FLOOD INSURANCE STUDY

VOLUME 1 OF 5

ARAPAHOE COUNTY, COLORADO

AND INCORPORATED AREAS

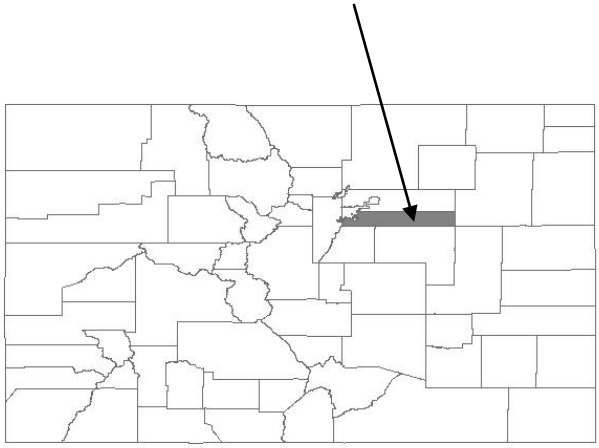
Notice

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

Community Name	Community Number
ARAPAHOE COUNTY UNINCORPORATED AREAS	080011
AURORA, CITY OF	080002
CENTENNIAL, CITY OF	080315
CHERRY HILLS VILLAGE, CITY OF	080013
COLUMBINE VALLEY, TOWN OF	080014
*DEER TRAIL, CITY OF	080015
ENGLEWOOD, CITY OF	085074
*FOXFIELD, TOWN OF	080091
GLENDALE, CITY OF	080247
GREENWOOD VILLAGE, CITY OF	080195
LITTLETON, CITY OF	080017
SHERIDAN, CITY OF	080018

*NON - FLOODPRONE

ARAPAHOE COUNTY



PRELIMINARY
03/10/2016

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
08005CV001C

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.

This FIS report was revised on 9/9/999. Users should refer to Section 10.0, Revisions Description, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this FIS report should be aware that the information presented in Section 10.0 supersedes information in Sections 1.0 through 9.0 of this FIS report.

Initial FIS Report Effective Date:	April 17, 1989
Revised FIS Report Dates:	August 16, 1995 October 7, 2008 December 17, 2010

The Preliminary FIS report does not include unrevised Floodway Data tables or unrevised Flood Profiles. These unrevised components will appear in the final FIS report.

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Exhibit 1 – Flood Profiles

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EXHIBITS

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

FLOOD INSURANCE STUDY
ARAPAHOE 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 Arapahoe County, Colorado including: the Cities of Aurora, Centennial, Cherry Hills Village, Deer Trail, Englewood, Glendale, Greenwood Village, Littleton and Sheridan; the Towns of Columbine Valley and Foxfield; and unincorporated areas of Arapahoe County (hereinafter referred to collectively as Arapahoe County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The Cities of Aurora and Littleton each fall in more than one county, but are included in their entirety in this FIS. The Town of Bennett falls in both Arapahoe and Adams Counties, but is excluded from this FIS and included in its entirety in the Adams County FIS. The Town of Bow Mar falls in both Arapahoe and Jefferson counties, but is excluded from this FIS and included in its entirety in the Jefferson County FIS. 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 Arapahoe County and incorporated areas 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.

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 original hydrologic and hydraulic analyses for the Flood Insurance Study for the unincorporated areas of Arapahoe County were performed by Gingery and Associates, Inc., for the Federal Insurance Administration (FIA), under Contract No. H-3716. This work was completed in July 1975 (Reference 1).

Hydrologic and hydraulic information for portions of Bear Creek, Big Dry Creek, Blackmer Gulch, Cherry Creek, Dutch Creek, Granby Ditch, Goldsmith Gulch, West Tributary to Goldsmith Gulch, Greenwood Gulch, Lee Gulch, Littles Creek,

Little Dry Creek, Quincy Gulch, Sable Ditch and Sable Ditch Overflow, Sand Creek, Slaughterhouse Gulch and its South Tributary, Toll Gate Creek, West Toll Gate Creek, West Toll Gate Creek Tributary, East Toll Gate Creek, Unnamed Creek, West Bijou Creek, Westerly Creek, Columbia Creek, and Side Creek and its Tributary were taken directly from the existing Flood Insurance Studies for Aurora, Cherry Hills Village, Columbine Valley, Englewood, Greenwood Village, Littleton, and Sheridan (References 2 through 9, respectively).

The hydrologic and hydraulic analyses for portions of First, Piney, Murphy, Lone Tree, Happy Canyon, Cottonwood and Littles Creeks and Lee Gulch were performed by J.F. Sato and Associates, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW84-C-1631. This work was completed in August 1985 (References 10, 11, 12, 13, 14, 15, and 16).

The hydraulic analyses for a portion of Cherry Creek extending from Cherry Creek State Recreation Area to the Arapahoe Douglas County line were performed by Greiner Engineering, as reported in River Run Development, Letter of Map Revision, Arapahoe County, Colorado, (Reference 17).

The revised hydraulic analyses for portions of East Toll Gate and West Toll Gate Creeks were performed by Merrick and Company, Greiner Engineering, and the City of Aurora Engineering Division (References 18, 19, 20, 21, and 22).

The hydraulic analysis for a portion of Unnamed Creek (Tributary to West Toll Gate Creek) was performed by Holland Corporation (Reference 23).

The hydrologic study of the South Platte River, from Chatfield Dam to the corporate limits of the City and County of Denver, was prepared by Merrick and Company, under contract to the Urban Drainage and Flood Control District (UDFCD), and was completed in May 1983.

The hydraulic analyses for the South Platte River, from the corporate limits of the City and County of Denver, upstream to the U.S. Army Corps of Engineers (COE) Channel Improvement Project, were performed by Wright Water Engineers, under contract to UDFCD, and were completed in September 1985. The hydraulic analyses of the COE Channel Improvement Project were also performed by Wright Water Engineers under contract to UDFCD (completed in September 1987). The hydraulic reanalyses of the South Platte River, from the COE Channel Improvement Project (Fairway Lane) upstream to the Chatfield Dam, were based on the COE September 1979 hydraulic computer model-, using the discharges determined by the May 1983 Merrick hydrologic study and was carried out by the FEMA Technical Evaluation Contractor, in November 1987.

For this countywide FIS report, revised hydrologic and hydraulic analyses were taken from reports prepared for the UDFCD on Box Elder Creek by Wright Water Engineers and CH2MHill (Reference 83), Cherry Creek by URS Corporation

(Reference 85), Little Dry Creek and Tributaries by WRC Engineering, Inc. (Reference 86), Goldsmith Gulch by Moser and Associates (Reference 87), SJCD 6200 by Olsson Associates (Reference 90) and Murphy Creek by Moser and Associates (Reference 91). These analyses were completed under contract with the UDFCD.

Base Map information shown on this FIRM was provided by the Arapahoe County GIS. Additional input was provided by the Cities of Aurora and Littleton. These data are current as of 2004.

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

1.3 Coordination

The Arapahoe County Planning Department supplied zoning and corporate boundary maps for areas throughout the county. Conferences were held with the County staff on June 5, July 15, and July 24, 1975. The final community coordination meeting for the original study of the unincorporated areas was held on September 16, 1975.The COE, Omaha District, supplied base mapping, hydrologic input, and information on Chatfield Dam for the study reach of the South Platte River. In addition, conferences were held with the COE, Omaha District, on October 16, 1974, November 27, 1974, and March 21, 1975. Of particular significance to this study was a COE floodplain information study of the Denver Metropolitan Region, dated October 1968 (Reference 24) and a Floodplain Information report prepared by the COE, dated July 1971 (Reference 25).

The U.S. Geological Survey (USGS) was contacted to obtain historical flow data (References 26, 27, and 28). Maps of flood-prone areas prepared by the USGS, showing approximate floodplain boundary delineations at a scale of 1:24,000, were also reviewed (Reference 29).

At a meeting on August 16, 1974, attended by representatives of UDFCD, FIA, and Gingery Associates, Inc., the study reaches were clearly explained with the methodology to be used in the study. An additional meeting was held on January 24, 1975, to further clarify the purpose of the study and methods used for floodplain delineation. UDFCD supplied contour maps at 2-foot intervals for Big Dry Creek, Sand Creek, and Coal Creek along with an interim report entitled Major Drainageway Master Plan--Big Dry Creek (Reference 30).

Numerous other agencies and individuals were contacted for background information, including the Colorado Water Conservation Board (CWCB), which provided published rainfall-runoff data (Reference 31); Colorado Highway Department; Union Pacific Railroad; and U.S. Soil Conservation Service (SCS). Private citizens of Watkins, Strasburg, Byers, and Deer Trail were interviewed

regarding past floods, high-water marks, and flood damage.

Prior to the restudy, a meeting was held in early April 1984 with the Arapahoe County Engineering Department and UDFCD to define study reaches; however, no reaches were identified at this meeting. The study reaches were selected at a meeting in late April 1984 attended by the study contractor and FEMA.

An intermediate community coordination meeting for the restudy was held in July 1985 and attended by the County, the study contractor and the FEMA representative to explain the reaches studied and the methods used.

UDFCD provided copies of previous master plans and flood hazard delineation maps that covered some of the stream reaches being studied. The County provided up-to-date road maps and corporate boundary maps.

FEMA authorized a countywide restudy for Arapahoe County in December 1985.

For this countywide FIS report, an initial coordination meeting was attended by FEMA; Arapahoe County; the Cities of Aurora, Centennial, Cherry Hills Village, Englewood, Glendale, Greenwood Village, Littleton, and Sheridan; the Town of Columbine Valley; the CWCB; the UDFCD; Michael Baker, Jr., the National Service Provider; and Merrick and Co., the study contractor, on October 26, 2004. At this meeting, the communities were notified that their FIS report and FIRMs 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 Arapahoe County along with the City of Aurora.

The results of this countywide study were reviewed at the final Consultation Coordination Officer (CCO) meeting held on December 18, 2008, at the Southeast Metro Stormwater Authority office in Englewood, Colorado. The meeting was attended by representatives of UDFCD, FEMA, the State of Colorado, FEMA contractors and local communities. All issues raised at that meeting have been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Arapahoe County, Colorado including the incorporated towns, cities, and communities which fall within more than one county as described in Section 1.1 (excluding the Towns of Bennett and Bow Mar).

All or portions of the flooding sources listed in Table 1 were studied by detailed methods in previous Flood Insurance Studies (FISs) covering Arapahoe County and Incorporated Areas (References 2 through 11, 88, and 89).

TABLE 1 – FLOODING SOURCES STUDIED BY DETAILED METHODS

Stream	Stream
Bear Creek	Piney Creek
Bear Gulch	Prairie Dog Draw
Big Dry Creek	Prentice Gulch
Big Dry Creek Tributary A	Quincy Gulch
Blackmer Gulch	Rat Run
Box Elder Creek	Sable Ditch
Cardboard Draw	Sand Creek
Cherry Creek	Slaughterhouse Gulch
Cherry Creek Spillway Drain	SJCD 6100
Coal Creek	SJCD 6200
Coon Creek	South Platte River
Cottonwood Creek	South Tributary
Coyote Run	Spring Creek
East Toll Gate Creek	Slaughterhouse Gulch
First Creek	Toll Gate Creek
Goldsmith Gulch	Unnamed Creek
Granby Ditch	West Toll Gate Creek
Greenwood Gulch	West Toll Gate Creek Tributary
Happy Canyon Creek	West Tributary To Goldsmith Gulch
Lee Gulch	Westerly Creek
Littles Creek	Westerly Creek Overflow
Little Dry Creek	Willow Creek
Lone Tree Creek	Wolf Creek
Murphy Creek	Wolf Creek Tributary
Muskrat Run	Woodrat Gulch

For this countywide FIS, the following streams in Table 1a were either restudied or newly studied by detailed methods.

