98 #176

FLOOD PLAIN INFORMATION

CACHE LA POUDRE RIVER
HEWLETT GULCH
HILL GULCH
FALLS GULCH
WATHA GULCH
UNNAMED GULCH

MAY 1981

POUDRE PARK, LARIMER COUNTY, COLORADO

MAY 1981

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PREFACE

This report describes the flood characteristics of the Cache la Poudre River, Hewlett Gulch, Hill Gulch, Watha Gulch, Falls Gulch, and an unnamed gulch at an unincorporated area known as Poudre Park, Colorado. This area is about 9 miles upstream from the mouth of the Cache la Poudre River canyon. Poudre Park occupies a portion of the canyon.

This report was prepared for the guidance of local officials in planning the use and regulation of the flood plain. Four potential floods were used to represent degrees of major flooding that may occur in the future. These floods, the 10-year, 50-year, 100-year, and 500-year, are defined in the Glossary and should be given appropriate consideration in planning for safety of development in the flood plain. The 100-year and 500-year floods are further defined by flooded area maps that show the approximate areas that would be inundated. Flood profiles show the water depths of the 10-year, 50-year, 100-year, and 500-year floods relative to the streambed and water surface elevations of these floods across the width of the valley. Cross sections are presented to indicate ground level across the valley and the overlying flood depths of the 100-year and 500-year floods. The flood profiles and flooded area data presented are based on the existing conditions of the basin, stream, and valley when the report was prepared.

Preparation of this report was a result of efforts by county, state, and Federal government agencies. Survey data for this report was furnished by Larimer County and the Colorado Water Conservation Board. The Omaha District, U.S. Army Corps of Engineers conducted the technical aspects of this report. Publication and distribution of this report was accomplished by Larimer County.

BACKGROUND INFORMATION

PRINCIPAL FLOOD SOURCES

The Cache la Poudre River begins in the Rocky Mountains at the Continental Divide in north central Colorado. The river flows in a general easterly direction through Poudre Park to its confluence with the South Platte River east of Greeley, Colorado. The river drains about 415 square miles upstream from Poudre Park. Elevations in the basin upstream from Poudre Park range from 13,500 feet above mean sea level (m.s.l.) to 5,650 feet m.s.l. at Poudre Park.

Hewlett Gulch, a left bank tributary of the Cache la Poudre River, drains an area of 23 square miles located north and west from Poudre Park. Elevations in the basin range from about 7,700 feet m.s.l. to about 5,670 feet m.s.l.

Hill Gulch is a right bank tributary of the Cache la Poudre River. It drains 5.6 square miles and has basin elevations ranging from 7,700 feet m.s.l. to 5,654 feet m.s.l. The Hill Gulch basin is located south and west from Poudre Park.

Falls Gulch drains an area of 1.3 square miles located southwest from Poudre Park. Basin elevations range from 7,560 feet m.s.l. to 5,675 feet m.s.l. Falls Gulch is a right bank tributary of the Cache la Poudre River.

Watha Gulch, a right bank tributary of Hill Gulch drains an area of 1.1 square miles southeast from Poudre Park. Basin elevations range approximately between 7,500 feet m.s.l. and 5,735 feet m.s.l.

Unnamed Gulch drains .15 square miles. It is a right bank tributary of Falls Gulch. Basin elevations generally range between 6,850 feet m.s.l. and 5,770 m.s.l.

SOURCES OF DATA AND RECORDS

Information on past floods was obtained from Corps of Engineer flood records, U.S. Geological Survey stream gaging records, residents of Poudre Park, the State of Colorado, and Larimer County. Cross section data and topographic mapping having a contour interval of 2 feet and a scale of 1 inch equals 200 feet were established by photogrammetric methods from aerial photographs taken on 5 May 1977. These data were furnished by Larimer County in cooperation with the Colorado Water Conservation Board. U.S. Geological Survey 7.5 minute quadrangle maps with 40-foot contour intervals at a scale of 1 inch equals 2,000 feet were also used in the study. Bridge and roadway survey data were furnished by Larimer County.

STREAM GAGING RECORDS

Stream gaging data used in the study were collected by the U.S. Geological Survey on the Cache la Poudre River at locations about 10 miles upstream and about 9 miles downstream from Poudre Park. Tables 1-3 provide data pertinent to these stream gaging stations.

Table 1
Stream Gaging Data

Stream	Gage Location	Approximate Drainage Area (sq. mi.)	Gaging Records
Cache la Poudre River	500 feet southwest from Colorado Highway 14, .6 miles downstream from Elkhorn Creek, and about 10 miles upstream from Poudre Park	407	1946 to 1959
Cache la Poudre River	At mouth of Canyon, 1.2 miles upstream from Lewstone Creek, 9.3 miles northwest of Fort Collins Courthouse	1,056	1882 to present

Table 2
Annual Peak Discharges 1/ for the Cache la Poudre River at the Canyon Mouth 2/.

Date	Discharge (c.f.s.)
22 June 1883	7,900
20 May 1884	6,850
18 Aug 1886	4,820
9 June 1891	21,000
29 May 1900	5,000
21 May 1901	12,000
20 May 1904	3/
9 June 1905	4,700
19 June 1909	5,900
2 June 1914	5,380
23 June 1917	7,000
20 June 1918	5,200
9 June 1920	4,510
8 June 1921	5,230
15 June 1923	8,550
14 June 1924	7,440
31 May 1930	10,200
22 June 1938	6,180
22 June 1947	4,660
3 Aug 1951	4,630
11 June 1965	4,810
31 July 1976	7,340

1/ Only those years having a peak discharge of 4,500 c.f.s. or greater are indicated.

2/ From U.S.G.S. Gaging Station on Cache la Poudre River on the left bank at the mouth of the canyon 9.3 miles northwest of the courthouse in Fort Collins.

3/ Greater than the flood of 1891.

Table 3
Annual Peak Discharges for the Cache la Poudre River downstream from Elkhorn Creek 1/

Date	Discharge (c.f.s.)
7 June 1946	3,020
9 June 1947	3,830
3 June 1948	2,950
18 June 1949	3,610
17 June 1950	3,570
20 June 1951	3,860
11 June 1952	4,340
14 June 1953	3,340
21 May 1954	1,630
23 May 1955	1,890
3 June 1956	3,440
30 June 1957	4,900
29 May 1958	3,800
21 June 1959	2,840

1/ From U.S.G.S. Gaging Station on the Cache la Poudre River on left bank 500 feet southwest from Colorado Highway 14, .6 miles downstream from Elkhorn Creek, and about 10 miles upstream from Poudre Park.

FLOOD DESCRIPTIONS

The following accounts are representative of typical floods on the Cache la Poudre River for which information is available. Most of these accounts do not describe specifically accounts of flooding within the study reach of this report. They do, however, indicate that flood conditions existed along the stream implying that floodwaters may have been passing through the study reach.

June 1844 - French trapper, Antoine Janis, who lived on the Cache la Poudre River near present day Laporte stated that "On the first of June, 1844, I stuck my stake on a claim in the valley. At that time the streams were all very high and the valley black with buffalo."

June 1864 - Mountain snowmelt coupled with heavy rainfall in the upper Cache la Poudre River basin caused flooding along the Cache la Poudre River in the mountains and on the plains. At that time this flood was the worst known by white men.

May 1876 - Flooding occurred in the vicinity of Fort Collins and Greeley due to the Cache la Poudre River.

June 1884 - The melting of an unusually heavy snowpack in the spring of 1884 caused some flooding along the Cache la Poudre River.

June 1891 - Excessive runoff from mountain snowmelt caused the failure of Chambers Lake Dam in the headwaters of the Cache la Poudre River. According to the 11 June 1891 issue of the Fort Collins Courier, the floodwater ".... carried everything in

its way to destruction. Bridges, buildings, fences, headgates, cattle, and horses were swept into the whirling, roaring, rushing flood."

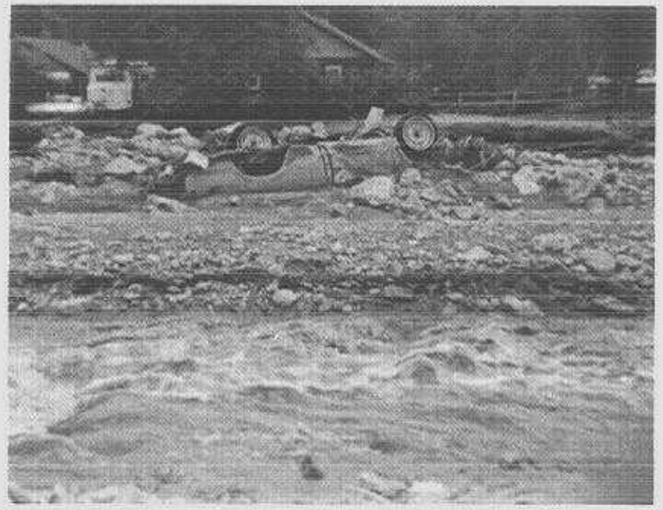
May 1904 - Heavy rainfall occurred over portions of the upper Cache la Poudre River basin. This flood was purportedly the largest at Fort Collins for which stream gaging data is available. However, since most of the floodwater originated in the North Fork Cache la Poudre River basin, the amount of flooding in the Poudre Park area is not known.

June 1923 - Mountain snowmelt and heavy rainfall created flooding along the Cache la Poudre River.

July 1976 - Heavy rainfall in the middle to upper Cache la Poudre River basin on 31 July, produced flooding in the Poudre Park vicinity along Falls Gulch, Hill Gulch, Hewlett Gulch, Watha Gulch, and minor flooding along the Cache la Poudre River. Most damage in the Poudre Park area from the flood occurred in the flood plains of the Cache la Poudre River tributaries.

Additional flooding has undoubtedly occureed in the Poudre Park area other than what has been described in this report. However, data describing these floods is meager.

The following two photographs were taken August 3, 1976. These pictures, as well as the photograph on the cover, were taken by Floyd Fry, from Columbine Lodge in Poudre Park. Both photographs and the cover picture were shot near reference point 44A illustrated on Plate 3.



FUTURE FLOODS

Floods of the same or larger magnitude than those that have occurred could occur in the future. To determine the flood potential of the study area, the 10-year, 50-year, 100-year, and 500-year floods were analyzed. The results of this analysis are presented in this report as a means of demonstrating the effects of large floods.

