Discovery Report

Lower Verdigris HUC-8 Watershed 11070105

Mayes, Muskogee, Rogers, Tulsa, Wagoner Counties

Muskogee, Catoosa, Claremore, Foyil, Inola, Oologah, Talala, Valley Park, Verdigris, Broken Arrow, Tulsa, Coweta, Fair Oaks, Okay, Porter, Red Bird, Tullahassee, Wagoner, Oklahoma

October 26, 2012

FEMA

Project Area Community List

Community Name	CID	Participating Community?
Mayes County	400458	Y
Muskogee County	400491	Y
City of Muskogee	400125	Y
Rogers County	405379	Y
City of Catoosa	400185	Y
City of Claremore	405375	Y
Town of Foyil	400565	N
Town of Inola	400188	N
Town of Oologah	400189	Y
City of Owasso	400210	Y
Town of Talala	400560	N
Valley Park	n/a	n/a
Town of Verdigris	400519	N
Tulsa County	400462	Y
City of Broken Arrow	400236	Y
City of Tulsa	405381	Y
Wagoner County	400215	Y
City of Coweta	400185	Y
Town of Fair Oaks	400509	N
Town of Okay	400217	Y
Town of Porter	400434	Suspended
Town of Red Bird	400321	Y
City of Tullahassee	400218	Y
City of Wagoner	400219	Y
Tribes		
Muscogee (Creek) Nation		N
Cherokee Nation		N

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Acronyms and Abbreviations

BFE	Base Flood Elevation
CAV	Community Assistance Visit
CEO	Chief Executive Officer
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFS	Cubic Feet per Second
CID	Community Identification Number
CLOMR	Conditional Letter of Map Revision
CNMS	Coordinated Needs Management Strategy
CRS	Community Rating System
DEM	Digital Elevation Model
eLOMA	Electronic Letter of Map Amendment
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FPA	Floodplain Administrator
FY	Fiscal Year
G&S	Guidelines and Standards for Flood Hazard Mapping Partners
GIS	Geographic Information System
HEC-1	Hydrologic Engineering Center – Hydrologic Model Program
HEC-2	Hydrologic Engineering Center – Hydraulic Model Program
HMP	Hazard Mitigation Plan
HUC	Hydrologic Unit Code
IDIQ	Indefinite Delivery Indefinite Quantity
LiDAR	Light Detection and Ranging System
LOMA	Letter of Map Amendment
LOMC	Letter of Map Change
LOMR	Letter of Map Revision
LOMR-F	Letter of Map Revision based on Fill
LVR	Lower Verdigris River

MIP	Mapping Information Platform
MLI	Midterm Levee Inventory
MXD	ArcMap map document extension
NAVD	North American Vertical Datum
NCDC	National Climatic Data Center
NFIP	National Flood Insurance Program
NHD	National Hydrologic Dataset
NRCS	Natural Resources Conservation Service
NVUE	New Validated or Updated Engineering
OKC	Oklahoma City
OWRB	Oklahoma Water Resources Board
PDF	Portable Document Format File
PMR	Physical Map Revision
RAMPP	Risk Mapping, Assessment, and Planning Partners
RCRA	Resource Conservation and Recovery Act
RSC	Regional Service Center
Risk MAP	Risk Mapping, Assessment, and Planning Program
RL	Repetitive Loss
SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer
SHP	ESRI Shapefile
SQ MI	Square Mile
SRL	Severe Repetitive Loss
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

I. Discovery Overview

The Federal Emergency Management Agency (FEMA) is currently implementing the Risk Mapping, Assessment, and Planning (Risk MAP) Program across the Nation. The purpose of Risk MAP is the continued improvement of flood hazard information for the National Flood Insurance Program (NFIP); the promotion of increased national awareness and understanding of flood risk; and the support of Federal, State, and local mitigation actions necessary to reduce risk.

The vision and intent of the Risk MAP Program, through collaboration with State and local entities, is to deliver quality data that increases public awareness and leads to mitigation actions that reduce risk to life and property. To achieve this vision, FEMA has transformed its traditional flood identification and mapping efforts into an integrated process of more accurately identifying, assessing, communicating, planning, and mitigating flood risks. Risk MAP will address gaps in flood hazard data to form a solid foundation for risk assessment and floodplain management and will provide State and local entities with information needed to mitigate flood related risks.

The FEMA Region VI office, in partnership with the State of Oklahoma, and the City of Tulsa, began the Discovery process in the Lower Verdigris (LVR) Watershed in April 2012. The goal of the Discovery process is to gather local information and readily available data to determine project viability and the need for Risk MAP products to assist in the movement of communities towards resilience. FEMA, its contractor, Meshek & Associates, PLC (Meshek), the State of Oklahoma, and the City of Tulsa partnered throughout the Discovery process to facilitate communications, meetings, risk identification, and final reporting and documentation.

Through the Discovery process, FEMA can determine which areas of the 8-digit Hydrologic Unit (HUC-8) Discovery watersheds to examine for further flood risk identification and assessment in a collaborative manner, taking into consideration the information collected from local communities. Discovery opens lines of communication and relies on local involvement for productive discussions about flood risk. The process provides a forum for a watershed-wide discussion of how each included community's individual flood risks are related to the flood risks present throughout the watershed. In Risk MAP, projects are analyzed on a watershed basis, so Discovery Meetings target numerous stakeholders throughout the watershed on local, regional, State, and Federal levels.

On June 13, 2012, FEMA and the State held a Discovery Meeting in the City of Tulsa, Oklahoma, in the LVR Watershed. During this meeting, FEMA and the State reached out to the local communities to:

- Gather information about local flood risk and flood hazards;
- Review current and historic mitigation plans to understand local mitigation capabilities, hazard risk assessments, and current or future mitigation activities; and
- Include multi-disciplinary staff from within their community to participate and assist in the development of a watershed vision.

The results of the Discovery process are presented in a Discovery Report, a watershed-scale Discovery Map, and the digital data that was gathered or developed during this process under a grant awarded by FEMA through the Oklahoma Department of Emergency Management (OEM) to OWRB as Agreement Number EMT-2011-CA-0003 Award. The digital data submitted (on DVD) with this report contain correspondence, exhibits used at the Discovery Meetings, Geographic Information System (GIS) data, mapping documents (PDF, shapefiles, personal geo-databases, and ESRI ArcGIS 10 MXDs), and other supplemental digital information. Any graphics shown in this report are available as larger format files for printing; and as GIS data that may be printed and used at any map scale.

i. Watershed Selection

The LVR Watershed, Hydrologic Unit Code (HUC) 11070105, is located in Northeast Oklahoma and covers 714.1 square miles. The watershed stretches across five counties (Mayes, Muskogee, Rogers, Tulsa and Wagoner), nineteen incorporated communities (cities and towns) and two tribes (Muscogee-Creek Nation and Cherokee Nation, Oklahoma). A map of the watershed is shown in Figure 1.

Based on the 2010 U.S. Census Bureau, the watershed population is approximately 118,662 and includes a portion of City of Tulsa, the second largest city in the state (population 391,322). This watershed is located in FEMA Region VI.

The watershed is located in what is called "Northeast Oklahoma Green Country." This name is derived from the more than 40 inches of rain the area receives each year on average, which makes the landscape considerably wetter and greener than the rest of state.

The primary river in the watershed is the *Verdigris River* which is a tributary of the Arkansas River in southeastern Kansas and northeastern Oklahoma. The Verdigris River, approximately 310 miles long, forms near Madison, Kansas, then flows south and enters the State of Oklahoma just south of Coffeyville, Kansas. The river joins the Arkansas River near the City of Muskogee and is a part of the Mississippi River watershed.

The following is a listing of dams under federal, state, local and utility jurisdiction located in the watershed. This list was obtained from the USACE, Tulsa District, in July 2012.

Dam Name	Owner Name
1. Broken Arrow Carousel Concourse Detention Pond	City of Broken Arrow
2. Lynn Lane Reservoir	City of Tulsa
3. Chail Lou Inc.	Chail Lou Inc
4. Chisum Pond	F L Chisum
5. Chouteau Lock And Dam 17	Coe
6. W. M. Dunn Trust	W. M. Dunn Trust
7. Kunzo Lake Dam	Forest Ridge Development Limited Partnership
8. R. D. Hull	R. D. Hull
9. Hutcheman	Hutcheman

Dam Name	Owner Name
10. Inola	Winthrop W. Ingersoll Et Al
11. Malchi	Carl G. Herrington
12. O. L. Fisher Pond	O.L.Fisher
13. 131003	Walter J. Thrun
14. 131014	Susan Wear
15. 131002	Reginald Baughman
16. 145003	Carson Collins
17. Oologah Lake	Coe
18. PSO	PSO
19. S Peterson	C. Peterson
20. Presettling Pond	Public Service Company
21. James M York	James M York
22. Timothy D & Ellen M Moss	Timothy D & Ellen M Moss
23. Public Service of Oklahoma	Public Service Inc.
24. Diamond Sevens	Diamond Sevens L.L.C.
25. Newt Graham Lock And Dam 18	Coe
26. Yonkipin Lake	Yonkipin Club
27. Wagner Co. Rwd #4 North Reservoir	Wagoner County Rwd #4
28. Claremore Lake	City of Claremore
29. Commodore Lake	Black Fox PSO
30. East Pre-Sedimentation Basin Dam	Broken Arrow Municipal Authority
31. Happy	Clifton L Carson

The Mid-Term Levee Inventory (MLI) contains records for the following levees in this watershed:

Levee Name	Flooding Source
Rogers 1512	Large Water Body
Rogers 1525	Large Water Body
Salt Creek - Verdigris River North Levee	Verdigris River
Verdigris River South Levee 1	Verdigris River
Verdigris River South Levee 2	Verdigris River
Old Channel South Of Fish Hatchery Levee	Old Channel

Figure 1: Watershed Locator Map

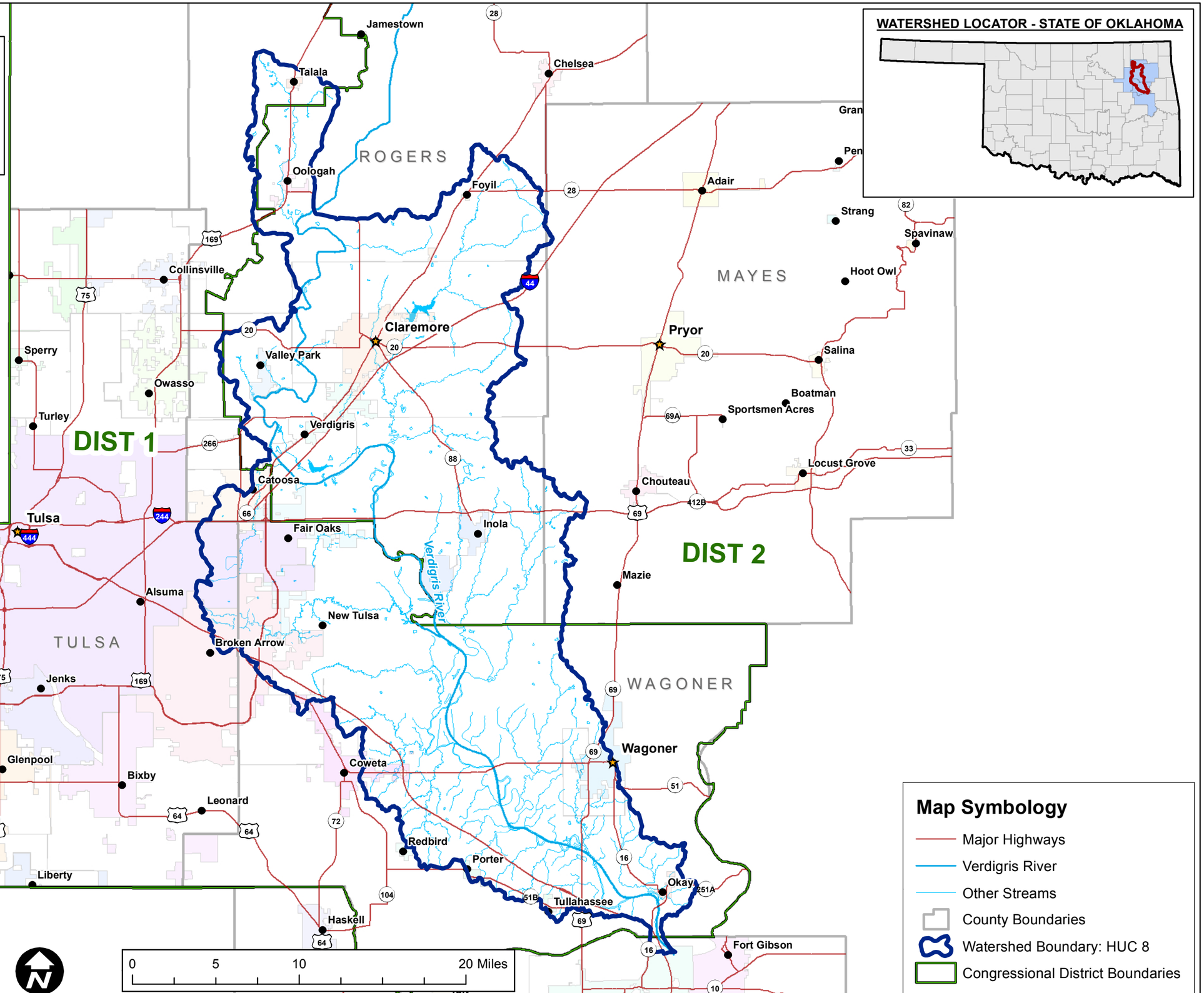
HUC Locater Map

Lower Verdigris Watershed

Oct 11 2012

FEMA

OWRB



The watershed contains populated areas as well as parks scattered throughout the watershed. No national forests or parks, or military facilities, are located in the watershed. Areas that may be excluded from flood risk consideration, if they have significant acreages, include large cemeteries, U.S. Environmental Protection Agency (EPA) remediation sites (i.e., Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) sites), prison areas, and water quality or flowage easement areas. These areas contribute to the overall square mileage of the watershed, but are not places where communities plan for population growth and development.

Table 1 shows the land use in the watershed. Of the total 714.06 square miles of land in the LVR Watershed, it is estimated that all areas, outside the 16.1 square miles of Undevelopable Areas (2% of the watershed), are available to be developed or have development and population currently in place. This results in approximately 98% of the watershed being subject to current or future development.

Table 1: Land Use within the Watershed

Land Use	Approximate Square Miles Within the Watershed
Incorporated Communities	99.3
Unincorporated Counties	615.3
Undevelopable Areas Within Watershed (sum of the rows below)	16.1
Lakes/Reservoirs/Detention Ponds	14.9
Parks/Preserves	0.0
Military Areas	0.0
Miscellaneous Non- Developable Areas	1.2

The majority of the LVR Watershed has been mapped for flood hazards in the past. The effective dates for the current county-wide Flood Insurance Rate Maps (FIRMs) are shown in Table 2.

Table 2: Effective Flood Insurance Rate Map Dates

County	Status	Effective Date
Mayes County	Effective	9/16/2011
Muskogee County	Effective	2/4/2001
Rogers County	Effective	4/3/2012
Tulsa County	Effective	10/16/2012
Wagoner County	Effective	4/17/2012

* Tulsa County has been partially remapped. Revised FIRM panels released in May 2012 are scheduled to become effective on October 16, 2012.

Currently, all communities but Foyil, Inola, Talala, Valley Park, Verdigris, Fair Oaks, and Porter participate in the NFIP. None of the Native American jurisdictions in the watershed participate in the NFIP.

Availability of topographic data is one of the factors in the selection and analysis of the watersheds, and digital, updated topographic data will be available for much of the area in the LVR Watershed. Recent Light Detection and Ranging (LIDAR) data are available for Broken Arrow, Oklahoma.

As for streams within the watershed, the U.S. Geological Survey (USGS) provides the National Hydrologic Dataset (NHD), consisting of hydrologic spatial files that can be used to identify stream locations. The NHD stream mileage was used to approximate the total potential stream miles for the watershed. Artificial flow paths were removed from the count, and only natural flow paths were counted. Based on the NHD, there are approximately 586 miles of streams in the LVR Watershed.

FEMA maintains a Coordinated Needs Management Strategy (CNMS) Inventory of the status and attributes of currently studied streams in FEMA's floodplain study inventory. In general, the stream mileage shown in CNMS reflects streams that have effective Special Flood Hazard Areas (SFHAs) designated for them. Table 3 compares the NHD data to the CNMS data in the LVR Watershed. It summarizes the status and attributes of studies in FEMA's floodplain study inventory.

Table 3: Stream Miles in the Watershed

Source	Stream Miles
NHD Streams	586
CNMS Streams (streams with effective SFHAs)	920
NHD Stream Miles not accounted for in CNMS	183

NHD = National Hydrologic Dataset
CNMS = Coordinated Needs Management Strategy
SFHA = Special Flood Hazard Area

In addition to listing the number of miles of studied streams within a watershed, CNMS documents contain physiological, climatological, or engineering methodological factors that may have changed since the date of the effective flood studies. The stream miles shown in CNMS are attributed with a Validation Status and Status Type that allows an evaluation of the condition of a given study or group of studies. Studies considered Valid in CNMS are the only ones that contribute to the New Validated or Updated Engineering NVUE) metric.

Figure 2 shows areas of relatively higher urban change within the watershed that can be used to help determine if streams are Valid. Streams are Valid if they meet NVUE Criteria. See Section III.iv., "Post-Discovery CNMS Analysis", for more information.

The NVUE metric is an indicator of the status of studies for the FEMA mapped SFHA inventory. The categorization of these studies as “Unverified” typically means that there has been some factor of change since the SFHA became effective or the effective SFHA may have a deficiency, such as areas with more than five new or removed hydraulic structures (bridge/culvert) in the SFHA or hot spots of Repetitive Loss/Severe Repetitive Loss (RL/SRL), warranting restudy. CNMS stream mileage categorized as “Requires Assessment” requires more input to determine their validity, often because they represent paper inventory or non-modernized studies. CNMS aids in identifying areas to be considered for study during the Discovery process by highlighting needs on a map, quantifying them (by mileage), and providing further categorization of these needs. Table 4 summarizes the NVUE stream mileage from CNMS.

