FLOOD INSURANCE STUDY

VOLUME 1 OF 3

ADAMS COUNTY, COLORADO

AND INCORPORATED AREAS

Community Name	Community Number
ADAMS COUNTY UNINCORPORATED AREAS	080001
BENNETT, TOWN OF	080003
BRIGHTON, CITY OF	080004
COMMERCE CITY, CITY OF	080006
FEDERAL HEIGHTS, CITY OF	080240
NORTHGLENN, CITY OF	080257
THORNTON, CITY OF	080007

Notice

This preliminary FIS report includes only revised Flood Profiles and Floodway Data tables. See "Notice to Flood Insurance Study Users" page for additional details.

REVISED PRELIMINARY
December 12, 2014

Federal Emergency Management Agency
FLOOD INSURANCE STUDY NUMBER
080001V001B

NOTICE TO

FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS report components.

Initial FIS Report Effective Date: December 15, 1989

Revised FIS Report Dates: August 16, 1995
March 5, 2007
XXXXX XX, 2015

This preliminary FIS report does not include unrevised Floodway Data tables or unrevised Flood Profiles. These Floodway Data tables and Flood Profiles will appear in the final FIS report.

TABLE OF CONTENTS – VOLUME I

Page

1.0 INTRODUCTION 1

1.1 Purpose of Study 1
1.2 Authority and Acknowledgements 1
1.3 Coordination 3

2.0 AREA STUDIED 4

2.1 Scope of Study 4
2.2 Community Description 8
2.3 Principal Flood Problems 10
2.4 Flood Protection Measures 13

3.0 ENGINEERING METHODS 14

3.1 Hydrologic Analyses 15
3.2 Hydraulic Analyses 22
3.3 Vertical Datum 26

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS 28

4.1 Floodplain Boundaries 28
4.2 Floodways 29

5.0 INSURANCE APPLICATIONS 66

6.0 FLOOD INSURANCE RATE MAP 67

7.0 OTHER STUDIES 69

8.0 LOCATION OF DATA 70

9.0 BIBLIOGRAPHY AND REFERENCES 70

10.0 REVISION DESCRIPTIONS 78

10.1 First Revision 78
10.2 Second Revision 79
10.3 Third Revision 80
10.4 Fourth Revision 85

TABLE OF CONTENTS – VOLUME I (Cont'd)

FIGURES

Page

Figure 1 - Floodway Schematic 30

TABLES

Table 1 – Flooding Sources Studied by Detailed Methods.....5
Table 2 – Flooding Sources Studied by Approximate Methods 7
Table 3 – Summary of Discharges.....18
Table 4 – Floodway Data.....31
Table 5 – Community Map History.....68

VOLUME II

EXHIBITS

Exhibit 1 – Flood Profiles

Basin 4100	Panels 001P-005P
Bear Gulch	Panels 006P-013P
Bear Gulch Tributary D	Panels 014P-015P
Bear Gulch Tributary E	Panel 016P
Bear Gulch Tributary G	Panels 017P-019P
Big Dry Creek	Panels 020P-026P
Box Elder Creek	Panels 027P-044P
Brantner Gulch	Panel 045P
Clear Creek	Panels 046P-052P
Clear Creek North Overflow	Panels 053P-054P
Comanche Creek	Panels 055P-073P
Comanche Creek Overflow	Panels 074P-076P
Coyote Run	Panels 077P-079P
First Creek	Panels 080P-081P
First Creek E-470 Split	Panels 082P
First Creek Tributary T	Panels 083P-084P
Grange Hall Creek	Panels 085P-097P
Grange Hall Creek 109th Ave. Overflow	Panel 098P
Grange Hall Creek Tributary	Panels 099-103P

TABLE OF CONTENTS (Cont'd)

VOLUME III

EXHIBITS

Exhibit 1 – Flood Profiles

Hayesmount Creek	Panels 104P-119P
Hayesmount Creek East Tributary	Panels 120P-125P
Hayesmount Creek West Tributary	Panels 126P-133P
Little Comanche Creek	Panel 134P
Little Dry Creek	Panels 135P-138P
Niver Creek	Panels 139P-143P
Niver Creek Tributary M	Panels 144P-146P
Northfield Creek (Downstream of UPRR)	Panels 147P-149P
Northfield Creek (Upstream of UPRR)	Panels 150P-151P
North Fork Grange Hall Creek	Panels 152P-155P
Sand Creek	Panels 156P-157P
Second Creek	Panels 158P-160P
South Fork Grange Hall Creek	Panels 161P-167P
South Platte River	Panels 168P-188P
Tanglewood Creek	Panel 189P
Tigers Reservoir Split Flow	Panel 190P
Wolf Creek	Panels 191P-196P

Exhibit 2 (Published Separately)
– Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
ADAMS COUNTY, COLORADO AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and supersedes the FIS reports and/or Flood Insurance Rate Maps (FIRMs) in the geographic area of Adams County, Colorado including: the Cities of Brighton, Commerce City, Federal Heights, Northglenn, and Thornton; the Town of Bennett; and unincorporated areas of Adams County (hereinafter referred to collectively as Adams County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by Adams County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the Cities of Arvada and Westminster are geographically located in Adams and Jefferson Counties and that the City of Aurora and the Town of Bennett are geographically located in Adams and Arapahoe Counties. The Cities of Arvada and Westminster are included in their entirety in the Jefferson County FIS, and the City of Aurora is included in its entirety in the Arapahoe County FIS. The Town of Bennett is included in its entirety in this FIS.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence, and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgements

The sources of authority for this FIS report are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for the original studies for the unincorporated areas of Adams County and the Cities of Brighton, Commerce City, Northglenn, and Thornton were performed by Gingery Associates, Inc., for the Federal Insurance Administration (FIA), under Contract No. H-3716. The work for these studies was completed in August 1976, November 1976, March 1977, and April 1979, respectively.

For the unincorporated areas of Adams County, approximate flood boundaries for standing bodies of water greater than 25 acres were arbitrarily determined in February 1977, by Dames & Moore, under contract to the FIA.

The Adams County study was revised on December 15, 1989, to modify the Special Flood Hazard Areas (SFHAs) along a reach of the South Platte River, Approximately 2.3 miles long. The revised reach extended form a point approximately 760 feet downstream of the westbound lane of Interstate Highway 270, upstream to the south boundary of Adams County, at the City and County of Denver corporate limits (Franklin Street).

The basis for the 1989 revision is revised hydraulic analyses conducted by Wright Water Engineers, Inc., Denver, Colorado, under contract to the Urban Drainage and Flood Control District (UDFCD). The revised hydraulic analyses utilized the U.S. Army Corps of Engineers (USACE) HEC-2 hydraulic computer model and were conducted in August 1986 and September 1987. The hydraulic reanalyses modified the 100- and 500-year flood boundaries and increased the base (100-year) flood elevations (BFEs) along portions of the South Platte River by up to 5 feet.

Additional hydraulic analyses within the City of Commerce City were completed by Simons, Li and Associates, Inc., in June 1987, to reflect channel modifications for a reach of Sand Creek between Vasquez and Brighton Boulevards. Revised hydraulic analyses were also conducted for a reach of the South Platte River, from approximately 760 feet downstream of westbound Interstate Highway 270 to the upstream corporate limits of Commerce City at Franklin Street, by Wright Water Engineers, Inc., under contract to the UDFCD.

The hydraulic reanalyses for the reach of the South Platte River through Commerce City were completed in September 1987.

The hydrologic and hydraulic analyses for detailed areas in the City of Federal Heights were performed by Greiner Engineering Sciences, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-83-C-1173. This study was completed in July 1984. Additional approximate analyses in this study were performed by the Colorado Water Conservation Board (CWCB) (Reference 1).

The August 16, 1995 revision (Reference 2) combined the Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) reports of the County and incorporated cities into the countywide format. Under the countywide format, FIRM panels have been produced using a single layout format for the entire area within the county instead of separate layout formats for each community.

For this countywide FIS report, revised hydrologic and hydraulic analyses were taken from reports prepared for the UDFCD on Box Elder Creek, Clear Creek, and the South Platte River. These analyses were completed by Wright Water Engineers,

Inc., Ayers Associates, Inc., and Camp Dresser & McKee, Inc., respectively, under contract with the UDFCD. Revised hydraulic analyses along Box Elder Creek were completed from the Weld County Boundary at 168th Avenue to approximately 9,730 feet upstream of East 72nd Avenue. Revised hydraulic analyses along Clear Creek were completed from the confluence with the South Platte River to the Jefferson County boundary at Sheridan Boulevard. Revised hydraulic analyses along the South Platte River were completed from the Weld County boundary at 168th Avenue to the City and County of Denver boundary at Franklin Street.

Base Map information shown on this FIRM was provided by the Adams County GIS Department and the Cities of Commerce City and Federal Heights GIS Departments. Additional input was provided by the Cities of Brighton, Northglenn, and Thornton in addition to the Town of Bennett. These data are current as of 2004.

The coordinate system used for the production of the digital FIRM is Universe Transverse Mercator referenced to North American Datum of 1983 and the GRS 80 spheriod, Western Hemisphere.

1.3 Coordination

The coordination for the original Adams County Flood Insurance Study was completed in multi-agency conferences managed by FEMA.

Officials of the Adams County Planning Commission, the Colorado Highway Department, the CWCB, the UDFCD, the USGS, the U.S. Soil Conservation Service (SCS), the U.S. Bureau of Reclamation, the USACE, Omaha District, the Denver Post newspaper, and local residents were contacted throughout this study; available maps, flood data, and historical information were obtained.

On October 23 and November 28, 1975, public hearings were held by the Adams County Planning Commission to review the floodplains within the county. A final community coordination meeting was held with the public and representatives from Gingery Associates, the Adams County Planning Commission, the UDFCD, and the FIA on August 26, 1976, to present and discuss the flood information prepared for the county. There were no problems raised at this meeting.

The initial coordination meetings for the Cities of Brighton, Commerce City, and Northglenn were held at a meeting attended by personnel of Gingery Associates, Inc., the FIA, and officials of the communities on February 12, 1976. The base map and topographic mapping used for this study were furnished by the communities, and the streams requiring detailed study were identified. On October 26, 1976, a final community coordination meeting was held with the City of Brighton. On March 7, 1977, a final community coordination meeting was held with the City of Commerce City, where results of the FIS were presented to city officials and

residents. On July 25, 1977, a final community coordination meeting was held with the City of Northglenn.

The draft report of the detailed study for the City of Federal Heights was discussed at a coordination meeting attended by representatives of the City of Federal Heights, FEMA, and the study contractor on April 25, 1983. Approximate analyses for Federal Heights were approved by FEMA for use in the FIS. The final community coordination meeting was held on April 2, 1985, and was attended by representatives of FEMA, the study contractor, and the City.

Community based map selection and identification of streams requiring detail study in the City of Thornton were accomplished in an initial coordination meeting attended by personnel of the study contractor, the FIA, and the UDFCD, as well as officials of the City of Thornton on March 11, 1976. A final community coordination meeting was held with the City of Thornton on July 25, 1977.

For the March 5, 2007 countywide FIS report, an initial coordination meeting was attended by FEMA; Adams County; the Cities of Commerce City, Northglenn, and Thornton; the Town of Bennett; the CWCB; the UDFCD; Michael Baker, Jr., the National Service Provider; and ICON Engineering, Inc., the study contractor, on October 5, 2004. At this meeting, the communities were notified that their FIS report and FIRM would be converted to a Digital FIRM (DFIRM) format. Additionally, streams to be added as detailed studies and approximate studies were selected, and base mapping and topographic mapping was provided by Adams County along with the City of Commerce City. Additional correspondence was held with the Cities of Brighton and Federal Heights. Base mapping and topographic mapping was also provided by Federal Heights.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Adams County, Colorado including the incorporated towns and cities, except communities which fall within more than one county as described in Section 1.1.

All or portions of the flooding sources listed in Table 1 were studied by detailed methods in previous Flood Insurance Studies (FISs) covering Adams County and Incorporated Areas (References 2 through 5 and 7 through 11).

TABLE 1 – FLOODING SOURCES STUDIED BY DETAILED METHODS

Stream
Basin 4100
Big Dry Creek
Brantner Gulch
Clear Creek
Comanche Creek
First Creek
First Creek E-470 Split
First Creek Tributary T
Grange Hall Creek
Grange Hall Creek Tributary
Little Dry Creek
Niver Creek
Niver Creek Tributary M
North Fork Grange Hall Creek
Northfield Creek
Sand Creek
Second Creek
South Fork Grange Hall Creek
South Platte River
Tanglewood Creek

For this countywide FIS, the following streams were either restudied or newly studied by detailed methods:

Stream	Limits of Revised or New Detailed Study
Bear Gulch	From the confluence with Box Elder Creek to City of Aurora boundary located 10,040 feet upstream of 48th Avenue.
Bear Gulch Tributary D	From the Adams County boundary, located approximately 440 feet upstream of the confluence with Bear Gulch, to approximately 3,800 feet upstream of the confluence with Bear Gulch.
Bear Gulch Tributary E	From the confluence with Bear Gulch to approximately 1,200 feet upstream of the confluence with Bear Gulch.
Bear Gulch Tributary G	From the confluence with Bear Gulch to approximately 5,600 feet upstream of the confluence with Bear Gulch.

Stream (Cont'd)	Limits of Revised or New Detailed Study
Box Elder Creek	From the Weld County boundary at 168th Avenue to approximately 9,730 feet upstream of East 72nd Avenue.
Clear Creek	From the confluence with the South Platte River to the Jefferson County boundary at Sheridan Boulevard.
Comanche Creek	From the Weld County boundary at 168th Avenue to the Arapahoe County boundary at Highway 36.
Hayesmount Creek	From the Weld County boundary at 168th Avenue to the City and County of Denver boundary located 2,720 feet upstream of East 120th Avenue.
Hayesmount Creek East Tributary	From the confluence with Hayesmount Creek to approximately 13,000 feet upstream of the confluence with Hayesmount Creek.
Hayesmount Creek West Tributary	From the confluence with Hayesmount Creek to approximately 11,710 feet upstream of 128th Avenue.
Little Comanche Creek	From the confluence with Comanche Creek to the Arapahoe County boundary at Highway 36.
South Platte River	From the Weld County boundary at 168th Avenue to the City and County of Denver boundary at Franklin Street.
Wolf Creek	From the confluence with Comanche Creek to the Arapahoe County boundary at Highway 36.

