BEFORE THE SECRETARY OF THE INTERIOR

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PETITION TO LIST THE WILLCOX PLAYA TIGER BEETLE (*CICINDELA WILLISTONI SULFONTIS*) UNDER THE ENDANGERED SPECIES ACT

CENTER FOR BIOLOGICAL DIVERSITY

August 12, 2025

NOTICE OF PETITION

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Pursuant to Section 4(b) of the Endangered Species Act ("ESA"), 16 U.S.C. § 1533(b); section 553(e) of the Administrative Procedure Act (APA), 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), the Center for Biological Diversity ("Center") and Barry Knisley hereby petition the Secretary of the Interior, through the U.S. Fish and Wildlife Service ("FWS" or "Service"), to protect the Willcox Playa tiger beetle (*Cicindela willistoni sulfontis)* as a threatened or endangered species. The petitioners also request that critical habitat be designated concurrently with the listing, pursuant to 16 U.S.C §1533(a)(3)(A) and 50 C.F.R. §424.12.

FWS has jurisdiction over this petition. This petition sets in motion a specific process, placing definite response requirements on FWS. Specifically, the Service must issue an initial finding as to whether the petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). FWS must make this initial finding "[t]o the maximum extent practicable, within 90 days after receiving the petition." *Id.*

The Center is a national, nonprofit conservation organization with more than 1.8 million members and online activists dedicated to the protection of endangered species and wild places.

C. Barry Knisley is Wornom Professor of Biology, Emeritus, at Randolph-Macon College. Prof. Knisley has studied the biology and conservation of tiger beetles for over 50 years, with over 80 journal articles and 4 books on these insects. He has worked closely with federal and state governments and numerous groups to obtain protection of rare tiger beetles and especially the unique habitat where they are often found.

Submitted this 12th day of August 2025

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I. EXECUTIVE SUMMARY

Sulphur Springs Valley in southeastern Arizona has the greatest tiger beetle diversity within the United States. At least 17 species of tiger beetles are known from this area, including the Willcox Playa tiger beetle (*Cicindela willistoni sulfontis*), which is only known from Willcox Playa, a dry lake at the center of Sulphur Springs Valley. The survival of this rare species is threatened by habitat drying due to climate change, surface water diversion, and groundwater withdrawal primarily for agriculture. *C. w. sulfontis* is additionally threatened by a proposed lithium production project, which has staked mining claims at multiple locations on the Playa, including in the habitat of *C. w. sulfontis,* and began exploratory drilling. Due to these and other threats, the Willcox Playa tiger beetle urgently needs the protections afforded by the ESA.

II. INTRODUCTION

In total at least one million species are facing extinction in the coming decades, with half being insects (IPBES, 2019 as cited in Cardoso et al. 2020, p. 2). Insect biomass, abundance, and diversity are estimated to have declined by 20%–75% over the last few decades in many taxonomic groups and ecosystems (Dalton et al. 2023, p. 1 and references cited therein). In the United States, even though there are approximately 91,000 described and 73,000 undescribed species of insects (Smithsonian 1996, p. 1), only approximately 100 (USFWS 2024, *entire*), or less than 0.1%, are listed as endangered or threatened under the Endangered Species Act. An evaluation of the conservation status of U.S. tiger beetles determined that 62 taxa are sufficiently rare to be considered for listing as Threatened or Endangered (Knisley et al. 2014, p. 93). However, only 5 are listed and none in the U.S. Southwest. In addition to being highly charismatic, tiger beetles are valuable indicators of habitat quality and of biodiversity (Knisley et al. 2014, p. 94 and references cited therein).

The Willcox Playa tiger beetle, *Cicindela willistoni sulfontis*, is a green to brown medium size subspecies endemic to Willcox Playa, Sulphur Springs Valley, Cochise County, Arizona. Willcox Playa and the surrounding Valley are known for having the greatest tiger beetle diversity within the US (Griffiths et al. 2014, p. 1; NPS 2025a, p. 1, and see also NAU 2024, p. 1). This diversity can at least partially be attributed to the isolation of Sulphur Springs Valley, its mostly internal drainage, and a topography which allows water to remain in blowouts for an extended time (Rumpp 1977, p. 170).

