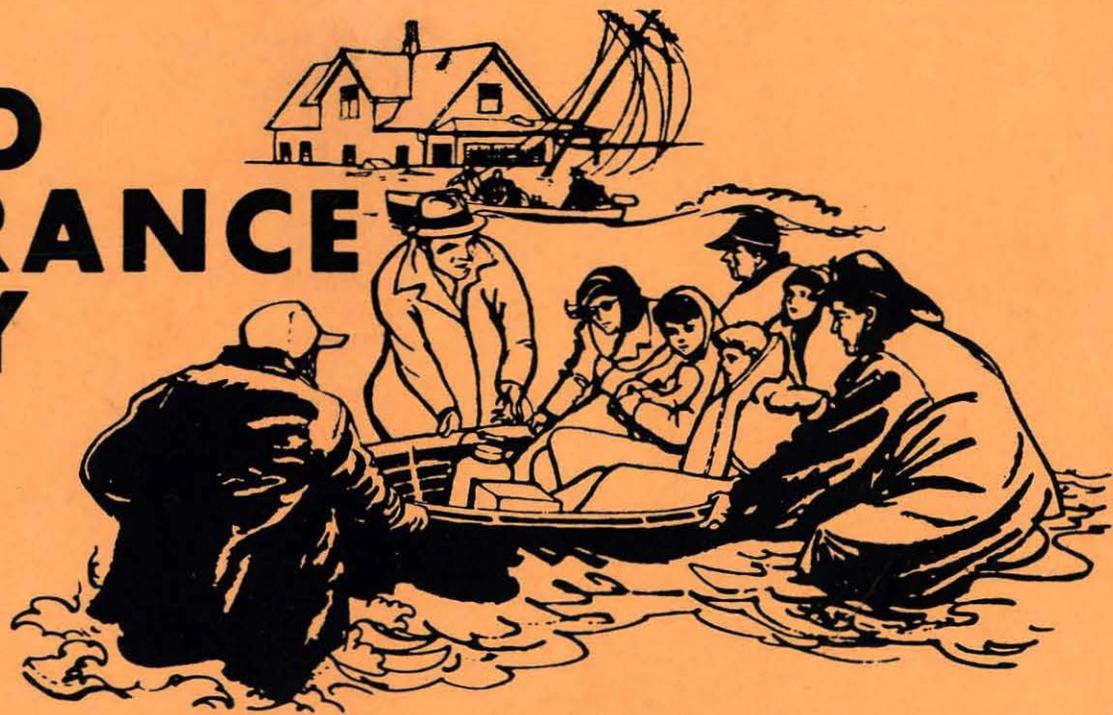


FLOOD INSURANCE STUDY



JEFFERSON COUNTY, COLORADO AND INCORPORATED AREAS VOLUME 1 OF 7

| COMMUNITY NAME | COMMUNITY NUMBER |
|--|---------------------|
| ARVADA, CITY OF | 085072 |
| *BOW MAR, CITY OF | 080232 |
| EDGEWATER, CITY OF | 080089 |
| GOLDEN, CITY OF | 080090 |
| *LAKESIDE, TOWN OF | 080311 |
| LAKEWOOD, CITY OF | 085075 |
| MORRISON, TOWN OF | 080092 |
| *MOUNTAIN VIEW, TOWN OF | 080254 |
| WESTMINSTER, CITY OF | 080008 |
| WHEAT RIDGE, CITY OF | 085079 |
| JEFFERSON COUNTY UNINCORPORATED AREAS | 080087 |

*NON-FLOODPRONE COMMUNITIES

JUNE 17, 2003



Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER

08059CV001A

Approximate analyses were used to study 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 and the communities.

2.2 Community Description

Jefferson County is located in north-central Colorado. It covers an area of 789 square miles with mountains along the west and "semiarid" plains in the east adjacent to the City and County of Denver (Reference 25). In addition, Jefferson County is bounded by the City of Littleton and Arapahoe, Adams, and Douglas Counties to the east; Teller County to the south; Park County to the south and southwest; Clear Creek and Gilpin Counties to the west; and Boulder County to the north.

The population of Jefferson County was approximately 501,591 in 1998 (Reference 26). Most people reside in the eastern part of the county.