Table 4: NVUE Approximate Stream Mileage in the Watershed

NVUE Validation Status	Stream Miles
CNMS Valid Zone AE	193.8
CNMS Valid Zone A	663.4
CNMS Unverified Zone AE/AH	62.7
CNMS Unverified Zone A	N/A
CNMS Zone AE Requiring Further Assessment or in the process of being studied	62.7
CNMS Zone A Requiring Further Assessment	4.4

Table 5 lists recent Major Disaster Declarations in the LVR Watershed. All of these disasters involve flood events which have occurred in the watershed over the last four years which averages to almost one presidentially-declared disaster per year.

Figure 2: 10 -Year View of Urban Change within the Watershed

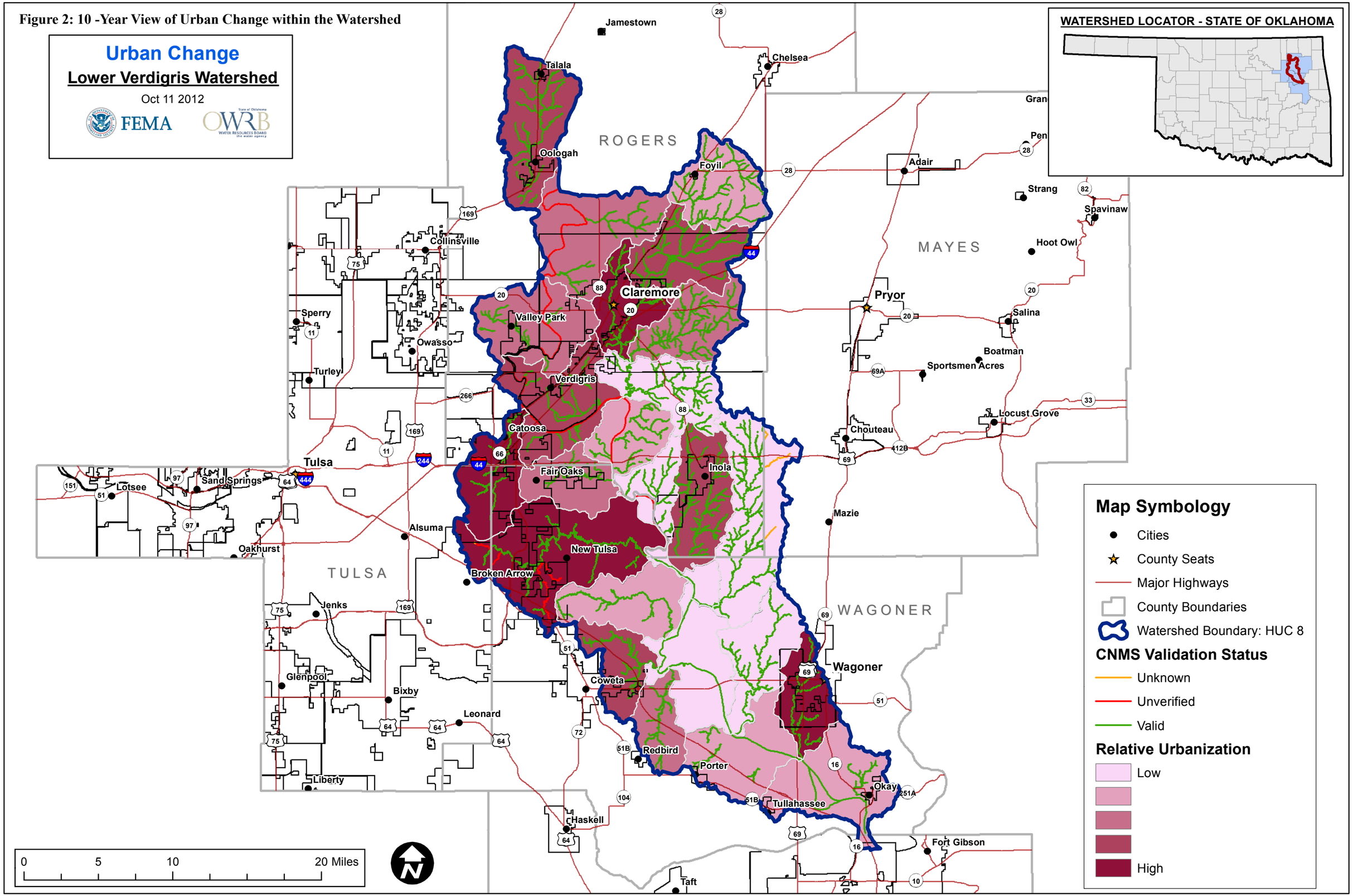


Table 5: Disaster Declarations in the Watershed

Date of Declaration	Watershed Counties Declared	For Hazard
5/5/2008	Mayes County, Muskogee County	Severe Storms, Flooding, and Tornadoes
5/9/2008	Mayes County, Muskogee County, Rogers County, and Wagoner County	Severe Storms, Tornadoes, and Flooding
7/9/2008	Rogers County	Severe Storms and Flooding
5/27/2011	Muskogee County	Severe Storms And Flooding

Table 6 shows the status of all the mitigation plans within the watershed. The Discovery process is a good opportunity for FEMA and State officials to touch base with local officials on the status of their mitigation plans. More information about mitigation plans for communities within the watershed is found in the Discovery Engagement Plan. Currently, not all approved dates and expiration dates are known for all the county and community mitigation plans; however, it is intended that this information will be obtained from the individual communities and this section updated as appropriate.

Table 6: Mitigation Plan Status

Organization and Plan	Date Approved by FEMA	Expires	Comments
State of Oklahoma Hazard Mitigation Plan	2/17/2011	2/16/2014	Adopted - 1/27/2011
Mayes County	6/04/2004	6/03/2009	Plan Being Written
Muskogee County	7/14/2009	7/13/2014	NOI submitted
Muskogee	3/25/2008	3/24/2013	NOI submitted
Rogers County	8/31/2010	8/30/2015	
Catoosa	8/31/2010	8/30/2015	In County Plan
Claremore	1/14/2008	1/13/2013	Separate from County
Foyil	8/31/2010	8/30/2015	
Inola	8/31/2010	8/30/2015	
Oologah	8/31/2010	8/30/2015	
Owasso	1/14/2008	1/13/2013	
Talala	8/31/2010	8/30/2015	
Valley Park			No Plan
Verdigris	8/31/2010	8/30/2015	
Tulsa County	9/23/2010	9/22/2015	
Broken Arrow	07/02/2012	07/01/2018	
Tulsa	10/06/2009	10/05/2014	Update in Process
Wagoner County	6/9/2009	6/8/2014	
Coweta	7/21/2011	7/20/2016	

Organization and Plan	Date Approved by FEMA	Expires	Comments
Fair Oaks	N/A	N/A	Unincorporated No Plan
Okay	N/A	N/A	No Plan
Porter	N/A	N/A	No Plan
Redbird	N/A	N/A	No Plan
Tullahassee	N/A	N/A	No Plan
Wagoner	N/A	N/A	No Plan

Table 7 shows the number of NFIP insurance claims within the watershed, by community and county, since the jurisdiction entered the program. Claims for each community are for the whole community, including areas outside of the watershed. Although the City of Tulsa has more claims than any other community, over the last 25 years, it has been proactive in implementing flood measures to mitigate future flood losses and was the first CRS community to achieve a "2" in the nation. Communities with the majority of the remaining claims are Tulsa County, City of Broken Arrow, City of Muskogee, Wagoner County, and City of Claremore, with Tulsa County having the next highest after the City of Tulsa.

Table 7: NFIP Insurance Claims by County and Community in the Watershed*

Community	Claims
Mayes County	39
Muskogee County	18
City of Muskogee	100
Rogers County	66
City of Catoosa	9
City of Claremore	76
Town of Foyil	0
Town of Inola	0
Town of Oologah	1
City of Owasso	13
Town of Talala	0
Valley Park	0
Town of Verdigris	0
Tulsa County	286
City of Broken Arrow	114
City of Tulsa	2573**
Wagoner County	93
City of Coweta	9
Town of Fair Oaks	0
Town of Okay	0
Town of Porter	0
Town of Red Bird	0

Community	Claims
City of Tullahassee	0
City of Wagoner	17
Tribes	N/A
Muscogee (Creek) Nation	N/A
Cherokee Nation	N/A

* Claims for each community are for the whole community, including areas outside of the watershed.
**Nearly 60 percent of City of Tulsa area is located outside of this watershed.

In addition to NFIP claims, there are 156 Non-Mitigated Repetitive Loss/Severe Repetitive Loss (RL/SRL) properties in the LVR Watershed. More than half of these (62%) are in the City of Tulsa followed by Wagoner County (15%). Table 8 summarizes these claims by county and community within the watershed. Communities not shown in Table 8 do not have RL/SRL properties.

Table 8: Non-Mitigated Repetitive and Severe Repetitive Losses in the Watershed

Non-Mitigated Losses by County			
County	Number of Properties	Total Claims	Average Number of Claims per Property
Rogers County	3	12	4
Wagoner County	16 (3 SRL)	47	2.9
Non-Mitigated Losses by Community*			
Community	Number of Properties	Total Claims	Average Number of Claims per Property
City of Broken Arrow	3 (1 SRL)	12	4
City of Claremore	6 (2 SRL)	37	6.2
City of Inola	5 (2 SRL)	23	4.6
City of Oologah	1	2	2
City Tulsa	1	2	2
City of Wagoner	1	2	2

*Communities not shown do not have RL/SRL properties.

During the Discovery process, watersheds are selected and analyzed at the HUC-8 level and evaluated using three major factors: population, topographic data availability, and risk decile. Risk decile is ranked 1 to 10, with 1 being the highest and 10 being the lowest. Risk decile is calculated using nine parameters. These include:

- Population density
- Historical population growth
- Predicted population growth
- Number of housing units
- Number of flood policies
- Number of single claims
- Number of repetitive losses
- Number of repetitive loss properties
- Number of declared disasters

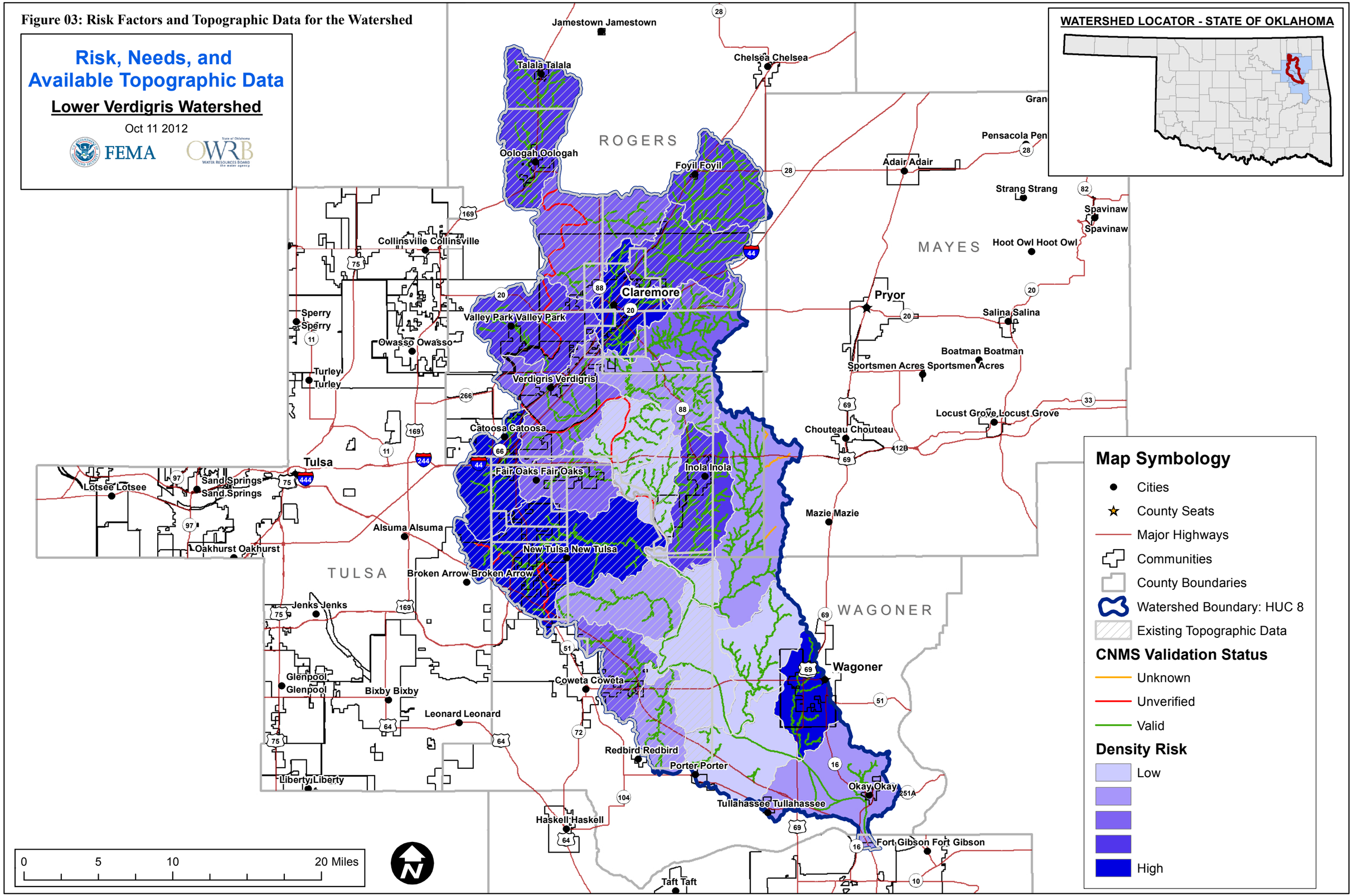
Table 9 shows the overall rankings of the LVR Watershed compared to other HUC-8 watersheds nationally and regionally. The measured amount of risk (or risk decile) for the *Lower Verdigris* is three. Decile risk is calculated from nine parameters including total population density, historical population growth, predicted population growth, housing units, flood policies, single claims, repetitive losses, repetitive loss properties and declared disasters. The scale is 1-10, 1 being the highest and 10 being the lowest. This HUC's risk decile rating is a three nationally and regionally. Considering the historical flooding events that have happened in the last decade or so within the states of Louisiana and Texas (also within Region 6) this makes the risk numbers for this watershed increasingly relevant.

Table 9: Watershed Risk Factor Rankings

Lower Verdigris Watershed Selection Rankings
National Risk Factor Rank: 608 National Risk Decile: 3 Average Annualized Loss: $13.6 million National Average Annualized Loss Rank: 533 National Overall Rank: 933
Region VI Risk Factor Rank: 314 Region VI Risk Decile: 3 Region VI Average Annualized Loss: $13.6 million Region VI Average Annualized Loss Rank: 293 Region VI Overall Rank: 218

Figure 3 shows risk factors and topographic data availability for the watershed. This information, along with rankings of smaller HUC-12 sub-watersheds, helps identify stream segments and locations where risk evaluation can be targeted. The combination of factors was important in the selection of this watershed for a Discovery project. All background information in this report for population data, historical flooding, and community information was obtained from the Engagement Plan for this watershed provided by CNMS, effective Flood Insurance Study (FIS) reports, and State and local hazard mitigation plans on file with FEMA Region VI.

Figure 03: Risk Factors and Topographic Data for the Watershed



II. Discovery Efforts

i. Engagement Plan

The LVR Watershed Engagement Plan was prepared during Pre-Discovery by the Regional Project Team. The Regional Project Team was made up staff listed in Table 10 below.

Table 10: Regional Project Team

Name	Organization	Project Role
Matt Dubois	FEMA Region VI	Project Monitor
Shanene Thomas	FEMA Region VI	Mitigation Planning Oversight
Don Davis	FEMA Region VI	Grants Specialist
Diane Howe	FEMA Region VI	Outreach Specialist
Roberto Ramirez	FEMA Region VI	Insurance Oversight
Joe Remondini	USACE	Flood Risk Engineer
Kent Wilkins	OWRB	CTP Project Manager
Gavin Brady	OWRB	State NFIP Coordinator/Compliance
Matthew Rollins	OWRB	GIS Specialist
Robert Fabian	OWRB	State Dam Safety Officer
Carl Watts	FEMA - Contractor	Insurance Specialist
Bill Penka	OEM	State Hazard Mitigation Officer
Brandon Claborn	Meshek & Associates	Discovery Project Manager
Chris Duncan	Meshek & Associates	Project Engineer
Janet Meshek	Meshek & Associates	Project Engineer
Ana Stagg	Meshek & Associates	Project Engineer
Chris Hill	Meshek & Associates	GIS Project Manager
Michael Couch	Meshek & Associates	GIS Specialist
Rita Henze	Meshek & Associates	Hazard Mitigation Plan Specialist
Lacie Jones	Meshek & Associates	Discovery Coordinator
Stephanie Minguez	Meshek & Associates	Project Engineer
Mark Swift	Swift Water Resources	Project Engineer
Bill Smith	HISINC	Project Engineer
Ellen Stevens	Ellen Stevens, Ph.D. P.E.	Project Engineer
Marc Utley	Utley & Associates	Project Engineer

FEMA = Federal Emergency Management Agency
USACE = U.S. Army Corps of Engineers
OWRB = Oklahoma Water Resources Board
OEM = Oklahoma Department of Emergency Management

The Engagement Plan is a tool that allows Regional Project Team members to understand the history of the watershed and highlights recent engagements with the FEMA Region VI Mitigation Division and the OWRB. In addition to contact information for key stakeholders and organizations in the watershed, the Engagement Plan captures media outlet information, the location and summary of recent articles or news releases, a strategy for keeping Congressional

liaisons involved in the Discovery process, and a history of communications. The various team members can use the Engagement Plan to strategize communications to the various groups within the watershed to deliver the Discovery Meeting messages and vision and to track hot topics or points of interest.

The Engagement Plan served as the initial repository for summary information about the watershed. Data for the LVR Watershed were discussed in the Pre-Discovery Data Gathering section of the Engagement Plan to provide background for the selection process to proceed through the Discovery process. This plan served as a clearinghouse for information about mitigation planning, active and closed grants, insurance policy information, socioeconomic overviews of the communities, and a review of the recent mapping initiatives in the watershed. From this collective review of the watershed, the project team can identify how communities within a project area should be engaged and selects from a high, medium, or low engagement strategy based on the risk, need, and political will of the communities. The complete Engagement Plan is included with the supplemental digital data that accompanies this report.

ii. Pre-Discovery Efforts

FEMA and the project team contacted watershed stakeholders via letters, telephone calls, emails, and an interactive website before the Discovery Meeting to request local participation and identify key people who should be included in the Discovery process. Stakeholders were also asked to provide any data that could assist in risk identification in the watershed.

