1994

Flood Insurance Study, City of South Salt Lake, Utah, Salt Lake County

Federal Emergency Management Agency

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

This publication incorporates revisions to the original Flood Insurance Study. These revisions are presented in Section 9.0.

This preliminary revised Flood Insurance Study contains only profiles added or revised as part of the restudy. All profiles will be included in the final published report.
FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of South Salt Lake, Salt Lake County, Utah, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program 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 Acknowledgments

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

The hydrologic and hydraulic analyses for this study were performed by Rollins, Brown, and Gunnell, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. H-4593. This study was completed in May 1982.

1.3 Coordination

Streams to be designated for detailed and approximate study were identified at a meeting attended by representatives of the study contractor, FEMA, Salt Lake County, and the City of South Salt Lake in September 1977.

Results of the hydrologic and hydraulic analyses were coordinated with representatives of the Salt Lake County Public Works Department, Flood Control and Water Quality Division; the U.S. Army Corps of Engineers; and the incorporated communities of Salt Lake County.

An intermediate coordination meeting was held on February 18, 1982, to allow community representatives to review the draft study.

In attendance were representatives of FEMA; the study contractor; the U.S. Army Corps of Engineers; Salt Lake County; and the Cities of South Salt Lake, Murray, Midvale, and West Valley City. Concern was expressed by representatives of the City of South Salt Lake over the depth and width of the Mill Creek floodplain. These concerns resulted in a hydraulic reanalysis of Mill Creek between Main Street and 700 East Street (upstream of the South Salt Lake corporate limits).

A final community coordination meeting for Salt Lake County and the Cities of Draper, Murray, Sandy City, and South Salt Lake was held on December 14, 1983. In attendance were representatives of FEMA, the study contractor, the county, and the incorporated communities. Two minor concerns raised at the meeting were that the studies did not reflect flows from the 1983 flood and the conversion of the detailed study reaches of the Jordan River between 2100 South Street and the North Jordan Canal Diversion Dam to approximate study. It was agreed that these problems would be addressed during the appeals period along with other minor concerns raised by the individual communities and the county. All requests were considered and, where appropriate, were acted upon in the preparation of this study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of South Salt Lake, Salt Lake County, Utah. The study area is shown on the Vicinity Map (Figure 1).

Mill Creek and Jordan River were selected for study by detailed methods within the community.

The detailed study reach of the Jordan River within South Salt Lake was converted to approximate study. This change resulted from uncertainties in frequency analysis of the hydrologic data and from uncertainties in hydraulic modeling caused by completed and ongoing modifications to the river channel initiated after the completion date of this study. In addition, downstream of the North Jordan Canal Diversion Dam, problems were encountered with elevation data on the orthophoto topographic maps used for the detailed flood boundary delineations; there were also discrepancies between the results of the step-backwater analysis and the detailed flood boundary delineations. Downstream of the diversion dam, approximate flood boundaries were taken from the Flood Hazard Boundary Map (Reference 1) and were supplemented by a U.S. Army Corps of Engineers Flood Plain Information report (Reference 2) where coverage from the Flood Hazard Boundary Map was not complete. Upstream of the diversion dam, approximate flood boundaries were adopted from the study contractor's detailed 100-year flood boundary delineations.

2
An area of shallow ponding in the northern part of South Salt Lake was added to this study from the Flood Insurance Study for Salt Lake City (Reference 3).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through May 1987.

2.2 Community Description

South Salt Lake is located in north-central Salt Lake County, in north-central Utah. South Salt Lake is bordered by the City of Salt Lake City on the north and east, the City of West Valley on the west, and unincorporated areas of Salt Lake County on the east and south. South Salt Lake has a population of approximately 10,000.

Much of the commercial and industrial development in South Salt Lake has taken place along Interstate Highway 15 and U.S. Highways 89 and 91, as well as in the Mill Creek flood plain, where there are also residential areas. The flood plain of the Jordan River is also largely developed.