TABLE 1a – FLOODING SOURCES RESTUDIED OR NEWLY STUDIED BY DETAILED METHODS

Stream	Limits of Revised or New Detailed Study
Box Elder Creek	Downstream limits of Aurora to Jewell Ave. extended
Bear Gulch	Downstream limits of Aurora to 38th Avenue
Coyote Run	Downstream limits of Aurora to Jewell Ave. extended
Prairie Dog Draw	Confluence to I-70
Rat Run	Confluence to study limit
Muskrat Run	Confluence to upstream of Gun Club Road

Stream	Limits of Revised or New Detailed Study
Woodrat Gulch	Confluence to study limit
Cardboard Draw	Confluence to study limit
Cherry Creek	Reservoir to Douglas County Line
Little Dry Creek	Clarkson to Quebec Street
Willow Creek	Confluence to Englewood Dam
Greenwood Gulch	Confluence to Holly Street
Quincy Gulch	Confluence to High Line Canal
Blackmer Gulch	Confluence to High Line Canal
Prentice Gulch	Confluence to Holly Street
Goldsmith Gulch	Belleview Avenue to Arapahoe Road
West Trib To Goldsmith	Confluence to Peakview Avenue
SJCD 6200	Confluence to Jefferson County Line
Murphy Creek	Confluence to Study Limit
Cherry Creek (Right Overbank Split Flow)	Station 89292 to Station 91117

All or portions of the streams in Table 2 were studied by approximate methods in previous Flood Insurance Studies for Arapahoe County and Incorporated Areas (References 2 -11, 88, 89).

TABLE 2 – FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Stream
Box Elder Creek upper reaches
Coal Creek upper reaches
Comanche Creek
Drainageway D in Columbine Valley
East Bijou Creek
Columbia Creek
Deer Trail Creek
First Creek
Kiowa Creek
Little Comanche Creek
Middle Bijou Creek
Muddy Creek
Upper reaches of Piney Creek
Senac Creek
Side Creek
Unnamed Tributary to Coal Creek
West Bijou Creek
West Box Elder Creek
West Toll Gate Creek
West Toll Gate Creek Tributary
Wolf 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, Arapahoe County, and the incorporated communities within Arapahoe County. This update also incorporates Letters of Map Revision issued by FEMA.

2.2 Community Description

Arapahoe County is located in central Colorado, just south and east of Denver. The general physical boundary is that of a rectangle 12miles by 72 miles, which extends from near the foothills of the Rocky Mountains to the open plains of eastern Colorado, covering approximately 864 square miles. The City of Aurora lies east of Denver, extending north into Adams County and south into Douglas County. The City of Littleton lies south and west of Denver, extending south into Douglas County and southwest into Jefferson County.

The climate in the study area varies slightly from the Denver metropolitan area to the prairie Lands on the eastern end; but, generally, it is characteristic of the temperate high plains. The mean annual temperature is 50.2°F; the mean annual snowfall is 45 inches, and the mean annual rainfall is 14.05 inches. With a mean growing season of 139 days, agriculture flourishes.

Today, Arapahoe County is still basically an agricultural and residential community, with most of the population concentrated in the western one-third of the county. During the past 25 years, the county population has grown rapidly as a result of Denver metropolitan area urbanization and subsequent extensive suburban development. County population figures for 1970 and 1980 are 161,000 and 293,621, respectively. This kind of suburban development pressure is now, and will continue to be, evident in and along the floodplains of Big Dry Creek, Little Dry Creek, Cottonwood Creek, Cherry Creek, Piney Creek, Sand Creek., Coal Creek, and the South Platte River. Residential growth has also occurred along the banks of Box Elder Creek and Comanche Creek.

The county lies within the South Platte River Basin, with headwaters extending into the Rocky Mountains to elevations of 14,000 feet. The waters of the South Platte River have been appropriated for municipal and irrigation usage. The South Platte River in Arapahoe County flows from south to north along the western edge of the county.

The South Platte River in Arapahoe County is a continuous flowing stream, whereas the tributaries are intermittent flowing streams. The South Platte River has

two major flooding characteristics-snowmelt and summer thunderstorms. The tributary basins are narrow and have clayey-loam soils. In the undeveloped portions of the basins, the ground cover consists of buffalo grass, willows, 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 onto the floodplain. In various reaches of the floodplains, development pressures continue to exist. The county government is working to retain the open space of the floodplain

2.3 Principal Flood Problems

The South Platte River flows through the western edge of Arapahoe County in shifting channels in a broad, shallow bed with low, flat overbanks. Streams tributary to the South Platte River are ephemeral and flow in steep, narrow channels; whereas those in the eastern two-thirds of the county flow in wide, flat channels similar to the South Platte River. Sheetflow occurs within the City of Littleton on the lower reaches of Littles Creek and Slaughterhouse Gulch.

All streams studied have had various structural improvements but the intense and infrequent thunderstorms characteristic of the area can generate floods in excess of existing structural capacities. The flood threat throughout the county has not been adequately defined and urbanization has occurred in certain areas without regard to the hazard.

Major floods have occurred on the South Platte River and its tributaries in Arapahoe County since 1844. During the period, 11 devastating floods have occurred on the South Platte River; 17 have occurred on Cherry Creek; 3 each have occurred on Bijou, Box Elder, Comanche, and Sand Creeks; and 1 has occurred on Toll Gate Creek. Historic flood information on other streams in Arapahoe County is not available.

In 1844 and 1864, reports read, "bottomlands near Denver were covered with water bluff to bluff." By 1876, encroachment into the floodplain had developed to such an extent that on May 23, 1876, the Rocky Mountain News reported, "(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."

The most significant floods of recent times on the South Platte River occurred in 1912, 1921, 1933, 1935, 1942, and 1965 during which discharges of 13,000 cubic feet per second (cfs), 8,790 cfs, 22,000 cfs, 12,320 cfs, 10,200 cfs, and 40,300 cfs, respectively, were recorded. Cherry Creek experienced a similar flood history, with discharges of 25,000 cfs, 34,000 cfs, 10,700 cfs, 17,600 cfs, 10,800 cfs and 39,900 cfs in 1912, 1933, 1945, 1946, 1963, and 1956, respectively.

In interviews held in Watkins, Strasburg, Byers, and Deer Trail regarding flood histories on Box Elder Creek, Comanche Creek, West Bijou Creek, and East Bijou Creek, residents recalled severe damage and lost lives in floods occurring in 1905, 1935, and 1965.

All of these floods of record on the South Platte River and tributaries have been generated near their headwaters on the slopes of Monument Divide, a high ridge located between Castle Rock and Colorado Springs and extending from the Rocky Mountains down into the plains near Limon, Colorado. Past floods of the mountain tributaries have resulted from snowmelt. Intensive rainstorms cause flooding in both the mountain tributaries and the eastern tributaries.

In 1912, Cherry Creek swelled to flood stage from cloudbursts centered simultaneously over Denver and the upper reaches of the creek. In 1933, similar circumstances caused the Castlewood Dam above Franktown in Douglas County to fail, sending a 34,000-cfs flow of water thundering down the canyon into Denver.

In 1965, the whole South Platte River Basin was drenched by a unique combination of orographic effects and meteorological conditions that caused the worst flooding in the region's recorded history. Severe thunderstorms had formed over the headwaters of Plum and Cherry Creeks on June 16 and slowly moved northeasterly down the creeks; thus, the heavy rains tended to follow and augment the peak flows. More than 14 inches of rain fell near Monument Divide at Palmer Lake in 4 hours. Overnight, westerly winds shifted the storm front to an orientation over the Kiowa and Bijou Creek basins to meet with thunderstorms forming just south of Agate, where 5.25 inches fell in 45 minutes. The net result was six persons drowned, two other deaths caused by flood-related activities, and estimated damages in the Denver area were $500 million.

Flood problems in the area have been the result of not only rare storm events but also of improper floodplain development. Visual accounts of floods have noted that the debris transported by floodwater contained natural debris, such as trees, rock, and soil, but consisted chiefly of items foreign to the floodplain, such as houses, bridges, automobiles, heavy equipment, lumber, house trailers, butane storage tanks, and other flotsam. With these items obstructing bridges and culverts, flood levels rose and caused more extensive damage. Property which was not structurally damaged by flood depths and velocities experienced much damage and cleanup cost resulting from mud and silt deposition and erosion.

2.4 Flood Protection Measures

The first tangible contribution to flood control on the streams flowing through Arapahoe County was made in 1890, when Castlewood Dam, primarily intended for irrigation storage, was completed by the Denver Land and Water Company on Cherry Creek, 35 miles upstream from Denver. The dam,

with a storage capacity of 4 billion gallons, 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 were taken on Cherry Creek in 1936 with the completion of the $800,000, 55-foot-high Kenwood Dam, 5 miles southeast of Denver, near Sullivan, Colorado. Despite its apparent guarantee of security, Kenwood Dam was not regarded as the complete answer to flood control on Cherry Creek and was abandoned. In 1950, Cherry Creek Dam was constructed just upstream of the former Kenwood Dam at a cost of $20 million. The dam spans 14,300 feet across the creek at a height of 140 feet, and now serves the community as a park and water recreation area as well as a retarding barrier for floods much larger than the event of June 1965. Cherry Creek Dam was designed and built by the COE to store the Standard Project Flood, which is approximately equivalent to the 500-year flood. The dam eliminates the flood potential from 385 square miles of the total drainage area of 409 square miles.

With the history of major flooding on the South Platte River through 1933, culminating in the planning, design, and construction of the Cherry Creek Reservoir in 1950, citizens of the Denver metropolitan area saw the need for an additional flood-control structure on the South Platte River, just downstream of the confluence with Plum Creek. During the 1950s, the planning and design for a flood-control reservoir were completed for Chatfield Dam. At that time, however, funding was not available to initiate and complete construction. The floods of 1965 changed the minds of many concerning the need for the structure. The loss of 8 lives and property damage assessed at $300 million in the Denver area prompted the release of funds and construction began. In 1973, final closure of the dam was made and the facility became capable of storing tributary floodwater. All the related reservoir improvements, including recreational facilities, became totally operational in 1976. Chatfield Dam is located approximately 0.5 mile above the City of Littleton corporate limits, in Douglas and Jefferson Counties. The reach of the South Platte River lying within Arapahoe County will still experience flooding from tributary streams at Littleton and downstream.

To assist the COE with needed flood-control measures along the 6.4 miles of the South Platte River that lie adjacent to the City of Littleton, in Arapahoe County, citizens of Littleton voted in 1971 to provide funds to assist the COE in implementing a mutually satisfactory project for flood control (References 32 and 33). In 1984, the City acquired and annexed property included within the 100-year floodplain limit within this 2-mile reach, and plans to retain the rural, open-space environment of the area.

On the remaining 4.4 miles of the South Platte River that are located in Arapahoe County and the City of Littleton, the COE had proposed a structural solution to flood control, incorporating channelization and diking. State funds have been appropriated for right-of-way acquisition and construction, for the purpose of this study, has been completed. The resulting channelization

project contains the accepted 100-year flood discharge and, therefore, this segment of the river presents minimal flood hazard to the county and affected communities.

The UDFCD and City of Littleton constructed a 100-year capacity channel for Littles Creek from its confluence with the South Platte River to the railroad corridor. The UDFCD and City of Littleton constructed a detention facility near Grant Street and storm sewer upstream and downstream on Slaughterhouse Gulch to reduce the frequency and severity of flooding. The Colorado Department of Transportation constructed a 100-year capacity box culvert on Slaughterhouse Gulch from the South Platte River to upstream of Santa Fe drive as part of a transportation project.

A major flood control structure in the City of Aurora is Quincy Dam on West Toll Gate Creek, which was completed in 1974. The dam and reservoir serve as a water storage facility and provide approximately 4,5000 acre feet of storage for flood control. The dam controls the upper 4.5 square miles of the drainage basin.

The UDFCD and Town of Columbine Valley constructed a 100-year capacity channel on Dutch Creek from the South Platte River to Platte Canyon Drive.

Major drainageway planning reports have been completed for all of the major drainageways in the populated areas of the county. These reports designate various structural measures and nonstructural actions that would be appropriate to alleviate potential flood damage along these streams.

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 the peak discharge-frequency relationships for each flooding source studied in detail affecting the geographic area of Arapahoe County.

Recorded flood information for the majority of the streams studied by detailed methods within Arapahoe County is nonexistent. Good records do exist for the South Platte River and Cherry Creek. Due to the construction of Chatfield Dam, the recorded information on the South Platte River is not applicable. As a result, synthetically derived hydrographs were computed to determine potential flood magnitudes for those streams with relatively small drainage basins in the Denver metropolitan area. These hydrographs reflect the effects of precipitation, ground cover, slope, drainage area, and other physical characteristics of the drainage basins. The synthetic hydrograph method was used on Big Dry Creek, Piney Creek, Cottonwood Creek, Murphy Creek, Cherry Creek, and South Platte River. Where available, hydrologic data were compared with other studies completed in the area (References 30, 34, and 35).

