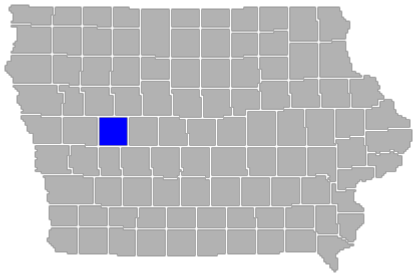
FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 1



CARROLL COUNTY, IOWA

AND INCORPORATED AREAS

COMMUNITY NAME	NUMBER
ARCADIA, CITY OF	190694
BREDA, CITY OF*	190926
CARROLL, CITY OF	190041
CARROLL COUNTY UNINCORPORATED AREAS	190039
COON RAPIDS, CITY OF	190042
DEDHAM, CITY OF	190043
GLIDDEN, CITY OF *	190044
HALBUR, CITY OF	190740
LANESBORO, CITY OF	190756
LIDDERDALE, CITY OF *	190930
MANNING, CITY OF	190046
TEMPLETON, CITY OF *	190811
WILLEY, CITY OF*	195240

*No Special Flood Hazard Areas Identified

FEMA

PRELIMINARY

June 8, 2015

FLOOD INSURANCE STUDY NUMBER
19027CV000A

Version Number 2.3.3.0

TABLE OF CONTENTS
Volume 1

		Page
SECTION 1.0 – INTRODUCTION		**1**
1.1	The National Flood Insurance Program	1
1.2	Purpose of this Flood Insurance Study Report	2
1.3	Jurisdictions Included in the Flood Insurance Study Project	2
1.4	Considerations for using this Flood Insurance Study Report	6
SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS		**17**
2.1	Floodplain Boundaries	17
2.2	Floodways	17
2.3	Base Flood Elevations	19
2.4	Non-Encroachment Zones	19
2.5	Coastal Flood Hazard Areas	22
2.5.1	Water Elevations and the Effects of Waves	22
2.5.2	Floodplain Boundaries and BFEs for Coastal Areas	22
2.5.3	Coastal High Hazard Areas	22
2.5.4	Limit of Moderate Wave Action	22
SECTION 3.0 – INSURANCE APPLICATIONS		**23**
3.1	National Flood Insurance Program Insurance Zones	23
3.2	Coastal Barrier Resources System	23
SECTION 4.0 – AREA STUDIED		**24**
4.1	Basin Description	24
4.2	Principal Flood Problems	24
4.3	Non-Levee Flood Protection Measures	25
4.4	Levees	25
SECTION 5.0 – ENGINEERING METHODS		**28**
5.1	Hydrologic Analyses	28
5.2	Hydraulic Analyses	30
5.3	Coastal Analyses	34
5.3.1	Total Stillwater Elevations	34
5.3.2	Waves	34
5.3.3	Coastal Erosion	34
5.3.4	Wave Hazard Analyses	34
5.4	Alluvial Fan Analyses	35
SECTION 6.0 – MAPPING METHODS		**35**
6.1	Vertical and Horizontal Control	35
6.2	Base Map	36
6.3	Floodplain and Floodway Delineation	37
6.4	Coastal Flood Hazard Mapping	39
6.5	FIRM Revisions	39

6.5.1 Letters of Map Amendment 39
6.5.2 Letters of Map Revision Based on Fill 39
6.5.3 Letters of Map Revision 40
6.5.4 Physical Map Revisions 40
6.5.5 Contracted Restudies 40
6.5.6 Community Map History 41

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION 43
7.1 Contracted Studies 43
7.2 Community Meetings 43

SECTION 8.0 – ADDITIONAL INFORMATION 45

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES 47

Figures

Page

Figure 1: FIRM Panel Index 9
Figure 2: FIRM Notes to Users 11
Figure 3: Map Legend for FIRM 13
Figure 4: Floodway Schematic 18
Figure 5: Wave Runup Transect Schematic 22
Figure 6: Coastal Transect Schematic 22
Figure 7: Frequency Discharge-Drainage Area Curves 30
Figure 8: 1% Annual Chance Total Stillwater Elevations for Coastal Areas 34
Figure 9: Transect Location Map 34

Tables

Page

Table 1: Listing of NFIP Jurisdictions 3
Table 2: Flooding Sources Included in this FIS Report 20
Table 3: Flood Zone Designations by Community 23
Table 4: Coastal Barrier Resources System Information 23
Table 5: Basin Characteristics 24
Table 6: Principal Flood Problems 24
Table 7: Historic Flooding Elevations 25
Table 8: Non-Levee Flood Protection Measures 25
Table 9: Levees 27
Table 10: Summary of Discharges 29
Table 11: Summary of Non-Coastal Stillwater Elevations 30
Table 12: Stream Gage Information used to Determine Discharges 30
Table 13: Summary of Hydrologic and Hydraulic Analyses 31
Table 14: Roughness Coefficients 34
Table 15: Summary of Coastal Analyses 34
Table 16: Tide Gage Analysis Specifics 34
Table 17: Coastal Transect Parameters 34

Table 18: Summary of Alluvial Fan Analyses 35
Table 19: Results of Alluvial Fan Analyses 35
Table 20: Countywide Vertical Datum Conversion 35
Table 21: Stream-by-Stream Vertical Datum Conversion 36
Table 22: Base Map Sources 36
Table 23: Summary of Topographic Elevation Data used in Mapping 37
Table 24: Floodway Data 38
Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams 39
Table 26: Summary of Coastal Transect Mapping Considerations 39
Table 27: Incorporated Letters of Map Change 40
Table 28: Community Map History 42
Table 29: Summary of Contracted Studies Included in this FIS Report 43
Table 30: Community Meetings 44
Table 31: Map Repositories 45
Table 32: Additional Information 46
Table 33: Bibliography and References 48

Volume 1

Exhibits

Flood Profiles	Panel
Middle Raccoon River	01-03 P

Published Separately

Flood Insurance Rate Map (FIRM)

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FLOOD INSURANCE STUDY REPORT
CARROLL COUNTY, IOWA

SECTION 1.0 – INTRODUCTION

1.1 The National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a voluntary Federal program that enables property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

For decades, the national response to flood disasters was generally limited to constructing flood-control works such as dams, levees, sea-walls, and the like, and providing disaster relief to flood victims. This approach did not reduce losses nor did it discourage unwise development. In some instances, it may have actually encouraged additional development. To compound the problem, the public generally could not buy flood coverage from insurance companies, and building techniques to reduce flood damage were often overlooked.

In the face of mounting flood losses and escalating costs of disaster relief to the general taxpayers, the U.S. Congress created the NFIP. The intent was to reduce future flood damage through community floodplain management ordinances, and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection.

The U.S. Congress established the NFIP on August 1, 1968, with the passage of the National Flood Insurance Act of 1968. The NFIP was broadened and modified with the passage of the Flood Disaster Protection Act of 1973 and other legislative measures. It was further modified by the National Flood Insurance Reform Act of 1994 and the Flood Insurance Reform Act of 2004. The NFIP is administered by the Federal Emergency Management Agency (FEMA), which is a component of the Department of Homeland Security (DHS).

Participation in the NFIP is based on an agreement between local communities and the Federal Government. If a community adopts and enforces floodplain management regulations to reduce future flood risks to new construction and substantially improved structures in Special Flood Hazard Areas (SFHAs), the Federal Government will make flood insurance available within the community as a financial protection against flood losses. The community's floodplain management regulations must meet or exceed criteria established in accordance with Title 44 Code of Federal Regulations (CFR) Part 60.3, *Criteria for land Management and Use*.

SFHAs are delineated on the community's Flood Insurance Rate Maps (FIRM). Under the NFIP, buildings that were built before the flood hazard was identified on the community's FIRMs are generally referred to as "Pre-FIRM" buildings. When the NFIP was created, the U.S. Congress recognized that insurance for Pre-FIRM buildings would be prohibitively expensive if the premiums were not subsidized by the Federal Government. Congress also recognized that most of these floodprone buildings were built by individuals who did not have sufficient knowledge of the flood hazard to make informed decisions. The NFIP requires that full actuarial rates reflecting the complete flood risk be charged on all buildings constructed or substantially improved on or after

the effective date of the initial FIRM for the community or after December 31, 1974, whichever is later. These buildings are generally referred to as “Post-FIRM” buildings.

1.2 Purpose of this Flood Insurance Study Report

This Flood Insurance Study (FIS) report revises and updates information on the existence and severity of flood hazards for the study area. The studies described in this report developed flood hazard data that will be used to establish actuarial flood insurance rates and to assist communities in efforts to implement sound floodplain management.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive than the minimum Federal requirements. Contact your State NFIP Coordinator to ensure that any higher State standards are included in the community’s regulations.

1.3 Jurisdictions Included in the Flood Insurance Study Project

This FIS Report covers the entire geographic area of Carroll County, Iowa.

The jurisdictions that are included in this project area, along with the Community Identification Number (CID) for each community and the 8-digit Hydrologic Unit Codes (HUC-8) sub-basins affecting each, are shown in Table 1. The Flood Insurance Rate Map (FIRM) panel numbers that affect each community are listed. If the flood hazard data for the community is not included in this FIS Report, the location of that data is identified.

The location of flood hazard data for participating communities in multiple jurisdictions is also indicated in the table.

Jurisdictions that have no identified SFHAs as of the effective date of this study are indicated in the table. Changed conditions in these communities (such as urbanization or annexation) or the availability of new scientific or technical data about flood hazards could make it necessary to determine SFHAs in these jurisdictions in the future.

