ADDENDUM
TO
MASTER DRAINAGE STUDY - STETSON HILLS
SAND CREEK CHANNEL IMPROVEMENTS
IN THE CITY OF COLORADO SPRINGS

Job No. 5197501
January, 1986

Greiner Engineering

ADDENDUM TO MASTER DRAINAGE STUDY - STETSON HILLS SAND CREEK CHANNEL IMPROVEMENTS IN THE CITY OF COLORADO SPRINGS

Job No. 5197501
January, 1986

PREPARED FOR:

AMWEST, INC.
5455 North Union Blvd.
Colorado Springs, Colorado 80936-5069

PREPARED BY:

GREINER ENGINEERING SCIENCES, INC.
570 W. 44th Avenue
Denver, Colorado 80216
(303) 455-7321

STATEMENTS

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the Master Plan of the drainage basin. I accept responsibility for any liability caused by the negligent acts, errors, or omissions on my part in preparing this report.

COLORADO REGISTERED
TYLER D. SMART
20779
PROFESSIONAL ENGINEER

Tyler D. Smart, P.E.
Manager-Hydraulics
GREINER ENGINEERING SCIENCES, INC.

The Developer and/or his representative has read and will comply with all the requirements specified in this drainage report and plan.

6/25/86

Authorized Representative
Amwest Development Corporation
5455 N. Union Boulevard
Colorado Springs, CO 80918

City of Colorado Springs:

Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980 as amended.

City Engineer — Date 7/1/86

* See Conditions of App'vl.

FLOODPLAIN STATEMENT

Portions of this site are located within the existing floodplain of Sand Creek Main Tributary. With the construction of the channel proposed in this report, the future floodplain will be within the channel. The existing FEMA floodplain areas will be protected by the construction of the channel and by overlot grading which will raise the lowest floor elevation of building structures at least one foot above the calculated 100-year water level.

Tyler D. Smart, P.E.
Manager - Hydraulics
Greiner Engineering Sciences, Inc.

COLORADO REGISTERED
TYLER D. SMART
20779
PROFESSIONAL ENGINEER

TABLE OF CONTENTS

* Conditions of Approval:

a) Subject to the requirements of the F.E.M.A. map revisions and the Army Corps of Engineers 404 permit.

b) Drainage basin and bridge fees subject to platting of channel right of way.

c) Earthwork for channel construction is reimbursible only for volumns within the channel right of way. Quantities to be verified by the Engineer with field data at the time of request for reimbursement.

DESIGN REPORT FOR PROPOSED
1.47 MILES OF CHANNEL IMPROVEMENTS
FOR SAND CREEK
IN THE CITY OF COLORADO SPRINGS

Job No. 5197501
January, 1986

PURPOSE OF STUDY

The purpose of this report is to present the results of the final design for the first phase of channel improvements for Sand Creek through the Stetson Hills Development. Design criteria, design assumptions and design calculations are presented. Reference is made to the "Stetson Hills Subdivision - Sand Creek Channel" Construction Drawings, Sheet 1 of 26 through Sheet 26 of 26, for detailed design information. Cost estimates for the proposed improvements are also presented at the end of this report.

LOCATION AND DESCRIPTION OF AREA

The Stetson Hills Subdivision is located in Sections 17, 18, 19, 20, 29 and 30, Township 13 South, Range 65 West of the Sixth Principal Meridian, City of Colorado Springs, El Paso County, Colorado. The location of the site is shown on the Vicinity Map (Figure 1, Appendix). The proposed Colorado Springs Ranch Subdivision is located adjacent to and south of the site. Sand Creek flows in a southerly direction through the center of the site. The stream location and the general development plans for the site area are shown on Figure 2 of the Appendix. The improvements to Sand Creek for this phase of the work will consist of the channelization of the southerly 7760 feet of the stream from the south property line of Stetson Hills to Bridlespur Boulevard.

The existing slope of the Sand Creek channel in this area varies from approximately 1.0 percent in the lower reaches to 1.5 percent in the upper reaches. Under existing conditions, the stream is intermittent, normally flowing only during and after times of precipitation. The channel area, for the most part, consists of slightly silty to silty sand overlaying claystone and sandstone bedrock. The overburden soils vary in depth from about 2 to 5 feet with some portions of the channel bottom being eroded down to bedrock. Several sandstone outcrops occur along the channel banks in the vicinity of the Barnes Road crossing.

Based on the soils borings and soils investigations completed for the design, the bedrock in the site area consists of claystones, siltstones and sandstones of the Denver Formation. The southerly portion of the alignment is underlain by mostly sandstones and siltstones, while the northerly portion of the alignment is underlain mostly by claystones and siltstones. The extent of the rock types is, however, highly erratic both in the lateral and vertical directions. The claystones and siltstones are described as being medium to very hard and the sandstone being very hard. The thickness of the weathered bedrock zone below the soil layer varies, but was generally estimated to be only a few feet thick. Most of the bedrock was estimated to be rippable with a D-9 ripper.

DESIGN FLOWS AND HYDROLOGY

The peak flows for the 100-year 24-hour storm for fully developed basin conditions were used for the design of the Sand Creek channel improvements. Hydrologic analysis for the Sand Creek basin has been performed in the "Sand Creek Master Drainage Drainage Planning Study" (Reference 2) and in the "Master Drainage Study for Stetson Hills" (Reference 3). Drainage basin parameters, rainfall data and computed existing condition and developed condition flows are presented in the above studies. The computed peak flows in the two studies differed slightly at the common design points. The discharge profiles for the reach of Sand Creek under consideration are shown in the Appendix (page 3A). To be conservative, the higher 100-year peak flows from the studies were used for the design of the channel improvements. The 100-year design flows used were:

South property line to Barnes Road (Station 0+00 to Station 21+00)	Q_{100} = 7660 cfs
Barnes Road to West Tributary (Station 21+00 to Station 30+27)	Q_{100} = 7080 cfs
West Tributary to East Tributary (Station 30+27 to Station 48+27)	Q_{100} = 5900 cfs
East Tributary to Bridlespur Boulevard (Station 48+27 to Station 77+60)	Q_{100} = 5600 cfs

DESIGN CONCEPTS AND CONSIDERATIONS

The concept proposed for this design is to realign Sand Creek by regrading the channel to eliminate the sharp existing curves. The channel bottom, based on the test borings, will be located in bedrock for most of the length except the lower 500 to 700 feet which will be located in sandy material. Based on the soils investigations, the bedrock was determined to in the rippable to marginally rippable range for excavation purposes. The erosive resistance of the bedrock is highly variable ranging from erosive soft weathered claystones to durable sandstones. The channel side slopes are proposed to be lined with riprap for erosion protection. The riprap slope lining will be keyed into the channel bottom 2 to 3 feet in rock cut areas. The 3-foot depth will be used in high velocity areas such as at the bottom of drop structures. In areas of sandy material, the riprap slope lining will be extended down below the channel bottom a minimum of 5 feet or to bedrock if the depth of the material is less than 5 feet. The channel sideslopes will be 2.5 horizontal to 1.0 vertical.

The proposed channel slope is 0.90 percent except for the lower approximately 315 feet where the slope will be 1.10 percent to match the proposed channel slope of the Colorado Springs Ranch development. The proposed channel will have a flat bottom with a width of 100 feet for the design flows of 7080 cfs to 7660 cfs and a width of 75 feet for the design flows of 5600 cfs to 5900 cfs. Except for the steeper slope and the sand bottom area in the lower reach, the flow in the channel will be subcritical for flows up to and including the 100-year design flows. Supercritical flow will occur only in the lower reach. Flow depths for the design flows for the major portion of the channel (subcritical flows) will range from 5.8 to 6.0 feet and flow velocities will range from 10.7 to 11.2 feet per second. The calculated Froude Numbers for these depths were approximately 0.85 to 0.86. In the lower reach of supercritical flow (lower 700± feet), flow depths will range from 4.7 to 5.0 feet with velocities of 13.6 to 14.5 feet per second and Froude Numbers of 1.13 to 1.24. Normal depth calculations and rating tables for the channel sections are enclosed in the Appendix.

Drop structures are proposed along the channel alignment to maintain the design slopes. A U.S. Bureau of Reclamation baffled chute drop is proposed upstream of the Barnes Road bridge. The baffled chute is used to make up the 7.5 foot grade change between the channel invert at the bridge and invert of the upstream channel. The baffled chute was designed per the Bureau of Reclamation criteria (Reference 10). The channel slope was reduced to 0.60 percent for a short distance upstream of the baffled chute to provide better hydraulic entrance conditions to the chute. The remaining drop structures will consist of sloped drops ranging from 2 feet to 3.5 feet high. All the drops are assumed to be located in bedrock. Because the durability of the bedrock is unknown, especially under the high velocities occurring at the drops, concrete lining is proposed through the drops and riprap is proposed along the channel bottom downstream of the drops. A concrete sill is proposed at the grade break in the sandy soil reach just upstream from the south property line. The sill is used to prevent degradation and meandering of the channel in this area.

A 12-foot wide multi-use trail will be constructed at the time of the channel construction. The trail will consist of 8 inches of gravel and will be located along west side of the channel in a 25-foot wide easement. Access to the trail will be provided from the future streets of the adjacent developments and from the adjacent park areas to be constructed. The location of the access points will be determined at the time of final design of these facilities. Several side tributaries will join the Sand Creek channel through this area. Design of the side tributary channels is not included in this contract and is to be done by others. Approximate locations of the tributary channels are shown on the plans. The trail crossings of the side tributaries will also be designed at the time of tributary channel design. Temporary grading and swales will be provided at the existing confluences of the side tributaries to provide drainage to channel.

The Barnes Road bridge, which is presently under construction, is the only crossing proposed for this reach of channel. A bridge or culvert will be designed in the future for the Bridlespur Boulevard crossing. The Barnes Road bridge was designed to provide no obstruction to the flow in the channel. The channel bottom width through the bridge was reduced to 75 feet and the 12-foot, multi-use trail was passed under the bridge. The trail was located 3.5 feet above the bottom of the channel to provide for passage of low flows without flooding the trail. The clearance between the low chord of the bridge and the trial was designed to be 8 feet.

The velocity of the 100-year design flow will be 14.3 feet per second which will prevent sedimentation around the bridge area. Riprap will be placed along the wingwall on the upstream and downstream sides to prevent erosion. The area directly under the bridge is protected by concrete aprons toedowned to bedrock.

In the interim period, the proposed channel grading will be tied into the existing channel at the upstream and downstream limits of construction. In the future, the downstream end of the channel will connect with the proposed channel to be constructed by the Colorado Springs Ranch Development. The channel will be transitioned from 100 feet wide to 75 feet wide at the lower end to match the width of the proposed Colorado Springs Ranch channel. The downstream channel is proposed to be constructed with soil-cement slope lining. The soil cement lining is to have 1:1 side slopes, but per discussions with Simons, Li & Associates, the soil cement side slopes will be transitioned to 2.5:1 to match the upstream riprap lining at the junction.

DESIGN CRITERIA AND HYDRAULIC CALCULATIONS

Design criteria set forth in the City of Colorado Springs "Subdivision Policy Manual" were used for this design. Where applicable, the recommendations presented in the "Sand Creek Master Drainage Planning Study" were followed.

The channel was sized to convey the 100-year developed flows. The channel side slopes will be 2.5 horizontal to 1.0 vertical and will be lined with riprap. The riprap will be keyed into the bedrock 2 to 3 feet through rock cut areas and will have a toe-down depth of 5 feet or down to bedrock in sandy material areas. A minimum freeboard of 25.0 percent of the calculated 100-year flow depth (but not less than 1.0 foot) is to be provided for the channel length.

Flow depths and velocities were computed using Manning's Equation for the channel reaches with constant cross-sections and slopes. The U.S. Corps of Engineers HEC-2 computer program was used to compute the depths and velocities through channel transitions and the direct step backwater method was used to estimate the flow profiles through sloped drop structures. All calculations are included in the Appendix.

Manning's roughness coefficients used in the calculations were .045 for riprap, .035 for rock cut areas, .022 for sand bottoms and .015 for concrete lining. Composite values for the channel sections based on the flow depth and the above values were used in the calculations.

The riprap for the channel side slope lining was sized using the computed 100-year flow velocities and the riprap sizing chart from the "Subdivision Policy Manual". The riprap size was checked using the tractive force method detailed in the Corps of Engineers Design Manual "Hydraulic Design of Flood Control Channels" (Reference 8). The riprap thickness used were two times the diameter of the specified size for sizes 6-inches through 12-inches and 1.5 times the diameter of the specified size for sizes larger than 12-inches. Gravel bedding material and filter fabric is to be placed under all riprap in soil areas.

The velocities downstream of the sloped drops range from 20 to 22 feet per second and would require riprap sizes and thicknesses too large to be practical. Since the drops will be located in bedrock, a 24-inch grouted riprap will be placed downstream of the drops. If deep sandy conditions are encountered, the size of the downstream riprap will be increased to 30-inches.

CONCLUSIONS

The purpose of this report is to analyze and document the improvements for the lower 7760 feet of Sand Creek through the Stetson Hills Subdivision. These improvements will straighten the channel, stabilize the side slopes and confine the 100-year flows within the improved channel. Detailed design information for the channel improvements are included in "Stetson Hills Subdivision - Sand Creek" Construction Drawings, Sheet 1 of 26 through Sheet 26 of 26.

Because the area of construction contains bedrock near the ground surface and because the bedrock is highly variable in composition and extent, the exact subsurface conditions are not known. During construction, the channel profile may need to be modified and the number and location of drops may be changed to facilitate construction and reduce cost. The basic design considerations as presented in this report will still apply.

The Federal Emergency Management Agency (FEMA) review process will begin soon after approval of these Construction Plans is received. No development of land within the existing 100-year floodplain can begin until the channel improvements have been completed and the floodplain is officially amended by FEMA.

Coordination is presently taking place with the U.S. Corps of Engineers for the mitigation of the loss of wet land areas due to the channel construction.

This design report and construction plans are submitted for review and approval.

Prepared by: Leroy L. Ciani
Leroy L. Ciani, P.E.
Project Engineer

Reviewed by: Tyler D. Smart
Tyler D. Smart, P.E.
Manager - Hydraulics

COLORADO REGISTERED
TYLER D. SMART
20779
PROFESSIONAL ENGINEER

LLC:ld

REFERENCES

1) City of Colorado Springs, "Determination of Storm Runoff Criteria", March 1977.

2) Simons Li & Associates, Inc., "Sand Creek Master Drainage Planning Study", City of Colorado Springs and El Paso County, "Development of Alternate Plans", July 1985.

3) Greiner Engineering Sciences, Inc., "Master Drainage Study for Stetson Hills", April 1985.

4) U.S. Department of Army Corps of Engineers, Hydrologic Engineering Center "HEC-2 Water Surface Profiles Generalized Computer Program", Davis, California 1976, Revised May 1984.

5) U.S. Department of Agriculture, Soil Conservation Service, "Guide for Selecting Roughness Coefficient "n" Values for Channels", December 1963.

6) Greiner Engineering Sciences, Inc., "Final Drainage Study for Stetson Hills Subdivision Filing No. 1 and 2", April 1985.

7) Simons Li & Associates, Inc., "Drainage and Flood Control Design Guidelines and Criteria, Channels and Hydraulic Structures on Sandy Soil", June 1981.

8) U.S. Corps of Engineers, Engineering Manual EM1110-2-1601 "Hydraulic Design of Flood Control Channels", July 1970.

9) Ven Te Chow, "Open-Channel Hydraulics", McGraw-Hill Book Company, New York, 1959.

10) U.S. Bureau of Reclamation "Hydraulic Design of Stilling Basins and Energy Dissipators", Engineering Monograph No. 25, 1984.

DRAINAGE FACILITIES COSTS
AND
BASIN AND BRIDGE FEES

Greiner Engineering Sciences, Inc.
Denver, Colorado

ENGINEER'S COST ESTIMATE

Project: STETSON HILLS SAND CREEK CHANNEL
Location: Sand Creek Channel between South Property Line and Bridlespur Boulevard in Stetson Hills Subdivision (7760 LF)
Job Number: 5197501
Date: January 24, 1986

Item	Quantity	Unit	Unit Price	Total Price
PUBLIC STORM FACILITIES				
1. Excavation (unclassified)	109,400	CY	$ 2.00	$ 218,800.00
2. Excavation Rock	220,800	CY	6.00	1,324,800.00
3. 12-inch Riprap	17,650	CY	30.00	529,500.00
4. 18-inch Riprap	4,080	CY	30.00	122,400.00
5. 24-inch Riprap	4,480	CY	35.00	156,800.00
6. Grouted 24-inch Riprap	8,410	CY	75.00	630,750.00
7. Granular Bedding Material	2,300	CY	20.00	46,000.00
8. Filter Cloth	17,000	SY	2.00	34,000.00
9. Baffled Chute Structure	-	LS	-	88,800.00
10. Concrete Check Structures	-	LS	-	7,600.00
11. Concrete - Sloped Drop Structures	17	EA	8,700.00	147,900.00
12. Class 4 Base Course Material (multi-use trail)	2,210	CY	16.00	35,360.00
SUBTOTAL				$ 3,342,710.00
CONTINGENCIES (10%)				334,271.00
TOTAL				$ 3,676,981.00
PRIVATE STORM FACILITIES				
1. 18-Inch Riprap	1,478	CY	$ 30.00	$ 44,340.00
2. Granular Bedding Material	450	CY	20.00	9,000.00
3. Filter Cloth	2,014	SY	2.00	4,028.00
SUBTOTAL				$ 57,368.00
CONTINGENCIES (10%)				5,736.80
TOTAL				$ 63,104.80

CITY OF COLORADO SPRINGS
The "America the Beautiful" City
DEPARTMENT OF PUBLIC WORKS   CITY ENGINEERING INSPECTIONS (303) 578-6782
105 WEST COSTILLA   P.O. BOX 1575
COLORADO SPRINGS, COLORADO 80901

January 27, 1986

TO WHOM IT MAY CONCERN: *(Correction Of December 16, 1985 Letter, Please Note Correction Below

The City of Colorado Springs Council at the December 10, 1985 meeting approved the drainage basin fees for 1986 as follows:

