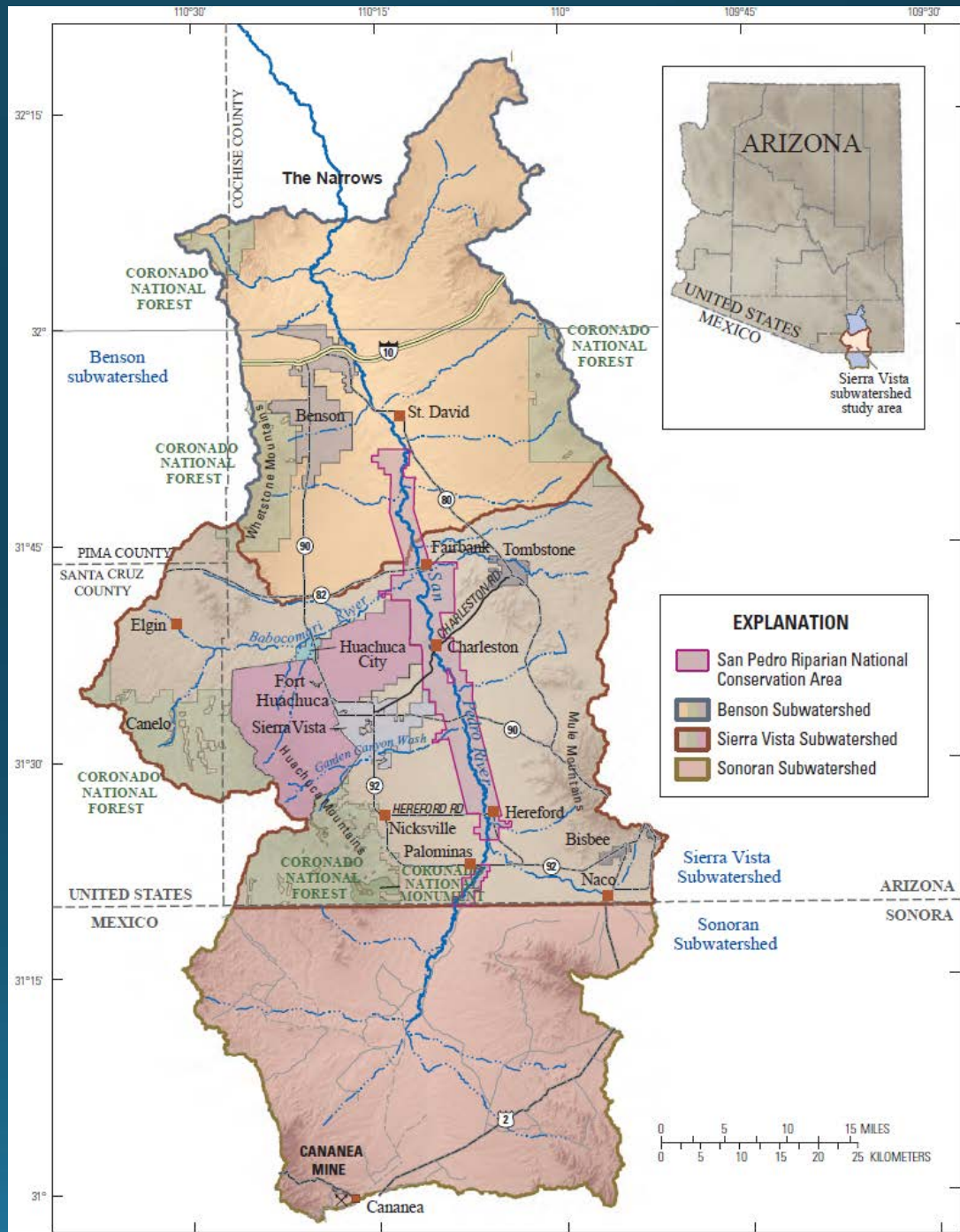
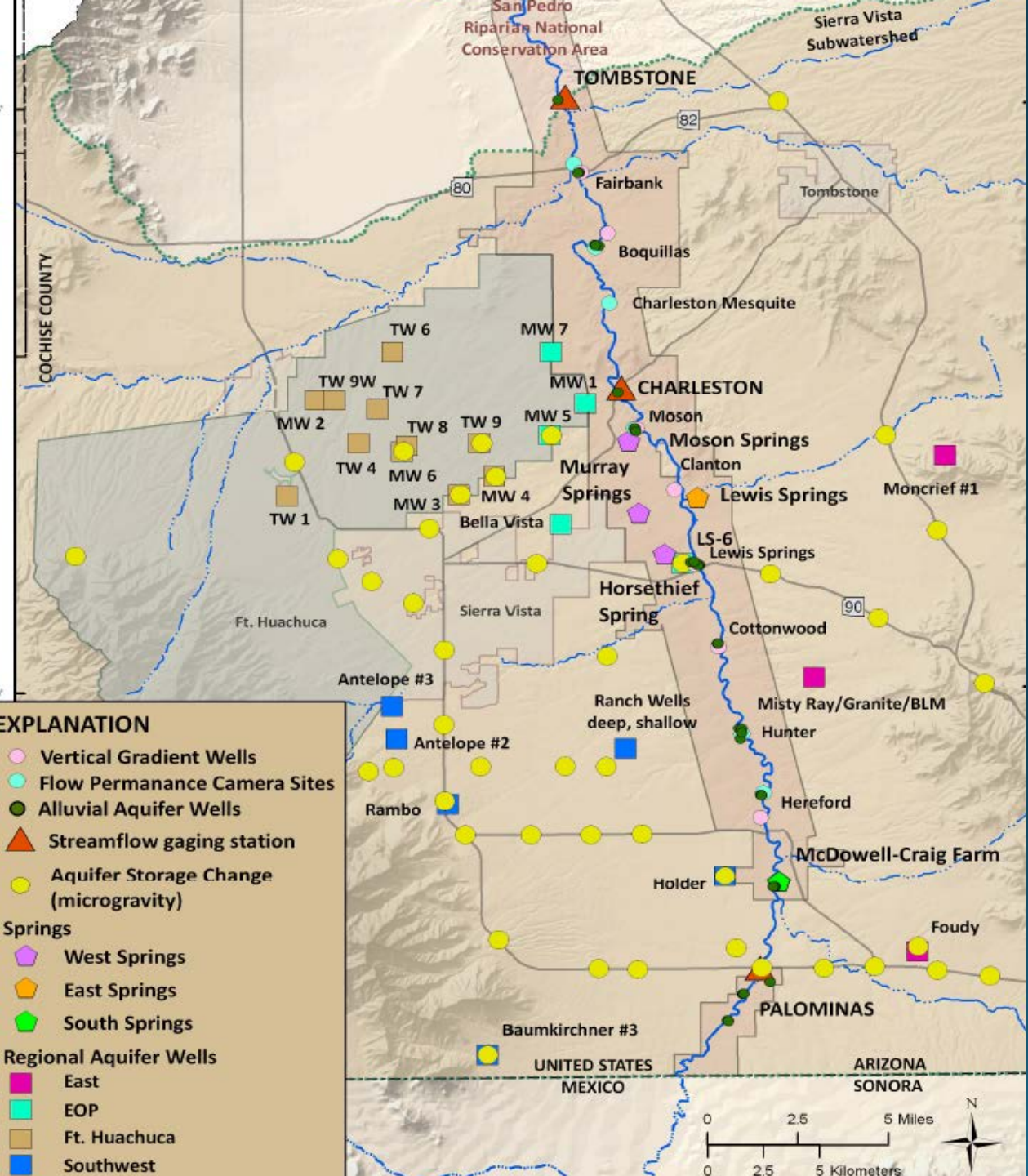