Jefferson County was named in honor of Thomas Jefferson. The county was created in 1861 and was one of the 17 original counties of the Colorado Territory. The early history of Jefferson County centers on two groups of people: fur trappers and gold prospectors exploring the sands of Clear Creek for placer gold in 1858. According to the Colorado State Historical Society, a pioneer mining camp known as Arapahoe City was located a few miles east of the present site of the City of Golden in November 1858. Reportedly, George A. Jackson and John H. Gregory went on from there to make their historic gold discoveries near Idaho Springs and Central City.

The development of Jefferson County began with the discovery of gold and the resulting gold mining. Other types of mining have gradually become more important than gold mining, with uranium currently one of the leading mining products. Agriculture also assumed a prominent role in the development of Jefferson County and, until the end of World War II, the county depended primarily upon a mining and agricultural economy.

Industry, which has developed since World War II, has produced a more diversified economy. Federal and local government activities also play a major role in the economy of the county.

Jefferson County is situated in an area of the complex Southern Rocky Mountain Province known as the Front Range. The Front Range and its accompanying hogback foothills, occupying most of the western and southern portions of the county, cross the county in a northwest-southeast direction. The remaining northeastern part of the county is composed of rolling hills, which taper off to what might be called the far western edge of the Great Plain area to the east. Elevations within the county vary from approximately 5,000 feet in the northeast to over 10,000 feet in the southwest.

Jefferson County lies within the South Platte River drainage basin. The major streams originate in the mountains in the west and flow generally to the east toward the South Platte River, which forms the southeast border of the county.

East of the foothills, the climate is continental. The general features are low relative humidity; an extensive amount of sunshine; light rainfall, confined largely to the warmer half of the year; moderately high wind movement; a large daily range in temperature; high day temperature in summer; and generally, in the winter, a few protracted cold spells.

The climate is characterized by cold winters and warm summers. Mean monthly temperatures range from approximately 30 degrees Fahrenheit (°F) in January to approximately 75°F in July, with an average annual temperature of approximately 50°F. Recorded temperature extremes are a high of 102°F to a low of -26°F. The average annual precipitation is 14.95 inches, falling mainly from April to August (Reference 27). The heaviest recorded general rainfalls have come in late May and early June, when the temperature contrast between warm surface air and cool upper air is greatest. The Front Range foothills of the Rocky Mountains area are also subject to a meteorological phenomenon known as cloudbursts. They are confined chiefly to the eastern foothills regions below an elevation of 7,500 feet and extend eastward toward the plains for approximately 50 miles. Cloudbursts develop when there is a marked temperature range within a relatively small area and occur in the afternoon or early evening of an unusually warm day. Cloudbursts are characterized by intense rainfall of short duration that is confined to a very small area. These storms have rarely occurred where precipitation could be measured at a weather station (Reference 28). In the area, the peak discharge from a cloudburst is greater than that caused by rainfall during a period of snowmelt.

The City of Golden, which is the county seat, was founded in 1859 and was first called Golden City. Golden was the capital of the Jefferson Territory from 1862 to 1867.

Golden is located in northern Jefferson County, approximately 8 miles west of Denver and 18 miles south of Boulder. The city lies at the base of the Front Range foothills of the Rocky Mountains. Golden encompasses an area of 7.1 square miles and had an estimated population of 15,259 in 1998 (Reference 26).

The stream network in Golden is composed of Clear Creek, which flows from west to east, and its tributaries. Tucker Gulch is a left-bank tributary, providing drainage for areas north of Clear Creek. Kenneys Run and Lena Gulch are right-bank tributaries, providing drainage from areas south of Clear Creek. The confluences of Tucker Gulch and Kenneys Run with Clear Creek occur within the City of Golden. The confluence of Lena Gulch with Clear Creek occurs downstream of the city.

Clear Creek has its source in the Rocky Mountains at the Continental Divide. After flowing easterly through the mountains, Clear Creek enters the high plains at Golden and flows northeasterly to Commerce City, where it joins the South Platte River. The 400-square-mile drainage area of Clear Creek above Golden is characterized by steep slopes, rugged terrain, and forests. Within Golden, the Clear Creek floodplain contains heavily developed areas as well as parks and campgrounds.