Table 1: Listing of NFIP Jurisdictions

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
City of Arcadia	190694	07100007, 10230007	19027C0108C	
City of Breda[1]	190926	07100006, 07100007	19027C0028C, 19027C0029C[2], 19027C0036C, 19027C0037C	
City of Carroll	190041	07100007	19027C0134C, 19027C0142C, 19027C0151C, 19027C0153C, 19027C0154C[2], 19027C0161C, 19027C0162C	
Carroll County, Unincorporated Areas	190039	07100006, 07100007, 10230007, 10240002, 10240003	19027C0025C, 19027C0028C, 19027C0029C[2], 19027C0036C, 19027C0037C, 19027C0050C, 19027C0068C, 19027C0069C, 19027C0075C, 19027C0079C, 19027C0083C, 19027C0087C, 19027C0091C, 19027C0100C, 19027C0108C, 19027C0125C, 19027C0134C, 19027C0138C, 19027C0139C, 19027C0142C, 19027C0150C, 19027C0151C,	

[1]No Special Flood Hazard Areas Identified

[2]Panel Not Printed

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Carroll County, Unincorporated Areas (continued)	190039		19027C0152C, 19027C0153C, 19027C0154C[2], 19027C0156C, 19027C0157C, 19027C0161C, 19027C0162C, 19027C0175C, 19027C0178C[2], 19027C0179C, 19027C0186C, 19027C0187C, 19027C0200C, 19027C0212C, 19027C0214C, 19027C0216C, 19027C0218C, 19027C0225C, 19027C0226C, 19027C0237C, 19027C0241C, 19027C0250C, 19027C0252C, 19027C0262C, 19027C0264C, 19027C0275C, 19027C0289C, 19027C0293C, 19027C0300C, 19027C0325C, 19027C0350C, 19027C0375C, 19027C0377C, 19027C0381C, 19027C0400C	

[2]Panel Not Printed

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
City of Coon Rapids	190042	07100007	19027C0289C, 19027C0293C, 19027C0377C, 19027C0381C	
City of Dedham	190043	07100007	19027C0262C, 19027C0264C	
City of Glidden[1]	190044	07100006, 07100007	19027C0178C[2], 19027C0179C, 19027C0186C, 19027C0187C	
City of Halbur	190740	07100007	19027C0138C, 19027C0139C, 19027C0226C	
City of Lanesboro	190756	07100006	19027C0079C, 19027C0083C, 19027C0087C, 19027C0091C	
City of Lidderdale[1]	190930	07100006, 07100007	19027C0068C, 19027C0069C, 19027C0156C, 19027C0157C	
City of Manning	190046	10240002	19027C0212C, 19027C0214C, 19027C0216C, 19027C0218C	
City of Ralston	190935	07100006	19027C0200C	Greene County, FIS Report, dated 7/14/14
City of Templeton[1]	190811	07100007, 10240003	19027C0237C, 19027C0241C	
City of Willey[1]	195240	07100007	19027C0252C	

[1]No Special Flood Hazard Areas Identified
[2]Panel Not Printed

1.4 Considerations for using this Flood Insurance Study Report

The NFIP encourages State and local governments to implement sound floodplain management programs. To assist in this endeavor, each FIS Report provides floodplain data, which may include a combination of the following: 10-, 4-, 2-, 1-, and 0.2-percent annual chance flood elevations (the 1% annual chance flood elevation is also referred to as the Base Flood Elevation (BFE)); delineations of the 1% annual chance and 0.2% annual chance floodplains; and 1% annual chance floodway. This information is presented on the FIRM and/or in many components of the FIS Report, including Flood Profiles, Floodway Data tables, Summary of Non-Coastal Stillwater Elevations tables, and Coastal Transect Parameters tables (not all components may be provided for a specific FIS).

This section presents important considerations for using the information contained in this FIS Report and the FIRM, including changes in format and content. Figures 1, 2, and 3 present information that applies to using the FIRM with the FIS Report.

- Part or all of this FIS Report may be revised and republished at any time. In addition, part of this FIS Report may be revised by a Letter of Map Revision (LOMR), which does not involve republication or redistribution of the FIS Report. Refer to Section 6.5 of this FIS Report for information about the process to revise the FIS Report and/or FIRM.

  It is, therefore, the responsibility of the user to consult with community officials by contacting the community repository to obtain the most current FIS Report components. Communities participating in the NFIP have established repositories of flood hazard data for floodplain management and flood insurance purposes. Community map repository addresses are provided in Table 31, "Map Repositories," within this FIS Report.

- New FIS Reports are frequently developed for multiple communities, such as entire counties. A countywide FIS Report incorporates previous FIS Reports for individual communities and the unincorporated area of the county (if not jurisdictional) into a single document and supersedes those documents for the purposes of the NFIP.

  The initial Countywide FIS Report for Carroll County became effective on (*DATE*). Refer to Table 28 for information about subsequent revisions to the FIRMs.

- The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Visit the FEMA Web site at http://www.fema.gov or contact your appropriate FEMA Regional Office for more information about this program.

- FEMA has developed a *Guide to Flood Maps* (FEMA 258) and online tutorials to assist users in accessing the information contained on the FIRM. These include how to read panels and step-by-step instructions to obtain specific information. To obtain this guide and other assistance in using the FIRM, visit the FEMA Web site at http://www.fema.gov.

Figure 1 serves as a guide to the panels for the community's at the time that this Index was printed. Since the geographic coverage of a FIRM may be quite large, the area is divided into sections called panels. The index is provided to indicate what areas on shown on each FIRM.

Because this Index may not be distributed to unaffected communities in subsequent revisions, users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center (MSC) website at http://msc.fema.gov, or by calling the FEMA Map Information eXchange (FMIX) at 1-877-336-2627

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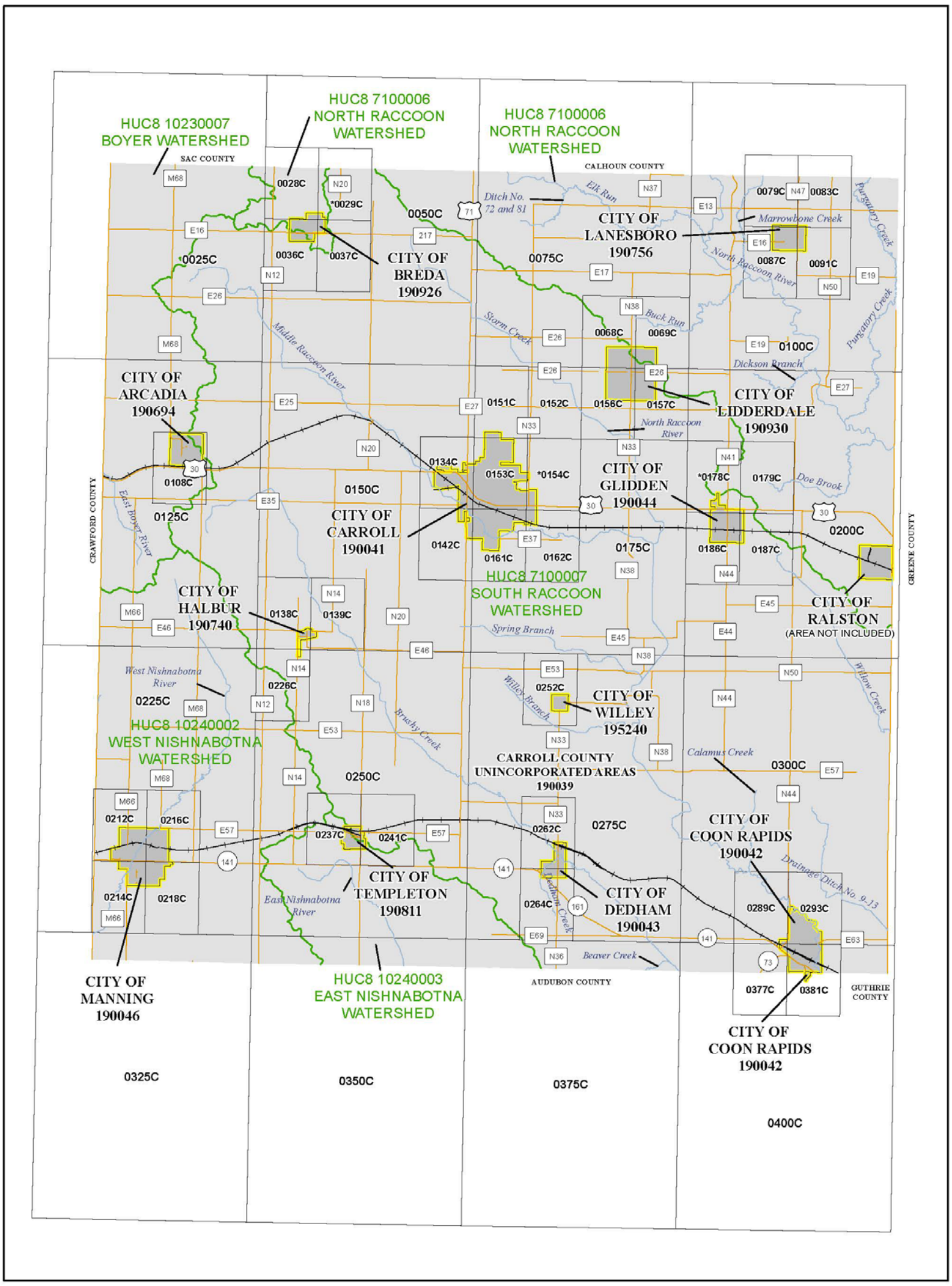
Figure 1: FIRM Panel Index



1 in = 3 miles

0 0.5 1 2 3 4 Miles

Map Projection:
State Plane Iowa South (FIPS Zone 1402) Coordinate System, Lambert Conformal Conic Projection; North American Datum 1983, GRS 1980 spheroid; North American Vertical Datum of 1988

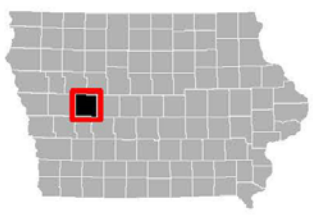
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

*PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

CARROLL COUNTY, IOWA And Incorporated Areas

PANELS PRINTED:
0025, 0028, 0036, 0037, 0050, 0068, 0069, 0075, 0079, 0083, 0087, 0091, 0100, 0108, 0125, 0134, 0138, 0139, 0142, 0150, 0151, 0152, 0153, 0156, 0157, 0161, 0162, 0175, 0179, 0186, 0187, 0200, 0212, 0214, 0216, 0218, 0225, 0226, 0237, 0241, 0250, 0252, 0262, 0264, 0275, 0289, 0293, 0300, 0325, 0350, 0375, 0377, 0381, 0400

FEMA

MAP NUMBER
19027CIND0A

EFFECTIVE DATE

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Figure 2 and Figure 3 notes provide additional information to clarify zone designations or special notes on the use of the FIRM.

Figure 2: FIRM Notes to Users

NOTES TO USERS

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

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

For community and countywide map dates, refer to Table 28 in this FIS Report.

