2870.00	1571.97	1578.36		1578.59	0.000557	4.02	761.06	138.32	0.28	6.39
Channel	23000.*	2870.00	1571.67	1578.08		1578.32	0.000549	4.01	764.76	138.48	0.28	6.41
Channel	22500	2870.00	1571.36	1577.82		1578.04	0.000537	3.98	770.46	138.73	0.28	6.45

HEC-RAS Plan: Q140 River: Spook Hill Reach: Channel Profile: No.1 (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	22000	3010.00	1571.05	1577.51		1577.76	0.000589	4.17	771.00	138.75	0.29	6.46
Channel	21500.*	3010.00	1570.74	1577.22		1577.47	0.000583	4.16	773.66	138.87	0.29	6.48
Channel	21000	3010.00	1570.43	1576.93		1577.18	0.000576	4.14	776.65	139.00	0.29	6.50
Channel	20600	3010.00	1570.18	1576.70		1576.95	0.000569	4.12	779.74	139.13	0.28	6.52
Channel	20300	3010.00	1570.00	1576.60		1576.84	0.000243	4.07	790.61	139.60	0.28	6.60
Channel	20000	3010.00	1567.80	1575.07		1576.60	0.000536	10.76	323.71	59.07	0.70	7.27
Channel	19500	3220.00	1566.90	1573.53	1573.53	1576.13	0.001060	13.69	264.73	52.93	0.94	6.63
Channel	19000.*	3220.00	1565.99	1572.76	1572.88	1575.56	0.001160	14.04	254.06	50.22	0.95	6.77
Channel	18500.*	3220.00	1565.09	1572.04	1572.18	1574.95	0.001212	14.16	247.85	47.75	0.95	6.95
Channel	18000.*	3220.00	1564.18	1571.23	1571.42	1574.31	0.001303	14.39	239.50	44.94	0.95	7.05
Channel	17500.*	3220.00	1563.28	1570.42	1570.59	1573.62	0.001388	14.55	232.49	42.08	0.96	7.14
Channel	17000.*	3220.00	1562.37	1569.51	1569.68	1572.87	0.001525	14.83	223.76	38.82	0.98	7.13
Channel	16500.*	3220.00	1561.47	1568.60	1568.71	1572.07	0.001643	14.99	217.83	35.60	0.99	7.13
Channel	16000.*	3220.00	1560.56	1567.63	1567.69	1571.21	0.001793	15.17	212.68	32.12	1.01	7.07
Channel	15500.*	3220.00	1559.66	1566.79	1566.74	1570.31	0.001811	15.06	213.83	30.00	0.99	7.13
Channel	15000.*	3220.00	1558.75	1565.90	1565.84	1569.40	0.001796	15.02	214.43	30.00	0.99	7.15
Channel	14373	3220.00	1557.62	1564.78	1564.71	1568.27	0.001786	14.99	214.82	30.00	0.99	7.16
Channel	14000.*	3220.00	1556.94	1564.03	1564.03	1567.59	0.001841	15.15	212.59	30.00	1.00	7.09
Channel	13500.*	3220.00	1556.04	1562.87	1563.33	1566.65	0.001849	15.63	209.17	35.87	1.05	6.83
Channel	13000	3220.00	1555.13	1561.24	1562.36	1565.58	0.002189	16.97	199.37	41.35	1.21	6.11
Channel	12600	3220.00	1554.41	1559.81	1561.23	1564.60	0.002571	18.15	192.67	45.65	1.38	5.40
Channel	12250	3220.00	1553.78	1558.53	1560.09	1563.60	0.002976	19.08	187.48	48.99	1.54	4.75
Channel	12000	3220.00	1553.33	1558.41	1559.64	1562.72	0.002324	17.64	203.97	50.32	1.38	5.08
Channel	11623	3220.00	1552.65	1558.06	1558.96	1561.75	0.001846	16.39	220.72	51.63	1.24	5.41
Channel	11000.*	3220.00	1551.52	1556.96	1557.83	1560.60	0.001802	16.26	222.59	51.78	1.23	5.44
Channel	10500.*	3220.00	1550.62	1556.06	1556.93	1559.70	0.001802	16.26	222.59	51.78	1.23	5.44
Channel	10000	3220.00	1549.72	1555.16	1556.03	1558.80	0.001802	16.26	222.59	51.78	1.23	5.44
Channel	9548	3220.00	1548.90	1554.34	1555.21	1557.98	0.001808	16.28	222.30	51.75	1.23	5.44

HEC-RAS Plan: Q150 River: Spook Hill Reach: Channel Profile: No.1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	41000	4200.00	1582.75	1590.46	1586.42	1590.79	0.000611	4.78	949.11	146.25	0.30	7.71
Channel	40500.*	4200.00	1582.44	1590.15		1590.48	0.000609	4.77	949.99	146.29	0.30	7.71
Channel	40000.*	4200.00	1582.14	1589.85		1590.18	0.000610	4.78	949.38	146.26	0.30	7.71
Channel	39500.*	4200.00	1581.83	1589.55		1589.88	0.000608	4.77	950.65	146.31	0.30	7.72
Channel	39000.*	4200.00	1581.52	1589.25		1589.57	0.000605	4.76	951.90	146.37	0.30	7.73
Channel	38500.*	4200.00	1581.21	1588.95		1589.27	0.000602	4.76	953.63	146.44	0.30	7.74
Channel	38000.*	4200.00	1580.91	1588.65		1588.98	0.000602	4.75	953.88	146.45	0.30	7.74
Channel	37500.*	4200.00	1580.60	1588.35		1588.68	0.000598	4.75	955.62	146.52	0.30	7.75
Channel	37000.*	4200.00	1580.29	1588.06		1588.38	0.000594	4.74	957.67	146.60	0.30	7.77
Channel	36500.*	4200.00	1579.98	1587.76		1588.08	0.000590	4.72	960.20	146.71	0.30	7.78
Channel	36000.*	4200.00	1579.68	1587.47		1587.79	0.000588	4.72	961.24	146.75	0.30	7.79
Channel	35500.*	4200.00	1579.37	1587.18		1587.50	0.000583	4.71	964.16	146.87	0.30	7.81
Channel	35000	4200.00	1579.06	1586.89		1587.21	0.000577	4.69	967.44	147.00	0.30	7.83
Channel	34500	4575.00	1578.75	1586.50		1586.88	0.000712	5.17	954.81	146.48	0.33	7.75
Channel	34000.*	4575.00	1578.44	1586.13		1586.52	0.000732	5.22	946.06	146.13	0.33	7.69
Channel	33500.*	4575.00	1578.13	1585.75		1586.15	0.000757	5.27	935.62	145.70	0.34	7.62
Channel	33000	4575.00	1577.82	1585.35		1585.76	0.000789	5.34	922.79	145.17	0.34	7.53
Channel	32500.*	4575.00	1577.51	1584.93		1585.35	0.000832	5.43	906.73	144.50	0.35	7.42
Channel	32000.*	4575.00	1577.20	1584.48		1584.92	0.000891	5.55	886.35	143.65	0.36	7.28
Channel	31500.*	4575.00	1576.90	1583.98		1584.45	0.000984	5.73	857.68	142.45	0.38	7.08
Channel	31000.*	4575.00	1576.59	1583.40		1583.92	0.001126	5.97	820.39	140.87	0.40	6.81
Channel	30500	4575.00	1576.28	1582.69		1583.29	0.001394	6.39	764.88	138.49	0.44	6.41
Channel	30000	3075.00	1575.98	1582.44		1582.71	0.000613	4.26	771.73	138.78	0.29	6.46
Channel	29500.*	3075.00	1575.67	1582.14		1582.40	0.000611	4.25	772.70	138.83	0.29	6.47
Channel	29000.*	3075.00	1575.36	1581.84		1582.10	0.000608	4.25	773.68	138.87	0.29	6.48
Channel	28500.*	3075.00	1575.05	1581.54		1581.80	0.000605	4.24	775.05	138.93	0.29	6.49
Channel	28000.*	3075.00	1574.74	1581.24		1581.50	0.000602	4.23	776.44	138.99	0.29	6.50
Channel	27500.*	3075.00	1574.43	1580.94		1581.20	0.000598	4.22	778.18	139.06	0.29	6.51
Channel	27000.*	3075.00	1574.13	1580.64		1580.90	0.000597	4.22	778.53	139.08	0.29	6.51
Channel	26500	3075.00	1573.82	1580.35		1580.60	0.000592	4.21	780.62	139.17	0.29	6.53
Channel	26000.*	3075.00	1573.51	1580.06		1580.31	0.000586	4.20	783.10	139.27	0.29	6.55
Channel	25500.*	3075.00	1573.20	1579.77		1580.02	0.000580	4.18	786.04	139.40	0.29	6.57
Channel	25000.*	3075.00	1572.90	1579.48		1579.73	0.000575	4.17	787.99	139.48	0.29	6.58
Channel	24500.*	3075.00	1572.59	1579.20		1579.45	0.000567	4.15	791.96	139.65	0.28	6.61
Channel	24000.*	3075.00	1572.28	1578.92		1579.17	0.000556	4.13	796.63	139.86	0.28	6.64
Channel	23500.*	3075.00	1571.97	1578.65		1578.90	0.000545	4.10	802.08	140.09	0.28	6.68
Channel	23000.*	3075.00	1571.67	1578.39		1578.63	0.000535	4.08	806.82	140.29	0.28	6.72
Channel	22500	3075.00	1571.36	1578.12		1578.36	0.000522	4.05	813.64	140.58	0.27	6.76

HEC-RAS Plan: Q150 River: Spook Hill Reach: Channel Profile: No.1 (Continued)

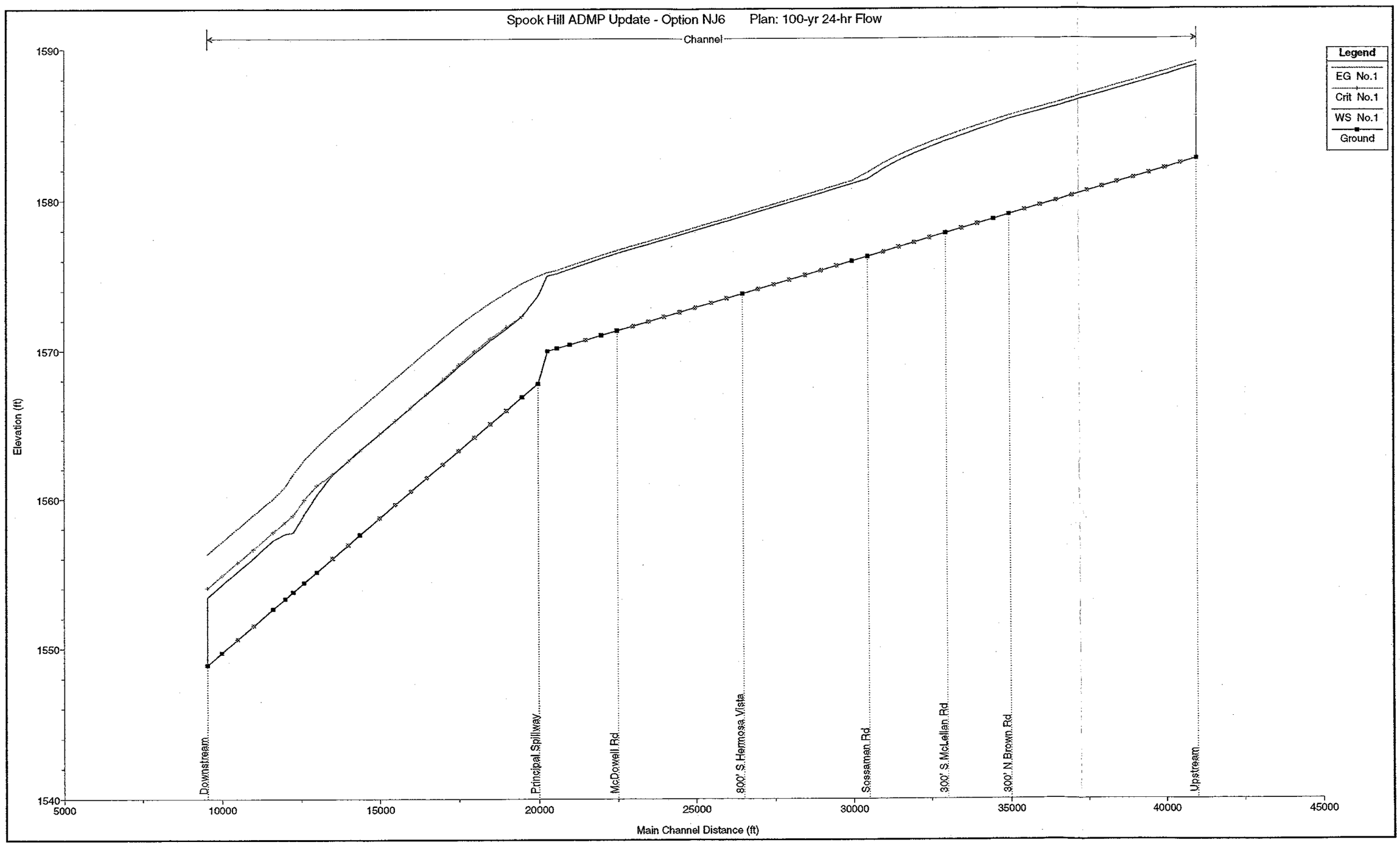
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	22000	3225.00	1571.05	1577.83		1578.09	0.000570	4.24	815.34	140.66	0.29	6.78
Channel	21500.*	3225.00	1570.74	1577.55		1577.80	0.000561	4.21	819.62	140.84	0.28	6.81
Channel	21000	3225.00	1570.43	1577.27		1577.52	0.000552	4.19	824.39	141.04	0.28	6.84
Channel	20600	3225.00	1570.18	1577.05		1577.30	0.000542	4.17	829.07	141.24	0.28	6.87
Channel	20300	3225.00	1570.00	1576.96		1577.20	0.000231	4.11	840.87	141.74	0.27	6.96
Channel	20000	3225.00	1567.80	1575.39		1576.97	0.000522	10.93	342.90	60.36	0.70	7.59
Channel	19500	3450.00	1566.90	1573.81	1573.81	1576.49	0.001043	13.95	279.48	54.04	0.94	6.91
Channel	19000.*	3450.00	1565.99	1573.05	1573.16	1575.93	0.001136	14.29	268.81	51.38	0.95	7.06
Channel	18500.*	3450.00	1565.09	1572.34	1572.48	1575.34	0.001185	14.41	262.49	48.96	0.94	7.25
Channel	18000.*	3450.00	1564.18	1571.55	1571.73	1574.71	0.001268	14.62	254.11	46.22	0.95	7.37
Channel	17500.*	3450.00	1563.28	1570.75	1570.94	1574.04	0.001352	14.80	246.53	43.40	0.95	7.47
Channel	17000.*	3450.00	1562.37	1569.86	1570.06	1573.32	0.001473	15.05	237.81	40.24	0.97	7.49
Channel	16500.*	3450.00	1561.47	1568.97	1569.11	1572.54	0.001583	15.22	231.28	37.08	0.98	7.50
Channel	16000.*	3450.00	1560.56	1567.99	1568.07	1571.70	0.001743	15.46	224.42	33.55	1.00	7.43
Channel	15500.*	3450.00	1559.66	1567.13	1567.08	1570.81	0.001801	15.40	224.11	30.52	0.99	7.47
Channel	15000.*	3450.00	1558.75	1566.24	1566.17	1569.90	0.001798	15.35	224.81	30.00	0.99	7.49
Channel	14373	3450.00	1557.62	1565.14	1565.04	1568.77	0.001779	15.29	225.63	30.00	0.98	7.52
Channel	14000.*	3450.00	1556.94	1564.36	1564.36	1568.09	0.001850	15.50	222.61	30.00	1.00	7.42
Channel	13500.*	3450.00	1556.04	1563.11	1563.70	1567.13	0.001885	16.15	217.85	36.83	1.07	7.07
Channel	13000	3450.00	1555.13	1561.45	1562.67	1566.05	0.002224	17.50	208.13	42.19	1.23	6.32
Channel	12600	3450.00	1554.41	1560.00	1561.52	1565.05	0.002602	18.68	201.30	46.40	1.39	5.59
Channel	12250	3450.00	1553.78	1558.70	1560.35	1564.04	0.003000	19.62	195.97	49.68	1.56	4.92
Channel	12000	3450.00	1553.33	1558.57	1559.90	1563.15	0.002373	18.21	212.31	50.98	1.40	5.24
Channel	11623	3450.00	1552.65	1558.23	1559.22	1562.16	0.001890	16.93	229.61	52.31	1.26	5.58
Channel	11000.*	3450.00	1551.52	1557.18	1558.09	1560.97	0.001790	16.64	233.94	52.65	1.23	5.66
Channel	10500.*	3450.00	1550.62	1556.28	1557.19	1560.07	0.001790	16.64	233.94	52.65	1.23	5.66
Channel	10000	3450.00	1549.72	1555.38	1556.29	1559.17	0.001790	16.64	233.94	52.65	1.23	5.66
Channel	9548	3450.00	1548.90	1554.55	1555.47	1558.36	0.001802	16.68	233.40	52.60	1.24	5.65

HEC-RAS Plan: n028 River: Spook Hill Reach: Channel Profile: No.1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	41000	3360.00	1582.75	1589.56	1585.93	1589.83	0.000610	4.39	819.40	140.83	0.30	6.80
Channel	40500.*	3360.00	1582.44	1589.25		1589.53	0.000608	4.39	820.34	140.87	0.30	6.81
Channel	40000.*	3360.00	1582.14	1588.95		1589.23	0.000609	4.39	819.86	140.85	0.30	6.81
Channel	39500.*	3360.00	1581.83	1588.65		1588.93	0.000606	4.38	821.19	140.91	0.30	6.82
Channel	39000.*	3360.00	1581.52	1588.35		1588.62	0.000603	4.38	822.49	140.96	0.30	6.83
Channel	38500.*	3360.00	1581.21	1588.05		1588.32	0.000599	4.37	824.13	141.03	0.29	6.84
Channel	38000.*	3360.00	1580.91	1587.75		1588.03	0.000599	4.37	824.33	141.04	0.29	6.84
Channel	37500.*	3360.00	1580.60	1587.45		1587.73	0.000595	4.36	826.26	141.12	0.29	6.85
Channel	37000.*	3360.00	1580.29	1587.16		1587.43	0.000590	4.35	828.52	141.22	0.29	6.87
Channel	36500.*	3360.00	1579.98	1586.87		1587.14	0.000584	4.33	831.18	141.33	0.29	6.89
Channel	36000.*	3360.00	1579.68	1586.58		1586.85	0.000581	4.33	832.71	141.40	0.29	6.90
Channel	35500.*	3360.00	1579.37	1586.29		1586.56	0.000573	4.31	836.18	141.54	0.29	6.92
Channel	35000	3360.00	1579.06	1586.01		1586.28	0.000565	4.29	840.14	141.71	0.29	6.95
Channel	34500	3660.00	1578.75	1585.64		1585.96	0.000694	4.72	830.87	141.32	0.32	6.89
Channel	34000.*	3660.00	1578.44	1585.28		1585.61	0.000711	4.76	824.08	141.03	0.32	6.84
Channel	33500.*	3660.00	1578.13	1584.91		1585.24	0.000734	4.81	815.63	140.67	0.33	6.78
Channel	33000	3660.00	1577.82	1584.53		1584.87	0.000763	4.86	805.35	140.23	0.33	6.70
Channel	32500.*	3660.00	1577.51	1584.12		1584.48	0.000801	4.94	792.33	139.67	0.34	6.61
Channel	32000.*	3660.00	1577.20	1583.69		1584.06	0.000855	5.04	775.55	138.95	0.35	6.49
Channel	31500.*	3660.00	1576.90	1583.22		1583.61	0.000942	5.20	751.35	137.90	0.36	6.32
Channel	31000.*	3660.00	1576.59	1582.68		1583.10	0.001075	5.41	719.73	136.52	0.39	6.09
Channel	30500	3660.00	1576.28	1582.01		1582.50	0.001326	5.78	671.99	134.40	0.43	5.73
Channel	30000	2460.00	1575.98	1581.74		1581.96	0.000588	3.86	675.98	134.58	0.28	5.76
Channel	29500.*	2460.00	1575.67	1581.45		1581.67	0.000581	3.85	678.77	134.70	0.28	5.78
Channel	29000.*	2460.00	1575.36	1581.17		1581.38	0.000572	3.83	682.21	134.86	0.28	5.81
Channel	28500.*	2460.00	1575.05	1580.89		1581.10	0.000561	3.81	686.38	135.04	0.28	5.84
Channel	28000.*	2460.00	1574.74	1580.62		1580.83	0.000549	3.78	691.43	135.27	0.27	5.88
Channel	27500.*	2460.00	1574.43	1580.35		1580.56	0.000535	3.75	697.39	135.53	0.27	5.92
Channel	27000.*	2460.00	1574.13	1580.09		1580.29	0.000522	3.72	702.92	135.78	0.27	5.96
Channel	26500	2460.00	1573.82	1579.84		1580.04	0.000505	3.68	710.72	136.12	0.26	6.02
Channel	26000.*	2460.00	1573.51	1579.60		1579.79	0.000485	3.64	719.84	136.52	0.26	6.09
Channel	25500.*	2460.00	1573.20	1579.36		1579.55	0.000464	3.59	730.44	136.99	0.25	6.16
Channel	25000.*	2460.00	1572.90	1579.14		1579.32	0.000444	3.54	741.11	137.45	0.25	6.24
Channel	24500.*	2460.00	1572.59	1578.93		1579.11	0.000420	3.48	754.87	138.05	0.24	6.34
Channel	24000.*	2460.00	1572.28	1578.73		1578.90	0.000395	3.41	770.26	138.72	0.24	6.45
Channel	23500.*	2460.00	1571.97	1578.55		1578.71	0.000369	3.34	787.75	139.47	0.23	6.58
Channel	23000.*	2460.00	1571.67	1578.38		1578.53	0.000344	3.27	805.60	140.24	0.22	6.71
Channel	22500	2460.00	1571.36	1578.21		1578.36	0.000319	3.19	826.30	141.12	0.21	6.85

HEC-RAS Plan: n028 River: Spook Hill Reach: Channel Profile: No.1 (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	22000	2580.00	1571.05	1578.05		1578.20	0.000326	3.27	846.22	141.97	0.22	6.99
Channel	21500.*	2580.00	1570.74	1577.90		1578.04	0.000301	3.19	869.02	142.93	0.21	7.15
Channel	21000	2580.00	1570.43	1577.76		1577.90	0.000276	3.11	893.58	143.95	0.20	7.33
Channel	20600	2580.00	1570.18	1577.65		1577.79	0.000257	3.04	914.91	144.84	0.20	7.47
Channel	20300	2580.00	1570.00	1577.58		1577.71	0.000244	2.99	930.74	145.50	0.19	7.58
Channel	20000	2580.00	1567.80	1576.91		1577.54	0.000905	6.96	439.45	66.45	0.41	9.11
Channel	19500	2760.00	1566.90	1576.25		1577.01	0.001137	7.64	423.05	63.78	0.44	9.35
Channel	19000.*	2760.00	1565.99	1575.64		1576.43	0.001180	7.69	415.46	61.75	0.44	9.65
Channel	18500.*	2760.00	1565.09	1575.00		1575.83	0.001233	7.76	406.92	59.61	0.43	9.91
Channel	18000.*	2760.00	1564.18	1574.34		1575.19	0.001291	7.83	398.15	57.34	0.43	10.16
Channel	17500.*	2760.00	1563.28	1573.63		1574.53	0.001363	7.92	388.30	54.93	0.43	10.35
Channel	17000.*	2760.00	1562.37	1572.89		1573.82	0.001444	8.01	378.08	52.36	0.44	10.52
Channel	16500.*	2760.00	1561.47	1572.09		1573.07	0.001548	8.13	366.55	49.57	0.44	10.62
Channel	16000.*	2760.00	1560.56	1571.23		1572.26	0.001675	8.27	354.33	46.53	0.45	10.67
Channel	15500.*	2760.00	1559.66	1570.28		1571.37	0.001851	8.46	340.28	43.13	0.46	10.62
Channel	15000.*	2760.00	1558.75	1569.21		1570.38	0.002098	8.71	324.60	39.25	0.47	10.46
Channel	14373	2760.00	1557.62	1567.55		1568.88	0.002678	9.26	299.44	33.41	0.52	9.93
Channel	14000.*	2760.00	1556.94	1566.40		1567.84	0.002854	9.66	291.00	37.60	0.55	9.46
Channel	13500.*	2760.00	1556.04	1564.77		1566.34	0.003089	10.20	284.65	43.48	0.61	8.73
Channel	13000	2760.00	1555.13	1563.18		1564.78	0.003160	10.50	286.94	49.10	0.65	8.04
Channel	12600	2760.00	1554.41	1562.18		1563.56	0.002629	10.02	311.74	55.10	0.63	7.77
Channel	12250	2760.00	1553.78	1561.66		1562.71	0.001810	8.94	360.35	61.50	0.56	7.88
Channel	12000	2760.00	1553.33	1561.20		1562.25	0.001816	8.95	359.88	61.47	0.56	7.87
Channel	11623	2760.00	1552.65	1560.51		1561.57	0.001823	8.96	359.42	61.44	0.56	7.86
Channel	11000.*	2760.00	1551.52	1559.37		1560.43	0.001834	8.98	358.66	61.39	0.56	7.85
Channel	10500.*	2760.00	1550.62	1558.43		1559.50	0.001874	9.04	355.96	61.22	0.57	7.80
Channel	10000	2760.00	1549.72	1557.42	1555.46	1558.53	0.001969	9.18	349.80	60.81	0.58	7.70
Channel	9548	2760.00	1548.90	1554.65	1554.65	1556.98	0.005890	13.07	238.60	53.00	0.96	5.75


Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
Channel
Legend
EG No.1
Crit No.1
WS No.1
Ground
Elevation (ft)
1590
1580
1570
1560
1550
1540
5000
10000
15000
20000
25000
30000
35000
40000
45000
Main Channel Distance (ft)
Downstream
Principal Spillway
McDowell Rd
800' S.Hermosa Vista
Sossaman Rd
300' S.McLellan Rd
300' N.Brown Rd
Upstream

(Concrete lining)

: match exist. Spook Hill Fly channel near outfall area

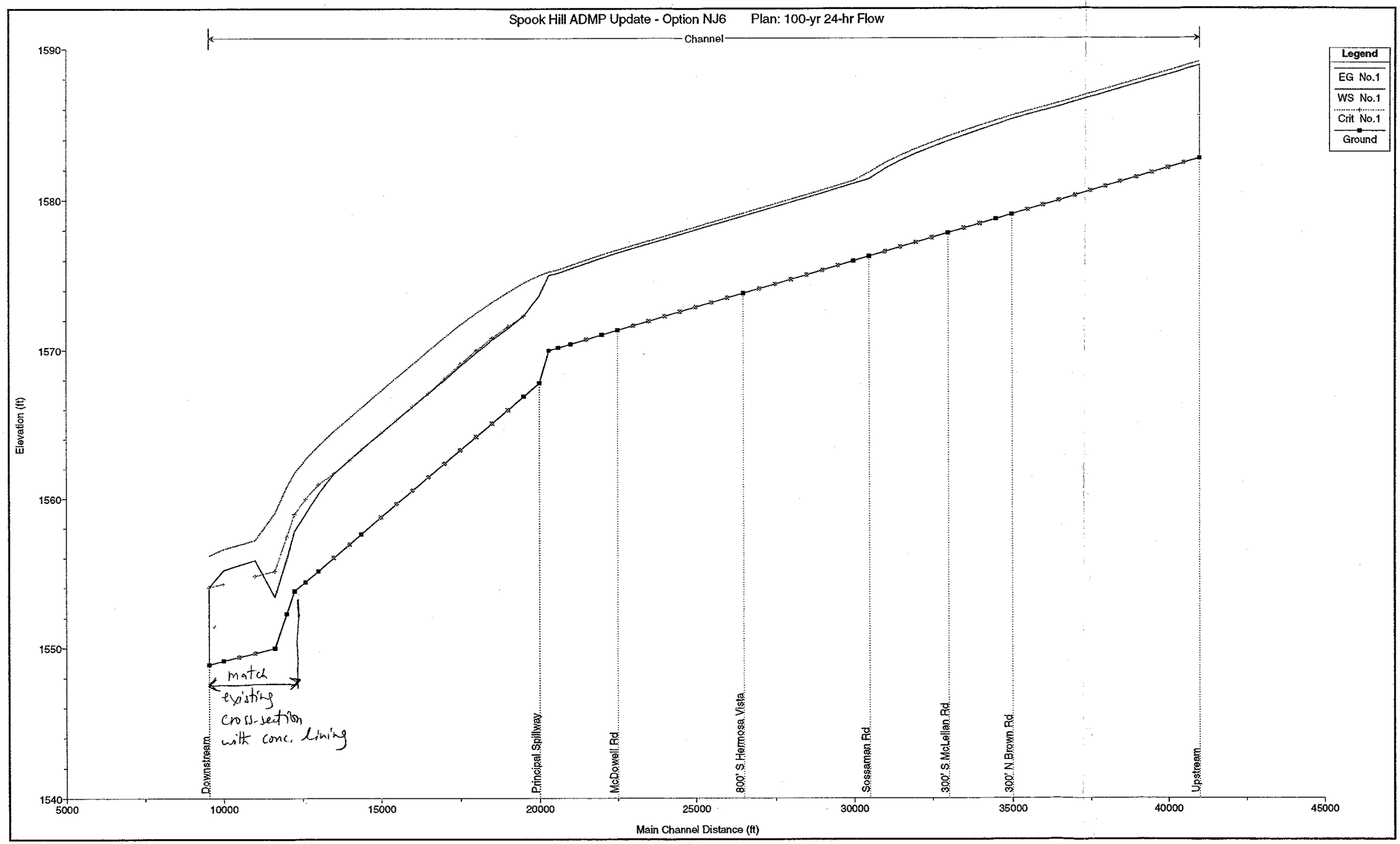
HEC-RAS Plan: 100-yr Flow River: Spook Hill Reach: Channel Profile: No.1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	41000	2800.00	1582.75	1588.89	1585.58	1589.13	0.000611	4.10	726.73	136.82	0.29	6.14
Channel	40500.*	2800.00	1582.44	1588.58		1588.83	0.000608	4.10	727.62	136.86	0.29	6.14
Channel	40000.*	2800.00	1582.14	1588.28		1588.53	0.000610	4.10	727.12	136.84	0.29	6.14
Channel	39500.*	2800.00	1581.83	1587.98		1588.22	0.000606	4.09	728.37	136.90	0.29	6.15
Channel	39000.*	2800.00	1581.52	1587.68		1587.92	0.000603	4.09	729.61	136.95	0.29	6.16
Channel	38500.*	2800.00	1581.21	1587.38		1587.62	0.000599	4.08	731.18	137.02	0.29	6.17
Channel	38000.*	2800.00	1580.91	1587.08		1587.32	0.000599	4.08	731.36	137.03	0.29	6.17
Channel	37500.*	2800.00	1580.60	1586.79		1587.03	0.000594	4.07	733.25	137.11	0.29	6.18
Channel	37000.*	2800.00	1580.29	1586.49		1586.73	0.000589	4.06	735.53	137.21	0.29	6.20
Channel	36500.*	2800.00	1579.98	1586.20		1586.44	0.000582	4.04	738.25	137.33	0.29	6.22
Channel	36000.*	2800.00	1579.68	1585.91		1586.15	0.000578	4.03	739.94	137.40	0.28	6.23
Channel	35500.*	2800.00	1579.37	1585.63		1585.86	0.000569	4.01	743.58	137.56	0.28	6.26
Channel	35000	2800.00	1579.06	1585.35		1585.58	0.000560	3.99	747.75	137.74	0.28	6.29
Channel	34500	3050.00	1578.75	1584.99		1585.27	0.000684	4.39	740.58	137.43	0.31	6.24
Channel	34000.*	3050.00	1578.44	1584.64		1584.92	0.000700	4.42	734.83	137.18	0.31	6.20
Channel	33500.*	3050.00	1578.13	1584.27		1584.56	0.000722	4.46	727.55	136.86	0.32	6.14
Channel	33000	3050.00	1577.82	1583.90		1584.20	0.000750	4.52	718.59	136.47	0.32	6.08
Channel	32500.*	3050.00	1577.51	1583.50		1583.81	0.000788	4.59	707.00	135.96	0.33	5.99
Channel	32000.*	3050.00	1577.20	1583.08		1583.40	0.000843	4.68	691.81	135.28	0.34	5.88
Channel	31500.*	3050.00	1576.90	1582.61		1582.96	0.000932	4.83	669.40	134.29	0.36	5.71
Channel	31000.*	3050.00	1576.59	1582.08		1582.45	0.001074	5.05	639.32	132.94	0.38	5.49
Channel	30500	3050.00	1576.28	1581.41		1581.84	0.001363	5.44	591.79	130.77	0.42	5.13
Channel	30000	2050.00	1575.98	1581.10		1581.30	0.000620	3.66	590.36	130.71	0.29	5.12
Channel	29500.*	2050.00	1575.67	1580.79		1580.99	0.000620	3.66	590.53	130.71	0.29	5.12
Channel	29000.*	2050.00	1575.36	1580.48		1580.68	0.000619	3.66	590.72	130.72	0.29	5.12
Channel	28500.*	2050.00	1575.05	1580.18		1580.37	0.000617	3.66	591.23	130.75	0.28	5.12
Channel	28000.*	2050.00	1574.74	1579.87		1580.07	0.000616	3.66	591.76	130.77	0.28	5.13
Channel	27500.*	2050.00	1574.43	1579.56		1579.76	0.000614	3.65	592.27	130.79	0.28	5.13
Channel	27000.*	2050.00	1574.13	1579.26		1579.45	0.000617	3.66	591.49	130.76	0.28	5.13
Channel	26500	2050.00	1573.82	1578.95		1579.15	0.000615	3.65	592.02	130.78	0.28	5.13
Channel	26000.*	2050.00	1573.51	1578.64		1578.84	0.000613	3.65	592.53	130.81	0.28	5.13
Channel	25500.*	2050.00	1573.20	1578.34		1578.53	0.000612	3.65	593.05	130.83	0.28	5.14
Channel	25000.*	2050.00	1572.90	1578.03		1578.23	0.000614	3.65	592.25	130.79	0.28	5.13
Channel	24500.*	2050.00	1572.59	1577.73		1577.92	0.000611	3.65	593.10	130.83	0.28	5.14
Channel	24000.*	2050.00	1572.28	1577.43		1577.62	0.000609	3.64	593.93	130.87	0.28	5.15
Channel	23500.*	2050.00	1571.97	1577.12		1577.32	0.000605	3.64	595.13	130.93	0.28	5.15
Channel	23000.*	2050.00	1571.67	1576.82		1577.02	0.000605	3.64	595.00	130.92	0.28	5.15
Channel	22500	2050.00	1571.36	1576.52		1576.72	0.000602	3.63	596.20	130.97	0.28	5.16

4/11/01

HEC-RAS Plan: 100-yr Flow River: Spook Hill Reach: Channel Profile: No.1 (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	22000	2150.00	1571.05	1576.18		1576.39	0.000678	3.83	591.54	130.76	0.30	5.13
Channel	21500.*	2150.00	1570.74	1575.83		1576.05	0.000696	3.87	586.51	130.53	0.30	5.09
Channel	21000	2150.00	1570.43	1575.47		1575.69	0.000720	3.91	580.10	130.24	0.31	5.04
Channel	20600	2150.00	1570.18	1575.17		1575.40	0.000744	3.95	574.10	129.96	0.31	4.99
Channel	20300	2150.00	1570.00	1575.04		1575.26	0.000321	3.91	579.67	130.22	0.31	5.04
Channel	20000	2150.00	1567.80	1573.68		1575.02	0.000603	9.91	245.72	53.53	0.72	5.88
Channel	19500	2300.00	1566.90	1572.33	1572.33	1574.53	0.001143	12.44	203.82	48.11	0.94	5.43
Channel	19000.*	2300.00	1565.99	1571.48	1571.61	1573.90	0.001286	12.86	193.39	45.13	0.97	5.49
Channel	18500.*	2300.00	1565.09	1570.71	1570.83	1573.23	0.001358	13.00	187.74	42.42	0.97	5.62
Channel	18000.*	2300.00	1564.18	1569.83	1569.99	1572.50	0.001486	13.25	180.37	39.32	0.98	5.65
Channel	17500.*	2300.00	1563.28	1568.96	1569.08	1571.72	0.001598	13.40	175.10	36.22	0.99	5.68
Channel	17000.*	2300.00	1562.37	1568.00	1568.10	1570.87	0.001765	13.62	169.72	32.78	1.01	5.63
Channel	16500.*	2300.00	1561.47	1567.12	1567.12	1569.98	0.001826	13.57	169.54	30.00	1.01	5.65
Channel	16000.*	2300.00	1560.56	1566.21	1566.22	1569.07	0.001826	13.56	169.56	30.00	1.01	5.65
Channel	15500.*	2300.00	1559.66	1565.32	1565.32	1568.17	0.001821	13.55	169.69	30.00	1.00	5.66
Channel	15000.*	2300.00	1558.75	1564.41	1564.41	1567.26	0.001821	13.55	169.70	30.00	1.00	5.66
Channel	14373	2300.00	1557.62	1563.32	1563.28	1566.13	0.001780	13.45	171.03	30.00	0.99	5.70
Channel	14000.*	2300.00	1556.94	1562.60	1562.60	1565.45	0.001821	13.55	169.71	30.00	1.00	5.66
Channel	13500.*	2300.00	1556.04	1561.70	1561.71	1564.55	0.001786	13.55	169.88	31.19	1.00	5.66
Channel	13000	2300.00	1555.13	1560.31	1560.94	1563.56	0.002014	14.58	162.53	37.62	1.13	5.18
Channel	12600	2300.00	1554.41	1558.98	1559.98	1562.64	0.002415	15.73	156.08	42.32	1.30	4.57
Channel	12250	2300.00	1553.81	1557.81	1558.96	1561.70	0.002832	16.59	151.88	46.02	1.46	4.00
Channel	12000	2300.00	1552.28	1555.92	1557.43	1560.78	0.003963	18.45	135.64	44.51	1.70	3.64
Channel	11623	2300.00	1549.99	1553.41	1555.14	1559.03	0.004974	19.81	125.78	43.64	1.89	3.42
Channel	11000.*	2300.00	1549.66	1555.87	1554.82	1557.21	0.000568	9.96	262.66	54.67	0.70	6.21
Channel	10500.*	2300.00	1549.40	1555.55		1556.92	0.000587	10.06	259.91	54.58	0.72	6.15
Channel	10000	2300.00	1549.14	1555.19	1554.29	1556.61	0.000619	10.23	255.42	54.37	0.73	6.05
Channel	9548	2300.00	1548.90	1554.04	1554.04	1556.17	0.001132	12.41	207.23	50.58	0.96	5.14


Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
Channel
Legend
EG No.1
WS No.1
Crit No.1
Ground
Elevation (ft)
1590
1580
1570
1560
1550
1540
5000
10000
15000
20000
25000
30000
35000
40000
45000
Main Channel Distance (ft)
Downstream
Principal Spillway
McDowell Rd
800' S Hermosa Vista
Sossaman Rd
300' S McLellan Rd
300' N Brown Rd
Upstream
match
existing
cross-section
with conc. lining

gabion @ end/ S.H Floodway

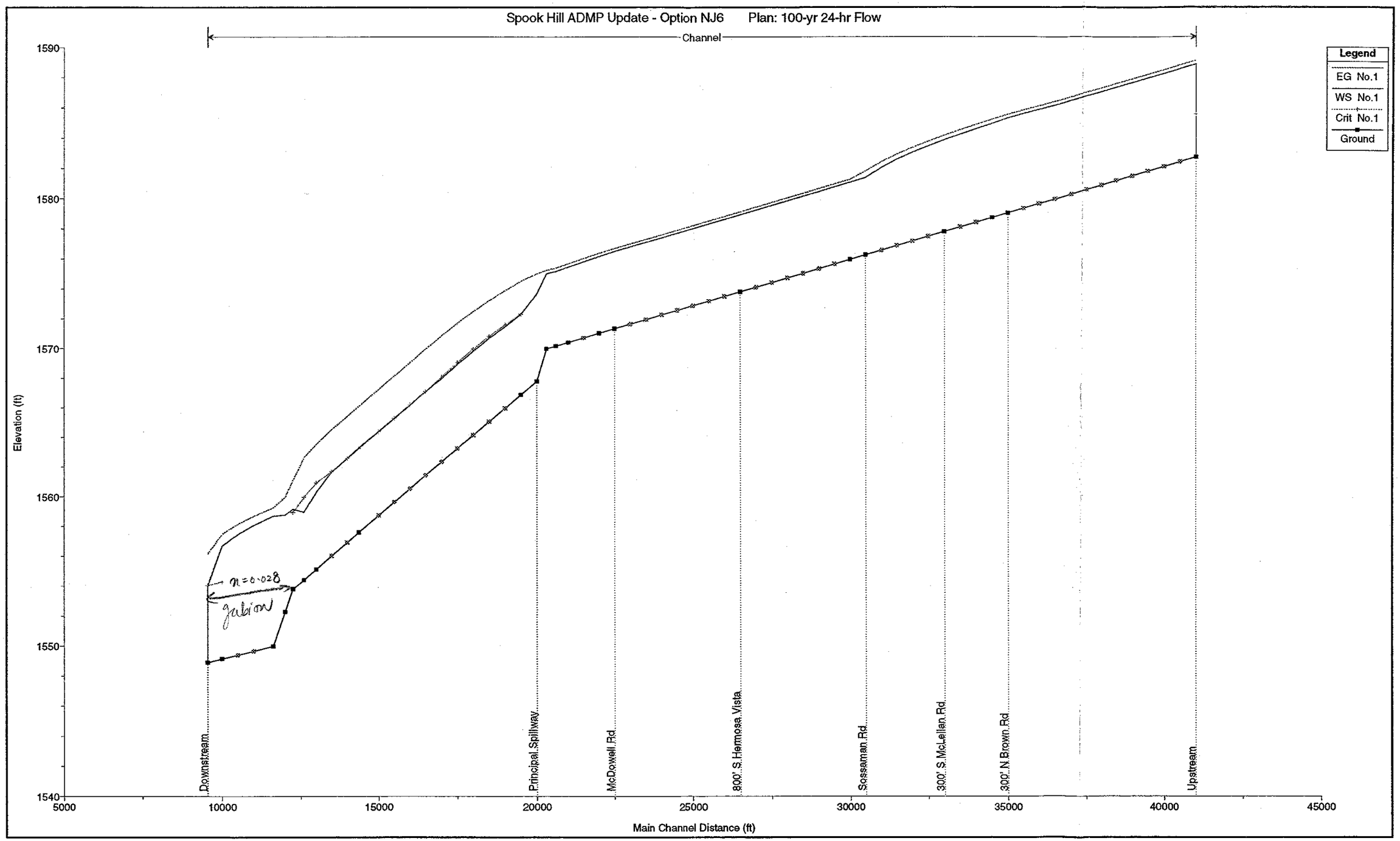
HEC-RAS Plan: 100-yr Flow River: Spook Hill Reach: Channel Profile: No.1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	41000	2800.00	1582.75	1588.89	1585.58	1589.13	0.000611	4.10	726.73	136.82	0.29	6.14
Channel	40500.*	2800.00	1582.44	1588.58		1588.83	0.000608	4.10	727.62	136.86	0.29	6.14
Channel	40000.*	2800.00	1582.14	1588.28		1588.53	0.000610	4.10	727.12	136.84	0.29	6.14
Channel	39500.*	2800.00	1581.83	1587.98		1588.22	0.000606	4.09	728.37	136.90	0.29	6.15
Channel	39000.*	2800.00	1581.52	1587.68		1587.92	0.000603	4.09	729.61	136.95	0.29	6.16
Channel	38500.*	2800.00	1581.21	1587.38		1587.62	0.000599	4.08	731.18	137.02	0.29	6.17
Channel	38000.*	2800.00	1580.91	1587.08		1587.32	0.000599	4.08	731.36	137.03	0.29	6.17
Channel	37500.*	2800.00	1580.60	1586.79		1587.03	0.000594	4.07	733.25	137.11	0.29	6.18
Channel	37000.*	2800.00	1580.29	1586.49		1586.73	0.000589	4.06	735.53	137.21	0.29	6.20
Channel	36500.*	2800.00	1579.98	1586.20		1586.44	0.000582	4.04	738.25	137.33	0.29	6.22
Channel	36000.*	2800.00	1579.68	1585.91		1586.15	0.000578	4.03	739.94	137.40	0.28	6.23
Channel	35500.*	2800.00	1579.37	1585.63		1585.86	0.000569	4.01	743.58	137.56	0.28	6.26
Channel	35000	2800.00	1579.06	1585.35		1585.58	0.000560	3.99	747.75	137.74	0.28	6.29
Channel	34500	3050.00	1578.75	1584.99		1585.27	0.000684	4.39	740.58	137.43	0.31	6.24
Channel	34000.*	3050.00	1578.44	1584.64		1584.92	0.000700	4.42	734.83	137.18	0.31	6.20
Channel	33500.*	3050.00	1578.13	1584.27		1584.56	0.000722	4.46	727.55	136.86	0.32	6.14
Channel	33000	3050.00	1577.82	1583.90		1584.20	0.000750	4.52	718.59	136.47	0.32	6.08
Channel	32500.*	3050.00	1577.51	1583.50		1583.81	0.000788	4.59	707.00	135.96	0.33	5.99
Channel	32000.*	3050.00	1577.20	1583.08		1583.40	0.000843	4.68	691.81	135.28	0.34	5.88
Channel	31500.*	3050.00	1576.90	1582.61		1582.96	0.000932	4.83	669.40	134.29	0.36	5.71
Channel	31000.*	3050.00	1576.59	1582.08		1582.45	0.001074	5.05	639.32	132.94	0.38	5.49
Channel	30500	3050.00	1576.28	1581.41		1581.84	0.001363	5.44	591.79	130.77	0.42	5.13
Channel	30000	2050.00	1575.98	1581.10		1581.30	0.000620	3.66	590.36	130.71	0.29	5.12
Channel	29500.*	2050.00	1575.67	1580.79		1580.99	0.000620	3.66	590.53	130.71	0.29	5.12
Channel	29000.*	2050.00	1575.36	1580.48		1580.68	0.000619	3.66	590.72	130.72	0.29	5.12
Channel	28500.*	2050.00	1575.05	1580.18		1580.37	0.000617	3.66	591.23	130.75	0.28	5.12
Channel	28000.*	2050.00	1574.74	1579.87		1580.07	0.000616	3.66	591.76	130.77	0.28	5.13
Channel	27500.*	2050.00	1574.43	1579.56		1579.76	0.000614	3.65	592.27	130.79	0.28	5.13
Channel	27000.*	2050.00	1574.13	1579.26		1579.45	0.000617	3.66	591.49	130.76	0.28	5.13
Channel	26500	2050.00	1573.82	1578.95		1579.15	0.000615	3.65	592.02	130.78	0.28	5.13
Channel	26000.*	2050.00	1573.51	1578.64		1578.84	0.000613	3.65	592.53	130.81	0.28	5.13
Channel	25500.*	2050.00	1573.20	1578.34		1578.53	0.000612	3.65	593.05	130.83	0.28	5.14
Channel	25000.*	2050.00	1572.90	1578.03		1578.23	0.000614	3.65	592.25	130.79	0.28	5.13
Channel	24500.*	2050.00	1572.59	1577.73		1577.92	0.000611	3.65	593.10	130.83	0.28	5.14
Channel	24000.*	2050.00	1572.28	1577.43		1577.62	0.000609	3.64	593.93	130.87	0.28	5.15
Channel	23500.*	2050.00	1571.97	1577.12		1577.32	0.000605	3.64	595.13	130.93	0.28	5.15
Channel	23000.*	2050.00	1571.67	1576.82		1577.02	0.000605	3.64	595.00	130.92	0.28	5.15
Channel	22500	2050.00	1571.36	1576.52		1576.72	0.000602	3.63	596.20	130.97	0.28	5.16

4/11/01

HEC-RAS Plan: 100-yr Flow River: Spook Hill Reach: Channel Profile: No.1 (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	22000	2150.00	1571.05	1576.18		1576.39	0.000678	3.83	591.54	130.76	0.30	5.13
Channel	21500.*	2150.00	1570.74	1575.83		1576.05	0.000696	3.87	586.51	130.53	0.30	5.09
Channel	21000	2150.00	1570.43	1575.47		1575.69	0.000720	3.91	580.10	130.24	0.31	5.04
Channel	20600	2150.00	1570.18	1575.17		1575.40	0.000744	3.95	574.10	129.96	0.31	4.99
Channel	20300	2150.00	1570.00	1575.04		1575.26	0.000321	3.91	579.67	130.22	0.31	5.04
Channel	20000	2150.00	1567.80	1573.68		1575.02	0.000603	9.91	245.72	53.53	0.72	5.88
Channel	19500	2300.00	1566.90	1572.33	1572.33	1574.53	0.001143	12.44	203.82	48.11	0.94	5.43
Channel	19000.*	2300.00	1565.99	1571.48	1571.61	1573.90	0.001286	12.86	193.39	45.13	0.97	5.49
Channel	18500.*	2300.00	1565.09	1570.71	1570.83	1573.23	0.001358	13.00	187.74	42.42	0.97	5.62
Channel	18000.*	2300.00	1564.18	1569.83	1569.99	1572.50	0.001486	13.25	180.37	39.32	0.98	5.65
Channel	17500.*	2300.00	1563.28	1568.96	1569.08	1571.72	0.001598	13.40	175.10	36.22	0.99	5.68
Channel	17000.*	2300.00	1562.37	1568.00	1568.10	1570.87	0.001765	13.62	169.72	32.78	1.01	5.63
Channel	16500.*	2300.00	1561.47	1567.12	1567.12	1569.98	0.001826	13.57	169.54	30.00	1.01	5.65
Channel	16000.*	2300.00	1560.56	1566.21	1566.22	1569.07	0.001826	13.56	169.56	30.00	1.01	5.65
Channel	15500.*	2300.00	1559.66	1565.32	1565.32	1568.17	0.001821	13.55	169.69	30.00	1.00	5.66
Channel	15000.*	2300.00	1558.75	1564.41	1564.41	1567.26	0.001821	13.55	169.70	30.00	1.00	5.66
Channel	14373	2300.00	1557.62	1563.32	1563.28	1566.13	0.001780	13.45	171.03	30.00	0.99	5.70
Channel	14000.*	2300.00	1556.94	1562.60	1562.60	1565.45	0.001821	13.55	169.71	30.00	1.00	5.66
Channel	13500.*	2300.00	1556.04	1561.70	1561.71	1564.55	0.001786	13.55	169.88	31.19	1.00	5.66
Channel	13000	2300.00	1555.13	1560.31	1560.94	1563.56	0.002014	14.58	162.53	37.62	1.13	5.18
Channel	12600	2300.00	1554.41	1558.98	1559.98	1562.64	0.002415	15.73	156.08	42.32	1.30	4.57
Channel	12250	2300.00	1553.81	1559.17	1558.96	1561.09	0.005297	11.83	218.33	51.48	0.90	5.36
Channel	12000	2300.00	1552.28	1558.79		1559.98	0.002587	9.41	279.56	55.95	0.65	6.51
Channel	11623	2300.00	1549.99	1558.71		1559.27	0.000852	6.56	413.57	64.85	0.39	8.72
Channel	11000.*	2300.00	1549.66	1558.08		1558.70	0.000977	6.87	393.59	63.53	0.42	8.42
Channel	10500.*	2300.00	1549.40	1557.48		1558.16	0.001139	7.21	373.05	62.33	0.45	8.08
Channel	10000	2300.00	1549.14	1556.70	1554.29	1557.50	0.001465	7.82	341.68	60.38	0.50	7.56
Channel	9548	2300.00	1548.90	1554.04	1554.04	1556.17	0.006164	12.41	207.23	50.58	0.96	5.14


Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
Channel
Legend
EG No.1
WS No.1
Crit No.1
Ground
Elevation (ft)
1590
1580
1570
1560
1550
1540
5000
10000
15000
20000
25000
30000
35000
40000
45000
Main Channel Distance (ft)
Downstream
Principal Spillway
McDowell Rd
800' S Hermosa Vista
Sossaman Rd
300' S McLellan Rd
300' N Brown Rd
Upstream
n=0.028
gabion

dirt @ end S.H. Floodway, part gabion

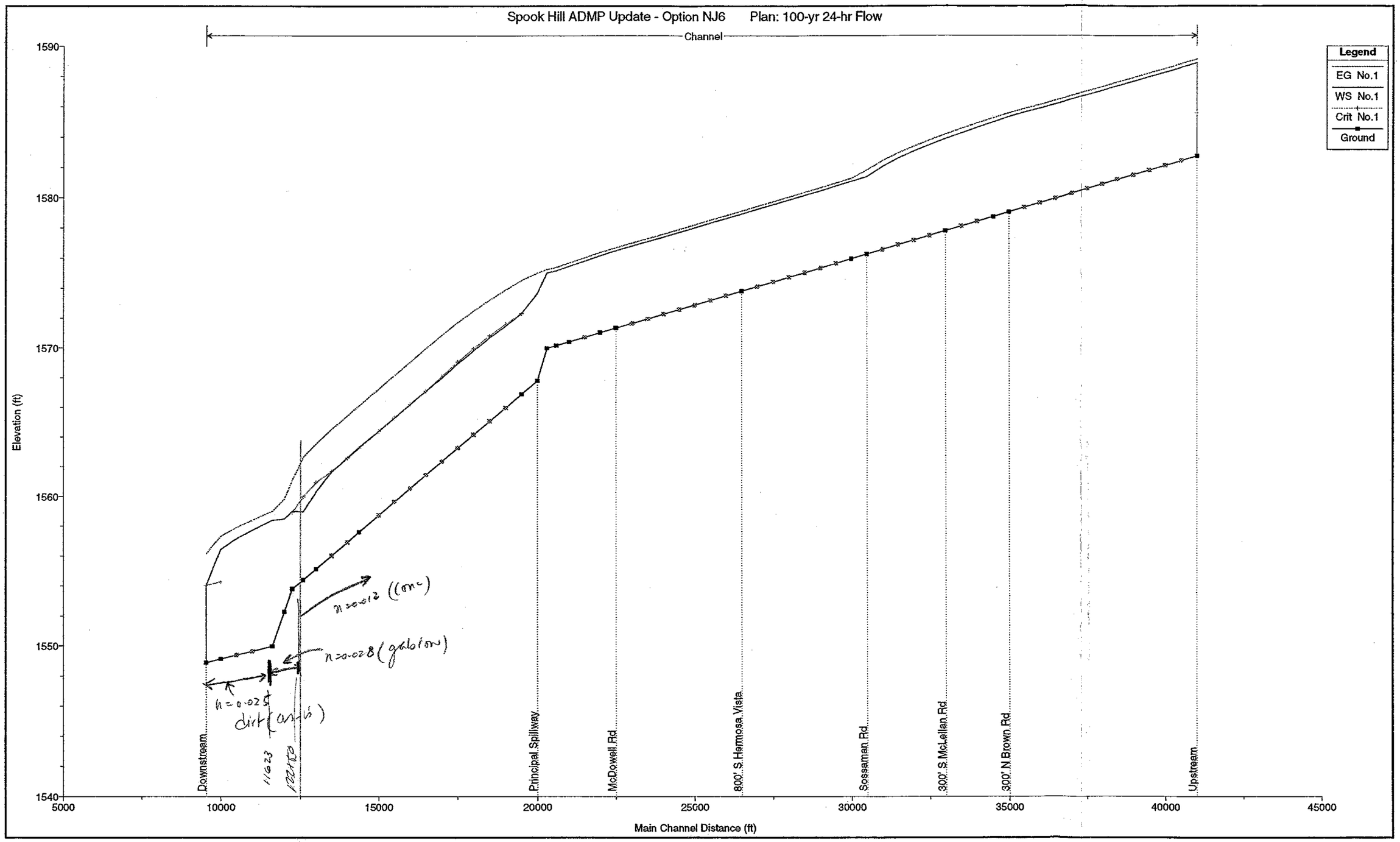
HEC-RAS Plan: 100-yr Flow River: Spook Hill Reach: Channel Profile: No.1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	41000	2800.00	1582.75	1588.89	1585.58	1589.13	0.000611	4.10	726.73	136.82	0.29	6.14
Channel	40500.*	2800.00	1582.44	1588.58		1588.83	0.000608	4.10	727.62	136.86	0.29	6.14
Channel	40000.*	2800.00	1582.14	1588.28		1588.53	0.000610	4.10	727.12	136.84	0.29	6.14
Channel	39500.*	2800.00	1581.83	1587.98		1588.22	0.000606	4.09	728.37	136.90	0.29	6.15
Channel	39000.*	2800.00	1581.52	1587.68		1587.92	0.000603	4.09	729.61	136.95	0.29	6.16
Channel	38500.*	2800.00	1581.21	1587.38		1587.62	0.000599	4.08	731.18	137.02	0.29	6.17
Channel	38000.*	2800.00	1580.91	1587.08		1587.32	0.000599	4.08	731.36	137.03	0.29	6.17
Channel	37500.*	2800.00	1580.60	1586.79		1587.03	0.000594	4.07	733.25	137.11	0.29	6.18
Channel	37000.*	2800.00	1580.29	1586.49		1586.73	0.000589	4.06	735.53	137.21	0.29	6.20
Channel	36500.*	2800.00	1579.98	1586.20		1586.44	0.000582	4.04	738.25	137.33	0.29	6.22
Channel	36000.*	2800.00	1579.68	1585.91		1586.15	0.000578	4.03	739.94	137.40	0.28	6.23
Channel	35500.*	2800.00	1579.37	1585.63		1585.86	0.000569	4.01	743.58	137.56	0.28	6.26
Channel	35000	2800.00	1579.06	1585.35		1585.58	0.000560	3.99	747.75	137.74	0.28	6.29
Channel	34500	3050.00	1578.75	1584.99		1585.27	0.000684	4.39	740.58	137.43	0.31	6.24
Channel	34000.*	3050.00	1578.44	1584.64		1584.92	0.000700	4.42	734.83	137.18	0.31	6.20
Channel	33500.*	3050.00	1578.13	1584.27		1584.56	0.000722	4.46	727.55	136.86	0.32	6.14
Channel	33000	3050.00	1577.82	1583.90		1584.20	0.000750	4.52	718.59	136.47	0.32	6.08
Channel	32500.*	3050.00	1577.51	1583.50		1583.81	0.000788	4.59	707.00	135.96	0.33	5.99
Channel	32000.*	3050.00	1577.20	1583.08		1583.40	0.000843	4.68	691.81	135.28	0.34	5.88
Channel	31500.*	3050.00	1576.90	1582.61		1582.96	0.000932	4.83	669.40	134.29	0.36	5.71
Channel	31000.*	3050.00	1576.59	1582.08		1582.45	0.001074	5.05	639.32	132.94	0.38	5.49
Channel	30500	3050.00	1576.28	1581.41		1581.84	0.001363	5.44	591.79	130.77	0.42	5.13
Channel	30000	2050.00	1575.98	1581.10		1581.30	0.000620	3.66	590.36	130.71	0.29	5.12
Channel	29500.*	2050.00	1575.67	1580.79		1580.99	0.000620	3.66	590.53	130.71	0.29	5.12
Channel	29000.*	2050.00	1575.36	1580.48		1580.68	0.000619	3.66	590.72	130.72	0.29	5.12
Channel	28500.*	2050.00	1575.05	1580.18		1580.37	0.000617	3.66	591.23	130.75	0.28	5.12
Channel	28000.*	2050.00	1574.74	1579.87		1580.07	0.000616	3.66	591.76	130.77	0.28	5.13
Channel	27500.*	2050.00	1574.43	1579.56		1579.76	0.000614	3.65	592.27	130.79	0.28	5.13
Channel	27000.*	2050.00	1574.13	1579.26		1579.45	0.000617	3.66	591.49	130.76	0.28	5.13
Channel	26500	2050.00	1573.82	1578.95		1579.15	0.000615	3.65	592.02	130.78	0.28	5.13
Channel	26000.*	2050.00	1573.51	1578.64		1578.84	0.000613	3.65	592.53	130.81	0.28	5.13
Channel	25500.*	2050.00	1573.20	1578.34		1578.53	0.000612	3.65	593.05	130.83	0.28	5.14
Channel	25000.*	2050.00	1572.90	1578.03		1578.23	0.000614	3.65	592.25	130.79	0.28	5.13
Channel	24500.*	2050.00	1572.59	1577.73		1577.92	0.000611	3.65	593.10	130.83	0.28	5.14
Channel	24000.*	2050.00	1572.28	1577.43		1577.62	0.000609	3.64	593.93	130.87	0.28	5.15
Channel	23500.*	2050.00	1571.97	1577.12		1577.32	0.000605	3.64	595.13	130.93	0.28	5.15
Channel	23000.*	2050.00	1571.67	1576.82		1577.02	0.000605	3.64	595.00	130.92	0.28	5.15
Channel	22500	2050.00	1571.36	1576.52		1576.72	0.000602	3.63	596.20	130.97	0.28	5.16

4/11/01

HEC-RAS Plan: 100-yr Flow River: Spook Hill Reach: Channel Profile: No.1 (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	22000	2150.00	1571.05	1576.18		1576.39	0.000678	3.83	591.54	130.76	0.30	5.13
Channel	21500.*	2150.00	1570.74	1575.83		1576.05	0.000696	3.87	586.51	130.53	0.30	5.09
Channel	21000	2150.00	1570.43	1575.47		1575.69	0.000720	3.91	580.10	130.24	0.31	5.04
Channel	20600	2150.00	1570.18	1575.17		1575.40	0.000744	3.95	574.10	129.96	0.31	4.99
Channel	20300	2150.00	1570.00	1575.04		1575.26	0.000321	3.91	579.67	130.22	0.31	5.04
Channel	20000	2150.00	1567.80	1573.68		1575.02	0.000603	9.91	245.72	53.53	0.72	5.88
Channel	19500	2300.00	1566.90	1572.33	1572.33	1574.53	0.001143	12.44	203.82	48.11	0.94	5.43
Channel	19000.*	2300.00	1565.99	1571.48	1571.61	1573.90	0.001286	12.86	193.39	45.13	0.97	5.49
Channel	18500.*	2300.00	1565.09	1570.71	1570.83	1573.23	0.001358	13.00	187.74	42.42	0.97	5.62
Channel	18000.*	2300.00	1564.18	1569.83	1569.99	1572.50	0.001486	13.25	180.37	39.32	0.98	5.65
Channel	17500.*	2300.00	1563.28	1568.96	1569.08	1571.72	0.001598	13.40	175.10	36.22	0.99	5.68
Channel	17000.*	2300.00	1562.37	1568.00	1568.10	1570.87	0.001765	13.62	169.72	32.78	1.01	5.63
Channel	16500.*	2300.00	1561.47	1567.12	1567.12	1569.98	0.001826	13.57	169.54	30.00	1.01	5.65
Channel	16000.*	2300.00	1560.56	1566.21	1566.22	1569.07	0.001826	13.56	169.56	30.00	1.01	5.65
Channel	15500.*	2300.00	1559.66	1565.32	1565.32	1568.17	0.001821	13.55	169.69	30.00	1.00	5.66
Channel	15000.*	2300.00	1558.75	1564.41	1564.41	1567.26	0.001821	13.55	169.70	30.00	1.00	5.66
Channel	14373	2300.00	1557.62	1563.32	1563.28	1566.13	0.001780	13.45	171.03	30.00	0.99	5.70
Channel	14000.*	2300.00	1556.94	1562.60	1562.60	1565.45	0.001821	13.55	169.71	30.00	1.00	5.66
Channel	13500.*	2300.00	1556.04	1561.70	1561.71	1564.55	0.001786	13.55	169.88	31.19	1.00	5.66
Channel	13000	2300.00	1555.13	1560.31	1560.94	1563.56	0.002014	14.58	162.53	37.62	1.13	5.18
Channel	12600	2300.00	1554.41	1558.98	1559.98	1562.64	0.002415	15.73	156.08	42.32	1.30	4.57
Channel	12250	2300.00	1553.81	1559.03	1558.96	1561.08	0.005847	12.21	211.06	50.91	0.94	5.22
Channel	12000	2300.00	1552.28	1558.51		1559.84	0.003048	9.92	264.05	54.83	0.70	6.23
Channel	11623	2300.00	1549.99	1558.41		1559.02	0.000975	6.86	394.17	63.64	0.42	8.42
Channel	11000.*	2300.00	1549.66	1557.74		1558.43	0.000911	7.23	372.36	62.18	0.45	8.08
Channel	10500.*	2300.00	1549.40	1557.18		1557.93	0.001049	7.56	354.52	61.12	0.48	7.78
Channel	10000	2300.00	1549.14	1556.46	1554.29	1557.33	0.001319	8.14	327.34	59.43	0.53	7.32
Channel	9548	2300.00	1548.90	1554.04	1554.04	1556.17	0.004914	12.41	207.23	50.58	0.96	5.14


Spook Hill ADMP Update - Option NJ6 Plan: 100-yr 24-hr Flow
Channel
Legend
EG No.1
WS No.1
Crit No.1
Ground
Elevation (ft)
1590
1580
1570
1560
1550
1540
5000
10000
15000
20000
25000
30000
35000
40000
45000
Main Channel Distance (ft)
Downstream
Principal Spillway
McDowell Rd
800' S Hermosa Vista
Sossaman Rd
300' S McLellan Rd
300' N Brown Rd
Upstream
n=0.012 (concrete)
n=0.028 (gabion)
n=0.025 dirt (earth)
11623
12215

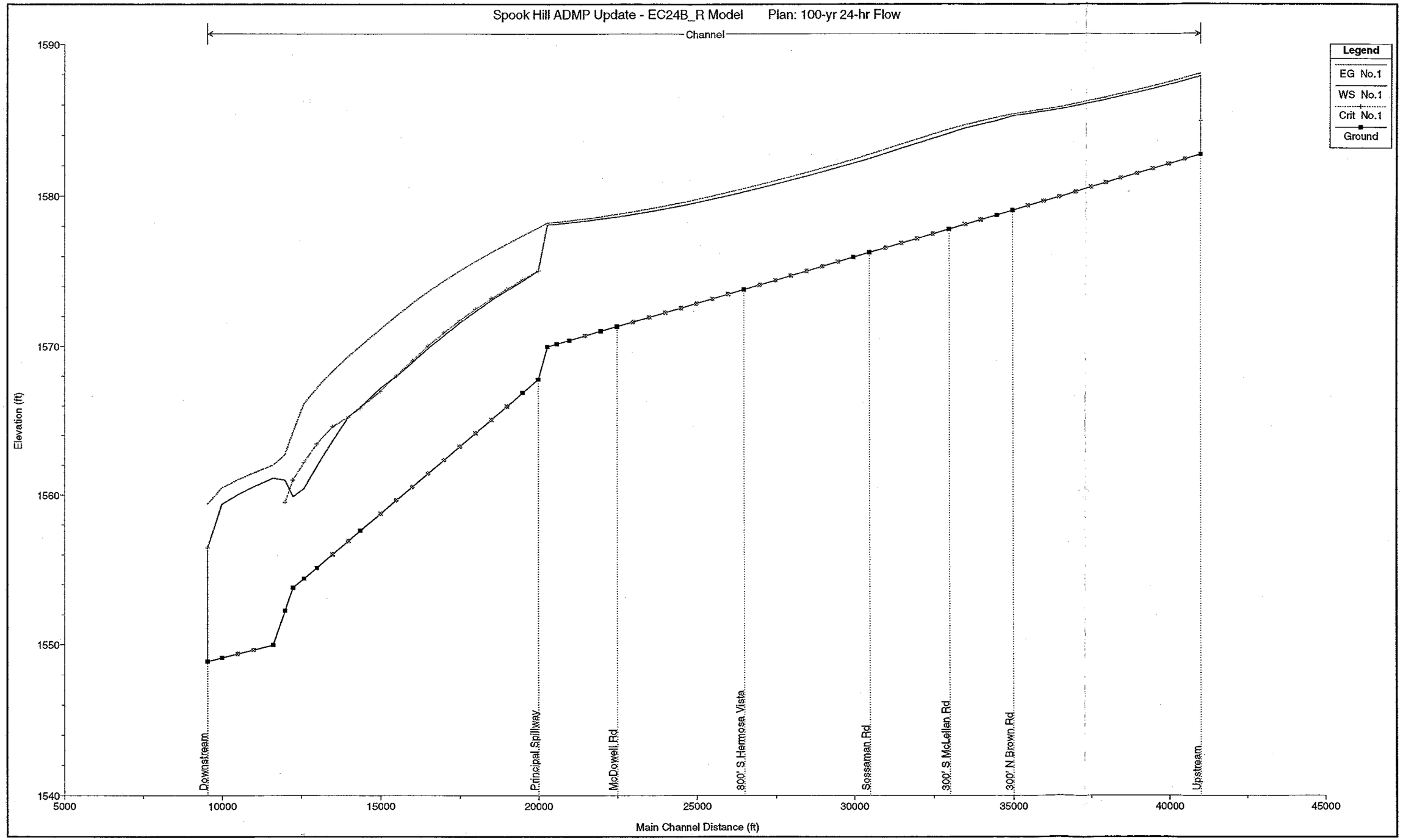
option = Non-jurisdictional : No pass Mountain, no off-line basin

HEC-RAS Plan: 100-yr Flow River: Spook Hill Reach: Channel Profile: No.1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	9548	4400.00	1548.90	1556.48	1556.48	1559.42	0.004242	14.94	342.27	60.32	0.96	7.58
Channel	10000	4050.00	1549.14	1559.41		1560.51	0.001107	9.34	519.98	70.00	0.51	10.27
Channel	10500.*	4050.00	1549.40	1560.03		1561.04	0.000966	8.93	544.37	70.00	0.48	10.63
Channel	11000.*	4050.00	1549.66	1560.56		1561.50	0.000878	8.66	562.01	70.00	0.46	10.90
Channel	11623	4050.00	1549.99	1561.15		1562.03	0.000796	8.38	581.07	70.00	0.44	11.16
Channel	12000	4050.00	1552.28	1561.02	1559.51	1562.74	0.002090	11.53	414.59	64.89	0.69	8.74
Channel	12250	4050.00	1553.81	1559.91	1561.03	1564.24	0.008125	17.88	257.41	54.43	1.28	6.10
Channel	12600	4050.00	1554.41	1560.46	1562.20	1566.17	0.002679	19.97	222.92	48.23	1.43	6.05
Channel	13000	4050.00	1555.13	1561.95	1563.45	1567.21	0.002317	18.79	229.81	44.20	1.27	6.82
Channel	13500.*	4050.00	1556.04	1563.65	1564.62	1568.34	0.002003	17.49	238.43	39.00	1.12	7.61
Channel	14000.*	4050.00	1556.94	1565.27	1565.27	1569.34	0.001746	16.20	251.04	33.07	0.99	8.33
Channel	14373	4050.00	1557.62	1565.91	1565.88	1570.03	0.001854	16.29	248.65	30.00	1.00	8.29
Channel	15000.*	4050.00	1558.75	1567.21	1567.00	1571.16	0.001716	15.95	254.10	31.25	0.97	8.46
Channel	15500.*	4050.00	1559.66	1568.00	1568.03	1572.05	0.001712	16.16	252.27	34.01	0.99	8.34
Channel	16000.*	4050.00	1560.56	1568.92	1569.07	1572.89	0.001598	16.03	257.57	37.30	0.98	8.36
Channel	16500.*	4050.00	1561.47	1569.89	1570.05	1573.67	0.001453	15.74	266.87	40.74	0.96	8.42
Channel	17000.*	4050.00	1562.37	1570.74	1570.93	1574.39	0.001359	15.56	274.59	43.74	0.95	8.37
Channel	17500.*	4050.00	1563.28	1571.59	1571.76	1575.06	0.001256	15.31	284.27	46.75	0.94	8.31
Channel	18000.*	4050.00	1564.18	1572.34	1572.51	1575.69	0.001192	15.17	291.79	49.37	0.94	8.16
Channel	18500.*	4050.00	1565.09	1573.10	1573.21	1576.28	0.001119	14.96	300.73	51.99	0.93	8.01
Channel	19000.*	4050.00	1565.99	1573.76	1573.86	1576.84	0.001083	14.88	306.60	54.24	0.94	7.77
Channel	19500	4050.00	1566.90	1574.37	1574.48	1577.39	0.001067	14.87	310.53	56.29	0.96	7.47
Channel	20000	4100.00	1567.80	1575.07	1575.07	1577.92	0.000992	14.64	324.01	59.09	0.96	7.27
Channel	20300	4100.00	1570.00	1578.13		1578.25	0.000092	2.88	1499.53	208.79	0.18	8.13
Channel	20600	4100.00	1570.18	1578.17		1578.30	0.000221	2.94	1469.79	207.94	0.18	7.99
Channel	21000	4100.00	1570.43	1578.26		1578.39	0.000237	3.01	1436.04	206.96	0.19	7.83
Channel	21500.*	4100.00	1570.74	1578.38		1578.52	0.000258	3.09	1396.51	205.81	0.20	7.64
Channel	22000	4100.00	1571.05	1578.50		1578.65	0.000281	3.17	1359.22	204.72	0.20	7.45
Channel	22500	4300.00	1571.36	1578.64		1578.81	0.000336	3.41	1323.40	203.67	0.22	7.28
Channel	23000.*	4300.00	1571.67	1578.81		1578.99	0.000360	3.48	1294.62	202.82	0.23	7.14
Channel	23500.*	4300.00	1571.97	1578.99		1579.17	0.000382	3.55	1270.23	202.10	0.24	7.02
Channel	24000.*	4300.00	1572.28	1579.18		1579.37	0.000405	3.61	1246.12	201.38	0.24	6.90
Channel	24500.*	4300.00	1572.59	1579.38		1579.58	0.000428	3.67	1224.50	200.73	0.25	6.79
Channel	25000.*	4300.00	1572.90	1579.59		1579.80	0.000450	3.73	1205.22	200.16	0.25	6.69
Channel	25500.*	4300.00	1573.20	1579.82		1580.03	0.000468	3.78	1190.19	199.71	0.26	6.62
Channel	26000.*	4300.00	1573.51	1580.05		1580.27	0.000488	3.82	1174.60	199.24	0.26	6.54
Channel	26500	4300.00	1573.82	1580.29		1580.52	0.000505	3.87	1161.41	198.84	0.27	6.47
Channel	27000.*	4300.00	1574.13	1580.54		1580.77	0.000522	3.90	1149.60	198.48	0.27	6.41

HEC-RAS Plan: 100-yr Flow River: Spook Hill Reach: Channel Profile: No.1 (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
Channel	27500.*	4300.00	1574.43	1580.80		1581.03	0.000533	3.93	1141.75	198.24	0.27	6.37
Channel	28000.*	4300.00	1574.74	1581.07		1581.30	0.000546	3.96	1132.90	197.98	0.28	6.33
Channel	28500.*	4300.00	1575.05	1581.34		1581.58	0.000558	3.99	1125.22	197.74	0.28	6.29
Channel	29000.*	4300.00	1575.36	1581.62		1581.86	0.000568	4.01	1118.73	197.55	0.28	6.26
Channel	29500.*	4300.00	1575.67	1581.90		1582.14	0.000577	4.03	1113.26	197.38	0.28	6.23
Channel	30000	4300.00	1575.98	1582.19		1582.43	0.000584	4.04	1108.73	197.24	0.29	6.21
Channel	30500	4650.00	1576.28	1582.47		1582.76	0.000688	4.38	1106.16	197.16	0.31	6.19
Channel	31000.*	4650.00	1576.59	1582.82		1583.10	0.000675	4.36	1112.92	197.37	0.31	6.23
Channel	31500.*	4650.00	1576.90	1583.16		1583.44	0.000664	4.33	1118.80	197.55	0.31	6.26
Channel	32000.*	4650.00	1577.20	1583.49		1583.77	0.000651	4.31	1125.70	197.76	0.30	6.29
Channel	32500.*	4650.00	1577.51	1583.82		1584.10	0.000645	4.30	1129.40	197.87	0.30	6.31
Channel	33000	4650.00	1577.82	1584.15		1584.42	0.000640	4.28	1132.27	197.96	0.30	6.33
Channel	33500.*	4100.00	1578.13	1584.50		1584.71	0.000487	3.75	1140.18	198.20	0.26	6.37
Channel	34000.*	4100.00	1578.44	1584.74		1584.95	0.000504	3.79	1127.08	197.80	0.27	6.30
Channel	34500	4100.00	1578.75	1584.99		1585.21	0.000521	3.83	1115.31	197.44	0.27	6.24
Channel	35000	3050.00	1579.06	1585.30		1585.42	0.000289	2.85	1114.44	197.42	0.20	6.24
Channel	35500.*	3050.00	1579.37	1585.44		1585.57	0.000317	2.94	1082.23	196.44	0.21	6.07
Channel	36000.*	3050.00	1579.68	1585.60		1585.74	0.000346	3.01	1052.92	195.54	0.22	5.92
Channel	36500.*	3050.00	1579.98	1585.78		1585.92	0.000372	3.08	1028.53	194.79	0.23	5.80
Channel	37000.*	3050.00	1580.29	1585.97		1586.11	0.000401	3.15	1004.63	194.05	0.23	5.68
Channel	37500.*	3050.00	1580.60	1586.17		1586.32	0.000428	3.22	983.84	193.41	0.24	5.57
Channel	38000.*	3050.00	1580.91	1586.38		1586.55	0.000454	3.28	965.73	192.84	0.25	5.47
Channel	38500.*	3050.00	1581.21	1586.61		1586.78	0.000475	3.32	951.86	192.41	0.25	5.40
Channel	39000.*	3050.00	1581.52	1586.85		1587.02	0.000497	3.37	938.16	191.98	0.26	5.33
Channel	39500.*	3050.00	1581.83	1587.10		1587.28	0.000517	3.41	926.62	191.62	0.26	5.27
Channel	40000.*	3050.00	1582.14	1587.36		1587.54	0.000535	3.45	916.94	191.32	0.27	5.22
Channel	40500.*	3050.00	1582.44	1587.63		1587.81	0.000547	3.47	910.47	191.12	0.27	5.19
Channel	41000	3050.00	1582.75	1587.90	1584.96	1588.08	0.000561	3.50	903.29	190.89	0.27	5.15


Spook Hill ADMP Update - EC24B_R Model Plan: 100-yr 24-hr Flow
Channel
Legend
EG No.1
WS No.1
Crit No.1
Ground
Elevation (ft)
1590
1580
1570
1560
1550
1540
5000
10000
15000
20000
25000
30000
35000
40000
45000
Main Channel Distance (ft)
Downstream
Principal Spillway
McDowell Rd
800' S Hermosa Vista
Sossaman Rd
300' S McLellan Rd
300' N Brown Rd
Upstream

Spook Hill ADMS Update May 14, 2001
Flood Control District of Maricopa County W/P # 99989
FCD 99-43

McKellips Road Alignment
Option EC2MK2E
Landscaped Earthen Channel Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Excavation	$4.00	CY	24,721	$98,884
2	Drop Structures	$310	CY	1,707	$529,235
3	Splitter Structures	$60,000	EA	3	$180,000
4	Culverts	$310	CY	232	$71,920
5	Baisn Excavation	$4	CY	189,567	$758,267
		SUBTOTAL MAJOR ELEMENTS			$1,638,305
		CONTINGENCIES:			
		Construction		35%	$573,407
		Engineering		7%	$114,681
		Construction Admin		6%	$98,298
		TOTAL MAJOR ELEMENTS			**$2,424,691**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping (Channel & Basins	$1.10	SF	936,882	$1,030,570
2	Fence	$12	LF	14,800	$177,600
3	Utility Relocations (W & S)	$8,000	EA	0	$0
		SUBTOTAL ADDITIONAL ELEMENTS			$1,208,170
		CONTINGENCIES:			
		Construction		35%	$422,859
		Engineering		7%	$84,572
		Construction Admin		6%	$72,490
		TOTAL ADDITIONAL ELEMENTS			**$1,788,091**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$16,000	AC	9.64	$154,240
2	Basin Land Acquisition	$14,300	AC	15.0	$214,500
		SUBTOTAL LAND ACQUISITION			$368,740
		CONTINGENCIES :		25%	$92,185
		TOTAL LAND ACQUISITION			**$460,925**
				TOTAL	***$4,673,708***

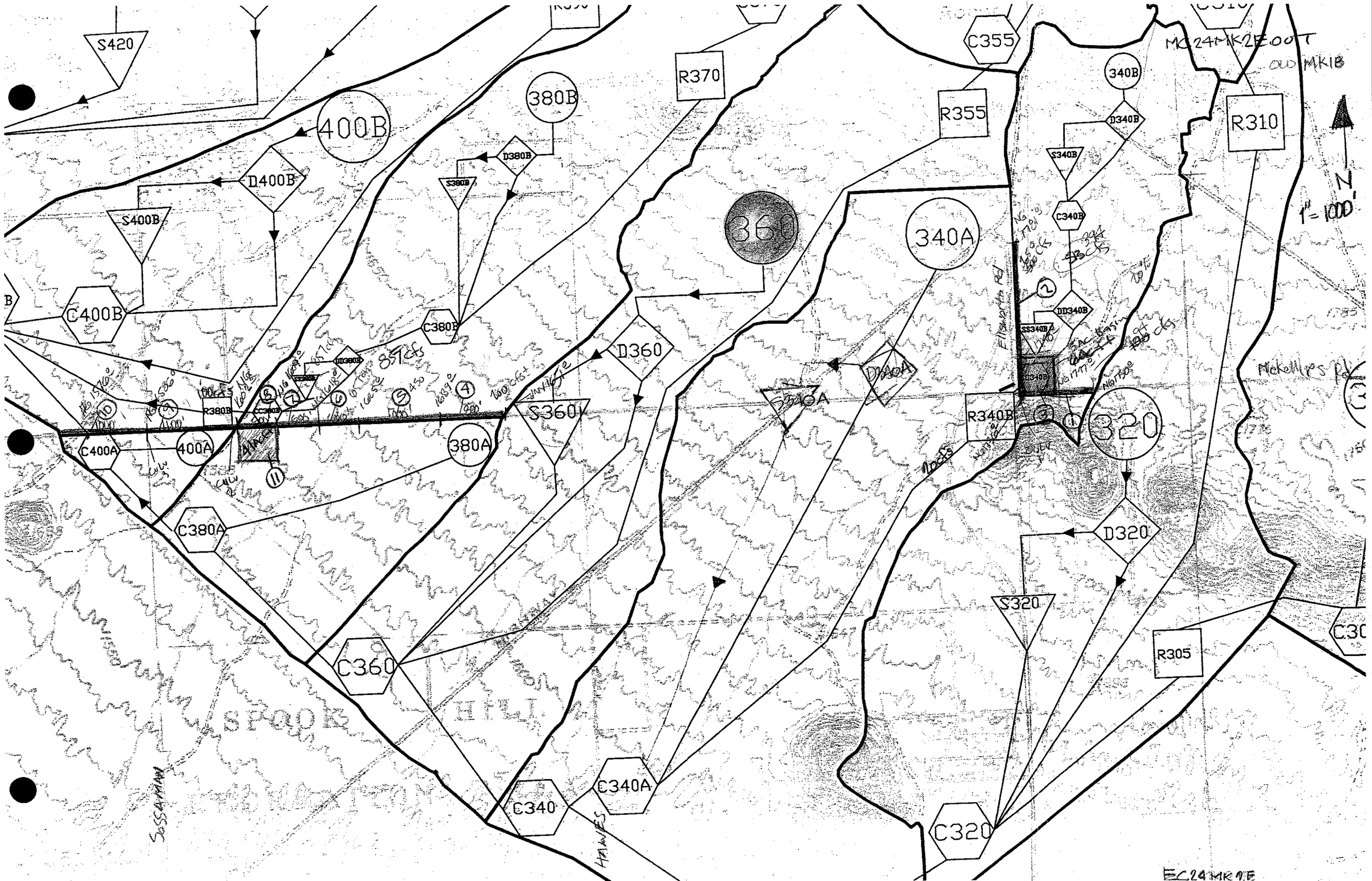
Land Takes
Mckellips Road Option 2E Earthen Channel
Level II

Segment	Feature	Parcel	Take (T, P, or N)	Parcel Area (acres)	Parcel Width (ft)	Depth of Take (ft)	Take Area (acres)	Take Area (%)	Land Value ($)	Cost ($)	
1	Channel	219-49-2H	P	75.22	1500	44	1.52	2.01%	$376,100	$7,576	
2	Channel	219-49-2H	P	75.22	1400	54	1.74	2.31%	$376,100	$8,678	
	Channel	~~219-31-45~~	P	9.56	600		0.00	0.00%	$191,140	$0	
	Channel	~~219-31-44~~	P	7.51	456.5		0.00	0.00%	$150,120	$0	
	Channel	~~219-31-67~~	P	171.26	600.8		0.00	0.00%	$85,632	$0	
	Channel	~~219-31-43~~	P	7.99	719.3		0.00	0.00%	$159,720	$0	
	Channel	~~219-31-42~~	P	12.82	641.3		0.00	0.00%	$256,380	$0	
	Channel	~~219-31-67~~	P	171.26	1865.1		0.00	0.00%	$85,632	$0	
	Channel	~~219-31-40~~	P	12.10	670.3		0.00	0.00%	$242,040	$0	
4	Channel	219-26-7A	P	36.88	250	52.4	0.30	0.82%	$700,500	$5,712	
4	Channel	219-26-6	P	38.03	550	52.4	0.66	1.74%	$722,500	$12,569	
5	Channel	219-26-6	P	38.03	750	64.6	1.11	2.92%	$722,500	$21,131	
5	Channel	219-26-4B	P	38.03	250	64.6	0.37	0.97%	$668,000	$6,512	
6	Channel	219-26-4B	P	38.03	500	64.6	0.74	1.95%	$668,000	$13,025	
7	Channel	219-26-4B	P	38.03	500	84.1	0.97	2.54%	$668,000	$16,956	
8	Channel	219-26-4B	P	38.03	70	84.1	0.14	0.36%	$668,000	$2,374	
8	Channel	219-26-3H	P	11.53	330.25	44	0.33	2.89%	$219,500	$6,351	
8	Channel	19-26-107	P	2.38	80	44	0.08	3.39%	$145,000	$4,915	
9	Channel	19-26-107	P	2.38	250	44	0.25	10.59%	$145,000	$15,359	
9	Channel	19-26-96E	P	3.77	620	44	0.63	16.60%	$98,000	$16,271	
10	Channel	19-25-11R	P	14.98	800	44	0.81	5.40%	$299,540	$16,162	$153,590
3	Basin	219-49-2H	P	75.22	470	470	5.07	6.74%	$376,100	$25,356	$25,356
11	Basin	219-26-7A	P	36.88	660	660	10.00	27.12%	$700,500	$189,951	$189,951
						Total (ac)	24.71				$368,897

MASTER SHEET – CHANNELS

	Preliminary Plan Section No.	Area	Sheet No.	D	HEC-1 Flow I.D.	Design Q100 (cfs)	Comp. Capacity (cfs)	Downstream Invert Elevation (ft)	Upstream Invert Elevation (ft)	Length (ft.)	Computed Invert Slope (ft./ft.)	Design Invert Slope (ft./ft.)	Total Vertical Drop (ft.)	No. of Drops	Vertical Drop (ft.)	Material Type	Manning's "n" Value	Bottom Width, W (ft.)	Depth of Flow (ft.)	Sideslope (H:1) Left (HL)	Sideslope (H:1) Right (HR)	Area (sf.)	Perimeter (ft.)	Flow Top Width (ft)	Hydraulic Depth (ft)	Froude Number	Type of Flow	Velocity (fps)	Freeboard (ft.)	Channel Design Depth Including Freeboard (ft)	Channel Topwidth Including Freeboard (ft)	Comment	Channel Width Plus 16' Access Road
McDowell Rd Option MD2E				12a		189	152	1828.0	1840.0	680	0.0182	0.0045	9.0	3	3.0	e	0.0250	8.0	2.0	4	4	32.0	24.5	24.0	1.3	0.73	Sub	4.8	1.0	3.0	32.0		48.0
				12b		25	28	1816.0	1826.0	660	0.0182	0.0045	9.0	3	3.0	e	0.0250	8.0	0.8	4	4	9.0	14.6	14.4	0.6	0.84	Sub	2.9	1.0	1.8	22.4		38.4
				2a		150	109	1783.0	1816.0	2140	0.0248	0.0085	39.0	13	3.0	e	0.0250	8.0	1.5	4	4	21.8	20.7	20.3	1.1	0.85	Sub	5.0	1.0	2.5	28.3		44.3
				2b		477	454	1752.0	1782.0	500	0.0200	0.0026	8.7	3	2.9	e	0.0250	20.0	2.9	4	4	91.6	43.9	43.2	2.1	0.60	Sub	4.9	1.0	3.9	51.2		67.2
				3a		723	551	1661.0	1751.0	4280	0.0210	0.0021	81.0	27	3.0	e	0.0250	20.0	3.4	4	4	113.8	48.0	47.1	2.4	0.55	Sub	4.8	1.0	4.4	55.1		71.1
				3b		989	709	1645.0	1661.9	1000	0.0160	0.0020	14.0	5	2.8	e	0.0250	20.0	3.9	4	4	138.8	52.2	51.2	2.7	0.55	Sub	5.1	1.1	5.0	59.6		75.8
				11		1249	1233	1580.0	1642.0	1550	0.0400	0.0013	60.0	20	3.0	e	0.0250	30.0	5.0	4	4	249.3	71.1	69.9	3.6	0.46	Sub	4.9	1.3	6.3	80.7		96.7
				4		201	151	1739.0	1753.0	2640	0.0053	0.0053	0.0	0	0.0	e	0.0250	8.0	1.9	4	4	39.9	23.8	23.3	1.3	0.78	Sub	5.0	1.0	2.9	31.3		47.3
				5		613	677	1799.0	1875.0	2640	0.0288	0.0015	72.0	24	3.0	e	0.0250	30.0	3.5	4	4	154.6	58.9	58.1	2.7	0.47	Sub	4.4	1.0	4.5	66.1		82.1
				6		100	106	1801.0	1828.0	1320	0.0189	0.0095	16.4	5	2.7	e	0.0250	10.0	1.4	4	4	21.8	21.5	21.2	1.0	0.84	Sub	4.8	1.0	2.4	29.2		45.2
				13		621	602	1816.0	1825.0	1000	0.0090	0.0020	7.0	3	2.3	e	0.0250	15.0	3.9	4	4	121.2	47.5	46.5	2.6	0.54	Sub	5.0	1.1	5.0	55.2		71.2
McKellipsi Rd Option MK2E				1		100	99	1744.0	1747.0	500	0.0060	0.0060	0.0	0	0.0	e	0.0250	8.0	1.5	4	4	21.0	20.4	20.0	1.1	0.81	Sub	4.7	1.0	2.5	28.0		44.0
				2		250	244	1744.0	1777.0	1500	0.0220	0.0035	27.6	9	3.1	e	0.0250	10.0	2.5	4	4	50.0	30.8	30.0	1.7	0.67	Sub	4.9	1.0	3.5	38.0		54.0
				4		200	206	1635.0	1646.0	800	0.0163	0.0035	10.2	3	3.4	e	0.0250	10.0	2.3	4	4	44.2	29.0	28.4	1.6	0.66	Sub	4.7	1.0	3.3	36.4		52.4
				5		450	449	1620.0	1635.0	1000	0.0150	0.0028	12.4	4	3.1	e	0.0250	15.0	3.2	4	4	89.0	41.4	40.6	2.2	0.60	Sub	5.0	1.0	4.2	48.6		64.6
				6		650	536	1615.0	1620.0	500	0.0100	0.0021	4.0	2	2.0	e	0.0250	15.0	4.0	4	4	124.0	46.0	47.0	2.6	0.56	Sub	5.1	1.1	5.1	55.8		71.8
				7		857	854	1605.0	1614.0	500	0.0180	0.0019	8.1	3	2.7	e	0.0250	30.0	3.7	4	4	167.6	60.8	59.8	2.8	0.54	Sub	5.1	1.0	4.8	68.1		84.1
				8		100	99	1598.0	1605.0	500	0.0140	0.0060	4.0	2	2.0	e	0.0250	8.0	1.5	4	4	21.0	20.4	20.0	1.1	0.81	Sub	4.7	1.0	2.5	28.0		44.0
				9		100	99	1583.0	1596.0	1100	0.0136	0.0060	8.4	3	2.8	e	0.0250	8.0	1.5	4	4	21.0	20.4	20.0	1.1	0.81	Sub	4.7	1.0	2.5	28.0		44.0
				10		100	99	1573.0	1583.0	1000	0.0100	0.0060	4.0	2	2.0	e	0.0250	8.0	1.5	4	4	21.0	20.4	20.0	1.1	0.81	Sub	4.7	1.0	2.5	28.0		44.0

	Excavated Volume (cy)	Unit Cost ($/cy)	Excavation Cost	Concrete Volume (cy)	Unit Cost ($/cy)	Concrete Cost	Fence Length (ft.)	Unit Cost ($/ft)	Fence Cost	Drop Structures (No.)	Drop Structure Size (CY)	Unit Cost ($/cy)	Drop Structures Cost	Drop Structure Size (LY2)	Unit Cost ($/yd)	Drop Structures Cost		No. of Utility Crossings	Unit Cost ($ per crossing)	Utilities Cost	Channel Length (ft)	Existing Right-of-Way Width (ft.)	Landscape Width Required (ft.)	Landscape Area Required (ft)	Landscaping Unit Cost ($/sf)	Total Landscape Cost		Land Acquisition (Channel & Maint Road)(Ac)	Unit Cost ($/sf)	Channel Land Acquisition Cost	Total Construction Cost	Total Contingencies Cost	Total Construction, Land, Landscape, and Contingencies Costs
McDowell Rd Option MD2E	2,347	$4	$9,387	0	$310	$0	1,320	$12	$15,840	3	50.2	$310	$46,712	96.3	$163	$47,100	-$388	0	$3,000	$0	680		32	21120	$1.10	$23,232.0		0.7	$1.00	$31,680	$72,327	$27,464	$154,723
	1,314	$4	$5,257	0	$310	$0	1,320	$12	$15,840	3	35.2	$310	$32,699	67.4	$163	$32,970	-$272	0	$3,000	$0	660		22	14784	$1.10	$16,262.4		0.6	$1.00	$25,344	$54,067	$20,545	$116,219
	6,216	$4	$24,870	0	$310	$0	4,280	$12	$51,360	13	44.3	$310	$178,810	85.0	$163	$180,051	-$1,440	0	$3,000	$0	2140		28	60805	$1.10	$66,885.3		2.2	$1.00	$94,845	$256,281	$97,367	$515,176
	3,593	$4	$14,373	0	$310	$0	1,000	$12	$12,000	3	77.7	$310	$72,216	148.5	$163	$72,607	-$389	0	$3,000	$0	500		51	25500	$1.10	$28,150.0		0.8	$1.00	$33,600	$99,980	$37,812	$198,352
	35,509	$4	$142,036	0	$310	$0	8,560	$12	$102,720	27	86.3	$310	$722,033	185.4	$163	$727,857	-$5,824	0	$3,000	$0	4280		55	235914	$1.10	$259,505.0		7.0	$1.00	$304,394	$972,615	$389,594	$1,908,107
	9,718	$4	$38,872	0	$310	$0	2,000	$12	$24,000	5	87.8	$310	$136,139	167.5	$163	$136,485	-$347	0	$3,000	$0	1000		60	59610	$1.10	$65,730.5		1.7	$1.00	$75,810	$199,357	$75,756	$418,713
	24,974	$4	$99,895	0	$310	$0	3,100	$12	$37,200	20	126.2	$310	$782,362	241.9	$163	$788,648	-$6,287	0	$3,000	$0	1550		81	125022	$1.10	$137,523.8		3.4	$1.00	$149,622	$925,744	$351,783	$1,564,873
	9,038	$4	$38,151	0	$310	$0	5,280	$12	$63,360	0	0.0	$310	$0	0.0	$163	$0	$0	0	$3,000	$0	2640		31	82579	$1.10	$90,837.1		2.9	$1.00	$124,819	$99,511	$37,814	
	28,037	$4	$112,147	0	$310	$0	5,280	$12	$63,360	24	103.5	$310	$769,713	198.4	$163	$775,946	-$6,233	0	$3,000	$0	2640		86	174461	$1.10	$191,898.3		5.0	$1.00	$216,691	$951,453	$361,552	$1,721,593
	3,923	$4	$15,691	0	$310	$0	2,640	$12	$31,680	6	42.0	$310	$78,102	79.9	$163	$78,153	-$51	0	$3,000	$0	1320		29	38544	$1.10	$42,398.4		1.4	$1.00	$58,664	$125,524	$47,699	$275,286
	8,715	$4	$34,860	0	$310	$0	2,000	$12	$24,000	3	68.6	$310	$63,813	128.7	$163	$62,944	$869	0	$3,000	$0	1000		55	55165	$1.10	$60,681.8		1.6	$1.00	$71,165	$121,803	$46,285	$299,936
McKellipsi Rd Option MK2E	1,426	$4	$5,704	0	$310	$0	1,000	$12	$12,000	0	3.4	$310	$0	0.0	$163	$0	$0	0	$3,000	$0	500		28	14000	$1.10	$15,400.0		0.5	$1.00	$22,000	$77,704	$6,727	$91,831
	7,000	$4	$28,000	0	$310	$0	3,000	$12	$36,000	9	61.0	$310	$170,158	117.2	$163	$171,884	-$1,726	0	$3,000	$0	1500		38	57000	$1.10	$62,700.0		1.9	$1.00	$81,000	$235,864	$89,636	$469,219
	3,465	$4	$13,862	0	$310	$0	1,600	$12	$19,200	3	64.0	$310	$59,492	123.8	$163	$60,519	-$1,027	0	$3,000	$0	800		36	29120	$1.10	$32,032.0		1.0	$1.00	$41,920	$93,561	$35,561	$203,093
	6,895	$4	$27,579	0	$310	$0	2,000	$12	$24,000	4	78.4	$310	$97,204	150.7	$163	$98,230	-$1,027	0	$3,000	$0	1000		49	48600	$1.10	$53,460.0		1.5	$1.00	$64,500	$149,810	$56,928	$324,797
	4,453	$4	$17,813	0	$310	$0	1,000	$12	$12,000	2	59.6	$310	$37,074	110.2	$163	$35,938	$1,136	0	$3,000	$0	500		56	27900	$1.10	$30,690.4		0.8	$1.00	$35,900	$85,751	$24,965	$157,344
	5,662	$4	$22,649	0	$310	$0	1,000	$12	$12,000	3	96.2	$310	$59,456	182.8	$163	$59,365	$91	0	$3,000	$0	500		66	34053	$1.10	$37,458.4		1.0	$1.00	$42,053	$124,014	$47,125	$250,851
	1,426	$4	$5,704	0	$310	$0	1,000	$12	$12,000	2	30.3	$310	$18,807	56.0	$163	$18,256	$551	0	$3,000	$0	500		28	14000	$1.10	$15,400.0		0.5	$1.00	$22,000	$35,960	$13,665	$57,024
	3,137	$4	$12,548	0	$310	$0	2,200	$12	$26,400	3	41.1	$310	$36,240	78.4	$163	$38,338	-$97	0	$3,000	$0	1100		28	30800	$1.10	$33,880.0		1.1	$1.00	$48,400	$77,286	$29,369	$158,934
	2,852	$4	$11,407	0	$310	$0	2,000	$12	$24,000	2	30.3	$310	$18,807	56.0	$163	$18,256	$551	0	$3,000	$0	1000		28	28000	$1.10	$30,800.0		1.0	$1.00	$44,000	$53,663	$20,392	$148,856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Spook Hill ADMS Update May 15, 2001
Flood Control District of Maricopa County W/P # 99989
FCD 99-43

McKellips Road Alignment
Option EC2MK1C
Landscaped Earthen Channel Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Excavation	$4.00	CY	46,182	$184,727
2	Drop Structures	$310	CY	2,643	$819,180
3	Splitter Structures	$60,000	EA	2	$120,000
4	Culverts	$310	CY	675	$209,250
5	Baisn Excavation	$4	CY	24,200	$96,800
		SUBTOTAL MAJOR ELEMENTS			$1,429,957
		CONTINGENCIES:			
		Construction		35%	$500,485
		Engineering		7%	$100,097
		Construction Admin		6%	$85,797
		TOTAL MAJOR ELEMENTS			**$2,116,336**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping (Channel & Basins	$1.10	SF	622,500	$684,750
2	Fence	$12	LF	14,800	$177,600
3	Utility Relocations (W & S)	$8,000	EA	0	$0
		SUBTOTAL ADDITIONAL ELEMENTS			$862,350
		CONTINGENCIES:			
		Construction		35%	$301,823
		Engineering		7%	$60,365
		Construction Admin		6%	$51,741
		TOTAL ADDITIONAL ELEMENTS			**$1,276,278**

LAND ACQUISITION:

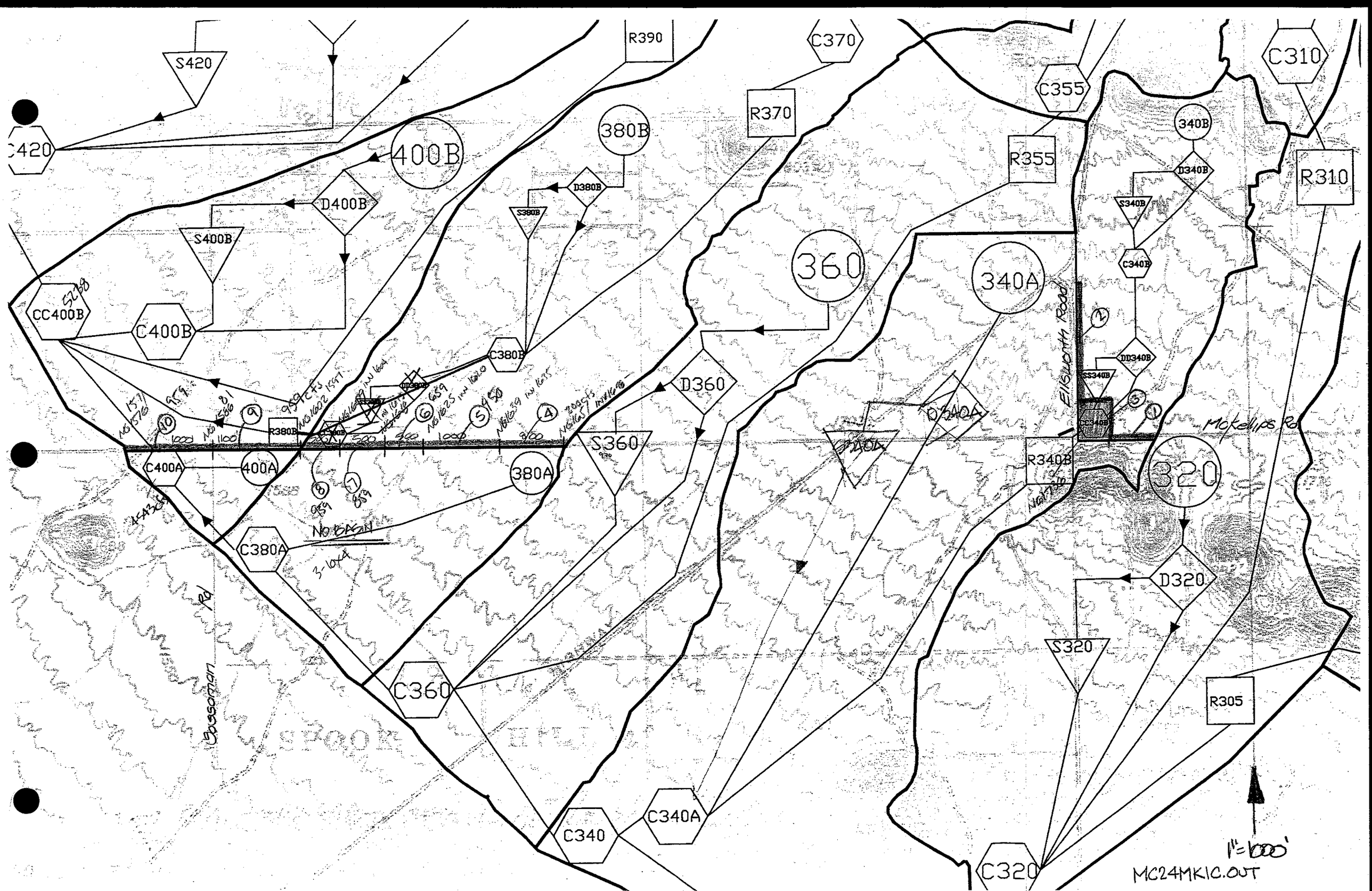
ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$18,200	AC	12.0	$218,400
2	Basin Land Acquisition	$5,100	AC	5.0	$25,500
		SUBTOTAL LAND ACQUISITION			$243,900
		CONTINGENCIES :		25%	$60,975
		TOTAL LAND ACQUISITION			**$304,875**
				TOTAL	***$3,697,489***

Wood/Patel

Level II

Segment	Feature	Parcel	Take (T, P, or N)	Parcel Area (acres)	Parcel Width (ft)	Depth of Take (ft)	Take Area (acres)	Take Area (%)	Land Value ($)	Cost ($)	
1	Channel	219-49-2H	P	75.22	1500	44	1.52	2.01%	$376,100	$7,576	
2	Channel	219-49-2H	P	75.22	1400	54	1.74	2.31%	$376,100	$8,678	
	Channel	~~219-31-45~~	P	9.56	600		0.00	0.00%	$191,140	$0	
	Channel	~~219-31-44~~	P	7.51	456.5		0.00	0.00%	$150,120	$0	
	Channel	~~219-31-67~~	P	171.26	600.8		0.00	0.00%	$85,632	$0	
	Channel	~~219-31-43~~	P	7.99	719.3		0.00	0.00%	$159,720	$0	
	Channel	~~219-31-42~~	P	12.82	641.3		0.00	0.00%	$256,380	$0	
	Channel	~~219-31-67~~	P	171.26	1865.1		0.00	0.00%	$85,632	$0	
	Channel	~~219-31-40~~	P	12.10	670.3		0.00	0.00%	$242,040	$0	
4	Channel	219-26-7A	P	36.88	250	52.4	0.30	0.82%	$700,500	$5,712	
4	Channel	219-26-6	P	38.03	550	52.4	0.66	1.74%	$722,500	$12,569	
5	Channel	219-26-6	P	38.03	750	64.6	1.11	2.92%	$722,500	$21,131	
5	Channel	219-26-4B	P	38.03	250	64.6	0.37	0.97%	$668,000	$6,512	
6	Channel	219-26-4B	P	38.03	500	74.3	0.85	2.24%	$668,000	$14,980	
7	Channel	219-26-4B	P	38.03	500	84.6	0.97	2.55%	$668,000	$17,057	
8	Channel	219-26-4B	P	38.03	70	84.6	0.14	0.36%	$668,000	$2,388	
8	Channel	219-26-3H	P	11.53	330.25	90	0.68	5.92%	$219,500	$12,990	
8	Channel	219-26-107	P	2.38	80	90	0.17	6.93%	$145,000	$10,053	
9	Channel	219-26-107	P	2.38	250	90	0.52	21.67%	$145,000	$31,416	
9	Channel	219-26-96E	P	3.77	620	90	1.28	33.96%	$98,000	$33,281	
10	Channel	219-25-11R	P	14.98	800	90	1.65	11.04%	$299,540	$33,058	$217,403
~~11~~	~~Basin~~	~~219-26-7A~~	~~P~~	~~36.88~~	~~660~~		~~0.00~~	~~0.00%~~	~~$700,500~~	~~$0~~	~~$0~~
						Channel Total (ac)	*11.95*				$217,403
3	Basin	219-49-2H	P	75.22	470	470	5.07	6.74%	$376,100	$25,356	$25,356
						Basin Total (ac)	5.07				