Tucker Gulch begins in the foothills northwest of Golden and winds its way through Golden Gate Canyon before flowing into Clear Creek in Golden. Tucker Gulch drains an area of 11.22 square miles above Clear Creek. Cressmans Gulch is a left-bank tributary to Tucker

Gulch, whose 1.48-square-mile drainage area covers the foothills and valley area west of North Table Mountain. The drainage areas in the upper portions of these stream basins have steep slopes and cover complexes that vary from forested areas to rangeland with rock outcroppings.

West Fork Kenneys Run and its tributaries drain a 3.43-square-mile basin that starts on the eastern face of Lookout Mountain and extends across the plains southwest of Golden. East Fork Kenneys Run drains a 1.78-square-mile basin that starts on the western face of South Table Mountain and extends across the plains southeast of Golden. The upper portions of both these basins have steep slopes and rugged terrain. The plains portion of the West Fork Kenneys Run basin is primarily hilly rangeland, with heavy urban development beginning north of 24th Street. The plains portion of the East Fork Kenneys Run basin has the same hilly topography as the West Fork Kenneys Run basin; but, overall, it has been more heavily developed. The forks join at 20th Street to form Kenneys Run, which flows northeasterly through a buried 8-foot diameter corrugated metal pipe culvert to its confluence with Clear Creek. The intervening 1-square-mile basin between the confluence of East and West Forks Kenneys Run and the mouth of Kenneys Run is a heavily urbanized area lying in the valley between Lookout and South Table Mountains. The floodplain areas for the entire length of Kenneys Run and the low portions of East and West Forks Kenneys Run have been densely developed.

Lena Gulch has its source on Lookout Mountain and flows northeasterly, where it joins Clear Creek in Wheat Ridge. Apex and Jackson Gulches drain the foothill area south of Lookout Mountain before joining below Heritage Square at the base of the foothills to form Lena Gulch. Lena Gulch then flows parallel to the north side of U.S. Highway 40 through the City of Golden. This reach also receives runoff from the northwestern slope of Green Mountain. The total drainage area of Lena Gulch affecting Golden is 3.68 square miles and is characterized by steep slopes, bedrock outcrops, some forested areas in the foothills, and by heavily developed floodplain areas in Golden. At several locations along Lena Gulch, the natural channel has been diverted and partially filled.

The City of Arvada is located on the east slope of the Rocky Mountains, about 6 miles northwest of the State Capitol building in Denver. The estimated population of Arvada in 1998 was 97,610 (Reference 26).

The majority of the streams that were studied within Arvada flow through somewhat dense residential and commercial areas. All of the study streams have their source of flow in the Rocky Flats area and eastern foothills of the Rocky Mountains. Ralston Creek is tributary to both the Ralston and Arvada Reservoirs and Leyden Creek is tributary to the Leyden Reservoir. Little Dry Creek flows through, or is adjacent to, both Lake Arbor and the Pomona Lakes, which are recreational facilities owned and maintained by the City of Arvada. The total basin area draining the study streams is approximately 104 square miles. The elevations within the drainage basins for the streams range from over 10,000 feet in the upper portion of the Ralston Creek basin to 5,250 feet at the confluence of Ralston Creek and Clear Creek. For the most part, the study streams have a relatively small base flow for most of the year.

The City of Edgewater is located on gently rolling land in eastern Jefferson County and is bordered by the City of Wheat Ridge to the north, the City of Lakewood to the west and

south, and the City and County of Denver to the east. Edgewater is immediately west of Sloans Lake, a park in the City of Denver.

The City of Edgewater is fully developed with the exception of a few areas of vacant land. The estimated population in 1998 was 4,508 (Reference 26).

Elevations in Edgewater range from approximately 5,200 feet to approximately 5,500 feet.

The City of Lakewood is located in Jefferson County, sprawling between Denver and the foothills of the Rocky Mountains. On August 28, 1969, Lakewood was transformed from the most populated unincorporated area in the United States to Colorado's fourth largest city. The estimated population in 1998 was 136,883 (Reference 26).

Lakewood lies in the drainage of Lena Gulch, Dry Gulch, Lakewood Gulch, South Lakewood Gulch, McIntyre Gulch, Weir Gulch, Sanderson Gulch, North Sanderson Gulch, Bear Creek and several unnamed streams. These streams all flow in a westerly to easterly direction and are left-bank tributaries of the South Platte River.

