The Importance of Arizona's Ephemeral Streams

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The recently-finalized Navigable Waters Protection Rule (the "new rule") reduces the number of waters in Arizona that will receive water quality protection through the federal Clean Water Act. The new rule defines "waters of the United States" under the Clean Water Act; ephemeral streams are categorically excluded from "waters of the United States" and, as a consequence, are excluded from federal water quality protection. Ephemeral streams flow during and after precipitation events. In Arizona, approximately 95% of total stream miles are ephemeral.[1] Other Arizona waters are now excluded from federal water quality protection, including certain perennial and intermittent rivers and streams and many wetlands.

The Arizona Department of Environmental Quality (ADEQ) has implemented the federal Clean Water Act for several decades but lacks authority under state law to protect Arizona waters that are no longer protected by the federal government. As ADEQ contemplates how to continue to protect the water quality of rivers, streams, and wetlands in the wake of the new federal rule, the inclusion of ephemeral streams in a state water quality protection program must be considered. Whether a river or stream flows year-round or a few weeks a year, from snowmelt, surface flow, or groundwater, both the waters and the streambeds through which they flow support water supplies, wildlife, native vegetation, and local communities and developments. Without regulatory protection, those benefits are at risk.

What are ephemeral streams and why are they important?

According to the new federal rule, ephemeral streams flow during and after precipitation events. They are distinguished from intermittent streams, which flow continuously for part of the year because of seasonal snow melt or a high water table. While ephemeral streams do not flow continuously, they are the threads that connect the arid landscape to rivers, lakes, reservoirs, and underground aquifers.

Arizona's ephemeral streams **protect surface water and groundwater quality**, **buffer and protect downstream private property** by conveying flood waters and sediment flows, **recharge groundwater levels** for agriculture and communities, and are as important as perennial rivers in **providing habitat for birds and other wildlife.**[2]

[1] United States Environmental Protection Agency (EPA) (2019). *Streams Under CWA Section 404*: https://www.epa.gov/cwa-404/streams-under-cwa-section-404

[2] Lainie R. Levick et al. EPA (2008). *The Ecological and Hydrological Significance of Ephemeral and Intermittent Streams in the Arid and Semi-Arid American Southwest*: https://www.epa.gov/sites/production/files/2015-03/documents/ephemeral_streams_report_final_508-kepner.pdf

Water Quality Protection

Ephemeral streams play an important role in improving water quality. During floods and periods of stream flow, the roots and stems of riparian trees and vegetation capture sediment, build up stream banks, and reduce erosion.[3] These natural streambank elements slow flood waters and absorb potentially harmful runoff from human activities, as well as other pollutants that gather and flow across the land and through storm drains during rain events.[4] This important function of ephemeral streams helps to filter water as it recharges local groundwater tables that are often used by local communities as a principal water source.

However, what flows into ephemeral streams is as important as what flows through them. While the function of ephemeral streams contributes to improved water quality, ephemeral streams can also convey polluted and contaminated flood waters across the landscape, through urban areas, and into perennial rivers downstream. For this reason, it is important that ephemeral streams are protected from discharges of pollutants from industrial and urban activity.

Flood Protection

Since 2010, Arizona has lost more than $3 billion in direct damages from extreme weather, and in Tucson, flooding has accounted for 96% of all property losses.[5] Flood protection is an increasingly important issue across the United States as freshwater flooding causes an average of $8.2 billion in damages each year, and the total U.S. population exposed to serious risk of flooding is 2.6 – 3.1 times higher than previous estimates[6]. In Arizona, monsoon events, hurricane-derived storms, and soaking winter rains can produce significant precipitation, peak flows, and flood events.

