

Ceremonial and Subsistence Water Use

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Summary

Water for cultural and religious purposes, referred to as ceremonial and subsistence (C&S) use, is a distinctive feature of many Indigenous and other communities. Whether this constitutes a legitimate claim for water for an American Indian Tribe in the United States was litigated in the context of a trial to determine the federal government's obligation to reserve water for Indian Tribes whom it had settled on reservations during the 19th century. Following a U.S. Supreme Court ruling in 1963, the amount of water the federal government was obligated to provide was defined as the quantity of water that could be used to grow crops profitably on the reservation. In 2001, the Arizona Supreme Court adopted a new definition, for Arizona, namely the amount of water that ensured the reservation would be a permanent homeland. However, parts of this 2001 ruling were contradictory and seemed to support the profitable irrigation standard. What the Arizona Supreme Court actually meant was not put to the test until the Hopi water rights trial in 2020. The Hopi Tribe's water rights claims included a claim for new water to replace diminishing local water supplies in order for the Tribe to continue cultivating traditional varieties of corn and other crops. Hopi agricultural practices date back at least a millennium and are a central part of Hopi culture and religion. The crops are used in cultural and religious ceremonies and are not sold commercially. The Hopi claim for water for irrigation to support C&S cultivation was opposed by the other parties to the case and was rejected by the court.

Keywords: cultural, ceremonial, religious water use, Indigenous communities, Native American water rights, Winters doctrine, Practicably Irrigable Acreage, Hopi Tribe

Subjects: Sustainability and Solutions

Introduction

Households and communities use water for many purposes. In the United States, some of these uses of water are commonly categorized as “DCMI” (domestic, commercial, municipal, and industrial). Other water use categories include irrigated agriculture, water for recreation, and water for the environment (e.g., minimum river flows to sustain ecosystems).

Domestic water use (the “D” in “DCMI”) occurs both inside and outside the home and includes water for five main activities. First, households need small amounts of water for drinking and cooking (approximately 5–10 liters per capita per day). Second, households use water for washing themselves and their possessions (e.g., dishes, clothes, their houses, tools, bicycles, and automobiles). Third, households use water for feces and urine disposal (e.g., septic and sewer systems). Fourth, households provide water to both indoor and outdoor plants, both for growing

food and for aesthetic purposes (e.g., growing vegetables and watering lawns). Fifth, households provide water to their animals (e.g., pets and livestock) for drinking, washing, and food preparation.

What is missing in this common (DCMI) conceptualization of the types of water use is water for cultural and religious purposes. Many Indigenous communities—as well as others—have used water in their ceremonial and religious practices for centuries. Indigenous peoples put great value in the use of water for cultural, ceremonial, and religious purposes and, importantly, for growing crops to be used in cultural and religious ceremonies. Water for subsistence agriculture may be conceptualized as an integral part of cultural and religious traditions. However, national water agencies struggle to value water for cultural, ceremonial, religious, and subsistence uses and often fail to allocate water to Indigenous peoples for such purposes.

The very small amounts of water used for religious ceremonies such as baptism seem to non-Indigenous water users as insignificant and to easily fall under the category of domestic use. However, for many Indigenous communities, the problem is more complicated. They may use only very small amounts of water from sacred springs and other water sources for cultural and religious ceremonies, but they may also need larger amounts of water to grow crops for religious and cultural purposes, which may include gifts of agricultural produce and other nonmonetary exchanges. Such noncommercial agricultural water use may require significant amounts of water for irrigation.

For non-Indigenous people, water use for noncommercial, traditional, or subsistence agriculture would seem to fit within the “irrigation water use” category and indeed at first glance such a categorization seems logical. However, there is a catch. States typically look at the use of natural resources, such as water use, from a development or pecuniary perspective (Scott, 1998).

Non-Indigenous communities also use water for cultural purposes, although they may not recognize it as such. For example, throughout the southwestern United States, millions of households use scarce water supplies to water lawns and trees outside their homes in an attempt to recreate the vegetation that their ancestors experienced in the eastern United States, East Asia, Europe, and on the African savannah (Appleton, 1996; Orians, 2014; Whittington, 2016). Water for such outdoor use is usually classified as part of household domestic use in DCMI water use.

As an illustration of the concept of C&S water use and some of the issues involved, this article describes the one case where the concept has been litigated in the United States in the context of judicial determination of the water right of the Hopi Tribe in Arizona, United States. The article first summarizes the legal context of water rights for Indigenous Tribes in the United States in which the issue of a water right for C&S water use was raised. Then it describes how the Hopi Tribe formulated its claim for C&S water use and differentiated it from claims for water used for other purposes. Finally, the article describes how the claim was received—and rejected.

The Legal Context for a Water Right for an Indian Tribe in the United States

In the United States, the allocation of water resources is generally a matter of state law. In a few cases, however, the federal government may also allocate water rights, water rights for Indian Tribes being one such instance under a U.S. Supreme Court ruling in *Winters v. the United States* (1908). In that case, the Supreme Court examined tribal rights to water on the Fort Belknap Reservation in Montana. The Reservation had been created in 1888 under an agreement between tribal parties and the U.S. government. The agreement assigned land for the Reservation, but made no allocation of water. Subsequently, non-Indian settlers moved in along the Milk River upstream of the Reservation and, by 1905, their diversions were causing shortage on the Reservation. An action was filed to restrain the upstream settlers from constructing and operating waterworks on the Milk River. The Court found that the agreement creating the Reservation sought to transition the Indians to an agrarian lifestyle, but that the Reservation lands “were arid, and, without irrigation, were practically valueless.” Accordingly, the Court held that the establishment of the Reservation impliedly reserved for the Reservation the amount of water necessary to irrigate its lands for them to become “a pastoral and civilized people.” The Court upheld the power of the federal government “to reserve the waters [of a state] and exempt them from appropriation under state laws.” It continued: “That the Government did reserve them we have decided, and for a use which would be necessarily continued through the years.” In western states employing appropriative water rights, the water rights reserved by the federal government for a Tribe often have seniority over other water uses in the state.¹ A federal reserved water right is superior to state-based appropriative water rights. Moreover, unlike other appropriative water rights, under the *Winters* doctrine the Tribe does not lose the right if it does not maintain continuous use of the right.