CODE #	BASIN NAME	1985 DRAINAGE FEE/ACRE	1985 BRIDGE FEE/ACRE	% OF INCREASE	1986 DRAINAGE FEE/ACRE	1986 BRIDGE FEE/ACRE
01	SAND CREEK	$4,794.00	$400.00	5%	$5,034.00	$420.00
02	SPRING CREEK	$3,695.00		5%	$3,880.00	$ -0-
03	TEMPLETON GAP	*$2,436.00	27.00	5%	*$2,558.00	$ 28.00
04	DOUGLAS CREEK	$4,300.00	$ 99.00	5%	$4,515.00	$104.00
05	19TH STREET	$1,403.00		5%	$1,473.00	$ -0-
06	POPES BLUFF	$1,427.00	$243.00	5%	$1,498.00	$255.00
07	CAMP CREEK	$ 790.00		5%	$ 830.00	$ -0-
08	PETERSON FIELD	$3,612.00	$209.00	5%	$3,793.00	$219.00
09	SOUTH ROCKRIMMON	$1,675.00		5%	$1,759.00	$ -0-
10	PULPIT ROCK	$2,361.00		5%	$2,479.00	$ -0-
11	DRY CREEK	$2,030.00		5%	$2,132.00	$ -0-
12	NORTH ROCKRIMMON	$2,142.00		5%	$2,249.00	$ -0-
13	COTTONWOOD CREEK	$3,136.00	$144.00	5%	$3,293.00	$151.00
14	MISCELLANEOUS	$2,601.00			$2,925.00 1	$ -0-
15	MESA	$2,230.00		5%	3912 ~~$2,342.00~~	$ -0-
16	21ST STREET	$2,143.00		5%	$2,250.00	$ -0-
17	BEAR CREEK	$1,379.00	$129.00	5%	$1,448.00	$135.00
18	SOUTHWEST AREA	$4,665.00		5%	$4,898.00	$ -0-
19	WINDMILL GULCH	$4,265.00	$117.00	5%	$4,478.00	$123.00
20	BLK. SQUIRREL CK.	$4,782.00	$660.00		$4,782.00 2	$660.00

FOOTNOTES: 1 Miscellaneous fee is computed as a simple average of all studied basins

2 New fee, approved by the Drainage Board on 11/21/85, no increase proposed for 1986

THE FEE CHANGE IS EFFECTIVE JANUARY 1, 1986

Sincerely,

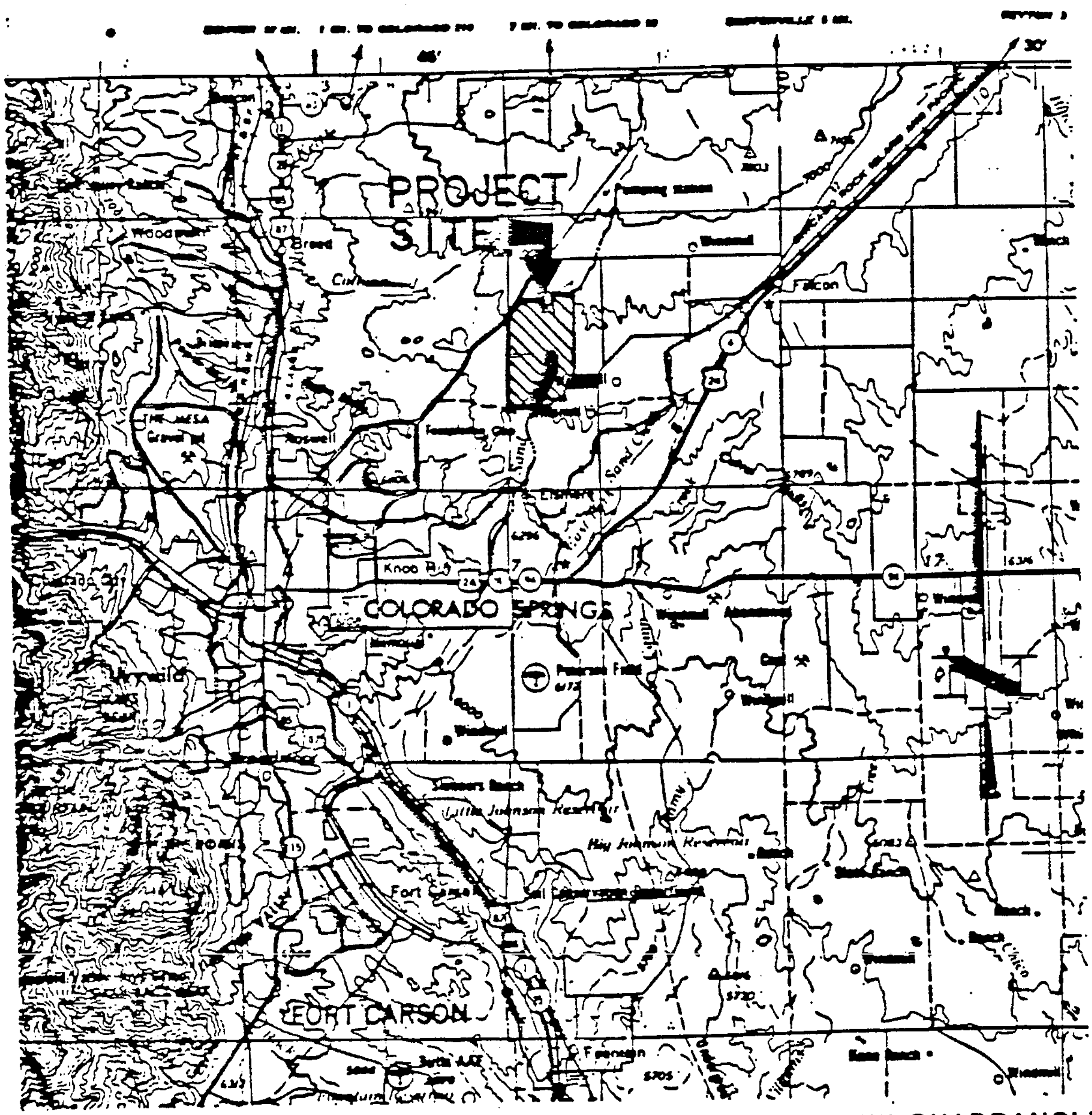
Gary R. Haynes

Gary R. Haynes
City Engineer

GRH/jgk

cc: DeWitt Miller, Director of Public Works

APPENDIX



SCALE: 1' = 250,000'

FALCON NW QUADRANGLE
SECTIONS 17,18,19,20,29 & 30
T. 13 S., R. 65 W.

VICINITY MAP

GREINER ENGINEERING

FIGURE 1

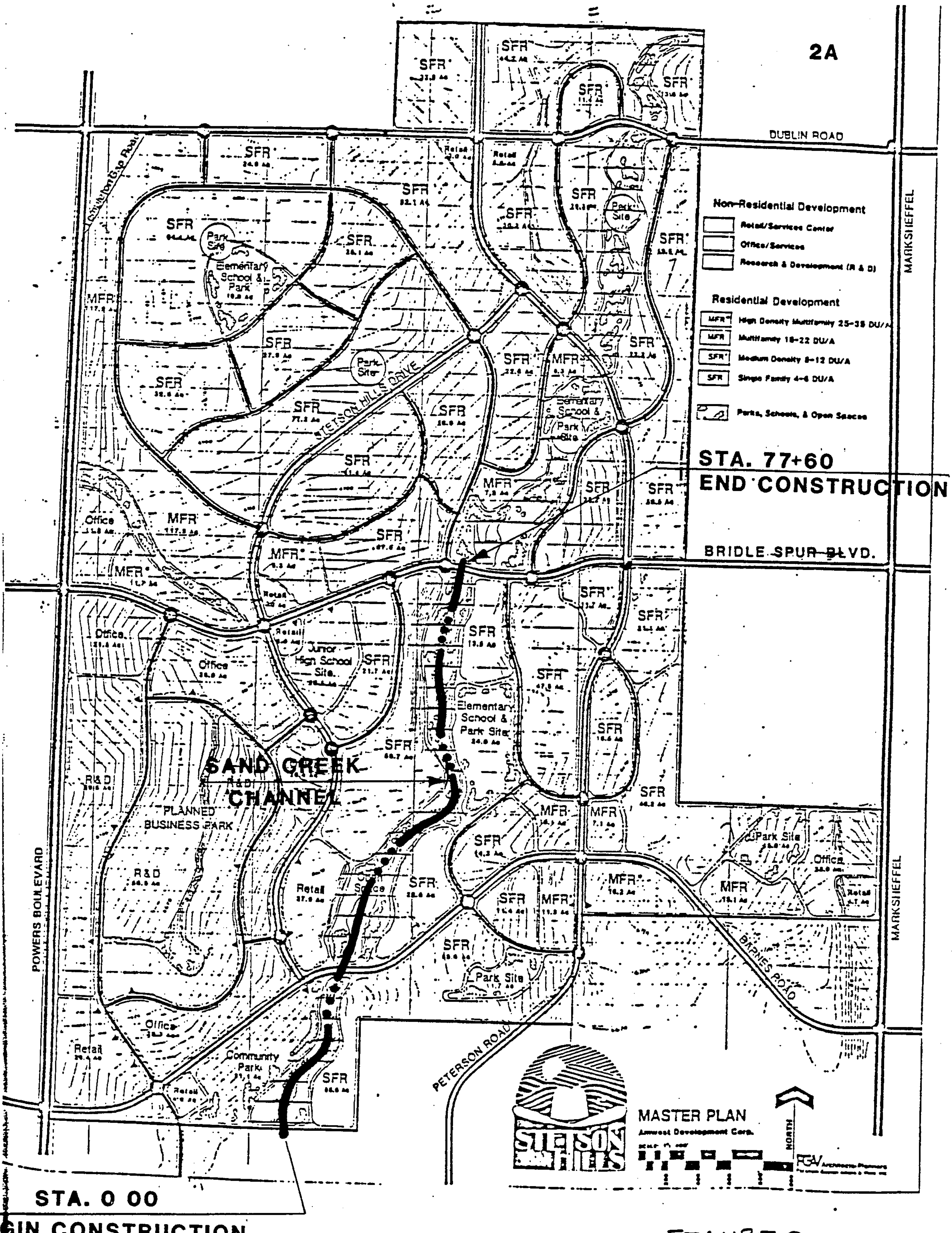
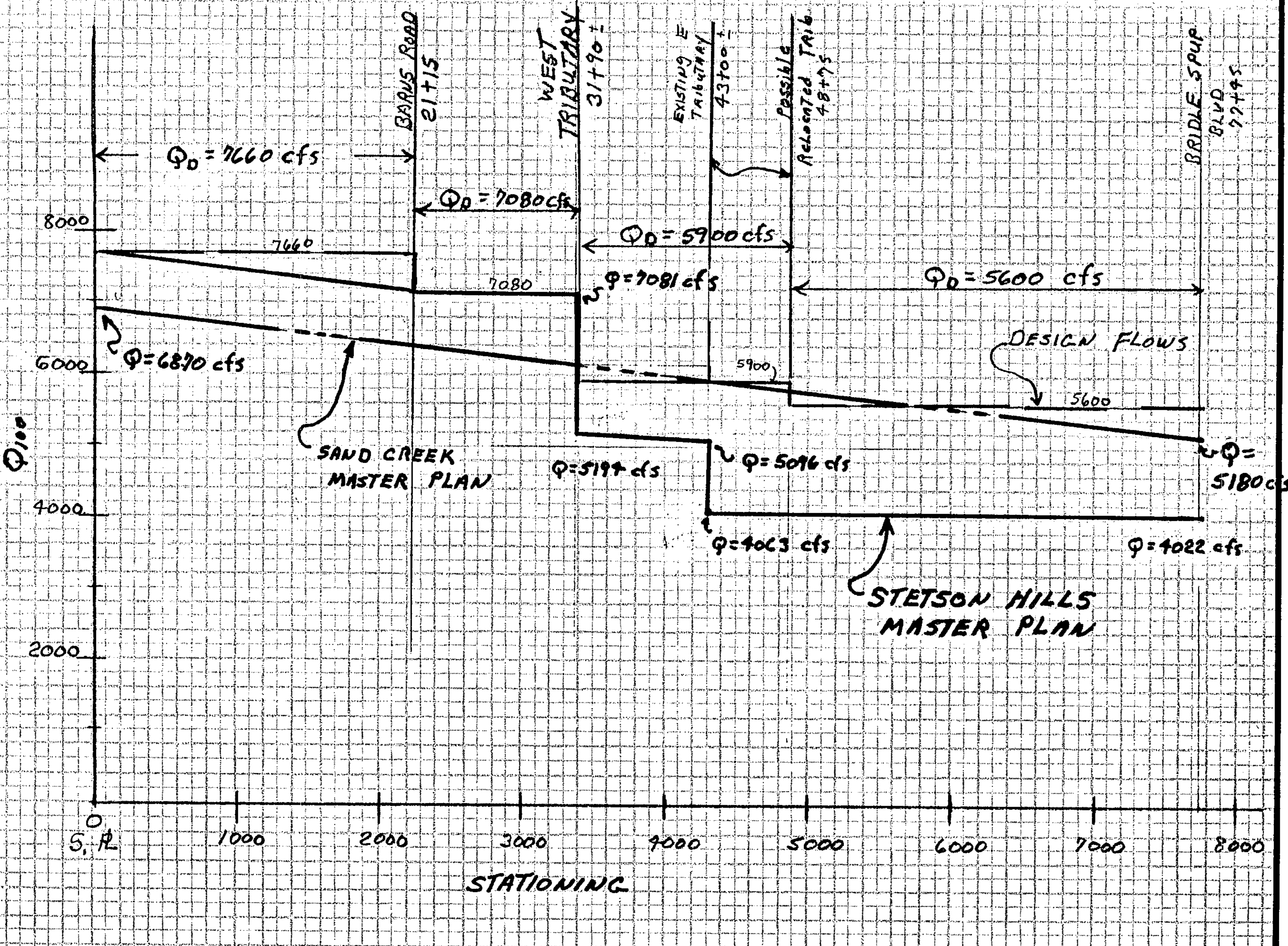

2A
DUBLIN ROAD
Non-Residential Development
Retail/Services Center
Office/Services
Research & Development (R & D)
Residential Development
High Density Multifamily 25-35 DU/A
Multifamily 18-22 DU/A
Medium Density 8-12 DU/A
Single Family 4-6 DU/A
Parks, Schools, & Open Spaces
MARKSHEFFEL
STETSON HILLS DRIVE
STA. 77+60
END CONSTRUCTION
BRIDLE SPUR BLVD.
SAND CREEK
CHANNEL
PLANNED
BUSINESS PARK
POWERS BOULEVARD
BARNES ROAD
PETERSON ROAD
MASTER PLAN
Amwest Development Corp.
STETSON HILLS
NORTH
STA. 0 00
BEGIN CONSTRUCTION

FIGURE 2



STREAM STATIONING VS DISCHARGE RATES
FOR
DESIGN FLOWS SAND CREEK CHANNEL

Greiner Engineering

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☐ COLORADO SPRINGS, COLORADO
☐ ALBUQUERQUE, NEW MEXICO
☐ KEMMERER, WYOMING

PROJECT STETSON HILLS - SAND CREEK
JOB NUMBER 519750l SHEET 3A OF
CALCULATED BY LLC DATE 3/86
CHECKED BY DATE

Greiner Engineering

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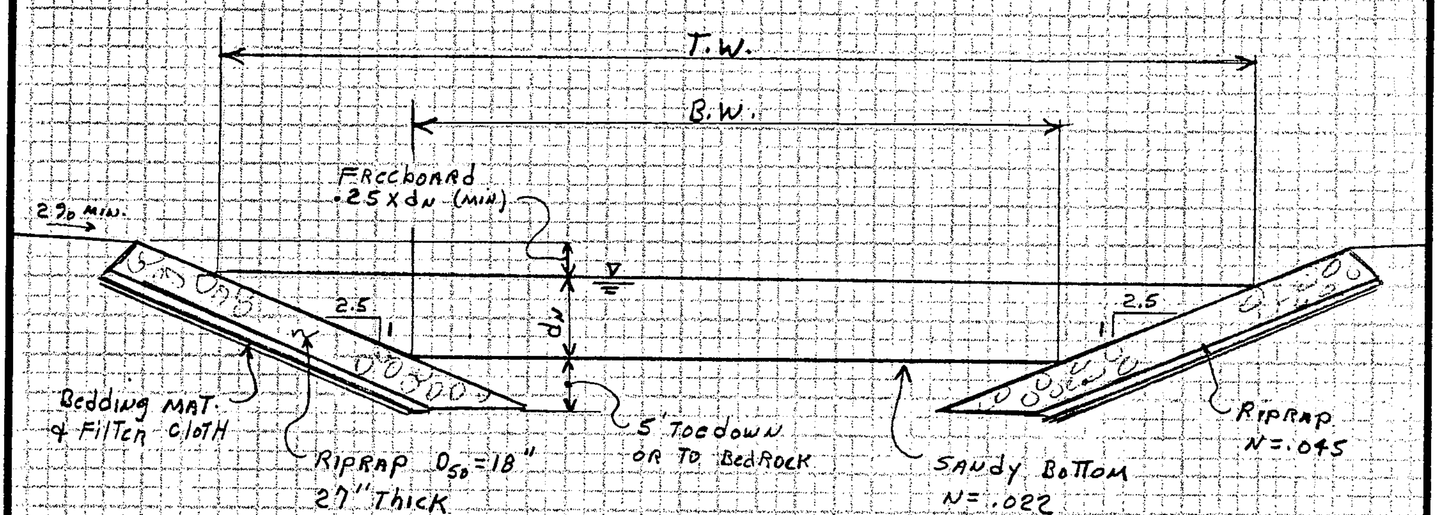
☐ COLORADO SPRINGS, COLORADO
☐ ALBUQUERQUE, NEW MEXICO
☐ KEMMERER, WYOMING

PROJECT Stetson Hills - Sand Creek
JOB NUMBER 5197501 SHEET 4A OF
CALCULATED BY LLC DATE 1/86
CHECKED BY CMB DATE 1/22/86

PROPOSED CHANNEL SECTION 0+00 TO 7+00 ±



TYPICAL SECTION LOWER SAND AND SOIL REACH

NORMAL DEPTH PARAMETERS S_0 = .009 ft/ft

Design Flow Q_{100}	B.W.	d_N	T.W.	A	N_C	V	F
7660 cfs	100'	5.01	125.05'	563.8 ft²	.0280	13.60 ft/sec	1.13
7660	75'	6.23	106.15	564.3	.0312	13.56	1.04
				S_0 = .011 ft/ft			
7660	100	4.72	123.60	527.7	.0280	14.51	1.24
7660	75	5.84	109.20	523.3	.031	14.53	1.14

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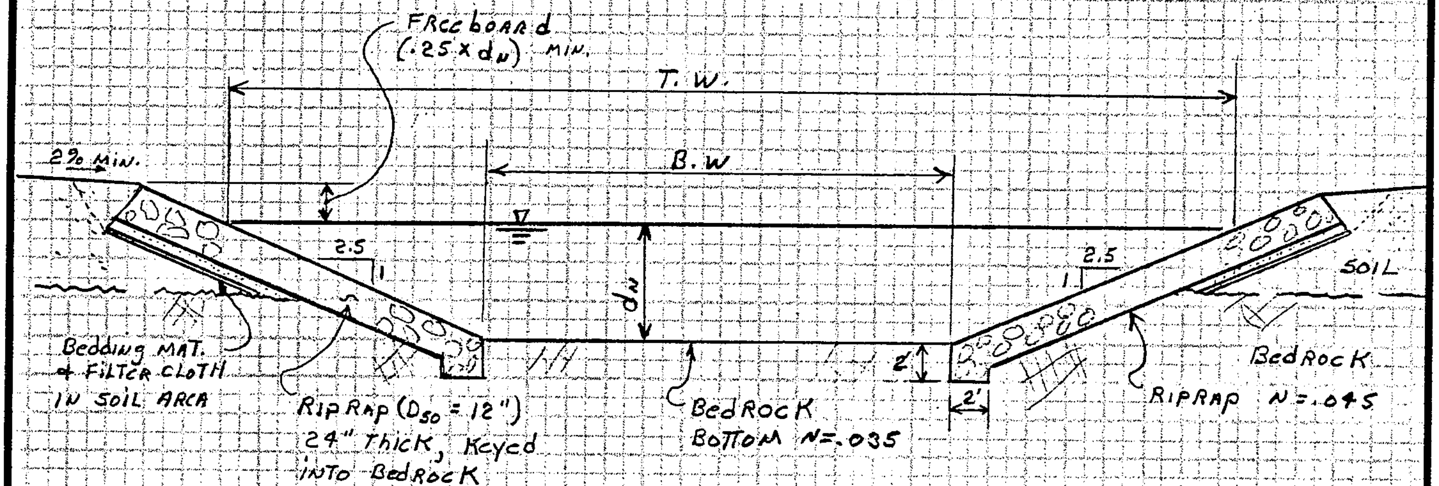
PROJECT STETSON Hills - SAND CReeK
JOB NUMBER 5197501 SHEET 5A OF
CALCULATED BY LLC DATE 12/85
CHECKED BY CMB DATE 1/22/86