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

PRELIMINARY FIS REPORT: FEMA maintains information about map features, such as street locations and names, in or near designated flood hazard areas. Requests to revise information in or near designated flood hazard areas may be provided to FEMA during the community review period, at the final Consultation Coordination Officer's meeting, or during the statutory 90-day appeal period. Approved requests for changes will be shown on the final printed FIRM.

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

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

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

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 4.3 "Non-Levee Flood Protection Measures" of this FIS Report for information on flood control structures for this jurisdiction.

PROJECTION INFORMATION: The projection used in the preparation of the map was Iowa State Plane South. The horizontal datum was NAD83 GRS1980 Spheroid. Differences in

Figure 2. FIRM Notes to Users

datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to the North American Vertical Datum of 1988 (NAVD 88)**.** These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988 (NAVD 88)**,** visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

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

BASE MAP INFORMATION: Base map information shown on the FIRM was provided by Iowa Geological and Water Survey, Department of Natural Resources (DNR). For information about base maps, refer to Section 6.2 “Base Map” in this FIS Report.

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

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Carroll County, Iowa, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 28 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Carroll County, Iowa, effective *(DATE)*.

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

Figure 3: Map Legend for FIRM

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

	Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)
Zone A	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. No base (1% annual chance) flood elevations (BFEs) or depths are shown within this zone.
Zone AE	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone, either at cross section locations or as static whole-foot elevations that apply throughout the zone.
Zone AH	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the hydraulic analyses are shown at selected intervals within this zone.
Zone AO	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the hydraulic analyses are shown within this zone.
Zone AR	The flood insurance rate zone that corresponds to areas that were formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
Zone A99	The flood insurance rate zone that corresponds to areas of the 1% annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.
Zone V	The flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.
Zone VE	Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.
	Regulatory Floodway determined in Zone AE.

Figure 3: Map Legend for FIRM

OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced the flood risk from the 1% annual chance flood.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible
NO SCREEN	Unshaded Zone X: Areas determined to be outside the 0.2% annual chance flood hazard
FLOOD HAZARD AND OTHER BOUNDARY LINES	
(ortho) (vector)	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
Aqueduct *Channel* *Culvert* *Storm Sewer*	Channel, Culvert, Aqueduct, or Storm Sewer
Dam *Jetty* *Weir*	Dam, Jetty, Weir
	Levee, Dike, or Floodwall accredited or provisionally accredited to reduce the flood risk from the 1% annual chance flood.
	Levee, Dike or Floodwall not accredited to reduce the flood risk from the 1% annual chance flood.
Bridge	Bridge

Figure 3: Map Legend for FIRM

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.*	
CBRS AREA 09/30/2009	Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.
OTHERWISE PROTECTED AREA 09/30/2009	Otherwise Protected Area
REFERENCE MARKERS	
22.0	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
B 20.2	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
5280 21.1	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
17.5	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
8	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
513	Base Flood Elevation Line (shown for flooding sources for which no cross sections or profile are available)
ZONE AE (EL 16)	Static Base Flood Elevation value (shown under zone label)
ZONE AO (DEPTH 2)	Zone designation with Depth
ZONE AO (DEPTH 2) (VEL 15 FPS)	Zone designation with Depth and Velocity

Figure 3: Map Legend for FIRM

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

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1% annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2% annual chance (500-year) flood is employed to indicate additional areas of flood hazard in the community.

Each flooding source included in the project scope has been studied and mapped using professional engineering and mapping methodologies that were agreed upon by FEMA and Carroll County as appropriate to the risk level. Flood risk is evaluated based on factors such as known flood hazards and projected impact on the built environment. Engineering analyses were performed for each studied flooding source to calculate its 1% annual chance flood elevations; elevations corresponding to other floods (e.g., 10-, 4-, 2-, 0.2-percent annual chance, etc.) may have also been computed for certain flooding sources. Engineering models and methods are described in detail in Section 5.0 of this FIS Report. The modeled elevations at cross sections were used to delineate the floodplain boundaries on the FIRM; between cross sections, the boundaries were interpolated using elevation data from various sources. More information on specific mapping methods is provided in Section 6.0 of this FIS Report.

Depending on the accuracy of available topographic data (Table 23), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1% and 0.2% annual chance floodplain boundaries, regulatory water surface elevations (BFEs), and/or a regulatory floodway. Similarly, other flooding sources may be mapped to show only the 1% annual chance floodplain boundary on the FIRM, without published water surface elevations. In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% annual chance floodplain boundary is shown on the FIRM. Figure 3, "Map Legend for FIRM", describes the flood zones that are used on the FIRMs to account for the varying levels of flood risk that exist along flooding sources within the project area. Table 2 and Table 3 indicate the flood zone designations for each flooding source and each community within Carroll County, Iowa, respectively. Table 2, "Flooding Sources Included in this FIS Report," lists each flooding source, including its study limits, affected communities, mapped zone on the FIRM, and the completion date of its engineering analysis from which the flood elevations on the FIRM and in the FIS Report were derived. Descriptions and dates for the latest hydrologic and hydraulic analyses of the flooding sources are shown in Table 13. Floodplain boundaries for these flooding sources are shown on the FIRM (published separately) using the symbology described in Figure 3. On the map, the 1% annual chance floodplain corresponds to the SFHAs. The 0.2% annual chance floodplain shows areas that, although out of the regulatory floodplain, are still subject to flood hazards.

Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data. The procedures to remove these areas from the SFHA are described in Section 6.5 of this FIS Report.

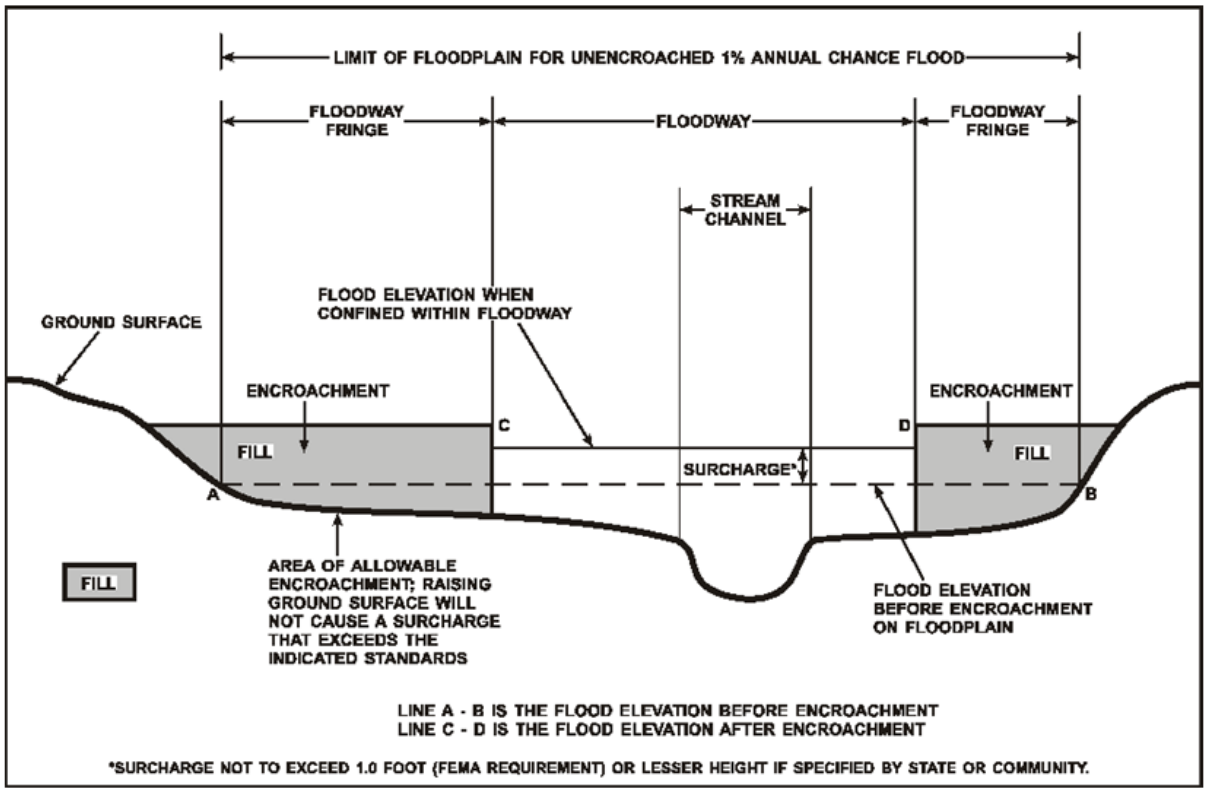
2.2 Floodways

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 balancing floodplain development against increasing flood hazard. With this approach, the area of the 1% annual chance floodplain on a river is divided into a floodway and a floodway fringe based on hydraulic modeling. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment in order to carry the 1% annual chance flood. The floodway fringe is the area between the floodway and the 1% annual chance floodplain boundaries where encroachment is permitted. The floodway must be wide enough so that the floodway fringe could be completely obstructed without increasing the water surface elevation of the 1% annual chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

To participate in the NFIP, Federal regulations require communities to limit increases caused by encroachment to 1.0 foot, provided that hazardous velocities are not produced. Regulations for Iowa require communities in Carroll County to limit increases caused by encroachment to 1.0 foot and several communities may have adopted additional restrictions. The floodways in this project are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway projects.

Figure 4: Floodway Schematic



Floodway widths presented in this FIS Report and on the FIRM were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. For certain stream segments, floodways were adjusted so that the amount of floodwaters conveyed on each side of the floodplain would be reduced equally. The results of the floodway computations have been tabulated for selected cross sections and are shown in Table 24, “Floodway Data.”

All floodways that were developed for this FIS project are shown on the FIRM using the symbology described in Figure 3. In cases where the floodway and l% annual chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown on the FIRM. For information about the delineation of floodways on the FIRM, refer to Section 6.3.

2.3 Base Flood Elevations

The hydraulic characteristics of flooding sources were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. The Base Flood Elevation (BFE) is the elevation of the 1% annual chance flood. These BFEs are most commonly rounded to the whole foot, as shown on the FIRM, but in certain circumstances or locations they may be rounded to 0.1 foot. Cross section lines shown on the FIRM may also be labeled with the BFE rounded to 0.1 foot. Whole-foot BFEs derived from engineering analyses that apply to coastal areas, areas of ponding, or other static areas with little elevation change may also be shown at selected intervals on the FIRM.

