Going with the Flow Update

Analysis of Water Sentinels flow data for the Upper Verde River.

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November 2024

SIERRA CLUB GRAND CANYON

H_2O Sentinels

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Fig 1. Verde River. Photo Credit Sinjin Eberle.

The Verde River

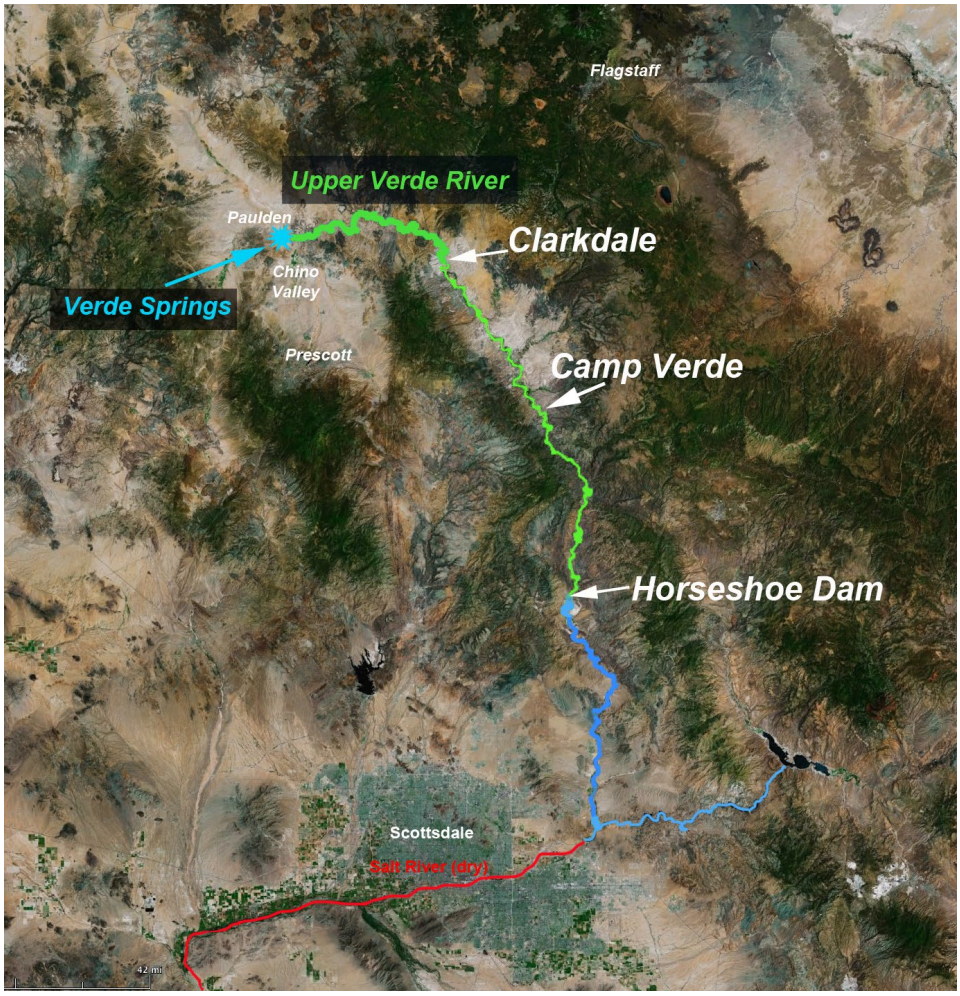

Fig 2. Google Earth view of Verde River. Green: free flowing. Blue: Regulated. Red: Formerly perennial.

Introduction

The Verde River is a green artery pulsing through the heart of Arizona, a jewel of the Southwest continuously flowing over 190 miles from Paulden to the Salt River near Scottsdale. It has maintained this course for 2.5 million years.

Since Arizona's statehood, groundwater pumping and surface water diversions have severely impacted major groundwater basins and seriously degraded five of Arizona's six major perennial rivers: the Colorado, Gila, Salt, Santa Cruz, and much of the San Pedro. The Verde River survives as one of the last living[1] rivers in Arizona.

[1] A living river has natural vegetation, perennial flow, and natural flood flow cycles.

The upper Verde, tucked away deep within the Prescott National Forest between Paulden and Clarkdale, is remote, unknown, under-appreciated, and threatened. The upper Verde's future is clouded by unmitigated groundwater pumping and climate change that may eventually convert 25 miles of a living river into a dead, dry wash. In less than a century, human enterprises have diminished the river to half of the predevelopment flow. We are now witnessing the destruction of the upper Verde, one of the last surviving living rivers in Arizona.

This report documents a pattern of sharply declining flows, suggesting that future perennial flow in the upper Verde River and the associated aquatic and riparian habitat are deeply threatened. Until now, the Verde River has been fully ecologically functional; that is no longer true.

The destruction of the Verde River is not inevitable. We can live here responsibly, enjoying a comfortable lifestyle while protecting our natural areas and our wildlife. The question is: Do we have the political will?

Value of the Verde River

Economy: The Verde sustains more than 700 jobs and over $100 million in economic value in the Verde Valley[2]. It provides 40 percent of the Phoenix area's surface water supply. Plus, natural areas are proven to benefit local economies. Figuratively, the Verde River connects the people of Yavapai County to the citizens in Phoenix.

Recreation: As our population grows, we require more recreational areas. The upper Verde is a wonderful place for people to hike, hunt, fish, camp, backpack, kayak, canoe, view wildlife, photograph, ride horses, climb rocks, and observe birds.

Quality of Life: Clean air, unfettered open spaces and bodies of water, and opportunities to view wildlife enhance our daily living.

Scenery: Primal colors and spectacular rock formations create scenery second to none in the state — red rocks, green plants, blue sky, and white clouds. The Verde displays tremendous natural beauty.

Fig 3. Upper Verde River

[2] Garrick, McCoy, and Aylward, 2011. The Cornerstones Report - Market-based Responses to Arizona's Water Sustainability Challenges. Available at https://cwagaz.org/images/Reports/RefLib/Cornerstone-111811-medres.pdf

Cultural and Historic Values: The entire river corridor is laced with ancient petroglyphs, campsites, structures, and artifacts revealing the historical lifestyle of Indigenous people. The river and its springs are an essential spiritual and cultural foundation for the Yavapai-Apache Nation. Also, remnants of early Arizona ranching history dot the region.

Fig 4. Petroglyphs

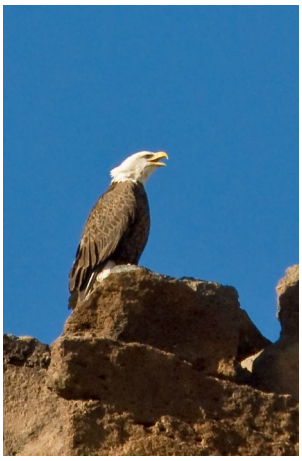

Fig 5. Bald Eagle

Wildlife: Although the Verde River watershed comprises only 5.8 percent of the land area in Arizona, it contains the best remaining riparian areas — lush, green ribbons full of life. The Verde supports a surprisingly large fraction of Arizona's vertebrate species[3]: 78 percent of breeding bird species, 89 percent of bat and carnivore species, 83 percent of native ungulate species, and 76 percent of reptiles and amphibian genera — an impressive concentration of wildlife. Many bald eagles overwinter on the Verde. Seven eagle chicks have fledged at Del Rio Springs in the last five years. The Verde River, the lifeblood of the watershed, supports most of Arizona's wildlife species, a heritage we all share.

Endangered Species: The Verde River supports a rich and diverse variety of plants, animals, and fish[4]. The Endangered Species Act (ESA) lists 19 species in the Verde watershed, including the yellow-billed cuckoo, the southwestern willow flycatcher, native fish and snakes, and more. Wildlife managers monitor an additional 16 sensitive species of concern.