			I.D.	Design Q100 (cfs)	Comp. Capacity (cfs)	Downstream Invert Elevation (ft)	Upstream Invert Elevation (ft)	Length (ft.)	Computed Invert Slope (ft./ft.)	Design Invert Slope (ft./ft.)	Total Vertical Drop (ft.)	No. of Drops	Vertical Drop (ft.)	Material Type	Manning's "n" Value	Bottom Width, W (ft.)	Depth of Flow(ft.)	Froude Number	Type of Flow	Velocity (fps)	Freeboard (ft.)	Channel Design Depth Including Freeboard (ft)	Channel Topwidth Including Freeboard(ft)	Channel Width Plus 16' Access Road	Excavated Volume (cy)	Unit Cost ($/cy)	Excavation Cost	Concrete Volume (cy)	Unit Cost ($/cy)	Concrete Cost	Fence Length (ft.)	Unit Cost ($/ft)	Fence Cost	Drop Structures (No.)	Drop Structure Size (CY)	Unit Cost ($/cy)	Drop Structures Cost	No. of Utility Crossings	Unit Cost ($ per crossing)	Utilities Cost	Channel Length (ft)	Landscape Width Required (ft.)	Landscape Area Required (ft.)	Landscaping Unit Cost ($/sf)	Total Landscape Cost	Land Acquisition Channel & Maint Road(Ac.)	Zoning	Unit Cost ($/sf)	Channel Land Acquisition Cost	Total Construction Cost	Total Contingencies Cost	Total Construction, Land, Landscape, and Contingencies Costs
McKellipsl Rd Option MK1C			1	100	99	1744.0	1747.0	500	0.0060	0.0060	0.0	0	0.0	e	0.0250	8.0	1.5	0.81	Sub	4.7	1.0	2.5	28.0	44.0	833	$4	$3,333	0	$310	$0	1,000	$12	$12,000	0	0.0	$310	$0	0	$3,000	$0	500	28	14000	$1.10	$15,400.0	0.5	Res. N.	$1.00	$22,000	$15,333	$5,827	$58,560
			2	250	248	1744.0	1777.0	1500	0.0220	0.0035	27.8	9	3.1	e	0.0250	10.0	2.5	0.67	Sub	4.9	1.0	3.5	38.2	54.2	4,709	$4	$18,836	0	$310	$0	3,000	$12	$36,000	9	61.2	$310	$170,872	0	$3,000	$0	1500	38	57240	$1.10	$62,964.0	1.9	Res. N.	$1.00	$81,240	$227,443	$86,428	$458,076
			4	200	206	1635.0	1648.0	800	0.0163	0.0035	10.2	4	2.6	e	0.0250	10.0	2.3	0.66	Sub	4.7	1.0	3.3	36.4	52.4	2,268	$4	$9,074	0	$310	$0	1,600	$12	$19,200	4	49.1	$310	$60,850	0	$3,000	$0	800	36	29120	$1.10	$32,032.0	1.0	Res. N.	$1.00	$41,920	$88,792	$33,741	$196,486
			5	450	449	1620.0	1635.0	1000	0.0150	0.0026	12.4	4	3.1	e	0.0250	15.0	3.2	0.60	Sub	5.0	1.0	4.2	48.6	64.6	4,647	$4	$19,787	0	$301	$0	2,000	$12	$24,000	4	78.4	$310	$97,204	0	$3,000	$0	1000	49	48600	$1.10	$53,460.0	1.5	Res. N.	$1.00	$64,600	$142,017	$53,966	$314,043
			6	659	656	1613.0	1620.0	500	0.0140	0.0020	6.0	2	3.0	e	0.0250	20.0	3.8	0.54	Sub	5.0	1.0	4.6	56.3	74.3	3,468	$4	$13,871	0	$310	$0	1,000	$12	$12,000	2	91.2	$310	$56,538	0	$3,000	$0	500	58	29138	$1.10	$32,051.5	0.9	Res. N.	$1.00	$37,138	$82,884	$31,488	$183,542
			7	859	852	1604.0	1613.0	500	0.0180	0.0018	8.1	3	2.7	e	0.0250	30.0	3.8	0.52	Sub	5.0	1.0	4.8	68.6	84.6	4,401	$4	$17,604	0	$310	$0	1,000	$12	$12,000	3	97.4	$310	$90,584	0	$3,000	$0	500	69	34268	$1.10	$37,716.3	1.0	Res. N.	$1.00	$42,268	$120,144	$45,655	$245,809
			8	959	955	1597.0	1604.0	500	0.0140	0.0017	6.2	2	3.1	e	0.0250	35.0	3.8	0.51	Sub	5.0	1.1	4.9	74.0	90.0	4,916	$4	$19,658	0	$310	$0	1,000	$12	$12,000	2	118.4	$310	$73,416	0	$3,000	$0	500	74	36964	$1.10	$40,682.0	1.0	Res. N.	$1.00	$44,964	$105,507	$40,206	$231,679
			9	959	955	1581.0	1597.0	1100	0.0145	0.0017	14.1	5	2.8	e	0.0250	35.0	3.8	0.51	Sub	5.0	1.1	4.9	74.0	90.0	10,812	$4	$43,248	0	$310	$0	2,200	$12	$26,400	5	109.5	$310	$169,800	0	$3,000	$0	1100	74	81364	$1.10	$89,500.4	2.3	Res. N.	$1.00	$98,964	$240,008	$91,203	$519,676
			10	959	955	1571.0	1581.0	1000	0.0100	0.0017	8.3	3	2.8	e	0.0250	35.0	3.8	0.51	Sub	5.0	1.1	4.9	74.0	90.0	9,829	$4	$39,316	0	$310	$0	2,000	$12	$24,000	3	107.4	$310	$99,915	0	$3,000	$0	1000	74	73967	$1.10	$81,364.0	2.1	Res. N.	$1.00	$89,967	$163,386	$62,087	$396,805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Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

May 18, 2001
W/P # 99989

McDowell Road Alignment
Option EC2MD2E
Landscaped Earthen Channel Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Excavation	$4.00	CY	86,458	$345,831
2	Drop Structures	$310	CY	10,154	$3,147,838
3	Splitter Structures	$60,000	EA	4	$240,000
4	Culverts	$310	CY	1,389	$430,590
5	Basin Excavation	$4	CY	250,067	$1,000,267
		SUBTOTAL MAJOR ELEMENTS			$5,164,525
		CONTINGENCIES:			
		Construction		35%	$1,807,584
		Engineering		7%	$361,517
		Construction Admin		6%	$309,872
		TOTAL MAJOR ELEMENTS			**$7,643,498**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping (Channel & Basins	$1.10	SF	1,746,717	$1,921,389
2	Fence	$12	LF	36,780	$441,360
3	Utility Relocations (W & S)	$8,000	EA	2	$16,000
		SUBTOTAL ADDITIONAL ELEMENTS			$2,378,749
		CONTINGENCIES:			
		Construction		35%	$832,562
		Engineering		7%	$166,512
		Construction Admin		6%	$142,725
		TOTAL ADDITIONAL ELEMENTS			**$3,520,548**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$89,088	AC	34.26	$3,052,155
2	Basin Land Acquisition	$24,411	AC	18.62	$454,533
		SUBTOTAL LAND ACQUISITION			$3,506,688
		CONTINGENCIES :		25%	$876,672
		TOTAL LAND ACQUISITION			**$4,383,360**
				TOTAL	***$15,547,405***

	I.D.	Design Q100 (cfs)	Comp. Capacity (cfs)	Downstream Invert Elevation (ft)	Upstream Invert Elevation (ft)	Length (ft.)	Computed Invert. Slope (ft./ft.)	Design Invert Slope (ft./ft.)	Total Vertical Drop (ft.)	No. of Drops	Vertical Drop (ft.)	Material Type	Manning's "n" Value	Bottom Width, W (ft.)	Depth of Flow(ft.)	Sideslope (H:1) Left (HL)	Sideslope (H:1) Right (HR)
McDowell Rd Option MD2E	12a	169	152	1828.0	1840.0	660	0.0182	0.0045	9.0	3	3.0	e	0.0250	8.0	2.0	4	4
	12b	25	26	1816.0	1828.0	660	0.0182	0.0045	9.0	3	3.0	e	0.0250	6.0	0.8	4	4
	2a	150	109	1763.0	1816.0	2140	0.0248	0.0065	39.0	13	3.0	e	0.0250	8.0	1.5	4	4
	2b	477	454	1752.0	1762.0	500	0.0200	0.0026	8.7	3	2.9	e	0.0250	20.0	2.9	4	4
	3a	723	551	1661.0	1751.0	4280	0.0210	0.0021	81.0	27	3.0	e	0.0250	20.0	3.4	4	4
	3b	989	709	1645.0	1661.0	1000	0.0160	0.0020	14.0	5	2.8	e	0.0250	20.0	3.9	4	4
	11	2016	2044	1580.0	1642.0	1550	0.0400	0.0013	60.0	20	3.0	e	0.0250	57.0	5.0	4	4
	4	201	151	1739.0	1753.0	2640	0.0053	0.0053	0.0	0	0.0	e	0.0250	8.0	1.9	4	4
	5	613	677	1799.0	1675.0	2640	0.0288	0.0015	72.0	24	3.0	e	0.0250	30.0	3.5	4	4
	6	100	106	1801.0	1826.0	1320	0.0189	0.0065	16.4	6	2.7	e	0.0250	10.0	1.4	4	4
	13	621	602	1816.0	1825.0	1000	0.0090	0.0020	7.0	3	2.3	e	0.0250	15.0	3.9	4	4

I.D.	Area (sf.)	Perimeter (ft.)	Flow Top Width (ft)	Hydraulic Depth (ft)	Froude Number	Type of Flow	Velocity (fps)	Freeboard (ft.)	Channel Design Depth Including Freeboard (ft)	Channel Topwidth Including Freeboard(ft)	Channel Width Plus 16' Access Road	Excavated Volume (cy)	Unit Cost ($/cy)	Excavation Cost	Concrete Volume (cy)	Unit Cost ($/cy)	Concrete Cost	Fence Length (ft.)	Unit Cost ($/lf)	Fence Cost
12a	32.0	24.5	24.0	1.3	0.73	Sub	4.8	1.0	3.0	32.0	48.0	1,467	$4	$5,867	0	$310	$0	1,320	$12	$15,840
12b	9.0	14.6	14.4	0.6	0.64	Sub	2.9	1.0	1.8	22.4	38.4	669	$4	$2,675	0	$310	$0	1,320	$12	$15,840
2a	21.8	20.7	20.3	1.1	0.85	Sub	5.0	1.0	2.5	28.3	44.3	3,656	$4	$14,624	0	$310	$0	4,280	$12	$51,360
2b	91.6	43.9	43.2	2.1	0.60	Sub	4.9	1.0	3.9	51.2	67.2	2,571	$4	$10,284	0	$310	$0	1,000	$12	$12,000
3a	113.8	48.0	47.1	2.4	0.55	Sub	4.8	1.0	4.4	55.1	71.1	26,138	$4	$104,551	0	$310	$0	8,560	$12	$102,720
3b	138.8	52.2	51.2	2.7	0.55	Sub	5.1	1.1	5.0	59.8	75.8	7,355	$4	$29,418	0	$310	$0	2,000	$12	$24,000
11	384.0	98.1	96.9	4.0	0.47	Sub	5.3	1.4	6.3	107.8	123.8	30,022	$4	$120,088	0	$310	$0	3,100	$12	$37,200
4	29.9	23.8	23.3	1.3	0.78	Sub	5.0	1.0	2.9	31.3	47.3	5,588	$4	$22,353	0	$310	$0	5,280	$12	$63,360
5	154.6	58.9	58.1	2.7	0.47	Sub	4.4	1.0	4.5	66.1	82.1	21,185	$4	$84,738	0	$310	$0	5,280	$12	$63,360
6	21.8	21.5	21.2	1.0	0.84	Sub	4.8	1.0	2.4	29.2	45.2	2,300	$4	$9,199	0	$310	$0	2,640	$12	$31,680
13	121.2	47.5	46.5	2.6	0.54	Sub	5.0	1.1	5.0	55.2	71.2	6,524	$4	$26,095	0	$310	$0	2,000	$12	$24,000

I.D.	Drop Structures (No.)	Drop Structure Size (CY)	Unit Cost ($/cy)	Drop Structures Cost	No. of Utility Crossings	Unit Cost ($ per crossing)	Utilities Cost	Channel Length (ft)	Landscape Width Required (ft.)	Landscape Area Required (ft.)	Landscaping Unit Cost ($/sf)	Total Landscape Cost	Land Acquisition (Channel & Maint Road)(Ac.)	Zoning	Unit Cost ($/sf)	Channel Land Acquisition Cost	Total Construction Cost	Total Contingencies Cost	Total Construction, Land, Landscape, and Contingencies Costs
12a	3	50.2	$310	$46,712	0	$3,000	$0	660	32	21120	$1.10	$23,232.0	0.7	Res. N.	$1.00	$31,680	$68,807	$26,147	$149,866
12b	3	35.2	$310	$32,699	0	$3,000	$0	660	22	14784	$1.10	$16,262.4	0.6	Res. N.	$1.00	$25,344	$51,486	$19,565	$112,656
2a	13	44.3	$310	$178,610	0	$3,000	$0	2140	28	60605	$1.10	$66,665.3	2.2	Res. N.	$1.00	$94,845	$246,034	$93,493	$501,037
2b	3	77.7	$310	$72,218	0	$3,000	$0	500	51	25600	$1.10	$28,160.0	0.8	Res. N.	$1.00	$33,600	$94,891	$36,059	$192,710
3a	27	86.3	$310	$722,033	0	$3,000	$0	4280	55	235914	$1.10	########	7.0	Res. N.	$1.00	$304,394	$935,129	$355,349	#######
3b	5	87.8	$310	$136,139	0	$3,000	$0	1000	60	59810	$1.10	$65,790.5	1.7	Res. N.	$1.00	$75,810	$189,904	$72,163	$403,667
11	20	168.6	$310	#######	0	$3,000	$0	1550	108	167058	$1.10	########	4.4	Res. N.	$1.00	$191,858	#######	$460,221	#######
4	0	0.0	$310	$0		$3,000	$0	2640	31	82579	$1.10	$90,837.1	2.9	$1	$1.00	$124,619	$85,713	$32,571	
5	24	103.5	$310	$769,713	0	$3,000	$0	2640	66	174451	$1.10	########	5.0	Res. N.	$1.00	$216,691	$924,044	$351,137	#######
6	6	42.0	$310	$78,102	0	$3,000	$0	1320	29	38544	$1.10	$42,398.4	1.4	Res. N.	$1.00	$59,664	$119,032	$45,232	$266,326
13	3	68.6	$310	$63,813	0	$3,000	$0	1000	55	55165	$1.10	$60,681.8	1.6	Res. N.	$1.00	$71,165	$113,038	$42,955	$287,840

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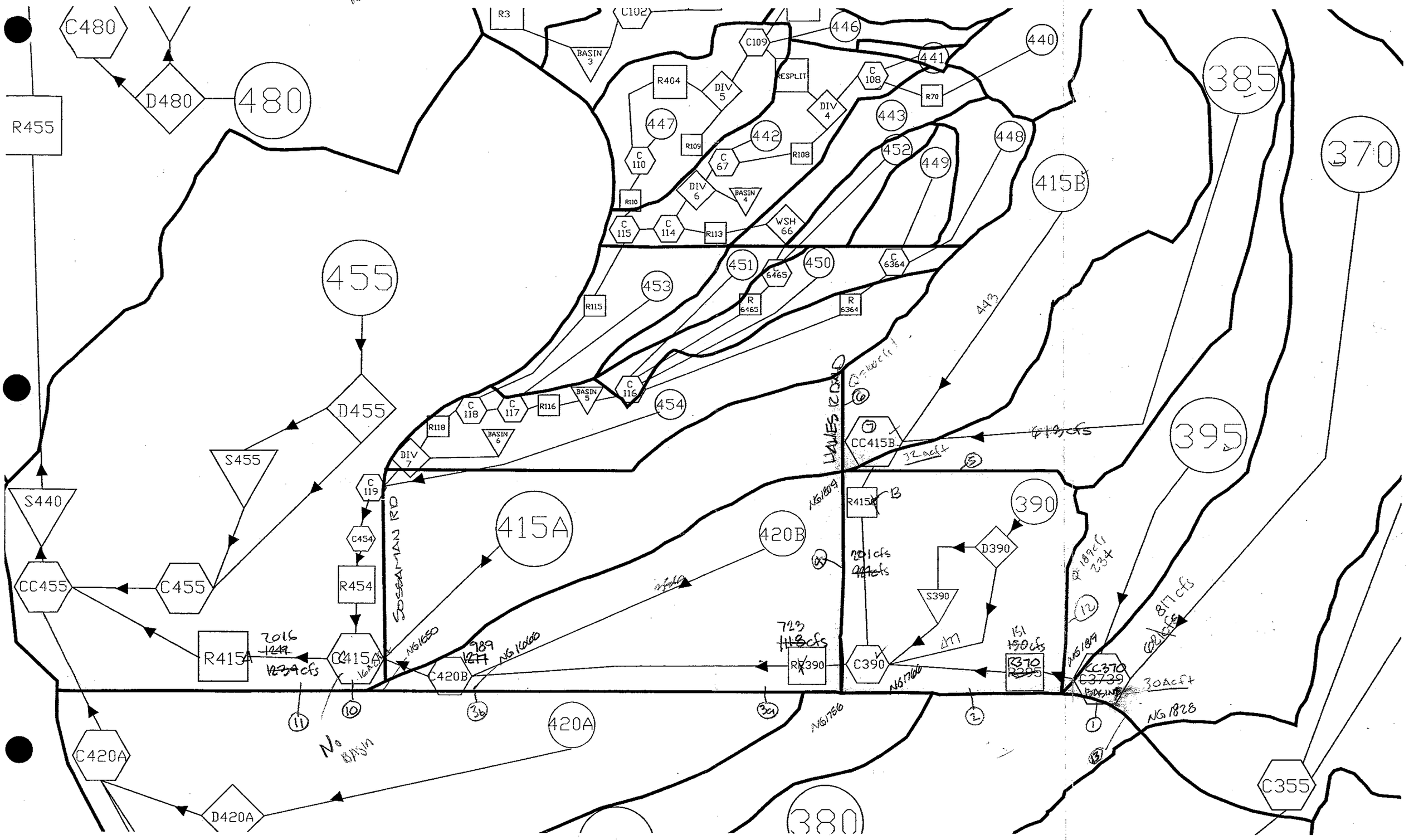

Land Takes
McDowell Road Option 2e Earthen Channel
Level II

Segment	Feature	Parcel	Take (T, P, or N)	Parcel Area (acres)	Parcel Width (ft)	Depth of Take (ft)	Take Area (acres)	Take Area (%)	Land Value ($)	Cost ($)	
2	Channel	219-24-048	N					0.00%	$232,000	$0	
2	Channel	219-24-049	N					0.00%	$279,500	$0	
2	Channel	219-24-050	N					0.00%	$62,000	$0	
2	Channel	219-24-051	N					0.00%	$62,000	$0	
2	Channel	219-24-052	N					0.00%	$62,000	$0	
2	Channel	219-24-053	N					0.00%	$254,500	$0	
2	Channel	219-24-054	N					0.00%	$62,000	$0	
2	Channel	219-24-055	N					0.00%	$62,000	$0	
2	Channel	219-24-056	N					0.00%	$65,000	$0	
2	Channel	219-24-057	N					0.00%	$264,000	$0	
2	Channel	219-24-058	N					0.00%	$268,500	$0	
2	Channel	219-24-059	N					0.00%	$62,000	$0	
2	Channel	219-24-060	N					0.00%	$305,000	$0	$0
3a	Channel	219-23-025G	T				0.99	100.00%	$138,000	$138,000	
3a	Channel	219-23-026E	P	4.70	330	75	0.57	12.09%	$439,109	$53,084	
3a	Channel	219-23-027G	T				1.09	100.00%	$180,500	$180,500	
3a	Channel	219-23-027D	T				1.14	100.00%	$154,000	$154,000	
3a	Channel	219-23-027B	P	4.70	330	75	0.57	12.09%	$187,500	$22,667	
3a	Channel	219-23-028L	T				0.90	100.00%	$180,500	$180,500	
3a	Channel	219-23-028N	T				0.86	100.00%	$208,690	$208,690	
3a	Channel	219-23-028E	T				1.17	100.00%	$179,000	$179,000	
3a	Channel	219-23-028J	T				1.31	100.00%	$179,000	$179,000	
3a	Channel	219-23-029B	P	2.82	198	75	0.34	12.09%	$158,500	$19,161	
3a	Channel	219-23-029C	P	1.88	132	75	0.23	12.09%	$64,500	$7,797	
3a	Channel	219-23-030A	P	2.34	165	75	0.28	12.14%	$172,500	$20,943	
3a	Channel	219-23-031A	P	2.35	165	75	0.28	12.09%	$134,500	$16,260	$1,359,601
3b	Channel	219-22-012C	P	2.35	165	80	0.30	12.89%	$70,200	$9,052	
3b	Channel	219-22-012B	P	2.35	165	80	0.30	12.89%	$150,000	$19,342	
3b	Channel	219-22-023C	T				0.87	100.00%	$127,000	$127,000	
3b	Channel	219-22-023E	T				1.33	100.00%	$156,500	$156,500	
3b	Channel	219-22-022G	P	2.03	305	80	0.56	27.59%	$104,500	$28,835	
3b	Channel	219-22-021A	P	4.20	330	80	0.61	14.43%	$111,500	$16,089	
3b	Channel	219-22-020C	P	4.48	420	80	0.77	17.22%	$89,560	$15,420	
3b	Channel	219-22-019H	P	1.81	190	80	0.35	19.28%	$63,000	$12,146	
3b	Channel	219-22-018Q	T				0.93	100.00%	$122,500	$122,500	
3b	Channel	219-22-018L	T				0.8	100.00%	$124,500	$124,500	
3b	Channel	219-22-024B	T				0.8	100.00%	$61,000	$61,000	
3b	Channel	219-22-024D	P	1.89	130	80	0.24	12.63%	$216,000	$27,286	$719,671
1	Basin	219-33-027A	P	19.28	609	660	9.23	47.86%	$385,600	$184,545	$184,545
10	Basin	219-19-8K	P	32.56	660	330	0.00	0.00%	$1,418,300	$0	$0
12	Channel	219-33-027A	P	19.28	1246	43	1.23	6.38%	$385,600	$24,600	$24,600
13	Channel	219-31-004E	T				0.24	100.00%	$16,000	$16,000	
13	Channel	219-31-004F	T				1.21	100.00%	$148,500	$148,500	
13	Channel	219-31-004C	P	7.81	660	71	1.08	13.77%	$169,000	$23,278	$187,778
6	Channel	219-24-003M	P	4.70	330	45	0.34	7.25%	$322,000	$23,356	
6	Channel	219-24-003P	T				2.20	100.00%	$193,500	$193,500	
6	Channel	219-24-001H	P	37.90	635	45	0.66	1.73%	$720,000	$12,462	
6	Channel	219-24-001Q	P	8.90	625	45	0.65	7.25%	$256,500	$18,608	$247,926
7	Basin	219-24-003N	T	9.39	620	660	9.39	100.00%	$266,000	$266,000	$266,000
5	Channel	219-24-003R	P	5.00	330	82	0.62	12.42%	$191,000	$23,730	
5	Channel	219-24-003V	T				1.1	100.00%	$170,500	$170,500	
5	Channel	219-24-003U	T				1.1	100.00%	$193,500	$193,500	
5	Channel	219-24-004G	P	10.00	659.68	82	1.24	12.42%	$200,000	$24,836	
5	Channel	219-24-004F	T				1.3	100.00%	$25,980	$25,980	
5	Channel	219-24-004D	T				3.7	100.00%	$74,020	$74,020	$512,567
						Total (ac)	52.88				$3,502,688
						Basin (ac)	18.62				$450,545
						Channel (ac)	34.26				$3,052,143

Spook Hill ADMS Update April 30, 2001
Flood Control District of Maricopa County W/P # 99989
FCD 99-43

McDowell Road Alignment
Option EC2MD3E
Landscaped Earthen Channel Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Excavation	$4.00	CY	115,365	$461,460
2	Drop Structures	$310	CY	14,437	$4,475,431
3	Splitter Structures	$60,000	EA	4	$240,000
4	Culverts	$310	CY	608	$188,356
5	Basin Excavation	$4	CY	250,067	$1,000,267
		SUBTOTAL MAJOR ELEMENTS			$6,365,514
		CONTINGENCIES:			
		Construction		35%	$2,227,930
		Engineering		7%	$445,586
		Construction Admin		6%	$381,931
		TOTAL MAJOR ELEMENTS			**$9,420,961**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping (Channel & Basins	$1.10	SF	2,174,115	$2,391,526
2	Fence	$12	LF	47,340	$568,080
3	Utility Relocations (W & S)	$8,000	EA	2	$16,000
		SUBTOTAL ADDITIONAL ELEMENTS			$2,975,606
		CONTINGENCIES:			
		Construction		35%	$1,041,462
		Engineering		7%	$208,292
		Construction Admin		6%	$178,536
		TOTAL ADDITIONAL ELEMENTS			**$4,403,897**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$202,850	AC	18.40	$3,732,440
2	Basin Land Acquisition	$24,200	AC	18.62	$450,604
		SUBTOTAL LAND ACQUISITION			$4,183,044
		CONTINGENCIES :		25%	$1,045,761
		TOTAL LAND ACQUISITION			**$5,228,805**
				TOTAL	***$19,053,663***

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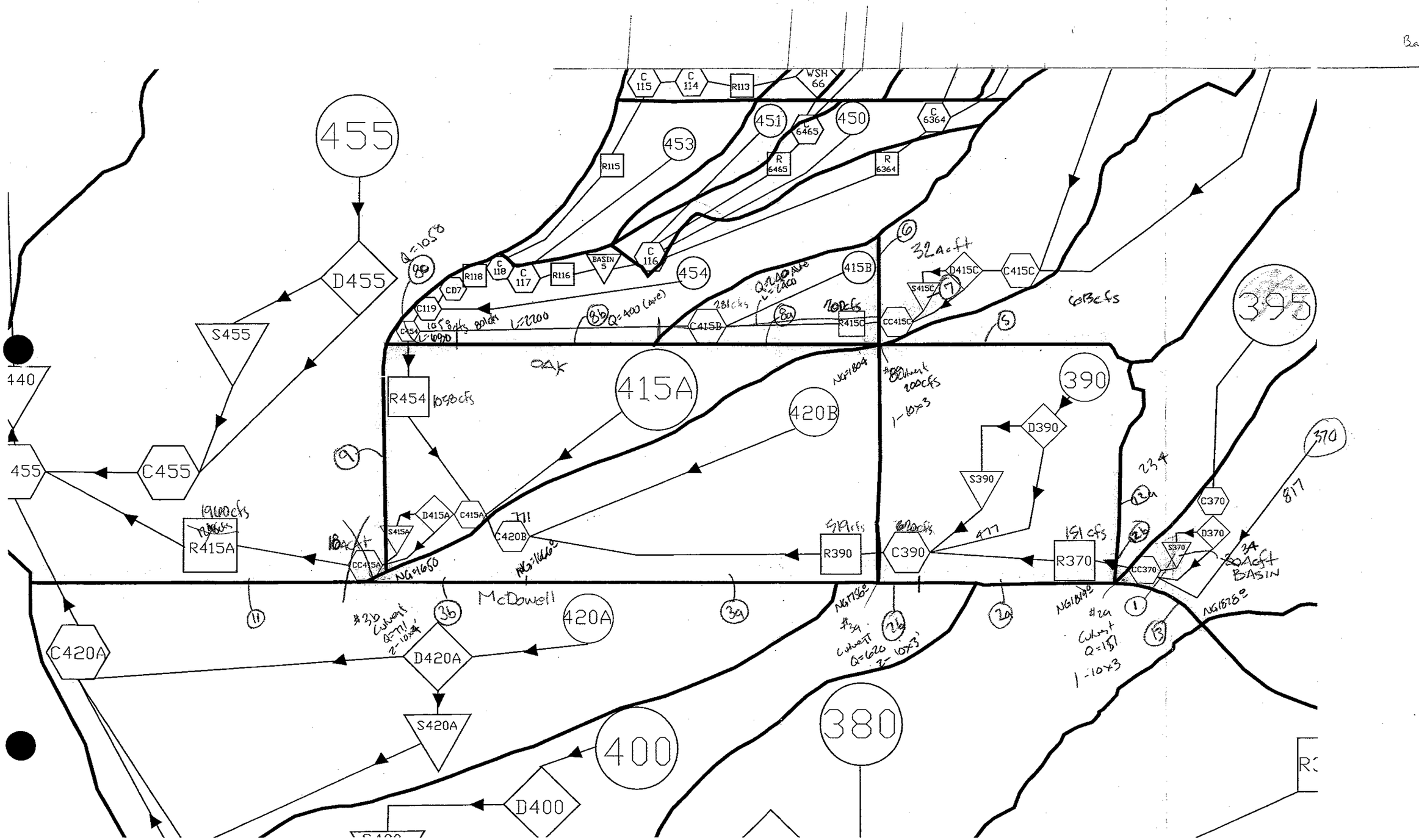
Beverly Midland



Land Takes
McDowell Road Option 3e Earthen Channel
Level II

Segment	Feature	Parcel	Take (T, P, or N)	Parcel Area (acres)	Parcel Width (ft)	Depth of Take (ft)	Take Area (acres)	Take Area (%)	Land Value ($)	Cost ($)	
2	Channel	219-24-048	N					0.00%	$232,000	$0	
2	Channel	219-24-049	N					0.00%	$279,500	$0	
2	Channel	219-24-050	N					0.00%	$62,000	$0	
2	Channel	219-24-051	N					0.00%	$62,000	$0	
2	Channel	219-24-052	N					0.00%	$62,000	$0	
2	Channel	219-24-053	N					0.00%	$254,500	$0	
2	Channel	219-24-054	N					0.00%	$62,000	$0	
2	Channel	219-24-055	N					0.00%	$62,000	$0	
2	Channel	219-24-056	N					0.00%	$65,000	$0	
2	Channel	219-24-057	N					0.00%	$264,000	$0	
2	Channel	219-24-058	N					0.00%	$268,500	$0	
2	Channel	219-24-059	N					0.00%	$62,000	$0	
2	Channel	219-24-060	N					0.00%	$305,000	$0	$0
3a	Channel	219-23-025G	T					100.00%	$138,000	$138,000	
3a	Channel	219-23-026E	P	4.70	330	71	0.54	11.44%	$439,109	$50,253	
3a	Channel	219-23-027G	T					100.00%	$180,500	$180,500	
3a	Channel	219-23-027D	T					100.00%	$154,000	$154,000	
3a	Channel	219-23-027B	P	4.70	330	71	0.54	11.44%	$187,500	$21,458	
3a	Channel	219-23-028L	T					100.00%	$180,500	$180,500	
3a	Channel	219-23-028N	T					100.00%	$208,690	$208,690	
3a	Channel	219-23-028E	T					100.00%	$179,000	$179,000	
3a	Channel	219-23-028J	T					100.00%	$179,000	$179,000	
3a	Channel	219-23-029B	P	2.82	198	71	0.32	11.44%	$158,500	$18,139	
3a	Channel	219-23-029C	P	1.88	132	71	0.22	11.44%	$64,500	$7,382	
3a	Channel	219-23-030A	P	2.34	165	71	0.27	11.49%	$172,500	$19,826	
3a	Channel	219-23-031A	P	2.35	165	71	0.27	11.44%	$134,500	$15,392	$1,352,139
3b	Channel	219-22-012C	P	2.35	165	82	0.31	13.22%	$70,200	$9,279	
3b	Channel	219-22-012B	P	2.35	165	82	0.31	13.22%	$150,000	$19,826	
3b	Channel	219-22-023C	T					100.00%	$127,000	$127,000	
3b	Channel	219-22-023E	T					100.00%	$156,500	$156,500	
3b	Channel	219-22-022G	P	2.03	305	82	0.57	28.28%	$104,500	$29,556	
3b	Channel	219-22-021A	P	4.20	330	82	0.62	14.79%	$111,500	$16,492	
3b	Channel	219-22-020C	P	4.46	420	82	0.79	17.65%	$89,560	$15,806	
3b	Channel	219-22-019H	P	1.81	190	82	0.36	19.76%	$63,000	$12,449	
3b	Channel	219-22-018Q	T					100.00%	$122,500	$122,500	
3b	Channel	219-22-018L	T					100.00%	$124,500	$124,500	
3b	Channel	219-22-024B	T					100.00%	$61,000	$61,000	
3b	Channel	219-22-024D	P	1.89	130	82	0.24	12.95%	$216,000	$27,968	$722,875
1	Basin	219-33-027A	P	19.28	609	660	9.23	47.86%	$385,600	$184,545	$184,545
~~40~~	~~Basin~~	219-19-8K	P	32.56	660	0	0.00	0.00%	$1,418,300	$0	$0
12	Channel	219-33-027A	P	19.28	1246	55	1.57	8.16%	$385,600	$31,465	$31,465
13	Channel	219-31-004E	T					100.00%	$16,000	$16,000	
13	Channel	219-31-004F	T					100.00%	$148,500	$148,500	
13	Channel	219-31-004C	P	7.81	660	71	1.08	13.77%	$169,000	$23,278	$187,778
6	Channel	219-24-003M	P	4.70	330	45	0.34	7.25%	$322,000	$23,356	
6	Channel	219-24-003P	T					100.00%	$193,500	$193,500	
6	Channel	219-24-001H	P	37.90	635	45	0.66	1.73%	$720,000	$12,462	
6	Channel	219-24-001Q	P	8.90	625	45	0.65	7.25%	$256,500	$18,608	$247,926
7	Basin	219-24-003N	T	9.39	620	660	9.39	100.00%	$266,000	$266,000	$266,000
5	Channel	219-24-003R	P	5.00	330	80	0.61	12.12%	$191,000	$23,152	

5	Channel	219-24-003V	T					100.00%	$170,500	$170,500	
5	Channel	219-24-003U	T					100.00%	$193,500	$193,500	
5	Channel	219-24-004G	P	10.00	659.68	80	1.21	12.12%	$200,000	$24,231	
5	Channel	219-24-004F	T					100.00%	$25,980	$25,980	
5	Channel	219-24-004D	T					100.00%	$74,020	$74,020	$511,382
8a	Channel	219-21-8B	P	2.25	297	59	0.40	17.88%	$104,500	$18,683	
8a	Channel	219-21-19B	T					100.00%	$249,000	$249,000	
8a	Channel	219-21-17C	T					100.00%	$192,500	$192,500	
8a	Channel	219-21-15	P	2.27	300	59	0.41	17.88%	$80,500	$14,391	
8a	Channel	219-21-13	P	4.41	630	59	0.85	19.34%	$204,000	$39,464	
8a	Channel	219-21-11B	P	2.14	305	59	0.41	19.34%	$187,500	$36,263	
8a	Channel	219-21-10C	P	2.14	305	59	0.41	19.34%	$197,000	$38,100	$588,401
8b	Channel	219-20-4	P	20.00	660	65	0.98	4.92%	$300,000	$14,773	
8b	Channel	219-20-3	P	20.00	660	65	0.98	4.92%	$300,000	$14,773	
8b	Channel	219-20-2H	P	3.00	426.43	65	0.64	21.21%	$157,500	$33,407	
8b	Channel	219-20-2G	P	6.10	214.5	65	0.32	5.24%	$91,500	$4,798	$67,750
8c	Channel	219-20-2G	P	6.10	680	97	1.51	24.81%	$91,500	$22,699	$22,699
						Total (ac)	37.02				$4,182,961
						Basin (ac)	18.62				$450,545
						Channel (ac)	18.40				$3,732,415

			Q	Design Q100 (cfs)	Comp. Capacity (cfs)	Downstream Invert Elevation (ft)	Upstream Invert Elevation (ft)	Length (ft)	Computed Invert Slope (ft./ft.)	Design Invert Slope (ft./ft.)	Total Vertical Drop (ft.)	No. of Drops	Vertical Drop (ft.)	Material Type	Manning's "n" Value	Bottom Width, W (ft.)	Depth of Flow (ft.)	Froude Number	Type of Flow	Velocity (fps)	Freeboard (ft.)	Channel Design Depth Including Freeboard (ft)	Channel Topwidth Including Freeboard (ft)	Channel Width Plus 6' Access Road
McDowell Rd Option MD3E			12a	234	236	1828.0	1840.0	660	0.0182	0.0045	9.0	3	3.0	e	0.0250	15.0	2.0	0.74	Sub	6.1	1.0	3.0	39.0	55.0
			12b	25	26	1816.0	1828.0	660	0.0182	0.0045	9.0	3	3.0	e	0.0250	8.0	0.8	0.64	Sub	2.9	1.0	1.8	22.4	38.4
			2a	151	150	1763.0	1816.0	2140	0.0248	0.0065	39.0	13	3.0	e	0.0250	16.0	1.3	0.85	Sub	5.0	1.0	2.3	36.4	52.4
			2b	477	484	1752.0	1762.0	500	0.0200	0.0026	8.7	3	2.9	e	0.0250	20.0	3.0	0.60	Sub	5.0	1.0	4.0	52.0	68.0
			3a	519	523	1661.0	1751.0	4280	0.0210	0.0021	81.0	27	3.0	e	0.0250	20.0	3.3	0.55	Sub	4.8	1.0	4.3	54.4	70.4
			3b	771	777	1645.0	1661.0	1000	0.0160	0.0020	14.0	5	2.8	e	0.0250	30.0	3.5	0.55	Sub	5.0	1.0	4.5	66.0	82.0
			11	1960	1959	1580.0	1642.0	1550	0.0400	0.0013	60.0	20	3.0	e	0.0250	75.0	4.3	0.46	Sub	5.0	1.2	5.4	118.4	134.4
			5	613	603	1799.0	1675.0	2640	0.0288	0.0015	72.0	24	3.0	e	0.0250	30.0	3.3	0.47	Sub	4.2	1.0	4.3	64.4	80.4
			6	100	100	1801.0	1826.0	1320	0.0189	0.0065	16.4	6	2.7	e	0.0250	10.0	1.4	0.84	Sub	4.8	1.0	2.4	28.9	44.9
			8a	240	240	1738.0	1800.0	2400	0.0258	0.0045	51.2	17	3.0	e	0.0250	20.0	1.8	0.74	Sub	5.0	1.0	2.8	42.2	58.2
			8b	400	396	1691.0	1739.0	2200	0.0218	0.0030	41.4	14	3.0	e	0.0250	20.0	2.6	0.63	Sub	5.0	1.0	3.6	48.8	64.8
			8c	1056	1052	1676.0	1690.0	680	0.0206	0.0014	13.0	5	2.6	e	0.0250	40.0	4.0	0.47	Sub	4.7	1.1	5.1	80.7	96.7
			9	1058	1053	1645.0	1675.0	2640	0.0114	0.0016	25.8	9	2.9	e	0.0250	40.0	3.9	0.50	Sub	4.9	1.1	4.9	79.4	95.4
			13	600	598	1816.0	1825.0	1000.0	0.0090	0.0020	7.0	3	2.3	e	0.0250	15.0	3.9	0.54	Sub	5.0	1.1	5.0	56.1	71.1

			Excavated Volume (cy)	Unit Cost ($/cy)	Excavation Cost	Concrete Volume (cy)	Unit Cost ($/cy)	Concrete Cost	Fence Length (ft.)	Unit Cost ($/ft)	Fence Cost	Drop Structures (No.)	Drop Structure Size (CY)	Unit Cost ($/cy)	Drop Structures Cost	No. of Utility Crossings	Unit Cost ($ per crossing)	Utilities Cost	Channel Length (ft)	Landscape Width Required (ft.)	Landscape Area Required (ft.)	Landscaping Unit Cost ($/sf)	Total Landscape Cost	Land Acquisition (Channel & Maint Road)(Ac.)	Zoning	Unit Cost ($/sf)	Channel Land Acquisition Cost	Total Construction Cost	Total Contingencies Cost	Total Construction, Land, Landscape, and Contingencies Costs
McDowell Rd Option MD3E			1,980	$4	$7,920	0	$310	$0	1,320	$12	$15,840	3	61.2	$310	$56,930	0	$3,000	$0	660	39	25740	$1.10	$28,314.0	0.6	Res. N.	$1.00	$36,300	$81,164	$30,842	$176,620
			669	$4	$2,675	0	$310	$0	1,320	$12	$15,840	3	35.2	$310	$32,699	0	$3,000	$0	660	22	14784	$1.10	$16,262.4	0.6	Res. N.	$1.00	$25,344	$61,468	$19,565	$112,658
			4,958	$4	$19,834	0	$310	$0	4,280	$12	$51,360	13	57.0	$310	$229,570	0	$3,000	$0	2140	36	77896	$1.10	$85,685.6	2.6	Res. N.	$1.00	$112,138	$302,615	$114,994	$615,430
			2,667	$4	$10,667	0	$310	$0	1,000	$12	$12,000	3	76.9	$310	$73,346	0	$3,000	$0	500	52	26000	$1.10	$28,600.0	0.8	Res. N.	$1.00	$34,000	$96,408	$36,635	$195,643
			25,357	$4	$101,428	0	$310	$0	6,560	$12	$102,720	27	85.1	$310	$712,601	0	$3,000	$0	4280	54	232832	$1.10	########	6.6	Res. N.	$1.00	$301,312	$922,496	$350,549	########
			8,000	$4	$32,000	0	$310	$0	2,000	$12	$24,000	5	96.9	$310	$180,228	0	$3,000	$0	1000	66	66000	$1.10	$72,600.0	1.9	Res. N.	$1.00	$52,000	$206,612	$78,513	$439,725
			30,095	$4	$120,380	0	$310	$0	3,100	$12	$37,200	20	185.2	$310	########	0	$3,000	$0	1550	118	183462	$1.10	########	4.8	Res. N.	$1.00	$205,282	########	$499,701	########
			19,845	$4	$79,380	0	$310	$0	5,280	$12	$63,360	24	100.8	$310	$750,144	0	$3,000	$0	2640	64	170016	$1.10	########	4.9	Res. N.	$1.00	$212,256	$898,958	$341,604	########
			2,243	$4	$8,972	0	$310	$0	2,640	$12	$31,680	6	41.5	$310	$77,246	0	$3,000	$0	1320	29	38122	$1.10	$41,933.8	1.4	Res. N.	$1.00	$59,242	$117,946	$44,820	$263,944
			7,590	$4	$30,760	0	$310	$0	4,800	$12	$57,600	17	66.3	$310	$349,596	0	$3,000	$0	2400	42	101376	$1.10	########	3.2	Res. N.	$1.00	$139,776	$440,879	$167,534	$859,702
			10,091	$4	$40,363	0	$310	$0	4,400	$12	$52,800	14	75.4	$310	$327,045	0	$3,000	$0	2200	49	107800	$1.10	########	3.3	Res. N.	$1.00	$142,560	$422,475	$160,540	$843,671
			7,729	$4	$30,915	0	$310	$0	1,360	$12	$16,320	5	111.1	$310	$172,191	0	$3,000	$0	680	81	54866	$1.10	$60,352.6	1.5	Res. N.	$1.00	$65,746	$218,839	$83,159	$428,096
			28,703	$4	$114,811	0	$310	$0	5,280	$12	$63,360	9	119.0	$310	$331,943	0	$3,000	$0	2640	79	209491	$1.10	########	5.8	Res. N.	$1.00	$251,731	$511,570	$194,397	########
			6,498	$4	$25,990	0	$310	$0	2,000	$12	$24,000	3	68.5	$310	$63,695	0	$3,000	$0	1000	55	55063	$1.10	$60,569.3	1.6	Res. N.	$1.00	$71,063	$112,817	$42,871	$287,321

Wood/Patel

Spook Hill ADMS Update April 26, 2001
Flood Control District of Maricopa County W/P # 99989
FCD 99-43

Pass Mountain Berm/Channel
Level II Concept Analysis Opinion of Probable Costs
Earthen Berm/Channel

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Excavation	$4.00	CY	107,048	$428,190
2	Berm Earthwork	$2.00	CY	22,080	$44,160
3	Drop Structures	$310	CY	699	$216,659
4	Culverts	$310	CY	254	$78,740
		SUBTOTAL MAJOR ELEMENTS			$767,749
		CONTINGENCIES:			
		Construction		35%	$268,712
		Construction Admin		6%	$46,065
		TOTAL MAJOR ELEMENTS			**$1,082,526**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping	$1.10	SF	996,000	$1,095,600
2	Fence	$12	LF	14,720	$176,640
3	Utility Relocations	$8,000	EA	0	$0
		SUBTOTAL ADDITIONAL ELEMENTS			$1,272,240
		CONTINGENCIES:			
		Construction		35%	$445,284
		Construction Admin		6%	$76,334
		TOTAL ADDITIONAL ELEMENTS			**$1,793,858**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$43,560	AC	22.9	$996,000
2	Basin Land Acquisition	$0	AC	0	$0
		SUBTOTAL LAND ACQUISITION			$996,000
		CONTINGENCIES :		25%	$249,000
		TOTAL LAND ACQUISITION			**$1,245,000**
				TOTAL	***$4,121,384***

5-10'x3' Boxes
700cfs
140cfs/culvert

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

April 26, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Span (ft)	10.0
Culvert Rise (ft)	3.0
FHWA Chart Number	8
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.013
Entrance Loss Coefficient of Culvert Opening	0.2
Culvert Length (ft)	55.0
Invert Elevation at Downstream end of Culvert (ft)	1,884.47
Invert Elevation at Upstream end of Culvert (ft)	1,884.74
Culvert Slope (ft/ft)	0.0049
Starting Flow Rate (cfs)	140.0
Incremental Flow Rate (cfs)	0.0
Ending Flow Rate (cfs)	140.0
Starting Tailwater Depth (ft)	3.7
Incremental Tailwater Depth (ft)	0.05
Ending Tailwater Depth (ft)	3.7

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
140.0	3.7	2.94	3.91	1.56	1.83	3.0	4.67

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WOOD/PATEL

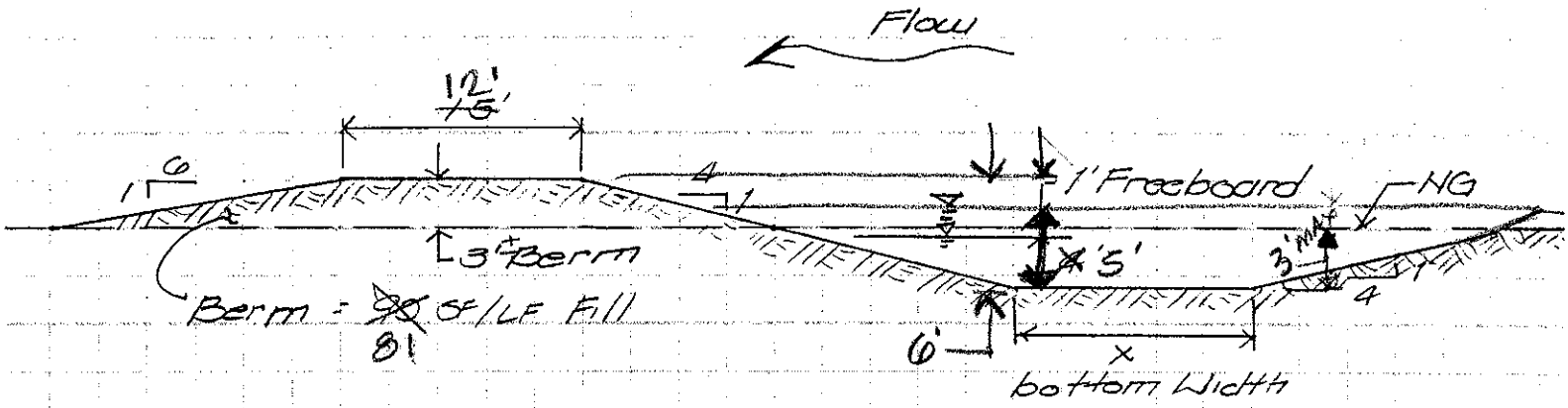
CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS

PROJECT Spook Hill ADMP

PROJECT No. 99989 SHEET No. 1 OF

CALCULATED BY JG DATE ~~8/4/00~~ 4/25/01 CHECKED BY DATE

Pass Mt Preliminary cost estimate, Level II

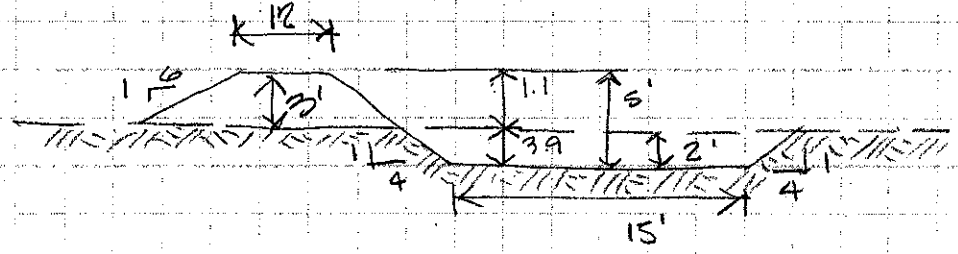


TYPICAL CHANNEL/BERM @ PASS MT. DIVERSION

Berm = ~~90~~ 81 SF/LF

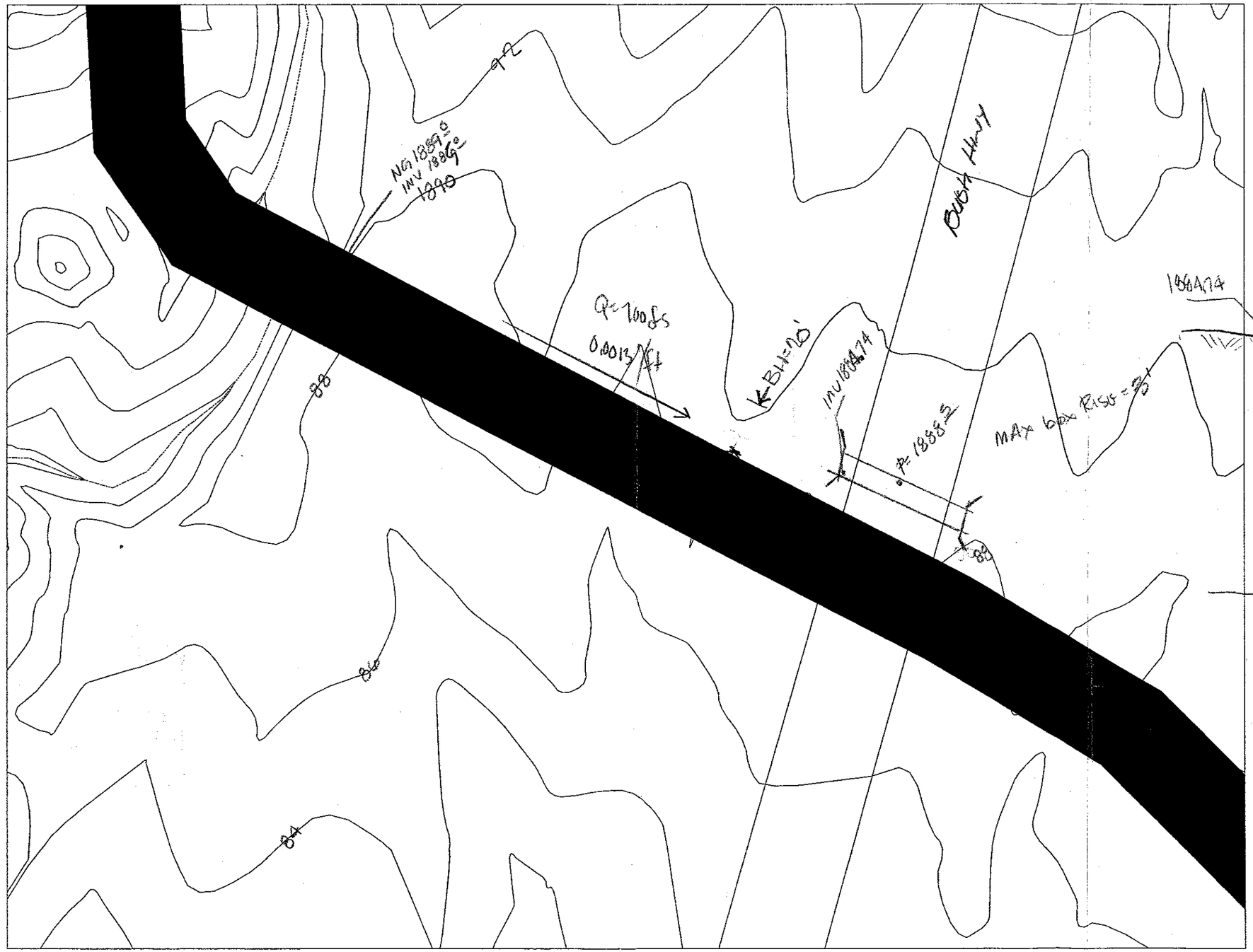
Channel = (see Spreadsheet)