Discharge magnitudes for Cache la Poudre River floods analyzed in this report were based upon an analysis of stream gaging data at the U.S.G.S. stream gages located about 10 miles and 9 miles upstream and downstream from Poudre Park respectively. Information on these stream gages was presented in table 1. Because of the lack of stream gaging data in the immediate vicinity of Poudre Park, the Massachusetts Institute of Technology Catchment Model (MITCAT) was used to develop a hydrologic model of the Cache la Poudre River basin upstream from the mouth of the canyon. This model was calibrated using discharge frequency relationships established by the analyses of the U.S.G.S. stream gaging stations. Rainfall values used in the MITCAT hydrologic model were obtained from the Precipitation-Frequency Atlas of the Western United States, Atlas 2, Volume III, Colorado published by the National Oceanic and Atmospheric Administration in 1973. Soil infiltration rates were determined using data developed by the Soil Conservation Service and the Colorado State University Experiment Station.

Discharge magnitudes for floods on Hewlett Gulch, Falls Gulch, Hill Gulch, Watha Gulch, and Unnamed Gulch analyzed in this report were also developed using MITCAT. Table 4, entitled "Cache la Poudre River Basin Drainage Areas", presents basin drainage areas at various locations along the Poudre Park study reach.

Tables 6, 7, 8, 9, 10 and 11 entitled "Flood Plain Reference Data, Cache la Poudre River, Hewlett Gulch, Hill Gulch, Falls Gulch, Watha Gulch, and Unnamed Gulch", respectively, presents discharge data used in this study.

Table 4
Cache la Poudre River Basin Drainage Areas

Location	Drainage Area (sq. mi.)
Cache la Poudre River	
Upstream from Falls Gulch	415
Downstream from Falls Gulch	416.3
Upstream from Hewlett Gulch	416.4
Downstream from Hewlett Gulch	439.4
Upstream from Hill Gulch	439.5
Downstream from Hill Gulch	445.1
Hewlett Gulch	
Mouth	23
Hill Gulch	
Upstream from Watha Gulch	4.3
Downstream from Watha Gulch	5.4
Mouth	5.6
Falls Gulch	
Upstream from Unnamed Gulch	1.1
Downstream from Unnamed Gulch	1.2
Mouth	1.3
Watha Gulch	
Mouth	1.1
Unnamed Gulch	
Mouth	.15

FREQUENCY

The 500-year flood is not the largest flood that can occur, but the probability of larger floods is remote. As can be seen from the gaging records for the Cache la Poudre River, discharges smaller than either the 100-year or 500-year floods are much more common. Large floods, however, can happen; this was clearly demonstrated by the Denver area floods of 1965, the June 1972 flood at Rapid City, South Dakota, and the July 1976 flood in the Big Thompson canyon.

The Cache la Poudre River in the Poudre Park area, as evidenced by tables 2 and 3, has not experienced a flood of magnitude similar to the 100-year flood for many years. However, stream basins in the general vicinity of the Cache la Poudre River basin have experienced such floods in recent years. The following table indicates the magnitude of these discharges and the drainage area upstream from the point of discharge measurement. For comparison purposes, the Cache la Poudre River at Poudre Park has a drainage area of 415 square miles upstream from Falls Gulch and a 100-year flood discharge at that location of 16,300 c.f.s.

Table 5
Peak Discharges in Stream Basins
in the Vicinity of the Cache la Poudre River

Stream	Location	Date	Drainage Area (sq. mi.)	Discharge (c.f.s.)
North Fork Cache la Poudre River	Livermore, Colorado	May 1904	568	20,000
Rapid Creek	1/ Rapid City, South Dakota	June 1972	52 2/	31,200
Big Thompson River	Above Drake, Colorado	July 1976	189	31,200

1/ Located upstream from Canyon Lake Dam.
2/ Uncontrolled drainage area downstream from Pactola Dam.

Flooding can occur with relatively little discharge in the event of channel blockage caused by debris or ice. In these situations, water surface elevations rise until relief is achieved by flows over the flood plain. Historical data, however, indicate that obstructions due to ice are not likely to occur in the study reach. The formation of obstructions at bridges in the study reach is, however, quite possible - especially due to debris accumulation.

HAZARDS OF LARGE FLOODS

The extent of damage caused by any flood depends on the topography of the area flooded, depth and duration of flooding, velocity of flow, rate of rise, developments on the flood plain, and amount of debris in the floodwater. A 100-year flood or a 500-year flood on the Cache la Poudre River and its tributaries in the study reach would result in the inundation of, and subsequent damage to residential properties and associated developments as well as public utilities and public roadways. Deep floodwater flowing at high velocity and carrying floating debris would create conditions hazardous to persons and vehicles attempting to cross flooded areas. In general, floodwater 3 or more feet deep and flowing at a velocity of 3 or more feet per second could easily sweep adult persons off their feet, thus creating definite danger or injury or drowning. Rapidly rising and swiftly flowing floodwater may trap persons in homes that are ultimately destroyed or in vehicles that are ultimately submerged or floated. Isolation of areas by floodwaters could create hazards in terms of medical, fire, or law enforcement emergencies.

Flooded areas and flood damages - Water surface profiles for the floods studied in this report were developed using the backwater computer program HEC-2, "Water Surface Profiles", developed by the U.S. Army Corps of Engineers. The computations were based

on channel and flood plain conditions as represented by survey data gathered in May 1977 and as supplemented by later field investigations.

The profiles on plates 6 through 12 show the water surface elevations and water depth of the 10-year, 50-year, 100-year, and 500-year floods relative to the streambed. In this particular case and throughout the study, the streambed is actually the channel low flow water surface elevation since the surveys were conducted by aerial photogrammetric methods. The water surface elevations of the 100-year and 500-year floods were used to determine flood limits on the cross sections and topographic maps. The results are shown on the Flooded Areas, plates 3 through 5. An index to the Flooded Areas plates is on plate 2. Representative cross sections are illustrated on plates 13 and 14. The cross sections show ground elevations across the valley on both sides of the channel and the depths of overbank flooding. Reference points, coinciding with the locations of the cross sections and pertinent planimetric features are shown on the Flooded Areas and profile for correlation between the drawings. Tables 6, 7, 8, 9, 10, and 11 provide data at reference point locations, including distance along the main channel centerline, elevations of the streambed, and elevations and discharges of the 10-year, 50-year, 100-year, and 500-year floods.

The Flooded Areas show the area that would be flooded by the 100-year and 500-year floods. The flood limits were located at each cross section and the intervening flood outlines were drawn based upon detailed topographic mapping, engineering judgment, and field observations. It is, however, possible that more or less flooding should be shown on the Flooded areas. For a specific situation, where more detailed accuracy of a flooded area is required, the flood limits can be more accurately established by determining the water surface elevation from the profile or reference tables and then locating that elevation by survey on the flood plain.

The detailed topographic mapping utilized to assist in delineating the outline of the 100-year and 500-year floods consists of maps having a scale of 1 inch equals 200 feet with a 2 foot contour interval. These maps were prepared under contract with the Colorado Water Conservation Board in cooperation with Larimer County. These maps, now used for administrative purposes, are on file and available for public inspection at the Planning Department, Larimer County Courthouse, Fort Collins, Colorado.

A reference line is shown on the Flooded Areas for the Cache la Poudre River, Hewlett Gulch, Hill Gulch, Falls Gulch, Watha Gulch, and Unnamed Gulch. This line is used for reference only and does not necessarily coincide with the existing stream channel.

The flood elevations shown on the profile and in tables 6-11 apply laterally from the channel over most of the flood plain width. Road crossings and other topographic features can alter the lateral flood elevations. Depending on whether these features divert or block flows, the flood elevations at the edge of the flood plain may be higher or lower than at the channel.

Flood plain widths vary from one area to another throughout the study reach. The 100-year flood plain width of the Cache la Poudre River varies from a minimum near 110 feet to a maximum near 650 feet with an average of 350 feet. The 100-year flood plain width of Hewlett Gulch, Hill Gulch, Falls Gulch, Watha Gulch, and Unnamed Gulch generally ranges between a minimum of 20 feet and a maximum of 250 feet with an average of 75 feet. All roadways in Poudre Park are overtopped by the 100-year flood at some location in the study reach.

Obstructions to floodflows - Several roadways cross the flood plain of the Cache la Poudre River and tributaries in the study

reach. The physical characteristics of these roadways created conditions in this study which resulted in an increase in water surface elevation immediately upstream from these roadways ranging from 0 to 4 feet. The upstream water surface elevations would increase drastically if the bridge area were substantially reduced by debris, especially at those roadways having high embankments. These higher water surface elevations would flood more area than shown in this report and increase velocities through the unobstructed portions of the bridges.

The profiles on plates 6 through 12 show the extent to which flood stages are increased at the bridges. An appreciable stage increase occurs on the Cache la Poudre River at bridges located at reference point 59A, 67A, and 72A. Appreciable stage increases also occur on Hill Gulch at reference point 11 and 18A.

Velocities of flow - Water velocities during floods depend upon such factors as size and shape of the channel and flood plain cross section, conditions of the stream, and bed slope; all of these factors vary on different streams and at different locations on the same stream. On the Cache la Poudre River in the study reach, the channel velocity for the 100-year flood, in general, ranges from 9 to 20 feet per second. The overbank velocity for the 100-year flood ranges, in general, from 3 to 6 feet per second. These values for the Cache la Poudre River tributaries studied in this report are generally 5 to 9 feet per second for the channel and 2 to 4 feet per second for the overbank.

Rate of rise and duration of flooding - Rate of rise and duration of flooding, for floods comparable to the 100-year or 500-year flood, can vary over a wide range. In the Poudre Park area, a 100-year or a 500-year flood on the Cache la Poudre River would be

expected to peak about 2 1/2 hours after the time of initial rise. The flood would have a duration of about 13 hours. Similarly for Hewlett Gulch, Hill Gulch, and Falls Gulch, these values would generally be 1 - 1 1/2 hours and 5 - 6 hours respectively. The time to flood peak and flood duration for Watha Gulch and Unnamed Gulch for a 100-year or 500-year flood would be about 1/2 - 1 hour and 2 - 3 hours respectively.

GLOSSARY OF TERMS

Flood

An overflow on lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: (1) the inundation of land is temporary; and (2) the land is adjacent to and inundated by overflow from a river, a stream, an ocean, a lake, or other body of standing water.

Normally, a flood is considered as any temporary rise in streamflow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflow, and other problems.

Flood Crest

The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Plain

The relatively flat area or low lands adjoining the channel of a river, stream, water course, ocean, lake or other body of standing water which has been or may be covered by floodwater.

Flood Profile

A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is

generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage

The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Head Loss

The effect of obstructions, such as narrow bridge openings or buildings, that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

Left Bank

The bank on the left side of a river, stream, or water course looking downstream.