In preparation for the Discovery Meeting, the Regional Project Team:

- Gathered information about local flood risk and flood hazards.
- Collected and reviewed mitigation plans to understand local mitigation capabilities, hazard risk assessments, and current or future mitigation activities.
- Encouraged communities in the watershed to develop a vision for the watershed's future.
- Used all information gathered to determine which areas of the watershed might require further study through a Risk MAP project.

The Regional Project Team then began outreach efforts to the local governments in the watershed, along with Federal and State Congressional representatives, public officials (including floodplain managers, emergency managers, and planners), the USACE, State departments, and the Muscogee (Creek) Nation and Cherokee Nation Tribes of Oklahoma to inform them of the Discovery process and invite them to participate and contribute relevant information. The following key steps were taken before the Discovery Meeting was held:

- The City of Tulsa's contractor, Meshek & Associates, PLC, organized the meeting dates, locations, and facilities.
- A website was established to allow electronic interaction between the Project Team and the stakeholders. Stakeholders were notified of the website and provided access to enter important data regarding known flood risk areas.

- The Project Team made phone calls to as many community policymakers and decision makers; Floodplain Administrators (FPAs); Tribes, Federal, State, and local officials; and other project stakeholders as could be contacted to inform them of the meetings and request data.
- Phone calls were followed with a combination of emails, faxes, newsletters, U.S. mail, and the interactive website to inform the counties, communities; Tribes, Federal, State, and local officials; and other project stakeholders and interested groups about the meeting and to request data. This information was also posted on the website.
- Stakeholders were requested and encouraged to identify and notify other stakeholders.
- Invitation letters, a watershed map, and a Data Questionnaire were emailed to the counties, communities, the Muscogee-Creek Nation and Cherokee Nation Tribes, other stakeholders, and interested groups.
- The Project Team followed the initial contacts with regular emails to remind stakeholders of the meeting details and logistics and provide information. The website was updated routinely with meeting specifics and information.
- An invitation with meeting details was emailed to the entire membership of the Oklahoma Floodplain Managers Association (OFMA).
- The City of Tulsa invited the USACE and a FEMA contractor, specializing in flood insurance, to participate as an active member of the Regional Project Team.

Copies of key correspondence associated with Discovery are included with the supplemental digital data that accompanies this report.

iii. Discovery Meeting

One meeting was held for the LVR Watershed. The meeting time and location is shown in Table 11.

Table 11: Project Discovery Meeting Times and Locations

Date and Time	Location
June 13, 2012 9:00 AM - 1:00 PM	Centennial Center 1028 East 6th Street Tulsa, OK 74120

The format for the Discovery Meeting was an informal “Come and Go” style with two brief presentations interspersed during the first and last hour of the three hour time period. Presentations consisted of one formal presentation and a second less formal presentation to provide attendees an overview of Risk MAP, its purpose and process, including the purpose behind the Discovery Meeting, and introduce the attendees to the different Discovery stations and Project Team. Large scale watershed maps, using aerial photography of the watershed overlaid with the local County and community boundaries and road names, were located along one wall and included the following information:

- Flood risk, need, and topographic data
- Population density
- Urbanization
- Stream miles mapped
- Current Letters of Map Change (LOMCs)
- RL/SRL claims
- Hazard mitigation grant activity
- Hazard Mitigation Plans

Every attendee received a packet of information including the following information:

- Understanding Risk in Watersheds – Discovery in Lower Verdigris Watershed
- Watershed Talking Points: Key Messages for Lower Verdigris Watershed
- FEMA Hazard Mitigation Assistance
- FEMA Unified Hazard Mitigation Assistance Grant Programs
- FEMA Mitigation Planning
- HUC-8 Lower Verdigris Watershed Locator Map
- FEMA New Levee Analysis and Mapping Approaches Being Mapped Fact Sheet
- Lower Verdigris Watershed Pre-Discovery Newsletter
- The Voice Newsletter
- FEMA What Is Risk MAP?
- Risk MAP Discovery Brochure
- FEMA Risk MAP Process Path
- FEMA Do You Have a Hazard Mitigation Plan?
- FEMA Tribal Mitigation Planning
- Lower Verdigris Watershed Engagement Plan Executive Summary
- The Lower Verdigris Watershed List of Communities
- List of FEMA Acronyms and Abbreviations

Four Discovery stations, focusing on Grants, Planning, Compliance and Mitigation, and Mapping, were available for Attendees to interact with knowledgeable staff. Each station was equipped with a copy of the NFIP "Answers to Questions About the NFIP", March 2011 as well as comment sheets to document flood issues, areas of concern and any other information provided by individual attendees.

At each station, attendees were asked to contribute watershed information and issues on a comment form. Members of the Regional Project Team were available at each station to answer questions and collect watershed and community-specific flood-related information and concerns. Attendees were also able to point out on the watershed maps any flood hazard concerns or issues and then mark them on the maps. After visiting a station, attendees rotated to the next station, and each attendee was encouraged to stop at all four stations. Attendees were encouraged to provide any relevant information (not brought with them to the Discovery Meeting) to the Project Team afterward.

Information sheets were collected at each station and the Discovery watershed maps were collected for future reference. These information sheets are included in the supplemental digital data that accompanies this report.

The four stations also had the following:

- *Mapping Station*: The Mapping station was divided into three mini-stations, each one equipped with a computer which provided attendees immediate access to a GIS web-based viewer and allowed attendees to identify quickly and easily localized flood problems, known areas of risk, concerns related to effective FIRMs, and any recent flood mitigation projects. Locations and areas of hazards and risks identified by attendees were then flagged within the watershed with an identification number and the data were input into the computer as well as logged on individual comment sheets also using the same identification number. OWRB staff assisted at the Mapping station.
- *Grants Station*: Community Benefits and Grant Opportunities – This station was manned by the Oklahoma State Hazard Mitigation Officer (SHMO) who informed attendees of grant opportunities and availability as well as provided handouts on various FEMA grant programs.
- *Planning Station*: Mitigation Planning and Mitigation Activities – Experienced GIS staff and hazard mitigation planners were available at this station to answer attendee questions and collect information regarding the availability and status of hazard mitigation plans and/or emergency action plans, any GIS-based community data, land use data, hazard mitigation projects underway or constructed since the update of the hazard mitigation plans, any environmental issues, and tribal data.
- *Compliance and Mitigation Station*: NFIP Community Actions – The Oklahoma NFIP Coordinator and an NFIP representative were present at this station to explain available NFIP opportunities and insurance availability as well as collect current data from attendees and establish follow up visits with the counties, communities and tribe within the watershed.

iv. Data Gathering Overview

The Discovery Meeting was attended by local participants. A full list of attendees is provided in the sign-in sheets in the digital data that accompanies this report. The meetings were well attended with most local communities represented. Attendees included:

- Federal and State agencies
- Congressional representatives
- County Commissioners
- Conservation District staff
- City Managers
- Local Tribes
- Local Floodplain Managers
- Emergency Management staff
- Community Planners
- Community Public Works staff

The meeting afforded personal, interactive communication with attendees at each station. The Project Team interviewed attendees and listed areas of positive mitigation and ongoing concerns for the watershed.

Feedback from the attendees indicated that they felt this was an opportunity to express their concerns about the watershed and that they preferred the interactive stations rather than a lengthy presentation. Many attendees were appreciative of the chance to speak with the Project Team members from both FEMA and the State of Oklahoma. Some information that was collected was:

- Areas with local drainage or surface water flooding issues
- Places where bridges or roads are regularly closed due to flooding or flooded
- Places where structures flood and there is no current SFHA defined
- Places where the effective FIRM and FIS products were believed not to reflect actual conditions
- Areas that have been mitigated through buy-out or elevation of structures
- Areas of high urban change and planned growth
- Studies being conducted by others that could be of use in future mapping and mitigation activities

The information from the comment forms and the locations of the concerns were compiled into a spatial data set after the meetings. This spatial set is included in the digital data accompanying this report.

Data collected from websites, invitees during Outreach contacts and emails prior to the Discovery Meeting are summarized in Table 12.

Table 12: Data Collection Summary – Pre-Discovery Meeting

Data Location	Data Custodian	Data Set Description
Watershed-wide	FEMA	Effective FIRM and FIS and back-up
Watershed-wide	FEMA	Letter of Map Change (LOMC) locations
Watershed-wide	OWRB	Locations of Repetitive Loss/Severe Repetitive Loss (RL/SRL)
Watershed-wide	FEMA	Location of funded grants
Watershed-wide	U.S. Census	Populated area and population characteristics
Watershed-wide	FEMA	Location of available or planned areas of updated Light Detection and Ranging (LiDAR) or other topographic data
Watershed-wide	USGS	Watershed HUC boundaries, NHD streams, stream gage information
Watershed-wide	FEMA	Participation in the NFIP, Community Rating System (CRS) ratings
Watershed-wide	Community Representatives	Currently accepted HMPs
Watershed-wide	FEMA	Disaster Declarations
Watershed-wide	FEMA	CNMS information

The availability of topographic data is an important factor in the selection and analysis of the watersheds. Preliminary research indicated that digital, updated topographic data is available for much of the area in the LVR Watershed. During 2002, the USACE updated topographic data for two large areas in the northeastern part of the watershed, while the Indian Nations Council of Governments (INCOG) updated topographic data for another part of the northeastern watershed in 2007. Between 2008 and 2010, the City of Tulsa updated its contours.
Additionally, the National Resources Conservation Services (NRCS) plans to acquire topographic data for portions of Muskogee, Wagoner and Tulsa Counties in 2012.

Table 13 summarizes the comments and issues collected at the four stations during the Discovery Meeting. Scans of comment forms are included in the digital deliverables. Locations of concerns and other comments have been recorded in an ESRI spatial file and included in the digital deliverables. Some areas of concern identified at the meetings were determined to be outside the watershed and have been noted in the table.

Table 13: Summary of Data Collected During the Discovery Meeting and Post-Meeting

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
C1	USACE	USACE	• A USACE Representative discussed Floodplain FP 101/202 training with the SHMO.
C2	Congressman Boren's Office	Congressman Boren's Office	• Claremore's Northeastern Technology Center (NTC) has a program for community projects called EAST (Environmental and Spatial Technology). The website is (www.eastproject.org). This program could possibly provide interns for FPAs and planners. Claremore's NTC website is www.ntceast.org.
C3	Muskogee County	Muskogee County	• In the County most repetitive losses are on acreages and people are not interested in buyouts. • There have been many complaints related to the effective maps, specifically that the preliminary maps were much different than the final maps. (There were a lot of grievances.)
C4	Town of Okay	Town of Okay	• The Town of Okay will be included in the next HMP update for Wagoner County, but is currently not in any plan. • The Town of Okay would like to obtain grants for drainage, bridge replacement, sirens, etc. • The Town of Okay spoke with a representative of the USACE about a damaged one-lane bridge from Okay to an island on the Verdigris River inside the navigation system (the Town thinks it is owned by the USACE). Mosquitos are a horrible problem. The USACE will investigate on the USACE side. This bridge has become a danger to pedestrians. • Major drainage issues are causing street flooding and access problems because of inadequate maintenance and flat slopes. The Town of Okay only has two employees to perform all of the maintenance work. • The Town of Okay will pursue REAP and CDBG grants.
C5	Rogers County	Rogers County	• The FPA for Rogers County began his position two days prior to this Discovery Meeting, and he has very little information at this time. • A Discovery Team member and the SHMO explained HMA funding to Rogers County. • The Rogers County FPA will send in an NOI to get funding. • The SHMO described how the funding and the application process works.
C6	Adams Creek	City of Broken Arrow	• The City of Broken Arrow would like to see the new Adams Creek study upgraded to replace the effective DFIRM.

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
C7	Spunky Creek	City of Broken Arrow	• The City of Broken Arrow would like to add the portion of Spunky Creek that is in the City of Broken Arrow to the Tulsa study area and would be able to contribute financially. • A Discovery Team member worked with the FEMA Project Monitor to explain how to make Broken Arrow a part of the East Tulsa CTP project area.
C8	City of Broken Arrow	City of Broken Arrow	• The City of Broken Arrow's Hazard Mitigation Plan was approved July, 2012. • The City of Broken Arrow would like to update/change their ordinances to adopt fully urbanized floodplains and those beyond the FIRM boundaries. • The City of Broken Arrow would like to pursue showing these areas as Zone X and the freeboard requirements (2'4" for residential) can be reconciled between existing and urbanized floodplains. • A Discovery Team member discussed this issue with the FEMA Project Monitor and determined that it would be better to do this under the non-regulatory products umbrella. The Discovery Team member emailed Broken Arrow's FPA with FEMA's suggestions.
C9	City of Muskogee	City of Muskogee	• The City of Muskogee requested a pdf file of the Discovery Meeting information packet so that it can be distributed to staff members at the City. • A Discovery Team member will forward the packet to him.
C10	City of Owasso	City of Owasso	• The City of Owasso will apply for the update to the City's HMP sometime soon. They are 2-1/2 years out and do not have funding for local match in the 12/13 budget year. The City of Owasso will send a request for the NOI form to OEM.
C11	Rogers County	Rogers County	• The County Engineer for Rogers County will contact the Rogers County Emergency Manager to get a copy of the HMP, and then discuss funding options for the various communities for their mitigation actions. The County Engineer will also discuss applying for an update now so that the schools can be included in the County Plan.
C12	Rogers County	Rogers County	• The Rogers County HMP was adopted on January 28, 2010.
M1	City of Muskogee	City of Muskogee	• This comment is outside the watershed. The existing annexed houses are located in the floodplain. The City of Muskogee is looking at buyout options.

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M2	City of Claremore	City of Claremore	• The City of Claremore sent topographic data for FEMA to use in Map Mod. This data was not used.
M3	City of Claremore	City of Claremore	• In the Southpoint Development in the City of Claremore, the Zone A doesn't match the terrain.
M4	City of Claremore	City of Claremore	• The City of Claremore has updated models and mapping from their MDP that were done after Map Mod.
M5	City of Claremore	City of Claremore	• In the City of Claremore, Zone A was eliminated during the Map Mod process.
M6	City of Claremore	City of Claremore	• The City of Claremore has sent information regarding these comments during the appeals/protest period of Map Mod.
M7	City of Claremore	City of Claremore	• The City of Claremore has the information that was sent during the appeals/protest period and is willing to send that information to FEMA if needed.
M8	City of Claremore	City of Claremore	• In the City of Claremore, the mapping is incorrect around the Quik Trip near JM Davis Boulevard and Lynn Riggs Boulevard.
M9	City of Claremore	City of Claremore	• The City of Claremore questioned how to get BFEs on Zone As. A team member explained that the USACE provides this service.
M10	Lower Adams Creek	Wagoner County	• Lower Adams Creek from Covington Tributary down to the mouth in Wagoner County has debris issues and sedimentation.
M11	Lower Adams Creek	Wagoner County	• A Wagoner County Commissioner has visited with the USACE and NACO about potential solutions to the debris and sedimentation issues in Lower Adams Creek.
M12	Wagoner County	Wagoner County	• Wagoner County is updating their Hazard Mitigation Plan.
M13	Wagoner County	Wagoner County	• In Wagoner County, there is a culvert near the intersection of 305th and 51st Street that overtops.
M14	Wagoner County	Wagoner County	• There are flooding issues in Wagoner County. The County just installed a new project near East 41st Street South and Oneta Road (S 241st East Avenue).
M15	Town of Okay	Town of Okay	• There are many local drainage problems such as blocked culverts and flooded streets contributing to "Verdigris Confluence" with Arkansas River. These areas are not located in SFHA, but the area needs funding to correct the problems.

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M16	Town of Okay	Town of Okay	• There is an old bridge to an island that has collapsed. This land used to be a City Park. The land (island) was returned to the USACE as part of a navigation channel. The Town of Okay needs a grant to restore this bridge. The Town of Okay would like to have jurisdiction over the island and use it for a public park. This area used to have walking trails, picnic areas, etc. There is a trail in place on the overland side and on the island, but the bridge has disconnected the trail. There is potential to add a boat ramp on either side for recreation/fishing access providing income to the Town of Okay.
M17	Town of Okay	Town of Okay	• In the Town of Okay, there are low water crossings upstream of a bridge that is causing stagnant water between the old bridge and the low water crossing. There is a significant mosquito problem and it is a health hazard. The USACE added low water pipes; however, they are clogged and do not allow low flow passage to reduce the stagnant water.
M18	Town of Okay	Town of Okay	• There is potential for a port facility if water access to the old slough were opened.
M19	Town of Okay	Town of Okay	• In addition, there is also potential for river way economic development other than navigation traffic, such as fishing tournaments, if this access were opened.
M20	Verdigris River	City of Muskogee	• Only a small area of the LVR Watershed falls within the City of Muskogee and it is all farmland. There are many potential issues that need to be discussed when the next HUC 8 to south is evaluated by FEMA.
M21	Adams Creek	Broken Arrow	• In the City of Broken Arrow, there is construction on the Turnpike and no LOMR has been completed for this location.
M22	Adams Creek	Broken Arrow	• There is a regional detention facility in the City of Broken Arrow and a new arterial road on 209th that is in the planning phase.
M23	Adams Creek	Broken Arrow	• The Adams Creek MDP was recently completed and needs to be incorporated into the FIS.
M24	Spunky Creek	Broken Arrow	• The City of Broken Arrow would consider participating with other communities in a mapping study.
M25	Broken Arrow	Broken Arrow	• The City of Broken Arrow will be updating ordinances for the new Tulsa county maps; they will also update their stormwater regulations.