The principal stream in the Salt Lake Valley is the Jordan River. It originates in Utah Lake at an elevation of approximately 4,489 feet and flows northerly through the center of the valley to terminate in the Great Salt Lake.

The east side stream tributaries to the Jordan River originate in the higher elevations of the Wasatch Mountains. These streams emerge at the foothill line and flow westerly across terraces formed by the recession of prehistoric Lake Bonneville. Mill Creek is a perennial tributary stream that drains the center portion of the Wasatch Mountains on the eastern side of the valley. Mill Creek has a fairly steep gradient as it crosses the terraces, but flattens as it reaches the valley floor. Drainage areas of the tributaries to the Jordan River range from the high areas of the Wasatch Mountains, above an elevation of 11,000 feet, to the valley floor, at an elevation of 4,250 feet.

Soils typically found in the terraces are granular while the valley floor is primarily composed of clays or clayey gravels.

Vegetation ranges from conifer, aspen, and oak in the higher mountain elevations to scrub oak, sage, and underbrush in the lower mountain elevations. Residential valley areas, are vegetated mainly with lawn grasses, ornamental shrubbery, and shade trees. Undeveloped valley areas are mostly covered by grasses and sagebrush. Aspen and cottonwood trees grow along the stream courses.

The Salt Lake Valley has a temperate, semiarid climate with four distinguishable seasons. Temperatures generally range from -20°F in winter to 105°F in summer. Precipitation tends to vary directly with elevation, from 16 inches annually on the valley floor to 40 inches annually in the high mountains (Reference 4).

2.3 Principal Flood Problems

Floods in the Salt Lake Valley generally occur due to three types of events: snowmelt runoff, cloudburst rainstorms, and general rainstorms. Snowmelt floods usually occur in April, May, and June. Cloudburst rainstorms are high-intensity, short-duration storms that usually occur over a relatively small area. These storms are characterized by high runoff peaks, but low volumes. They generally occur from June through October. General rainstorms are caused by low-intensity rainfall occurring over a longer period of time. These storms can have a higher peak than the snowmelt flood and many times can have a higher volume than the cloudburst events. General rainstorms can occur at any time during the year.

The history of Salt Lake County indicates that although flooding can be caused by any of these types of events, the most dramatic and extensive flooding has been due to snowmelt and cloudbursts.

Streamflow gages on the east side tributary streams are generally located at the canyon mouths. These gages, therefore, give an accurate measurement of snowmelt runoff, but do not include any indication of runoff associated with cloudburst rainfall in the urbanized area.

Significant snowmelt flows occurred in the study area in 1909, 1912, 1921, 1949, and 1952. A partial list of some of these floods with their estimated recurrence intervals is shown below. The flow values shown are the mean daily flows. Instantaneous peaks would be somewhat higher.

<table>
<thead>
<tr>
<th>Year</th>
<th>Stream</th>
<th>Flow (Cubic Feet per Second)</th>
<th>Estimated Recurrence Interval (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1909</td>
<td>Mill Creek 1</td>
<td>112</td>
<td>13</td>
</tr>
<tr>
<td>1912</td>
<td>Mill Creek 1</td>
<td>121</td>
<td>20</td>
</tr>
<tr>
<td>1921</td>
<td>Mill Creek 1</td>
<td>104</td>
<td>10</td>
</tr>
<tr>
<td>1921</td>
<td>Jordan River</td>
<td>1,020</td>
<td>20</td>
</tr>
<tr>
<td>1949</td>
<td>Mill Creek 1</td>
<td>152</td>
<td>50</td>
</tr>
<tr>
<td>1952</td>
<td>Mill Creek 1</td>
<td>102</td>
<td>10</td>
</tr>
<tr>
<td>1952</td>
<td>Jordan River</td>
<td>1,410</td>
<td>50</td>
</tr>
</tbody>
</table>

1 At Canyon Mouth - Salt Lake City stream gage No. 10170000
2 At Jordan Narrows - U.S. Geological Survey stream gage No. 10167000
Flooding problems on Mill Creek occur nearly every year during the spring snowmelt. These problems are created by channel constrictions at Highland Drive, 300 East Street, State Street, and the Union Pacific and Denver and Rio Grande Railroad crossings (Reference 10). Flooding along Mill Creek and the other east side tributaries is aggravated during rainstorms by the inflow from storm sewers that drain the urbanized areas.