Upper San Pedro Basin and Sierra Vista subwatershed, southeastern Arizona



Types and locations of ground-water and surface water monitoring in the Sierra Vista subwatershed

(missing: water quality sampling locations, wet-dry mapping)



USGS Hydrological Monitoring in the Upper San Pedro River basin

- 1998 – Upper San Pedro Partnership created in part to resolve widely varying opinions about fate of San Pedro River. **GW and SW monitoring begins in earnest**
- 2001 - 2004 – **Monitoring expands** with funding sponsored by Rep. Kolbe for SPRNCA Water Needs Report (published 2006)
- 2003 – USPP recognized by U.S. Congress through Defense Authorization Act of 2004
- 2004 - 2011 – Annual 2004 Defense Act Section 321 Reporting on USPP efforts to achieve sustainable groundwater use in Sierra Vista subwatershed (**relies on monitoring data**)
- 2007 – USGS Groundwater model published (**based on monitoring data as have subsequent updates**)
- 2016 – Sustainability report published (USGS) that assessed in detail USPP movement toward sustainable groundwater use (**analysis of monitoring data through 2012**)

Why USGS?

- the *highest quality, unbiased*, scientific information, analysis, and interpretation
- techniques and methods of data collection and data management evolve but are also uniform across the country and fully vetted
- USGS data are always available to *everyone* via the National Water Information System (NWIS) website and (or) directly from our scientists

USGS data collection

- data stations are located spatially using high precision GPS tools and are leveled in or GPS'd again periodically to ensure station location accuracy
- data are collected following standard USGS protocols (repeat measurements within tolerances; station condition notes; site photographs; other protocols depending upon nature of measurement)
- measurements are stored on electronic platforms (tablets or laptops) in the field as well as additional hard-copy notes

USGS data management

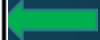
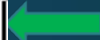
- data are worked up by the field technician back in the office (e.g., continuous discharge is adjusted to manual field measurements using a rating that is based on stage-discharge relationship)
- technician writes up a station analysis that includes condition of site and any changes to the stream channel
- a second technician reviews the data and the station analysis for correctness, validity of the rating used, and comprehensible writing
- a senior level technician approves the final product
- random audits or known hydrologic changes can trigger an additional review

Sierra Vista Subwatershed	APPROXIMATE TOTAL COSTS			Updated: 02-08-18
	Priority Level	long-term committed	un-committed	
Monitoring Program and Cost Estimates	I	\$168,100	\$0	
	II	\$9,600	\$51,570	
	III	\$87,000	\$16,000	
	IV	\$63,000	\$91,000	
	TOTAL	\$327,700	\$158,570	