All or portions of the streams in Table 2 were studied by approximate methods in previous Flood Insurance Studies for Adams County and Incorporated Areas (References 2 through 5 and 7 through 11).

TABLE 2 – FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Stream

Bijou Creek
Portions of Brantner Gulch
DFA 0054-1
East Bijou Creek
First Creek
Portions of Grange Hall Creek
Grange Hall Tributary Southeast
Hidden Lake
Kiowa Creek
Lost Creek
McKay Lake Drainageway
Morris Creek
Muddy Creek
Mustang Creek
Niver Canal
Portions of Niver Creek
Niver Creek Tributary L
Portions of Niver Creek Tributary M
Portions of Northfield Creek
Preble Creek
Quail Creek
Sack Creek
Second Creek
Shay Ditch
Short Run
South Fork Preble Creek
South Sack Creek
Third Creek
Todd Creek
Tributary 2 to Todd Creek
Tributary 4 to Todd Creek
Tributary to Brantner Gulch
Tributary II to Brantner Gulch
Tributary VII to Brantner Gulch
Wadley North
Wadley South
West Bijou Creek

For this countywide FIRM, the existing FIRM was converted to a Digital FIRM (DFIRM). Detailed analyses were taken from the effective FIRM or from existing UDFCD reports. The existing detailed analysis was originally used in developed areas or areas with a high development potential. The existing approximate

analysis was originally used to study those areas for which detailed information was not available or those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA, CWCB, UDFCD, Adams County, and the incorporated communities within Adams County.

2.2 Community Description

Adams County is located in central Colorado, just north and east of Denver, the state capital. The general shape of the physical boundary resembles a rectangle that is 18 miles wide by 72 miles long. Extending from near the foothills of the Rocky Mountains easterly to the open plains of the state, Adams County covers approximately 1,180 square miles. It is bordered on the north by Morgan and Weld Counties, on the east by Washington County, on the south by Arapahoe and Denver Counties, and on the west by Jefferson and Broomfield Counties.

The City of Brighton is located in north central Adams County. Brighton has grown from a stagecoach stop in the early 1860s, to a rapidly growing city at the fringe of the Denver metropolitan area. The City originally based its economy on agriculture, which expanded rapidly after development of an extensive irrigation system in the early 1900s. Today, agriculture still plays a significant role in the economy; however, the pressures of urban growth are currently changing this emphasis. The community has grown steadily over the years since its incorporation, but its pace has dramatically changed since 1970 by an increase in population of over 200 percent, from 8,309 in 1970 to an estimated 25,122 in 2004 (Reference 6).

Commerce City is situated in the southwestern corner of Adams County. The City is 15 miles south of Brighton, the county seat. The City and County of Denver, the state capital, and the U.S. Army's Rocky Mountain Arsenal border the City on the east. The City and County of Denver also forms the southern boundary, and Adams County adjoins Commerce City to the north and west.

Commerce City was first incorporated in December of 1952 and named Commerce Town. The population increased 750 percent from 1,200 in 1952 to 9,000 in 1960, at which time Commerce Town became Commerce City. As of 1980, the City had a population of approximately 16,230. In 2004, the population was estimated to be approximately 29,670 (Reference 6).

The City of Federal Heights is located in west-central Adams County, approximately 5 miles north of the City and County of Denver corporate limits and 1.5 miles east of the Jefferson County line. Federal Heights is bordered by the Cities of Thornton on the east, Westminster on the west, and Northglenn on the northeast. Federal Heights experienced much growth between 1970, when the population was 1,502, and 1980, when the population figure was 7,846 (Reference). In 2004, the population was estimated to be approximately 12,096 (Reference 6).

The City of Northglenn is located in west-central Adams County, Colorado, and is approximately 6 miles north of Denver. The City is bounded by the City of Thornton to the east, north, and south, and the City of Westminster to the west. Development in the City of Northglenn is mainly residential, except for small areas of retail and service related industry. In 2004, the population of the City of Northglenn was approximately 37,061 (Reference 6).

The City of Thornton is located in the west-central part of Adams County, approximately 6 miles north of Denver. The City is bounded by the City of Northglenn to the northwest, by the Town of Federal Heights to the west, and by the unincorporated areas of Adams County to the east and south. Thornton first became incorporated in 1956. In terms of population, the growth of Thornton has been sporadic. The population from 1960 to 1970 only increased by 1,988; yet, from 1970 to the 1976 estimate, the City had increased by 18,084 to the 1976 estimated population of 31,425 (References 15 and 16). In 2004, the population for the City of Thornton was approximately 102,261 (Reference 6).

The Town of Bennett was incorporated in 1930 with a population of 211. Bennett is located just north of Interstate Highway 70 in Eastern Adams County, 25 miles from the City and County of Denver (Reference 13). The Town is bounded by unincorporated Adams County to the north, west and east, and by unincorporated Arapahoe County to the south. In 2003, the population was estimated to be 2,271 (Reference 81).

The climate varies slightly from the Denver metropolitan area to the prairie lands in the east; but, generally, it is characteristic of the temperate high plains. The mean annual temperature is 50 degrees Fahrenheit (°F) with a mean annual snowfall of 60.1 inches and rainfall of 15.5 inches. The mean growing season is 166 days (Reference 82).

Adams County was fragmented from Arapahoe County in November 1902, by the state legislature. During the early days of national expansion and exploration, Adams County was visited by many trappers and explorers, including General Zebulon Pike in 1806 and General John C. Fremont in 1853. When gold was discovered along Clear Creek and elsewhere in the Rocky Mountain foothills, extensive growth was experienced, and permanent settlement began. In 1858, Colonel Jack Henderson established the first permanent settlement, called Henderson's Island, near what is now the Town of Henderson. The Kansas Pacific and the Denver Pacific Railroads, in 1871, built lines through what is now the City of Brighton, bringing the impetus for increased cattle production and agricultural development along the South Platte River Valley.

Today, Adams County is one of the richest irrigated and dry land farming areas in the country. The southwestern corner of the county has undergone heavy industrial and residential development. In recent years the county has experienced a rapid

growth in population resulting from Denver metropolitan area urbanization and subsequent suburban development. The U.S. Census Bureau lists county population figures for 1970, 1974, and 1980 (projected) as 185,789; 225,600; and 263,827, respectively. In 2004, the population was approximately 398,165 (Reference 6).

The South Platte River flows through the county in shifting channels in a broad, shallow bed with low, flat overbanks. It is a continuous flowing stream, whereas all the tributaries except Clear Creek are intermittent flowing streams. The South Platte River and its tributaries have two major flooding characteristics, snow melt and summer weather fronts or thunderstorms. The tributary basins are narrow, hydraulically steep, and composed of highly erodible clay and loam soils. In the undeveloped portions of the basins, the ground cover is predominantly short grass called buffalo grass and willow and cottonwood trees.

Development has occurred up to the channels on the tributaries. The floodplain on the South Platte River in the past was mostly agricultural, but today commercial, industrial, and residential development has encroached into the floodplain.

2.3 Principal Flood Problems

Major recorded floods have occurred on the South Platte River and its tributaries since 1844 in the Adams County area. During that period, eleven devastating floods have occurred on the South Platte River, three on Clear Creek, and three each on Box Elder, Comanche, and Bijou Creeks.

In 1844 and 1864, reports stated that "bottomlands near Denver were covered with water bluff to bluff" (Reference 20). By 1876, encroachment into the floodplain had developed to such an extent that on May 23, 1876, the Rocky Mountain News reported that, "[The South Platte River] was higher to be sure…several feet higher perhaps in 1864… but it was not able to work such destruction at that time as now. There was not so much town here in 1864, as now, nor as many bridges" (Reference 17).

The most significant floods of recent times on the South Platte River occurred in 1912, 1921, 1933, 1935, 1942, 1965, and 1973. The discharges for these floods were 13,000 cubic feet per second (cfs), 8,790 cfs, 22,000 cfs, 12,320 cfs, 10,200 cfs, 40,300 cfs, and 33,000 cfs, respectively, at the Denver gage. Clear Creek experienced flood discharges of 8,700 cfs, 5,390 cfs, and 5,250 cfs in 1888, 1933, and 1956, respectively recorded at the Golden gage. Citizens interviewed in Watkins, Strasburg, Byers, and Deer Trail recalled severe damage and lives lost in 1905, 1933, 1935, and 1965 floods on Box Elder Creek, Comanche Creek, West Bijou Creek, and East Bijou Creek.

Almost all record floods on the South Platte River have been generated near the river's headwaters on the slopes of Monument Divide, a high ridge located between Castle Rock and Colorado Springs, extending from the Rocky Mountains down to

the plains near Limon, Colorado. Past floods have resulted from snowmelt and intensive rain storms over the mountain tributaries, rainstorms over the eastern tributaries, and combinations of these conditions.

In 1965, a unique combination of orthographic effects and meteorological conditions in the South Platte River Basin caused the worst flooding in the region's recorded history. Severe thunderstorms commenced over the headwaters of Plum Creek and Cherry Creek on June 16, and moved northeasterly down the creeks following and augmenting peak flows. More than 14 inches of rain were recorded at Palmer Lake in 4 hours. Overnight, westerly winds moved the storm front to a position over the Kiowa and Bijou Creek Basins where it met with thunderstorms forming just south of Agate. Here, 5.25 inches fell in 45 minutes. The net results of these conditions were six people drowned, two other deaths caused by flood-related activities, and estimated damages of $500 million in the South Platte River Basin, of which $300 million occurred in the Denver area.

Major floods affecting the City of Commerce City area have occurred on the South Platte River and Sand Creek since 1844. During that period, 11 floods occurred on the South Platte and 10 notable floods occurred on Sand Creek.

The major cause of floods on the South Platte River and Sand Creek are cloudbursts of intensive rainstorms which normally occur during the period of May through August. The South Platte River flooding is also aggravated by snowmelt runoff on the tributary streams during the rainstorm period.

There are two areas of shallow sheet flow within Commerce City, both of which are along Sand Creek. The upstream area is on the southwest side of Sand Creek between the corporate limits and east 49th Drive. In this area, the ground slopes away from the channel, and the flow cannot return. The second area is under interstate Highway 270, at the two railroad underpasses to the northwest. During a large flood event, the flood waters will pass under the interstate bridge and flow along the low ground away from the channel, returning to the South Platte River north of East 64th Avenue.

Severe flood runoff is transported through the City of Federal Heights as both overland shallow flow and as channel flow. The steep slope of the land, the close proximity of mobile homes to Tributary M of Niver Creek, and the presence of several culverts that are inadequate to convey major storm runoff combine to create flooding problems.

The runoff upstream of Zuni Street is overland flow that can overtop roads and inundate mobile home trailers. The average slope is 3.5 percent; therefore, excessive velocities occur.

Downstream of Zuni Street, the runoff flows through the culverts and well-defined channels; however, there is some overland flow. Roads and mobile homes can be inundated. The average slope in this area is 1.5 percent.

On June 13, 1984, severe rainfall runoff cause considerable damage to mobile home trailers, to private property, and to the channel. One fatality was directly attributed to the shallow overland flow. Unofficial estimates gave the peak discharge from the storm as 800 to 1,000 cfs at Pecos Street; this was the result of a 4.2-inch rainfall, which fell within 3 hours. The discharge is comparable to a 100-year event. The extent of inundation shown in this Flood Insurance Study is approximately the same as that which occurred during the June 1984 event.

Similar flooding problems as those outlined above could occur in the floodplains of Niver Creek and Tributary L of Niver Creek in the event of further development.

Much of Niver Creek's floodplain is in park land. However, downstream near Zuni Street, mobile homes are located in the approximate floodplain. At the upstream end of Niver Creek, streets and homes in low areas were affected during the June 1984 flood event.

The main cause of floods in the City of Northglenn is cloudbursts, which usually occur during the months of May through August.

Documentation of historical floods and damage estimates on the streams within corporate limits of Northglenn is sparse. The streams have caused overland inundation of homes and streets, but no discharge or damage estimates have been recorded.

The main cause of floods in the City of Thornton is cloudbursts which normally occur during the period of May through August.

Documentation of historical floods and damage estimates on the streams within the corporate limits of Thornton is sparse. The streams have caused overland inundation of homes and streets, but no recorded discharges or damage estimates exist.

There are also areas in southeast Thornton which experience shallow sheetflow flooding from the South Platte River.

Major flooding in the Town of Bennett has been well documented back to 1875, where a major flood along Kiowa Creek overflowed the channel banks and destroyed the Town. After that flooding event, the Town was moved to its present day location.

2.4 Flood Protection Measures

The first tangible contribution to flood control affecting Adams County streams was made in 1890, when the Castlewood Dam, primarily intended for irrigation storage, was completed by the Denver Land and Water Company on Cherry Creek, 35 miles upstream from Denver in Douglas County. The dam, with a storage capacity of approximately 13,000 acre-feet, was mistakenly regarded by many as protection against deluges. In August 1933, the dam burst under pressure of water from severe thunderstorms in the upper Cherry Creek Basin. Flood control measures on Cherry Creek began in 1936 with the completion of the $800,000, 55-feet high Kenwood Dam, 5 miles from southeast Denver, near Sullivan, Colorado. Despite security, Kenwood Dam was not regarded as the complete answer to flood control on Cherry Creek; therefore, in 1950, the Cherry Creek Dam was constructed just upstream of Kenwood at a cost of $20 million. The dam, 14,300 feet wide and 140 feet high, now serves Denver as a park and water recreation area as well as a retarding barrier for floods much larger than the event of June 1965.

With a history of major flooding on the South Platte River through 1933, and with the culmination of planning, design, and construction of Cherry Creek Reservoir in 1950, the Denver metropolitan area saw an additional need for a flood control structure on the South Platte River just downstream of the Plum Creek confluence. During the 1950s, planning and design for the Chatfield Dam flood control reservoir was completed. At that time, however, funding was not available to initiate and complete construction. Three hundred million dollars in property damages suffered in 1965 flooding changed the minds of many and led to project funding and construction. In 1973, final closure of the dam was made, and the facility became capable of storing tributary floodwaters. Chatfield Dam is located approximately 0.5 mile above the City of Littleton, Colorado, in Douglas and Jefferson Counties.

In addition to the Cherry Creek, Mt. Carbon, and Chatfield Dams, one additional flood control measure, the Bear Creek Dam, was envisioned in the early 1940s. Authorization for funding and design of the dam did not occur until 1968. Construction on the $68 million earthfill structure was started in July 1974, and was completed in 1982. The dam is over 170 feet high and approximately 7,000 feed wide, having a storage capacity of 75,000 acre-feet.