PROPOSED CHANNEL SECTION 7+00± TO 77+60±



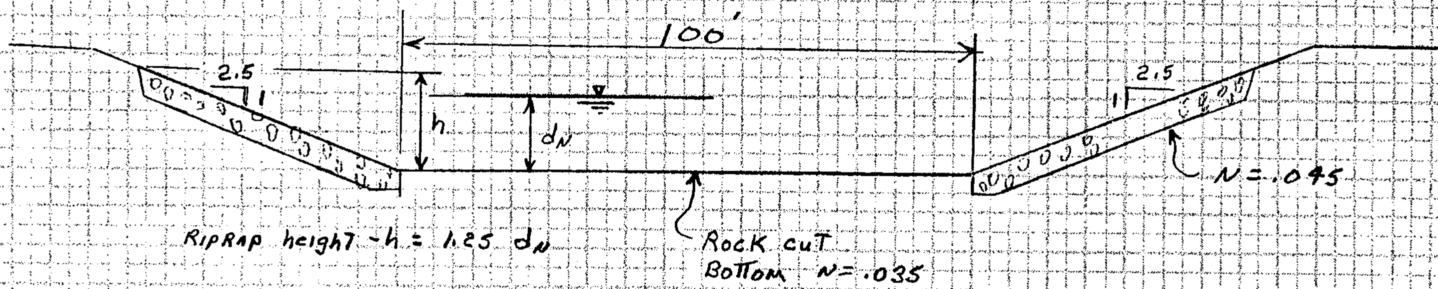
TYPICAL SECTION ROCK CUT BOTTOM

SLOPE = .009 ft/ft

NORMAL DEPTH FLOW PARAMETERS

Design Flow Q_{100}	B.W.	d_N	T.W.	A	N_c	V	F
7660 cfs	100'	5.96'	129.80'	684.8 ft²	.0377	11.20 ft/sec	.86
7080	100'	5.68	128.40	648.6	.0376	10.92	.85
5900	75'	6.04	105.20	544.2	.0383	10.85	.84
5600	75'	5.85	104.25	524.3	.0382	10.68	.84

RATING TABLE - CHANNEL ROCK CUT BOTTOM



		$S_o = .005$			$S_o = .007$			$S_o = .009$			$S_o = .011$			$S_o = .013$		
d_N	T.W.	Q	V	F	Q	V	F	Q	V	F	Q	V	F	Q	V	F
1.0	105.0	297	2.90	.52	351	3.43	.61	398	3.89	.69	441	4.30	.77	479	4.67	.83
2.0	110.0	936	4.46	.57	1108	5.28	.67	1256	5.98	.76	1389	6.61	.84	1510	7.19	.92
3.0	115.0	1829	5.67	.60	2164	6.71	.71	2454	7.61	.80	2713	8.41	.89	2949	9.15	.96
4.0	120.0	2946	6.70	.62	3486	7.92	.73	3953	8.98	.83	4370	9.93	.91	4751	10.80	.99
5.0	125.0	4276	7.60	.63	5059	8.99	.75	5,736	10.20	.85	6342	11.27	.94	6894	12.26	1.02
6.0	130.0	5784	8.38	.64	6843	9.92	.76	7760	11.25	.86	8579	12.43	.95	9326	1352	1.03
7.0	135.0	7488	9.10	.65	8860	10.77	.77	10,096	12.21	.87	11,106	13.50	.96	12074	14.68	1.05
7.5	137.5	8418	9.45	.65	9960	11.18	.77	11,294	12.68	.88	12486	14.02	.97	13574	15.24	1.06

S_o	@ Q_{100} = 5600 cfs			@ Q_{100} = 5900 cfs			@ Q_{100} = 7080 cfs			@ Q_{100} = 7660		
	d_N	V_N	F	d_N	V_N	F	d_N	V_N	F	d_N	V_N	F
.005	5.89	8.29	.64	6.07	8.44	.64	6.77	8.95	.65	7.09	9.17	.65
.007	5.31	9.30	.75	5.49	9.46	.75	6.12	10.03	.76	6.42	10.29	.76
.009	4.93	10.11	.85	5.08	10.30	.85	5.68	10.92	.86	5.96	11.20	.86
.011	4.64	10.81	.92	4.79	11.02	.93	5.34	11.69	.94	5.60	12.00	.95
.013	4.41	11.42	1.01	4.56	11.63	1.01	5.08	12.37	1.02	5.33	12.70	1.02

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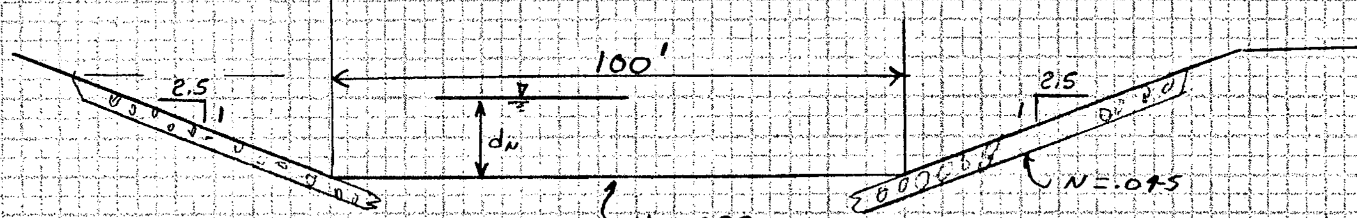
PROJECT: STETSON Hills - SAND CREEK
JOB NUMBER: 519501
SHEET 6A OF
CALCULATED BY: [illegible] DATE 12/85
CHECKED BY: CMB DATE 1/22/86



height of RipRap = $1.25 \times d_N$

NORMAL DEPTH

RATING TABLE - CHANNEL SANDY BOTTOM

		$S_0 = .005$			$S_0 = .007$			$S_0 = .009$			$S_0 = .011$			$S_0 = .013$		
d_N	T.W.	Q	V	F	Q	V	F	Q	V	f	Q	V	F	Q	V	F
1.0	105.0	440	4.30	.77	521	5.08	.91	591	5.77	1.03	653	6.37	1.14	710	6.93	1.24
2.0	110.0	1352	6.44	.82	1600	7.62	.97	1814	8.64	1.10	2005	9.55	1.22	2180	10.38	1.32
3.0	115.0	2575	7.98	.84	3046	9.45	.99	3454	10.71	1.13	3819	11.84	1.25	4152	12.87	1.35
4.0	120.0	3893	8.85	.81	4606	10.47	.96	5223	11.87	1.09	5775	13.12	1.21	6278	14.27	1.31
5.0	125.0	5696	10.13	.84	6739	11.98	1.00	7641	13.58	1.13	8448	15.02	1.25	9184	16.33	1.36
6.0	130.0	7519	10.90	.83	8896	12.89	.99	10086	14.62	1.12	11152	16.16	1.24	12124	17.57	1.34
7.0	135.0	9485	11.53	.82	11222	13.64	.97	12,725	15.47	1.10	14068	17.10	1.22	15294	18.59	1.33

S_0	@ Q_{100} = 5600 cfs			@ Q_{100} = 5900 cfs			@ Q_{100} = 7080 cfs			@ Q_{100} = 7660 cfs		
	d_N	V_N	F	d_N	V_N	F	d_N	V_N	F	d_N	V_N	F
.005	4.95	10.06	.84	5.11	10.22	.84	5.77	10.72	.83	6.07	10.97	.83
.007	4.49	11.23	.98	4.63	11.44	.98	5.17	12.14	.99	5.43	12.41	.99
.009	4.17	12.18	1.10	4.30	12.40	1.10	4.78	13.22	1.12	5.01	13.60	1.13
.011	3.91	13.04	1.21	4.05	13.22	1.21	4.51	14.11	1.23	4.72	14.51	1.24
.013	3.69	13.88	1.33	3.82	14.07	1.32	4.29	14.89	1.33	4.50	15.32	1.34

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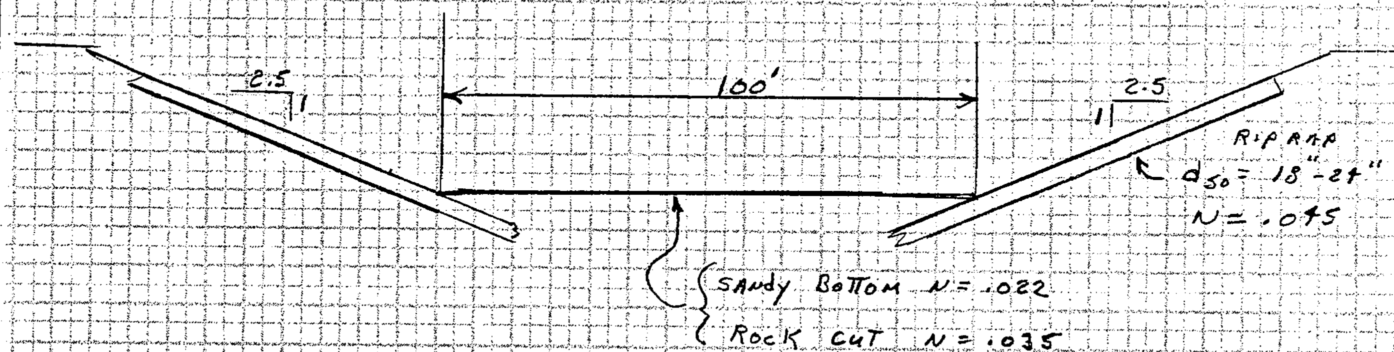
PROJECT Stetson Hills - Sand Creek
JOB NUMBER 519750l SHEET 7A OF
CALCULATED BY [illegible] DATE 12/85
CHECKED BY CMB DATE 1/22/86

COMPOSITE "N" VALUES FOR CHANNEL



COMPOSITE "N" VALUES: $N_c = \dfrac{\left(\sum_{1}^{N} P_N N_N^2\right)^{1/2}}{P^{1/2}}$

SANDY BOTTOM:	d	S.S. W.P.	TOTAL W.P.	N_c
	1.0	5.38	105.38	.024
	2.0	10.77	110.77	.025
	3.0	16.16	116.16	.026
	4.0	21.54	121.54	.028
	5.0	26.93	126.93	.028
	6.0	32.31	132.31	.029
	7.0	37.70	137.70	.030

ROCK CUT BOTTOM	d	S.S. W.P.	TOTAL W.P.	N_c
	1.0	5.38	105.38	.0356
	2.0	10.77	110.77	.0361
	3.0	16.16	116.16	.0366
	4.0	21.54	121.54	.0370
	5.0	26.93	126.93	.0373
	6.0	32.31	132.31	.0377
	7.0	37.70	137.70	.0380

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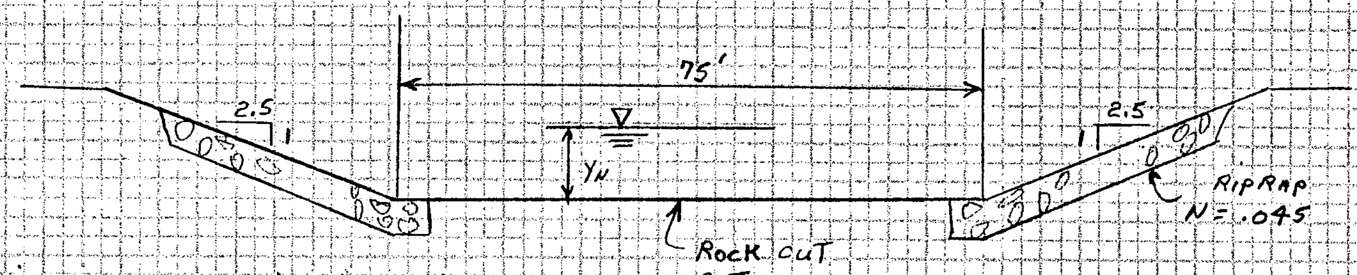
PROJECT Stetson Hills - Sand Creek
JOB NUMBER 519750I SHEET 9A OF
CALCULATED BY ZRC DATE 12/85
CHECKED BY CMB DATE 1/22/86

RATING TABLE - CHANNEL ROCK CUT BOTTOM



height of RipRap $h = 1.25 \times Y_N$

d_N	T.W.	$S_o = .005$ Q	V	F	$S_o = .007$ Q	V	F	$S_o = .009$ Q	V	F	$S_o = .011$ Q	V	F	$S_o = .013$ Q	V	F
1.0	80.0	223	2.86	.51	263	3.39	.61	298	3.84	.69	329	4.25	.76	358	4.62	.83
2.0	85.0	700	4.37	.56	828	5.18	.66	939	5.87	.75	1038	6.49	.83	1129	7.05	.91
3.0	90.0	1368	5.53	.59	1619	6.54	.70	1835	7.42	.79	2029	8.20	.87	2206	8.91	.95
4.0	95.0	2205	6.49	.60	2609	7.67	.71	2959	8.70	.81	3271	9.62	.90	3556	10.46	.97
5.0	100.0	3204	7.32	.62	3791	8.66	.73	4298	9.82	.83	4752	10.86	.92	5166	11.81	.99
6.0	105.0	4351	8.06	.63	5148	9.53	.74	5837	10.81	.84	6453	11.95	.93	7015	12.99	1.01
7.0	110.0	5655	8.73	.63	6691	10.33	.75	7586	11.72	.85	8387	12.95	.94	9118	14.08	1.02
8.0	115.0	7104	9.35	.64	8405	11.06	.76	9531	12.54	.86	10536	13.86	.95	11454	15.07	1.03

S_o	@ Q_{100} = 5600 cfs d_N	V_N	F	@ Q_{100} = 5900 cfs d_N	V_N	F	@ Q_{100} = 7080 cfs d_N	V_N	F	@ Q_{100} = 7660 cfs d_N	V_N	F
.005	6.96	8.70	.63	7.18	8.84	.63	7.98	9.34	.64	—	—	—
.007	6.31	9.79	.74	6.50	9.96	.75	7.24	10.51	.75	7.58	10.75	.75
.009	5.85	10.68	.84	6.04	10.85	.84	6.72	11.48	.85	7.04	11.75	.85
.011	5.51	11.43	.92	5.69	11.62	.92	6.34	12.30	.93	6.64	12.60	.94
.013	5.25	12.12	1.00	5.42	12.31	1.00	6.03	13.03	1.01	6.32	13.35	1.01

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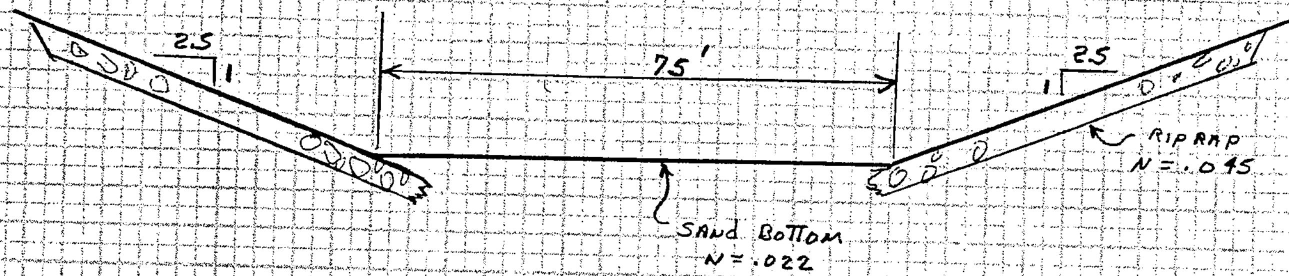
PROJECT: STETSON HILL - SAND CREEK
JOB NUMBER: 5197501 SHEET 10A OF ____
CALCULATED BY: LRC DATE 12/85
CHECKED BY: CMB DATE 1/22/86



RATING TABLE - CHANNEL W/ SANDY BOTTOM

		$S_o = .007$			$S_o = .009$			$S_o = .011$			$S_o = .013$		
d_N	TW	Q	V	F	Q	V	F	Q	V	F	Q	V	F
1.0	80.00	392	5.05	.90	444	5.73	1.03	491	6.34	1.14	534	6.89	1.23
2.0	85.00	1159	7.25	.93	1315	8.22	1.06	1453	9.08	1.17	1580	9.88	1.27
3.0	90.00	2139	8.64	.92	2425	9.80	1.04	2681	10.83	1.15	2915	11.78	1.25
4.0	95.00	3374	9.92	.92	3826	11.25	1.05	4230	12.44	1.16	4598	13.52	1.26
5.0	100.00	4789	10.95	.92	5430	12.41	1.05	6003	13.72	1.16	6526	14.92	1.26
6.0	105.00	6360	11.78	.92	7212	13.36	1.04	7973	14.76	1.15	8667	16.05	1.25
7.0	110.00	8070	12.46	.90	9151	14.13	1.03	10117	15.62	1.14	10998	16.99	1.23

@ Q_{100} = 5600 cfs

S_o	d_N	V_N	F
.007	5.53	11.42	.92
.009	5.09	12.54	1.05
.011	4.78	13.45	1.16
.013	4.53	14.31	1.26

@ Q = 7080 cfs

S_o	d_N	V_N	F
.007	6.43	12.10	.91
.009	5.93	13.31	1.04
.011	5.55	14.34	1.15
.013	5.27	15.23	1.25

@ Q_{100} = 5900

.007	5.72	11.57	.92
.009	5.28	12.69	1.04
.011	4.94	13.67	1.16
.013	4.69	14.51	1.26

@ Q = 7660 cfs

.007	6.76	12.33	.91
.009	6.23	13.56	1.04
.011	5.84	14.63	1.15
.013	5.54	15.58	1.25