For the large drainage basins to the east of the Denver metropolitan area, flood magnitudes for the selected frequencies were computed using the USGS regional analysis outlined in Water Supply Paper 1680 (Reference 36) for Region B, Area 10. The relationship between flood magnitude and frequency, as portrayed in the composite frequency curve in Water-Supply Paper 1680, was extrapolated to give a ratio of 100-year flood discharge to mean annual discharge as the basis for the regional curve in Figures 1, 2, 3, and 4. The streams whose hydrology was derived from this regional analysis were the upper reaches of Piney Creek and Coal Creek, Lone Tree Creek, Senac Creek, 1-05-4412 Creek, West Box Elder Creek, Box Elder Creek, Kiowa Creek, Wolf Creek., Comanche Creek, Little Comanche Creek, West Bijou Creek, Middle Bijou Creek, and Deer Trail Creek. This curve was used as a comparison for synthetically generated hydrograph flows for each stream in the study. For some streams, the 100-year flood discharge generated by hydrograph methods is higher than the curve would indicate due to the effects of recent urbanization.

The South Platte River peak discharges for the 100- and 500-year floods below the dam were computed to reflect information on the operation of Chatfield Dam. For that reason, the South Platte River does not match the USGS regional data.

Rainfall data for the synthetic hydrologic analyses was taken from the UDFCD Urban Storm Drainage Criteria Manual (Reference 37). Synthetic hydrograph procedures used in the study included the Colorado Urban Hydrograph Procedure (CUHP), outlined in the UDFCD Manual (Reference 37), and the COE HEC-1 Flood Hydrograph Package (Reference 38). The 500-year flood discharges for all

detailed-study streams were checked by straight-line extrapolation of frequencies previously determined using the procedure of the USGS (References 27 and 36), and compared to the COE Standard Project Flood data when available.

Hydrologic analyses included in the Flood Insurance Studies for the incorporated communities of Aurora, Cherry Hills Village, Littleton, and Sheridan were incorporated into the restudy in their entirety with the exception of streams or portions of streams which were superseded by more up-to-date information (References 2, 3, and 5 through 9).

In addition, hydrologic data from various engineering reports (discussed in Section 7.0) were used extensively in the restudy of Arapahoe County. The methods used in these reports include CUHP, MITCAT, and Stormwater Management Model (References 10, 11, 12, 13, 14, 15, and 16).

Peak discharge-drainage area relationships for the streams studied by detailed methods within Arapahoe County, except Spring Creek and SJCD 6100, are shown in Table 3 and Figures 1, 2, 3, and 4.