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M26	Broken Arrow	Broken Arrow	• The City of Broken Arrow has new EAPs for a treatment plant near Verdigris and newly certified dams.
M27	Adams Creek	Broken Arrow	• The City of Broken Arrow has high water marks from the 2006 flood.
M28	Adams and Spunky Creek	Broken Arrow	• There is flooding in a subdivision in Wagoner County that is not on the maps.
M29	Salt Creek	City of Tulsa	• A detailed study is needed in the unincorporated areas of east Tulsa to identify areas of risk and prevent future development in areas of high risk.
M30	Adams Creek Tributaries	City of Tulsa	• A detailed study is needed in the unincorporated areas of east Tulsa to identify areas of risk and prevent future development in areas of high risk.
M31	Fife Creek Tributaries	City of Coweta	• This area has an approximate study with a Zone A floodplain. A detailed study is needed since development is anticipated in the future.
M32	Polecat Watershed	City of Coweta	• During a previous discovery meeting an area near Wal-Mart was identified as a problem. The City of Coweta FPA will provide additional data to the Discovery Team.
M33	Fife Creek Tributaries	City of Coweta	• Discussed how the City of Coweta can improve their chances to get a project funded through Risk MAP.
M34	Verdigris River	City of Catoosa	• A portion of Rogers Point is shown in the AE floodplain. The City of Catoosa has topography that shows this area is above the stated BFE. The City will provide the CTP Partner with the data.
M35	Spunky Creek	City of Catoosa	• The new Reasors and the Catoosa Shopping Center are shown in the floodplain yet a considerable amount of fill was used to raise the area above the BFE.
M36	Spunky Creek	City of Catoosa	• There are several areas east of the Hard Rock Casino that have approximate Zone A areas bordered by detailed Zone AE areas on the upstream and downstream side. This area needs to be restudied.
M37	Spunky Creek	City of Catoosa	• The City of Tulsa has planned to study Spunky Creek upstream of the City of Catoosa. The effective model for this section is more than 20 years old. It would be great if the City's planned project could be extended to the Verdigris River. This would address the previous three comments.
M38	Spunky Creek Tributary	City of Catoosa	• The bridge near 200th East Avenue and Admiral Place in Catoosa has been replaced but the maps have not been updated.

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M39	Spunky Creek Tributary	City of Catoosa	• The bridge near 200th East Avenue and 1st Place in Catoosa has been replaced but the maps have not been updated.
M40	Spunky Creek Tributary	City of Catoosa	• The floodplain on the golf course at the Hard Rock Casino in Catoosa is disconnected from the floodplain downstream. This area has been improved as part of the recent development and I-44 improvements. A detailed study of this area is needed. This is currently Cherokee owned land.
M41	Spunky Creek Tributary	City of Catoosa	• The floodplain west of 177th E Avenue in Catoosa is disconnected from the floodplain downstream. A detailed study of this area is needed.
M42	Ft. Gibson Lake	Wagoner County	• There are problems with the new maps relating to decertification of the levees near Wagoner – and based on the comments from the public and discussions at the Discovery Meeting – additional education is needed. A FEMA representative discussed the need to have a public meeting to discuss the changes and identify options for updating the BFE's as needed and obtaining levee certification.
M43	Adams Creek	Wagoner County	• Upstream of Midway Road, there is an updated detailed study that was completed in 2011. The Wagoner County Engineer will provide this information to the CTP. The area downstream of Midway needs to be updated to the Verdigris River with a new detailed study.
M44	Verdigris River Tributary	City of Wagoner	• This area in the City of Wagoner has a new approximate study on the 2012 maps. A detailed study is needed due to urbanization.
M45	Verdigris River Tributary	City of Wagoner	• This area in the City of Wagoner has a new approximate study on the 2012 maps. A detailed study is needed due to urbanization.
M46	Verdigris River Tributary	City of Wagoner	• This area in the City of Wagoner has a new approximate study on the 2012 maps. A detailed study is needed due to urbanization.
M47	Bull Creek	Wagoner County	• Bull Creek in Wagoner County has a new approximate study. There are several planned bridge improvements and a detailed study would be helpful.

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
M48	Salt Creek	Wagoner County	• The City of Tulsa is planning an updated study on the upper portion of Salt Creek. This study should be continued downstream to the Verdigris River due to residential development and planned bridge improvements.
M49	Spunky Creek & Tributaries	City of Tulsa	• A detailed study is needed in the unincorporated areas of east Tulsa to identify areas of risk and prevent future development in areas of high risk.
N1	City of Claremore	City of Claremore	• The City of Claremore inquired for the number of policies held in the city.
N2	City of Catoosa	City of Catoosa	• Ordinances are currently being discussed with city officials in the City of Catoosa. The City wants flood proofing reinstated. The City also inquired about requirements to participate in the CRS.
N3	City of Claremore	City of Claremore	• The City spoke to a Discovery Team member about adoption of the new maps and how it affects property owners. The PPR program was also explained to the City. The grandfathering program was also discussed – i.e. how to obtain an elevation certificate now so that they can get Zone X certification on the previous map.
N4	Rogers County	Rogers County	• Rogers County inquired about general information regarding the NFIP program. The Rogers County FPA recently joined the staff and does not have wide knowledge. OWRB will perform a CAC.
N5	City of Claremore	City of Claremore	• The City of Claremore requested information regarding regulation of mobile homes near the floodplain. A Discovery Team member stated that they cannot use loose blocks if they are placed more than three feet high; more than three feet high, they must use a permanent foundation.
N6	Mayes County	Mayes County	• Mayes County inquired about changing the Ordinance to include no rise. They intend to investigate increasing regulation to achieve risk reduction.
N7	Wagoner County	Wagoner County	• Wagoner County requested information regarding assistance for the mitigation of unmapped, localized drainage issues. They have issues with flooding due to backwater effects. They have spoken with the USACE about an island in the Town of Okay that is part of a trail way.
N8	Rogers County	Rogers County	• Rogers County expressed concerns about regulations.
N9	City of Broken Arrow	City of Broken Arrow	• The City of Broken Arrow inquired about issues with a FEMA generated letter for PRP extensions.
P1	Congressman Dan Boren	Congressman Dan Boren	• Congressman Dan Boren is responsible for only a small portion of Mayes County within this HUC-8. • Discovery Team members were informed of the hiring

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
			of a new Floodplain Manager Larry Curtis in Rogers County.
P2	City of Broken Arrow	City of Broken Arrow	• The City of Broken Arrow's Hazard Mitigation Plan has been adopted and approved by FEMA, effective July, 2012 (including Union and Broken Arrow school districts). The City is a member of CRS and has higher ordinance standards. It is likely that the City will amend its ordinance in the near future due to mapping changes. The City has topographical data from LiDAR that was recently flown. The Master Drainage Plan for Spunky Creek is becoming outdated and needs updating. The other Master Drainage Plans are generally current. The City has Emergency Action Plans for its dams and a new Emergency Action Plan for its Water Treatment Plant. The Team requested that the City send this information. No particular mitigation actions were underway (pending approval of its Hazard Mitigation Plan).
P3	City of Catoosa	City of Catoosa	• Catoosa has a Hazard Mitigation Plan that is being integrated with the Rogers County HMP. Catoosa will provide an electronic copy of the Plan to the Discovery Team. The City is considering criteria for joining the CRS program. Team Members provided the City a quick overview of CRS benefits and FEMA's website as well as the contact information for two local participating communities. The City has constructed two new expanded bridges (one at First Place which is not quite finished and the other over Admiral on a Spunky Creek Tributary) in the Rolling Hills neighborhood that was found to flood after a study was completed for the area. A drainage study was also performed on Pine Street and is included with the new mapping. The Team requested copies of any drainage studies and the comprehensive land use plan. A new development is planned on the southern half of the block on the northwest corner of Highway 66/I-44 junction. The Reasor's Store at Rice and Highway 66 has onsite detention. The Corps of Engineers property at highway 66 at Verdigris is used by the City as a park. Both of these properties are shown as if in the floodplain on the new maps but are outside the floodplain based upon the topographic data. The City also has some topographic data on several parks and neighborhoods; the City was asked to provide the information to the Team. The Team requested copies of all topographic information and plans for any new development.

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
P4	City of Coweta	City of Coweta	• Coweta has updated its Hazard Mitigation Plan and has already provided it to the Team. Its topographic data is provided by INCOG. The Team requested the topographic data be provided to them. Two flood mitigation acquisitions are underway currently in Cottonwood Acres. One of the two is completed and the second is pending completion. The City has obtained sirens, a Blackboard mass communication system, and weather radios as mitigation efforts. It had a drainage study completed by the USACE in 1980 and is trying to identify funding to implement its recommendation to clear its channels. The City has comprehensive land use information. The Team may need to follow up with a request. INCOG has its zoning and parcel data. No Dam Emergency Action Plans exist at this time.
P5	Rogers County	Rogers County	• Rogers County has a Hazard Mitigation Plan. The Team requested a copy of the Plan. Any topographic data would be available from INCOG. The Team needs to follow up with a request for the data. There are dams on Lake Oologah and Claremore Lake but the Emergency Action Plans are not the responsibility of the County. Stone Canyon development, west of the Port of Catoosa, is a large new development currently underway. The County has a fully interactive GIS mapping system. The County had an emergency with a roadway being washed away by recent flooding at a culvert location that is a repeat incident location currently being considered for upgrade and in the midst of replacement. The Team requested the location of this washout. Six units of duplexes along Archer Court in Claremore flooded the week prior to the Discovery Meeting; they are recommended for acquisition in Claremore's Master Drainage Plan.
P6	City of Muskogee	City of Muskogee	• The City has a Hazard Mitigation Plan, topographic data and GIS data which has already been provided to the Team. It does not participate in CRS but expressed an interest in learning more about the program. Team Members provided the City a quick overview of benefits and FEMA's website as well as the contact information for two local participating communities. The City provided Team Members print copies of its floodplain ordinance, stormwater permitting activities and zoning legend which was scanned into the computer as back up data.

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
P7	City of Owasso	City of Owasso	• The City of Owasso has a Hazard Mitigation Plan (updated in 2010). The Team informed the City of the importance of updating it again by 2015 and stressed the need to begin the update process in the near future. The City Engineer was not aware if the City participated in the CRS program or not. The new Garnett Detention and channel may not be located on the existing floodplain maps (needs checking). The City is considering a new ordinance for the maintenance of detention ponds but no details are available at present. New bridges have been constructed on 86th (Ranch Creek) and by the golf course. Sam's Club is planning a new development near the northeast of 96th Street North and 129th E. Avenue and will be providing onsite detention to avoid any adverse impact on the existing downstream development.
P8	City of Owasso	City of Owasso	• A new bridge in Owasso at Preston Lakes on 86th Street is due to begin construction. A LOMA for Eagles Landing in Owasso has been submitted to FEMA but is not reflected on the new maps for Rogers County. A new bridge is also underway on 161st Avenue between 76th and 86th streets. Staff believes this should read – Has been constructed on 161st Avenue between 86th and 96th streets. An email has been sent to Jarrod Sanders for clarification.
P9	Town of Okay	Town of Okay	• The Town of Okay does not have a Hazard Mitigation Plan but is talking to Wagoner County about joining its Plan. The Town is a member of the NFIP but has no mapped floodplains. Its flooding is related to street flooding. A Dollar General Store is currently under construction along York Street.
P10	Wagoner County	Wagoner County	• The County has a Hazard Mitigation Plan and is planning to enroll in CRS after the adoption of its new maps. Both the City and County have GIS capability. The Team requested the provision of the parcel data controlled by the USACE) have been decertified y FEMA resulting in hundreds of structures in the City of Wagoner now designated within the floodplain. The USACE is working on the certification of the levees but the solution is still two years away; in the interim, the owners of the impacted structures will be required to purchase flood insurance. Team members explained opportunities for insurance relief through the Preferred Risk Policy. The levees along the Verdigris River have also been decertified but with little effect on the

Item	Flooding Source	Information Provided By	Discovery Meeting Comment Summary
P10 (Cont.)	Wagoner County	Wagoner County	area's structures. The flood pool at Fort Gibson has also been mapped much higher (up to 20 feet difference) than shown by the USACE and is adversely impacting structures. The City and County want relief and request that the USACE and FEMA resolve the data discrepancy quickly. The City of Wagoner and the County did not appeal the maps during the Appeal Process period since Fort Gibson is outside the City's authority and responsibility and the local jurisdictions did not understand the possibility that the existence of a federal structure could adversely impact their local areas.
P11	City of Kiefer	City of Kiefer	• The City of Kiefer approved its Hazard Mitigation Plan at the last Council meeting.

All supporting information, data, and files collected for this report are included in the supplemental digital data submitted with this report. The following is a directory listing of the files and folders included and which data are found under each sub-folder. If a submittal is not applicable for the LVR Watershed, a Readme Text file is included in its place noting that it was not included.

11070105\Discovery

- 1-Project_Discovery_Initiation
  - Project_Team_Information
  - Community_Contact_List
  - Engagement Plan
- 2-Discovery_Meeting
  - Meeting Attendance Record
  - Meeting Agenda Meeting Minutes
  - Presentation
  - Exhibits
  - Correspondence
    - Initial Contact Letters
    - Invitation Letters
    - Thank You Letters
- 3-Post_Discovery
  - Discovery Maps
  - Discovery Report
  - Scope of Work and Mapping Activity Statement
- 4-Supplemental_Data
  - GIS (Personal geodatabase files and metadata)
  - Hazard Mitigation Plan
  - Outreach Newsletters

III. Watershed Findings

Once the data was collected from the Discovery Meeting, an analysis was performed to identify critical areas highlighted as concerns for future projects in the watershed. The analysis focused on areas within the watershed that had been identified as having mitigation action plans for the future. The details in this section supplement the documentation supporting the need for further mitigation actions or studies in particular streams, reaches, or communities in the watershed.

This section describes the riverine floodplain analysis as either basic or enhanced. The basic analysis will produce a model-backed Zone A floodplain delineation. The enhanced analysis will produce a model-backed Zone AE floodplain delineation. These analysis types are discussed in more detail below as part of the evaluation of needs.

i. Engineering Review of Community Comments

All comments were filtered to determine which were engineering-related. Engineering-related comments provided by communities during the Discovery Meeting were then analyzed. These comments were reviewed in terms of hydrologic and hydraulic issues in the watershed and with any general floodplain or Base Flood Elevation (BFE) related comments. All comments were investigated to determine whether or not they would have any effect on the hydrology of the watershed.

One recurring issue identified by many communities was mapping errors such as areas that are shown in the floodplain but have been raised above the BFE, Zone As that do not match the terrain, and Zone As that were eliminated during the Map Mod Process. Communities and counties having issues with current FIRMs are: City of Claremore, City of Catoosa, and City of Tulsa.

For example, at the Discovery Meeting, the City of Claremore discussed several mapping errors or omissions that occurred during the Map Mod process. Issues mentioned included updated topographic data sent to FEMA (to be utilized during the mapping process) that was not used, Zone A not matching the terrain in the Southpoint Development, and a perceived mapping error near the Quik Trip. The City commented that information was sent regarding these issues to FEMA during the Map Mod appeals process.

The City of Catoosa noted areas that were shown on the maps as being in the floodplain however were elevated above the BFE. Also, there are areas that have Zone A floodplains bordered by Zone AEs on the upstream and downstream sides of the floodplain.

The City of Tulsa communicated intent to study Spunky Creek upstream of the City of Catoosa. The effective model in this area is over twenty years old and outdated. Extending the study area to the Verdigris River would eliminate several of the mapping issues in Catoosa. The City of Tulsa also noted Salt Creek, Spunky Creek and its tributaries, Adams Creek and its tributaries, and Fife Creek and tributaries as areas where a detailed study is needed. Detailed studies are needed to identify high risk areas and guide future development.

Wagoner County discussed the problems surrounding the decertification of the levees near Wagoner. A public meeting may be needed to discuss the changes.

Many comments also addressed the locations and types of flooding within communities, including repetitive loss structures and structures that have been replaced after being washed out during storm events. These structures were identified during the Discovery Meeting.

Discussions included difficulties encountered by communities when regulating development in Zone As without Base Flood Elevations. Communities noted the availability of detailed topographic data which may be provided to FEMA to facilitate detail study of Zone As. Other communities discussed concerns over FIRMs Zone A and Zone AEs that do not tie together, channels that are located outside the floodway and flooding issues that extend beyond the floodplain areas shown in the effective FIRMs.

ii. Post-Discovery Hydrology

Reviews of the hydrologic information were performed in the LVR Watershed after the Discovery Meeting. These reviews focused on:

- Peak discharges in the watershed
- Limited gage analyses in the watershed

The 1-percent-annual-chance peak discharges were reviewed for all streams across community and county boundaries. Areas with Letters of Map Revision (LOMRs) were specifically checked because LOMRs may indicate that there are larger issues. Information obtained from USGS gages was checked against the effective FIS for consistency. This analysis could potentially flag anomalies that would indicate that the hydrology is out of date, too high, or too low for the watershed.

Peak discharges in the watershed were reviewed based on effective FIS reports, flow gages, and available LOMRs. Areas of special interest were county boundaries and locations of LOMRs and gages. Hydrologic models were not provided for areas studied by basic methods.

iii. Frequency Analysis

The LVR Watershed has only one stream gage currently active. A frequency analysis was performed on this gage using the USGS PeakFQWin program. The gage, located on the Verdigris River, has 77 years' worth of data; however, there has been much regulation through dam construction along this river during that time. The last of the flood control structures was completed in 1983. Thus, only the records after that date were used in the analysis. A map of the gage site is shown in Figure 4.

The comparison between the published FIS discharges and the gage analysis was made and listed in Table 14. The discharges from the gage analysis are very similar to the current FIS flow rates.