River floodplains, including ephemeral ones, are natural flood control and mitigation infrastructure. Floodplains form an interconnected network of floodwater conveyance channels. **Ephemeral streams help reduce the risks from overland flooding in urban areas, agricultural fields, and private property by dissipating flows, reducing erosion, and aiding infiltration.**[7] Maintaining, managing, and restoring natural flood conveyances such as ephemeral streams can lower flood insurance rates, decrease economic losses from property damage, bolster property values, increase tax revenues, and provide jobs.[8]

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[3] George Zaimes et al. University of Arizona (2007). *Understanding Arizona's Riparian Areas:* https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1432.pdf

[4] Zaimes et al. University of Arizona (2007).

[5] Laura A. Bakkensen and Riana D. Johnson. Making Action Possible for Southern Arizona (2017). *The Economic Impacts of Extreme Weather: Tucson and Southern Arizona's Current Risks and Future Opportunities*: https://mapazdashboard.arizona.edu/sites/default/files/images/bakkensen_johnson_map_white_paper_the_economic_impacts_of_extreme_weather.pdf

[6] Oliver E J Wing et al. Environmental Research Letters (2018). *Estimates of Present and Future Flood Risk in the Conterminous United States*: https://iopscience.iop.org/article/10.1088/1748-9326/aaac65/pdf

[7] Levick et al. EPA (2008).

[8] Brandon Parsons et al. ECONorthwest and American Rivers (2020). *Economic Outcomes of Urban Floodplain Restoration:* https://s3.amazonaws.com/american-rivers-website/wp-content/uploads/2020/06/05111836/AR-Economic-Outcomes-Report.pdf

Groundwater Recharge

Ephemeral streams in Arizona play an outsized role in facilitating groundwater recharge. Ephemeral channels, with their sandy and coarse grained soils, provide a much more rapid infiltration of water when compared to the tight clay soils of the surrounding area. And, relative to open desert and uplands, ephemeral streams generally have higher vegetation density which acts to reduce runoff velocity once overland flows enter floodplains. Ephemeral streams are corridors for riparian trees and shrubs that increase soil moisture and accelerate infiltration during flood surges and snowmelt seasons.[9]

As an example, 12 to 19 percent of the estimated average recharge in the Sierra Vista sub-watershed in Cochise County is comprised of ephemeral channel recharge.[10] Absent ephemeral corridors for conveyance, this runoff is more likely to be lost to evaporation, or exacerbate overland flooding, or both, and would not effectively recharge local aquifers. For agriculture and certain local communities, ephemeral streams, as vehicles for groundwater recharge, are a key component of the local water cycle.

Wildlife Habitat and Connectivity

Ephemeral streams are an essential part of the hydrologic network, conveying flood waters directly to perennial streams and groundwater aquifers that humans and wildlife depend upon for water, habitat, and a cooling refuge from the desert heat. Along many of the ephemeral streams in the desert Southwest, native trees like Velvet Mesquite (*Prosopis velutina*), Palo Verde (*Parkinsonia florida*), and Ironwood (*Olneya tesota*) thrive. Remarkably, while these woodlands along ephemeral streams comprise only five percent of the land cover in the desert regions of the Southwest, they provide habitat to 90 percent of the bird life in the region.[11]

Both resident and migratory birds can reliably find cover, protection, nesting sites, and forage in ephemeral stream woodlands. With a higher moisture content and humidity, these ephemeral stream woodlands attract abundant and diverse wildlife and provide important migratory corridors between mountain ranges, downstream of perennial rivers, and around urban areas. Numerous birds, mammals, reptiles, and amphibians utilize Arizona's natural ephemeral streams, including Lucy's Warblers, Bell's Vireos, Phainopeplas, Ladder-backed Woodpeckers, ring tail cats, javelina, gray fox, desert mule deer, mountain lions, and desert tortoises.

Furthermore, when effluent (treated wastewater or reclaimed water) meets adequate standards and is discharged into an ephemeral stream, fish and wildlife can thrive. Effluent-fed streams can serve as refuges for aquatic biodiversity and corridors of ecological connectivity, especially in semi-arid and arid regions[12].