MONITORING COSTS	frequency	stations	cost/station/yr	total cost/yr committed	total cost/yr uncommitted	priority level	Committed long-term funding source
<i>SPRNC A water levels (wells)</i>	Q						
Vertical gradient (continuous)	(C)	18	\$1,500	\$27,000		I	USPP
Long term record (discrete)		20	\$600	\$12,000		I	USPP
Additional transducers		3	\$2,500	\$7,500		I	USPP
Short term record (discrete)		32	\$500		\$16,000	III	None
BLM water rights wells	(C)	8		100%		I	BLM (no usgs)
<i>(all costs include data mgmt)</i>							
<i>Regional water levels (wells)</i>	Q						
Ft. Huachuca		14	\$600	\$8,400		I	FT. HUACHUCA
Other		15	\$600	\$9,000		I	ARS (CC-USGS data mgmt)
<i>(all costs include data mgmt)</i>							
<i>Stream discharge (gaging stations)</i>	~M						
Main stem & Lower Babo		4	17,400	\$69,600		I	CC, Ft.H, USGS match
Mountain (low flow) & Upper Babo		5	17,400	\$87,000		III	CC,USGS match
Lewis Springs stage recorder		1	-- see Lewis Springs site, included below --				
Monthly seepage run (13 total; 10 in SV SW)		10	?	100%		III	BLM
<i>(all costs include data mgmt)</i>							
<i>Streamflow permanence (cameras)</i>	Q						
Cameras		7	\$500	\$3,500		II	ARS
Wet-dry Mapping		45 mi+	?	100%		I	TNC, BLM (no usgs)
<i>(incl. data mgmt & perm calc)</i>							



MONITORING COSTS	frequency	stations	cost/station/yr	total cost/yr committed	total cost/yr uncommitted	priority level	Committed long-term funding source
	<i>Lewis Springs site</i> (stream stage, wells, data mgmt.)	~M	1	\$17,400	\$17,400		I
<i>Springs discharge</i> (manual meas., data mgmt)	Q	5	\$1,220	\$6,100		II	Cochise County (w/ USGS match)
<i>Isotope sampling</i> (San Pedro & Babo; incl. data mgmt.)	~M	6	\$2,870	\$17,200		I	Cochise County (w/ USGS match)
<i>Aquifer storage change</i> (gravity, grav data mgmt; data report)	A	54	\$955		\$51,570	II	None
Detention pond infiltr. (transducer)	Q						
Sierra Vista		5	?	?		IV	ARS (no usgs)
Ft. Huachuca		6		\$69,600		IV	FT. HUACHUCA
Cochise County		1	\$10,000 (?)	\$10,000		IV	CC--Palominas (no usgs)
Moisture monitoring							
Precipitation gages	C	26	?	100%		II	ARS (no usgs)
Soil moisture sensors	C	26	?	100%		IV	ARS (no usgs)
Riparian ET monitoring	C	1	?	100%		III	ARS (no usgs)
Water Quality	A						
San Pedro at Charleston		1	\$31,000		\$31,000	IV	USGS (NAWQA)
Passive WQ sampling at springs		5	\$12,000		\$60,000	IV	NONE
		number of stations	approximate total costs				
			committed		uncommitted		
TOTAL MONITORING:		215	\$344,300		\$158,570		
M = monthly; Q = quarterly; A = annual; C = continuous				100% = paid for and collected by given agency/organization			
TOTAL MONITORING:		214	\$327,700		\$158,570		
M = monthly; Q = quarterly; A = annual; C = continuous				100% = paid for and collected by given agency/organization			



Budget for federal FY 2018

Agreement #18CMAZ05900, between USGS and Cochise County

Task	Cost item	Cost (in dollars)
Operation of Lewis Springs monitoring site	Data collection/site operation	17,400
Operation of Banning Creek stream gaging station	Data collection/site operation	17,400
Operation of Upper Babocomari stream gaging station	Data collection/site operation	17,400
Operation of Ramsey Canyon stream gaging station	Data collection/site operation	17,400
Collection of stream samples and analyses of stable isotopes of water	Labor	6,800
	Lab analyses	9,000
	Equipment	700
	Shipping	700
Spring discharge measurements	Data collection, 5 springs	6,100
Data management and other activities	Subwatershed data management/entry; data and information requests	12,000
Total of project cost items		104,900

Funding source – USGS 34,500

Funding source – Cochise County 70,400

Total project funding 104,900



Contact information:

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Tucson, AZ 85719

bgungle@usgs.gov

520-670-3303

Additional Slides—

- Banning Creek gaging station overview
- Gaging station drainage areas
- 2012 GW sustainability summary graphic
- Sierra Vista Subwatershed precipitation 1991-2012