Throughout the study segment of the South Platte River in Adams County, levees have also been constructed as a flood protection measure. However, past evidence shows these levees to be ineffective against 100-year frequency floods. On large segments of the South Platte River, historical records indicate that the 1965 and 1973 floods were of the 100-year magnitude or greater.

A major drainageway planning report has been completed for Big Dry Creek (Reference 20). This report designates various structural measures and

nonstructural actions which would be appropriate to alleviate potential flood damage along this stream.

In the City of Federal Heights, a detention pond was constructed near Elm Court, at the upstream limit of study for Tributary M of Niver Creek. This pond is designated to attenuate the peak 100-year flow from 226 cfs to 200 cfs.

Nonstructural measures of flood protection are also used to aid in the prevention of future flood damage. These are the result of regulations of the UDFCD, located in Denver, Colorado.

The City of Thornton has completed improvements on Niver Creek to reduce or eliminate future flood damages. The effects of these improvements were considered in the study for Thornton.

The City has also made improvements on the Northfield Creek (Hoffman Drainageway) which have alleviated potential flood damages. These improvements were considered in the study.

The other flood protection measures which are presently in existence are local floodplain management measures. The City of Thornton passed the Storm Drainage and Flood Control Ordinance, Ordinance No. 693, on July 28, 1975, which requires any new development to provide detention storage so that the runoff rate before and after anticipated development will not increase flows.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rate floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods of greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 1-percent-annual-chance flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

South Platte River

Data used in the hydrologic analyses include synthetically developed storm runoff records, and information from the USACE study of the South Platte River (Reference 21). These discharge profiles were keyed to the 100-year flood values computed from the Denver and Henderson gaging records, which were adjusted for the regulating effects of Chatfield, Mt. Carbon, and Cherry Creek Reservoirs. The Denver gage operated from May to October 1889, from June to October 1890, and from July 1895 to the present. The Henderson gage has been in operation since 1926. Values above and below these gaging stations were based on the USACE analysis using their hydrologic computer model for the South Platte River (Reference 21). This study was revised to use the final versions of the discharge profiles, covering the segment downstream of the Henderson Gaging Station (Reference 22).

Little Dry Creek, Big Dry Creek, Hidden Lake, Niver Creek, and Northfield Creek

For Little Dry Creek, Big Dry Creek, Hidden Lake, Niver Creek, and Northfield Creek, synthetically developed hydrographs were computed to determine potential flood magnitudes. Rainfall data used in the development of these hydrographs were taken from the Denver Regional Council of Governments' Urban Storm Drainage Criteria Manual (USDCM) (Reference 23). Synthetic hydrograph procedures used in the study include the Colorado Urban Hydrograph Procedure (CUHP), outlined in the USDCM and the USACE HEC-1 Computer Hydrograph Package (Reference 24). Discharges were also computed on Big Dry Creek, prior to the start of this study, by the Denver area UDFCD (Reference 20). The discharges computed for this stream varied only slightly from those computed in the previous study. Therefore, the original information was used.

Tributary M of Niver Creek

Peak discharges for the 10- and 100-year floods for Tributary M of Niver creek were developed using the CUHP (Reference 31) and USACE HEC-1 (Reference 24) computer models. The watershed was subdivided into six subbasins. For each subbasin, peak flow hydrographs were developed using the CUHP model. Parameters for the hydrograph development include rainfall data (Reference 32), soil type, land use, basin area, and basin geometry (References 33, 34, and 35). The outflow hydrographs derived for the subbasins were then used for the HEC-1 model, which was channel and storage routing capability using the Modified Puls methods.

The result from the HEC-1 analysis shows that the upper pond near Elm Circle attenuates the 100-year peak flow from 226 cfs to 200 cfs. The flows vary from 200 cfs upstream to 1,086 cfs at Pecos Street.

Grange Hall Creek, South Fork Grange Hall Creek, Grange Hall Creek Tributary, Basin 4100, and Brantner Gulch

Synthetically developed hydrographs were computed to determine the 10-, 50-, and 100-year discharges. Rainfall data used in the development of these hydrographs were taken from the USDCM (Reference 36). The 500-year discharge on all stream was obtained from a straight-line plot on log probability paper.

The 10-, 50-, and 100-year values for Grange Hall Creek, South Fork Grange Hall Creek, and Grange Hall Creek Tributary were provided by the UDFCD (Reference 37).

The 10-, 50-, and 100-year values for Basin 4100 and Brantner Gulch were computed by the study contractor.

Tanglewood Creek

Since no stream gage data were available for Tanglewood Creek, a rainfall runoff analysis was conducted on the watershed to determine the flood discharges. This was accomplished by using the UDFCD CUHP rainfall-runoff computer program to develop the storm hydrographs (Reference 31) and the USACE HEC-1 flood hydrograph package computer program for the stream and reservoir routings (Reference 38). For this analysis, basin characteristics which define the size, shape and runoff characteristics of the watershed as well as rainfall amounts based on the selected recurrence intervals (obtained from the National Oceanic and Atmospheric Administration atlas of precipitation – Reference 32) are used to compute flood hydrographs for various design points in the basin. All stream and reservoir routings were accomplished using the Modified Puls Method.

Since there was a lack of 500-year precipitation data, the 500-year frequency storm runoff values at each design point were calculated. The logarithmic values of the 10-, 50-, and 100-year peak discharges were fit to a regression line by method of least squares. The 500-year discharges were analytically extrapolated from the regression line based upon a log-normal probability relationship.

Box Elder Creek, Hayesmount Creek, Hayesmount Creek East Tributary, Hayesmount Creek West Tributary, Bear Gulch, and Bear Gulch Tributaries D, E, and G.

Peak discharges for Box Elder Creek, Hayesmount Creek, Hayesmount Creek East Tributary, Hayesmount Creek West Tributary, Bear Gulch, and Bear Gulch

Tributaries D, E, and G were developed using the CUHPF/PC (Reference 83) and UDSWM 95 (Reference 84) computer programs. The watershed was subdivided into four major sub-watersheds encompassing smaller subbasins. Parameters for each subbasin include rainfall data, soil type, land use, basin area, and basin geometry (Reference 23). The outflow hydrographs derived for the CUHP models were then routed downstream in UDSWM, which utilizes the kinematic wave rating approach.

Other Areas

For the larger drainage basins east of the Denver metropolitan area, discharge versus drainage area relationships were developed. These determinations were based on the standard log-Pearson Type III statistical analysis (Reference 25) of flood discharge records from several streams adjacent to the study area as well as in eastern Colorado. The discharge records for the steams considered covered periods from 10 to 74 years. The data used in making these determinations were recorded at 18 gaging stations by the USGS (References 27 and 29) and compared to the USACE Standard Project Flood data when available (References 12, 21, and 30).

Peak discharge-drainage area relationships for streams studied by detailed methods are shown in Table 3.

TABLE 3 – SUMMARY OF DISCHARGES

Flooding Source/Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10- Percent	2- Percent	1- Percent	0.2-Percent
Basin 4100					
At Mouth	1.80	240	340	380	500
Bear Gulch					
At Confluence with Box Elder Creek	19.80	1,400	4,400	6,300	10,300
Bear Gulch Tributary D					
At Confluence with Bear Gulch	1.20	265	690	938	1,391
Bear Gulch Tributary E					
At Confluence with Bear Gulch	0.80	230	538	699	1,009
Bear Gulch Tributary G					
At Confluence with Bear Gulch	2.40	507	1,298	1,754	2,587
Big Dry Creek					
At Union Pacific Railroad	84.20	7,700	12,200	14,000	18,800
At Interstate 25	56.84	3,830	7,010	8,839	16,729
At 120th Avenue	43.54	2,480	6,290	8,109	15,849
Upstream of Confluence of Airport Creek	32.89	2,060	5,260	6,929	13,370
At 0.8 mile downstream of Denver-Boulder Turnpike	21.46	1,720	4,220	5,669	10,659
At 0.2 mile upstream of confluence with Walnut Creek	19.66	1,050	2,270	3,040	5,120
At Stanley Lake Outflow	16.75	145	320	675	1,099
At Stanley Lake Inflow	16.75	1,710	3,930	4,930	9,040
Box Elder Creek					
At 168th Avenue	243.00	1,100	7,400	11,500	20,600
Downstream of Confluence with Bear Gulch	227.00	1,100	6,900	10,400	17,600
Upstream of the Confluence with Bear Gulch	207.00	1,000	5,600	8,900	15,300
At Interstate 70	202.00	1,246	5,741	9,140	15,618
Brantner Gulch					
At the City of Thornton Corporate Limits	1.3	480	720	830	1,100
Clear Creek					
At South Platte Confluence	--[1]	--[1]	--[1]	23,100	--[1]
At Interstate 76	--[1]	--[1]	--[1]	10,079[2]	--[1]
At Sheridan Boulevard Bridge	--[1]	--[1]	--[1]	20,590	--[1]
Clear Creek North Overflow					
At Lowell Street	--[1]	--[1]	--[1]	11,609	--[1]

[1]Data not available
[2]Reflects Flow spills to Clear Creek North Overflow

TABLE 3 - SUMMARY OF DISCHARGES CONTINUED

Flooding Source/Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10- Percent	2- Percent	1- Percent	0.2-Percent
Comanche Creek					
At Adams/Arapahoe County Limit (U.S. Highway 36)	84.00	1,00	2,400[3]	4,112[3]	6,618[3]
At 26th Avenue	94.40	1,103	4,773	9,640[4]	12,704
Above Confluence with Wolf Creek	124.00	--[1]	--[1]	12,049	--[1]
Below Confluence with WolfCreek	224.3	--[1]	--[1]	23,187	--[1]
At Weld County Line	245.2	--[1]	--[1]	48,864[5]	--[1]
Comanche Creek Rt. Bank Overflow					
At U.S. Highway 36	--[1]	--[6]	--[6]	1,500	--[7]
Just downstream of 56th Avenue	--[1]	--[7]	--[7]	4,996	--[7]
Coyote Run					
At Interstate 70/U.S. Highway 36	17	1,680	4,960	6,940	10,800
First Creek					
Approximately 1,090 feet downstream of 48th Avenue	15.30	1,315	3,729	5493	7808
At Piccadilly Road	15.10	1,311	3,725	5491	7790
Approximately 1,920 feet upstream of Piccadilly Road	14.70	1,295	3,660	5380	7623
At 26th Avenue	14.10	1,292	3,610	5304	7491
First Creek Tributary T					
Approximately 480 feet upstream of Piccadilly Road	8.10	535	1770	2532	4027
Approximately 1,560 feet downstream of E-470	5.30	354	1342	1697	3247
Approximately 1,420 feet upstream of E-470	5.30	938	2882	4186	5808
Grange Hall Creek					
At Riverdale Road	7.10	1,700	2,067	2,214	2,600
At Colorado Boulevard	6.30	1,616	1,798	1,943	2,000

[1]Data not available
[3]Just upstream of Highway 36, discharge from Comanche Creek & Little Comanche Creek converge and then split at Highway 36
[4]Upstream of 26th Avenue, 275 cfs overtops into Comanche Creek Overflow
[5]Includes discharge from Kiowa Creek
[6]10-percent and 2-percent contained in channel of Little Comanche Creek and Comanche Creek
[7]Not computed for overflow

TABLE 3 - SUMMARY OF DISCHARGES CONTINUED

Flooding Source/Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10- Percent	2- Percent	1- Percent	0.2-Percent
Grange Hall Creek (continued)					
Downstream of Confluence with North Fork Grange Hall Creek	4.70	1,058	1,161	1,204	1,600
Downstream of Confluence with South Fork Grange Hall Creek	3.40	1,166	1,582	1,769	2,200
Downstream of Washington Street Pond	1.30	642	868	976	1,200
At Washington Street Pond	1.30	957	1,195	1,283	1,450
Grange Hall Creek Tributary					
At Mouth	1.20	644	865	959	1,200
At 112th Avenue	1.10	594	799	887	1,140
Downstream Union Pacific Railroad	0.60	466	635	693	900
Hayesmount Creek					
At 168th Avenue	30.40	530	1,600	2,400	3,900
Hayesmount Creek East Tributary					
At Confluence with Hayesmount Creek	5.40	290	863	1,247	2,038
Hayesmount Creek West Tributary					
At Confluence with Hayesmount Creek	6.80	477	1,469	2,109	3,322
Little Comanche Creek					
At U.S. Highway 36	10.40	500	2,400[3]	5,800[3]	6,618[3]
Little Dry Creek					
At Confluence with Clear Creek	13.10	2,200	3,030	3,370	4,200
Downstream of Federal Boulevard	12.20	2,160	2,950	3,270	4,000
Upstream of Federal Boulevard	12.20	2,590	3,430	3,790	4,630
Niver Creek					
At Confluence with South Platte River	6.60	1,850	2,860	3,250	4,350
At York Street	6.30	1,800	2,780	3,150	4,260
At North Washington Street	5.40	1,450	2,160	2,760	3,900
North Fork Grange Hall Creek					
At Confluence with Grange Hall Creek	1.10	490	539	560	600
Northfield Creek					
At Union Pacific Railroad	1.20	680	1,050	1,240	1,850
At East 88th Avenue	0.80	490	580	680	1,000

[3]Just upstream of Highway 36, discharge from Comanche Creek & Little Comanche Creek converge and then split at Highway 36

TABLE 3 - SUMMARY OF DISCHARGES CONTINUED

Flooding Source/Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10- Percent	2- Percent	1- Percent	0.2-Percent
Sand Creek					
At Confluence with South Platte River	196.00	11,000	24,200	30,500	36,200
At Quebec Street	189.00	10,500	23,300	30,000	33,000
Second Creek					
At City of Denver Corporate Limits	7.7	870	2,871	4,122	6,035
At the confluence with Possum Gully	7.0	870	2,871	4,122	6,035
At of the confluence with Gopher Gulch	4.8	616	2,070	2,967	4,324
At East 64th Avenue	3.0	437	1,471	2,106	3,053
At East 56th Avenue	1.8	291	960	1,356	1,933
South Fork Grange Hall Creek					
At Mouth	1.70	639	797	856	1,100
South Platte River[8]					
At Confluence with Todd Creek	5,026.00	11,400	25,500	33,600	59,450
At Confluence with Clear Creek	4,572.00	12,700	27,500	37,600	66,710
Tanglewood Creek					
At Confluence with Big Dry Creek	1.12	340	758	934	1,655
At Upstream Study Limit	0.11	105	217	253	424
Tributary M of Niver Creek					
At Pecos Street	0.92	490	--[1]	1,050	--[1]
At Bryant Drive	0.49	450	--[1]	925	--[1]
At upstream Limit of Study Near Elm Circle	0.18	88	--[1]	200	--[1]
Wolf Creek					
Above Confluence with Comanche Creek	100.30	--[1]	--[1]	12,408	--[1]

[7]Just Assuming Chatfield and Cherry Creek Dam Gates Closed when Flow Gage Reaches 5,000 cfs

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the Flood Insurance Rate Map (FIRM) represent rounded whole-foot elevations and may not exactly reflect the report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

Unless otherwise noted, for all streams studied by detailed methods, the water-surface elevations for floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 39).