Native Fish: Of Arizona's original 33 native fish, three are extinct, 19 are protected by the ESA, and most are in the Verde[5]. The upper Verde River sustains critical habitat for three native fish protected by the Endangered Species Act: razorback sucker, loach minnow, and spikedace. The upper Verde hosts other sensitive fish species of concern: Sonora sucker, Desert sucker, and roundtail chub.

Fig 6. Sonora sucker

Uniqueness: Of Arizona's six major perennial rivers, the Gila, Salt, and Santa Cruz rivers have been consumed by dams and groundwater pumping, the Colorado is fully diverted and no longer flows to the Gulf of California, and the San Pedro is struggling for life. The Verde River is the longest surviving living river in Arizona.

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[3] Biological Inventory of the Verde Watershed, Anthony Krzysik, PhD, 2011 available at https://cwagaz.org/images/Reports/RefLib/BioInv UVWSR.pdf

[4] Ibid

5 https://ecos.fws.gov/ecp0/reports/species-listed-by-state-report?state=AZ&status=listed

Stewardship: Because we exploit our forests, rivers, and land for the resources that support our society, some environmental degradation is inevitable. Our challenge is to manage this rich and amazing world sustainably so our kids, and their children, can also live comfortably and enjoy nature and wildlife, and so these lands and waters continue to sustain a diversity of life and species. We can learn from local Indigenous communities: the Yavapai-Apache Nation (YAN) in Camp Verde. Monica Marquez, a Yavapai, said: "Water is Life. You never take it all." Vince Randall, past YAN Tribal Chairman and Apache Cultural Chair, asked: "When are you going to learn to share with all living things? When will you learn the true meaning of stewardship? Will it be when there is only one of you left?"

Fig 7. Lush riparian habitat

Water is Life: To indigenous people, the land, plants, and animals are alive; they are identified as beings to be respected, not as nouns representing objects to be owned and exploited. When asked "Where is the river?" they reply "The river lives over there."

Sierra Club Arizona Water Sentinels

Fig 8. Water Sentinels at work.

This report is made possible by the Sierra Club Arizona Water Sentinels, citizen science volunteers dedicated to protecting all waters supported by the Sierra Club. They share a common vision of protecting flowing streams and wildlife to assure that communities can access clean drinking water. The Arizona Water Sentinels are part of the Sierra Club's Grand Canyon Chapter.

The US Geological Survey maintains automated stream gages that record data every 15 minutes at three locations on the upper Verde River: Del Rio Springs, near Paulden, and near Clarkdale. However, there are important data gaps. Since 2007, dedicated Water Sentinels volunteers have collected monthly flow data[6] at each of three additional sites that USGS does not measure. These measurements are snapshots taken at a point in time that supplement the USGS data. These data, in combination with USGS stream gauging data, inform an analysis of the current and projected condition of the upper Verde River.

The Water Sentinels are trained by USGS hydrologists, use certified instruments, and follow USGS measurement protocols. Water Sentinels data are entered into databases maintained by the Arizona Department of Environmental Quality.

[6] https://cwagaz.org/resources/technical-library/item/water-sentinels-flow-data-2024?highlight=WzIwMjRd

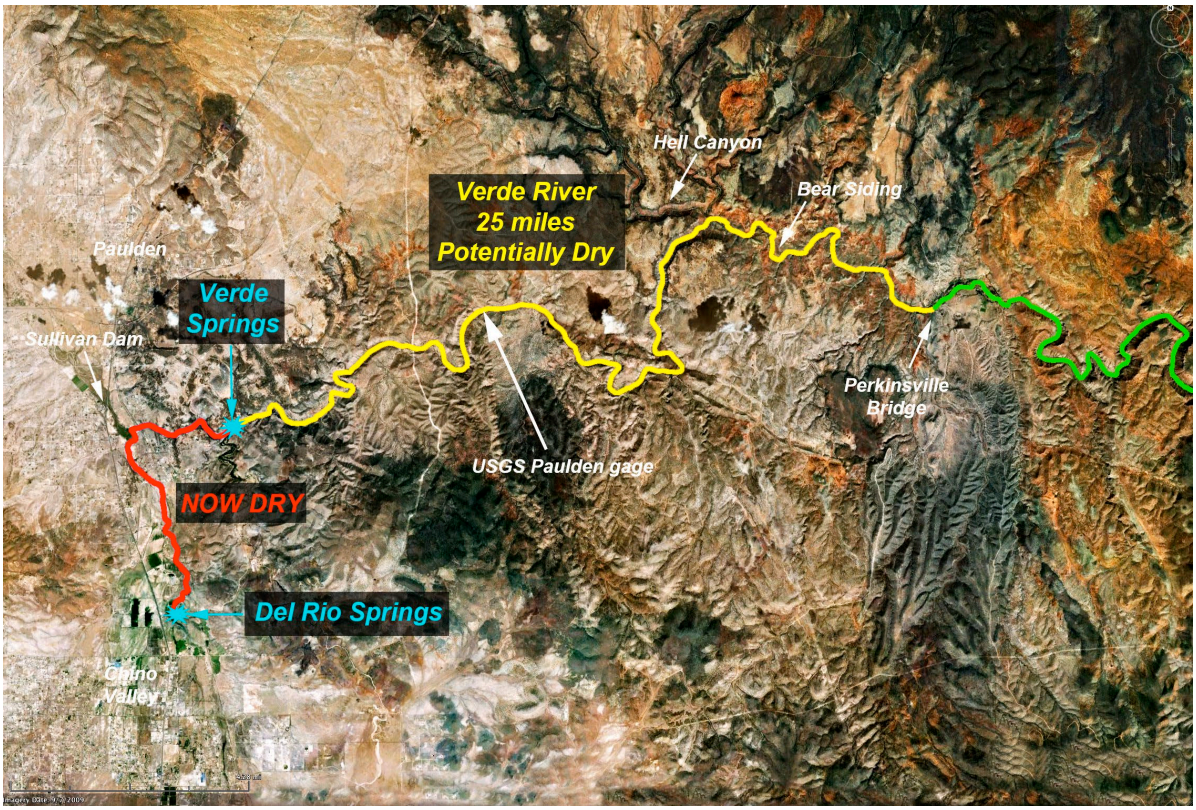


Fig 9. Key locations on the upper Verde River. Google Earth image.

Del Rio Springs Data[7]

Del Rio

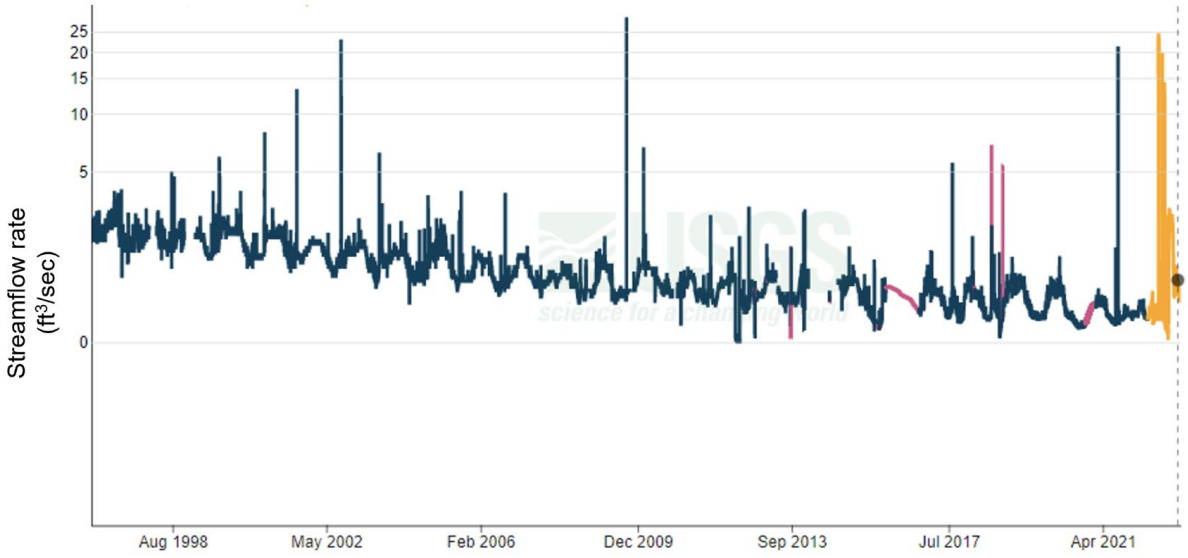


Fig 10. USGS Streamflow Data at Del Rio Springs.

