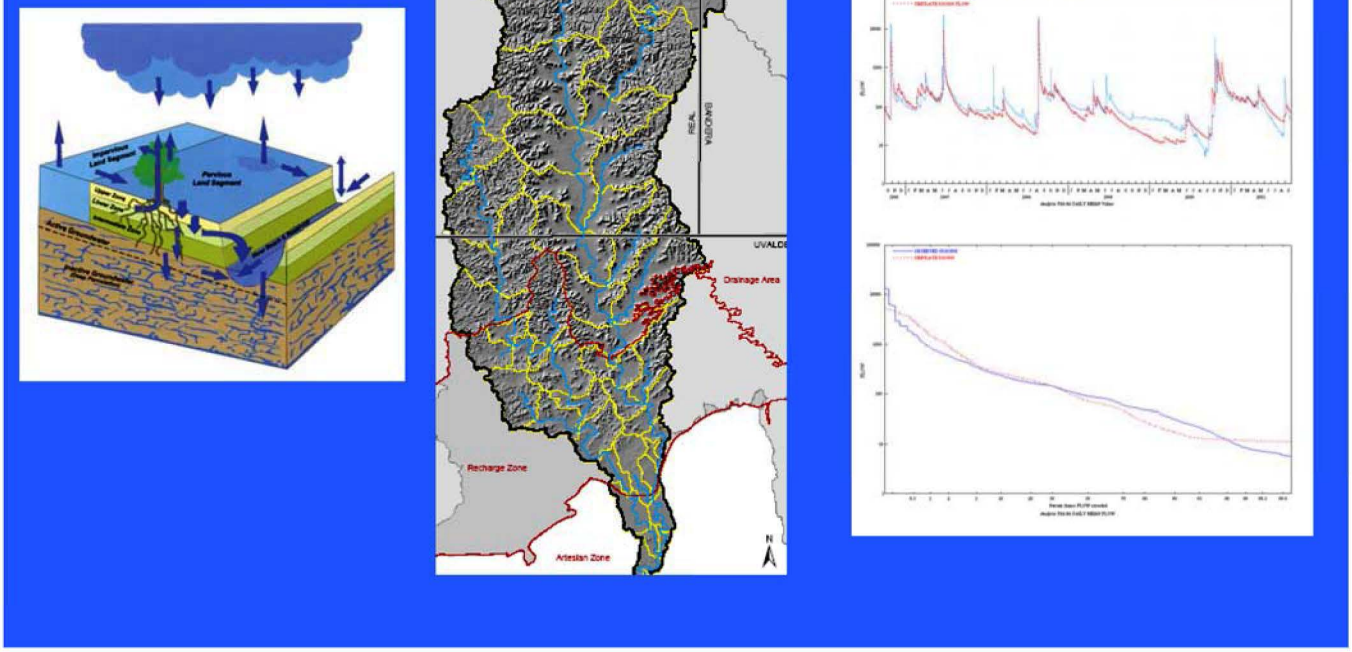
HSPF Recharge Models for the San Antonio Segment of the Balcones Fault Zone Edwards Aquifer

LBG-GUYTON ASSOCIATES
and **AQUA TERRA Consultants**

in association with
Espey Consultants, Inc.
Bradford Wilcox, Ph.D.
GlynData

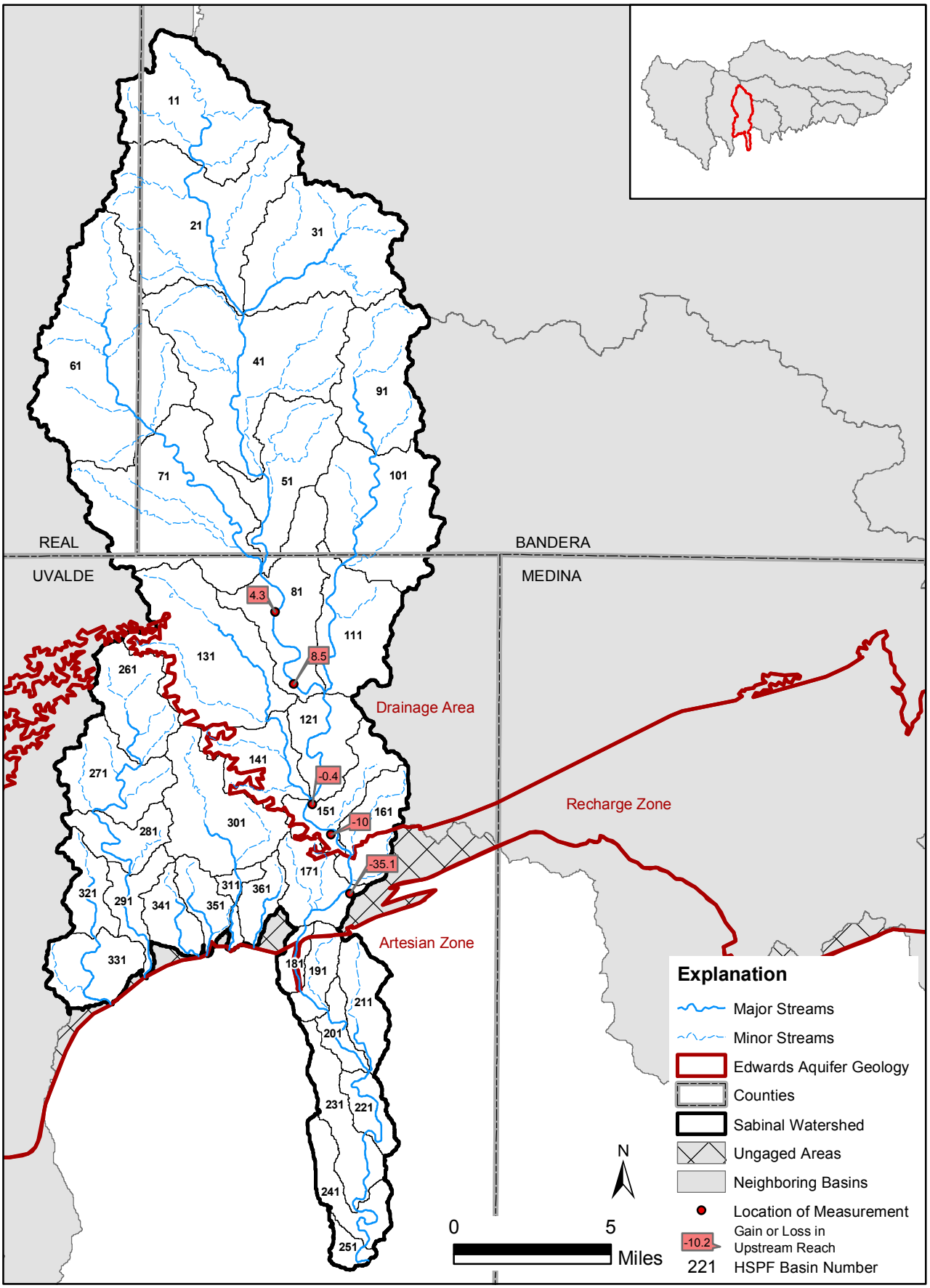
Part 3



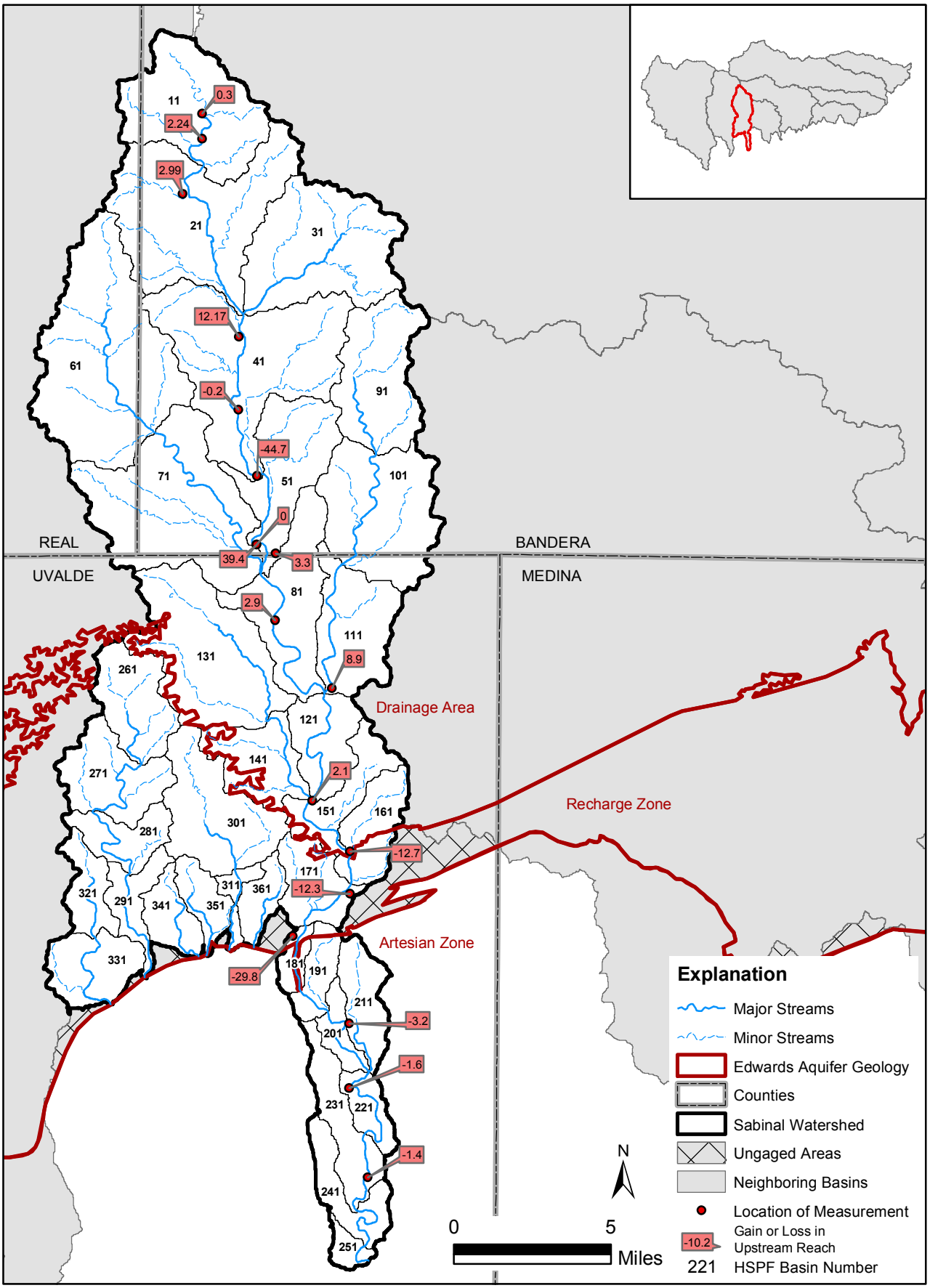
EAA Contract 02-87-AS

Prepared for:
Edwards Aquifer Authority
January 2005

SABINAL BASIN



USGS Gain/Loss Study 220 in the Sabinal Basin



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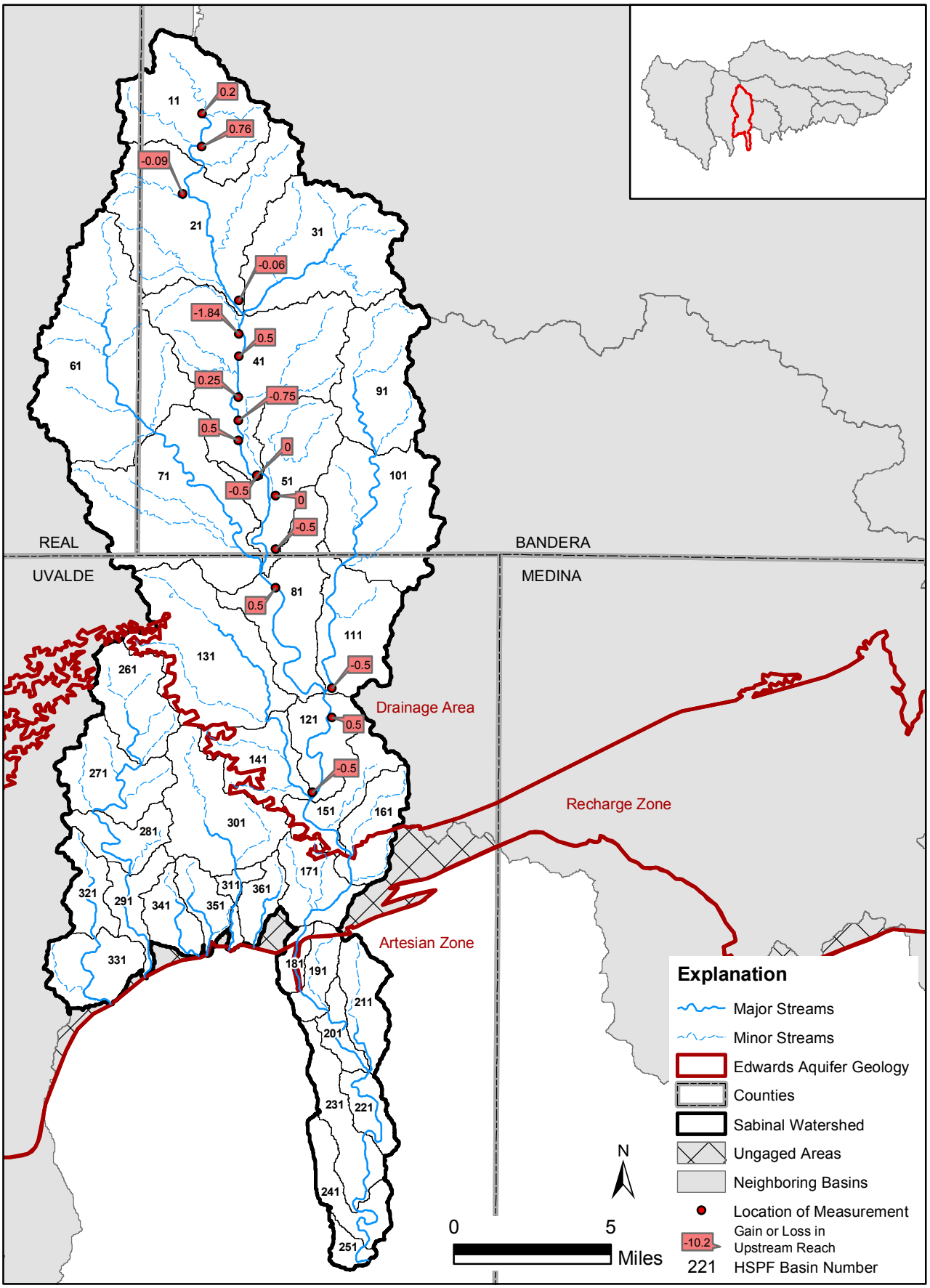

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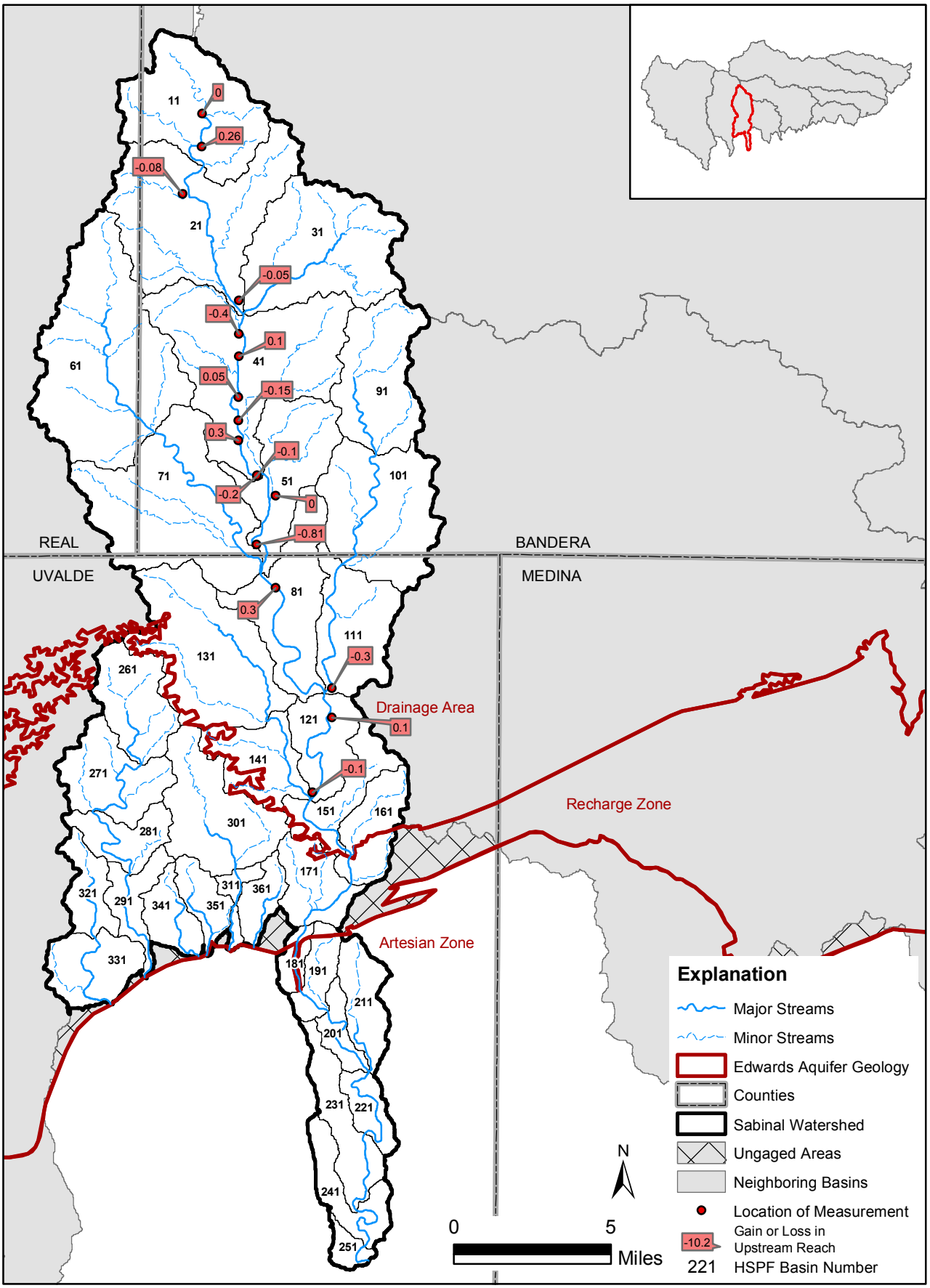

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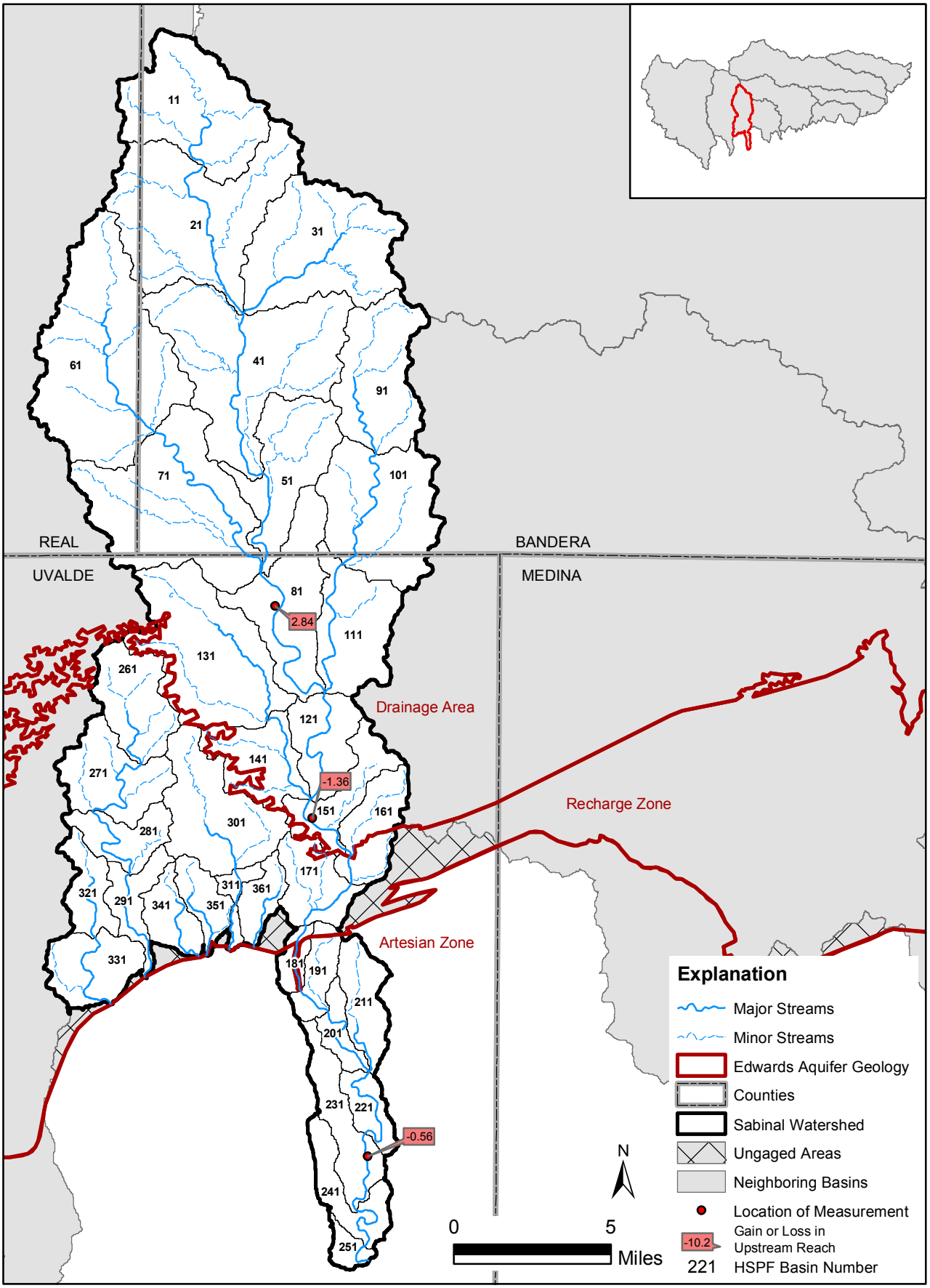

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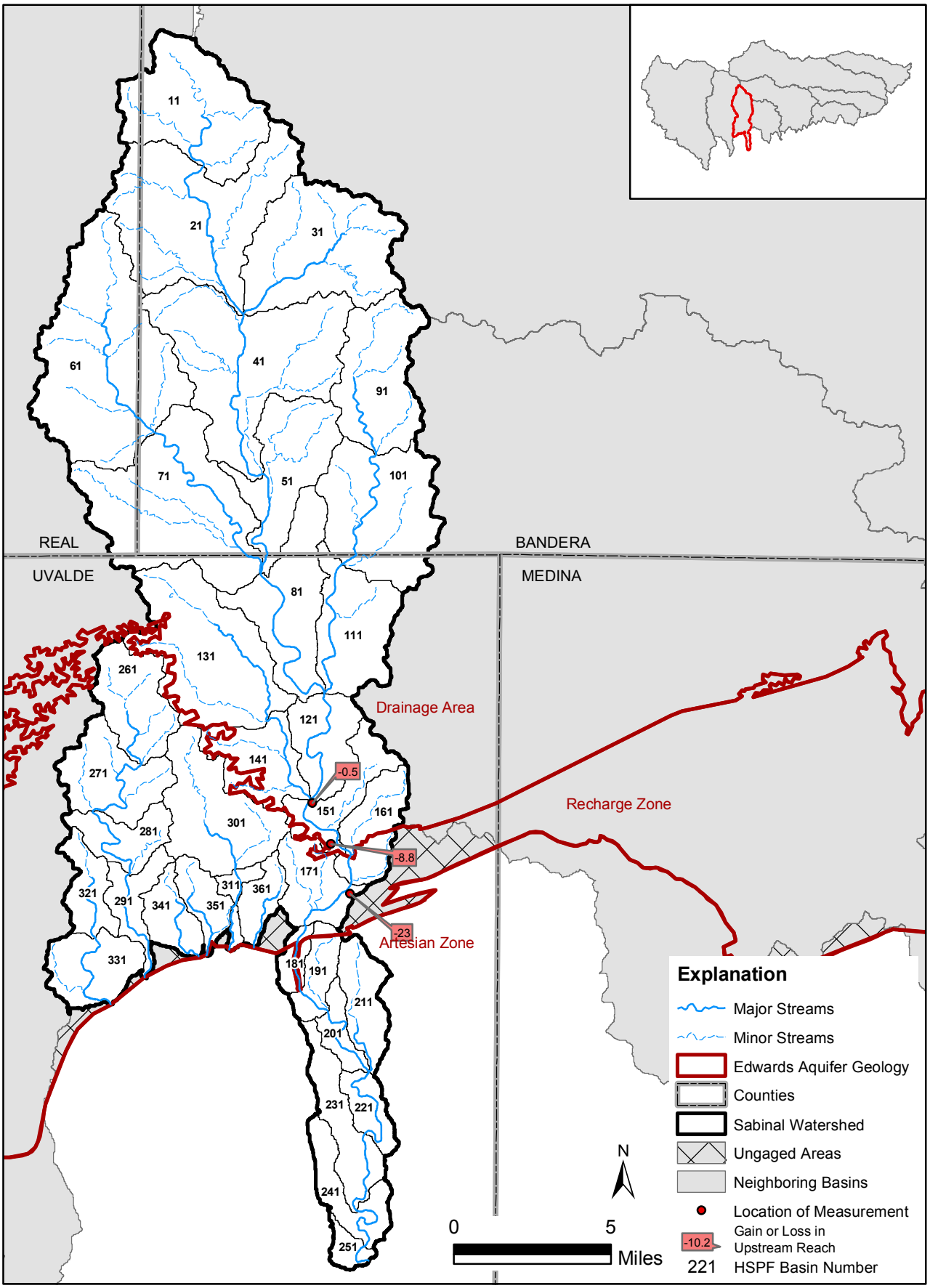

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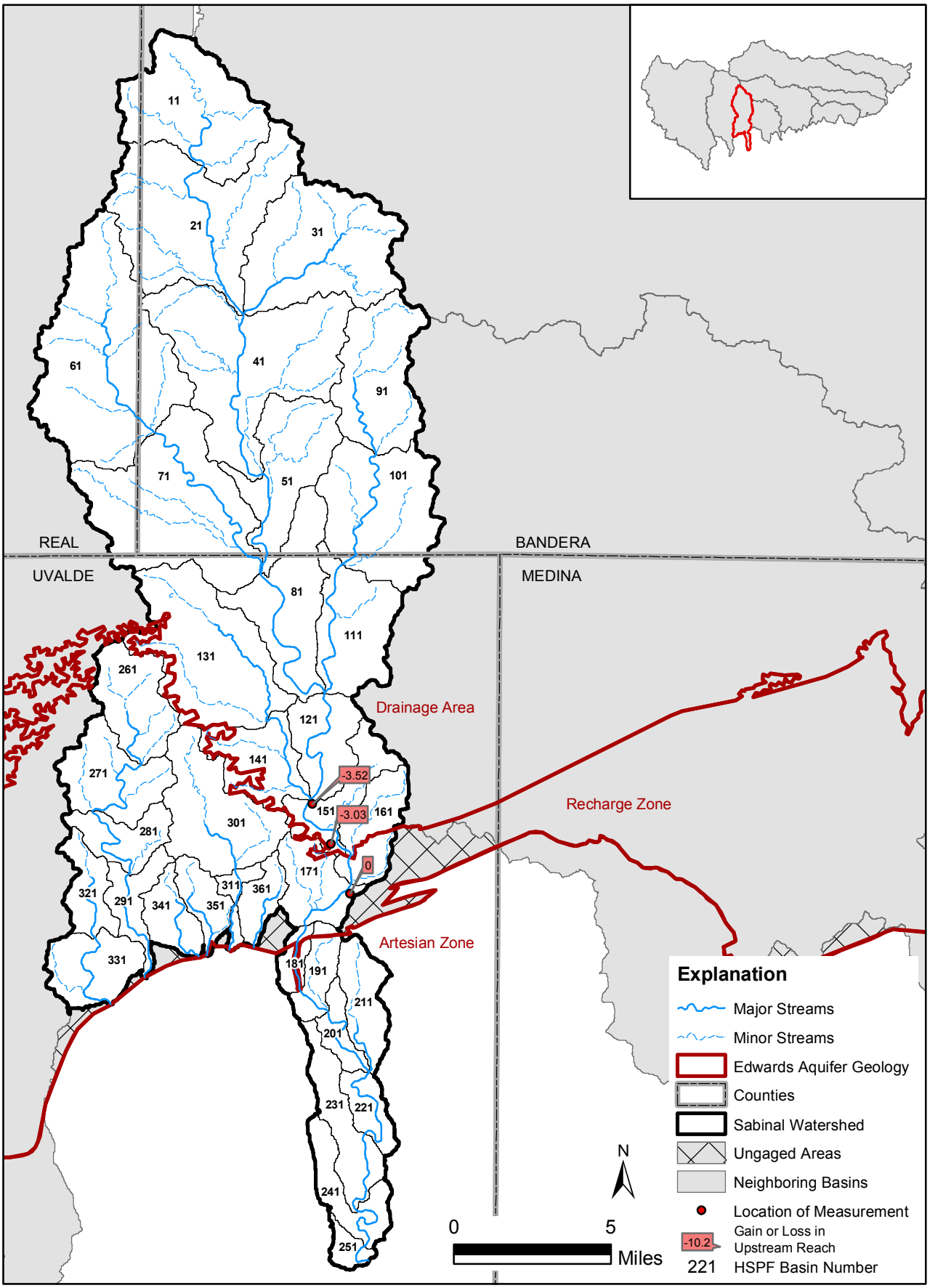

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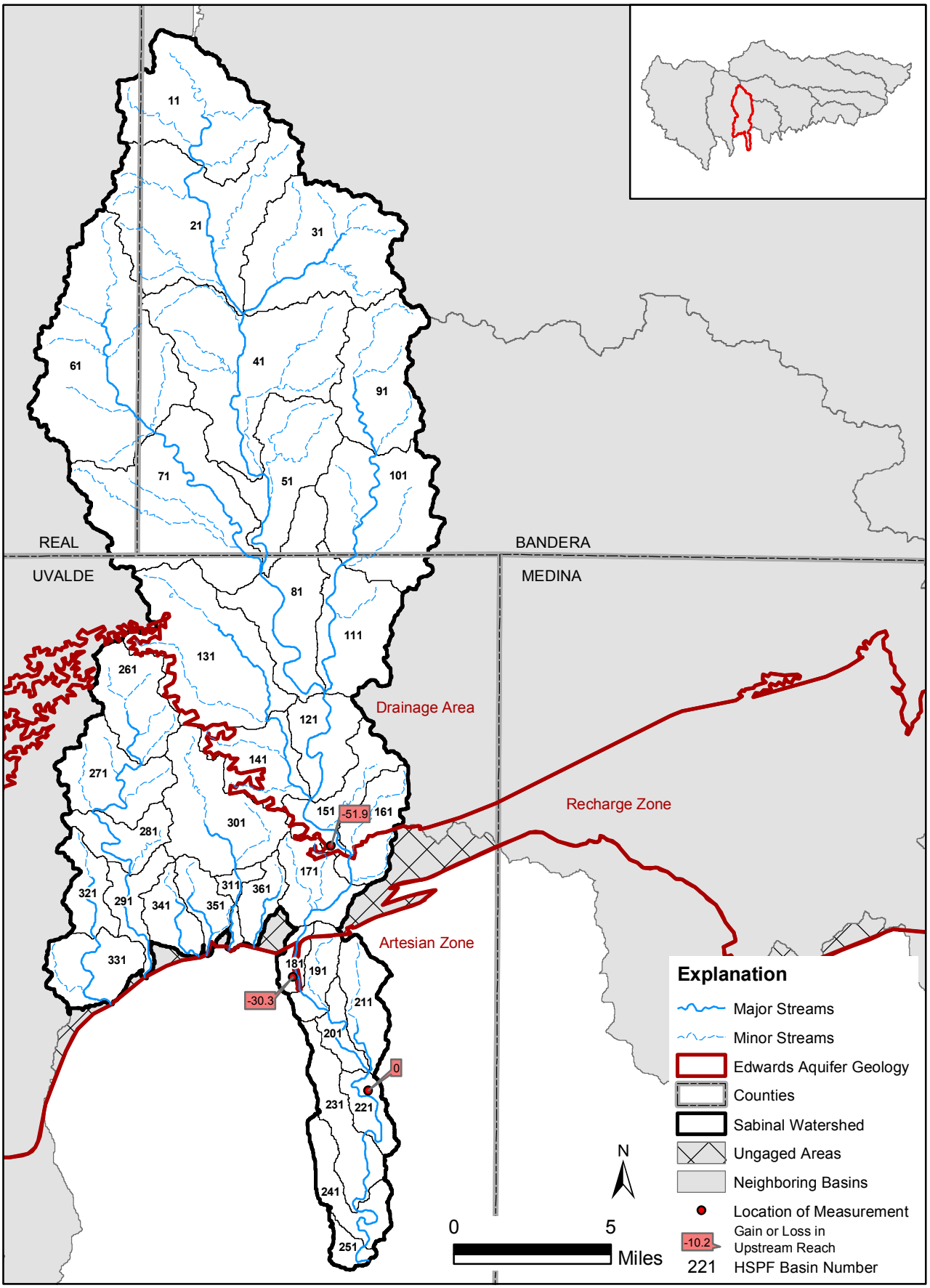