Little Dry Creek, Northfield Creek and Niver Creek

Cross section data for Little Dry Creek, Northfield Creek, and Niver Creek were field surveyed and were located at close intervals above and below culverts, bridges, and drop structures in order to compute the effects of backwater. When necessary, USGS topographic maps at a scale of 1:24,000, with a contour interval of 10 feet (Reference 34) were used to supplement the field-surveyed data.

Channel roughness factors (Manning's "n") for these computations were assigned on the basis of field inspection of the floodplain areas and engineering judgment. Bridge geometry and elevation information was obtained from the Colorado State Highway Department, when available, or measured in the field.

Starting water-surface elevations for the tributaries of the South Platte River were taken from previously computed stage-discharge relationships when available (Reference 21). In many cases, control elevations were shifted upstream to bridges or culverts. Where no other information or control structures were available, the starting water-surface elevations were computed by the slope-area method option of the HEC-2 program (Reference 39).

These analyses indicate that flood flow from Little Dry Creek is divided into two flow paths in the area downstream of the Colorado and Southern Railroad crossing. The Little Dry Creek profiles show the individual elevations for both of these separate flow paths.

Flooding from Northfield Creek above Devonshire Boulevard does not necessarily follow the natural stream channel. For this area, flood profiles were developed using hydraulic flow lines, labeled as base line of flow on the maps and profiles.

The reach of Sand Creek between Vasquez and Brighton Boulevards within Commerce City was revised to reflect a hydraulic analysis carried out by Simons, Li and Associates, Inc., based on new topographic information (Reference 41).

Tributary M of Niver Creek

Cross sections for the backwater analyses for Tributary M of Niver Creek were obtained from topographic maps, provided by the City, at a scale of 1:1,200, with a contour interval of 2 feet (Reference 35). All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the stream and floodplain areas. Roughness values for the main channel ranged from 0.02 to 0.04, and overbank roughness values ranged from 0.02 to 0.07.

The starting water-surface elevation was derived from hand computations for the peak flow at Pecos Street. The computation derived rating curves for pressure and weir flow at Pecos Street crossing. The culverts at Holiday Glen and Holiday Circle were included in the HEC-2 models. However, three long culverts that have limited capacity of fully contain the 10- and 100-year peak flows were not included. These culverts extend from the east branch of Holiday Circle to 100 feet downstream of Holiday Vale; from the east branch of Holiday Terrace downstream 200 feet; and from Holiday Parkway downstream 200 feet. The culvert under Holiday Parkway is submerged due to backwater from Pecos Street for the 10- and 100-year floods.

Grange Hall Creek, South Fork Grange Hall Creek, Grange Hall Creek Tributary, Basin 4100, and Brantner Gulch

Cross section data for Grange Hall Creek, South Fork Grange Hall Creek, and Grange Hall Creek Tributary were taken from aerial mapping at a scale of 1:6,000, with a contour interval of 2 feet (Reference 42). The cross section information on Basin 4100 and Brantner Gulch was obtained by field measurements. Field measurements were also taken to obtain elevation data and structural geometry of all bridges and culverts.

Roughness coefficients (Manning's "n") were estimated by field inspection. Values used ranged from 0.025 to 0.040 for the channel and from 0.035 to 0.070 for the overbank.

Starting water-surface elevations were determined for Brantner Gulch by normal depth analysis and for Basin 4100 by inspection of the culvert at the downstream study limit.

The water-surface elevations for Grange Hall Creek and tributaries were computed using a step-backwater model similar to HEC-2, developed by the USACE (Reference 39). The starting water-surface elevations were provided by the UDFCD (Reference 37).

Tanglewood Creek

Cross sections used in the backwater analyses were obtained by aerial photogrammetry (Reference 43). The below water sections of all cross sections were obtained by field measurement. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Roughness factors (Manning's "n") used in the hydraulic computations for the study areas were chosen by engineering judgment and based on field observations of the flooding sources and floodplain areas. Roughness values for the main channels of the streams studied range from 0.020 to 0.065 with floodplain roughness values ranging form 0.020 to 0.100.

Starting water-surface elevations were based on hand calculations at control sections; obtained by the slope area method, or determined for a tributary to a major stream from the major stream at concurrent flows.

Niver Creek, Tributary L of Niver Creek, Tributary M of Niver Creek, and Northfield Creek

In the City of Federal Heights, an approximate floodplain analysis was carried out for Niver Creek and Tributary L of Niver Creek using assumed depths based on a review of the Tributary M profile and available hydrologic information, extensive field reconnaissance, and engineering judgment.

Through the City of Thornton, the approximate 100-year flood elevation of Niver Creek and Tributaries L and M were based on the Phase B report, Water and Drainage at Niver Creek (Reference 44), and supplemental data provided by the City of Thornton. The approximate 100-year flood elevations along Northfield Creek (Hoffman Drainageway) were based on the Interim Drainage Study of Hoffman Way (Reference 45), the Adams County Flood Insurance Study (Reference 2), and additional data provided by the engineering department of the City of Thornton.

Hidden Lake

Approximate 100-year flooding along portions of Hidden Lake Drainageway were taken from the UDFCD study for that drainage system (Reference 46). For the remaining approximate studies, elevations were determined by normal depth calculations using approximate cross sections taken from USGS maps (Reference 34).

South Platte River

Cross-section data for the hydraulic analysis along the South Platte River were obtained from 2-foot contour mapping, provided by Adams County and supplemented with field survey cross-sections obtained by Camp Dresser & McKee, Inc. and the UDFCD (Reference 85). Roughness factors were based on current field information in addition to roughness factors used in previous hydraulic modeling studies for the South Platte River (Reference 86). Water surface elevations for the selected recurrence intervals along the South Platte River were developed using the USACE River Analysis System computer program (Reference 87). Split flow and divided flow were considered in the hydraulic analysis of the South Platte River.

In several reaches of the study area, embankments adjacent to the main channel act as levees. Since the stability of these embankments is unknown, and they are not certified by the USACE, the levees were modeled both as intact and as failing in order to determine the water surface elevations along the main channel at overbank areas accordingly.

Box Elder Creek, Hayesmount Creek, Hayesmount Creek East Tributary, Hayesmount Creek West Tributary, Bear Gulch, and Bear Gulch Tributaries D, E, and G

Cross-sections for Box Elder Creek, Hayesmount Creek, Hayesmount Creek East Tributary, Hayesmount Creek West Tributary, Bear Gulch, and Bear Gulch Tributaries D, E, and G were obtained from digital mapping provided by the UDFCD (Reference 88), at a map scale of 1” = 200-feet and a contour interval of 2-feet. Roughness coefficients were determined through field observation, review of the USACE recommended values, and consultation with UDFCD staff. For Hayesmount Creek, roughness coefficients ranged from 0.035 to 0.06, and the overbank roughness values were generally 0.035 for both the channel and overbanks, except in areas of significant vegetation, where the channel roughness value was increased to 0.04. Water surface elevations for the selected recurrence intervals was developed using the USACE River Analysis System computer program (Reference 87).

Comanche Creek, Little Comanche Creek, and Wolf Creek

Water surface elevations of floods of the selected recurrence intervals were developed using the USACE River Analysis System computer program (Reference 87) for Comanche Creek, Little Comanche Creek, and Wolf Creek.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which floodway was computed

(Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

3.3 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. It is important to note that adjacent communities may be referenced to NGVD29. This may result in differences in base flood elevations across the corporate limits between communities.
As noted above, the elevations shown in the FIS report and on the FIRM for Adams County and Incorporated Areas are referenced to NAVD88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD29 by applying a standard conversion factor.

The conversion from NGVD29 to NAVD88 ranged between 2.60 and 3.06 for this county. Accordingly, due to the range in conversion factors, an average conversion factor was established for the entire county. The elevations shown in the FIS report and on the FIRM were, therefore, converted to NAVD88 using a countywide approach in which an average conversion was established for the county. The conversion factor for NGVD 29 to NAVD 88 of 2.87 feet was used for each flooding source in the community.

The BFEs shown in the FIRM represent whole-foot rounded values. For example, a BFE of 5202.4 will appear as 5202 on the FIRM and 5202.6 will appear as 5203. Therefore, users who wish to convert the elevations in this FIS to NGVD29 should apply the stated conversion factor to elevations shown on the Flood Profiles and supporting data tables in the FIS report, which are shown at a minimum to the nearest 0.1 foot.

For more information on NAVD88, see the publication entitled, *Converting the National Flood Insurance Program to the North American Vertical Datum of 1988* (FEMA Publication FIA-20/June 1992), or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and

Atmospheric Administration, Rockville, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

Qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks catalogued by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)

- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutments)

- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below frost line)
- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line or steel witness post)

To obtain up-to-date elevation information on NGS bench marks shown on the FIRM, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov. Map users should seek verification of non-NGS monument elevations when using these elevations for construction or floodplain management purposes.

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS report and FIRM for this community. Interested individuals may contact FEMA to access this data.

For information on additional control points maintained by Adams County that are not shown on the FIRM, please visit www.co.adams.co.us.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance flood elevations and delineations of the 1- and 0.2-percent-annual-chance floodplain boundaries and 1-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data table and Summary of Stillwater Elevations Table. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:24,000; 1:2,400; 1:6,000; and 1:1,200; with contour intervals of 10 and 2 feet (References 34, 35, 40, 42, 43, 47, and 48).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones AH, AO, AR, and A99); and the 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2).

Within the City of Commerce City, areas of shallow sheet flow outside the aerial photo mapping limits were delineated using a topographic map at a scale of 1:24,000, with a contour interval of 10 feet (Reference 34).

Approximate 100-year floodplain boundaries within the City of Federal Heights were delineated using topographic maps at a scale of 1:1,200, with a contour interval of 2 feet (Reference 49).

Approximate 100-year floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map for the City of Thornton (Reference 50).

Approximate flood boundaries in some portions of the City of Northglenn were taken from the FIA's Flood Hazard Boundary Map (Reference 51); others were taken from USGS Flood Prone Area Maps (Reference 52).

For streams studied by approximate methods in other areas of Adams County, the boundaries of the 100-year flood were delineated using the determined elevations and topographic maps (Reference 34), and were reconciled with USGS Flood Prone Area Maps (Reference 52), and concurrent studies completed on Second and Third Creeks for the UDFCD (Reference 53). The boundary of the 100-year flood for portions of Hidden Lake Drainageway was taken from the UDFCD study for that drainage system (Reference 46).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The City of Brighton, the City of Thornton, and Adams County have ordinances which limit the increase in flood heights to 0.5 foot above the pre-floodway elevation; therefore floodways having no more than a 0.5-foot surcharge have been delineated for these communities.

Floodways were not computed along Tributary M of Niver Creek through the City of Federal Heights because they were not within the scope of this study.

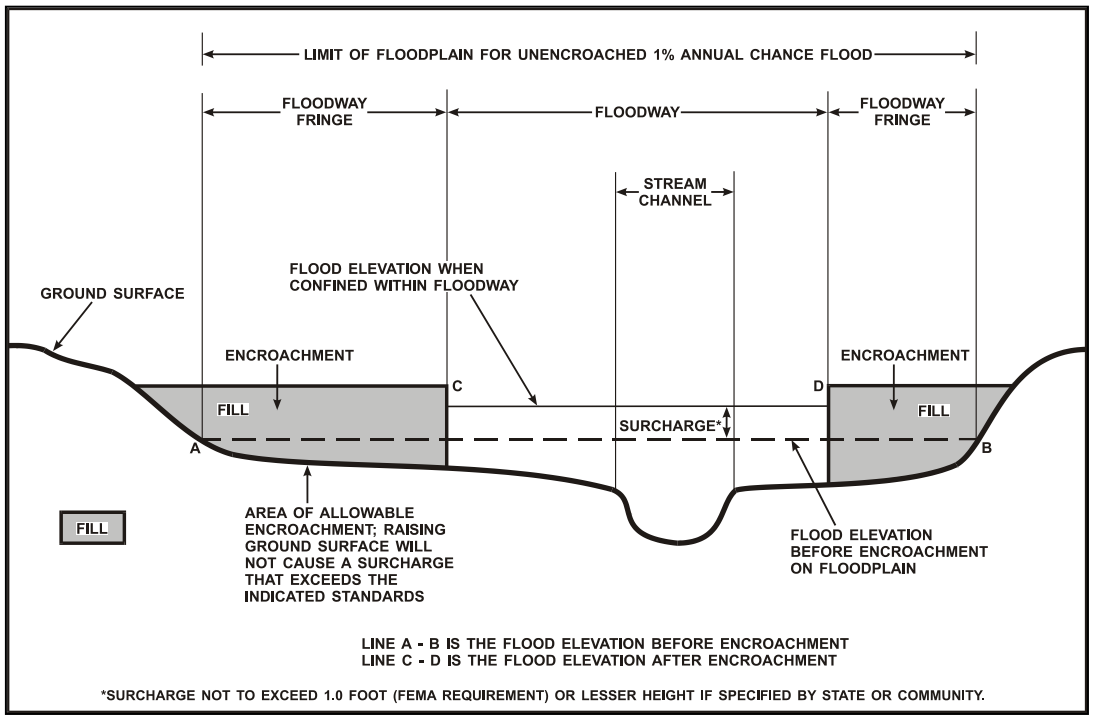
The floodway presented in this FIS report and on the FIRM was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results

of the floodway computations have been tabulated for selected cross sections (Table 6). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

Portions of the floodway for Big Dry Creek extend beyond the corporate limits for Adams County identified in this FIS report.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

Figure 1 - Floodway Schematic



FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
FIRST CREEK								
AN	87,165	352	1,862	2.9	5,450.2	5,450.2	5,450.2	0.0
AO	87,494	225	1,198	4.5	5,450.3	5,450.3	5,450.3	0.0
AP	88,368	268	793	6.8	5,450.8	5,450.8	5,450.8	0.0
AQ	89,587	417	1,031	5.2	5,454.9	5,454.9	5,454.9	0.0
AR	91,150	855	1,636	3.2	5,459.9	5,459.9	5,459.9	0.0
AS	92,804	655	1,221	4.3	5,465.9	5,465.9	5,465.9	0.0
AT	93,956	455	856	6.2	5,475.5	5,475.5	5,475.5	0.0

[1] Stream distance in feet above confluence with South Platte River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

FIRST CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
FIRST CREEK E-470 SPLIT A	1,214	113	173	6.9	5,495.6	5,495.6	5,496.5	0.9

[1] Stream distance in feet above confluence with First Creek

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

FIRST CREEK E-470 SPLIT

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
FIRST CREEK TRIBUTARY T								
I	7,655	150	550	4.1	5,419.4	5,419.4	5,419.5	0.1
O	15,097	250	359	4.7	5,457.3	5,457.3	5,457.6	0.3

[1] Stream distance in feet above confluence with First Creek

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

FIRST CREEK TRIBUTARY T

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SECOND CREEK								
C	72,783	380	1,065	3.6	5,324.4	5,324.4	5,324.8	0.4
D	73,489	185	542	5.8	5,328.9	5,328.9	5,329.1	0.2
E	73,984	156	436	7.3	5,332.2	5,332.2	5,332.6	0.4
F	74,428	278	610	4.7	5,335.3	5,335.3	5,335.7	0.4
G	74,880	224	489	5.1	5,338.7	5,338.7	5,339.0	0.3
Q	83,810	122	286	5.6	5,405.8	5,405.8	5,406.2	0.4
R	84,809	107	198	8.5	5,414.6	5,414.6	5,414.8	0.2

[1] Stream distance in feet above confluence with South Platte River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

SECOND CREEK

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or base flood depths are shown within this zone.