[7] https://waterdata.usgs.gov/monitoring-location/09502900/#parameterCode=00065&period=P7D&showMedian=false

Springs is the historical headwaters of the Verde River located at the north end of the Little Chino Valley[8]. It is the only surface water drain for the Little Chino Aquifer where, since the 1940s, groundwater pumping in excess of recharge has caused groundwater levels to decline over 100 feet.[9] The Arizona Department of Water Resources (ADWR) estimates that the predevelopment flow at Del Rio Springs was over 4,000 acre-feet per year (afy).[10] Currently that flow has declined to about 5 percent of the predevelopment flow, a direct result of groundwater pumping in the Little Chino sub-basin[11] exceeding natural recharge. ADWR groundwater models[12] project that Del Rio Springs will cease to flow in 2025. Next year! Lower Little Chino Creek (formerly the Verde River) upstream of the Sullivan Dam is now ephemeral, flowing only after large storms.

Six miles of the upper Verde is now dry between Del Rio Springs and Verde Springs, a casualty of excessive groundwater pumping in the Little Chino Aquifer.

Above Verde Springs Data

Fig 11. Sullivan Dam in flood at river mile 0. Gary Beverly Photo

[8] Verde River and Del Rio Springs. (n.d.). Retrieved from https://cwagaz.org/index.php?option=com_content&view=article&id=171&Itemid=456
[9] Groundwater level changes in the Prescott AMA, based on data from ADWR. Available at https://cwagaz.org/resources/technical-library/category/cwag
[10] Application of the Prescott Active Management Area Groundwater Flow Model Planning Scenario 1999-2025, Modeling Report No. 12. Available at https://cwagaz.org/images/Reports/RefLib/Modeling_Report_12.pdf
[11] Ecology and Importance of Verde Springs Headwaters. (n.d.). Retrieved from https://springstewardshipinstitute.org/verde-springs-ecology
[12] Nelson, Application of the Prescott Active Management Area Groundwater Flow Model Planning Scenario 1999-2025. Available at https://cwagaz.org/images/Reports/RefLib/Modeling_Report_12.pdf

Groundwater from the Big Chino aquifer travels through the sand, gravel, and limestone to emerge at Verde Springs, a hundred yards downstream of the Granite Creek confluence at approximately river mile 2 (measured from Sullivan Dam). USGS scientific reports[13] have determined that 80-86 percent of Verde Springs flow comes from Big Chino groundwater. Verde Springs is the source of perennial flow in the river.[14] It is the major source of perennial flow until several miles below Perkinsville Bridge at river mile 26.2. Verde Springs is a linear seep, not a point source, into the riverbed extending to the USGS Paulden stream gauge at mile 9.8.

The Arizona Water Sentinels observe flow at the confluence of Granite Creek and the Verde River, above Verde Springs. The flow is usually zero with some seasonal variation. For example, in February of 2020, the flow was 0.13 cfs, in February of 2022 it was 0.4 cfs, but in February of 2023 it was 72.4 cfs due to a winter storm. Absent flood flows, the February flow represents a trickle of water from two sources: Granite Creek and Stillman Lake. Granite Creek is ephemeral from Prescott downstream to Little Granite Spring, located 1.6 miles from the confluence. This spring is small, less than 1 cfs, and supports a rich riparian forest along the stream. In the summer, evapotranspiration by the forest consumes the flow and the confluence is dry. In the winter when the forest is dormant, a trickle reaches the confluence. The contribution of subsurface flow from Stillman Lake is unknown but very small. It is inappropriate to analyze the numbers because the measured flow values are within the error limits and there are multiple water sources. Qualitatively, the flow observations show that there is no perennial surface flow above Verde Springs.

[13] Geologic Framework of Aquifer Units and Ground-Water Flowpaths, Verde River Headwaters, North-Central Arizona, only available online at https://pubs.usgs.gov/of/2004/1411

14 This is the conventional perspective. There is no clear geologic definition of "perennial" and other perennial rivers can have short dry reaches. An unnamed small spring supplies a very shallow Stillman Lake between approximately river mile 1 to 1.8, impounded by a low gravel bar formed by Granite Creek flood flows. Thus, there is an argument for stating that perennial flow in the Verde begins at Stillman Lake, river mile 1.