Figure 4: USGS Gage Locations

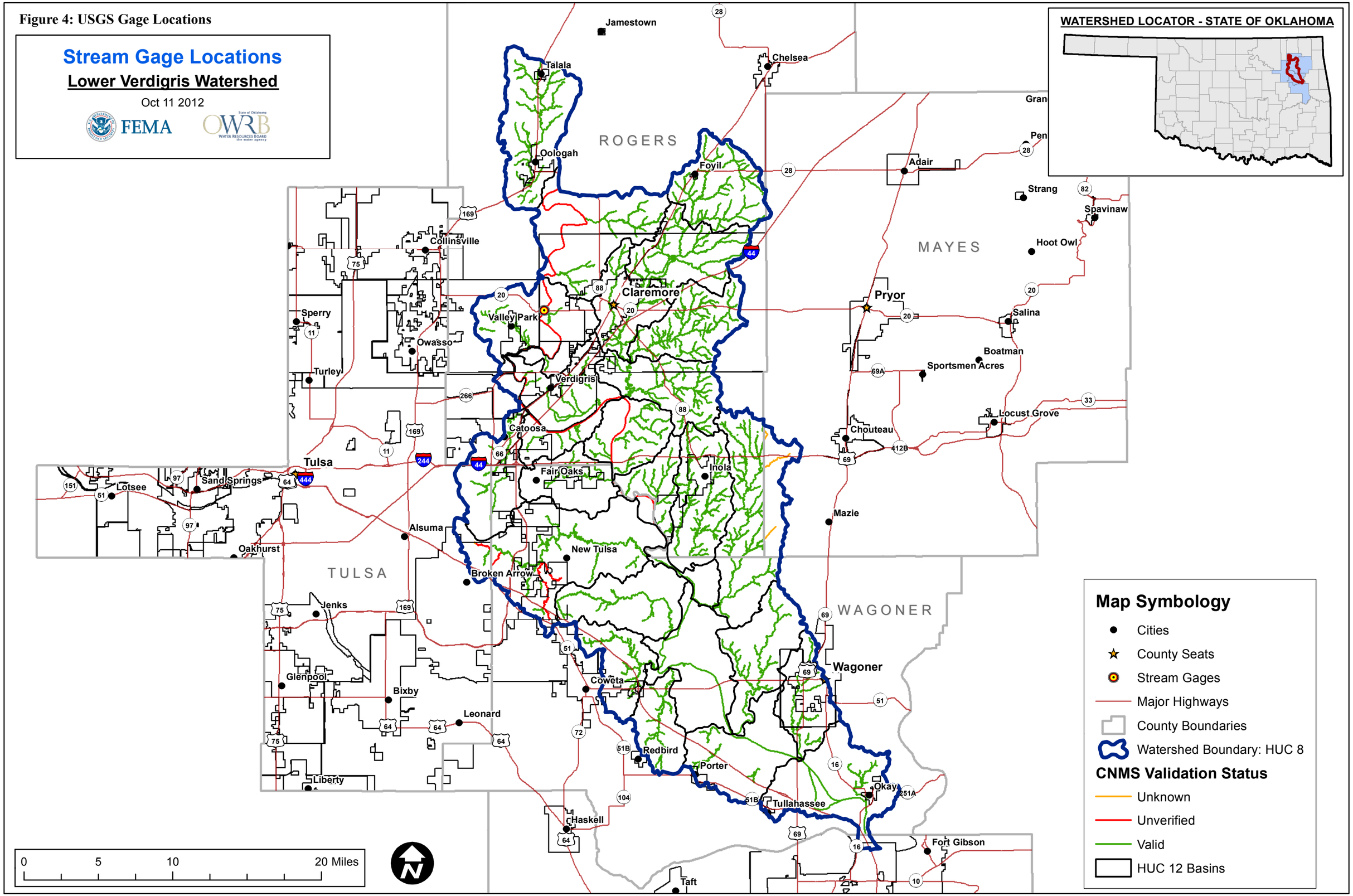


Table 14: Comparison of 1-Percent-Annual-Chance Peak Flows of Gage Frequency Analysis and Effective Discharges

Stream Name and Location	USGS Gage	Drainage Area from USGS Gage (square miles)	Effective Discharges Source	Effective 1% Annual-Chance Discharge (cfs)	95% Confidence Limits Lower (cfs) (Gage)	1% Annual-Chance Discharge from PeakFQWin (Gage)	95% Confidence Limits Upper (cfs) (Gage)	Number of Peaks on Record
Verdigris River near Claremore, OK	7176000	6,534	Rogers County FIS	80,000	130,800 60,070	179,500 76,160	285,600108,200	77*

*77 total years but only 28 were used due to regulation changes
USGS = U.S. Geological Survey
cfs = cubic feet per second

iv. Post-Discovery CNMS Analysis

Although the LVR Watershed comprises five counties, only Rogers, Tulsa, and Wagoner Counties were part of a detailed CNMS Phase III process. Mayes and Muskogee Counties were not included in the CNMS database. Table 15 (next page) shows a listing of detailed study streams (Zone AE) contained in the CNMS for the LVR Watershed.

All validation was performed as per the CNMS Database User's Guide Version 4.3 dated June 2011. The CNMS validation elements attempt to identify changes in the physical environment, climate, and engineering methodologies since the date of the effective analysis (different from the effective issuance date). According to the CNMS validation process, the studied reach is considered unverified or is assigned an unverified status, if one of seven critical elements fails, or if four or more of the 10 secondary elements fail during stream reach level validation. Definitions for each validation element, as described in the CNMS Database User's Guide, are provided in Table 16.

A review of all stream segments, including any Zone As, was performed as part of this analysis. For detailed streams, an inventory of streams that have either failed one or more validation elements or streams which contain null[1] values for validation elements was performed – and is summarized in Table 15. Data retrieved from the City of Tulsa's CMS (Channel Management System) database which contains bank and bottom scour information for Tulsa streams was also considered. The stream segments that were identified as having significant scour problems in the City of Tulsa's study were included as failed CNMS Critical Element C7, and noted as C7* in Table 15, for ease of identification from other sources of data.

The following is a detail of the CNMS review findings by County:

Mayes County, OK

Mayes County was not included in CNMS Phase III. The CNMS contains information for 4.22 miles of Zone A streams (Bull Creek and Unnamed Stream) located within the Bull Creek HUC-12 Watershed. These streams had a validation status of Unknown and are not model-backed. No change to the Unknown status of these streams is recommended.

Muskogee County, OK

Muskogee County was not included in CNMS Phase III. The CNMS contains no streams located in Muskogee County.

[1] The term null refers to CNMS elements which contained no information – or were empty.

Table 15: Current CNMS Validation Status and Discovery Level CNMS Review for Detailed Streams

Stream Name	County	Original CNMS Data				Discovery Level CNMS Review			
		Validation Status	Failed CNMS Elements	Unknown CNMS Elements	Null Elements	Date of Effective Study	Age of Effective Study	Failed CNMS Elements	Recommended Validation Status Change
Boggy Creek	Rogers County	Valid	S3, S6	C3, S1, S10	C1, C2, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9	3/1/1984	29	C3	Unknown
Cat Creek Reach ID 401310100181	Rogers County	Valid	S2, S4		C1, C2, C3, C4, C5, C6, C7, S1, S3, S5, S7, S8, S9, S10	10/30/1990	22	C3, C5	Unverified
Cat Creek Reach ID 401310100182	Rogers County	Valid			C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S5, S7, S8, S9, S10	3/1/1984	29	S6	Unknown
Dog Creek	Rogers County	Valid			C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S5, S7, S8, S9, S10	9/10/1976	37	C5	Unknown
Dover Tributary 1	Rogers County	Valid	S3, S4, S6	C3, S1, S10	C1, C2, C4, C5, C6, C7, S2, S5, S7, S7, S8, S9	3/1/1984	29	C3	Unknown
Dover Tributary 2	Rogers County	Valid	S3, S6	C3, S1, S10	C1, C2, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9	3/1/1984	29	C3	Unknown
Dover Tributary 3	Rogers County	Valid	S3, S6	C3, S1, S10	C1, C2, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9	3/1/1984	29	C3	Unknown
Dover Tributary 4	Rogers County	Valid	S3, S6	C3, S1, S10	C1, C2, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9	3/1/1984	29	C3	Unknown
Inola Creek	Rogers County	Valid	S3, S6	C3, S1, S10	C1, C2, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9	9/10/1976	37	C3	Unknown
Otter Creek	Rogers County	Valid	S6	C3, S1, S10	C1, C2, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9	9/10/1976	37	C3	Unknown
Panther Creek	Rogers County	Valid		C3, S1, S10	C1, C2, C4, C5, C6, C7, S2, S3, S4, S5, S6, S7, S8, S9	9/10/1976	37	C3, C5	Unverified
Pea Creek	Rogers County	Valid	S3, S6	C3, S1, S10	C1, C2, C4, C5, C6, C7, S2, S3, S4, S5, S7, S8, S9	9/10/1976	37	C3	Unknown
Spunky Creek	Rogers County	Valid	S3, S6		C1, C2, C3, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9, S10	9/10/1976	37	C7*	Unknown
Spunky Creek Tributary	Rogers County	Valid	S3, S4, S6		C1, C2, C3, C4, C5, C6, C7, S2, S5, S7, S8, S9, S10	1/1/1984	29	C5, C7*	Unverified
Verdigris River-Big Flag Lake	Rogers County	Unverified	C1, S3, S4, S6		C2, C3, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9, S10	Unknown	Unknown	C5	No Change
Verdigris River-Honey Creek	Rogers County	Unverified	C1, S3, S4, S6		C2, C3, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9, S10	Unknown	Unknown		No Change
Verdigris River-Moss Creek	Rogers County	Unverified	C1, S3, S4, S6		C2, C3, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9, S10	Unknown	Unknown		No Change
Verdigris River-Sweetwater Creek	Rogers County	Unverified	C1, S3, S4, S6		C2, C3, C4, C5, C6, C7, S2, S4, S5, S7, S8, S9, S10	Unknown	Unknown		No Change
Adams Creek	Tulsa County	Unverified	C6		C1, C2, C3, C4, C5,C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	7/1/1983	30	C5	No Change
Adams Creek Tributary E	Tulsa County	Valid	S4		C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	7/1/1983	30	Age of Study	Unknown
Spunky Creek	Tulsa County	Valid			C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	9/1/1979	34	C3, C7*	Unknown
Spunky Creek Tributary A	Tulsa County	Valid			C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	9/1/1979	34	C3, C7*	Unverified

Stream Name	County	Original CNMS Data				Discovery Level CNMS Review			
		Validation Status	Failed CNMS Elements	Unknown CNMS Elements	Null Elements	Date of Effective Study	Age of Effective Study	Failed CNMS Elements	Recommended Validation Status Change
Spunky Creek Tributary B	Tulsa County	Valid			C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	9/1/1979	34	C3, C7*	Unverified
Spunky Creek Tributary B-1	Tulsa County	Valid			C1, C2, C3, C4, C5, C6, C7, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	9/1/1979	34	C3, C7*	Unverified
Adams Creek	Wagoner County	Valid	S2, S4, S6	C7	C1, C2, C3, C4, C5, C6, S1, S3, S5, S6, S7, S8, S9, S10	5/1/1986	27	C7*	Unknown
Covington Creek	Wagoner County	Unverified	S2, S3, S6, S7	C7	C1, C2, C3, C4, C5, C6, S1, S4, S5, S7, S8, S9, S10	5/1/1986	27	C5	No Change
Covington Creek Tributary	Wagoner County	Valid	S3, S6, S7	C7	C1, C2, C3, C4, C5, C6, S1, S2, S4, S5, S7, S8, S9, S10	5/1/1986	27	C5	Unknown
East Coal Creek	Wagoner County	Valid	S4	C7	C1, C2, C3, C4, C5, C6, S1, S2, S3,S5, S6, S7, S8, S9, S10	5/1/1986	27		No Change
Lonestar Creek	Wagoner County	Unverified	C5, S6	C7	C1, C2, C3, C4, C6, S1, S2, S3, S4, S7, S8, S9, S10	5/1/1986	27	C5	No Change
Midway Creek	Wagoner County	Valid	S6	C7	C1, C2, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27		Unknown
Salt Creek	Wagoner County	Valid	S6	C7	C1, C2, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27	C5	Unknown
Salt Creek Tributary 1	Wagoner County	Valid	S6	C7	C1, C2, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27	C5	Unknown
Salt Creek Tributary 2	Wagoner County	Valid	S6	C7	C1, C2, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27		Unknown
School Creek	Wagoner County	Valid	S4, S6	C7	C1, C2, C3, C4, C5, C6, S1, S2, S3, S5, S7, S8, S9, S10	5/1/1986	27		Unknown
Springtown Creek	Wagoner County	Valid	S6	C7	C1, C2, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27		Unknown
Spunky Creek	Wagoner County	Valid	S6	C7	C1, C2, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27	C5, C7*	Unknown
Spunky Creek Tributary A	Wagoner County	Valid	S6	C7	C1, C2, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27	C7*	Unknown
Timber Creek	Wagoner County	Unverified	C6, S3, S6	C7	C1, C2, C3, C4, C5, S1, S2, S4, S5, S7, S8, S9, S10	5/1/1986	27		No Change
Verdigris River Divergence Channel	Wagoner County	Valid		C7	C1, C2, C3, C4, C5, C6, S1, S2, S3, S4, S5, S6, S7, S8, S9, S10	5/1/1986	27	C3	Unknown
Verdigris River-Commodore Creek	Wagoner County	Unknown	S6	C7	C1, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27	C3	No Change
Verdigris River-Outlet	Wagoner County	Unknown	S6	C7	C1, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27		No Change
Verdigris River-Port Of Dunkin	Wagoner County	Unknown	S6	C7	C1, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27		No Change
Verdigris River-Strawberry Creek	Wagoner County	Unknown	S6	C7	C1, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27		No Change
West Coal Creek	Wagoner County	Valid	S6	C7	C1, C2, C3, C4, C5, C6, S1, S2, S3, S4, S5, S7, S8, S9, S10	5/1/1986	27	C5	Unknown

Table 16: Failed Element for Streams

Element Name	Issue Being Identified by the Element	Element Description
C1	Major change in gage record since effective analysis that includes major flood events	Failure of this element happens when a major change in the gage record occurs after the date of the Effective Study.
C2	Updated and effective peak discharges differ significantly based on confidence limits criteria	Failure of this element indicates that the updated and effective peak discharges differ significantly from the current confidence limits criteria since the date of the Effective Study.
C3	Model methodology no longer appropriate (one-dimensional vs. two-dimensional)	This element fails when the model methodology used no longer meets current guidelines and specifications.
C4	Major flood control structure added or removed	Failure of this element indicates the addition or removal of a major flood control structure (i.e., certified levee or seawall, reservoir with more than 50 acre-ft storage per square mile).
C5	Current channel reconfiguration outside effective SFHA	Failure of this element indicates the streamline is seen on imagery as outside the SFHA and cannot be explained by a minor mapping error, which could be corrected through base fitting.
C6	More than five new or removed hydraulic structures	This element fails when more than five new or removed hydraulic structures that impact the BFEs have not been identified.
C7	Significant channel fill or scour	Failure of this element indicates a significant channel or scour has been identified.
S1	Use of rural regression equations in urbanized areas	This element attempts to flag studies in current urban areas where rural regression equations were used for the Effective Study hydrology.
S2	Repetitive losses outside the SFHA	This element fails when repetitive losses have been noted outside of the SFHA. Repetitive losses determined to be from an unmapped source, or due to local drainage issues are not considered.

Element Name	Issue Being Identified by the Element	Element Description
S3	Increase in impervious area in subbasin of more than 50 percent	Failure of this element identifies a significant increase in impervious area (due to urban development since the study date) based on best available land use/land cover data sources.
S4	More than one and less than five new or removed hydraulic structures (bridge/culvert) impacting BFEs	This element identifies addition or removal of more than one, but less than five hydraulic structures along the studied streams since the date of the Effective Study.
S5	Channel improvements / shoreline changes	Failure of this element indicates the FIRM, Imagery, or other data input sources show channel improvements since the study date.
S6	Better topographic or bathymetric data available	Failure of this element indicates better topographic or bathymetric data has been made available since the Effective Study date.
S7	Changes to vegetation or land use	Failure of this element indicates there have been significant changes in land use or vegetative cover since the date of the Effective Study.
S8	Failure to identify primary frontal dune in coastal areas	Failure of this element indicates that the primary frontal dune was not properly identified in coastal areas.
S9	Significant storms with high water marks	Failure of this element indicates that recent storm surge high waters marks were not identified.
S10	New regression equations available	Failure of this element indicates updates to regression equations since the date of study for studies that used a regression analysis for hydrology.

Rogers County, OK

Rogers County was included in CNMS Phase III. The CNMS includes 625.15 stream miles – of which 50.70 have a validation status of Unverified and 574.45 have a validation status of Valid.

Out of those listed as Valid, 507.3 stream miles are listed as Flood Zone A and are model-backed. Of the Valid Zone A streams, 3.14 miles show significant scour based on the City of Tulsa's CMS data. These streams include Spunky Creek, Spunky Creek Tributary 1 and four Unnamed Streams located in the Spunky Creek HUC-12.

Rogers County Zone A Streams Failing Critical Element C7

Reach ID	Stream name	Length (mi)
401310100232	Unnamed Stream	0.04
401310100135	Spunky Creek Tributary 1	0.81
401310100136	Spunky Creek	1.13
401310100860	Unnamed Stream	0.35
401310101043	Unnamed Stream	0.51
401310101041	Unnamed Stream	0.30

Additionally, 15.77 miles of the Zone A streams fail Critical Element C5 indicating that the current channel reconfiguration is outside of the effective SFHA. These streams should be corrected to a validation of Unverified. All streams are identified as Unnamed and listed below:

Rogers County Zone A Streams Failing Critical Element C5

Reach ID	Stream name	Length (mi)
401310101252	Unnamed Stream	0.26
401310100698	Unnamed Stream	1.21
401310100404	Unnamed Stream	0.79
401310100494	Unnamed Stream	1.42
401310100797	Unnamed Stream	0.26
401310101215	Unnamed Stream	1.71
401310100284	Unnamed Stream	0.42
401310101154	Unnamed Stream	3.54
401310101153	Unnamed Stream	1.79
401310100611	Unnamed Stream	0.31
401310101140	Unnamed Stream	0.76
401310101146	Unnamed Stream	1.28
401310100215	Unnamed Stream	0.62
401310100214	Unnamed Stream	0.77
401310101018	Unnamed Stream	0.62

There are 116.59 remaining stream miles in Rogers County that are listed as Zone AE. Of those, 50.7 are listed as Unverified and 65.89 are listed as Valid. These are all redelineations.

Verdigris River: A 50.7 stream mile segment of the Verdigris River (Reach ID 401310100193) failed Critical Element C1 and Secondary Elements S3, S4 and S6 which indicates that:

- A major change in the gage record occurs after the date of the Effective Study;
- A significant increase in impervious area (due to urban development since the study date and based on best available land use/land cover data) has occurred;

- The addition or removal of more than one, but less than five hydraulic structures along the studied streams, has occurred since the date of the Effective Study[2], and
- Better topographic data has been made available since the Effective Study date.[3]

No change in the Unverified status is recommended for all of the Verdigris River stream segment.

Recommended CNMS Status modifications from Valid to Unverified:

Cat Creek: A segment of Cat Creek (Reach ID 401310100181) lists the hydrologic model as "TR-55 (JUNE 1986)" and is listed as one of the "Current Unacceptable Models" by FEMA. Therefore, because the model methodology used no longer meets current guidelines and specifications, this stream segment fails Critical Element C3.

Additionally, this segment fails Secondary Elements S2, S4 and S6, indicating that:

- Repetitive losses (not from an unmapped source or due to local drainage issues) have been noted outside the SFHA;
- The addition or removal of more than one, but less than five hydraulic structures along the studied streams, since the date of the Effective Study, has occurred, and
- Better topographic data has become available since the date of the Effective Study.