Zone AE

Zone AE is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance risk zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance risk zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot base flood depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Zone AR is the flood insurance risk zone that corresponds to an area of special flood hazard formerly protected from the 1-percent-annual-chance flood event by the flood-control system that was subsequently decertified. Zone AR indicates that the former flood-control system is being restored to provide protection from the 1-percent-annual-chance or greater flood event.

Zone A99

Zone A99 is the flood insurance risk zone that corresponds to areas of the 1-percent-annual-chance floodplain that will be protected by a Federal flood protection system

where construction has reached specified statutory milestones. No BFEs or depths are shown within this zone.

Zone X

Zone X is the flood insurance risk zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or base flood depths are shown within this zone.

Zone X (Future Base Flood)

Zone X (Future Base Flood) is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined based on future-conditions hydrology. No BFEs or base flood depths are shown within this zone.

Zone D

Zone D is the flood insurance risk zone that corresponds to unstudied areas where flood hazards are undetermined but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance risk zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the geographic area of Adams County, excluding those communities which fall within more than one county as described in Section 1.1. Previously separate FIRMs were prepared for each identified floodprone incorporated community and the unincorporated areas of the county. Historical data relating to the maps prepared for each community are presented in Community Map History (Table 5).

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE(S)	FIRM EFFECTIVE DATE(S)	FIRM REVISION DATE(S)
Adams County (Unincorporated Areas)	February 1, 1979	--	February 1, 1979	December 15, 1989 August 16, 1995
Bennett, Town of	August 16, 1995	--	August 16, 1995	--
Brighton, City of	February 22, 1974	--	November 16, 1977	August 16, 1995
Commerce City, City of	June 28, 1974	July 11, 1975	February 15, 1978	October 6, 1978 January 19, 1982 September 30, 1988 December 5, 1989 August 16, 1995
Federal Heights, City of	July 11, 1975	--	April 15, 1986	August 16, 1995
Northglenn, City of	August 22, 1975	--	September 15, 1978	March 31, 1981 August 16, 1995
Thornton, City of	November 1, 1974	October 1, 1976	June 15, 1978	January 19, 1982 August 16, 1995

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

This Flood Insurance Study supercedes all previous FIS reports and FIRMs covering the unincorporated areas of Adams County and the incorporated areas of the Cities of Brighton, Commerce City, Federal Heights, Northglenn, and Thornton, and the Town of Bennett (References 2, 5, 7, 8, 9, and 10, respectively). The Cities of Arvada, Aurora, and Westminster have individual, separately published Flood Insurance Studies (References 3 and 4), which are not superseded by this countywide Flood Insurance Study.

There are past published reports on flooding throughout Adams County. The 1963 USACE Denver Metropolitan Region Flood Plain Information (FPI) report, Volume I, (Reference 21) was adopted by the Colorado Water Conservation Board (CWCB) in 1967 as the official floodplain study for the South Platte River. Following the 1965 flood and other, more recent, flood experiences, as well as the construction of Chatfield Dam, the USACE considers the 1963 FPI for the South Platte River to be outdated. In September of 1977, the UDFCD published a Flood Hazard Area Delineation of the South Platte River.

The UDFCD published an updated Flood Hazard Area Delineation Report of the South Platte River in April of 2005 (Reference 85). This report was incorporated into this FIS.

An FPI report (Reference 30) was prepared in 1968 by the USACE, Omaha District, which included Little Dry Creek in Adams County. Minor discrepancies occurred because the USACE assumed blockage at culverts and bridges during flooding stages, and the present study is based on unobstructed flow.

The UDFCD published a report on Big Dry Creek (Reference 20) in March 1973 and was incorporated into the FIS.

The UDFCD published a Flood Hazard Area Delineation report for the Lower Box Elder Creek Watershed in September 2001 (Reference 89). This report identified flood hazard information on Box Elder Creek, Hayesmount Creek, and Bear Gulch. This report was incorporated into this FIS.

An FPI report was published in January 1966 by the USACE, Omaha District, regarding flooding along Clear Creek (Reference 12). Peak discharges for Clear Creek were recomputed by the UDFCD, and the revised floodplain boundaries were incorporated as an approximate Special Flood Hazard Area. The FIS study report was later revised to reflect updated hydrologic and hydraulic analyses prepared in a 1979 UDFCD report (Reference 59) for Clear Creek. The revised flooding was included as a detailed analysis. Floodway and 500-year floodplain boundaries were not determined.

The UDFCD published a report on Niver Creek in February 1974 (Reference 54). The report contained two 100-year profiles, one reflected existing conditions and a fully developed basin, and the second reflected channel improvements with discharges based on a fully developed basin. Since the publication, some of the channel improvements have been made. Also, this FIS report reflects only present basin development. Therefore, no comparison can be made between profiles.

A report on Northfield Creek, prepared by Hogan & Olhausen for the City of Thornton (Reference 55), was published in March 1976. When compared, the 100-year discharges in this study were found to be different from those determined for the present FIS study. This difference is due to the different methods used to determine discharges. A meeting was held on April 16, 1976, with the UDFCD, the City of Thornton, Hogan & Olhausen, and Gingery Associates in order to resolve the difference in discharges. The main reason for the discrepancy was because Hogan & Olhausen considered residential areas as being 25 percent impervious while the present study used a 50 percent impervious figure, the figure recommended by the UDFCD in their USDCM for use in the Denver metropolitan area. At this meeting, a resolution was never confirmed; therefore, the FIA was contacted for a final ruling. The FIA decided to use the 50 percent impervious figure.

Approximate flood boundaries were adopted from studies on First Creek (Reference 56), Second and Third Creek (Reference 57), and Grange Hall Creek (Reference 58).

Zone A approximate flooding has been added to the FIRM for Brantner Gulch, Tributary VIII Northern to Brantner Gulch, Direct Flow Area 0054-1, McKay Lake Drainageway, Morris Creek, Mustang Run, Preble Creek, South Fork Preble Creek, Quail Creek, Sack Creek, Sack Creek South, Shay Ditch, Short Run, Todd Creek, Tributary 2 to Todd Creek, Tributary 4 to Todd Creek, Wadley Creek North, and Wadley Creek South. The source of the flood data for the identified streams were UDFCD Flood Hazard Area Delineation reports (References 60-64).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA Mitigation Division, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225-0267.

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10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revision made since the original FIS report and FIRM were printed. Future revisions may be made that do not result in the republishing of the FIS report. All users are advised to contact the community repositories of flood hazard data to obtain the most up-to-date flood hazard information.

10.1 First Revision (December 15, 1989)

South Platte River

This study was revised on December 15, 1989, to modify the SFHAs in the unincorporated areas of Adams County along a reach of the South Platte River. The revised reach extended from a point approximately 760 feet downstream of the westbound lane of Interstate 270, upstream to the south boundary of Adams County, at the City and County of Denver corporate limits (Franklin Street).

The basis for this revision is revised hydraulic analyses conducted by Wright Water Engineers, Inc., Denver, Colorado, under contract to the Urban Drainage and Flood Control District. The revised hydraulic analyses utilized the USACE HEC-2 hydraulic computer model and were conducted in August 1986 and September 1987. The hydraulic analyses modified the 100-year and 500-year flood boundaries and increased the base (100-year) flood elevations (BFEs) along portions of the South Platte River by up to 5 feet. A floodway was not analyzed for this reach due to the split flow situations along the South Platte's floodplain.

Third Creek

This study was revised to incorporate a LOMR issued on September 28, 1988 for Third Creek in the unincorporated areas of Adams County. The purpose of the LOMR was to reflect channel modification and lot grading through Third Creek Estates Subdivision downstream of East 132nd Avenue.

Hidden Lakes Drainageway

This study was revised to reflect a LOMR issued on July 21, 1987, for the completion of a flood control project in the vicinity of Hidden Lakes Drainageway, in unincorporated areas of Adams County. Based on data submitted with the LOMR, the 100-year flood boundaries were revised to reflect approximately 0.8-mile of channel modifications along Lowell Boulevard, located south of West 67th Avenue.

10.2 Second Revision (August 16, 1995)

Countywide Update

This revision has combined the FIS reports and FIRMs of the County and incorporated cities into the countywide format.

Under the countywide format, FIRM panels have been produced using a single layout format for the entire area within the county instead of separate layout formats for each community. The single layout format facilitates the matching of adjacent panels and depicts the flood hazard area within the entire panel border, even in areas beyond a community corporate boundary line. In addition, under the countywide format, this single FIS report provides all FIS information and data for the entire county area.

The mapping for the countywide conversion was prepared using digital TIGER files obtained from the U.S. Department of Commerce, Bureau of the Census. Previously published Flood Insurance Rate Map data produced manually was converted to vector digital data by a digitization process. These vector digital data were fit to raster digital images of the USGS quadrangle maps of the county area to provide horizontal positioning.

This revision also incorporated revisions to the flooding along Clear Creek to reflect the hydrologic and hydraulic analyses prepared in a 1979 UDFCD report (Reference 59). The revised flooding was included as a detailed analysis and updates the flooding shown on the previous effective maps. Floodway and 500-year floodplain boundaries were not determined. The revisions to Clear Creek are reflected in the profiles and on the FIRMS.

For Brantner Gulch, this study replaced existing Zone A flooding shown previously and added new Zone A Special Flood Hazard Areas (SFHAs). The LOMR issued to the City of Thornton on December 16, 1992, to revise the Zone A SFHA along Brantner Gulch between 123rd and 124th Avenues and Colorado Boulevard and Monroe Street, was superseded by the information presented for Brantner Gulch (Reference 63). The existing detailed flooding show from Colorado Avenue to approximately 2,600 feet downstream of Colorado Avenue was not revised.

A new Zone A SFHA was added for Direct Flow Area 0054-1 from its confluence with the South Platte River upstream to Holly Street. The LOMR issued to the City of Thornton on January 19, 1989, to revise the Zone A SFHA from Holly Street upstream to East 112th Avenue was not superseded by this study. The SFHA was continued north of East 112th Avenue.

New SFHAs were also added for: McKay Lake Drainageway, Morris Creek, Mustang Run, North Tributary VII to Brantner Gulch, Preble Creek, South Fork

Preble Creek, Quail Creek, Sack Creek, Sack Creek South, Shay Ditch, Short Run, Tributary 4 to Todd Creek, Wadley North Creek, and Wadley South Creek.

Flooding was revised and added to Todd Creek and Tributary 2 to Todd Creek.

This flood information was provided by the U.S. Department of the Interior, Bureau of Reclamation, under Inter-Agency Agreement No. EMW-90-E-3456, as part of the Limited Map Maintenance Program. The source of the flood data for the identified stream were UDFCD Flood Hazard Area Delineation reports (References 60 through 64).

Letters of Map Revision (LOMRs)

The following LOMRs are included in this update:

The LOMR issued January 19, 1989, for the City of Thornton, revised the Zone A SFHA delineations along East 112th Avenue and the area southeast of East 112th Avenue to Holly Street, reflecting major drainage improvements completed.

The LOMR issued June 9, 1992, for the City of Commerce City, incorporates modifications to the floodway along Sand Creek in the vicinity of East 49th Street.

The LOMR issued June 21, 1994, for the City of Thornton incorporates modifications to the floodplain boundary delineations along Niver Creek from Washington Street upstream to Interstate Highway 25.

The LOMR issued July 14, 1994, for the City of Northglenn, revised the FIRM to reflect elevation by the placement of fill along North For Grange Hall Creek.

10.3 Third Revision (March 5, 2007)

This study was revised as part of a Digital Flood Insurance Rate Map (DFIRM) conversion for Adams County and incorporated areas. This study incorporated the new countywide DFIRM conversion prepared by the UDFCD. The UDFCD contracted ICON Engineering, Inc. to digitize the flood data from various sources and to prepare the data in conformance with the FEMA DFIRM specifications.

Flood information used for the DFIRM conversion came from four sources: the UDFCD's Flood Hazard Area Determination studies; the work maps from the original FIS; and the work maps from several LOMRs.

Box Elder Creek

The UDFCD published a Flood Hazard Area Delineation report (Reference 89) for the Lower Box Elder Creek watershed in September 2001. This report

identified flood hazard information on Box Elder Creek, Hayesmount Creek, and Bear Gulch. This report was incorporated into this FIS.

South Platte River

The UDFCD published a Flood Hazard Area Delineation report for the South Platte River in April 2005 (Reference 85). This report was incorporated into this FIS.