USGS Paulden Stream Gage

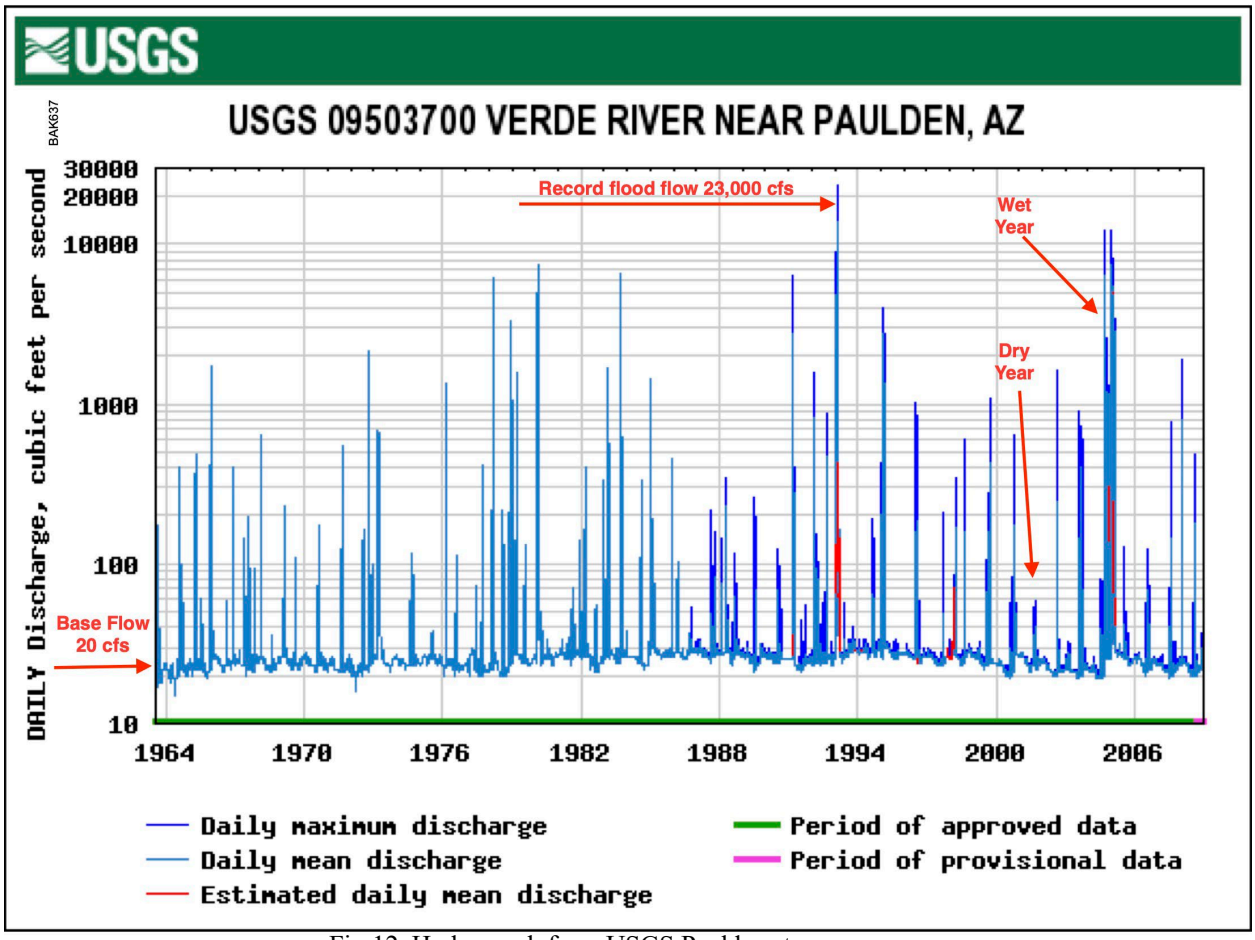


Fig 12. Hydrograph from USGS Paulden stream gage

The US Geological Survey established a stream gage at river mile 9.8, the downstream boundary of the Upper Verde Watershed. The gage has recorded flow at 15-minute intervals since October 1963. The hydrograph[15] reveals a steady minimum base flow with sharp spikes from flood flow. Base flow is groundwater released from aquifers; this sustains perennial flow. Intermittent precipitation events add to the total flow. The maximum recorded flow is 23,000 cfs recorded in February 1993 – equivalent to more than two Colorado Rivers! Flood flow spikes are typical in southwestern desert rivers. After storms, the flow returns to base flow levels in a few days.

Base flow is measured as the average of the lowest flow for 7 consecutive days in a water year (October 1st through September 30th). USGS scientific reports[16] have determined that 80-86 percent of the base flow comes from Big Chino groundwater. The graph below uses data from the USGS Paulden gauge at river mile 9.8. From 1997 to 2022 the base flow declined at a rate of -0.36 cfs per year. The decline is

[15] https://waterdata.usgs.gov/monitoring-location/09503700/#parameterCode=00065&period=P7D&showMedian=false
[16] Wirt, DeWitt, and Langenheim, Geologic Framework of Aquifer Units and Ground-Water Flowpaths, Verde River Headwaters, North-Central Arizona. Available at https://pubs.usgs.gov/of/2004/1411

probably due to a combination of groundwater pumping in the Big Chino aquifer and increased temperatures associated with climate change.

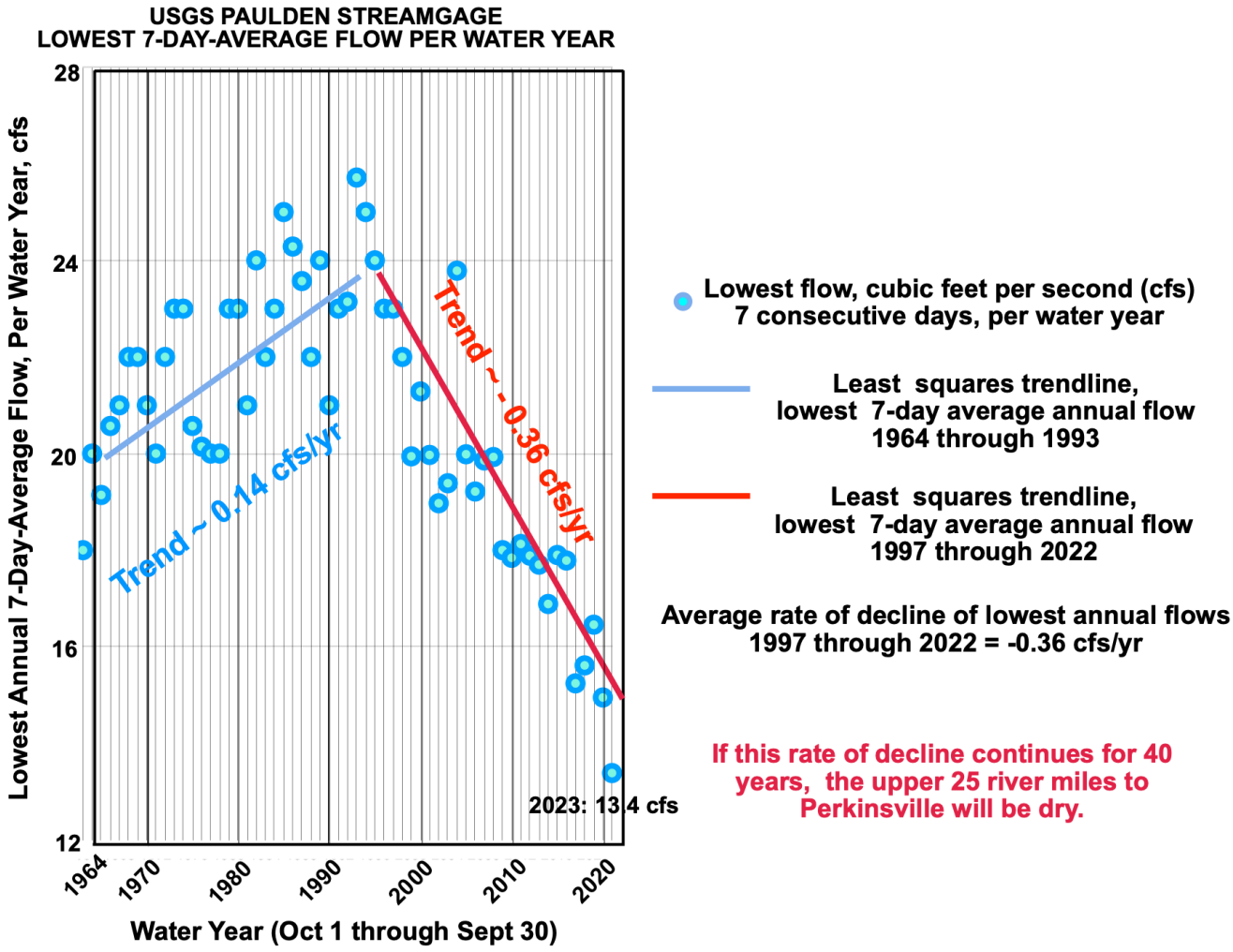


Fig 13. USGS Paulden Base Flow. Graph Courtesy of Ed Wolfe.

Bear Siding Data Site

The Water Sentinels recorded data at Bear Siding at river mile 19.4. The stretch between the USGS Paulden gauge and the Bear Siding site is about 9.4 miles. This part of the Verde River is untouched by roads and crossings.