The Town of Morrison is located at the base of the foothills of the Front Range of the Rocky Mountains. It is approximately 12 miles southwest of the State Capitol building and lies in the center of Jefferson County. The estimated population in 1998 was 459 (Reference 26). The town has an area of approximately 0.25 square mile.

Morrison is situated at the point where Bear Creek Canyon opens onto the plains. Bear Creek, which drains an eastern slope of the Front Range, emerges from the foothills and flows through the center of town. Mount Vernon Creek, a much smaller stream and a left-bank tributary to Bear Creek, has its junction with Bear Creek in the center of town.

Bear Creek is subject to cloudburst-type floods, and it is possible that a peak from both Bear Creek and Mount Vernon Creek could reach Morrison at approximately the same time, causing very high flood levels in the town, perhaps as high as 10 to 15 feet. From the foothills near Morrison, Bear Creek flows through a valley for a distance of 10 miles to its junction with the South Platte River. It drains an area of approximately 165 square miles above the Morrison gage, which is near the State Highway 8 bridge over Bear Creek.

Mount Vernon Creek drains an area of approximately 10 square miles beginning near Genesee Park along Interstate Highway 70 at its upper end and empties into Bear Creek at Morrison. Another left-bank tributary to Bear Creek, called Bear Creek Tributary No. 1, drains an area of 0.65 square mile and also has its junction with Bear Creek near the center of town.

The City of Westminster is located on the east slope of the Rocky Mountains, about 8 miles northwest of the State Capitol building in Denver. In 1998, the population of Westminster was estimated at 95,691 (Reference 26).

Big Dry Creek has its source in the Rocky Flats area southwest of the City of Boulder, and is a tributary to Standley Lake. Walnut Creek begins near the Rocky Flats Plant of the Atomic Energy Commission, and is a tributary to the Great Western Reservoir. Little Dry Creek originates just southwest of Standley Lake, passing through Arvada and Westminster to Clear Creek. Airport Creek has its source in the Jeffco Airport area.

All of the other streams studied have their sources basically within the city limits, and have little or no flow most of the time.

The total drainage area of Big Dry Creek to Interstate 25 (I25) is 56.84 square miles, of which 16.75 square miles are above the two reservoirs. Watershed elevations range from approximately 6,500 feet at the headwaters of the drainage area of Standley Lake to 5,160 feet at I25.

The City of Wheat Ridge is located in Jefferson County, bounded by Denver to the east and the frontal range of the Rocky Mountains on the west. On August 20, 1969, Wheat Ridge was converted from a large unincorporated area into a municipality. The estimated population in 1998 was 28,870 (Reference 26). Wheat Ridge lies in the drainage of Clear Creek of which Lena Gulch is a right-bank tributary. Clear Creek is a left-bank tributary of the South Platte River. Originating along the Continental Divide, Clear Creek flows eastward to its confluence with the South Platte River near Welby.

2.3 Principal Flood Problems

Past flooding along most of the streams in the county is not well documented. On any of the small, ungaged streams there are no available data regarding flood magnitude or damage. There are some records available for the larger streams in and near Jefferson County, and it is reasonable to assume that floods occurred simultaneously on the smaller streams as well (References 29 through 32). Records that are available include:

Bear Creek – Flooding occurred along the creek in 1876, 1894, 1896, 1957, 1965, and 1969. The 1896 flood was the largest. Twenty-seven lives were lost, and severe property damage was reported from Evergreen to the mouth. The discharge at the Morrison gaging station was 8,600 cubic feet per second (cfs) (Reference 33).

Clear Creek – Past floods on Clear Creek have been infrequent and more severe in the upper reaches (Reference 34). Major flooding occurred in Golden in 1888 (8,700 cfs), and 1956 (5,250 cfs), and in Derby in 1965 (5,070 cfs).

South Platte River – Large floods were reported in 1844, 1864, 1867, 1876, 1894, 1921, 1933, 1942, 1965, and 1973. The largest and most damaging of these occurred June 16 and 17, 1965, when a discharge of 40,300 cfs was computed at USGS stream gage No. 06714000, near the 19th Street Bridge in Denver. Flooding occurred throughout the South Platte River basin resulting in six drowning, two other deaths caused by flood-related activities, and damage estimated at \$500 million, of which \$300 million occurred in the Denver area (References 29 through 32).