Letters of Map Revision (LOMRs)

The LOMR issued March 13, 1997 for the City of Thornton revised the FIRM to reflect changes along Grange Hall Creek and Grange Hall Creek Tributary due to the construction of a floodwall at Colorado Boulevard. Revisions occurred along Grange Hall Creek from approximately 500 feet downstream of East 108th Avenue to approximately 600 feet upstream of the confluence with Grange Hall Creek Tributary. Revisions along Grange Hall Creek Tributary occurred from the confluence with Grange Hall Creek to approximately 800 feet upstream of the confluence.

The LOMR issued August 23, 2000 for the Cities of Northglenn and Thornton revised the FIRM to show effects of construction of the Thornton Town Center along South Fork Grange Hall Creek from approximately 950 feet downstream of Grant Street to Melody Drive. The construction of the Thornton Town Center included installation of a new concrete box culvert below Grant Street; construction of a storage pond upstream of Grant Street; and installation of a box culvert between the storage pond and Interstate Highway 25 (I-25). The construction resulted in a realignment of the South Fork Grange Hall Creek from approximately 800 feet downstream of Grant Street to Huron Street.

The LOMR issued December 6, 1999 for unincorporated areas of Adams County, the City of Westminster, and the City of Thornton revised the FIRM to reflect changes along Big Dry Creek from 136th Avenue to Interstate Highway 25 (I-25).

The LOMR issued February 7, 2000 for the City of Federal Heights revised the FIRM to show the effects of placement of fill associated with the Northmoor subdivision development on the south side of Tributary L to Niver Creek from Huron Street to approximately 1000 feet upstream of Huron Street.

The LOMR issued September 11, 2000 for the City of Federal Heights revised the FIRM to correct an error in streambed elevation used in the effective hydraulic model for Tributary M of Niver Creek. Modifications occurred from approximately 250 feet downstream to approximately 120 feet upstream of Bryant Drive.

The LOMR issued February 8, 2001 for the City of Thornton revised the FIRM to reflect changes along Niver Creek associated with the American Furniture Warehouse development. Modifications occurred along Niver Creek from just upstream of the confluence with Tributary L to Niver Creek to approximately 320 feet downstream of Interstate Highway 25 (I-25).

The LOMR issued September 25, 2001 for the City of Thornton revised the FIRM to reflect changes along Wadley South Creek associated with the Haven at York Street development. Revisions occurred along Wadley South Creek from the confluence with Big Dry Creek for the Union Pacific Railroad.

The LOMR issued November 25, 2002 for the City of Commerce City and Adams County revised the FIRM to reflect changes along First Creek associated with the the Belle Creek Filing 1 development from Brighton Road to approximately 400 feet upstream of U.S. Highway 85.

The LOMR issued November 29, 2002 for Adams County and the City of Brighton revised the FIRM to reflect changes along Second Creek associated with construction of the State Highway E-470 Tollway. Modifications occurred along Second Creek for the Union Pacific Railroad to just downstream of East 124th Avenue.

The LOMR issued January 30, 2003 for Adams County, the City of Commerce City, and the City of Thornton revised the FIRM to show the effects of updated topographic information along the South Platte River form approximately 500 feed upstream of 104th Avenue to approximately 3,100 feet downstream of East 88th Avenue.

The LOMR issued May 29, 2003 for Adams County and the City of Westminster revised the FIRM to reflect channel improvements along Big Dry Creek between Interstate Highway 25 and Huron Street.

The LOMR issued July 2, 2003 for the City of Thornton revised the FIRM to reflect changes along an unnamed tributary to Grange Hall Creek due to the construction of Birch Street and 105th Avenue. Modifications occurred along the unnamed tributary to Grange Hall Creek from the confluence with Grange Hall Creek to Colorado Boulevard.

The LOMR issued August 20, 2003 for Adams County revised the FIRM to incorporate updated topographic data, the new Pecos Street bridge, and the widening of the channel along Clear Creek form approximately 3,300 feet downstream of Pecos Street to the Colorado and Southern Railroad.

The LOMR issued August 29, 2003 for Adams County and the City of Thornton revised the FIRM to reflect channel modifications associated with the proposed

realignment of 152nd Avenue along Wadley North Creek from the confluence with Big Dry Creek to just downstream of the Union Pacific Railroad.

The LOMR issued August 29, 2003 for the City of Thornton and the City of Northglenn revised the FIRM to reflect modifications to Eastlake Reservoirs Nos. 2 and 3 and channel impacts along Brantner Gulch from the Eastlake reservoirs to Colorado Boulevard.

The LOMR issued December 4, 2003 for Adams County revised the FIRM to reflect modifications along Todd Creek and Tributary 4 to Todd Creek (Tributary 4) associated with the construction of the State Highway E-470 Tollway.

The LOMR issued January 24, 2004 for Adams County, the City of Brighton, and the City of Commerce City revised the FIRM to reflect channel improvements associated with the construction of the State Highway E-470 Tollway along Third Creek from west of Chambers Road upstream to Tower Road. The E-470 Highway construction project incorporated a regional stormwater detention facility south of 120th Avenue, bridge/culvert crossings at 120th Avenue and at the ramp from Highway E-470 to Interstate Highway 76, and relocation/channelization of portions of Third Creek.

The LOMR issued May 14, 2004 for Adams County revised the FIRM to reflect changes in Special Flood Hazard Areas, Base Flood Elevations, and Floodway for Comanche Creek, Little Comanche Creek, and Wolf Creek based on more detailed topographic information. The revised reaches extend along Comanche Creek from the Adams County boundary with Weld County to just downstream of 26th Avenue, along Wolf Creek from the confluence with Comanche Creek to just downstream of U.S. Highway 36 (US 36), and along Little Comanche Creek from the confluence with Comanche Creek to just downstream of US 36.

The LOMR issued May 12, 2004 for Adams County and the City of Brighton revised the FIRM to reflect modifications along the South Platte River and Second Creek resulting from the construction of the State Highway E-470 Tollway (E-470). Modifications along the South Platte River occurred from approximately 760 feet upstream of the confluence with Second Creek to E-470. Modifications along Second Creek occurred at the confluence with the South Platte River.

The LOMR issued July 14, 2004 for Adams County and the City of Commerce City revised the FIRM to reflect changes along First Creek, Tributary Channel A to First Creek, and Tributary Channel B to First Creek, associated with Belle Creek subdivision Filing No. 4. Modifications occurred along First Creek and the tributary channels from approximately 900 feet upstream of Brighton Boulevard to the Union Pacific Railroad.

The LOMRs issued July 16, 2004 for Adams County and the City of Thornton revised the FIRM to reflect modifications along Big Dry Creek and Big Dry Creek North Area Tributaries (Mustang Run, Sack Creek South, and Short Run) associated with the construction of the State Highway E-470 Tollway.

The LOMR issued September 29, 2004 for Adams County and the City of Westminster revised the FIRM to reflect construction of culverts along Little Dry Creek at the Colorado and Southern Railroad at West 64th Avenue. Modifications occurred along Little Dry Creek from West 64th Avenue to just upstream of Federal Boulevard. The base flood elevation along Clear Creek was also affected by this revision.

The LOMR issued May 11, 2005 revised the FIRM to reflect changes in Special Flood Hazard Area, Base Flood Elevation, and Floodway for the South Platte River associated with Tigers Reservoir from approximately 2,350 feet upstream of McKay Road to East 88th Avenue. These changes to the FIRM are the result of revised hydraulic analysis to incorporate the effects of Tigers Reservoir along the South Platte River.

The LOMR issued July 8, 2005 for the City of Thornton revised the FIRM to reflect changes along South Fork Preble Creek associated with the construction of a box culvert at the Larkridge Mall development. The Special Flood Hazard Area for South Fork Preble Creek is contained within the constructed box culvert.

The LOMR issued July 25, 2005 for the City of Thornton revised the FIRM to reflect changes along Big Dry Creek associated with the construction of a new bridge at 136th Avenue.

The LOMR issued March 31, 2006 for Adams County and the City of Aurora revised the FIRM to reflect changes along First Creek associated with the construction of the Prologis Park 70 development.

The LOMR issued May 11, 2006 for Adams County and the City of Thornton revised the FIRM to reflect changes along Grange Hall Creek associated with the construction of box culverts extensions at Holly Street.

The LOMR issued May 26, 2006 for Adams County and the City of Commerce City revised the FIRM to reflect updated topography along Second Creek associated with the Second Creek Farm Filing No. 1 development.

The LOMR issued June 13, 2006 for the City of Thornton revised the FIRM to reflect the changes along South Fork Preble Creek associated with the construction of the Larkridge Retail Center.

The LOMR issued September 26, 2006 for Adams County revised the FIRM to reflect changes along McKay Lake Drainageway associated with the improvements at McKay Lake and the Huntington Trails development.

10.4 Fourth Revision

The final CCO meeting was held for this study on _____, and was attended by _____.

This study was revised on _____, to incorporate a Physical Map Revision (PMR) for the detailed existing conditions hydrologic and hydraulic study of First Creek, First Creek TributaryT, and Second Creek. The study reach encompasses approximately 5.56 miles of First Creek extending from approximately 930 feet downstream of Buckley Road to approximately 20,250 feet upstream of Powhaton Road, approximately 5.5 miles of First Creek Tributary T from the confluence with First Creek to approximately 330 feet upstream of 26th Avenue, and approximately 3.9 miles of Second Creek extending from approximately 1,730 feet downstream of the confluence with Possum Creek to approximately 6,970 feet upstream of East 56th Avenue. The PMR was based on existing conditions data provided in the engineering report entitled "Flood Hazard Area Delineation First Creek (upstream of Buckley Road)" prepared by Moser & Associates Engineering, dated October 2011 (Reference 90) and the existing conditions flood hazard information developed in the engineering report entitled "Flood Hazard Area Delineation for Second Creek Upstream of Denver International Airport" prepared by Matrix Design Group, Inc. and Olsson Associates, dated May 2011 (Reference 91).

<u>First Creek and First Creek Tributary T</u>

Moser & Associates Engineering performed the hydrologic analysis and floodplain mapping for the study of First Creek and First Creek Tributary T under contract with Urban Drainage and Flood Control District (UDFCD), in joint sponsorship with the City and County of Denver and the City of Aurora.

The storm runoff hydrographs and routing for First Creek and First Creek Tributary T were generated using CUHP 2005 Versions 1.3.1 and the Environmental Protection Agency's Stormwater Management Model (SWMM) Version 5.0 Build 5.0.013. The 1-hour and 6-hour rainfall depths for the 2-, 5-, 10-, 25-, 50-, and 100-year storm events were gathered from Figures RA-1 through RA-12 in the Urban Storm Drainage Criteria Manual (USDCM, 2001). The 500-year storm was determined from a logarithmic regression line fit to the known rainfall depths (Reference 90).

Hydrualic analyses for the revision were carried out using the U.S. Army Corps of Engineers' River Analysis System (HEC-RAS) version 4.0.0. The cross sections in HEC-RAS were developed using Autodesk Land Development Desktop as well

as the HEC GEORAS plugin to ESRI ArcView. The sections were cut from 2-foot interval digital terrain model data supplied by the UDFCD. This model was compiled from several data sources including 2008 USGS LiDAR mapping, Denver 2-foot GIS mapping and 2-foot mapping from the City of Aurora.

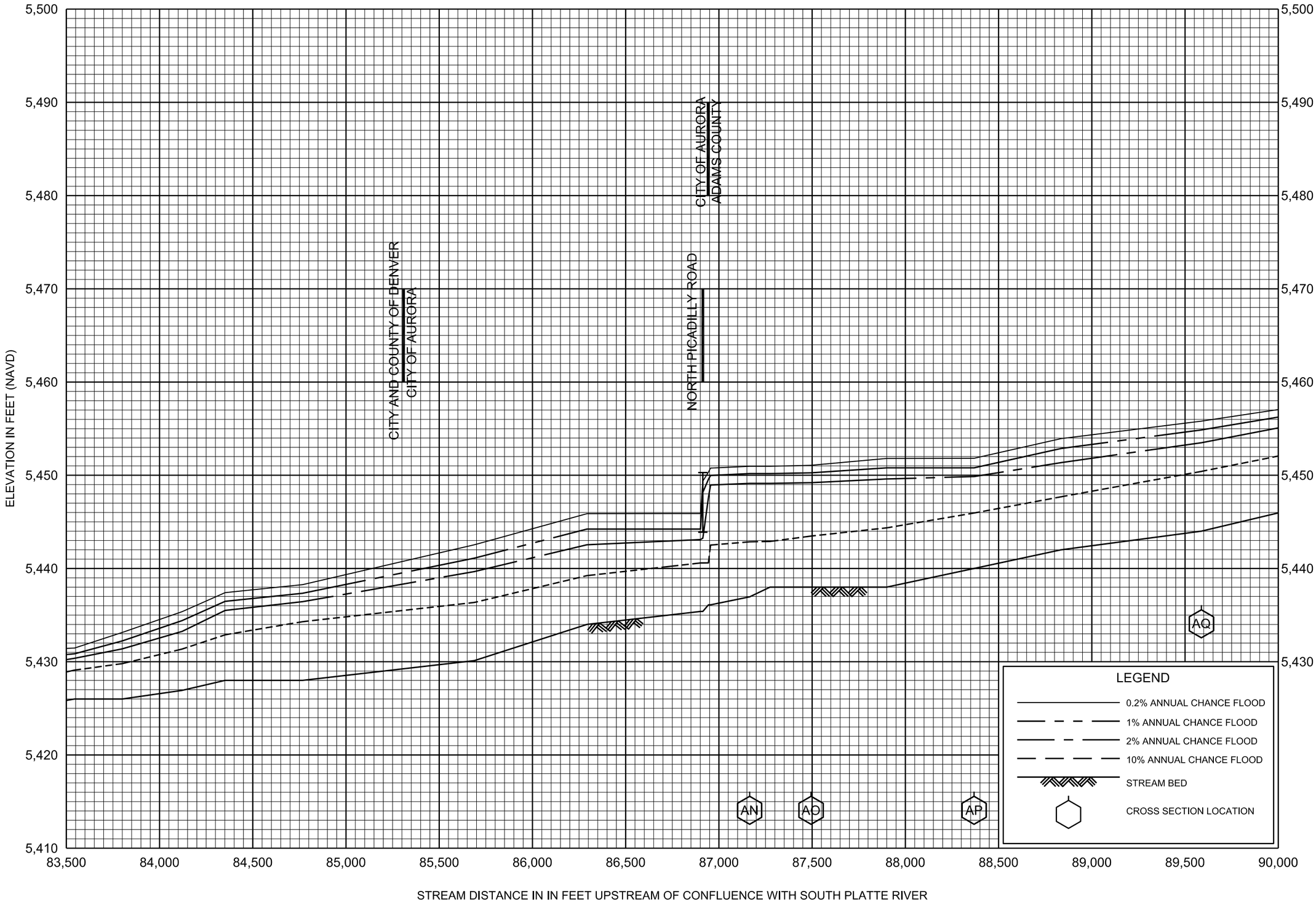
Second Creek

Matrix Design Group Inc. and Olsson Associates performed the hydrologic analysis and floodplain mapping for the study of Second Creek under contract with Urban Drainage and Flood Control District City and City of Aurora.