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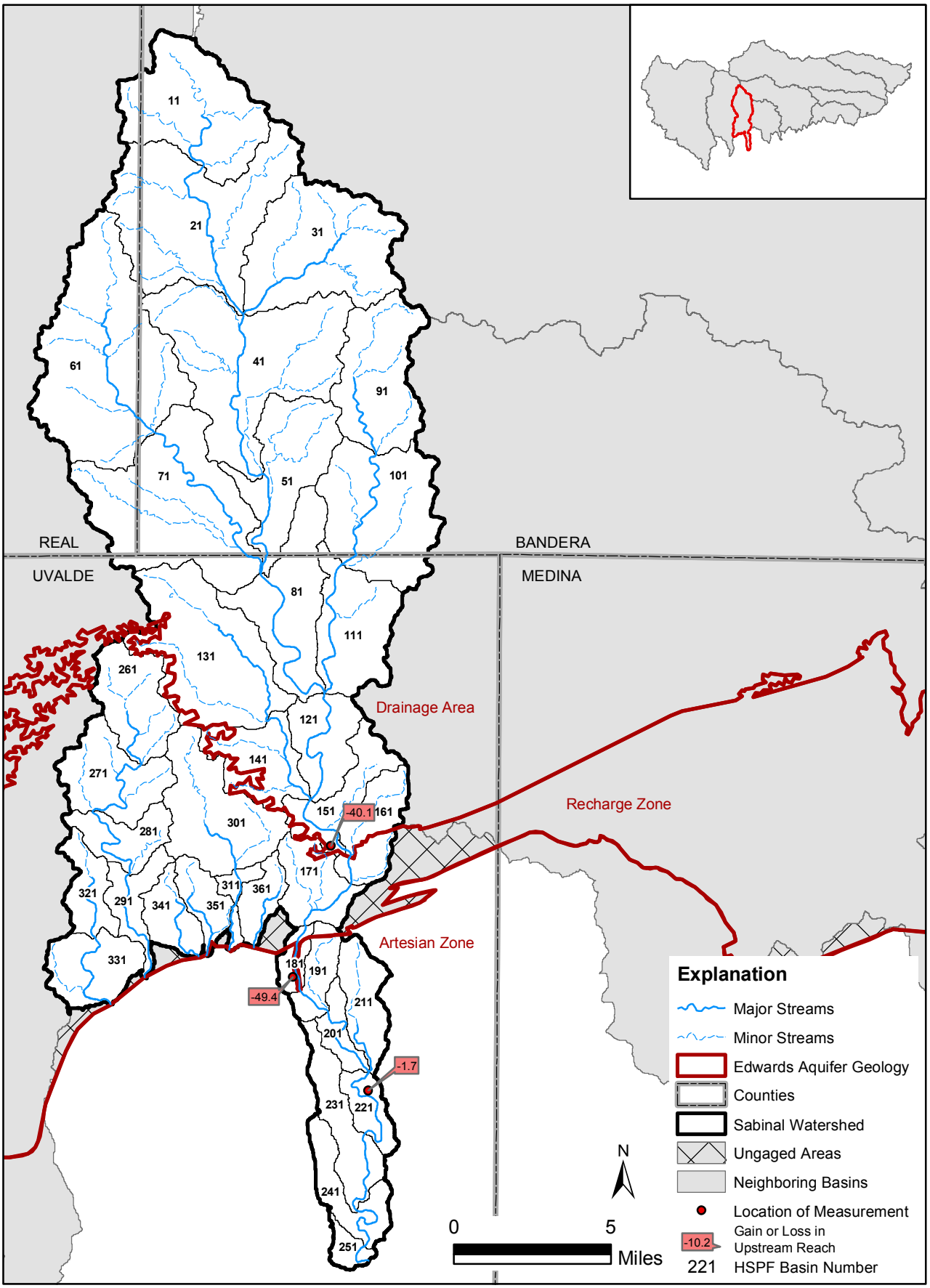
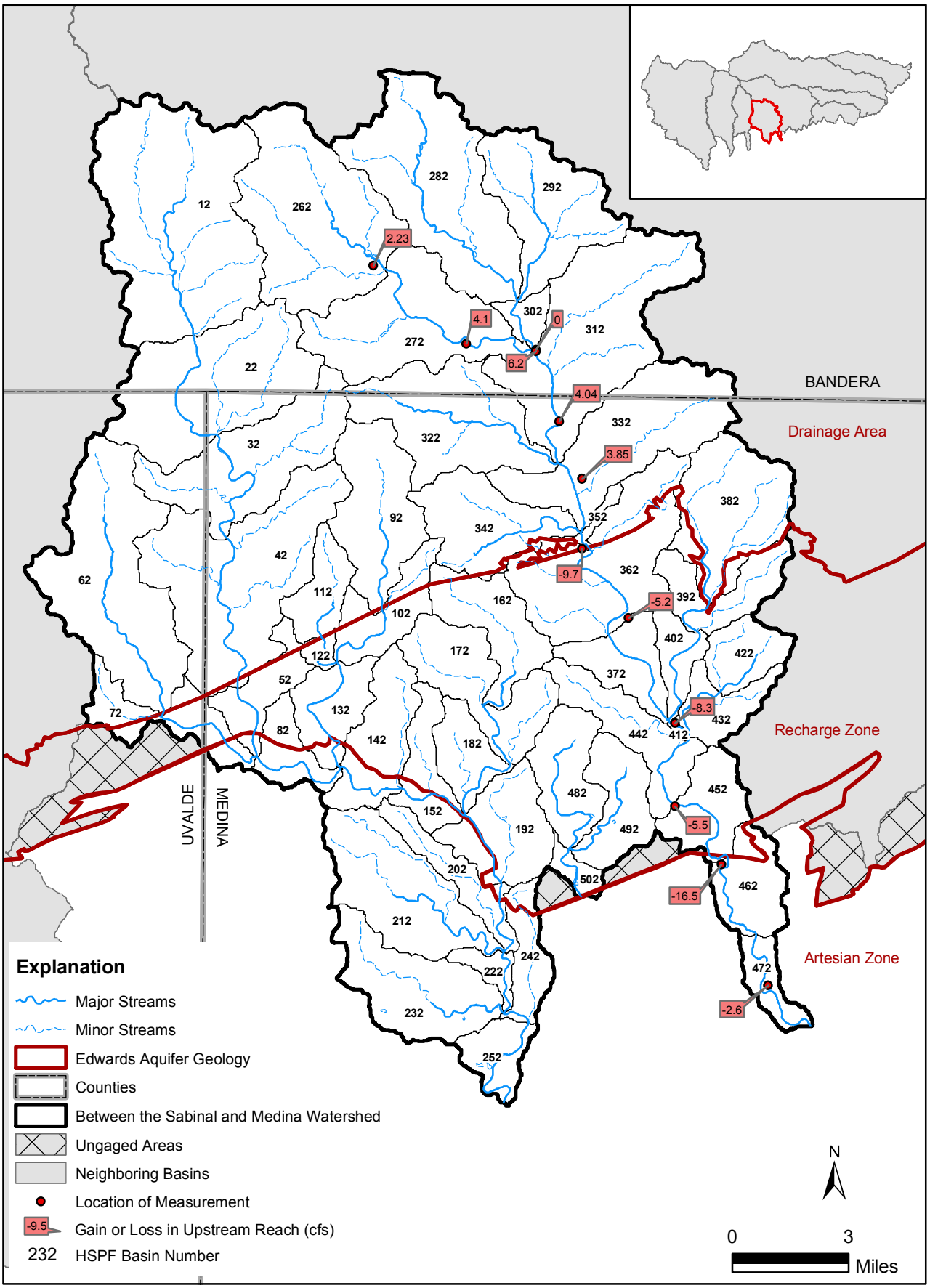
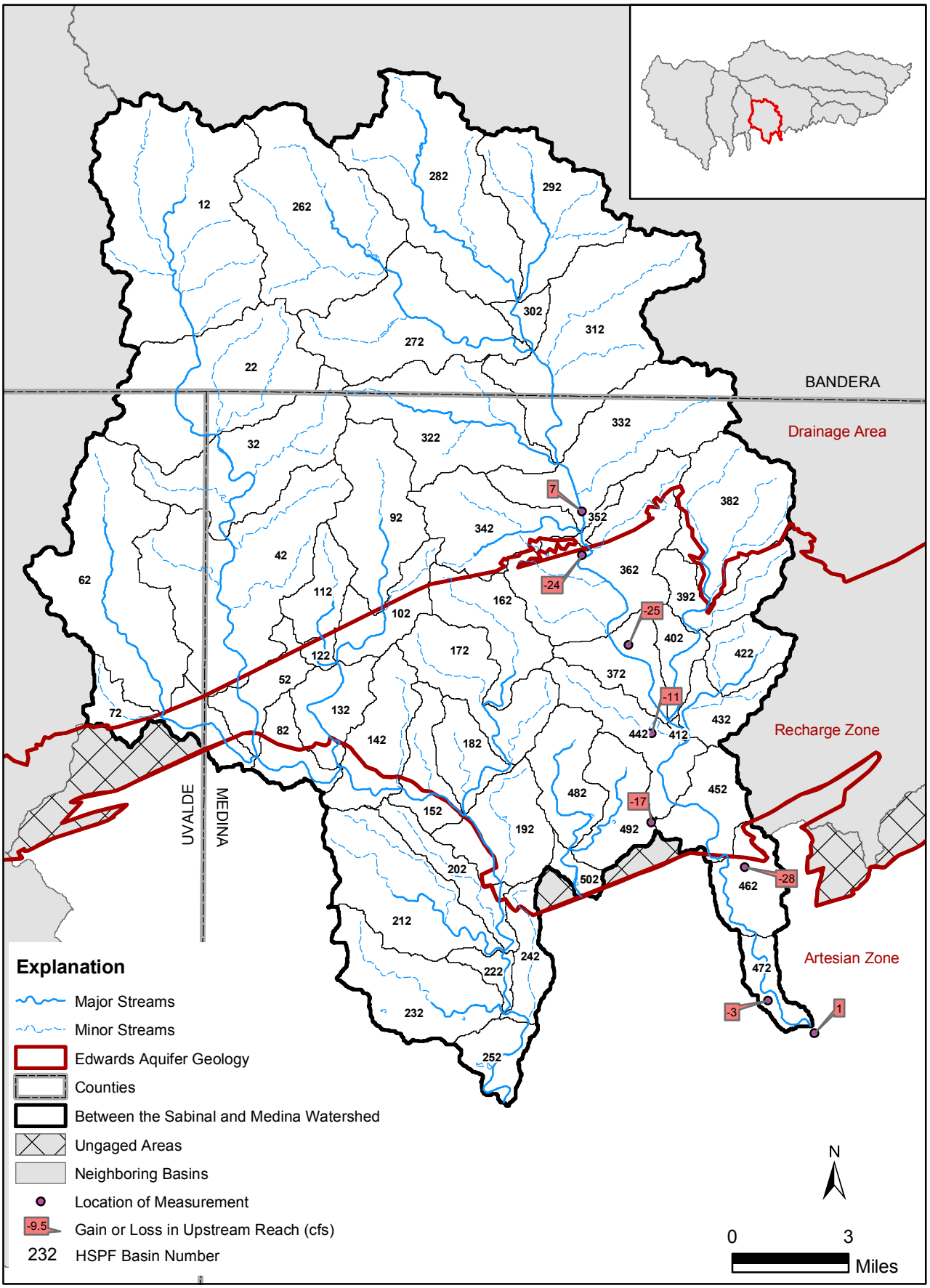


USGS Gain/Loss Study 228 in the Sabinal Basin

SABINAL - MEDINA BASIN



USGS Gain/Loss Study 162 Between the Sabinal and Medina Basins



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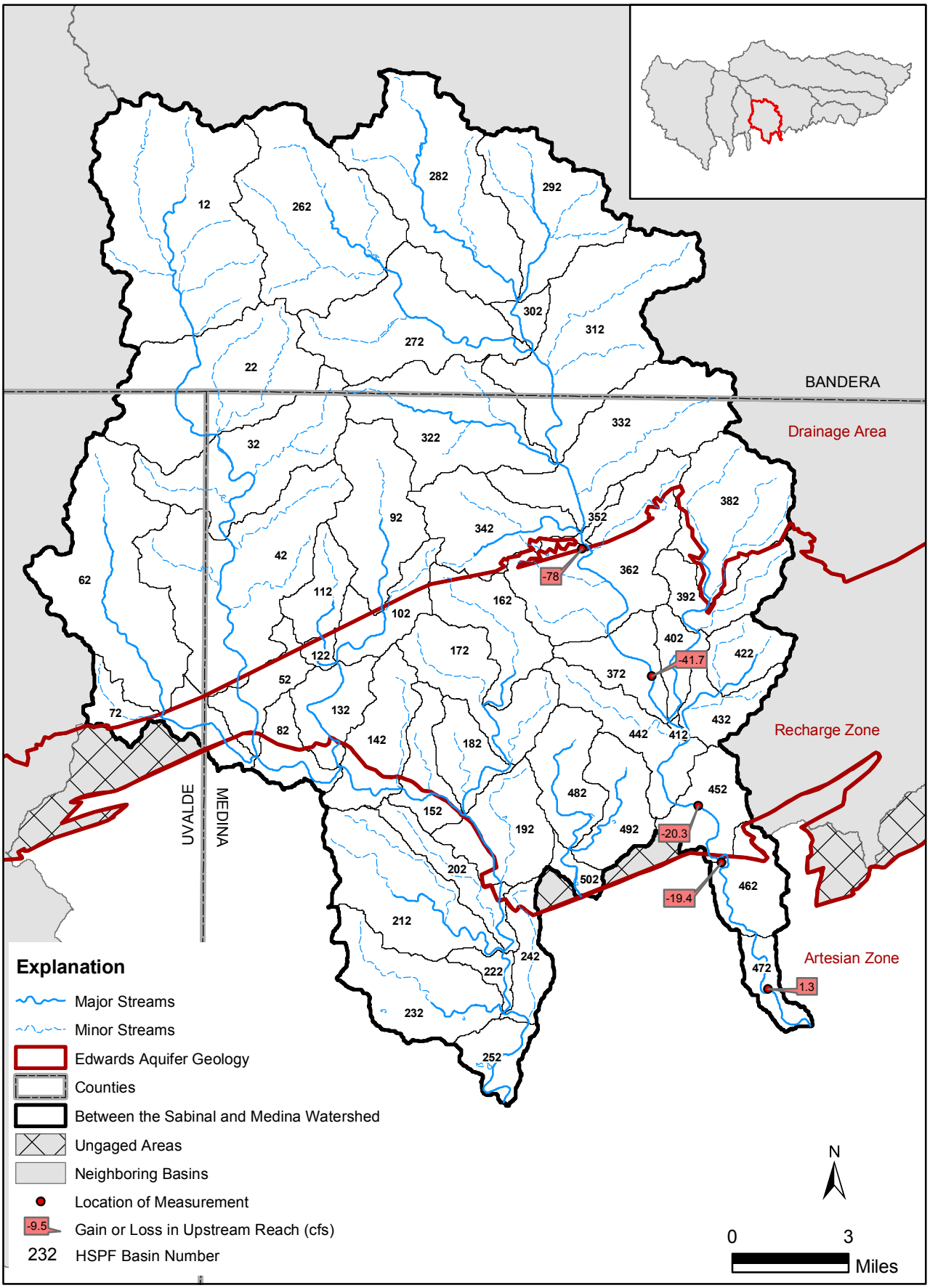

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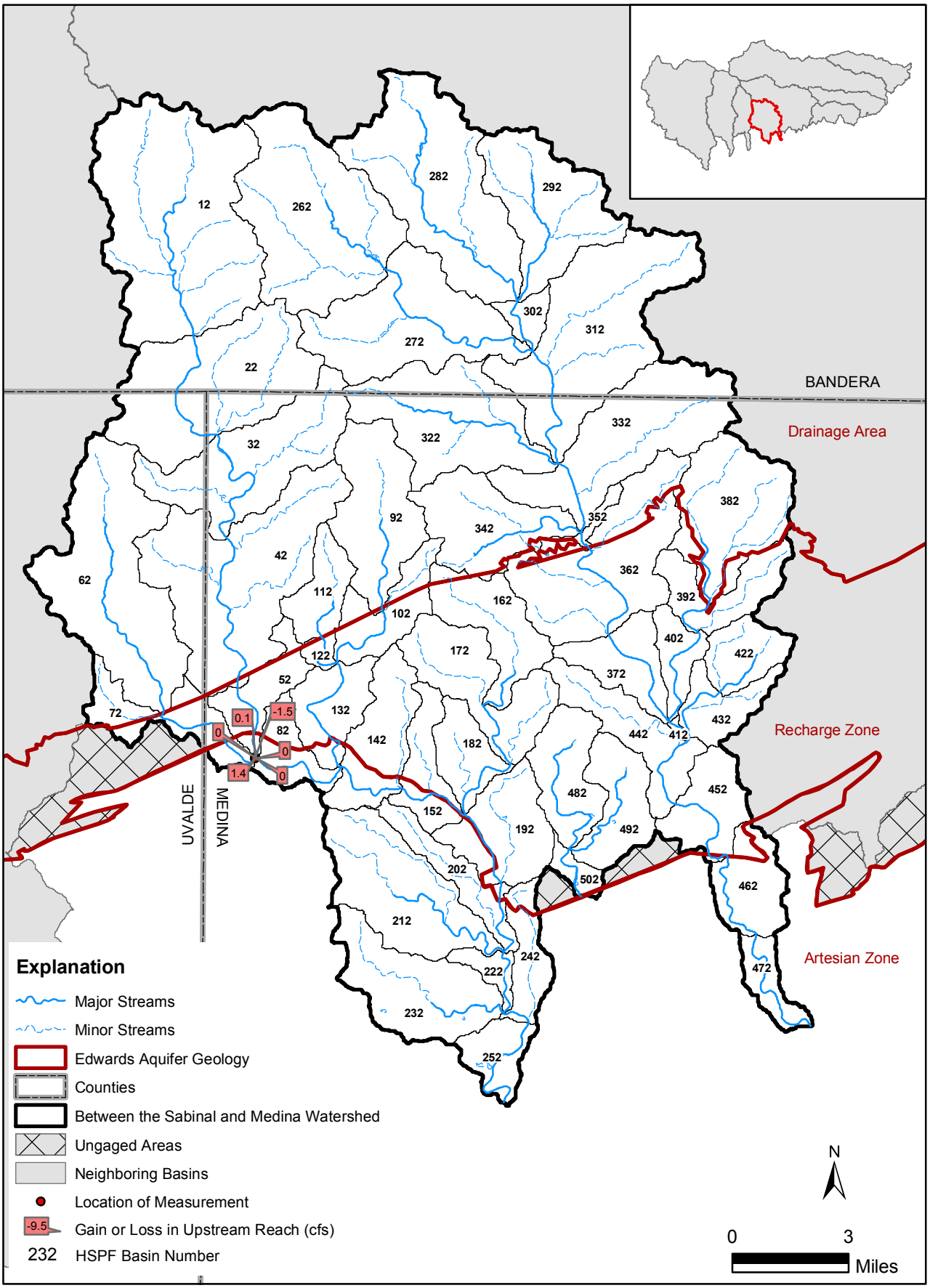

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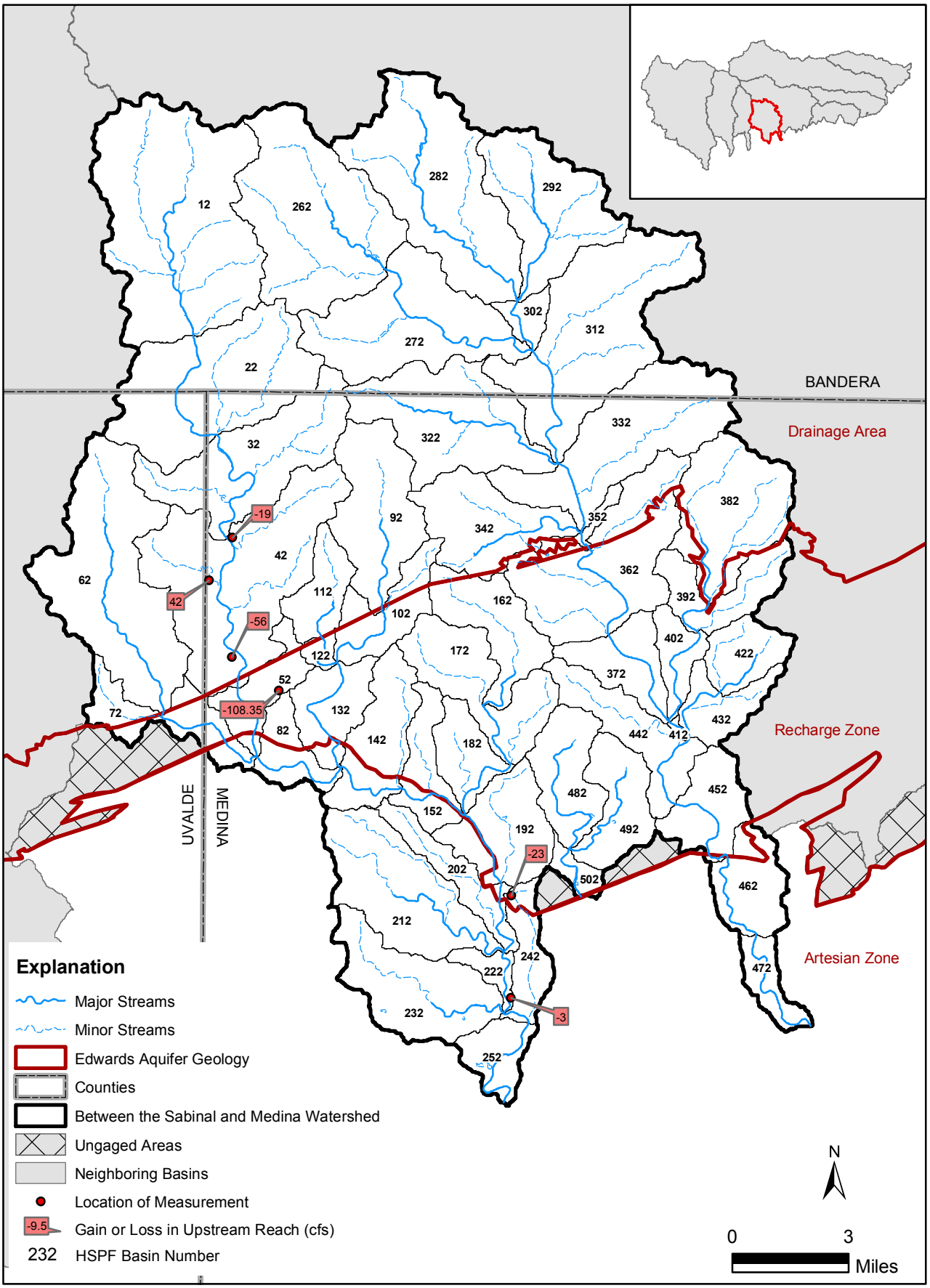

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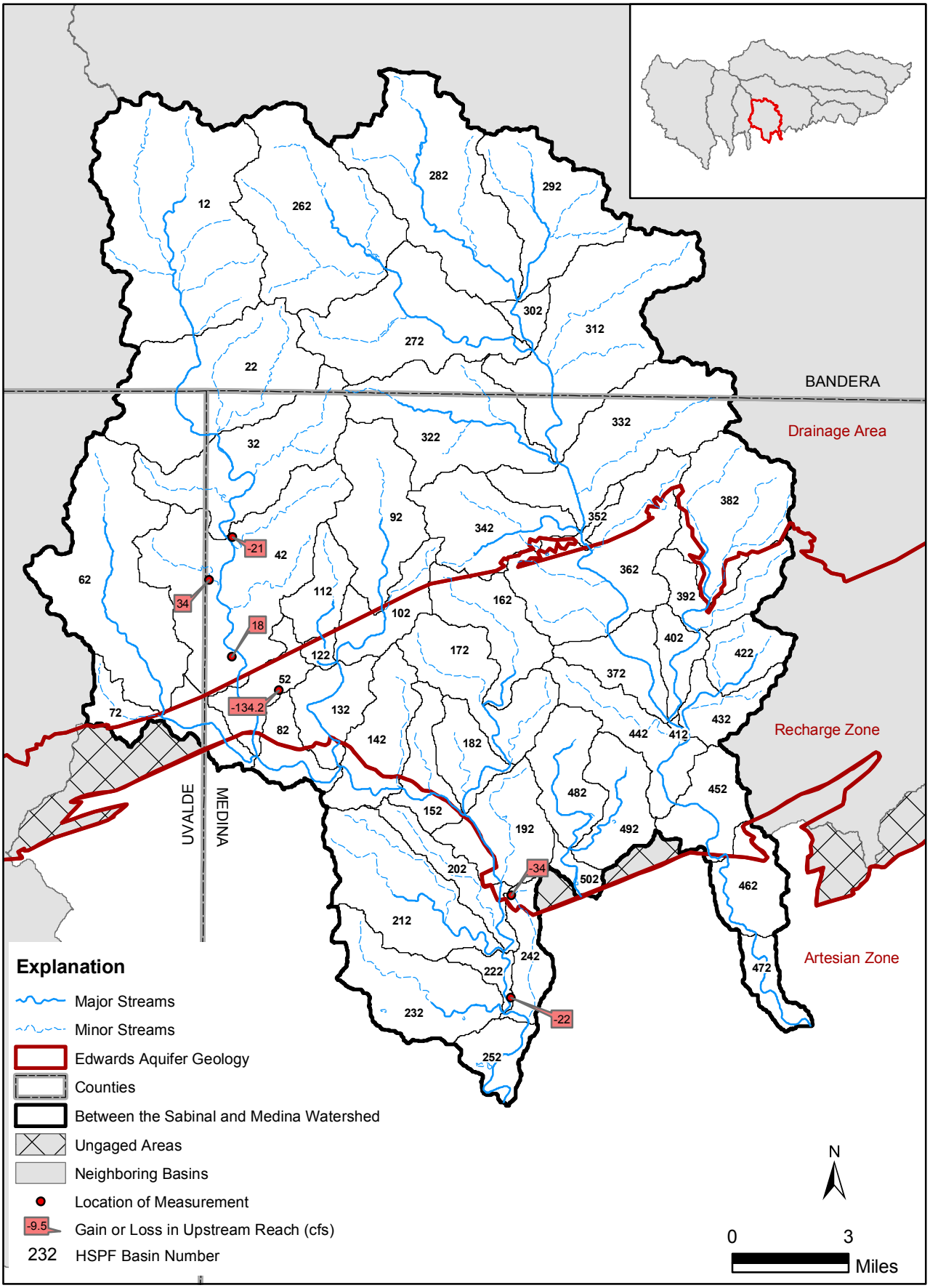

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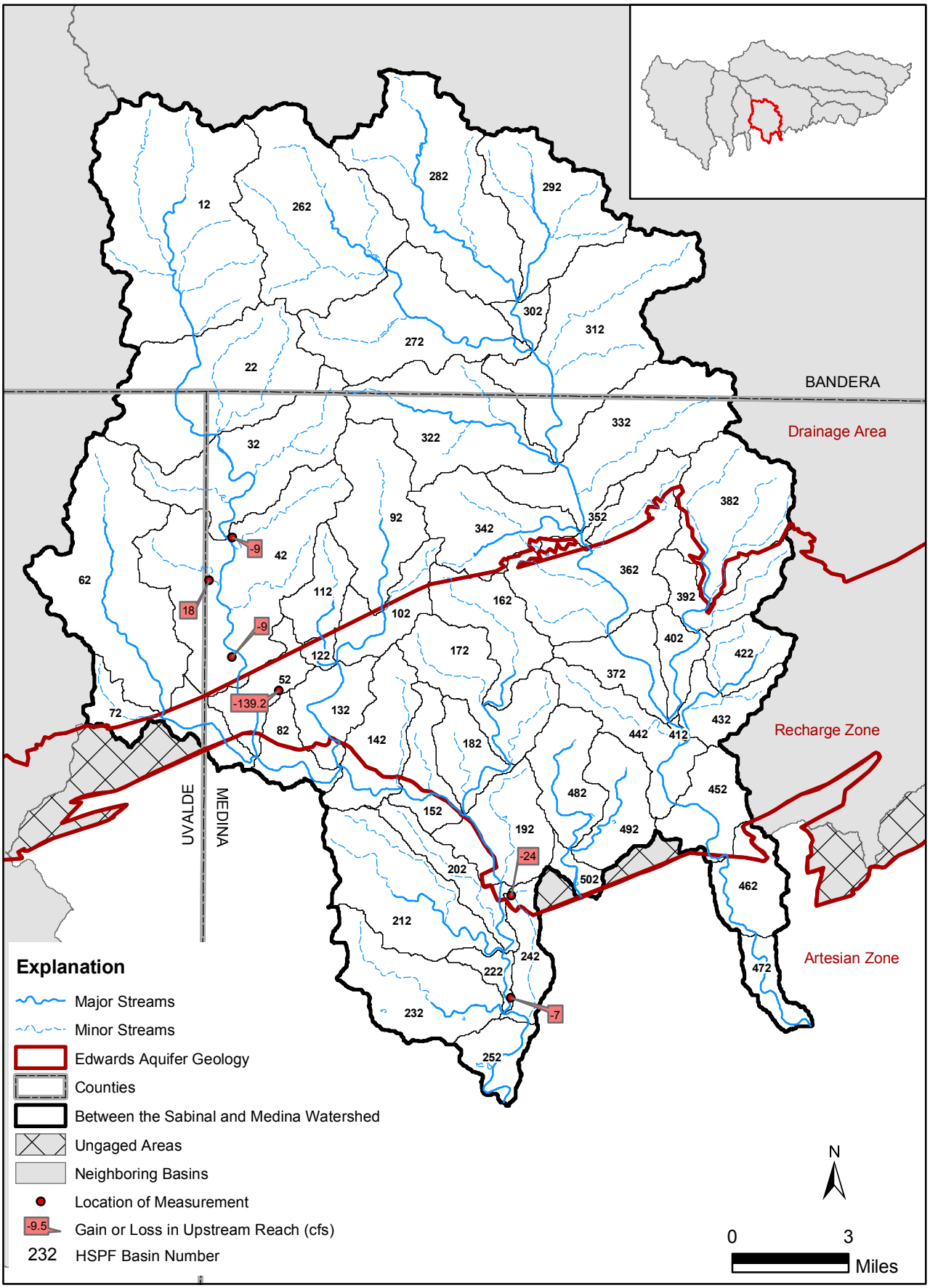

