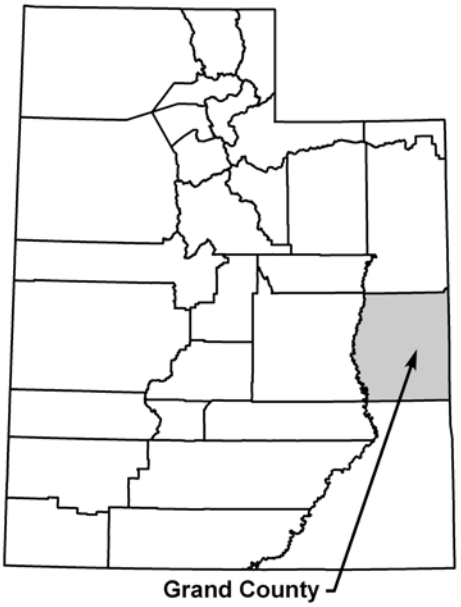
FLOOD INSURANCE STUDY

GRAND COUNTY, UTAH
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
* Castle Valley, Town of	490110
Grand County (Unincorporated areas)	490232
Moab, City of	490072

* NON-FLOODPRONE



REVISED:
April 3, 2020

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
49019CV000B

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) 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 Community Map Repository. It is advisable to contact the community repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

The Letter of Map Revision (LOMR) for the reach of Colorado River near Kings Bottom is reflected in the current maps, but did not trigger republication of this report.

Selected Flood Insurance Rate Map panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways and cross sections). In addition, former flood insurance risk zone designations have been changed as follows:

Old Zone(s)	New Zone
A1 – A30	AE
B	X
C	X

Initial FIS Effective Date: April 2, 2009

First FIS Revision Date: April 3, 2020. Physical Map Revision to incorporate LOMR 15-08-1440P into panels that were not previously printed.

FLOOD INSURANCE STUDY
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1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and supersedes the FIS report and Flood Insurance Rate Maps (FIRMs) and Flood Boundary and Floodway Maps in the geographic area of the City of Moab, and portions of Grand County, Utah, in the vicinity of the City of Moab (see Flood Insurance Rate Map Index), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by community officials to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local planners to further promote sound land use and floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (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.

The Digital Flood Insurance Rate Map (DFIRM) and FIS Report for the area in the vicinity of the City of Moab have been produced in digital format. Flood hazard information was converted to meet the FEMA DFIRM database specifications and Geographic Information System (GIS) format requirements. The flood hazard information was created and is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community.

The Town of Castle Valley and the City of Green River were not included in this study. It should be noted that the Town of Castle Valley was previously found to be in a non-floodprone area.

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 detailed hydrologic and hydraulic analyses for this study were performed by Bowen, Collins & Associates. The hydrologic analyses for Mill Creek and Pack Creek and the hydraulic analyses for Mill Creek were performed for a Letter of Map Revision sponsored by the City of Moab in February 2006. The hydraulic analyses for Pack Creek and the Colorado River and the conversion of the Mill Creek analyses to digital format were completed by Bowen, Collins & Associates in association with AMEC for the Utah Office of Emergency Services, a Federal Emergency Management Agency (FEMA) Cooperating Technical Partner (CTP), under Utah State Contract Number 066016. This work was completed in September 2006.

Bulletin 17B, Guidelines for Determining Flood Flow Frequency (References 6 and 7) recommends performing a sensitivity analysis to test if the upper tail of the flood frequency curve is sensitive to low flows. A sensitivity analysis was performed using different threshold values. The final analysis used a threshold value of 300 cfs to reduce the effects of the low flow "non-flood" events on the upper portion of the flood frequency curve. No historic discharge data were used in the analysis.

Stream gage records for Pack Creek exist only for the years 1955 to 1959 and are inadequate for development of flood frequency estimates using statistical methods. Therefore, the methods described in the National Flood Frequency

Program – Methods for Estimating Flood Magnitude and Frequency in Rural Areas in Utah (References 10 and 11) were used develop flood frequency discharges for Mill Creek using regional regression equations. Version 3 of the NFF computer program was used to apply the appropriate regional regression equation in computing flood frequency discharges, but the results were area weighted with the statistical analyses from Mill Creek to refine the results. A similar procedure was used to develop the flood frequency discharges for Mill Creek below the Pack Creek confluence. A more detailed summary of the hydrologic analysis is presented in a hydrology report that is included in the Technical Support Data Notebook on file in the FEMA archives and at the Community Map Repository.