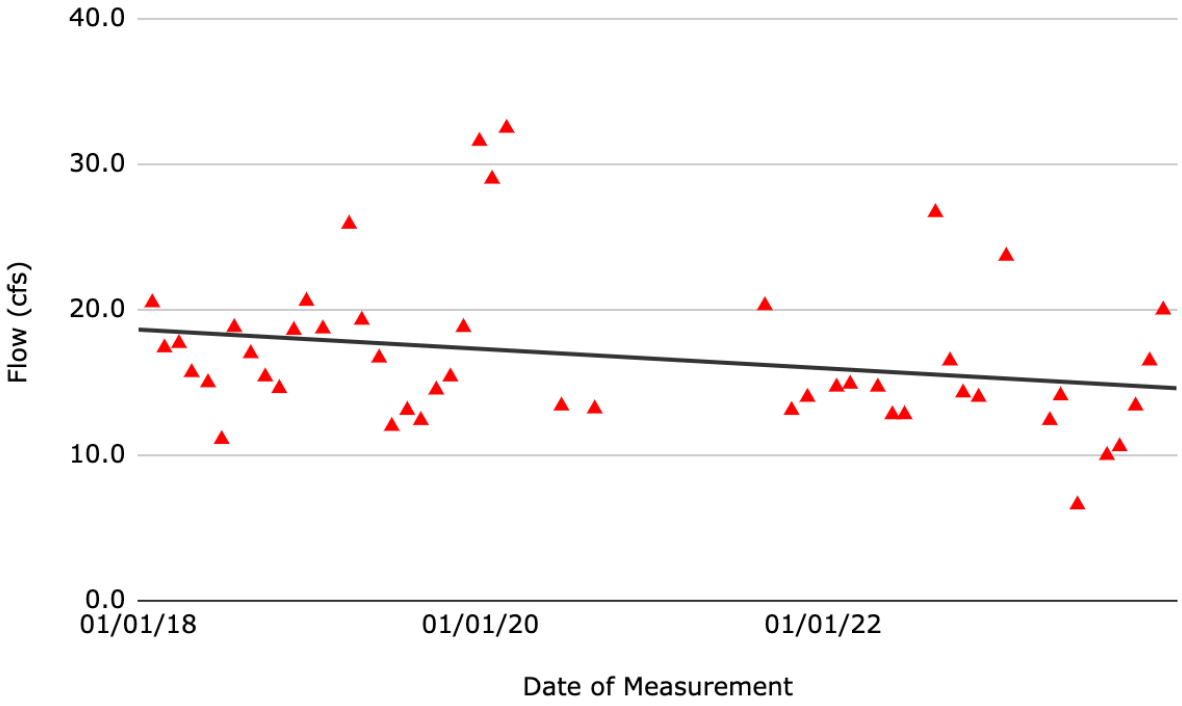


Fig 14. Flow data for Bear Siding Site

The above graph plots the flow of the Verde at Bear Siding. There is a downward trend of flow at this site from 2018 to 2023. The sporadic high flows are caused by intermittent precipitation events that cause ephemeral tributary streams to flow.

The flow at this site over the past 5 years ranged from 6.6 cfs in June 2023 to 32.5 cfs in February 2020. It is common to see high flows during the winter months due to winter storms and lows in early summer before the summer monsoon. However, from 2013 to 2018, the flow at Bear Siding ranged from 11.5 cfs in June 2017 to 70.2 cfs in February 2017.

Perkinsville Data Site

The Water Sentinels data collected at Perkinsville Bridge, river mile 26.2, is extremely significant. The data include flow in the main channel plus flow in a small irrigation ditch from a diversion point upstream of the main channel measurement.

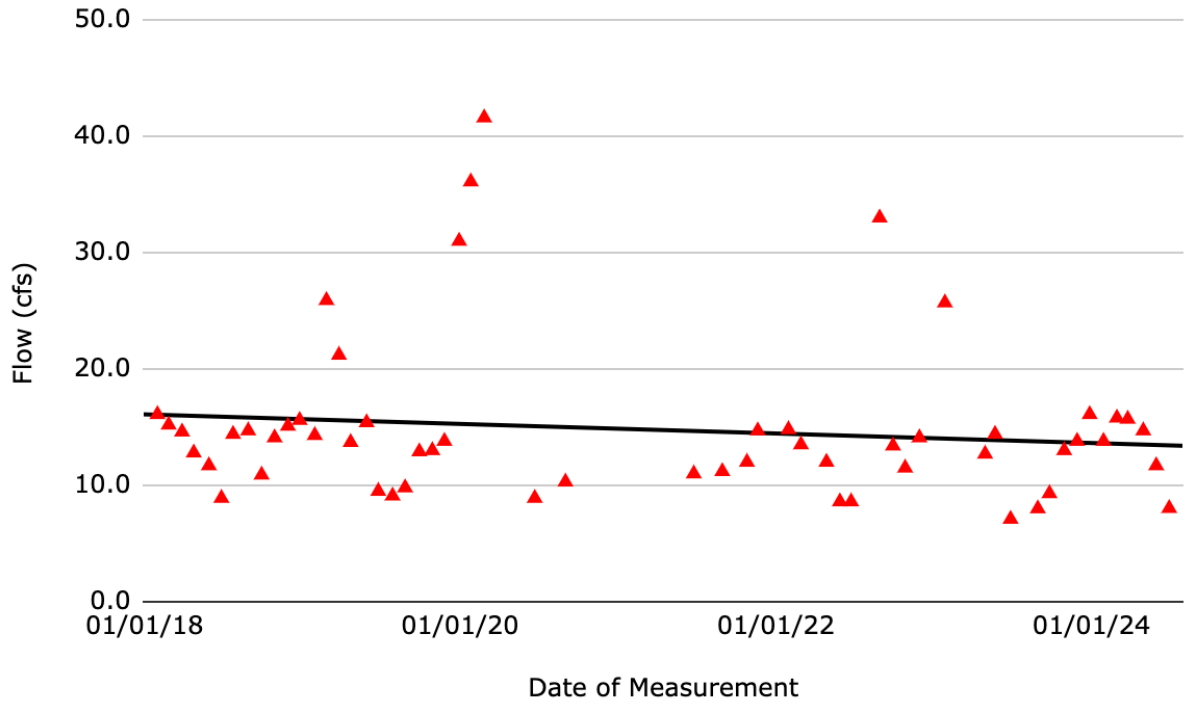


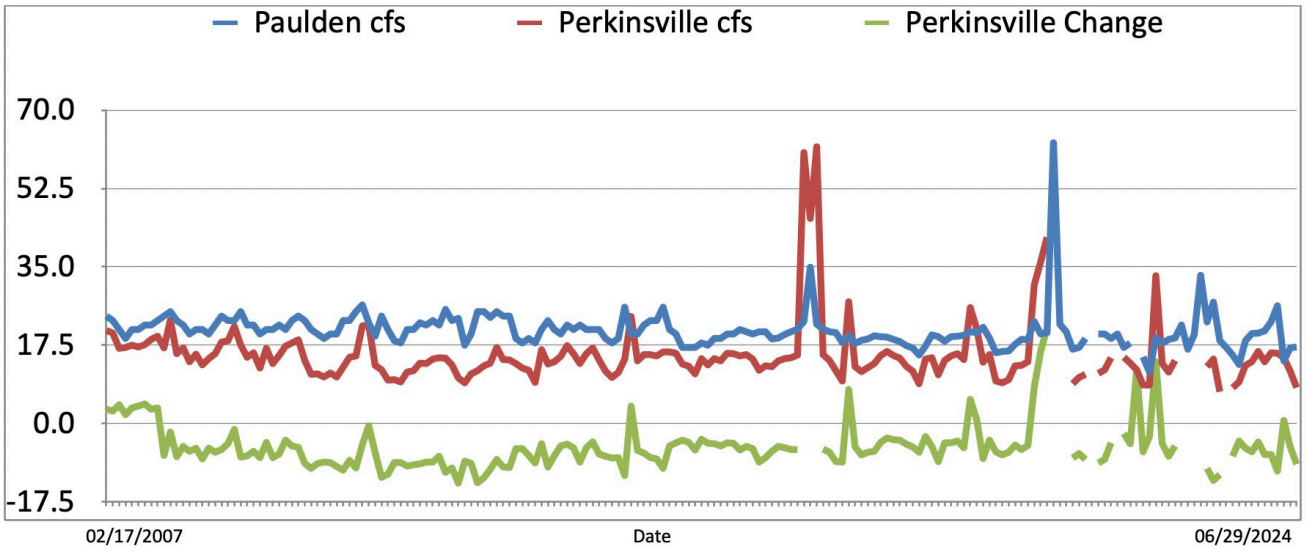
Fig 15. Flow data for Perkinsville Site

The chart above plots the water measurements at the Perkinsville Site between January 1, 2018, through January 1, 2024. The plotted data show the same decreasing trend of flow observed in upstream sites. Missing data points are due to the Covid-19 pandemic, unsafe high flow, or muddy conditions. In past reports, the yearly ranges and continually declining trend lines indicate a steady decline in base flow. Overall, this chart depicts a continuing downward trend in flow.