Cross sections with BFEs shown on the FIRM correspond to the cross sections shown in the Floodway Data table and Flood Profiles in this FIS Report. BFEs are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM.

2.4 Non-Encroachment Zones

Some States and communities use non-encroachment zones to manage floodplain development. For flooding sources with medium flood risk, field surveys are often not collected and surveyed bridge and culvert geometry is not developed. Standard hydrologic and hydraulic analyses are still performed to determine BFEs in these areas. However, floodways are not typically determined, since specific channel profiles are not developed. To assist communities with managing floodplain development in these areas, a “non-encroachment zone” may be provided. While not a FEMA designated floodway, the non-encroachment zone represents that area around the stream that should be reserved to convey the 1% annual chance flood event. As with a floodway, all surcharges must fall within the acceptable range in the non-encroachment zone.

General setbacks can be used in areas of lower risk (e.g. unnumbered Zone A), but these are not considered sufficient where unnumbered Zone A is replaced by Zone AE. The NFIP requires communities to ensure that any development in a non-encroachment area causes no increase in BFEs. Communities must generally prohibit development within the area defined by the non-encroachment width to meet the NFIP requirement. Regulations for Iowa require communities in Carroll County to limit increases caused by encroachment to 1.0 foot and several communities may have adopted additional restrictions for non-encroachment areas.

Non-encroachment determinations may be delineated where it is not possible to delineate floodways because specific channel profiles with bridge and culvert geometry were not developed. Any non-encroachment determinations for this FIS project have been tabulated for selected cross sections and are shown in Table 25, “Flood Hazard and Non-Encroachment Data for Selected Streams.” Areas for which non-encroachment zones are provided show BFEs and the 1% annual chance floodplain boundaries mapped as zone AE on the FIRM but no floodways.

Table 2: Flooding Sources Included in this FIS Report

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Middle Raccoon River	City of Carroll, Carroll County Unincorporated Areas	Approximately 3,100 feet upstream of Carroll County Road N-33	Approximately 1,000 feet upstream Chicago and North Western Railroad	07100007	5.1		Y	AE	October 1988
Approximate flooding sources in Boyer Watershed	City of Arcadia, Carroll County Unincorporated Areas	Carroll County portion of Boyer Watershed	Carroll County portion of Boyer Watershed	10230007	18.4		N	A	October 13, 2013
Approximate flooding sources in East Nishnabotna Watershed	City of Templeton, Carroll County Unincorporated Areas	Carroll County portion of East Nishnabotna Watershed	Carroll County portion of East Nishnabotna Watershed	10240003	13.2		N	A	October 13, 2013
Approximate flooding sources in North Raccoon Watershed	City of Lanesboro, Carroll County Unincorporated Areas	Carroll County portion of North Raccoon Watershed	Carroll County portion of North Raccoon Watershed	07100006	85.9		N	A	October 13, 2013
Approximate flooding sources in South Raccoon Watershed	City of Arcadia, City Carroll, City of Coon Rapids, City of Dedham, , City of Halbur, City of Willey, Carroll County Unincorporated Areas	Carroll County portion of South Raccoon Watershed	Carroll County portion of South Raccoon Watershed	07100007	219.8		N	A	October 13, 2013

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Approximate flooding sources in West Nishnabotna Watershed	City of Manning, Carroll County Unincorporated Areas	Carroll County portion of West Nishnabotna Watershed	Carroll County portion of West Nishnabotna Watershed	10240002	42.7		N	A	October 13, 2013

2.5 Coastal Flood Hazard Areas

This section is Not Applicable to this FIS Project.

2.5.1 Water Elevations and the Effects of Waves

This section is Not Applicable to this FIS Project.

Figure 5: Wave Runup Transect Schematic
[Not Applicable to this FIS Project]

2.5.2 Floodplain Boundaries and BFEs for Coastal Areas

This section is Not Applicable to this FIS Project.

2.5.3 Coastal High Hazard Areas

This section is Not Applicable to this FIS Project.

Figure 6: Coastal Transect Schematic
[Not Applicable to this FIS Project]

2.5.4 Limit of Moderate Wave Action

This section is Not Applicable to this FIS Project.

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

For flood insurance applications, the FIRM designates flood insurance rate zones as described in Figure 3, "Map Legend for FIRM." Flood insurance zone designations are assigned to flooding sources based on the results of the hydraulic or coastal analyses. Insurance agents use the zones shown on the FIRM and depths and base flood elevations in this FIS Report in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

The 1% annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (e.g. Zones A, AE, V, VE, etc.), and the 0.2% annual chance floodplain boundary corresponds to the boundary of areas of additional flood hazards.

Table 3 lists the flood insurance zones in the unincorporated and incorporated areas of Carroll County.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
City of Arcadia	A, X
City of Breda	X
City of Carroll	A, AE, X
Carroll County Unincorporated Areas	A, AE, X
City of Coon Rapids	A, X
City of Coon Rapids	A, X
City of Dedham	A, X
City of Glidden	X
City of Halbur	A, X
City of Lanesboro	A, X
City of Lidderdale	X
City of Manning	A, X
City of Templeton	X
City of Willey	X

3.2 Coastal Barrier Resources System

The Coastal Barrier Resources Act (CBRA) of 1982 was established by Congress to create areas along the Atlantic and Gulf coasts and the Great Lakes, where restrictions for Federal financial assistance including flood insurance are prohibited. In 1990, Congress passed the Coastal Barrier Improvement Act (CBIA), which increased the extent of areas established by the CBRA and added "Otherwise Protected Areas" (OPA) to the system. These areas are collectively referred to as the John. H Chafee Coastal Barrier Resources System (CBRS). The CBRS boundaries that have been identified in the project area are in Table 4, "Coastal Barrier Resource System Information."

Table 4: Coastal Barrier Resources System Information

[Not Applicable to this FIS Project]

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

Table 5 contains a description of the characteristics of the HUC-8 sub-basins within which each community falls. The table includes the main flooding sources within each basin, a brief description of the basin, and its drainage area.

Table 5: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)
Boyer	10230007	Boyer River	A small portion of this watershed is located in the west and northwestern part of Carroll County, which drains to the Missouri-Nishnabotna River Basin	35
East Nishnabotna	10240003	East Nishnabotna River	The smallest watershed within Carroll County and is located in the south section of the county, which drains to the Missouri-Nishnabotna River Basin	23
North Raccoon	07100006	North Raccoon River	The second largest watershed within Carroll County located in the north and northeast part of the county, which drains to the Des Moines River Basin	102
South Raccoon	07100007	South Raccoon River	The largest watershed within Carroll County emcompassing more than half of the county stretching from the southeast to the northwest, which drains to the Des Moines River Basin	345
West Nishnabotna	10240002	West Nishnabotna River	This watershed is located in the southwest section of Carroll County, which drains to the Missouri-Nishnabotna River Basin	65

4.2 Principal Flood Problems

Table 6 contains a description of the principal flood problems that have been noted for Carroll County by flooding source.

Table 6: Principal Flood Problems

Flooding Source	Description of Flood Problems
Middle Raccoon River	In the City of Carroll, Middle Raccoon River is subject to flash flooding caused by spring snowmelt combined with rainfall or intense rainfall in late spring and summer.

Table 7 contains information about historic flood elevations in the communities within Carroll County.

Table 7: Historic Flooding Elevations
[Not Applicable to this FIS Project]

4.3 Non-Levee Flood Protection Measures

Table 8 contains information about non-levee flood protection measures within Carroll County such as dams, jetties, and or dikes. Levees are addressed in Section 4.4 of this FIS Report.

Table 8: Non-Levee Flood Protection Measures
[Not Applicable to this FIS Project]

4.4 Levees

For purposes of the NFIP, FEMA only recognizes levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with comprehensive floodplain management criteria. The Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10) describes the information needed for FEMA to determine if a levee system reduces the risk from the 1% annual chance flood. This information must be supplied to FEMA by the community or other party when a flood risk study or restudy is conducted, when FIRMs are revised, or upon FEMA request. FEMA reviews the information for the purpose of establishing the appropriate FIRM flood zone.

Levee systems that are determined to reduce the risk from the 1% annual chance flood are accredited by FEMA. FEMA can also grant provisional accreditation to a levee system that was previously accredited on an effective FIRM and for which FEMA is awaiting data and/or documentation to demonstrate compliance with Section 65.10. These levee systems are referred to as Provisionally Accredited Levees, or PALs. Provisional accreditation provides communities and levee owners with a specified timeframe to obtain the necessary data to confirm the levee's certification status. Accredited levee systems and PALs are shown on the FIRM using the symbology shown in Figure 3 and in Table 9. If the required information for a PAL is not submitted within the required timeframe, or if information indicates that a levee system no longer meets Section 65.10, FEMA will de-accredit the levee system and issue an effective FIRM showing the levee-impacted area as a SFHA.

FEMA coordinates its programs with USACE, who may inspect, maintain, and repair levee systems. The USACE has authority under Public Law 84-99 to supplement local efforts to repair flood control projects that are damaged by floods. Like FEMA, the USACE provides a program to allow public sponsors or operators to address levee system maintenance deficiencies. Failure to do so within the required timeframe results in the levee system being placed in an inactive status in the USACE Rehabilitation and Inspection Program. Levee systems in an inactive status are ineligible for rehabilitation assistance under Public Law 84-99.

FEMA coordinated with the USACE, the local communities, and other organizations to compile a list of levees that exist within Carroll County. Table 9, "Levees," lists all accredited levees, PALs, and de-accredited levees shown on the FIRM for this FIS Report. Other categories of levees may also be included in the table. The Levee ID shown in this table may not match numbers based on other identification systems that were listed in previous FIS Reports. Levees identified as PALs in the table are labeled on the FIRM to indicate their provisional status.

Please note that the information presented in Table 9 is subject to change at any time. For that reason, the latest information regarding any USACE structure presented in the table should be obtained by contacting USACE and accessing the USACE national levee database. For levees owned and/or operated by someone other than the USACE, contact the local community shown in Table 31.