The *Winters* ruling did not specify how a federal reserved water right should be quantified, nor did federal common law provide a quantification method (Cosens, 2002). Quantification was left for later judicial interpretation. A federal reserved water right is limited to the “amount of water necessary to fulfill the purpose of the reservation, no more”—a “minimal need” standard (*Cappaert v. United States*, 1976).²

In *Arizona v. California* (1963), the State of Arizona had argued that the reserved water rights of Indian Tribes should be based on their “reasonably foreseeable needs,” and recommended that these be based in part on population projections and associated per-capita water requirements. However, the U.S. Supreme Court rejected Arizona’s proposed quantification method, holding that population projections were too “uncertain.” Instead, the Court adopted a “Practically Irrigable Acreage” (PIA) standard for quantifying a Tribe’s federal reserved water rights. The PIA standard held that a Tribe should only be granted federal reserved water rights to the extent that the Tribe could demonstrate that its use of irrigation water would be both technically and financially feasible. This involves a two-part determination: what acreage on the reservation is irrigable by which crops, and what part of that acreage, using how much water, can be farmed at a

profit? However, once a quantum of water has been allocated to an Indian reservation under the PIA standard, it need *not* be used to grow crops; it can be put to any other use, which is perhaps paradoxical.

Four observations can be made about the PIA standard.

The PIA standard is timeless. The reservation's acreage is presumed to be unchanged and unchanging, and agricultural technology is taken as unchanging, as is climate; thus, it is a once-and-for-all calculation.³

The PIA standard plays out unequally for reservations with a different geography and topology. In *Arizona v. California*, the Indian Tribes considered by the Court had reservations directly adjacent to the Colorado River and readily irrigable from it. Given their location and population size, the PIA standard turned out to be a generous criterion for those Tribes. Not so for a Tribe located in an arid area, like the Hopi.

The PIA standard either ignores the purpose of the reservation or assumes that the purpose is to function as a farming community. Arguably, that was what the *Winters* Court presumed in 1908. Whether that would be a reasonable presumption in 1963, or in 2023, is questionable, since many Tribes have diversified their economies and no longer rely on agriculture as the primary source of income.⁴

Even if the *Winters* Court saw the Fort Belknap Reservation as a farming community in 1908, underlying that would be a vision of the Reservation as a *homeland* for the Tribe. A homeland is a social and cultural community. A homeland is a place where a community can endure. It must be livable, and people must be able to thrive there. If the larger purpose of a *Winters* right for an Indian reservation is to be a homeland, that would have two key implications.

First, if the purpose for which water is being allocated is to create a homeland, the calculation of commercial profit and loss is a category error. Establishing or maintaining a homeland is a social goal and, if it is to be appraised in economic terms, it is through a *social benefit–cost analysis*.⁵ That is how, since 1983, the federal government had appraised water projects under the 1902 Reclamation Act and other federal programs (Council on Environmental Quality, 1983). And before 1983, the financial criterion of revenue minus cost was not consistently—or even regularly—applied to federal water projects (Haveman, 1965, 1972).⁶ Second, since a homeland is a social and cultural enterprise, there could be social and cultural uses of water that constitute part of the “minimal need” of a homeland.⁷

Whereas the earlier litigation regarding federal Indian reserved water rights took place in the U.S. Supreme Court, in the 1970s the forum switched to the state courts. In 1952, Congress enacted what is known as the McCarran Amendment which allowed the federal government to be included in state water adjudications. Although the Amendment was not about Indian reserved water rights and did not explicitly mention them, the U.S. Supreme Court determined in 1976 that the Amendment allowed state courts to adjudicate Indian reserved water rights.

That the purpose of an Indian reservation was to be a permanent homeland was made explicit by the Wyoming Supreme Court, *In re Rights to Use Water in Big Horn River*, 763 P.2d 76 (Wyo 1988), and affirmed by an equally divided U.S. Supreme Court, *Wyoming v. United States*, 492 U.S. 406 (1988; “Big Horn II”). The Special Master in Wyoming found that the purpose of the Wind River Reservation, when created in 1868, was to “provide the Indians with a homeland where they could develop their civilization” and recommended reserving water for irrigation, stock watering, fisheries, wildlife and aesthetics, mineral and DDMI uses.⁸ The Wyoming Supreme Court rejected this, holding that the purpose was purely agricultural, with no implied reserved right for a fishery or for mineral and industrial uses. The reserved right for municipal, domestic, livestock, and commercial uses were included within the agricultural purpose. There was no implied right for wildlife or for aesthetic preservation (Dworkin, 2011).

The purpose of an Indian reservation was raised again in Arizona in the context of general stream adjudications for the Gila and Little Colorado River systems, both systems containing Indian reservations with claims to federal reserved rights.⁹ Between 1990 and 2002, in the Gila River adjudication, the Arizona Supreme Court considered six questions pertinent to stream adjudications in Arizona, which were argued and decided in separate trials. One question was the standard to be used in Arizona for determining the amount of water under a federal Indian reserved right. The Arizona Supreme Court issued its decision in November 2001 (“Gila V”).¹⁰ The decision is not unambiguous.

The Court started by affirming that the essential purpose of Indian reservations is to provide Native American people with a “permanent home and abiding place” that is a “livable” environment (¶16). The court “should have before it actual and proposed uses, accompanied by the parties’ recommendations regarding feasibility and the amount of water necessary to accomplish the homeland purpose” (¶21). “Limiting an Indian reservation’s purpose to agriculture,” as in the PIA standard, “assumes that the Indian peoples will not enjoy the same style of evolution as other people, nor are they to have the benefits of modern civilization” (¶24). “Other right holders are not constrained in this, the twenty-first century, to use water in the same manner as their ancestors in the 1800s.” “Just as the nation’s economy has evolved, nothing should prevent tribes from diversifying their economies if they so choose and are reasonably able to do so” (¶25). The PIA standard has a “potential for inequitable treatment of tribes” based solely on geographical location and topography (¶33). “Another concern with the PIA is that it forces tribes to pretend to be farmers in an era when ‘large agricultural projects . . . are risky, marginal enterprises’” (¶34). “Limiting the applicable inquiry to a PIA analysis not only creates a temptation for tribes to concoct inflated, unrealistic irrigation projects, but deters consideration of actual water needs based on realistic economic choices” (¶35). “A tribe’s history will likely be significant. Deference should be given to practices requiring water use that are embedded in Native American traditions. Some rituals may date back hundreds of years, and tribes should be granted water rights necessary to continue such practices into the future. An Indian reservation could not be a true homeland otherwise” (¶42). “Preservation of culture benefits both Indians and non-Indians; for this reason, Congress has recognized the ‘unique values of Indian culture’ in our society.” “Water uses that have particular cultural significance should be respected, where possible” (¶43).