Hydrology of the upper portion of Second Creek (upstream of the Denver International Airport) was developed for the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year storm events. The generation and routing of the storm runoff hydrographs for the upper portion of Second Creek was performed using CUHP version 1.3.3 and EPA SWMM 5.0, version 5.0.020.

The hydraulics of Upper Second Creek main stem were modeled using HEC-RAS, version 4.1.0. The City of Aurora provided 2-foot (ft) interval LIDAR mapping for this project. The LIDAR mapping is referenced to the NAVD 88 vertical datum and the NAD 83 horizontal datum. The Second Creek, Possum Gully, and Gopher Gulch road crossing structures were surveyed by Accurate EngiSurv, LLC. UDFCD provided 2009 aerial photography. The City of Aurora provided GIS files of utilities, parcels, and street centerlines in the vicinity of the project.

This revision supersedes the Letter of Map Revision (LOMR) issued April 04, 2007, (Case No. 07-08-0252P), for Adams County, Colorado Unincorporated Areas.



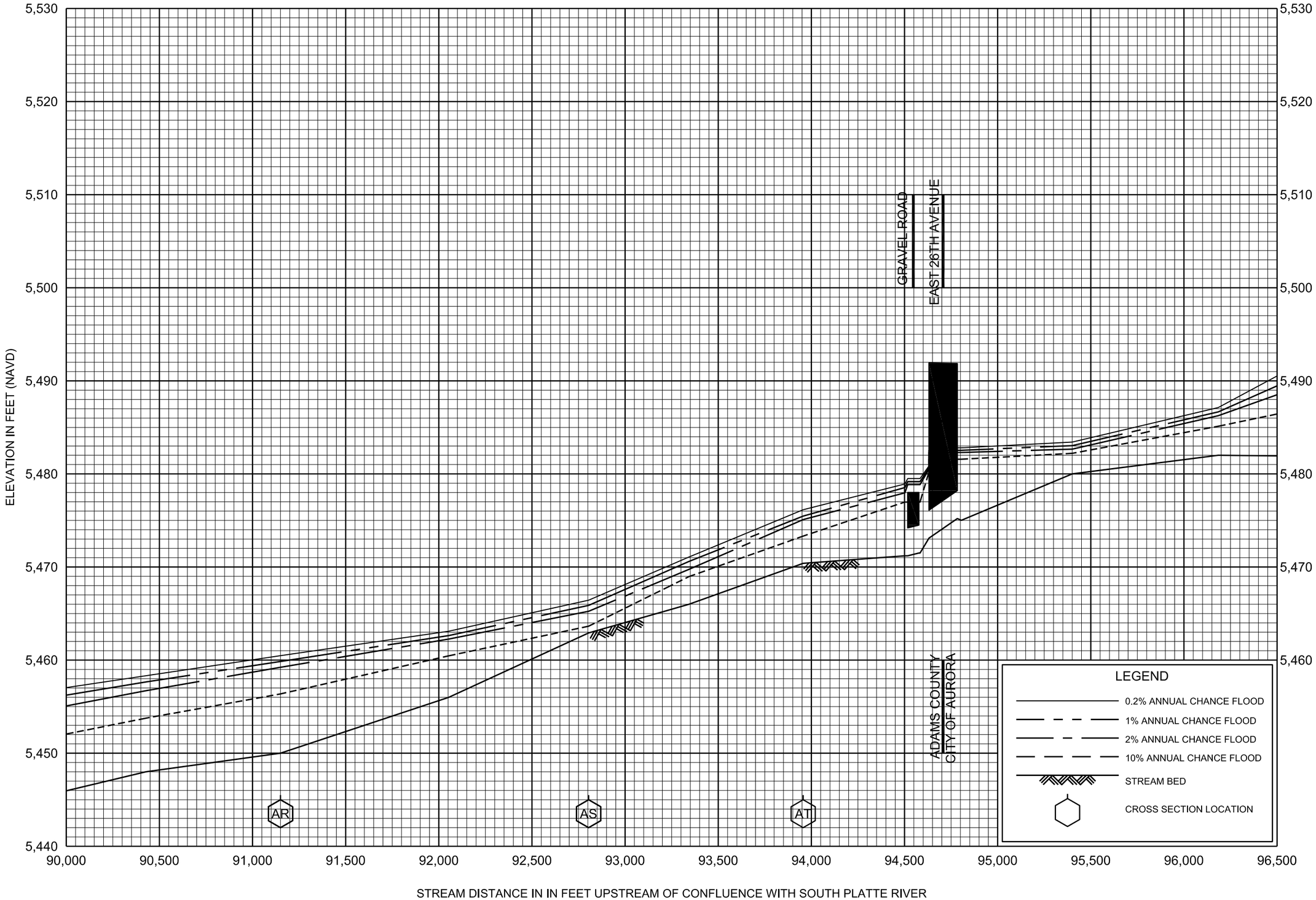
FLOOD PROFILES

FIRST CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS



FLOOD PROFILES

FIRST CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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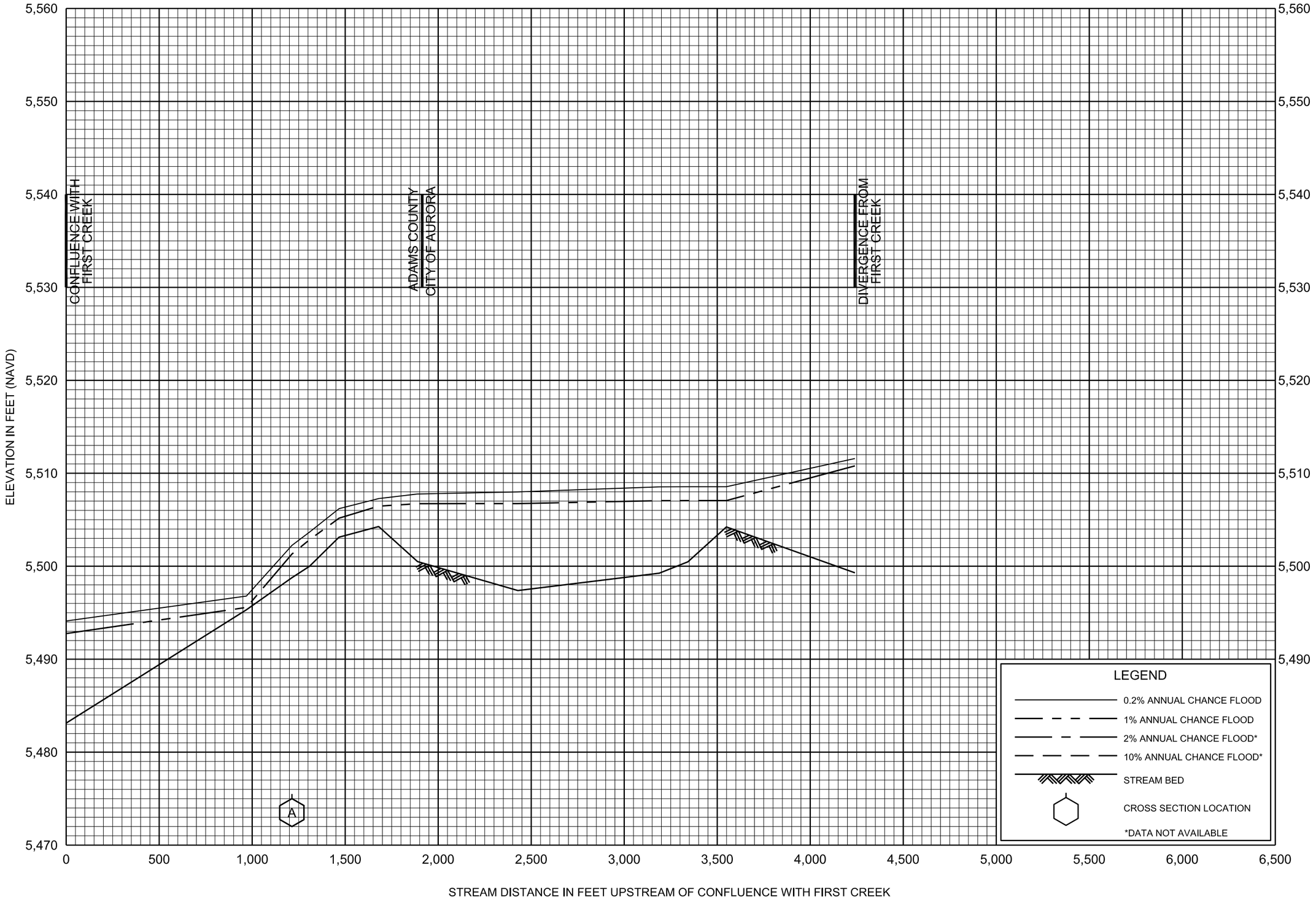

FLOOD PROFILES

FIRST CREEK E-470 SPLIT

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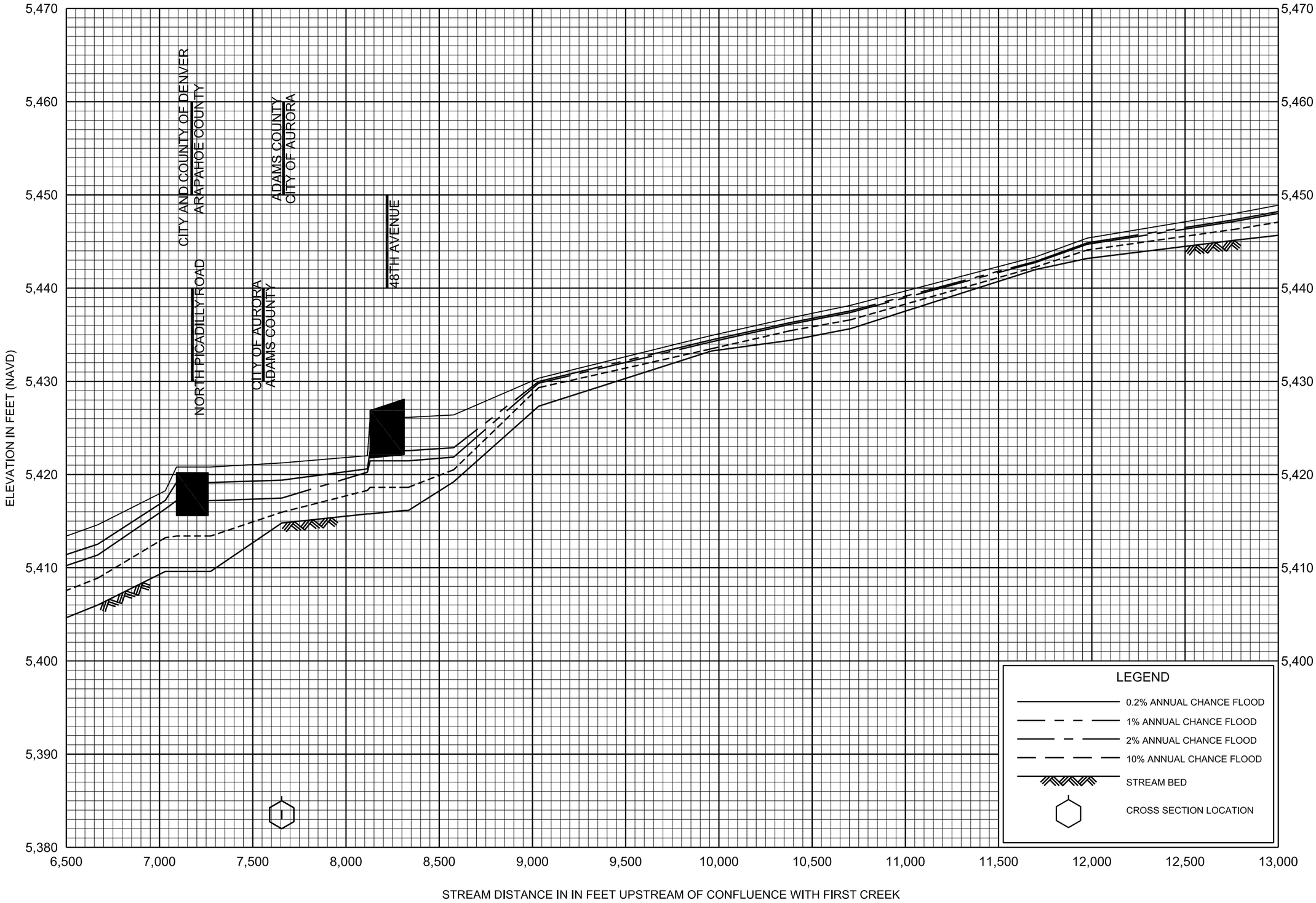
ADAMS COUNTY, CO