Table 9: Levees

Community	Flooding Source	Levee Location	Levee Owner	USACE Levee	Levee ID	Covered Under PL84-99 Program?	FIRM Panel(s)	Levee Status
City of Carroll	Middle Raccoon River	Water Disposal Ponds	City of Carroll	No		No	19027C0161C	Unknown

SECTION 5.0 – ENGINEERING METHODS

For the flooding sources 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 at least once on the average during any 10-, 25-, 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-, 25-, 50-, 100-, and 500-year floods, have a 10-, 4-, 2-, 1-, and 0.2% annual 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 exceedance) during the term of a 30-year mortgage is approximately 26 percent (about 3 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.

The engineering analyses described here incorporate the results of previously issued Letters of Map Change (LOMCs) listed in Table 27, “Incorporated Letters of Map Change”, which include Letters of Map Revision (LOMRs). For more information about LOMRs, refer to Section 6.5, “FIRM Revisions.”

5.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for each flooding source studied. Hydrologic analyses are typically performed at the watershed level. Depending on factors such as watershed size and shape, land use and urbanization, and natural or man-made storage, various models or methodologies may be applied. A summary of the hydrologic methods applied to develop the discharges used in the hydraulic analyses for each stream is provided in Table 13. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

A summary of the discharges is provided in Table 10. Frequency Discharge-Drainage Area Curves used to develop the hydrologic models may also be shown in Figure 7 for selected flooding sources. A summary of stillwater elevations developed for non-coastal flooding sources is provided in Table 11. (Coastal stillwater elevations are discussed in Section 5.3 and shown in Table 17.) Stream gage information is provided in Table 12.

Table 10: Summary of Discharges

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (CFS)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
Middle Raccoon River	At County Road N33	74.3	4,196	*	6,714	7,886	*	11,000
Middle Raccoon River	At Main Street Bridge	58.7	3,663	*	5,905	6,951	*	10,000

*Not calculated for this FIS project

Figure 7: Frequency Discharge-Drainage Area Curves

[Not Applicable to this FIS Project]

Table 11: Summary of Non-Coastal Stillwater Elevations

[Not Applicable to this FIS Project]

Table 12: Stream Gage Information used to Determine Discharges

[Not Applicable to this FIS Project]

5.2 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. Base flood elevations on the FIRM represent the elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations. These whole-foot elevations may not exactly reflect the elevations derived from the hydraulic analyses. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM. The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For streams for which hydraulic analyses were based on cross sections, locations of selected cross sections are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 6.3), selected cross sections are also listed on Table 24, “Floodway Data.”

A summary of the methods used in hydraulic analyses performed for this project is provided in Table 13. Roughness coefficients are provided in Table 14. Roughness coefficients are values representing the frictional resistance water experiences when passing overland or through a channel. They are used in the calculations to determine water surface elevations. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 13: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits		Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
	Downstream Limit	Upstream Limit					
Middle Raccoon River	Approximately 3,100 feet upstream of Carroll County Road N-33	Approximately 1,000 feet upstream Chicago and North Western Railroad	Regression Equations	HEC-2	October 1988	AE w/Floodway	The peak flow discharges were computed using the report, "Method for Estimating the Magnitude and Frequency of Floods at Ungaged Sites on Unregulated Rural Streams in Iowa (USGS, 1987). It was assumed that 90% of the drainage area displayed characteristics of the Region 3 equations and 10% displays characteristics of the Region 4 equations
Approximate flooding sources in Boyer Watershed	Carroll County portion of Boyer Watershed	Carroll County portion of Boyer Watershed	Regression Equations	HEC RAS 3.0 and up	October 13, 2013	A	For streams studied by approximate methods, the peak flood discharges were computed for the 10-, 2-, 1- and 0.2-percent-annual-chance storm events using hydrologic analyses recommended by the Iowa Department of Natural Resources (IDNR) and the Iowa Department of This hydrologic analysis method includes use of gage information and USGS regression equations. For additional information on the hydrologic analyses please refer to the Technical Support Data Notebook on the MIP

Flooding Source	Study Limits		Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
	Downstream Limit	Upstream Limit					
Approximate flooding sources in East Nishnabotna Watershed	Carroll County portion of East Nishnabotna Watershed	Carroll County portion of East Nishnabotna Watershed	Regression Equations	HEC RAS 3.0 and up	October 13, 2013	A	For streams studied by approximate methods, the peak flood discharges were computed for the 10-, 2-, 1- and 0.2-percent-annual-chance storm events using hydrologic analyses recommended by the Iowa Department of Natural Resources (IDNR) and the Iowa Department of This hydrologic analysis method includes use of gage information and USGS regression equations. For additional information on the hydrologic analyses please refer to the Technical Support Data Notebook on the MIP
Approximate flooding sources in North Raccoon Watershed	Carroll County portion of North Raccoon Watershed	Carroll County portion of North Raccoon Watershed	Regression Equations	HEC RAS 3.0 and up	October 13, 2013	A	For streams studied by approximate methods, the peak flood discharges were computed for the 10-, 2-, 1- and 0.2-percent-annual-chance storm events using hydrologic analyses recommended by the Iowa Department of Natural Resources (IDNR) and the Iowa Department of This hydrologic analysis method includes use of gage information and USGS regression equations. For additional information on the hydrologic analyses please refer to the Technical Support Data Notebook on the MIP

Flooding Source	Study Limits		Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
	Downstream Limit	Upstream Limit					
Approximate flooding sources in South Raccoon Watershed	Carroll County portion of South Raccoon Watershed	Carroll County portion of South Raccoon Watershed	Regression Equations	HEC RAS 3.0 and up	October 13, 2013	A	For streams studied by approximate methods, the peak flood discharges were computed for the 10-, 2-, 1- and 0.2-percent-annual-chance storm events using hydrologic analyses recommended by the Iowa Department of Natural Resources (IDNR) and the Iowa Department of This hydrologic analysis method includes use of gage information and USGS regression equations. For additional information on the hydrologic analyses please refer to the Technical Support Data Notebook on the MIP
Approximate flooding sources in West Nishnabotna Watershed	Carroll County portion of West Nishnabotna Watershed	Carroll County portion of West Nishnabotna Watershed	Regression Equations	HEC RAS 3.0 and up	October 13, 2013	A	For streams studied by approximate methods, the peak flood discharges were computed for the 10-, 2-, 1- and 0.2-percent-annual-chance storm events using hydrologic analyses recommended by the Iowa Department of Natural Resources (IDNR) and the Iowa Department of This hydrologic analysis method includes use of gage information and USGS regression equations. For additional information on the hydrologic analyses please refer to the Technical Support Data Notebook on the MIP

Table 14: Roughness Coefficients

Flooding Source	Channel "n"	Overbank "n"
Middle Raccoon River	0.020-0.035	0.050-0.080
Approximate flooding sources in Boyer Watershed	0.035	0.030-0.120
Approximate flooding sources in East Nishnabotna Watershed	0.035-0.045	0.020-0.150
Approximate flooding sources in North Raccoon Watershed	0.030-0.045	0.020-0.150
Approximate flooding sources in South Raccoon Watershed	0.030-0.045	0.020-0.150
Approximate flooding sources in West Nishnabotna Watershed	0.035-0.045	0.020-0.150

5.3 Coastal Analyses

This section is Not Applicable to this FIS Project.

Table 15: Summary of Coastal Analyses
[Not Applicable to this FIS Project]

5.3.1 Total Stillwater Elevations

This section is Not Applicable to this FIS Project.

Figure 8: 1% Annual Chance Total Stillwater Elevations for Coastal Areas
[Not Applicable to this FIS Project]

Table 16: Tide Gage Analysis Specifics
[Not Applicable to this FIS Project]

5.3.2 Waves

This section is Not Applicable to this FIS Project.

5.3.3 Coastal Erosion

This section is Not Applicable to this FIS Project.

5.3.4 Wave Hazard Analyses

This section is Not Applicable to this FIS Project.

Table 17: Coastal Transect Parameters
[Not Applicable to this FIS Project]

Figure 9: Transect Location Map
[Not Applicable to this FIS Project]

5.4 Alluvial Fan Analyses

This section is Not Applicable to this FIS Project.

Table 18: Summary of Alluvial Fan Analyses
[Not Applicable to this FIS Project]

Table 19: Results of Alluvial Fan Analyses
[Not Applicable to this FIS Project]

SECTION 6.0 – MAPPING METHODS

6.1 Vertical and Horizontal Control

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 (NGVD29). With the completion of the North American Vertical Datum of 1988 (NAVD88), many FIS Reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

Flood elevations shown in this FIS Report and on the FIRMs are referenced to North American Vertical Datum of 1988 (NAVD 88). These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between NGVD29 and NAVD88 or other datum conversion, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

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

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

To obtain current elevation, description, and/or location information for benchmarks in the area, please contact information services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

The datum conversion locations and values that were calculated for Carroll County are provided in Table 20.

Table 20: Countywide Vertical Datum Conversion
[Not Applicable to this FIS Project]

A countywide conversion factor was not generated for Carroll County. Calculations for the vertical offsets on a stream by stream basis are depicted in Table 21.

Table 21: Stream-by-Stream Vertical Datum Conversion

Flooding Source	Average Vertical Datum Conversion Factor ()
Middle Raccoon River	+0.36

6.2 Base Map

The FIRMs and FIS Report for this project have been produced in a digital format. The flood hazard information was converted to a Geographic Information System (GIS) format that meets FEMA's FIRM database specifications and geographic information standards. This information 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 FIRM Database includes most of the tabular information contained in the FIS Report in such a way that the data can be associated with pertinent spatial features. For example, the information contained in the Floodway Data table and Flood Profiles can be linked to the cross sections that are shown on the FIRMs. Additional information about the FIRM Database and its contents can be found in FEMA's *Guidelines and Standards*. https://www.fema.gov/media-library/assets/documents/32786?id=7577

Base map information shown on the FIRM was derived from the sources described in Table 22.

Table 22: Base Map Sources

Data Type	Data Provider	Data Date	Data Scale	Data Description
Digital Orthophoto	Iowa Department of Natural Resources	2009	1: 400	Base Imagery
Political boundaries	US Census 2010	2010-2014	1:12,000	Municipal and county boundary
Transportation Features	US Census 2010 TIGER files	2010	1:12,000	Roads and railroad line data
Surface Water Features	Iowa Department of Natural Resources	2010	1:12,000	Streams, rivers, and lakes data
Public Land Survey System (PLSS)	Iowa Department of Natural Resources	1998	1:12,000	PLSS data were digitized from USGS quadrangles

6.3 Floodplain and Floodway Delineation

The FIRM shows tints, screens, and symbols to indicate floodplains and floodways as well as the locations of selected cross sections used in the hydraulic analyses and floodway computations.