2.4 Flood Protection Measures

Utah Lake, at the head of the Jordan River, affords a reduction of floods along the Jordan River above 2100 South Street. This lake is a natural water body that has been artificially modified so that the water-surface elevation can be controlled through the use of several large radial gates and a pumping station. The ability to raise and lower the lake elevation causes conflicts between the water users and the property owners adjacent to the lake. To resolve the conflicts, in 1885 a "compromise level" elevation of 4,488.34 feet was agreed upon. Whenever runoff forecasts indicate that the water surface will exceed the compromise level, the lake is drawn down to permit discharges comparable to natural conditions.

A number of irrigation diversions along the Jordan River near the southern boundary of Salt Lake County, such as Turner Dam at Jordan Harrows, can substantially reduce floods. Most outflow from Utah Lake, except during periods of high flow such as the 100- and 500-year floods, can be diverted to these canals.

The U.S. Army Corps of Engineers has constructed levees along the Jordan River up to the mouth of Mill Creek and along the north bank of Mill Creek up to just downstream of the Denver and Rio Grande Western Railroad. These levees contain 100-year flood flows with a minimum freeboard of 3 feet. Five-hundred-year flows can overtop the Mill Creek levees.

Officials of Salt Lake County have established, in their Public Works Department, a Flood Control and Water Quality Division. It is the responsibility of this office to manage and enforce the county development and flood control ordinances in the unincorporated areas. The department also works with the incorporated communities within the county, as requested, to manage and review flood flow-control projects. Salt Lake County also has a county-wide flood control tax, which enables it to obtain tax funds for use in construction of new flood control projects and maintenance of existing facilities.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail 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 which 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 flood plain 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 which 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), and, 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 community.

Several stream gages have been operated on the Salt Lake County streams since the beginning of the century by Salt Lake City and the U.S. Geological Survey (References 5 and 6). A summary of the various gages, their locations, operating agencies, and lengths of record, is shown in Table 1.

<table>
<thead>
<tr>
<th>Gage Location</th>
<th>Operating Agency</th>
<th>Length of Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt Lake City</td>
<td>U.S. Geological Survey</td>
<td>1900-1990</td>
</tr>
<tr>
<td>South Salt Lake</td>
<td>U.S. Geological Survey</td>
<td>1920-1990</td>
</tr>
</tbody>
</table>

Floodflow-frequency analyses for the snowmelt events were performed for Mill Creek. The peak flow values were computed based on the U.S. Water Resources Council guidelines for determining floodflow frequencies (Reference 7). This method uses existing streamflow data and a log-Pearson Type III distribution in conjunction with a regional skew to predict floodflows. Streamflow records dating back to 1890 were used in the analysis.

Existing streamflow information is not adequate to predict cloudburst runoff values downstream of the canyon mouths, where flows depend on inflow from the urban area.