But then the Court seemed to change tack. “Any development plan will carefully consider natural resources (including potential water uses), so that water actually granted will be put to its best use on the reservation” (¶44). “Tribal development plans or other evidence should address, and the court should consider, ‘the optimal manner of creating jobs and income for the tribes [and] the most efficient use of the water’” (¶45). “However, any proposed projects should be scrutinized to insure that they are practical and economical” (¶46). “If a federally reserved right is to be tailored to a reservation’s ‘minimal need,’ as we believe it must, then population necessarily must be part of the equation” (¶47). “The court’s function is to determine the amount of water necessary to effectuate this purpose [a permanent homeland], tailored to the reservation’s minimal need” (¶48). “Projects must be economically sound. When water, a scarce resource, is put to efficient use on the reservation, tribal economies and members are the beneficiaries” (¶49).

Thus, *Gila V* unambiguously rejects the PIA standard as the sole measure of the water rights for a homeland for an Indian reservation in Arizona. Beyond that, the standard to be used is ambiguous. The homeland is to be permanent; how much water constitutes the minimal need to be livable? Indian peoples are to enjoy the same style of evolution as other people and to have the benefits of modern civilization; what amount of water is their minimal need for that to occur? Deference is to be given to practices that are embedded in Native American traditions; how does one define the minimal need for such deference? The Tribe’s use of water must be economically sound; is economic soundness still to be determined by profit and loss as in the PIA standard, a private benefit–cost test, or by a social benefit–cost test? These questions were left to be determined in subsequent litigation.¹¹

To deal with these issues, the Hopi Tribe hired the authors in February 2003 to testify on its behalf in the Little Colorado River adjudication. However, these issues were not litigated until a trial commenced on the Hopi Tribe’s reserved right to water of the Little Colorado River in July 2020, almost nineteen years after *Gila V* was issued.

The timing came about as follows. Other water rights determinations in Arizona, including those of Indian Tribes involved in the Gila River adjudication, had not gone to a formal trial—they had been resolved through a process of negotiated settlement. A settlement allows a Tribe to quantify its water right through an agreement among the parties, including the state government, water districts, and private water users, without the formality of a judicial determination. Approval and implementation of Indian water rights settlements typically requires federal action, often in the form of congressional approval. In addition, settlements often unleash federal funding to pay for the infrastructure required for a Tribe to be able to access the water allotted to it.

Since 2001, there have been two Indian water rights settlements in Arizona related to the Little Colorado River adjudication. The Little Colorado River rises in western New Mexico and becomes a tributary of the Colorado River in Arizona. The river itself is 338 miles long, of which 265 miles lie within Arizona. Together with its tributaries, it drains an area of about 26,500 mi², of which 24,875 mi² lie within Arizona. Four Indian Reservations are located in the Arizona portion of the watershed: the Navajo Tribe (Arizona area 17,550 mi²), the Hopi Tribe (2,513 mi²), the White

Mountain Apache Tribe (2,609 mi²), and the Zuni Tribe (20 mi²).¹² The Zuni Tribe reached a settlement in 2003, and the White Mountain Apache Tribe in 2010. That left the Hopi Tribe and the Navajo Tribe still tied up in the adjudication.

The Hopi and Navajo, in northeastern Arizona, have a long history of antagonism, with the Hopi Reservation entirely enclosed by the Navajo Reservation. The Hopi Reservation was established by executive order of President Arthur in 1882. Today, there are 23,592 Hopi in the United States with about 8,500 living on the Reservation. The Navajo Reservation was established by treaty with the U.S. government in 1868, and occupies portions of northeastern Arizona, northwestern New Mexico, and southeastern Utah; the Arizona portion accounts for about 64% of the total Reservation area. Overall, Navajo is the largest Indian reservation in the United States. There are about 405,200 Navajo in the United States, of whom 143,435 live on the Reservation.

The Hopi have lived in the Four Corners region for more than 2,000 years and trace their ancestry to the Ancient Puebloan cultures. The Hopi village of Old Oraibi was settled in the 11th century and is considered the oldest continuously inhabited settlement in North America. The Navajo originated from northwest Canada and Alaska and moved into the southwest perhaps around the 15th century. The Hopi are a largely sedentary pueblo people and their traditional culture centered on farming, growing corn, beans, melons, and squash.¹³ The Navajo generally do not live in villages; their traditional economy centered on raising sheep and they live widely dispersed across the Reservation. The Hopi and Navajo have feuded over land and water since the mid-19th Century. The conflict again came to a boil in the 1970s leading Congress to intervene with the Navajo–Hopi Land Settlement Act of 1974. Disagreement continued at a lower level of intensity through the 1990s.

Between 2008 and 2012, there were attempts at reaching a settlement of the Hopi and Navajo claims for a reserved right to the waters of the Little Colorado River basin, but the negotiations broke down. The adjudication of the federal reserved rights of the Hopi was stayed during the negotiations but, in 2015, the litigation resumed and preparations began for the trial of Hopi water rights. In Arizona, the standard procedure in a general stream adjudication involving Native American claims is to bifurcate the proceedings such that the first proceeding focuses exclusively on determining Tribal claims of reserved water rights, with the second then adjudicating all non-Indian claims to the stream. Things were done differently in the Little Colorado River adjudication. It was decided to split the determination of federal reserved water rights into two separate trials, a first trial to determine the rights of the Hopi Tribe followed by a second trial to determine those of the Navajo—even though both trials would be interpreting the same Arizona homeland standard.¹⁴ The Hopi trial was further divided into two phases: a preliminary factual phase to determine the Tribe's water rights for its past and present uses of water and a second phase to determine its future uses of water, the phase in which its federal reserved water right was to be decided.