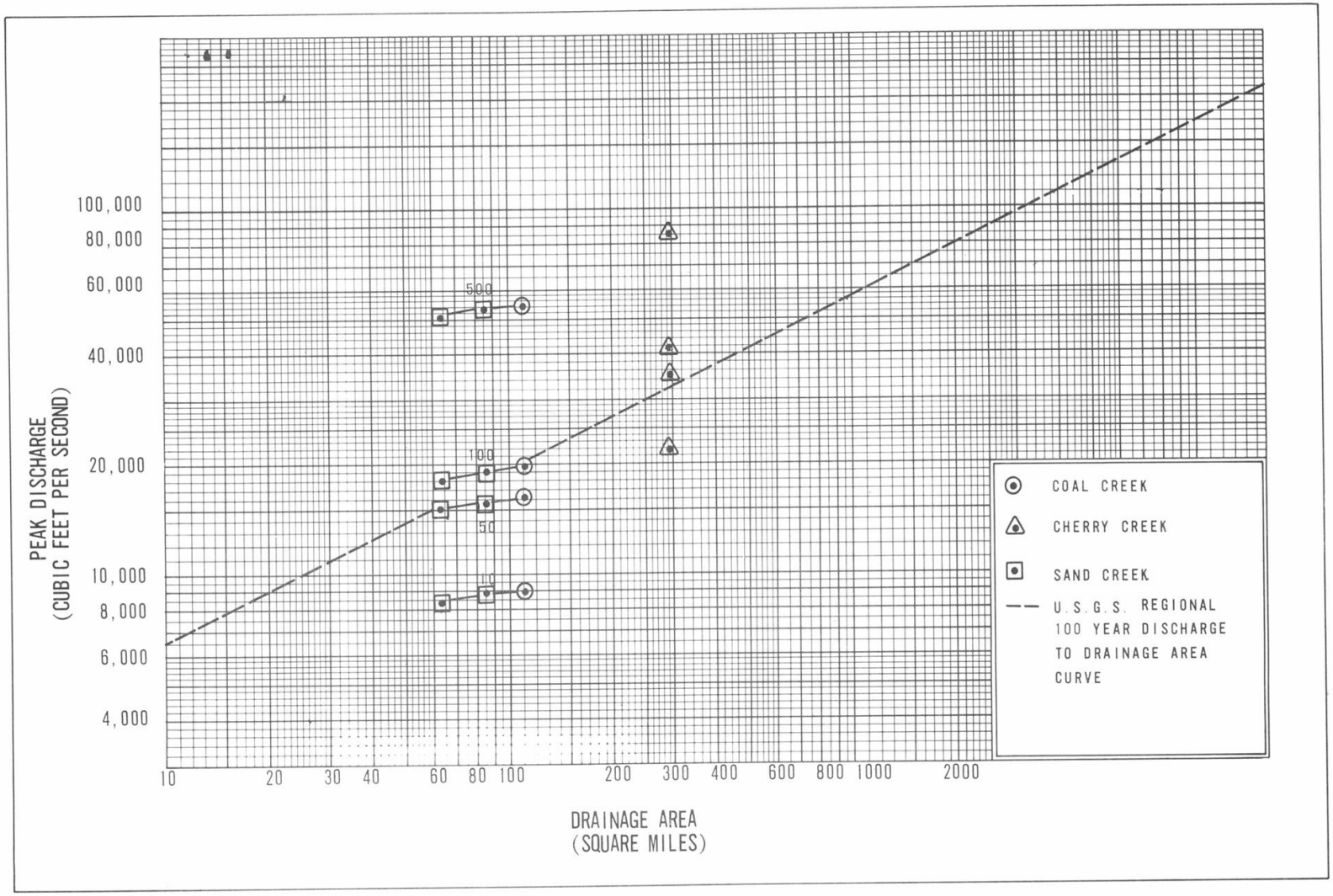


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO
AND INCORPORATED AREAS

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

COAL CREEK, CHERRY CREEK, SAND CREEK

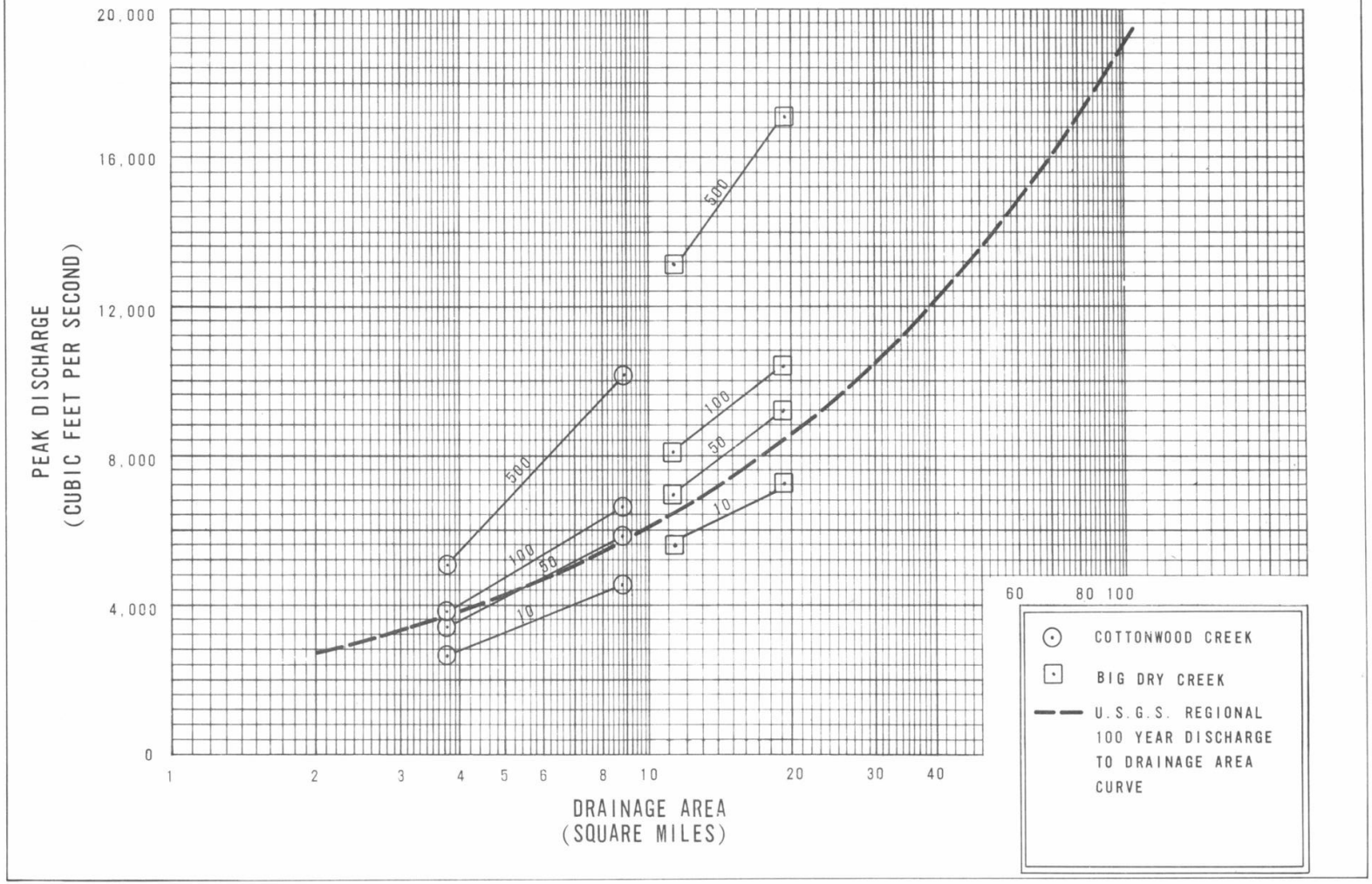


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO
AND INCORPORATED AREAS

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

COTTONWOOD CREEK, BIG DRY CREEK

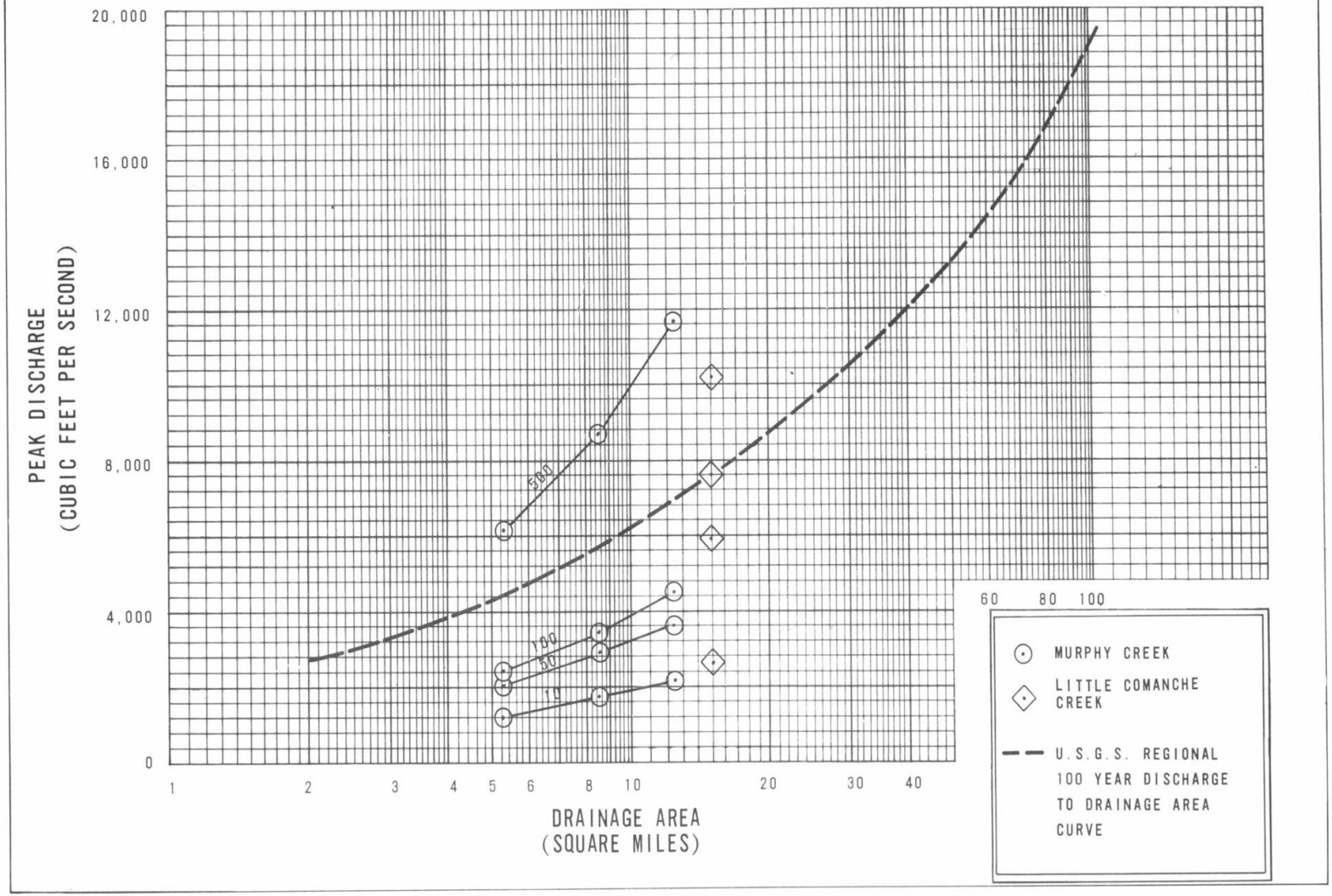


FIGURE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO
AND INCORPORATED AREAS

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

MURPHY CREEK, LITTLE COMANCHE CREEK

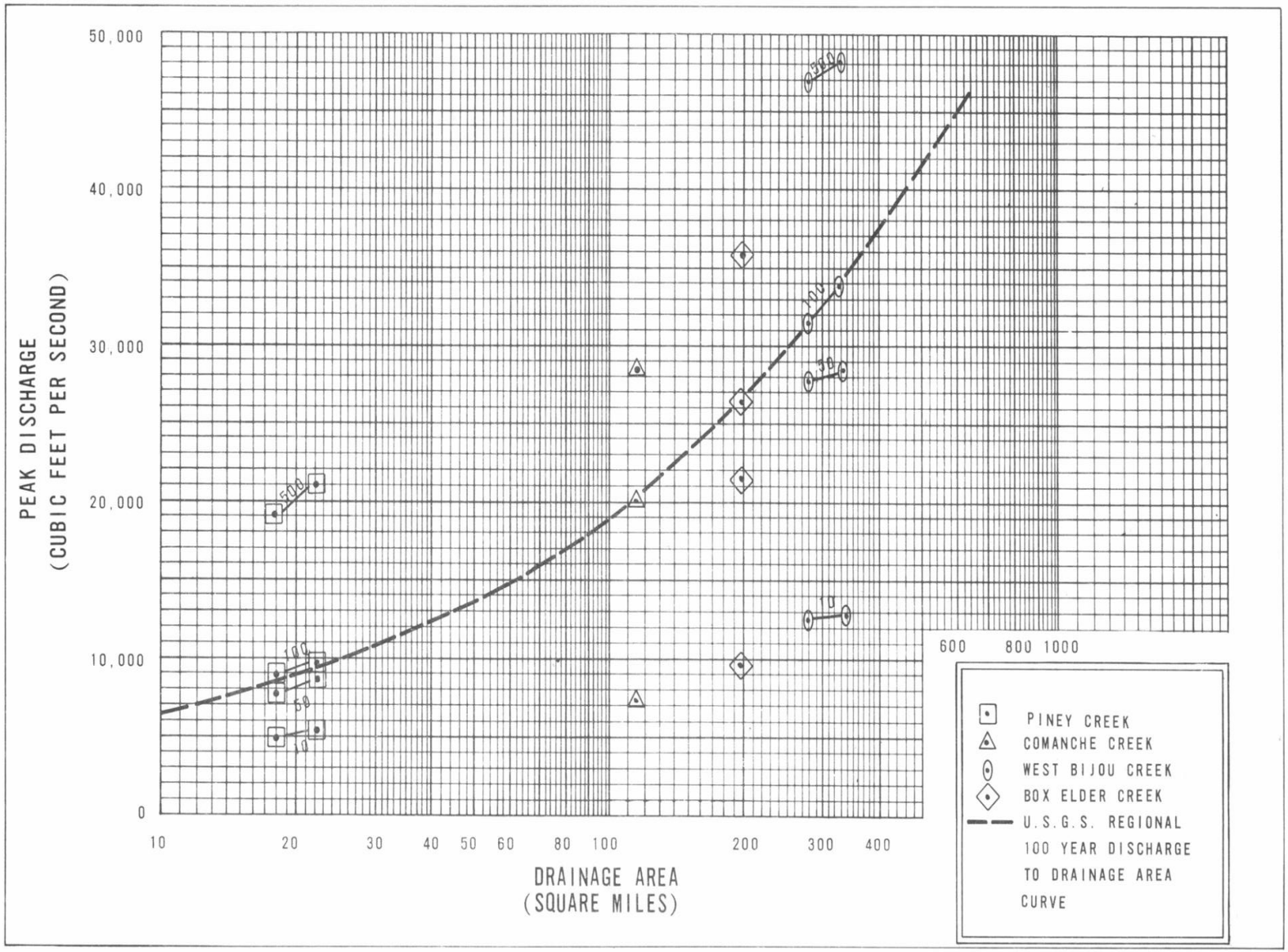


FIGURE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO
AND INCORPORATED AREAS

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

PINEY CREEK , COMANCHE CREEK
WEST BIJOU CREEK , BOX ELDER CREEK

TABLE 3 – SUMMARY OF DISCHARGES

Flooding Source/Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Antelope Creek					
At Confluence with Piney Creek	2.5	730	1,820	2,430	4,060
Antelope Creek Split Flow					
At Confluence with Piney Creek	--[1]	--[2]	138	210	428
Bear Creek					
At Mouth	22	4,170	6,920	8,150	11,280
Bear Gulch					
At Mouth	19.8	1410	4360	6300	10200
Big Dry Creek					
Above Windermere Street	11.0	5,100	7,000	8,100	13,100
At Confluence with South Platte River	19.0	7,100	9,100	10,400	17,200
At Littleton Boulevard	19.5	7,000	9,250	10,400	10,750
Blackmer Gulch					
At Confluence with Greenwood Gulch	2.3	1,390	1,850	1,950	2,330
At Confluence with Quincy Gulch	1.5	780	1,040	1,100	1,330
At Holly Street	0.5	385	500	540	640
Box Elder Creek					
Upstream of Coyote Run	173.5	780	5,520	8,760	15,000
At I-70	165.5	780	5,560	8,820	15,100
At Upstream Limit of Study	127.2	780	5,590	8,880	15,200
Cardboard Draw					
At Mouth	2.3	270	710	990	1,520
Cherry Creek					
At Downstream Limit of Study	340	10,300	31,000	51,000	150,000
	169	3,300	9,300	13,300	63,000
Cherry Creek Spillway Drain					
At Mouth	1.9	610	2,100	3,180	7,700
Cherry Creek (Right Overbank Split Flow)					
At Arapahoe Road	--[1]	1	2,090	7,077	62,211
Coon Creek					
At Confluence with Dutch Creek	--[1]	--[1]	--[1]	2,900	--[1]

Flooding Source/Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Cottonwood Creek					
At Peoria Street	--[1]	2,630	3,880	4,690	6,220
Downstream of Peakview Avenue	--[1]	2,340	3,410	3,910	4,760
At Easter Avenue	--[1]	2,070	3,040	3,500	4,220
Downstream of Airport Tributary	--[1]	1,960	3,430	4,200	5,470
Coyote Run					
At Mouth	28.7	1,750	5,960	8,600	13,600
I-70/US-36	17.0	1,680	4,960	6,940	10,800
Below confluence with Woodrat Gulch	8.5	960	2,840	3,970	6,130
Dutch Creek					
Upstream of Platte Canyon Road	--[1]	--[1]	--[1]	7,400	--[1]
East Toll Gate Creek					
Above Confluence with West Toll Gate Creek	10.8	1,420	4,800	7,500	18,500
At Confluence with Side Creek	8.9	1,600	5,400	8,100	19,300
At Hampden Avenue	2.6	430	800	1,060	3,400
At South Gun Club Road	1.5	390	860	1,250	2,900
At Aurora Parkway	0.3	130	220	270	1,110
First Creek					
Upstream of Smith Road	--[1]	1,930	--[1]	4,000	--[1]
At I-70	11.6	1,230	3,300	4,790	6,750
At 6th Avenue	4.5	450	1,450	1,910	2,810
First Creek Tributary T					
At Picadilly Road	8.1	530	1,770	2,530	4,030
At Harvest Road	2.7	610	1,790	2,510	3,440
Granby Ditch					
At Mouth	3.74	1,800	2,460	2,775	3,450
Above Confluence with Sable Ditch	2.28	935	1,280	1,445	1,800
At Colfax Avenue	1.96	488	876	1,080	1,732
At Laredo Street	1.38	212	372	447	1,170
Goldsmith Gulch					
At Belleview Road	2.6	1,270	1,950	2,250	3,050
West Tributary to Goldsmith Gulch					
At Orchard Road	1.3	530	840	1,000	1,380
Greenwood Gulch					
At Belleview Road	3.3	1,800	2,550	2,750	3,200
At Confluence with Prentice Creek	2.7	1,700	2,300	2,450	2,800
At Orchard Road	1.2	1,100	1,500	1,600	1,850

Flooding Source/Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Happy Canyon Creek					
U/S of Confluence with Cherry Creek	--[1]	--[1]	--[1]	3,690	--[1]
Havana Tributary					
At confluence with Cottonwood Creek	--[1]	660	1,080	1,360	1,970
Inverness Tributary					
At confluence with Cottonwood Creek	--[1]	530	870	1,100	1,610
Lee Gulch					
At Confluence with South Platte River	2.5	1,900	2,500	2,900	4,500
Little's Creek					
At Confluence with South Platte River	2.3	1,800	2,300	2,800	4,200
Little Dry Creek					
Upstream of Uinta Street	0.73	755	1,317	1,587	2,140
Upstream of Arapahoe Road	1.55	1,113	2,157	2,673	3,725
Holly Dam	2.07	1,183	2,413	3,076	4,330
Clarkson Street	23.66	2,275	3,750	4,580	5,970
Logan Street	--[1]	2,275[3]	3,210	3,540	5,960
Cinderella Conduit Entrance	--[1]	2,350[3]	3,340	3,660	6,090[3]
South Platte River Confluence	24.96	2,470[3]	3,420	3,770	6,200
Lone Tree Creek					
Downstream of Arapahoe Airport Runway	0.31	54	227	259	--[1]
At Cherry Creek Rec. Area Boundary	1.64	1,085	1,841	2,205	--[1]
Murphy Creek					
Upstream of the Confluence with Murphy Creek Tributary	0.09	86	154	181	234
Downstream of the Confluence with Murphy Creek Tributary	--[1]	329	592	704	874
Approximately 1,093 upstream of East Alexander Drive	0.98	624	1,168	1,425	1,838
At Mouth	--[1]	--[1]	--[1]	4,450	--[1]
Murphy Creek Tributary					
Upstream of the Confluence with Murphy Creek	--[1]	243	438	525	640
Peoria Tributary					
At confluence with Cottonwood Creek	--[1]	430	710	880	1,400
Prairie Dog Draw					
At Mouth	6.3	850	2,200	3,020	4,600