Banning Creek stream-gaging station

control



Banning Creek gage house

satellite communication
antenna to uplink
continuous data

precipitation gage

data recorder,
uplink gear,
other stream gaging
gear inside

Banning Creek gaging station

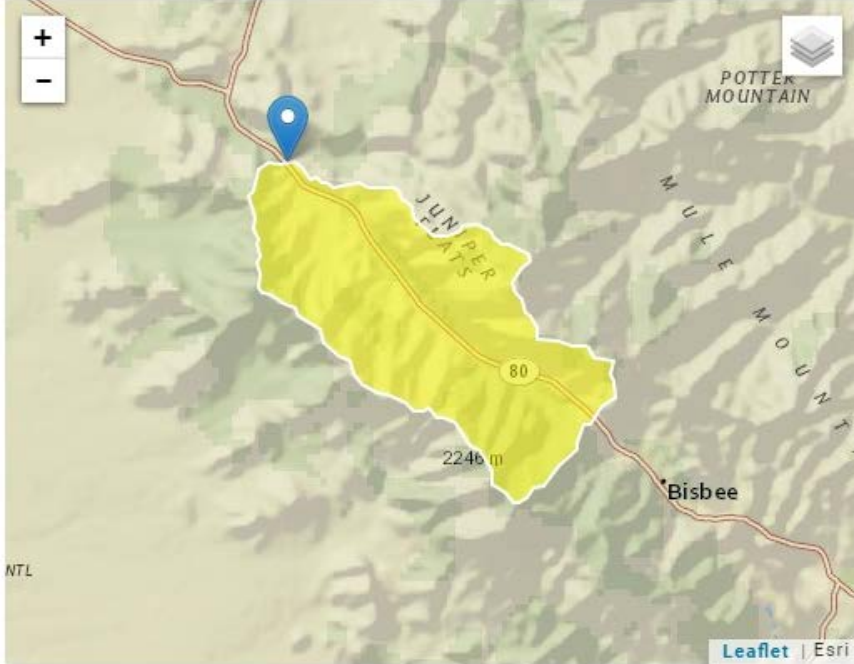
gage house →

orifice line ↙ ↘

staff gage ↙

StreamStats Report

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Banning Creek gage drainage characteristics

Basin Characteristics			
Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	43.94	percent
DRNAREA	Area that drains to a point on a stream	8.83	square miles
LU92DEV	Percent of area covered by all densities of developed land using 1992 NLCD	0	
OUTLETELEV	Elevation of the stream outlet in thousands of feet above NAVD88.	4872.97	feet

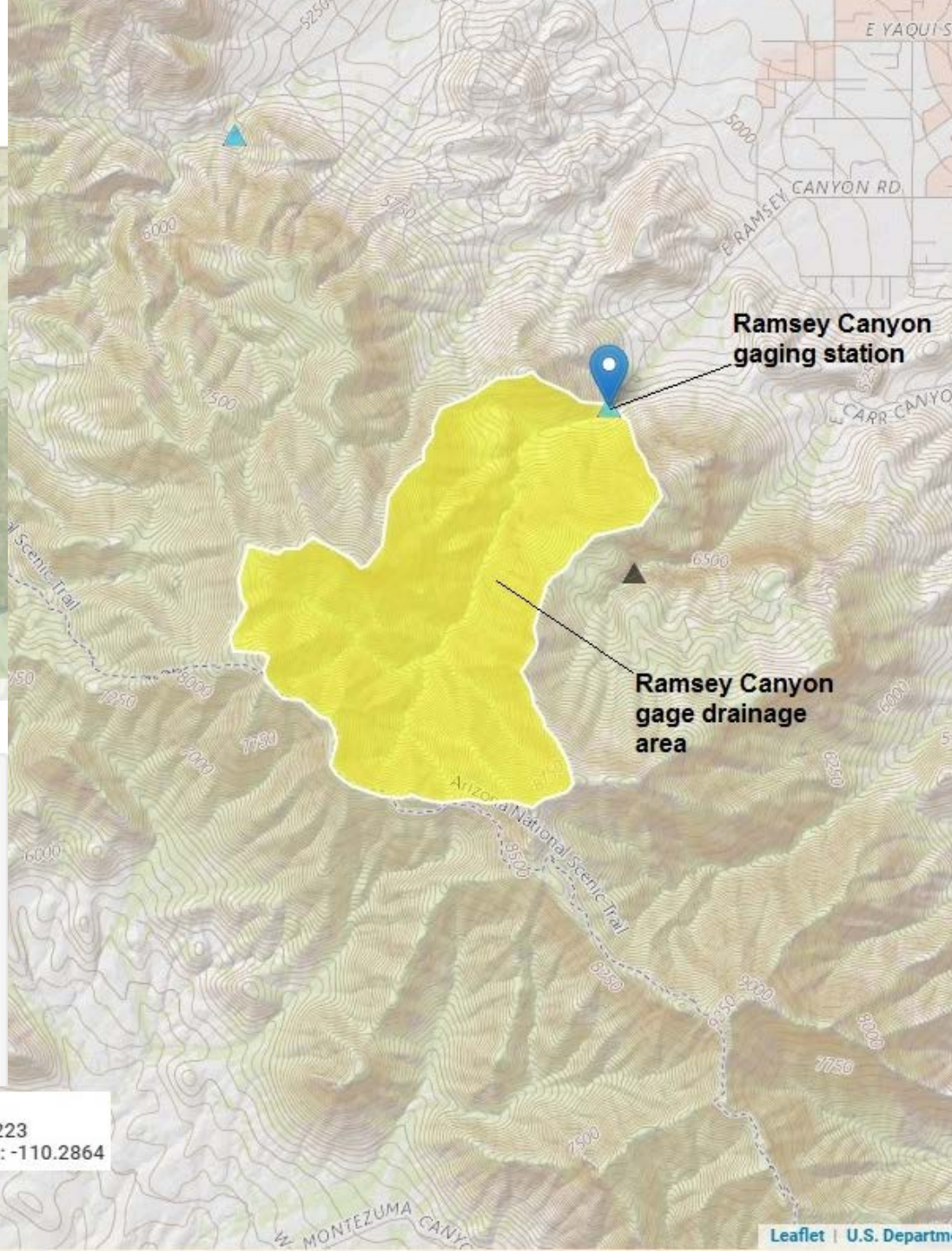
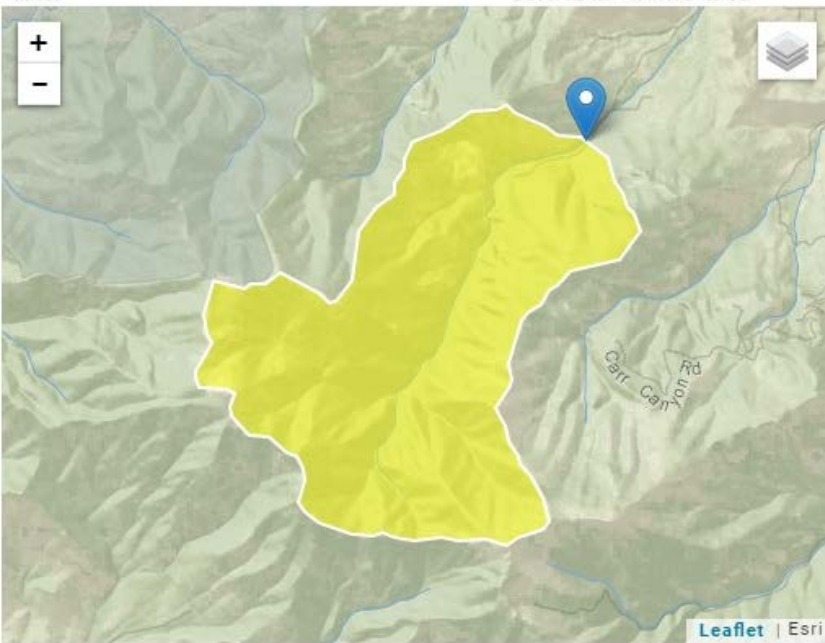
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1 km
 1 mi