The active parties in the Hopi water rights trial were the Hopi Tribe, the U.S. Department of Justice (DoJ), the Navajo Tribe, the Arizona State Land Department, the Salt River Project,¹⁵ the City of Flagstaff, and the Little Colorado River Coalition.¹⁶ In a water right determination, the DoJ represents the interests of the United States as the trustee of the Tribe, in this case as the trustee

for the Hopi and Navajo Tribes. It thus supports the interests of both the Hopi and Navajo Tribes. In the Hopi water rights trials, the role played mainly by the Navajo was as an opponent of the Hopi claims. The other parties—the Salt River Project, the City of Flagstaff, the Little Colorado River Coalition, and the Arizona State Land Department—also functioned as opponents of Hopi’s water claims.

The Little Colorado River adjudication technically takes place in the Superior Court of Apache County, but the trial proceedings were moved to the Superior Court of Maricopa County in Phoenix. The proceedings in an adjudication are held not before the Superior Court judge in charge of the adjudication but, rather, before a Special Water Master appointed by that judge.¹⁷ The Special Master managed the overall adjudication process under the direction of the judge in charge, set the rules, heard all the trials arising out of the adjudication, reported to the judge on all factual and legal issues raised, and recommended a final decree to the judge. After hearing and resolving any objections to the Special Master’s report and recommendations, the Superior Court judge issues a final decree for the watershed being adjudicated.¹⁸

With the Hopi water rights case, the first phase was conducted between September and December 2018. The second phase, delayed by COVID-19, was conducted between September 2020 and February 2021. Closing arguments were held on September 30 and October 1, 2021.

The Special Master issued her recommended water rights decree on May 25, 2022.¹⁹

The Claim for C&S Water Use on the Hopi Reservation

Context: The Claims Presented by the Hopi Tribe

The claim for C&S water use was one of several claims presented by the Hopi Tribe and the U.S. Department of Justice (DoJ). Other claims included a claim for water for domestic, commercial, municipal, and industrial (DCMI) uses, including light industrial uses; a claim for water for coal mining and for three industrial-scale energy generation facilities; and a claim for water for livestock uses, including water to grow alfalfa to support a commercial feedlot operation. Of these, only the DCMI claim became relevant to the C&S claim, and only that claim is mentioned further here.²⁰ There were actually two claims for water for traditional Hopi agriculture. One was a claim for surface water from the northern washes on the Hopi Reservation based on the historical past and present use of those flows. The other was the C&S claim, a claim for groundwater as a replacement supply for local water sources expected to diminish in the future.

For DCMI, all the parties accepted an approach that projected the future tribal population and combined this with an estimate of average per capita usage. However, the parties disagreed over both of those numbers. With regard to population size, besides demographic methodology, two issues arose: (a) at what point in time to measure the Hopi population, and (b) whether to include off-Reservation Hopi. The DoJ presented expert testimony from a demographer regarding the on-Reservation population, who projected a Reservation population of 49,301 by 2110, and what was called the “stable population,” measuring the projected maximum future population on the

Reservation, estimated at 52,016. The Hopi Tribe had first used the DoJ population figures but then hired its own testifying expert who projected a 2100 Hopi Tribal membership of 42,422, broken down between 19,084 Hopi on the Reservation and 23,338 Hopi off the Reservation, plus 1,058 non-Hopi on the Reservation, for a combined total of 43,480. The expert for the City of Flagstaff projected 18,255 on the Reservation in 2110. The expert for the Arizona State Land Department projected 8,155 on the Reservation in 2100.

Counting Hopi living off-Reservation is salient for two reasons. Firstly, many Hopi leave the Reservation at some point in their lives, especially for postsecondary education and/or employment, but later return. A survey of on-Reservation households conducted by the authors in 2005–2006 found that 61% of respondents had lived off-Reservation at some time (Whittington et al., 2009).²¹ Secondly, many Hopi living off-Reservation return periodically to visit family and participate in dances and other clan and village ceremonies. Thus, the village water systems serve a larger population than just village residents. Ultimately, however, the Special Master settled on the on-Reservation population figure of 18,255.

Current DCMI usage on the Hopi Reservation amounts to 60–65 gallons per capita per day (gpcd). This reflects not only Hopi culture to use water sparingly but also the minimal—almost colonial-level—standard of water distribution infrastructure installed by the federal government on Indian reservations, which does not provide for population growth, commercial or industrial use, or even fire prevention. It also reflects the poverty and the primitive quality of much housing on the Hopi Reservation. What was relevant for the Hopi trial was the level of *future* water use. Up to 2015, the federal government had used 160 gpcd to plan off-Reservation water projects but, for the Hopi trial, the DoJ's expert lowered that to 150 gpcd, while agreeing that 160 gpcd would still be a reasonable value. The Hopi and Navajo Tribes advocated 160 gpcd. The City of Flagstaff advocated 100 gpcd.

Both the Hopi Tribe and the DoJ justified their gpcd values by the notion of parity with DCMI use off-Reservation. The DoJ's expert noted that the average per capita withdrawal of water in the three counties where the Little Colorado River watershed is located had declined from 153 gpcd in 2010 to 148 gpcd in 2015,²² which he attributed to conservation. For that reason, he advocated 150 gpcd. As it happens, about 44% of the population in those three counties lives on the Hopi and Navajo Reservations. Therefore, DCMI withdrawal *off-Reservation* in those counties would amount to about 206 gpcd in 2015. The Special Master was uncomfortable with the notion of parity. She was also taken with the notion that conservation would continue to reduce DCMI use in the future. She held, as a finding of fact, that a federal reserved water right cannot be based upon historically higher rates of water usage for DCMI purposes. Eventually, however, she backed her way into a figure of 150 gpcd for future Hopi DCMI use.

Why a C&S Water Use Claim?

Growing corn and other traditional crops permeates Hopi culture, society, and religion. It is a key part of Hopi identity—to be a Hopi is to be a farmer raising the traditional crops with the traditional methods of dryland and irrigated farming. The Hopi corn itself is distinctive, with

short ears and multiple varieties, including white corn, blue corn, red corn, purple corn, and yellow corn. Each type has specific ceremonial and culinary uses. Sometimes corn is consumed as part of the ceremony or ritual. For example, blue corn is used for making piki and somiviki that are served at certain ceremonies (Puhuyesva, 2018). In other cases, corn is used in ceremonies and rituals, but not consumed; for example, a perfect ear of white corn is placed beside a newborn infant when it first comes home, and another example is that, at a funeral, corn meal is spread at the bottom of the grave (Wall & Masayesva, 2004).