AND INCORPORATED AREAS



FLOOD PROFILES

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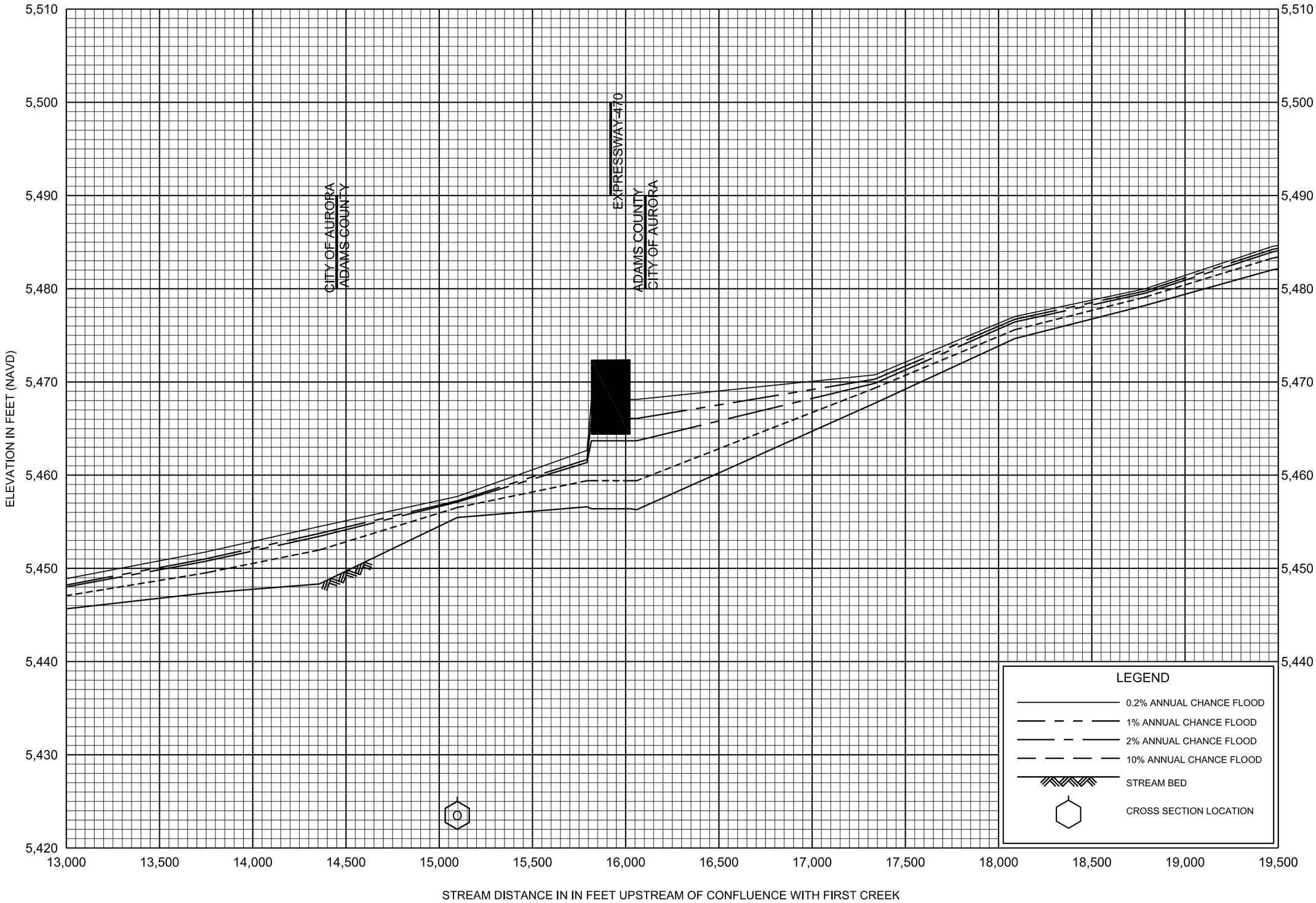
ADAMS COUNTY, CO

AND INCORPORATED AREAS



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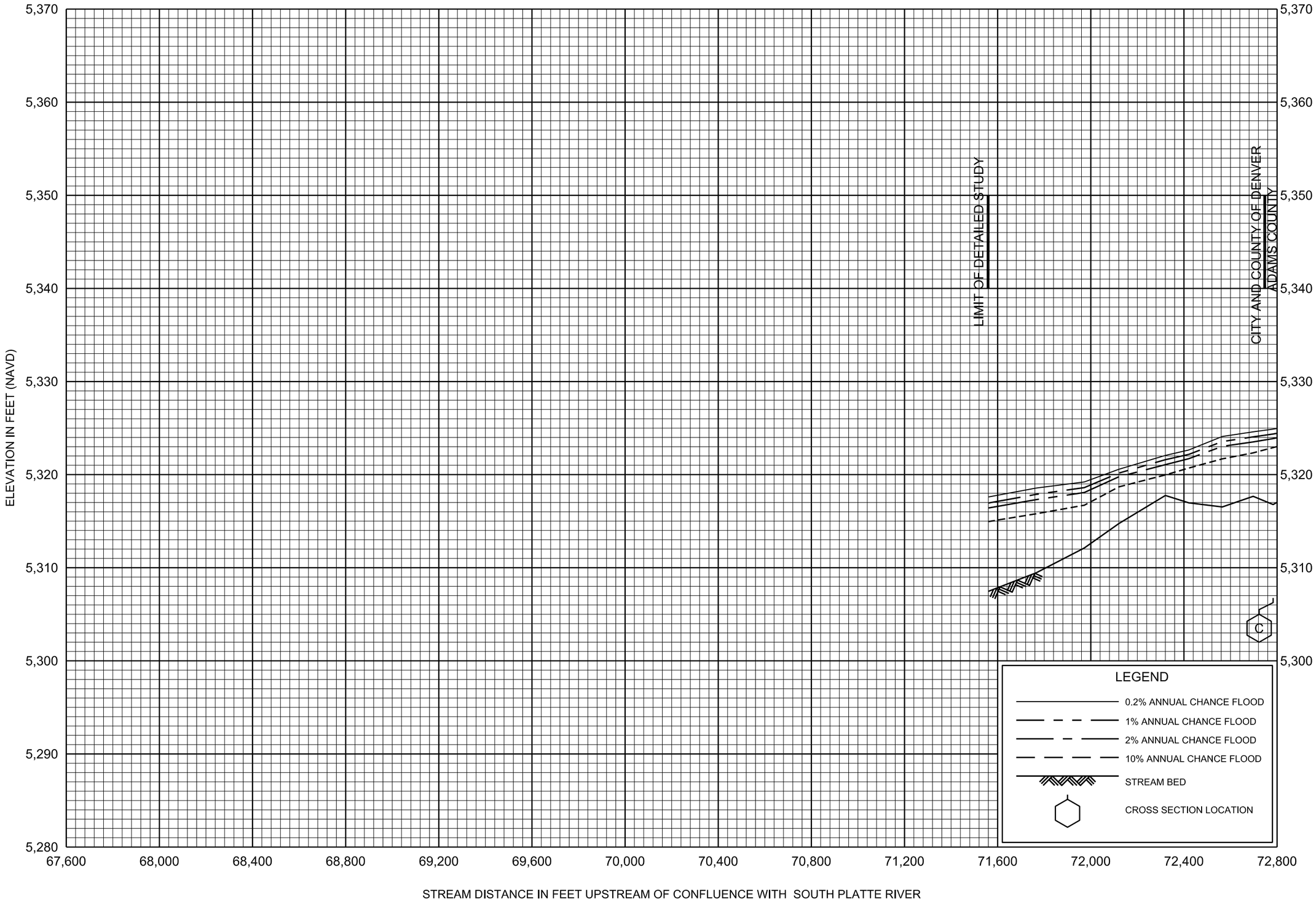


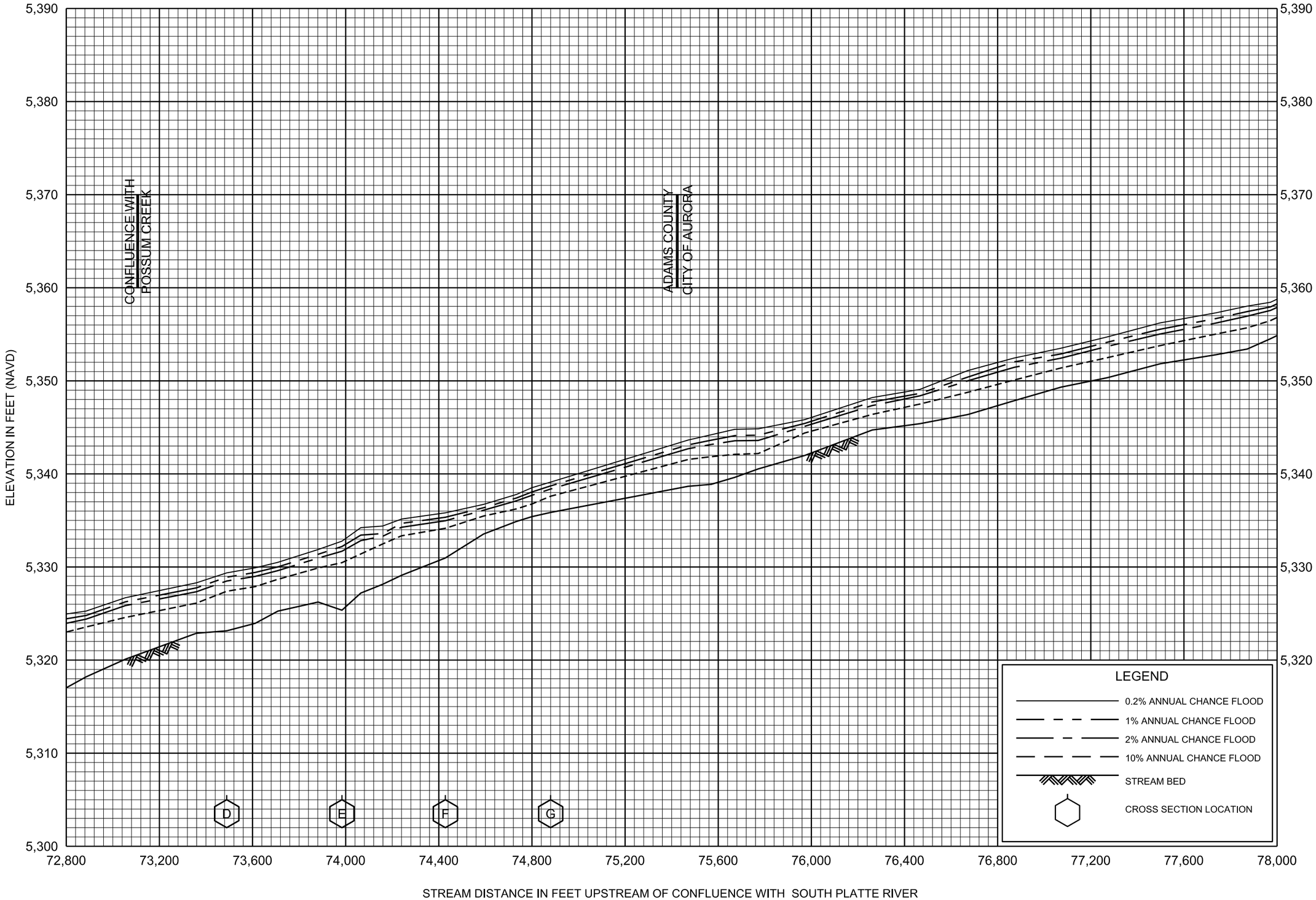
FLOOD PROFILES

SECOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS



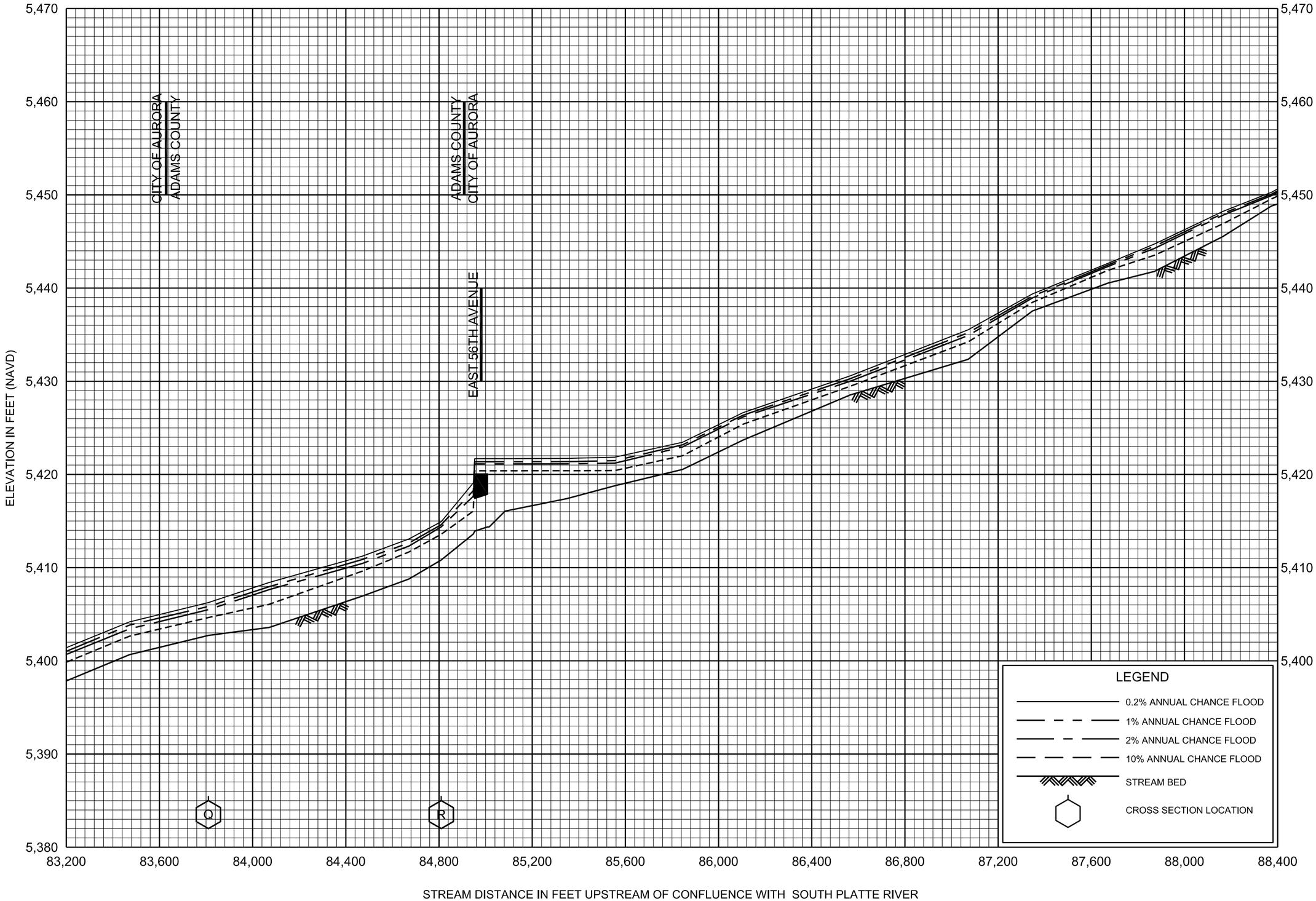
FLOOD PROFILES

SECOND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS



FLOOD PROFILES

SECOND CREEK

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AND INCORPORATED AREAS

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