For riverine flooding sources, the mapped floodplain boundaries shown on the FIRM have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic elevation data described in Table 23. In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

The floodway widths presented in this FIS Report and on the FIRM were 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. Table 2 indicates the flooding sources for which floodways have been determined. The results of the floodway computations for those flooding sources have been tabulated for selected cross sections and are shown in Table 24, "Floodway Data."

Table 23: Summary of Topographic Elevation Data used in Mapping

Community	Flooding Source	Source for Topographic Elevation Data					
		Description	Scale	Contour Interval	$RMSE_z$	$Accuracy_z$	Citation
Carroll County	All Sources	Light Detection and Ranging data (LiDAR)	N/A	N/A		18.5cm (bare earth) 37cm (dense vegetation)	Iowa Department of Natural Resources Iowa Statewide 1 M LiDAR Collection

BFEs shown at cross sections on the FIRM represent the 1% annual chance water surface elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Middle Raccoon River								
A	3,700	100	986	8.0	1215.5	1215.5	1216.3	0.8
B	4,610	160	1,529	5.2	1217.2	1217.2	1217.8	0.6
C	5,180	170	1,490	5.3	1217.6	1217.6	1218.3	0.7
D	6,100	180	1,247	6.3	1218.3	1218.3	1219.1	0.8
E	7,500	200	1,764	4.5	1220.0	1220.0	1220.7	0.7
F	8,600	240	2,101	3.8	1220.7	1220.7	1221.5	0.8
G	10,000	270	1,637	4.8	1221.4	1221.4	1222.1	0.7
H	11,000	160	1,146	6.9	1222.2	1222.2	1223.1	0.9
I	11,700	240	1,586	5.0	1223.9	1223.9	1224.3	0.4
J	12,600	315	1,601	4.9	1224.7	1224.7	1225.3	0.6
K	13,300	360	1,629	4.8	1225.7	1225.7	1226.5	0.8
L	13,800	200	1,092	7.2	1226.1	1226.1	1227.0	0.9
M	14,850	260	1,591	4.4	1229.1	1229.1	1229.4	0.3
N	15,930	220	1,678	4.1	1230.3	1230.3	1231.0	0.7
O	17,000	691	3,512	2.0	1231.0	1231.0	1231.8	0.8
P	18,010	240	1,413	4.9	1231.4	1231.4	1232.1	0.7
Q	19,610	160	995	7.0	1233.8	1233.8	1234.4	0.6
R	20,110	180	1,259	5.5	1235.0	1235.0	1235.6	0.6
S	21,270	200	2,115	3.3	1236.5	1236.5	1237.0	0.5
T	22,260	200	1,565	4.4	1236.8	1236.8	1237.3	0.5
U	22,570	200	1,697	4.1	1237.2	1237.2	1237.8	0.6
V	23,200	260	1,588	4.4	1237.7	1237.7	1238.3	0.6
W	24,250	400	2,510	2.8	1239.0	1239.0	1239.7	0.7
X	25,300	500	2,880	2.4	1239.4	1239.4	1240.3	0.9
Y	26,200	550	2,971	2.3	1239.7	1239.7	1240.7	1.0
Z	29,550	652	3,698	1.9	1243.7	1243.7	1244.5	0.8

[1]Feet above Carroll County Road N33

Table 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, IA
AND INCORPORATED AREAS

FLOODWAY DATA

MIDDLE RACCOON RIVER

Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams
[Not Applicable to this FIS Project]

6.4 Coastal Flood Hazard Mapping

This section is Not Applicable to this FIS Project.

Table 26: Summary of Coastal Transect Mapping Considerations
[Not Applicable to this FIS Project]

6.5 FIRM Revisions

This FIS Report and the FIRM are based on the most up-to-date information available to FEMA at the time of its publication; however, flood hazard conditions change over time. Communities or private parties may request flood map revisions at any time. Certain types of requests require submission of supporting data. FEMA may also initiate a revision. Revisions to FIS projects may take several forms, including Letters of Map Amendment (LOMAs), Letters of Map Revision Based on Fill (LOMR-Fs), Letters of Map Revision (LOMRs) (referred to collectively as Letters of Map Change (LOMCs)), Physical Map Revisions (PMRs), and FEMA-contracted restudies. These types of revisions are further described below. Some of these types of revisions do not result in the republishing of the FIS Report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data (shown in Table 31, "Map Repositories").

6.5.1 Letters of Map Amendment

A LOMA is an official revision by letter to an effective NFIP map. A LOMA results from an administrative process that involves the review of scientific or technical data submitted by the owner or lessee of property who believes the property has incorrectly been included in a designated SFHA. A LOMA amends the currently effective FEMA map and establishes that a specific property is not located in a SFHA. A LOMA cannot be issued for properties located on the PFD (primary frontal dune).

To obtain an application for a LOMA, visit http://www.fema.gov and download the form "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill". Visit the "Flood Map-Related Fees" section to determine the cost, if any, of applying for a LOMA.

FEMA offers a tutorial on how to apply for a LOMA. The LOMA Tutorial Series can be accessed at http://www.fema.gov/plan/prevent/fhm/ot_lmreq.shtm.

For more information about how to apply for a LOMA, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627).

6.5.2 Letters of Map Revision Based on Fill

A LOMR-F is an official revision by letter to an effective NFIP map. A LOMR-F states FEMA's determination concerning whether a structure or parcel has been elevated on fill above the base flood elevation and is, therefore, excluded from the SFHA.

Information about obtaining an application for a LOMR-F can be obtained in the same manner as

that for a LOMA, by visiting http://www.fema.gov for the "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill" or by calling the FEMA Map Information eXchange, toll free, at 1-877-FEMA MAP (1-877-336-2627). Fees for applying for a LOMR-F, if any, are listed in the "Flood Map-Related Fees" section.

A tutorial for LOMR-F is available at http://www.fema.gov/plan/prevent/fhm/ot_lmreq.shtm.

6.5.3 Letters of Map Revision

A LOMR is an official revision to the currently effective FEMA map. It is used to change flood zones, floodplain and floodway delineations, flood elevations and planimetric features. All requests for LOMRs should be made to FEMA through the chief executive officer of the community, since it is the community that must adopt any changes and revisions to the map. If the request for a LOMR is not submitted through the chief executive officer of the community, evidence must be submitted that the community has been notified of the request.

To obtain an application for a LOMR, visit http://www.fema.gov and download the form "MT-2 Application Forms and Instructions for Conditional Letters of Map Revision and Letters of Map Revision". Visit the "Flood Map-Related Fees" section to determine the cost of applying for a LOMR. For more information about how to apply for a LOMR, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627) to speak to a Map Specialist.

Previously issued mappable LOMCs (including LOMRs) that have been incorporated into the Carroll County FIRM are listed in Table 27.

Table 27: Incorporated Letters of Map Change
[Not Applicable to this FIS Project]

6.5.4 Physical Map Revisions

PMRs are an official republication of a community's NFIP map to effect changes to base flood elevations, floodplain boundary delineations, regulatory floodways and planimetric features. These changes typically occur as a result of structural works or improvements, annexations resulting in additional flood hazard areas or correction to base flood elevations or SFHAs.

The community's chief executive officer must submit scientific and technical data to FEMA to support the request for a PMR. The data will be analyzed and the map will be revised if warranted. The community is provided with copies of the revised information and is afforded a review period. When the base flood elevations are changed, a 90-day appeal period is provided. A 6-month adoption period for formal approval of the revised map(s) is also provided.

For more information about the PMR process, please visit http://www.fema.gov and visit the "Flood Map Revision Processes" section.

6.5.5 Contracted Restudies

The NFIP provides for a periodic review and restudy of flood hazards within a given community. FEMA accomplishes this through a national watershed-based mapping needs assessment strategy, known as the Coordinated Needs Management Strategy (CNMS). The CNMS is used by FEMA to assign priorities and allocate funding for new flood hazard analyses used to update the FIS Report and FIRM. The goal of CNMS is to define the validity of the engineering study data

within a mapped inventory. The CNMS is used to track the assessment process, document engineering gaps and their resolution, and aid in prioritization for using flood risk as a key factor for areas identified for flood map updates. Visit www.fema.gov to learn more about the CNMS or contact the FEMA Regional Office listed in Section 8 of this FIS Report.

6.5.6 Community Map History

The current FIRM presents flooding information for the entire geographic area of Carroll County. Previously, separate FIRMs, Flood Hazard Boundary Maps (FHBMs) and/or Flood Boundary and Floodway Maps (FBFMs) may have been prepared for the incorporated communities and the unincorporated areas in the county that had identified SFHAs. Current and historical data relating to the maps prepared for the project area are presented in Table 28, "Community Map History." A description of each of the column headings and the source of the date is also listed below.

- *Community Name* includes communities falling within the geographic area shown on the FIRM, including those that fall on the boundary line, nonparticipating communities, and communities with maps that have been rescinded. Communities with No Special Flood Hazards are indicated by a footnote. If all maps (FHBM, FBFM, and FIRM) were rescinded for a community, it is not listed in this table unless SFHAs have been identified in this community.

- *Initial Identification Date (First NFIP Map Published)* is the date of the first NFIP map that identified flood hazards in the community. If the FHBM has been converted to a FIRM, the initial FHBM date is shown. If the community has never been mapped, the upcoming effective date or "pending" (for Preliminary FIS Reports) is shown. If the community is listed in Table 28 but not identified on the map, the community is treated as if it were unmapped.

- *Initial FHBM Effective Date* is the effective date of the first Flood Hazard Boundary Map (FHBM). This date may be the same date as the Initial NFIP Map Date.

- *FHBM Revision Date(s)* is the date(s) that the FHBM was revised, if applicable.

- *Initial FIRM Effective Date* is the date of the first effective FIRM for the community.