The survival of *C. w. sulfontis* is threatened by warmer temperatures and prolonged drought conditions caused by anthropogenic climate change, as well as surface water diversion, and groundwater withdrawal primarily for agriculture. *C. w. sulfontis* is additionally threatened by lithium exploration and development. Over a hundred claims on federal land, as well as state mineral exploration permits, have recently been established at multiple locations on the Playa, including in the habitat of *C. w. sulfontis*. The primary concern is that the main known habitat of

C. w. sulfontis habitat will be converted to a mine site (or lithium extraction operation) and lead to extinction of the species. A secondary concern is that a mining operation will be established nearby and lead to severe population declines due to drawdown of groundwater levels and other factors.

Other threats to *C. w. sulfontis* include pollution, small population size effects, potentially off-road vehicle activity, and collection by tiger beetle and insect collectors. There are no adequate existing regulatory mechanisms to protect this species from extinction.

The Willcox Playa tiger beetle urgently needs the protections afforded by the ESA.

III. NATURAL HISTORY

A. Taxonomy

Cicindela willistoni occurs in scattered saline habitats from the southern Great Plains of Kansas and Oklahoma west to California and north to Wyoming and Oregon (Pearson et al. 2015, p. 124). Eight subspecies are recognized (Knisley et al. 2023, p. 144). *C. w. sulfontis* was described by Rumpp (1977, p. 170-172) as a subspecies endemic to the Willcox Playa. The type series for the description included 217 specimens, 213 from the only known population in the northwestern section of the Willcox Playa and 4 others that are likely dispersers from the Playa (Rumpp 1977, p. 171). Rumpp was a well-respected taxonomic authority of tiger beetles, having described numerous southwestern taxa.

B. Description

This subspecies is a medium-sized tiger beetle (holotype male and allotype female 13 mm in length) with a broad maculation connected along the margin of the elytra. The dorsal color is either green or brown with very few intermediates. Rumpp's type series included 118 green forms, 91 brown and 8 intermediates (Rumpp 1977, p. 170-171). All of the larval instars of this subspecies were described by Knisley and Pearson (1984, p. 514-516).

C. Biology.

Most species of tiger beetles in the U.S. have either a summer or spring-fall life cycle pattern based on when adults are active. Most subspecies of *C. willistoni* have a spring-fall life cycle, but *C. w. sulfontis* is unique in having a pattern where the adult activity coincides with the monsoon in July and August, with some adults surviving into October (Rumpp 1977, p. 171-172). Adults emerge with the onset of the monsoon rains (Rumpp 1977, p. 172), with mating, oviposition and hatching of the larvae occurring thereafter. Development of the larvae to the adult stage likely takes 2 years (Knisley 1987, p. 1194), and larval activity is highest from July through August, absent in January, February and June, and occurs at reduced levels during the remaining months (Ibid, p. 1196).

Larvae of *C. w. sulfontis* and several other *C. willistoni* subspecies are unique in building a turret or chimney several centimeters (cm) tall that extends the burrow opening above the playa surface (Knisley and Pearson 1981, p. 402). Knisley and Pearson (1981) determined the turret was an adaptation for larvae to increase prey capture and thermoregulate. The extension of the burrow above the surface was an attractive spot for potential prey insects because of the shade and slightly lower temperature. The lower temperature at the burrow mouth also increased the foraging time of the larvae during the day (Knisley and Pearson 1981, p. 405).

Soil moisture and associated temperatures are thought to be critical for the activity of larvae of the tiger beetle genus *Cicindela* (Paarman 1973 as cited in Knisley and Pearson 1981, p. 402). Under desiccating soil moisture levels, the larvae plug the burrow and retreat to the bottom 15-30 cm below the surface, becoming inactive until soil moisture levels rise sufficiently (Knisley and Pearson 1981, p. 402). This burrow plugging and subsequent period of inactivity is in turn likely related to a lack of prey: studies with Sulphur Springs Valley tiger beetles have demonstrated that food is the primary limiting factor for both adults and larvae, and prey abundance is directly related to soil moisture (Pearson and Knisley 1985, *entire*; Knisley 1987, *entire*; Knisley and Juliano 1988, *entire*). This is especially true for *C. w. sulfontis* as prey in its playa habitat (including primarily Diptera, but also Collembola, Coleoptera, Hymenoptera and Aranca) is among the lowest of any habitats in the Valley (Knisley 1987, p. 1197). During prolonged dry periods, there is a decline in prey, and based on a study with Sulphur Springs Valley tiger beetles, increased likelihood of mortality from starvation (Knisley and Juliano 1988, p. 1990). Reduced soil moisture during droughts can also dry the soil to the bottom of the shallower first instar burrows thereby increasing mortality from desiccation (Ibid). During the dry periods with reduced prey, adults are, moreover, likely to be smaller, decreasing fecundity and decreasing resistance to starvation (Pearson and Knisley 1985 as cited in Knisley and Juliano 1988, p. 1990).