Flooding Source/Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Prentice Gulch					
At Mouth	0.8	640	870	920	1,030[2]
Quincy Gulch					
At Confluence with Blackmer Gulch	0.8	610	810	850	1,000
At South Bellaire Street	0.4	320	420	445	550
Rat Run					
At Mouth	2.9	440	1,120	1,530	2,310
Sable Ditch					
Above Confluence with Granby Ditch	1.46	910	1,250	1,405	1,760
At Colfax Avenue	1.02	730	1,030	1,030	1,410
Sand Creek					
At Mouth	147	10,000	22,000	29,000	55,000
At Colfax Avenue	97	6,700	15,900	21,500	45,000
Second Creek					
At downstream Limit of Study	7.7	870	2,871	4,122	6,035
At 56th Avenue	1.8	291	960	1,356	1,933
Slaughterhouse Gulch					
At Confluence with South Platte River	2.0	1,400	1,700	2,000	2,900
South Tributary to Slaughterhouse Gulch					
At Confluence w/ Slaughterhouse Gulch	.37	438	520	550	720
SJCD 6200					
Upstream of Platte Canyon Road	--[1]	--[1]	--[1]	2,280	--[1]
South Platte River					
Approximately 100 Feet Downstream of Confluence with Bear Creek	--[1]	4,900	10,900	14,600	25,000
Just Upstream of Confluence with Bear Creek	--[1]	4,900	10,300	13,500	23,000
Just Downstream of Confluence with Big Dry Creek	--[1]	4,300	9,500	12,700	22,000
Approximately 100 Feet Upstream of Confluence with Big Dry Creek	--[1]	3,300	6,900	8,900	15,000
Approximately 100 Feet Downstream of Confluence with Dutch Creek	--[1]	2,700	5,000	6,400	10,000
Just Upstream of Confluence with Dutch Creek	--[1]	1,300	2,200	2,700	4,000
Spring Creek					
At Confluence with Willow Creek	1.25	508	1,177	1,603	3,085
At Mineral Avenue	1.11	489	1,158	1,600	3,085

Flooding Source/Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
At County Line Road	0.71	401	907	1,259	2,440
Sterne Parkway Overflow					
250 feet downstream of South Broadway	--[1]	--[1]	--[1]	128	--[1]
Toll Gate Creek					
At Mouth	41	4,400	15,500	24,000	57,000
At East 6th Avenue	34.7	4,050	13,900	21,200	52,000
West Toll Gate Creek					
At East Mississippi Avenue	17.9	2,950	10,000	15,200	37,000
Below Confluence with West Toll Gate Tributary	16.9	2,800	9,400	14,400	35,000
At Buckley Road	14.8	2,150	7,300	11,200	27,400
Below Confluence with Unnamed Creek	13.1	1,100	3,650	5,900	14,000
At East Quincy Avenue	4.5	1,100	3,650	4,500	14,000
West Toll Gate Creek Tributary					
At Mouth	2.6	610	1,950	3,100	7,400
Unnamed Creek (Tributary to West Toll Gate Creek)					
At Mouth	6.1	1,150	3,900	6,000	14,200
Upstream of Picadilly Detention Pond	1.5	--[1]	--[1]	1,810	--[1]
Tributary to Unnamed Creek					
Upstream of Picadilly Detention Pond	0.6	--[1]	--[1]	1,290	--[1]
Westerly Creek					
At 14th Avenue	10.8	2,700	4,200	5,000	6,800
At Pond A-B	5.8	400	1,150	1,650	2,650
Willow Creek					
At Dry Creek Road	--[1]	3,410	7,000	9,010	12,140
At Quebec Street	--[1]	2,780	5,410	6,830	9,000
At County Line Road	--[1]	2,150	3,500	4,240	5,620
Woodrat Gulch					
At Mouth	3.4	470	1,280	1,780	2,740
Wolf Creek					
Upstream of Interstate 70	82.2	4,485	10,603	14,686	24,966
At Confluence with Wolf Creek Tributary	71.7	4,278	10,233	14,166	24,082
Wolf Creek Tributary					
At Mouth	3.5	571	1,185	1,578	2,683

[1]Data not available [2]No flow at this discharge [3]Value was extrapolated

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 FIRM represent founded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data Table in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

Water-surface elevation of floods of the selected recurrence intervals were computed through the use of the COE HEC-2 stepbackwater computer program (Reference 38). Starting water-surface elevations for the tributaries of the South Platte River were taken from previously computed stage-discharge relationships when available. 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.

Detailed cross section data for Cottonwood Creek, Cherry Creek, Piney Creek, Murphy Creek, Coal Creek, Comanche Creek, Little Comanche Creek, West Bijou Creek, and Box Elder Creek were field surveyed and were located at close intervals above and below culverts in order to compute the effects of backwater. For Little Dry Creek, Big Dry Creek, and Sand Creek, cross sections were taken from detailed topographic maps (References 30 and 34). Detailed mapping of the South Platte River was secured from the COE. The USGS topographic mapping, at a scale of 1:24,000, with a contour interval of 10 feet, was used to supplement field survey data (Reference 29).

Hydraulic analyses included in the Flood Insurance Studies for the incorporated communities of Aurora, Cherry Hills Village, Columbine Valley, Englewood, Greenwood Village, Littleton, and Sheridan were incorporated into the restudy in their entirety with the exception of streams or portions of streams which were superseded by more up-to-date information (References 2, 3, 5 through 9, 88, 89).

Hydraulic analyses for portions of First Creek, Piney Creek, Murphy Creek, Lone Tree Creek, Happy Canyon Creek, Cottonwood Creek, Lee Gulch, and Littles Creek were taken from published UDFCD reports (References 10, 11, 12, 13, 14, 15, and 16).

Additional hydraulic analyses from the various engineering reports discussed in Section 7.0 have been incorporated into the Arapahoe County restudy.

Hydraulic analyses for portions of Big Dry Creek Tributary A, East Tributary to West Toll Gate Creek, First Creek, Sampson Gulch, and Senac Creek were performed using topographic maps at a scale of 1:24,000, with a contour interval of

10 feet (Reference 39). Field surveyed cross sections were used and normal-depth calculations were performed in order to obtain top widths at the selected cross sections. Cross section information for channel geometry and surrounding areas was taken from existing reports (References 40, 41, 42, and 43).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

For the approximate studies, floodplain limits were defined by normal-depth calculations in approximate, typical cross sections taken from USGS maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles 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 Arapahoe 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 NGVD29 to NAVD88 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.

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 A, AE, AH, and AO); and the 0.2-percent-annual-chance floodplain boundary of areas of moderate flood hazards. In cases where the 1- and 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.

Approximate 1-percent-annual-chance floodplain boundaries in some portions of the study area were taken directly from the Flood Insurance Rate Map for the Town of Deer Trail, Colorado (Reference 59).

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

4.2 Floodways

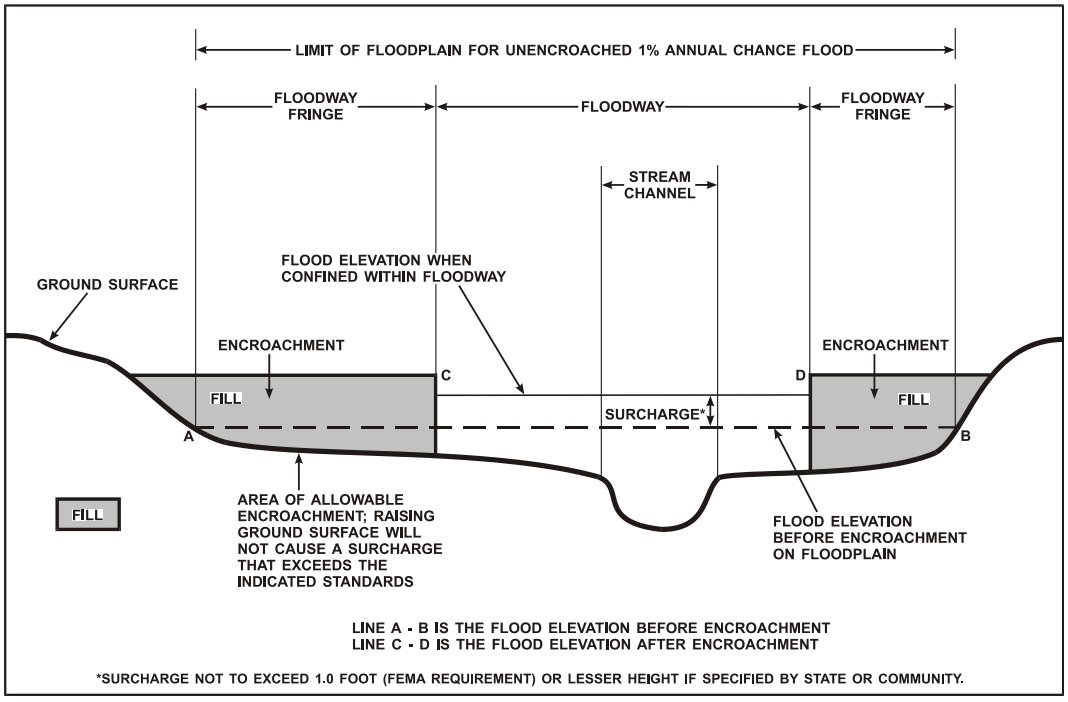
Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management

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 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 4). 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.

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 5.

Figure 5 - 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
AC	34,766	687	3,098	4.8	5,658.2	5,658.2	5,658.6	0.4
AD	36,166	405	1,789	8.1	5,663.0	5,663.0	5,663.3	0.3
AE	37,251	363	2,047	7.0	5,670.4	5,670.4	5,670.4	0.0
AF	37,709	293	1,555	9.3	5,671.7	5,671.7	5,672.0	0.3
AG	38,865	375	1,977	7.3	5,676.3	5,676.3	5,676.6	0.3
AH	40,291	336	2,095	6.9	5,689.0	5,689.0	5,689.0	0.0
AI	41,665	440	2,065	7.0	5,693.9	5,693.9	5,694.4	0.5
AJ	42,756	535	2,371	6.1	5,700.4	5,700.4	5,700.4	0.0
AK	44,195	581	2,452	5.9	5,708.4	5,708.4	5,708.4	0.0
AL	45,657	621	2,432	5.2	5,713.1	5,713.1	5,713.1	0.0
AM	47,917	500	1,673	7.6	5,725.7	5,725.7	5,725.8	0.1
AN	48,879	430	1,727	7.3	5,729.6	5,729.6	5,729.8	0.2
AO	49,841	449	2,141	5.9	5,735.7	5,735.7	5,736.0	0.3
AP	50,671	634	2,376	5.3	5,740.5	5,740.5	5,740.5	0.0
AQ	51,582	520	1,969	6.4	5,742.4	5,742.4	5,742.6	0.2
AR	53,194	461	2,249	5.6	5,752.1	5,752.1	5,752.2	0.1
AS	53,975	476	1,775	7.1	5,754.8	5,754.8	5,755.2	0.4
AT	54,632	418	3,781	3.3	5,763.6	5,763.6	5,763.6	0.0
AU	55,802	461	1,657	7.6	5,764.8	5,764.8	5,764.8	0.0
AV	57,691	581	1,857	6.7	5,774.1	5,774.1	5,774.1	0.0
AW	58,630	295	2,113	5.9	5,780.5	5,780.5	5,780.9	0.4

[1] FEET UPSTREAM CONFLUENCE WITH SAND CREEK

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

COAL 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
AX	60,576	200	1,177	10.6	5,790.3	5,790.3	5,790.3	0.0
AY	60,905	328	2,500	5.0	5,794.0	5,794.0	5,794.0	0.0
AZ	61,210	390	2,718	4.6	5,794.8	5,794.8	5,794.8	0.0
BA	62,003	384	2,304	5.4	5,802.0	5,802.0	5,802.0	0.0
BB	62,871	239	1,431	8.7	5,804.6	5,804.6	5,805.0	0.4
BC	63,246	378	1,971	6.3	5,807.8	5,807.8	5,807.8	0.0
BD	64,099	280	2,117	5.9	5,812.3	5,812.3	5,812.3	0.0
BE	64,754	270	1,378	9.0	5,814.2	5,814.2	5,814.6	0.4
BF	65,217	315	1,857	6.7	5,817.7	5,817.7	5,818.0	0.3
BG	65,833	310	1,437	8.7	5,827.2	5,827.2	5,827.2	0.0
BH	67,151	619	2,899	4.3	5,837.4	5,837.4	5,837.4	0.0
BI	69,018	370	1,545	8.1	5,845.4	5,845.4	5,845.6	0.2
BJ	71,001	681	2,856	4.4	5,860.7	5,860.7	5,860.7	0.0
BK	73,232	476	2,128	5.6	5,871.4	5,871.4	5,871.9	0.5
BL	74,410	420	2,230	5.3	5,877.1	5,877.1	5,877.6	0.5
BM	74,610	400	1,950	6.1	5,877.8	5,877.8	5,878.1	0.3
BN	75,198	317	1,572	7.6	5,880.0	5,880.0	5,880.5	0.5
BO	76,500	480	1,910	6.2	5,893.5	5,893.5	5,893.5	0.0
BP	77,136	565	1,866	6.4	5,896.4	5,896.4	5,896.5	0.1
BQ	78,267	423	1,317	9.0	5,902.3	5,902.3	5,902.4	0.1
BR	78,626	552	2,077	5.7	5,907.5	5,907.5	5,907.9	0.4