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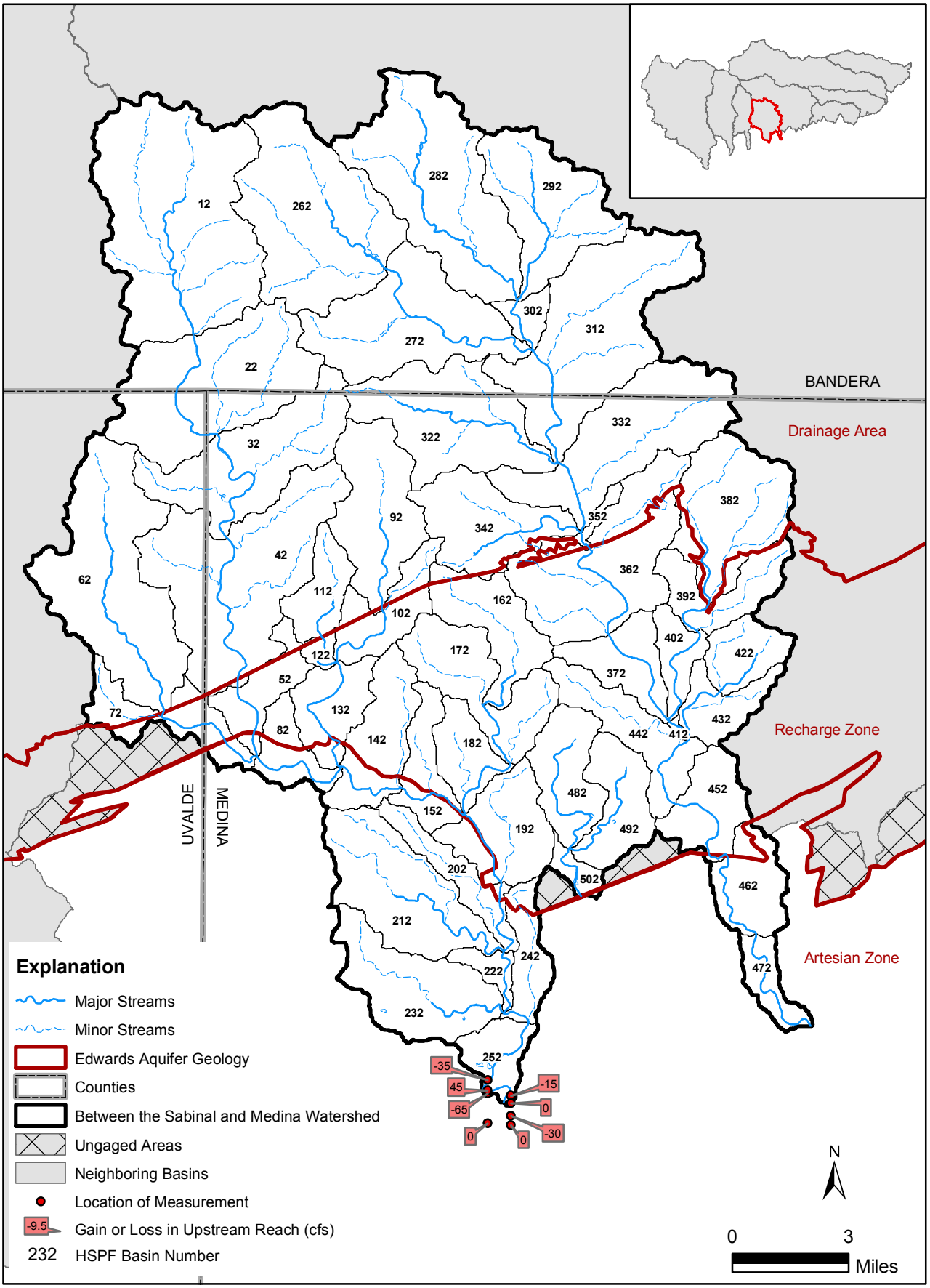
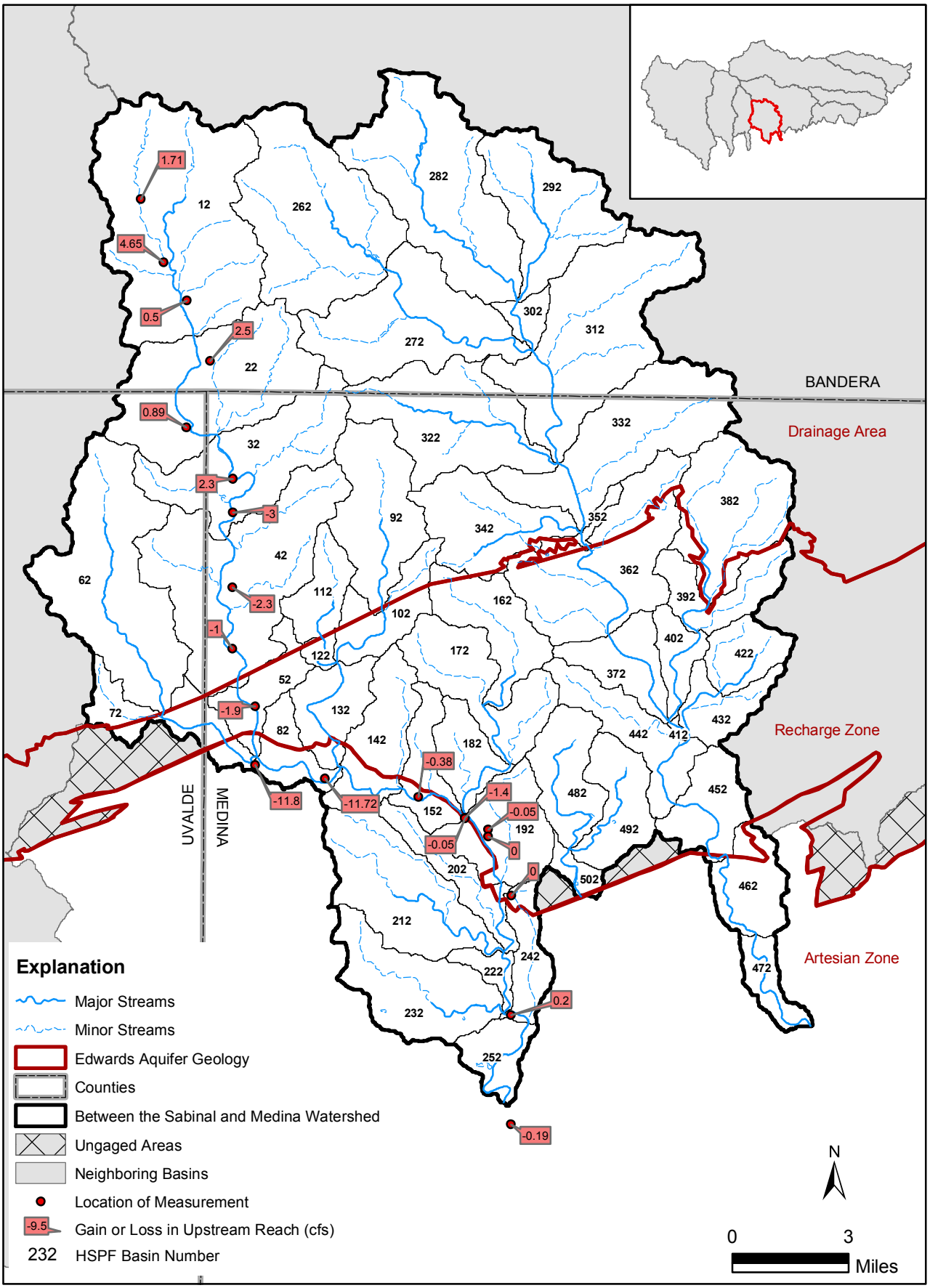


USGS Gain/Loss Study 232 Between the Sabinal and Medina Basins



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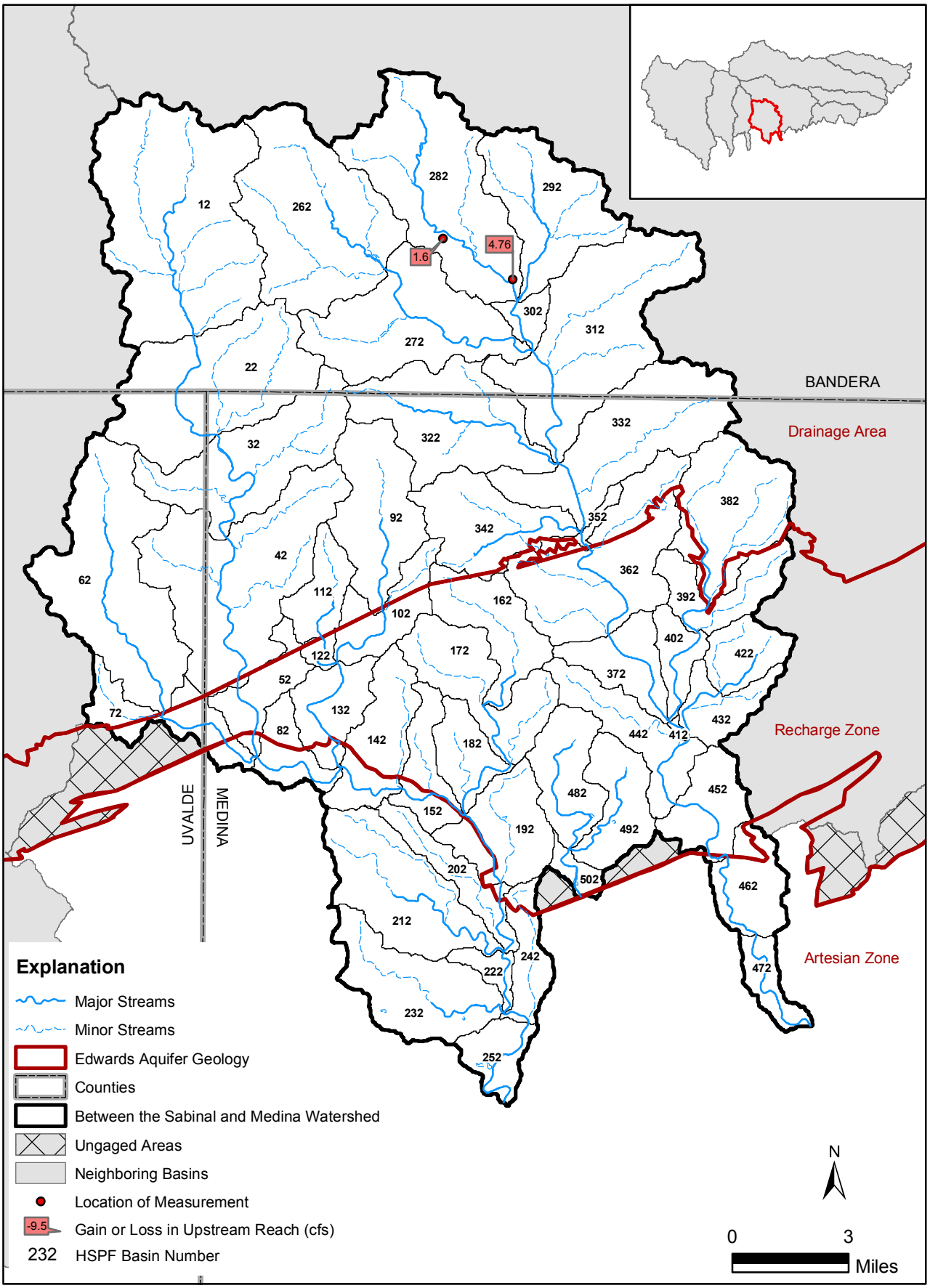
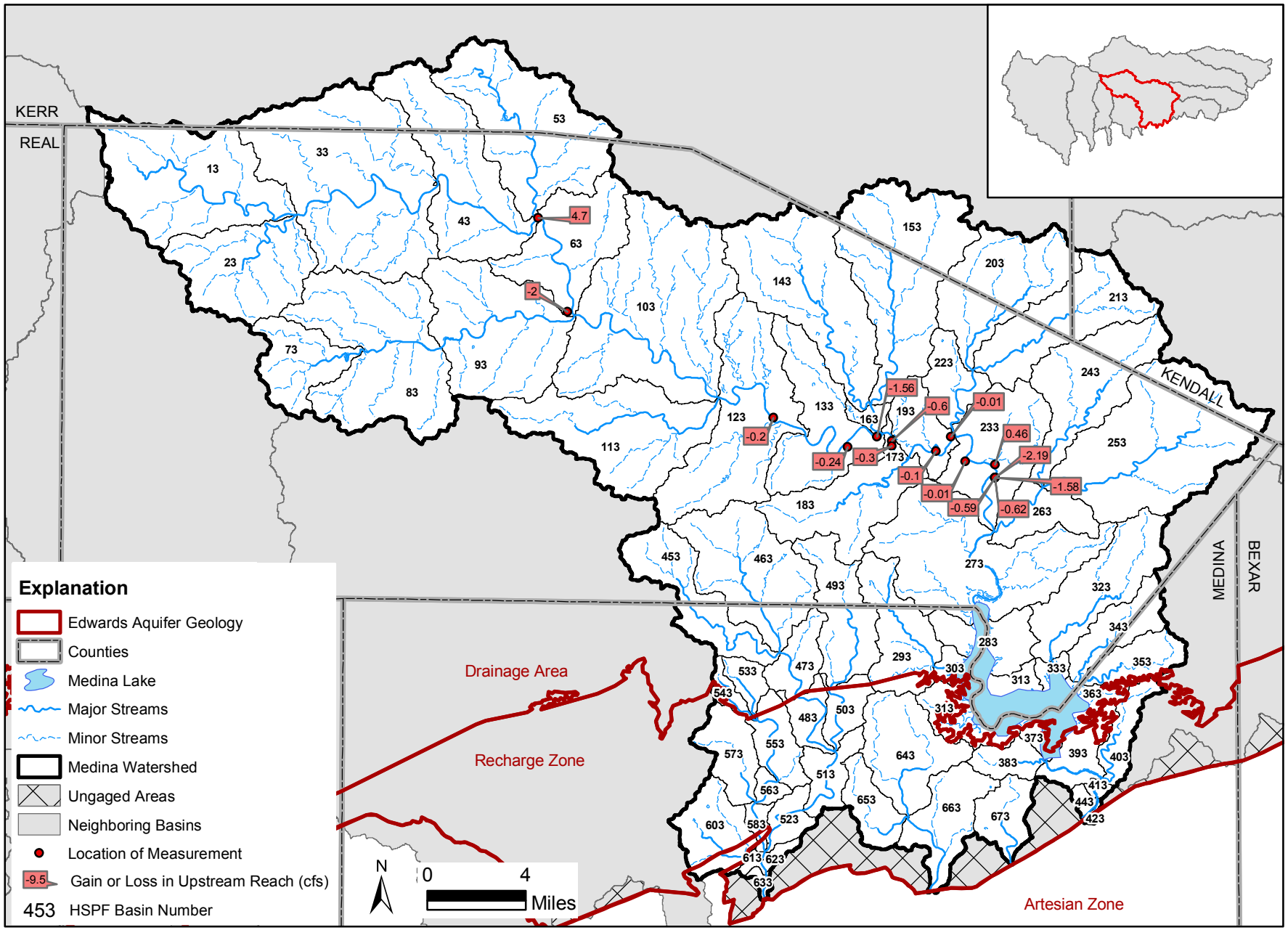
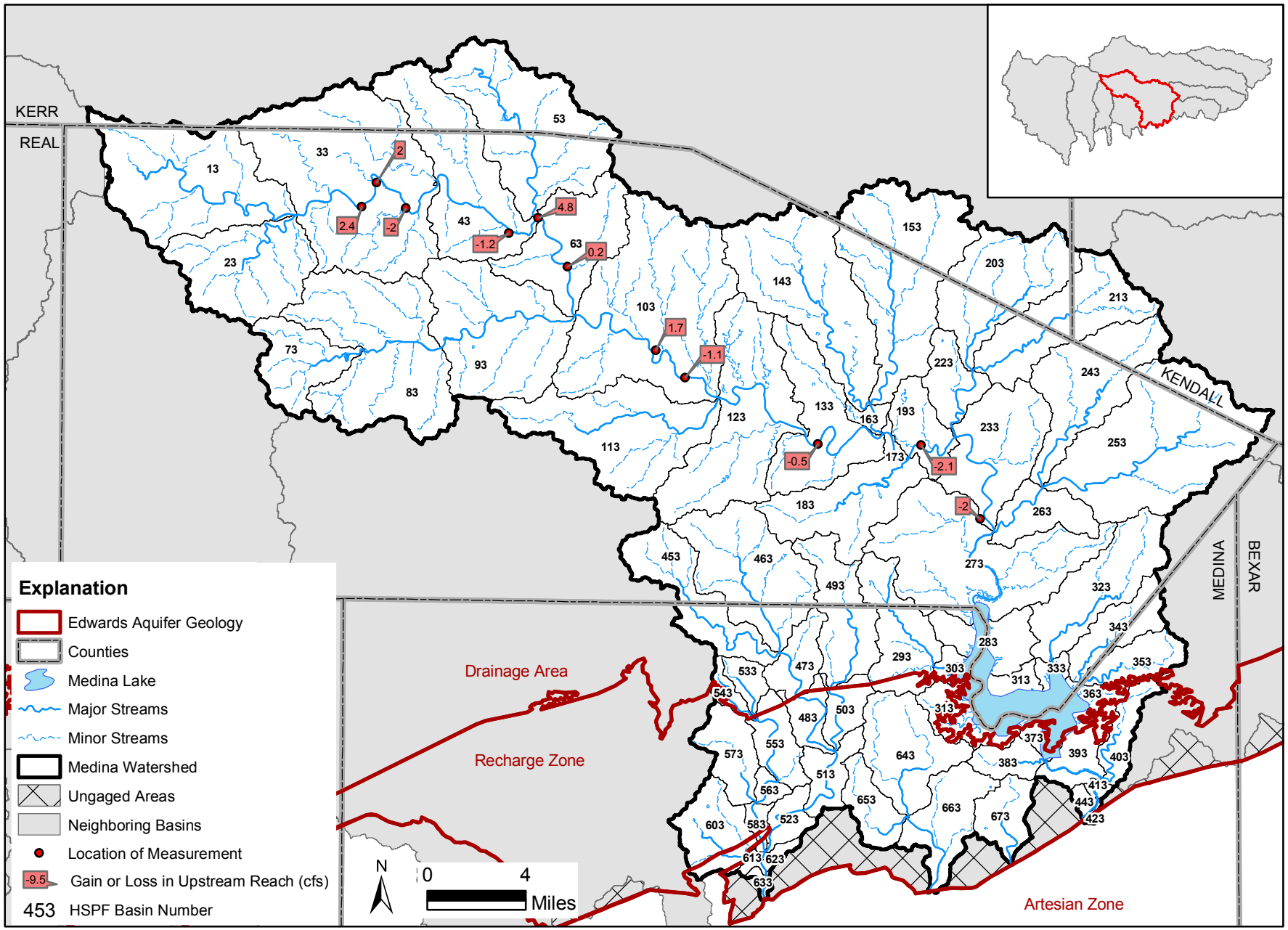


USGS Gain/Loss Study 242 Between the Sabinal and Medina Basins

MEDINA BASIN



USGS Gain/Loss Study 125 in the Medina Basin



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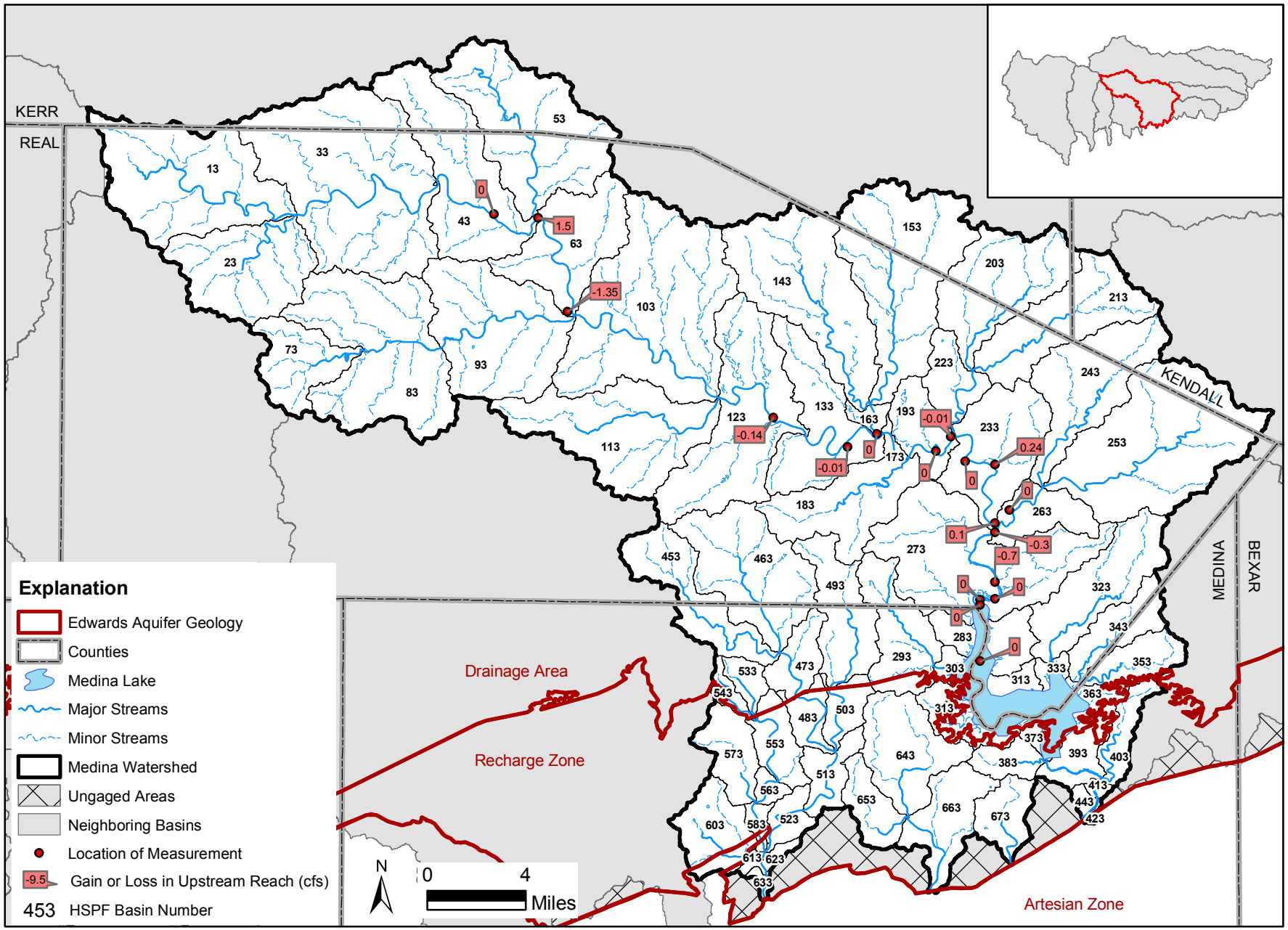

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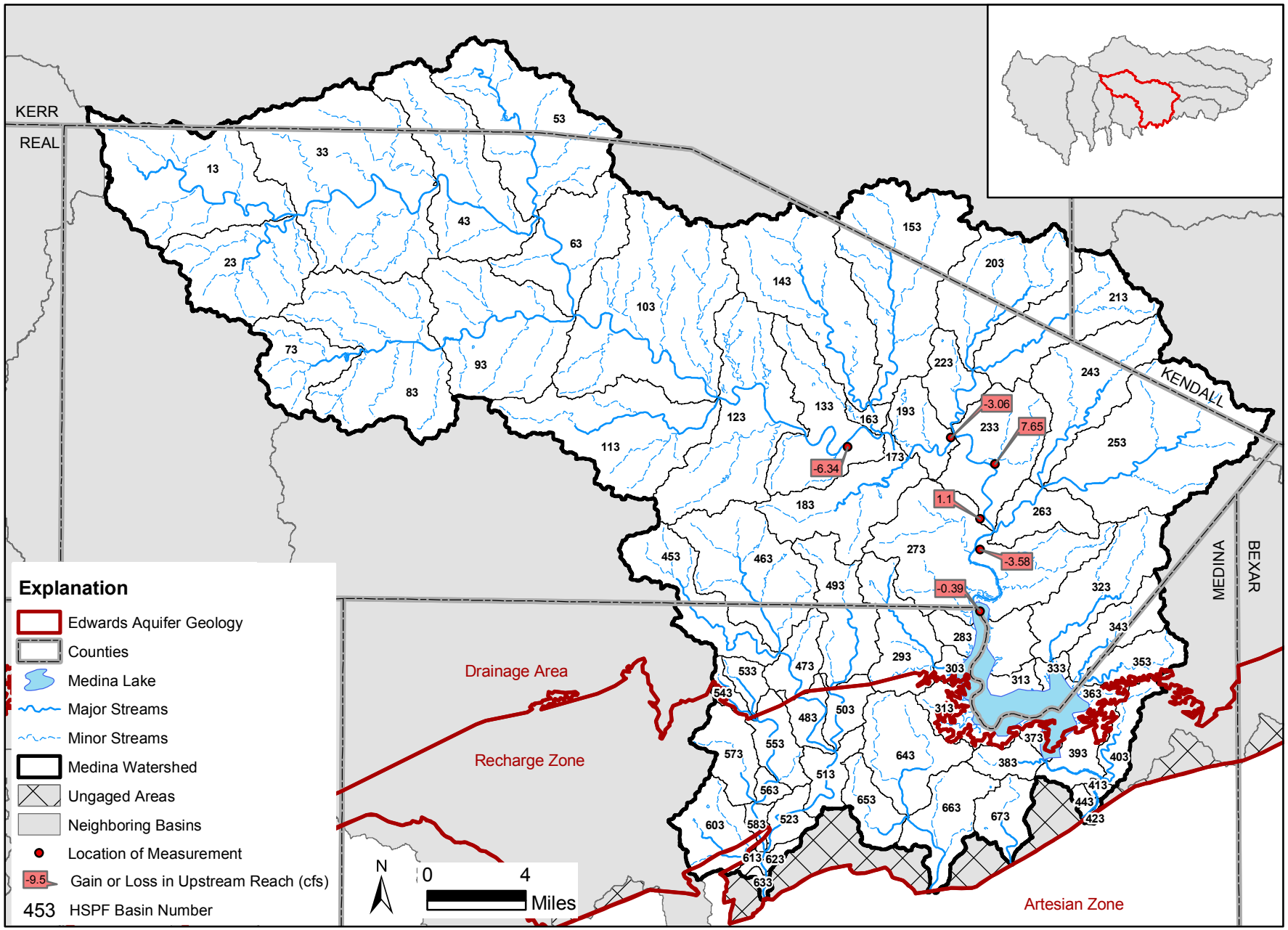

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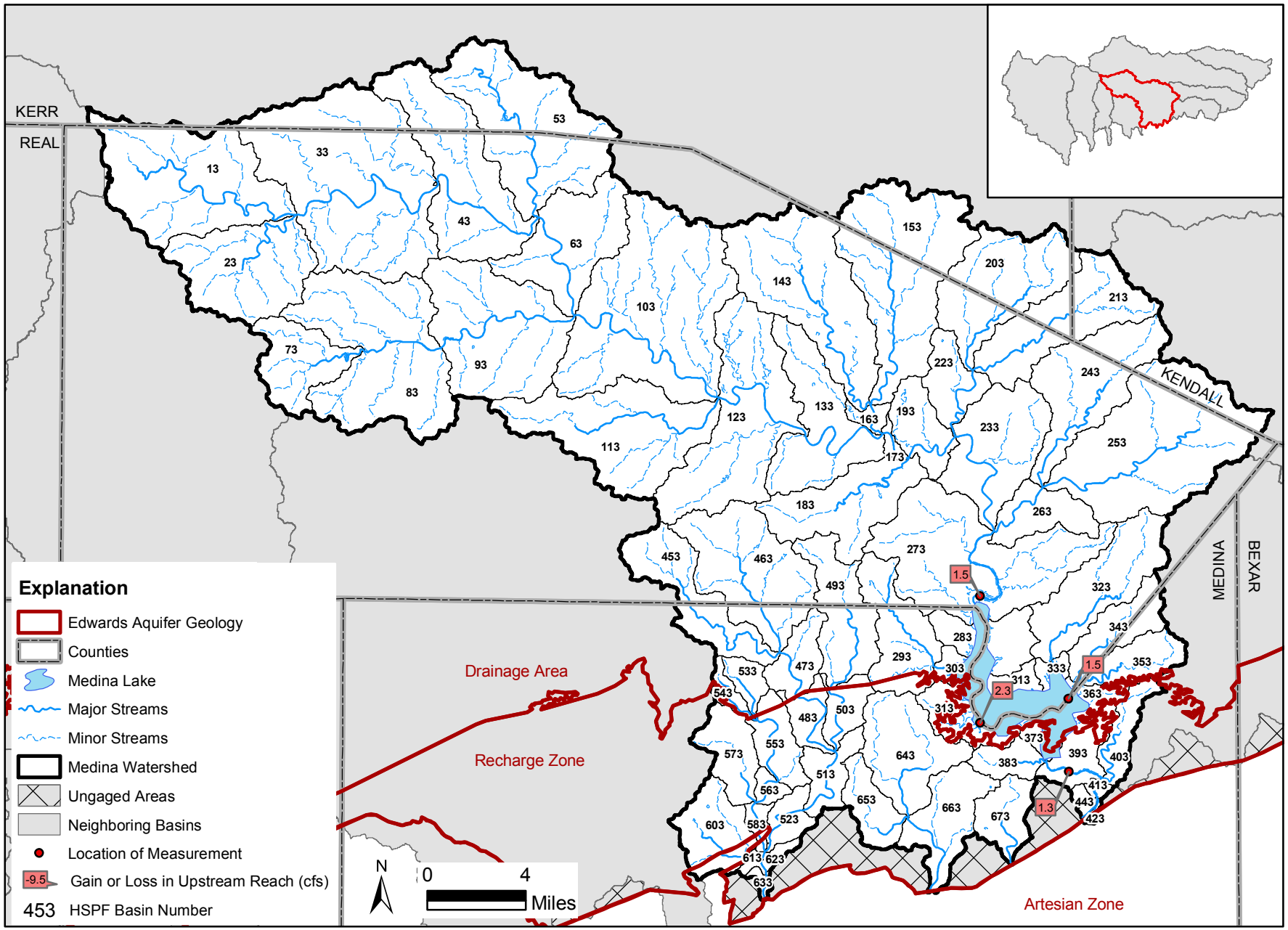