Over two millennia, both the corn and the traditional Hopi ways of farming were adapted to the arid climate. The Hopi learned to supplement the limited rainfall with water from streams, springs, and seeps directed to crops by berms, check dams, and other constructed features. They spread their risks by cultivating in a variety of locations. They cultivate dryland, rain-fed fields, planting corn and cotton in several fields far apart. They plant in canyon bottomlands where groundwater is near the surface and accessible to the plant roots. And they plant near permanent springs using spring water to irrigate, including spring-irrigated communal gardens on the side or at the base of the three Hopi Mesas (Ferguson, 2004).

In the future, many of these traditional Hopi agricultural practices will become increasingly tenuous. There has been a lowering of the local groundwater table around the Mesas, causing reduced flows from springs and seeps that traditionally served for irrigation. Down-cutting of the washes has reduced the availability of water to lands traditionally irrigated there. Climate change will bring hotter air and soil temperatures plus more frequent and intense droughts, threatening the surface water flows on which the Hopi Tribe currently relies (Cosens & Chaffin, 2016). The continuation of Hopi farming on the scale necessary to ensure the survival of the Hopi ceremonial and cultural traditions will require a lessening of the heavy reliance on rain-fed, dryland farming. That could be brought about if a federal reserved water right were granted for this use of water, which is consistent with *Gila V*'s statement that "some rituals may date back hundreds of years, and tribes should be granted water rights necessary to continue such practices into the future." This would be an insurance policy to preserve the Hopi culture and guarantee the permanence of the Reservation as a homeland.

One approach would be to create new irrigated community gardens around each Hopi village. In these new gardens, each family that wishes to participate could own plots and cultivate their own crops. Such new irrigated gardens would continue the Hopi tradition of individual families being responsible for farming their own fields. Instead of local surface water, the water source would be a right to surface water or groundwater from within the watershed but off the Reservation. The creation of such proposed irrigated family gardens would not mean that all cultivation of rain-fed, dryland fields ceases. Rather, the continuation of traditional agricultural practices on the Hopi Reservation will require a shift over time toward the new irrigated family gardens as climate change progresses.

How the C&S Claim Was Calculated

To implement this conception required (a) an estimate of the size of the future Hopi population, (b) an estimate of the percent of Hopi households who would want to cultivate traditional crops in an irrigated garden, (c) the acreage a participating household would want to cultivate, and (d) the crop irrigation requirement for traditional Hopi crops grown at an irrigated garden.

Item (a) was the DoJ projection of the Hopi stable population, or whatever long-run population the Special Master adopted. Item (b) drew on a detailed survey of Hopi households conducted by the authors in the summers of 2005 and 2006, which found that 38% of the households farmed dryland fields or spring-irrigated gardens away from home (Whittington et al., 2009). In addition, 15% of the households raised crops by their homes using water from their piped water connection, but not away from their home. The remaining 47% of households did not engage in growing crops, but about 10% of those households said that they would want to farm a plot if they could.²³ Many of the households who engaged in dryland or spring-irrigated farming cultivate several fields, both dryland and spring-irrigated. Many households in this group are likely to want a plot in an irrigated community garden if one were available. The authors felt it was reasonable to assume that 50%–80% of these households would want an irrigated family garden if this option were available, plus about 10% of the households not currently farming or farming near their home would want to farm in a community irrigated garden if that option were available. Overall, the authors assumed that about 30% of Hopi households would want to use new village community gardens.

Items (c) and (d) also drew on the findings of the household survey for estimates of the size of a plot a household would want to cultivate and the mix of crops households would want to grow. The irrigation requirement for that crop mix was estimated for the authors by an agronomic consultant engaged by the Hopi Tribe.

These calculations generated an estimate of 9,471 acre-feet (AF) per year as the Hopi C&S claim if sized to the DoJ population estimate of 52,016. If sized to the population size adopted by the Special Master, the claim would amount to 3,322 AF/yr. For comparison, the DDMI allotment awarded by the Special Master was 3,069 AF/yr.

Also, by way of comparison, the Salt River Project delivers about 40,000 AF of untreated “urban flood irrigation” to 13,300 acres of residential area in its metropolitan Phoenix service area annually. This water is not counted as DDMI use and is supplemental to the (treated) supply serving DDMI use there. It is used to maintain lush yards and tropical gardens with shrubbery and nonnative trees. It can be considered a cultural water use because it has no commercial purpose and is justified for its distinct cultural benefit in preserving a sense of place. Tempe views it as a “neighborhood and community asset: [It is] historic and unique – worth preserving. Mature tree canopy has numerous qualitative benefits” (City of Tempe Public Works, 2014). In Glendale, “[I]t’s a service that provides an amenity to the entire community because it helps greenery, there’s the historic nature of it, it assists us with greenhouse gases and carbon sequestration, all those things” (Hanemann & Whittington, 2019a).

The C&S Water Use Claim at Trial

At the Hopi trial, the C&S claim was opposed by the Navajo Tribe. The DoJ supported the claim, but it relied on the Hopi Tribe to provide the evidence in support of the claim. The other parties opposed the C&S claim.

One objection was that the Hopi Tribe's C&S claim would be duplicative of its DCMi claim. Both the Hopi Tribe and the DoJ disagreed. In formulating the C&S claim, it was assumed that the 10% of households who currently grow traditional crops by their home using their home water supply would continue to do so—those households were covered by the DCMi claim and excluded from the C&S claim. But the Hopi villages are densely packed, individual homes are small, and many have no space for a garden. Due to the lack of space and, also, lack of hydraulic capacity, the new irrigated community gardens would have to be located outside the villages, off the village water network. Families farming in a proposed community garden would have a plot averaging 0.8 acre per family; no garden that size exists in any of the Hopi villages. A family cultivating its plot in a community garden would be pulling 45,000 gallons per day or more during an irrigation episode. Nothing remotely like that volume of water is deliverable to Hopi homes with the small-diameter village water pipe systems. A preliminary investigation showed that more than enough suitable land exists outside Hopi villages to accommodate the proposed community gardens, some farmed by the Hopi Tribe in the past but not at present and not part of the Hopi Tribe's irrigation claim.