[1] FEET UPSTREAM CONFLUENCE WITH SAND CREEK

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

COAL 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
BS	79,556	614	1,245	9.6	5,912.3	5,912.3	5,912.3	0.0
BT	80,955	318	1,619	7.4	5,924.6	5,924.6	5,924.7	0.1
BU	82,088	397	2,550	4.7	5,930.5	5,930.5	5,930.5	0.0
BV	82,430	295	1,135	9.7	5,931.4	5,931.4	5,931.4	0.0
BW	85,700	492	3,299	3.3	5,952.9	5,952.9	5,953.4	0.5
BX	86,473	525	1,403	7.8	5,954.6	5,954.6	5,954.7	0.1

[1] FEET UPSTREAM CONFLUENCE WITH SAND CREEK

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

COAL CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
COON CREEK								
A	100	114	484	6.1	5,398.9	5,398.9	5,398.9	0.0
B	882	142	514	5.8	5,407.3	5,407.3	5,407.5	0.2

[1]Feet above confluence with Dutch Creek

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

COON CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
DUTCH CREEK								
A	115	153	785	9.5	5,330.4	5,330.4	5,330.4	0.1
B	1,756	139	776	9.6	5,339.7	5,339.7	5,339.7	0.0
C	2,307	130	682	10.9	5,344.6	5,344.6	5,344.6	0.0
D	4,573	159	1,181	6.3	5,365.0	5,365.0	5,365.0	0.0
E	7,898	163	719	10.2	5,388.2	5,388.2	5,388.4	0.2
F	9,397	133	818	8.9	5,397.6	5,397.6	5,397.6	0.0
G	9,697	151	747	9.8	5,400.2	5,400.2	5,400.3	0.1

[1]Feet above confluence with South Platte River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

DUTCH CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
THREE LAKES TRIBUTARY								
A	131	41	104	8.5	5,371.7	5,371.7	5,371.8	0.1
B	300	39	114	7.8	5,374.4	5,374.4	5,374.4	0.0

[1]Feet above confluence with Dutch Creek

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

THREE LAKES TRIBUTARY

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 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.

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 Arapahoe County, including those communities which fall within more than one county as described in Section 1.1. Previously, separate FIRMs were prepared for the cities of Aurora and Littleton, and for Arapahoe County and Incorporated Areas. 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 REVISION DATE(S)	FIRM EFFECTIVE DATE(S)	FIRM REVISION DATE(S)
Arapahoe County (Unincorporated Areas)	December 20, 1974		August 15, 1977	August 16, 1995
Aurora, City of	July 26, 1974		June 1, 1978	September 7, 1998
Centennial, City of	December 11, 2002		August 16, 1995	August 16, 1995
Cherry Hills Village, City of	May 10, 1974		August 1, 1978	August 16, 1995
Columbine Valley, Town of	January 25, 1974	April 23, 1976	June 15, 1978	December 2, 1980 August 16, 1995
*Deer Trail, City of	November 29, 1974			
Englewood, City of	February 9, 1972		July 1, 1974	April 11, 1975 June 24, 1977 July 28, 1978 December 5, 1979 August 16, 1995
*Foxfield, Town of				
Glendale, City of	April 17, 1989		April 17, 1989	August 16, 1995
Greenwood Village, City of	December 27, 1974		January 5, 1978	December 16, 1980 August 16, 1995
Littleton, City of	February 1, 1974		December 1, 1978	September 29, 1989
Sheridan, City of	May 3, 1974		July 13, 1976	December 4, 1985 August 16, 1995

*Non-Floodprone

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

This Flood Insurance Study supersedes all previous FIS reports and FIRMs covering the unincorporated areas of Arapahoe County and the incorporated areas of the Cities of Aurora, Centennial, Cherry Hills Village, Englewood, Glendale, Greenwood Village, Littleton, and Sheridan; and the Town of Columbine Valley (References 2, 5, 7, 8, 9, 10, 88 and 89).

The reaches of East Toll Gate Creek from Chambers Road to 1,300 feet upstream and from South Buckley Road to 0.8 mile upstream were analyzed by Merrick and Company and Greiner Engineering Sciences, Inc., respectively (References 18 and 19, respectively). The revised hydraulic analyses for West Toll Gate Creek from Mississippi Avenue to approximately 800 feet upstream of Mexico Avenue, and the portion of West Toll Gate Creek from South Buckley Road upstream to East Hampden Avenue were performed by the City of Aurora Engineering Division (References 21 and 22). The analyses for the portion of West Toll Gate Creek between East Hampden and East Quincy Avenues was performed by Merrick and Company (Reference 19). The hydrologic analyses for all the revisions were originally performed by the COE and Gingery and Associates for the effective FIS for Aurora (Reference 2).

Revised hydrologic and hydraulic analyses for the portion of Cherry Creek from Cherry Creek State Recreation Area to upstream of the Arapahoe/Douglas County line were performed by Greiner Engineering Sciences, Inc. as a part of the River Run Development Report (Reference 17).

The revised hydraulic analyses for portions of Prentice Gulch, Willow Creek, Greenwood Gulch, Spring Creek, Goldsmith Gulch, SJCD 6100, SJCD 6200, Dutch Creek, Coon Creek, and Lee Gulch were taken from published UDFCD reports (References 44, 60, 61, 62, 63, and 64).

Flood Insurance Studies have been prepared for the City and County of Denver and Adams, Douglas, and Jefferson Counties (References 65, 66, 67, and 68, respectively). Those studies are in general agreement with this study.

Historical data relating to the maps prepared for each community are presented in the Community Map History data (Table 5).

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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90. Urban Drainage and Flood Control District, Flood Hazard Area Delineation, Massey Draw and SJCD (South), prepared by Olsson Associates, December, 2005.

91. Urban Drainage and Flood Control District, Flood Hazard Area Delineation, Murphy Creek, prepared by Moser and Associates, September, 2006.

92. Urban Drainage and Flood Control District, Flood Hazard Area Delineation, Cottonwood Creek, prepared by Muller Engineering Company, Inc., August 2011.

93. Urban Drainage and Flood Control District, Flood Hazard Area Delineation, East Toll Gate Creek (Upper), prepared by J3 Engineering Consultants, December 2010.

94. Urban Drainage and Flood Control District, Flood Hazard Area Delineation, First Creek (Upstream of Buckley Road), prepared by Moser & Associates Engineering, October 2011.

95. Urban Drainage and Flood Control District, Flood Hazard Area Delineation, Piney Creek and Antelope Creek, prepared by WRC Engineering, Inc., December 2011.

96. Urban Drainage and Flood Control District, Flood Hazard Area Delineation, Second Creek (Upstream of Denver International Airport), Existing Conditions Flood Hazard Information developed with this study, prepared by Olsson Associates and Matrix Design Group, Inc., May 2011.

97. Urban Drainage and Flood Control District, Flood Hazard Area Delineation, Willow Creek, prepared by CH2M Hill, December 2010.

98. Urban Drainage and Flood Control District, Flood Hazard Area Delineation, Dutch Creek, Coon Creek, Lilley Gulch and Three Lakes Tributary, prepared by PBS&J, March 2008.

99. Urban Drainage and Flood Control District, Flood Hazard Area Delineation, Coal Creek (ARAPCO) Flood Hazard Area Delineation, prepared by Matrix Design Group, August 2014.

10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions 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

This study was revised on March 4, 1991, to show modifications to the flooding and base flood elevations along Little Dry Creek as the result of revised hydrology for the entire basin and culvert and channel improvements from the South Platte River upstream to Clarkson Street, as approved in the Conditional Letters of Map Revision issued on February 19, 1987, and August 21, 1987.

An updated hydrologic evaluation for Little Dry Creek was conducted by McLaughlin Water Engineers, Ltd. (MWE), in July 1986 to determine the 100-year flow by utilizing the 1982 version of Colorado Urban Hydrograph Procedure in conjunction with the UDSWM2-PC model. The 100-year discharge used for this floodplain analysis was taken from the updated 1986 hydrologic analysis for the 100-year event. The hydrologic analyses for the 10-, 50-, and 500-year events are based on an earlier report by Sellards and Grigg, Inc., in 1981. Along Little Dry Creek, the 100-year discharge of 3,770 cfs from the 1986 updated hydrologic study is lower than the 100-year discharge of 6,650 cfs presented in the previous Flood Insurance Study report due to the effects of the Holly and Englewood Dams.

The basis for this revision is the completion of a box culvert and channel improvements along Little Dry Creek from the confluence of the South Platte River to Clarkson Street in Englewood, Colorado. The box culvert, located approximately 800 feet upstream of Santa Fe Drive and approximately 600 feet downstream of South Broadway Street, was designed to convey the 10-, 50-, and 100-year floods. The 100- and 500-year floodplain and 100-year floodway delineations and base flood elevations were modified based on the following information:

- Drawings 1 through 12, XI and X2 of "as-built" plans entitled "Little Dry Creek - South Platte River to Clarkson Street, City of Englewood, Colorado; Floodplain Delineation for Constructed Improvements," prepared by MWE, dated April 1989, for the City of Englewood, Colorado.

- A report entitled "Hydraulic Calculations for Little Dry Creek through the City of Englewood," dated April 1989, also prepared by MWE. This report contains hydraulic calculations and HEC-2 hydraulic computer model runs

for the 10-, 50-, 100-, and 500-year recurrence interval floods for a reach of Little Dry Creek from the South Platte River to Clarkson Street.

These calculations and models reflect the effects of the construction of the culvert located from Santa Fe Drive upstream to Broadway Street, and channel improvements from the South Platte River to Santa Fe Drive and from Broadway Street to Clarkson Street. As a result of these improvements, the base flood elevations were decreased, and modifications to the floodway and the 100- and 500-year floodplain boundaries were made, as shown on Flood Insurance Rate Map Panels 0060 and 0070. Because a revised hydraulic analysis was not developed upstream of South Clarkson Street, there is an approximate Zone A transition from South Clarkson Street to the culvert entrance. Also, because the 500-year recurrence interval flood is not conveyed by the culvert, a separate water-surface profile panel labeled "500-year overflow" is included in the water-surface profile panels for Little Dry Creek.

Distances on the profiles and Floodway Data Tables have been corrected to reflect miles measured from the confluence with the South Platte River. Cross sections previously labeled A through BM along Little Dry Creek as shown on the Flood Insurance Rate Map have been relabeled 0 through CA to account for the addition of the new cross sections labeled A through N along the study reach. The water-surface profile panels for Little Dry Creek have also been renumbered in order to take into account the addition of six profiles for the study area, arid the profiles listed after Little Dry Creek in the Flood Insurance Study report have been renumbered as a result of this addition. The Floodway Data Tables and Summary of Discharges Table have also been revised to reflect the effects of the reanalysis.

The communities affected by this revision along Little Dry Creek are the unincorporated areas of Arapahoe County, the City of Cherry Hills Village, the City of Englewood, and the City of Greenwood Village.

The reach of Big Dry Creek from approximately 1,360 feet downstream of Colorado Boulevard to approximately 2,440 feet upstream of Colorado Boulevard has been revised to reflect the change in base flood elevations and floodway and floodplain delineations due to the newly built Colorado Boulevard Bridge and channel improvements. The COE HEC-2 hydraulic computer program was used by Merrick and Company to perform the new hydraulic analyses. The 100-year floodway and floodplain delineations were also prepared by Merrick and Company on a topographic map at a scale of 1:50, with a contour interval of 2 feet (Reference 69). The Floodway Data Table and Flood Profile Panels for Big Dry Creek have been revised between cross sections BA and BE as a result of this analysis.