Reference Point

A numbered point identifying a specific location used for correlating the data shown in various forms throughout the report.

Right Bank

The bank on the right side of a river, stream, or water course looking downstream.

10-, 50-, 100-, and 500-Year Flood

A flood having a 10, 2, 1, or .2 percent probability, respectively, of occurrence in any year or an average frequency of occurrence in the order of once in 10, 50, 100, or 500 years,

respectively. The flood may occur in any year. It is based on statistical analyses of streamflow records and analyses of rainfall and runoff characteristics in the general region of the watershed.

Sheet Flow

The water which is diverted from the main floodflow by obstructions and variances in topography. This water flows at shallow depths and normally at elevations different from the water flowing in the adjacent channel or on the adjacent flood plain. Due to the shallow depths and irregular flow patterns associated with this type of flow, computations to predict flow depth are considered impractical.

Top of Waterway

This is the roof of the opening in a stream crossing through which water flows under normal conditions. It is the underside of the deck span - sometimes called "low steel", the roof of a box culvert, or the crown of an arched or circular culvert.

Table 6
Flood Plain Reference Data
Cache la Poudre River

Identification	Reference Point Number	Distance From Mouth Ft.	Stream Bed Elevation Ft.-m.s.l.	10-Year Flood Elevation Ft.-m.s.l.	10-Year Peak Discharge c.f.s.	50-Year Flood Elevation Ft.-m.s.l.	50-Year Peak Discharge c.f.s.	100-Year Flood Elevation Ft.-m.s.l.	100-Year Peak Discharge c.f.s.	500-Year Flood Elevation Ft.-m.s.l.	500-Year Peak Discharge c.f.s.
Upstream Limit of Study Cross Section 1-1	45	331,625	5673.8	5683.3		5687.1		5689.1		5694.2	
	46	331,430	5673.3	5682.2		5686.0		5688.0		5693.1	
	47	331,290	5672.5	5681.0		5684.9		5686.8		5692.0	
	48	331,170	5671.4	5679.9	4960	5683.8	11,590	5686.0	16,300	5691.3	31,870
Falls Gulch	48A	331,050			5170		12,280		17,320		36,220
	49	331,020	5671.6	5678.5		5682.8		5685.1		5690.3	
	50	330,850	5667.9	5677.1		5681.7		5684.2		5689.6	
	51	330,695	5667.0	5675.5		5679.1		5680.5		5686.0	
	52	330,610	5667.0	5674.9		5678.2		5679.7		5683.2	
Hewlett Gulch	52A	330,510									
	53	330,455	5666.3	5673.1		5676.5		5677.9		5681.9	
	54	330,285	5664.5	5671.2		5675.0		5676.7		5680.7	
Cross Section 2-2	55	330,125	5663.4	5668.9		5672.5		5674.3		5679.8	
	56	329,920	5660.7	5666.6		5670.9		5673.0		5679.1	
	57	329,790	5655.1	5665.7		5670.1		5672.4		5678.8	
	58	329,620	5654.3	5664.4		5669.6		5672.0		5678.3	
	59	329,430	5654.2	5662.5		5666.9		5669.3		5675.2	
Bridge	59A	329,225	5652.0	U/S 5660.7		5665.6		5668.2		5674.2	
				D/S 5659.7		5664.0		5665.6		5670.3	
	60	329,205	5652.0	5659.7	5170	5664.0	12,280	5665.6	17,320	5670.3	36,220
Hill Gulch	60A	329,135			5220		12,460		17,580		36,820
	61	329,055	5650.0	5658.3		5663.0		5664.6		5669.3	
Cross Section 3-3	62	328,880	5649.0	5656.1		5659.2		5661.1		5665.1	
	63	328,740	5647.8	5654.8		5657.5		5659.0		5663.8	
	64	328,510	5646.0	5651.1		5654.3		5656.2		5661.3	
	65	328,310	5644.0	5648.8		5652.7		5654.7		5659.8	
	66	328,120	5641.0	5646.8		5651.3		5653.4		5658.6	
Bridge	66A	327,925	5634.0	U/S 5644.0		5699.4		5651.8		5656.9	
				D/S 5641.2		5646.0		5649.1		5654.6	
	67	327,865	5634.2	5641.2		5646.0		5649.1		5654.6	
Bridge	67A	327,765	5631.6	U/S 5640.6		5645.8		5649.1		5654.5	
				D/S 5638.8		5642.7		5644.7		5650.8	
	68	327,710	5629.8	5638.8		5642.7		5644.7		5650.8	
Cross Section 4-4	69	327,560	5629.5	5637.6		5641.4		5643.2		5649.5	
	70	327,425	5628.5	5635.4		5639.1		5641.6		5648.5	
	71	327,290	5627.1	5634.3		5638.5		5641.4		5648.5	
	72	327,140	5626.2	5632.8		5636.5				5646.8	
Bridge	72A	327,085	5621.4	U/S 5630.9		5635.0		5639.7		5646.6	
				D/S 5629.5		5633.5		5635.8		5642.7	
	73	326,870	5618.5	5626.1		5630.8		5633.4		5640.9	
	74	326,595	5615.2	5623.3		5628.9		5631.5		5638.9	
	75	326,390	5611.5	5622.2		5627.3		5629.3		5636.4	
	76	326,175	5610.9	5618.2		5623.1		5626.5		5634.7	
	77	325,975	5609.0	5616.1		5623.3		5626.0		5634.7	
Cross Section 5-5	78	325,780	5604.0	5613.0		5617.2		5619.2		5626.2	
Downstream Limit of Study	79	325,520	5602.5	5609.7	5220	5613.9	12,460	5616.2	17,580	5622.4	36,820

Table 7
Flood Plain Reference Data
Hewlett Gulch

Identification	Reference Point Number	Distance From Mouth Ft.	Stream Bed Elevation Ft.-m.s.l.	10-Year Flood Elevation Ft.-m.s.l.	10-Year Peak Discharge c.f.s.	50-Year Flood Elevation Ft.-m.s.l.	50-Year Peak Discharge c.f.s.	100-Year Flood Elevation Ft.-m.s.l.	100-Year Peak Discharge c.f.s.	500-Year Flood Elevation Ft.-m.s.l.	500-Year Peak Discharge c.f.s.
Upstream Limit of Study Cross Section 6-6	22	1390	5702.9	5706.7	600	5708.1	1790	5708.9	2700	5710.6	6090
	23	1240	5699.7	5703.6		5705.0		5705.6		5707.3	
	24	1135	5696.5	5699.5		5701.1		5702.0		5703.7	
	25	1000	5690.0	5694.2		5696.7		5698.0		5701.4	
	26	790	5683.7	5689.3		5691.8		5693.1		5695.9	
Cross Section 7-7	27	610	5679.9	5684.9		5687.4		5688.6		5692.6	
	28	365	5672.8	5678.5		5681.5		5683.1		5685.3	
	29	250	5670.2	5676.1		5678.3		5679.1		5682.8	
	30	115	5669.2	5673.5		5676.9		5678.3		5682.1	
Mouth	52A	0	5666.8	5673.5	600	5676.9 1/	1790	5678.3 1/	2700	5682.1 1/	6090

1/ Backwater from the Cache la Poudre River

Table 8
Flood Plain Reference Data
Hill Gulch

Identification	Reference Point Number	Distance From Mouth Ft.	Stream Bed Elevation Ft.-m.s.l.	10-Year Flood Elevation Ft.-m.s.l.	10-Year Peak Discharge c.f.s.	50-Year Flood Elevation Ft.-m.s.l.	50-Year Peak Discharge c.f.s.	100-Year Flood Elevation Ft.-m.s.l.	100-Year Peak Discharge c.f.s.	500-Year Flood Elevation Ft.-m.s.l.	500-Year Peak Discharge c.f.s.
Upstream Limit of Study	1	2820	5756.5	5761.2	280	5763.5	850	5764.2	1220	5766.1	2330
	2	2665	5751.0	5754.7		5756.8		5757.9		5759.5	
	3	2520	5744.0	5748.5		5749.9		5750.5		5752.1	
	4	2360	5740.0	5742.0		5742.9		5743.4		5744.2	
	5	2190	5730.0	5733.4	280	5734.7	850	5735.2	1220	5736.6	2330
Watha Gulch	5A	2175			360		1080		1520		2970
	6	2095	5727.5	5729.8		5731.0		5731.5		5732.5	
	7	1915	5722.8	5725.9		5727.0		5727.3		5728.5	
Cross Section 10-10	8	1860	5717.0	5720.3		5722.0		5722.7		5723.6	
	9	1745	5711.4	5715.1		5716.9		5717.6		5719.3	
	10	1590	5705.8	5709.7		5711.9		5712.8		5714.5	
Hill Gulch Road	11	1495	5700.3	U/S 5706.3		5709.7		5712.2		5713.7	
				D/S 5704.9		5707.2		5708.1		5709.7	
	12	1360	5697.8	5701.5		5703.2		5703.8		5705.5	
	13	1240	5693.5	5697.8		5699.2		5699.9		5701.7	
	14	1080	5690.5	5693.6		5695.1		5695.6		5697.0	
	15	970	5687.2	5690.4		5691.9		5692.4		5693.7	
Cross Section 11-11	16	860	5683.5	5687.2		5689.1		5689.7		5691.3	
	17	775	5681.0	5684.5		5685.8		5686.4		5687.7	
	18	650	5676.9	5682.3		5684.2		5684.6		5686.0	
Colorado Highway 14	18A	550	5676.9	U/S 5680.9		5683.9		5684.2		5685.5	
				D/S 5676.7		5678.2		5678.7		5679.9	
	19	465	5672.3	5675.5		5676.3		5676.7		5677.9	
	20	320	5666.0	5670.2		5672.5		5672.8		5673.4	
	21	140	5657.6	5661.7		5663.4		5665.0		5670.0	
Mouth	60A	0	5651.1	5658.9	360	5663.4	1080	5665.0	1520	5670.0	2970