- *FIRM Revision Date(s)* is the date(s) the FIRM was revised, if applicable. This is the revised date that is shown on the FIRM panel, if applicable. As countywide studies are completed or revised, each community listed should have its FIRM dates updated accordingly to reflect the date of the countywide study. Once the FIRMs exist in countywide format, as Physical Map Revisions (PMR) of FIRM panels within the county are completed, the FIRM Revision Dates in the table for each community affected by the PMR are updated with the date of the PMR, even if the PMR did not revise all the panels within that community.

The initial effective date for the Carroll County FIRMs in countywide format was [DATE].

Table 28: Community Map History

Community Name	Initial Identification Date (First NFIP Map Published)	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
City of Arcadia		N/A	N/A		
City of Breda[1]	N/A	N/A	N/A		
City of Carroll	6/28/1974	6/28/1974	N/A	3/19/1990	
Carroll County Unincorporated Areas	6/17/1977	6/17/1977	N/A	6/17/1986	
City of Coon Rapids	5/3/1974	5/3/1974	4/23/1976	4/30/1986	
City of Dedham	11/1/1974	11/1/1974	N/A	9/1/1986	
City of Glidden[1]	8/16/1974	8/16/1974	10/24/1975		
City of Halbur		N/A	N/A		
City of Lanesboro		N/A	N/A		
City of Lidderdale[1]	N/A	N/A	N/A		
City of Manning	8/23/1974	8/23/1974	12/26/1975	9/1/1986	
City of Templeton[1]	N/A	N/A	N/A		
City of Willey		N/A	N/A		

[1] No Special Flood Hazard Areas Identified

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION

7.1 Contracted Studies

Table 29 provides a summary of the contracted studies, by flooding source,that are included in this FIS Report.

Table 29: Summary of Contracted Studies Included in this FIS Report

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
All approximate flooding sources	(*Date*)	Iowa Flood Center and IIHR-Hydroscience and Engineering	ESD7385SR ALST100332	1/30/2013	City of Arcadia, City of Carroll, City of Coon Rapids, City of Dedham, City of Halbur, City of Lanesboro, City of Manning, City of Willey, Carroll County
Middle Raccoon River	3/19/1990	U.S. Army Corps of Engineers, Rock Island District	EMW-87-E-2549	October 1988	City of Carroll, Carroll County

Financial support to prepare this publication was provided by the Federal Emergency Management Agency through a cooperative agreement with the Iowa Department of Natural Resources. The information contained in this publication has not been reviewed by FEMA for technical accuracy, and does not necessarily reflect the view of the Federal Emergency Management Agency. The information may be revised due to appeals or comments submitted to FEMA

7.2 Community Meetings

The dates of the community meetings held for this FIS project and any previous FIS projects are shown in Table 30. These meetings may have previously been referred to by a variety of names (Community Coordination Officer (CCO), Scoping, Discovery, etc.), but all meetings represent opportunities for FEMA, community officials, study contractors, and other invited guests to discuss the planning for and results of the project.

Table 30: Community Meetings

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
City of Carroll	March 19, 1980	9/2/1987	Letter Notification	All communities and Iowa DNR
Carroll County and Incorporated Areas	(*DATE*)	3/28/2011	Discovery	All communities and Iowa DNR
	(*DATE*)	3/29/2011	Discovery	All communities and Iowa DNR
	(*DATE*)	3/31/2011	Discovery	All communities and Iowa DNR
	(*DATE*)	4/4/2011	Discovery	All communities and Iowa DNR
	(*DATE*)	4/12/2011	Discovery	All communities and Iowa DNR
	(*DATE*)	11/5/2013	Flood Risk Review	Carroll County, City of Manning, and Iowa DNR
	(*DATE*)	1/7/2014	Resilience	Carroll County and Iowa DNR
	(*DATE*)	1/23/2014	Flood Risk Review	Carroll County, City of Carroll, City of Manning, City of Breda, City of Templeton, City of Glidden, Iowa DNR and Iowa Flood Center
	(*DATE*)	5/24/2014	Flood Risk Review	Carroll County, City of Manning, City of Carroll and Iowa DNR
	(*DATE*)		Final CCO	

SECTION 8.0 – ADDITIONAL INFORMATION

Information concerning the pertinent data used in the preparation of this FIS Report can be obtained by submitting an order with any required payment to the FEMA Engineering Library. For more information on this process, see http://www.fema.gov.

Table 31 is a list of the locations where FIRMs for Carroll County can be viewed. Please note that the maps at these locations are for reference only and are not for distribution. Also, please note that only the maps for the community listed in the table are available at that particular repository. A user may need to visit another repository to view maps from an adjacent community.

Table 31: Map Repositories

Community	Address	City	State	Zip Code
Carroll County Unincorporated Areas	114 E. 6th Street	Carroll	IA	51401
City of Arcadia	205 W. Front Street	Arcadia	IA	51430
City of Breda	108 N. 2nd Street	Breda	IA	51436
City of Carroll	117 E. 5th Street	Carroll	IA	51401
City of Coon Rapids	123 3rd Avenue	Coon Rapids	IA	50058
City of Dedham	210 Main Street	Coon Rapids	IA	51440
City of Glidden	108 Idaho Street	Glidden	IA	51443
City of Halbur	300 1st Street	Halbur	IA	51444
City of Lanesboro	210 E Main Street	Lanesboro	IA	51451
City of Lidderdale	115 North Main Street	Lidderdale	IA	51452
City of Manning	717 3rd Street	Manning	IA	51455
City of Templeton	108 S. Main Street	Templeton	IA	51463
City of Willey	248 Olympic Avenue	Willey	IA	51401

The National Flood Hazard Layer (NFHL) dataset is a compilation of effective FIRM databases and LOMCs. Together they create a GIS data layer for a State or Territory. The NFHL is updated as studies become effective and extracts are made available to the public monthly. NFHL data can be viewed or ordered from the website shown in Table 32.

Table 32 contains useful contact information regarding the FIS Report, the FIRM, and other relevant flood hazard and GIS data. In addition, information about the state NFIP Coordinator and GIS Coordinator is shown in this table. At the request of FEMA, each Governor has designated an agency of State or territorial government to coordinate that State's or territory's NFIP activities. These agencies often assist communities in developing and adopting necessary floodplain management measures. State GIS Coordinators are knowledgeable about the availability and location of state and local GIS data in their state.

Table 32: Additional Information

FEMA and the NFIP	
FEMA and FEMA Engineering Library website	http://www.fema.gov
NFIP website	http://www.fema.gov/national-flood-insurance-program
NFHL Dataset	http://msc.fema.gov
FEMA Region VII	Federal Regional Center, 9221 Ward Parkway, Suite 300, Kansas City, Missouri 64114-3323 (816) 283-7002
Other Federal Agencies	
USGS website	http://www.usgs.gov
Hydraulic Engineering Center website	http://www.hec.usace.army.mil
State Agencies and Organizations	
State NFIP Coordinator	Bill Cappuccio Iowa Department of Natural Resources Wallace State Office Building Des Moines, IA 50319 515-281-8942 bill.cappuccio@dnr.iowa.gov
State GIS Coordinator	Chris Ensminger Iowa Department of Natural Resources 502 E 9th Street Des Moines, IA 50319 Phone: 515-281-4216 chris.ensminger@dnr.iowa.gov
State Floodplain Mapping Coordinator	Scott Ralston Iowa Department of Natural Resources 502 E 9th Street Des Moines, IA 50319 Phone: 515-725-8321 Scott.Ralston@dnr.iowa.gov

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES

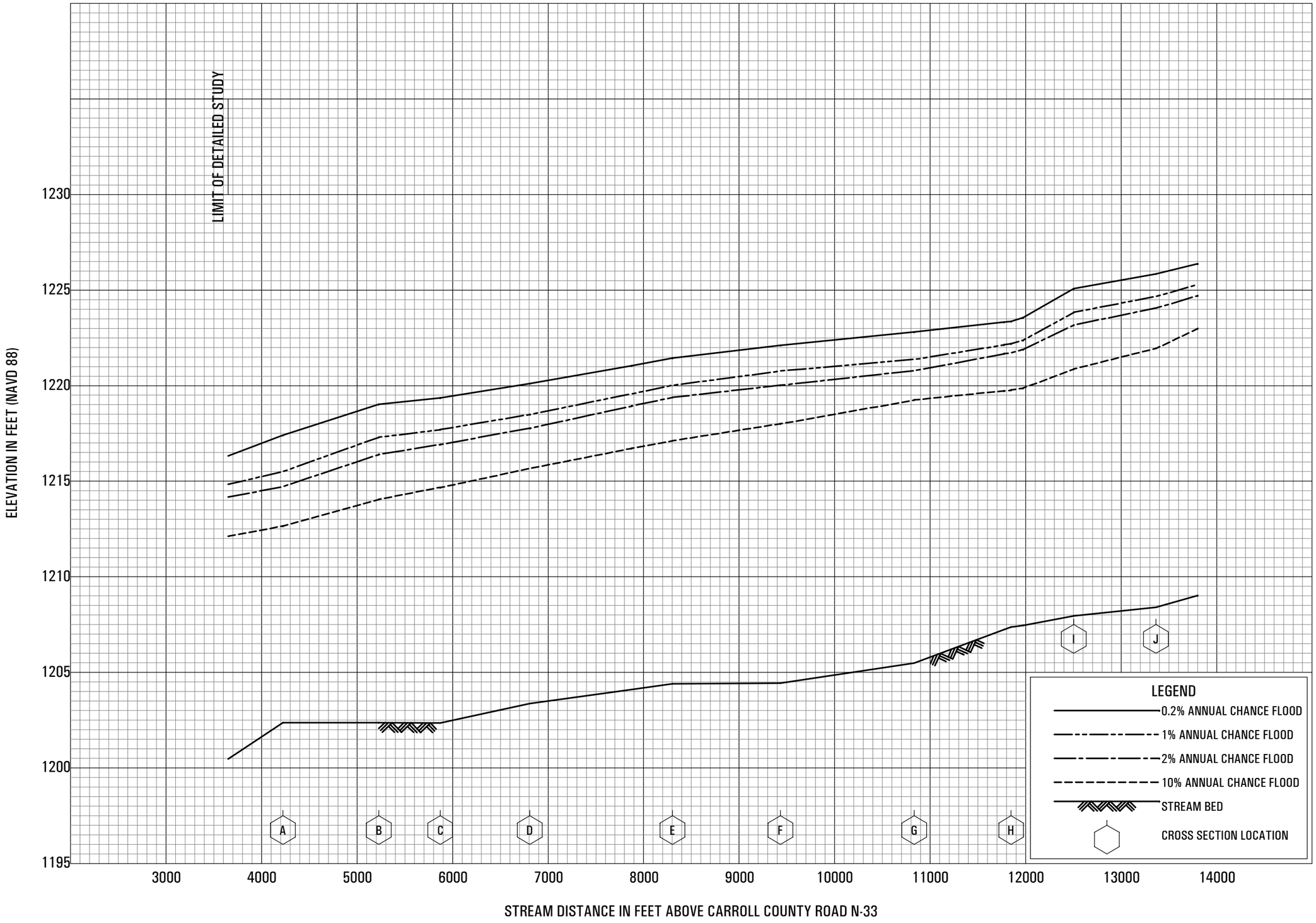
Table 33 includes sources used in the preparation of and cited in this FIS Report as well as additional studies that have been conducted in the study area.