In addition to soil moisture, larval activity of *C. w. sulfontis* is likely related to soil temperature, with Knisley and Pearson 1981 estimating a voluntary maximum field temperature for larval activity at the mouth of the burrow of 39.5°C (Knisley and Pearson 1981, p. 404).

D. Habitat

Throughout its range in central and southwestern United States, adults and larvae of *Cicindela willistoni* occupy saline-alkali flats with little or no vegetation (Knisley and Pearson 1981, p. 402). *C. w. sulfontis* is only known from the northwestern side of Willcox Playa, an approximately 50 square mile dry lake, that is the remnant of the much larger Pleistocene-age Lake Cochise (Towne and Freark 2001a, p. 5 and Oram 1993 cited therein). The Playa is a sparsely vegetated desert grassland floored with white silt and clay (NAU 2024, p. 1). Adults and immatures of *C. w. sulfontis* occur along the edges and flats of the Playa. Larvae primarily occur on the Playa, with fewer individuals occurring in a roadside ditch at the edge of the Playa (Knisley and Pearson 1984, p. 515-516).

Given that it occurs nowhere else, *C. w. sulfontis* has likely adapted to the unique pre-development surface water and soil moisture regime at Willcox Playa. According to Knisley and Pearson 1981, the presence of *C. w. sulfontis* on the Playa is explained by the Playa surface being the closest habitat to the underground water table (Knisley and Pearson 1981, p. 409). "Even in the driest months of the year (May-June), the soil can be moist only 5-7 cm beneath the substrate surface. The moisture may provide a more moderate habitat for the tiger beetle larvae than the more porous substrates at higher elevations, in which the other tiger beetle larvae occur. Larvae on the playa could then respond quickly to subtle and favourable changes in conditions above ground and become active throughout more of the year. In addition, the playa drains the entire valley. Thus isolated rainstorms on any of the surrounding mountains can eventually supply moisture to the playa. In contrast, the moisture levels of all the other habitats are largely dependent on direct rainfall. Besides affecting development directly, extended activity and access to food for larvae could affect their body size (Sweeney & Vannote, 1978) and reproductive potential as adults (Chiang & Hodson, 1950)" (Ibid, p. 410). As will be discussed in more detail below, however, the hydrology of the Sulphur Springs Valley has changed drastically over the last many decades.

The unique habitat characteristics of the Willcox Playa likely explain the evolution of the larval turrets in *C. w. sulfontis*: "larval turrets would probably not be effective in the other habitats occupied by tiger beetle species in Sulphur Springs Valley. For instance, the high sand content of moist soils in the valley would mechanically prohibit turret construction. Also, the presence of vegetation significantly increases the height of the warm boundary layer (Geiger, 1965). To effectively raise the larvae out of the higher unshaded temperatures near vegetated substrates, the turrets might have to be 10-20cm high, depending on the height and density of the vegetation. The cost in construction and maintenance of such tall turrets would likely be great" (Knisley and Pearson 1981, p. 408-409).