Although not studied using details methods, a flood frequency analysis was also completed for the Colorado River using annual peak discharges from USGS gage 09180500. The period of record for the analysis was 1914 to 1917, and 1923 to 2005. Due to the length of record, no generalized skew was used. No historic discharge data were used in the analysis. The FFA computer program and the procedures outlined in Bulletin 17 B were utilized in performing the analysis.

Peak discharge-drainage area relationships for the Colorado River, Mill Creek and Pack Creek are shown in Table 1.

TABLE 1 – SUMMARY OF DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance	0.2-percent Annual Chance
COLORADO RIVER, Near Cisco, Utah	24,100	59,000	78,500	86,000	100,000
MILL CREEK					
Below Pack Creek confluence	132.3	3,580	7,660	9,940	16,650
3.5 miles upstream from the mouth of Mill Creek at confluence with Colorado River	74.9	2,910	6,250	8,670	15,400
PACK CREEK					
At Mill Creek Drive	57.4	2,560	5,480	7,120	11,920

capacity problems and the related shallow flooding can be easily mitigated for the 100-year event, the base flood elevations for Mill Creek and Pack Creek were computed assuming the entire 100-year discharge would remain in the channel and routed downstream rather than subtracting the over bank flows upstream. This is believed to be prudent and conservative, and the approach is supported by community officials for managing development in or near the floodplains. The extent of the shallow flooding areas caused by channel overtopping were developed assuming the capacity restrictions remain unchanged during a flood.

The areas of 100-year shallow flooding associated with surface runoff originating in the slickrock area, along the east side of the city, was determined using a normal depth analysis and previous U.S. Soil- Conservation Service calculations (Reference 3). In the southwestern portion of Moab, 500-year flood boundaries were determined using U.S. Soil Conservation Service calculations (Reference 3). The results were verified by local residents.

The approximate flood boundaries associated with the 100-year flood on the Colorado River in the vicinity of Moab were developed from information provided by the USGS in association with USGS Scientific Investigations Report 2005-5022 (Reference 5). That study utilized the USGS Multi- Dimensional Surface Water Modeling System (MD_SWMS) to evaluate hydraulic characteristics of the section of the Colorado River near Moab. USGS personnel utilized their model with the 100-year discharge listed in Table 1 to develop the approximate floodplain boundary shown on the FIRM.

3.3 Vertical Datum

The "approximate" floodplain referenced above was refined by the Kane Creek LOMR and a regulatory Floodway was also designated for the area.

All FIS reports 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 used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD). With the completion of the North American Vertical Datum of 1988 (NAVD), many FIS reports and FIRMs are now prepared using NAVD as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. It is important to note that the 1991 base map used to delineate the floodplain boundaries was developed on the NGVD29 datum. The flood boundaries and elevations were developed using the NGVD29 datum and mapping, then converted to NAVD88 for publishing. The conversion was made by adding 3.32 feet to the NGVD29 elevations provided by field survey and topographic mapping. For information regarding conversion between the NGVD and NAVD, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

The streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary, are shown on the FIRMs (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 and are presented in Table 2. 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 1.