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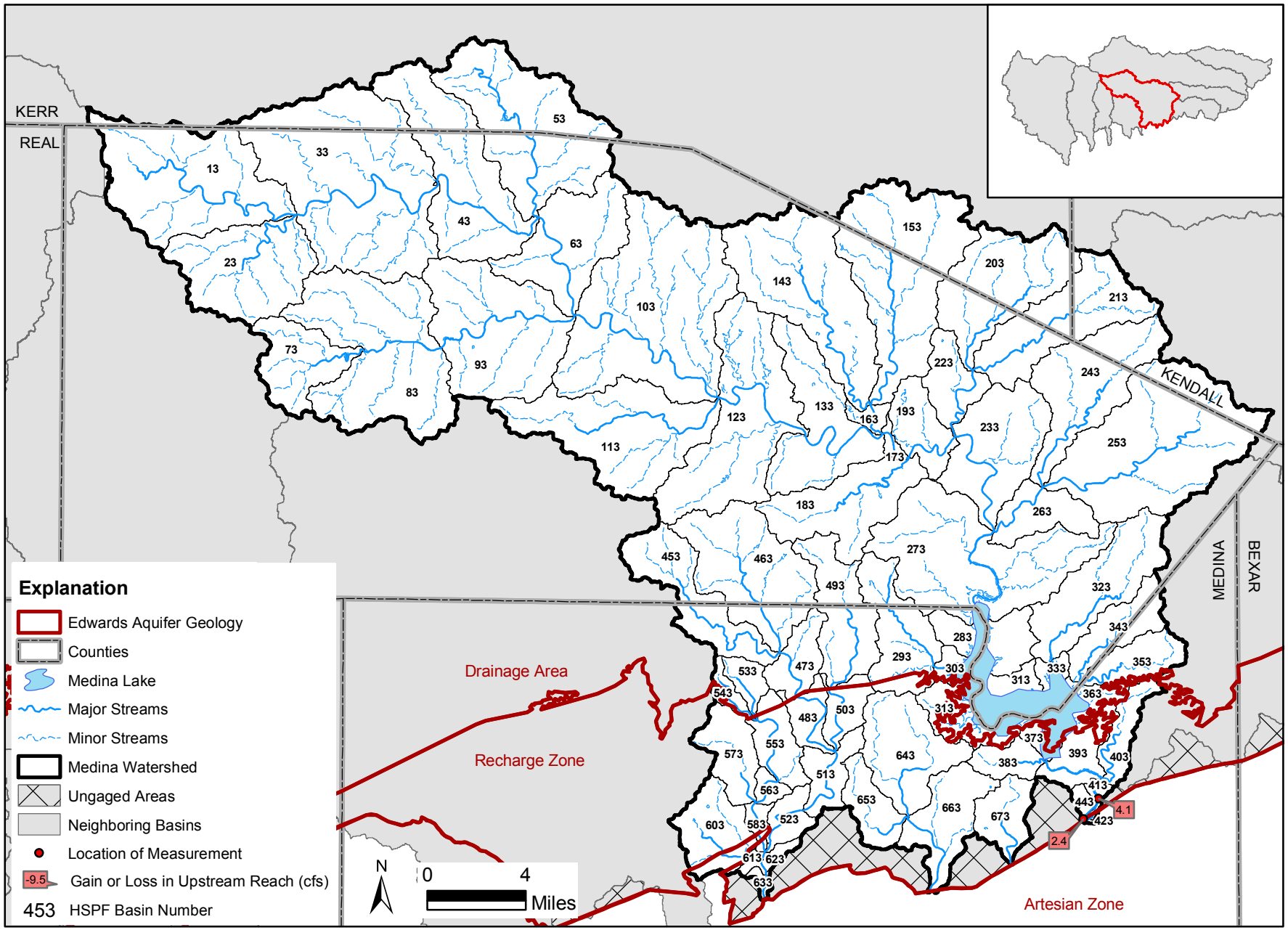

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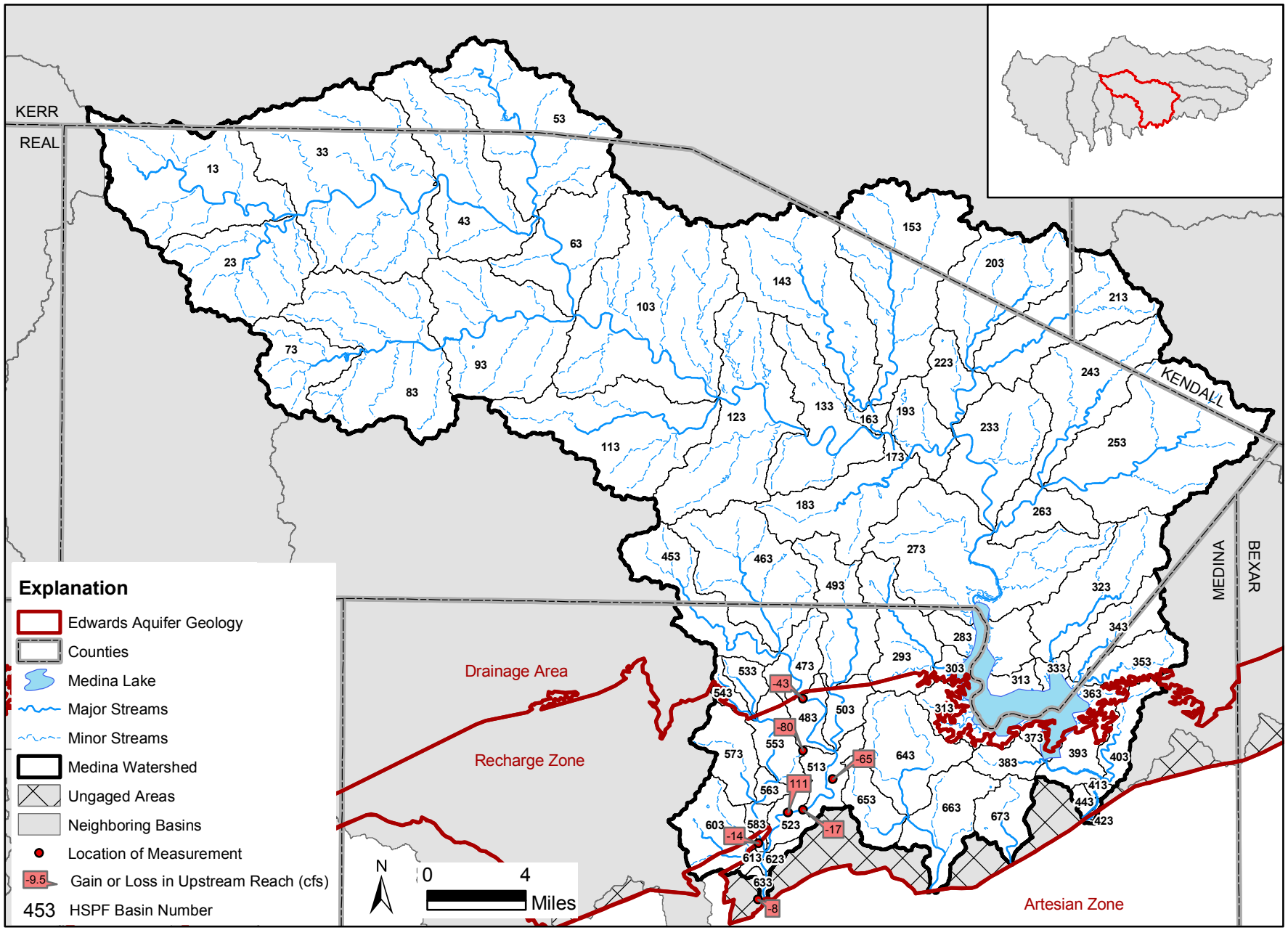

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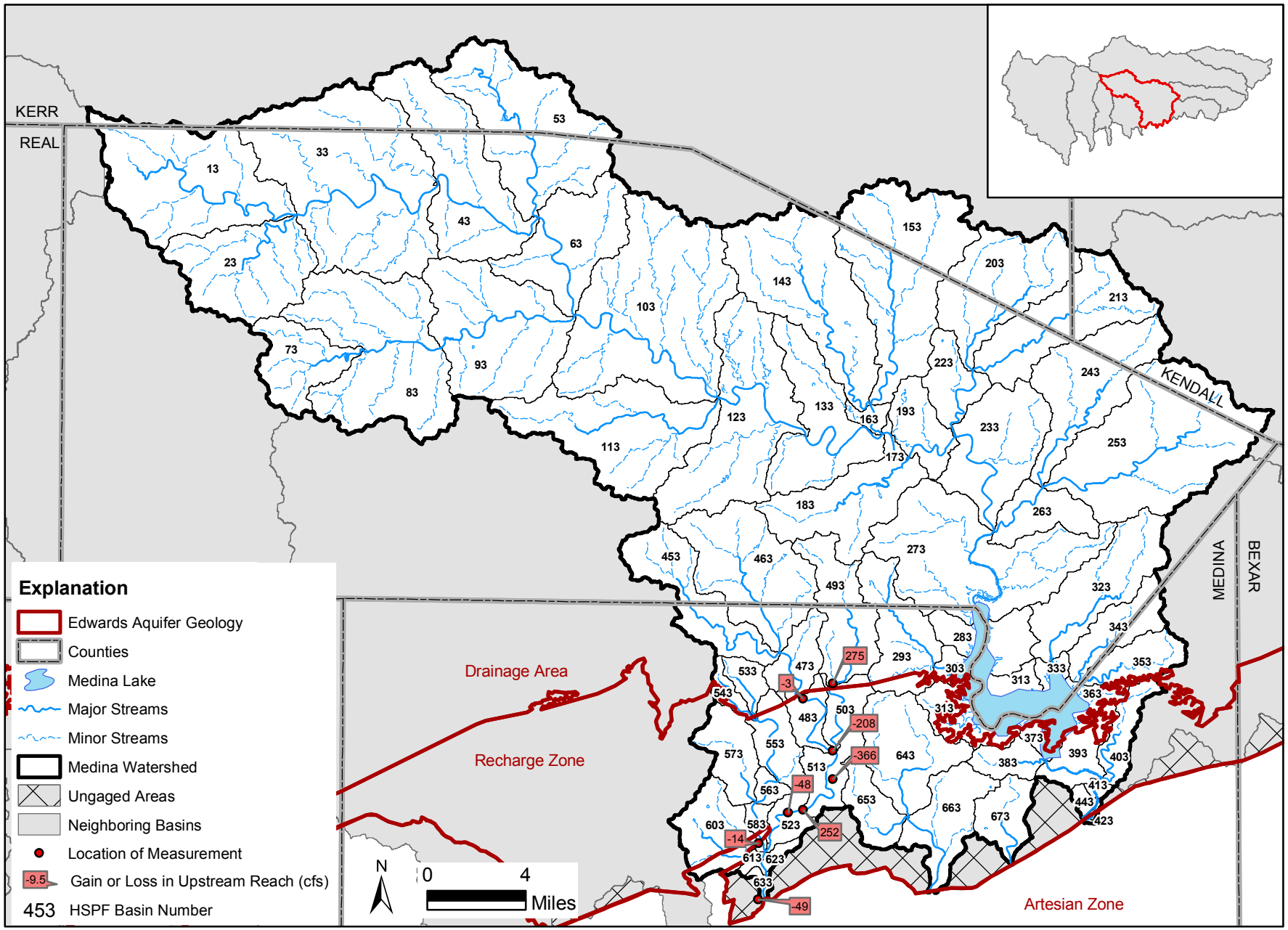

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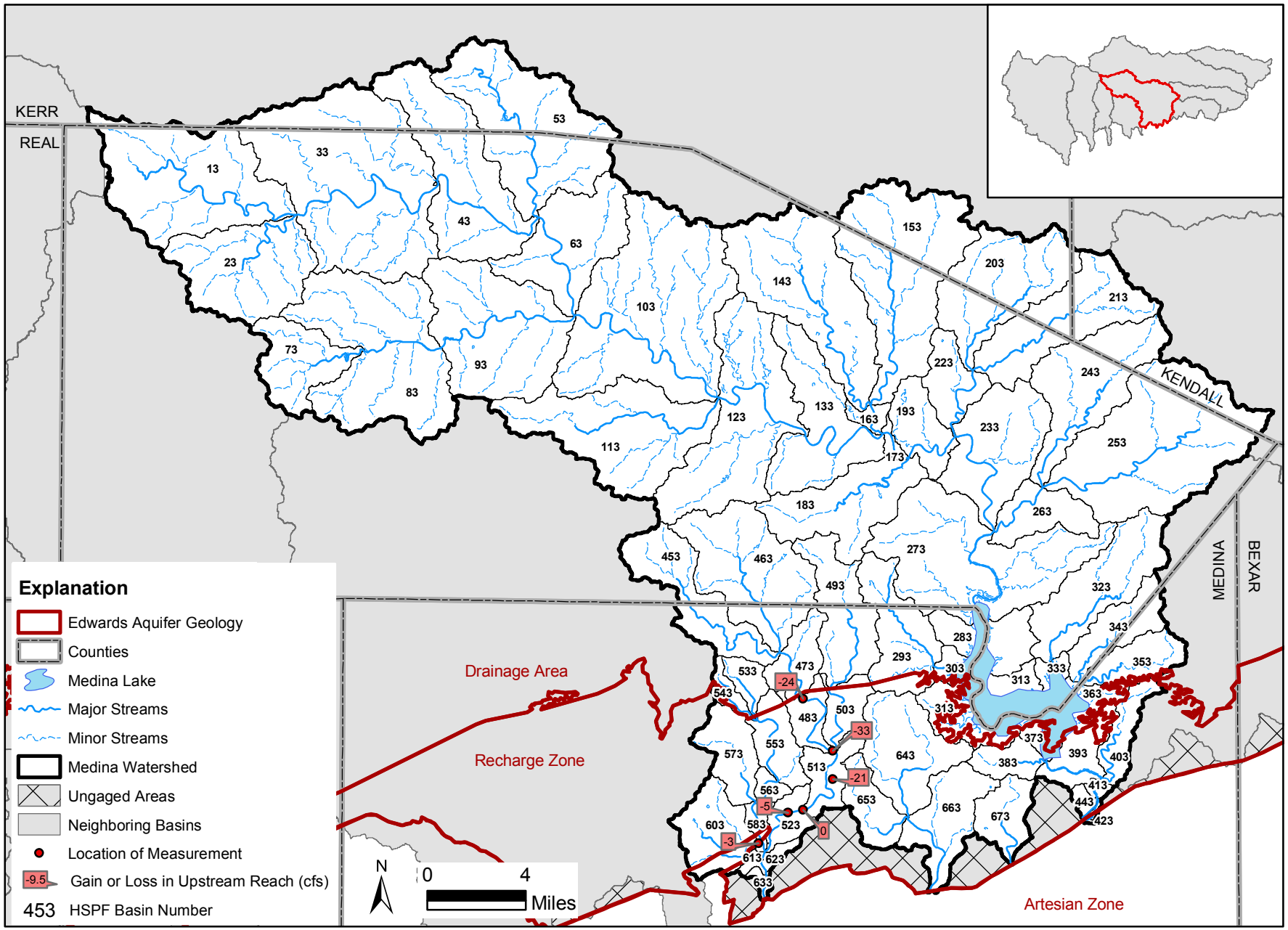

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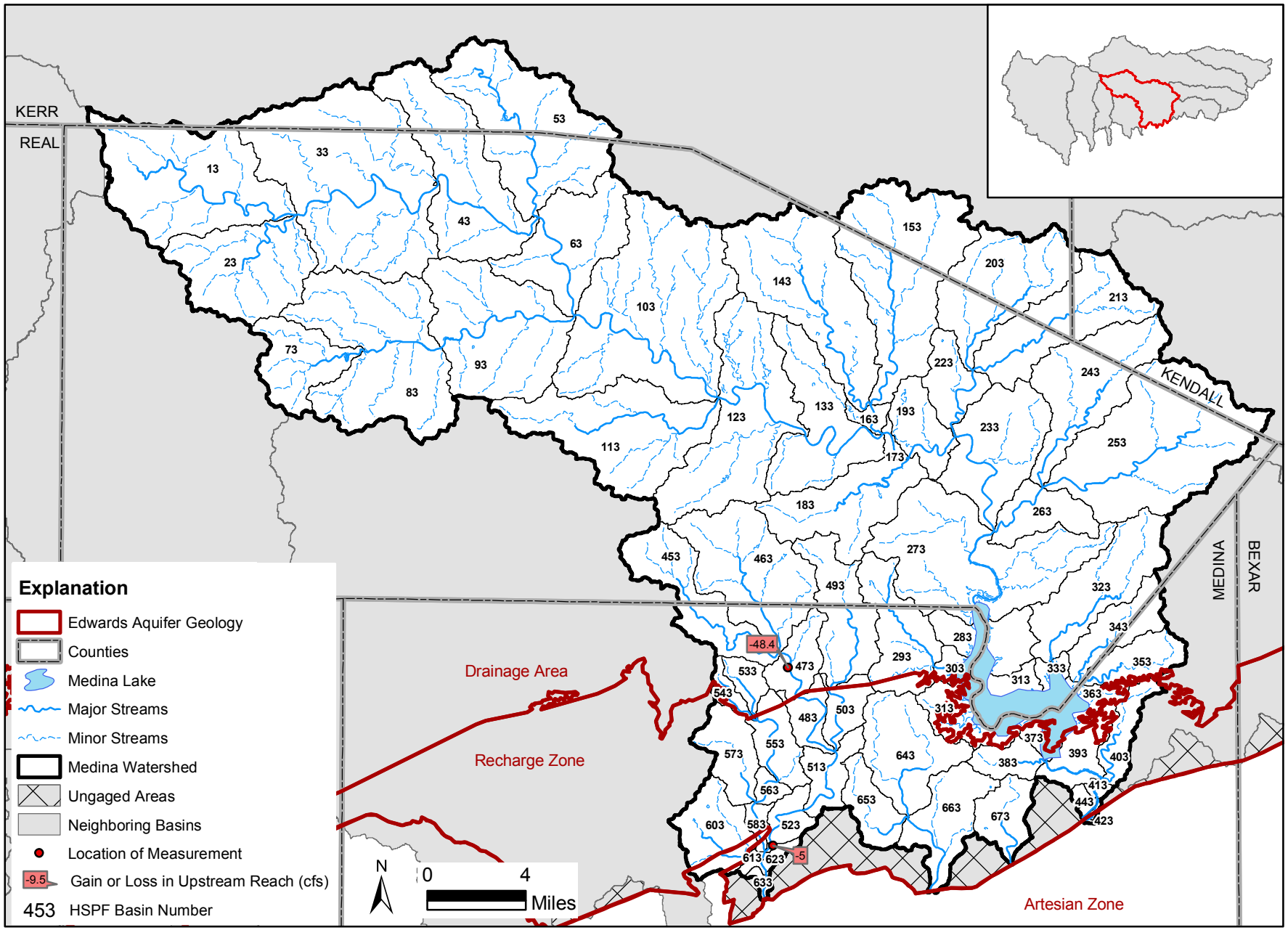

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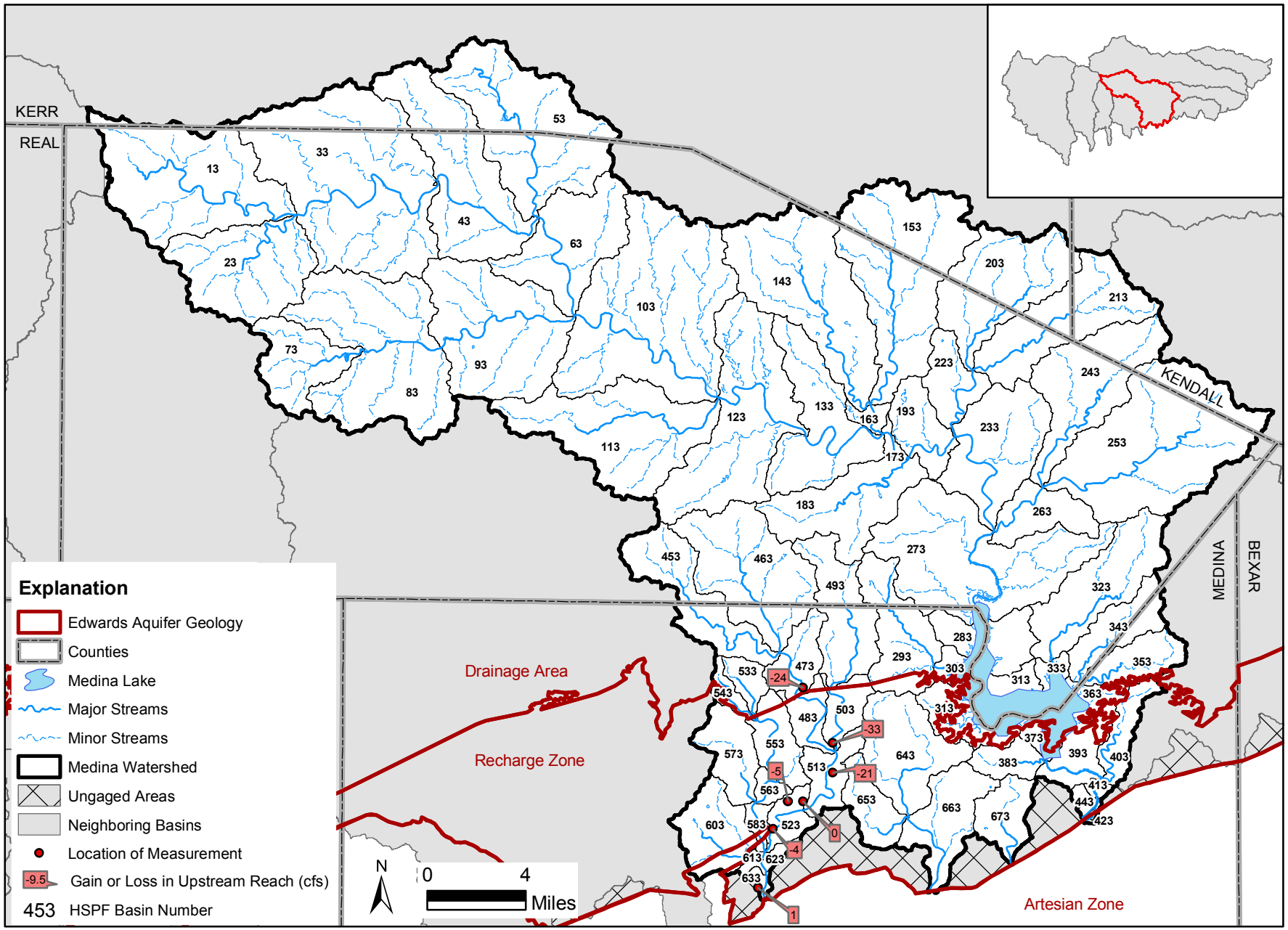
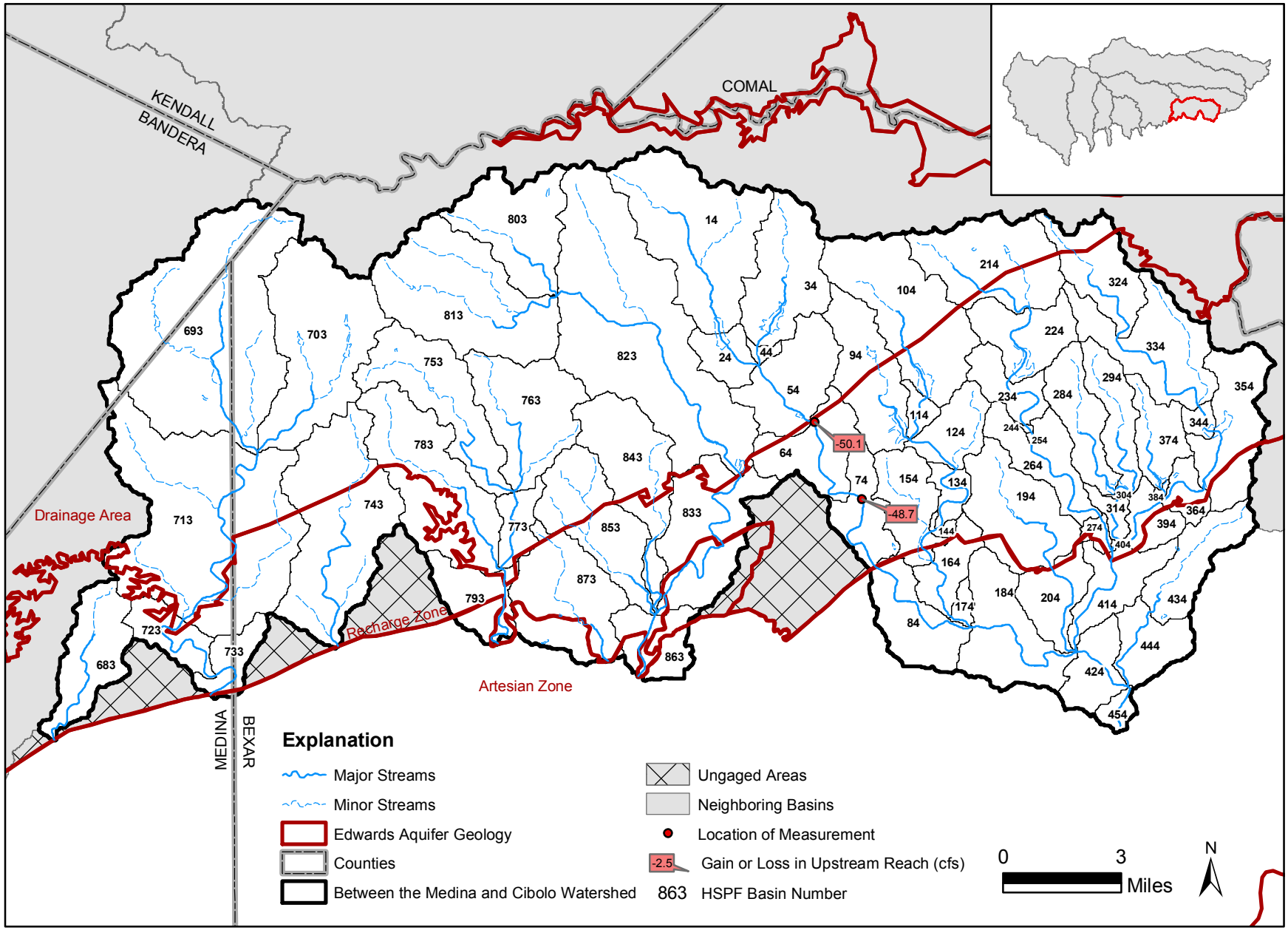
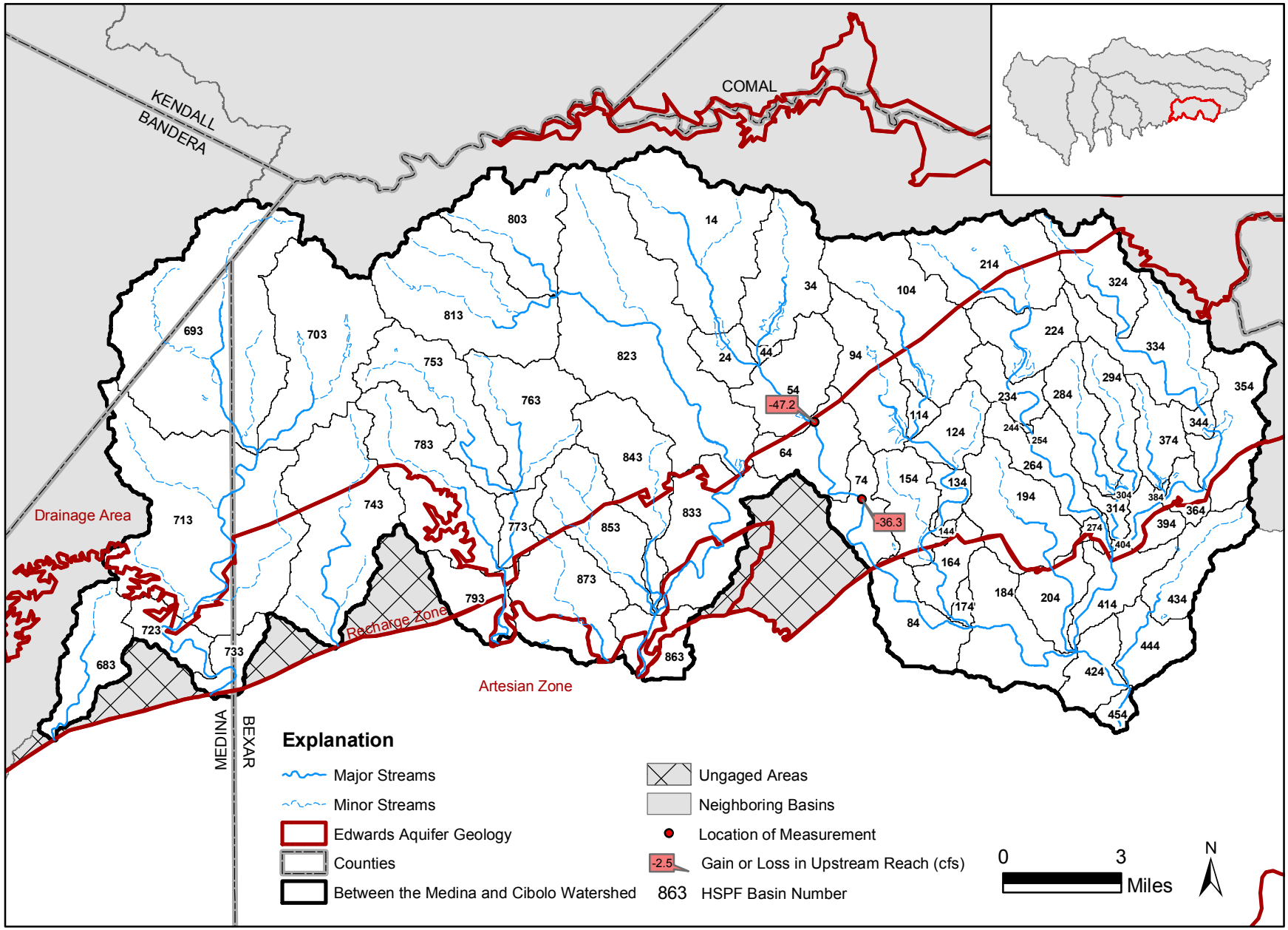


USGS Gain/Loss Study 181 in the Medina Basin

CIBOLO - MEDINA BASIN



USGS Gain/Loss Study 354 Between the Medina and Cibolo Basins



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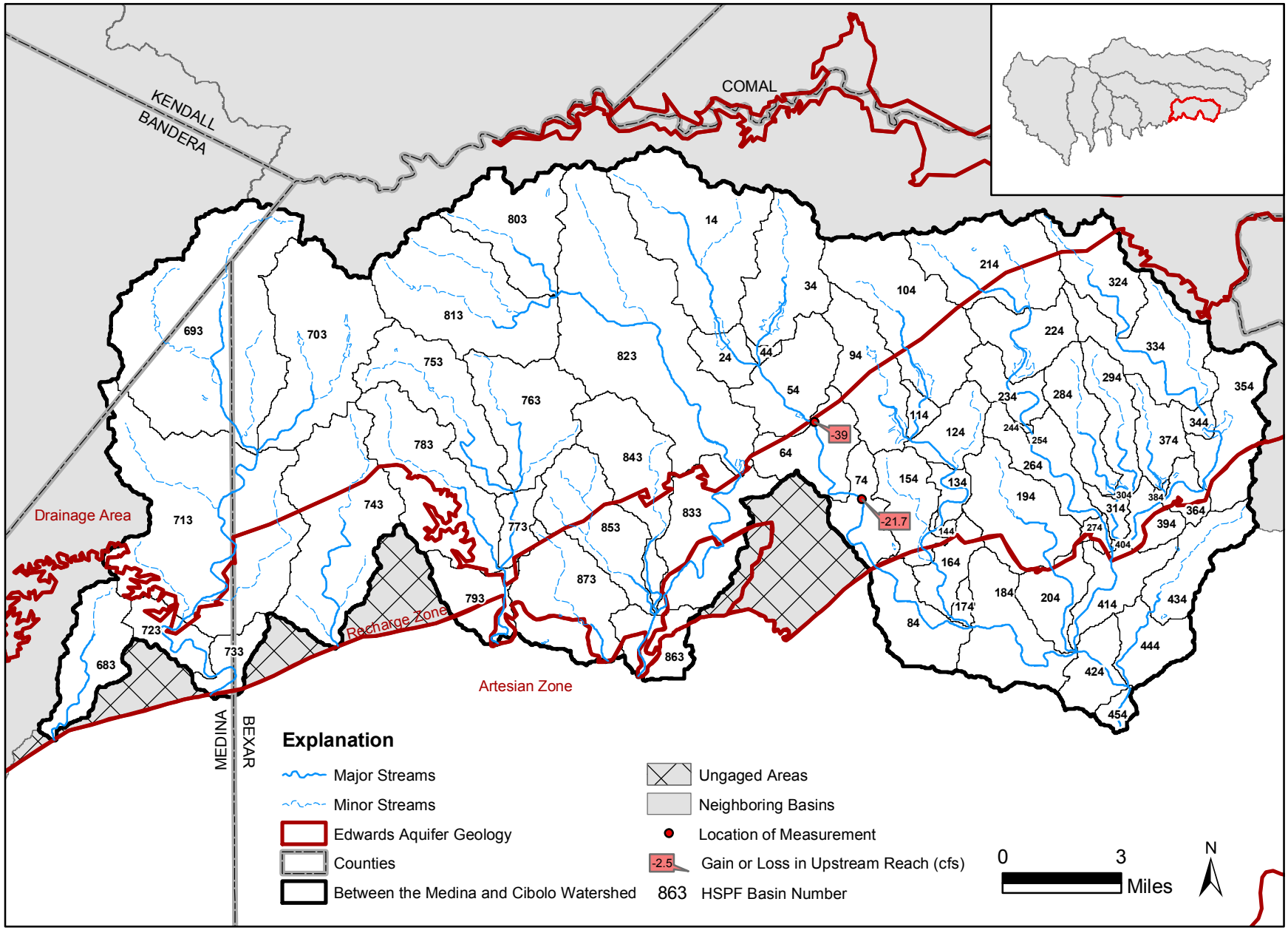