This revision also incorporated the Letter of Map Revision (LOMR) issued for Arapahoe County, Colorado on August 13, 1990, for an area along Cottonwood Creek from an existing pedestrian bridge (located approximately 900 feet upstream of Inverness Drive East) to County Line Road. This LOMR was based

on better topographic data and a revised hydraulic analysis. The basis for this LOMR was the following submitted data: a report entitled "Request for Letter of Map Revision and Request for Conditional Letter of Map Revision for Cottonwood Creek, Arapahoe County, Colorado," dated March 1990, and prepared by Greenhorne & O'Mara, Inc., and an asbuilt drawing entitled "Cottonwood Creek Floodplain and Floodway for Letter of Map Revision," dated January 1990, prepared by Greenhorne & O'Mara, Inc. As a result of the above-referenced data, profile panels were also revised.

10.2 Second Revision

This study was revised on December 3, 1993, to show revised floodplain analyses for Big Dry Creek, Goldsmith Gulch, Piney Creek, and Willow Creek.

The hydraulic analysis was performed by Love & Associates, Inc., Boulder, Colorado, for the Federal Emergency Management Agency (FEMA) under their Limited Map Maintenance Program (LMMP), Contract No. EMW-90-C-3132, completed in March 1992.

An initial Consultation and Coordination Officer (CCO) meeting was held in July 1990, and attended by representatives of Arapahoe County, FEMA, and Love & Associates, Inc.

Contacts to acquire information were made with the Arapahoe County Department of Highways /Engineering, the Urban Drainage and Flood Control District, and FEMA. The area of study included portions of the City of Greenwood Village and the unincorporated areas of Arapahoe County.

Principal Flood Problems

Factors that aggravate flood problems: All streams studied in this Flood Insurance Study have had structural improvements, but intense and infrequent thunderstorms can generate floods in excess of existing structural capacities. Urbanization has occurred and development continues along these streams. This will increase debris loading in flood events and cause obstruction of bridges and culverts, thus causing more extensive damage.

Flood Protection Measures

Structures: Drop structures have been constructed on several of the creeks studied, as well as improved culverts and bridges on roads.

Dams: Englewood Dam, located on Willow Creek, provides flood protection for the area around Willow Creek downstream of the dam to its confluence with Little Dry Creek.

Hydrologic Analyses

In general, the only source of hydrologic information for these creeks is the previous Flood Insurance Studies and HEC-2 decks, although some additional information was available for Big Dry Creek and Willow Creek.

Goldsmith Gulch

The only source of information for Goldsmith Gulch in the LMMP study reach is the previous Flood Insurance Study HEC-2 deck in which the discharge varies by reach. At Dayton Street the 100-year discharge is 1,090 cubic feet per second (cfs) and at the outlet of Arapahoe Lake the 100-year discharge is 800 cfs.

Piney Creek

The only source of information for Piney Creek hydrology is the previous Flood Insurance Study HEC-2 deck in which the discharge varies by reach. The discharges at Parker Road are:

Return Period (year)	Flood Insurance Study (cfs)
10	5,400
50	8,500
100	9,800
500	21,000

Willow Creek

The primary source of information for Willow Creek is the McCall, Ellingson & Morrill (1974) report which was used for the previous Flood Insurance Study. The computer model input was unavailable for this study. Greenhorne & O'Mara (1989) used the McCall, Ellingson & Morrill report as a basis for a study located upstream of Englewood Dam. Downstream of Englewood Dam, the McCall, Ellingson & Morrill report presents a flow rate at the confluence with Little Dry Creek, but does not report the outflow rate of the dam. McLaughlin Water Engineers (1986) present flow rates for the outlet of Englewood Dam and at the confluence with Little Dry Creek. The 100-year discharge from each of these sources is presented below (References 70, 71, and 72).

Willow Creek 100-Year Discharges

Downstream of Englewood Dam		Upstream of Englewood Dam			
Confluence with Little Dry Creek (0.37 mi^2)	Englewood Dam outlet outflow	Dry Creek Road (8.1 mi^2)	Upstream of Confluence with Tributary (6.9 mi^2)	Quebec Street (6.55 mi^2)	Mineral Avenue (5.46 mi^2)
660[1]	190[2]	6100[1]	5200[1]	5070[3]	4600[1]
880[2]					

[1] McCall, Ellingson & Morrill (1974)
[2] McLaughlin Water Engineers (1986)
[3] Greenhorne & O'Mara (1989)

Big Dry Creek

Two sources of information exist for Big Dry Creek. The first is a previous Flood Insurance Study HEC-2 deck, and the second is a FEMA accepted Letter of Map Revision (LOMR) for the channel from approximately 2,000 feet upstream of South Colorado Boulevard to approximately 1,000 feet downstream of South Colorado Boulevard (Reference 73). The table below shows the flow rates for Big Dry Creek at South Colorado Boulevard. The 100-year flow rates for the two FEMA accepted studies differ by over 1,000 cfs at this location. The data from the 1974 Flood Insurance Study were used for this study.

Big Dry Creek at South Colorado Boulevard

Return Period (year)	Flood Insurance Study (1974)	LOMR (1988)
10	6,673	
50	8,520	
100	9,757	8,600
500	15,968	

Hydraulic Analysis

Cross section data for streams in the area were digitized from maps and copied from previous HEC-2 decks.

All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Roughness coefficients (Manning's "n") were estimated from field inspection and photographs of the study reaches. Water-surface profiles were developed using the HEC-2 computer backwater model (Reference 74). Profiles were determined

for the 100-year floods on Goldsmith Gulch and Willow Creek, and the 10-, 50-, 100-, and 500-year floods for Piney Creek and Big Dry Creek.

The starting water-surface elevations for all streams were obtained from the previous Flood Insurance Study.

All elevations are referenced to National Geodetic Vertical Datum of 1929.

Maps used for floodplain boundaries are as follows:

1) Topographic maps used as work maps: Scale 1:1,200, Contour interval 2 feet, (References 75, 76, 77, and 78)

2) Arapahoe County Base Maps: Scale 1:2,400, no contours (Reference 79)

3) USGS quad map; Highlands Ranch Quadrangle: Scale 1:12,000, Contour interval 10 feet, (Reference 80)

4) Federal Emergency Management Agency, Flood Insurance Rate Map Panel 0800500095F; Arapahoe County: Scale 1:6,000, no contours (Reference 81)

Floodways

Equal conveyance reduction encroachment Method 4 was used for the floodway determination for Big Dry Creek and Piney Creek.

10.3 Third Revision

Digital Update

The mapping for this update has been prepared using digital data. Previously published Flood Insurance Rate Map data produced manually have been converted to vector digital data by a digitizing process. These vector data were fit to raster digital images of the USGS quadrangle maps of the county area to provide horizontal positioning.

Road, highway names and centerline data have been obtained from the United States Census Bureau's TIGER (Topologically Integrated Geographic Encoding and Referencing) File. The centerlines were modified to the positional accuracy of the USGS quadrangle, and the roads, highways, and street names were modified from the Flood Insurance Rate Map panels. The City of Aurora road and highway names and centerline data have been obtained from the City of Aurora, Department of Public Works, Geographic Information System. The adjusted centerline data were then computer plotted with the

digitized floodplain data to produce the countywide Flood Insurance Rate Map panels. Floodplain data for South Platte River were added based on work maps produced by Wright Water Engineers, Inc., for the Urban Drainage and Flood Control District in September 1987. Floodplain representation was matched to that in Denver County for a reach of 1,500 feet downstream (north) of Dartmouth Avenue.

Floodplain data for 3,600 feet of West Harvard Gulch were added to Arapahoe County based on work maps and analyses produced by Gingery Associates, Inc., for the Urban Drainage and Flood Control District, October 1978. Floodplain data were tied into that in Denver County at Colorado Southern Railroad (downstream) and South Zuni Street (upstream).

Floodplain data for Littles Creek were updated based upon hydrologic and hydraulic analyses performed by J. F. Sato and Associates for FEMA under Contract No. EMW-84-C-1631, completed in August 1985.

As a result of the channel improvement project for the reach of Littles Creek downstream from the Atchison, Topeka and Santa Fe and the Denver and Rio Grande Western railroads to its confluence with the South Platte River, the 100-year base flood would be contained within the channel. The hydraulic reanalysis for this reach of Littles Creek was performed by Love and Associates, Inc., in January 1989 (Reference 82).

The LOMR issued on July 15, 1991, for the City of Greenwood Village, to show the effects of more detailed topographic information along Prentice Gulch from the confluence of Greenwood Gulch to Holly Street, was included in this update. As a result of the more detailed topographic information, the 100-year floodplain boundary, base flood elevations, and floodway boundary have been revised along Prentice Gulch. The Floodway Data Table has also been updated.

The LOMR issued on April 20, 1992, for the City of Greenwood Village to show the effects of a revised hydraulic analysis which utilized better topographic data along Greenwood Gulch from the confluence with Prentice Gulch and Highline Canal upstream to South Holly Street was included in this update. As a result of the revised hydraulic analysis, the 100-year floodplain boundary, base flood elevations, floodway boundary, and Floodway Data Table were revised.

The LOMR issued on April 16, 1993, for the City of Greenwood Village to show the effects of channel improvements, which include realignment of the channel and more detailed topographic information along Goldsmith Gulch between East Belleview Avenue and South Yosemite Street was included in this update. As a result of the improvements and more detailed topographic information, the 100-year floodplain boundary and floodway have been shifted

approximately 150 feet to the east. In addition, base flood elevations were increased a maximum of 4 feet, from approximately 450 feet upstream of East Belleview Avenue to approximately 150 feet upstream of Yosemite Street. The Floodway Data Table has also been updated. The LOMR issued on September 26, 1994, for Arapahoe County to show the effects of more detailed topographic information and the existing bridge at East Iliff Avenue along Cherry Creek, from approximately 1,000 feet downstream of East Iliff Avenue to approximately 1,050 feet upstream of East Iliff Avenue, was included in this update. As a result of the more detailed topographic information, the elevations and floodplain boundary delineations along Cherry Creek have been revised.

10.4 Fourth Revision

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

The cities of Aurora, Littleton, and Centennial were added to the DFIRM as a part of this revision. Previously, Aurora and Littleton had separate FIRMs. Centennial was incorporated after the date of the previous effective FIS and FIRM.

Flood information used for the DFIRM conversion came from three sources: the UDFCD's Flood Hazard Area Delineation studies; the work maps from the original FIS; and the work maps from several Letters of Map Revision (LOMRs).

Flood Hazard Area Delineation Studies

The UDFCD published a Flood Hazard Area Delineation report (Reference 83) for the Lower Box Elder Creek watershed in September 2001. This report identified flood hazard information on Box Elder Creek and Bear Gulch. This report was incorporated into this FIS.

The UDFCD published a Flood Hazard Area Delineation report (Reference 84) for the Upper Box Elder Creek watershed in December, 1995. This report identified flood hazard information on Box Elder Creek, Coyote Run and several tributaries. This report was incorporated into this FIS.

The UDFCD published a Flood Hazard Area Delineation report (Reference 85) for the Cherry Creek watershed in May, 2003. This report identified flood hazard information on Cherry Creek from Cherry Creek Reservoir to the Douglas County line. This report was incorporated into this FIS.

The UDFCD published a Flood Hazard Area Delineation report (Reference 86) for the Little Dry Creek watershed in August, 2003. This report identified flood hazard

information on Little Dry Creek, Willow Creek, Greenwood Gulch, Quincy Gulch, Blackmer Gulch and Prentice Gulch. This report was incorporated into this FIS. An unpublished study revised the flood hazard information from Holly Dam to Quebec Street to correct obvious errors in the previous mapping.

The UDFCD published a Flood Hazard Area Delineation report (Reference 87) for the Upper Goldsmith Gulch watershed in April, 2005. This report identified flood hazard information on Goldsmith Gulch and the West Tributary. This report was incorporated into this FIS. An unpublished study revised the flood hazard information immediately above Caley Avenue to reflect a new detention pond.

The UDFCD published a Flood Hazard Area Delineation report (Reference 90) for the Massey Draw and SJCD 6200 watersheds in December, 2005. This report identified flood hazard information on SJCD 6200 and the North Tributary. This report was incorporated into this FIS.

The UDFCD published a Flood Hazard Area Delineation report (Reference 91) for the Murphy Creek watershed in September, 2006. This report identified flood hazard information on Murphy Creek. This report was incorporated into this FIS.

10.5 Fifth Revision

This study was revised on _____, to incorporate six different Flood Hazard Area Delineation Reports from UDFCD and several LOMRs.