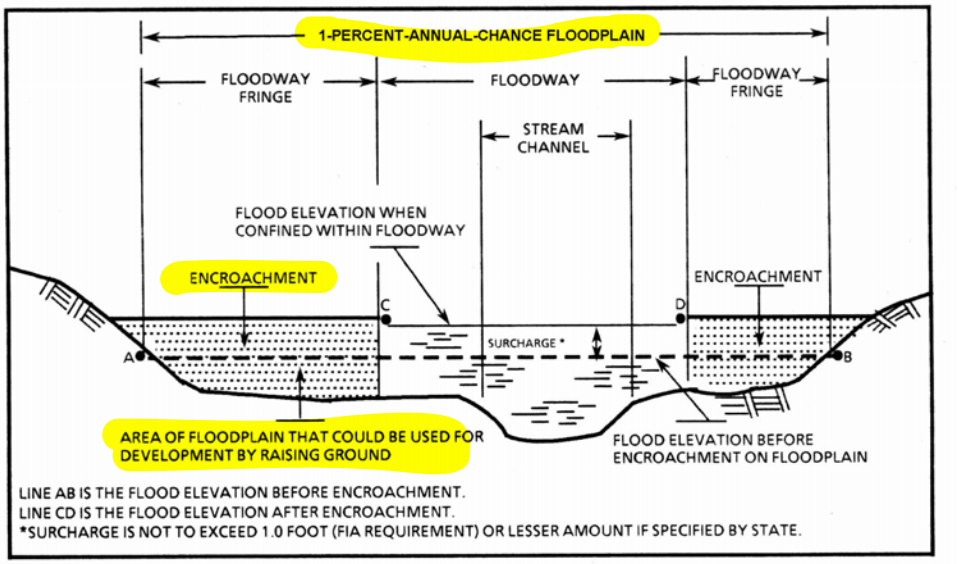

FIGURE 1 – FLOODWAY SCHEMATIC

5.0 INSURANCE APPLICATION

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 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.

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 City of Moab and surrounding area. Historical data relating to the maps prepared for City of Moab and Grand County are presented in Table 3.

7.0 OTHER STUDIES

The USGS published Scientific Investigations Report 2005-5022 (Reference 5), which summarizes the results of a study that evaluated the water surface elevations, shear stress, and distribution of two-dimensional velocities in the reach of the Colorado River in the vicinity of Moab, Utah. The primary purpose of that study was to evaluate the stability of the Moab uranium mill tailings adjacent to the Colorado River at the north end of the Moab Valley. The flood frequency analysis documented in that report estimated a 100-year discharge of 97,600 cfs, but that analysis utilized a historic discharge estimate of 125,000 cfs for a flood in 1884. The Study Contractor discussed the difference in the results of the flood frequency analyses performed by the USGS and this FIS, and USGS personnel agreed that their analysis was conservative because of the concern with the uranium tailings. USGS personnel developed the approximate floodplain included on the FIRM by utilizing the 86,000 cfs 100-year discharge and the USGS Multi-Dimensional Surface Water Modeling System (MD_SWMS) model that was utilized in the 2005 USGS study.

During 1975, the U.S. Soil Conservation Service conducted a flood hazard analysis for Moab (Reference 3). That report summarizes data associated with delineating the 100-year flood profiles and flood plain for Mill Creek, Pack Creek, and shallow flooding in Moab due to runoff from the slickrock drainage areas. The hydrologic data presented in the 1975 U.S. Soil Conservation Service report associated with Mill Creek and Pack Creek have been superseded by this FIS. However, the shallow flood hazard boundaries created by runoff originating in the slickrock areas and the mountain southwest of Moab were digitized as part of this FIS.

This FIS report either supersedes or is compatible with all previous studies on streams studied in this report and should be considered authoritative for purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Federal Insurance and Mitigation Division, Federal Emergency Management Agency, FEMA Region VIII, Denver Federal Center, Building 710, P.O. Box 25267, Denver, Colorado 80225-0267.

9.0 BIBLIOGRAPHY AND REFERENCES

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2. Federal Emergency Management Agency, Flood Insurance Study, City of Moab, Utah, Grand County, December 1979.

3. U.S. Department of Agriculture, Soil Conservation Service, Flood Hazard Analyses for Moab and Vicinity, Grand County, Utah, December 1975.

4. Western Regional Climate Center, Moab, Utah Period of Record Monthly Climate Summary, January 1, 1890 to December 31, 2005, www.wrc.dri.edu.

5. U.S. Department of the Interior, U.S. Geologic Survey, Scientific Investigations Report 2005-5022, Initial-Phase Investigation of Multi- Dimensional Streamflow Simulations in the Colorado River, Moab Valley, Grand County, Utah, 2004.

6. U.S. Department of the Interior, Geologic Survey, Office of Water Data Coordination, Interagency Advisory Committee on Water Data, Bulletin #17B, Guidelines for Determining Flood Flow Frequency, March 1982.

7. U.S. Department of the Interior, Geologic Survey, Office of Water Data Coordination, Advisory Committee on Water Information, Subcommittee on Hydrology, Hydrologic Frequency Analysis Work Group, Bulletin #17B, Frequently Asked Questions (When should low flows that are not identified as low outliers using the 17B default procedure be censored?), October 1999.

8. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-RAS River Analysis System software, Version 3.1.3, May 2005.