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[9] Zaimes et al. University of Arizona (2007).

[10] Alissa L Coes and Donald R Pool. United States Geological Survey (USGS) (2005). *Ephemeral-Stream Channel and Basin-Floor Infiltration and Recharge in the Sierra Vista Subwatershed of the Upper San Pedro Basin, Southeastern Arizona*: https://pubs.usgs.gov/of/2005/1023/

[11] Arizona-Sonora Desert Museum. University of California Press (1999). *A Natural History of the Sonoran Desert*.

[12] Rosemary Brandt. University of Arizona (2020). *Just Add Water: Biodiversity Resurgence in Effluent-Fed Desert Riverbeds:* https://news.arizona.edu/story/just-add-water-biodiversity-resurgence-effluent-fed-desert-riverbeds

What impacts ephemeral streams and why should they be protected?

Historic (especially pre-Clean Water Act) land development in Arizona has significantly altered the network of streams across the landscape. Ephemeral streams have been particularly impacted, as their essential contributions to wildlife, groundwater recharge, and water quality are more important than their dry appearance may suggest. Many ephemeral streams and the surrounding uplands have been filled in and paved, channelized and armored for urban flood control, altered for road construction, and used as dumpsites.

In Maricopa County alone, the Flood Control District issues an average of 550 floodplain use permits each year representing the many activities that use and alter ephemeral floodplains, including road crossings, building sites, and streamside modification.[13] The impacts of these disturbances on water quality and wildlife habitat are long-lasting. Expanded impervious surfaces increase runoff and decrease infiltration, which leads to greater erosion, diminished recharge, and more pollutants discharging across the landscape and into perennial streams and downstream aquifers.[14]

Given their importance and abundance across Arizona, it is essential to view ephemeral streams as part of a connected network of ecosystem functions and not in isolation.[15] With the benefits that ephemeral streams provide, it is important to consider their inclusion in a state water quality program.

Water Quality affects aquatic life

Point source discharges of effluent into ephemeral stretches of streams and rivers can sustain aquatic life and habitat when protective water quality standards are in place. Featured above: Santa Cruz River in Tucson[16]

[13] Flood Control District of Maricopa County (2019). *Maricopa County Flood Facts*: https://www.maricopa.gov/DocumentCenter/View/12589/Flood-Facts-CRS-Newsletter

[14] D.C. Goodrich et al. Journal of the American Water Resources Association (2018). *Southwestern Intermittent and Ephemeral Stream Connectivity*: https://www.tucson.ars.ag.gov/unit/publications/PDFfiles/2341.pdf

[15] Levick et al. EPA (2008).

[16] Brandt. University of Arizona (2020).

Ephemeral streams can convey significant floodwaters and enhance groundwater recharge

Photographs of an ephemeral stream, same location during flow (left), and dry (right), Tucson, Arizona[17]

Photographs from an unusually large flood event in an ephemeral stream that damaged roads and bridges, and flooded nearby homes, Tucson, Arizona, July 31, 2006[17]

[17] Levick et al. EPA (2008).

Ephemeral streams provide wildlife habitat

Ephemeral streams with habitat along their banks[18] [19] [20]

Conclusion

Clean water is essential to Arizona's economy, communities, and the birds, fish, and other wildlife that rely on it. We must ensure healthy water supplies for generations to come. The potential for cumulative negative impacts to our water quality is high if we do not safeguard our waters. Water quality standards, monitoring and assessment, a permitting system, and inspection and enforcement are all needed in a state water quality program to protect the various uses and users of water in Arizona. Given their many benefits, ephemeral streams should be no exception.

[18] Wash: HitchChic/Flickr https://www.flickr.com/photos/hitchchic/2604746495/
[19] Grapevine Mtn: Lhogue46/Flickr https://www.flickr.com/photos/hoguedesert/3377581130/
[20] Mesquite Wash: Johnida Dockens/Flickr https://www.flickr.com/photos/johnida/279269799/