Table 33: Bibliography and References

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
Base Map	Iowa Department of Natural Resources		Iowa Department of Natural Resources	Iowa City, Iowa	2009	
Hydrology	Iowa Department of Natural Resources	*IDOT, 2010 - IDOT, LRFD Design Manual*	Iowa Department of Natural Resources	Iowa City, Iowa	2014	http://www.iowadot.gov/bridge/manuallrfd.html
Hydraulics	Iowa Department of Natural Resources	*IDOT, 2010 - IDOT, LRFD Design Manual*	Iowa Department of Natural Resources	Iowa City, Iowa	2014	http://www.iowadot.gov/bridge/manuallrfd.html
Hydrology	U.S. Department of Agriculture	*Soil Survey of Carroll County, Iowa*	U.S. Department of Agriculture, Soil Conservation Service	Iowa City, Iowa	August 1982	

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
Hydrology	U.S. Geological Survey	*Water Resources Investigations 87-4132, Methods for Estimating Magnitude and Frequency of Floods at Ungaged Sites on Unregulated Rural Streams in Iowa*	U.S. Geological Survey	Lara, Iowa	1987	
Hydraulics	USACE	*HEC-2 Water Surface Profiles, Computer Program 723-X6-L202A*	USACE, Hydrologic Engineering Center	Davis, California	April 1984	

Profiles



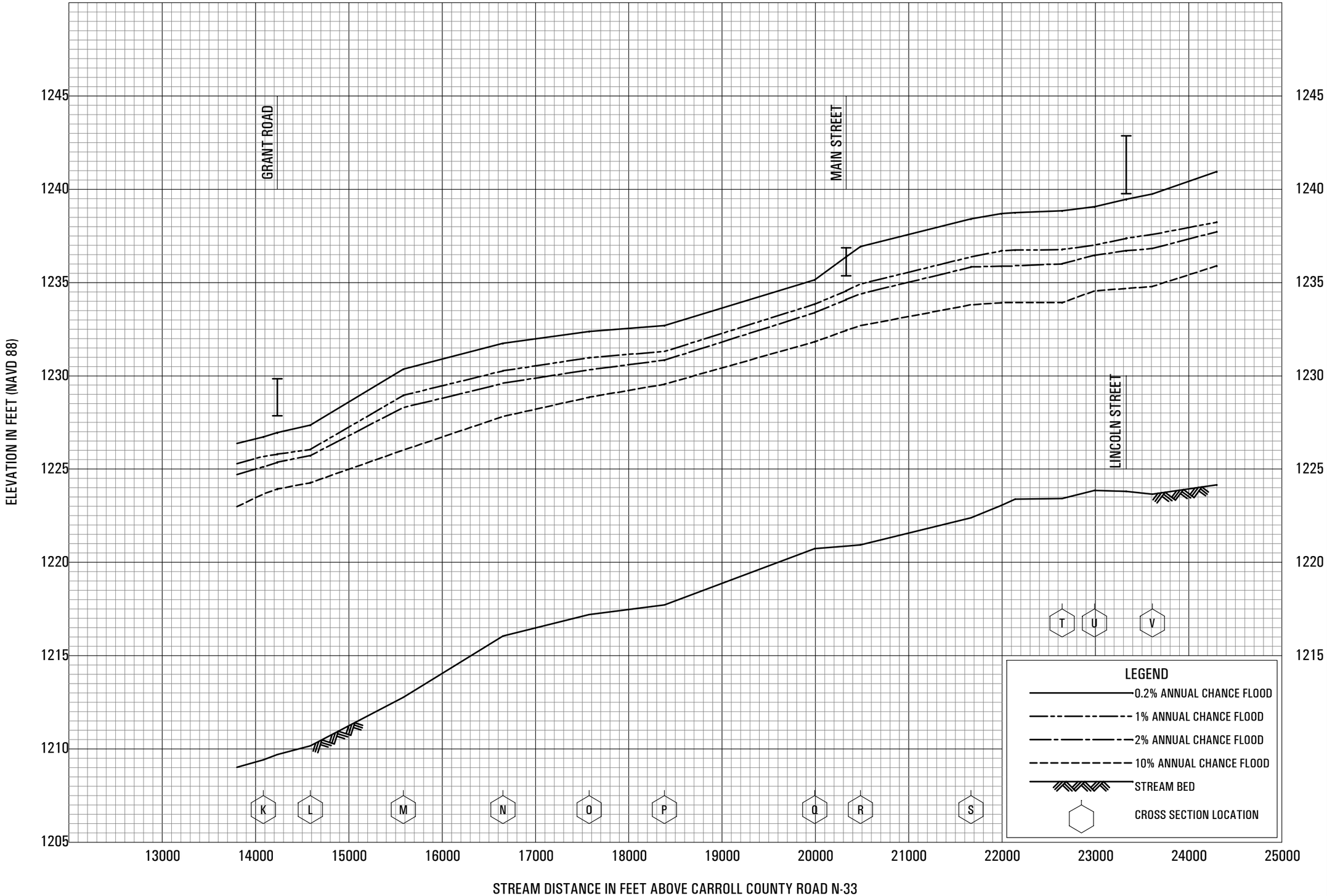
FLOOD PROFILES

MIDDLE RACCOON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, IA

AND INCORPORATED AREAS



FLOOD PROFILES

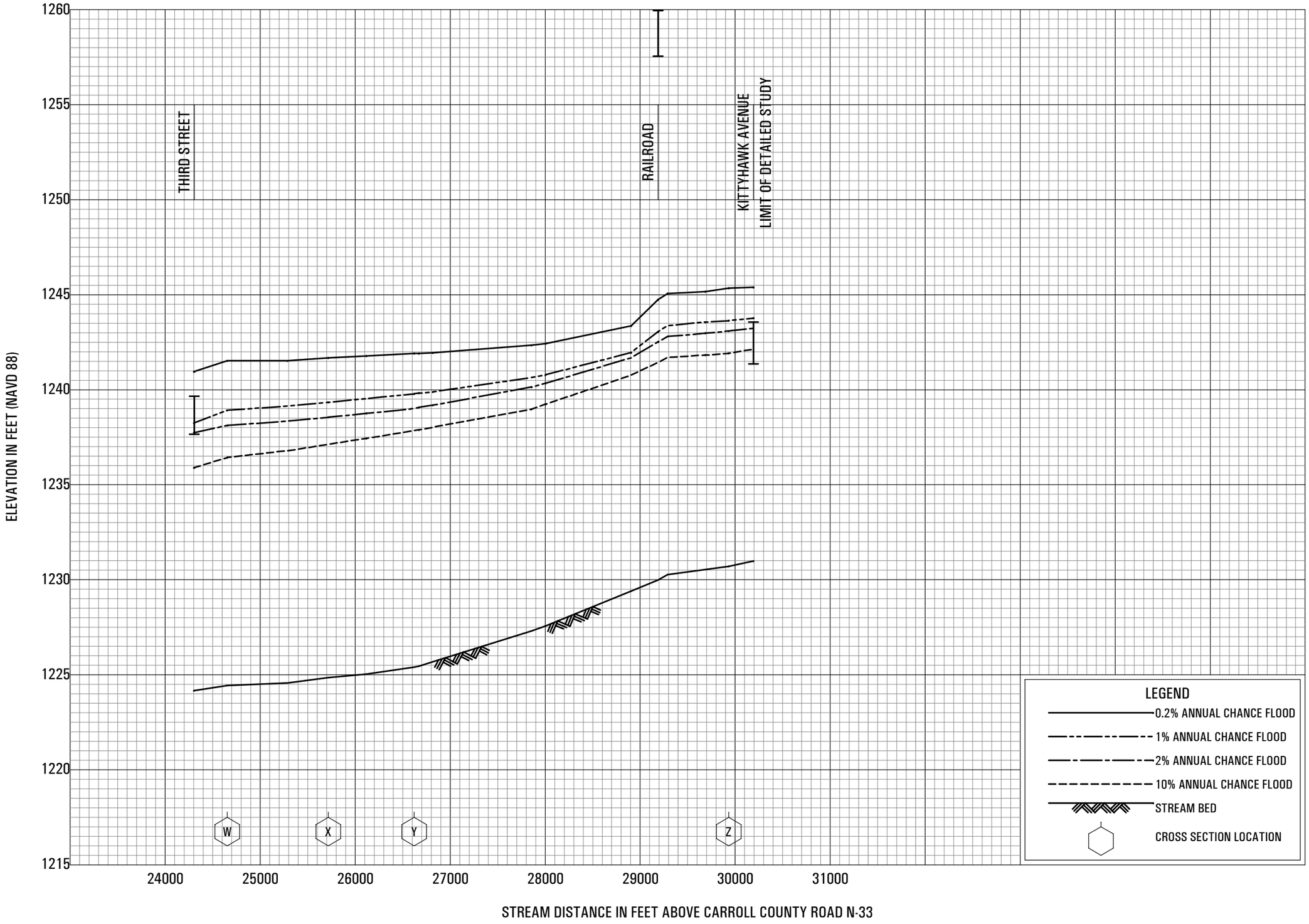
MIDDLE RACCOON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, IA

AND INCORPORATED AREAS

02P



FLOOD PROFILES

MIDDLE RACCOON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, IA

AND INCORPORATED AREAS

03P