Table 9
Flood Plain Reference Data
Falls Gulch

Identification	Reference Point Number	Distance From Mouth Ft.	Stream Bed Elevation Ft.-m.s.l.	10-Year Flood Elevation Ft.-m.s.l.	10-Year Peak Discharge c.f.s.	50-Year Flood Elevation Ft.-m.s.l.	50-Year Peak Discharge c.f.s.	100-Year Flood Elevation Ft.-m.s.l.	100-Year Peak Discharge c.f.s.	500-Year Flood Elevation Ft.-m.s.l.	500-Year Peak Discharge c.f.s.
Upstream Limit of Study	32	1725	5774.0	5775.8	70	5776.8	220	5777.2	320	5778.2	630
Unnamed Gulch	32A	1680			90		260		380		730
	33	1605	5764.4	5767.1		5768.3		5769.0		5770.3	
	34	1500	5756.3	5758.9		5760.1		5760.7		5762.0	
Cross Section 8-8	35	1385	5748.2	5750.8		5752.1		5752.7		5753.8	
	36	1275	5741.8	5744.1		5744.9		5745.2		5746.0	
	37	1185	5734.6	5737.2		5738.6		5739.2		5740.1	
	38	1030	5725.3	5727.7		5728.6		5728.9		5730.0	
	39	910	5719.5	5722.3		5723.7		5724.3		5725.7	
Falls Gulch Road	39A	850		U/S 5719.8		5720.8		5721.1		5722.3	
				D/S 5719.7		5720.7		5721.0		5722.2	
	40	800	5714.5	5717.3		5718.6		5719.0		5719.8	
Cross Section 9-9	41	690	5708.5	5711.6		5712.5		5712.9		5713.4	
Falls Gulch Road	42	505		U/S 5704.0		5704.6		5705.0		5706.5	
				D/S 5700.6		5702.7		5703.3		5705.1	
	43	380	5689.0	5693.4		5694.4		5694.8		5696.2	
	44	245	5683.2	5685.3		5686.5		5687.2		5690.7	
Colorado Highway 14	44A	145	5681.0	U/S 5683.9		5686.3		5687.0		5690.7	
				D/S 5682.3		5683.6		5684.3		5686.1	
Mouth	48A	0	5671.5	5678.8	90	5683.0	260	5685.5	380	5690.5	730

Table 10
Flood Plain Reference Data
Watha Gulch

Identification	Reference Point Number	Distance From Mouth Ft.	Stream Bed Elevation Ft.-m.s.l.	10-Year Flood Elevation Ft.-m.s.l.	10-Year Peak Discharge c.f.s.	50-Year Flood Elevation Ft.-m.s.l.	50-Year Peak Discharge c.f.s.	100-Year Flood Elevation Ft.-m.s.l.	100-Year Peak Discharge c.f.s.	500-Year Flood Elevation Ft.-m.s.l.	500-Year Peak Discharge c.f.s.
Upstream Limit of Study	85	275	5747.5	5749.4	80	5750.3	230	5750.7	330	5751.7	660
	86	135	5736.5	5738.8		5740.0		5740.5		5741.8	
	87	25	5732.5	5733.4		5734.7		5735.2		5736.4	
Mouth	5A	0	5729.5	5733.0	80	5734.1	230	5734.9	330	5736.4	660

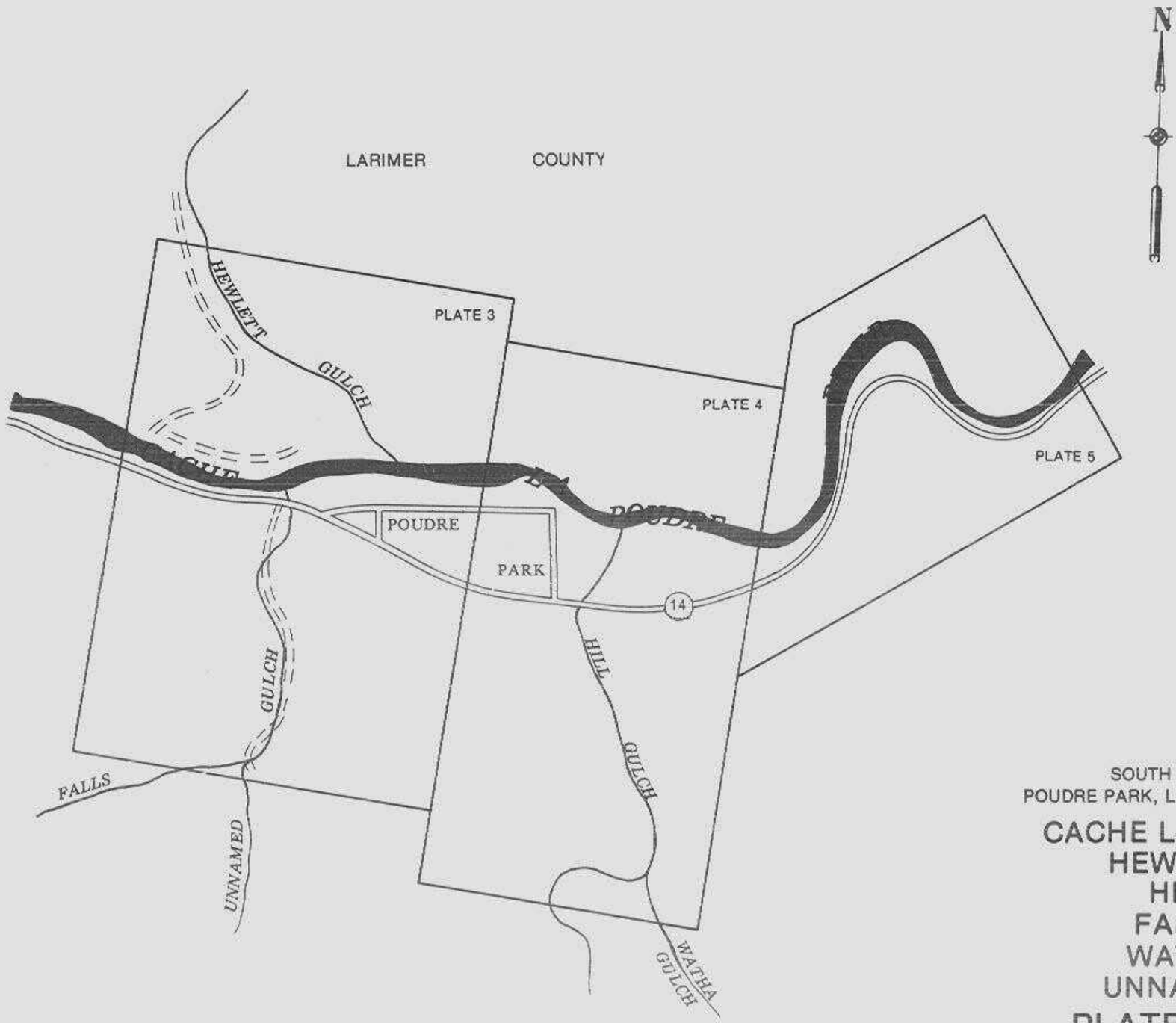
Table 11
Flood Plain Reference Data
Unnamed Gulch

Identification	Reference Point Number	Distance From Mouth Ft.	Stream Bed Elevation Ft.-m.s.l.	10-Year		50-Year		100-Year		500-Year	
				Flood Elevation Ft.-m.s.l.	Peak Discharge c.f.s.	Flood Elevation Ft.-m.s.l.	Peak Discharge c.f.s.	Flood Elevation Ft.-m.s.l.	Peak Discharge c.f.s.	Flood Elevation Ft.-m.s.l.	Peak Discharge c.f.s.
Upstream Limit of Study	31	235	5791.8	5793.0	10	5793.6	30	5793.7	40	5794.3	90
	31A	50	5778.0	5778.3		5778.7		5778.9		5779.5	
Mouth	32A	0	5771.1	5773.2	10	5774.3	30	5774.9	40	5775.9	90

BASIN MAP

NO SCALE

PLATE 1



SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

CACHE LA POUDRE RIVER
HEWLETT GULCH
HILL GULCH
FALLS GULCH
WATHA GULCH
UNNAMED GULCH

PLATE INDEX MAP

LEGEND:

100 YEAR FLOOD } 500 YEAR FLOOD

1 Channel and Valley Cross Section

Reference Point

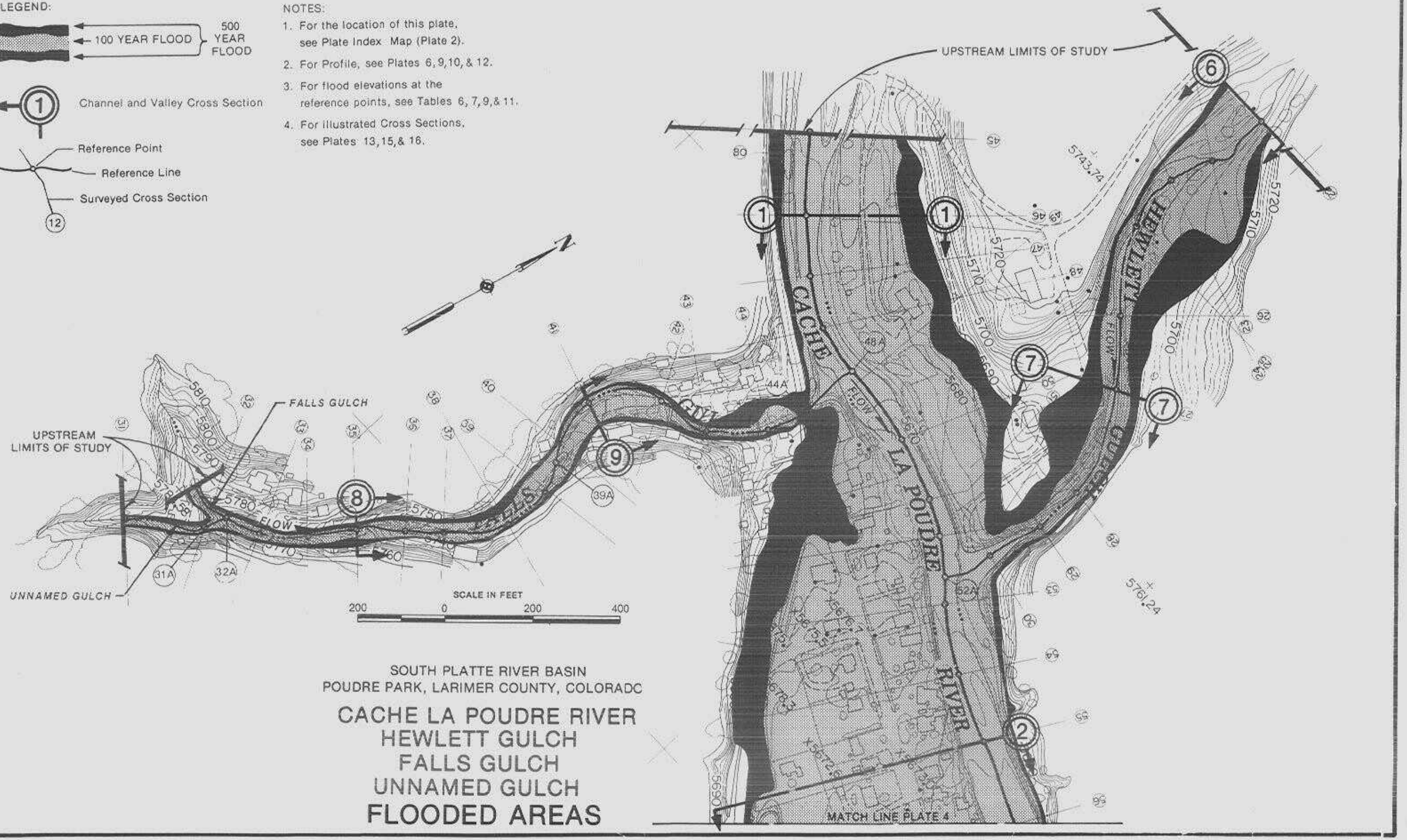
Reference Line

Surveyed Cross Section

12

NOTES:

1. For the location of this plate, see Plate Index Map (Plate 2).
2. For Profile, see Plates 6, 9, 10, & 12.
3. For flood elevations at the reference points, see Tables 6, 7, 9, & 11.
4. For illustrated Cross Sections, see Plates 13, 15, & 16.



SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

CACHE LA POUDRE RIVER
HEWLETT GULCH
FALLS GULCH
UNNAMED GULCH
FLOODED AREAS

LEGEND:

100 YEAR FLOOD / 500 YEAR FLOOD

Channel and Valley Cross Section

Reference Point

Reference Line

Surveyed Cross Section

NOTES:

1. For the location of this plate, see Plate Index Map (Plate 2)
2. For Profile, see Plates 6,7,11,& 12.
3. For flood elevations at the reference points, see Tables 6,8,& 10.
4. For illustrated Cross Sections, see Plates 14 & 17.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

CACHE LA POUDRE RIVER
HILL GULCH
WATHA GULCH
FLOODED AREAS

PLATE 4

LEGEND:

100 YEAR FLOOD } 500 YEAR FLOOD

Channel and Valley Cross Section

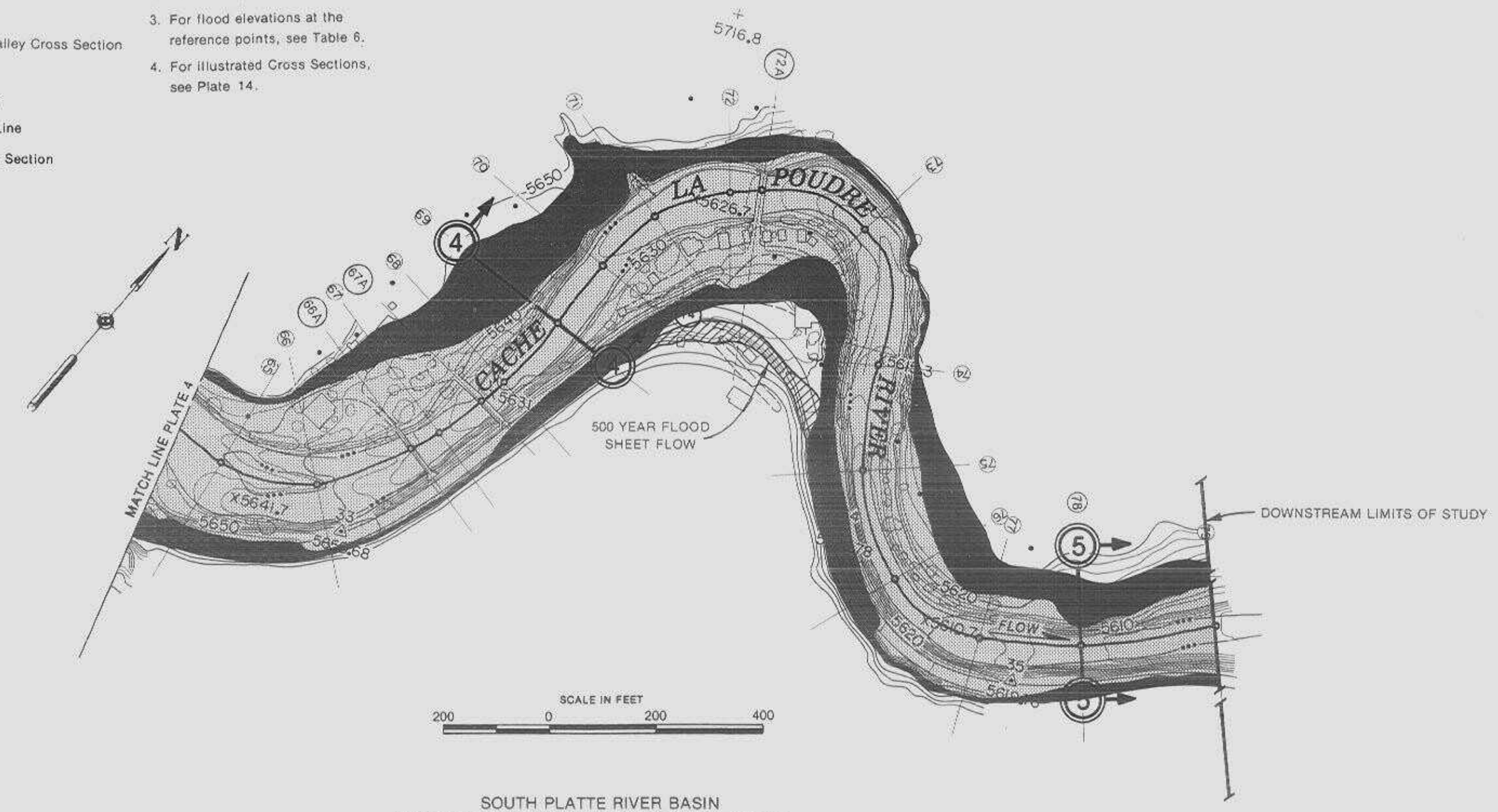
Reference Point

Reference Line

Surveyed Cross Section

NOTES:

1. For the location of this plate, see Plate Index Map (Plate 2).
2. For Profile, see Plates 7 & 8.
3. For flood elevations at the reference points, see Table 6.
4. For illustrated Cross Sections, see Plate 14.

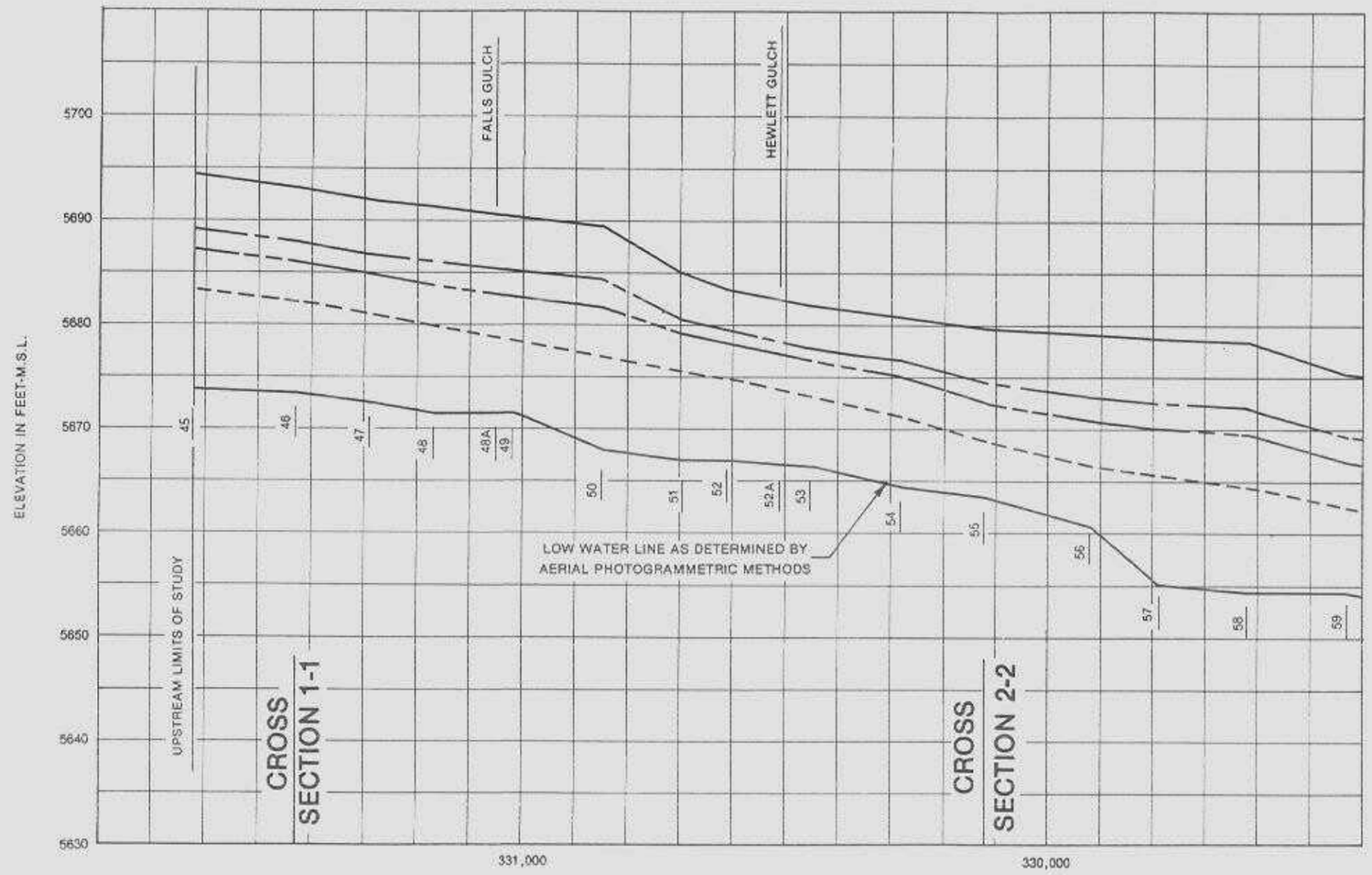


SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

CACHE LA POUDRE RIVER

FLOODED AREAS

PLATE 5



LEGEND:

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- Deck
- Bridge
- Top of Waterway
- 2 — Reference Point