Because of conscious efforts by Jefferson County, commercial and residential floodplain development has been severely restricted. However, some older developments, particularly in the mountain valleys and foothill areas, have a high potential for flooding problems.

Photographs of potential flooding in the City of Golden are shown in Figures 1-7. Photographs of potential flooding in the Town of Morrison are shown in Figures 8-11.

In general, within the city of Arvada, the streams are well defined with relatively narrow channels. Potential flooding problems along the streams can be attributed to the large

developed areas that have encroached into the overbanks of these channels, severely constricting the floodplain and diminishing the carrying capacity for large floodflows.

In the City of Edgewater, flood problems within the Sloans Lake subbasin occur as a result of overflow from the drainageway between Ingalls Street and 20th Avenue to the eastern corporate limits at Depew Street. Upstream of Ingalls Street and 20th Avenue to the western corporate limits, overflow is split between a storm sewer and the streets. Flooding in this area is caused in part by thunderstorms during the spring, perpetuated by antecedent ground mixture and melting snow.

In the City of Golden, manmade and natural obstructions in stream channels and floodplain areas impede the flow of water, creating a backwater effect that increases flood heights. These obstructions include bridges, culverts, stream-regulating structures, channel realignments from their natural course, buildings in the floodplains, and trees and brush in the stream channels.

The history of flooding in the City of Golden indicates that the most serious flooding has been the result of cloudbursts occurring from late May to early September. Several severe floods have been recorded in Golden since 1864. On August 1, 1888, cloudbursts along the Front Range produced a peak discharge on Clear Creek of 8,700 cfs that lasted for two hours. This discharge was measured 7 miles upstream of Golden. Most of the damage from this flood occurred in Clear Creek Canyon between Idaho Springs and Golden (Reference 28). On July 24, 1896, cloudbursts over Clear Creek Canyon and Golden Gate Canyon produced floods on both Clear Creek and Tucker Gulch. Three people were killed when a wall of water passed down Tucker Gulch. Most of the homes and businesses along lower Tucker Gulch sustained substantial damage (many were completely demolished) and most of the bridges across Clear Creek were swept away (Reference 35). On July 23 and 24, 1965, heavy rains over the Clear Creek and Tucker Gulch basins (4.5 inches in one hour being reported on Tucker Gulch) produced flash flooding in Golden and inundated a wide area, causing major damage to homes, bridges, and utility lines. The most extensive damage occurred along Tucker Gulch (Reference 34). The preceding descriptions are examples of some of the more amazing floods experienced in Golden; however, many other floods have also inflicted damage.

Within the Town of Morrison, the history of flooding indicates that floods occur from late May through early September, seemingly the result of cloudburst activity. Flood problems in the town result from high peaks occurring in Bear Creek and Mount Vernon Creek as they enter Morrison, especially when they occur simultaneously or in close succession. Much property has been destroyed, including bridges, railroad tracks, houses, and highways in the canyons (Reference 28).

Both manmade and naturally occurring obstructions exist within the floodplain, restricting the flow of water and causing an increase in flood levels. The obstructions consist of trees and a heavy growth of underbrush in some areas. Obstructions within the Bear Creek floodplain consist mostly of large rocks, trees, and some brush areas within the floodplain.

Many smaller tributaries to Bear Creek upstream from Morrison contribute relatively large peak flows to the Bear Creek floodplain and thus to Morrison.

The highest recorded floods for Morrison occurred on July 24, 1896; July 7, 1933; and September 2 and 3, 1938. The peak flows estimated for the 1896 and 1933 floods above Mount Vernon Creek are 8,600 cfs and 8,110 cfs, respectively. The 1938 flood was caused by a cloudburst that centered on the divide between Mount Vernon and Bear Creeks near the top of Genesee Mountain. The highest peak for Bear Creek at Morrison, above Mount Vernon Creek, was only 6,200 cfs; however, the peak for Mount Vernon Creek at Morrison was 9,230 cfs (Reference 28). Other floods of lesser magnitude occurred on Bear Creek in 1934, 1957, 1965, and 1969 (Reference 36).