StreamStats Report

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Ramsey Canyon gaging station

Ramsey Canyon gage drainage area

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	59.78	percent
DRNAREA	Area that drains to a point on a stream	4.16	square miles
LU92DEV	Percent of area covered by all densities of developed land using 1992 NLCD	0	
OUTLETELEV	Elevation of the stream outlet in thousands of feet above NAVD88.	5540.26	feet

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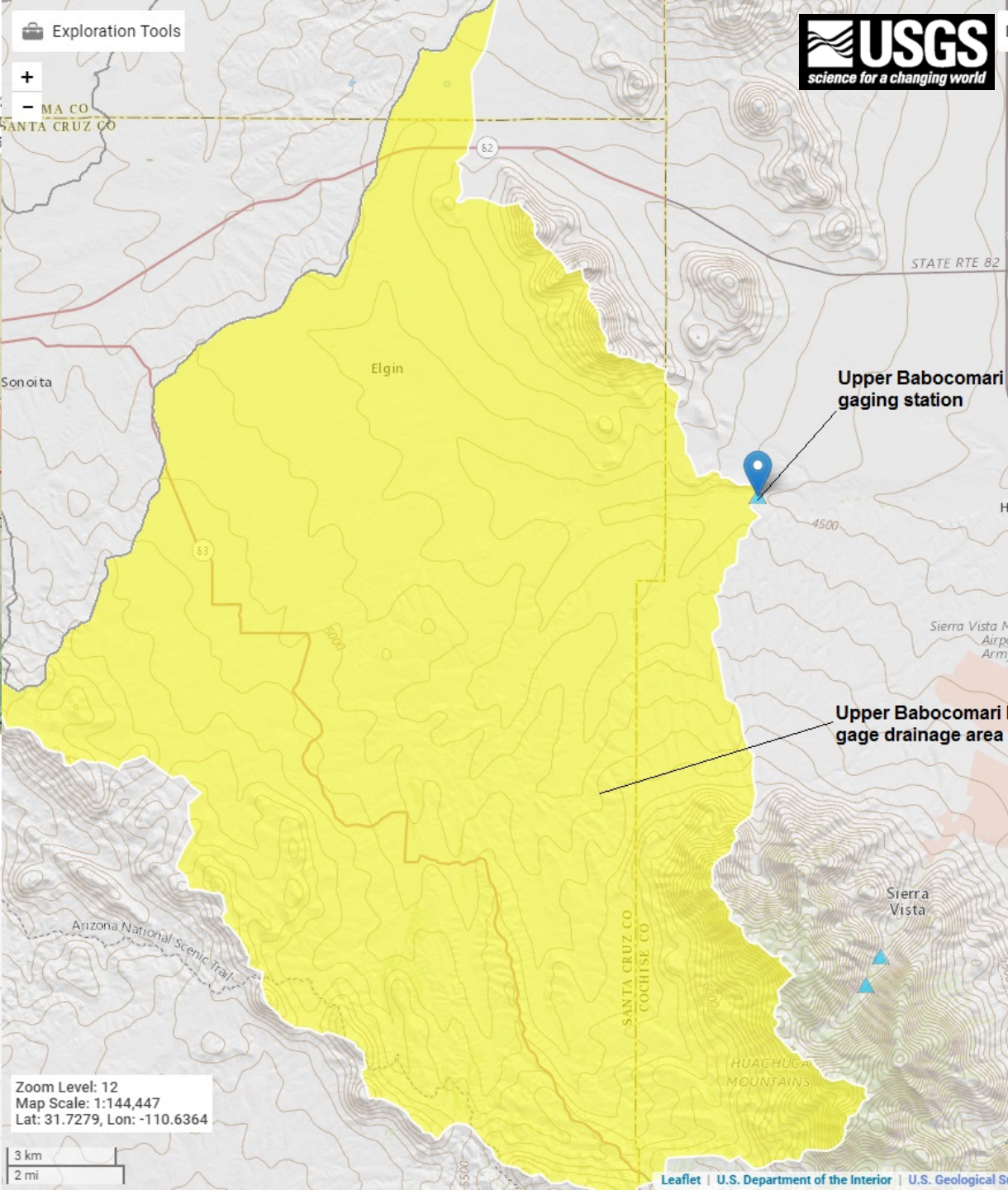
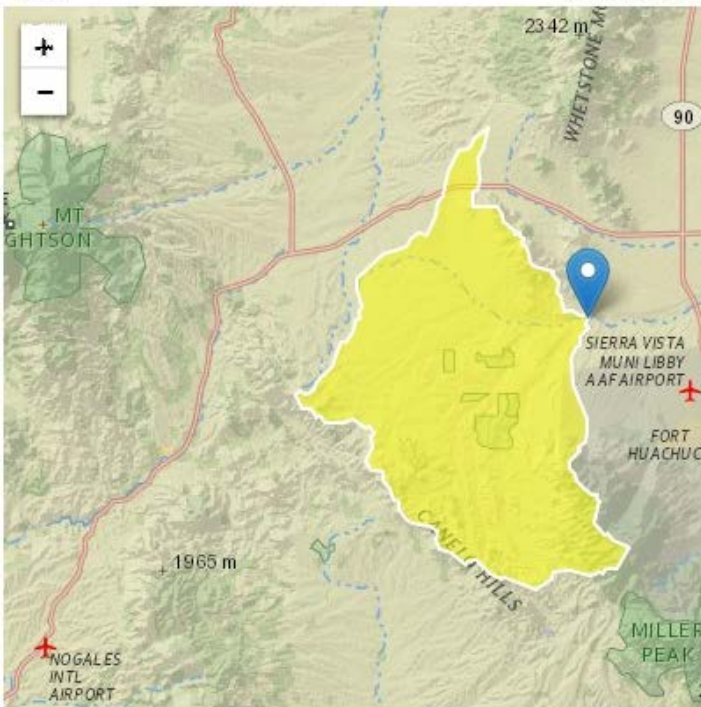


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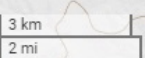
Exploration Tools