The UDFCD published a Flood Hazard Area Delineation report (Reference 92) for Cottonwood Creek and its tributaries in August 2011. The analysis was conducted by Muller Engineering Company, Inc., and identified flood hazard information on Cottonwood Creek, Havana Tributary, Inverness Tributary, and Peoria Tributary. This report was incorporated into this FIS and the DFIRM.

The UDFCD published a Flood Hazard Area Delineation report (Reference 93) for upper East Toll Gate Creek in December 2010. The analysis was conducted by J3 Engineering Consultants and identified flood hazard information on East Toll Gate Creek. This report was incorporated into this FIS and the DFIRM.

The UDFCD published a Flood Hazard Area Delineation report (Reference 94) for First Creek and its tributary in October 2011. The analysis was conducted by Moser and Associates Engineering, and identified flood hazard information on First Creek, First Creek Tributary T, and First Creek – E470 Split. This report was incorporated into this FIS and the DFIRM.

The UDFCD published a Flood Hazard Area Delineation report (Reference 95) for Piney Creek and Antelope Creek in December 2011. The analysis was conducted

by WRC Engineering, Inc., and identified flood hazard information on Piney Creek, Piney Creek Split Flow, Antelope Creek, and Antelope Creek Split Flow. This report was incorporated into this FIS and DFIRM.

The UDFCD published a Flood Hazard Area Delineation report (Reference 96) for Second Creek in May 2011. This analysis was conducted by Olsson Associates and Matrix Design Group, Inc., and identified flood hazard information on Second Creek upstream of Denver International Airport. This report was incorporated into this FIS and DFIRM.

The UDFCD published a Flood Hazard Area Delineation report (Reference 97) for Willow Creek in December 2010. This analysis was conducted by CH2M Hill and identified flood hazard information on Willow Creek. The existing conditions flood hazard area information developed with this report was incorporated into this FIS and DFIRM.

10.6 Sixth Revision

This study was revised on _____, to incorporate the Flood Hazard Area Delineation Reports from UDFCD as described below.

The UDFCD published a Flood Hazard Area Delineation report (Reference 98) for Dutch Creek, Coon Creek, Lilley Gulch and Three Lakes Tributary in March 2008. The analysis was conducted by PBS&J, and identified flood hazard information on the above stream reaches. This report was incorporated into this revision of the FIS and DFIRM for portions of Dutch Creek, Coon Creek and Three Lakes Tributary.

The UDFCD published a Flood Hazard Area Delineation report (Reference 99) for Coal Creek in August 2014. The analysis was conducted by Matrix Design Group, and identified flood hazard information on the above stream reaches. This report was incorporated into this revision of the FIS and DFIRM for portions of Coal Creek in Arapahoe County.

a. Acknowledgments

The Dutch Creek, Coon Creek and Three Lakes Tributary study flow path through Arapahoe County, Colorado were performed by PBS&J for Urban Drainage and Flood Control District as part of the "Flood Hazard Area Delineation Dutch Creek, Coon Creek, Lilley Gulch, and Three Lakes Tributary". FEMA reviewed and accepted these data for the purposes of this revision (Pending).

The Coal Creek study flow path through Arapahoe County, Colorado were performed by Matrix Design Group, Inc. for Urban Drainage and Flood Control District as part of the "Flood Hazard Area Delineation Sand Creek

Colfax to Yale Study". FEMA reviewed and accepted these data for the purposes of this revision (Pending).

b. Scope

Detailed hydrologic and hydraulic analyses were conducted for these portions of Dutch Creek, Coon Creek and Three Lakes Tributary. This portion of Coon Creek is approximately 1,460 feet long, Dutch Creek is approximately 9840 feet long. Three Lakes Tributary is approximately 510 feet long.

Detailed hydrologic and hydraulic analyses were conducted for this portion of Coal Creek. Topography within the study area generally slopes to the northwest with slopes ranging from 0 to 4 percent. The lowest and highest elevations within the study area are 5,640 feet and 5,960 feet NAVD, respectively. This portion of Coal Creek is approximately 52,440 feet long, measured along the low flow channel inside the study area, starting at the approximately 690 feet upstream of the Corporate Limits of the City of Aurora and ending at the Arapahoe County corporate limits. Coal Creek is a broad, natural drainageway with mild to steep sloping banks.

c. Hydrology

For Dutch Creek, Coon Creek, Three Lakes Tributary and Coal Creek study, Peak discharges for the 0.2-, 1-, 2, and 10-percent-annual-chance of occurrence events were analyzed using the Colorado Urban Hydrograph Procedure (CUHP 2005), version 1.3.3, to generate hydrographs for each subwatershed. Hydrographs for the subwatersheds were routed using the Environmental Protection Agency Stormwater Management Model (EPA SWMM), version 5.0, to determine peak discharge rates at selected design points. The EPA SWMM results were then compared to watersheds of similar size and imperviousness.

d. Hydraulic

For Dutch Creek, Coon Creek and Three Lakes Tributary study, the U.S. Army Corps of Engineer's step backwater program HEC-RAS, Version 3.1.3, was used for the floodplain analysis of the drainage ways. Cross sections used by the HEC-RAS model were developed from the digital elevation model (DEM) developed from the breakline survey file provided by Urban Drainage under separate survey contract. Bridges and culverts were individually surveyed or measured in the field.

For Coal Creek Study, the U.S. Army Corps of Engineer's step backwater program HEC-RAS, Version 4.1.0, was used for the floodplain analysis of the drainage ways. Cross sections used by the HEC-RAS model were developed electronically by cutting the triangulated irregular network (TIN) developed from the USGS topographic 2-foot contour mapping provided by UDFCD. Bridges and culverts were individually surveyed or measured in the field. The average spacing of cross sections is 372 feet, with the maximum spacing at 702 feet.

A steady flow analysis was utilized to determine the flood profiles for the 0.2-, 1-, 2, and 10-percent-annual-chance storm events. Flow change locations were established at critical design points where there are significant changes in hydrology as determined by the EPA SWMM model. Between flow change locations, steady flow is maintained for defined channel segments along the reach.

e. Manning

For Dutch Creek, Coon Creek and Three Lakes Tributary study, estimates of channel and overbank roughness were made from aerial photographs and field observations. Manning's 'n' values ranged from 0.03 to 0.045 in the channel and from 0.03 to 0.08 in the overbank areas. Blocked obstructions and ineffective flow were utilized to account for large structures and flow conveyance paths.

For Coal Creek Study, estimates of channel and overbank roughness for existing conditions were made from aerial photographs and field observation, and through experience for future fully developed conditions. Manning's n values in the hydraulic model ranged from 0.035 to 0.075 in the channel section, and from 0.02 to 0.08 in the overbank areas.

Summary of peak discharges for the revised streams in this revision are displayed below.

		Peak Discharges (Cubic Feet per Second)			
Flooding Source/Location	Drainage Area (Square Miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Coal Creek					
At East Yale Avenue	--[1]	4,972	11,489	14,982	21,714
At Mutchie Creek Confluence	--[1]	4,698	11,003	14,425	20,928
Approximately 2,700 ft Upstream of E. Quincy	--[1]	3,095	9,177	12,656	19,154
At Llama Drow	--[1]	2,505	8,614	11,919	17,916
County Line Road	--[1]	2,495	8,035	10,991	16,351

Flooding Source/Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Coon Creek					
At County Boundary	--[1]	1,215	2,333	2,958	3,982
Dutch Creek					
At County Boundary	--[1]	1,700	3,213	4,380	6,252
At confluence of Coon Creek	--[1]	2,925	5,826	7,293	10,308
Approximately 320 feet downstream of confluence of three lakes tributary	--[1]	2,947	5,452	7,446	10,561
Three Lakes Tributary					
Approximately 300 feet upstream of confluence with Dutch Creek	--[1]	397	719	882	1,171

[1]Data not available

APPENDIX A

Figure 6. FIRM Notes to Users

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

The map is for use in administering the NFIP. It may not identify all areas subject to flooding, particularly from local drainage sources of small size. Consult the community map repository to find updated or additional flood hazard information.

BASE FLOOD ELEVATIONS: For more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations and/or Transect Data tables within this FIS Report. Use the flood elevation data within the FIS Report in conjunction with the FIRM for construction and/or floodplain management.

Coastal Base Flood Elevations shown on the map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Coastal flood elevations are also provided in the Summary of Stillwater Elevations table and Transect Data table in the FIS Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table and Transect Data table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on the FIRM.

FLOODWAY INFORMATION: Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the FIS Report for this jurisdiction.

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to the "Flood Protection Measures" section of this FIS Report for information on flood control structures for this jurisdiction.

PROJECTION INFORMATION: The projection used in the preparation of the map was Universal Transverse Mercator (UTM) Zone 10. The horizontal datum was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map

features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community listed on the FIRM Index.

BASE MAP INFORMATION: Base map information shown on this FIRM is current as of 2015, provided in digital format by the Arapahoe County, City of Aurora, and City of Littleton Geographic Information System (GIS) Departments.

The map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map.

Corporate limits shown on the map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after the map was published, map users should contact appropriate community officials to verify current corporate limit locations.

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Arapahoe County, Colorado, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to the FIRM Index to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before [*most recent FIRM panel date*].

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Arapahoe County, CO.

ACCREDITED LEVEE: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To mitigate flood risk in residual risk areas, property owners and

residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/national-flood-insurance-program.

FLOOD RISK REPORT: A Flood Risk Report (FRR) may be available for many of the flooding sources and communities referenced in this FIS Report. The FRR is provided to increase public awareness of flood risk by helping communities identify the areas within their jurisdictions that have the greatest risks. Although non-regulatory, the information provided within the FRR can assist communities in assessing and evaluating mitigation opportunities to reduce these risks. It can also be used by communities developing or updating flood risk mitigation plans. These plans allow communities to identify and evaluate opportunities to reduce potential loss of life and property. However, the FRR is not intended to be the final authoritative source of all flood risk data for a project area; rather, it should be used with other data sources to paint a comprehensive picture of flood risk.

Figure 7. Map Legend for FIRM

SPECIAL FLOOD HAZARD AREAS: *The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. See note for specific types. If the floodway is too narrow to be shown, a note is shown.*

Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)

Zone A — The flood insurance rate zone that corresponds to the 1% annual chance floodplains. No base (1% annual chance) flood elevations (BFEs) or depths are shown within this zone.

Zone AE — The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone.

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

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

Zone AR — The flood insurance rate zone that corresponds to areas that were formerly protected from the 1% annual chance flood by a 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% annual chance or greater flood.

Zone A99 — The flood insurance rate zone that corresponds to areas of the 1% annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.

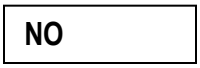
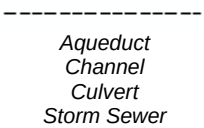
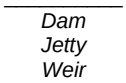
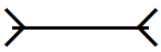
Zone V — The flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.

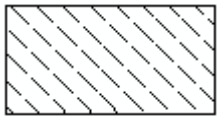
Zone VE — Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.

Regulatory Floodway determined in Zone AE.

OTHER AREAS OF FLOOD HAZARD

Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.

	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced the flood risk from the 1% annual chance flood. See Notes to Users for important information.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
(ortho) (vector)	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
	Channel, Culvert, Aqueduct, or Storm Sewer
	Dam, Jetty, Weir
	Levee, Dike, or Floodwall
	Bridge
COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas. See Notes to Users for important information.*	

 CBRS AREA 09/30/2009	Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.
 OTHERWISE PROTECTED AREA 09/30/2009	Otherwise Protected Area
REFERENCE MARKERS	
22.0 ●	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
B 20.2	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
5280 21.1	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
17.5	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
8	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
513	Base Flood Elevation Line
ZONE AE (EL 16)	Static Base Flood Elevation value (shown under zone label)
ZONE AO (DEPTH 2)	Zone designation with Depth
ZONE AO (DEPTH 2) (VEL 15 FPS)	Zone designation with Depth and Velocity

BASE MAP FEATURES

Missouri Creek	River, Stream or Other Hydrographic Feature
234	Interstate Highway
234	U.S. Highway
234	State Highway
234	County Highway
MAPLE LANE	Street, Road, Avenue Name, or Private Drive if shown on Flood Profile
RAILROAD	Railroad
	Horizontal Reference Grid Line
—	Horizontal Reference Grid Ticks
+	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
$^{42}76^{000m}$E	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16’ 52.5”	Corner Coordinates (Latitude, Longitude)