An inspection of the floodplain indicates that a portion of the centerline for the stream is outside the SFHA which results in the failure of Critical Element C5.

Because of the above, the validation should be changed from Valid to Unverified.

Panther Creek: Panther Creek (Reach ID 401310100188) lists Critical Element C3 and Secondary Elements S1 and S10 as Unknown, indicating that:

- The model methodology used may no longer meet current guidelines and specifications;
- Rural regression equations may have been used for the Effective Study in current urban areas, and
- Updates may exist to regression equations since the date of study for studies that used a regression analysis for hydrology.

An inspection of the floodplain indicates that a portion of the centerline for the stream is outside the SFHA which results in the failure of Critical Element C5.

[2] The Effective Study date is 1976.
[3] The Effective Study date is 1976.

Because of the above, the validation should be changed from Valid to Unverified.

Spunky Creek Tributary: The hydrologic model is listed as SNYDER METHOD, and should be corrected to HEC1. The Effective Date is 1/1/1984. Spunky Creek Tributary fails Secondary Elements S3, S4 and S6, indicating:

- A significant increase has occurred in impervious area (due to urban development since the study date based on best available land use/land cover data sources);
- Better topographic data has become available since the Effective Study date, and
- The addition or removal of more than one, but less than five hydraulic structures along the studied streams since the date of the Effective Study, has occurred.

An inspection of the floodplain indicates that a portion of the centerline for the stream is outside the SFHA which results in the failure of Critical Element C5. The stream was also noted as having significant scour problems – City of Tulsa's CMS (Channel Management System) – thereby failing Critical Element C7.

Because of the above, the validation should be changed from Valid to Unverified.

<u>Recommended CNMS Status modifications from Valid to Unknown:</u>

Boggy Creek: The 0.92-mile Boggy Creek segment (Reach ID 401310100155) lists Critical Element C3 and Secondary Elements S1 and S10 as Unknown indicating that:

- The model methodology used may no longer meet current guidelines and specifications;
- Rural regression equations may have been used for the Effective Study in current urban areas, and
- Updates to regression equations may exist since the date of study for studies that used a regression analysis for hydrology.

Boggy Creek fails Secondary Elements S3 and S6 indicating that:

- A significant increase in impervious area has occurred due to urban development since the study date and based on best available land use/land cover data sources, and
- Better topographic data has been made available since the Effective Study date.

Because of the Unknown value listed in Critical Element C3, two secondary elements listed as Fail and two others as Unknown, this validation should be corrected from Valid to Unknown

Cat Creek: A Cat Creek segment (Reach ID 401310100182) lists a hydrologic model as SNYDER METHOD and should be corrected to HEC1. The Effective

Study date is 3/1/1984. This segment fails Secondary Element S6 because better topographic data is available.

Due to the age of the study and because this is a redelineation using old topography, the validation of this segment should be changed from Valid to Unknown.

Dog Creek: The 14.18-mile Dog Creek segment (Reach ID 401310100183) fails Secondary Element S6 indicating that better topographic data is available. The Effective Study date is 9/10/1976. The redelineation was performed using "USGS quads photorevised 1980 and 1982".

Due to the age of the study and because this is a redelineation of a 1976 study (using 30 year old 10-foot contour maps), the validation of this segment should be changed from Valid to Unknown.

Dover Tributaries 1, 2, 3 and 4: All four of these Dover Tributaries have Unknown listed for Critical Element C3 and Secondary Elements S1 and S10 which indicate:

- The model methodology used may no longer meet current guidelines and specifications;
- Rural regression equations may have been used for the Effective Study in current urban areas, and
- Updates to regression equations may exist since the date of study for studies that used a regression analysis for hydrology.

All four of the tributaries fail Secondary Elements S3 and S6, indicating that:

- A significant increase has occurred in impervious area as a result of urban development since the study date and based on the best available land use/land cover data sources, and
- Better topographic data has been made available since the Effective Study date.

Dover Tributary 1 also fails Secondary Element S4 indicating that the addition or removal of more than one, but less than five hydraulic structures along the studied streams have been noted since the date of the Effective Study.

Due to the Unknown value listed in Critical Element C3, and at least two Secondary Elements listed as Fail and an additional three others listed as Unknown, these validations should be changed from Valid to Unknown.

Inola Creek: Inola Creek (Reach ID 401310100186) lists Critical Element C3 and Secondary Elements S1 and S10 as Unknown, indicating that:

- The model methodology used may no longer meet current guidelines and specifications;

- Rural regression equations may have been used for the Effective Study in current urban areas, and
- Updates may exist to regression equations since the date of study for studies that used a regression analysis for hydrology.

Inola Creek fails Secondary Elements S3 and S6 indicating that:

- A significant increase in impervious area has occurred due to urban development since the study date and based on best available land use/land cover data sources, and
- Better topographic data has become available since the Effective Study date.

Due to the Unknown value listed in Critical Element C3, and at least two Secondary Elements listed as Fail and an additional two others listed as Unknown, this validation should be corrected from Valid to Unknown.

Otter Creek: Otter Creek (Reach ID 401310100151) lists Critical Element C3 and Secondary Elements S1 and S10 as Unknown, indicating that:

- The model methodology used may no longer meet current guidelines and specifications;
- Rural regression equations may have been used for the Effective Study in current urban areas, and
- Updates may exist to regression equations since the date of study for studies that used a regression analysis for hydrology.

Otter Creek fails Secondary Element S6, indicating that better topographic data has been made available since the Effective Study date.

Due to the Unknown value listed in Critical Element C3, one Secondary Element listed as Fail and an additional two others listed as Unknown, this validation should be changed from Valid to Unknown.

Pea Creek: Pea Creek (Reach ID 401310100163) lists Critical Element C3 and Secondary Elements S1 and S10 as Unknown, indicating that:

- The model methodology used may no longer meet current guidelines and specifications;
- Rural regression equations may have been used for the Effective Study in current urban areas, and
- Updates may exist to regression equations since the date of study for studies that used a regression analysis for hydrology.

Pea Creek fails Secondary Elements S3 and S6, indicating that:

- A significant increase has occurred in impervious area (due to urban development since the study date) based on best available land use/land cover data sources, and

- Better topographic data has been made available since the Effective Study date.

Due to the Unknown value listed in Critical Element C3, two Secondary Elements listed as Fail and an additional two others listed as Unknown, this validation should be changed from Valid to Unknown.

Spunky Creek: The hydrologic model is listed as SNYDER METHOD and should be corrected to HEC1. The Effective Date is 9/10/1976. Spunky Creek (Reach ID 401310100153) fails Secondary Elements S3 and S6, indicating that:

- A significant increase in impervious area has occurred due to urban development since the study date and based on the best available land use/land cover data sources, and
- Better topographic data has been made available since the Effective Study date.

Because of the age of the studies coupled with the locally observed large changes in urbanization, and because this portion of the creek changes from Zone A to Zone AE and back, this stream segment validation should be changed from Valid to at least Unknown.

Tulsa County, OK

Tulsa County was included in CNMS Phase III. Tulsa County has 9.04 stream miles in the LVR Watershed, 0.21 stream miles of which are Zone A and 8.83 stream miles are listed as Zone AE. Of the Valid Zone A streams, none show significant scour based on the City of Tulsa's CMS data nor fail Critical Element C5 (indicating that the current channel reconfiguration is outside of the effective SFHA). The following provides an evaluation of Zone AE streams.

Adams Creek: The hydrologic model is listed as SNYDER METHOD and should be corrected to HEC1. The effective date of the studies for Adams Creek is 7/1/83.

The 1.60 stream mile segment of Adams Creek (Reach ID 401430100100) failed Critical Element C6 which is an indication that more than five new or removed hydraulic structures (which impact the BFE's) have been identified. Also, an inspection of the floodplain indicates that a portion of the centerline for the stream is outside the SFHA which results in the failure of Critical Element C5.

No change to the Unverified status of the Adams Creek segment is recommended.

<u>Recommended CNMS Status modifications from Valid to Unverified:</u>

Spunky Creek Tributaries A, B and B-1: The hydrologic model is listed as SNYDER METHOD, and should be corrected to HEC1. The Effective Date is 9/1/1979. None of the three tributaries (the 0.79 stream mile segment Tributary A

- Reach ID 401430100203, the 2.09 stream mile segment Tributary B - Reach ID 401430100165, and the 1.64 stream mile segment of Tributary B-1 - Reach ID 401430100169) fail any Critical or Secondary Elements in the original CNMS data. However, a review of the City of Tulsa's CMS database reveals that significant scour occurs in all three segments resulting in the failure of Critical Element C7.

Because of the age of the studies and the locally observed large changes in urbanization, as well as the significant scour, the validation for each of these three stream segments should be changed from Valid to Unverified.

Recommended CNMS Status modifications from Valid to Unknown:

Adams Creek Tributary E: The hydrologic model is listed as SNYDER METHOD and should be corrected to HEC1. The effective date of the studies for Adams Creek is 7/1/83. This 1.77 stream mile segment (Reach ID 401430100047) failed Secondary Element S4, indicating that either the addition or removal of more than one but less than five hydraulic structures along the studied stream has occurred. Because of the age of the study and the locally observed large changes in urbanization, this stream segment validation should be changed from Valid to Unknown.

Spunky Creek: The hydrologic model is listed as SNYDER METHOD, and should be corrected to HEC1. The Effective Date of the studies for Spunky Creek is 9/1/1979. This 0.77 stream mile segment (Reach ID 401430100205) does not fail any Critical or Secondary Elements in the original CNMS data.

Because of the age of the study and the locally observed large changes in urbanization, this stream segment validation should be changed from Valid to Unknown.

Wagoner County, OK

Rogers County was included in CNMS Phase III. Wagoner County has 285.97 stream miles in the CNMS database. Of those, 156.1 miles are listed as Flood Zone A with a validation of Valid.

Out of those Zone A streams listed as Valid, none show significant scour based on the City of Tulsa's CMS data. However, 14.76 miles of Zone A streams fail Critical Element C5 indicating that the current channel reconfiguration is outside of the effective SFHA as listed below. These streams should be corrected to a validation of Unverified.

Wagoner County Zone A Streams Failing Critical Element C5

Reach ID	Stream name	Length (mi)
401450100389	NP	0.97
401450100401	NP	0.84
401450100438	NP	0.66
401450100441	NP	1.05

Wagoner County Zone A Streams Failing Critical Element C5

Reach ID	Stream name	Length (mi)
401450100470	NP	0.56
401450110293	NP	0.37
401450110327	Strawberry Creek	1.20
401450110328	Gar Creek	3.50
401450110362	NP	1.08
401450110365	NP	1.51
401450110372	NP	0.44
401450110405	NP	0.77
401450110420	NP	0.18
401450110514	NP	0.44
401450110524	Fife Creek	1.20

The remaining 129.88 miles are listed as Zone AE. Of the Zone AE streams, 78.37 stream miles have a validation of Valid and 10.43 stream miles have a validation of Unverified.

Covington Creek Tributary to Adams Creek: The effective date of the studies for the Adams Creek tributaries is 5/1/1986. The Covington Creek Tributary to Adams Creek (6.37 stream miles) has Critical Element C7 listed as Unknown, indicating that significant scour may be occurring in the stream. It also failed Secondary Elements S2, S3, S6 and S7 indicating that:

- Repetitive losses have been noted outside of the SFHA;
- A significant increase in impervious area has been noted due to urban development since the study date and using the best available land use/land cover data sources;
- Better topographic data has been made available since the Effective Study date, and
- Significant changes in land use or vegetative cover has occurred since the Effective Study date.

The Timber Creek Tributary (2.69 stream miles) and the Lonestar Creek Tributary to Adams Creek: The Timber Creek Tributary (2.69 stream miles) and the Lonestar Creek Tributary to Adams Creek (1.37 stream miles) had Critical Element C7 listed as Unknown indicating that significant scour may be occurring in the streams. The Timber Creek Tributary also failed Critical Element C6 which indicates that more than five new or removed hydraulic structures impacting the BFE's have been identified.

The Timber Creek Tributary to Adams Creek failed Secondary Elements S3 and S6 indicating that:

- A significant increase in impervious area has occurred due to urban development since the study date and based on the best available land use/land cover data sources, and

- Better topographic data has been made available since the Effective Study date.

The Lonestar Creek Tributary to Adams Creek failed Critical Element C5, indicating that the streamline is seen on imagery as outside the SFHA and cannot be explained by a minor mapping error, which could be corrected through base fitting. This tributary also failed Secondary Element S6 indicating that better topographic data has been made available since the Effective Study date.

No changes to these Unverified streams are recommended.

Recommended CNMS Status modifications from Valid to Unknown:

Adams Creek: This 23.65 stream mile segment (Reach ID 401450110843) lists Critical Element C7 as Unknown, indicating that a significant channel fill or scour may have occurred since the effective analysis was completed.

Adams Creek also failed Secondary Elements S2, S4 and S6, indicating that:

- Repetitive losses have been noted outside of the SFHA;
- Either the addition or removal of more than one, but less than five hydraulic structures along the studied stream has occurred, and
- Better topographic data has been made available since the Effective Study date.

The stream was also noted as having significant scour problems – City of Tulsa's CMS (Channel Management System) – thereby failing Critical Element C7.

Due to Critical Element C7, this validation should be corrected from Valid to Unknown.

Covington Creek Tributary to Adams Creek: This 0.76 stream mile segment (Reach ID 401450110653) lists Critical Element C7 as Unknown, indicating that a significant channel fill or scour may have occurred since the effective analysis was completed.

Covington Creek Tributary to Adams Creek also failed Secondary Elements S3, S6 and S7, indicating that:

- A significant increase in impervious area has been noted due to urban development since the study date and based on the best available land use/land cover data sources;
- Better topographic data has become available since the Effective Study date, and
- Significant changes in land use or vegetative cover have occurred since the date of the Effective Study.

The stream was also noted as having significant scour problems – City of Tulsa's CMS (Channel Management System) – thereby failing Critical Element C7.

Due to Critical Element C7, and Unknown status of three Secondary Elements, this validation should be changed from Valid to Unknown.

School Creek Tributary to Adams Creek: This 4.06 stream mile segment (Reach ID 401450110685) lists Critical Element C7 as Unknown, indicating that a significant channel fill or scour may have occurred since the effective analysis was completed.

School Creek Tributary to Adams Creek also failed Secondary Elements S4 and S6 indicating that:

- Either the addition or removal of more than one, but less than five hydraulic structures along the studied stream has occurred, and
- Better topographic data has been made available since the Effective Study date.

Due to the Unknown value listed for Critical Element C7, this validation should be changed from Valid to Unknown.

East Coal Creek: This 10.56 stream mile segment (Reach ID 401450110320) lists Critical Element C7 as Unknown which indicates that a significant channel fill or scour may have occurred since the effective analysis was completed. East Coal Creek also failed Secondary Element S4 indicating that either the addition or removal of more than one but less than five hydraulic structures along the studied stream has occurred.

Due to the Unknown value listed for Critical Element C7, this validation should be corrected from Valid to Unknown.

West Coal Creek: This 18.24 stream mile segment (Reach ID 401450110546) lists Critical Element C7 as Unknown, indicating that a significant channel fill or scour may have occurred since the effective analysis was completed. West Coal Creek also failed Secondary Element S6 which indicates that better topographic data has been made available since the Effective Study date.

Due to the Unknown value listed for Critical Element C7, this validation should be corrected from Valid to Unknown.

Midway Creek Tributary to Adams Creek: This 2.46 stream mile segment (Reach ID 401450110771) lists Critical Element C7 as Unknown indicating that a significant channel fill or scour may have occurred since the effective analysis was completed. Midway Creek Tributary to Adams Creek also failed Secondary Element S6 which indicates that better topographic data has become available since the Effective Study date.

Due to the Unknown value listed for Critical Element C7, this validation should be corrected from Valid to Unknown.

Salt Creek: This 7.11 stream mile segment (Reach ID 401450110793) lists Critical Element C7 as Unknown which indicates that a significant channel fill or scour may have occurred since the effective analysis was completed. Salt Creek also failed Secondary Element S6 indicating that better topographic data has been made available since the Effective Study date. Lastly, an inspection of the floodplain indicates that a portion of the centerline for the stream is outside the SFHA which results in the failure of Critical Element C5.

Because of the above, this validation should be corrected from Valid to Unknown.

Salt Creek Tributary 1: This 0.50 stream mile segment (Reach ID 401450110817) lists Critical Element C7 as Unknown indicating that a significant channel fill or scour may have occurred since the effective analysis was completed. Salt Creek Tributary 1 also failed Secondary Element S6 indicating that better topographic data has become available since the Effective Study date. Lastly, an inspection of the floodplain indicates that a portion of the centerline for the stream is outside the SFHA which results in the failure of Critical Element C5.

Because of the above, this validation should be corrected from Valid to Unknown.

Salt Creek Tributary 2: This 0.45 stream mile segment (Reach ID 401450110796) lists Critical Element C7 as Unknown which indicates that a significant channel fill or scour may have occurred since the effective analysis was completed. Salt Creek Tributary 2 also failed Secondary Element S6 indicating that better topographic data has been made available since the Effective Study date.

Due to the Unknown value listed for Critical Element C7, this validation should be corrected from Valid to Unknown.

Springtown Creek Tributary to Adams Creek: This 0.53 stream mile segment (Reach ID 401450110772) lists Critical Element C7 as Unknown indicating that a significant channel fill or scour may have occurred since the effective analysis was completed. Springtown Creek Tributary to Adams Creek also failed Secondary Element S6 indicating that better topographic data has been made available since the Effective Study date.

Due to the Unknown value listed for Critical Element C7, this validation should be corrected from Valid to Unknown.

Spunky Creek: This 4.64 stream mile segment (Reach ID 401450110811) lists Critical Element C7 as Unknown indicating that a significant channel fill or scour may have occurred since the effective analysis was completed. Spunky Creek also

failed Secondary Element S6 indicating that better topographic data has been made available since the Effective Study date.

An inspection of the floodplain indicates that a portion of the centerline for the stream is outside the SFHA which results in the failure of Critical Element C5. The stream was also noted as having significant scour problems – City of Tulsa's CMS (Channel Management System) – thereby failing Critical Element C7.

Because of the above, this validation should be corrected from Valid to Unknown.

Spunky Creek Tributary A: This 0.68 stream mile segment (Reach ID 401450110826) lists Critical Element C7 as Unknown which indicates that a significant channel fill or scour may have occurred since the effective analysis was completed. Spunky Creek Tributary A also failed Secondary Element S6 indicating that better topographic data has been made available since the Effective Study date.