Upper Babocomari gaging station basin characteristics

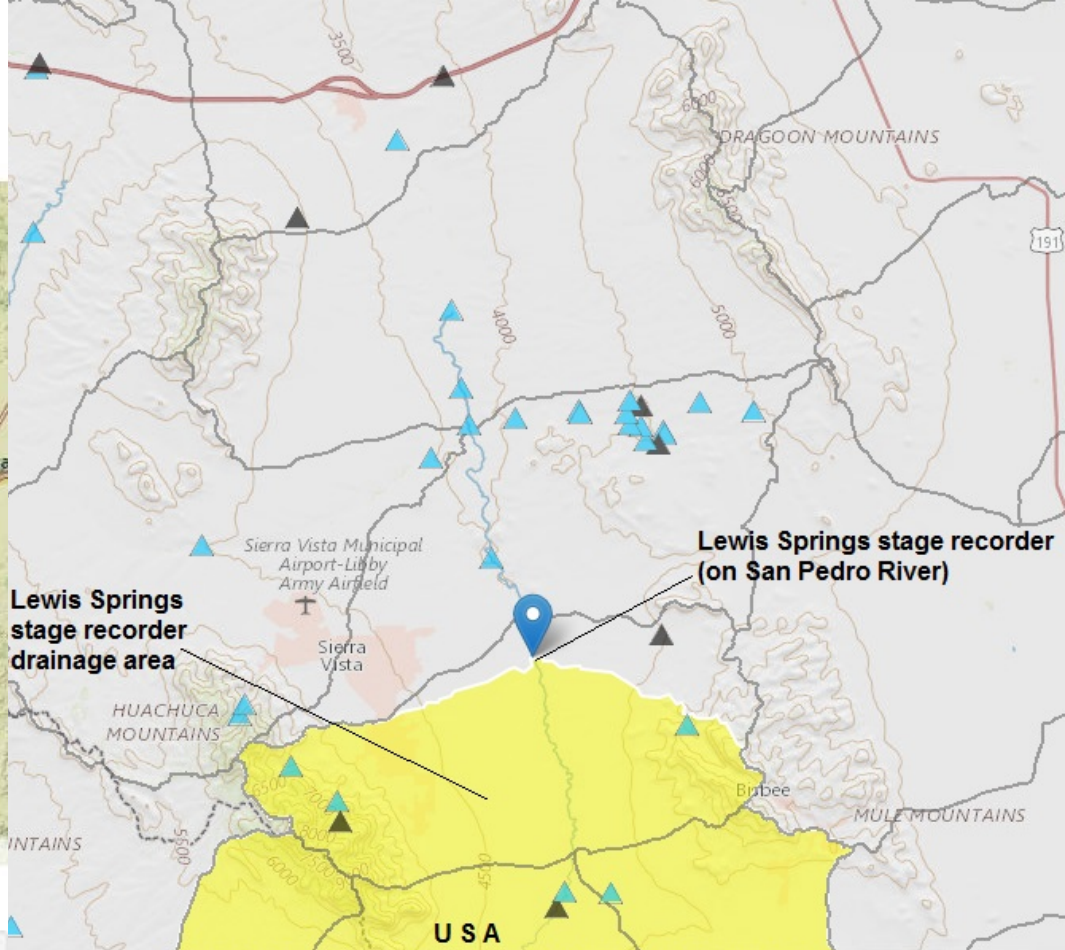
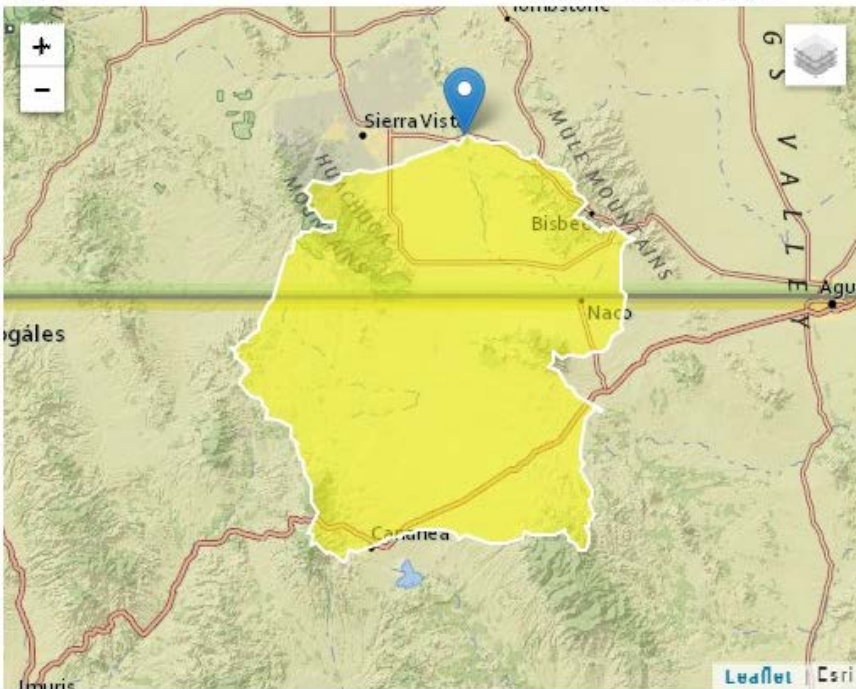
Basin Characteristics	
Parameter Code	Parameter Description
BSLDDEM10M	Mean basin slope computed from 10 m DEM
DRNAREA	Area that drains to a point on a stream
LU92DEV	Percent of area covered by all densities of developed land using 1992 NLCD
OUTLETELEV	Elevation of the stream outlet in thousands of feet above NAVD88.