@ S_o = .010 Q = 5904 TW = 100.5 V = 13.19 F = 1.102

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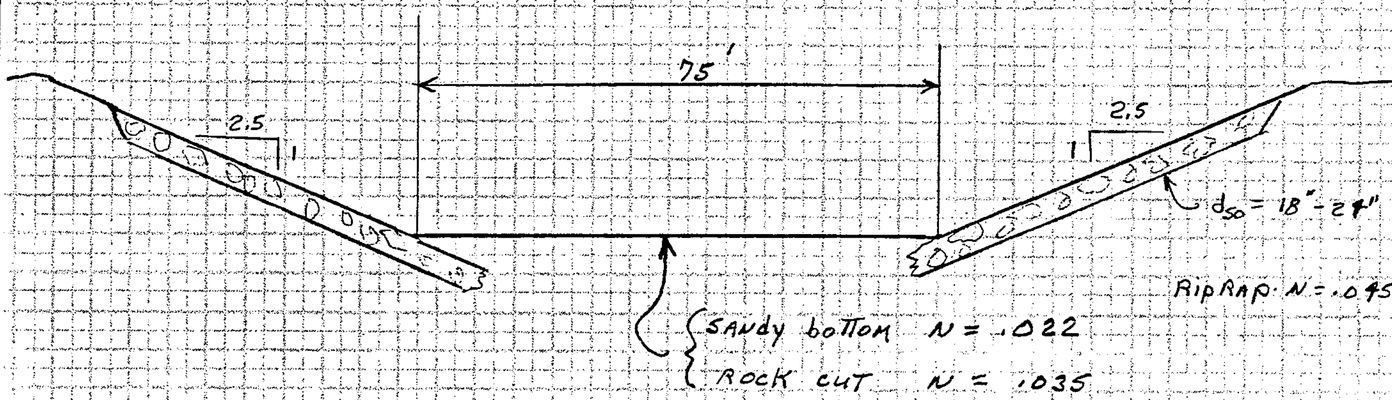
PROJECT STETSON Hills - SAND CReek
JOB NUMBER 5197501 SHEET 11 A OF
CALCULATED BY LLC DATE 12/85
CHECKED BY CMB DATE 1/22/86

COMPOSITE "N" VAlues FOR CHANNEL



COMPOSITE "N" VAlues : (CHOW P.P. 136)

$$N_c = \frac{\left(\sum_{1}^{N}(P_N n_N^2)\right)^{1/2}}{P^{1/2}}$$

SANdy BOTTOM :

d	S.S. W.P.	TOTAL W.P.	N_c
1'	5.38	80.38	.024
2'	10.77	85.77	.026
3'	16.16	91.16	.028
4'	21.54	96.54	.029
5'	26.93	101.93	.030
6'	32.31	107.31	.031
7'	37.70	112.70	.032

ROCK CUT BOTTOM :

d	S.S. W.P.	TOTAL W.P.	N_c
1'	5.38	80.38	.0358
2'	10.77	85.77	.0364
3'	16.16	91.16	.0370
4'	21.54	96.54	.0375
5'	26.93	101.93	.0379
6'	32.31	107.31	.0383
7'	37.70	112.70	.0386
8'	43.08	118.08	.0389

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PROJECT STETSON HILLS - SAND CREEK
JOB NUMBER 5197501 SHEET 11AA OF
CALCULATED BY LLC DATE 3/86
CHECKED BY DATE

RIPRAP SLOPE PROTECTION HEIGHTS FOR CHANNEL

FOR STRAIGHT PORTIONS OF CHANNEL AND INSIDE OF CURVES USE:

H (RIPRAP HEIGHT) $= 1.25\ d_N$ ∴ FREEBOARD $= .25\ d_N$ BUT NOT LESS THAN 1'

FOR OUTSIDE OF CURVES ADD SUPERELEVATION OF FLOW TO FREEBOARD:

$H_c = 1.25 \times d_N + \Delta y$ ∴ FREEBOARD $= 1.25 d_N + \Delta y$

FROM CORPS OF ENGINEERS "HYDRAULIC DESIGN OF FLOOD CONTROL CHANNELS", EM 1110-2-1601 JULY 1970

$$\text{SUPERELEVATION} - \Delta y = \frac{C V^2 W}{g R}$$

W = FLOW TOP WIDTH (LEVEL WATER SURFACE)
V - MEAN CHANNEL VELOCITY
R_A - CENTER LINE RADIUS
C - 0.5 TRAPEZOIDAL CHANNEL $F < 1.0$
1.0 TRAPEZOIDAL CHANNEL $F > 1.0$

CURVE STATIONING	Q_{100}	d_N	V_N	W	F	R_A	Δy	H	H_c	COMMENTS
0+06.77 TO 1+81.61	7660	6.89 TO 5.80	10.53 TO 14.7	122.9 104.1	.76 TO 1.16	298.80	.71 TO 2.34	8.61 TO 7.25	9.32 TO 9.59	TRANSITION USE 9.5'
2+48.94 TO 4+17.85	7660	5.01	13.60	125.05	1.13	450.0	1.60	6.26	7.86	
6+92.02 TO 8+95.08	7660	5.96	11.20	129.8	.86	400.0	.63	7.45	8.08	
9+85.46 TO 13+47.27	7660	"	"	"	"	400.0	.63	7.45	8.08	
16+59.63 TO 18+48.54	7660	"	"	"	"	400.0	.63	7.45	8.08	
21+99.63 TO 22+76.10	7080					600.0				TRANSITION AREA - BARNS Rd. BRIDGE

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PROJECT: STETSON HILLS - SAND CREEK
JOB NUMBER: 5197501
SHEET: 11AB OF
CALCULATED BY: LLC
DATE: 3/86
CHECKED BY:
DATE:

RIPRAP SLOPE PROTECTION HEIGHTS FOR CHANNEL
(CONT.)

CURVE STATIONING	Q_{100}	d_N	V_N	W	F	R_A	ΔY	H	H_c	COMMENTS
25+87.49 – 27+86.52	7080	5.68	10.92	128.4	.85	500.0	.48	7.10	7.57	
29+10.38 – 30+54.73	7080	"	"	"	"	400.0	.59	7.10	7.69	
31+79.22 – 33+16.07	5900	6.04	10.85	105.2	.84	400.0	.48	7.55	8.03	
40+70.16 – 42+48.35	5900	"	"	"		350.0	.55	7.55	8.10	
44+67.68 – 50+31.35	5900	"	"	"		360.0	.53	7.55	8.08	
52+49.78 – 53+20.52	5600	5.85	10.68	104.25	.84	250.0	.74	7.31	8.05	
53+70.52 – 55+49.53	5600	"	"	"	"	290.72	.64	7.31	7.95	
58+29.17 – 61+47.72	5600	"	"	"	"	350.0	.53	7.31	7.84	
62+94.35 – 66+15.82	5600	"	"	"	"	300.0	.62	7.31	7.93	
68+19.97 – 71+05.88	5600	"	"	"	"	300.0	.62	7.31	7.93	
72+37.35 – 73+93.31	5600	"	"	"	"	400.0	.46	7.31	7.77	
73+93.31 – 75+46.28	5600	"	"	"	"	315.14	.59	7.31	7.80	

DUE TO SHORT DISTANCES between curves and Reverse curves use 8' height of RipRap both side to provide for free board and superelevation

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PROJECT STETSON Hills - SAND CREEK
JOB NUMBER 5197501 SHEET 12A OF
CALCULATED BY LLC DATE 1/86
CHECKED BY CMB DATE 1/22/86

RIPRAP DESIGN BASED ON TRACTIVE FORCE (LOCAL BOUNDARY SHEAR)

Ref. U.S. CORPS OF ENGINEERS EM 1110-2-1601 "Hydraulic DESIGN OF Flood CONTROL Channels" July 1970

Local Boundary Shear - $\tau_0 = \dfrac{\gamma \bar{V}^2}{\left(32.6 \log_{10} \dfrac{12.2 Y}{D_{50}}\right)^2}$

γ - UNIT WT. of WATER 62.4 lb/ft³

$\bar{V}$ - Average Local Velocity

D_{50} - Average RipRap Diameter

RipRap Design Shear - $\tau = a(\gamma_s - \gamma) D_{50}$ - (Shear RipRap can safely withstand)

γ_s - UNIT WT. of STONE

$a = .04$

RipRap Design Shear on side slope:

$$\tau' = \tau \left(1 - \frac{\sin^2 \phi}{\sin^2 \theta}\right)^{1/2}$$

ϕ - Angle of side slope

θ - Angle of Repose RipRap (40° assumed)

FROM NORMAL DEPTH CALCULATION FOR Channel

$S_0 = .009$ ft/ft B.W. = 100' S.S. = 2.5:1 (21.8014°)

$Q_{100} = 7660$ cfs $d_N = 5.96'$ $V_N = 11.20$ F = .86

USED 24" Thick RipRap Slope Lining $D_{50} = 12"$

$$\tau_0 = \frac{\gamma \bar{V}^2}{\left(32.6 \log_{10} \frac{12.2 Y}{D_{50}}\right)^2} = \frac{62.4 \times (11.20)^2}{\left(32.6 \log_{10} \frac{12.2 \times 5.96}{1.00}\right)^2} = 2.12 \text{ PSF}$$

RIPRAP DESIGN (CONT.)

$\tau = .04(\gamma_s - \gamma)\, D_{50}$

Assume RipRap S.G. = 2.60
$\therefore \gamma_s = 162$ lb/ft³
(Colorado Springs Criteria)

$\tau = .04(162 - 62.4)\, 1.0 = 3.98$ psf

$\tau' = \tau\left(1 - \frac{\sin^2\phi}{\sin^2\theta}\right)^{1/2} = 3.98\left(1 - \frac{\sin^2 21.801°}{\sin^2 40.0°}\right)^{1/2} = 3.27$ psf (.82)

$\tau' = 3.27 > \tau_0 = 2.12$ $\therefore$ $D_{50} = 12''$ RipRap would be adequate for channel side slope protection for slopes of .009 ft/ft

FROM Colorado Springs Criteria:

For $V = 12$ ft/sec Stone size required = 9" grouted OR 1 size larger - 12" for ungrouted

have $V = 11.20$ ft/sec $\therefore$ $D_{50} = 12''$ (OK)

For remaining sections u/s (Q_{100} = 7080, 5900 + 5600 cfs) $V_N < 12$ ft/sec

Check Lower Channel Reach $S_0 = .011$ ft/ft

Assumed sandy bottom; From normal depth calcs.:

$S_0 = .009$ ft/ft, B.W. = 100', S.S. = 2.5:1 (21.8014°)

$Q_{100} = 7660$ cfs $d_N = 5.01'$ $V_N = 13.60$ ft/sec

Used 27" Thick RipRap Slope Lining $D_{50} = 18''$

$$\tau_0 = \frac{62.4 \times (13.60)^2}{\left(32.6 \log_{10} \frac{12.2 \times 5.01}{1.50}\right)^2} = 4.19 \text{ psf}$$

$\tau = .04(162 - 62.4)\, 1.50 = 5.98$ psf

$\tau' = 5.98\,(.82) = 4.90 > \tau_0 = 4.19$ (OK)

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PROJECT STETSON HILLS - SAND CREEK
JOB NUMBER 5197501 SHEET 14A OF
CALCULATED BY LLC DATE 1/86
CHECKED BY CMB DATE 1/22/86

RIPRAP DESIGN (CONT.)

FROM Colorado Springs Criteria:

FOR V = 14 ft/sec   STONE SIZE REQUIRED = 12"
INCREASE ONE SIZE FOR UNGROUTED → 18"

have velocity = 13.60 ft/sec (OK)

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PROJECT STETSON Hills - SAND CREEK
JOB NUMBER 5197501 SHEET 16A OF
CALCULATED BY LLC DATE 1/86
CHECKED BY CMB DATE 1/22/86

DROP STRUCTURE DESIGN

Design Considerations:

1) Channel Bottom except for Lower ± 500' is to be cut in the existing Bed Rock

2) The Bed Rock varies from claystone & siltstone to sandstone with varying hardness and durability. The extent of the various grades of rock are highly erratic.

3) The sandstones are considered as moderately hard but would be subject to weathering; claystones & siltstones would be highly subject to weathering on exposure and would be subject to water erosion.

4) Due to cost of rock excavation, extent of rock excavation should be minimized. Drop heights limited to 2' to 3' with 3.5' maximum.

DROP DESIGN:

For the 2'–3.5' Drops, a sloped drop cut in the bedrock was considered the most economical and would require less "structural" type construction.

Because of the possible severe weathering of the bedrock on exposure and erosion potential due to both low trickle flows and high flows, the face of the sloped drops should be protected in most cases. A concrete lining with u/s & D/s cutoff walls is proposed. If very hard rock that would be considered durable is encountered, the concrete lining may be eliminated.

To protect the channel area D/s of the drops from the high velocities, the channel riprap sideslope lining would be increased in size and thickness and grouted where required

1-A

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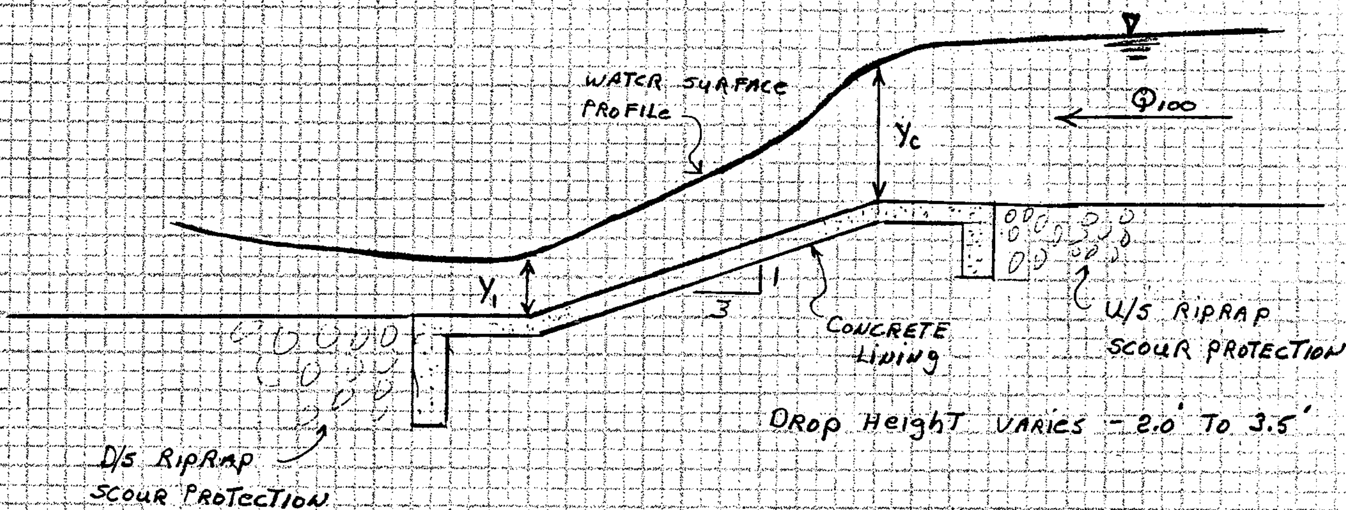
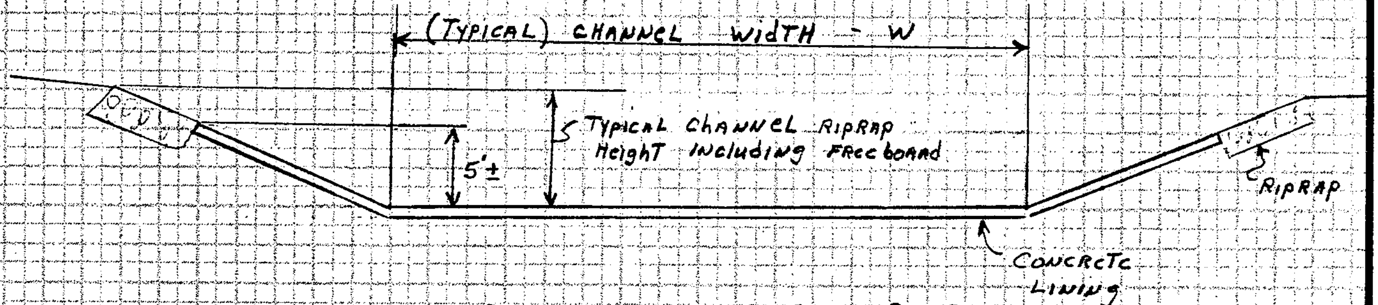
PROJECT STETSON HILLS - SAND CREEK
JOB NUMBER 5197501 SHEET 17A OF
CALCULATED BY LLC DATE 1/86
CHECKED BY CMB DATE 1/22/86

HYDRAULIC ANALYSIS - SLOPED DROPS



DROP HEIGHT VARIES - 2.0' TO 3.5'



TYPICAL SECTION THRU DROP

USE DIRECT STEP METHOD TO CALCULATE WATER SURFACE PROFILE: Ref. CHOW "OPEN CHANNEL HYDRAULICS"

$$\Delta X = \frac{E_2 - E_1}{S_0 - S_f} = \frac{\Delta E}{S_0 - S_f}$$

$$E = Y + \alpha \, V^2/2g \qquad S_f = \frac{n^2 V^2}{2.22 R^{4/3}}$$

USE: n (CONCRETE) = .015

α (Energy coef.) = 1.05

(used calculator program for above equations)

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PROJECT STETSON Hills - SAND CREEK
JOB NUMBER 5197501 SHEET 18A OF
CALCULATED BY LLC DATE 1/86
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HYDRAULIC ANALYSIS - SLOPED DROPS (CONT.)