In the City of Westminster, the streams that flow into Standley Lake and Great Western Reservoir, along with Big Dry and Little Dry Creeks, are generally well defined with relatively narrow channels. The tributaries to Big Dry and Little Dry Creeks are not very well defined and at times, are generally shallow with low banks. Industrial and residential developments exist along portions of the streams, especially below the reservoirs.

Generally, the streams are intermittent, having little or no flow most of the time. Flooding in the Westminster area is caused by heavy local rainstorms. Flooding occurred in May 1973, especially in the vicinity of Big Dry Creek at Huron Street.

2.4 Flood Protection Measures

There are numerous dams, reservoirs, and channel improvements within Jefferson County. Many of these flood protection measures affect flood peaks on the streams included in this study. In addition to an active floodplain management program, the major flood protection measures are listed below:

Bear Creek – Evergreen Lake, located just upstream of Evergreen, is primarily used for water supply and recreation and provides little routing effect to the flood peak. Mt. Carbon Dam and the Bear Creek Lake were designed by the USACE for the purpose of flood control. Peak flows from the 100-year event have been reduced from 30,000 cfs to approximately 1,000 cfs through storage in the reservoir. However, because of its location, there is little protection provided for other areas in Jefferson County.

Bear Creek Tributaries No. 1 and No. 3 – Storm sewers have been constructed at various places along these streams. During a flood event, these storm sewers will overtop, and damage caused by the resultant flooding may be greater than before the storm sewers were installed.

Bergen Creek – Channel improvements have been constructed immediately downstream from State Highway 74. These improvements provide significant protection to the adjacent buildings, but are overtopped during extreme flood events.

Buffalo Creek – Wellington Lake is located near the headwaters of Buffalo Creek. This lake is used for water supply and recreation and provides negligible flood protection.

Clear Creek – There are few flood protection measures for Clear Creek that cover areas in Jefferson County. Some channelization work has been done in and near Golden, but this has little effect during a flood peak. Additional channel improvements have been constructed between Marshall Street and Wadsworth Boulevard.

Coon Creek – There are three on-stream reservoirs on Coon Creek that help to reduce the flood peaks in their immediate vicinity. These are Grant A Lake, Beer Sisters Lake, and an unnamed reservoir at the upstream study limit.

Lena Gulch – Channelization has been completed through the Denver West Office Park. The improvements are sufficient to provide protection for the office buildings in this area.

Lena Gulch Tributary – Channel improvements have been constructed from approximately the mouth upstream to Pike Street. Good flood protection is provided to residences in this area.

Leyden Creek – Leyden Lake, located just upstream of Indiana Street, provides some storage routing during flood events. The 100-year peak discharge is reduced from 3,750 cfs to 2,200 cfs downstream of the lake.

Lilley Gulch – There is one small reservoir just downstream of South Kipling Street and several places where ponding could occur behind road embankments. However, these areas do not provide enough storage to significantly affect the peak discharges.

North Branch Coon Creek – An unnamed reservoir located just upstream of South Simms Street provides little flood peak reduction.

Ralston Creek – Ralston Reservoir, located west of State Highway 93, provides some storage routing during flood events. Blunn Reservoir is inoperative, but may provide additional flood protection in the future.

SJCD 6100 – Webster Pond, located just upstream from Webster Street, provides some flood storage area, but has a minor effect on the peak discharges. Channel improvements have been constructed between Lamar Street and Pierce Street, which provide good flood protection in this area.

SJCD 6200 North Tributary – Channel improvements have been constructed between Ken Caryl Avenue and South Kendall Boulevard, and a storm sewer has been installed between Ken Caryl Avenue and Platte Canyon Road. These facilities provide a moderate degree of flood protection in this area.

Troublesome Creek – There are several small on-stream ponds that have a negligible effect on peak discharges.

Van Bibber Creek – Channel improvements have been constructed along the north side of West 58th Avenue.

Van Bibber Tributary – Ramstetter Reservoir, which is located at the upstream end of the area studied, near State Highway 93, provides minimal routing effect to the peak discharges.

In the City of Arvada, flood protection measures on the study streams consist primarily of channelization projects and improvements to a number of important bridges. Future protection measures on the streams were designed, as outlined in the UDFCD plans entitled

“Major Drainageway Planning Study for Lower Ralston/Van Bibber and Leyden Creeks” (Reference 37). These future measures consist of additional channelization and the use of detention ponds.