Section 1 cut d=3.9, fb=1.1, b=15', 4:1, n=0.0025, L=1500'



Culverts @ Bush hwy. 5-10'x3' Boxes

1"=40'



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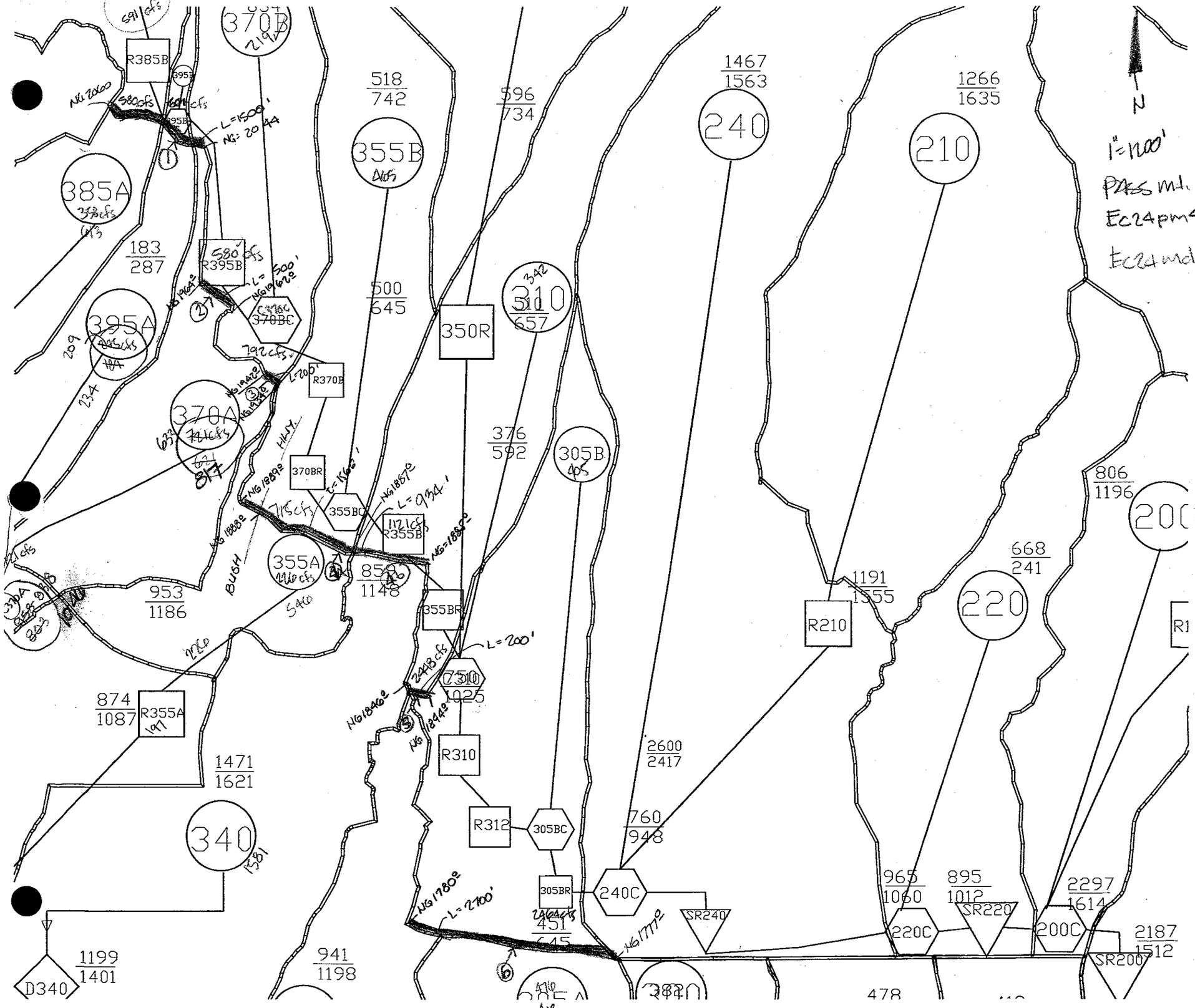
Pass Mountain

4/18/01


N
1"=1200'
Pass mt. Diversion
Ec24pm4r.Dat
.out
Ec24md2E.out - Mcdowell model for comparison of Peak flows.
385B
R385B
370B
395B
R395B
385A
395A
370A
355B
350R
310
240
210
305B
R370B
370BR
355BC
R355B
355A
355BR
R355A
R310
R312
305BC
305BR
240C
R210
220
200
R1
220C
200C
SR240
SR220
SR200
340
D340
518
742
596
734
1467
1563
1266
1635
183
287
500
645
376
592
953
1186
858
1148
874
1087
1471
1621
1191
1355
668
241
806
1196
2600
2417
760
948
965
1060
895
1012
2297
1614
2187
1512
1199
1401
941
1198
451
645
478
L=1500'
L=1044'
L=200'
L=934'
L=2100'
792 cfs
2448 cfs
BUSH

	I.D.	Design Q100 (cfs)	Comp. Capacity (cfs)	Downstream Invert Elevation (ft)	Upstream Invert Elevation (ft)	Length (ft.)	Computed Invert. Slope (ft./ft.)	Design Invert Slope (ft./ft.)	Total Vertical Drop (ft.)	No. of Drops	Vertical Drop (ft.)	Material Type	Manning's "n" Value	Bottom Width, W (ft.)	Depth of Flow (ft.)	Sideslope (H:1) Left (H:1)	Sideslope (H:1) Right (H:1)	Area (sf.)	Perimeter (ft.)	Flow Top Width (ft)	Hydraulic Depth (ft)	Froude Number	Type of Flow	Velocity (fps)	Freeboard (ft.)	Channel Design Depth Including Freeboard (ft)	Channel Topwidth Including Freeboard (ft)	Channel Width Plus 10' Access Road
McDowell Rd Option MD2E	12a	189	152	1828.0	1840.0	680	0.0182	0.0045	9.0	3	3.0	e	0.0250	8.0	2.0	4	4	32.0	24.5	24.0	1.3	0.73	Sub	4.8	1.0	3.0	32.0	48.0
	12b	25	26	1816.0	1828.0	660	0.0182	0.0045	9.0	3	3.0	e	0.0250	8.0	0.8	4	4	9.0	14.6	14.4	0.6	0.64	Sub	2.9	1.0	1.6	22.4	38.4
	2a	150	109	1763.0	1816.0	2140	0.0248	0.0065	39.0	13	3.0	e	0.0250	8.0	1.5	4	4	21.8	20.7	20.3	1.1	0.85	Sub	5.0	1.0	2.5	26.3	44.3
	2b	477	454	1752.0	1762.0	500	0.0200	0.0026	8.7	3	2.9	e	0.0250	20.0	2.9	4	4	91.8	43.9	43.2	2.1	0.60	Sub	4.9	1.0	3.9	51.2	67.2
	3a	723	551	1661.0	1751.0	4280	0.0210	0.0021	81.0	27	3.0	e	0.0250	20.0	3.4	4	4	113.8	48.0	47.1	2.4	0.55	Sub	4.8	1.0	4.4	55.1	71.1
	3b	969	709	1645.0	1661.0	1000	0.0160	0.0020	14.0	5	2.8	e	0.0250	20.0	3.9	4	4	138.8	52.2	51.2	2.7	0.55	Sub	5.1	1.1	5.0	59.8	75.8
	11	1249	1233	1580.0	1642.0	1550	0.0400	0.0013	60.0	20	3.0	e	0.0250	30.0	5.0	4	4	249.3	71.1	69.9	3.6	0.46	Sub	4.9	1.3	6.3	80.7	96.7
	4	201	151	1739.0	1753.0	2640	0.0053	0.0053	0.0	0	0.0	e	0.0250	8.0	1.9	4	4	29.9	23.8	23.3	1.3	0.78	Sub	5.0	1.0	2.9	31.3	47.3
	5	613	577	1799.0	1675.0	2640	0.0288	0.0015	72.0	24	3.0	e	0.0250	30.0	3.5	4	4	154.6	58.9	58.1	2.7	0.47	Sub	4.4	1.0	4.5	68.1	82.1
	6	100	106	1801.0	1820.0	1320	0.0189	0.0055	16.4	6	2.7	e	0.0250	10.0	1.4	4	4	21.8	21.5	21.2	1.0	0.84	Sub	4.8	1.0	2.4	23.2	45.2
	13	621	602	1816.0	1825.0	1000	0.0090	0.0020	7.0	3	2.3	e	0.0250	15.0	3.9	4	4	121.2	47.5	46.5	2.6	0.54	Sub	5.0	1.1	5.0	55.2	71.2
cKellipsi Rd Option MK2E	1	100	99	1744.0	1747.0	500	0.0060	0.0059	0.0	0	0.0	e	0.0250	8.0	1.5	4	4	21.0	20.4	20.0	1.1	0.81	Sub	4.7	1.0	2.5	28.0	44.0
	2	250	244	1744.0	1777.0	1500	0.0220	0.0035	27.8	9	3.1	e	0.0250	10.0	2.5	4	4	50.0	30.6	30.0	1.7	0.67	Sub	4.9	1.0	3.5	38.0	54.0
	4	200	208	1635.0	1648.0	800	0.0163	0.0035	10.2	3	3.4	e	0.0250	10.0	2.3	4	4	44.2	29.0	28.4	1.6	0.66	Sub	4.7	1.0	3.3	36.4	52.4
	5	450	449	1620.0	1635.0	1000	0.0150	0.0026	12.4	4	3.1	e	0.0250	15.0	3.2	4	4	89.0	41.4	40.6	2.2	0.60	Sub	5.0	1.0	4.2	46.6	64.6
	6	650	636	1615.0	1620.0	500	0.0100	0.0021	4.0	2	2.0	e	0.0250	15.0	4.0	4	4	124.0	48.0	47.0	2.6	0.56	Sub	5.1	1.1	5.1	55.8	71.8
	7	857	854	1605.0	1614.0	500	0.0180	0.0019	8.1	3	2.7	e	0.0250	30.0	3.7	4	4	167.5	60.8	59.8	2.8	0.54	Sub	5.1	1.0	4.8	68.1	84.1
	8	100	99	1598.0	1605.0	500	0.0140	0.0060	4.0	2	2.0	e	0.0250	8.0	1.5	4	4	21.0	20.4	20.0	1.1	0.81	Sub	4.7	1.0	2.5	28.0	44.0
	9	100	99	1583.0	1598.0	1100	0.0136	0.0060	8.4	3	2.8	e	0.0250	8.0	1.5	4	4	21.0	20.4	20.0	1.1	0.81	Sub	4.7	1.0	2.5	28.0	44.0
	10	100	99	1573.0	1583.0	1000	0.0100	0.0060	4.0	2	2.0	e	0.0250	8.0	1.5	4	4	21.0	20.4	20.0	1.1	0.81	Sub	4.7	1.0	2.5	28.0	44.0
Pass Mountain Diversion	1	590	589	2041.0	2057.0	1500	0.0107	0.0020	13.0	5	2.6	e	0.0250	15.0	3.9	4	4	119.3	47.2	46.2	2.6	0.54	Sub	4.9	1.1	5.0	54.8	70.8
	2	580	577	1959.0	1961.0	500	0.0040	0.0020	1.0	1	1.0	e	0.0250	15.0	3.9	4	4	117.5	46.8	45.9	2.6	0.54	Sub	4.9	1.1	4.9	54.3	70.3
	3	580	589	1931.0	1939.0	200	0.0400	0.0020	7.6	3	2.5	e	0.0250	15.0	3.9	4	4	119.3	47.2	46.2	2.6	0.54	Sub	4.9	1.1	5.0	54.8	70.8
	4a	700	695	1884.0	1886.0	1570	0.0013	0.0013	0.0	0	0.0	e	0.0250	20.0	4.3	4	4	160.0	55.5	54.4	2.9	0.45	Sub	4.3	1.1	5.4	63.6	79.6
	4b	1120	1119	1881.0	1884.0	930	0.0032	0.0015	1.6	1	1.6	e	0.0250	35.0	4.3	4	4	224.5	70.5	69.4	3.2	0.49	Sub	5.0	1.2	5.5	78.8	94.8
	5	2448	2489	1841.0	1843.0	200	0.0100	0.0013	1.7	0	0.0	e	0.0250	100.0	4.2	4	4	490.6	134.8	133.6	3.7	0.47	Sub	5.1	1.1	5.3	142.8	158.8
	6	2464	2696	1774.0	1777.0	2450	0.0012	0.0012	0.0	0	0.0	e	0.0250	100.0	4.5	4	4	531.0	137.1	136.0	3.9	0.45	Sub	5.1	1.2	5.7	145.8	161.8

	I.D.	Excavated Volume (cy)	Unit Cost ($/cy)	Excavation Cost	Concrete Volume (cy)	Unit Cost ($/cy)	Concrete Cost	Fence Length (ft.)	Unit Cost ($/ft)	Fence Cost	Drop Structures (No.)	Drop Structure Size (CY)	Unit Cost ($/cy)	Drop Structure Cost	No. of Utility Crossings	Unit Cost ($ per crossing)	Utilities Cost	Channel Length (ft)	Landscape Width Required (ft.)	Landscape Area Required (ft.)	Landscaping Unit Cost ($/sf)	Total Landscape Cost	Land Acquisition (Channel & Maint Road/Ac.)	Zoning	Unit Cost ($/sf)	Channel Land Acquisition Cost	Total Construction Cost	Total Contingencies Cost	Total Construction, Land, Landscape, and Contingencies Costs
McDowell Rd Option MD2E	12a	2,347	$4	$9,387	0	$310	$0	1,320	$12	$15,840	3	50.2	$310	$46,712	0	$3,000	$0	660	32	21120	$1.10	########	0.7	Res. N.	$1.00	$31,680	$72,327	$27,484	$154,723
	12b	1,314	$4	$5,257	0	$310	$0	1,320	$12	$15,840	3	35.2	$310	$32,669	0	$3,000	$0	660	22	14784	$1.10	########	0.6	Res. N.	$1.00	$25,344	$54,067	$20,545	$116,219
	2a	6,216	$4	$24,870	0	$310	$0	4,280	$12	$51,360	13	44.3	$310	$178,610	0	$3,000	$0	2140	29	60605	$1.10	########	2.2	Res. N.	$1.00	$94,845	$326,281	$97,387	$515,178
	2b	3,693	$4	$14,373	0	$310	$0	1,000	$12	$12,000	3	77.7	$310	$72,218	0	$3,000	$0	500	51	25500	$1.10	########	0.8	Res. N.	$1.00	$33,600	$98,980	$37,612	$198,352
	3a	35,509	$4	$142,038	0	$310	$0	8,560	$12	$102,720	27	86.3	$310	$722,033	0	$3,000	$0	4280	55	235914	$1.10	########	7.0	Res. N.	$1.00	$304,394	$972,615	$369,594	########
	3b	9,718	$4	$38,872	0	$310	$0	2,000	$12	$24,000	5	87.8	$310	$136,139	0	$3,000	$0	1000	60	59810	$1.10	########	1.7	Res. N.	$1.00	$75,810	$199,357	$75,756	$416,713
	11	24,974	$4	$99,895	0	$310	$0	3,100	$12	$37,200	20	126.2	$310	$782,362	0	$3,000	$0	1550	51	125022	$1.10	########	3.4	Res. N.	$1.00	$149,622	$925,744	$351,763	########
	4	9,008	$4	$36,151	0	$310	$0	5,280	$12	$63,360	0	0.0	$310	$0	0	$3,000	$0	2640	31	82579	$1.10	########	2.9	$1	$1.00	$124,619	$89,511	$37,814	
	5	28,037	$4	$112,147	0	$310	$0	5,280	$12	$63,360	24	103.5	$310	$769,713	0	$3,000	$0	2640	66	174451	$1.10	########	5.0	Res. N.	$1.00	$216,691	$951,453	$361,552	########
	6	3,923	$4	$15,691	0	$310	$0	2,640	$12	$31,680	6	42.0	$310	$78,102	0	$3,000	$0	1320	29	38544	$1.10	########	1.4	Res. N.	$1.00	$59,664	$125,324	$47,699	$276,288
	13	8,715	$4	$34,860	0	$310	$0	2,000	$12	$24,000	3	68.6	$310	$63,813	0	$3,000	$0	1000	55	55165	$1.10	########	1.6	Res. N.	$1.00	$71,165	$121,803	$46,285	$299,936
cKellipsi Rd Option MK2E	1	1,426	$4	$5,704	0	$310	$0	1,000	$12	$12,000	0	3.4	$310	$0	0	$3,000	$0	500	28	14000	$1.10	########	0.5	Res. N.	$1.00	$22,000	$17,704	$6,727	$61,631
	2	7,000	$4	$28,000	0	$310	$0	3,000	$12	$36,000	9	61.0	$310	$170,156	0	$3,000	$0	1500	38	57000	$1.10	########	1.9	Res. N.	$1.00	$81,000	$235,884	$89,636	$469,219
	4	3,465	$4	$13,862	0	$310	$0	1,600	$12	$19,200	3	64.0	$310	$59,492	0	$3,000	$0	800	36	29120	$1.10	########	1.0	Res. N.	$1.00	$41,920	$53,581	$35,561	$203,093
	5	6,895	$4	$27,579	0	$301	$0	2,000	$12	$24,000	4	78.4	$310	$97,204	0	$3,000	$0	1000	49	49000	$1.10	########	1.5	Res. N.	$1.00	$64,600	$149,810	$56,928	$324,797
	6	4,453	$4	$17,813	0	$310	$0	1,000	$12	$12,000	2	59.8	$310	$37,074	0	$3,000	$0	500	56	27909	$1.10	########	0.8	Res. N.	$1.00	$35,909	$65,751	$24,985	$157,344
	7	5,662	$4	$22,649	0	$310	$0	1,000	$12	$12,000	3	96.2	$310	$89,466	0	$3,000	$0	500	68	34053	$1.10	########	1.0	Res. N.	$1.00	$42,053	$124,014	$47,125	$250,651
	8	1,426	$4	$5,704	0	$310	$0	1,000	$12	$12,000	2	30.3	$310	$18,807	0	$3,000	$0	500	28	14000	$1.10	########	0.5	Res. N.	$1.00	$22,000	$35,990	$13,665	$87,024
	9	3,137	$4	$12,548	0	$310	$0	2,200	$12	$26,400	3	41.1	$310	$38,240	0	$3,000	$0	1100	28	30800	$1.10	########	1.1	Res. N.	$1.00	$48,400	$77,286	$29,369	$188,934
	10	2,852	$4	$11,407	0	$310	$0	2,000	$12	$24,000	2	30.3	$310	$18,807	0	$3,000	$0	1000	28	28000	$1.10	########	1.0	Res. N.	$1.00	$44,000	$53,663	$20,392	$148,055
Pass Mountain Diversion	1	12,894	$4	$51,575	0	$310	$0	3,000	$12	$36,000	5	75.1	$310	$116,465	0	$3,000	$0	1500	55	82135	$1.10	########	2.4	Res. N.	$1.00	$106,135	$203,605	$77,370	$477,458
	2	4,239	$4	$16,955	0	$310	$0	1,000	$12	$12,000	1	32.7	$310	$10,140	0	$3,000	$0	500	54	27174	$1.10	########	0.8	Res. N.	$1.00	$35,174	$37,814	$14,368	$117,249
	3	1,719	$4	$6,877	0	$310	$0	400	$12	$4,800	3	73.4	$310	$68,244	0	$3,000	$0	200	55	10951	$1.10	########	0.3	Res. N.	$1.00	$14,151	$79,509	$30,214	$136,821
	4a	17,170	$4	$68,680	0	$310	$0	3,140	$12	$37,680	0	7.7	$310	$0	0	$3,000	$0	1570	64	99629	$1.10	########	2.9	Res. N.	$1.00	$124,949	$106,360	$40,417	$361,539
	4b	13,572	$4	$54,287	0	$310	$0	1,860	$12	$22,320	1	70.4	$310	$21,810	0	$3,000	$0	930	79	73257	$1.10	########	2.0	Res. N.	$1.00	$88,137	$97,215	$36,942	$302,677
	5	5,898	$4	$23,594	0	$310	$0	400	$12	$4,800	0	17.2	$310	$0	0	$3,000	$0	200	143	28560	$1.10	########	0.7	Res. N.	$1.00	$31,760	$28,394	$10,790	$102,359
	6	77,756	$4	$311,023	0	$310	$0	4,920	$12	$59,040	0	17.6	$310	$0	0	$3,000	$0	2460	146	355670	$1.10	########	9.1	Res. N.	$1.00	$398,030	$370,063	$140,624	########

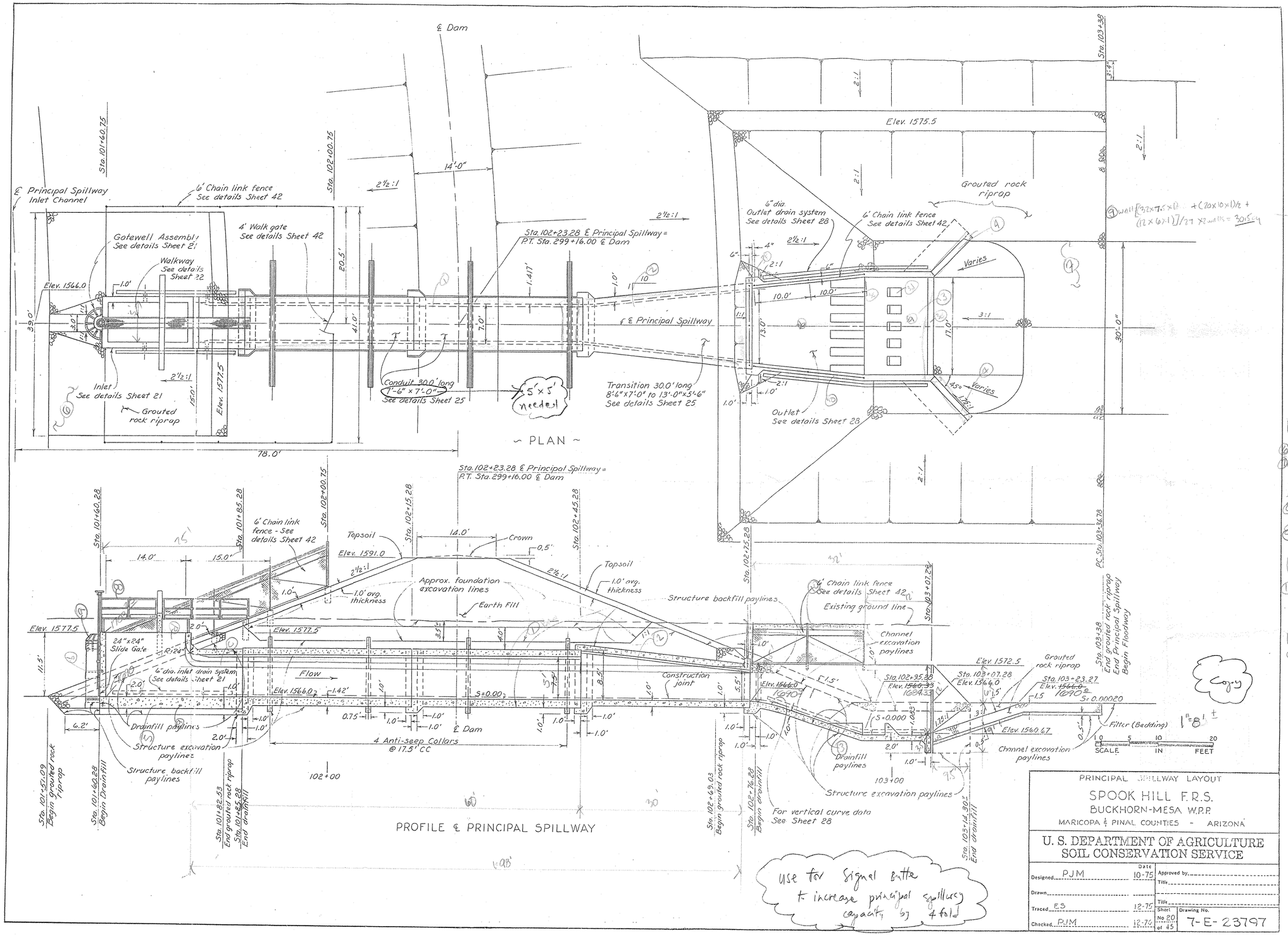
Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

May 1, 2001
W/P # 99989

Signal Butte Principal Spillway Modification

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Concrete Spillway (Inlet, box ,outlet, etc.)	$450	CY	201	$90,585
2	Grouted Riprap	$45	SY	645	$29,025
3	Handrail	$50	LF	64	$3,200
4	Fence	$11	LF	215	$2,365
5	Walkway	$100	LF	25	$2,500
6	Removals (Spillway, Riprap, Headwalls, etc.)	$50,000	EA	1	$50,000
				SUBTOTAL MAJOR ELEMENTS	$177,675
		CONTINGENCIES:			
		Construction		35%	$62,186
		Engineering		7%	$12,437
		Construction Admin		6%	$10,661
				TOTAL MAJOR ELEMENTS	**$262,959**



PRINCIPAL SPILLWAY LAYOUT

SPOOK HILL F.R.S.

BUCKHORN-MESA W.P.P.

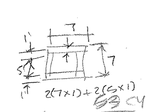
MARICOPA & PINAL COUNTIES - ARIZONA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed PJM	Date 10-75	Approved by	
Drawn		Title	
Traced E.S	12-75	Title	
Checked PJM	12-74	Sheet No 20 of 45	Drawing No. 7-E-23797

FORM SCS-313C

Concrete



① 5'x5' Box = 1' thick walls = 24 SF/LF
(24x600 LF)/27 cf = 53 cy — 53 cy

② 20' Transition – Ave w = 9', 2(9x1)+2(5x1) = 28 SF/LF
(28x30)/27 = — 31 cy

③ Spillway floor –
ⓐ (17'x12'x1')/27 = 7.6 cy
ⓑ [(7+19/2)x28x1]/27 = 12 cy
ⓒ [(5x2x1)/2]x6/27 = 1 cy
ⓓ (2x1.5+(2x2/2))x1.5x5/27 = 1 cy
ⓔ (17x1x2.5)/27 = 1.5 cy
ⓕ (1x3x13)/27 = 1.5 cy — 35 cy

④ Outlet transition –
2x[(9x9.5x1)+(6.5x9.5)/2]/27 = — 9 cy

⑤ Inlet structure
ⓐ Floor – (7x25x2)/27 = 13 cy
ⓑ Front wall – (11.5'x5'x1')/27 = 2 cy
ⓒ Top – 9.5x7x1)/27 = 2.5 cy
Stem (6x7x1)/27 = 1.5 cy
ⓓ walls – [(25x5x1)+(14x6.5x1)]x2/27 = 16 cy — 35 cy

183 cy

Rip Rap

⑥ Inlet (34x31.5)-(7x16)/9 = 125 SY
⑦ Outlet (75'x70)-(17x33.5)/9 = 520 SY — 645 SY

Hand Rail

⑧ 25+25+7+7 — 64 LF

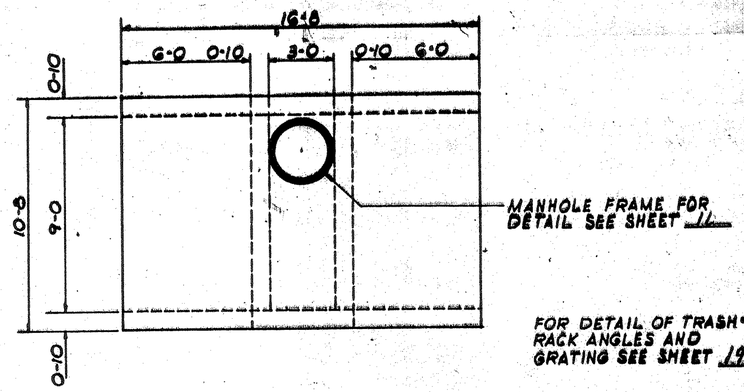
⑨ Gatewell Assembly — 1 EA

Fence (chain link)

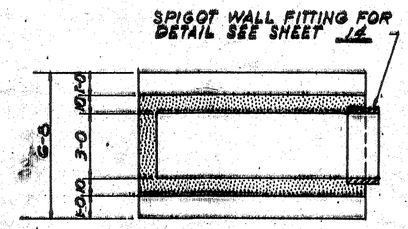
⑩ 53 outlet + 162 — 215 LF

Remarks

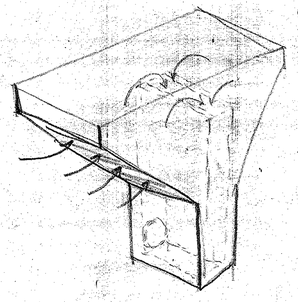
(Inlet, culvert, spillway, etc.) — 1 EA

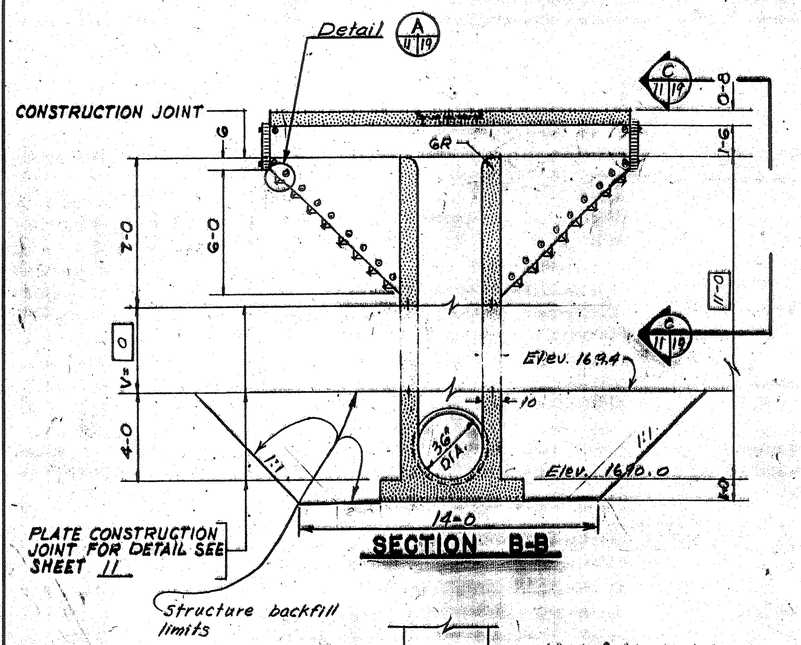


TOP PLAN

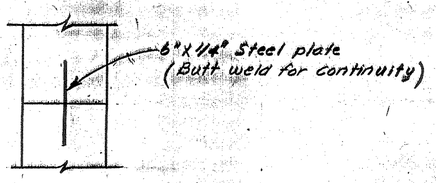


SECTION A-A



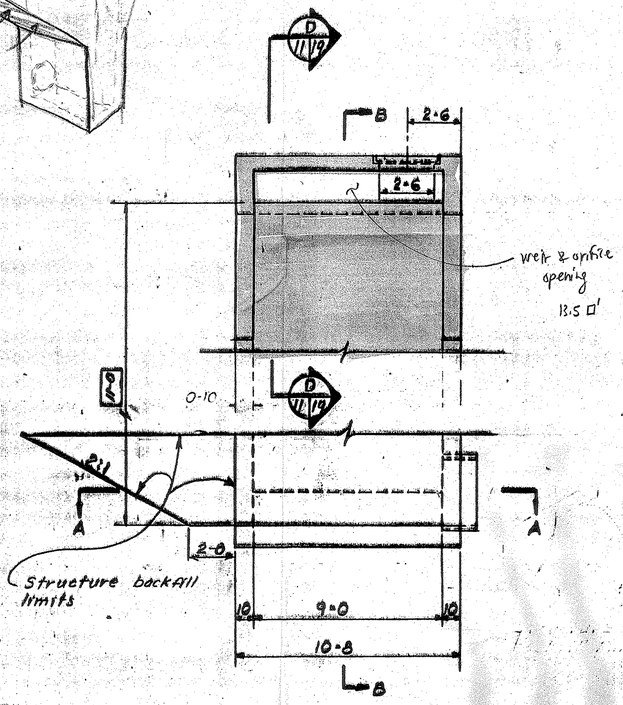


SECTION B-B

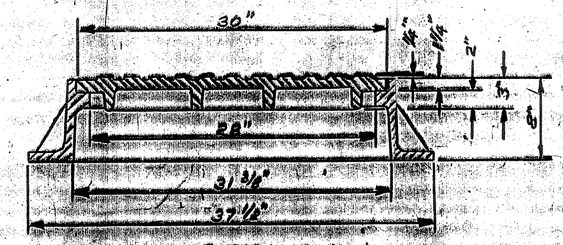


CONSTRUCTION JOINT
(not to scale)

0 1 2 3 4 5 6 7 8 9
SCALE IN FEET



SIDEWALL ELEVATION



MANHOLE FRAME & LID
(not to scale)

STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
B1	5	11	6-2	1	–	–	67-10
B2	5	7	10-2	1	–	–	71-2
B3	5	26	9-3	21	3-1	3-2	240-6
B4	5	7	10-2	1	–	–	71-2
B5	5	11	6-2	1	–	–	67-10
B6	5	2	2-7	1	–	–	5-2
B7	5	6	7-0	21	0-11	6-1	42-0
B8	5	3	7-0	21	0-11	6-1	21-0
B9	5	16	6-11	21	0-11	6-0	110-8
B10	5	12	9-8	1	–	–	116-0
B11	5	5	3-8	1	–	–	18-4
B12	5	18	9-0	21	3-0	6-0	162-0
B13	5	2	7-8	21	1-8	6-0	15-4
B14	5	4	6-11	21	0-11	6-0	27-8
B15	5	4	6-7	21	0-7	6-0	26-4
B16	5	4	6-5	21	0-5	6-0	25-8
B17	5	2	2-5	1	–	–	4-10
B18	5	1	2-4	1	–	–	2-4
B19	5	2	2-10	1	–	–	5-8

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
T1	5	16	6-6	1	–	–	104-0
T2	5	12	9-8	1	–	–	116-0
T3	5	16	6-7	1	–	–	108-0
T4	5	6	8-10	1	–	–	53-0
T5	5	6	8-10	1	–	–	53-0
T6	5	28	9-0	21	3-0	6-0	252-0
T7	5	2	3-8	1	–	–	7-4
T8	5	2	6-6	1	–	–	13-4
T9	5	2	9-2	1	–	–	18-4
T10	5	2	11-8	1	–	–	23-4
T11	5	2	14-2	1	–	–	28-4
T12	5	2	16-3	1	–	–	32-6
T13	5	4	7-8	1	–	–	30-8
T14	5	4	6-3	1	–	–	25-8
T15	5	4	5-2	1	–	–	20-8
T16	5	4	3-11	1	–	–	15-8
T17	5	4	2-8	1	–	–	10-8
T18	5	4	10-7	19	2-2	3-5	42-4
T19	5	2	4-3	1	–	–	8-6
T20	5	2	6-8	1	–	–	13-4
T21	5	2	9-2	1	–	–	18-4
T22	5	2	11-8	1	–	–	23-4
T23	5	2	14-2	1	–	–	28-4
T24	5	2	16-3	1	–	–	32-6
T25	5	4	7-8	1	–	–	30-8
T26	5	4	6-5	1	–	–	25-8
T27	5	4	5-2	1	–	–	20-8
T28	5	4	3-11	1	–	–	15-8
T29	5	4	2-8	1	–	–	10-8
T30	5	4	10-7	19	2-2	3-5	42-4
T31	5	2	16-3	1	–	–	32-6
T32	5	2	16-3	1	–	–	32-6
T33	4	24	9-8	1	–	–	232-0
T34	4	2	6-2	1	–	–	12-4
T35	4	9	16-3	1	–	–	146-3
T36	4	4	6-7	1	–	–	26-4
T37	5	2	2-6	21	1-10	0-10	5-4
T38	5	28	7-7	21	1-10	3-11	217-0
T39	5	2	3-3	21	1-10	6-3	16-6
T40	4	4	6-7	1	–	–	26-4
T41	4	9	16-3	1	–	–	146-3

QUANTITIES

STEEL

#4 BARS – 389-6 = 394 LBS
#5 BARS – 2392-4 = 2492 LBS
#6 BARS – 240-6 = 362 LBS
3248 LBS

CONCRETE = 20.5 + 0.85 V = 20.5 CU. YDS

LENGTH OF #6 BARS = 2,389-4
(2389-4) + (LENGTH OF BARS R1 THROUGH R7)

INLET STRUCTURE PRINCIPAL SPILLWAY
INLET STRUCTURE LAYOUT & STEEL SCHEDULE
SIGNAL BUTTE F.R.S.
BUCKHORN-MESA W.R.P.
MARICOPA COUNTY, ARIZONA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed Standard 5-1-68
Drawn
Traced
Checked W.E.P. 8-84
Approved by
Title
Date
Sheet No. 11 of 23
Drawing No. 83010-AZ-CH

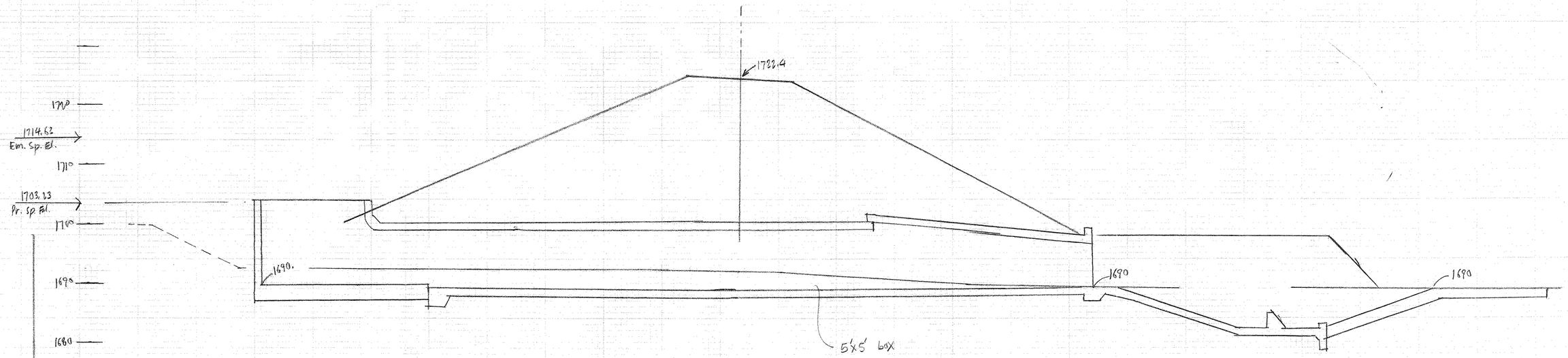
STANDARD COVERED RISER

DESIGN CONSTANTS $f'_c = 4000$ psi $f_c = 1600$ psi
$n = 8$ $f_s = 20{,}000$ psi

STANDARD DWG. NO. ES-3036-1510.E

DATE 4-65 SHEET 1 OF 4

LOEWER SARGENT & ASSOC.
ARCHITECTS & ENGINEERS
3720 FARRAGUT AVE., KENSINGTON, MD.

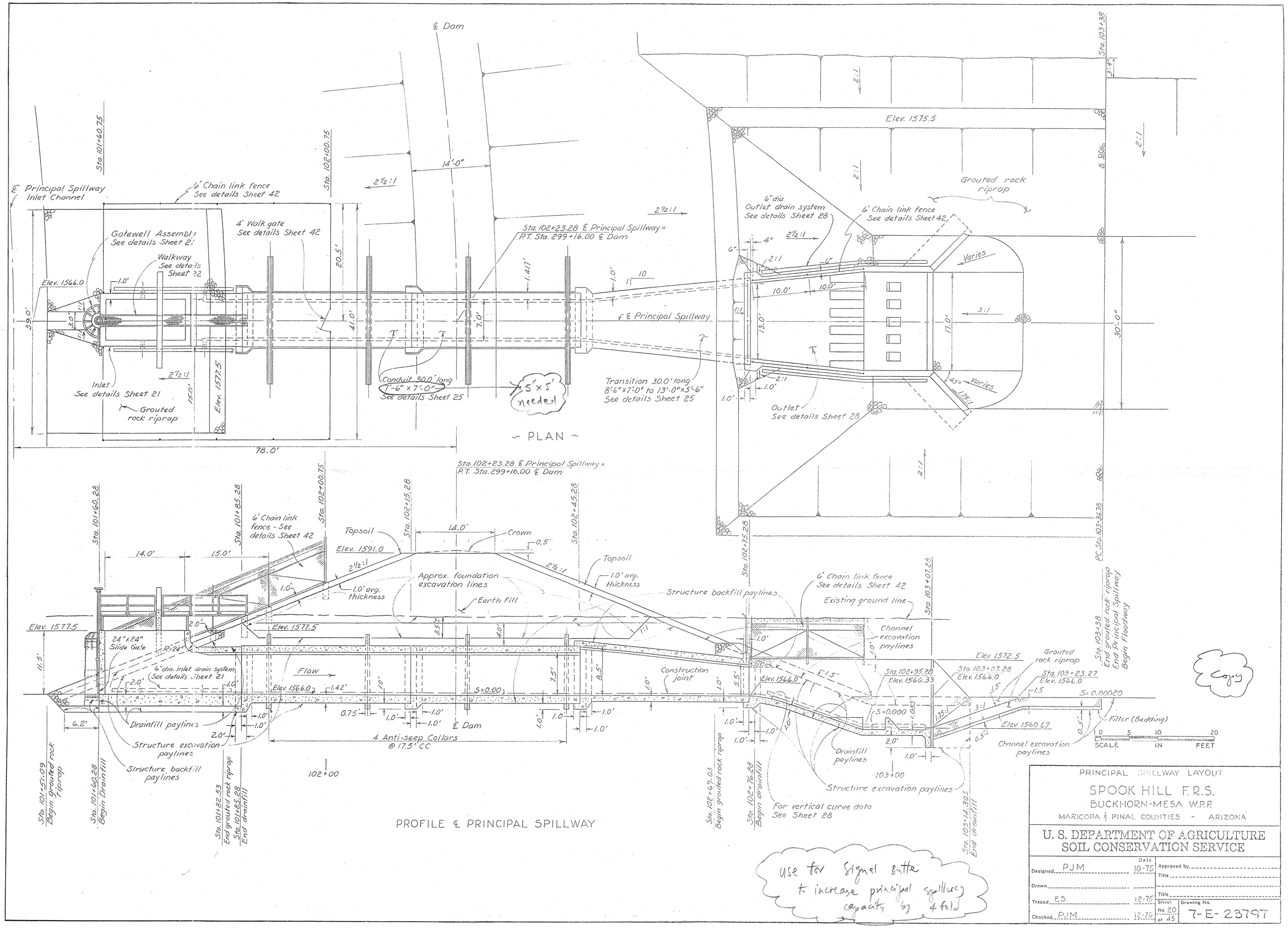


Signal Butte FRS
Profile: ℄ Principal Spillway

SCALE 1" = 10' (V)
1" = 10' (H)

FCD Datum

(SCS + 2.23 = FCD)



PRINCIPAL SPILLWAY LAYOUT

SPOOK HILL F.R.S.

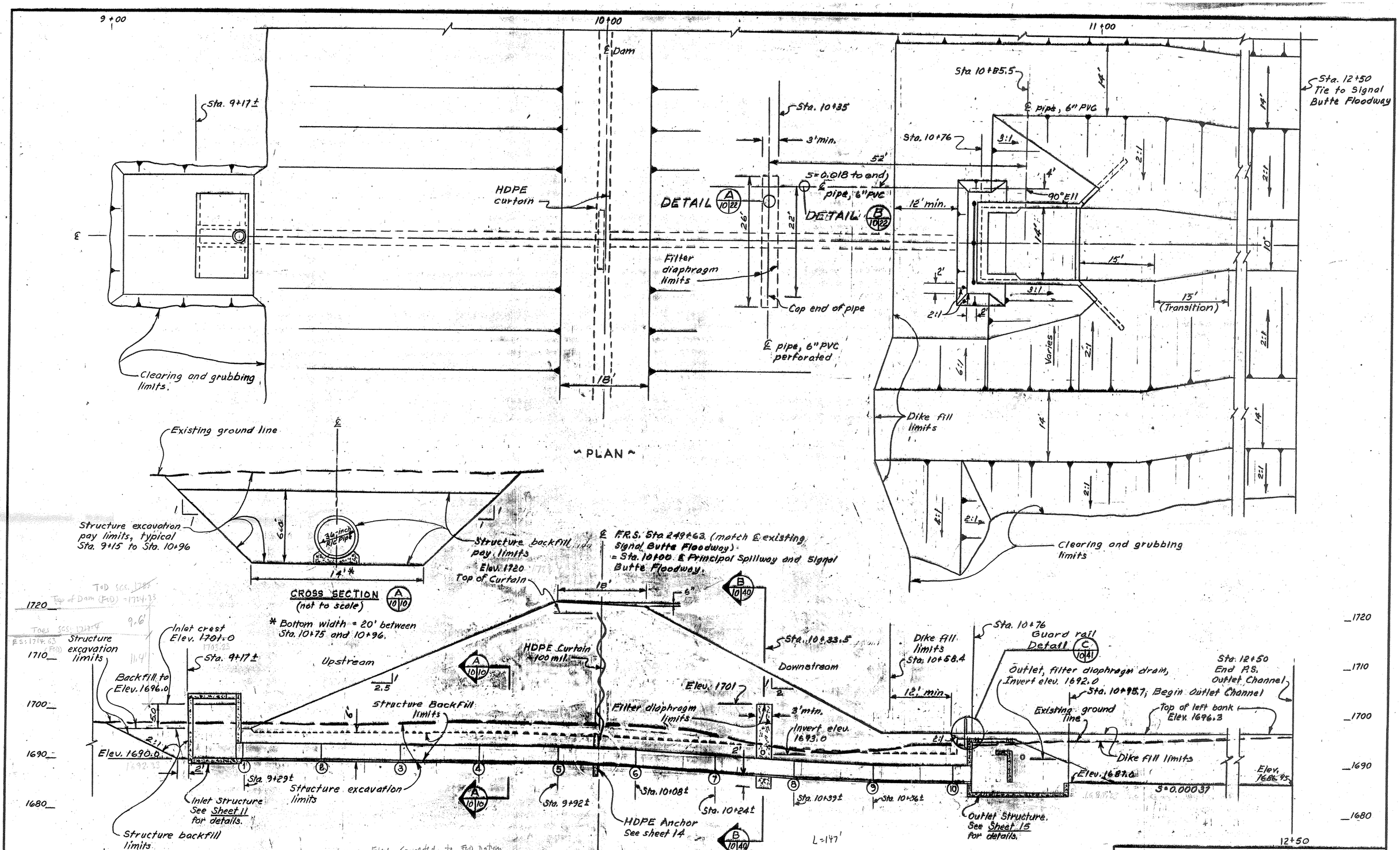
BUCKHORN-MESA W.P.P.

MARICOPA & PINAL COUNTIES - ARIZONA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed PJM	Date 10-75	Approved by	
Drawn		Title	
Traced ES	12-75	Title	
Checked PJM	12-76	Sheet No. 20 of 45	Drawing No. 7-E-23797

FORM SCS-313C



PIPE JOINT INVERT ELEVATIONS			
1	1690.0	6	1689.5
2	1690.0	7	1688.5
3	1690.0	8	1687.5
4	1690.0	9	1687.0
5	1690.0	10	1687.0

PROFILE ℄ PRINCIPAL SPILLWAY

SCALE IN FEET 10 0 10 20

PRINCIPAL SPILLWAY
PLAN & PROFILE

SIGNAL BUTTE F.R.S.
BUCKHORN-MESA W.RR
MARICOPA COUNTY, ARIZONA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed SML	Date 11-81	Approved by	
Drawn RAP	11-81	Title	
Traced F.F.S.	12-81	Title	
Checked WEP	8-84	Sheet No. 10 of 43	Drawing No. 83010-AZ-CH

SCS-ENG-313C (REV. 6-78)

WOOD/PATEL

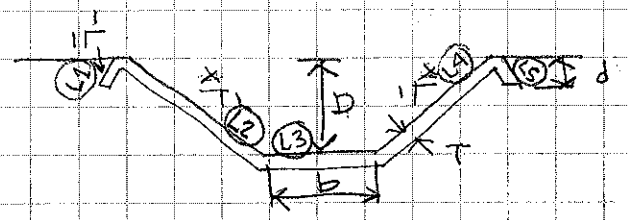
CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT Sopeak Wall No.

CALC'D BY JET CHK'D BY

SHEET OF DATE 5/2/01

Signal Butte Outfall Channel
for Quadrupled Spillway Design
Channel lining costs



Overall length = (L1+L2+L3+L4+L5)

L1 = L5 & L2 = L4

L = 2(L1) + 2(L2) + L3

$L_1 = \sqrt{2 \cdot d^2}$

$L_2 = \sqrt{D^2 + (dx)^2}$

$L_3 = b$

V = (L · T)/27 = cy/lf

d = 2, b = 10, D = 9.3, T = 0.5

@ d = 9.3', b = 10', x = 2, T = 0.5, d = 2', Conc = 1.06 cy/lf

STA 12+50 to STA 23+00
1050 lf × 1.06 = 1113 cy

@ d = 9.3', b = 10, x = 2, T = 0.5 d = 2, conc = 1.17 cy/lf
STA 23+00 to STA 30+00
700 lf × 1.17 = 819 cy

Total Concrete Volume = 1,932 cy
Earthwork = 1,932 cy

conc	1932 cy @	$250/cy	= $483,000
	1932 cy @	$4/cy	= $7,700
			$490,700

Signal Butte Culvert
No upgrade Required

Signal Butte Box

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

May 2, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Span (ft)	7.0
Culvert Rise (ft)	6.0
FHWA Chart Number	8
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.013
Entrance Loss Coefficient of Culvert Opening	0.2
Culvert Length (ft)	50.0
Invert Elevation at Downstream end of Culvert (ft)	1,686.3
Invert Elevation at Upstream end of Culvert (ft)	1,686.31
Culvert Slope (ft/ft)	0.0002
Starting Flow Rate (cfs)	224.5
Incremental Flow Rate (cfs)	0.0
Ending Flow Rate (cfs)	224.5
Starting Tailwater Depth (ft)	4.8
Incremental Tailwater Depth (ft)	0.05
Ending Tailwater Depth (ft)	4.8

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
224.5	4.8	5.1	5.68	6.0	3.17	4.8	6.68

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Dodson & Associates, Inc., 5629 FM 1960 West, Suite 314, Houston, TX 77069
Phone:(281)440-3787, Fax:(281)440-4742, Email:software@dodson-hydro.com
All Rights Reserved.

Exist Box 2-7x6 @ 449 cfs from EC24_NJG HEC1 output File.
Box can handle Flow without additional Cells.