In 2007, the flow of the Verde River at the Perkinsville site had a range between 16-21 cfs[17]. In 2011, the range was between 9-15 cfs. In 2017 the Perkinsville site had a range of 7.9-11.9 cfs[18]. Most recently in 2023, the Verde had a range between 7.1-25.7 cfs.

[17] The Sierra Club. (2013). *Going with the flow*. Grand Canyon Chapter. Pawlowski, S. https://www.sierraclub.org/sites/default/files/sce/grand-canyon-chapter/conservation/Going_with_the_Flow_Final_05-02-2013.pdf

[18] The Sierra Club (2018) *Going With the Flow Update*. Shultis, R. https://www.sierraclub.org/sites/default/files/sce/grand-canyon-chapter/conservation/Going%20with%20the%20Flow%20Update%20Final_04-23-2018.pdf



The above graph shows that flow at Perkinsville (mile 26.2) is less than at the USGS Paulden stream gauge (mile 9.8), indicating a "losing reach" where flow decreases as water moves downstream[19]. This is due to a combination of evaporation from water surfaces, infiltration into the stream bed, and evapotranspiration from the surrounding riparian vegetation. The average flow reduction at Perkinsville compared to USGS Paulden for 2017-2024 is 7.6 cfs.

Fig 16. Flow comparison between Paulden and Perkinsville

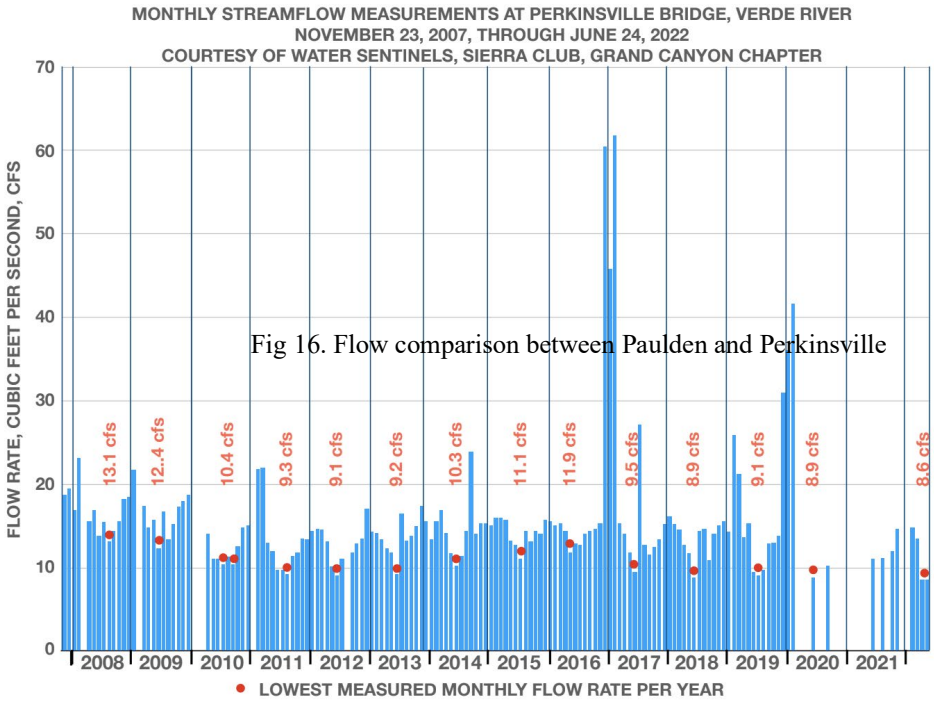


Fig 17. Water Sentinels Streamflow Measurements at Perkinsville. Graph courtesy of Ed Wolfe.

[19] Valerie. (2023). How do gaining and losing streams differ? Retrieved from https://wildearthlab.com/2023/04/26/gaining-and-losing-streams/

The above graph depicts the average monthly flow recorded by the Water Sentinels at Perkinsville. The ebb and flow of the Verde has an annual cycle, but the lowest measured monthly flow occurs in June (indicated by red dot) before the seasonal monsoon thunderstorms.

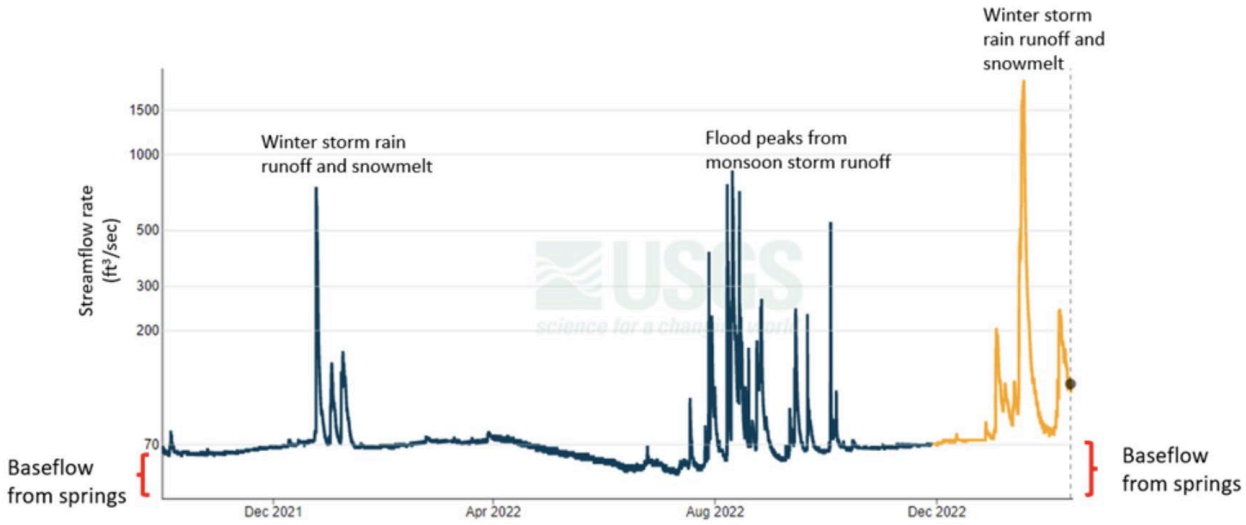


Fig 18. USGS flow data from Clarkdale gage

USGS Clarkdale Data

USGS maintains an automated stream gage at river mile 37 upstream from Clarkdale. The hydrograph shows the typical peak flows of the Verde occurring from winter storm runoff and summer monsoons[20] and includes all the tributary water sources. Downstream from Perkinsville, groundwater inflows from aquifers to the north have increased base flow to approximately 65 cfs.