To obtain flow values in these areas, the HEC-1 computer runoff model, developed at the U.S. Army Corps of Engineers Hydrologic Engineering Center, was used (Reference 8). This model uses a kinematic wave calculation to produce runoff due to rainfall. The model computes and routes flows based on physical characteristics of the basin, such as percent imperviousness, infiltration rates, and basin area and slope, and storm characteristics, such as precipitation depths, rainfall distribution, and rainfall duration.
<table>
<thead>
<tr>
<th>Stream and Location</th>
<th>Gage Number</th>
<th>Operating Agency</th>
<th>Years of Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jordan River</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Jordan Narrows</td>
<td>10167000</td>
<td>U.S. Geological Survey</td>
<td>1913-Present</td>
</tr>
<tr>
<td>At 9400 South Street</td>
<td>10167200</td>
<td>U.S. Geological Survey</td>
<td>1965-1968</td>
</tr>
<tr>
<td>Mill Creek</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Canyon Mouth</td>
<td>10170000</td>
<td>Salt Lake City</td>
<td>1898-Present</td>
</tr>
</tbody>
</table>
Rainfall depths were obtained from Precipitation-Frequency Atlas of the Western United States, Volume VI, Utah, prepared by the National Oceanic and Atmospheric Administration (Reference 9). Due to the lack of available rainfall-runoff data, it was not possible to calibrate the computer model. The results of the log-Pearson Type III analyses for Mill Creek were combined with the results of the HEC-1 analyses. Snowmelt events, with long sustained peak discharges, dominated upstream of canyon mouths; cloudburst events, with short, intense peak discharges, dominated downstream of canyon mouths.

The hydrologic analyses described above for Mill Creek were performed by the U.S. Army Corps of Engineers as part of Jordan River Investigation, Utah (Reference 10).

A summary of the drainage area-peak discharge relationships computed for each stream studied in detail is shown on Table 2.

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.

Water-surface elevations of floods of the selected recurrence intervals for the detailed study streams were computed using the U.S. Army Corps of Engineers HEC-2 step-backwater computer program (Reference 11).

The hydraulic analyses for Mill Creek were performed by the U.S. Army Corps of Engineers as part of Jordan River Investigation, Utah (Reference 10). These analyses were revised where necessary, by the study contractor.

Cross section data for Mill Creek were developed by the U.S. Army Corps of Engineers for Jordan River Investigation, Utah (Reference 10). Cross sections for Mill Creek were taken from topographic maps at a scale of 1:600, with a contour interval of 2 feet (Reference 12).

The study contractor revised the hydraulic analysis for Mill Creek between Main Street and 700 East Street. New cross section data for this reach were field surveyed and extended by using orthophoto topographic maps at a scale of 1:2,400, with contour intervals of 2.5 and 5 feet (Reference 13).

Supplemental cross sections to define new bridges or changes in topography were made as a part of this Flood Insurance Study. All bridges, dams, and culverts were field checked to obtain information to describe their structural geometry.
Table 2. Summary of Discharges

<table>
<thead>
<tr>
<th>Flooding Source and Location</th>
<th>Drainage Area (Square Miles)</th>
<th>Peak Discharges (Cubic Feet per Second)</th>
<th>10-Year</th>
<th>50-Year</th>
<th>100-Year</th>
<th>500-Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mill Creek</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>700 East Street (Upstream of South Salt Lake)</td>
<td>33</td>
<td>700</td>
<td>750</td>
<td>800</td>
<td>850</td>
<td></td>
</tr>
<tr>
<td>Interstate Highway 15</td>
<td>38</td>
<td>540$^1$</td>
<td>670$^1$</td>
<td>750</td>
<td>1,600</td>
<td></td>
</tr>
<tr>
<td>Jordan River</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narrows</td>
<td>2,755</td>
<td>1,260</td>
<td>2,400</td>
<td>3,000</td>
<td>4,800</td>
<td></td>
</tr>
<tr>
<td>9000 South Street</td>
<td>2,905</td>
<td>1,170</td>
<td>2,300</td>
<td>2,790</td>
<td>4,465</td>
<td></td>
</tr>
<tr>
<td>5800 South Street</td>
<td>2,985</td>
<td>1,200</td>
<td>2,280</td>
<td>2,850</td>
<td>4,560</td>
<td></td>
</tr>
<tr>
<td>Little Cottonwood Creek Confluence</td>
<td>--2</td>
<td>1,585</td>
<td>3,010</td>
<td>3,740</td>
<td>5,925</td>
<td></td>
</tr>
<tr>
<td>Big Cottonwood Creek Confluence</td>
<td>--2</td>
<td>1,930</td>
<td>3,665</td>
<td>4,535</td>
<td>7,145</td>
<td></td>
</tr>
<tr>
<td>Mill Creek Confluence</td>
<td>--2</td>
<td>2,000</td>
<td>3,800</td>
<td>4,700</td>
<td>7,400</td>
<td></td>
</tr>
<tr>
<td>2100 South Street</td>
<td>3,165$^3$</td>
<td>2,000</td>
<td>3,800</td>
<td>4,700</td>
<td>7,400</td>
<td></td>
</tr>
</tbody>
</table>