Channel Depth (ft)	Bottom Width (ft)	Side Slope (H:1)	Turn Down (ft)	Thickness (ft)	Turn Down Depth (ft)	Concrete (cy/lf)
9.3	10	2	2	0.5	2	1.06
9	10	2	2	0.5	2	1.04
8	10	2	2	0.5	2	0.95
7	10	2	2	0.5	2	0.87
6	10	2	2	0.5	2	0.79
5	10	2	2	0.5	2	0.70
4	10	2	2	0.5	2	0.62
3	10	2	2	0.5	2	0.54
2	10	2	2	0.5	2	0.46
1	10	2	2	0.5	2	0.37
	10	2	2	0.5	2	0.29
	10	2	2	0.5	2	0.29
	10	2	2	0.5	2	0.29
	10	2	2	0.5	2	0.29
	10	2	2	0.5	2	0.29

WOOD/PATEL

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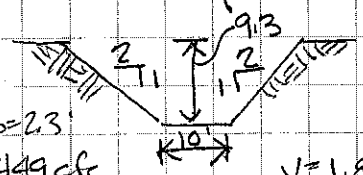
PROJECT Spook Hill ADMP NO. 99591
CALC'D BY DGT CHK'D BY
SHEET 1 OF DATE 5/2/01

Signal Butte Floodway

Sta 12+50 to 23+00

Quadrupled spillway capacity, Q_{100} = 449 cfs (EC24_NT6.OUT)

Find: channel improvements required to contain quadrupled flow rate

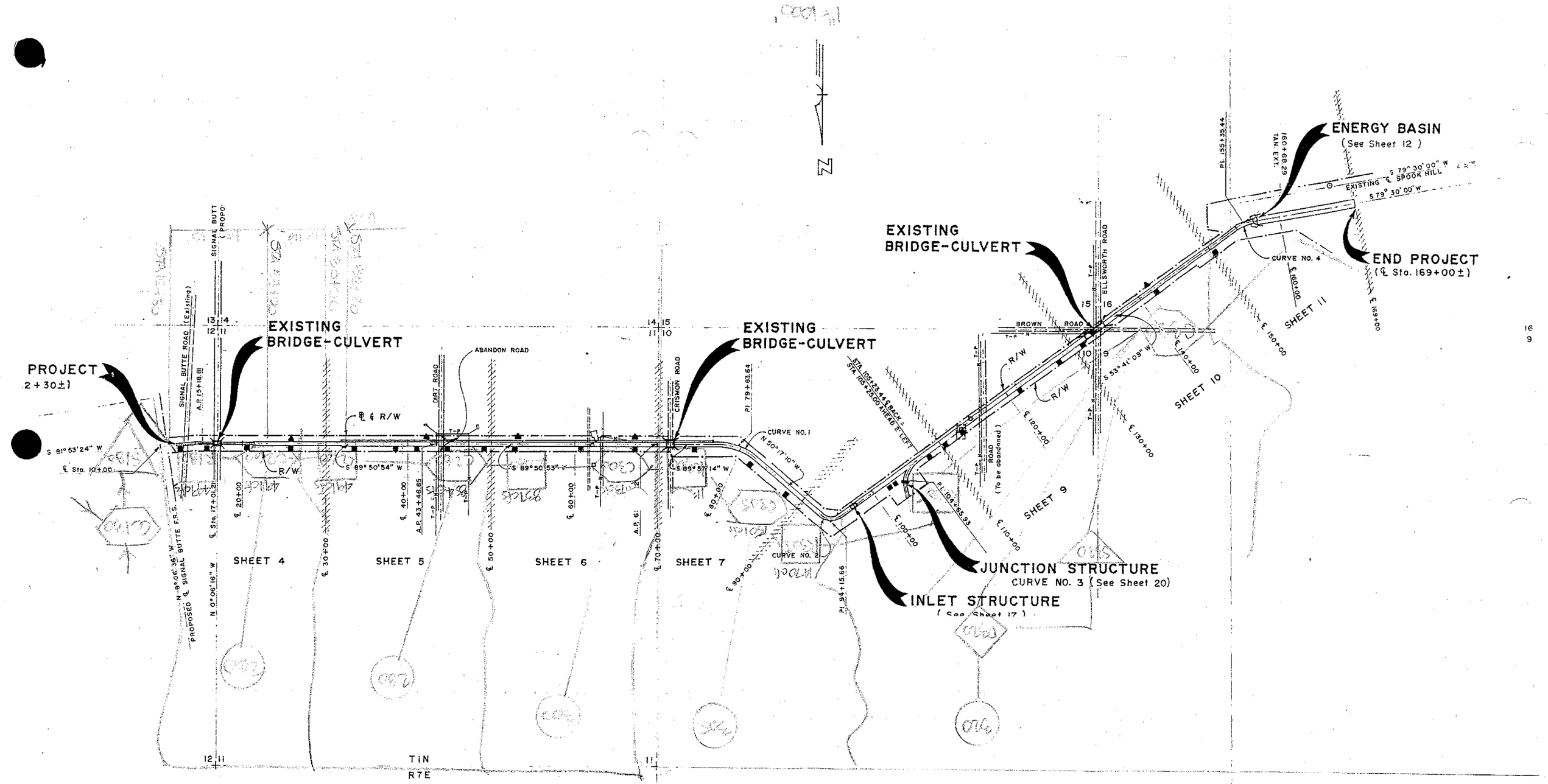


Sta 12+50 to 23+00,
Use d = 7', S = 0.0003'/ft, b = 10', z = 2:1, Fb = 2.3'
@ n = 0.035 (Existing), Q_{cap} = 315 cfs < 449 cfs, V = 1.87 fps
@ n = 0.014 (Conc Lining), Q_{cap} = 786 cfs < 449 ∴ OK, V = 4.7 fps
depth @ 449 cfs = 5.4', V = 4.07 fps

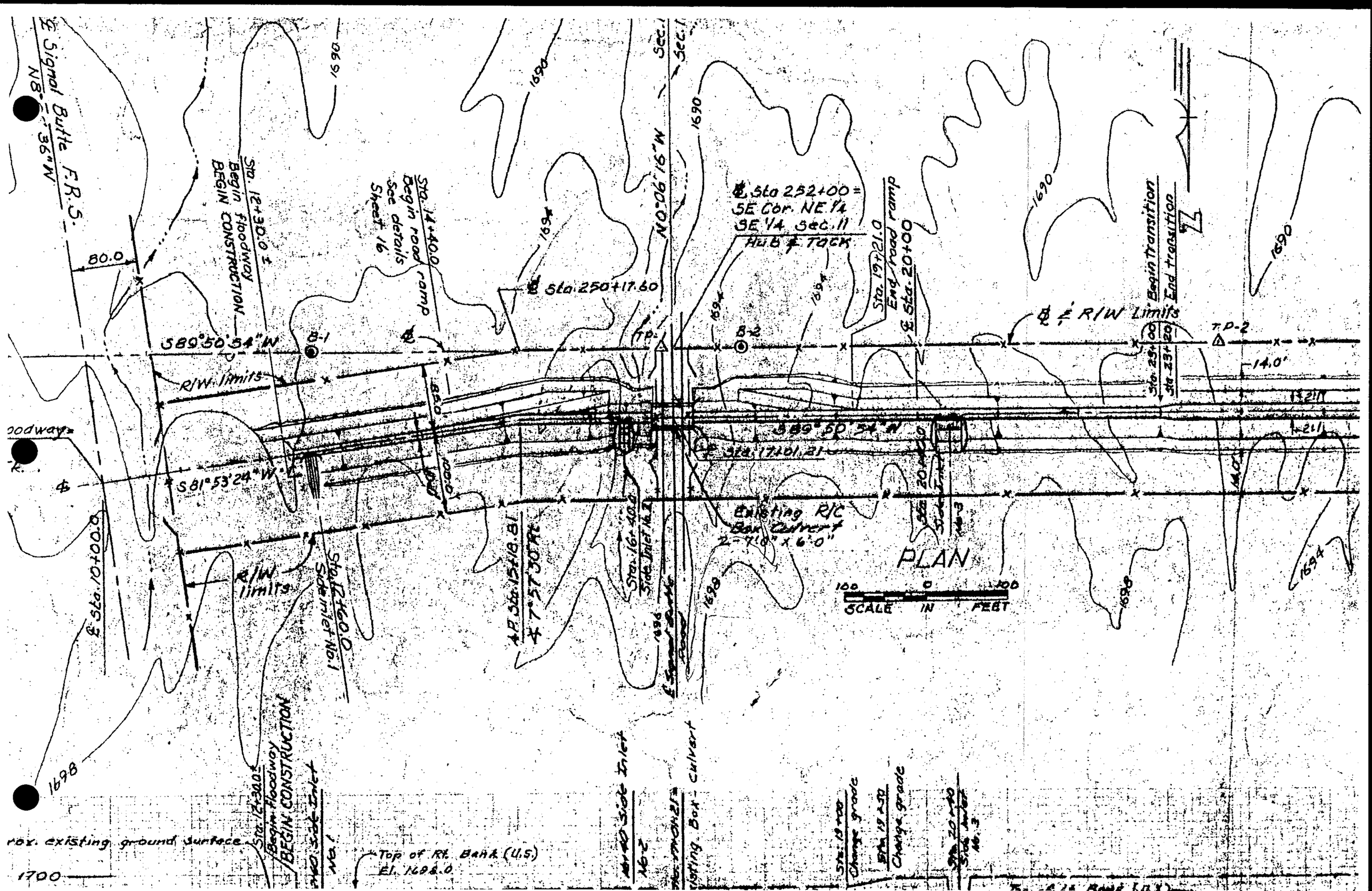
Sta 23+00 to 32+20 @ d = 7.6, Fb = 1.7', n = 0.035
Use, d = 7', S = 0.0003 '/ft, b = 16', 2:1, Fb = 2.3' Q_{cap} = 491 cfs
@ n = 0.035 (existing), Q_{cap} = 417 cfs < 491 cfs, V = 2.0 fps
@ n = 0.014 (Conc Lining), Q_{cap} = 1042 cfs, V = 4.97 fps
depth @ 491 cfs = 4.8', V = 4.06 fps

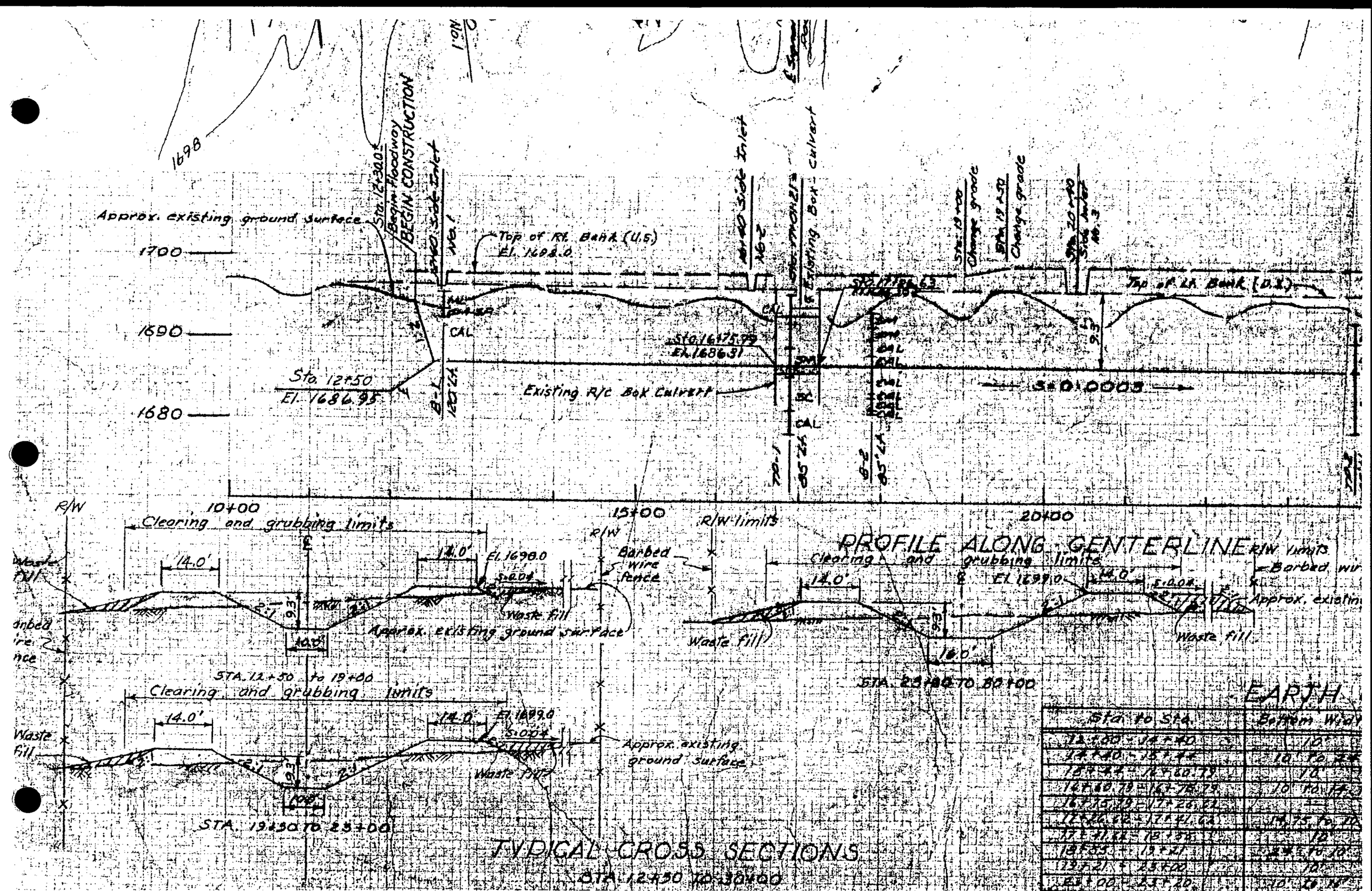
Sta 32+20 to 37+00
Use d = 7', S = 0.0003'/ft, b = 20, 2:1 @ d = 7.1, Q_{cap} = 500 cfs > 491 ∴ OK
@ n = 0.035 (existing), Q_{cap} = 486 cfs, V = 2.05 fps V = 2.06 fps

Signal Butte Box Culvert
2-7'x6' - 84sf, depth of flow = 4'


PROJECT
2+30±)
EXISTING
BRIDGE-CULVERT
EXISTING
BRIDGE-CULVERT
EXISTING
BRIDGE-CULVERT
ENERGY BASIN
(See Sheet 12)
END PROJECT
(℄ Sta. 169+00±)
JUNCTION STRUCTURE
CURVE NO. 3 (See Sheet 20)
INLET STRUCTURE
(See Sheet 17)
SIGNAL BUTTE ROAD (Existing)
SIGNAL BUTT
DIRT ROAD
ABANDON ROAD
CRISMON ROAD
ELLSWORTH ROAD
BROWN ROAD
ROAD (To be abandoned)
SPOOK HILL
EXISTING ℄ SPOOK HILL
S 81° 53' 24" W
℄ Sta. 10+00
℄ R/W
R/W
S 89° 50' 54" W
S 89° 50' 53"
S 89° 57' 14" W
CURVE NO. 1
N 50° 17' 10" W
CURVE NO. 2
CURVE NO. 4
S 79° 30' 00" W
S 53° 41' 09" W
SHEET 4
SHEET 5
SHEET 6
SHEET 7
SHEET 9
SHEET 10
SHEET 11
T1N
R7E

LEGEND


℄ Signal Butte F.R.S.
N8°36"W
80.0
Sta. 12+30.0 ±
Begin floodway
BEGIN CONSTRUCTION
Sta. 14+40.0
Begin road ramp
See details
Sheet 16
℄ Sta. 250+17.60
N0°06'16"W
℄ Sta 252+00 =
SE Cor. NE 1/4
SE 1/4 Sec. 11
HUB & TACK
Sta. 19+21.0
End road ramp
℄ Sta. 20+00
Begin transition
End transition
℄ & R/W Limits
S89°50'54"W
B-1
B-2
TP-1
TP-2
R/W limits
85.0
100.0
S89°50'54"W
℄ Sta. 17+01.21
S81°53'24"W
℄ Sta. 10+00.0
R/W limits
Sta. 17+00.0
Side Inlet No. 1
4 P. Sta. 15+18.81
47°57'30" Rt.
Sta. 16+40.0
Side Inlet No. 2
Existing R/C
Box Culvert
2-7'0" x 6'0"
Side Inlet No. 3
PLAN
100 0 100
SCALE IN FEET
14.0'
1690
1694
1698
Sta. 12+30.0 ±
Begin floodway
BEGIN CONSTRUCTION
Side Inlet No. 1
Side Inlet No. 2
Existing Box - Culvert
Sta. 18+00
Change grade
Sta. 19+50
Change grade
Sta. 20+00
Side Inlet No. 3
Top of Rt. Bank (U.S.)
El. 1698.0
1700


Approx. existing ground surface
1700
1690
1680
1698
Sta. 12+30.0±
Begin Roadway
BEGIN CONSTRUCTION
Side Inlet No. 1
Top of Rt. Bank (U.S.)
El. 1688.0
Sta. 12+50
El. 1686.95
Existing R/C Box Culvert
Sta. 16+75.99
El. 1686.31
Existing Box Culvert
Sta. 19+00
Change grade
Sta. 19+50
Change grade
Sta. 20+00
Side Inlet No. 3
Top of Lt. Bank (D.S.)
S=0.0005
PROFILE ALONG CENTERLINE
R/W
10+00
Clearing and grubbing limits
14.0'
El. 1698.0
Barbed wire fence
Waste fill
Approx. existing ground surface
STA. 12+50 to 19+00
Clearing and grubbing limits
El. 1699.0
STA. 19+50 to 25+00
15+00
R/W limits
Clearing and grubbing limits
El. 1699.0
STA. 25+00 to 30+00
20+00
R/W limits
Barbed wire
Approx. existing
TYPICAL CROSS SECTIONS
STA. 12+50 to 30+00
EARTH
Sta. to Sta.
Bottom Width

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS

PROJECT Spook Hill : Signal Butte Principal spillway Sht. 1/6

PROJECT NO. _____ SHEET NO. _____ OF _____

CALCULATED BY tcf DATE _____ CHECKED BY _____ DATE 4/01

Given: Based on the TR-20 100-yr Run, which assumes - 4x PS capacity,
- Pass Mtn Diversion inple

Q_{100} (outflow) = 576 cfs (see sht. 2/6)
High water = 1711.73 (FED Datum) (see sht. 3/6)

Goal: Find a box-conduit size which can handle Q_{100} = 576 cfs @ HW = 1711.73, Preli. level work

Try: - 5'x5' box conduit (with layout similar to Spook Hill FRS PS)

- Approximate Tailwater using existing outfall channel section, upgraded with concrete lining (see sht 4/6)

∴ channel depth = 6' ± at Q_{100} = 576 cfs = TW

- Perform conduit performance curve for a 5'x5' box culvert (see shts 5&6/6)

HW = 21.63'
capacity = 597 cfs ≅ 576 cfs ∴ OK for preli. design

TR-20 Output Comparison

Signal Butte FRS

Emerg. Spillway Crest = 1712.40 ft
Top of Dam = 1721.77 ft

		Recreated Original Model	Recreated Model w/Actual Storage, Quadrupled PS Outflow, & Pass Mountain Diversion Extension	Difference
PSH	Maximum Stage (ft)	1712.61 ft	1709.50 ft	(3.11 ft)
	Peak Inflow (cfs)	8209.2	8353.5	1.758%
	Inflow Volume (ac-ft)	1703.8	1991.9	16.909%
	Peak Storage (ac-ft)	1391.6	1040.2	(25.252%)
	Peak Outflow (cfs)	158.4	576.0	263.636%
10-day PSH	Maximum Stage (ft)	1713.17 ft	1711.17 ft	(2.00 ft)
	Peak Inflow (cfs)	4577.8	5628.4	22.950%
	Inflow Volume (ac-ft)	2667.2	3146.8	17.981%
	Peak Storage (ac-ft)	1479.6	1250.2	(15.504%)
	Peak Outflow (cfs)	303.5	600.7	97.924%
ESH	Maximum Stage (ft)	1716.20 ft	1716.33 ft	0.13 ft
	Peak Inflow (cfs)	5488.5	6795.9	23.821%
	Inflow Volume (ac-ft)	3320.1	4115.5	23.957%
	Peak Storage (ac-ft)	1944.9	2036.8	4.725%
	Peak Outflow (cfs)	2188.0	2806.4	28.263%
FBH	Maximum Stage (ft)	1722.52 ft	1722.12 ft	(0.40 ft)
	Peak Inflow (cfs)	14360.9	14388.5	0.192%
	Inflow Volume (ac-ft)	8066.8	9061.3	12.328%
	Peak Storage (ac-ft)	3146.8	3144.0	(0.089%)
	Peak Outflow (cfs)	10247.2	10135.4	(1.091%)

6/6

3/6

Ash Patel

From: Rick Hiner
Sent: Monday, April 30, 2001 10:35 AM
To: Ash Patel
Subject: RE: Signal Butte

Based on the original design survey data (NGVD '29):

Emergency Spillway Crest = 1712.4
Original 100-year HW Elevation = 1712.63
W/Pass Mntn & 4X Spillway = 1709.50

Based on the new survey data (NGVD '88):

Emergency Spillway Crest = 1714.63
Original 100-year HW Elevation = 1714.86
W/Pass Mntn & 4X Spillway = 1711.73

-----Original Message-----
From: Ash Patel
Sent: Monday, April 30, 2001 10:24 AM
To: Rick Hiner
Subject: Signal Butte

I need to know our 100-year HW elevation in FRS with quadruple spillway capacity and Pass Mtn in place. Thanks!

Ashok C. Patel P. E.
Principal

Wood, Patel & Associates, Inc.
2051 West Northern Avenue, Suite 100
Phoenix, AZ 85021
(602)335-8504 (Direct Line)
(602)335-8500 (Office)
(602)335-8580 (Fax)
Email: **apatel@woodpatel.com**
Web Address: www.woodpatel.com

TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

April 30, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Channel Bottom Slope (ft/ft)	0.0003
Manning's Roughness Coefficient (n-value)	0.014
Channel Left Side Slope (horizontal/vertical)	2.0
Channel Right Side Slope (horizontal/vertical)	2.0
Channel Bottom Width (ft)	10.0
Minimum Flow Depth (ft)	1.0
Maximum Flow Depth (ft)	9.0
Incremental Head (ft)	1.0

COMPUTATION RESULTS

Flow Depth (ft)	Flow Rate (cfs)	Flow Velocity (fps)	Froude Number	Velocity Head (ft)	Energy Head (ft)	Flow Area (sq ft)	Top Width (ft)
1.0	19.47	1.62	0.309	0.041	1.041	12.0	14.0
2.0	66.79	2.39	0.337	0.088	2.088	28.0	18.0
3.0	142.39	2.97	0.354	0.137	3.137	48.0	22.0
4.0	249.09	3.46	0.367	0.186	4.186	72.0	26.0
5.0	390.02	3.9	0.377	0.236	5.236	100.0	30.0
6.0	568.28	4.31	0.385	0.288	6.288	132.0	34.0
7.0	786.94	4.68	0.393	0.341	7.341	168.0	38.0
8.0	1,048.98	5.04	0.4	0.395	8.395	208.0	42.0
9.0	1,357.3	5.39	0.406	0.451	9.451	252.0	46.0

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Signal Butte FRS outlet to Floodway

Exist. channel (lined with concrete - upgraded)

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

April 30, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Span (ft)	5.0
Culvert Rise (ft)	5.0
FHWA Chart Number	10
FHWA Scale Number (Type of Culvert Entrance)	2
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	125.0
Invert Elevation at Downstream end of Culvert (ft)	1,690.0
Invert Elevation at Upstream end of Culvert (ft)	1,690.01
Culvert Slope (ft/ft)	0.0001
Starting Flow Rate (cfs)	100.0
Incremental Flow Rate (cfs)	100.0
Ending Flow Rate (cfs)	700.0
Starting Tailwater Depth (ft)	2.5
Incremental Tailwater Depth (ft)	1.0
Ending Tailwater Depth (ft)	8.5

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
100.0	2.5	3.65	4.08	5.0	2.32	2.5	8.0
200.0	3.5	5.85	6.41	5.0	3.68	3.68	10.88
300.0	4.5	8.62	6.97	5.0	4.82	5.0	12.0
400.0	5.5	12.14	13.01	5.0	5.0	5.0	16.0
500.0	6.5	16.66	18.24	5.0	5.0	5.0	20.0
600.0	7.5	22.19	24.4	5.0	5.0	5.0	24.0
700.0	8.5	28.72	31.51	5.0	5.0	5.0	28.0

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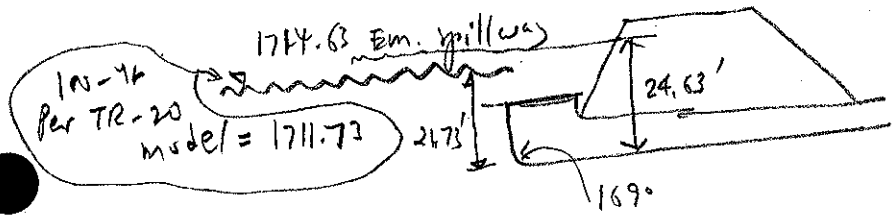
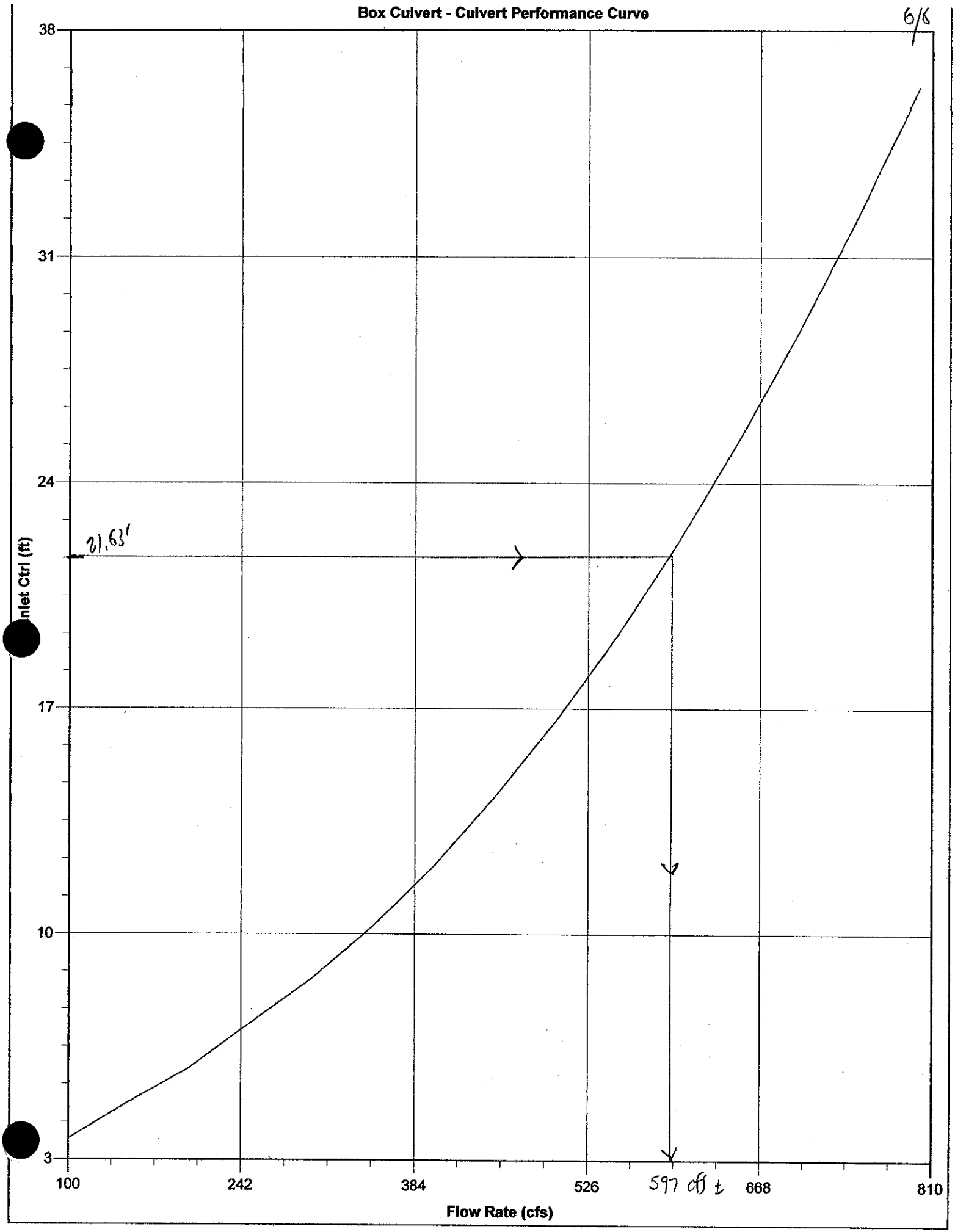
(signal Butte FRS with 4X exist. prin. spillway capacity

Try 5'x5' box culvert



H	Q
24.63	600 cfs
21.63	

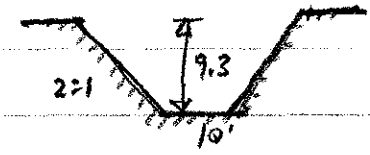

Box Culvert - Culvert Performance Curve
6/6
38
31
24
17
10
3
Inlet Ctrl (ft)
21.63'
100
242
384
526
597 cfs ±
668
810
Flow Rate (cfs)

V: 1"=3.684 ft

3/01

Signal Butte Floodway (sht. 4/50 design plans) Hydraulics

outfall from S.B. FRS:



n = .035
S = .0003 ′/′

1. sta. 12+50 to 23+00

@ 7' depth Cap = 315 cfs V = 1.87 Fr = 0.16

if n = .013, " = 848 = 5.04 = .42

Box @ Signal butte Rd: 2 - 7'x6' (84 □') will need upgrade

2. sta. 23+00 to 32+00 w/ n=.035 B = 16', @ 7' depth, Q = 417 cfs, V = 2 fps, Fr = "

w/ n = .013 " " = 1123 = 5.3 = .4

Conclusion:

with a possible quadrupled spillway capacity, anticipated PS Q100 ≅ ~~400~~ cfs, 576 cfs

The floodway needs minor upgrade from station 12+50 to 23+00 to handle Q = ~~400~~ 576 cfs.

A lined bottom is recommended.

Existing Condition Model 3/01

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	TIME OF OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE
+	HYDROGRAPH AT	10	951.	12.27	114.	31.	11.	.70	
+	ROUTED TO	R10	882.	12.40	114.	31.	11.	.70	
+	ROUTED TO	R12	824.	12.63	114.	31.	11.	.70	
+	HYDROGRAPH AT	20	959.	12.43	128.	32.	12.	1.12	
+	2 COMBINED AT	C20	1606.	12.57	240.	63.	23.	1.82	
+	ROUTED TO	R20	1604.	12.57	240.	63.	23.	1.82	
+	HYDROGRAPH AT	40	2582.	12.30	252.	66.	24.	2.23	
+	HYDROGRAPH AT	60	1553.	12.40	228.	61.	22.	1.75	
+	3 COMBINED AT	C60	5208.	12.37	708.	188.	68.	5.80	
+	ROUTED TO	S60	118.	14.23	117.	113.	68.	5.80	
+	ROUTED TO	R60	118.	14.30	117.	113.	68.	5.80	
+	ROUTED TO	RR60	118.	14.40	117.	113.	68.	5.80	
+	HYDROGRAPH AT	80	1868.	12.27	179.	46.	17.	1.48	
+	2 COMBINED AT	C80	1918.	12.27	284.	156.	86.	1.48	
+	ROUTED TO	R80	1891.	12.27	284.	156.	86.	1.48	
+	HYDROGRAPH AT	100	404.	12.20	58.	15.	5.	.48	
+	2 COMBINED AT	C100	2272.	12.27	339.	170.	91.	1.96	
+	ROUTED TO	R100	2268.	12.30	339.	170.	91.	1.96	
+	HYDROGRAPH AT	120	3232.	12.27	326.	88.	32.	2.20	
+	2 COMBINED AT	C120	5439.	12.27	652.	250.	121.	4.16	
+	ROUTED TO	R120	5368.	12.30	652.	250.	121.	4.16	
+	HYDROGRAPH AT	140	632.	12.13	64.	17.	6.	.60	
+	HYDROGRAPH AT	150	572.	12.17	49.	13.	5.	.41	
+	ROUTED TO	R150	546.	12.23	49.	13.	5.	.41	
+	ROUTED TO	R152	511.	12.33	49.	13.	5.	.41	
+	HYDROGRAPH AT	160	217.	12.40	35.	9.	3.	.37	
	HYDROGRAPH AT								

Apex Dam

+	180	785.	12.37	90.	23.	8.	1.00
+ 5 COMBINED AT	C180	7141.	12.30	875.	307.	142.	6.54
+ HYDROGRAPH AT	210	1266.	12.17	105.	27.	10.	.79
+ ROUTED TO	R210	1191.	12.23	105.	27.	10.	.79
+ HYDROGRAPH AT	240	1440.	12.30	158.	40.	14.	1.41
+ 2 COMBINED AT	C240	2574.	12.27	260.	67.	24.	2.20
+ ROUTED TO	S240	751.	12.70	213.	55.	20.	2.20
+ ROUTED TO	R240	749.	12.77	212.	55.	20.	2.20
+ HYDROGRAPH AT	220	651.	12.20	65.	17.	6.	.47
+ 2 COMBINED AT	C220	904.	12.60	273.	72.	26.	2.67
+ ROUTED TO	S220	846.	12.80	265.	70.	25.	2.67
+ ROUTED TO	R220	845.	12.83	265.	70.	25.	2.67
+ HYDROGRAPH AT	190	1403.	12.17	116.	31.	11.	.92
+ ROUTED TO	R190	1348.	12.23	116.	31.	11.	.92
+ ROUTED TO	R192	1267.	12.30	116.	31.	11.	.92
+ HYDROGRAPH AT	200	797.	12.17	69.	19.	7.	.53
+ 3 COMBINED AT	C200	2149.	12.30	439.	117.	42.	4.12
+ ROUTED TO	S200	2038.	12.37	433.	113.	41.	4.12
+ ROUTED TO	R200	2032.	12.37	433.	113.	41.	4.12
+ ROUTED TO	SS200	1253.	12.77	312.	83.	30.	4.12
+ ROUTED TO	RR200	1240.	12.87	310.	83.	30.	4.12
+ 2 COMBINED AT	CC180	7141.	12.30	1175.	389.	171.	10.66
Sign-d Bartle + ROUTED TO	S180	113.	29.13	113.	113.	88.	10.66
+ ROUTED TO	R180	113.	29.20	113.	113.	88.	10.66
+ HYDROGRAPH AT	260	404.	12.10	41.	11.	4.	.26
+ 2 COMBINED AT	C260	408.	12.10	130.	121.	96.	.27
+ ROUTED TO	R260	394.	12.20	130.	120.	96.	.27
+ HYDROGRAPH AT	280	509.	12.10	44.	12.	4.	.32
+ 2 COMBINED AT	C280	847.	12.13	168.	130.	99.	.59
+ ROUTED TO	R280	826.	12.20	168.	130.	99.	.59
HYDROGRAPH AT							

+	300	400.	12.10	33.	9.	3.	.29
+ 2 COMBINED AT	C300	1158.	12.17	197.	137.	102.	.88
+ ROUTED TO	R300	1115.	12.23	196.	137.	101.	.88
+ HYDROGRAPH AT	305	451.	12.27	77.	20.	7.	.70
+ 2 COMBINED AT	C305	1547.	12.23	269.	155.	108.	1.58
+ ROUTED TO	R305	1528.	12.30	269.	155.	108.	1.58
+ HYDROGRAPH AT	350	1192.	12.20	103.	27.	10.	.97
+ DIVERSION TO	SF350	596.	12.20	51.	13.	5.	.97
+ HYDROGRAPH AT	D350	596.	12.20	51.	13.	5.	.97
+ ROUTED TO	R350	531.	12.40	51.	13.	5.	.97
+ HYDROGRAPH AT	310	376.	12.33	49.	12.	4.	.56
+ 2 COMBINED AT	C310	880.	12.40	99.	25.	9.	.94
+ ROUTED TO	R310	771.	12.73	99.	25.	9.	.94
+ HYDROGRAPH AT	320	942.	12.20	121.	34.	12.	.95
+ DIVERSION TO	BS320	401.	11.97	21.	6.	2.	.95
+ HYDROGRAPH AT	D320	942.	12.20	106.	28.	10.	.95
+ HYDROGRAPH AT	RT320	401.	11.97	21.	6.	2.	.95
+ ROUTED TO	S320	4.	4.20	4.	4.	2.	.95
+ 4 COMBINED AT	C320	2431.	12.30	471.	209.	128.	3.47
+ HYDROGRAPH AT	340	1459.	12.17	184.	55.	20.	1.44
+ DIVERSION TO	BS340	1459.	12.17	104.	28.	10.	1.44
+ HYDROGRAPH AT	D340	1191.	12.33	96.	26.	10.	1.44
+ HYDROGRAPH AT	RT340	1459.	12.17	104.	28.	10.	1.44
+ ROUTED TO	S340	19.	9.03	19.	19.	10.	1.44
+ 3 COMBINED AT	C340	3598.	12.33	580.	253.	147.	4.91
+ HYDROGRAPH AT	RT350	596.	12.20	51.	13.	5.	.97
+ ROUTED TO	RR350	526.	12.47	51.	13.	5.	.97
+ HYDROGRAPH AT	355	518.	12.33	71.	18.	7.	.68
+ 2 COMBINED AT	C355	979.	12.43	121.	32.	11.	1.24
+ ROUTED TO	R355	896.	12.73	121.	32.	11.	1.24
HYDROGRAPH AT							

+	360	732.	12.23	110.	33.	12.	.88
+ DIVERSION TO	BS360	732.	12.23	52.	14.	5.	.88
+ HYDROGRAPH AT	D360	645.	12.37	67.	18.	7.	.88
+ HYDROGRAPH AT	RT360	732.	12.23	52.	14.	5.	.88
+ ROUTED TO	S360	10.	8.63	10.	10.	5.	.88
+ 4 COMBINED AT	C360	4336.	12.37	766.	308.	169.	7.03
+ HYDROGRAPH AT	370	591.	12.30	78.	21.	8.	.67
+ HYDROGRAPH AT	395	183.	12.23	25.	7.	2.	.20
+ 2 COMBINED AT	C370	763.	12.30	102.	28.	10.	.87
+ ROUTED TO	R370	666.	12.67	102.	28.	10.	.87
+ HYDROGRAPH AT	380	589.	12.27	91.	25.	9.	.90
+ DIVERSION TO	BS380	589.	12.27	56.	14.	5.	.90
+ HYDROGRAPH AT	D380	364.	12.67	38.	10.	4.	.90
+ HYDROGRAPH AT	RT380	589.	12.27	56.	14.	5.	.90
+ ROUTED TO	S380	10.	11.47	10.	10.	5.	.90
+ 4 COMBINED AT	C380	4577.	12.37	906.	352.	186.	8.80
+ HYDROGRAPH AT	390	463.	12.03	33.	10.	3.	.24
+ DIVERSION TO	BS390	95.	11.73	6.	2.	1.	.24
+ HYDROGRAPH AT	D390	463.	12.03	30.	8.	3.	.24
+ HYDROGRAPH AT	RT390	95.	11.73	6.	2.	1.	.24
+ ROUTED TO	S390	1.	.90	1.	1.	1.	.24
+ 2 COMBINED AT	C390	464.	12.03	31.	9.	3.	.24
+ ROUTED TO	RR390	329.	12.50	31.	9.	3.	.24
+ HYDROGRAPH AT	400	351.	12.23	47.	13.	5.	.62
+ DIVERSION TO	BS400	262.	12.10	10.	3.	1.	.62
+ HYDROGRAPH AT	D400	351.	12.23	39.	10.	4.	.62
+ HYDROGRAPH AT	RT400	262.	12.10	10.	3.	1.	.62
+ ROUTED TO	S400	2.	8.70	2.	2.	1.	.62
+ 2 COMBINED AT	C400	353.	12.23	41.	12.	5.	.62
+ 3 COMBINED AT	CC400	5093.	12.37	972.	371.	194.	9.66
HYDROGRAPH AT							

+		385	588.	12.23	70.	20.	7.	.53
+	DIVERSION TO	SF385	353.	12.23	42.	12.	4.	.53
+	HYDROGRAPH AT	D385	235.	12.23	28.	8.	3.	.53
+	ROUTED TO	R385	202.	12.60	28.	8.	3.	.53
+	HYDROGRAPH AT	420	752.	12.20	92.	26.	9.	.85
+	DIVERSION TO	BS420	269.	11.97	15.	4.	2.	.85
+	HYDROGRAPH AT	D420	752.	12.20	83.	22.	8.	.85
+	HYDROGRAPH AT	RT420	269.	11.97	15.	4.	2.	.85
+	ROUTED TO	S420	13.	11.03	12.	4.	2.	.85
+	4 COMBINED AT	C420	5697.	12.37	1078.	399.	204.	10.87
+	HYDROGRAPH AT	440	180.	12.03	12.	3.	1.	.08
+	ROUTED TO	R70	178.	12.07	12.	3.	1.	.08
+	HYDROGRAPH AT	441	16.	12.03	1.	0.	0.	.01
+	2 COMBINED AT	C108	193.	12.07	14.	4.	1.	.09
+	DIVERSION TO	SPLIT	97.	12.07	7.	2.	1.	.09
+	HYDROGRAPH AT	D4	97.	12.07	7.	2.	1.	.09
+	ROUTED TO	R108	90.	12.13	7.	2.	1.	.09
+	HYDROGRAPH AT	442	102.	12.10	9.	2.	1.	.10
+	2 COMBINED AT	C67	188.	12.10	15.	4.	1.	.19
+	DIVERSION TO	BASIN4	115.	12.10	6.	1.	1.	.19
+	HYDROGRAPH AT	D6	73.	12.10	10.	3.	1.	.19
+	HYDROGRAPH AT	RTD6	115.	12.10	6.	1.	1.	.19
+	ROUTED TO	SD6	1.	11.90	1.	1.	1.	.19
+	2 COMBINED AT	CD6	74.	12.10	10.	4.	1.	.19
+	HYDROGRAPH AT	443	148.	12.07	14.	4.	1.	.08
+	DIVERSION TO	WSH66	78.	11.90	12.	3.	1.	.08
+	HYDROGRAPH AT	D66	70.	12.07	3.	1.	0.	.08
+	ROUTED TO	R113	69.	12.07	3.	1.	0.	.08
+	2 COMBINED AT	C114	140.	12.07	13.	4.	2.	.27
+	HYDROGRAPH AT	444	82.	12.03	5.	1.	0.	.04
	ROUTED TO							

+	R58	78.	12.07	5.	1.	0.	.04
HYDROGRAPH AT +	445	296.	12.03	18.	5.	2.	.19
2 COMBINED AT +	C107	368.	12.03	22.	6.	2.	.23
ROUTED TO +	R107	369.	12.07	22.	6.	2.	.23
HYDROGRAPH AT +	RTB2	97.	12.07	7.	2.	1.	.09
ROUTED TO +	RSPLIT	96.	12.07	7.	2.	1.	.09
HYDROGRAPH AT +	446	65.	12.03	6.	2.	1.	.04
3 COMBINED AT +	C109	525.	12.07	35.	9.	3.	.27
DIVERSION TO +	WSH404	35.	11.73	7.	2.	1.	.27
HYDROGRAPH AT +	D5	490.	12.07	27.	7.	2.	.27
ROUTED TO +	R109	475.	12.10	27.	7.	2.	.27
HYDROGRAPH AT +	447	138.	12.07	12.	4.	1.	.09
HYDROGRAPH AT +	RT404	35.	11.73	7.	2.	1.	.27
ROUTED TO +	R404	35.	11.90	7.	2.	1.	.27
3 COMBINED AT +	C110	639.	12.07	46.	13.	5.	.36
ROUTED TO +	R110	637.	12.10	46.	13.	5.	.36
2 COMBINED AT +	C115	769.	12.10	59.	17.	6.	.63
ROUTED TO +	R115	772.	12.10	59.	17.	6.	.63
HYDROGRAPH AT +	448	88.	12.03	6.	2.	1.	.05
HYDROGRAPH AT +	449	80.	12.03	5.	1.	0.	.05
2 COMBINED AT +	C6364	166.	12.03	11.	3.	1.	.09
ROUTED TO +	R6364	141.	12.17	11.	3.	1.	.09
HYDROGRAPH AT +	450	61.	12.20	6.	2.	1.	.07
HYDROGRAPH AT +	451	18.	12.17	2.	1.	0.	.03
2 COMBINED AT +	C451	78.	12.20	8.	2.	1.	.09
HYDROGRAPH AT +	RT66	78.	11.90	12.	3.	1.	.08
HYDROGRAPH AT +	452	62.	12.03	4.	1.	0.	.04
2 COMBINED AT +	C6465	140.	12.03	16.	4.	2.	.04
ROUTED TO +	R6566	136.	12.10	16.	4.	2.	.04
3 COMBINED AT +	C116	346.	12.17	35.	9.	3.	.23
ROUTED TO							

+	BASIN5	153.	12.47	35.	9.	3.	.23
ROUTED TO +	R116	151.	12.53	35.	9.	3.	.23
HYDROGRAPH AT +	453	62.	12.10	7.	2.	1.	.06
2 COMBINED AT +	C117	170.	12.50	41.	11.	4.	.29
2 COMBINED AT +	C118	856.	12.10	99.	28.	10.	.92
ROUTED TO +	R118	846.	12.10	99.	28.	10.	.92
DIVERSION TO +	BASIN6	245.	12.10	10.	2.	1.	.92
HYDROGRAPH AT +	D7	601.	12.10	89.	25.	9.	.92
HYDROGRAPH AT +	RTD7	245.	12.10	10.	2.	1.	.92
ROUTED TO +	SD7	1.	11.97	1.	1.	1.	.92
2 COMBINED AT +	CD7	602.	12.10	90.	26.	10.	.92
HYDROGRAPH AT +	454	157.	12.17	21.	6.	2.	.18
2 COMBINED AT +	C119	750.	12.13	109.	32.	12.	1.10
ROUTED TO +	R454	733.	12.20	109.	32.	12.	1.10
HYDROGRAPH AT +	415	562.	12.17	76.	22.	8.	.61
HYDROGRAPH AT +	RT385	353.	12.23	42.	12.	4.	.53
ROUTED TO +	RR385	308.	12.60	42.	12.	4.	.53
3 COMBINED AT +	C415	1434.	12.20	225.	64.	24.	1.71
ROUTED TO +	R415	1426.	12.27	225.	64.	24.	1.71
HYDROGRAPH AT +	455	1346.	12.13	142.	43.	16.	1.11
DIVERSION TO +	BS455	1346.	12.13	137.	37.	13.	1.11
HYDROGRAPH AT +	D455	55.	12.77	16.	6.	2.	1.11
HYDROGRAPH AT +	RT455	1346.	12.13	137.	37.	13.	1.11
ROUTED TO +	S455	25.	10.47	25.	25.	13.	1.11
2 COMBINED AT +	C455	80.	12.77	41.	31.	16.	1.11
3 COMBINED AT +	CC455	6819.	12.37	1302.	479.	240.	13.69
Spook Hill Dam ROUTED TO +	S440	261.	17.43	259.	239.	155.	13.69
ROUTED TO +	R455	261.	18.43	259.	239.	152.	13.69
HYDROGRAPH AT +	480	1050.	12.10	96.	29.	11.	.73
DIVERSION TO +	BS480	455.	11.90	27.	8.	3.	.73
HYDROGRAPH AT							

+	D480	1050.	12.10	78.	21.	8.	.73
HYDROGRAPH AT +	RT480	455.	11.90	27.	8.	3.	.73
ROUTED TO +	S480	6.	3.90	6.	6.	3.	.73
2 COMBINED AT +	C480	1056.	12.10	84.	27.	11.	.73
2 COMBINED AT +	CC480	1056.	12.10	308.	270.	174.	.73
ROUTED TO +	R480	780.	12.33	308.	270.	173.	.73
HYDROGRAPH AT +	456	468.	12.07	35.	10.	4.	.26
DIVERSION TO +	BASIN1	184.	12.07	8.	2.	1.	.26
HYDROGRAPH AT +	D1	284.	12.07	27.	8.	3.	.26
DIVERSION TO +	WA30	58.	12.07	10.	3.	1.	.26
HYDROGRAPH AT +	CD2	226.	12.07	18.	4.	2.	.26
ROUTED TO +	R456	213.	12.13	18.	4.	2.	.26
HYDROGRAPH AT +	457	264.	12.07	20.	5.	2.	.19
2 COMBINED AT +	C101	462.	12.10	38.	10.	4.	.45
DIVERSION TO +	BASIN2	165.	12.10	7.	2.	1.	.45
HYDROGRAPH AT +	D3	297.	12.10	30.	8.	3.	.45
HYDROGRAPH AT +	RTD3	165.	12.10	7.	2.	1.	.45
ROUTED TO +	SD3	2.	11.90	2.	2.	1.	.45
2 COMBINED AT +	CD3	299.	12.10	32.	9.	4.	.45
ROUTED TO +	R101	297.	12.10	32.	9.	4.	.45
HYDROGRAPH AT +	458	356.	12.03	25.	7.	2.	.19
2 COMBINED AT +	C103	635.	12.07	56.	16.	6.	.64
ROUTED TO +	R103	630.	12.07	56.	16.	6.	.64
HYDROGRAPH AT +	RT30	58.	12.07	10.	3.	1.	.26
ROUTED TO +	R30	57.	12.10	10.	3.	1.	.26
HYDROGRAPH AT +	RTB1	184.	12.07	8.	2.	1.	.26
ROUTED TO +	B1	37.	12.23	8.	2.	1.	.26
ROUTED TO +	RB1	37.	12.30	8.	2.	1.	.26
2 COMBINED AT +	CDIV	87.	12.20	17.	5.	2.	.12
HYDROGRAPH AT +	459	44.	12.03	3.	1.	0.	.03
2 COMBINED AT							

+	C52	114.	12.13	20.	6.	2.	.15
ROUTED TO +	R52	113.	12.17	20.	6.	2.	.15
HYDROGRAPH AT +	460	214.	12.07	19.	6.	2.	.14
2 COMBINED AT +	C102	312.	12.07	39.	12.	4.	.29
ROUTED TO +	BASIN3	71.	12.63	39.	12.	4.	.29
ROUTED TO +	R3	71.	12.77	39.	12.	4.	.29
HYDROGRAPH AT +	461	161.	12.10	17.	5.	2.	.12
2 COMBINED AT +	C104	213.	12.10	55.	17.	6.	.41
2 COMBINED AT +	C106	835.	12.07	110.	32.	12.	1.05
ROUTED TO +	R106	797.	12.13	110.	32.	12.	1.05
HYDROGRAPH AT +	462	538.	12.07	40.	11.	4.	.30
2 COMBINED AT +	C56	1254.	12.10	149.	42.	16.	1.35
2 COMBINED AT +	C462	1476.	12.30	364.	293.	185.	2.09
ROUTED TO +	R462	1464.	12.33	363.	293.	185.	2.09
ROUTED TO +	RR462	1443.	12.40	363.	293.	184.	2.09
HYDROGRAPH AT +	500	1073.	12.27	122.	33.	12.	.93
2 COMBINED AT +	C500	2361.	12.30	471.	320.	195.	3.02

*** NORMAL END OF HEC-1 ***

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS

PROJECT Spook Hill ADMP update

PROJECT NO. 99891 SHEET NO. 1 OF

CALCULATED BY BT DATE 7/20/01 CHECKED BY DATE

Existing Culvert Capacity Calculations

Culvert analysis calculations were performed to determine existing culvert capacities @ Pipe full and at Maximum capacity before overtopping of roadway occurs.

Note: 1) For arch pipe, circular pipe with an equivalent area was used for calculations.

2) In some locations, the adjacent roadway elevation is below the top of inlet pipe. At these locations, the capacity before overtopping should be used as MAX cap.

3) No provision has been made for pipe clogging.