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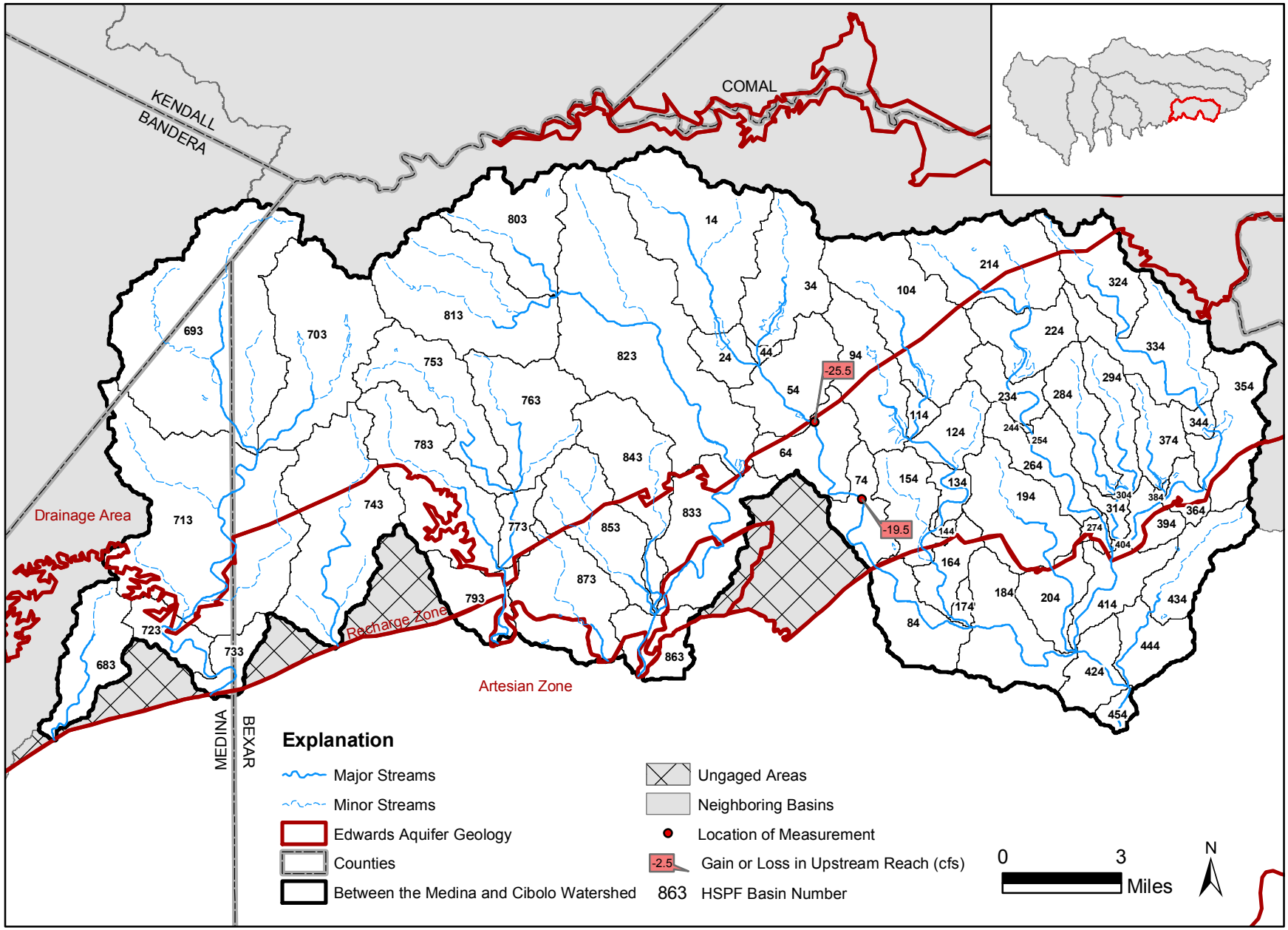
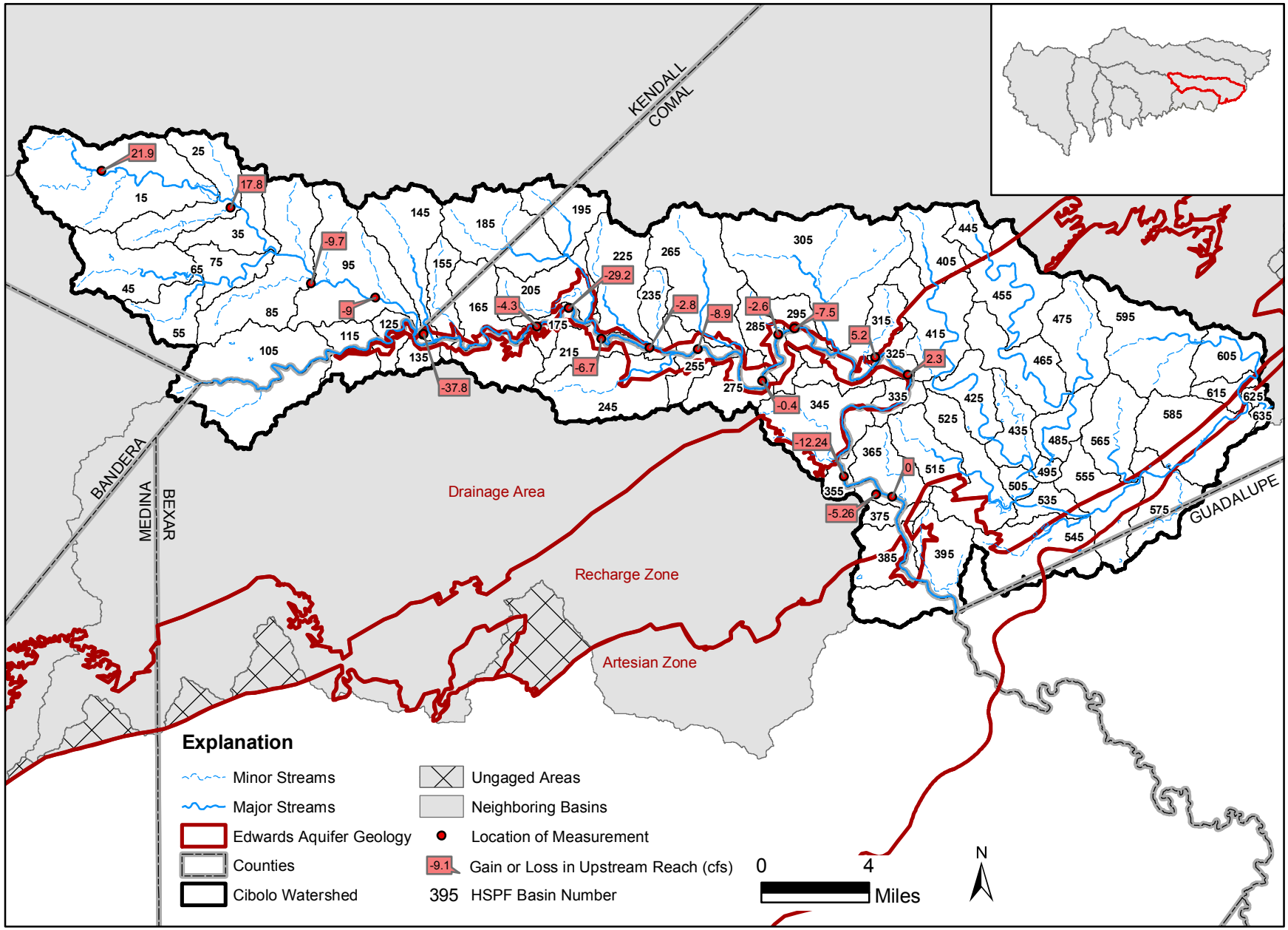


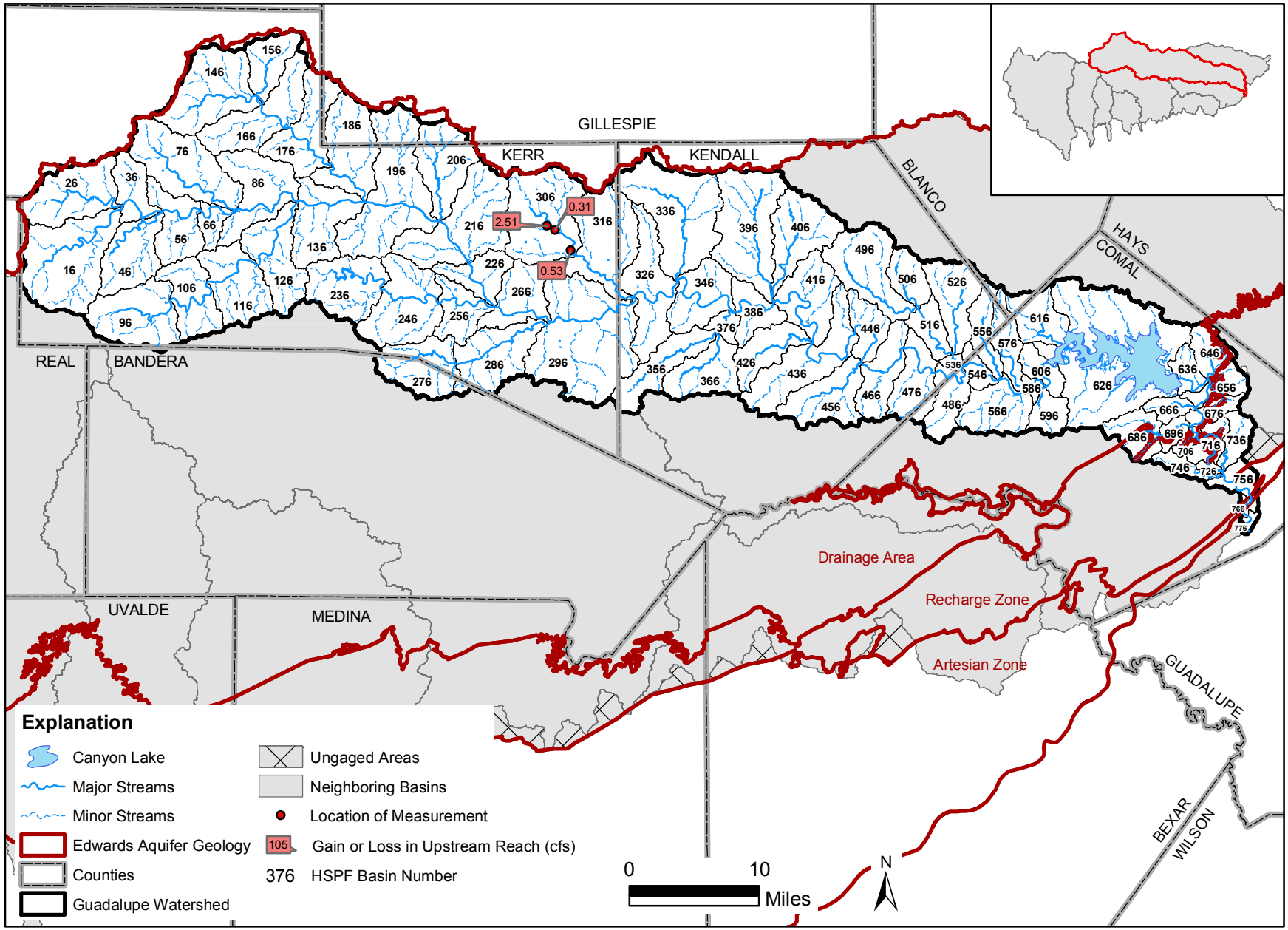
USGS Gain/Loss Study 359 Between the Medina and Cibolo Basins

CIBOLO BASIN

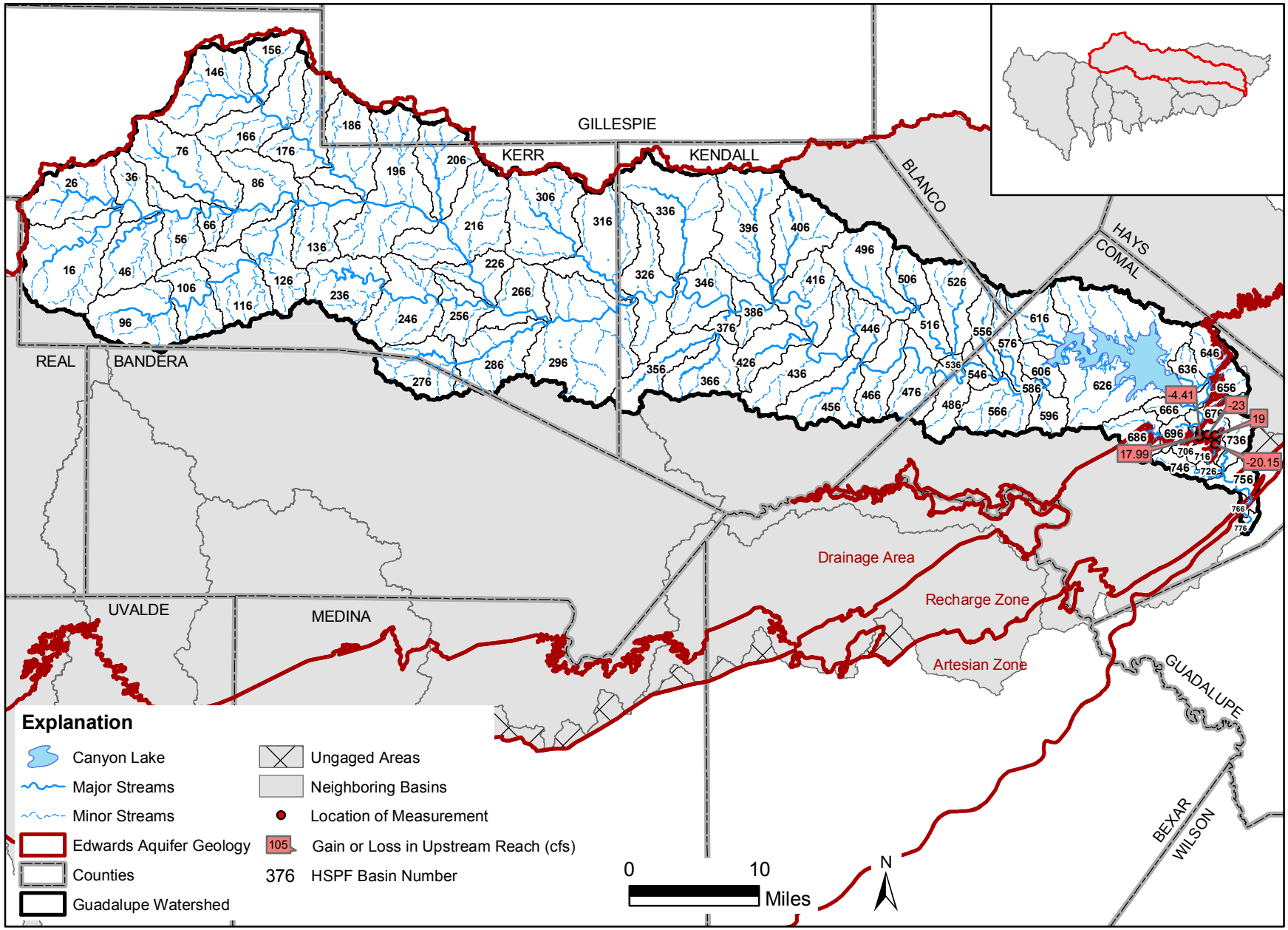


USGS Gain/Loss Study 348 in the Cibolo Basin

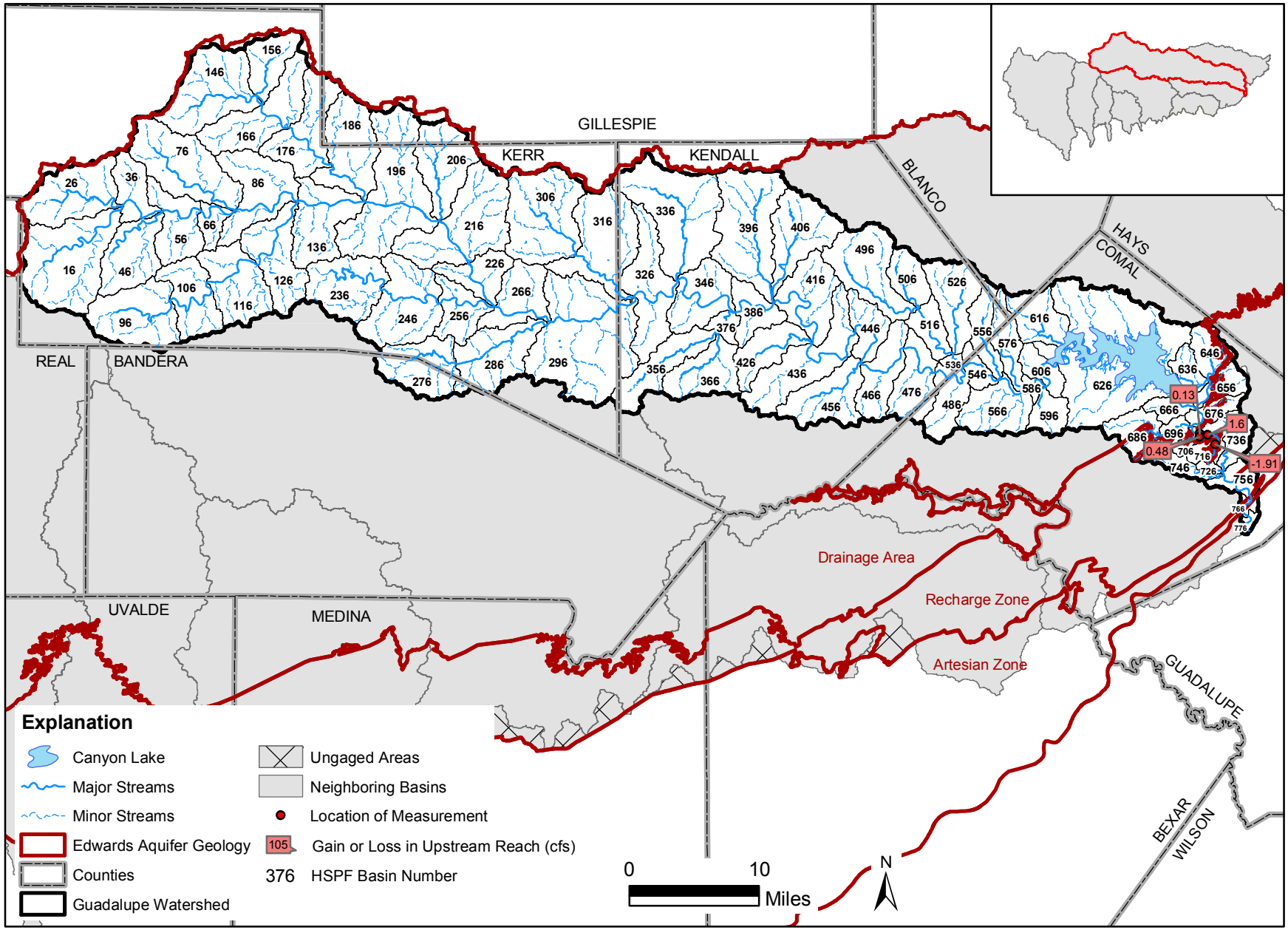
GUADALUPE BASIN



USGS Gain Loss Study 105 in the Guadalupe Basin



USGS Gain Loss Study 107 in the Guadalupe Basin



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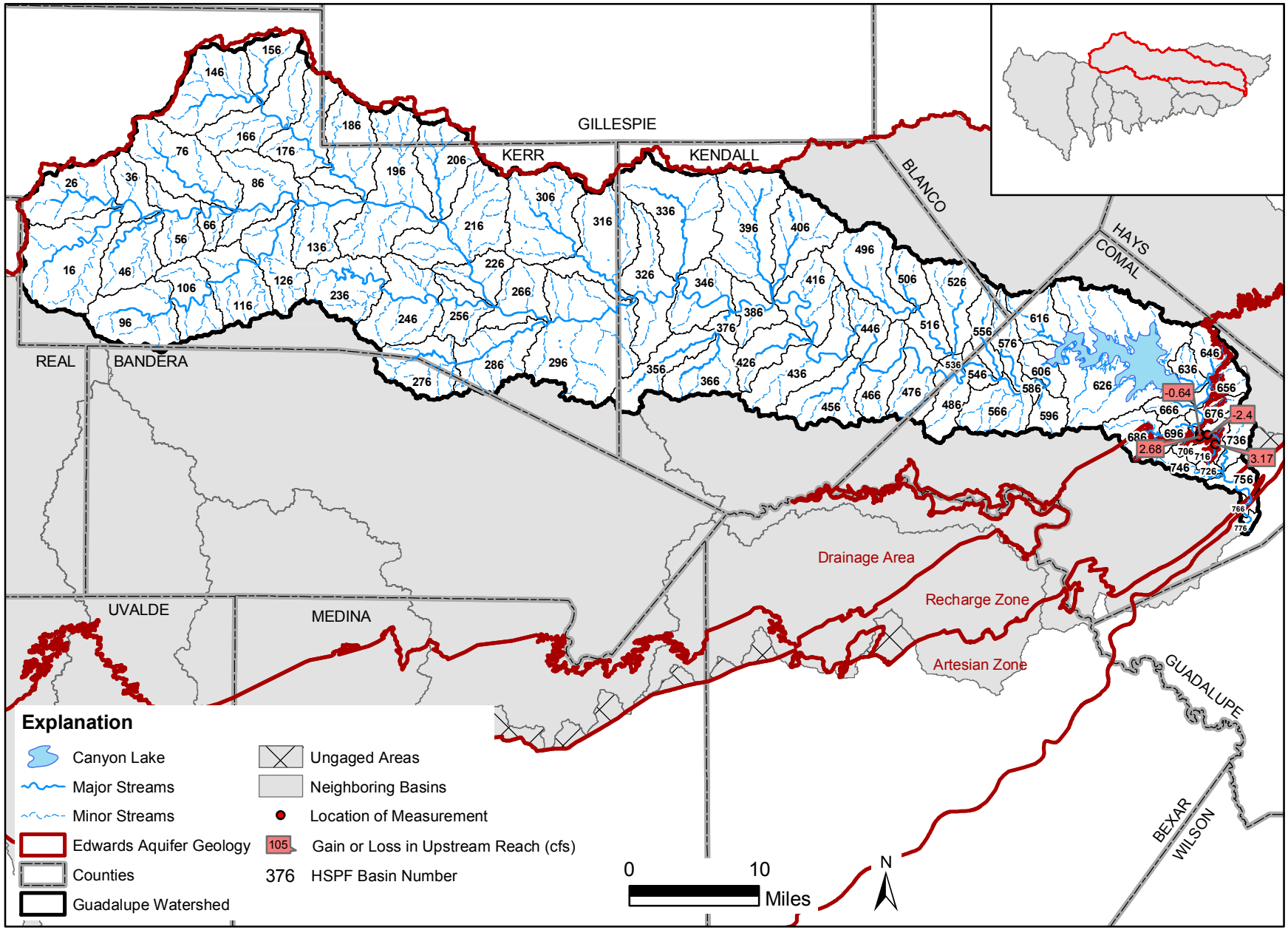

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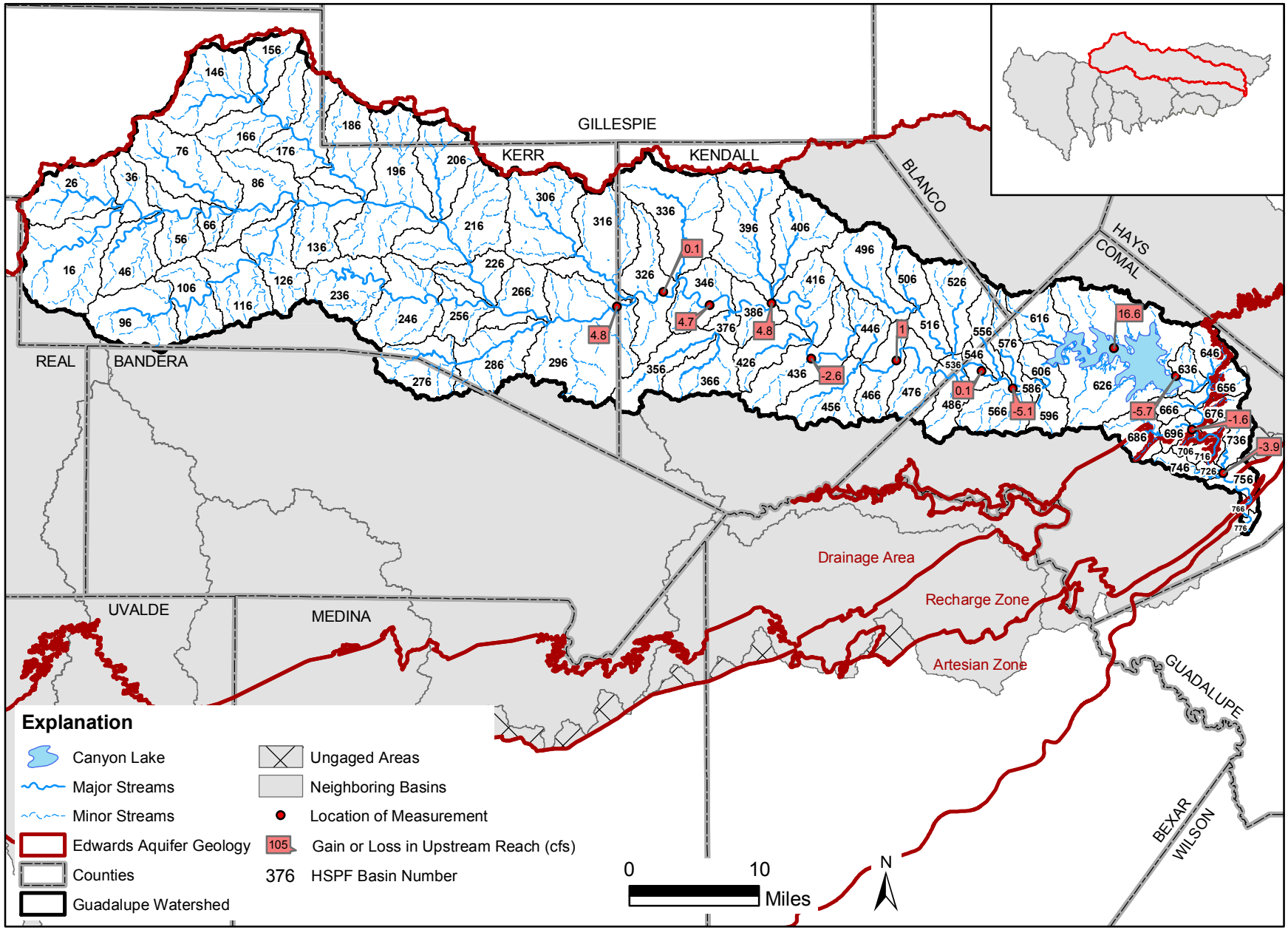

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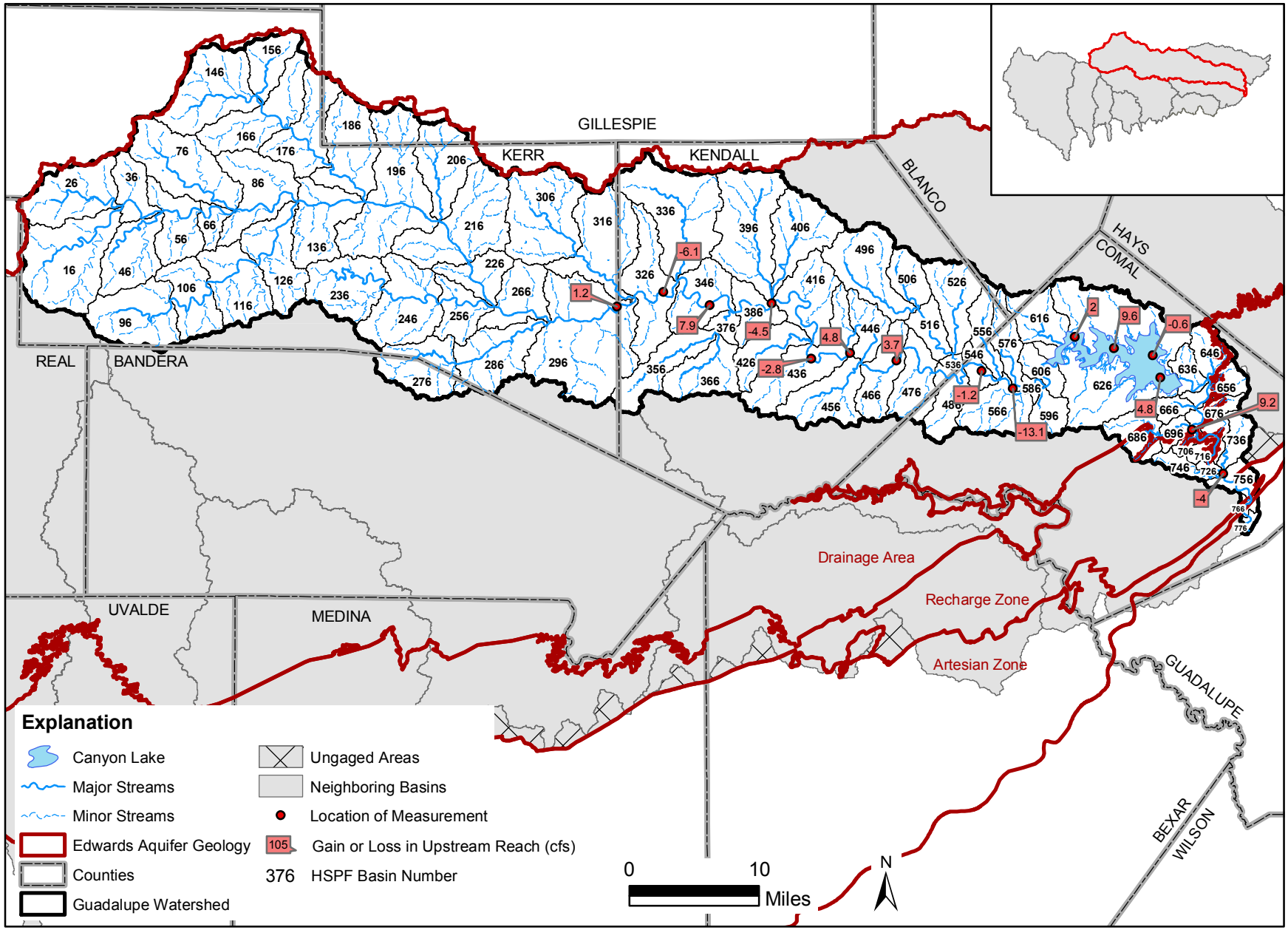