CALCULATE CRITICAL depth Y_c @ Top of DROP

FOR TRAPEZOIDAL channel @ CRITICAL Depth:

$$F = \frac{V}{\sqrt{g \, A/_{TW} \, 1/_\alpha}} = 1.0$$

α Assumed AS 1.05 ("CHOW" Page 27)

CHANNEL BOTTOM WIDTH = 100' S.S. = 2.5:1

	Q	Y_c	T.W.	A	V_c
	2000 cfs	2.31'	111.55'	249.34 ft²	8.19 ft/sec
	3000	3.01	115.05	323.65	9.27
	4000	3.62	118.10	394.76	10.13
	5000	4.18	120.90	461.68	10.83
	6000	4.70	123.50	525.22	11.42
(Q_{100} Reach-2)	7080	5.23	126.15	591.38	11.97
(Q_{100} Reach-1)	7660	5.49	127.45	624.35	12.27

CHANNEL BOTTOM WIDTH = 75' S.S. = 2.5:1

	Q	Y_c	T.W	A	V_c
	1000 cfs	1.76'	83.80'	139.74 ft²	7.17 ft/sec
	2000	2.76	88.80	226.04	8.85
	3000	3.59	92.95	301.47	9.95
	4000	4.31	96.55	369.69	10.82
	5000	4.96	99.80	433.50	11.53
(Q_{100} Reach-4)	5600	5.32	101.60	469.76	11.92
(Q_{100} Reach-3)	5900	5.50	102.50	488.12	12.09

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PROJECT STETSON-HILLS - SAND CREEK
JOB NUMBER 5197501 SHEET 19A OF ____
CALCULATED BY LLC DATE 1/86
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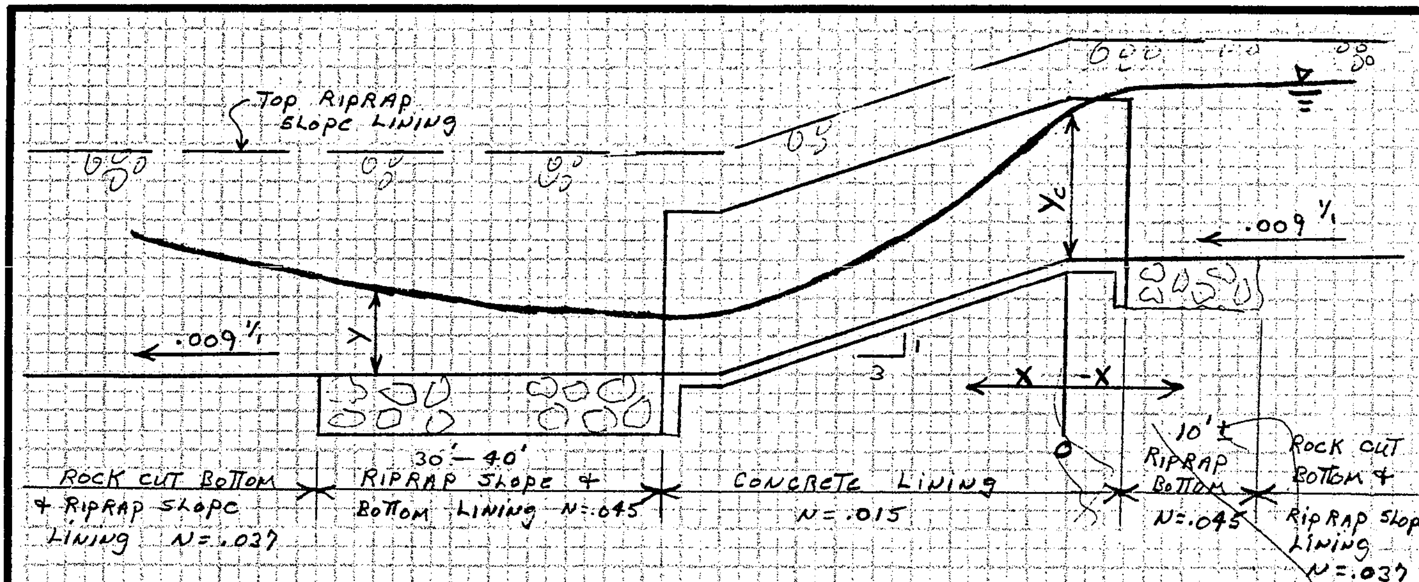

W.S. PROFILES D/S + U/S OF SLOPED DROP

(ROCK CUT CHANNEL BOTTOM)

BOTTOM WIDTH = 100', S.S. = 2.5:1, Q_{100} = 7660 cfs, Y_N = 5.96', Y_c = 5.49'

2.5' DROP HEIGHT					3.0' DROP HEIGHT					3.5' DROP HEIGHT				
X	Y	V	F	Y_2	X	Y	V	F	Y_2	X	Y	V	F	Y_2
-7.83	5.90	11.31	.89	—										
-3.98	5.80	11.53	.92	—		(SAME)						(SAME)		
-2.61	5.75	11.65	.93	—										
0	5.49	12.27	1.00	—	0	5.49	12.27	1.00	—	0	5.49	12.27	1.00	—
7.50	3.41	20.70	2.10	8.57	9.00	3.28	21.58	2.18	8.60	10.50	3.17	22.39	2.30	8.83
20.07	3.70	18.95	1.81	7.79	20.91	3.55	19.82	1.98	8.30	22.44	3.44	20.50	2.07	8.51
32.64	4.00	17.41	1.60	7.28	34.19	3.86	18.10	1.74	7.74	35.92	3.75	18.68	1.81	7.93
42.48	4.20	16.51	1.49	6.97	42.00	4.05	17.17	1.61	7.42	48.68	4.06	17.13	1.60	17.13
55.57	4.40	15.68	1.38	6.67	49.39	4.20	16.51	1.49	6.97	55.58	4.20	16.51	1.49	6.97
68.16	4.60	14.93	1.29	6.39	62.48	4.40	15.68	1.38	6.67	68.67	4.40	15.68	1.38	6.67
80.03	4.80	14.25	1.21	6.13	75.08	4.60	14.93	1.29	6.39	81.27	4.60	14.93	1.29	6.39
90.78	5.00	13.62	1.13	5.88	86.94	4.80	14.25	1.21	6.13	93.13	4.80	14.25	1.21	6.13
					97.70	5.00	13.62	1.13	5.88	103.89	5.00	13.62	1.13	5.88

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PROJECT STETSON HILLS - SAND CREEK
JOB NUMBER 5197501 SHEET 20A OF
CALCULATED BY ZLC DATE 1/86
CHECKED BY CMB DATE 1/23/86

HYDRAULIC ANALYSIS - SLOPED DROPS (CONT.)

CALCULATE W.S. PROFILE U/S + D/S OF SLOPED DROPS

BOTTOM WIDTH = 100', S.S. = 2.5:1, Q_{100} = 7080 cfs, Y_N = 5.68', Y_C = 5.23'

2.5' DROP HEIGHT					3.0' DROP HEIGHT					3.5' DROP HEIGHT				
X	Y	V	F	Y_2	X	Y	V	F	Y_2	X	Y	V	F	Y_2
-6.77	5.60	11.09	.90	—	(SAME)					(SAME)				
-3.34	5.50	11.32	.92	—										
-1.25	5.40	11.55	.95	—										
0	5.23	11.97	1.00	—	0	5.23	11.97	1.00	—	0	5.23	11.97	1.00	—
7.50	3.21	20.42	2.13	8.21	9.00	3.09	21.27	2.26	8.46	10.50	2.97	22.19	2.40	8.72
19.95	3.50	18.60	1.87	7.65	21.58	3.38	19.31	1.97	7.88	23.06	3.26	20.08	2.08	8.11
32.40	3.80	17.02	1.64	7.13	34.24	3.68	17.62	1.73	7.33	35.43	3.55	18.32	1.83	7.56
45.53	4.00	16.09	1.52	6.81	42.23	3.88	16.63	1.59	16.63	48.40	3.87	16.68		
58.30	4.20	15.26	1.41	6.51	48.02	4.00	16.09	1.52	6.81	54.68	4.00	16.09	1.52	6.81
70.52	4.40	14.50	1.31	6.23	60.79	4.20	15.26	1.41	6.51	67.45	4.20	15.26	1.41	6.51
81.92	4.60	13.80	1.22	5.97	73.01	4.40	14.50	1.31	6.23	79.67	4.40	14.50	1.31	6.23
92.04	4.80	13.17	1.14	5.72	84.41	4.60	13.80	1.22	5.97	91.06	4.60	13.80	1.22	5.97
100.09	5.00	12.59	1.07	5.48	94.53	4.80	13.17	1.14	5.72	101.19	4.80	13.17	1.14	5.72
					102.58	5.00	12.59	1.07	5.48	109.24	5.00	12.59	1.07	5.48

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JOB NUMBER 5197501 SHEET 21A OF
CALCULATED BY LLC DATE 1/86
CHECKED BY CMB DATE 1/23/86

HYDRAULIC ANALYSIS - SLOPED DROPS (CONT)

CALCULATE W.S. PROFILES U/S & D/S OF SLOPED DROPS

BOTTOM WIDTH = 75' S.S. = 2.5:1 Q_{100} = 5900 cfs d_N = 6.04 d_c = 5.50'

2.0' DROP HEIGHT

X	Y	V	F	Y_2
-12.89	6.00	10.92	.87	—
-7.49	5.90	11.14	.89	—
-3.86	5.80	11.37	.92	—
-1.58	5.70	11.60	.94	—
0	5.50	12.09	1.00	—
6.00	3.59	19.57	1.96	8.33
18.72	3.90	17.85	1.72	7.75
31.20	4.21	16.39	1.53	7.23
41.91	4.40	15.59	1.43	6.93
54.34	4.60	14.82	1.33	6.65
66.01	4.80	14.13	1.24	6.37
76.57	5.00	13.48	1.16	6.10
85.40	5.20	12.89	1.09	5.85

3.0' DROPE HEIGHT

X	Y	V	F	Y_2
(SAME)				
0	5.50	12.09	1.00	—
9.00	3.30	21.48	2.24	8.92
21.64	3.59	19.57	1.96	8.33
34.35	3.89	17.90	1.73	7.77
42.03	4.08	16.97	1.61	7.45
47.89	4.20	16.43	1.53	7.25
60.79	4.40	15.59	1.43	6.93
73.20	4.60	14.82	1.33	6.65
84.86	4.80	14.13	1.24	6.37
95.42	5.00	13.48	1.16	6.10
104.25	5.20	12.89	1.09	5.85

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PROJECT STETSON Hills - SAND CREEK
JOB NUMBER 519750 1 SHEET 22A OF
CALCULATED BY LLC DATE 1/86
CHECKED BY CMB DATE 1/23/86

SLOPED DROPS - UPSTREAM + DOWNSTREAM RIPRAP PROTECTION

UPSTREAM DRAWDOWN CURVE - @ End concrete Lining
depth ≃ 5.75' Velocity ≃ 11.65 ft/sec

use Corps of Engineers RipRap Design Equations (see p.p. 12A)

Assume $d_{50} = 12''$ RipRap

$$\text{Boundary shear} = \tau_o = \frac{\gamma \bar{V}^2}{\left(32.6 \log_{10} \frac{12.2\,Y}{D_{50}}\right)^2} = \frac{62.4\,(11.65)^2}{\left(32.6 \log_{10} \frac{12.2 \times 5.75}{1.0}\right)^2}$$

$$\tau_o = 2.34 \text{ PSF}$$

RipRap Design shear - $\tau = .04(\gamma_s - \gamma)\,D_{50}$

γ_s Assumed @ 162 lb/ft³

$$\tau = .04(162 - 62.4)\,1.0 = 3.98 \text{ PSF}$$

For Side Slopes - $\tau' = \tau\left(1 - \frac{\sin^2\phi}{\sin^2\theta}\right)^{1/2}$

$\phi = 21.80°$ (2.5:1) $\theta = 40°$ Angle Repose

$$\tau' = 3.98\left(1 - \frac{\sin^2 21.8°}{\sin^2 40°}\right)^{1/2} = 3.27 \text{ PSF} > 2.34 \text{ (ok)}$$

(.82 written above)

use $d_{50} = 12''$ RipRap 24" Thick To 10' u/s of Drop

Velocities @ The bottom of Drops would vary From 20.7 ft/sec To 22.4 ft/sec

Based on RipRap equations, would need RipRap size in excess of 48" and 72" Thick, which would NOT be practical or Realistic

Could extend concrete Downstream To Form A Stilling basin. Based on Available Tailwater D/S, concrete Lining would have To be extended ±3' below channel grade To Force A Jump And The concrete lining would need To be extended Through The Jump Area. Cost would be 3 To 4 Times cost of just The drop height Lining And There would be A stagnant Pool of water d/s of Drop For most of year.

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PROJECT STETSON Hills - SAND CREEK
JOB NUMBER 5197501 SHEET 24A OF
CALCULATED BY LLC DATE 1/86
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SLOPED DROPS - RIPRAP PROTECTION

24" RipRAP Design SHEAR Bottom of channel $\tau = .04(162 - 62.4)\,2.0 = 8.0$ PSF

24" RipRAP Design SHEAR Side slopes (2.5:1) $\tau' = .82 \times 8.0 = 6.56$ PSF

FOR 2.0 To 2.5' Drops Assume 30 of BOT. RipRAP D/S of Drop
FOR 3.0 DROP " 35' " " " " "
FOR 3.5 DROP " 40

@ $Q_{100} = 7660$ cfs Bottom width 100' - From flow profiles Velocity AT These points ARE 16.5 ft/sec & depth = 4.2'
(FOR Lower Flows upstream & 75' wide channel, velocities are just slightly less so design for the 7660 cfs would pertain throughout the length of channel for DROPS)

Boundary shear @ $Y = 4.2'$ & $V = 16.5$ ft/sec

$$\tau_0 = \frac{62.4 \times (16.5)^2}{\left(32.6 \log_{10} \frac{12.2 \times 4.2}{2.0}\right)^2} = 8.05 \approx \tau = 8.0 \quad \text{(OK)}$$

USE BOTTOM RipRAP: 2' To 2.5' DROPS - 30' D/S of CONC. LINING
2.5' To 3.0 DROPS - 35' D/S " " "
3.0 To 3.5 DROPS - 40' D/S " " "

Assume RipRAP on Side Slope grouted from End Conc. Lining To 20' past Bottom RipRAP Limits
@ This point computed velocity ≈ 15.3 ft/sec ; Y = 4.5'

$$\tau_0 = \frac{62.4 \times (15.3)^2}{\left(32.6 \log_{10} \frac{12.2 \times 4.5}{2.0}\right)^2} = 6.64 \text{ psf} \approx \tau' = 6.56 \text{ psf} \quad \text{(OK)}$$

CARRY GROUTED RipRAP SIDESLOPES 20' PAST BOTTOM RipRAP LIMITS

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PROJECT STETSON Hills - SAND CREEK
JOB NUMBER 519750/ SHEET 23A OF
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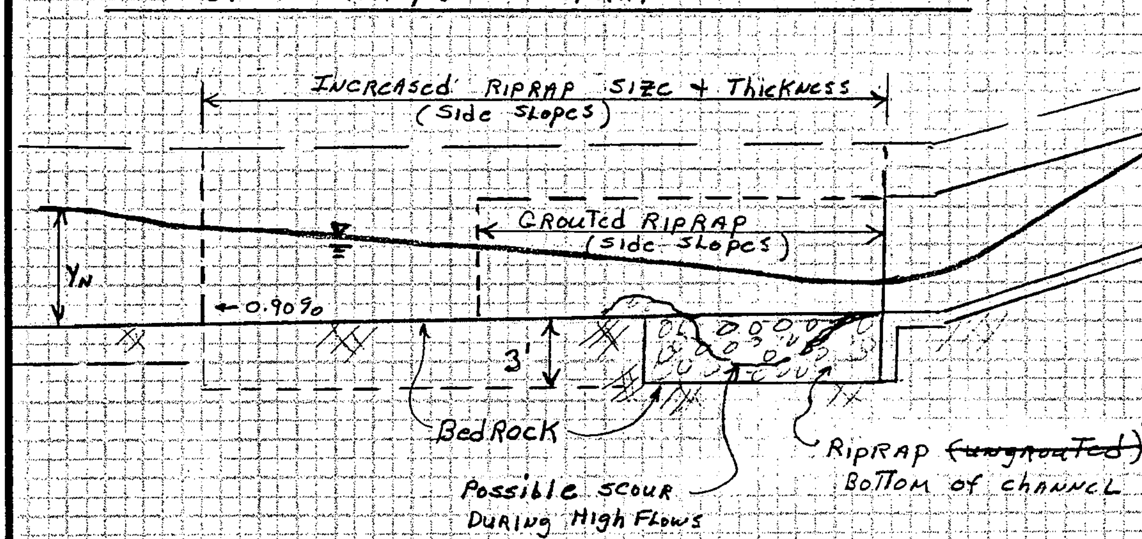
SLOPED DROPS - RIPRAP PROTECTION



PER CITYS REQUIREMENT BOTTOM RIP-RAP IS TO BE GROUTED
3/86 LLC

PROPOSED SCOUR TYPE BASIN D/S OF DROP

Based on calculated water surface profiles, water depth does not reach normal depth until approx. 100 D/s from bottom of Drop (Assuming A Rigid bottom). A hydraulic jump does not occur due to limited channel normal depth Downstream.

RipRap to be placed Across channel Bottom D/s of Drop. RipRap will serve to protect the BedRock from exposure and erosion during low to moderate flows. During high flows RipRap will scour forming a scour hole + mound downstream which will help in dissipating the energy and Reduce d/s velocities. Because of the bedRock, scour depth would be limited to the thickness of RipRap. The scour hole would fill with sediment at end of storm (If desired RipRap could be pushed back in place)

RipRap on side slopes to be grouted through High velocity Area

Use D_{50} = 24" RipRap 36" Thick

Bottom RipRap to extend D/s to the point where the 24" RipRap would withstand the computed velocities (100-year flows)

Grouted RipRap to extend D/s to the point where the 24" RipRap on the side slopes would withstand the velocities

36" Thick RipRap (D_{50} = 24") would extend D/s to point not Required ∴ point where normal channel RipRap Adequate

Note: Distances should be conservative since during high flows scour area would dissipate some energy reducing velocities

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PROJECT: STETSON Hills - SAND CREEK
JOB NUMBER: 5197501 SHEET 25A OF
CALCULATED BY: LLC DATE: 1/86
CHECKED BY: CMB DATE: 1/23/86

SLOPED DROPS - RIPRAP PROTECTION

LIMITS FOR 24" RIPRAP D/S OF DROP

END 24" RIPRAP SLOPE PROTECTION @ POINT NORMAL 12" RIPRAP LINING IS ADEQUATE

FOR $D_{50} = 12''$ $\tau = .04(162 - 62.4)\,1.0 = 3.98$ PSF

$\tau' = .82 \times 3.98 = 3.26$ PSF

FROM FLOW PROFILES THE 100-YEAR WATER DEPTH WOULD REACH NORMAL DEPTH APPROXIMATELY 50' OR LESS FROM THE LIMITS OF THE BOTTOM RIPRAP LIMITS

	DISTANCE FROM END CONCRETE SLOPE LINING		
	2.0' TO 2.5' DROP	2.5' TO 3.0' DROP	3.0' TO 3.5' DROP
BOTTOM RIPRAP	30'	35'	40'
GROUTED RIPRAP (SLOPE LINING)	50'	55'	60'
24" RIPRAP (SLOPE LINING)	100'	105'	110'

BASED ON THE DESIGN PROFILE AND SOIL BORINGS, ALL THE SLOPED DROPS WOULD BE LOCATED IN BEDROCK. IF SANDY CONDITION WOULD BE ENCOUNTERED, ABOVE DIMENSIONS COULD BE USED EXCEPT RIPRAP SIZE WOULD BE INCREASED TO 30 INCHES. AND RIPRAP SLOPE LINING WOULD BE TOED DOWN 5'. LARGER RIPRAP USED IN THE SANDY AREAS SINCE RIPRAP FAILURE IN A SANDY AREA COULD CAUSE MORE DAMAGE THAN RIPRAP FAILURE IN BEDROCK AREA.