In Arvada, a number of reservoirs exist on the study streams which provide incidental flood protection, even though they were not specifically designed as flood control structures. Arvada Reservoir, which is owned and maintained by the City of Arvada, and Ralston Reservoir, which is owned and maintained by the Denver Water Board, are located on Ralston Creek. Lake Arbor, which is located on Tributary C of Little Dry Creek, and the Pomona Lakes, which are located on Little Dry Creek, are designated as recreation facilities that are owned and operated by the City of Arvada. Leyden Lake, located on Leyden Creek, is currently a water storage facility owned and operated by the Farmers High Line Canal Company. The above-mentioned reservoirs, with the exception of Leyden Lake and Arvada Reservoir, are expected to attenuate the 100-year frequency event. In addition, the City of Arvada has provided assurances to FEMA that these reservoirs, with the exception of Leyden Lake, would continue to be maintained and operated.

The City of Edgewater, in conjunction with the City of Lakewood and City and County of Denver, permitted the UDFCD to plan and implement channel and culvert improvements in 1977. The UDFCD constructed the West 18th Avenue extension channel from Depew Street to Sheridan Boulevard. To improve the efficiency of bridge culverts at Depew Street and Sheridan Boulevard, the UDFCD installed twin 12- by 5-foot culverts at Depew Street and four 7- by 5-foot precast-concrete boxes at Sheridan Boulevard. All construction was completed by early 1983. The installed culverts relieve bottleneck conditions caused by inundation. In 1987, channel improvements between Ingalls Street and 20th Avenue to Depew Street were completed. A detention pond outside the corporate limits at 25th Avenue and Wadsworth Street reduces sheetflow east of Pierce Street.

No flood protection measures are provided upstream of Golden on any of the streams. Within the city, channelization measures have been taken in some areas; primarily, these measures are concrete walls to streamline the flow. Tucker Gulch has been sufficiently channelized from State Highway 58 to its confluence with Clear Creek to pass the 100-year flood. The existing channelization of sections of Clear Creek is not sufficient to protect the city from 100-year floods and floods of higher recurrence intervals. Clear Creek is channelized from Washington Avenue downstream.

The city has enacted an ordinance to minimize property damage and danger to life in floodplain areas (Reference 38). Provisions in the ordinance regulate and restrict the following: land use and development patterns; construction practices and flood proofing measures; presence of potentially hazardous debris and pollutants; design and construction of water-supply systems, waste-water systems, and other public works; and design and construction of drainage systems subjecting other property to floodwater damage.

No flood protection measures have been provided immediately upstream of the Town of Morrison. Streams within Morrison have been channelized. Brick walls serving to streamline the flow comprise most of the channelization measures. However, most of the beneficial effects of the walls are nullified due to the adjacent growth of vegetation. These walls were built many years ago and have had little maintenance since that time.

Removal of vegetation, sediment deposits, debris, and rocks from the floodways of Bear Creek, Mount Vernon Creek, and Bear Creek Tributary No. 7 would improve flood control, but the problem of the inadequate capacity of the State Highway 8 box culvert would remain.

There are no flood protection works in the City of Westminster on the streams in the areas that were studied. However, two large reservoirs, Standley Lake and Great Western Reservoir, exist at the upstream limits of the study area and provide incidental protection even though they were not designed for flood control storage.

In addition, Ketner and Jackson Lake reservoirs exist within the study area but are primarily used for irrigation purposes and therefore, were not considered as flood protection structures. Westminster has passed zoning ordinances to prohibit construction within floodplains to lessen potential flood damage. The Ketner Reservoir has been renovated to increase its flood storage capacity, thus reducing the downstream flows and floodplains.

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, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

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

Jefferson County (Unincorporated Areas)

Detailed discussions of the hydrologic analyses for the streams studied were presented in previous hydrology reports. The hydrologic analyses for Cold Spring, Kerr, Swede, and Switzer Gulches, and the SJCD 6200 North Tributary were discussed in a 1982 hydrology report (Reference 39). The remainder of the streams was discussed in a four-part technical addendum prepared in 1979 (Reference 40).