$^1$Discharge Reductions are Due to Overbank Storage (Generally a Result of Construction in the Flood Plain)

$^{1\text{Data Not Available}}$

$^{1\text{Value Estimated Based on Published Drainage Area for Gage at 1700 South Street}}$
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 Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's \( n \)) used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. Roughness values ranged from 0.025 to 0.100 for main channels and from 0.030 to 0.200 for overbank areas.

Starting water-surface elevations for Mill Creek were determined by normal depth calculations.

Excess overland flows from the east congregate in a large pond created by the Denver and Rio Grande Western Railroad embankment located north of South Salt Lake at approximately 600 West Street in Salt Lake City. The flood elevation of the ponding was determined using the NRC-I flood hydrograph package (Reference 8). This analysis was performed for the Flood Insurance Study for Salt Lake City (Reference 3).

The area protected from the 100-year flood by the Mill Creek levee was determined by a modification of the NRC-2 backwater analysis of Mill Creek (Reference 11). This area lies approximately between 900 West Street and the Denver and Rio Grande Western Railroad, north of Mill Creek to 21st South Street (State Highway 201).

The hydraulic analyses for this study were based on unobstructed flow. It should be noted that flood elevations shown on the profiles are considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400, with contour intervals of 2.5 and 5 feet (Reference 13).

Flood boundaries for Mill Creek (with the exception of 100-year flood boundaries between Main Street and 700 East Street) were delineated by the U.S. Army Corps of Engineers for Jordan River Investigation, Utah (Reference 10).

The flood boundaries for the ponding area created by the Denver and Rio Grande Western Railroad embankment in Salt Lake City were delineated on a topographic map at a scale of 1:24,000, with a contour interval of 5 feet (Reference 14), based on the elevations determined by the methods discussed in Section 3.2.

The flood boundary of the levee-protected area north of Mill Creek was delineated on the 1:24,000-scale maps referenced above (Reference 14).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain 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.

As mentioned earlier, approximate flood boundaries in some portions of the study area were taken from the Flood Hazard Boundary Map (Reference 1).

For the streams studied by approximate methods, only the 100-year flood plain boundary is shown.

4.2 Floodways

Encroachment on flood plains, 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 flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroach-
ment so that the 100-year 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 floodways presented in this study were computed on the basis of equal-conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

Figure 2. Floodway Schematic
<table>
<thead>
<tr>
<th>CROSS SECTION</th>
<th>DISTANCE (FEET)</th>
<th>WIDTH (FEET)</th>
<th>SECTION AREA (SQUARE FEET)</th>
<th>MEAN VELOCITY (FEET PER SECOND)</th>
<th>REGULATORY WATER SURFACE ELEVATION (FEET)</th>
<th>WITHOUT FLOODWAY (FEET)</th>
<th>WITH FLOODWAY (FEET)</th>
<th>INCREASE (NGVD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2,020</td>
<td>18</td>
<td>81</td>
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<td>4,232.8</td>
<td>4,233.8</td>
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<td>B</td>
<td>3,160</td>
<td>66</td>
<td>318</td>
<td>2.0</td>
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<td>4,234.7</td>
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<td>C</td>
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<td>4,235.6</td>
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<td>4,235.7</td>
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<td>4,241.3</td>
<td>4,242.3</td>
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<td>156</td>
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<td>4,241.9</td>
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<td>0.9</td>
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<td>142</td>
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<td>4,246.6</td>
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<td>0.2</td>
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1 Feet Above Mouth
<table>
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<tr>
<th>CROSS SECTION</th>
<th>DISTANCE (FEET)</th>
<th>WIDTH (FEET)</th>
<th>SECTION AREA (SQUARE FEET)</th>
<th>MEAN VELOCITY (FEET PER SECOND)</th>
<th>BASE FLOOD WATER SURFACE ELEVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>REGULATORY</td>
</tr>
<tr>
<td>Jordan River</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>FEET NGVD</td>
</tr>
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<td>186</td>
<td>1,632</td>
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<td>1013</td>
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</tbody>
</table>