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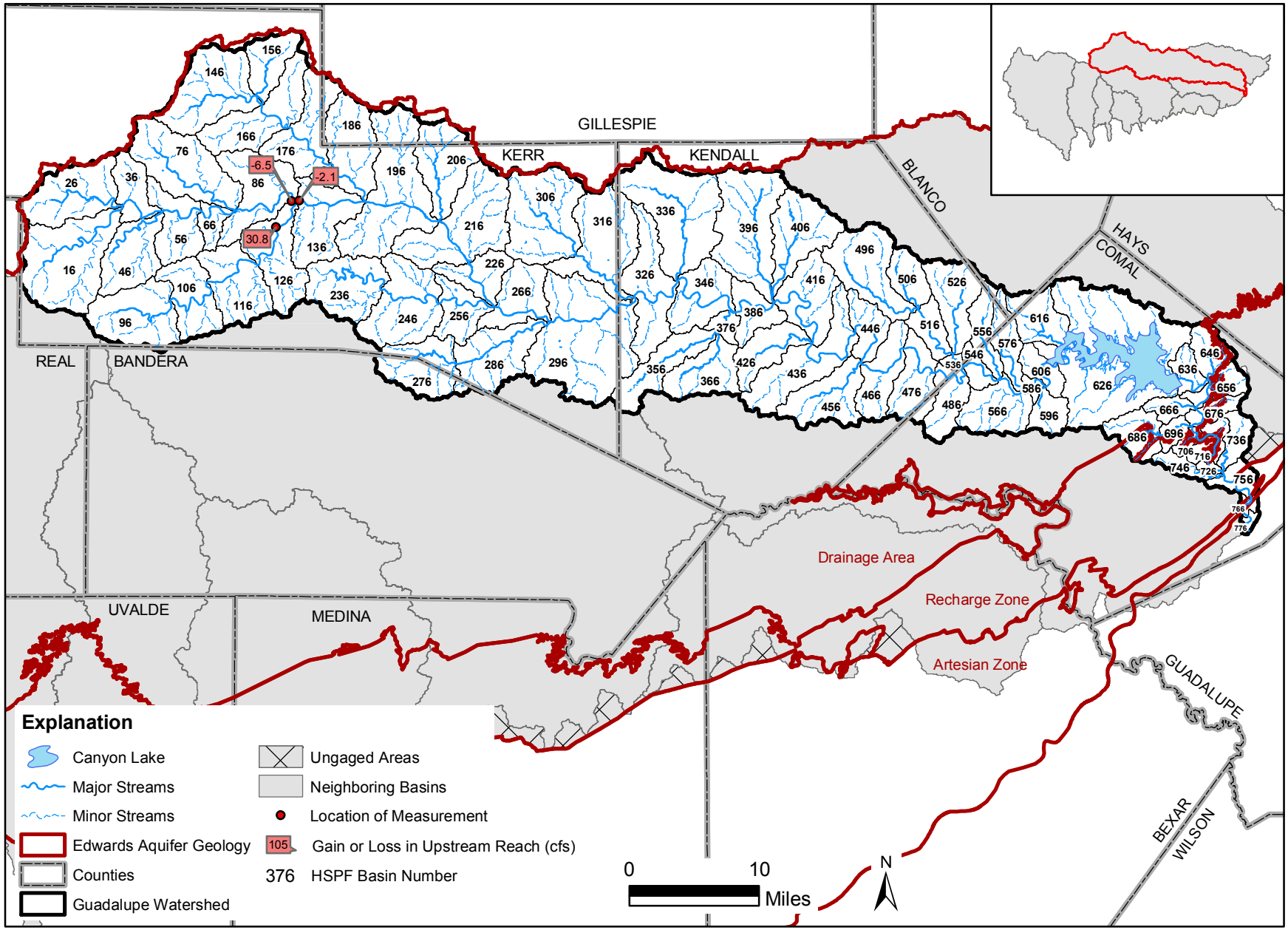

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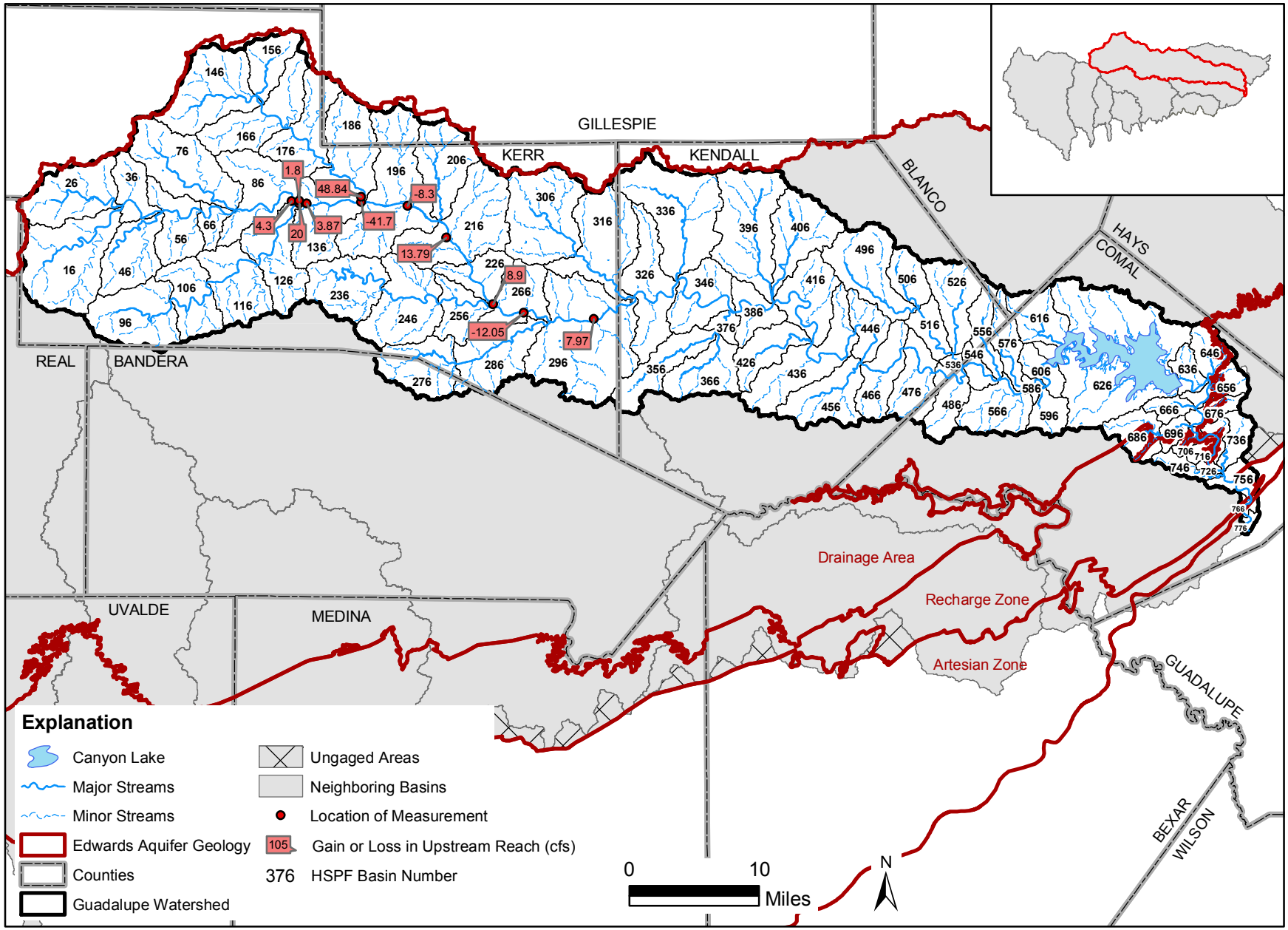

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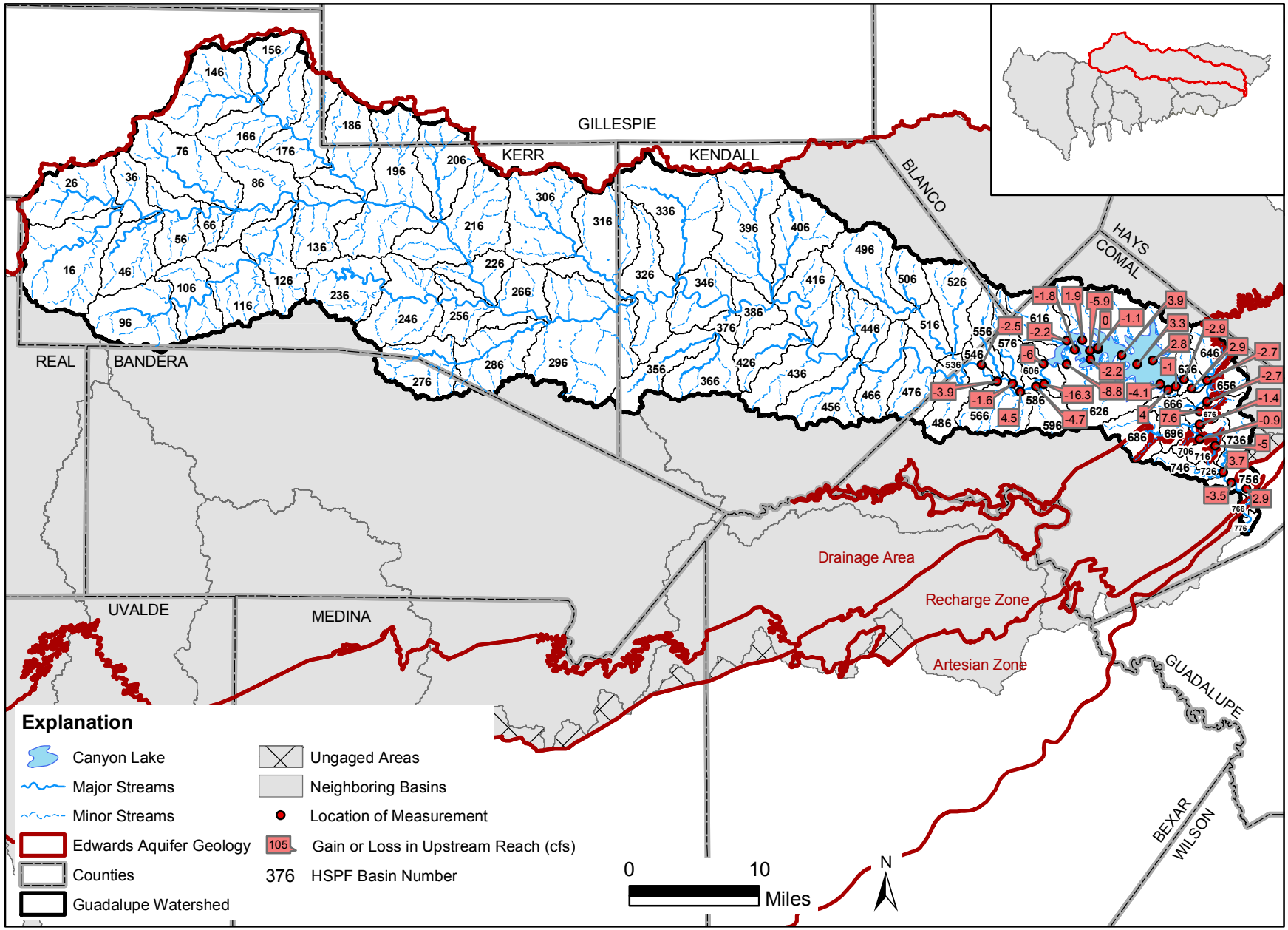

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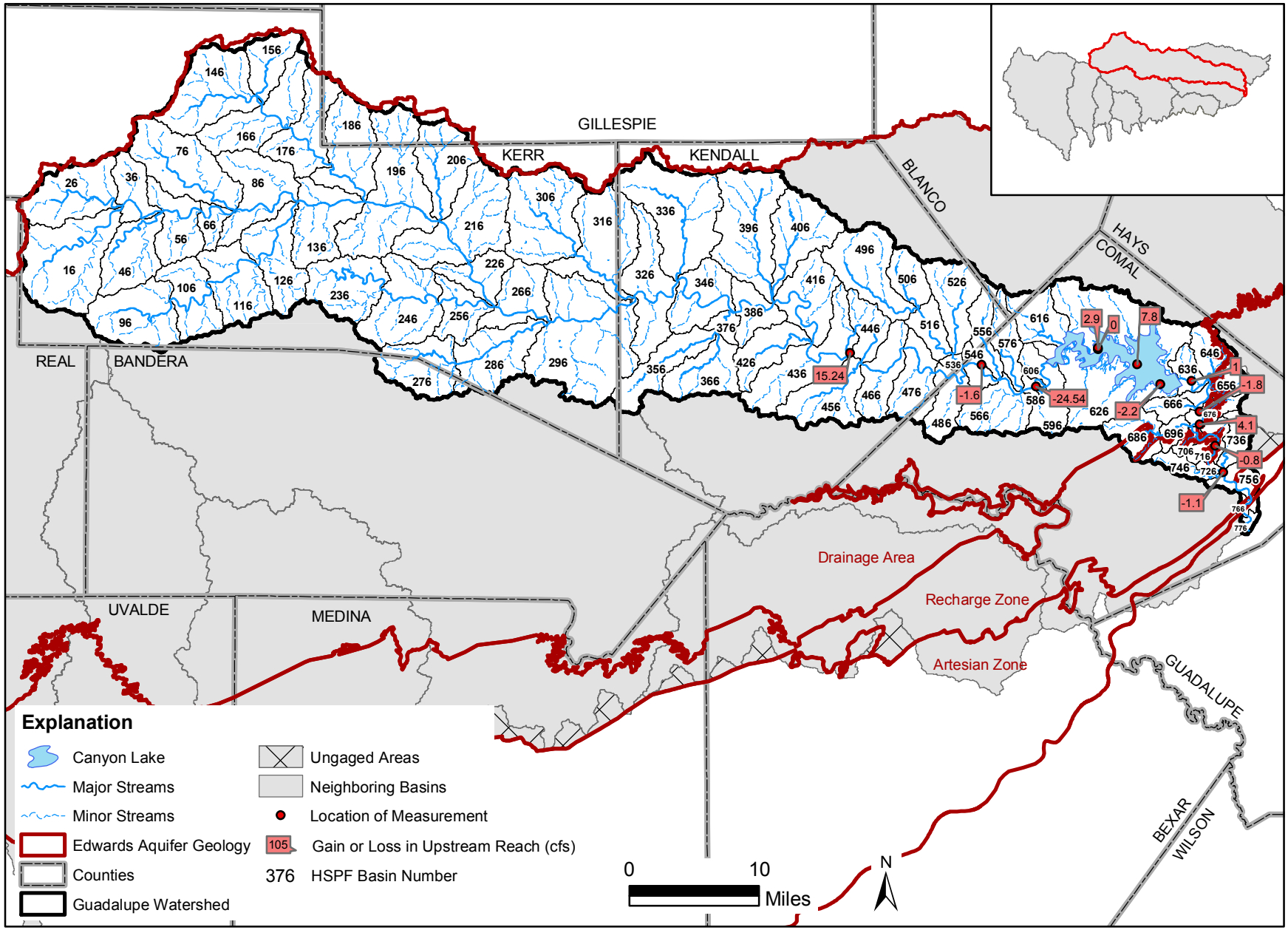

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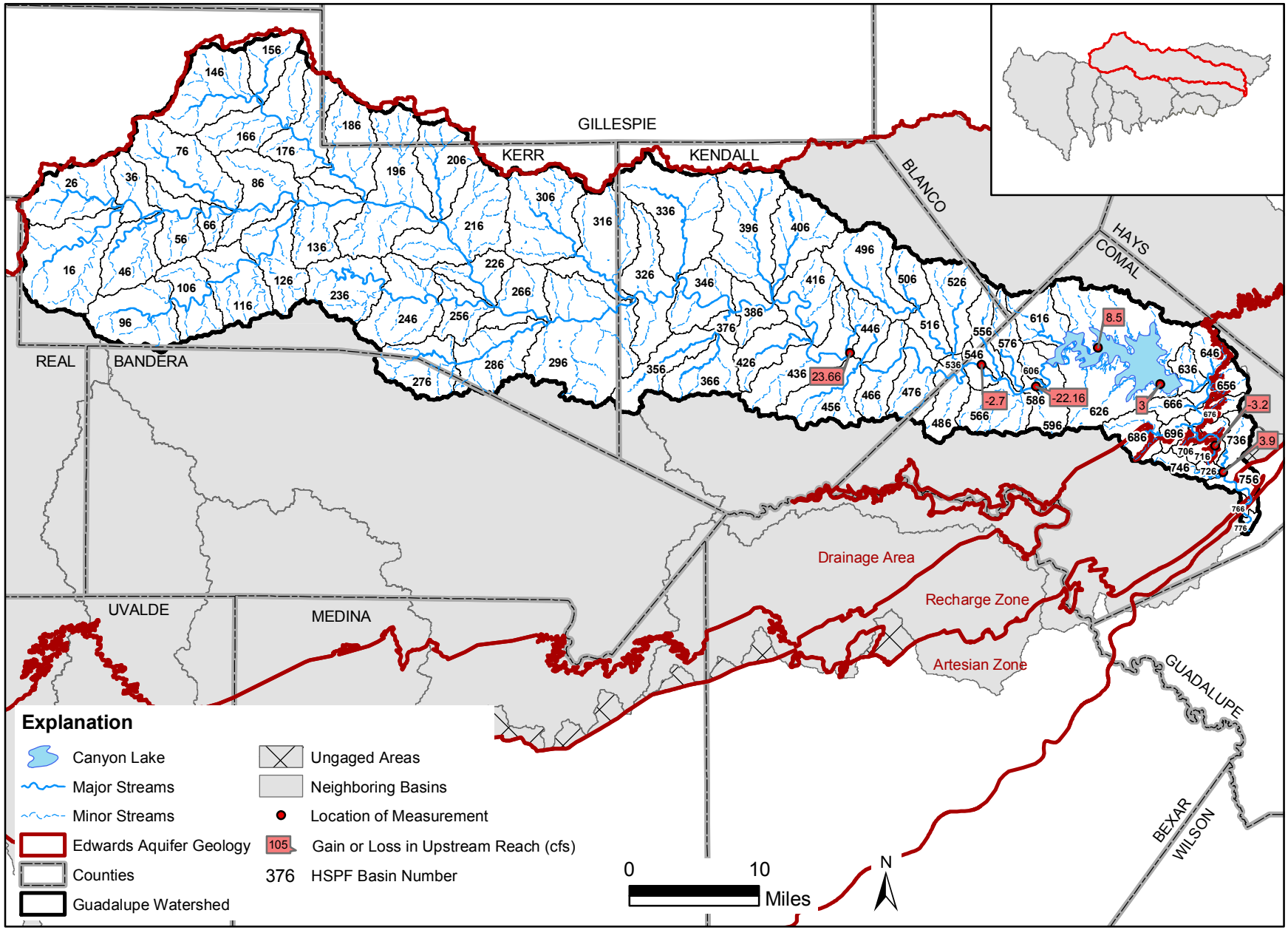

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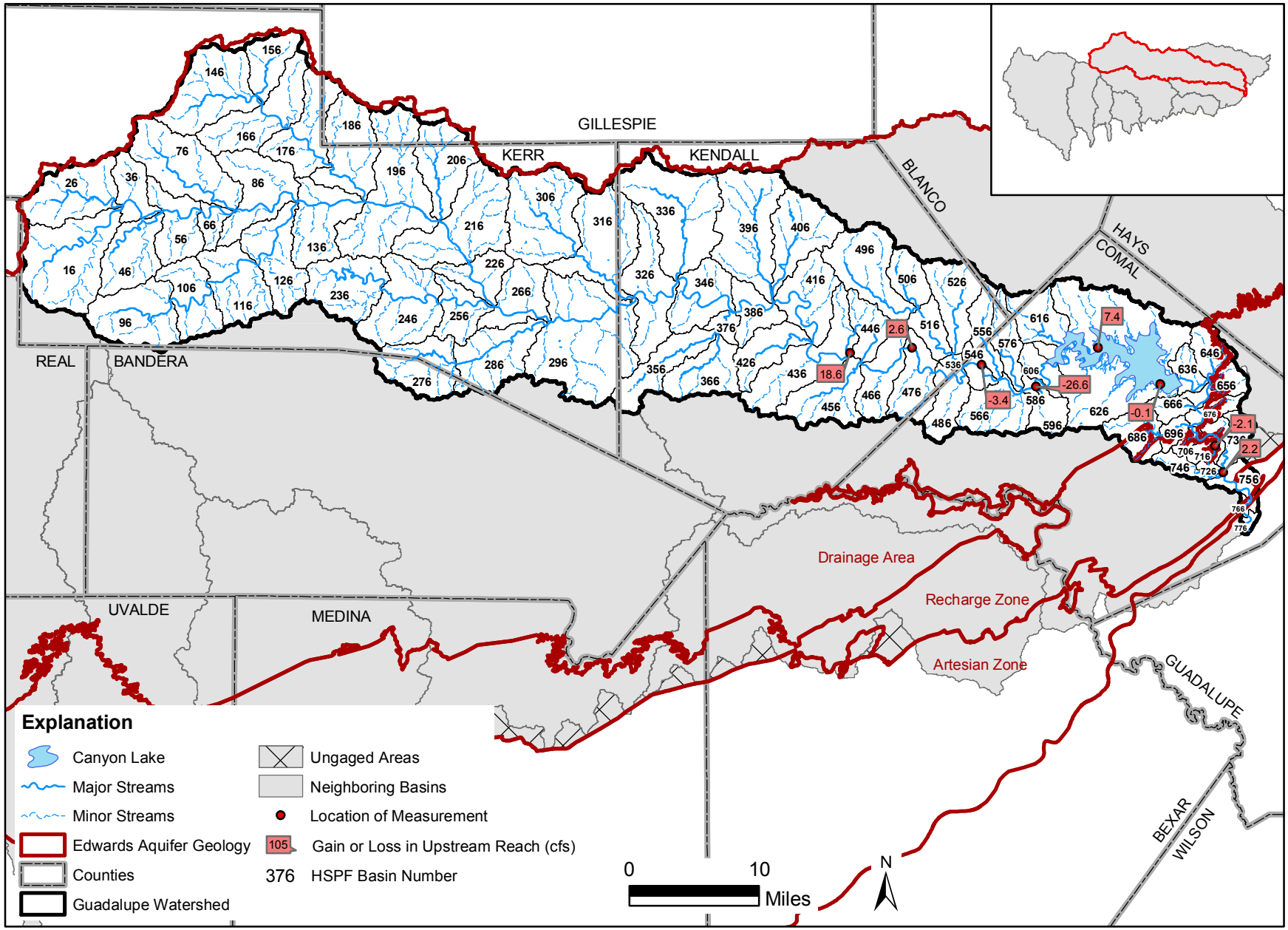

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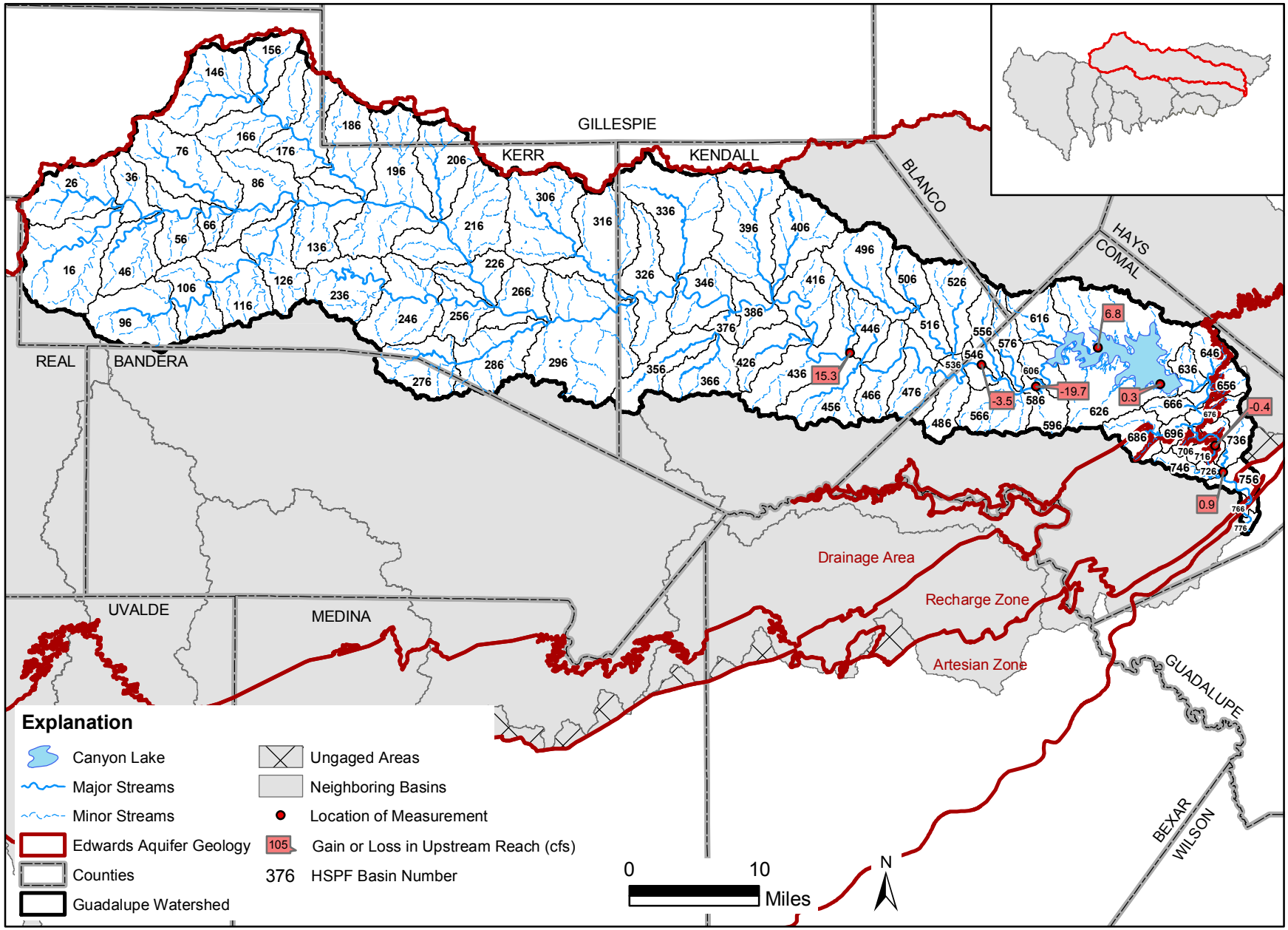

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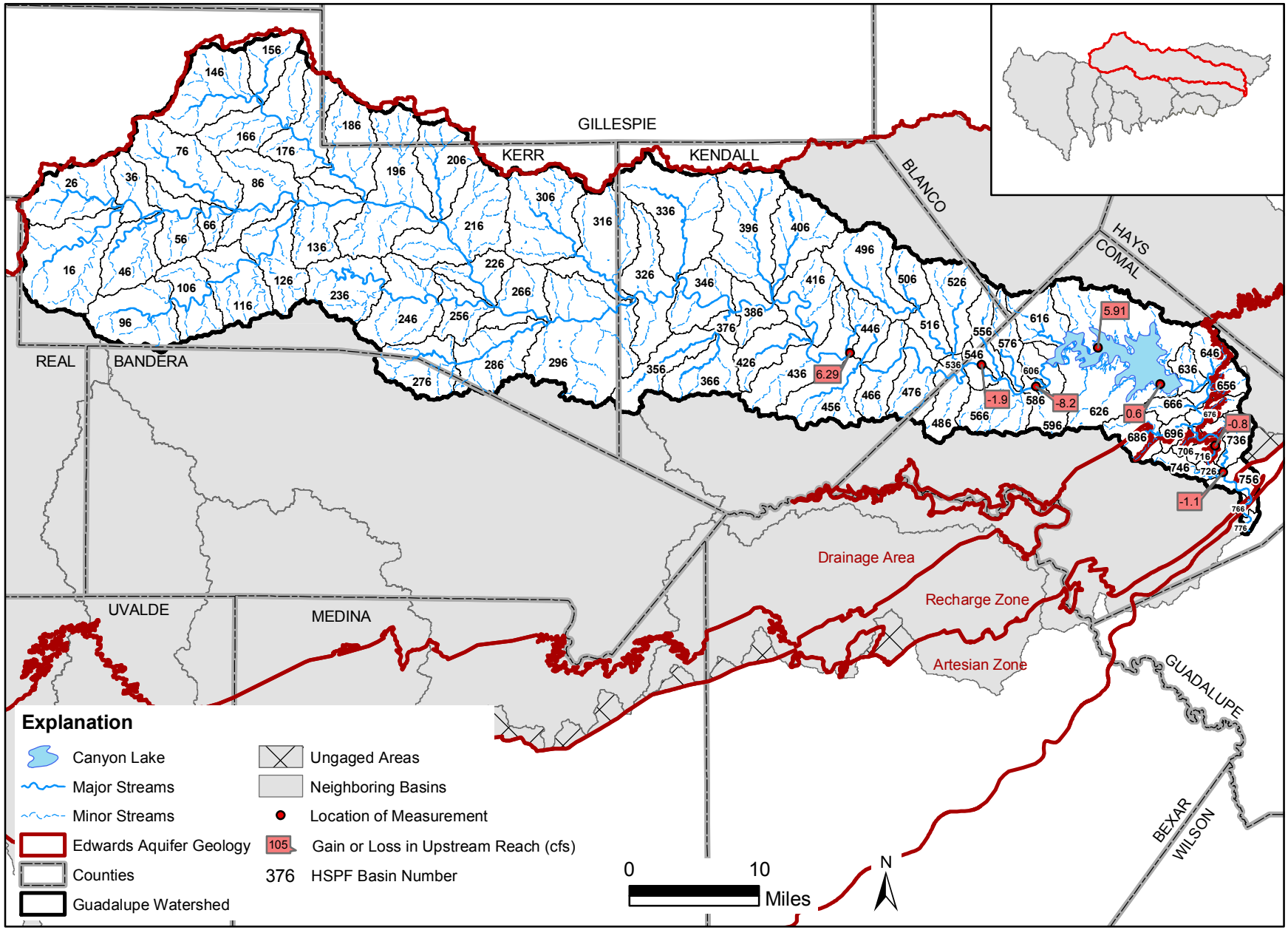

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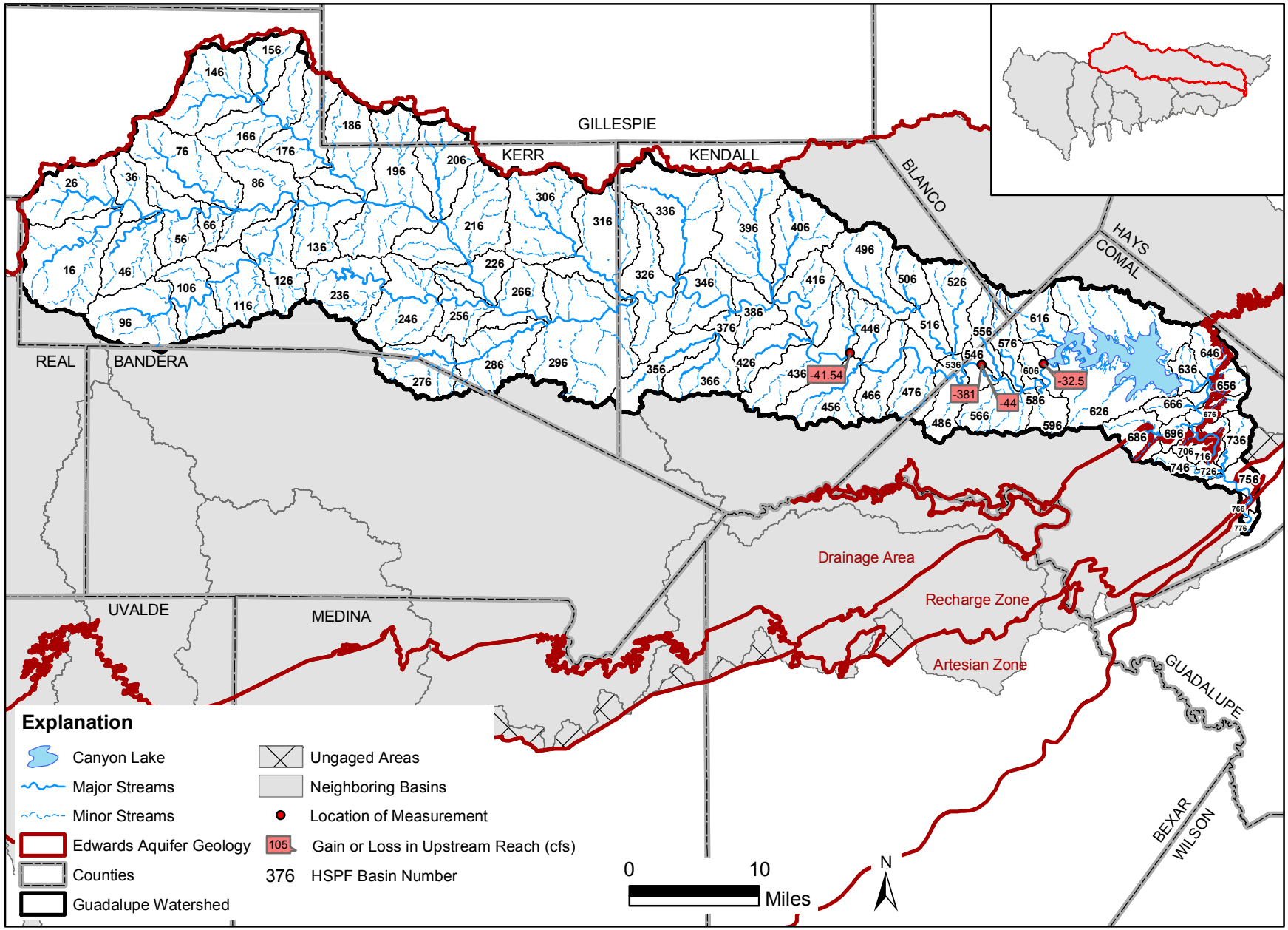