The stream was also noted as having significant scour problems – City of Tulsa's CMS (Channel Management System) – thereby failing Critical Element C7.

Due to the Unknown value listed for Critical Element C7, this validation should be corrected from Valid to Unknown.

Verdigris River (Verdigris River-Commodore Creek) and Verdigris River Divergence Channel: The 42.30 stream mile segment of the Verdigris River (Reach ID 401450110202) failed Secondary Element S6 indicating that better topographic data has been made available since the Effective Study date. Both the Verdigris River and the 4.73 stream mile reach of the Verdigris River Divergence Channel (Reach ID 401450110206) list Critical Elements C7 as Unknown, indicating that a significant channel fill or scour may have occurred since the effective analysis was completed.

Based on the above, the validation for the Verdigris River Divergence Channel should be changed from Valid to Unknown. No change is recommended to validation status of the Verdigris River-Commodore Creek.

Table 17 shows the study methodologies for Zone AE streams studied by enhanced methods and their validation status.

Table 17: Hydrologic and Hydraulic Information for Enhanced Streams

Stream Name	County	Validation Status	Date of Effective Analysis	Hydrology Model	Hydraulic Model
Boggy Creek	Rogers	Valid	3/1/1984	OTHER	Unknown
Cat Creek	Rogers	Valid	10/30/1990	TR-55 (JUNE 1986)	HEC-2
Cat Creek	Rogers	Valid	3/1/1984	SNYDER METHOD	HEC-2
Dog Creek	Rogers	Valid	9/10/1976	SNYDER METHOD	HEC-2
Dover Tributary 1	Rogers	Valid	3/1/1984	OTHER	Unknown
Dover Tributary 2	Rogers	Valid	3/1/1984	OTHER	Unknown
Dover Tributary 3	Rogers	Valid	3/1/1984	OTHER	Unknown
Dover Tributary 4	Rogers	Valid	3/1/1984	OTHER	Unknown
Inola Creek	Rogers	Valid	9/10/1976	OTHER	Unknown
Otter Creek	Rogers	Valid	9/10/1976	OTHER	Unknown
Panther Creek	Rogers	Valid	9/10/1976	OTHER	Unknown
Pea Creek	Rogers	Valid	9/10/1976	OTHER	Unknown
Spunky Creek	Rogers	Valid	9/10/1976	SNYDER METHOD	HEC-2
Spunky Creek Tributary	Rogers	Valid	1/1/1984	SNYDER METHOD	HEC-2
Verdigris River-Big Flag Lake	Rogers	Unverified	1/0/1900	GAGE ANALYSIS	HEC-2
Verdigris River-Honey Creek	Rogers	Unverified	1/0/1900	GAGE ANALYSIS	HEC-2
Verdigris River-Moss Creek	Rogers	Unverified	1/0/1900	GAGE ANALYSIS	HEC-2
Verdigris River-Sweetwater Creek	Rogers	Unverified	1/0/1900	GAGE ANALYSIS	HEC-2
Adams Creek	Tulsa	Unverified	7/1/1983	SNYDER METHOD	HEC-2
Adams Creek Tributary E	Tulsa	Valid	7/1/1983	SNYDER METHOD	HEC-2
Spunky Creek	Tulsa	Valid	9/1/1979	HEC-1	HEC-2
Spunky Creek Tributary A	Tulsa	Valid	9/1/1979	HEC-1	HEC-2
Spunky Creek Tributary B	Tulsa	Valid	9/1/1979	HEC-1	HEC-2
Spunky Creek Tributary B-1	Tulsa	Valid	9/1/1979	HEC-1	HEC-2
Adams Creek	Wagoner	Valid	5/1/1986	2037	1032
Covington Creek	Wagoner	Unverified	5/1/1986	2037	1032
Covington Creek Tributary	Wagoner	Valid	5/1/1986	2037	1032

Stream Name	County	Validation Status	Date of Effective Analysis	Hydrology Model	Hydraulic Model
East Coal Creek	Wagoner	Valid	5/1/1986	2037	1032
Lonestar Creek	Wagoner	Unverified	5/1/1986	2037	1032
Midway Creek	Wagoner	Valid	5/1/1986	2037	1032
Salt Creek	Wagoner	Valid	5/1/1986	2037	1032
Salt Creek Tributary 1	Wagoner	Valid	5/1/1986	2037	1032
Salt Creek Tributary 2	Wagoner	Valid	5/1/1986	2037	1032
School Creek	Wagoner	Valid	5/1/1986	2037	1032
Springtown Creek	Wagoner	Valid	5/1/1986	2037	1032
Spunky Creek	Wagoner	Valid	5/1/1986	2037	1032
Spunky Creek Tributary A	Wagoner	Valid	5/1/1986	2037	1032
Timber Creek	Wagoner	Unverified	5/1/1986	2037	1032
Verdigris River Divergence Channel	Wagoner	Valid	5/1/1986	OTHER	1032
Verdigris River-Commodore Creek	Wagoner	Unknown	5/1/1986	OTHER	1032
Verdigris River-Outlet	Wagoner	Unknown	5/1/1986	OTHER	1032
Verdigris River-Port Of Dunkin	Wagoner	Unknown	5/1/1986	OTHER	1032
Verdigris River-Strawberry Creek	Wagoner	Unknown	5/1/1986	OTHER	1032
West Coal Creek	Wagoner	Valid	5/1/1986	2037	1032

Additionally, 160.53 miles of Zone A streams shown as Valid include no data under Hydrologic or Hydraulic Model and an Effective Study date of December 1, 2007.

v. Post- Discovery Hydraulics and Floodplain Analysis

Analyses of the hydraulic and floodplain data were performed by reviewing the FIS report and FIRMs. A search was performed for available models on FEMA's MIP.

Several disconnects were identified at the watershed boundaries and the county boundaries. Table 18 lists these disconnects for the LVR Watershed.

Table 18: Hydraulic Issues with Floodplain Boundaries

Stream Name	Issue	Location
Spunky Creek Tributary B	Disconnected Floodplain	There is a disconnected floodplain boundary between Tulsa County and Wagoner County.
Verdigris River	Disconnected Floodplain	There is a disconnected floodplain boundary between Wagoner County and Muskogee County.
Verdigris River	Disconnected Floodplain	There is a disconnected floodplain at the watershed boundary between the LVR Watershed and the Dirty Greenleaf watershed.

Table 19 identifies recent LOMRs in the watershed that have impacted hydraulics and may have created disconnects upstream and downstream.

Table 19: LOMRs that Revise Hydraulics within the Watershed

Stream Name	Case Number	Basis of Request	Notes
Verdigris River	03-06-012P	Hydraulic Analysis	LOMR that revised BFEs on a flooding source based on a hydraulic analysis.
Unnamed Tributary To An Unnamed Tributary To East Creek	03-06-111P	Hydraulic Analysis, Hydrologic Analysis, New Topographic Data	LOMR that revised a Zone A based on new topographic information, hydrologic and hydraulic analyses. Project includes channelization, culvert(s), and fill.
Verdigris River	03-06-1392P	Hydraulic Analysis, New Topographic Data	LOMR that revised BFEs on a flooding source based on a hydraulic analysis and new topographic data.
Unnamed North & South Tributary To Mossy Creek	06-06-B958P	Hydraulic Analysis, Hydrologic Analysis, New Topographic Data	LOMR that revised a Zone A based on new topographic information, hydrologic and hydraulic analyses. Project includes channelization and a detention basin.

IV. Watershed Options

In conjunction with the assessment of risk, need, and the availability of topographic data, as well as the input of stakeholders in this watershed, flood hazard delineation projects should be initiated in the LVR Watershed. Table 20 lists some potential needs in the watershed and actions that could be taken under each of the four areas discussed during the Discovery Meetings, which are:

- Risk identification and communication, including traditional flood studies and data updates;
- NFIP community actions, including insurance-related mitigation or information;
- Mitigation planning and mitigation actions, including items related to planning updates, and
- Community benefits and grant opportunities, which relate to outreach and disaster preparedness as well as non-flooding hazards like safe room information.

Table 20: Potential Watershed Needs and Actions

Risk Identification and Communication
• Update FISs and FIRMs for flooding sources identified by the communities as needing updates due to updated topographic information, infrastructure improvement projects not incorporated into the effective FIS and FIRMs, and inaccuracies in effective information. – City of Muskogee noted complaints related to the effective maps, specifically that the preliminary maps were much different than the final maps. – City of Claremore provided topographic data for use in Map Mod to FEMA which was not used. – City of Broken Arrow noted that no LOMR has been completed for construction on Turnpike. Also, flooding in a subdivision in Wagoner County is not shown on maps. – City of Claremore noted that the Southpoint Development, Zone A, does not match terrain. – City of Tulsa requested detailed study for the newly incorporated areas of east Tulsa to identify areas of risk and guide future development. – City of Coweta requested detailed study of Fife Creek tributaries (Zone A) to guide development. – City of Catoosa noted issues with current maps. Comments noted included new development erroneously shown inside the floodplain, lack of detailed studies for Zone As and omission of new construction and drainage improvements. – City of Claremore noted that comments provided to FEMA during appeal process were omitted in final maps. Information provided during appeal process is available for FEMA review.

Risk Identification and Communication (Continued)

- Wagoner County noted the availability of new approximate study for Bull Creek. County requested detailed studies to guide design of new bridge improvements.
- Wagoner County requested information regarding assistance for the mitigation of unmapped, localized drainage issues. They have issues with flooding due to backwater effects. They have also spoken with the USACE regarding the bridge and island off of the Verdigris River in the Town of Okay.

- Assist communities obtain RiskMAP project funding by using local drainage studies as leverageable data.
  - City of Broken Arrow, Claremore and Tulsa and Wagoner County noted availability of citywide master drainage documents, updated detailed hydrologic and hydraulic studies and revised floodplain mapping.
  - Document already in use as non-regulatory products.
- Facilitate cooperative efforts between communities with common watershed to prepare master drainage planning studies and RiskMAP projects.
  - City of Broken Arrow is agreeable to participating with other communities in a mapping study. Broken Arrow wishes to contribute financially to add its portion of Spunky Creek to the Tulsa study area.
  - City of Catoosa requested that the Spunky Creek study extend to the Verdigris River.
  - City of Tulsa is planning an updated study on the upper portion of Salt Creek, and Wagoner County would benefit from continuing the study downstream to the Verdigris River to better guide residential development and planned bridge improvements in the area.
- Perform and/or update FISs on streams identified as having excessive streambed and bank erosion. Evaluate the Lower end of Adams Creek in Wagoner County.
- Deliver presentations on the benefits of Risk MAP to interested communities.

NFIP Community Action

- Deliver presentations on the benefits of joining the NFIP to non-participating, interested communities.
- Deliver presentations on the CRS program to interested communities. Cities of Muskogee and Catoosa noted interest in the program.
- Train communities on the electronic Letter of Map Amendment (eLOMA) process to facilitate LOMC submissions.

NFIP Community Action (Continued)
• Work with Tribes to increase communication. • Provide support to communities as necessary for adoption of new maps. Cities of Broken Arrow, Claremore and Catoosa, and Mayes and Rogers Counties made general inquiries about ordinance adoption and regulations. • Provide community assistance on Preferred Risk Policy extensions and other NFIP-related issues. Cities of Broken Arrow and Claremore, and Counties of Tulsa, Rogers and Wagoner inquired on the subject.
Community Benefits and Grant Opportunities
• Additional communities in NFIP. • Community outreach improved. • Increased facilitation for HMP Grants applications. • Expedite the Grant approval process. • Local drainage and flooding issue addressed. • Updated and current flood hazard information for communities. • Increased credibility of NFIP information. • Identification of local drainage issues and possible solutions. • Area-wide risk communication efforts and supporting data improved. • Economic development in Okay, OK for floodplain-related activities.

To further detail the list of needs captured during the Discovery Meeting and in any follow-up correspondence, Table 21 provides a specific evaluation of streams or areas that could benefit from additional study. FEMA-based metrics are noted that would be met if the need or issue was addressed and if any current FEMA map actions would impact the activity. A comment or concern raised by a stakeholder during the Discovery process that could be correlated to one of the Needs or Actions for the watershed is also noted. There are some needs and actions listed that were not noted by any particular community but were improvements that could be made in the LVR Watershed to meet general FEMA Regional goals.

Needs are identified as being on the critical path as high, medium or low priority or as something that a State or local community could be tasked with completing. These definitions are also included in Table 21.

- **High** – Local community would immediately benefit from the action, and FEMA's metrics would also be met.
- **Medium** – Local community would benefit over the longer term from the action, and a portion of FEMA's metrics may be met.

- **Low** – Local community activities can continue without this revision, and FEMA‟s metrics are not impacted.
- **Community Action** – Activity would be more appropriate as a community-led action rather than a FEMA-led action.

Table 21: Metrics and Rankings of Needs

Item	Description of Need **Evaluation Guide** **Community Action** – Activity would be more appropriate as a community-led action **Low** – Local community activities can continue without this revision, and FEMA"s metrics are not impacted **Medium** – Local community would benefit over the longer term from the action, and a portion of FEMA"s metrics may be met **High** – Local community would immediately benefit from the action, and FEMA's metrics would also be met		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Location of Need/Project	Details				
A	Mitigation / Prepare New HMP	• Completion of new HMP is recommended for the following communities: ○ Fair Oaks ○ Okay ○ Porter ○ Redbird ○ Tullahassee ○ Wagoner • Town of Okay is to be included in HMP update for Wagoner County.	• None	• Facilitate the application for HMP Grants • Expedite the Grant approval process	Community Action	C4, C12
B	Mitigation / HMP Updates	• The following plans are undergoing update, review and/or approval. ○ Broken Arrow ○ Catoosa ○ Mayes County • Communities should update their HMP any time flood risks change and develop mitigation strategies in an on-going fashion. • Update with mitigation successes to show work completed.	• None	• Impacts all communities • Facilitate the application for HMP Grants • Expedite the Grant approval process	Community Action	M11, C10, C11, C12, P3, P6
C	Mitigation / HMP Approval	• City of Broken Arrow's Hazard Mitigation Plan update is almost complete. • City of Kiefer approved Hazard Mitigation Plan.	• None	• Impacts community • Facilitate the application for HMP Grants • Expedite the Grant approval process	Community Action	C8, P4, P11
D	Outreach / NFIP	• City of Claremore inquired for the number of policies held in the city. • Rogers County inquired about general information regarding the NFIP program.	• None	• Community outreach improved	Community Action	C1, C2, C6, M9, N4
E	Outreach / Coordination for Dam Emergency Action Plan	• Communities expressed concern over program due to lack of hydrologic and hydraulic modeling on dams. • Emergency Action Plans are incomplete or missing. Examples were given as dams on Lake Oologah and Claremore Lake. • OWRB has begun to request Emergency Action Plans for dams. • OWRB to coordinate and assists communities with compliance.	• None	• Community outreach improved	Community Action	P4, M26
F	Outreach / Coordination for Discovery	• Communities requested copies of the Discovery information packets for distribution to additional city staff. • City of Tulsa and OWRB to provide Discovery Reports.	• None	• Community outreach improved	Community Action	C9

Item	Description of Need **Evaluation Guide** **Community Action** – Activity would be more appropriate as a community-led action **Low** – Local community activities can continue without this revision, and FEMA"s metrics are not impacted **Medium** – Local community would benefit over the longer term from the action, and a portion of FEMA"s metrics may be met **High** – Local community would immediately benefit from the action, and FEMA's metrics would also be met		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Location of Need/Project	Details				
G	Outreach / Coordination for Grant Opportunities	• Town of Okay requested grant information for drainage, bridge replacement, sirens etc., to pursue REAP and CDBG grants. • Rogers County requested assistance with grant requirements. • Rogers County seeking funding options for the various communities mitigation actions. • OWRB to provide information on grants for small communities / private owners for dam repair and breach inundation mapping.	• None	• Community outreach improved	Community Action	C4, C5, C11
H	Outreach / Coordination for Repetitive Loss Grant Opportunities	• In Muskogee County most repetitive losses are on acreages. Reported lack of support for buyouts. • OWRB to extend outreach for the State Repetitive Loss program.	• None	• Community outreach improved	Community Action	C3
I	Outreach / Coordination to enter CRS program	• City of Catoosa inquired about requirements to participate in the CRS. • City of Muskogee expressed an interest in learning more about the CRS program. • Wagoner County is planning to enroll in CRS after the adoption of its new maps. • OWRB to extend outreach for CRS program.	• None	• Potential decrease in flood insurance premiums • Community outreach improved	Community Action	N2, P2, P6, P10
J	Outreach / Master Drainage Planning	• City of Broken Arrow requested assistance from FEMA for the completion of a Master Drainage Plan (MDP) for Spunky Creek in cooperation with City of Tulsa. • City of Tulsa requested assistance from FEMA for completion of Master Drainage Plan for portions of Adams Creek and Salt Creek.	• None	• Identification of local drainage issues and possible solutions • Grant application for assistance in mitigation • Community outreach improved	Community Action	P2
K	HAZUS Outreach / Coordination	• Provide information from the Average Annualized Loss Study. • Introduction to HAZUS.	• None	• Communities become more familiar with the HAZUS program and are prepared to use Risk MAP products when they are issued. • HAZUS can be used for HMP updates.	Medium	No specific comment
L	Updating the FIRM and FIS for Adams Creek, Tulsa and Wagoner Counties. • Communities requested detailed study to facilitate regulation of future development. • 41.31 miles of detailed hydrology and hydraulics available from the new Adams Creek Study. • Reported flooding in a subdivision in Wagoner County not shown on maps.	• Upgrade 41.31 miles of detailed hydrologic and hydraulic analysis to Risk MAP format. • 3.77 miles of detailed hydrologic and hydraulic analysis for DFIRM. • Convert 9.68 miles of approximate Zone A studies to detailed Zone AE. • Add 31.91 miles of detailed study for unmapped stream in the DFIRM, not included in miles of floodplain mapping • 86.88 miles of floodplain mapping • Noted availability of high water marks from the 2006 flood.	• None	• 12.17 miles of new NVUE-compliant streams, 0.21 miles from Unknown and 11.96 miles from Unverified. • 31.91 miles of new NVUE-compliant streams that were formerly not mapped. • FIRMs updated to reflect existing conditions. • FIRMs updated to reflect existing conditions. • Community outreach improved.	High	C6, M21, M22, M23, M27, M28, M44, M10, M11, M31