1Feet Above Surplus Canal Diversion
5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of South Salt Lake.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

<table>
<thead>
<tr>
<th>Average Difference Between 10- and 100-Year Floods</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 feet</td>
<td>0.5 foot</td>
</tr>
<tr>
<td>2 to 7 feet</td>
<td>1.0 foot</td>
</tr>
<tr>
<td>7.1 to 12 feet</td>
<td>2.0 feet</td>
</tr>
<tr>
<td>More than 12 feet</td>
<td>3.0 feet</td>
</tr>
</tbody>
</table>

The locations of the reaches determined for the flooding sources of South Salt Lake are shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 feet, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for South Salt Lake is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

A Flood Insurance Study has been prepared for the City of Salt Lake City (Reference 3), and another one is being prepared for the unincorporated areas of Salt Lake County (Reference 15). Those studies are in agreement with this Flood Insurance Study.
A Flood Hazard Boundary Map has previously been published for the City of South Salt Lake (Reference 1). This map was used as the source for approximate flood boundaries for this Flood Insurance Study. In detailed-study areas, this study represents a more recent and comprehensive analysis; therefore, it supersedes the Flood Hazard Boundary Map.

A Flood Hazard Boundary Map for the City of West Valley City (Reference 16) is being prepared. It will agree with the results of this study.

A Flood Plain Information (FPI) report by the U.S. Army Corps of Engineers for the lower Jordan River and its tributaries (Reference 2) included analyses of Mill Creek. Due to different values used for parameters such as infiltration rates and permeability, the discharges used for Mill Creek in this study are generally lower than those in the FPI report. Additionally, there are differences between this study and the FPI report due to revised hydraulic analyses and the use of more recent topographic mapping. Flood boundaries for the Jordan River from the FPI report were used to supplement approximate flood boundaries in areas not covered by the Flood Hazard Boundary Map (Reference 1).

A report by the U.S. Army Corps of Engineers, entitled Jordan River Investigation, Utah (Reference 10), was the source of the hydrologic and hydraulic analyses and flood boundaries for Mill Creek except where modified by the study contractor.

A recent report prepared by the U.S. Army Corps of Engineers (Reference 17) reevaluated the frequency of flood discharges along Mill, Big Cottonwood, and Little Cottonwood Creeks. This report considered the impacts of the extreme flood of September 1983 and of recent urban development. The Corps of Engineers report indicates that discharges along these three streams, in general, are larger than those used in this study; however, they are not significantly larger statistically. Changes have occurred along the stream channels since the September 1983 flood and additional changes are ongoing or planned. An assessment of the preciseness of discharge rates and the reliability of available hydraulic channel information suggests that future flood hazards along Mill, Big Cottonwood, and Little Cottonwood Creeks are defined in this study within the range of currently attainable reliability.