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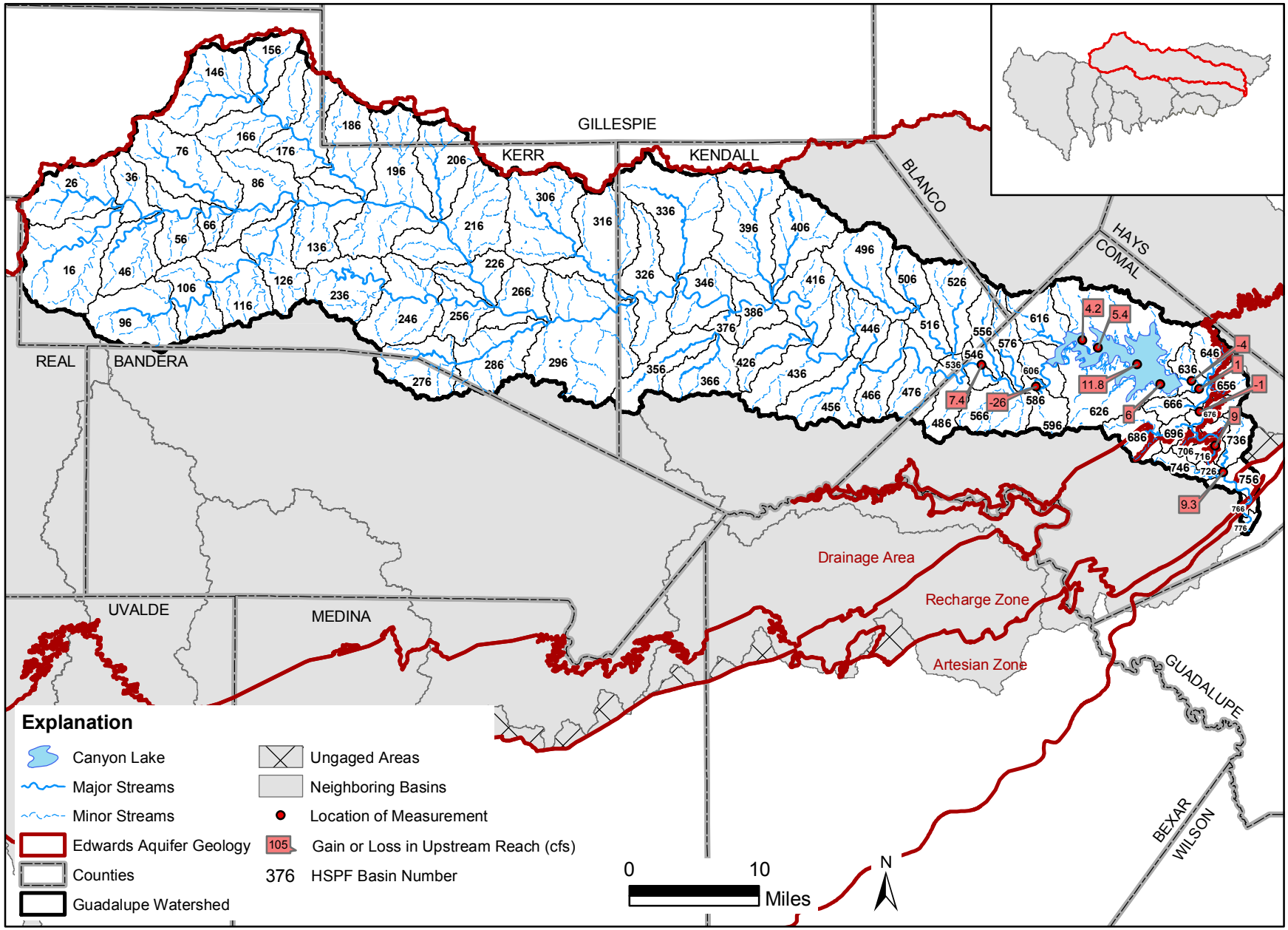

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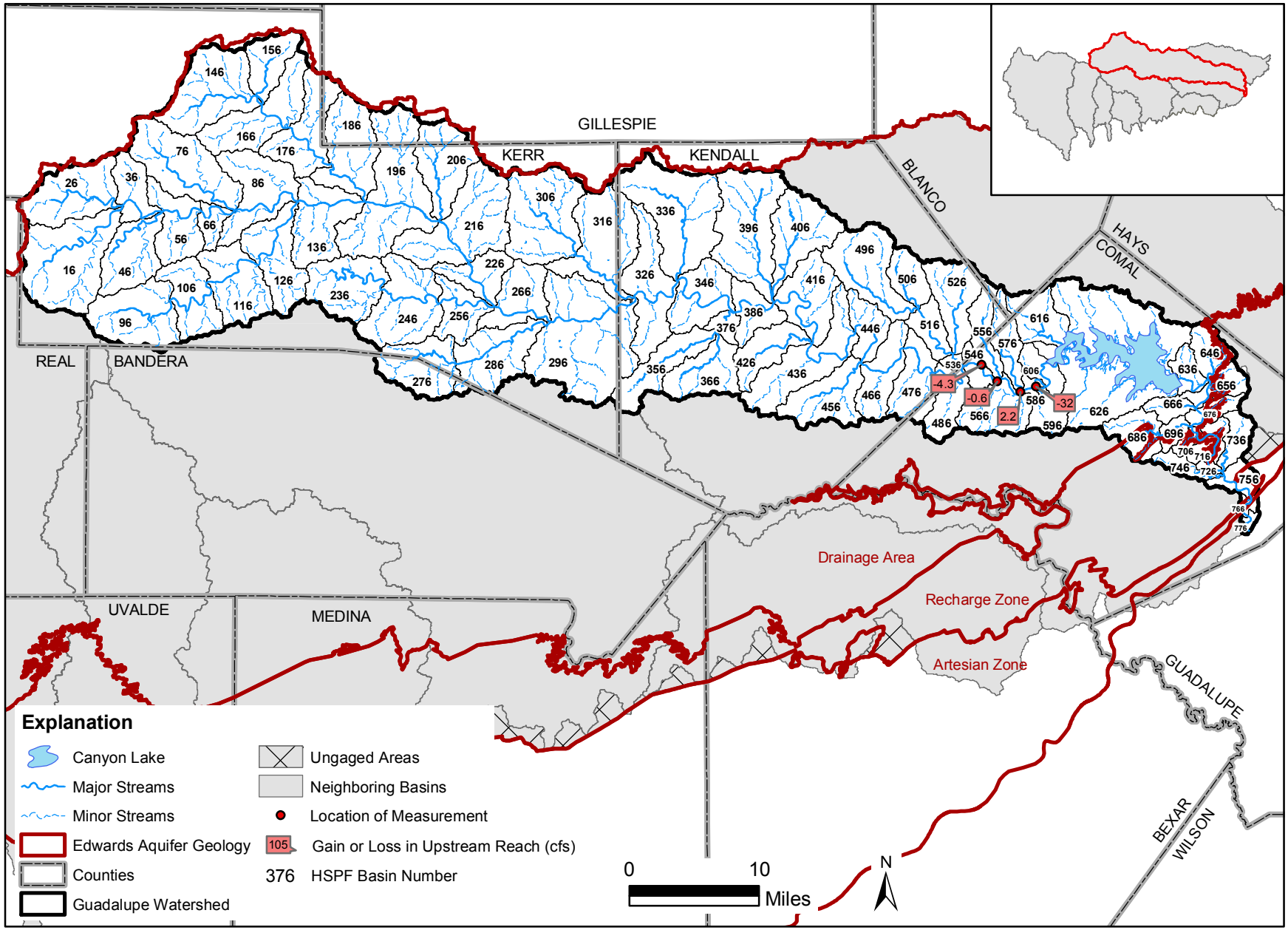

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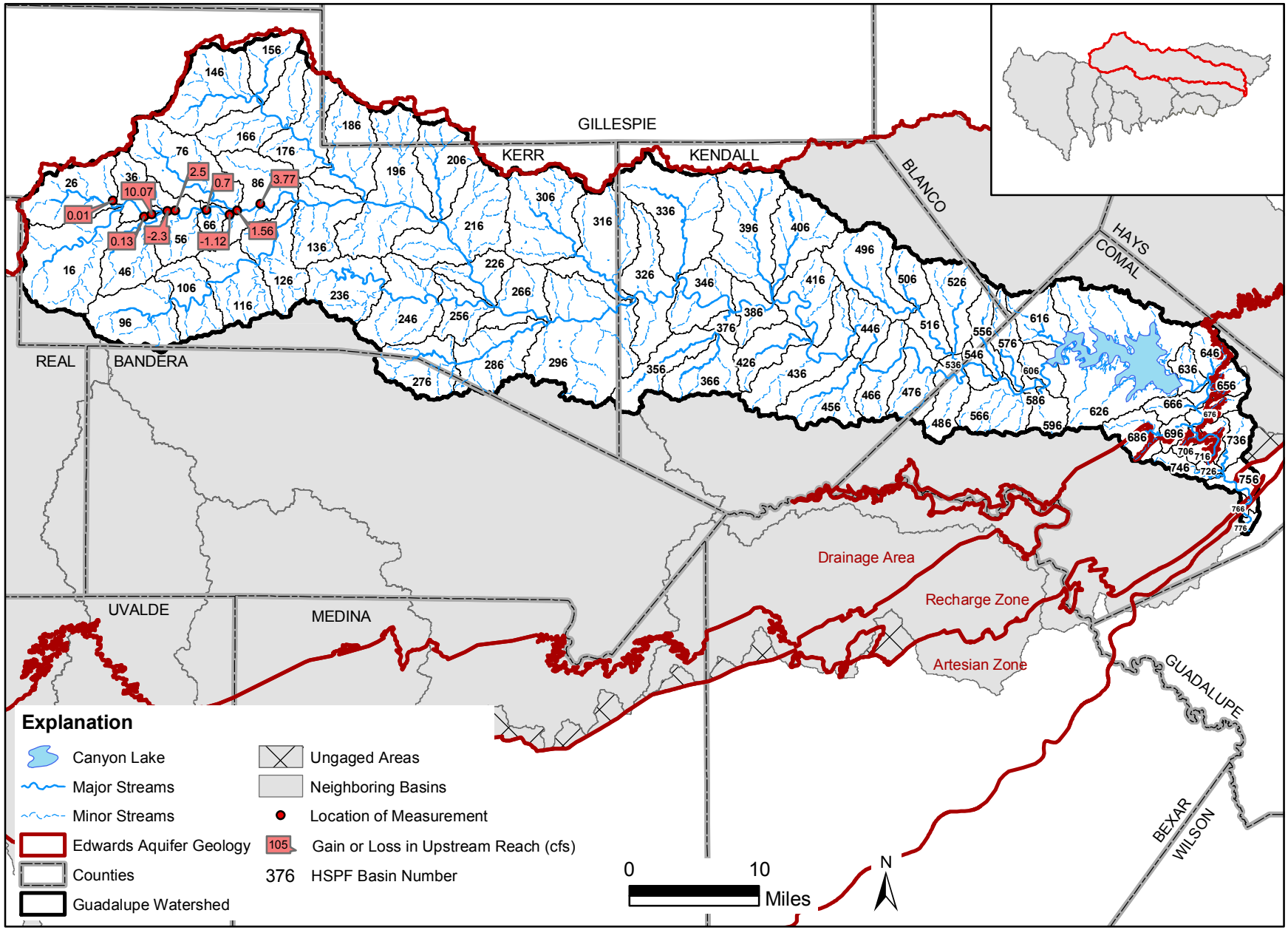
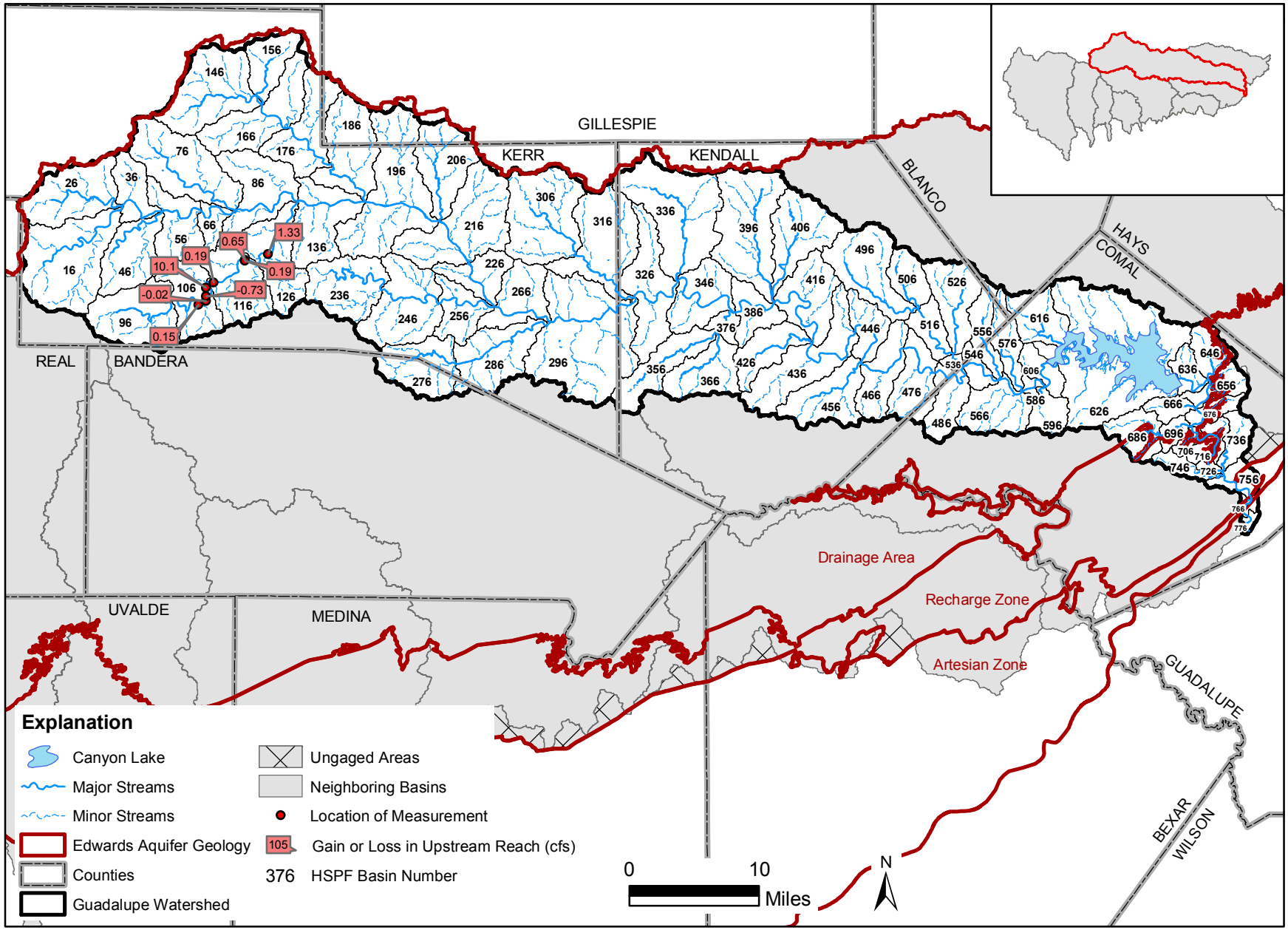
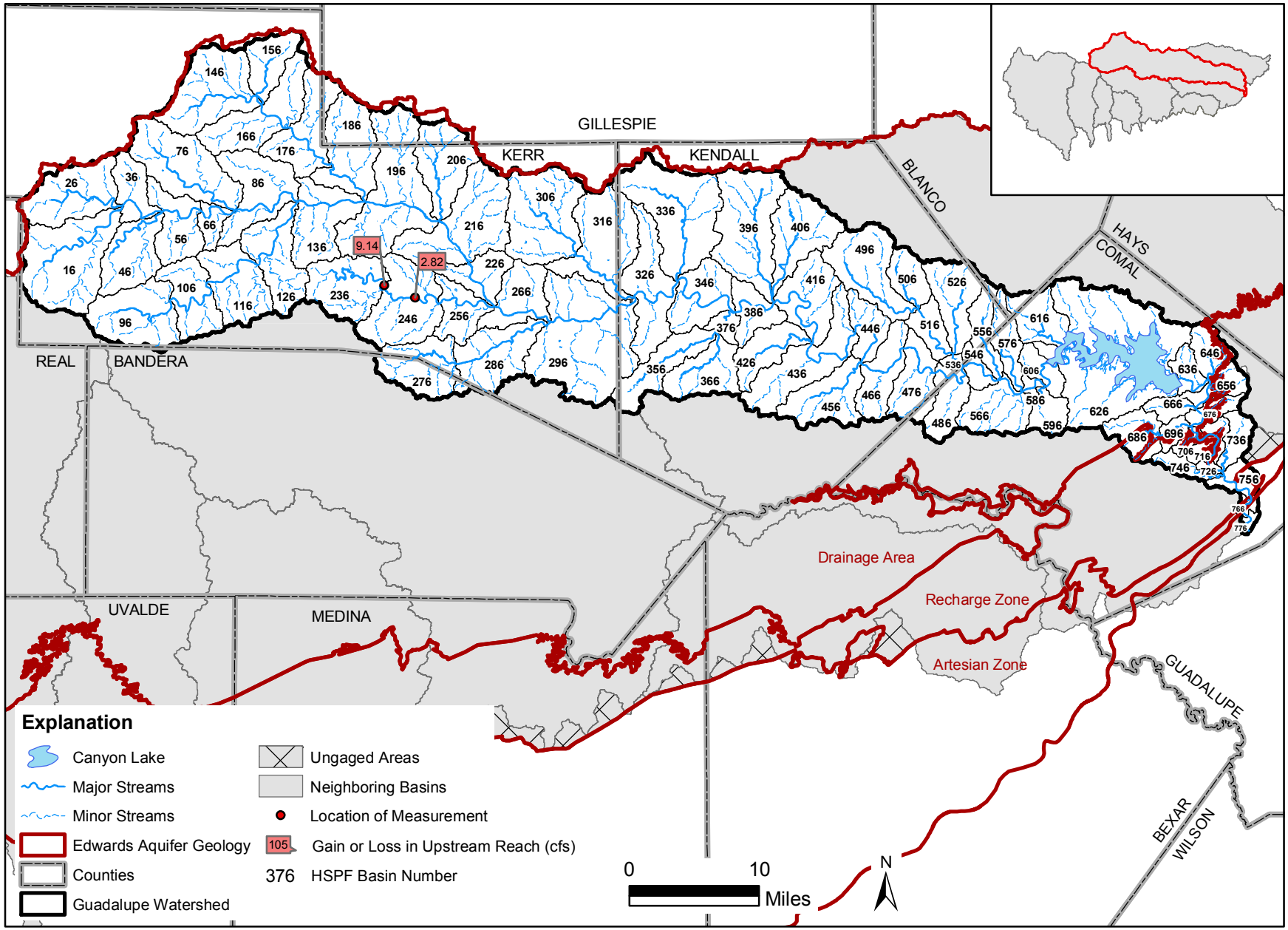


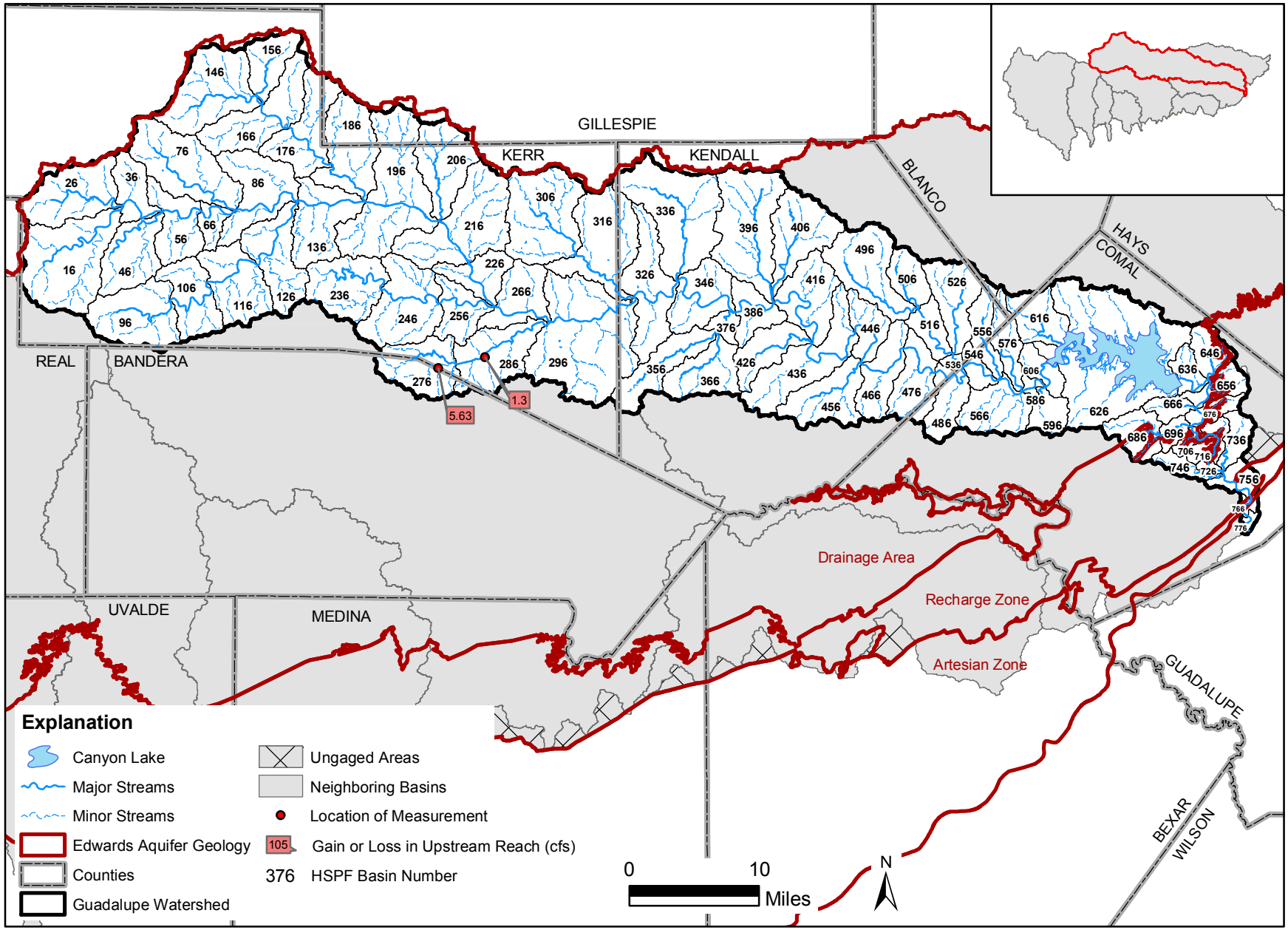
USGS Gain Loss Study 131 in the Guadalupe Basin