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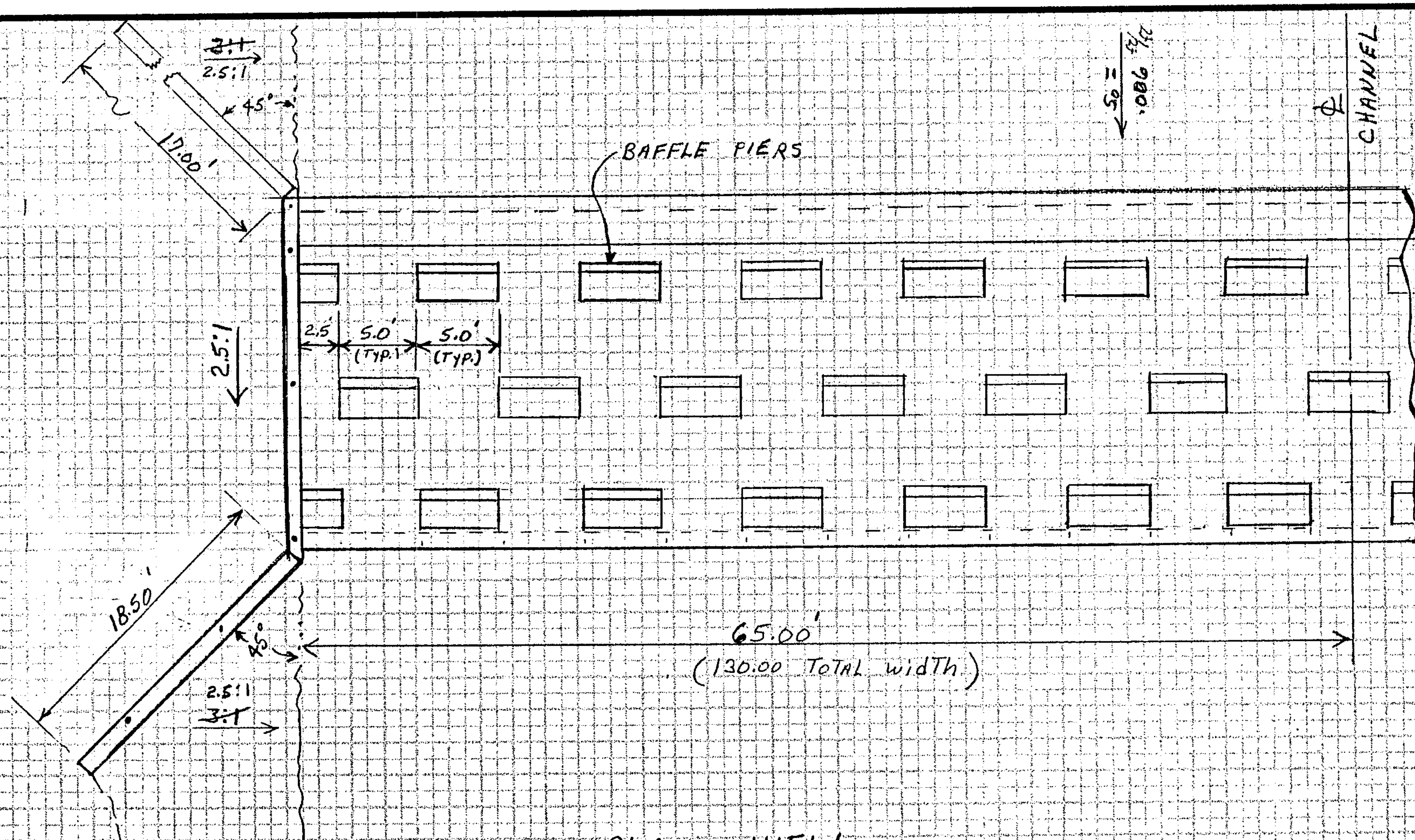
PROJECT STETSON HILLS CHANNEL
JOB NUMBER 5197501 SHEET 26A OF
CALCULATED BY LLC DATE 12/3/85
CHECKED BY CMB DATE 1/23/86



PLAN VIEW

BAFFLED CHUTE

(u/s BARNS ROAD BRIDGE)

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PROJECT: STETSON HILLS CHANNEL
JOB NUMBER: 5197501 SHEET 27A OF ____
CALCULATED BY: LLC DATE: 12/3/85
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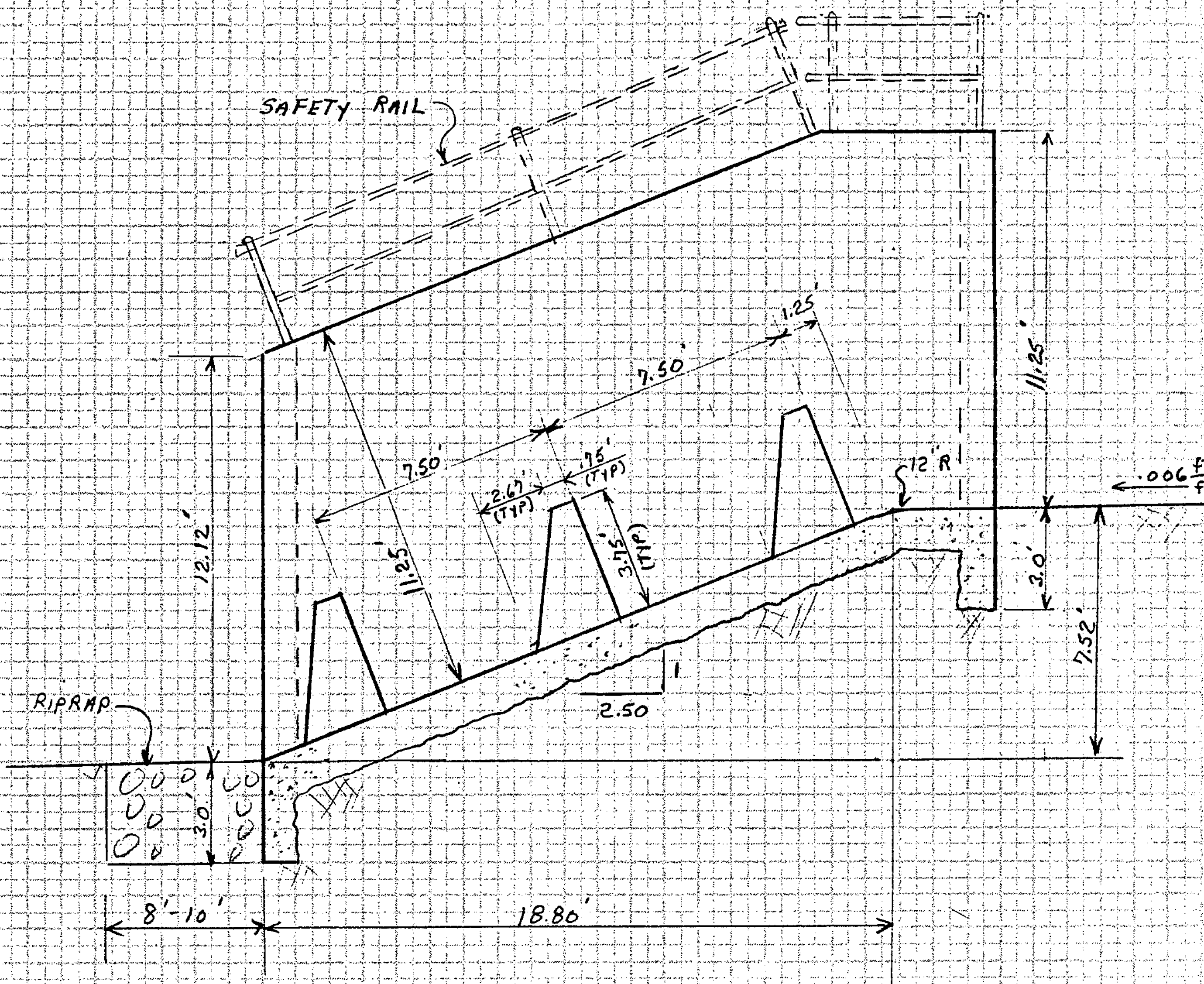

BAFFLED CHUTE SECTION

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PROJECT Stetson Hills Sand Crk Channel
JOB NUMBER 5197501 SHEET 28A OF
CALCULATED BY LLC DATE 12/3/85
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HYDRAULIC DESIGN OF BAFFLED APRON DROP
U/S OF BARNS ROAD BRIDGE

Ref. ENGINEERING MONOGRAPH NO. 25 - Hydraulic Design of STILLING BASINS AND ENERGY DISSIPATORS - BUREAU OF RECLAMATION

Design $Q = Q_{100} = 7660$ cfs

MAXIMUM UNIT discharge Recommended = 60 cfs/ft

$q = Q_{100}/W \qquad W = Q_{100}/q = \frac{7660 \text{ cfs}}{60 \text{ cfs/ft}} = 127.67'$

SAY use Chute width $W = 130'$

$q = \frac{7660 \text{ cfs}}{130 \text{ ft}} = 58.92$ cfs/ft

Approach Velocity $V_A = \sqrt[3]{gq} - 5$ Ideal conditions

@ $V_A = \sqrt[3]{gq}$ Flow conditions not acceptable

@ The Design slope of .009 ft/ft have $V_N = 11.20$ ft/sec

$\sqrt[3]{gq} = \sqrt[3]{32.2 \times 58.92} = 12.38$ ft/sec

$\sqrt[3]{gq} - 5 = 12.38 - 5 = 7.38$

APPROACH VELOCITY AT .009'/' CHANNEL SLOPE ON THE HIGH SIDE. TRY REDUCING UPSTREAM SLOPE TO .006 ft/ft.

TRANSITION CHANNEL U/S FROM 100' BOTTOM WIDTH TO 130' BOTTOM WIDTH

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PROJECT Stetson Hills Sand Creek channel
JOB NUMBER 5197501 SHEET 29A OF
CALCULATED BY LLC DATE 12/3/85
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BAFFLED APRON DROP HYDRAULIC DESIGN (CONT.)
(Recommended Dimensions from Bureau Nomograph)

CRITICAL DEPTH of DROP chute – $D_c = \sqrt[3]{q^2/g}$

$$D_c = \sqrt[3]{\frac{(58.92)^2}{32.2}} = 4.76'$$

Baffle pier height – $H \simeq .8\ D_c = .8 \times 4.76 = 3.80'$
say use $H = 3.75'$ (3'-9")

Pier width & spacing $1\tfrac{1}{2}H$ To H (5.62' To 3.75')

PARTIAL blocks width $\tfrac{1}{3}H$ To $\tfrac{2}{3}H$ (1.25 To 2.5')

use Pier Block width = 5'-0"
use PARTIAL Block width = 2'-6"

Longitudinal spacing between Blocks = $2H$ = 7.50'

WALL Height normal To slope = $3H = 3 \times 3.75 = 11.25'$

FROM preliminary grades The vertical Drop Required ≈ 7.5'

Generally in erodable material The Lower end of The chute is Buried 1 or 2 baffles below The channel Bottom grade To Account for possible scour Downstream

Since The bottom of The channel is Located in Rock Down stream scour would be minimal ∴ There would be no Reason To construct The chute below channel grade

TRY using A 2.5:1 slope on chute

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PROJECT Stetson Hills Channel Sand CRK
JOB NUMBER 519750l SHEET 30A OF ____
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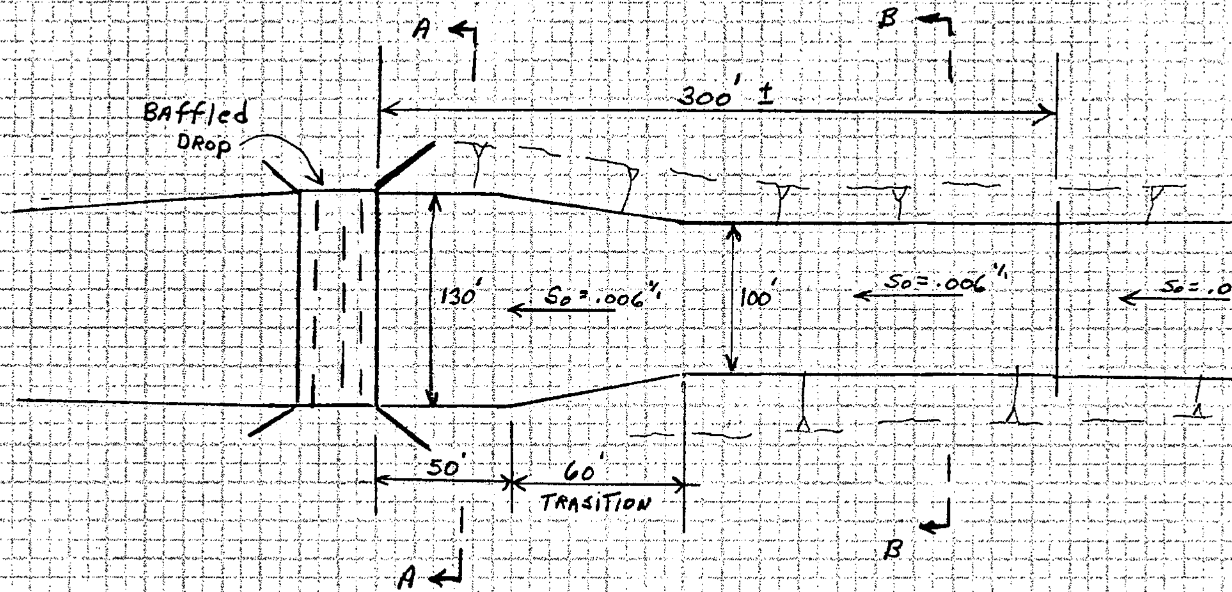
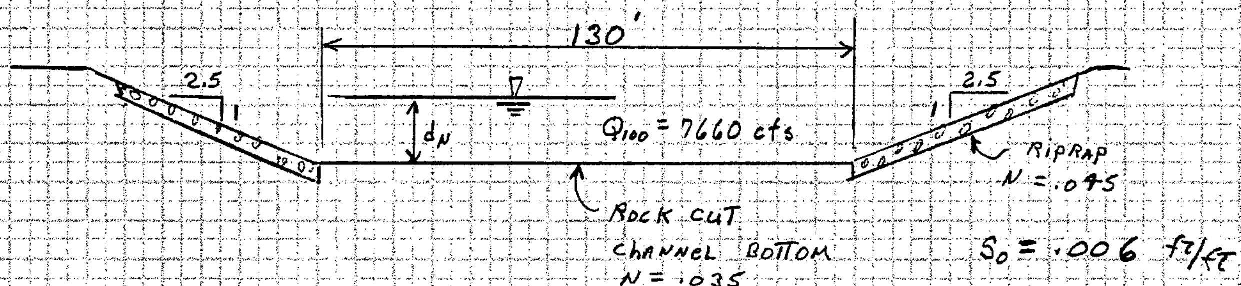


BAFFLED APRON DROP APPROACH CHANNEL

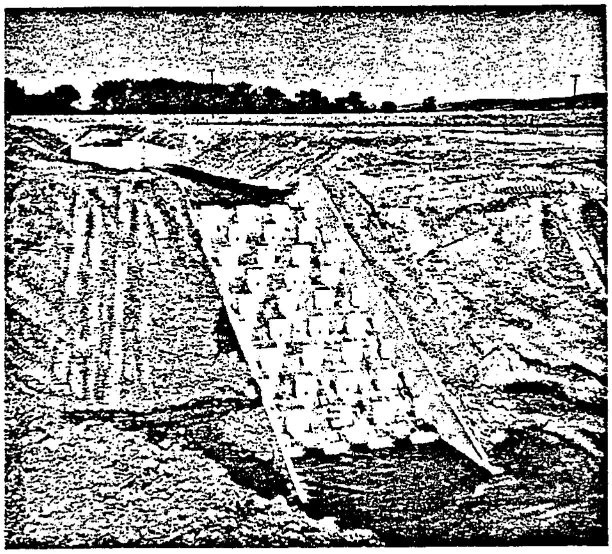


SECTION A-A

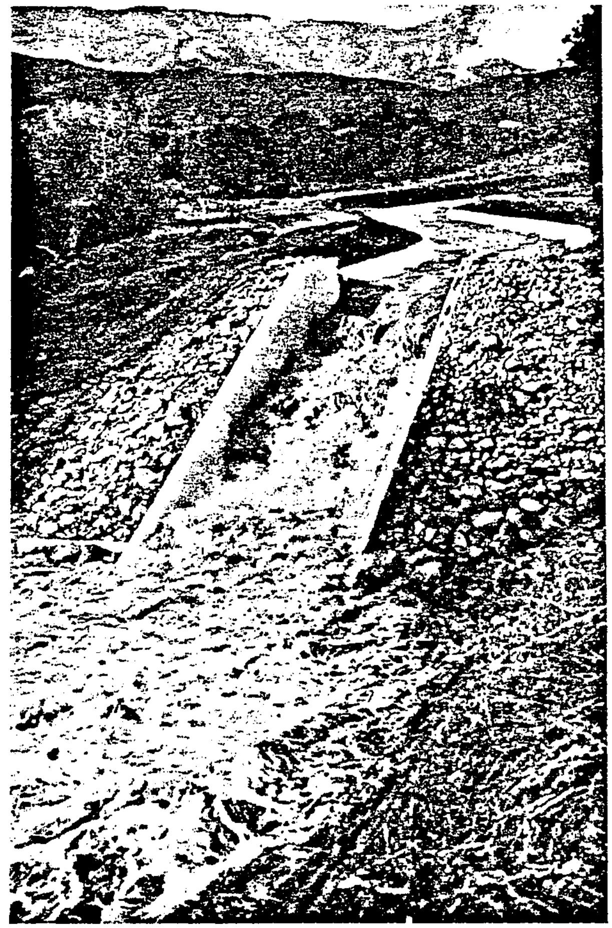
d_N	TW	N_c	Q	V	F
5.00	155.0	.0369	6094	8.55	.70
6.00	160.0	.0372	8245	9.48	.72
5.74	158.7	.0371	7666	9.25	.71 ←

Lessening the channel slope up-stream anymore may cause siltation problems u/s of drop. Approach velocity of ≈ 9.25 ft/sec would probably be OK since it is for the 100-year event.

Ideal condition $V_A = \sqrt[3]{gq} - 5 = \sqrt[3]{32.2 \times 58.92} - 5 \cong 7.4$ ft/sec



▲ Culbertson Canal Wasteway 3.3 after a discharge of 75 c.f.s. in May 1959.



Robles-Casitas Canal between Sta. 294 and Sta. 298 with 500 c.f.s. discharging into Santa Ana Creek. Waves in canal section occasionally splash over top of canal concrete lining. ▶

FIGURE 136.—*Performance of prototype structures.*

another. The baffle piers prevent undue acceleration of the flow as it passes down the chute. Since the flow velocities entering the downstream channel are relatively low, no stilling basin is required. The chute, on a 2:1 slope or flatter, may be designed to discharge up to 60 c.f.s. per foot of width, and the drop may be as high as structurally feasible. The lower end of the chute is constructed to below stream-bed level and backfilled as necessary. Degradation or scour of the stream bed, therefore, does not adversely affect the performance of the structure. The simplified hydraulic design procedure given in the numbered steps refers to Figure 140. More detailed explanations have been given in the text.