[20] Ecology and Importance of Verde Springs Headwaters. (n.d.). Retrieved from https://springstewardshipinstitute.org/verde-springs-ecology

Seepage Data

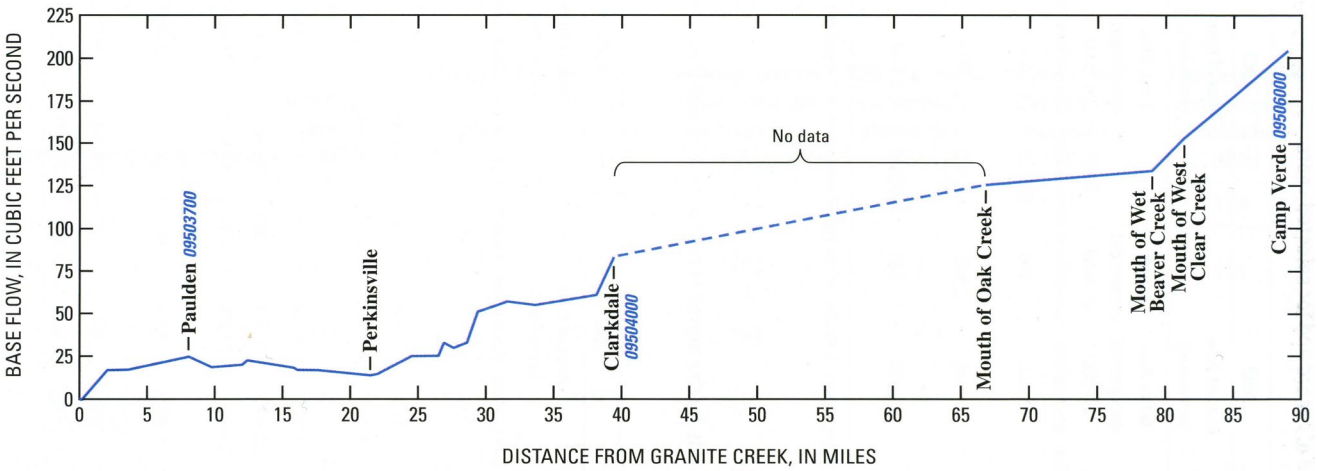


Fig 19. Gaining and losing reaches on the Verde River

In the above graph, USGS measured and inferred[21] the changes in river flow (a seepage graph) moving downriver for the upper 90 miles of the Verde. The graph shows base flow increasing up to the Paulden stream gage, then decreasing to Perkinsville Bridge, then continuously increasing to the Camp Verde gage.

The Water Sentinels have added detailed data to the USGS estimates as shown in Figure 20 below. The map presents flow data collected on one day from river mile 9.8 at the USGS Paulden gauge to river mile 26.2 at Perkinsville Bridge. It was collected by four groups measuring approximately every mile along the upper Verde River on June 1, 2013.

The readings show how the flow varies along the river on one day. From river mile (RM) 9.8 at the USGS Paulden gauge to RM 13.4 there is a decline of 4.7 cfs in 3.6 miles. Increases at RM 15.6 are due to the nearby Duff Spring. Flow drops another 3.9 cfs at RM 17.6 and picks up again to 16.5 at RM 18.9, likely due to subsurface flows from Hell Canyon. By RM 22.2, one of the Bear Siding Water Sentinels routine data sites, the flow has declined to 11.9 cfs, probably due to infiltration into a broad gravel cobble stream bed. The Verde continues to lose flow as it moves downstream to Perkinsville. The highest reading of the day is 21 cfs at USGS Paulden at RM 9.8, declining to the lowest flow of 11.4 cfs at RM 24.9 with a loss of 9.6 cfs.

[21] Blasch, K.W., Hoffmann, J.P., Graser, L.F., Bryson, J.R., and Flint, A.L., 2006, Hydrogeology of the upper and middle Verde River watersheds, central Arizona: U.S. Geological Survey Scientific Investigations Report 2005–5198, 102 p., 3 plates.

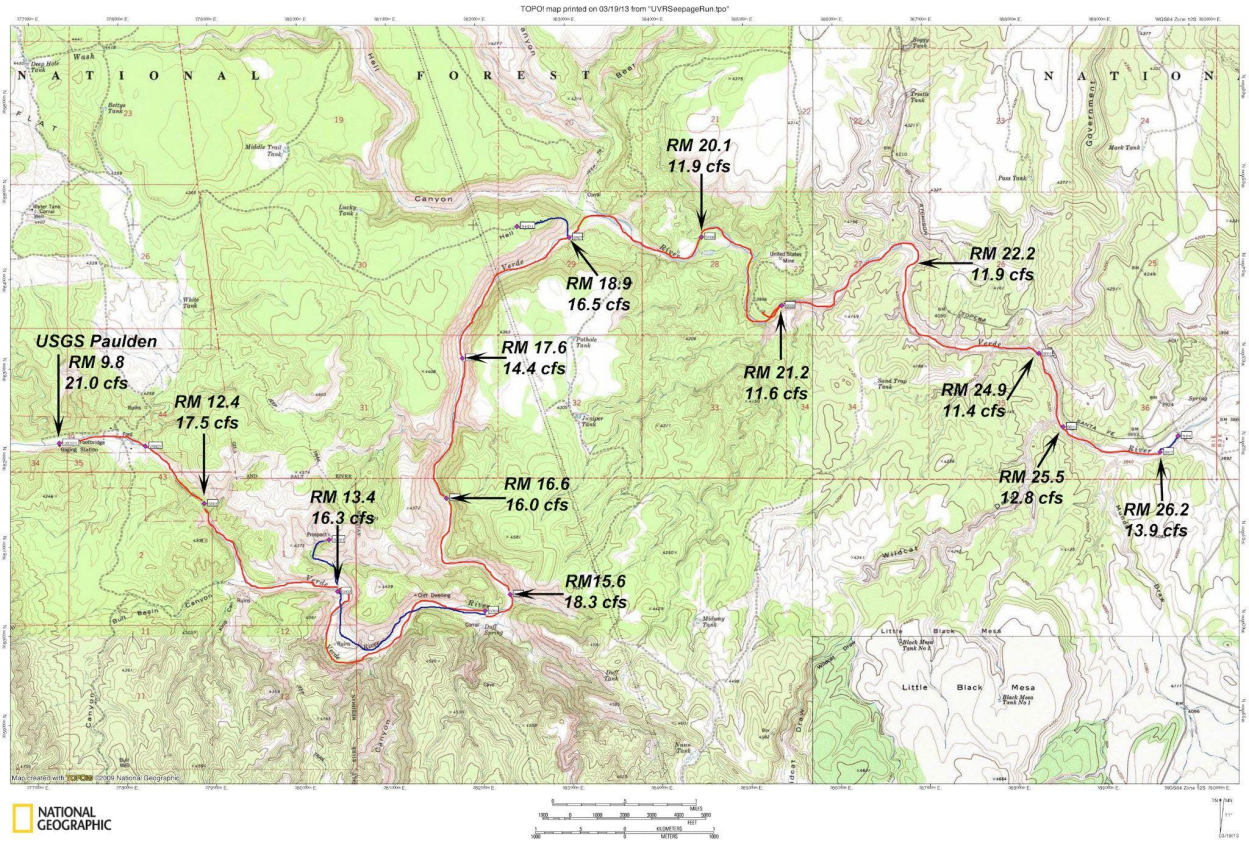


Fig 20. Water Sentinels seepage data describing losing reach of the upper Verde River

The losing flow reach is caused by a combination of evaporation from water surfaces, evapotranspiration from the surrounding riparian vegetation, and infiltration into the stream bed where the regional water table is below the stream bed. Water that infiltrates into the stream bed is likely to reappear as surface flow further downstream. The continuous interaction between surface flow and groundwater is normal and expected behavior for southwestern rivers in arid landscapes.

Effects on Habitat

The US Forest Service Rocky Mountain Research Service in Flagstaff published "Upper Verde River Habitat Analysis Executive Summary 2020 - 2023"[22] in late 2023. The report is rich in data for the upper Verde: lidar surveys, transects of vegetation and channel structure, instream habitats, and E-DNA for fish. The 2023 report was sponsored by the US Bureau of Reclamation and Prescott National Forest for comparison with an earlier 2012 report[23].