Another objection was that, as an agricultural claim, the C&S claim should be subjected to the Practicably Irrigable Acreage (PIA) test. However, the C&S claim was not a claim for commercial irrigation. Growing traditional Hopi crops is a way of life for the Hopi Tribe, not a day job. Crops produced at the irrigated garden would not be grown for profit. None of them would be sold off the Reservation and almost none sold on the Reservation except at local farmers' markets. They would be shared with friends and extended family for use primarily in Hopi ceremonies and religious rituals and for subsistence. The purpose was to maintain those ceremonies and rituals into the future as existing water supplies dwindle.

The Muddy Waters of Economic Soundness

To support its water claims, the Hopi Tribe submitted its expert reports by March 15, 2019. The other parties had until May 15, 2019, to submit their objections. Among its objections, the City of Flagstaff submitted rebuttal testimony that the volume of water claimed by the Hopi Tribe for DCMi and C&S uses would need to be conveyed from off-Reservation, and the cost of the conveyance infrastructure would vastly exceed what Hopi families living on the Reservation could afford to pay. Left unstated, but surely implied, was that the Hopi Tribe's DCMi and C&S claims would fail a PIA test.

The Hopi Tribe's response ("surrebuttal"), due June 15, 2019, argued: (a) The allocation of water for a federal Indian reserved water right to render the Hopi Reservation a comfortable homeland should not be sized according to whether the Hopi are themselves able to pay for the infrastructure delivering that water. (b) If the infrastructure were financed by the federal government and were subject to an economic test, it would be the same test applied to federal

water projects, namely a *social benefit–cost test* (Council on Environmental Quality, 2013). Given that *Gila V*'s assertion that the preservation of a distinctive Native American culture “benefits both Indians and non-Indians,” an economic evaluation would assess the benefit of preserving the Hopi culture and way of life not just to the Hopi themselves but also to the rest of the U.S. public.²⁴

In August 2019, after the deadline for their surrebuttal, the authors were able to conduct such an assessment, using a representative national sample of U.S. households and implementing an economic survey method known as *contingent valuation* in a manner authorized by the federal guidelines for economic evaluation of water projects. The survey found that 76% of respondents were willing to pay \$5 a year for five years to have the federal government cover the cost of construction to bring water to the Hopi Reservation to make sure that the Reservation will be a livable home in the future.²⁵ The survey findings were submitted to the court in a supplementary report on September 23, 2019.

This report met with fierce opposition ostensibly because it came after the deadline for the submission of expert reports to be used at the trial.²⁶ On September 25, 2019, the Little Colorado River Coalition filed a motion to preclude the survey, any related documents, and any oral testimony about the survey's contents. On September 27, 2019, the Special Master issued an order forbidding testimony about the survey at the trial. In January 2020, the Hopi Tribe filed a motion seeking to prevent the parties from questioning the authors at trial about whether they had conducted a social benefit–cost analysis as referenced in the June 2019 surrebuttal out of concern that such questioning would be unfair. On March 30, 2020, a peer-reviewed journal article was published presenting the details of the authors' valuation survey and its findings in relation to the engineering cost of a pipeline to convey water to the Hopi Reservation (Carson et al., 2020).²⁷ In the article, the authors concluded that the benefits to the U.S. public, while not the entirety of the social benefit since they excluded benefits to the Hopi themselves, clearly outweigh the likely cost of the pipeline.²⁸ The Hopi Tribe then moved to enter this published article as a learned treatise on its exhibit list for the trial.²⁹ The Salt River Project opposed both Hopi motions and further requested that any testimony about social benefit–cost methodology be precluded at the trial.

The Special Master ruled on August 6, 2020, finding that the September 2019 survey report

provides no information about the value of a private benefit. It is even questionable whether, without expert economic interpretation, the report quantified a social benefit. . . . On its face, the Survey Report only provides the information that 780 respondents were willing to pay a total of \$25 over five years for a construction project to transport water to the Hopi Reservation.

(Superior Court of the State of Arizona in and for the County of Apache, n.d., p. 8, lines 14–15)³⁰

While it is “a component” of a social benefit–cost analysis, the survey report is not a social benefit–cost analysis.³¹ Therefore, no social benefit–cost analysis had been conducted. Consequently, questions by parties of the Hopi Tribe's economic experts about the lack of a social

benefit–cost analysis “would jeopardize neither truth nor fairness at the trial” (Superior Court of the State of Arizona in and for the County of Apache, n.d., p. 9, line 2). Since a social cost–benefit analysis had not been performed, it therefore was not relevant to a determination of whether a particular use of water is economically sound. “Based on the demonstrated absence of analysis undertaken, . . . , no expert testimony about the social cost–benefit methodology or a social cost analysis, as defined by Dr. Hanemann, will be admitted” (Superior Court of the State of Arizona in and for the County of Apache, n.d., p. 11, lines 23–24).

The effect was to leave the PIA test as the only admissible standard of economic soundness.

Disposition of the C&S Water Use Claim

The Hopi Tribe had submitted two claims for water for traditional Hopi agriculture. One was a claim for surface water from the northern washes on the Hopi Reservation based on the historical past and present use of those flows. The other was the C&S claim for groundwater as a replacement supply for local water sources expected to diminish in the future.

With regard to the first claim, the DoJ estimated the maximum amount of water diverted by the Hopi Tribe from the northern washes since the mid-1950s at 18,897 AF/yr. Based on usage in earlier times, the Hopi Tribe claimed all the flow of the northern washes. The Special Master rejected the Hopi claim and awarded the DoJ claim of 18,897 AF. By the mid-1950s, the Hopi Reservation was in the midst of a drought, and the Special Master acknowledged that, “the combination of drought and large-scale irrigation projects caused the percentage of [Hopi] farmed land dependent solely on rain to decline as a percentage of total cultivated land” (Superior Court of the State of Arizona in and for the County of Apache, 2022, p. 159). However, “a demonstrated historical use that is no longer in use does not support a federal reserved water right” (Superior Court of the State of Arizona in and for the County of Apache, 2022, p. 177, lines 23–24).