Following the disastrous flooding along Utah Lake and the Jordan River in 1983 and 1984, Salt Lake County and Utah County officials commissioned an investigation by CH2M HILL, Inc., of remedial measures to mitigate future flood losses. The resulting report (Reference 18) proposed channel modifications on the Jordan River, a flow control structure for Utah Lake, and a plan for regulating Utah Lake outflows. These proposals were based on design discharge values established through an analysis of historical Jordan River and tributary floodflow records and a synthesis of impacts of controlled releases from Utah Lake. These design discharges are shown in Table 4. The design discharges were used in a hydraulic step-backwater model (Reference 11) of the Jordan River which assumed all proposed channel modifications to be in place. This analysis resulted
Table 4. Jordan River Proposed Design Discharges

<table>
<thead>
<tr>
<th>Location</th>
<th>Design Discharge (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100 South Street to Mill Creek Confluence</td>
<td>4,500</td>
</tr>
<tr>
<td>Mill Creek Confluence to Big Cottonwood Creek Confluence</td>
<td>4,500</td>
</tr>
</tbody>
</table>

1Source of Discharge Data: Utah Lea/L Jordan River Flood Management Plan, Phase I Report (Reference 18)
in a water-surface profile shown in this Flood Insurance Study as the Utah Lake/Jordan River Flood Management Plan Profiles. No comparison or correlation between these profiles and the data presented in this study can be made or is intended. Most of the Jordan River channel modifications and the Utah Lake outflow control structure have not been completed. The proposed plan for regulating outflows from Utah Lake is not being used at present.

The study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Building 710, Denver Federal Center, Lakewood, Colorado 80225. 

8.0 BIBLIOGRAPHY AND REFERENCES

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11. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, Computer Program 723-K 6-1202A HEC-2 Water-Surface Profiles, Davis, California, November 1976, with updates

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9.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood hazard data located at the City Engineering Department, South Salt Lake City, 220 East Morris Avenue, South Salt Lake, Utah 84155.

9.1 First Revision

This study was revised on September 30, 1994, to include the restudy of the Jordan River conducted for FEMA by CH2M Hill under Contract No. EMW-90-0-C-3104. The restudy was completed in November 1992.

The Jordan River was studied in detail from the Utah - Salt Lake County line to the Surplus Canal Diversion near 2100 South Street. The study area includes portions of the unincorporated areas of Salt Lake County, as well as portions of the Cities of West Valley, South Salt Lake, Murray, Midvale, West Jordan, South Jordan, Sandy, Riverton, Draper, Bluffdale, and Salt Lake City.

Hydrologic analyses were performed to establish discharge-frequency relationships at four locations in the study reach of the Jordan River. Historic streamflow data were analyzed in accordance with criteria outlined in Bulletin No. 178, Guidelines for Determining Flood Flow Frequency (Reference 19).

Historic Utah Lake stage records beginning in 1884, and a high water reference of 1862, were used in conjunction with a stage-discharge curve to estimate historic natural discharges in the Jordan River. These data were used to supplement the U.S. Geological Survey (USGS) streamflow data to develop the discharge-frequency curves. The locations, length of record, and operating agency, and type of record available for the streamflow gages used for this study are summarized in Table 1.

The streamflow gaging records for the Jordan River consist of two data populations as a result of the operational effects of the Compromise Agreement: natural releases and pumped releases (Reference 20). The two data populations were analyzed independently to develop flood flow frequency curves for snowmelt events, as it was determined that floods caused by snowmelt events are generally more severe than those caused by rainfall events. Flood peaks caused by rainfall events were not evaluated with peaks caused by snowmelt events so that the data populations would be homogeneous. The most severe snowmelt floods on the Jordan River are associated with natural releases and high levels of Utah Lake.

Discharge contributions to the Jordan River from Mill Creek, Big Cottonwood Creek, and Little Cottonwood Creek were based on estimated 100-year tributary discharges at the canyon mouths developed by the U.S. Army Corps of Engineers (USACE) (Reference 17).

The peak discharge-drainage area relationships developed for the Jordan River were added to Table 2.