Item	Description of Need **Evaluation Guide** **Community Action** – Activity would be more appropriate as a community-led action **Low** – Local community activities can continue without this revision, and FEMA"s metrics are not impacted **Medium** – Local community would benefit over the longer term from the action, and a portion of FEMA"s metrics may be met **High** – Local community would immediately benefit from the action, and FEMA's metrics would also be met		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Location of Need/Project	**Details**				
M	Updating the FIRM and FIS for Cat Creek, Rogers County. • Community noted changes in mapping due to development. Comments provided during appeal process. • Requested for study due to significant, recent urbanization changes and replacement of structures.	• 11.49 miles of detailed hydrologic and hydraulic study. • 5.41 miles of additional detailed hydrologic and hydraulic analysis on Cat Creek and unnamed tributaries, converting Zone A to AE. • Add 1.75 miles of detailed study for unmapped stream in the DFIRM, not included in miles of floodplain mapping • 13.24 miles of floodplain mapping.	• None	• 1.75 miles of new NVUE-compliant streams that were formerly not mapped. • No NVUE for 11.49 miles (study already valid in CNMS). • FIRMs updated to reflect existing conditions. • Community outreach improved.	High	M1-M8

N	Updating the FIRM and FIS for Spunky Creek and Tributaries, Tulsa and Wagoner Counties.
	• Community requested detailed study for the following:
	  ○ Unincorporated areas of east Tulsa to identify areas of risk and guide future development risk.
	  ○ Approximate Zone As (areas east of the Hard Rock Casino) bordered by detailed Zone AE.
	  ○ Disconnected floodplain (Hard Rock Casino golf course). Area improved as part of the recent development and I-44 improvements.
	  ○ Disconnected floodplain west of 177th E Avenue.
	  ○ Spunky Creek extend Tulsa-planned detailed study to the Verdigris River (Catoosa) and include City of Broken Arrow portion.
	• All Zone AE areas are based on 1976, 1979 or 1984. Some Zone As were updated in 2008.
	• 8.93 miles of Zone AE are currently included in a Risk MAP project being performed by the City of Tulsa.
		• 21.49 miles of detailed hydrologic and hydraulic study.
		• Of the 21.49 stream miles, 8.93 miles of updated, detailed hydrology and hydraulics is already being completed by City of Tulsa as a Risk MAP project.
		• 4.06 miles of Zone A coverted to Zone AE.
		• 5.4 miles of new detailed hydrology and hydraulics on previously unmapped streams
		• 26.89 miles of floodplain mapping.
			• None	• 5.4 miles of new NVUE for previously unmapped streams.
				• No NVUE for 21.49 miles (study already valid in CNMS).
				• Community outreach improved.
				• FIRMs updated to reflect existing conditions.
					High	C7, M24, M28, M29-1/2, M35-M41, P3

O	Updating the FIRM and FIS for Dog Creek, Rogers County. Claremore Lake Dam to Panther Creek. • Dog Creek effective model dated 1976. • Redelineation performed using "USGS quads photorevised 1980 and 1982".	• 7.59 miles of updated detailed hydrologic and hydraulic study. • Convert 2.88 miles of Zone A to Zone AE. • 5.62 miles of new detailed hydrology and hydraulics on previously unmapped streams • 16.09 miles of floodplain mapping • Newer topo is available.	• None	• 5.62 miles of new NVUE for previously unmapped streams. • No NVUE for (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	None

Item	Description of Need **Evaluation Guide** **Community Action** – Activity would be more appropriate as a community-led action **Low** – Local community activities can continue without this revision, and FEMA"s metrics are not impacted **Medium** – Local community would benefit over the longer term from the action, and a portion of FEMA"s metrics may be met **High** – Local community would immediately benefit from the action, and FEMA's metrics would also be met		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Location of Need/Project	Details				
P	Updating the FIRM and FIS for Inola Creek, Wagoner County. • Area has had significant development, however no detailed studies exist. • Effective model for Inola Creek dates to 1976.	• 12.58 miles of updated detailed hydrologic and hydraulic analysis. • Convert 5.68 miles of Zone A to Zone AE. • 26.13 miles of floodplain mapping.	• None	• No NVUE for (study already valid in CNMS).Community outreach improved.	Medium	None
Q	Updating the FIRM and FIS for Pea Creek, Wagoner County. • Area has had significant development, however no detailed studies exist. • Effective model for Pea Creek dates to 1976.	• 8.37 miles of updated detailed hydrologic and hydraulic analysis. • Convert 17.75 miles of Zone A to Zone AE. • 26.13 miles of floodplain mapping.	• None	• No NVUE for 26.13 miles (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	None
R	Updating the FIRM and FIS for Bacon Creek, Rogers County. • Community requested master drainage plan for Verdigris. • Significant development in the area. No detailed study available to guide development.	• 0 miles of updated detailed hydrologic and hydraulic study. • Convert 4.86 miles of Zone A to Zone AE. • 4.86 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M37
S	Updating the FIRM and FIS for Mossy Creek and Tributary (Big Lake), Rogers County. • Area has had significant development, however no detailed studies exist.	• 0 miles of updated detailed hydrologic and hydraulic study. • Convert 6.45 miles of Zone A to Zone AE. • 6.45 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	None
T	Updating the FIRM and FIS for Commodore Creek, Rogers County. • Area has had some development, however no detailed studies exist.	• 0 miles of updated detailed hydrologic and hydraulic study. • Convert 6.47 miles of Zone A to Zone AE. • 6.47 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	None
U	Updating the FIRM and FIS for Fourmile Creek, Rogers County. • No detailed studies available. Area includes Oolagah and Talala. • New structures (improved bridges impacting Four Mile Creek) not shown on maps.	• 0 miles of updated detailed hydrologic and hydraulic study. • Convert 25.11 miles of Zone A to Zone AE. • 16.03 miles of new detailed hydrology and hydraulics on previously unmapped streams • 41.14 miles of floodplain mapping.	• None	• 16.03 miles of new NVUE for previously unmapped streams. • No NVUE for 25.11 miles (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	None

Item	Description of Need **Evaluation Guide** **Community Action** – Activity would be more appropriate as a community-led action **Low** – Local community activities can continue without this revision, and FEMA"s metrics are not impacted **Medium** – Local community would benefit over the longer term from the action, and a portion of FEMA"s metrics may be met **High** – Local community would immediately benefit from the action, and FEMA's metrics would also be met		Impacts from Any Current Map Actions	FEMA Metric or Community Benefit	Evaluation	Relates to Community Comment Number
	Location of Need/Project	Details				
V	Updating the FIRM and FIS for Coal Creek (East), Wagoner County. • Community noted that the City of Wagoner has a new approximate study on the 2012 maps inside the City limits. A detailed study is needed due to urbanization. • East Coal Zone Aes are based on a 1986 study, while urbanization has occurred.	• 10.27 miles of updated detailed hydrologic and hydraulic study. • Convert 4.31 miles of Zone A to Zone AE. • 11.51 miles of new detailed hydrology and hydraulics on previously unmapped streams • 26.09 miles of floodplain mapping.	• None	• 11.51 miles of new NVUE for previously unmapped streams. • No NVUE for 14.68 miles (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	None
W	Updating the FIRM and FIS for Fife Creek, Wagoner County. • Community requested conversion of 12.44 miles of approximate study to detailed study.	• 0 miles of updated detailed hydrologic and hydraulic study. • Convert 12.44 miles of Zone A to Zone AE. • 12.44 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M31, M33
X	Updating the FIRM and FIRM and FIS for Salt Creek, Wagoner and Rogers Counties. • Communities have requested addition of stream miles for detailed study in this potentially urbanized location. • City of Broken Arrow agreed to participate financially to the expanded project. • City of Tulsa is currently studying a portion of this stream as part of a current Risk MAP project.	• 8.09 miles of updated detailed hydrologic and hydraulic study. • Convert 6.69 miles of Zone A to Zone AE. • Add 32.46 miles of unmapped stream to Zone AE • 47.24 miles of floodplain mapping.	• None	• 32.46 miles of new NVUE for previously unmapped streams. • No NVUE for 14.78 miles (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	M29, M48
Y	Updating the FIRM and FIS for the Verdigris River in Rogers County. • Entire segment in Rogers County is listed as Unverified in the CNMS data. • Effective model date is unknown.	• 41.02 miles of updated detailed hydrologic and hydraulic study. • 41.02 miles of floodplain mapping.	• None	• 41.02 miles of new NVUE. • Community outreach improved. • FIRMs updated to reflect existing conditions.	High	M15, M20
Z	Updating the FIRM and FIS for Bull Creek, Wagoner County. • County has requested detailed studies in order to prepare appropriate hydraulic designs for several bridges to be replaced.	• 16.86 miles of detailed hydrologic and hydraulic study. • 16.86 miles of floodplain mapping.	• None	• No NVUE (study already valid in CNMS). • Community outreach improved. • FIRMs updated to reflect existing conditions.	Medium	M47

Item	Need/Location of Project
A	Mitigation / Prepare New HMP
B	Mitigation / HMP Updates
C	Mitigation / HMP Approval
D	Outreach / NFIP
E	Outreach / Coordination for Dam Emergency Action Plan
F	Outreach / Coordination for Discovery
G	Outreach / Coordination for Grant Opportunities
H	Outreach / Coordination for Repetitive Loss Grant Opportunities
I	Outreach / Coordination to enter CRS program
J	Outreach / Master Drainage Planning
K	HAZUS Outreach/Coordination
L	Updating the FIRM and FIS for Adams, Creek, Tulsa and Wagoner Counties.
M	Updating the FIRM and FIS for Cat Creek in Rogers County
N	Updating the FIRM and FIS for Spunky Creek and Tributaries, Tulsa and Wagoner Counties.
O	Updating the FIRM and FIS for Dog Creek, Rogers County, from Claremore Lake Dam to the confluence with Panther Creek.
P	Updating the FIRM and FIS for Inola Creek, Wagoner County.
Q	Updating the FIRM and FIS for Pea Creek, Wagoner County.
R	Updating the FIRM and FIS for Bacon Creek, Rogers County.
S	Updating the FIRM and FIS for Mossy Creek and Tributary (Big Lake), Rogers County.
T	Updating the FIRM and FIS for Commodore Creek, Rogers County.
U	Updating the FIRM and FIS for Fourmile Creek, Rogers County.
V	Updating the FIRM and FIS for Coal Creek (East), Wagoner County.
W	Updating the FIRM and FIS for Fife Creek, Wagoner County.
X	Updating the FIRM and FIRM and FIS for Salt Creek, Wagoner and Rogers Counties.
Y	Updating the FIRM and FIS for the Verdigris River in Rogers County.
Z	Updating the FIRM and FIS for Bull Creek, Wagoner County.

Effective Flood Insurance Rate Map Dates		
County	Status	Effective Date
Mayes County	Effective	09/16/11
Muskogee County	Effective	02/04/01
Rogers County	Effective	04/03/12
Tulsa County	Effective	10/16/12
Wagoner County	Effective	04/17/12

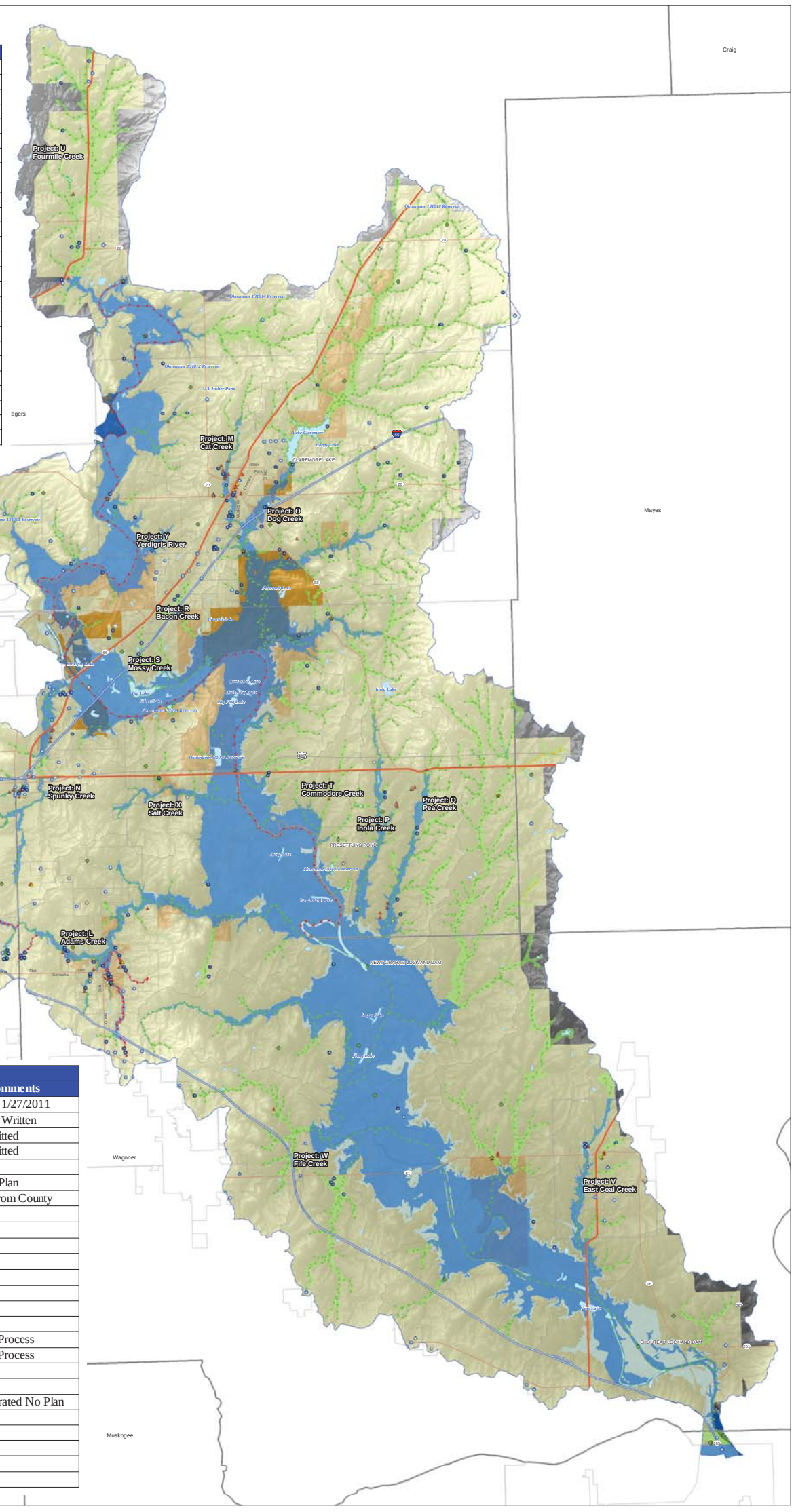
* Tulsa County has been partially remapped. Revised FIRM panels released in May 2012 are scheduled to become effective on October 16, 2012.

Non-Mitigated Losses by County (Unincorporated)			
County	Number of Properties	Total Claims	Average Number of Claims per Property
Rogers County	3	12	4
Wagoner County	16 (3 SRL)	47	2.9

Non-Mitigated Losses by Community			
City	Number of Properties	Total Claims	Average Number of Claims per Property
City of Broken Arrow	3 (1 SRL)	12	4
City of Claremore	6 (2 SRL)	37	6.2
Town of Inola	5 (2 SRL)	23	4.6
City of Oologah	1	2	2
City Tulsa	1	2	2
City of Wagoner	1	2	2

*Communities not shown do not have any identified RL/SRL properties.

Mitigation Plan Status			
Organization and Plan	Date Approved by FEMA	Expires	Comments
State of Oklahoma Hazard Mitigation Plan	02/17/11	02/16/14	Adopted - 1/27/2011
Mayes County	06/04/04	06/03/09	Plan Being Written
Muskogee County	07/14/09	07/13/14	NOI submitted
Muskogee	03/25/08	03/24/13	NOI submitted
Rogers County	08/31/10	08/30/15	
Catoosa	08/31/10	08/30/15	In County Plan
Claremore	01/14/08	01/13/13	Separate from County
Foyil	08/31/10	08/30/15	
Inola	08/31/10	08/30/15	
Oologah	08/31/10	08/30/15	
Owasso	01/14/08	01/13/13	
Talala	08/31/10	08/30/15	
Valley Park			No Plan
Verdigris	08/31/10	08/30/15	
Tulsa County	09/23/10	09/22/15	
Broken Arrow, City of	10/08/04	10/08/09	Update in Process
Tulsa, City of	10/06/09	10/05/14	Update in Process
Wagoner County	06/09/09	06/08/14	
Coweta	07/21/11	07/20/16	
Fair Oaks	N/A	N/A	Unincorporated No Plan
Okay	N/A	N/A	No Plan
Porter	N/A	N/A	No Plan
Redbird	N/A	N/A	No Plan
Tullahassee	N/A	N/A	No Plan
Wagoner	N/A	N/A	No Plan



MAP SYMBOLOGY

- Watershed
- HUC 12 Boundaries
- Native_Lands
- Dams
- USGS Gages
- Citizen Comment locations
- LOMC Locations
- Mitigation Grant
- Repetetive Loss
- Severe Repetetive Loss

Community Participation

- Not Participating in NFIP
- Participating in NFIP

CNMS Data

- Validated
- Unknown
- Unverified

Effective Flooding

- AE; AH; AO
- A
- 500Y

Avg. Annualized Loss

Total Loss

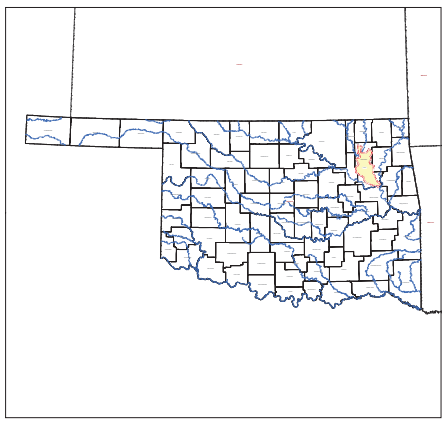
- Very Low
- Low
- Medium
- High
- Very High

N

Miles

0 2.5 5 10 15

WATERSHED LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM
Discovery Map

LOWER VERDIGRIS WATERSHED

OWRB the water agency

FEMA

Total Stream Miles:	1103
Studied Stream Miles:	910
Detailed Study Stream Miles:	245
Approximate Study Stream Miles:	665
Population:	118662

HUC-8 Code
11070105

Release Date: 10/26/2012

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