Spook Hill ADMS Update

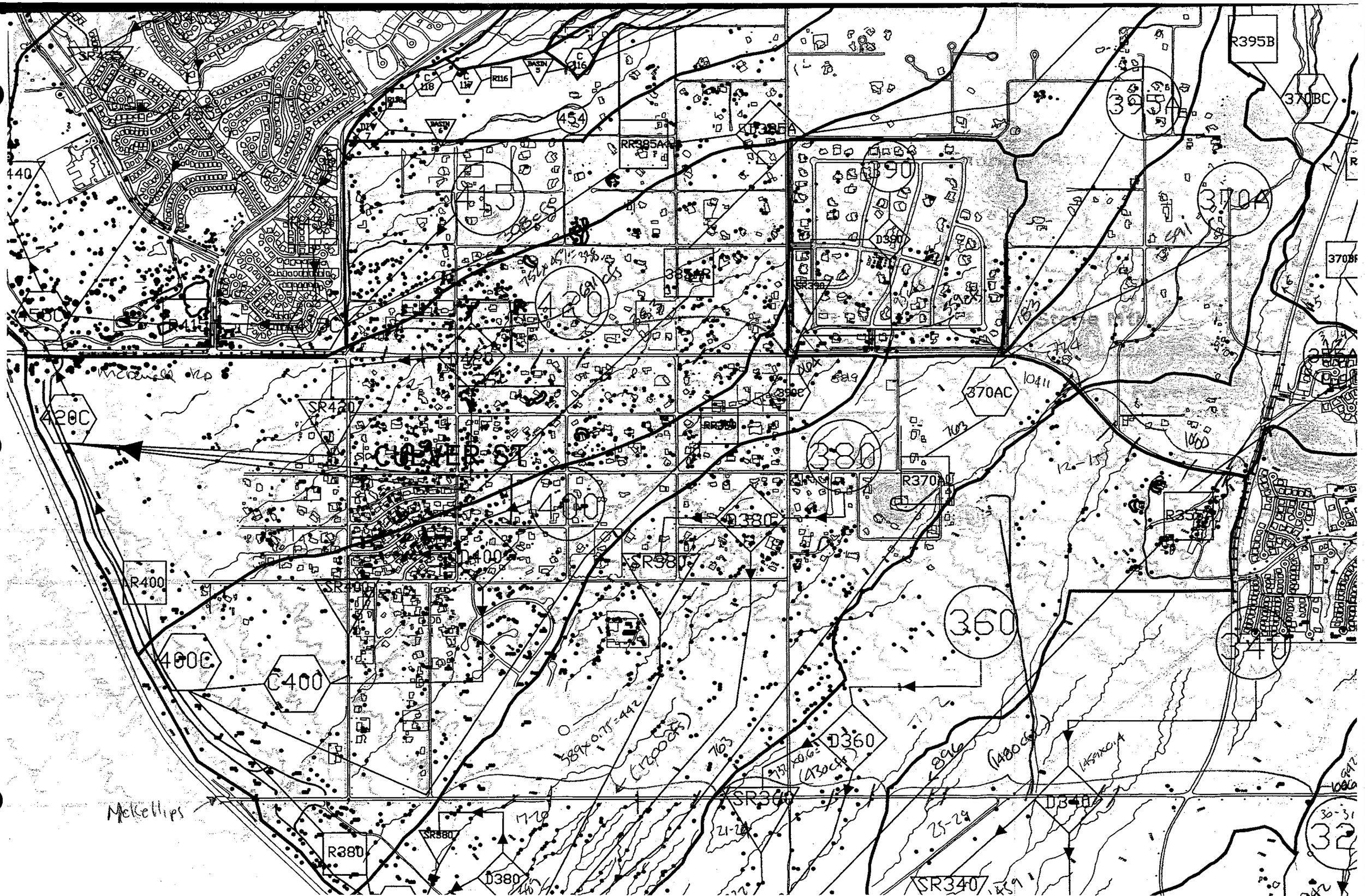
Flood Control District of Maricopa County

March 21, 2001

Culvert Field Survey Data

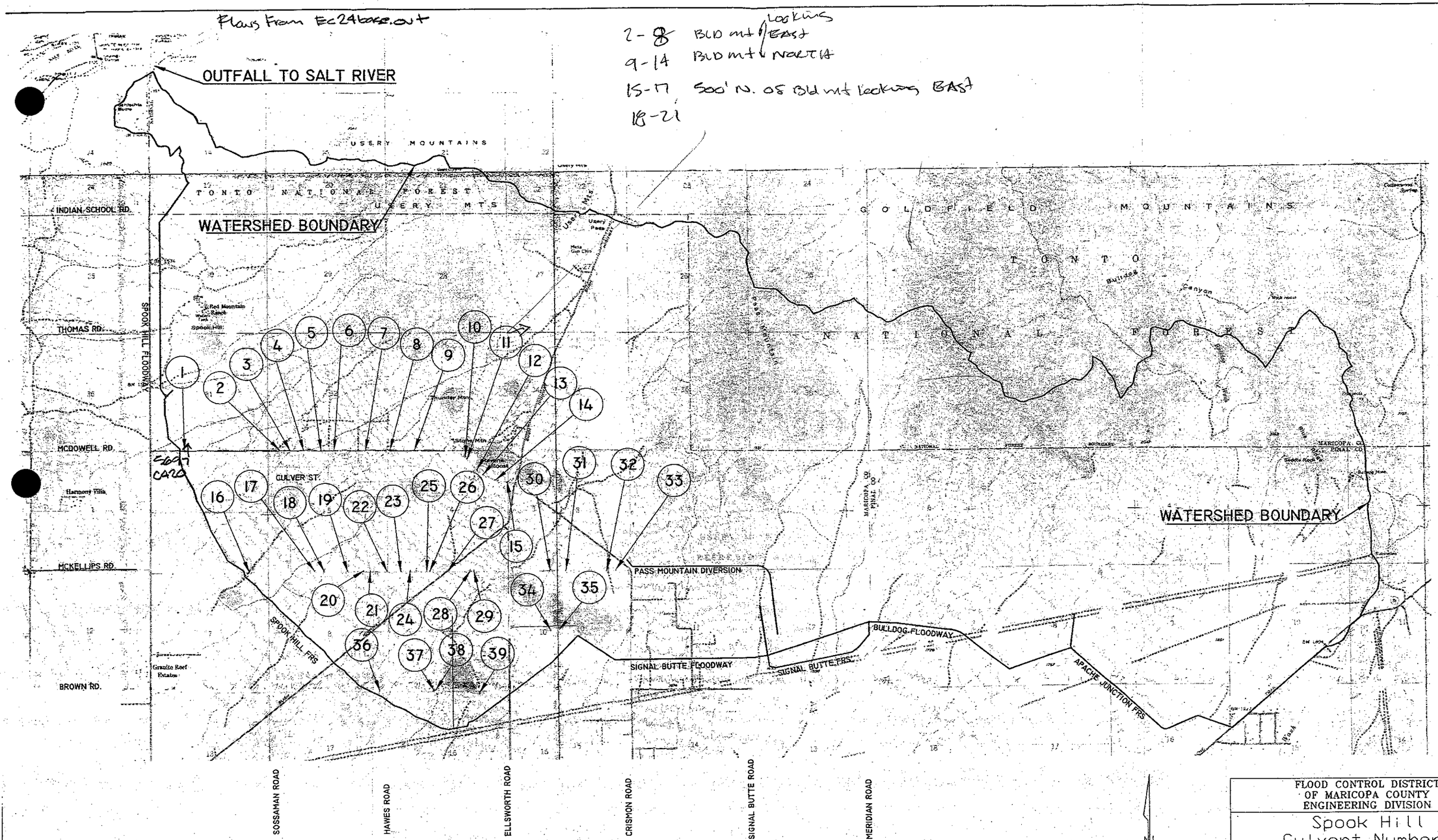
Culvert Number	Culvert Location	Size of Culvert	Equivalent Circular Pipe Diameter (in)	Upstream Culvert Invert Elev	Downstream Culvert Invert Elev	Pipe Length	Upstream Edge of Pavement Elev	Headwater Depth (Invert to Pavement)	Maximmun Culvert Capacity Before Roadway Overtopping (cfs)	Approximate 100-Yr, 24-Hr Flow (cfs)	Culvert Capacity as a % of 100-Yr, 24-Hr Flow
1	150' E of Viaduct @ McDowell Rd	110" Galv CMP		1568.69	1568.28	138.8	1586.91	18.22	1,022		
								Total	1,022	4,791	21%
2	250' East of 76thSt & McDowell Rd	24" Galv CMPA	21	1655.15	1653.99	68.1	1657.40	2.25	14		
3	200' W of 78th St & McDowell	42" Galv CMPA	36	1661.75	1659.92	71.0	1665.67	3.92	44		
4	150' E of 78thSt & McDowell Rd	36" Galv CMPA	30	1673.75	1672.16	57.1	1676.71	2.96	29		
5	200' E of 79th St & McDowell Rd	30" Galv CMPA	24	1689.41	1687.72	73.7	1691.70	2.29	16		
6	150' E of 79th St & McDowell Rd	36" Galv CMPA	30	1700.70	1698.53	77.5	1703.13	2.43	22		
7	150' E of 82nd St & McDowell Rd	36" Galv CMPA	30	1728.88	1727.33	58.6	1732.35	3.47	33		
								Total	158	691	23%
8	75' E of Hawes Rd & McDowell Rd	30" CP		1753.60	1751.91	114.5	1757.85 (a)	4.25	40		
9	100' E of Thunderbird Rd & McDowell Rd	60" CP		1777.84	1774.16	99.2	1781.92 (a)	4.08	129		
								Total	169	559	30%
10	E Property line of 8660 E McDowell Rd	32" CMPA	30	1824.00	1822.96	59.3	1828.27	4.27	40		
11	New Box Culvert Not Field Surveyed	2-8' x 3' Boxes						6 +/-	440		
11a (c)	50' E of E Prop Line 8660 E McDowell Road	42" CMPA		VOID					N/A		
11b (c)	50' E of E Prop Line 8660 E McDowell Road	48" CMPA							N/A		
								Total	480	774	62%
12	90th St & McDowell	24" CMPA	21	1814.74	1814.50	60.3	1817.34	2.6	11		
13	150' E of 90th St & McDowell Rd	18" CP		1808.62	1808.87	46.2	1811.28	2.66	11		
14	700' E of 90th St & McDowell Rd	22" CMPA	18	1820.71	1819.47	69.2	1822.34	1.63	7		
15a	92nd St & McDowell Rd	60" CMPA	48	1829.05	1826.94	85.2	1832.65	3.6	75		
15b	92nd St & McDowell Rd	62" CMPA	54	1829.17	1827.42	84.9	1833.00	3.83	99		
								Total	203	1,080	19%
16	300' E of McKellips Rd & Viaduct	120" Galv CMP		1569.56	1569.41	148.7	1589.56	20	1,287		
								Total	1,287	5,093	25%
17	Entrance to " The Estate" North Side	36" CP		1613.85	1613.00	62.2	1617.71	3.86	48		
18	200' E of Entrance to "The Estates" on McKellips Rd	36" CP		1620.70	1619.42	62.2	1624.15	3.45	43		
19	800' E of Entrance to "The Estates" on McKellips Rd	30" CP		1634.64	1634.07	60.9	1638.28	3.64	34		
20	1200' E of Entrance to "The Estates" on McKellips Rd	30" CP		1644.30	1643.93	61.2	1648.04	3.74	35		
								Total	160	1,200	13%
21	1400' E of Entrance to "The Estates" on McKellips Rd	36" CP		1649.19	1648.65	62.4	1653.15	3.96	49		
22	Hawes Rd & McKellips Rd	36" CP		1660.38	1659.81	62.3	1664.49	4.11	51		
23	350' E of Hawes Rd & McKellips Rd	30" CP		1670.89	1670.36	61.2	1674.15	3.26	31		
24	700' E of Hawes Rd & McKellips Rd	34" CP		1676.66	1676.17	62.3	1680.89	4.23	48		
								Total	179	460	39%
25	1100' E of Hawes Rd & McKellips Rd	30"CP		1688.24	1688.02	61.2	1692.70	4.46	41		
26	1200' E of Hawes Rd & McKellips Rd	36" CP		1689.98	1689.33	62.5	1694.92	4.94	61		
27	1700' E of Hawes Rd & McKellips Rd	30" CMPA	24	1701.63	1700.99	101.4	1705.26	3.63	23		
28	600' W of McKellips Rd and Usery Pass	36" CP		1712.11	1711.71	62.6	1717.36	5.25	64		
29	500' W of McKellips Rd and Usery Pass	30" CP		1714.95	1714.22	61.4	1719.37	4.42	41		
								Total	230	1,480	16%
30	2000' E of McKellips Rd and Usery Pass	2 - 75" W x 38" H		1749.80	1747.90	119.1	1755.71	5.91	250		
31a	500' E of McKellips Rd and Boulder Mtn	2 - 38" CP		1761.00	1760.46	114.0	1765.64	4.64	126		
								Total	376	1,006	37%
32	800' W of McKellips Rd and Crismon Rd	30" CP		1761.28	1761.24	61.2	1767.46	6.18	52		
33	500' W of McKellips Rd and Crismon Rd	30" CP		1764.98	1764.04	61.1	1768.08	3.1	29		
								Total	81	400	20%
34	300' W of McLellan Rd & Aaron	4bbl - 10' x 3'		1694.85	1694.30	53.0	1700.08	5.23	285		
35	McLellan Rd & Aaron	24" CP		1689.79	(b)	Unknown	1695.22	5.43	N/A		
36	200' E of Viaduct on Brown Rd	104" Galv CMP		1571.25	1571.13	86.1	1583.91	12.66	685		
37	400' E of 86th St & Brown Rd	2 - 24" CP		1598.36	1598.03	117.0	1601.70	3.34	36		
38	400' E of 86th St & Brown Rd	3 - 24" CP		1598.72	1598.04	156.6	1602.44	3.72	63		
39	50' W of 90th St & Brown Rd	10' x 3' Box		1616.44	1615.25	104.6	1620.89	4.45	185		

Notes:
(a) - Top of Curb Elevation
(b) - North Side (Inlet) Only
(c) - Culverts 11a and 11b have beer removed and replaced with box culvert #11 as part of a development improvements.


CLAYER ST
McKellips
R395B
370BC
395A
370A
390
D390
SR390
420
420C
SR420
380
R370A
D380
SR380
400
D400
SR400
R400
400C
C400
360
D360
SR360
340
D340
SR340
R380
D380
R355
370AC
454
RR385A
385A
C 118
C 117
R116
BASIN 5
C 116
DIV 7
BASIN 6
440
450C
R415
SR415
R390
390C
RR390
R370
R355

Flows from Ec24bake.out

2-8 Bld mt looking EAST
9-14 Bld mt NORTH
15-17 500' N. of Bld mt looking EAST
18-21



FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

Spook Hill
Culvert Numbers

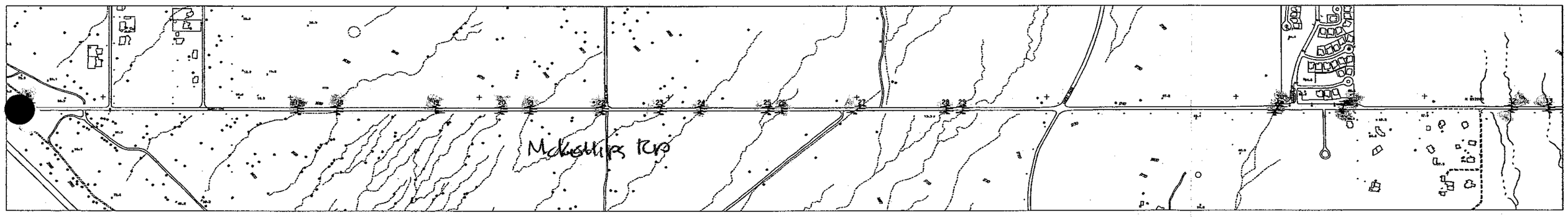
	BY	DA
DESIGNED	R. HINER	06/00
DRAWN	S. CAMPBELL	06/00
CHECKED	A. PATEL	06/00

WOOD, PATEL & ASSOCIATES, INC.
2051 WEST NORTHERN, SUITE 100
PHOENIX, ARIZONA (602) 335-8500

DRAWING NO. spkhl-cul_nmbrs.dwg

SHEET 1 OF 1

1"=1000'



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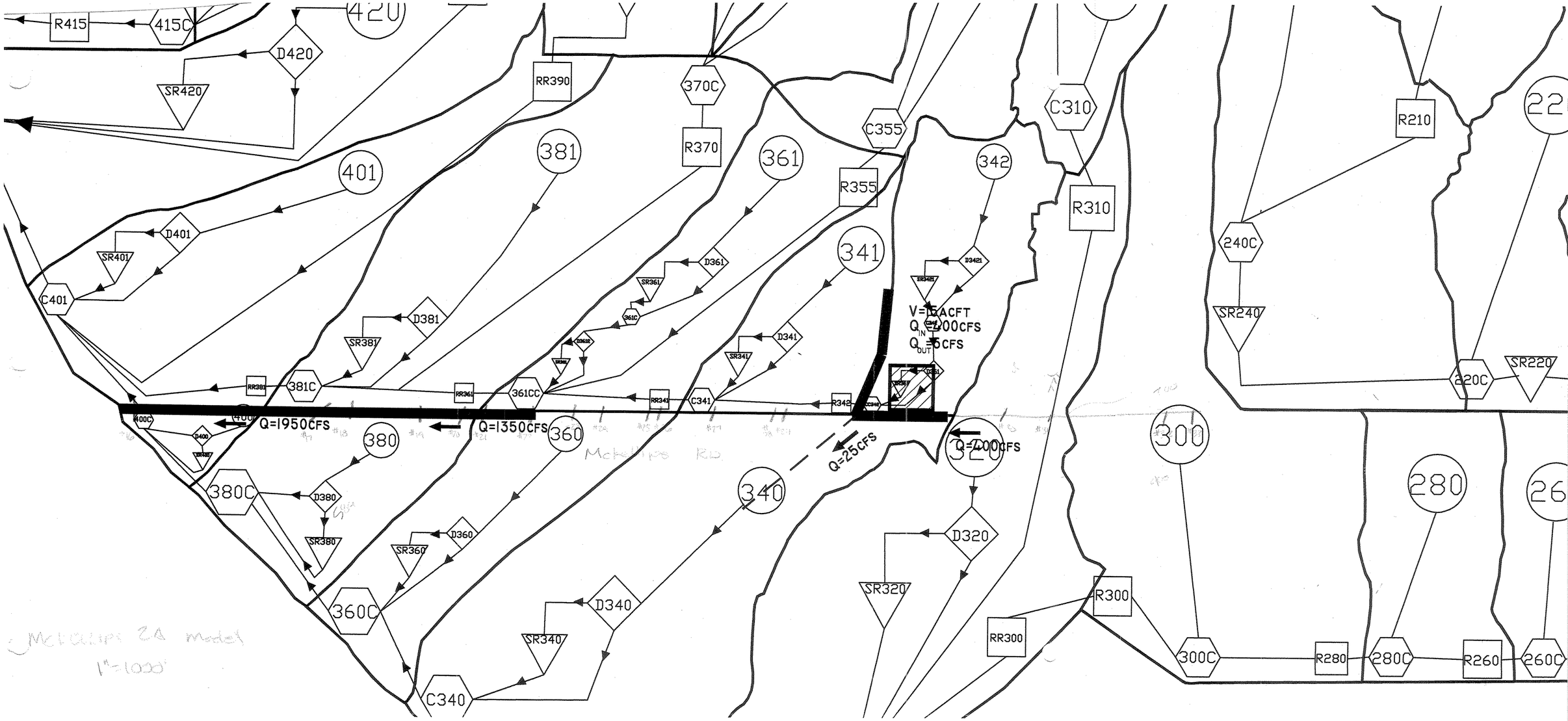
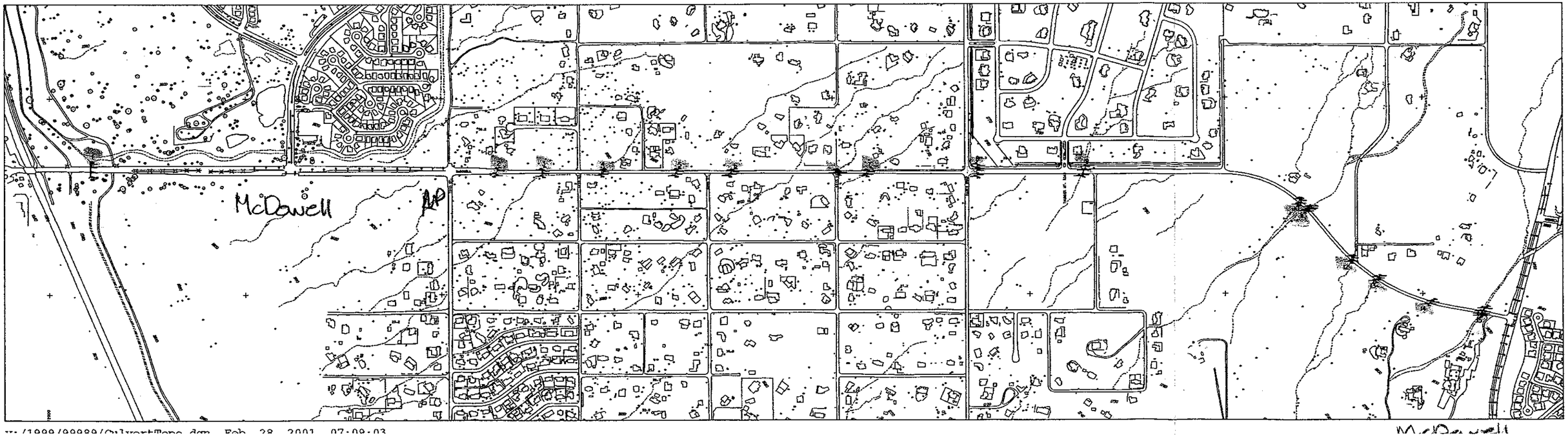
McKellips



McKellips 2A model
1"=1000'

1" = 600'



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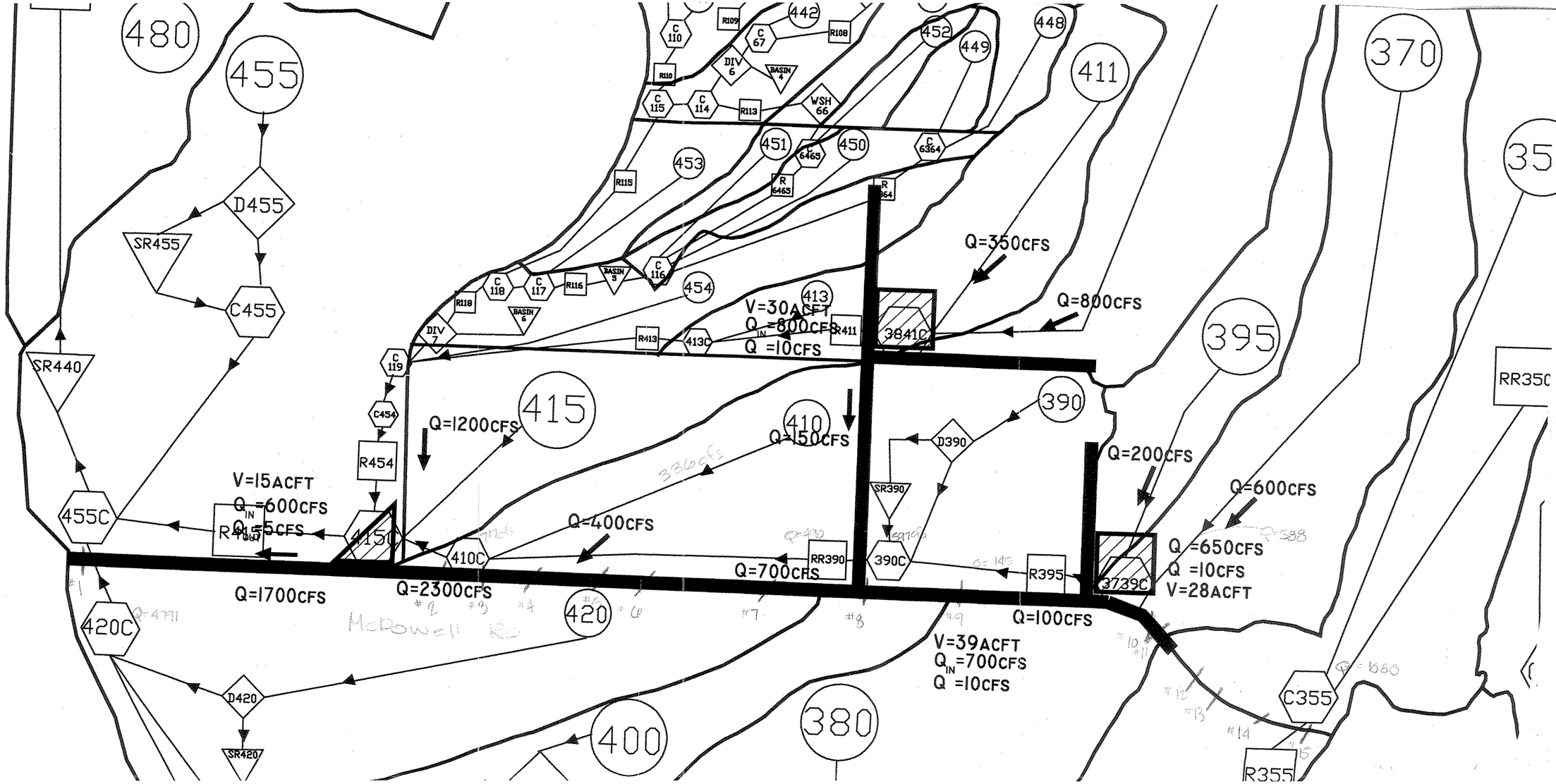
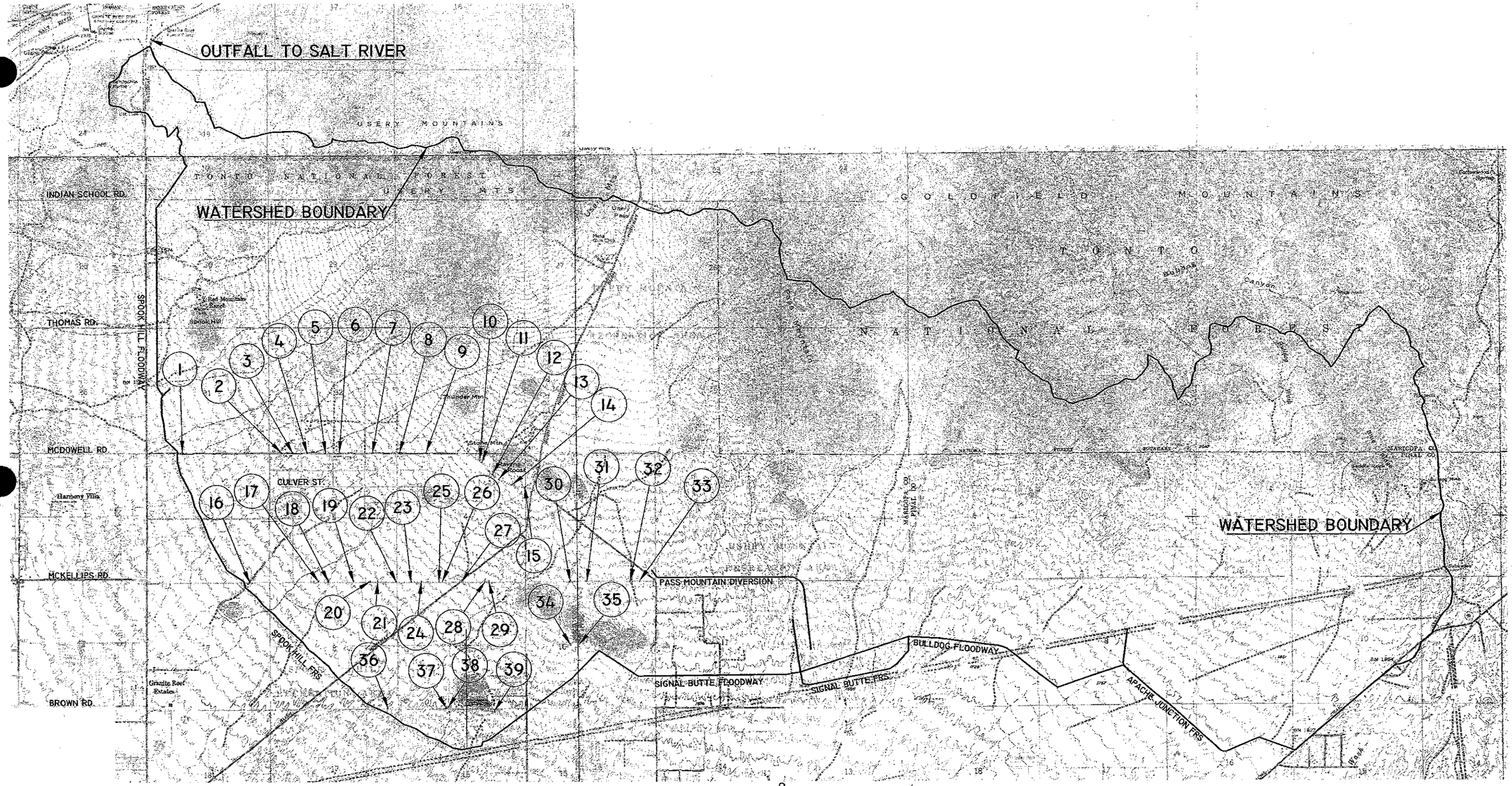
McDowell



McDowell Rd main

Pipe	Q
1	4791



FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

Spook Hill Culvert Numbers

	BY	DATE
DESIGNED	R. HINER	06/00
DRAWN	S. CAMPBELL	06/00
CHECKED	A. PATEL	06/00

WOOD, PATEL & ASSOCIATES, INC.
2051 WEST NORTHERN, SUITE 100
PHOENIX, ARIZONA (602) 335-8500

DRAWING NO.
spkhi-cul_nmbrs.dwg

SHEET 1 OF 1

Culvert #1
110" CMP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 27, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	9.12
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	2
Manning's Roughness Coefficient (n-value)	0.027
Entrance Loss Coefficient of Culvert Opening	0.8
Culvert Length (ft)	138.8
Invert Elevation at Downstream end of Culvert (ft)	1,568.28
Invert Elevation at Upstream end of Culvert (ft)	1,568.69
Culvert Slope (ft/ft)	0.003
Starting Flow Rate (cfs)	465.0
Incremental Flow Rate (cfs)	25.0
Ending Flow Rate (cfs)	1,090.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.2
Ending Tailwater Depth (ft)	6.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
465.0	1.0	8.08	9.08	9.12	5.29	5.29	11.84	← Pipe full
490.0	1.2	8.36	9.4	9.12	5.43	5.43	12.08	
515.0	1.4	8.63	9.71	9.12	5.58	5.58	12.31	
540.0	1.6	8.91	10.02	9.12	5.71	5.71	12.53	
565.0	1.8	9.18	10.34	9.12	5.85	5.85	12.76	
590.0	2.0	9.45	10.66	9.12	5.98	5.98	12.99	
615.0	2.2	9.71	11.0	9.12	6.11	6.11	13.21	
640.0	2.4	9.98	11.33	9.12	6.24	6.24	13.44	
665.0	2.6	10.25	11.69	9.12	6.36	6.36	13.67	
690.0	2.8	10.51	12.06	9.12	6.48	6.48	13.9	
715.0	3.0	11.45	10.62	9.12	6.6	9.12	10.95	
740.0	3.2	12.29	10.92	9.12	6.71	9.12	11.33	
765.0	3.4	13.02	11.3	9.12	6.82	9.12	11.71	
790.0	3.6	13.63	11.63	9.12	6.93	9.12	12.09	
815.0	3.8	14.07	11.96	9.12	7.04	9.12	12.48	
840.0	4.0	14.51	12.26	9.12	7.14	9.12	12.86	
865.0	4.2	14.98	12.6	9.12	7.24	9.12	13.24	
890.0	4.4	15.45	12.99	9.12	7.33	9.12	13.62	
915.0	4.6	15.94	13.34	9.12	7.42	9.12	14.01	
940.0	4.8	16.45	13.7	9.12	7.51	9.12	14.39	
965.0	5.0	16.96	14.06	9.12	7.6	9.12	14.77	
990.0	5.2	17.49	14.43	9.12	7.68	9.12	15.15	
1,015.0	5.4	18.04	14.77	9.12	7.76	9.12	15.54	← Max Cap (1022cfs)
1,040.0	5.6	18.59	15.15	9.12	7.84	9.12	15.92	
1,065.0	5.8	19.16	15.56	9.12	7.91	9.12	16.3	
1,090.0	6.0	19.75	15.94	9.12	7.98	9.12	16.69	

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Culvert #2
24"CMPA
(24"x18")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	1.75
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	68.1
Invert Elevation at Downstream end of Culvert (ft)	1,653.99
Invert Elevation at Upstream end of Culvert (ft)	1,654.95
Culvert Slope (ft/ft)	0.0141
Starting Flow Rate (cfs)	6.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	16.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.2
Ending Tailwater Depth (ft)	3.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
6.0	1.0	1.3	1.42	0.97	0.9	1.0	4.22	
7.0	1.2	1.43	1.55	1.07	0.98	1.2	3.98	
8.0	1.4	1.56	1.68	1.17	1.05	1.4	3.88	
9.0	1.6	1.69	1.82	1.28	1.12	1.6	3.9	← Pipe full
10.0	1.8	1.82	2.17	1.41	1.18	1.75	4.16	
11.0	2.0	1.96	2.65	1.75	1.24	1.75	4.57	
12.0	2.2	2.17	3.15	1.75	1.29	1.75	4.99	
13.0	2.4	2.3	3.68	1.75	1.34	1.75	5.4	
14.0	2.6	2.48	4.24	1.75	1.39	1.75	5.82	← Max Cap
15.0	2.8	2.67	4.83	1.75	1.43	1.75	6.24	
16.0	3.0	2.87	5.44	1.75	1.48	1.75	6.65	

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Culvert #3
42" CMPA
(42" x 29")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	3
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.8
Culvert Length (ft)	71.0
Invert Elevation at Downstream end of Culvert (ft)	1,659.92
Invert Elevation at Upstream end of Culvert (ft)	1,661.75
Culvert Slope (ft/ft)	0.0258
Starting Flow Rate (cfs)	24.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	46.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.1

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
24.0	1.0	2.45	0.0	1.34	1.58	1.34	7.82	
26.0	1.1	2.59	0.0	1.41	1.65	1.41	7.98	
28.0	1.2	2.73	0.0	1.47	1.71	1.47	8.13	
30.0	1.3	2.87	0.0	1.53	1.77	1.53	8.28	
32.0	1.4	3.0	0.0	1.59	1.84	1.59	8.41	← Pipe Full
34.0	1.5	3.14	0.0	1.65	1.89	1.65	8.53	
36.0	1.6	3.28	0.0	1.71	1.95	1.71	8.64	
38.0	1.7	3.41	0.0	1.77	2.01	1.77	8.75	
40.0	1.8	3.55	0.0	1.83	2.06	1.83	8.85	
42.0	1.9	3.69	0.0	1.89	2.11	1.89	8.94	
44.0	2.0	3.88	0.0	1.95	2.16	1.95	9.02	← Max Cap
46.0	2.1	4.07	0.0	2.02	2.21	2.02	9.1	

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Culvert #4
36" CMPA
(35" x 24")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	57.1
Invert Elevation at Downstream end of Culvert (ft)	1,672.16
Invert Elevation at Upstream end of Culvert (ft)	1,673.75
Culvert Slope (ft/ft)	0.0278
Starting Flow Rate (cfs)	17.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	37.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
17.0	1.0	2.02	0.0	1.19	1.39	1.19	7.39	
19.0	1.1	2.17	0.0	1.27	1.48	1.27	7.6	
21.0	1.2	2.33	0.0	1.35	1.56	1.35	7.79	
23.0	1.3	2.48	0.0	1.42	1.63	1.42	7.96	← Pipe full
25.0	1.4	2.64	0.0	1.5	1.7	1.5	8.1	
27.0	1.5	2.79	0.0	1.58	1.77	1.58	8.24	
29.0	1.6	3.05	0.0	1.66	1.84	1.66	8.36	← Max Cap
31.0	1.7	3.2	0.0	1.75	1.9	1.75	8.46	
33.0	1.8	3.4	0.0	1.84	1.96	1.84	8.54	
35.0	1.9	3.62	0.0	1.93	2.01	1.93	8.59	
37.0	2.0	3.84	0.0	2.04	2.06	2.04	8.61	

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Culvert #5
30"CMPA
(28"x20")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	73.7
Invert Elevation at Downstream end of Culvert (ft)	1,687.72
Invert Elevation at Upstream end of Culvert (ft)	1,689.41
Culvert Slope (ft/ft)	0.0229
Starting Flow Rate (cfs)	10.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	20.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
10.0	1.0	1.65	0.0	1.05	1.13	1.05	6.02	
11.0	1.1	1.76	0.0	1.11	1.19	1.11	6.16	
12.0	1.2	1.87	0.0	1.17	1.24	1.17	6.28	
13.0	1.3	1.97	0.0	1.23	1.3	1.23	6.39	← Pipe full
14.0	1.4	2.08	0.0	1.3	1.35	1.3	6.49	
15.0	1.5	2.19	0.0	1.36	1.4	1.36	6.57	
16.0	1.6	2.34	0.0	1.43	1.44	1.43	6.65	← Max Cap
17.0	1.7	2.5	2.55	1.51	1.49	1.7	5.97	
18.0	1.8	2.6	2.64	1.59	1.53	1.8	6.04	
19.0	1.9	2.74	2.74	1.69	1.57	1.69	6.72	
20.0	2.0	2.89	3.22	2.0	1.61	2.0	6.37	

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Culvert #6
36"CMPA
(35"x24")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	77.5
Invert Elevation at Downstream end of Culvert (ft)	1,698.53
Invert Elevation at Upstream end of Culvert (ft)	1,700.7
Culvert Slope (ft/ft)	0.028
Starting Flow Rate (cfs)	16.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	26.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
16.0	1.0	1.94	0.0	1.15	1.35	1.15	7.29
17.0	1.1	2.02	0.0	1.19	1.39	1.19	7.4
18.0	1.2	2.1	0.0	1.23	1.44	1.23	7.51
19.0	1.3	2.17	0.0	1.27	1.48	1.27	7.62
20.0	1.4	2.25	0.0	1.31	1.52	1.31	7.71
21.0	1.5	2.33	0.0	1.34	1.56	1.34	7.8
22.0	1.6	2.4	0.0	1.38	1.6	1.38	7.89 ← MAX Cap
23.0	1.7	2.48	0.0	1.42	1.63	1.42	7.97
24.0	1.8	2.56	0.0	1.46	1.67	1.46	8.05
25.0	1.9	2.64	0.0	1.5	1.7	1.5	8.13
26.0	2.0	2.71	0.0	1.54	1.74	1.54	8.19

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Culvert #7
36"CMPA
(35"x24")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	58.6
Invert Elevation at Downstream end of Culvert (ft)	1,727.33
Invert Elevation at Upstream end of Culvert (ft)	1,728.88
Culvert Slope (ft/ft)	0.0265
Starting Flow Rate (cfs)	17.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	41.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.2

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
17.0	1.0	2.02	0.0	1.21	1.39	1.21	7.25	← Pipe full
19.0	1.1	2.18	0.0	1.29	1.48	1.29	7.46	
21.0	1.2	2.33	0.0	1.37	1.56	1.37	7.63	
23.0	1.3	2.48	0.0	1.45	1.63	1.45	7.8	
25.0	1.4	2.64	0.0	1.53	1.7	1.53	7.95	
27.0	1.5	2.79	0.0	1.61	1.77	1.61	8.07	
29.0	1.6	3.05	0.0	1.7	1.84	1.7	8.18	
31.0	1.7	3.21	0.0	1.78	1.9	1.78	8.28	
33.0	1.8	3.4	0.0	1.88	1.96	1.88	8.35	← Max Cap
35.0	1.9	3.62	0.0	1.98	2.01	1.98	8.39	
37.0	2.0	3.85	3.74	2.11	2.06	2.11	8.38	
39.0	2.1	4.08	3.89	2.5	2.11	2.5	7.95	
41.0	2.2	4.34	3.21	2.5	2.15	2.5	8.35	

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Culvert #8
30"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 19, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	114.5
Invert Elevation at Downstream end of Culvert (ft)	1,751.9
Invert Elevation at Upstream end of Culvert (ft)	1,753.6
Culvert Slope (ft/ft)	0.0148
Starting Flow Rate (cfs)	20.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	46.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.3

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
20.0	1.0	2.3	0.0	1.05	1.52	1.05	10.2	
22.0	1.1	2.46	0.0	1.11	1.6	1.11	10.46	← Pipe full Capacity
24.0	1.2	2.62	0.0	1.17	1.67	1.17	10.7	
26.0	1.3	2.79	0.0	1.22	1.74	1.22	10.91	
28.0	1.4	3.0	0.0	1.27	1.8	1.27	11.13	
30.0	1.5	3.2	0.0	1.33	1.87	1.33	11.32	
32.0	1.6	3.35	0.0	1.38	1.93	1.38	11.49	
34.0	1.7	3.57	0.0	1.44	1.98	1.44	11.65	
36.0	1.8	3.8	0.0	1.49	2.04	1.49	11.8	
38.0	1.9	4.04	0.0	1.54	2.08	1.54	11.94	
40.0	2.0	4.3	0.0	1.6	2.13	1.6	12.06	← Max Cap
42.0	2.1	4.57	0.0	1.65	2.17	1.65	12.19	
44.0	2.2	4.85	0.0	1.71	2.21	1.71	12.29	
46.0	2.3	5.15	0.0	1.77	2.24	1.77	12.38	

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Culvert #9
60"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 19, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	5.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	99.2
Invert Elevation at Downstream end of Culvert (ft)	1,774.16
Invert Elevation at Upstream end of Culvert (ft)	1,777.84
Culvert Slope (ft/ft)	0.0371
Starting Flow Rate (cfs)	95.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	129.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.7

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
95.0	1.0	4.03	0.0	1.41	2.77	1.41	20.8
97.0	1.1	4.09	0.0	1.43	2.8	1.43	20.91
99.0	1.2	4.15	0.0	1.45	2.83	1.45	21.04
101.0	1.3	4.2	0.0	1.46	2.86	1.46	21.16
103.0	1.4	4.26	0.0	1.48	2.89	1.48	21.27
105.0	1.5	4.32	0.0	1.49	2.92	1.49	21.39
107.0	1.6	4.37	0.0	1.5	2.95	1.5	21.52
109.0	1.7	4.43	0.0	1.52	2.98	1.52	21.62
111.0	1.8	4.49	0.0	1.53	3.01	1.53	21.75
113.0	1.9	4.54	0.0	1.55	3.03	1.55	21.84
115.0	2.0	4.6	0.0	1.56	3.06	1.56	21.96
117.0	2.1	4.66	0.0	1.58	3.09	1.58	22.05
119.0	2.2	4.71	0.0	1.59	3.12	1.59	22.16
121.0	2.3	4.77	0.0	1.6	3.14	1.6	22.27
123.0	2.4	4.83	0.0	1.62	3.17	1.62	22.37
125.0	2.5	4.88	0.0	1.63	3.2	1.63	22.47
127.0	2.6	4.94	0.0	1.64	3.22	1.64	22.57
129.0	2.7	5.0	0.0	1.66	3.25	1.66	22.67 ← *Pipe full Cap

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*Culvert partially full of sediment. Invert elev unknown.

Culvert #10
32" CMPA
(35"x24")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	59.3
Invert Elevation at Downstream end of Culvert (ft)	1,822.96
Invert Elevation at Upstream end of Culvert (ft)	1,824.0
Culvert Slope (ft/ft)	0.0175
Starting Flow Rate (cfs)	22.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	46.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.2

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
22.0	1.0	2.42	2.62	1.61	1.6	1.6	6.65	← Pipe full
24.0	1.1	2.57	2.76	1.72	1.67	1.67	6.9	
26.0	1.2	2.73	2.89	1.83	1.74	1.74	7.14	
28.0	1.3	2.94	3.03	1.95	1.8	1.8	7.38	
30.0	1.4	3.16	3.18	2.1	1.87	1.87	7.63	
32.0	1.5	3.31	3.35	2.5	1.93	1.93	7.88	
34.0	1.6	3.52	3.58	2.5	1.98	1.98	8.14	
36.0	1.7	3.74	3.14	2.5	2.04	2.5	7.33	
38.0	1.8	3.97	3.43	2.5	2.08	2.5	7.74	
40.0	1.9	4.22	3.7	2.5	2.13	2.5	8.15	← Max Cap
42.0	2.0	4.48	3.99	2.5	2.17	2.5	8.56	
44.0	2.1	4.75	4.27	2.5	2.21	2.5	8.96	
46.0	2.2	5.03	4.57	2.5	2.24	2.5	9.37	

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Culvert #11
B-8'x3'
Clinents Estimated for
New Culv. under Const.:

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

March 20, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Span (ft)	8.0
Culvert Rise (ft)	3.0
FHWA Chart Number	8
FHWA Scale Number (Type of Culvert Entrance)	3
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	200.0
Invert Elevation at Downstream end of Culvert (ft)	100.0
Invert Elevation at Upstream end of Culvert (ft)	101.0
Culvert Slope (ft/ft)	0.005
Starting Flow Rate (cfs)	120.0
Incremental Flow Rate (cfs)	10.0
Ending Flow Rate (cfs)	220.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
120.0	1.0	3.27	0.0	1.58	1.91	1.58	9.51
130.0	1.1	3.45	0.0	1.67	2.02	1.67	9.75
140.0	1.2	3.63	0.0	1.75	2.12	1.75	9.99
150.0	1.3	3.94	0.0	1.84	2.22	1.84	10.21
160.0	1.4	4.32	0.0	1.92	2.32	1.92	10.41
170.0	1.5	4.57	0.0	2.0	2.41	2.0	10.61
180.0	1.6	4.83	0.0	2.08	2.51	2.08	10.8
190.0	1.7	5.1	0.0	2.16	2.6	2.16	10.98
200.0	1.8	5.39	0.0	2.24	2.69	2.24	11.15
210.0	1.9	5.69	0.0	2.32	2.78	2.32	11.31
220.0	2.0	6.01	0.0	2.4	2.86	2.4	11.47 ← MAX cap per Bbl

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Culvert #11a
42"CMPA
VOID
Culvert Removed & Replaced by #11

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	59.5
Invert Elevation at Downstream end of Culvert (ft)	1,822.55
Invert Elevation at Upstream end of Culvert (ft)	1,827.42
Culvert Slope (ft/ft)	0.0818
Starting Flow Rate (cfs)	30.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	50.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
30.0	1.0	2.53	0.0	1.11	1.77	1.11	12.67
32.0	1.1	2.65	0.0	1.15	1.84	1.15	12.88
34.0	1.2	2.76	0.0	1.18	1.89	1.18	13.11
36.0	1.3	2.88	0.0	1.22	1.95	1.22	13.31
38.0	1.4	3.0	0.0	1.26	2.01	1.26	13.5 ← Pipe full *
40.0	1.5	3.12	0.0	1.3	2.06	1.3	13.69
42.0	1.6	3.23	0.0	1.33	2.11	1.33	13.87
44.0	1.7	3.42	0.0	1.37	2.16	1.37	14.04
46.0	1.8	3.6	0.0	1.4	2.21	1.4	14.19
48.0	1.9	3.73	0.0	1.44	2.26	1.44	14.35
50.0	2.0	3.84	0.0	1.47	2.3	1.47	14.51

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*Culvert full of sediment. Invert elev. unknown.

Culvert #11b
48" CMPA
(49" x 33")
VOID
Culvert Removed & Replaced by #11

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.5
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	60.2
Invert Elevation at Downstream end of Culvert (ft)	1,822.99
Invert Elevation at Upstream end of Culvert (ft)	1,826.86
Culvert Slope (ft/ft)	0.0643
Starting Flow Rate (cfs)	50.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	70.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
50.0	1.0	3.26	0.0	1.46	2.21	1.46	13.2
52.0	1.1	3.35	0.0	1.49	2.26	1.49	13.34
54.0	1.2	3.44	0.0	1.52	2.3	1.52	13.49
56.0	1.3	3.53	0.0	1.55	2.34	1.55	13.61 ← Pipe full *
58.0	1.4	3.63	0.0	1.58	2.39	1.58	13.74
60.0	1.5	3.72	0.0	1.61	2.43	1.61	13.85
62.0	1.6	3.82	0.0	1.64	2.47	1.64	13.97
64.0	1.7	3.96	0.0	1.67	2.51	1.67	14.08
66.0	1.8	4.12	0.0	1.7	2.55	1.7	14.2
68.0	1.9	4.26	0.0	1.73	2.58	1.73	14.31
70.0	2.0	4.36	0.0	1.76	2.62	1.76	14.4

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* Culvert full of sediment. Invert elevation unknown.

Culvert #12
24"CMPA
(24"x18")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	1.75
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	60.3
Invert Elevation at Downstream end of Culvert (ft)	1,814.5
Invert Elevation at Upstream end of Culvert (ft)	1,814.74
Culvert Slope (ft/ft)	0.004
Starting Flow Rate (cfs)	7.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	17.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
7.0	1.0	1.44	1.71	1.75	0.98	1.0	4.93	
8.0	1.1	1.57	1.89	1.75	1.05	1.1	5.03	
9.0	1.2	1.7	1.91	1.75	1.12	1.2	5.12	←Pipe full
10.0	1.3	1.83	2.15	1.75	1.18	1.3	5.22	
11.0	1.4	1.97	2.41	1.75	1.24	1.4	5.33	←Max Cap
12.0	1.5	2.18	2.69	1.75	1.29	1.5	5.47	
13.0	1.6	2.31	3.0	1.75	1.34	1.6	5.64	
14.0	1.7	2.49	3.34	1.75	1.39	1.7	5.87	
15.0	1.8	2.68	4.31	1.75	1.43	1.75	6.24	
16.0	1.9	2.88	4.79	1.75	1.48	1.75	6.65	
17.0	2.0	3.1	5.29	1.75	1.51	1.75	7.07	

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Culvert #13
18"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	1.5
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.013
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	46.62
Invert Elevation at Downstream end of Culvert (ft)	1,808.87
Invert Elevation at Upstream end of Culvert (ft)	1,808.88
Culvert Slope (ft/ft)	0.0002
Starting Flow Rate (cfs)	6.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	16.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
6.0	1.0	1.46	1.62	1.5	0.95	1.0	4.79	← Pipe full
7.0	1.1	1.64	1.81	1.5	1.02	1.1	5.04	
8.0	1.2	1.86	1.72	1.5	1.1	1.5	4.53	
9.0	1.3	2.04	1.9	1.5	1.16	1.5	5.09	
10.0	1.4	2.28	2.09	1.5	1.22	1.5	5.66	
11.0	1.5	2.55	2.9	1.5	1.27	1.5	6.22	← MAX CAP
12.0	1.6	2.84	3.27	1.5	1.31	1.5	6.79	
13.0	1.7	3.16	3.67	1.5	1.35	1.5	7.36	
14.0	1.8	3.5	4.08	1.5	1.38	1.5	7.92	
15.0	1.9	3.87	4.52	1.5	1.41	1.5	8.49	
16.0	2.0	4.27	4.98	1.5	1.42	1.5	9.05	

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Culvert #14
22" CMPA
(21"x15")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 21, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	1.5
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.014
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	69.2
Invert Elevation at Downstream end of Culvert (ft)	1,819.47
Invert Elevation at Upstream end of Culvert (ft)	1,820.71
Culvert Slope (ft/ft)	0.0179
Starting Flow Rate (cfs)	6.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	16.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
6.0	1.0	1.43	0.0	0.71	0.95	0.71	7.24	← Pipe full
7.0	1.1	1.59	0.0	0.78	1.02	0.78	7.52	← Max Cap
8.0	1.2	1.82	0.0	0.85	1.1	0.85	7.76	
9.0	1.3	2.0	0.0	0.92	1.16	0.92	7.96	
10.0	1.4	2.24	0.0	0.98	1.22	0.98	8.15	
11.0	1.5	2.49	2.04	1.05	1.27	1.05	8.29	
12.0	1.6	2.77	2.48	1.13	1.31	1.13	8.38	
13.0	1.7	3.07	2.95	1.22	1.35	1.22	8.42	
14.0	1.8	3.4	3.45	1.37	1.38	1.5	7.92	
15.0	1.9	3.75	3.98	1.5	1.41	1.5	8.49	
16.0	2.0	4.13	4.53	1.5	1.42	1.5	9.05	

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Culvert #15a
60"CMPA

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 22, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	4.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.02
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	85.2
Invert Elevation at Downstream end of Culvert (ft)	1,826.94
Invert Elevation at Upstream end of Culvert (ft)	1,829.05
Culvert Slope (ft/ft)	0.0248
Starting Flow Rate (cfs)	65.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	75.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
65.0	1.0	3.62	0.0	1.86	2.43	1.86	11.34
66.0	1.1	3.66	0.0	1.88	2.45	1.88	11.38
67.0	1.2	3.69	0.0	1.9	2.47	1.9	11.43
68.0	1.3	3.73	0.0	1.91	2.49	1.91	11.47
69.0	1.4	3.77	0.0	1:93	2.51	1.93	11.51
70.0	1.5	3.81	0.0	1.94	2.53	1.94	11.55
71.0	1.6	3.85	0.0	1.96	2.55	1.96	11.59
72.0	1.7	3.88	0.0	1.98	2.57	1.98	11.64
73.0	1.8	3.92	0.0	1.99	2.58	1.99	11.68
74.0	1.9	3.96	0.0	2.01	2.6	2.01	11.71
75.0	2.0	4.0	0.0	2.03	2.62	2.03	11.75 ← Pipe full

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Culvert 156
62" CMPA
(64"x43")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 22, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	4.5
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.02
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	84.9
Invert Elevation at Downstream end of Culvert (ft)	1,827.42
Invert Elevation at Upstream end of Culvert (ft)	1,829.17
Culvert Slope (ft/ft)	0.0206
Starting Flow Rate (cfs)	79.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	101.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.1

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
79.0	1.0	3.82	0.0	2.06	2.6	2.06	11.1
81.0	1.1	3.88	0.0	2.09	2.63	2.09	11.18
83.0	1.2	3.94	0.0	2.12	2.67	2.12	11.25
85.0	1.3	4.01	0.0	2.15	2.7	2.15	11.31
87.0	1.4	4.07	0.0	2.18	2.73	2.18	11.38
89.0	1.5	4.13	0.0	2.21	2.77	2.21	11.45
91.0	1.6	4.2	0.0	2.24	2.8	2.24	11.52
93.0	1.7	4.26	0.0	2.27	2.83	2.27	11.58
95.0	1.8	4.33	0.0	2.3	2.86	2.3	11.64
97.0	1.9	4.39	0.0	2.33	2.89	2.33	11.7
99.0	2.0	4.45	0.0	2.35	2.92	2.35	11.76 ← Pipe full cap.
101.0	2.1	4.52	0.0	2.38	2.95	2.38	11.81

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Culvert #10
120" CMP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 22, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	10.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	2
Manning's Roughness Coefficient (n-value)	0.03
Entrance Loss Coefficient of Culvert Opening	0.8
Culvert Length (ft)	148.7
Invert Elevation at Downstream end of Culvert (ft)	1,569.41
Invert Elevation at Upstream end of Culvert (ft)	1,569.56
Culvert Slope (ft/ft)	0.001
Starting Flow Rate (cfs)	567.0
Incremental Flow Rate (cfs)	80.0
Ending Flow Rate (cfs)	1,447.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.1

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
567.0	1.0	8.67	10.0	10.0	5.7	5.7	12.26	← Pipe full
647.0	1.1	9.44	10.91	10.0	6.11	6.11	12.88	
727.0	1.2	10.2	11.84	10.0	6.49	6.49	13.48	
807.0	1.3	10.94	12.87	10.0	6.85	6.85	14.08	
887.0	1.4	12.12	12.16	10.0	7.18	7.18	14.69	
967.0	1.5	14.35	13.1	10.0	7.5	10.0	12.31	
1,047.0	1.6	15.74	14.14	10.0	7.79	10.0	13.33	
1,127.0	1.7	17.04	15.17	10.0	8.06	10.0	14.35	
1,207.0	1.8	18.44	16.24	10.0	8.31	10.0	15.37	
1,287.0	1.9	19.94	17.32	10.0	8.54	10.0	16.39	← MAX cap
1,367.0	2.0	21.53	18.5	10.0	8.74	10.0	17.41	
1,447.0	2.1	23.22	19.7	10.0	8.92	10.0	18.42	

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Culvert #17
36"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	62.2
Invert Elevation at Downstream end of Culvert (ft)	1,613.0
Invert Elevation at Upstream end of Culvert (ft)	1,613.85
Culvert Slope (ft/ft)	0.0137
Starting Flow Rate (cfs)	36.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	48.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.2

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
36.0	1.0	3.04	0.0	1.37	1.95	1.37	11.47	← Pipefull
37.0	1.1	3.1	0.0	1.39	1.98	1.39	11.55	
38.0	1.2	3.16	0.0	1.41	2.01	1.41	11.64	
39.0	1.3	3.22	0.0	1.43	2.03	1.43	11.71	
40.0	1.4	3.28	0.0	1.45	2.06	1.45	11.79	
41.0	1.5	3.34	0.0	1.47	2.09	1.47	11.87	
42.0	1.6	3.41	0.0	1.5	2.11	1.5	11.93	
43.0	1.7	3.48	0.0	1.52	2.14	1.52	12.0	
44.0	1.8	3.59	0.0	1.54	2.16	1.54	12.07	
45.0	1.9	3.68	0.0	1.56	2.19	1.56	12.14	
46.0	2.0	3.76	0.0	1.58	2.21	1.58	12.21	
47.0	2.1	3.82	0.0	1.6	2.23	1.6	12.27	
48.0	2.2	3.87	0.0	1.62	2.26	1.62	12.33	← Max Cap