The paper reveals that the upper Verde is:

[22] Leonard, Sankey, Tango, and Tyler. Upper Verde River Habitat Analysis Executive Summary 2020 - 2023. Available at https://cwagaz.org/images/Reports/RefLib/UVR_Final_Report.pdf

[23] Neary, Daniel G.; Medina, Alvin L.; Rinne, John N., eds. 2012. Synthesis of Upper Verde River research and monitoring 1993-2008. Gen. Tech. Rep. RMRS- GTR-291. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 296 p.

- Declining in flow, which triggers changes in aquatic habitat.
- Losing aquatic habitat types preferred by native fish.
- Aggrading the banks by about a foot by streamside sediments accumulation.
- Becoming channelized by woody bankside vegetation.
- Suffering significant declines in native fish species in the reach above Hell Canyon, based on E-DNA data.
- Suggests that the aquatic habitat upstream from Hell Canyon (river mile 19) may no longer be suitable native fish habitat. However, the reach between Hell Canyon and Sycamore Creek is less impacted.

In June 2022 the Arizona Game and Fish Department monitored the species and number of native and non-native fish in the upper river[24]. They found one desert sucker - 0.27% of all the fish sampled. This represents a surprising 100-fold decline in native fish compared to the earlier 2012 report which reported 20% native fish in abundant numbers in this reach.

Summary

The flow data from USGS and the Arizona Water Sentinels show:

- Groundwater pumping in the Little Chino Aquifer has reduced the flow of Del Rio Springs, the historical headwaters of the Verde River, to 5% of the predevelopment flow causing the upper six miles of the river to dry up. Perennial flow now begins at Verde Springs.
- Groundwater pumping and climate change reduced the 2024 base flow at USGS Paulden to a record low of 13.4 cfs. The predevelopment base flow was 28 cfs.[25] This represents a 52% reduction in base flow.
- Since the mid 1990's, the base flow at USGS Paulden has declined 0.36 cfs/yr. At that rate the river will be dry at USGS Paulden in four decades.
- Water Sentinels data from Perkinsville Bridge indicates that the average flow for 2017-2024 at Perkinsville is 7.6 cfs less than at USGS Paulden. Therefore, a reduction in flow at USGS Paulden of 7.6 cfs may result in a dry river at Perkinsville Bridge. At the current rate of base flow decline, this may occur in two decades.
- The Endangered Species Act lists Perkinsville Bridge as Critical Habitat for three native fish, two snakes, and one bird. A dry river here will seriously affect these species.
- Recent studies of the aquatic habitat and species indicate a profound loss of native fish populations in the upper 19 miles.

Prior to the 2023 RMRS report, the Sierra Club considered the upper Verde to be ecologically functioning despite reduced flow. Now we must regard the upper Verde as critically endangered and ecologically impaired due to rapidly declining flow.

[24] Verde River: Verde Ranch - Perkinsville Fish Survey July 12-14, 2022, Stites and Chmiel. Available at https://cwagaz.org/images/Reports/RefLib/R3_VerdeVR-PR_07122022_Final 1.pdf

[25] Pool, D.R., Blasch, K.W., Callegary, J.B., Leake, S.A., and Graser, L.F., 2011, Regional groundwater-flow model of the Redwall-Muav, Coconino, and alluvial basin aquifer systems of northern and central Arizona: U.S. Geological Survey Scientific Investigations Report 2010-5180, v. 1.1, 101 p. See table on page 58.

The Future of the Verde

We are now witnessing the destruction of one of Arizona's last surviving perennial rivers.

As stated in the beginning, this report is aimed to create an awareness of the shrinking base flow of the Verde River to the public and stakeholders living in its upper watershed.

Rapidly growing cities in the watershed are demanding more and more water, draining the groundwater aquifers that feed the river. Declining flows have degraded the riparian areas that are home to ESA listed native species. With the continuing droughts in the Southwest, the upper Verde may become a dry wash with no surface water in a few decades.

Slowing the rate of climate change, addressing its impacts, and reducing carbon emissions are essential to protecting the river from climate change[26]. Although climate change is a global issue that is not under our immediate or local control, local measures should contribute their share of mitigation efforts.

Mitigation of groundwater pumping is absolutely essential to the future of the Verde River. This is the responsibility of the Arizona Legislature, the Yavapai County Board of Supervisors, and the partners of the Big Chino export scheme: the City of Prescott and the Town of Prescott Valley. Government officials should manage to address issues of inequity, overconsumption, and water supply scarcities. Government-based policies should be crafted with participation of all stakeholders, including Tribal Nations, the public, environmental advocates, and under-represented voices.

There are some hopeful projects in the Big Chino Valley. Prescott National Forest is acquiring private ranch lands in the upper Big Chino to prevent development. Salt River Project and The Nature Conservancy are working to purchase conservation easements from large ranches. The Trust for Public Land has successfully achieved the transfer of 720 acres of private land (previously slated for development) to Arizona State Parks to eventually become the Verde Headwaters State Park. A coalition[27] of conservation organizations has submitted a proposal to designate the Upper Verde Wild and Scenic River. These projects are helpful in the long term but will not address the near-term decline of base flow that is an immediate and existential threat to the upper Verde.

Fundamentally, the upper Verde is now in an extremely fragile and vulnerable condition. We must act quickly to minimize future disastrous damage to the Verde River by creating a sustainable water future for both humans and wildlife.

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[26] American Rivers Climate Strategies. (n.d.). Retrieved from https://www.americanrivers.org/wp-content/uploads/2021/11/River-Climate-Policy-Recommendations_Final45-1.pdf

[27] American Rivers, Sierra Club, The Wilderness Society, American Whitewater, Friends of the Verde River, the Yavapai-Apache Nation, Arizona Wild, and the Citizens Water Advocacy Group.

Appendix A: Flow Data

Download data: https://cwagaz.org/resources/technical-library/item/water-sentinels-flow-data-2024?highlight=WzIwMjRd

Appendix B:
Verde Watershed Species Listed by the Endangered Species Act

Source: https://ecos.fws.gov/ecp0/reports/species-listed-by-state-report?state=AZ&status=listed

Update April 2022: USFWS determined that Roundtail chub and Headwater chub (formerly candidates) will not be listed.

Riparian Species (obligate and facultative):

Yellow-billed cuckoo (Threatened, Critical Habitat proposed)
Southwestern willow flycatcher (Endangered, CH designated)
Narrow-headed gartersnake (Threatened, CH proposed)
Northern Mexican gartersnake (Threatened, CH proposed)
Chiricahua leopard frog (Threatened, CH designated)
Spikedace (Endangered, CH designated)
Loach minnow (Endangered, CH designated)
Razorback sucker (Endangered, CH designated)
Gila chub (Endangered, CH designated)
Colorado pikeminnow (Endangered, experimental population)
Gila topminnow (Endangered, CH designated)
Gila trout (Threatened, CH designated)
Woundfin (Endangered, experimental population)

Upland Species:
Arizona cliffrose (Endangered, no CH)
Mexican spotted owl (Threatened, CH designated)
Black-Footed ferret (Endangered, no CH)
Lesser long-nosed bat (Endangered, no CH)
California condor (Endangered, experimental population)

Appendix C: Watched Species in the Verde Watershed

“Sensitive Species” (Prescott National Forest)
Sonora sucker
Desert sucker
Speckled dace
Longfin dace
Lowland leopard frog
Arizona toad
Common black hawk
American peregrine falcon
Abert’s towhee
Western red bat
Pale Townsend’s big-eared bat
Pocket free-tailed bat

“Species of Concern” (Arizona Department of Game and Fish)
Osprey
Belted kingfisher
River otter
Least bittern