The HEC-2 computer model developed by the study contractor as part of the Utah Lake/Jordan River Flood Management Program in 1984 was used as a basis for performing the hydraulic analyses of the Jordan River (Reference 18). The cross sections used to develop that model were field surveyed in June 1984 during the peak flow period. That model was calibrated to the 1984 event. To update the model developed in 1984, 78 additional cross sections were added to the 1984 model. Cross section data for approximately 38 of the supplemental cross sections were obtained from a 1987 survey where monumented cross sections were established between 2100 South and 14600 South to monitor erosion and deposition. The data for the remaining 40 cross sections were field surveyed in 1980 and 1994. Overbank and underwater data were obtained by field surveys for all channel cross sections. In some areas (i.e., between 2100 South and the Mill Creek confluence) supplemental overbank cross section data were obtained from the 1990 orthophoto topographic maps provided by Salt Lake County (Reference 21). The portion of the HEC-2 model for the study reach upstream of Turner Dam was obtained from data developed by the USACE. All hydraulic structures were surveyed to obtain elevation and structural geometry data.

Water-surface elevations for floods of the selected recurrence intervals were computed using the HEC-2 Water Surface Profiles computer program developed by the USACE (Reference 22). Starting water-surface elevations were determined using the slope-area method.

Natural channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations and of the stream and floodplain areas. Roughness values ranged from 0.022 to 0.077 for the natural main channel and from 0.075 to 0.225 for overbank areas. Main channel roughness coefficients of 0.012 and 0.013 were used to model flow through two of the concrete diversion structures on the river.
Orthophoto topographic maps with a scale of 1:4,800 and a contour interval of 4 feet, with 2-foot supplemental contours, were provided to the study contractor by Salt Lake County (Reference 21). The photograph date of the study area was November 11, 1990.

Five shallow flooding or ponding zones (Zone AH) are identified on the maps. One of these areas is located just downstream of the Big Cottonwood Creek confluence. Another is located just upstream of the 4500 South Street bridge. The other three are located between the south side of the Sharon Steel tailings pile and the North Jordan Diversion structure.

The AH Zone located just downstream of the Big Cottonwood Creek confluence is located in a low area behind a short levee. This levee is not a FEMA certified levee, it provides less than 3 feet of freeboard during the 100-year flood, and shallow flooding occasionally occurs in the area because of inadequate internal drainage facilities. The flood elevation in this area was assumed to be equal to the water-surface elevation in the Jordan River.

The other four AH Zones are shallow flooding areas in low overbank areas along the Jordan River. The flood elevations in those areas were estimated from the water surface in the river at the low points where water enters those areas.

Flood boundaries for the Jordan River were delineated using orthophoto topographic maps at a scale of 1:4,800 with a contour interval of 4 feet and supplemental 2-foot contours. The contours on these maps extend to a point that is either 1,000 feet from the channel or 10 feet above the top of the bank, whichever comes first. In areas where the floodplain exceeded contoured areas on the maps, USGS quadrangle maps were used to supplement the contours on the orthophoto topographic maps (Reference 23). In the west overbank area between 2100 South Street and the Decker Lake Drain, the orthophoto topographic map contour data were supplemented with contour data from 1985 orthophoto topographic mapping with a contour interval of 5 feet provided by West Valley City (Reference 24).

The Summary of Discharges Table and Floodway Data Table were revised to include data for the Jordan River, and Flood Profiles for the Jordan River were added.

As a part of this update, the Utah Lake/Jordan River Flood Management Plan Profiles (Jordan River) have been removed from this report.

Also, as a part of this update, the Flood Insurance Rate Map for the City of South Salt Lake was converted to the Map Initiatives format. In the Map Initiatives format, all base flood elevations, cross sections, and floodplain and floodway boundaries are shown on the Flood Insurance Zone Map. The Flood Insurance Zone Designations were changed to reflect the Map Initiatives format as follows:

**Zone A:** Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

**Zone A: A1:** Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

**Zone AH:** Zone AH is the flood insurance rate Zone that corresponds to the areas of 100-year flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

**Zone X:** Zone X is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

In addition, the Flood Insurance Zone Data Table was removed from the Flood Insurance Study report, and all zone designations and reach determinations were removed from the profiles.