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Culvert #18
36"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	62.2
Invert Elevation at Downstream end of Culvert (ft)	1,619.42
Invert Elevation at Upstream end of Culvert (ft)	1,620.7
Culvert Slope (ft/ft)	0.0206
Starting Flow Rate (cfs)	35.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	47.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.2

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
35.0	1.0	2.96	0.0	1.2	1.92	1.2	13.23	
36.0	1.1	3.02	0.0	1.22	1.95	1.22	13.35	← Pipe full
37.0	1.2	3.09	0.0	1.24	1.98	1.24	13.43	
38.0	1.3	3.15	0.0	1.26	2.01	1.26	13.54	
39.0	1.4	3.21	0.0	1.28	2.03	1.28	13.62	
40.0	1.5	3.27	0.0	1.29	2.06	1.29	13.71	
41.0	1.6	3.33	0.0	1.31	2.09	1.31	13.8	
42.0	1.7	3.4	0.0	1.33	2.11	1.33	13.89	
43.0	1.8	3.47	0.0	1.35	2.14	1.35	13.98	← Max Cap
44.0	1.9	3.58	0.0	1.37	2.16	1.37	14.06	
45.0	2.0	3.67	0.0	1.38	2.19	1.38	14.15	
46.0	2.1	3.75	0.0	1.4	2.21	1.4	14.23	
47.0	2.2	3.81	0.0	1.42	2.23	1.42	14.3	

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Culvert #19
30"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	60.9
Invert Elevation at Downstream end of Culvert (ft)	1,634.07
Invert Elevation at Upstream end of Culvert (ft)	1,634.64
Culvert Slope (ft/ft)	0.0094
Starting Flow Rate (cfs)	22.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	46.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.2

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
22.0	1.0	2.47	0.0	1.27	1.6	1.27	8.81	←Pipe full
24.0	1.1	2.63	0.0	1.34	1.67	1.34	8.99	
26.0	1.2	2.79	0.0	1.4	1.74	1.4	9.17	
28.0	1.3	3.01	0.0	1.47	1.8	1.47	9.33	
30.0	1.4	3.2	0.0	1.54	1.87	1.54	9.47	
32.0	1.5	3.35	0.0	1.61	1.93	1.61	9.6	
34.0	1.6	3.57	0.0	1.68	1.98	1.68	9.71	←Max Cap
36.0	1.7	3.8	0.0	1.75	2.04	1.75	9.81	
38.0	1.8	4.05	0.0	1.83	2.08	1.83	9.89	
40.0	1.9	4.31	0.0	1.91	2.13	1.91	9.95	
42.0	2.0	4.58	0.0	2.0	2.17	2.0	9.98	
44.0	2.1	4.86	0.0	2.11	2.21	2.11	9.97	
46.0	2.2	5.16	4.52	2.27	2.24	2.27	9.81	

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Culvert #20
30"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	61.2
Invert Elevation at Downstream end of Culvert (ft)	1,643.93
Invert Elevation at Upstream end of Culvert (ft)	1,644.3
Culvert Slope (ft/ft)	0.006
Starting Flow Rate (cfs)	22.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	46.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.2

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
22.0	1.0	2.47	0.0	1.45	1.6	1.45	7.46	← Pipe full
24.0	1.1	2.63	0.0	1.53	1.67	1.53	7.6	
26.0	1.2	2.8	0.0	1.62	1.74	1.62	7.73	
28.0	1.3	3.01	0.0	1.71	1.8	1.71	7.84	
30.0	1.4	3.21	0.0	1.8	1.87	1.8	7.93	
32.0	1.5	3.36	0.0	1.9	1.93	1.9	7.99	
34.0	1.6	3.58	3.51	2.01	1.98	2.01	8.03	← Max Cap
36.0	1.7	3.81	3.65	2.16	2.04	2.16	7.99	
38.0	1.8	4.05	3.8	2.5	2.08	2.5	7.74	
40.0	1.9	4.31	3.98	2.5	2.13	2.5	8.15	
42.0	2.0	4.58	4.19	2.5	2.17	2.5	8.56	
44.0	2.1	4.87	3.2	2.5	2.21	2.5	8.96	
46.0	2.2	5.16	3.35	2.5	2.24	2.5	9.37	

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Culvert #21
36"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	62.4
Invert Elevation at Downstream end of Culvert (ft)	1,648.65
Invert Elevation at Upstream end of Culvert (ft)	1,649.19
Culvert Slope (ft/ft)	0.0087
Starting Flow Rate (cfs)	35.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	50.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.5

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
35.0	1.0	2.98	0.0	1.54	1.92	1.54	9.6	← Pipe Cap
36.0	1.1	3.04	0.0	1.56	1.95	1.56	9.67	
37.0	1.2	3.1	0.0	1.59	1.98	1.59	9.73	
38.0	1.3	3.17	0.0	1.62	2.01	1.62	9.8	
39.0	1.4	3.23	0.0	1.64	2.03	1.64	9.86	
40.0	1.5	3.29	0.0	1.67	2.06	1.67	9.92	
41.0	1.6	3.35	0.0	1.69	2.09	1.69	9.98	
42.0	1.7	3.41	0.0	1.72	2.11	1.72	10.03	
43.0	1.8	3.49	0.0	1.74	2.14	1.74	10.08	
44.0	1.9	3.59	0.0	1.77	2.16	1.77	10.14	
45.0	2.0	3.69	0.0	1.8	2.19	1.8	10.19	
46.0	2.1	3.76	0.0	1.82	2.21	1.82	10.23	
47.0	2.2	3.83	0.0	1.85	2.23	1.85	10.28	
48.0	2.3	3.88	0.0	1.87	2.26	1.87	10.33	
49.0	2.4	3.91	0.0	1.9	2.28	1.9	10.38	← Max Cap
50.0	2.5	3.99	0.0	1.93	2.3	1.93	10.42	

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Culvert #6
36"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	62.3
Invert Elevation at Downstream end of Culvert (ft)	1,659.81
Invert Elevation at Upstream end of Culvert (ft)	1,660.38
Culvert Slope (ft/ft)	0.0091
Starting Flow Rate (cfs)	35.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	65.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.5

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
35.0	1.0	2.98	0.0	1.51	1.92	1.51	9.81	← Pipe Cap
37.0	1.1	3.1	0.0	1.56	1.98	1.56	9.95	
39.0	1.2	3.23	0.0	1.61	2.03	1.61	10.07	
41.0	1.3	3.35	0.0	1.66	2.09	1.66	10.19	
43.0	1.4	3.48	0.0	1.71	2.14	1.71	10.3	
45.0	1.5	3.69	0.0	1.76	2.19	1.76	10.41	
47.0	1.6	3.83	0.0	1.81	2.23	1.81	10.51	
49.0	1.7	3.91	0.0	1.87	2.28	1.87	10.61	
51.0	1.8	4.07	0.0	1.92	2.32	1.92	10.69	← Max Cap
53.0	1.9	4.23	0.0	1.97	2.37	1.97	10.78	
55.0	2.0	4.41	0.0	2.02	2.41	2.02	10.85	
57.0	2.1	4.58	0.0	2.08	2.45	2.08	10.92	
59.0	2.2	4.77	0.0	2.13	2.48	2.13	10.98	
61.0	2.3	4.96	0.0	2.19	2.52	2.19	11.04	
63.0	2.4	5.16	0.0	2.25	2.55	2.25	11.08	
65.0	2.5	5.36	0.0	2.31	2.59	2.31	11.11	

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Culvert #23
30"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	61.2
Invert Elevation at Downstream end of Culvert (ft)	1,670.36
Invert Elevation at Upstream end of Culvert (ft)	1,670.89
Culvert Slope (ft/ft)	0.0087
Starting Flow Rate (cfs)	21.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	36.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.5

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
21.0	1.0	2.39	0.0	1.26	1.56	1.26	8.46	
22.0	1.1	2.47	0.0	1.3	1.6	1.3	8.56	← Pipe Cap
23.0	1.2	2.55	0.0	1.33	1.63	1.33	8.65	
24.0	1.3	2.63	0.0	1.37	1.67	1.37	8.73	
25.0	1.4	2.71	0.0	1.4	1.7	1.4	8.82	
26.0	1.5	2.79	0.0	1.44	1.74	1.44	8.9	
27.0	1.6	2.88	0.0	1.47	1.77	1.47	8.97	
28.0	1.7	3.01	0.0	1.51	1.8	1.51	9.05	
29.0	1.8	3.12	0.0	1.54	1.84	1.54	9.12	
30.0	1.9	3.2	0.0	1.58	1.87	1.58	9.19	
31.0	2.0	3.25	0.0	1.62	1.9	1.62	9.24	← Max Cap
32.0	2.1	3.36	0.0	1.65	1.93	1.65	9.3	
33.0	2.2	3.46	0.0	1.69	1.96	1.69	9.36	
34.0	2.3	3.57	0.0	1.73	1.98	1.73	9.4	
35.0	2.4	3.69	0.0	1.77	2.01	1.77	9.45	
36.0	2.5	3.8	3.63	1.8	2.04	1.8	9.49	

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Culvert #24
34"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.83
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	62.3
Invert Elevation at Downstream end of Culvert (ft)	1,676.17
Invert Elevation at Upstream end of Culvert (ft)	1,676.66
Culvert Slope (ft/ft)	0.0079
Starting Flow Rate (cfs)	30.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	58.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.4

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
30.0	1.0	2.8	0.0	1.49	1.81	1.49	8.92	← Pipe full
32.0	1.1	2.93	0.0	1.55	1.87	1.55	9.06	
34.0	1.2	3.07	0.0	1.61	1.93	1.61	9.18	
36.0	1.3	3.2	0.0	1.67	1.98	1.67	9.3	
38.0	1.4	3.39	0.0	1.73	2.04	1.73	9.42	
40.0	1.5	3.57	0.0	1.79	2.09	1.79	9.52	
42.0	1.6	3.68	0.0	1.86	2.14	1.86	9.61	
44.0	1.7	3.83	0.0	1.92	2.19	1.92	9.69	
46.0	1.8	4.01	0.0	1.98	2.24	1.98	9.77	
48.0	1.9	4.2	0.0	2.05	2.28	2.05	9.83	← MAX Cap
50.0	2.0	4.4	0.0	2.12	2.32	2.12	9.88	
52.0	2.1	4.6	0.0	2.2	2.36	2.2	9.92	
54.0	2.2	4.82	0.0	2.28	2.4	2.28	9.94	
56.0	2.3	5.04	0.0	2.38	2.44	2.38	9.93	
58.0	2.4	5.27	4.77	2.5	2.47	2.5	9.85	

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Culvert # 25
30"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	61.2
Invert Elevation at Downstream end of Culvert (ft)	1,688.02
Invert Elevation at Upstream end of Culvert (ft)	1,688.24
Culvert Slope (ft/ft)	0.0036
Starting Flow Rate (cfs)	20.0
Incremental Flow Rate (cfs)	1.5
Ending Flow Rate (cfs)	41.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.4

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
20.0	1.0	2.32	2.44	1.62	1.52	1.52	6.41	← Pipe full
21.5	1.1	2.44	2.55	1.7	1.58	1.58	6.59	
23.0	1.2	2.56	2.66	1.79	1.63	1.63	6.77	
24.5	1.3	2.68	2.77	1.89	1.69	1.69	6.96	
26.0	1.4	2.8	2.88	2.0	1.74	1.74	7.14	
27.5	1.5	2.95	2.99	2.13	1.79	1.79	7.32	
29.0	1.6	3.13	3.11	2.5	1.84	2.5	5.91	
30.5	1.7	3.24	3.23	2.5	1.88	2.5	6.21	
32.0	1.8	3.36	3.35	2.5	1.93	2.5	6.52	
33.5	1.9	3.52	3.47	2.5	1.97	2.5	6.82	
35.0	2.0	3.69	3.6	2.5	2.01	2.5	7.13	
36.5	2.1	3.87	3.75	2.5	2.05	2.5	7.44	
38.0	2.2	4.06	2.99	2.5	2.08	2.5	7.74	
39.5	2.3	4.25	3.12	2.5	2.12	2.5	8.05	
41.0	2.4	4.45	3.26	2.5	2.15	2.5	8.35	← Max Cap

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Culvert #20
30"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	62.5
Invert Elevation at Downstream end of Culvert (ft)	1,689.33
Invert Elevation at Upstream end of Culvert (ft)	1,689.98
Culvert Slope (ft/ft)	0.0104
Starting Flow Rate (cfs)	35.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	63.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.4

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
35.0	1.0	2.98	0.0	1.46	1.92	1.46	10.29	← Pipe full
37.0	1.1	3.1	0.0	1.5	1.98	1.5	10.43	
39.0	1.2	3.22	0.0	1.55	2.03	1.55	10.57	
41.0	1.3	3.35	0.0	1.6	2.09	1.6	10.7	
43.0	1.4	3.48	0.0	1.65	2.14	1.65	10.82	
45.0	1.5	3.68	0.0	1.69	2.19	1.69	10.94	
47.0	1.6	3.82	0.0	1.74	2.23	1.74	11.05	
49.0	1.7	3.91	0.0	1.79	2.28	1.79	11.15	
51.0	1.8	4.07	0.0	1.84	2.32	1.84	11.26	
53.0	1.9	4.23	0.0	1.88	2.37	1.88	11.35	
55.0	2.0	4.4	0.0	1.93	2.41	1.93	11.43	
57.0	2.1	4.58	0.0	1.98	2.45	1.98	11.51	
59.0	2.2	4.77	0.0	2.03	2.48	2.03	11.58	
61.0	2.3	4.96	0.0	2.08	2.52	2.08	11.65	← Max Cap
63.0	2.4	5.16	0.0	2.13	2.55	2.13	11.71	

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Culvert #27
30"CMPA
(28"x20")

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	101.4
Invert Elevation at Downstream end of Culvert (ft)	1,700.99
Invert Elevation at Upstream end of Culvert (ft)	1,701.63
Culvert Slope (ft/ft)	0.0063
Starting Flow Rate (cfs)	13.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	27.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.4

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
13.0	1.0	2.02	0.0	1.2	1.3	1.2	6.64	← Pipe full
14.0	1.1	2.14	0.0	1.26	1.35	1.26	6.74	
15.0	1.2	2.25	0.0	1.32	1.4	1.32	6.84	
16.0	1.3	2.4	0.0	1.38	1.44	1.38	6.92	
17.0	1.4	2.55	0.0	1.45	1.49	1.45	6.99	
18.0	1.5	2.64	0.0	1.52	1.53	1.52	7.04	
19.0	1.6	2.79	2.76	1.6	1.57	1.6	7.07	
20.0	1.7	2.95	2.85	1.69	1.61	1.69	7.05	
21.0	1.8	3.11	2.96	2.0	1.64	2.0	6.68	
22.0	1.9	3.29	2.43	2.0	1.68	2.0	7.0	
23.0	2.0	3.47	3.5	2.0	1.71	2.0	7.32	← Max Cap
24.0	2.1	3.66	3.79	2.0	1.74	2.0	7.64	
25.0	2.2	3.85	4.09	2.0	1.76	2.0	7.96	
26.0	2.3	4.06	4.4	2.0	1.79	2.0	8.28	
27.0	2.4	4.27	4.71	2.0	1.81	2.0	8.59	

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Culvert #E8
36"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 23, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	62.6
Invert Elevation at Downstream end of Culvert (ft)	1,711.71
Invert Elevation at Upstream end of Culvert (ft)	1,712.11
Culvert Slope (ft/ft)	0.0064
Starting Flow Rate (cfs)	35.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	65.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.5

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
35.0	1.0	2.98	0.0	1.69	1.92	1.69	8.56	← Pipe full
37.0	1.1	3.11	0.0	1.75	1.98	1.75	8.67	
39.0	1.2	3.23	0.0	1.81	2.03	1.81	8.77	
41.0	1.3	3.36	0.0	1.87	2.09	1.87	8.87	
43.0	1.4	3.49	0.0	1.93	2.14	1.93	8.95	
45.0	1.5	3.69	0.0	1.99	2.19	1.99	9.03	
47.0	1.6	3.83	0.0	2.05	2.23	2.05	9.11	
49.0	1.7	3.91	0.0	2.12	2.28	2.12	9.17	
51.0	1.8	4.07	0.0	2.19	2.32	2.19	9.23	
53.0	1.9	4.24	0.0	2.26	2.37	2.26	9.27	
55.0	2.0	4.41	0.0	2.34	2.41	2.34	9.3	
57.0	2.1	4.59	0.0	2.42	2.45	2.42	9.31	
59.0	2.2	4.77	4.54	2.52	2.48	2.52	9.3	
61.0	2.3	4.96	4.64	2.65	2.52	2.65	9.24	
63.0	2.4	5.16	4.76	3.0	2.55	3.0	8.91	← Max Cap
65.0	2.5	5.37	4.89	3.0	2.59	3.0	9.2	

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Culvert #29
30"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 27, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	61.4
Invert Elevation at Downstream end of Culvert (ft)	1,714.22
Invert Elevation at Upstream end of Culvert (ft)	1,714.95
Culvert Slope (ft/ft)	0.0119
Starting Flow Rate (cfs)	22.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	52.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.5

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
22.0	1.0	2.47	0.0	1.18	1.6	1.18	9.63	← Pipe full
24.0	1.1	2.63	0.0	1.24	1.67	1.24	9.85	
26.0	1.2	2.79	0.0	1.3	1.74	1.3	10.05	
28.0	1.3	3.0	0.0	1.36	1.8	1.36	10.22	
30.0	1.4	3.2	0.0	1.42	1.87	1.42	10.39	
32.0	1.5	3.35	0.0	1.48	1.93	1.48	10.55	
34.0	1.6	3.57	0.0	1.54	1.98	1.54	10.68	
36.0	1.7	3.8	0.0	1.6	2.04	1.6	10.81	
38.0	1.8	4.05	0.0	1.67	2.08	1.67	10.92	
40.0	1.9	4.3	0.0	1.73	2.13	1.73	11.02	← Max Cap
42.0	2.0	4.57	0.0	1.8	2.17	1.8	11.11	
44.0	2.1	4.86	0.0	1.87	2.21	1.87	11.18	
46.0	2.2	5.16	0.0	1.94	2.24	1.94	11.23	
48.0	2.3	5.47	0.0	2.03	2.27	2.03	11.25	
50.0	2.4	5.79	0.0	2.13	2.3	2.13	11.22	
52.0	2.5	6.13	5.23	2.3	2.32	2.3	11.01	

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Culvert #30
2-75"x38" ARCH
CONCRETE

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

March 20, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Span (ft)	6.5
Culvert Rise (ft)	3.0
FHWA Chart Number	8
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	61.4
Invert Elevation at Downstream end of Culvert (ft)	1,714.22
Invert Elevation at Upstream end of Culvert (ft)	1,714.95
Culvert Slope (ft/ft)	0.0119
Starting Flow Rate (cfs)	80.0
Incremental Flow Rate (cfs)	10.0
Ending Flow Rate (cfs)	180.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	1.0
Ending Tailwater Depth (ft)	11.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
80.0	1.0	2.68	0.0	1.06	1.68	1.06	11.62
90.0	2.0	2.91	0.0	1.14	1.81	1.14	12.09
100.0	3.0	3.13	2.98	1.23	1.94	1.23	12.52
110.0	4.0	3.34	4.13	1.31	2.07	3.0	5.64
120.0	5.0	3.62	5.3	1.39	2.2	3.0	6.15
130.0	6.0	4.1	6.48	1.47	2.32	3.0	6.67
140.0	7.0	4.4	7.67	1.55	2.43	3.0	7.18
150.0	8.0	4.69	8.88	1.62	2.55	3.0	7.69
160.0	9.0	5.0	10.1	1.7	2.66	3.0	8.21
170.0	10.0	5.34	11.34	1.77	2.77	3.0	8.72
180.0	11.0	5.69	12.59	1.84	2.88	3.0	9.23

125cfs/Pipe
250cfs/total

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Culvert #31a
E-38"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 27, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.17
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	114.0
Invert Elevation at Downstream end of Culvert (ft)	1,760.46
Invert Elevation at Upstream end of Culvert (ft)	1,761.0
Culvert Slope (ft/ft)	0.0047
Starting Flow Rate (cfs)	39.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	69.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.5

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
39.0	1.0	3.09	0.0	1.91	2.0	1.91	7.84	
41.0	1.1	3.2	0.0	1.98	2.05	1.98	7.92	← Pipe full (each pipe)
43.0	1.2	3.32	0.0	2.04	2.1	2.04	8.0	
45.0	1.3	3.43	0.0	2.11	2.15	2.11	8.07	
47.0	1.4	3.54	0.0	2.18	2.2	2.18	8.14	
49.0	1.5	3.66	0.0	2.25	2.25	2.25	8.19	
51.0	1.6	3.85	3.9	2.32	2.29	2.29	8.33	
53.0	1.7	4.0	3.99	2.4	2.34	2.4	8.28	
55.0	1.8	4.1	4.09	2.48	2.38	2.48	8.31	
57.0	1.9	4.19	4.18	2.57	2.42	2.57	8.32	
59.0	2.0	4.34	4.28	2.67	2.46	2.67	8.31	
61.0	2.1	4.49	4.39	2.81	2.5	2.81	8.24	
63.0	2.2	4.65	4.5	3.17	2.54	3.17	7.98	← Max Q/p (each pipe)
65.0	2.3	4.82	4.62	3.17	2.58	3.17	8.24	
67.0	2.4	4.98	4.75	3.17	2.61	3.17	8.49	
69.0	2.5	5.16	4.88	3.17	2.65	3.17	8.74	

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Culvert #3E
30"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 27, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	61.2
Invert Elevation at Downstream end of Culvert (ft)	1,761.24
Invert Elevation at Upstream end of Culvert (ft)	1,761.28
Culvert Slope (ft/ft)	0.0007
Starting Flow Rate (cfs)	20.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	54.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.7

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
20.0	1.0	2.32	2.48	2.5	1.52	1.52	6.41	← Pipe full
22.0	1.1	2.48	2.64	2.5	1.6	1.6	6.65	
24.0	1.2	2.64	2.79	2.5	1.67	1.67	6.9	
26.0	1.3	2.8	2.95	2.5	1.74	1.74	7.14	
28.0	1.4	3.02	3.12	2.5	1.8	1.8	7.38	
30.0	1.5	3.21	3.29	2.5	1.87	1.87	7.63	
32.0	1.6	3.37	3.47	2.5	1.93	1.93	7.88	
34.0	1.7	3.58	2.93	2.5	1.98	2.5	6.93	
36.0	1.8	3.81	3.06	2.5	2.04	2.5	7.33	
38.0	1.9	4.06	3.18	2.5	2.08	2.5	7.74	
40.0	2.0	4.32	3.3	2.5	2.13	2.5	8.15	
42.0	2.1	4.59	3.44	2.5	2.17	2.5	8.56	
44.0	2.2	4.87	3.56	2.5	2.21	2.5	8.96	
46.0	2.3	5.17	3.7	2.5	2.24	2.5	9.37	
48.0	2.4	5.48	3.85	2.5	2.27	2.5	9.78	
50.0	2.5	5.8	5.65	2.5	2.3	2.5	10.19	
52.0	2.6	6.14	6.01	2.5	2.32	2.5	10.59	← Max Cap
54.0	2.7	6.49	6.38	2.5	2.34	2.5	11.0	

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Culvert #33
30"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 27, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	61.1
Invert Elevation at Downstream end of Culvert (ft)	1,764.04
Invert Elevation at Upstream end of Culvert (ft)	1,764.98
Culvert Slope (ft/ft)	0.0154
Starting Flow Rate (cfs)	22.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	37.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.5

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
22.0	1.0	2.46	0.0	1.1	1.6	1.1	10.59	← Pipe full
23.0	1.1	2.54	0.0	1.13	1.63	1.13	10.72	
24.0	1.2	2.62	0.0	1.15	1.67	1.15	10.84	
25.0	1.3	2.7	0.0	1.18	1.7	1.18	10.95	
26.0	1.4	2.79	0.0	1.21	1.74	1.21	11.06	
27.0	1.5	2.87	0.0	1.23	1.77	1.23	11.17	
28.0	1.6	3.0	0.0	1.26	1.8	1.26	11.27	
29.0	1.7	3.11	0.0	1.29	1.84	1.29	11.37	← Max Cap
30.0	1.8	3.2	0.0	1.32	1.87	1.32	11.46	
31.0	1.9	3.25	0.0	1.34	1.9	1.34	11.56	
32.0	2.0	3.35	0.0	1.37	1.93	1.37	11.64	
33.0	2.1	3.45	0.0	1.39	1.96	1.39	11.73	
34.0	2.2	3.57	0.0	1.42	1.98	1.42	11.81	
35.0	2.3	3.68	0.0	1.45	2.01	1.45	11.89	
36.0	2.4	3.8	0.0	1.47	2.04	1.47	11.96	
37.0	2.5	3.92	3.31	1.5	2.06	1.5	12.04	

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Culvert #34
4-10'x3' Box Culverts

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

March 20, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Span (ft)	10.0
Culvert Rise (ft)	3.0
FHWA Chart Number	8
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	104.6
Invert Elevation at Downstream end of Culvert (ft)	1,615.25
Invert Elevation at Upstream end of Culvert (ft)	1,616.44
Culvert Slope (ft/ft)	0.0114
Starting Flow Rate (cfs)	200.0
Incremental Flow Rate (cfs)	10.0
Ending Flow Rate (cfs)	300.0
Starting Tailwater Depth (ft)	2.0
Incremental Tailwater Depth (ft)	0.2
Ending Tailwater Depth (ft)	4.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
200.0	2.0	4.1	0.0	1.42	2.32	1.42	14.12
210.0	2.2	4.3	0.0	1.46	2.39	1.46	14.35
220.0	2.4	4.48	0.0	1.51	2.47	1.51	14.57
230.0	2.6	4.68	0.0	1.55	2.54	1.55	14.79
240.0	2.8	4.88	0.0	1.6	2.62	1.6	15.01
250.0	3.0	5.09	3.82	1.64	2.69	1.64	15.21
260.0	3.2	5.3	4.18	1.69	2.76	1.69	15.41
270.0	3.4	5.53	4.55	1.73	2.83	1.73	15.61
280.0	3.6	5.77	4.93	1.77	2.9	1.77	15.79
290.0	3.8	6.01	5.31	1.81	2.97	1.81	15.98
300.0	4.0	6.26	5.7	1.86	3.0	1.86	16.16

MAX CAP 285cfs/BBI

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Culvert #36
104" CMP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 27, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	8.67
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	2
Manning's Roughness Coefficient (n-value)	0.027
Entrance Loss Coefficient of Culvert Opening	0.8
Culvert Length (ft)	86.1
Invert Elevation at Downstream end of Culvert (ft)	1,571.13
Invert Elevation at Upstream end of Culvert (ft)	1,571.25
Culvert Slope (ft/ft)	0.0014
Starting Flow Rate (cfs)	415.0
Incremental Flow Rate (cfs)	10.0
Ending Flow Rate (cfs)	685.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	3.7

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
415.0	1.0	7.74	8.67	8.67	5.06	5.06	11.6	← Pipe full
425.0	1.1	7.86	8.8	8.67	5.12	5.12	11.71	
435.0	1.2	7.98	8.93	8.67	5.18	5.18	11.81	
445.0	1.3	8.09	9.07	8.67	5.25	5.25	11.91	
455.0	1.4	8.21	9.2	8.67	5.31	5.31	12.01	
465.0	1.5	8.33	9.33	8.67	5.37	5.37	12.11	
475.0	1.6	8.45	9.46	8.67	5.43	5.43	12.21	
485.0	1.7	8.56	9.59	8.67	5.49	5.49	12.31	
495.0	1.8	8.68	9.73	8.67	5.55	5.55	12.41	
505.0	1.9	8.8	9.86	8.67	5.6	5.6	12.51	
515.0	2.0	8.91	9.99	8.67	5.66	5.66	12.61	
525.0	2.1	9.03	10.13	8.67	5.72	5.72	12.71	
535.0	2.2	9.14	10.26	8.67	5.77	5.77	12.81	
545.0	2.3	9.26	10.4	8.67	5.83	5.83	12.92	
555.0	2.4	9.38	10.54	8.67	5.88	5.88	13.02	
565.0	2.5	9.49	10.67	8.67	5.94	5.94	13.12	
575.0	2.6	9.61	10.81	8.67	5.99	5.99	13.22	
585.0	2.7	9.72	10.96	8.67	6.04	6.04	13.32	
595.0	2.8	9.84	11.1	8.67	6.09	6.09	13.42	
605.0	2.9	9.95	11.24	8.67	6.15	6.15	13.52	
615.0	3.0	10.27	11.39	8.67	6.2	6.2	13.62	
625.0	3.1	10.68	11.54	8.67	6.25	6.25	13.72	
635.0	3.2	11.06	11.69	8.67	6.3	6.3	13.83	
645.0	3.3	11.43	11.85	8.67	6.35	6.35	13.93	
655.0	3.4	11.77	12.01	8.67	6.39	6.39	14.03	
665.0	3.5	12.09	12.18	8.67	6.44	6.44	14.14	
675.0	3.6	12.39	10.37	8.67	6.49	8.67	11.43	
685.0	3.7	12.67	10.49	8.67	6.54	8.67	11.6	← Max cap

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Culvert #37
2-24"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 27, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	117.0
Invert Elevation at Downstream end of Culvert (ft)	1,598.03
Invert Elevation at Upstream end of Culvert (ft)	1,598.36
Culvert Slope (ft/ft)	0.0028
Starting Flow Rate (cfs)	7.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	22.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.5

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
7.0	1.0	1.35	1.46	1.05	0.94	1.0	4.46	
8.0	1.1	1.46	1.58	1.13	1.01	1.1	4.52	
9.0	1.2	1.58	1.69	1.22	1.07	1.2	4.57	
10.0	1.3	1.69	1.8	1.31	1.13	1.3	4.63	
11.0	1.4	1.8	1.91	1.41	1.19	1.4	4.68	
12.0	1.5	1.91	2.03	1.51	1.24	1.5	4.75	← Pipe full (each pipe)
13.0	1.6	2.03	2.15	1.64	1.3	1.6	4.83	
14.0	1.7	2.14	2.28	1.87	1.35	1.7	4.92	
15.0	1.8	2.25	2.43	2.0	1.4	1.8	5.04	
16.0	1.9	2.41	2.26	2.0	1.44	2.0	5.09	
17.0	2.0	2.55	2.92	2.0	1.49	2.0	5.41	
18.0	2.1	2.64	3.17	2.0	1.53	2.0	5.73	← pipe full (each pipe)
19.0	2.2	2.79	3.43	2.0	1.57	2.0	6.05	
20.0	2.3	2.95	3.69	2.0	1.61	2.0	6.37	
21.0	2.4	3.12	3.97	2.0	1.64	2.0	6.68	
22.0	2.5	3.29	4.26	2.0	1.68	2.0	7.0	

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Culvert #38
3-24"CP

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 27, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	156.6
Invert Elevation at Downstream end of Culvert (ft)	1,598.04
Invert Elevation at Upstream end of Culvert (ft)	1,598.72
Culvert Slope (ft/ft)	0.0043
Starting Flow Rate (cfs)	10.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	25.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.5

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
10.0	1.0	1.69	1.82	1.14	1.13	1.13	5.45	
11.0	1.1	1.8	1.92	1.21	1.19	1.19	5.65	
12.0	1.2	1.91	2.02	1.28	1.24	1.24	5.84	← Pipe full (each pipe)
13.0	1.3	2.03	2.12	1.36	1.3	1.3	6.01	
14.0	1.4	2.14	2.22	1.44	1.35	1.4	5.96	
15.0	1.5	2.25	2.32	1.53	1.4	1.5	5.93	
16.0	1.6	2.41	2.42	1.62	1.44	1.6	5.94	
17.0	1.7	2.55	2.54	1.76	1.49	1.76	5.82	
18.0	1.8	2.64	2.69	2.0	1.53	1.8	6.04	
19.0	1.9	2.79	2.43	2.0	1.57	2.0	6.05	
20.0	2.0	2.95	3.31	2.0	1.61	2.0	6.37	
21.0	2.1	3.11	3.61	2.0	1.64	2.0	6.68	← Max Cap (each pipe)
22.0	2.2	3.29	3.93	2.0	1.68	2.0	7.0	
23.0	2.3	3.47	4.25	2.0	1.71	2.0	7.32	
24.0	2.4	3.66	4.58	2.0	1.74	2.0	7.64	
25.0	2.5	3.86	4.93	2.0	1.76	2.0	7.96	

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Culvert #39
10'x3' Box

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

March 20, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Span (ft)	10.0
Culvert Rise (ft)	3.0
FHWA Chart Number	8
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	104.6
Invert Elevation at Downstream end of Culvert (ft)	1,615.25
Invert Elevation at Upstream end of Culvert (ft)	1,616.44
Culvert Slope (ft/ft)	0.0114
Starting Flow Rate (cfs)	150.0
Incremental Flow Rate (cfs)	10.0
Ending Flow Rate (cfs)	250.0
Starting Tailwater Depth (ft)	1.0
Incremental Tailwater Depth (ft)	1.0
Ending Tailwater Depth (ft)	11.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
150.0	1.0	3.08	0.0	1.17	1.91	1.17	12.78
160.0	2.0	3.22	0.0	1.22	2.0	1.22	13.07
170.0	3.0	3.36	2.74	1.27	2.08	1.27	13.35
180.0	4.0	3.49	3.85	1.32	2.16	3.0	6.0 ← Max Cap
190.0	5.0	3.82	4.97	1.37	2.24	3.0	6.33
200.0	6.0	4.1	6.1	1.42	2.32	3.0	6.67
210.0	7.0	4.3	7.23	1.46	2.39	3.0	7.0
220.0	8.0	4.48	8.37	1.51	2.47	3.0	7.33
230.0	9.0	4.68	9.51	1.55	2.54	3.0	7.67
240.0	10.0	4.88	10.66	1.6	2.62	3.0	8.0
250.0	11.0	5.09	11.82	1.64	2.69	3.0	8.33

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Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

August 9, 2001
W/P # 99989

McDowell Road Alignment

From Level I analysis, Option MD1B, estimate costs for entire option based on sample segment (Sossaman to Hawes)

Earthen Channel Option MD2E-From Level II Analysis	$15,151,877
Earthen Channel Estimate for McDowell Rd, Sossaman to Hawes Rd (1 mile)	$5,891,194
Total earth channel cost assuming 1.52 miles of earth channel	$8,954,614
Cost of option MD1B which is not associated with channel construction	$6,197,263

Option	Sample Segment Cost	Estimated Total Cost	Additional Compared to CMP Cost
Earthen Channel	$5,891,194	$15,151,877	$4,288,076
RGRCP	$3,884,222	$12,101,281	$1,237,480
Box Culvert with Roughness Elements	$3,792,525	$11,961,901	$1,098,100
CMP Type II Aluminized Slurry Backfill	$3,070,091	$10,863,801	$0

Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

May 15, 2001
W/P # 99989

McDowell Road Alignment
Sossaman Road to Hawes Road
Landscaped Earthen Channel Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Excavation	$4.00	CY	55,103	$220,412
2	Drop Structures	$310	CY	3,327	$1,031,314
3	Culverts	$310	CY	1,389	$430,590
		SUBTOTAL MAJOR ELEMENTS			$1,682,316
		CONTINGENCIES:			
		Construction		35%	$588,811
		Engineering		7%	$117,762
		Construction Admin		6%	$100,939
		TOTAL MAJOR ELEMENTS			**$2,489,828**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping	$1.10	SF	363,053	$399,358
2	Fence	$12	LF	10,560	$126,720
3	Utility Relocations (W & S)	$8,000	EA	2	$16,000
		SUBTOTAL ADDITIONAL ELEMENTS			$542,078
		CONTINGENCIES:			
		Construction		35%	$189,727
		Engineering		7%	$37,945
		Construction Admin		6%	$32,525
		TOTAL ADDITIONAL ELEMENTS			**$802,276**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$118,208	AC	17.59	$2,079,272
2	Basin Land Acquisition	$24,197	AC		$0
		SUBTOTAL LAND ACQUISITION			$2,079,272
		CONTINGENCIES :		25%	$519,818
		TOTAL LAND ACQUISITION			**$2,599,090**
				TOTAL	***$5,891,194***

W:\1999Projects\99989-Spook Hill ADMP Update\Spreadsheets\CostEstimates\ALternative Cost Analysis\Level II\Conveyance cost analysis - McKellips & McDowell.xls-Earthen Channel

Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

August 9, 2001
W/P # 99989

McKellips Road Alignment

From Level I analysis, Option MK2E, estimate costs for entire option based on sample segment.

Earthen Channel Option MK2E-From Level II Analysis	$4,673,708
Earthen Channel Estimate for McKellips Rd (Segments 4, 5, 6, 7, 8, 9, & 10) Length = 5400 ft.	$1,425,593
Total earth channel cost assuming 5400 feet of earth channel	$1,425,593
Cost of option MK2E which is not associated with channel construction	$3,248,115

	McDowell Reach				McKellips Reach
	Earthen Channel	RGRCP	Box Culvert with Roughness Elements	CMP Type II Aluminized Slurry Backfill	Earthen Channel
Cost of Major Elements for the McDowell Reach (5280 feet)	$2,489,828	$3,211,004	$3,119,307	$2,396,873	NA
Major elements adjusted to McKellips Reach costs (5280 feet)	$700,277	$903,112	$877,322	$674,133	$700,277
Cost of Major Elements adjusted to 5400 feet of reach length	$716,193	$923,637	$897,261	$689,455	$716,193
Cost of Additional Elements (5400 feet)	NA	$375,866	$375,866	$375,866	$537,729
Cost of Land Acquisition (5400 feet)	NA	$312,652	$312,652	$312,652	$171,671
Total Adjusted Cost (5400 feet)	NA	$1,612,156	$1,585,779	$1,377,973	$1,425,593

Option	Sample Segment Cost	Estimated Total Cost	Additional Compared to CMP Cost
Earthen Channel	$1,425,593	$4,673,708	$47,620
RGRCP	$1,612,156	$4,860,271	$234,183
Box Culvert with Roughness Elements	$1,585,779	$4,833,894	$207,806
CMP Type II Aluminized Slurry Backfill	$1,377,973	$4,626,088	$0

Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

May 15, 2001
W/P # 99989

McKellips Road Alignment
5400 feet Channel Segment
Landscaped Earthen Channel Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Excavation	$4.00	CY	19,221	$76,884
2	Drop Structures	$310	CY	1,158	$358,980
3	Splitter Structures	$60,000	EA	0	$0
4	Culverts	$310	CY	155	$48,050
5	Baisn Excavation	$4	CY	0	$0
		SUBTOTAL MAJOR ELEMENTS			$483,914
		CONTINGENCIES:			
		Construction		35%	$169,370
		Engineering		7%	$33,874
		Construction Admin		6%	$29,035
		TOTAL MAJOR ELEMENTS			**$716,193**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping (Channel & Basins)	$1.10	SF	212,482	$233,730
2	Fence	$12	LF	10,800	$129,600
3	Utility Relocations (W & S)	$8,000	EA	0	$0
		SUBTOTAL ADDITIONAL ELEMENTS			$363,330
		CONTINGENCIES:			
		Construction		35%	$127,166
		Engineering		7%	$25,433
		Construction Admin		6%	$21,800
		TOTAL ADDITIONAL ELEMENTS			**$537,729**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$21,492	AC	6.39	$137,337
2	Basin Land Acquisition	$14,300	AC	0.0	$0
		SUBTOTAL LAND ACQUISITION			$137,337
		CONTINGENCIES :		25%	$34,334
		TOTAL LAND ACQUISITION			**$171,671**
				TOTAL	***$1,425,593***

Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

August 9, 2001
W/P # 99989

Cost Analysis for Conveyance Materials on McDowell & McKellips Roads

Option	McDowell Road		McKellips Road	
	Estimated Total Cost	Additional Compared to CMP Cost	Estimated Total Cost	Additional Compared to CMP Cost
Earthen Channel	$15,151,877	$4,288,076	$4,673,708	$47,620
RGRCP	$12,101,281	$1,237,480	$4,860,271	$234,183
Box Culvert with Roughness Elements	$11,961,901	$1,098,100	$4,833,894	$207,806
CMP Type II Aluminized Slurry Backfill	$10,863,801	$0	$4,626,088	$0

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT Spook Hill NO. 99989

Conveyance Cost Analysis
McDowell & Mckellips

CALC'D BY JDS CHK'D BY

SHEET 1 OF DATE 5/11/01

— Update the McDowell Road option cost analysis based on sample segment (Sossaman to Hawes).

The sample segment length is 1 mile or 5280'

• Use lengths of segments 5, 6, and 11 from the Level I Analysis of option MD2E

Assume that half of these lengths are effective in calculating the prorated cost

Section	Length
5	2640
6	1320
11	1550
	5510 / 2 = 2755 ft USE

← See spreadsheet for the remaining analysis

Mckellips Road

Assume that the cost for major elements has a linear relationship between the different materials on McDowell & Mckellips.

Therefore the cost ratios between the earthen channel and the other material designs is the same on Mckellips as calculated for McDowell. Right of way and additional elements costs will have the same per foot cost.

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

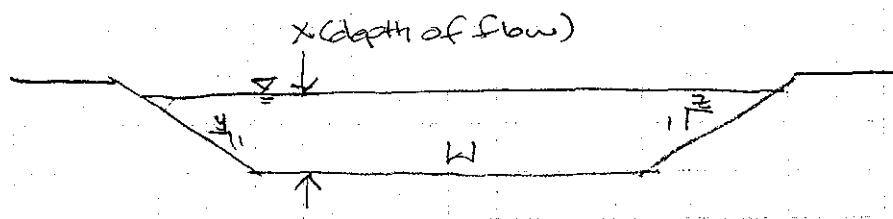
PROJECT _____ NO. _____

CALC'D BY _____ CHK'D BY _____

SHEET _____ OF _____ DATE _____

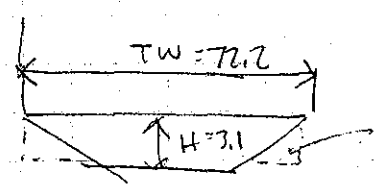
$L_t = 2.68$
$L_s = 23.42$
$L_f = 12.26$
$L_1 = 6$

AREA



$w = x + \frac{y \cdot x^2}{2} + \frac{z \cdot x^2}{2}$ $y = 4, x = 3, z = 4, w = 40$

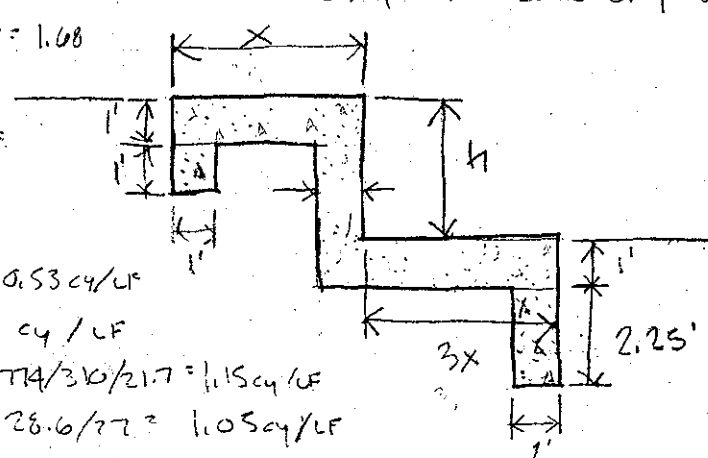
Area of Drop = Top width (including freeboard) • Height of drop



Drop Structure AREA

$h = 3.2$
TW 87
A = 278.8 \$136,336
3 \$45,445 / 310 / 87 = 1.68
$h = 3.2$, $x = 9.6$, $3x = 28.8$
$28.8 + 9.6 + 3.2 = 41.6 = 1.54$ cy/LF

226.6 SF · 163 = \$36,939 / Drop
\$310/cy for conc drop structures
119 cy / 72.2 = 1.65 cy/LF



$4x + 3.1 = (1.65 \cdot 27)$
$x = 10.4$
$x = 3h$

$h = 1$
TW = 56.8 9252 / 310 / 56.8 = 0.53 cy/LF
$1 + 3 + 9 = 13 / 27 = 0.48$ cy / LF
$h = 2.2$, TW = 21.7, A = 47.7 \$774 / 310 / 21.7 = 1.15 cy/LF
$2.2 + (3 \cdot 2.2) + 3 \cdot (3 \cdot 2.2) = 28.6 / 27 = 1.05$ cy/LF
$h = 3.3$, TW = 31.4, A = 104 16946 / 310 / 104 = 0.53 cy/LF
$3.3 + (3 \cdot 3.3) + 3 \cdot (3 \cdot 3.3) = 43.9 = 1.58$

Offline Basin Parameters

Alternative Name: Non-Jurisdictional

Option Name: NJ4

Basin Name: SS380

Items	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)
Inflow	C380	4597	1077
Bypass	DD380	1960	976
Div. Flow	380S	2637	100
Bleedoff	SS380	38	100
Total D/S Flow	CC380	1998	1077

Alternative Name: Non-Jurisdictional

Option Name: NJ6

Basin Name: SS380

Items	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)
Inflow	C380	3382	1410
Bypass	DD380	1975	1375
Div. Flow	380S	1407	32
Bleedoff	SS380	25	32
Total D/S Flow	CC380	2000	1410

Offline Basin Parameters

Alternative Name: McDowell Road

Option Name: MD2E

No Basin

Basin Name:	S370			S415B			S415A		
Items	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)
Inflow	C370	1046	58	C415B	973	65	C415A	1970	194
Bypass	D370	140	24	D415B	190	32	D415A	1240	180
Div. Flow	BS370	906	34	BS415B	783	34	BS415A	730	14
Bleedoff	S370	10	34	S415B	10	34	S415A	5	14
Total D/S Flow	CC370	150	58	CC415B	200	65	CC415A	1245	194

Alternative Name: McDowell Road

Option Name: MD3E

No Basin

Basin Name:	S370			S415C			S415A		
Items	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)
Inflow	C370	1046	58	C415C	973	65	C415A	1974	200
Bypass	D370	140	24	D415C	190	34	D415A	1240	182
Div. Flow	BS370	906	34	BS415C	783	32	BS415A	734	18
Bleedoff	S370	10	34	S415C	10	32	S415A	5	18
Total D/S Flow	CC370	150	58	CC415C	200	65	CC415A	1245	200

Offline Basin Parameters

Alternative Name: McKellips Road

Option Name: MK2E

Basin Name: SS340B SS380B

Items	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)
Inflow	C340B	394	14	C380B	986	75
Bypass	DD340B	18	8	DD380B	85	32
Div. Flow	BS340B	376	6	BS380B	900	44
Bleedoff	SS340B	2	6	SS380B	15	44
Total D/S Flow	CC340B	20	14	CC380B	100	75

Alternative Name: McKellips Road

Option Name: MK1C

Basin Name: SS340B

Items	Hydrograph Name	Peak Flow (cfs)	Volume (Ac-Ft)
Inflow	C340B	394	14
Bypass	DD340B	18	8
Div. Flow	BS340B	376	6
Bleedoff	SS340B	2	6
Total D/S Flow	CC340B	20	14

Spook Hill ADMS Update
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FCD 99-43

April 12, 2001
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McDowell Road Alignment

From Level I analysis, Option MD1B, estimate costs for entire option based on sample segment (Sossaman to Hawes)

Earthen Channel Option MD1B-From Level I Analysis	$17,420,000
Earthen Channel Estimate for McDowell Rd, Sossaman to Hawes Rd (1 mile)	$5,875,881
Total earth channel cost assuming 1.75 miles of earth channel	$10,282,792
Cost of option MD1B which is not associated with channel construction	$7,137,208

Option	Sample Segment Cost	Estimated Total Cost	Additional Compared to CMP Cost
Earthen Channel	$5,875,881	$17,420,000	$6,522,098
RGRCP	$3,884,222	$13,934,596	$3,036,694
Box Culvert with Roughness Elements	$3,792,525	$13,774,126	$2,876,224
CMP Type II Aluminized Slurry Backfill	$2,148,968	$10,897,902	$0

Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

April 4, 2001
W/P # 99989

McDowell Road Alignment
Sossaman Road to Hawes Road
Landscaped Earthen Channel Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Excavation	$4.00	CY	55,103	$220,412
2	Drop Structures	$310	CY	3,327	$1,031,314
3	Culverts	$310	CY	1,389	$430,590
		SUBTOTAL MAJOR ELEMENTS			$1,682,316
		CONTINGENCIES:			
		Construction		35%	$588,811
		Engineering		7%	$117,762
		Construction Admin		6%	$100,939
		TOTAL MAJOR ELEMENTS			**$2,489,828**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping	$1.10	SF	363,053	$399,358
2	Fence	$12	LF	10,560	$126,720
3	Utility Relocations (W & S)	$8,000	EA	2	$16,000
		SUBTOTAL ADDITIONAL ELEMENTS			$542,078
		CONTINGENCIES:			
		Construction		35%	$189,727
		Engineering		7%	$37,945
		Construction Admin		6%	$32,525
		TOTAL ADDITIONAL ELEMENTS			**$802,276**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$201,268	AC	10.27	$2,067,022
2	Basin Land Acquisition	$28,280	AC		$0
		SUBTOTAL LAND ACQUISITION			$2,067,022
		CONTINGENCIES :		25%	$516,756
		TOTAL LAND ACQUISITION			**$2,583,778**
				TOTAL	***$5,875,881***

W:\1999Projects\99989-Spook Hill ADMP Update\Spreadsheets\CostEstimates\ALternative Cost Analysis\Level I\McDowell - Sossaman to Hawes CMP cost Analysis.xls-Earthen Channel

Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

April 4, 2001
W/P # 99989

McDowell Road Alignment
Sossaman Road to Hawes Road
RGRCP Pipe Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	132" RCP Pipe (Non-Std Length)	$762	LF	99	$75,398
2	126" RCP Pipe (Non-Std Length	$711	LF	66	$46,939
3	120" RCP Pipe (Non-Std Length)	$658	LF	75	$49,350
4	114" RCP Pipe	$445	LF	1,155	$513,975
5	114" RCP Pipe (Non-Std Length)	$623	LF	59	$36,757
6	108" RCP Pipe	$407	LF	564	$229,548
7	108" RCP Pipe (Non-Std Length)	$570	LF	70	$39,886
8	102" RCP Pipe	$349	LF	551	$192,299
9	96" RCP Pipe	$295	LF	573	$169,035
10	96" RCP Pipe (Non-Std Length)	$413	LF	149	$61,537
11	90" RCP Pipe	$262	LF	554	$145,148
13	78" RCP Pipe	$200	LF	1,081	$216,200
14	96" (78" I.D.) Diss. Ring	$1,025	EA	45	$46,125
15	108" (90" I.D.) Diss. Ring	$1,300	EA	18	$23,400
16	114" (96" I.D.) Diss. Ring	$1,450	EA	14	$20,300
17	120" (102" I.D.) Diss. Ring	$1,600	EA	17	$27,200
18	126" (108" I.D.) Diss. Ring	$1,900	EA	15	$28,500
19	132" (114" I.D.) Diss. Ring	$2,200	EA	20	$44,000
20	Export		CY		$0
21	Manholes	$6,000	EA	34	$204,000
			SUBTOTAL MAJOR ELEMENTS		$2,169,598
		CONTINGENCIES:			
		Construction		35%	$759,359
		Engineering		7%	$151,872
		Construction Admin		6%	$130,176
			TOTAL MAJOR ELEMENTS		**$3,211,004**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping	$1.10	SF	211,200	$232,320
2	Fence	$12	LF	0	$0
3	Utility Relocations (W & S)	$8,000	EA	2	$16,000
			SUBTOTAL ADDITIONAL ELEMENTS		$248,320
		CONTINGENCIES:			
		Construction		35%	$86,912
		Engineering		7%	$17,382
		Construction Admin		6%	$14,899
			TOTAL ADDITIONAL ELEMENTS		**$367,514**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Parcel Land Acquisition	$87,120	AC	2.42	$210,830
2	Basin Land Acquisition	$28,280	AC	0.00	$0
			SUBTOTAL LAND ACQUISITION		$210,830
		CONTINGENCIES :		45%	$94,874
			TOTAL LAND ACQUISITION		**$305,704**
				TOTAL	*$3,884,222*

Wood/Patel

Spook Hill ADMS Update April 11, 2001
Flood Control District of Maricopa County W/P # 99989
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McDowell Road Alignment
Sossaman Road to Hawes Road
Box Culvert Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	10' x 7' Box Culvert	$300	CY	3,546	$1,063,656
2	10' x 4' Box Culvert	$300	CY	2,909	$872,784
3	Export	$7	CY	17,600	$123,200
4	Manholes	$6,000	EA	8	$48,000
		SUBTOTAL MAJOR ELEMENTS			$2,107,640
		CONTINGENCIES:			
		Construction		35%	$737,674
		Engineering		7%	$147,535
		Construction Admin		6%	$126,458
		TOTAL MAJOR ELEMENTS			**$3,119,307**

ADDITIONAL ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping	$1.10	SF	211,200	$232,320
2	Fence	$12	LF	0	$0
3	Utility Relocations (W & S)	$8,000	EA	2	$16,000
		SUBTOTAL ADDITIONAL ELEMENTS			$248,320
		CONTINGENCIES:			
		Construction		35%	$86,912
		Engineering		7%	$17,382
		Construction Admin		6%	$14,899
		TOTAL ADDITIONAL ELEMENTS			**$367,514**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$87,120	AC	2.42	$210,830
2	Basin Land Acquisition	$28,280	AC	0.00	$0
		SUBTOTAL LAND ACQUISITION			$210,830
		CONTINGENCIES :		45%	$94,874
		TOTAL LAND ACQUISITION			**$305,704**
				TOTAL	***$3,792,525***