Zoom Level: 12
Map Scale: 1:144,447
Lat: 31.7279, Lon: -110.6364



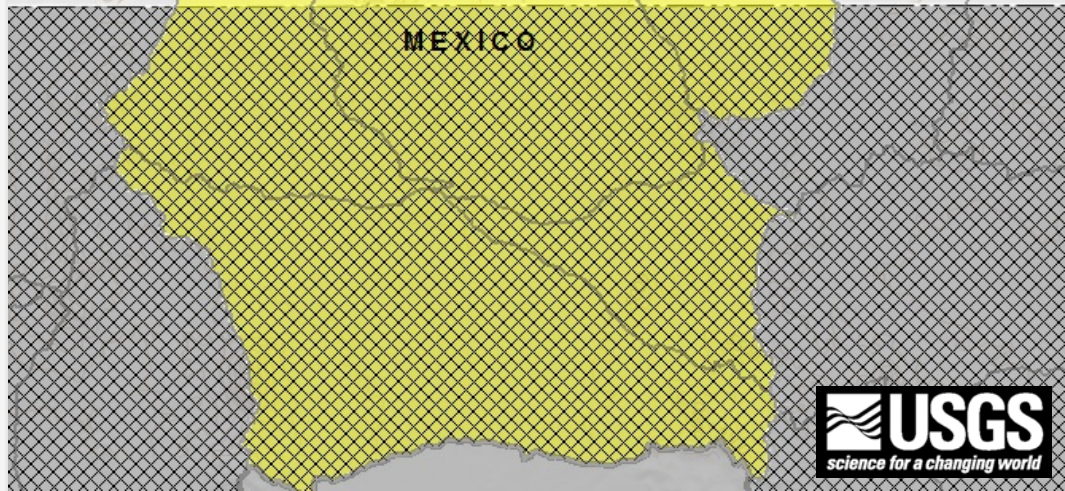
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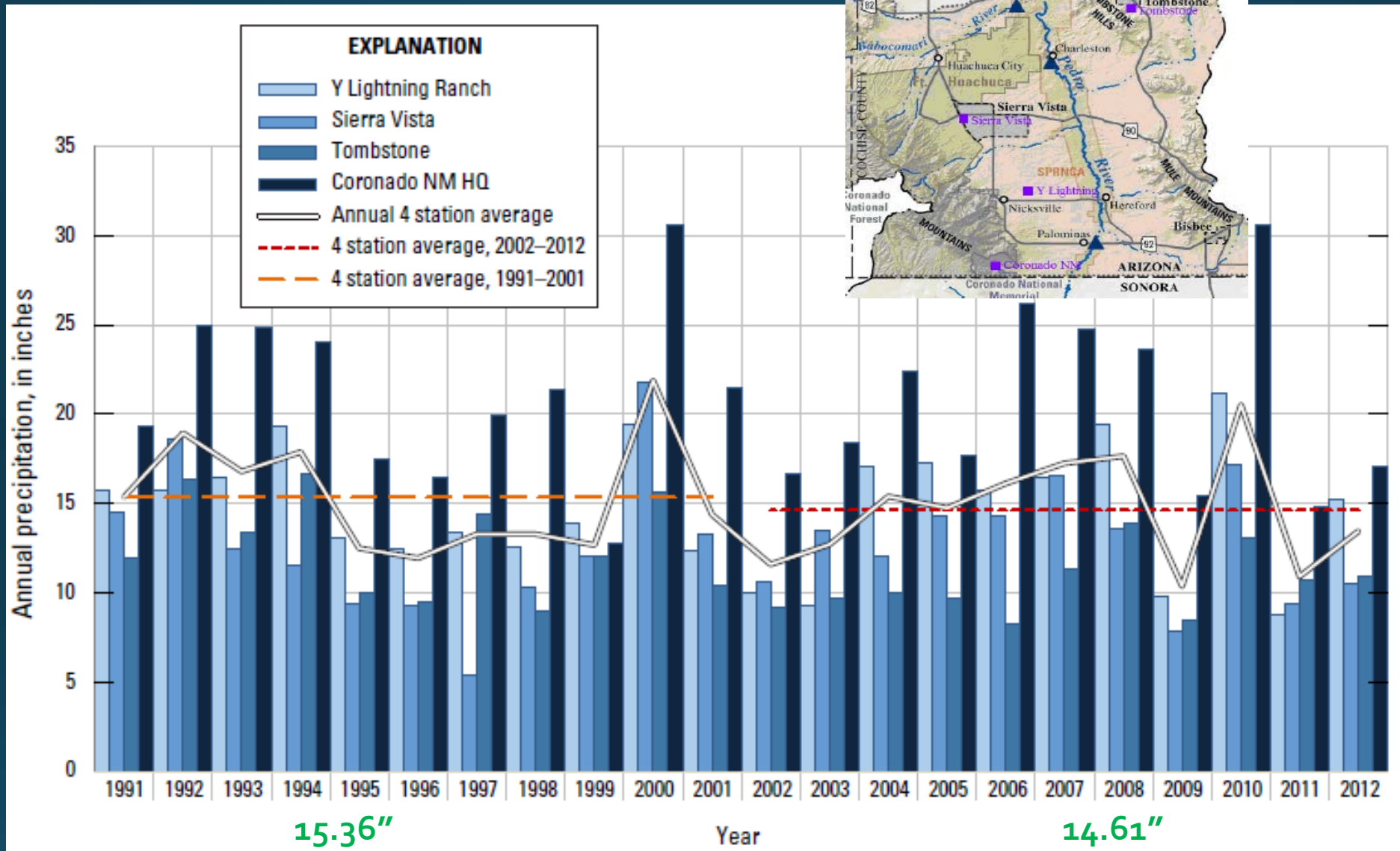
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Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDDEM10M	Mean basin slope computed from 10 m DEM	8.46	percent
CH92_01DEV	Percent Difference between 1992 and 2001 area covered by developed land using NLCD	0	
CH92_01FOR	Percent Difference between 1992 and 2001 area covered by forest using NLCD	0	
DRNAREA	Area that drains to a point on a stream	1061.76	square miles
LU92DEV	Percent of area covered by all densities of developed land using 1992 NLCD	1	
OUTLETELEV	Elevation of the stream outlet in thousands of feet above NAVD88.	4047.74	feet





Annual precipitation (4-station average)