USGS Gain Loss Study 132 in the Guadalupe Basin

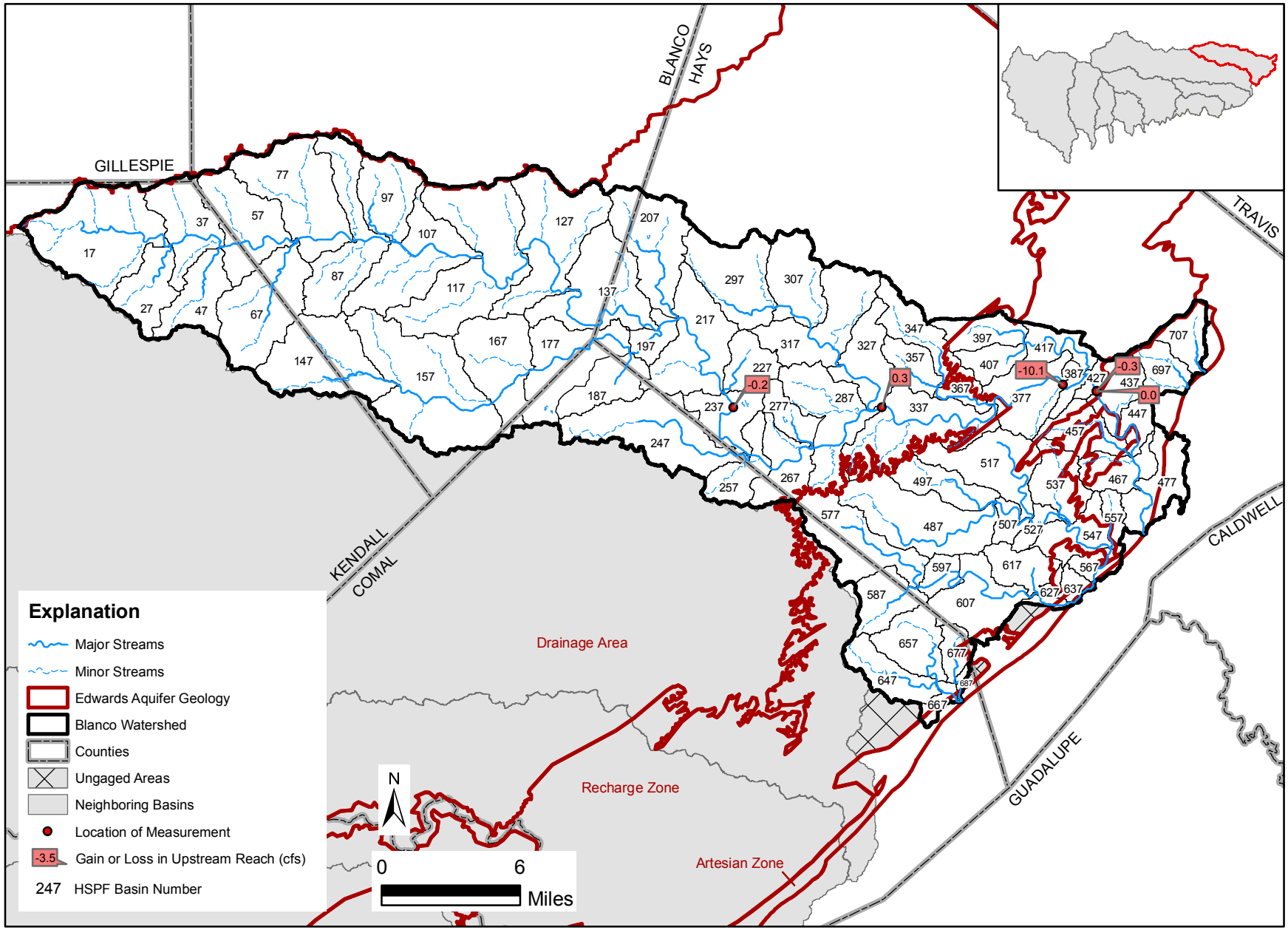


USGS Gain Loss Study 133 in the Guadalupe Basin

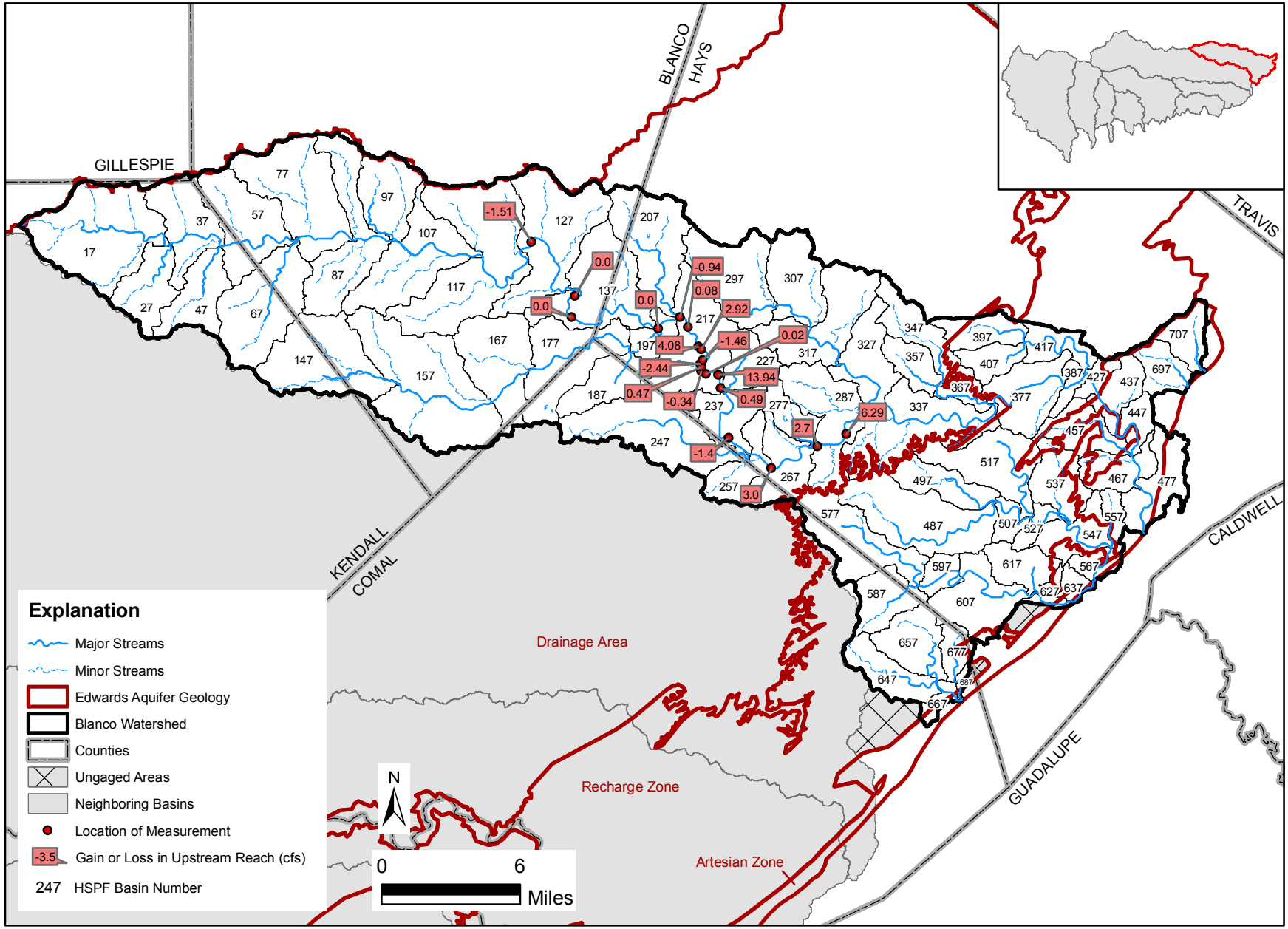


USGS Gain Loss Study 134 in the Guadalupe Basin

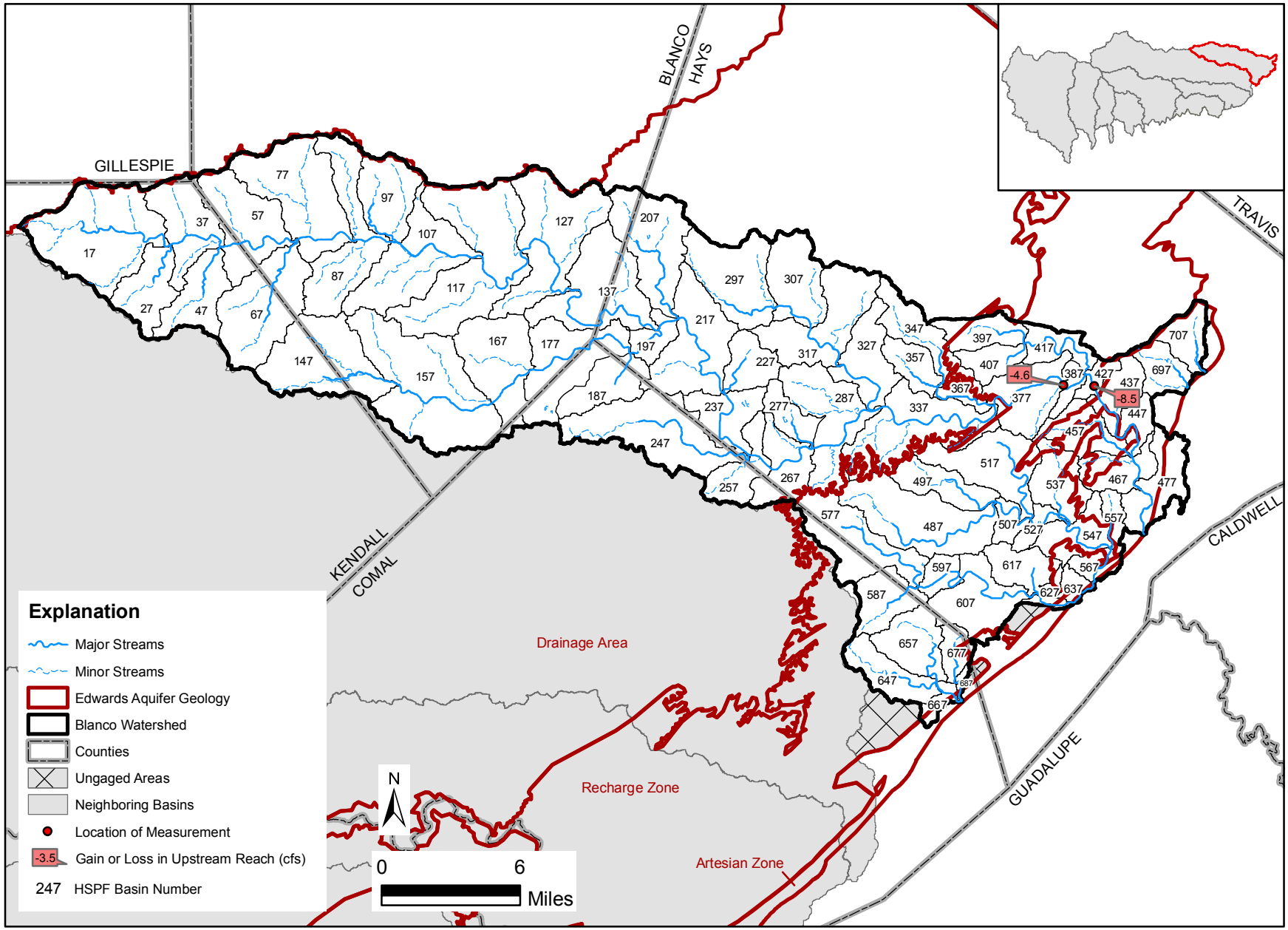
BLANCO BASIN



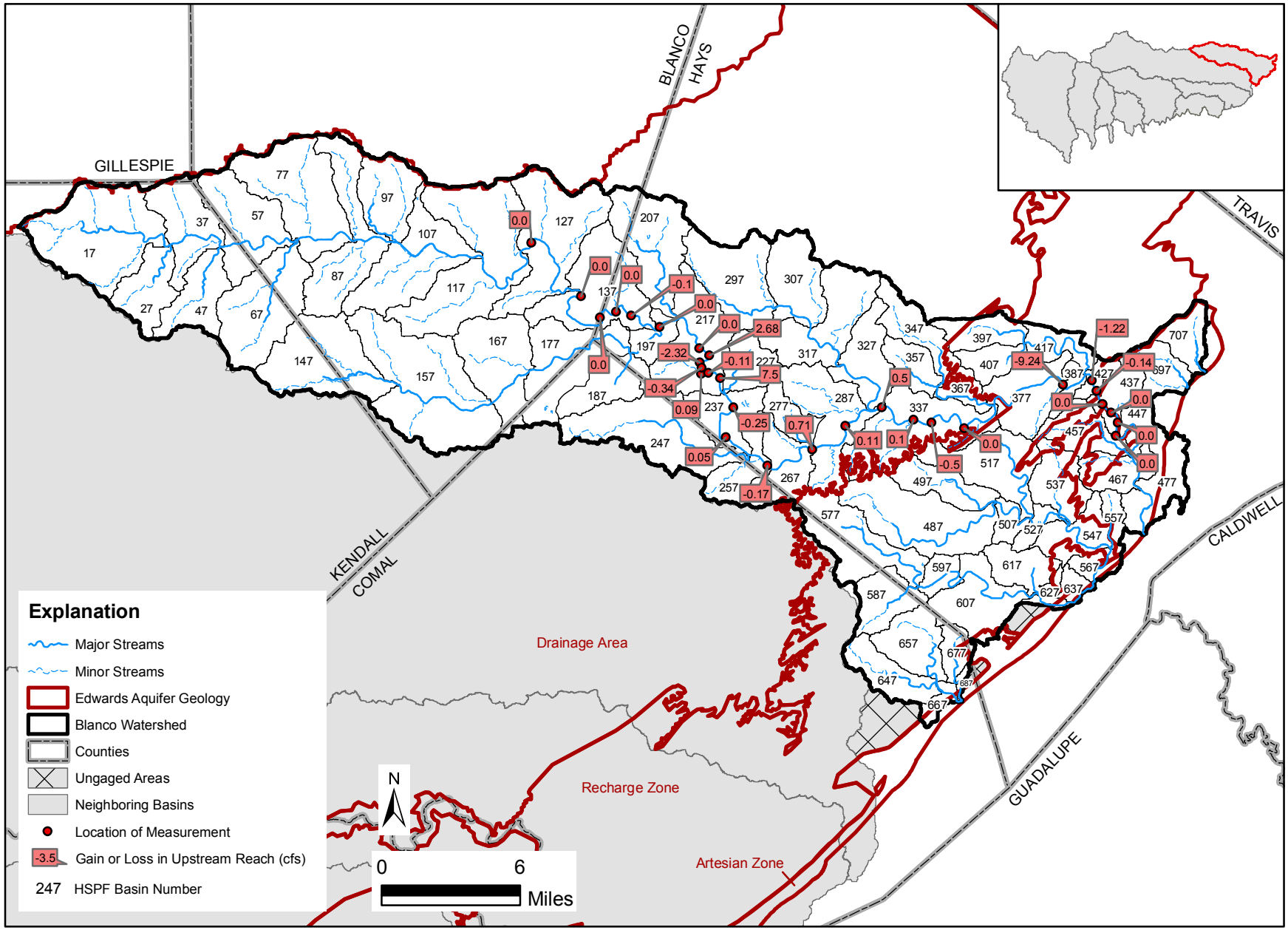
USGS Gain/Loss Study 97 in the Blanco Basin



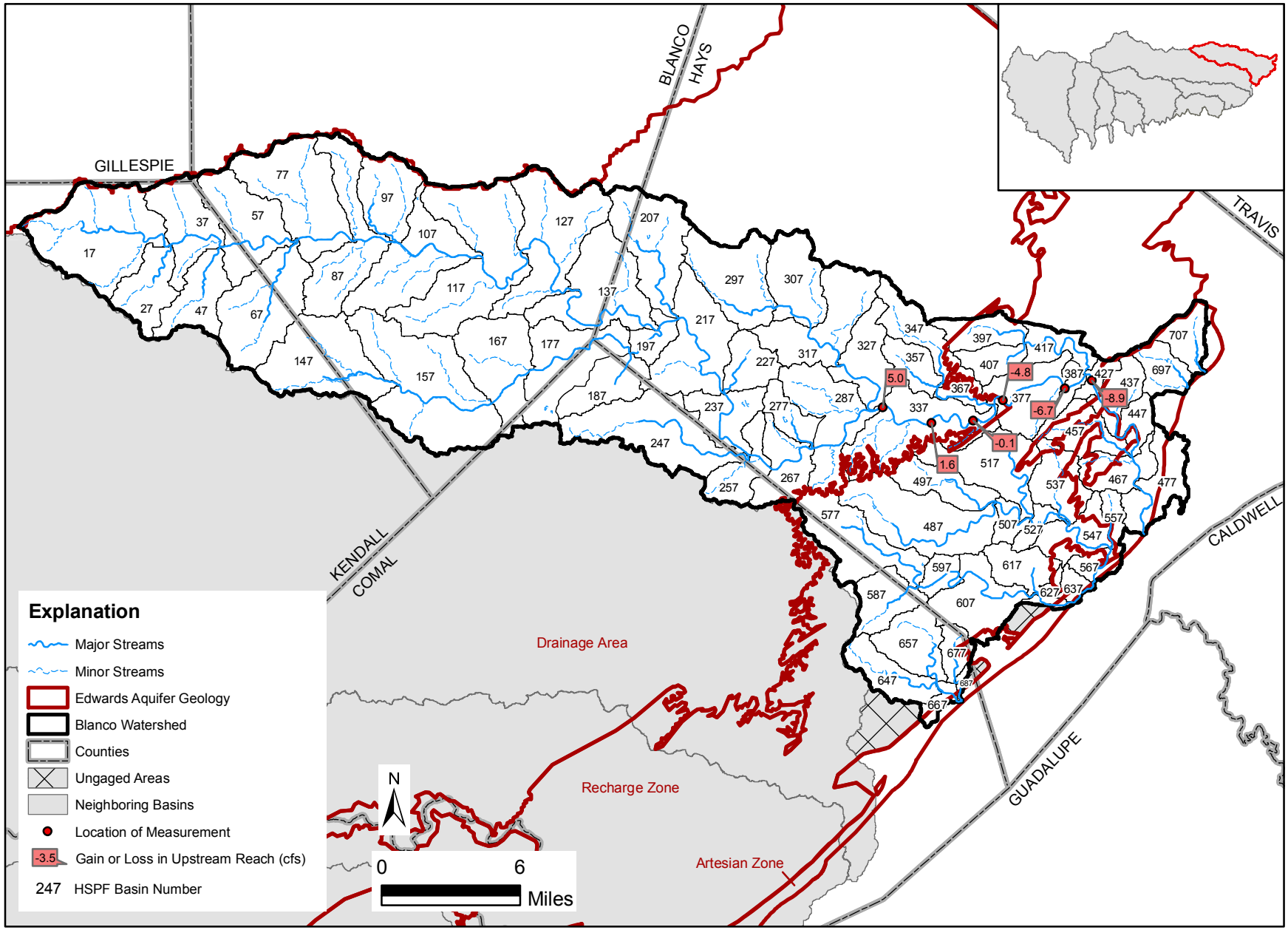
USGS Gain/Loss Study 98 in the Blanco Basin



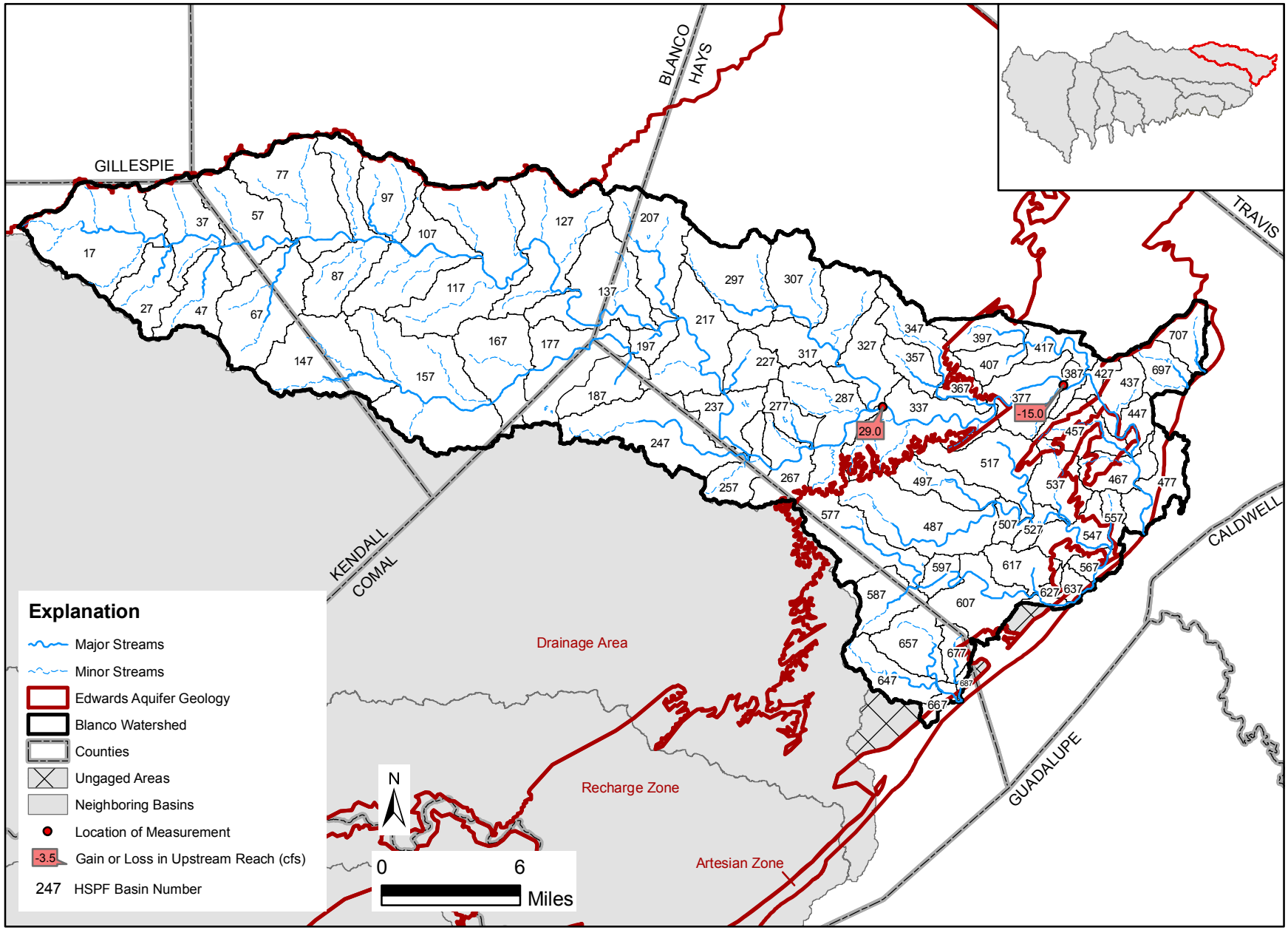
USGS Gain/Loss Study 99 in the Blanco Basin



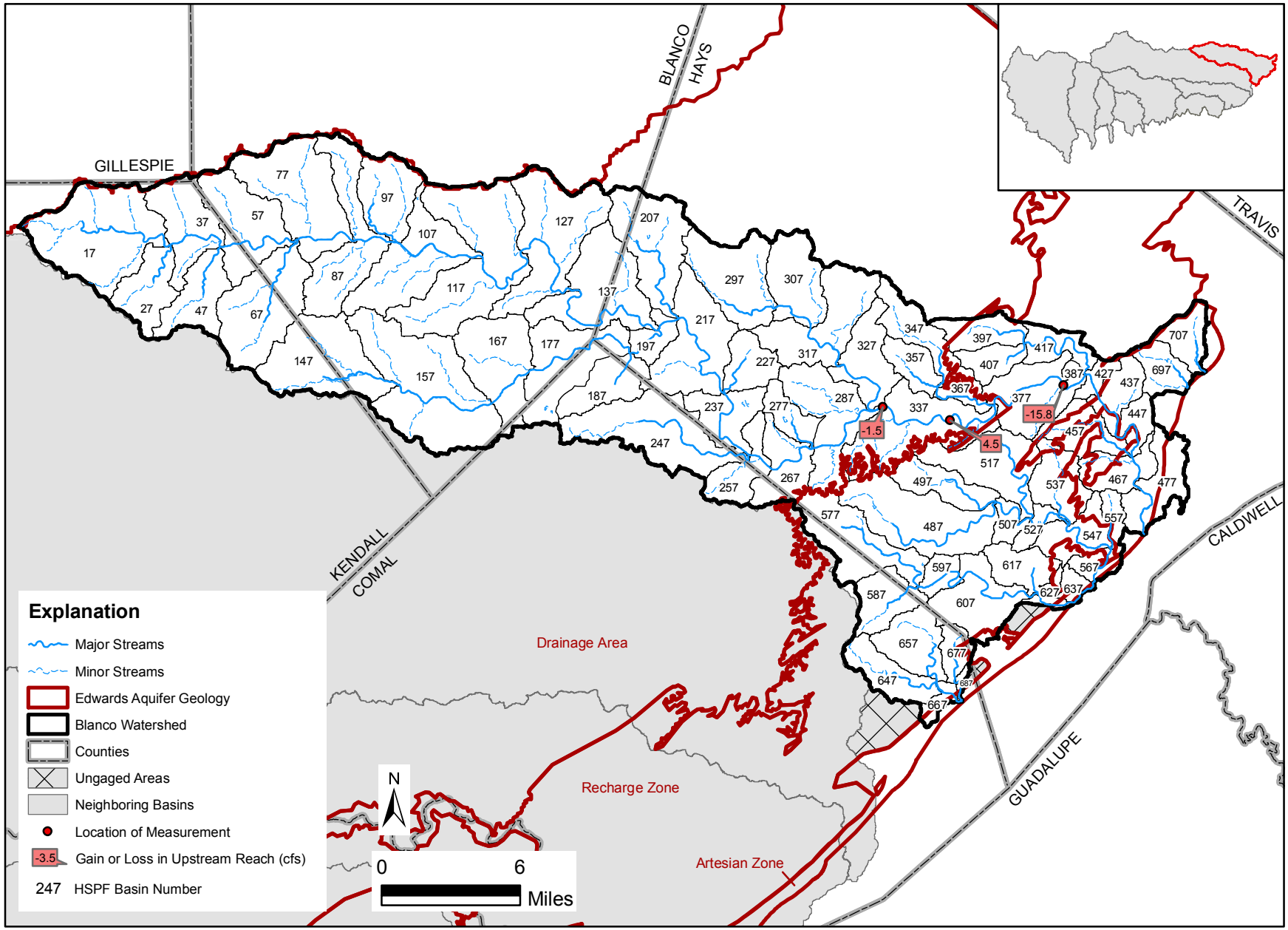
USGS Gain/Loss Study 100 in the Blanco Basin



USGS Gain/Loss Study 101 in the Blanco Basin



USGS Gain/Loss Study 102 in the Blanco Basin



USGS Gain/Loss Study 103 in the Blanco Basin

APPENDIX J
Input/Output Guidance for HSPF Model Files

Table J- 1 Summary of Input and Output Files for HSPF Models

Basin	Batch File (.BAT)	Input Files (.UCI)	Output Message File (.MES)	Specific Job
Frio	runFRIOX.	FRIO01X	FRIO01X	Model Calibration
		FRIOCX*	FRIOCX	Modeling pre-gaged period, 01/01/50 - 08/31/52
		FRIO50X	FRIO50X	Modeling gaged period, 09/01/52 - 12/31/00
		FRIOSPX	FRIOSPX	Totaling Recharge from land and channel segments, 1950-2000
		DISFRIO	DISFRIO	Display Yearly Recharge Table by mm/dd
Sabinal	runSABIX	SABI01X	SABI01X	Model Calibration
		SABI50X	SABI50X	Modeling gaging period, 01/01/50 - 12/31/00
		SABISPX	SABISPX	Totaling Recharge from land and channel segments, 1950-2000
		DISSABI	DISSABI	Display Yearly Recharge Table by mm/dd
Sabinal - Medina	runSAMEX	SECO01X	SECO01X	Model Calibration
		SECOCX*	SECOCX	Modeling pre-gaged period, 01/01/50 - 04/30/61
		SECO50X	SECO50X	Modeling gaged period, 05/01/61 - 12/31/00
		SECOSPX	SECOSPX	Totaling Recharge from land and channel segments, 1950-2000
		DISSECO	DISSECO	Display Yearly Recharge Table by mm/dd
Sabinal - Medina	runSAMEX	HONDO01X	HONDO01X	Model Calibration
		HONDOCX*	HONDOCX	Modeling pre-gaging period, 01/01/50 - 08/31/52
		HONDO50X	HONDO50X	Modeling gaging period, 09/01/52 - 12/31/00
		HONDOSPX	HONDOSPX	Totaling Recharge from land and channel segments, 1950-2000
		DISHONDO	DISHONDO	Display Yearly Recharge Table by mm/dd
Sabinal - Medina				
	runSAMEX	SAMERSUM		Summing Recharge in Seco and Hondo
		DISSAME	DISSAME	Display Yearly Recharge Table by mm/dd
Medina	runMEDIX	MEDI01X	MEDI01X	Model Calibration
		MEDICX*	MEDICX	Modeling pre-gaged period, 01/01/50 - 09/30/82
		MEDI50X	MEDI50X	Modeling gaged period, 10/01/82 - 12/31/00
		MEDISPX	MEDISPX	Totaling Recharge from land and channel segments, 1950-2000
		DISMEDI	DISMEDI	Display Yearly Recharge Table by mm/dd

Table J- 1 Summary of Input and Output Files for HSPF Models

Basin	Batch File (.BAT)	Input Files (.UCI)	Output Message File (.MES)	Specific Job
Medina				
	runMEDIX	VERDECX*	VERDECX	Modeling ungaged basin, 1950-2000
		VERDESPX	VERDESPX	Totaling Recharge from land and channel segments, 1950-2000
		DISVERDE	DISVERDE	Display Yearly Recharge Table by mm/dd
Medina				
	runMEDIX	MEDIRSUM	MEDIRSUM	Summing Recharge in Medina and Verde
		DISMEDIT	DISMEDIT	Display Yearly Recharge Table by mm/dd
Medina - Cibolo	runMECIX	SALA01X	SALA01X	Model Calibration
		SALACX*	SALACX	Modeling pre-gaged period, 01/01/50 - 11/30/97
		SALA50X	SALA50X	Modeling gaged period, 12/01/97 - 12/31/00
		SALASPX	SALASPX	Totaling Recharge from land and channel segments, 1950-2000
		DISSALA	DISSALA	Display Yearly Recharge Table by mm/dd
Medina - Cibolo				
	runMECIX	HELOCX*	HELOCX	Modeling ungaged basin, 1950-2000
		HELOSPX	HELOSPX	Totaling Recharge from land and channel segments, 1950-2000
		DISHELO	DISHELO	Display Yearly Recharge Table by mm/dd
Medina - Cibolo				
	runMECIX	MECIRSUM	MECIRSUM	Summing Recharge in Area between Medina and Cibolo
		DISMECI	DISMECI	Display Yearly Recharge Table by mm/dd
Cibolo	runCIBOX	CIBO01X	CIBO01X	Model Calibration
		CIBOCX*	CIBOCX	Modeling pre-gaging period, 01/01/50 - 05/22/96
		CIBO50X	CIBO50X	Modeling gaged period, 05/23/96 - 12/31/00
		CIBOSPX	CIBOSPX	Totaling Recharge from land and channel segments, 1950-2000
		DISCIBO		Display Yearly Recharge Table by mm/dd

Table J- 1 Summary of Input and Output Files for HSPF Models

Basin	Batch File (.BAT)	Input Files (.UCI)	Output Message File (.MES)	Specific Job
Cibolo	runCIBOX	COMALCX*		Modeling ungaged period, 1950-2000
		COMALSPX		Totaling Recharge from land and channel segments, 1950-2000
		DISCOMAL		Display Yearly Recharge Table by mm/dd
Cibolo				
	runCIBOX	CIBORSUM	CIBORSUM	Summing recharge in Cibolo and Comal
		DISCIBOT		Display Yearly Recharge Table by mm/dd
Guadalupe	runGUADX	GUAD01X	GUAD01X	Model Calibration
		GUADPREX	GUADPREX	Modeling pre-Canyon Lake period, 01/01/50 - 02/28/60
		GUAD50X	GUAD50X	Modeling post-Canyon Lake period, 03/01/60 - 12/31/00
		GUADSPX	GUADSPX	Totaling Recharge from land and channel segments, 1950-2000
		DISGUAD		Display Yearly Recharge Table by mm/dd
Nueces	runNUECX	NUEC01X	NUEC01X	Model Calibration
		NUEC50X	NUEC50X	Modeling gaged period, 01/01/50 - 12/31/00
		NUECSPX	NUECSPX	Totaling Recharge from land and channel segments, 1950-2000
		DISNUEC	DISNUEC	Display Yearly Recharge Table by mm/dd
Blanco	runBLANX	BLAN01X	BLAN01X	Model Calibration
		BLAN50X	BLAN50X	Modeling gaged period, 01/01/50 - 12/31/00
		BLANSPX	BLANSPX	Totaling Recharge from land and channel segments, 1950-2000
		DISBLAN	DISBLAN	Display Yearly Recharge Table by mm/dd

* Hydrologic Model is used for the ungaged time period.

Table J- 2 Summary of Input and Output WDM Files for HSPF Models

Basin	Data Storage File (.WDM)	Data Stored
Frio	FRIO1	Observed rainfall, evap, flow data, and simulated flow by the hydrologic model
	FRIO1X	Observed rainfall, evap, flow data, and simulated flow by the recharge model
	FRIO2	Recharge data from land segment and channel reach by the hydrologic model
	FRIO2X	Recharge data from land segment and channel reach by the recharge model
Sabinal	SABI1	Observed rainfall, evap, flow data, and simulated flow by the hydrologic model
	SABI1X	Observed rainfall, evap, flow data, and simulated flow by the recharge model
	SABI2	Recharge data from land segment and channel reach by the hydrologic model
	SABI2X	Recharge data from land segment and channel reach by the recharge model
Sabinal - Medina	SAME1	Observed rainfall, evap, flow data, and simulated flow by the hydrologic model
	SAME1X	Observed rainfall, evap, flow data, and simulated flow by the recharge model
	SAME2	Recharge data from land segment and channel reach by the hydrologic model
	SAME2X	Recharge data from land segment and channel reach by the recharge model
Medina	MEDI1	Observed rainfall, evap, flow data, and simulated flow by the hydrologic model
	MEDI1X	Observed rainfall, evap, flow data, and simulated flow by the recharge model
	MEDI2	Recharge data from land segment and channel reach by the hydrologic model
	MEDI2X	Recharge data from land segment and channel reach by the recharge model
Medina - Cibolo	MECI1	Observed rainfall, evap, flow data, and simulated flow by the hydrologic model
	MECI1X	Observed rainfall, evap, flow data, and simulated flow by the recharge model
	MECI2	Recharge data from land segment and channel reach by the hydrologic model
	MECI2X	Recharge data from land segment and channel reach by the recharge model
Cibolo	CIBO1	Observed rainfall, evap, flow data, and simulated flow by the hydrologic model
	CIBO1X	Observed rainfall, evap, flow data, and simulated flow by the recharge model
	CIBO2	Recharge data from land segment and channel reach by the hydrologic model
	CIBO2X	Recharge data from land segment and channel reach by the recharge model
Guadalupe		
	GUAD1	Observed rainfall, evap, flow data, and simulated flow by the hydrologic model
	GUAD1X	Observed rainfall, evap, flow data, and simulated flow by the recharge model
	GUAD2	Recharge data from land segment and channel reach by the hydrologic model
	GUAD2X	Recharge data from land segment and channel reach by the recharge model
Nueces	NUEC1	Observed rainfall, evap, flow data, and simulated flow by the hydrologic model
	NUEC1X	Observed rainfall, evap, flow data, and simulated flow by the recharge model
	NUEC2	Recharge data from land segment and channel reach by the hydrologic model
	NUEC2X	Recharge data from land segment and channel reach by the recharge model

Table J- 2 Summary of Input and Output Files for HSPF Models

Basin	Data Storage File (.WDM)	Data Stored
Blanco	BLAN1	Observed rainfall, evap, flow data, and simulated flow by the hydrologic model
	BLAN1X	Observed rainfall, evap, flow data, and simulated flow by the recharge model
	BLAN2	Recharge data from land segment and channel reach by the hydrologic model
	BLAN2X	Recharge data from land segment and channel reach by the recharge model

APPENDIX K

Distribution of Recharge to MODFLOW

Distribution of Recharge to MODFLOW

The HSPF recharge models for the nine basins calculate recharge occurring in land and stream segments using the variable identified as IGWI (Inactive Groundwater Inflow), which is representative of flux between active and inactive groundwater storage. Inactive groundwater is water that has percolated deep enough so that it is no longer subject to depletion by evapotranspiration or other discharge mechanisms, such as flow to a stream.

Daily or monthly recharge estimates from the HSPF models are geographically distributed into the MODFLOW model grid. To distribute recharge from stream reaches, it is assumed that recharge along each individual reach is uniform. Geographic Information System (GIS) tools are used to superimpose HSPF land segments and river reaches over the recharge zone onto the MODFLOW grid and uniformly distribute recharge values to each MODFLOW stress period. Recharge associated with cross-formational transfer from the Trinity and Edwards Plateau are not added to the MODFLOW recharge datasets because that inflow has been implemented via the MODFLOW well package as an injection volume in the current MODFLOW model.

Figure K-1 provides a schematic illustration of geographical recharge distribution from stream reaches and subwatersheds onto the MODFLOW grid.

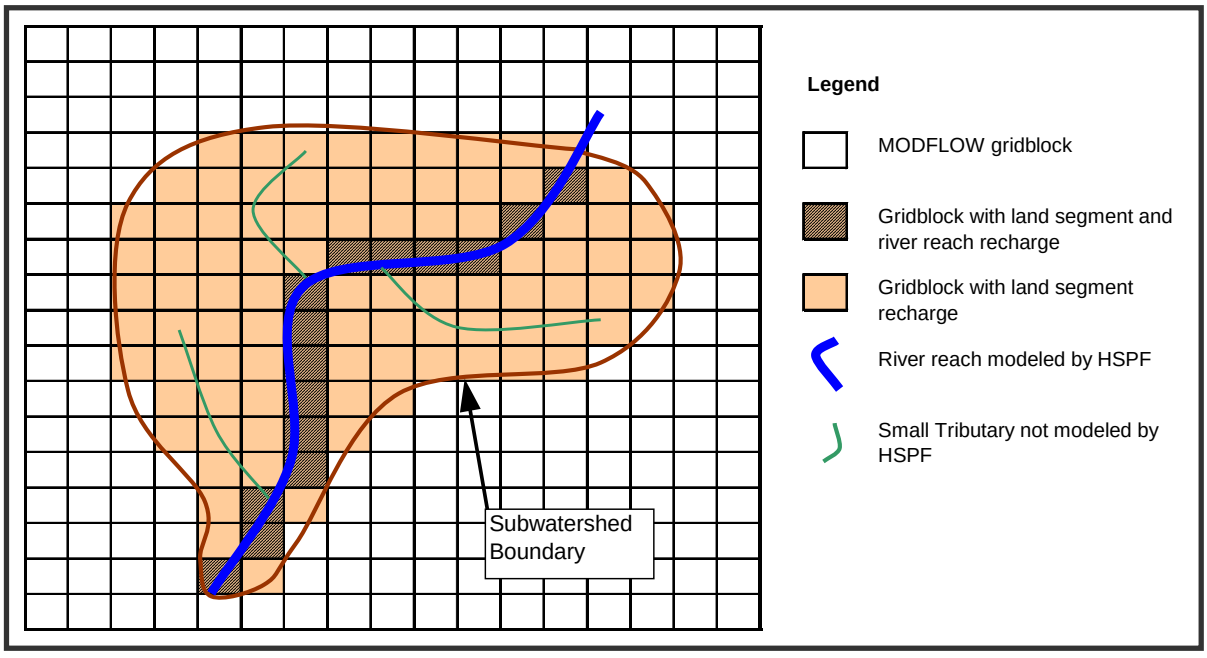


Figure K- 1 Schematic Illustration of Recharge Distribution to the MODFLOW Grid