Wood/Patel

Spook Hill ADMS Update
Flood Control District of Maricopa County
FCD 99-43

April 4, 2001
W/P # 99989

McDowell Road Alignment
Sossaman Road to Hawes Road
CMP Pipe Option

MAJOR ELEMENTS:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	114" CMP Pipe	$359	LF	660	$236,940
2	108" CMP Pipe	$292	LF	1,320	$385,440
3	102" CMP Pipe	$278	LF	660	$183,480
4	96" CMP Pipe	$262	LF	660	$172,920
5	90" CMP Pipe	$238	LF	1,320	$314,160
6	84" CMP Pipe	$224	LF	660	$147,840
7	Export	$7	CY	18,676	$130,729
8	Manholes	$6,000	EA	8	$48,000
		SUBTOTAL MAJOR ELEMENTS			$997,129
		CONTINGENCIES:			
		Construction		35%	$348,995
		Engineering		7%	$69,799
		Construction Admin		6%	$59,828
		TOTAL MAJOR ELEMENTS			**$1,475,751**

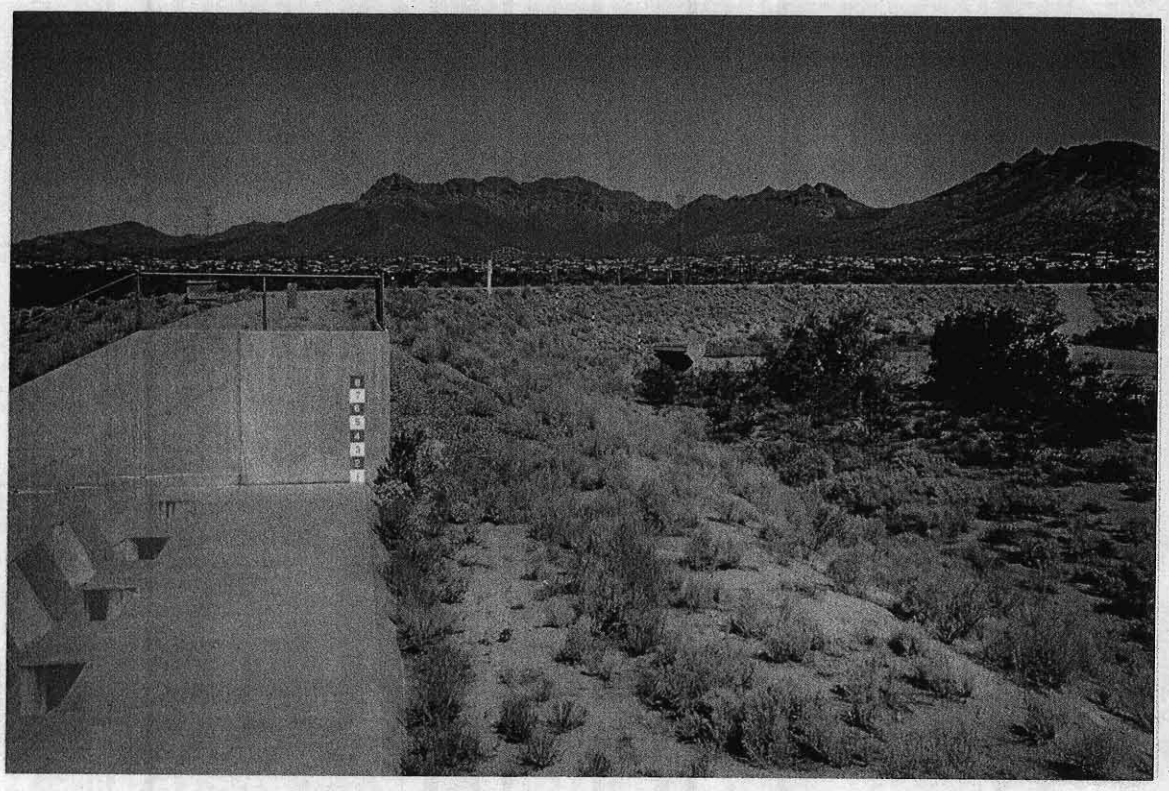
CMP Aluminized Type II with Concrete Invert and with slurry backfil to 1' over top of pipe

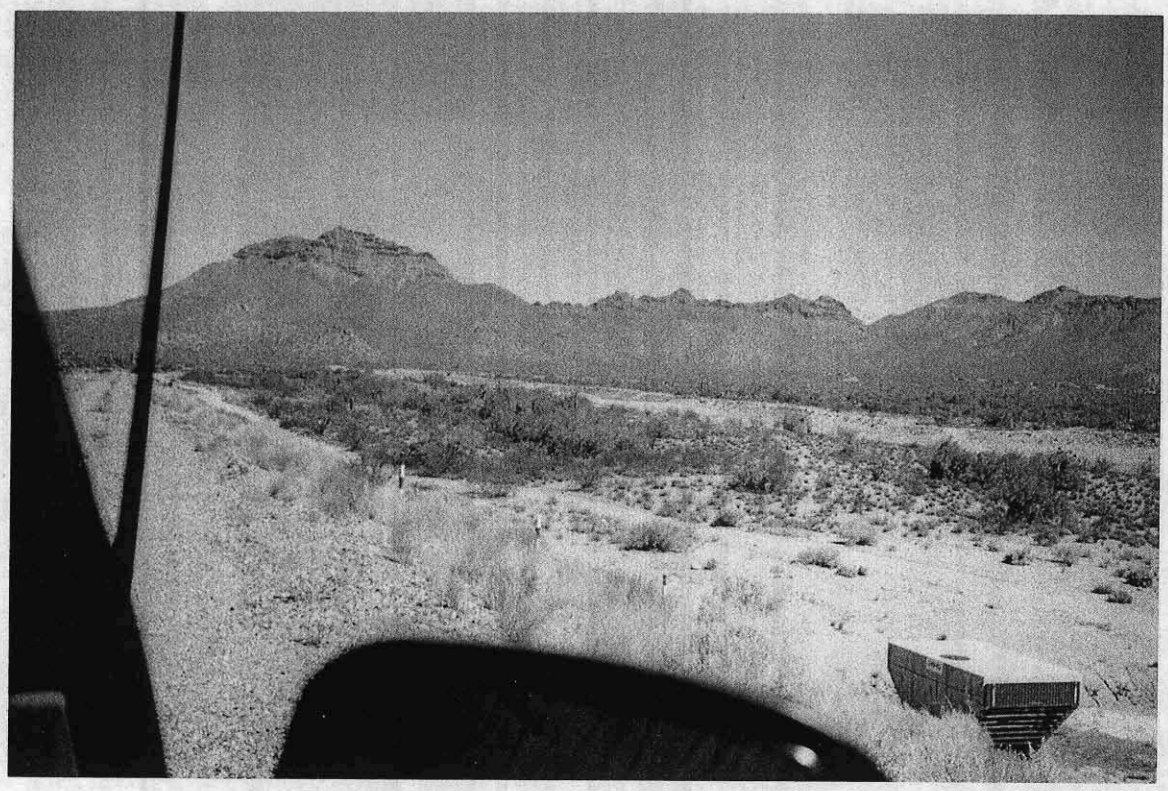
ADDITIONAL ELEMENTS:

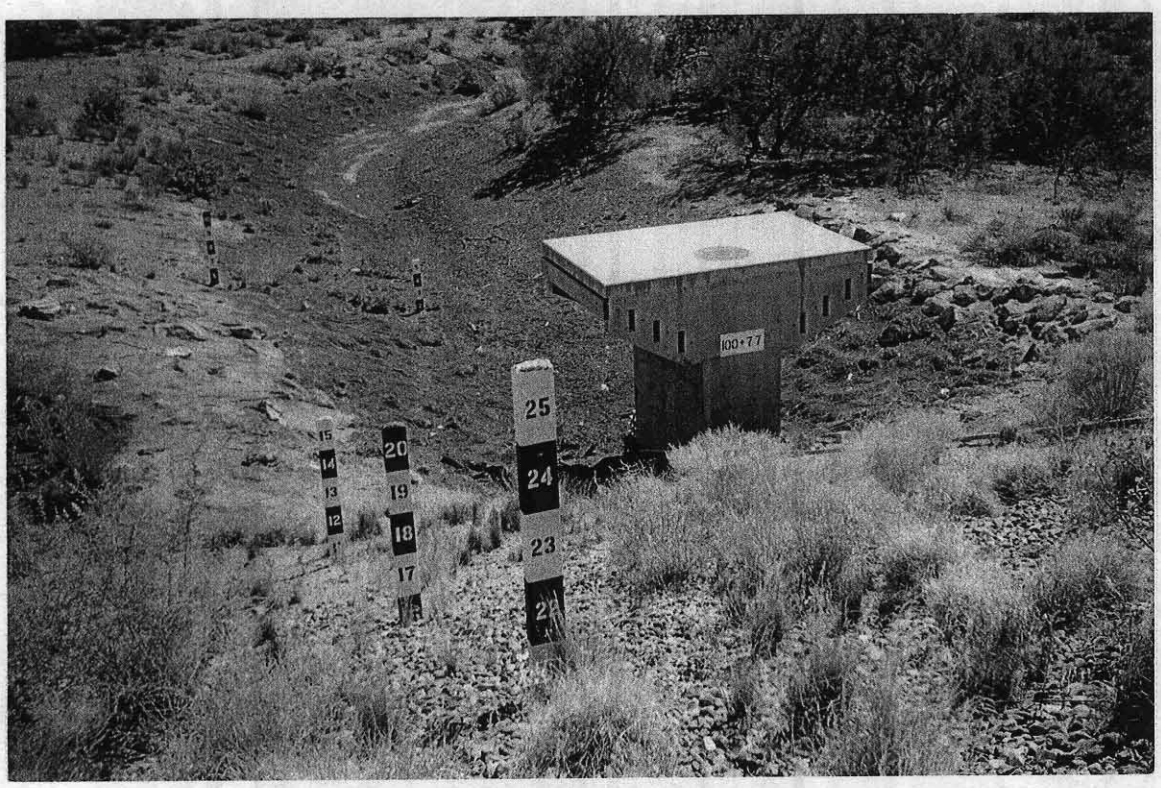
ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Landscaping	$1.10	SF	211,200	$232,320
2	Fence	$12	LF	0	$0
3	Utility Relocations (W & S)	$8,000	EA	2	$16,000
		SUBTOTAL ADDITIONAL ELEMENTS			$248,320
		CONTINGENCIES:			
		Construction		35%	$86,912
		Engineering		7%	$17,382
		Construction Admin		6%	$14,899
		TOTAL ADDITIONAL ELEMENTS			**$367,514**

LAND ACQUISITION:

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Channel Land Acquisition	$87,120	AC	2.42	$210,830
2	Basin Land Acquisition	$28,280	AC	0.00	$0
		SUBTOTAL LAND ACQUISITION			$210,830
		CONTINGENCIES :		45%	$94,874
		TOTAL LAND ACQUISITION			**$305,704**
				TOTAL	***$2,148,968***



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Fargo, ND 58107
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[redacted]

Date: March 8, 2001

Please deliver the following pages to: **Rick**

from: **Brian Eiseman**

Total number of pages including this cover letter: 10

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CULVERT VELOCITY REDUCTION BY INTERNAL ENERGY DISSIPATORS

The designer is often concerned with possible scour or erosion at the outlet of a drainage culvert constructed on a steep slope. Such erosion can cause serious maintenance, silting and pollution problems. The high velocity associated with flow on steep slopes is the critical parameter in the erosion process.

Reduction of the velocity of such flows is generally accomplished by the formation of a hydraulic jump. A hydraulic jump converts shallow, high velocity flow to deeper, low velocity flow while losing considerable energy in the resulting turbulence. Most outlet protection devices are essentially stilling basins, designed so the hydraulic jump is formed in the basin.

This article describes dissipators intended to form the hydraulic jump within the culvert, thus eliminating costly outlet structures. These dissipators are circular rings spaced along the pipe at the downstream end. The rings cause a series of hydraulic jumps to form in the barrel of the pipe, resulting in a near optimum dissipation of energy and virtually minimum possible total energy at the outlet.

GENERAL

Previous research conducted at Virginia Polytechnic Institute on the use of roughness elements in open channels established that excess energy in storm water flowing down steep drainage channels could be dissipated by constructing roughness elements within the channel. Since culverts operating under inlet control simulate open channel flow, application of this type of internal energy dissipation to culverts could possibly result in more efficient utilization of the culvert barrel and reduced outlet velocities.

In August, 1969, the American Concrete Pipe Association contracted with Virginia Polytechnic Institute and State University (VPI) to investigate and determine the feasibility and applicable design procedures for using roughness elements as energy dissipators of free-surface flow in circular concrete pipe culverts. Results of the research are published in Highway Research Record Number 373 **Roughness Elements as Energy Dissipators of Free-Surface Flow in Circular Pipes.** Because of the criteria of assuring free surface flow, full capacity of the conduit was not realized and necessitated an increase in pipe size within the length of culvert in which the roughness elements are placed. Based on the laboratory and field observations during this initial research, subsequent tests were conducted for full flow conditions occurring near the outlet end at maximum design discharge. By eliminating the criteria of free surface flow and allowing the culvert

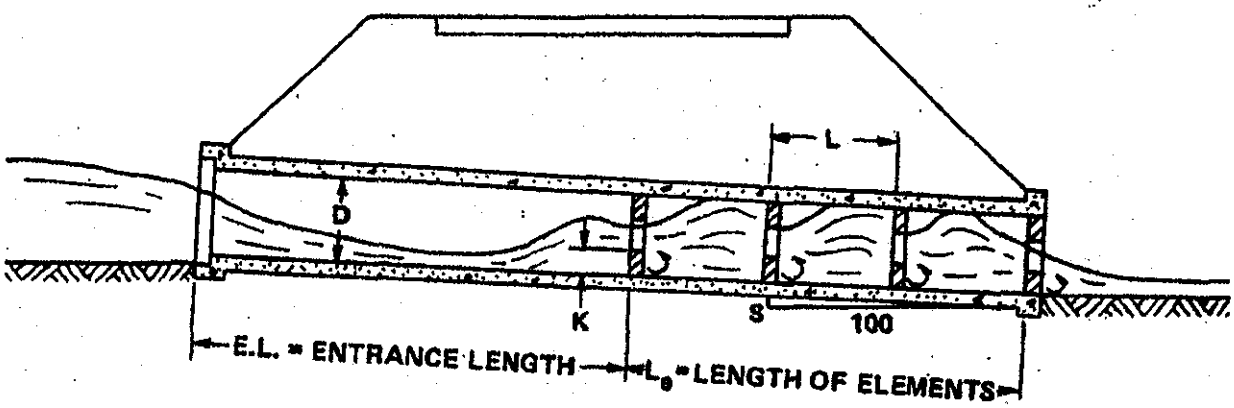


FIGURE 1. TUMBLING FLOW IN PIPE CULVERT.

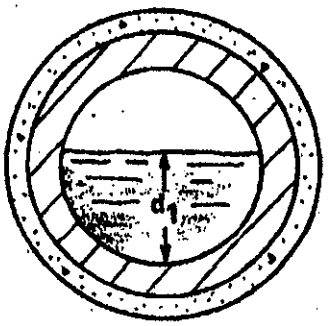


FIGURE 2. ROUGHNESS ELEMENT IN PIPE.

to approach full flow, it was found velocity reduction could be effected without an increase in pipe size. The results of this later research and design procedures for both the full flow condition and the free surface flow condition are presented in the following paragraphs.

FREE SURFACE FLOW TESTS

The performance characteristics of dissipator rings were investigated initially in laboratory models and later with a full scale 18-inch reinforced concrete pipe prototype. Different numbers of rings of various cross-sectional dimensions and spacings were tested in the 6-inch diameter clear plastic model pipe which could be adjusted to any slope from zero to 30 percent. An early conclusion was that only five rings were necessary to achieve consistent results. The full scale prototype was tested at flatter slopes than the laboratory model because test facilities with unlimited quantities of water were not available within a reasonable distance of VPI.

Since the objectives of the research were to dissipate energy and reduce high velocities associated with culverts on what are considered steep slopes, the culverts were operating under inlet control. Accordingly, the flow characteristics were observed to be one of critical flow at the entrance of the pipe with the flow accelerating down the length of the pipe until the first ring, or roughness element, was reached. At that point, a hydraulic jump was formed, with extreme turbulence. The flow then encountered another roughness element while still in an agitated condition from the first and this pattern of action was repeated until a cyclic condition was reached, where the flow conditions over the roughness elements were uniform. Generally, this cyclic action was attained after the second or third element. The agitated flow, characterized by a greater depth over the element than before it, a fall into a *valley* between the elements, and a form resembling a hydraulic jump shortly before the next element, is called *tumbling* flow. Thus one cycle is completed and the flow *tumbles* into the next cycle until the outlet is reached. This *tumbling* flow can only be established and maintained under less than full flow conditions. Figure 3 shows how tumbling flow with a free flow surface at less than maximum design discharge appeared in the 6-inch clear plastic pipe.

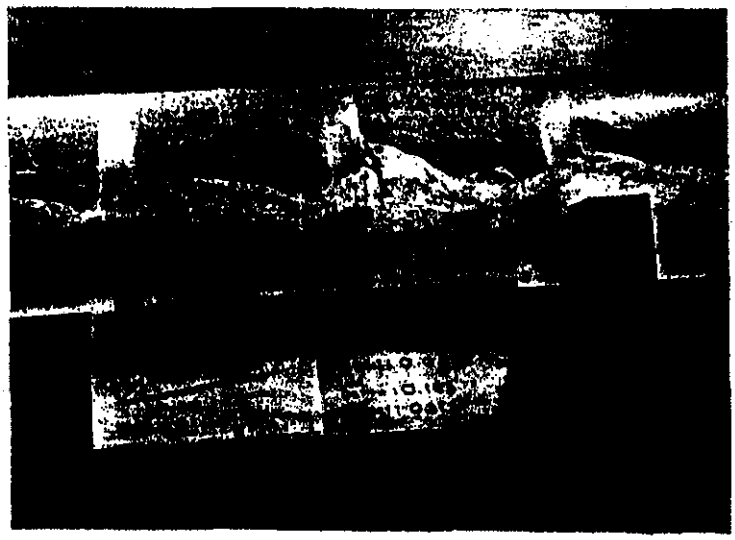


FIGURE 3. TUMBLING FLOW IN 6-INCH PLASTIC PIPE.

FULL FLOW TESTS

During the previous VPI research on open channel flow, it was observed that if one large dissipator element was placed upstream it created a large hydraulic jump which was maintained by the smaller downstream elements. In applying this observation to pipe flow at maximum design discharges, it was theorized that the hydraulic jump at the large upstream ring would cause the pipe to flow full with the smaller downstream rings maintaining the full flow condition.

Several tests of various ring configurations quickly indicated the soundness of this approach. Subsequently extended tests for the full flow condition were made in the laboratory model with a ring configuration consisting of three small rings at the exit preceded by one large ring at double spacing as illustrated in Figure 4. The three small rings were spaced at spacing-diameter ratio (L/D) of 1.5 with a ring height-diameter ratio (K/D) of 0.0625. The large ring, at double spacing, had a height ratio K/D of 0.146.

Model tests were run for this configuration at three slopes of 4.3, 9.3 and 15.2 percent. In order to compare these model tests with the full scale prototype tests under *free surface flow*, the range of test flows was equivalent to 10 to 15 cubic feet per second in an

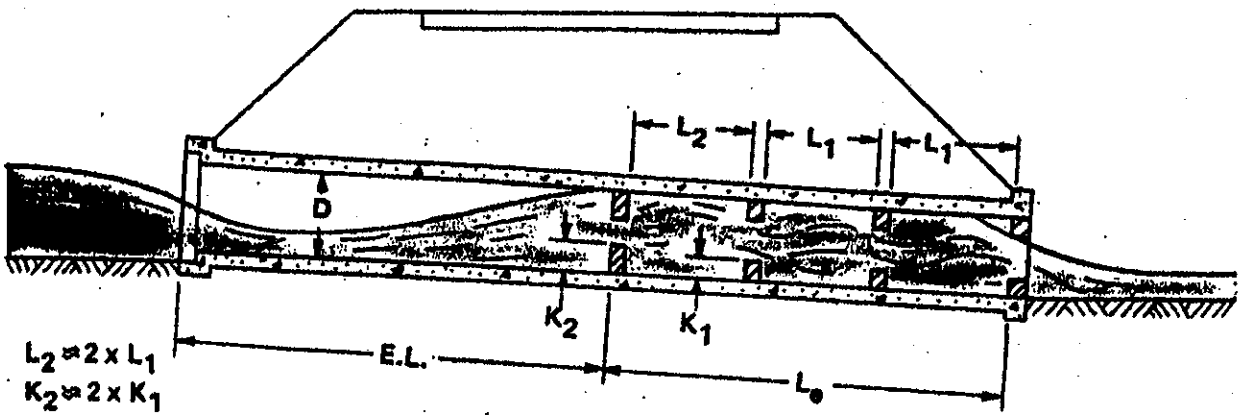


FIGURE 4. FULL FLOW IN PIPE CULVERT.

18-inch diameter pipe. In all of these larger flows (larger than indicated by tumbling flow criteria), the pipe flowed full at the outlet with the initial hydraulic jump varying in position above the leading ring depending upon the slope and flow rate. In some cases there were slugs of air moving unsteadily down the pipe, entering at a vortex in the headwater and moving through regions of full flow in entrained bubbles. In such cases, the quantity and movement of air through the pipe would indicate pressures only slightly above atmospheric and inlet control still governed. Table I details the test data and results and Table II lists the computations relating the test results to the expected performance of an 18-inch diameter prototype pipe. The prototype discharge Q_p was determined by using a Froude relationship for similitude, $Q_r = L_r^{5/2}$. In all cases except where tumbling flow is noted, the model pipe was flowing full at the downstream end. Therefore, prototype velocity Q_p was determined by dividing prototype discharge by prototype area, where the prototype area is the area of the pipe at the outlet minus the decrement in area resulting from the last ring.

TABLE I. TEST RESULTS OF 6-INCH PLASTIC PIPE.

Test Number	Slope (percent)	Q_{model} (cfs)	HW (inches)	$Q_{prototype}$ (cfs)	Remarks
1	15.2	0.946	7.00	14.7	Cavity from ring to approximately 10 feet upstream from first ring.
2	15.2	0.825	7.00	12.9	Cavity from ring to approximately 1 feet upstream from first ring.
3	15.2	0.676	6.00	10.5	Some air entrainment in ring area.
4	15.2	0.509	–	7.9	Verge of tumbling flow.
5	9.3	0.527	–	8.2	Verge of tumbling flow.
6	9.3	0.676	6.75	10.5	–
7	9.3	0.825	7.50	12.9	Cavity from 5 feet to 15 feet upstream from first ring.
8	9.3	0.946	8.00	14.7	Essentially full, some unsteady slugs of air.
9	4.3	0.866	15.00	13.4	Full.
10	4.3	0.769	10.25	12.0	Essentially full, some unsteady slugs of air.
11	4.3	0.676	7.75	10.5	Slugs of fluid progressing upstream to entrance, jump in front of ring.
12	4.3	0.528	6.50	8.2	Cavity from 6 feet to 1 foot, intermittent.
13	4.3	0.482	6.00	7.5	Tumbling flow.

TABLE II. CALCULATED PERFORMANCE OF 18-INCH CONCRETE PIPE.

Test Number	$Q_{prototype}$ (cfs)	V = Q/A (fps)	Q_{full} (cfs)	$\frac{Q_{prototype}}{Q_{full}}$	$\frac{V_{prototype}}{V_{full}}$	Percent Velocity Reduction
1	14.7	8.50	46	0.32	0.88	56.8
2	12.9	8.69	46	0.28	0.88	61.2
3	10.5	7.07	46	0.23	0.82	68.8
4	7.8	–	46	0.17	0.76	–
5	8.2	–	35	0.23	0.82	–
6	10.5	7.07	35	0.30	0.87	58.4
7	12.9	8.69	35	0.37	0.93	53.3
8	14.7	8.50	35	0.42	0.88	47.9
9	13.4	9.03	23	0.58	1.03	34.1
10	12.0	8.09	23	0.52	1.01	38.6
11	10.5	7.07	23	0.46	0.98	45.8
12	9.2	6.20	23	0.40	0.94	60.4
13	7.5	–	23	0.33	0.89	–

FULL FLOW DESIGN PROCEDURE

Based on the preceding full flow test results, the following design procedure is suggested:

1. Select required pipe size based on the hydraulic design procedures presented in Hydraulic Engineering Circular Nos. 5 or 10 prepared by the Federal Highway Administration or the Concrete Pipe Design Manual published by the American Concrete Pipe Association.
2. For culverts operating under inlet control, determine outlet velocity by means of Manning's Formula.
3. If velocity reduction is desired, select a roughness element size for the three downstream rings with a height-diameter ratio between 0.06 and 0.09,

   $0.06 \leq K/D \leq 0.09$

   and a spacing-diameter ratio of 1.5. $L/D = 1.5$

   The single upstream ring would then be located at twice this spacing and sized to be approximately double the downstream rings.
4. Determine the hydraulic cross-sectional area at the last downstream ring.
5. Divide the design discharge by the resultant area determined in Step 4 to determine the outlet velocity.

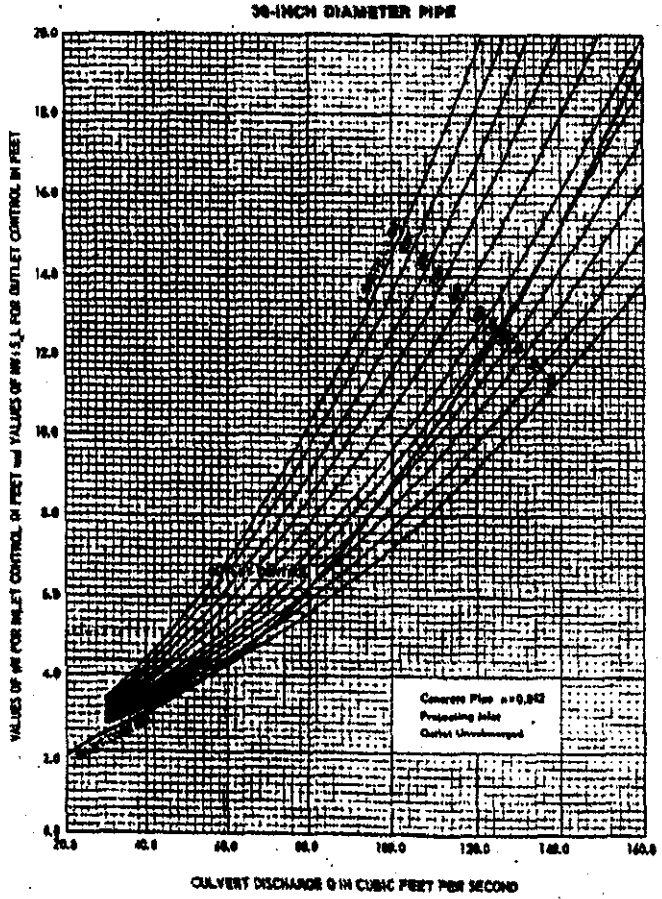
Example 1.

Given: Culvert, 36-inch diameter, 125 feet long, n = 0.012, 4% slope
Design Q = 60 cfs
AHW = 4.5 feet

Find: Size and spacing of roughness elements for full flow conditions

FIGURE 44

CULVERT CAPACITY
36-INCH DIAMETER PIPE



Solution:

1. Check culvert control.
   Figure 44, p. 222 Concrete Pipe Design Manual

   Inlet control:
   HW = 4.4 feet o.k.
   Outlet control:
   $HW + S_oL = 5.1$ feet
   $HW = 5.1 - 0.04 \times 125$
   HW = 0.1 feet o.k.

   Therefore, Inlet Control governs.

2. Determine outlet velocity
   Figure 4, p. 181 Concrete Pipe Design Manual

   $Q_{full} = 145$ cfs
   $V_{full} = 20.5$ fps

   Figure 18, p. 195 Concrete Pipe Design Manual

   $Q_d/Q_{full} = 60/145 = 0.41$
   $V_d/V_{full} = 0.94$
   $V_d = 0.94 \times 20.5 = 19.3$ fps

3. Velocity reduction desired.
   Downstream ring height
   $0.06 \leq K/D \leq 0.09$

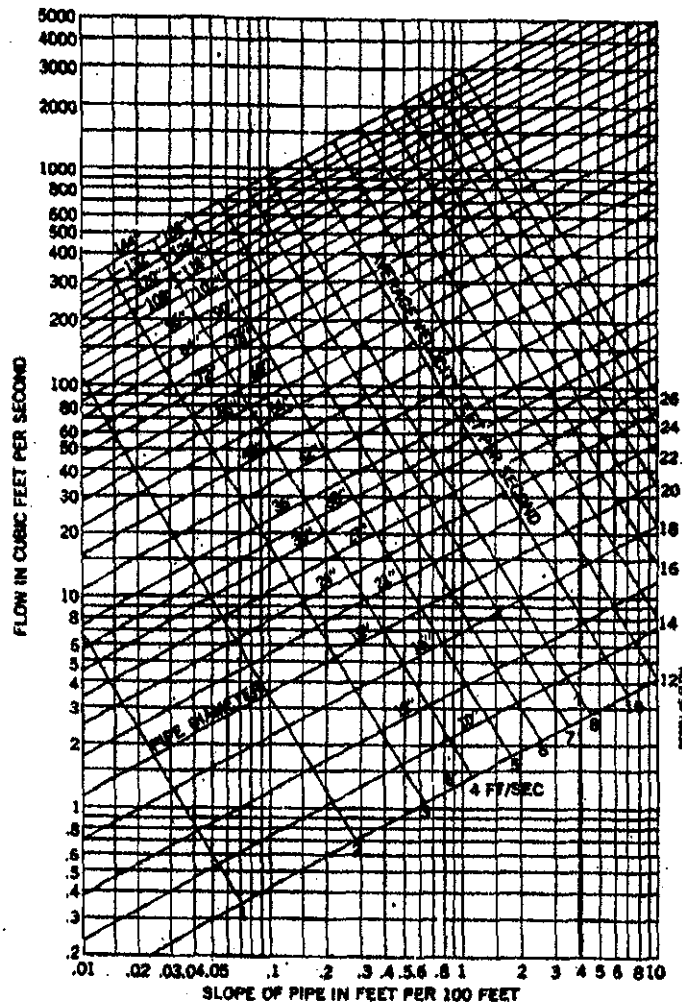
   Use K = 0.25 feet or 3 inches

   Downstream ring spacing
   L/D = 1.5
   Use L = 4.5 feet

   Upstream ring height
   Use K = 6 inches

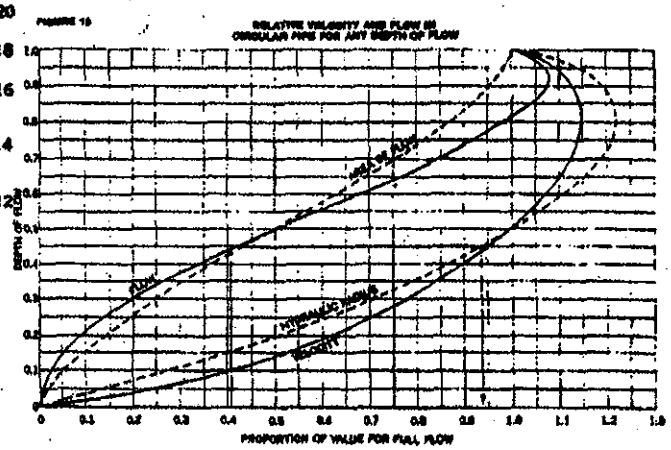
   Upstream ring spacing
   Use L = 9 feet

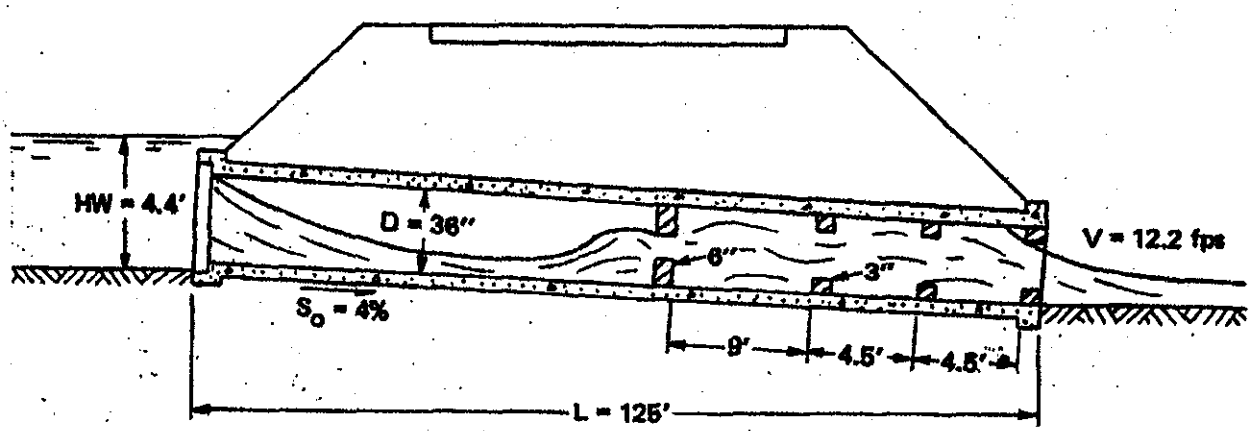
FIGURE 4 FLOW FOR CIRCULAR PIPE FLOWING FULL BASED ON MANNING'S EQUATION n=0.012



4. Determine Hydraulic cross-sectional area at last ring
   Pipe diameter = 36 inches
   Ring diameter = 30 inches
   From Table A-8 (on page 94) hydraulic cross-sectional area = 4.91 sq. ft.
5. Outlet Velocity
   $V = Q_d/A$
   $V = 60/4.91 = 12.2$ fps

   Therefore, use three downstream elements, 3 inches high, spaced 4.5 feet, preceded by one upstream element, 6 inches high, spaced 9 feet as illustrated.





FREE SURFACE FLOW DESIGN PROCEDURE

Based upon the free surface flow test results, the following design procedure is suggested:

1. Select required pipe size based on the hydraulic design procedures presented in Hydraulic Engineering Circular Nos. 5 or 10 prepared by the Federal Highway Administration or the Concrete Pipe Design Manual published by the American Concrete Pipe Association.
2. For culverts operating under inlet control, determine outlet velocity by means of Manning's Formula.
3. If velocity reduction is desired, select a pipe diameter within the following range:

$$\left[\frac{Q^2}{0.10g}\right]^{1/5} \leq D \leq \left[\frac{Q^2}{0.044g}\right]^{1/5}$$

where Q = design discharge
g = acceleration due to gravity (32.2)

The five dissipator rings will be placed within this pipe diameter.

4. Select a roughness element size for the dissipator rings with a height-diameter ratio between 0.10 and 0.15,

$$0.10 \leq K/D \leq 0.15$$

and a spacing-diameter ratio between 1.5 and 2.5.

$$1.5 \leq L/D \leq 2.5$$

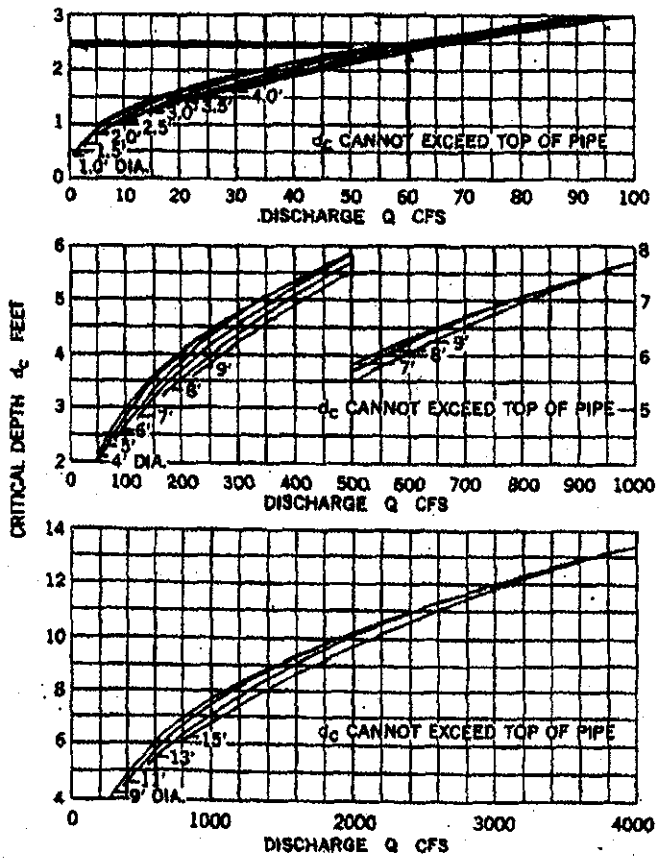
5. Determine hydraulic cross-sectional area at last dissipator ring based upon critical depth.
6. Divide the design discharge by the resultant area determined in Step 5 to determine the outlet velocity.

Example 2.

Given: Same as Example 1.

Find: Size and spacing of roughness elements for free surface flow conditions.

FIGURE 25 CRITICAL DEPTH CIRCULAR PIPE



Solution:

1. Check culvert control (see Example 1).
   Inlet control governs.
2. Determine outlet velocity (see Example 1).
   Q_{full} = 145 cfs
   V_{full} = 20.5 fps
   Q_{design} = 60 cfs
   V_{design} = 19.3 fps
3. Velocity reduction desired, select pipe diameter for culvert outlet.

$$\left[\frac{Q^2}{0.10g}\right]^{1/5} \leq D \leq \left[\frac{Q^2}{0.044g}\right]^{1/5}$$

$$\left[\frac{(60)^2}{(0.10)\ (32.2)}\right]^{1/5} \leq D \leq \left[\frac{(60)^2}{(0.044)\ (32.2)}\right]^{1/5}$$

$$4.0 \leq D \leq 4.8$$

Try a 48-inch diameter pipe.

4. Select roughness element size and spacing.

Size— $0.10 \leq \frac{K}{D} \leq 0.15$

$4.8 \leq K \leq 6.0$

Try K = 5 inches.

Spacing— $1.5 \leq \frac{L}{D} \leq 2.5$

$72 \leq L \leq 120$

Spacing of five elements between 6 and 10 feet allows placing one element in each of five last culvert sections.

5. Determine hydraulic cross-sectional area of last ring

   inside pipe diameter = 48-inches

   inside ring diameter = 38-inches (3.2 feet)

   From Figure 25, page 202, Concrete Pipe Design Manual, for D = 3.2 feet, d_c = 2.45 feet

   $$\frac{d_c}{D} = \frac{2.45}{3.2} = 0.765$$

   From Table A-10, page 363, Concrete Design Manual,

   $$\frac{\text{Area}}{D^2} = 0.6446$$

   Area = 0.6446 $(3.2)^2$

   Area = 6.62 sq. ft.

6. Determine outlet velocity.

   V = Q/A

   V = 60/6.62

   V = 9.1 fps

Therefore, use five elements, 5 inches high spaced 6 to 10 feet or the length of the pipe section if within this range, in the last five sections of pipe which are increased to 48 inches in diameter.

Discussion

The joining of the two sizes of pipe could be accomplished by telescoping or slipping the 36-inch pipe into the 48-inch pipe for at least the length of a normal joint and using normal sealing materials in the annular space.

Although the velocity reduction is somewhat greater for free surface flow than for full flow conditions, the method used should be selected only after a complete review of the economics, installation procedures and requirements of the project. Early consultation with the concrete pipe producer is suggested to take full advantage of manufacturing capabilities and design details.

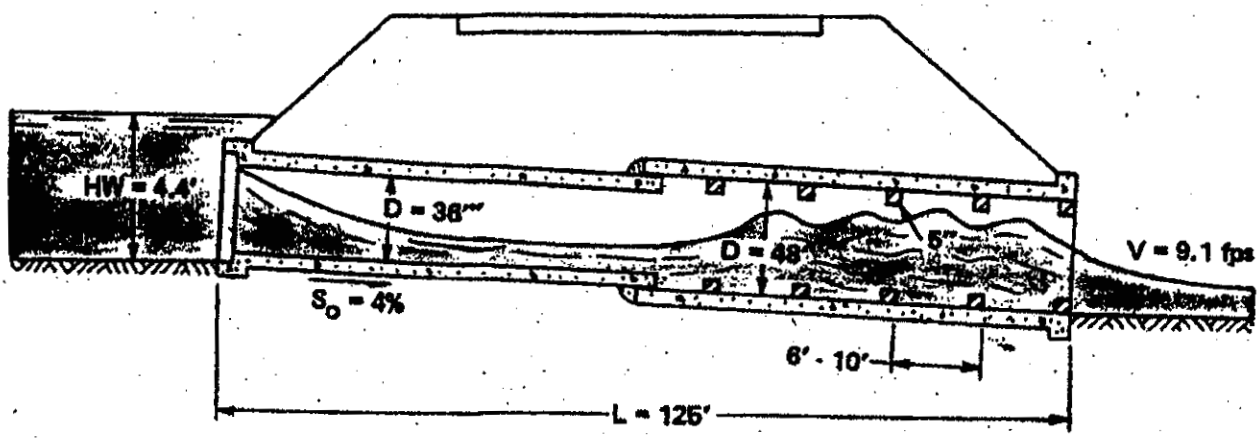


TABLE A-10

AREA, WETTED PERIMETER AND HYDRAULIC RADIUS OF PARTIALLY FILLED CIRCULAR PIPE

$\frac{d}{D}$	$\frac{area}{D^2}$	$\frac{wet.\ per.}{D}$	$\frac{hyd.\ rad.}{D}$	$\frac{d}{D}$	$\frac{area}{D^2}$	$\frac{wet.\ per.}{D}$	$\frac{hyd.\ rad.}{D}$
0.01	0.0013	0.2003	0.0066	0.51	0.4027	1.5908	0.2531
0.02	0.0037	0.2836	0.0132	0.52	0.4127	1.6108	0.2561
0.03	0.0068	0.3482	0.0197	0.53	0.4227	1.6308	0.2591
0.04	0.0105	0.4027	0.0262	0.54	0.4327	1.6509	0.2620
0.05	0.0147	0.4510	0.0326	0.55	0.4426	1.6710	0.2649
0.06	0.0192	0.4949	0.0389	0.56	0.4526	1.6911	0.2678
0.07	0.0242	0.5355	0.0451	0.57	0.4625	1.7113	0.2703
0.08	0.0294	0.5735	0.0513	0.58	0.4723	1.7315	0.2728
0.09	0.0350	0.6094	0.0574	0.59	0.4822	1.7518	0.2753
0.10	0.0409	0.6435	0.0635	0.60	0.4920	1.7722	0.2776
0.11	0.0470	0.6761	0.0695	0.61	0.5018	1.7926	0.2799
0.12	0.0534	0.7075	0.0754	0.62	0.5115	1.8132	0.2821
0.13	0.0600	0.7377	0.0813	0.63	0.5212	1.8339	0.2842
0.14	0.0668	0.7670	0.0871	0.64	0.5308	1.8546	0.2862
0.15	0.0739	0.7954	0.0929	0.65	0.5404	1.8756	0.2881
0.16	0.0811	0.8230	0.0986	0.66	0.5499	1.8965	0.2899
0.17	0.0885	0.8500	0.1042	0.67	0.5594	1.9177	0.2917
0.18	0.0961	0.8763	0.1097	0.68	0.5687	1.9391	0.2933
0.19	0.1038	0.9020	0.1152	0.69	0.5780	1.9606	0.2948
0.20	0.1118	0.9273	0.1206	0.70	0.5872	1.9823	0.2962
0.21	0.1199	0.9521	0.1258	0.71	0.5964	2.0042	0.2975
0.22	0.1281	0.9764	0.1312	0.72	0.6054	2.0264	0.2987
0.23	0.1365	1.0003	0.1364	0.73	0.6143	2.0488	0.2998
0.24	0.1449	1.0239	0.1416	0.74	0.6231	2.0714	0.3008
0.25	0.1535	1.0472	0.1466	0.75	0.6318	2.0944	0.3017
0.26	0.1623	1.0701	0.1516	0.76	0.6404	2.1176	0.3025
0.27	0.1711	1.0928	0.1566	0.77	0.6489	2.1412	0.3032
0.28	0.1800	1.1152	0.1614	0.78	0.6573	2.1652	0.3037
0.29	0.1890	1.1373	0.1662	0.79	0.6656	2.1896	0.3040
0.30	0.1982	1.1593	0.1709	0.80	0.6736	2.2143	0.3042
0.31	0.2074	1.1810	0.1755	0.81	0.6815	2.2395	0.3044
0.32	0.2167	1.2026	0.1801	0.82	0.6893	2.2653	0.3043
0.33	0.2260	1.2239	0.1846	0.83	0.6969	2.2916	0.3041
0.34	0.2355	1.2451	0.1891	0.84	0.7043	2.3186	0.3038
0.35	0.2450	1.2661	0.1935	0.85	0.7115	2.3462	0.3033
0.36	0.2546	1.2870	0.1978	0.86	0.7186	2.3746	0.3026
0.37	0.2642	1.3078	0.2020	0.87	0.7254	2.4038	0.3017
0.38	0.2739	1.3284	0.2061	0.88	0.7320	2.4341	0.3008
0.39	0.2836	1.3490	0.2102	0.89	0.7384	2.4655	0.2996
0.40	0.2934	1.3694	0.2142	0.90	0.7445	2.4981	0.2980
0.41	0.3032	1.3898	0.2181	0.91	0.7504	2.5322	0.2963
0.42	0.3130	1.4101	0.2220	0.92	0.7560	2.5681	0.2944
0.43	0.3229	1.4303	0.2257	0.93	0.7612	2.6081	0.2922
0.44	0.3328	1.4505	0.2294	0.94	0.7662	2.6467	0.2898
0.45	0.3428	1.4705	0.2331	0.95	0.7707	2.6908	0.2864
0.46	0.3527	1.4907	0.2366	0.96	0.7749	2.7389	0.2830
0.47	0.3627	1.5108	0.2400	0.97	0.7785	2.7934	0.2787
0.48	0.3727	1.5308	0.2434	0.98	0.7816	2.8578	0.2736
0.49	0.3827	1.5508	0.2467	0.99	0.7841	2.9412	0.2666
0.50	0.3927	1.5708	0.2500	1.00	0.7854	3.1416	0.2500

TABLE A-9

AREAS OF CIRCULAR SECTIONS (Square Feet)

Diameter									
Inches	Feet and Inches	0	⅛	¼	⅜	½	⅝	¾	⅞
0	0-0		.0001	.0003	.0006	.0014	.0021	.0031	.0042
1	0-1	.0055	.0068	.0096	.0103	.0123	.0144	.0167	.0192
2	0-2	.0218	.0246	.0276	.0308	.0341	.0376	.0413	.0451
3	0-3	.0491	.0533	.0576	.0621	.0668	.0717	.0767	.0819
4	0-4	.0873	.0928	.0985	.1044	.1104	.1167	.1231	.1296
5	0-5	.1364	.1433	.1503	.1576	.1650	.1726	.1803	.1883
6	0-6	.1963	.2045	.2131	.2217	.2304	.2394	.2485	.2576
7	0-7	.2673	.2769	.2867	.2967	.3068	.3171	.3276	.3382
8	0-8	.3491	.3601	.3712	.3826	.3941	.4057	.4176	.4296
9	0-9	.4418	.4541	.4667	.4794	.4922	.5053	.5185	.5319
10	0-10	.5454	.5591	.5730	.5871	.6013	.6157	.6303	.6450
11	0-11	.6600	.6750	.6903	.7057	.7213	.7371	.7530	.7691
12	1-0	.7854	.8018	.8185	.8353	.8522	.8693	.8866	.9041
13	1-1	.9218	.9396	.9576	.9757	.9940	1.013	1.031	1.050
14	1-2	1.069	1.088	1.106	1.127	1.147	1.167	1.187	1.207
15	1-3	1.227	1.248	1.268	1.289	1.310	1.332	1.353	1.376
16	1-4	1.398	1.419	1.442	1.462	1.485	1.507	1.530	1.553
17	1-5	1.576	1.600	1.623	1.647	1.670	1.694	1.718	1.742
18	1-6	1.767	1.792	1.817	1.842	1.867	1.892	1.917	1.943
19	1-7	1.969	1.995	2.021	2.047	2.074	2.101	2.127	2.154
20	1-8	2.182	2.209	2.237	2.264	2.292	2.320	2.348	2.377
21	1-9	2.405	2.434	2.463	2.492	2.521	2.551	2.580	2.610
22	1-10	2.640	2.670	2.700	2.731	2.761	2.792	2.823	2.854
23	1-11	2.885	2.917	2.948	2.980	3.012	3.044	3.076	3.109
24	2-0	3.142	3.174	3.207	3.241	3.274	3.307	3.341	3.375
25	2-1	3.409	3.443	3.477	3.512	3.547	3.581	3.616	3.652
26	2-2	3.687	3.723	3.758	3.794	3.830	3.866	3.903	3.939
27	2-3	3.976	4.013	4.050	4.087	4.125	4.162	4.200	4.239
28	2-4	4.278	4.314	4.353	4.391	4.430	4.469	4.508	4.547
29	2-5	4.587	4.627	4.666	4.706	4.746	4.787	4.827	4.868
30	2-6	4.909	4.950	4.991	5.032	5.074	5.115	5.157	5.199
31	2-7	5.241	5.284	5.326	5.369	5.412	5.455	5.498	5.541
32	2-8	5.585	5.629	5.673	5.717	5.761	5.806	5.850	5.895
33	2-9	5.940	5.985	6.030	6.075	6.121	6.167	6.213	6.259
34	2-10	6.305	6.351	6.398	6.445	6.492	6.539	6.586	6.634
35	2-11	6.681	6.729	6.777	6.825	6.874	6.922	6.971	7.020
36	3-0	7.069	7.118	7.167	7.217	7.266	7.316	7.366	7.416
37	3-1	7.467	7.517	7.568	7.619	7.670	7.721	7.773	7.824
38	3-2	7.876	7.928	7.980	8.032	8.084	8.137	8.190	8.243
39	3-3	8.296	8.349	8.403	8.456	8.510	8.564	8.618	8.672
40	3-4	8.727	8.781	8.836	8.891	8.946	9.001	9.057	9.113
41	3-5	9.168	9.224	9.281	9.337	9.393	9.450	9.507	9.564
42	3-6	9.621	9.678	9.736	9.794	9.852	9.910	9.968	10.03
43	3-7	10.08	10.14	10.20	10.26	10.32	10.38	10.44	10.50
44	3-8	10.56	10.62	10.68	10.74	10.80	10.86	10.92	10.98
45	3-9	11.04	11.11	11.17	11.23	11.29	11.35	11.42	11.48
46	3-10	11.54	11.60	11.67	11.73	11.79	11.86	11.92	11.98
47	3-11	12.05	12.11	12.18	12.24	12.31	12.37	12.44	12.50
48	4-0	12.57	12.63	12.70	12.76	12.83	12.90	12.96	13.03
49	4-1	13.10	13.16	13.23	13.30	13.36	13.43	13.50	13.57

by
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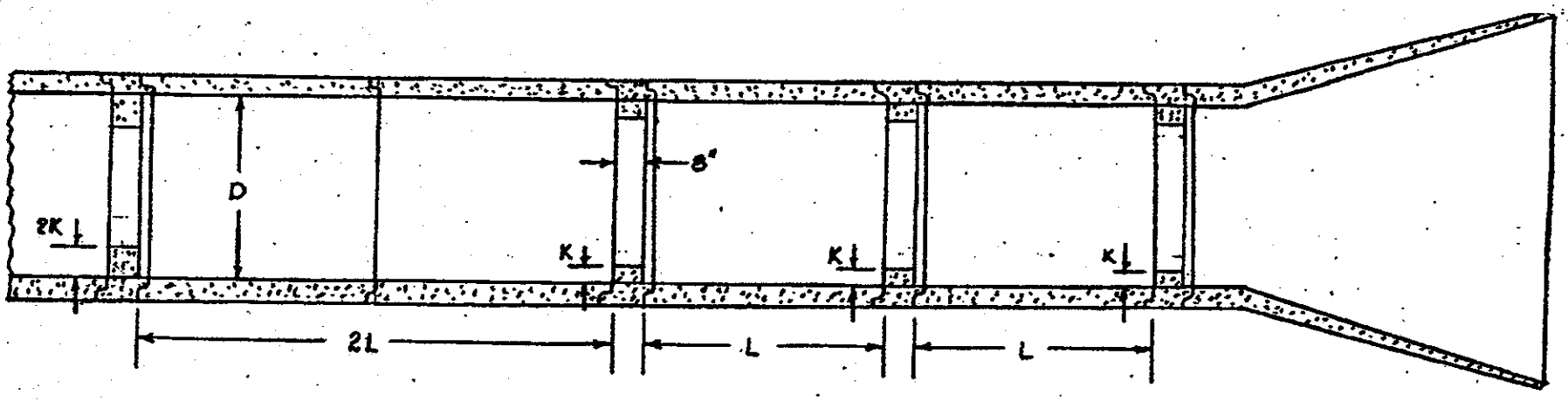

CRITERIA FOR VELOCITY REDUCTION: $0.06 \leq K/D \leq 0.09$ $L/D \cong 1.5$

36" Pipe: use $K = 3''$ $K/D = 3/36 = .083$ ok

$L = 4'$ $L/D = 48/36 = 1.33$ ok

Area $= \pi r^2 = \pi(18-3)^2 = 706.9$ sq. in. or 4.91 sq. ft.

$$V = Q/A = 70/4.91 = 14.3 \text{ ft./sec.}$$