Turning to the Hopi C&S claim for groundwater, the Special Master rejected it on four grounds. The Hopi Tribe did not adequately identify the specific locations of the proposed community irrigated gardens. It did not sufficiently specify the type of irrigation that would be applied. The proposed irrigated gardens were not a currently existing water use. Given that the proposed C&S community irrigated garden is a new irrigation project it must meet the PIA standard, and the Hopi Tribe failed to prove that it is economically sound.

In dismissing the need for new groundwater as a replacement for declining local water supplies, the Special Master was disregarding the fact that, since the 1950s, the Hopi Tribe had lost significant acreage irrigated with rainfall and surface water flows due to continuing drought conditions, and would lose more in the future with aridification caused by climate change. This myopia might have been an artifact of the procedural disconnect between a trial about past and present use and a trial about future use. The separation into two trials may have had the effect of reducing the focus on future hydrology relative to that on present and past hydrology.³²

Conclusions—An Obligation Abandoned

Since *Winters* in 1908, it has been recognized that the United States has an obligation to reserve a sufficient quantity of water for the Indian Tribes whom it settled on reservations so as to ensure that those reservations are livable and can function as a permanent homeland. How that amount of water is to be determined was left unspecified until *Arizona v. California* in 1963, which promulgated the Practicably Irrigable Acreage (PIA) standard. Even at that time, the PIA standard was an anachronism in conceptualizing a permanent homeland in terms applicable to a commercial enterprise and in applying a private benefit–cost test rather than a social benefit–cost test to a federal water project. In 2001, the Arizona Supreme Court revisited the PIA standard and appeared to reject it. However, *Gila V* was riddled with ambiguity. Therefore, only subsequent litigation could reveal what it might mean. Such litigation finally occurred for the first time with the Hopi portion of the Little Colorado River adjudication. Unless and until appealed, or further refined in later phases of that adjudication, the meaning of *Gila V* is revealed by the Special Master’s Final Report (2022). The result is a mixed bag. With regard to domestic, commercial, municipal, and industrial (DCMI) uses, in allotting 150 gpcd to the Hopi Tribe, the Special Master essentially adopted—albeit reluctantly—a version of the *parity* notion endorsed by the Arizona Supreme Court, that Indian peoples are to enjoy the same style of evolution as other people. However, with regard to the C&S claim, the Special Master was not willing to grant “deference to practices requiring water use that are embedded in Native American traditions.”

The Special Master’s ruling raises questions about the practical commitment to the permanence of the Reservation. The Hopi C&S use is a set of practices that unambiguously “date back hundreds of years.” Also, the C&S use of water is unambiguously not conducted for a commercial purpose. The circumstances prompting the Hopi Tribe’s C&S claim are well-documented changes in the surface water and groundwater hydrology, both current and projected future changes in hydrology. Those changes make it unlikely that some Hopi dryland farming practices can continue into the future—even until the end of this century. According to *Gila V*, a Tribe should be “granted water rights necessary to continue such practices into the future.” In the case of the proposed Hopi community gardens, while the crops grown and most of the irrigation practices would be the same as over the past hundreds of years, one aspect would be different: instead of channeling spring water and surface runoff to their plants, the Hopi would be channeling water delivered to the Reservation by a pipeline or aqueduct. According to the Special Master, that is not a current existing use. And, as such, it must pass the commercial test of the PIA standard.

It thus seems that the commitment to permanence runs into a Catch-22 of the Special Master’s devising. A reservation is to be a permanent homeland. That may become impossible if there is an adverse change in the hydrology on which the reservation depends. In that case, the reservation can continue permanently only if it is granted some replacement supply. But the use of the replacement supply will not be an existing use. It will be classified as a new use. As such, regardless of any commitment to the permanence of the reservation, the replacement has to pass the PIA test.

Indeed, for Indian water uses in Arizona other than DCMI, the Special Master's rulings seem to have the effect of elevating the PIA test as the key criterion. Will the absolute exclusion of testimony on social benefits or social costs also apply in the Navajo water right trial? If so, that would have the unfortunate consequence that, in the case of water for Indian Tribes in Arizona, unlike other beneficiaries of federal water projects, the economic criterion is not a social benefit–cost test but a private benefit–cost test. If the exclusion is relaxed in the Navajo water right trial, that would have the unfortunate effect of subjecting two Tribes to different interpretations of the state's *Gila V* standard.

From 1963 onward, the issue on the table is the manner in which the amount of water is to be determined that the United States reserved for an Indian reservation when the reservation was established. There was an implicit understanding that this obliged the United States to take some *affirmative steps* to secure that water for a Tribe. That understanding has now been shattered with a ruling of the U.S. Supreme Court in June 2023 (*Arizona et al. v. Navajo Nation et al.*, 2023). In that case, which is an outgrowth of the Navajo Tribe's claims with respect to the Little Colorado River adjudication, the Navajo Tribe filed suit seeking to compel the United States to take affirmative action to secure its needs. The States of Arizona, Nevada, and Colorado intervened against the Navajo Tribe to protect their interests in water from the Colorado River. In a 5–4 decision, the U.S. Supreme Court ruled that, while the United States did reserve a water right under its treaty with the Navajo Tribe, it has no obligation to take any affirmative steps to secure the water that it reserved.

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Notes

1. Uses predating the creation of the reservation have a time immemorial priority. New uses, or uses intended upon the creation of the reservation, have a priority date tied to the creation of the reservation.