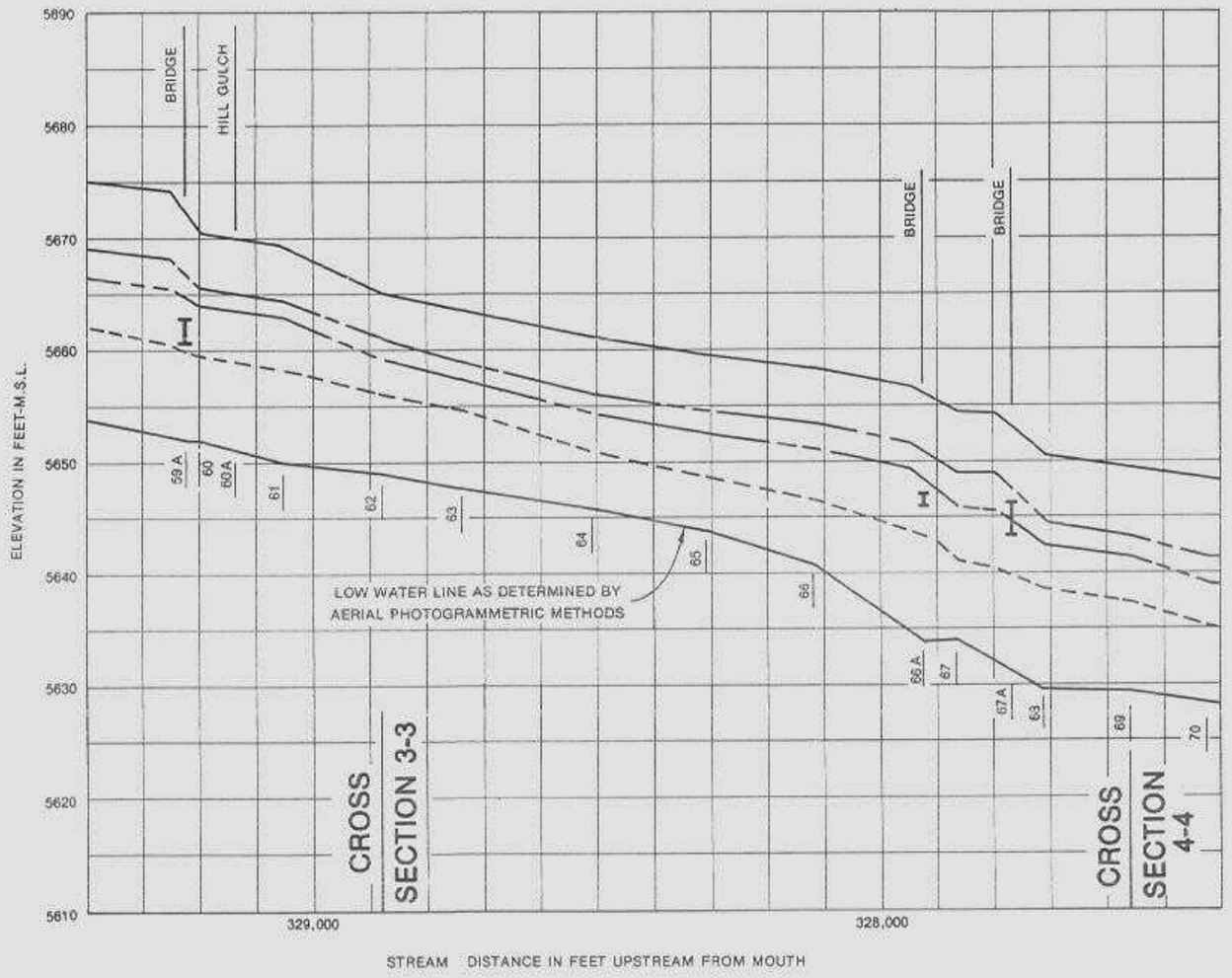
NOTES:

1. For location of Cross Sections see Plates 3 & 4.
2. For illustrated Cross Sections see Plate 13.
3. For flood elevations at the reference points, see Table 6.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

CACHE LA POUDRE RIVER PROFILE

PLATE 6



LEGEND:

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- Deck
- Bridge
- Top of Waterway
- 2 — Reference Point

NOTES:

1. For location of Cross Sections see Plates 4 & 5.
2. For illustrated Cross Sections see Plate 14.
3. For flood elevations at the reference points, see Table 6.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

CACHE LA POUDRE RIVER
PROFILE

LEGEND:

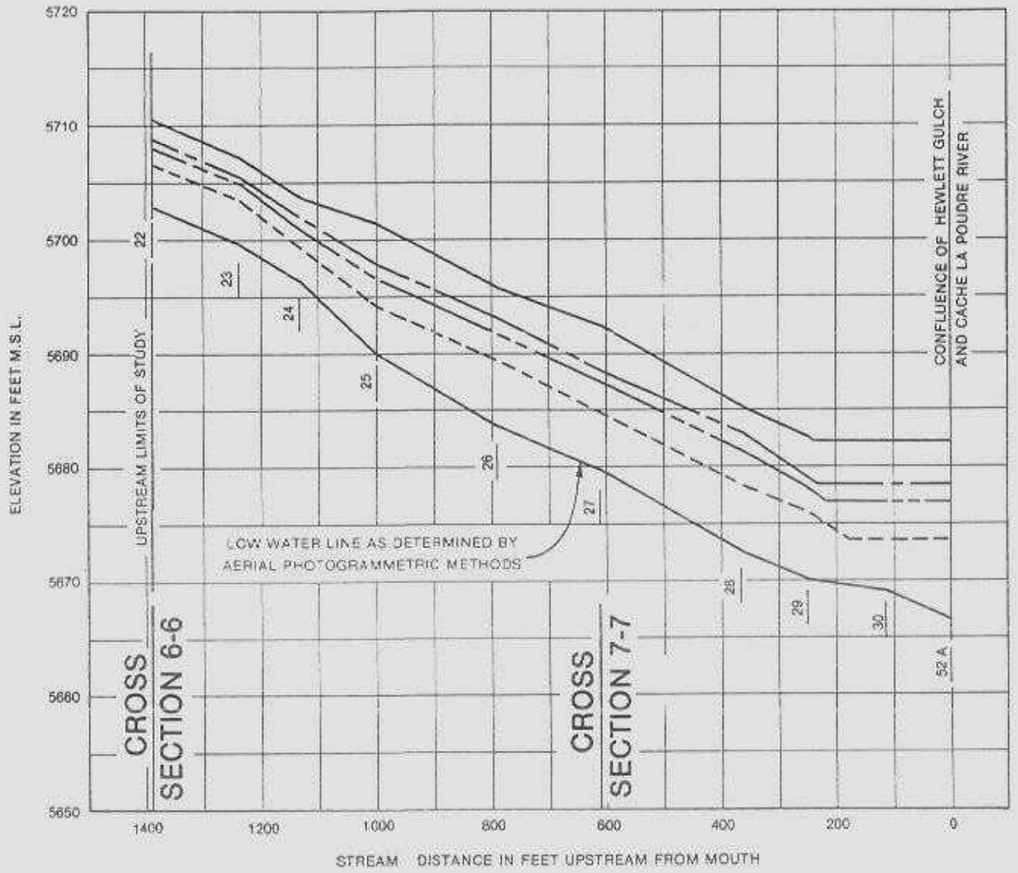
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- Deck
- Bridge
- Top of Waterway
- 2 — Reference Point

NOTES:

1. For location of Cross Sections see Plate 5.
2. For illustrated Cross Sections see Plate 14.
3. For flood elevations at the reference points, see Table 6.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

CACHE LA POUDRE RIVER
PROFILE



LEGEND:

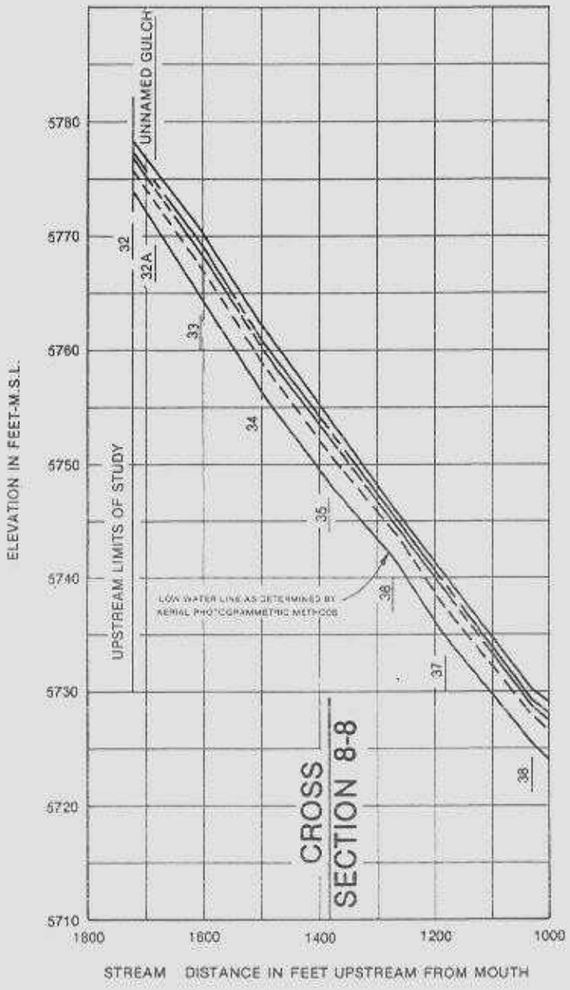
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- Deck
- Bridge
- Top of Waterway
- 2 — Reference Point

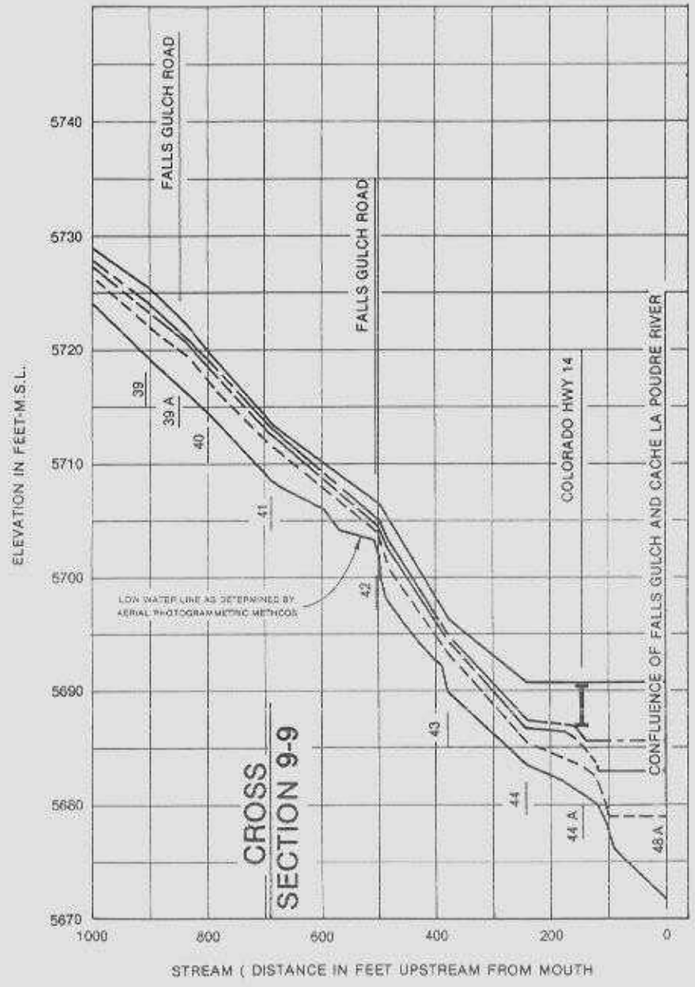
NOTES:

1. For location of Cross Sections see Plate 3.
2. For illustrated Cross Sections see Plate 15.
3. For flood elevations at the reference points, see Table 7.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

HEWLETT GULCH
PROFILE





LEGEND:

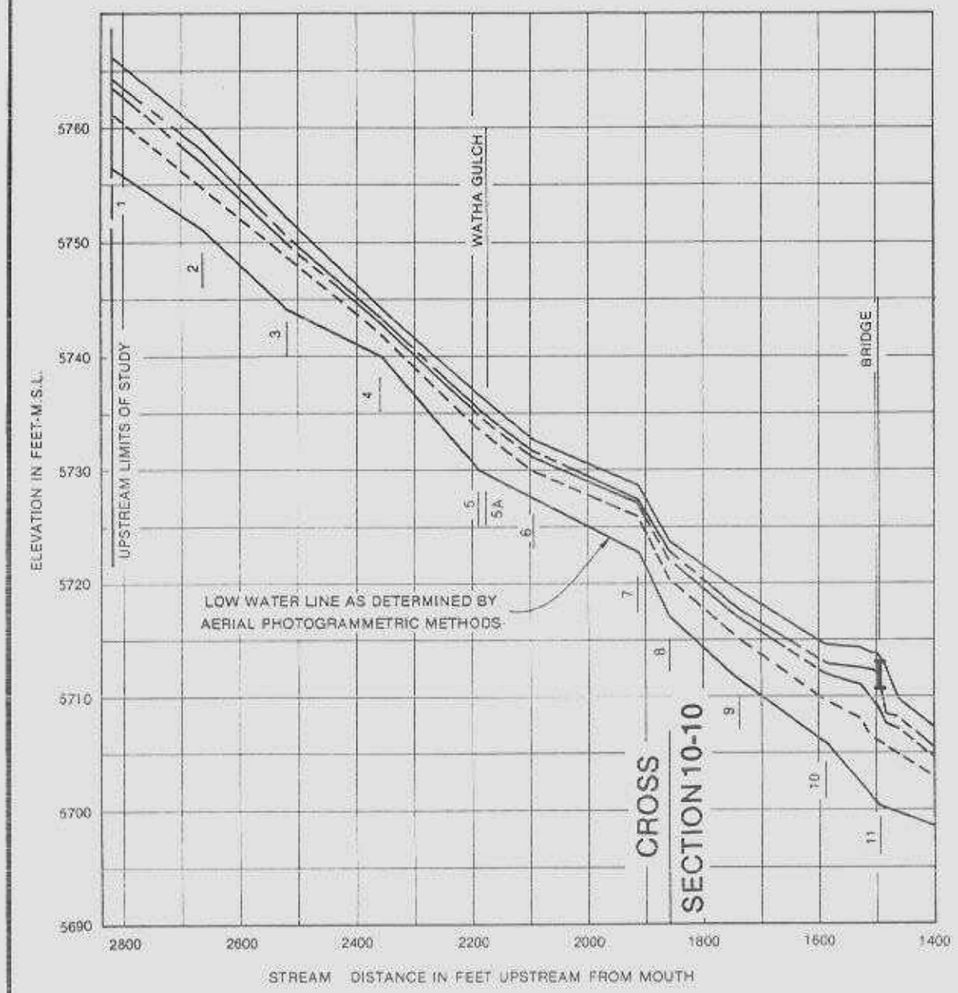
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- Deck
- Bridge
- Top of Waterway
- 2 — Reference Point

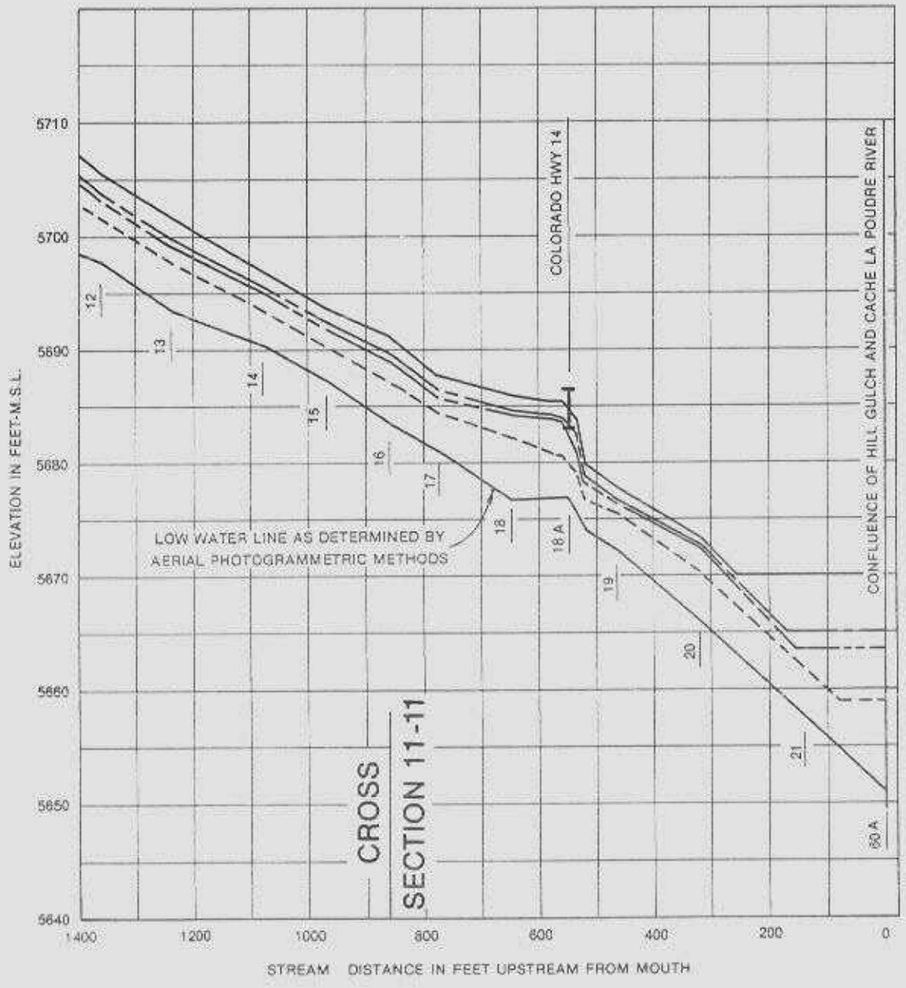
NOTES:

1. For location of Cross Sections see Plate 3.
2. For Illustrated Cross Sections see Plate 16.
3. For flood elevations at the reference points, see Table 9.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

FALLS GULCH
PROFILE





LEGEND:

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- Deck
- Bridge
- Top of Waterway
- 2 — Reference Point

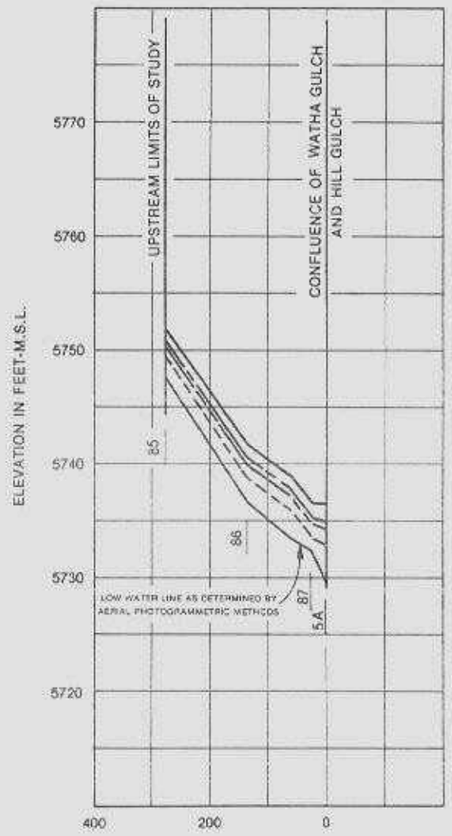
NOTES:

1. For location of Cross Sections see Plate 4.
2. For illustrated Cross Sections see Plate 17.
3. For flood elevations at the reference points, see Table 8.