Simplified Design Procedure

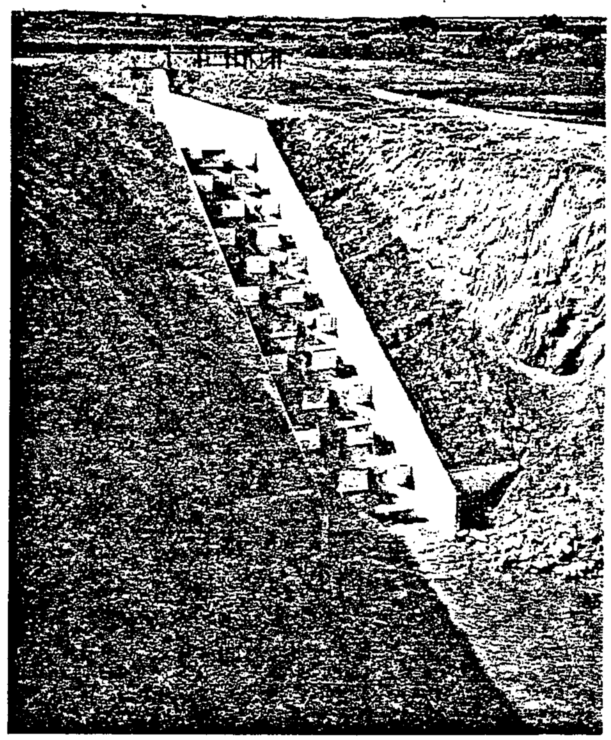
1. The baffled apron should be designed for the maximum expected discharge, Q.

2. The unit design discharge $q=\frac{Q}{W}$ may be as high as 60 c.f.s. per foot of chute width, W. Less severe flow conditions at the base of the chute exist for 35 c.f.s. and a relatively mild condition occurs for unit discharges of 20 c.f.s. and less.

3. Entrance velocity, V_1, should be as low as practical. Ideal conditions exist when $V_1=\sqrt[3]{gq}-5$, Curve D, Figure 125. Flow conditions are not acceptable when $V_1=\sqrt[3]{gq}$, Curve C, Figure 125.

4. The vertical offset between the approach channel floor and the chute is used to create a stilling pool or desirable V_1 and will vary in individual installations; Figures 103, 105, 107, and 109 show various types of approach pools. Use a short radius curve to provide a crest on the sloping chute. Place the first row of baffle piers close to the top of the chute no more than 12 inches in elevation below the crest.

▲ Stilling action of blocks is most effective for small discharges.

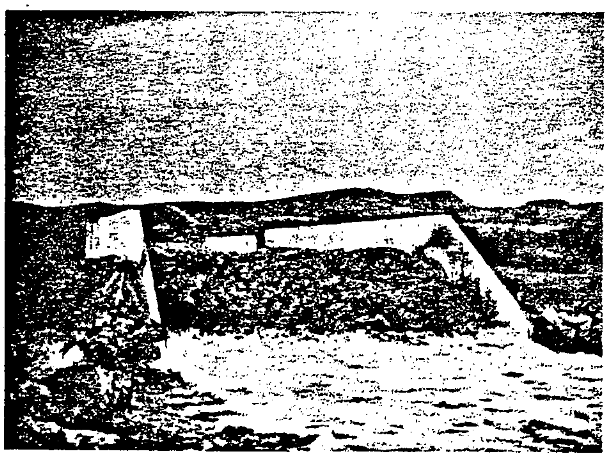


A small amount of riprap provides excellent protection to foot of chute. ▶

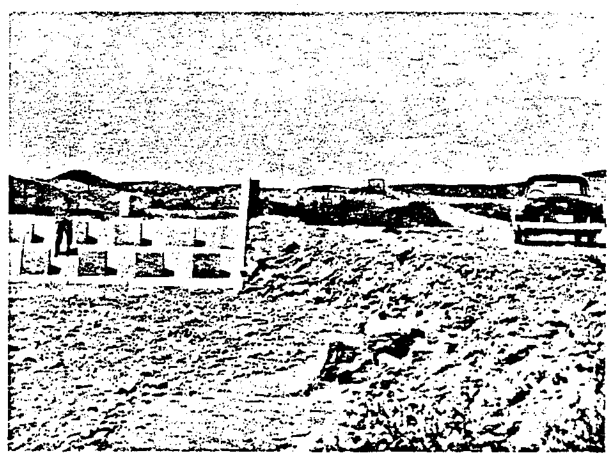
FIGURE 137.—*Frenchman-Cambridge Meeker Extension Canal Wasteway, Sta. 1777+18. Discharge about 5 c.f.s., design discharge 269 c.f.s.*

5. The baffle pier height, H, should be about 0.8 D_c, Curve B, Figure 125. The critical depth on the rectangular chute is $D_c=\sqrt[3]{\frac{q^2}{g}}$, Curve A. Baffle pier height is not a critical dimension but should not be less than recommended. The height may be increased to 0.9 D_c, Figure 125.

6. Baffle pier widths and spaces should be equal, preferably about 3/2 H, but not less than H. Other baffle pier dimensions are not critical;



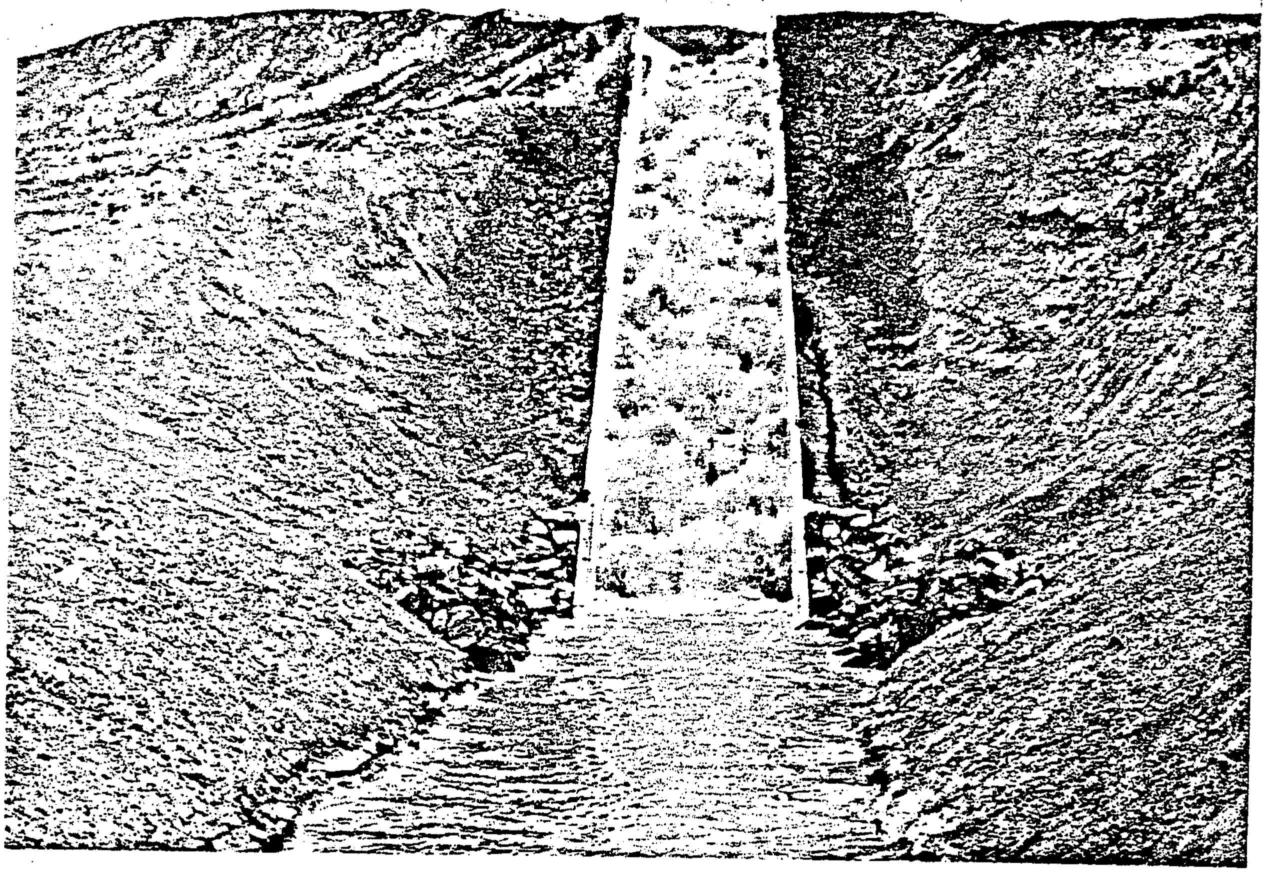
Estimated discharge 15 c.f.s. per foot width (half capacity).



Channel after flood—material was deposited rather than scoured.

North Branch Wasteway Channel, Picacho Arroyo System, Rio Grande project.

FIGURE 138.—*Baffled chute may produce channel aggradation rather than scour.*



Baffle piers 18″ high and 18″ wide—18″ spaces. Row spacing, 6′0″.

Chute 9′ wide and 90′ long—2 : 1 slope. Training walls 5′ high.

FIGURE 139.—*Kopp Wasteway on the Main East Canal, Michaud Flats project, Idaho, discharging 25 c.f.s. (one-third capacity).*

suggested cross section is shown. Partial blocks, width 1/3 H to 2/3 H, should be placed against the training walls in Rows 1, 3, 5, 7, etc., alternating with spaces of the same width in Rows 2, 4, 6, etc.

7. The slope distance (along a 2:1 slope) between rows of baffle piers should be 2 H, twice the baffle height H. When the baffle height is less than 3 feet, the row spacing may be greater than 2 H but should not exceed 6 feet. For slopes flatter than 2:1, the row spacing may be increased to provide the same vertical differential between rows as expressed by the spacing for a 2:1 slope.

8. The baffle piers are usually constructed with their upstream faces normal to the chute surface; however, piers with vertical faces may be used. Vertical face piers tend to produce more splash and less bed scour, but differences are not significant.

9. Four rows of baffle piers are required to establish full control of the flow, although fewer rows have operated successfully. Additional rows beyond the fourth maintain the control established upstream, and as many rows may be constructed as is necessary. The chute should be extended to below the normal downstream channel elevation as explained in the text of this section, and at least one row of baffles should be buried in the backfill.

34-A

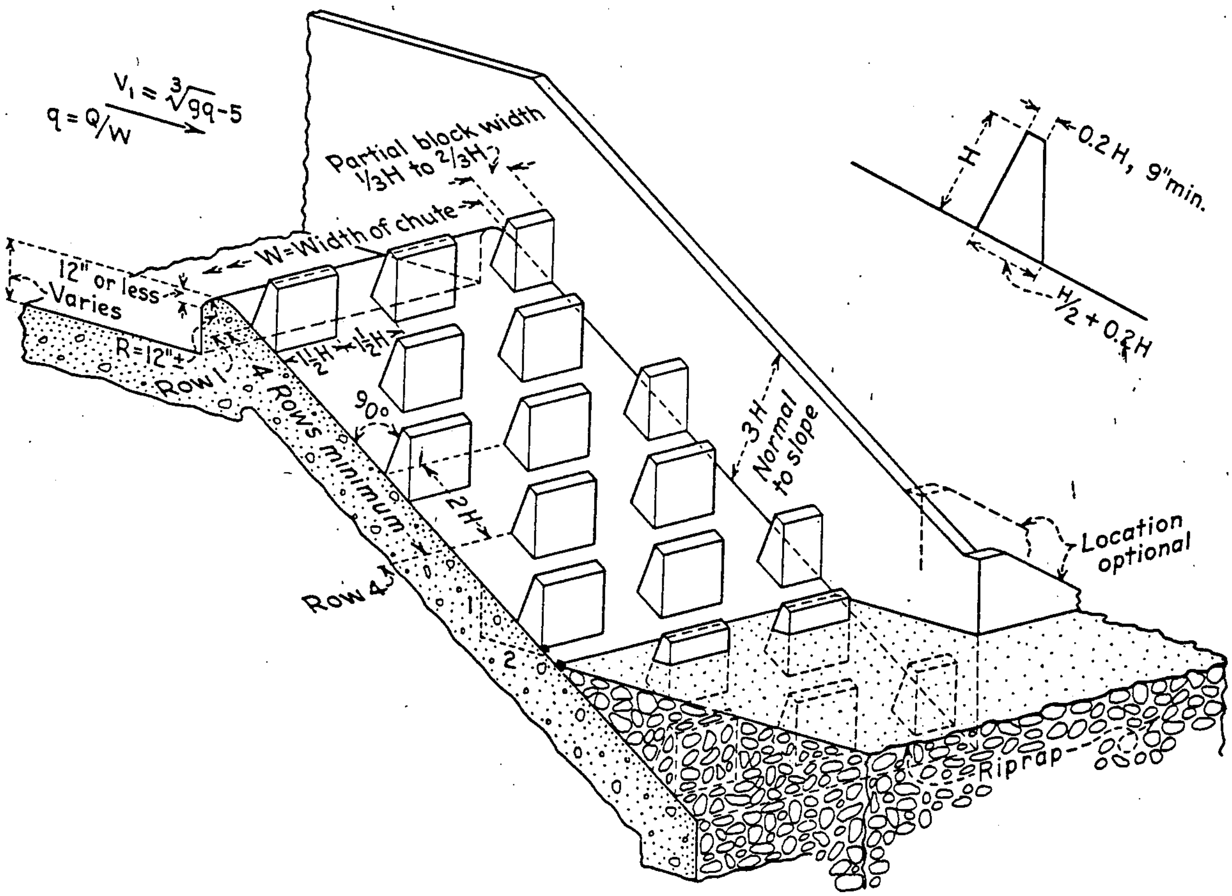


FIGURE 140.—*Basic proportions of a baffled chute.*

10. The chute training walls should be three times as high as the baffle piers (measured normal to the chute floor) to contain the main flow of water and splash. It is impractical to increase the wall heights to contain all the splash.

11. Riprap consisting of 6- to 12-inch stones should be placed at the downstream ends of the training walls to prevent eddies from working behind the chute. The riprap should not extend appreciably into the flow area. Figures 126 to 139 show effective and ineffective methods of placement on field structures.

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*****************************************************************
*   WATER SURFACE PROFILES                                      *
*   VERSION OF NOVEMBER 1976                                    *
*   UPDATED MAY 1984                                            *
*                                                               *
*   RUN DATE  14-MAR-86 TIME    08:57:59                        *
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*******************************************
*  U.S. ARMY CORPS OF ENGINEERS           *
*  THE HYDROLOGIC ENGINEERING CENTER      *
*  609 SECOND STREET, SUITE D             *
*  DAVIS, CALIFORNIA 95616                *
*  (916) 440-2105 (FTS) 448-2105          *
*******************************************
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X     X  XXXXXXX   XXXXX            XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X         XXXXX   XXXXX
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXXXXXX
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THIS RUN EXECUTED 24-MAR-86 08:58:20

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HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
ERROR CORR -  01,02,03,04,05,06
MODIFICATION -  50,51,52,53,54,55,56
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T1 GREINER ENGINEERING JOB NO 5197501
T2 STETSON HILLS - SAND CREEK CHANNEL DESIGN
T3 100 - YEAR FLOWS LOWER TRANSITION SUBCRITICAL FLOW

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	0.	0.	0.	-1.000000	0.00	0.0	7660.	524.420	0.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	-1.000	0.000	0.000	0.000	0.000	0.000	-1.000	0.000	0.000	0.000

J6	IHLEQ	ICOPY								
	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

NC	0.045	0.045	0.022	0.100	0.300	0.000	0.000	0.000	0.000	0.000
X1	64.000	4.000	25.000	107.500	0.000	0.000	0.000	0.000	0.000	0.000
GR	528.160	0.000	518.160	25.000	518.160	107.500	528.160	132.500	0.000	0.000
X1	100.000	4.000	25.000	113.500	27.000	40.000	36.000	0.000	0.000	0.000
GR	528.550	0.000	518.550	25.000	518.550	113.500	528.550	138.500	0.000	0.000
X1	140.000	4.000	25.000	120.000	34.000	48.000	40.000	0.000	0.000	0.000
GR	528.990	0.000	518.990	25.000	518.990	120.000	528.990	145.000	0.000	0.000
X1	189.000	4.000	25.000	125.000	44.000	58.000	49.000	0.000	0.000	0.000
GR	529.530	0.000	519.530	25.000	519.530	125.000	529.530	150.000	0.000	0.000
X1	239.000	4.000	25.000	125.000	50.000	50.000	50.000	0.000	0.000	0.000
GR	530.080	0.000	520.080	25.000	520.080	125.000	530.080	150.000	0.000	0.000
X1	289.000	4.000	25.000	125.000	50.000	50.000	50.000	0.000	0.000	0.000
GR	530.630	0.000	520.630	25.000	520.630	125.000	530.630	150.000	0.000	0.000
X1	315.000	4.000	25.000	125.000	26.000	26.000	26.000	0.000	0.000	0.000
GR	530.920	0.000	520.920	25.000	520.920	125.000	530.920	150.000	0.000	0.000
EJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

THIS RUN EXECUTED 24-MAR-86 08:58:27

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  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
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LOWER TRANSITION @ PROP. LINE
SUBCRITICAL RUN

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

100 - YEAR FLOWS LOWER T

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
*	64.000	0.00	0.00	0.00	518.16	7660.00	524.41 6.25	524.41	527.34	37.76	14.08	613.00	1246.57
	100.000	36.00	0.00	0.00	518.55	7660.00	525.44 6.89	524.55	527.53	23.67	11.89	727.79	1574.42
	140.000	40.00	0.00	0.00	518.99	7660.00	525.70 6.[illegible]	524.71	527.63	22.55	11.42	750.66	1613.24
	189.000	49.00	0.00	0.00	519.53	7660.00	525.71 6.18	525.07	527.81	27.17	11.86	713.50	1469.55
*	239.000	50.00	0.00	0.00	520.08	7660.00	525.62	525.62	528.26	39.59	13.30	630.12	1217.43
*	289.000	50.00	0.00	0.00	520.63	7660.00	526.17	526.17	528.81	39.46	13.29	630.79	1219.40
*	315.000	26.00	0.00	0.00	520.92	7660.00	526.46	526.46	529.10	39.50	13.29	630.60	1218.85

100 - YEAR FLOWS LOWER T

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	64.000	7660.00	524.41	0.00	0.00	-0.01	113.74	0.00
	100.000	7660.00	525.44	0.00	1.03	0.00	122.92	36.00
	140.000	7660.00	525.70	0.00	0.26	0.00	128.58	40.00
	189.000	7660.00	525.71	0.00	0.01	0.00	130.90	49.00
*	239.000	7660.00	525.62	0.00	-0.09	0.00	127.68	50.00
*	289.000	7660.00	526.17	0.00	0.56	0.00	127.70	50.00
*	315.000	7660.00	526.46	0.00	0.29	0.00	127.70	26.00

THIS RUN EXECUTED 17-MAR-86 10:54:15

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HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
ERROR CORR - 01,02,03,04,05,06
MODIFICATION - 50,51,52,53,54,55,56
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T1 GREINER ENGINEERING JOB NO. 5197501
T2 STETSON HILLS - SAND CREEK CHANNEL DESIGN
T3 100-YEAR FLOWS LOWER TRANSITION SUPERCRITICAL FLOW

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	0.	0.	1.	0.000000	0.00	0.0	7660.	523.780	0.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	-1.000	0.000	0.000	0.000	0.000	0.000	-1.000	0.000	0.000	0.000