2. Besides federal reserved water rights for Indian reservations, there are federal reserved rights for other purposes including national parks and monuments, national forests, and wildlife refuges. *Cappaert* involved land acquired by the U.S. Fish and Wildlife Service (FWS) that contained natural springs and a desert pupfish habitat. The FWS sought to protect the pupfish by regulating the flow of spring water, decreasing its availability to downstream landowners. This was the context in which the “minimal need” criterion was enunciated. Whether it applies to a federal reserved right for an Indian reservation—and, if so, what that means—was disputed at the second Hopi trial, conducted between September 2020 and February 2021.
3. This timeless quality served the purpose of quantifying a water right that a Tribe had not yet exercised while also providing certainty for off-reservation water users.
4. Like everybody else, the Tribal members need food. But, like everybody else, today they do not themselves produce most of the food that they eat.
5. A *private* benefit–cost test focuses on the benefits and costs accruing to the parties *directly* involved. Do their benefits exceed the costs for those who pay for the item? For example, a corporation should make an investment only if the benefits that accrue to it—the revenue generated—more than cover the cost of the investment. Similarly, a community may decide to make an investment to provide a service only if those served are willing to pay what the service costs. In contrast, a *social* benefit–cost test views the benefits and costs more broadly. Do the benefits to whomsoever they accrue exceed the costs to whomsoever they accrue? Do the benefits to all members of society exceed the direct and indirect costs that are borne by all members of society? The particular beneficiaries of a project may individually be unable to afford its cost, but the project may be judged worthwhile because of its larger social benefit, that is, to parties who also receive some benefits other than the direct project recipients.
6. Such inconsistencies persist with U.S. Army Corps of Engineers water projects (National Research Council, 2004).
7. The PIA standard allowed separately for some domestic use of water, defined as “the minimum water necessary for health, safety and welfare.” This covers no commercial or industrial use, and only a fraction of normal residential use.
8. This was no little matter. Tribes have long considered state courts to be hostile, and the U.S. Supreme Court had been seen by some states as excessively friendly to Indian water rights. Note that state court rulings on Indian reserved water rights are subject to review by the U.S. Supreme Court.
9. A general stream adjudication is a comprehensive judicial proceeding to determine the nature, extent, and relative priority of all water rights to a stream. Together, these two adjudications cover more than half of Arizona, including most of the state’s Indian reservations. The Gila River adjudication was initiated in 1974; the Little Colorado River adjudication in 1978. The former involves 40,000 parties and about 85,000 claims to water; the latter about 6,000 parties and 14,000 claims. In both cases, over 90% of the claims are small claims of less than 230 acre-feet for domestic use, irrigation, or stock ponds (used for watering livestock or wildlife).
10. 291 Ariz. 307, 35 P.3d 68 (2001).
11. Another unresolved question is whether—at the end of the day—the U.S. Supreme Court will accept *Gila V*’s homeland standard.
12. About 95% of the Zuni Reservation is in New Mexico.
13. Livestock became part of the Hopi economy with the Spanish, along with some vegetables and fruit trees. The Spanish explorers reported no other Indian peoples living in that area.
14. The bifurcation of Hopi and Navajo rights occurred because the Arizona Department of Water Resources, which conducts a hydrological study of the use and availability of water resources being claimed, stated that it could not handle both Hopi and Navajo claims simultaneously.

15. The Salt River Project is a large special district serving water and electricity in Central Arizona.
16. This is a collaboration of cities, towns, irrigation districts, water companies, farmers, and other private parties to preserve their water rights in the Little Colorado River adjudication.
17. A.R.S. § 45–255.
18. The Special Water Master for the Hopi proceeding was Special Water Master Susan Ward Harris, appointed in July 2015. She was a longtime tax lawyer who had taken a sabbatical to earn a master's degree in hydrology. She retired from the Little Colorado River adjudication at the beginning of 2023. She was replaced as Special Water Master in March 2023 by Sherri Zendri, previously general counsel of the Arizona Department of Environmental Quality.
19. The Navajo trial commenced in April 2023 and is expected to take about 4 years.
20. DCMI and C&S were the only claims on which the authors offered testimony.
21. In addition to on-Reservation employment prospects, other factors affecting the emigration and subsequent return to the Reservation include housing quality and living conditions, both highly inferior to those off-Reservation. As the Hopi Tribe and the DoJ both emphasized, whether or not the Hopi Tribe was awarded an adequate DCMI supply would significantly affect future emigration and Reservation population size.
22. Average DCMI *usage* in those counties was about 165 gpcd. About 9% of DCMI usage was recycled sewage treatment plant effluent. Usage of recycled sewage is both culturally unacceptable to the Hopi Tribe and physically infeasible because almost all the Hopi villages have sewage lagoons and notwastewater treatment plants.
23. 2005 and 2006 were both drought years. A plot was defined as larger than 1,000 square feet, which would indicate away from the home, given the housing density at the Hopi villages. 71% of those who did not water near their home said that this was because there was no suitable land near the home.
24. As stated in Hanemann and Whittington (2019b): “The value to non-Indians of preserving Hopi culture even if they never visit the Hopi Reservation is an example of what economists call existence value – the value placed on something by a person for reasons unconnected with their own use or experience of that item” (pp. 9–10). Similarly, Hanemann and Whittington (2018): “In contrast to a financial analysis, a social benefit–cost analysis considers the impact on the well-being of society as a whole. It considers *all* parties affected by the investment project. This includes not only the Hopi themselves but also the people of the United States who may have preferences (and do have a moral responsibility) about the safety and protection of the Hopi people. The United States public's willingness to pay to ensure that the Hopi Reservation continues to exist and Hopi culture remains part of the fabric of American life is a key component of a social benefit–cost analysis” (p. 21).
25. Unstated in the report was that, regardless of the Hopi household's willingness to pay, with 128.5 million non-Hopi households in the United States, the U.S. public's willingness to pay would more than cover the engineering cost of the conveyance infrastructure asserted by the City of Flagstaff's expert.
26. At that point, the trial itself was expected to begin in July 2020.
27. By this time, the trial had been postponed due to the COVID-19 epidemic. It did not start until September 14, 2020.
28. The article estimated the U.S. public's existence value for preserving the Hopi culture at \$2.8 billion conservatively, and more likely \$3.6 billion. The Hopi Tribe's estimate of the cost of the conveyance infrastructure was about \$900 million.
29. Under this doctrine, experts testifying in court can refer to and rely on authoritative publications within a particular field. It enables experts to present information and opinions that are generally accepted within the relevant professional community. The application of this doctrine varies in different jurisdictions.

30. This statement overlooks the fact that respondents were drawn from a nationally representative sample that was of a size, and selected in a manner, generally accepted in the survey research field.
31. This is casuistical reasoning. The survey report contained a benefit estimate. It did not contain a cost estimate, but it did not need to—cost estimates were already in the trial record as of June 15, 2019, through engineering reports submitted by the Hopi Tribe’s engineering expert and the City of Flagstaff’s experts.
32. The division of past, present, and future uses into two separate trials is not being employed for the Navajo Tribe’s water right trial.