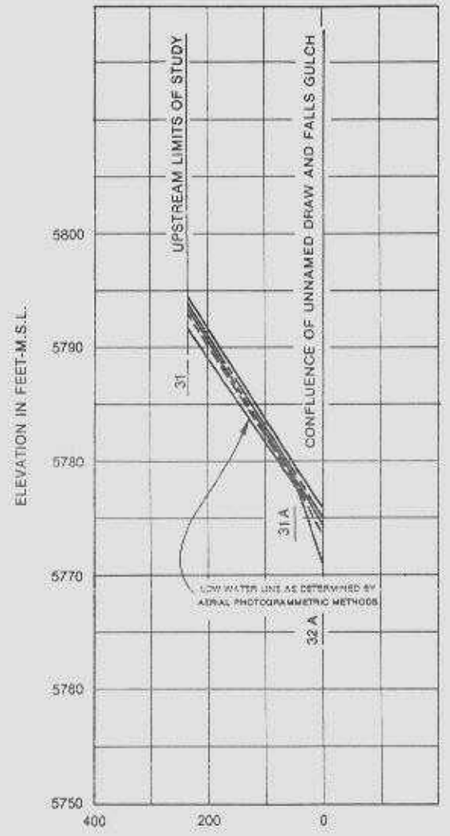
SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

HILL GULCH
PROFILE

WATHA GULCH



UNNAMED GULCH



LEGEND:

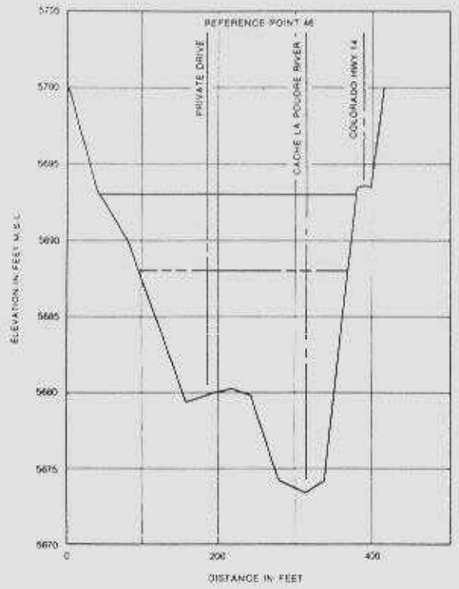
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- Deck
- Bridge
- Top of Waterway
- N — Reference Point

NOTES:

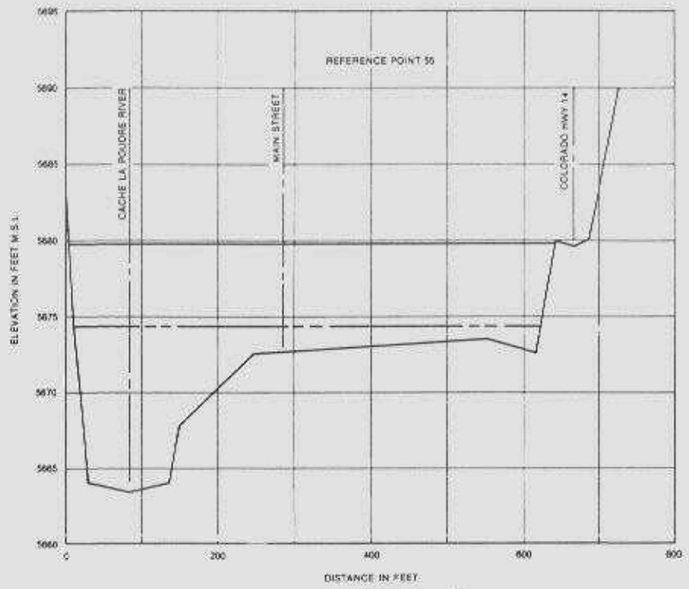
1. For location of Cross Sections see Plates 3 & 4.
2. For flood elevations at the reference points, see Tables 10&11.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

WATHA GULCH
UNNAMED GULCH
PROFILE



CROSS SECTION 1-1



CROSS SECTION 2-2

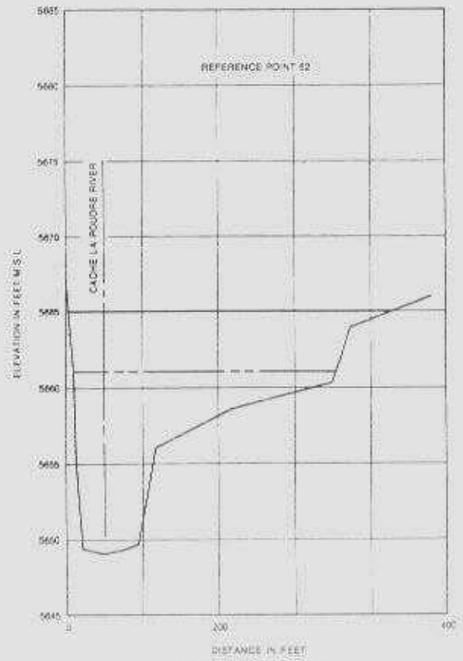
LEGEND:

500 YEAR FLOOD
100 YEAR FLOOD

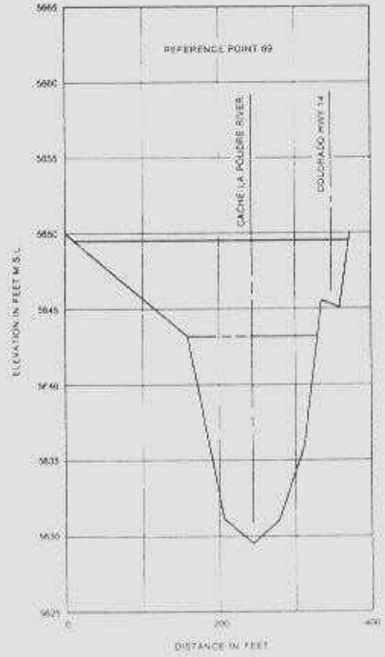
NOTES:
1. For location of Cross Sections see Plate 3.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

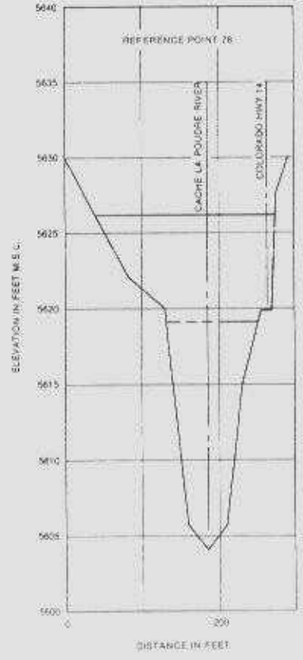
CACHE LA POUDRE RIVER
CROSS SECTION



CROSS SECTION 3-3



CROSS SECTION 4-4



CROSS SECTION 5-5

LEGEND:

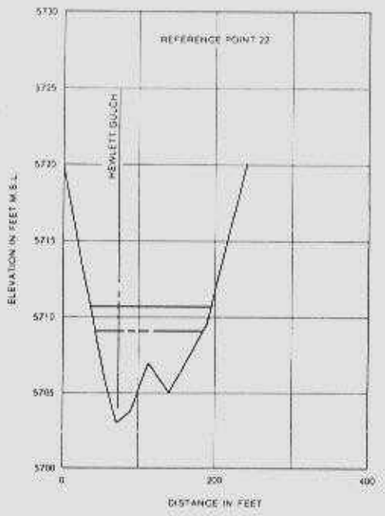
500 YEAR FLOOD
100 YEAR FLOOD

NOTES:
1. For location of Cross Sections see Plates 4 & 5.

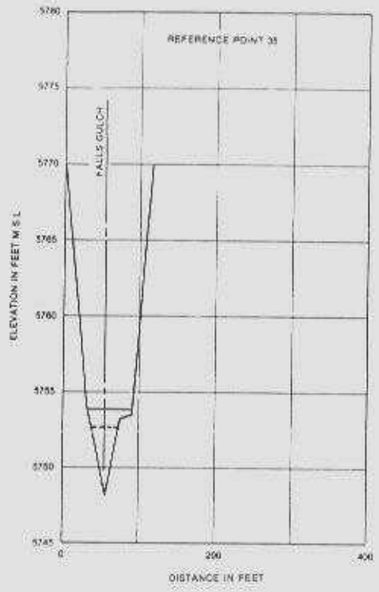
SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

CACHE LA POUDRE RIVER
CROSS SECTION

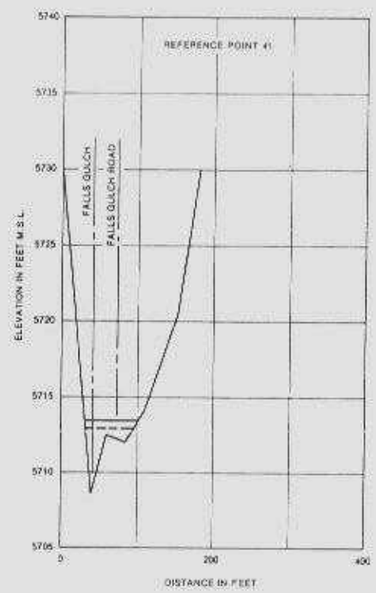
PLATE 13



CROSS SECTION 6-6



CROSS SECTION 8-8



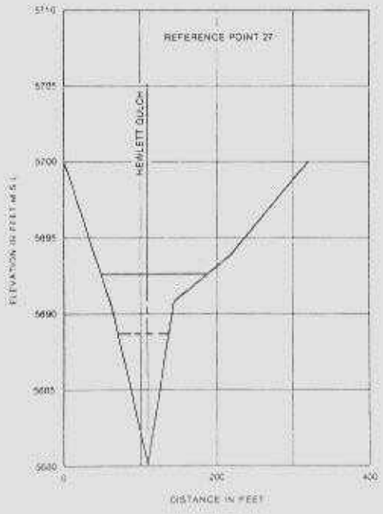
CROSS SECTION 9-9

LEGEND
500 YEAR FLOOD
100 YEAR FLOOD

NOTES
1. For location of Cross Sections see Plate 3.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

FALLS GULCH
CROSS SECTION



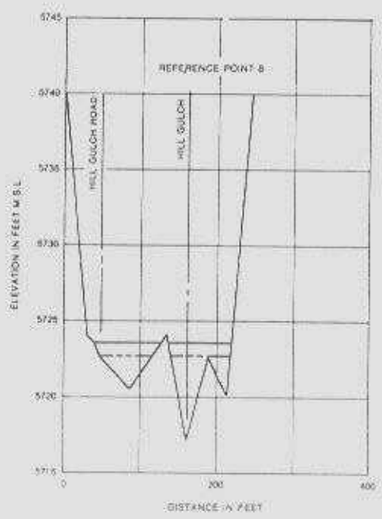
CROSS SECTION 7-7

LEGEND
500 YEAR FLOOD
100 YEAR FLOOD

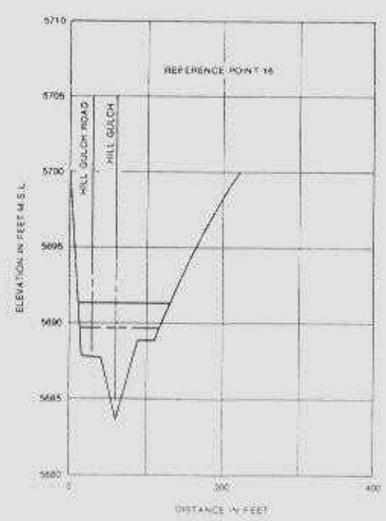
NOTES
1. For location of Cross Sections see Plate 3.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

HEWLETT GULCH
CROSS SECTION



CROSS SECTION 10-10



CROSS SECTION 11-11

LEGEND
500 YEAR FLOOD
100 YEAR FLOOD

NOTES
1. For location of Cross Sections see Plate 4.

SOUTH PLATTE RIVER BASIN
POUDRE PARK, LARIMER COUNTY, COLORADO

HILL GULCH
CROSS SECTION