J6	IHLEQ	ICOPY								
	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

NC	0.045	0.045	0.022	0.100	0.300	0.000	0.000	0.000	0.000	0.000
X1	189.000	4.000	25.000	125.000	44.000	58.000	49.000	0.000	0.000	0.000
GR	529.530	0.000	519.530	25.000	519.530	125.000	529.530	150.000	0.000	0.000
X1	140.000	4.000	25.000	120.000	34.000	48.000	40.000	0.000	0.000	0.000
GR	528.990	0.000	518.990	25.000	518.990	120.000	528.990	145.000	0.000	0.000
X1	100.000	4.000	25.000	113.500	27.000	40.000	36.000	0.000	0.000	0.000
GR	528.550	0.000	518.550	25.000	518.550	113.500	528.550	138.500	0.000	0.000
X1	64.000	4.000	25.000	107.500	29.000	44.000	36.000	0.000	0.000	0.000
GR	528.160	0.000	518.160	25.000	518.160	107.500	528.160	132.500	0.000	0.000
NC	0.045	0.020	0.022	0.100	0.300	0.000	0.000	0.000	0.000	0.000
X1	28.000	4.000	25.000	102.000	56.000	59.000	58.000	0.000	0.000	0.000
GR	527.750	0.000	517.750	25.000	517.750	102.000	527.750	127.000	0.000	0.000
NC	0.020	0.020	0.022	0.100	0.300	0.000	0.000	0.000	0.000	0.000
X1	30.000	4.000	25.000	100.000	46.000	46.000	46.000	0.000	0.000	0.000
GR	527.120	0.000	517.120	25.000	517.120	100.000	527.120	119.200	0.000	0.000
X1	76.000	4.000	20.400	95.400	46.000	46.000	46.000	0.000	0.000	0.000
GR	526.610	0.000	516.610	20.400	516.610	95.400	526.610	110.000	0.000	0.000

X1	122.000	4.000	15.800	90.800	58.000	58.000	58.000	0.000	0.000	0.000
GR	526.110	0.000	516.110	15.800	516.110	90.800	526.110	100.800	0.000	0.000
X1	180.000	4.000	10.000	85.000	70.000	70.000	70.000	0.000	0.000	0.000
GR	525.470	0.000	515.470	10.000	515.470	85.000	525.470	95.000	0.000	0.000
X1	250.000	4.000	10.000	85.000	100.000	100.000	100.000	0.000	0.000	0.000
GR	524.700	0.000	514.700	10.000	514.700	85.000	524.700	95.000	0.000	0.000
X1	350.000	4.000	10.000	85.000	100.000	100.000	100.000	0.000	0.000	0.000
GR	523.600	0.000	513.600	10.000	513.600	85.000	523.600	95.000	0.000	0.000
EJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

THIS RUN EXECUTED 17-MAR-86 10:54:28

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HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
ERROR CORR -  01,02,03,04,05,06
MODIFICATION -  50,51,52,53,54,55,56
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Lower Transition @ Prop. Line
Super critical Run

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

100-YEAR FLOWS LOWER TRA

SUMMARY PRINTOUT TABLE 150

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	140.000	49.00	0.00	0.00	518.99	7660.00	523.65	524.71	527.84	78.35	16.69	497.40	865.39
*	100.000	40.00	0.00	0.00	518.55	7660.00	524.05	524.53	527.43	51.16	15.05	562.32	1070.97
*	64.000	36.00	0.00	0.00	518.16	7660.00	524.42	524.42	527.34	37.52	14.05	614.31	1250.50
	28.000	36.00	0.00	0.00	517.75	7660.00	523.70	524.17	527.13	47.67	15.31	546.56	1109.40
	30.000	58.00	0.00	0.00	517.12	7660.00	522.65	523.59	526.75	62.66	16.71	481.91	967.72
	76.000	46.00	0.00	0.00	516.61	7660.00	522.17	523.16	526.44	63.92	16.96	471.67	958.13
	122.000	46.00	0.00	0.00	516.11	7660.00	521.76	522.74	526.13	63.54	17.09	465.13	960.97
	180.000	58.00	0.00	0.00	515.47	7660.00	521.05	522.19	525.72	68.58	17.59	449.40	924.97
	250.000	70.00	0.00	0.00	514.70	7660.00	520.04	521.39	525.16	79.50	18.40	429.08	859.09
	350.000	100.00	0.00	0.00	513.60	7660.00	518.75	520.29	524.27	89.78	19.10	413.08	808.42

100-YEAR FLOWS LOWER TRA

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	189.000	7660.00	523.78	0.00	0.00	0.00	121.25	0.00
	140.000	7660.00	523.65	0.00	-0.13	0.00	118.32	49.00
*	100.000	7660.00	524.05	0.00	0.40	0.00	116.00	40.00
*	64.000	7660.00	524.42	0.00	0.37	0.00	113.80	36.00
	28.000	7660.00	523.70	0.00	-0.72	0.00	106.75	36.00
	30.000	7660.00	522.65	0.00	-1.05	0.00	99.42	58.00
	76.000	7660.00	522.17	0.00	-0.47	0.00	94.48	46.00
	122.000	7660.00	521.76	0.00	-0.41	0.00	89.58	46.00
	180.000	7660.00	521.05	0.00	-0.71	0.00	86.15	58.00
	250.000	7660.00	520.04	0.00	-1.01	0.00	85.68	70.00
	350.000	7660.00	518.75	0.00	-1.28	0.00	85.31	100.00

THIS RUN EXECUTED 14-MAR-86 08:58:00

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**********************************************
HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
ERROR CORR -  01,02,03,04,05,06
MODIFICATION -  50,51,52,53,54,55,56
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T1 GREINER ENGINEERING JOB NO. 5197501
T2 STETSON HILLS-SAND CREEK CHANNEL DESIGN
T3 100-YEAR FLOWS BARNS RD. BRIDGE SUPER CRITICAL RUN

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	0.	0.	1.	0.000000	0.00	0.0	7660.	550.000	0.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	-1.000	0.000	0.000	0.000	0.000	0.000	-1.000	0.000	0.000	0.000

J6	IHLEQ	ICOPY								
	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

NC	0.032	0.032	0.035	0.100	0.400	0.000	0.000	0.000	0.000	0.000
X1	2320.000	4.000	0.000	130.200	25.000	25.000	25.000	0.000	0.000	0.000
GR	554.930	0.000	544.930	0.100	544.930	130.100	554.930	130.200	0.000	0.000
NC	0.045	0.045	0.035	0.100	0.300	0.000	0.000	0.000	0.000	0.000
X1	2295.000	4.000	25.000	142.500	45.000	45.000	45.000	0.000	0.000	0.000
GR	554.730	0.000	544.730	25.000	544.730	142.500	554.730	167.500	0.000	0.000
X1	2250.000	4.000	25.000	120.000	40.000	40.000	40.000	0.000	0.000	0.000
GR	554.500	0.000	544.500	25.000	544.500	120.000	554.500	152.500	0.000	0.000
NC	0.045	0.015	0.035	0.200	0.300	0.000	0.000	0.000	0.000	0.000
X1	2210.000	5.000	25.000	100.000	67.000	67.000	67.000	0.000	0.000	0.000
GR	554.070	0.000	544.070	25.000	544.070	100.000	547.570	110.500	554.070	110.600
NC	0.015	0.015	0.035	0.200	0.300	0.000	0.000	0.000	0.000	0.000
X1	2143.000	7.000	22.600	97.600	66.000	66.000	66.000	0.000	0.000	0.000
GR	553.200	0.000	546.700	0.100	546.700	12.100	543.200	22.600	543.200	97.600
GR	546.700	108.100	553.200	108.200	0.000	0.000	0.000	0.000	0.000	0.000
NC	0.015	0.045	0.035	0.100	0.400	0.000	0.000	0.000	0.000	0.000
X1	2077.000	7.000	22.600	97.600	54.000	54.000	54.000	0.000	0.000	0.000
GR	552.340	0.000	545.840	0.100	545.840	12.100	542.340	22.600	542.340	97.600
GR	545.840	108.100	552.340	108.200	0.000	0.000	0.000	0.000	0.000	0.000

NC	0.327	0.045	0.035	0.100	0.400	0.000	0.000	0.000	0.000	0.000
X1	2023.000	6.000	22.600	97.600	50.000	50.000	50.000	0.000	0.000	0.000
GR	551.640	0.000	545.140	0.100	545.140	12.100	541.640	22.600	541.640	97.600
GR	551.640	122.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NC	0.045	0.045	0.035	0.100	0.300	0.000	0.000	0.000	0.000	0.000
X1	1973.000	4.000	25.000	125.000	50.000	50.000	50.000	0.000	0.000	0.000
GR	551.190	0.000	541.190	25.000	541.190	125.000	551.190	150.000	0.000	0.000
X1	1923.000	4.000	25.000	125.000	50.000	50.000	50.000	0.000	0.000	0.000
GR	550.740	0.000	540.740	25.000	540.740	125.000	550.740	150.000	0.000	0.000
X1	1873.000	4.000	25.000	125.000	50.000	50.000	50.000	0.000	0.000	0.000
GR	550.290	0.000	540.290	25.000	540.290	125.000	550.290	150.000	0.000	0.000
EJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

THIS RUN EXECUTED 14-MAR-86 08:58:17

100-YEAR FLOW THRU BARNS ROAD BRIDGE
TRANSITION - SUPERCRITICAL FLOW PROFILE

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*****************************************************
 HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
 ERROR CORR -  01,02,03,04,05,06
 MODIFICATION -  50,51,52,53,54,55,56
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

100-YEAR FLOWS BARNS RD.

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
*	2320.000	0.00	0.00	0.00	544.93	7660.00	549.67	549.67	552.07	117.94	12.42	616.69	705.33
*	2295.000	25.00	0.00	0.00	544.73	7660.00	549.68	549.68	552.04	103.31	12.54	643.50	753.64
*	2250.000	45.00	0.00	0.00	544.50	7660.00	550.14	550.14	552.70	97.02	13.24	626.63	777.66
*	2210.000	40.00	0.00	0.00	544.07	7660.00	550.61 6.54	550.61	553.59	75.67	12.91	593.88	880.60
	2143.000	67.00	0.00	0.00	543.20	7660.00	548.45 5.25	549.45	552.68	123.66	14.27	489.03	688.84
*	2077.000	66.00	0.00	0.00	542.34	7660.00	548.47 6.13	548.53	551.58	79.59	12.69	583.71	858.63
	2023.000	54.00	0.00	0.00	541.64	7660.00	547.03 5.39	547.92	550.87	154.62	16.24	501.97	616.03
	1973.000	50.00	0.00	0.00	541.19	7660.00	545.43 4.24	546.69	549.84	236.95	17.16	470.58	497.62
*	1923.000	50.00	0.00	0.00	540.74	7660.00	546.22 5.98	546.22	548.77	99.26	13.14	622.78	768.87
*	1873.000	50.00	0.00	0.00	540.29	7660.00	545.77 5.98	545.77	548.32	98.93	13.13	623.45	770.14

100-YEAR FLOWS BARNS RD.

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	2320.000	7660.00	549.67	0.00	0.00	-0.33	130.09	0.00
*	2295.000	7660.00	549.68	0.00	0.01	0.00	142.27	25.00
*	2250.000	7660.00	550.14	0.00	0.45	0.00	127.40	45.00
*	2210.000	7660.00	550.61	0.00	0.47	0.00	101.89	40.00
	2143.000	7660.00	548.45	0.00	-2.15	0.00	108.05	67.00
*	2077.000	7660.00	548.47	0.00	0.01	0.00	108.08	66.00
	2023.000	7660.00	547.03	0.00	-1.43	0.00	111.01	54.00
	1973.000	7660.00	545.43	0.00	-1.60	0.00	121.27	50.00
*	1923.000	7660.00	546.22	0.00	0.78	0.00	127.39	50.00
*	1873.000	7660.00	545.77	0.00	-0.44	0.00	127.41	50.00

THIS RUN EXECUTED 14-MAR-86   08:47:58

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HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
ERROR CORR -  01,02,03,04,05,06
MODIFICATION -  50,51,52,53,54,55,56
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T1      GREINER ENGINEERING JOB. NO 5197501
T2      STETSON HILLS-SAND CREEK CHANNEL DESIGN
T3      100-YEAR FLOWS BARNS RD. BRIDGE SUBCRITICAL FLOW

J1  ICHECK    INQ      NINV     IDIR      STRT      METRIC    HVINS     Q        WSEL      FQ
      0.        0.       0.       0.  -1.000000     0.00      0.0    7660.   541.600    0.000

J2  NPROF     IPLOT    PRFVS    XSECV     XSECH     FN        ALLDC     IBW      CHNIM     ITRACE
    -1.000    0.000    0.000    0.000     0.000     0.000    -1.000     0.000    0.000     0.000

J6  IHLEQ     ICOPY
     1.000    0.000    0.000    0.000     0.000     0.000     0.000     0.000    0.000     0.000

NC     0.045     0.045     0.035     0.100     0.030     0.000     0.000     0.000     0.000     0.000
X1  1409.000     4.000    25.000   125.000     0.000     0.000     0.000     0.000     0.000     0.000
GR   546.110     0.000   536.110    25.000   536.110   125.000   546.110   150.000     0.000     0.000

X1  1419.000     4.000    25.000   125.000    10.000    10.000    10.000     0.000     0.000     0.000
GR   546.200     0.000   536.200    25.000   536.200   125.000   546.200   150.000     0.000     0.000

NC     0.045     0.045     0.035     0.000     0.000     0.000     0.000     0.000     0.000     0.000
X1  1509.000     4.000    25.000   125.000    90.000    90.000    90.000     0.000     0.000     0.000
GR   547.010     0.000   537.010    25.000   537.010   125.000   547.010   150.000     0.000     0.000

X1  1709.000     4.000    25.000   125.000   200.000   200.000   200.000     0.000     0.000     0.000
GR   548.810     0.000   538.810    25.000   538.810   125.000   548.810   150.000     0.000     0.000

X1  1973.000     4.000    25.000   125.000   264.000   264.000   264.000     0.000     0.000     0.000
GR   551.190     0.000   541.190    25.000   541.190   125.000   551.190   150.000     0.000     0.000

NC     0.015     0.045     0.035     0.000     0.400     0.000     0.000     0.000     0.000     0.000
X1  2023.000     6.000    22.600    97.600    50.000    50.000    50.000     0.000     0.000     0.000
GR   551.640     0.000   545.140     0.100   545.140    12.100   541.640    22.600   541.640    97.600
GR   551.640   122.600     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

NC     0.015     0.015     0.035     0.000     0.400     0.000     0.000     0.000     0.000     0.000
X1  2077.000     7.000    22.600    97.600    54.000    54.000    54.000     0.000     0.000     0.000
GR   552.340     0.000   545.840     0.100   545.840    12.100   542.340    22.600   542.340    97.600
GR   545.840   108.100   552.340   108.200     0.000     0.000     0.000     0.000     0.000     0.000
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NC	0.027	0.015	0.035	0.200	0.000	0.000	0.000	0.000	0.000	0.000
X1	2143.000	7.000	22.600	97.600	65.000	66.000	66.000	0.000	0.000	0.000
GR	553.200	0.000	546.700	0.100	546.700	12.100	543.200	22.600	543.200	97.600
GR	546.700	108.100	553.200	108.200	0.000	0.000	0.000	0.000	0.000	0.000
NC	0.045	0.027	0.035	0.100	0.000	0.000	0.000	0.000	0.000	0.000
X1	2210.000	5.000	25.000	100.000	67.000	67.000	67.000	0.000	0.000	0.000
GR	554.070	0.000	544.070	25.000	544.070	100.000	547.570	110.500	554.070	110.600
NC	0.045	0.045	0.035	0.100	0.000	0.000	0.000	0.000	0.000	0.000
X1	2235.000	4.000	25.000	112.500	25.000	25.000	25.000	0.000	0.000	0.000
GR	554.270	0.000	544.270	25.000	544.270	112.500	554.270	137.500	0.000	0.000
X1	2307.000	4.000	25.000	148.500	72.000	72.000	72.000	0.000	0.000	0.000
GR	554.830	0.000	544.830	25.000	544.830	148.500	554.830	173.500	0.000	0.000
EJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

THIS RUN EXECUTED 14-MAR-86 08:48:14

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HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
ERROR CORR - 01,02,03,04,05,06
MODIFICATION - 50,51,52,53,54,55,56
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100-YEAR FLOWS - THRU BARNS ROAD BRIDGE TRANSITION - SUBCRITICAL FLOW PROFILE

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

100-YEAR FLOWS BARNS RD.

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
*	1409.000	0.00	0.00	0.00	536.11	7660.00	541.59	541.59	544.14	99.14	13.14	623.01	769.31
	1419.000	10.00	0.00	0.00	536.20	7660.00	541.70	541.68	544.24	98.58	13.12	624.17	771.51
	1509.000	90.00	0.00	0.00	537.01	7660.00	542.83 5.82	542.49	545.07	80.79	12.34	665.87	852.21
	1709.000	200.00	0.00	0.00	538.81	7660.00	544.35 5.54	544.29	546.84	95.46	12.99	630.72	784.02
	1973.000	264.00	0.00	0.00	541.19	7660.00	546.91 5.72	546.66	549.24	85.54	12.56	653.60	828.21
*	2023.000	50.00	0.00	0.00	541.64	7660.00	547.92 6.28	547.92	550.90	73.34	12.37	600.89	894.44
*	2077.000	54.00	0.00	0.00	542.34	7660.00	548.56 6.22	548.56	551.50	64.74	11.56	593.14	952.00
*	2143.000	66.00	0.00	0.00	543.20	7660.00	549.48 6.28	549.48	552.23	74.26	12.46	599.65	888.90
*	2210.000	67.00	0.00	0.00	544.07	7660.00	550.44 6.37	550.44	553.36	93.51	14.10	576.70	792.15
	2235.000	25.00	0.00	0.00	544.27	7660.00	552.21 7.94	550.21	553.64	34.84	9.97	852.11	1297.69
	2307.000	72.00	0.00	0.00	544.83	7660.00	553.17 8.34	549.63	553.86	15.55	6.89	1204.79	1942.38

100-YEAR FLOWS BARNS RD.

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	1409.000	7660.00	541.59	0.00	0.00	-0.01	127.40	0.00
	1419.000	7660.00	541.70	0.00	0.11	0.00	127.44	10.00
	1509.000	7660.00	542.83	0.00	1.13	0.00	129.07	90.00
	1709.000	7660.00	544.35	0.00	1.52	0.00	127.70	200.00
	1973.000	7660.00	546.91	0.00	2.56	0.00	128.59	264.00
*	2023.000	7660.00	547.92	0.00	1.00	0.00	113.23	50.00
*	2077.000	7660.00	548.56	0.00	0.64	0.00	108.08	54.00
*	2143.000	7660.00	549.48	0.00	0.92	0.00	108.09	66.00
*	2210.000	7660.00	550.44	0.00	0.96	0.00	101.46	67.00
	2235.000	7660.00	552.21	0.00	1.77	0.00	127.19	25.00
	2307.000	7660.00	553.17	0.00	0.96	0.00	165.23	72.00