E. Hydrogeology

Willcox Playa is located in Sulphur Springs Valley, a large northwest trending intermontane through that extends from northeastern Sonora, Mexico to the headwaters of Aravaipa Creek in Graham County, Arizona (Brown and Schumann, 1969 as cited in Towne and Freark 2001a, p. 4-5). The Willcox Groundwater Basin (WGB) occupies the northern part of Sulphur Springs Valley, extending from Graham to Cochise Counties, approximately 80 miles east of Tucson (Towne and Freark 2001a, p. 3). The basin is bounded by the Pinaleno Mountains to the northeast, the Dos Cabezas and Chiricahua Mountains to the east, the Pedregosa and Swisshelm Mountains and Squaretop Hills to the south, and the Dragoon, Little Dragoon, Winchester, and Galiuro Mountains to the west (ADWR 1994 as cited in Towne and Freark 2001a, p. 5) (Figure 1). Elevations in the basin range from 10,717 feet above mean sea level (amsl) in the Pinaleno Mountains to approximately 4,130 feet amsl at the Playa, located at the center of the basin

(Towne and Freark 2001a, p. 5). The climate is generally semi-arid, characterized by hot summers and cool, moderate winters. Precipitation typically occurs as short intense rains from July to September, and as gentle long duration rains and some snow during the winter months. Drainage flows to the Willcox Playa, except for Whitewater Draw in the extreme southern portion of the basin, which drains into adjacent Douglas Basin (Oram 1993 as cited in Towne and Freark 2001a, p. 5). Due to anthropogenic modification (see below), streamflow now usually completely infiltrates before reaching the Playa but shallow, ephemeral ponds still form after heavy precipitation (Brown and Schumann 1969 as cited in Towne and Freark 2001a, p.5; NASA 2019, p. 43).

Similar to surface waters, groundwater in the WGB generally flows from mountain fronts towards the Playa. However, heavy groundwater pumping for irrigation has partially altered this flow and created groundwater depressions in intensively farmed areas (Towne and Freark 2001b, p. 2; ADWR 2018, p. 1). Groundwater in the WGB is stored within the regional basin-fill aquifer system, which consist of alluvial deposits that become deeper towards the basin's center, with a maximum thickness of approximately 1800 m (Job et al. 2023, p. 5 and Gootee 2012 cited therein). A more limited amount of water is also stored within the igneous, metamorphic, and sedimentary rocks that form the surrounding mountains (Towne and Freark 2001a, p. 6). The basin-fill is further divided into younger unconsolidated alluvium at the top and older consolidated alluvium at the bottom. The unconsolidated alluvium consists of interbedded lake-bed deposits of silt and clay and stream deposits of sand and gravel, while the consolidated alluvium consists of silt, clay, sand, gravel, conglomerate, sandstone, and mudstone. The stream deposits within the unconsolidated alluvium generally have high permeability and are therefore the most productive sequence in the basin-fill aquifer system. The lakebed deposits form a relatively impermeable layer that impedes the downward percolation of water in and around the Playa, forming a zone of shallow groundwater in the area (Towne and Freark 2001a, p. 7) (Figure 2). This perched groundwater zone is clearly defined on the east and south sides of the Playa, but around the northern and western edges, appears to grade into the regional aquifer, making the boundary indistinct. Depth to groundwater in this shallow groundwater zone ranges from 13 feet below land surface (bls) to 107 feet bls (Oram 1993, p. 1; Towne and Freark 2001a, p. 7).

Recharge in the WGB largely results from runoff and seepage along the adjoining mountain fronts, with additional recharge from agricultural irrigation (Job et al. 2023, p. 5). Discharge "pre-development" (i.e. up until 1940) likely consisted of groundwater discharge from 1) springs located around the periphery of the Playa, including Croton and Sulphur Springs; 2) flowing artesian wells located around the periphery of the Playa; 3) modest rates of pumpage from shallow wells located mostly adjacent to the Playa; and 4) evapotranspiration outflows including evaporation from upward seepage and evapotranspiration of riparian vegetation in shallow water table areas near the Playa. Some groundwater discharge and evaporation is also assumed to have occurred on the Playa surface itself (ADWR 2018, p. 17-18 and Meizner and Kelton, 1913 cited therein). Due to declining groundwater levels, however, there has been a significant decrease in groundwater discharge from evapotranspiration and spring discharge in the vicinity of the

Willcox Playa (Ibid, p. 4) (and the same can be inferred for the Playa itself: see ADWR 2018, p. 39 and section V below).

At the northern and southern end of the WGB, saturated alluvial material extends into the Aravaipa and Douglas Groundwater Basins, respectively. However, groundwater flow is limited in each case by a groundwater divide, which limits inter-basin flow (ADWR 2018 as cited in Job et al 2023, p. 5).

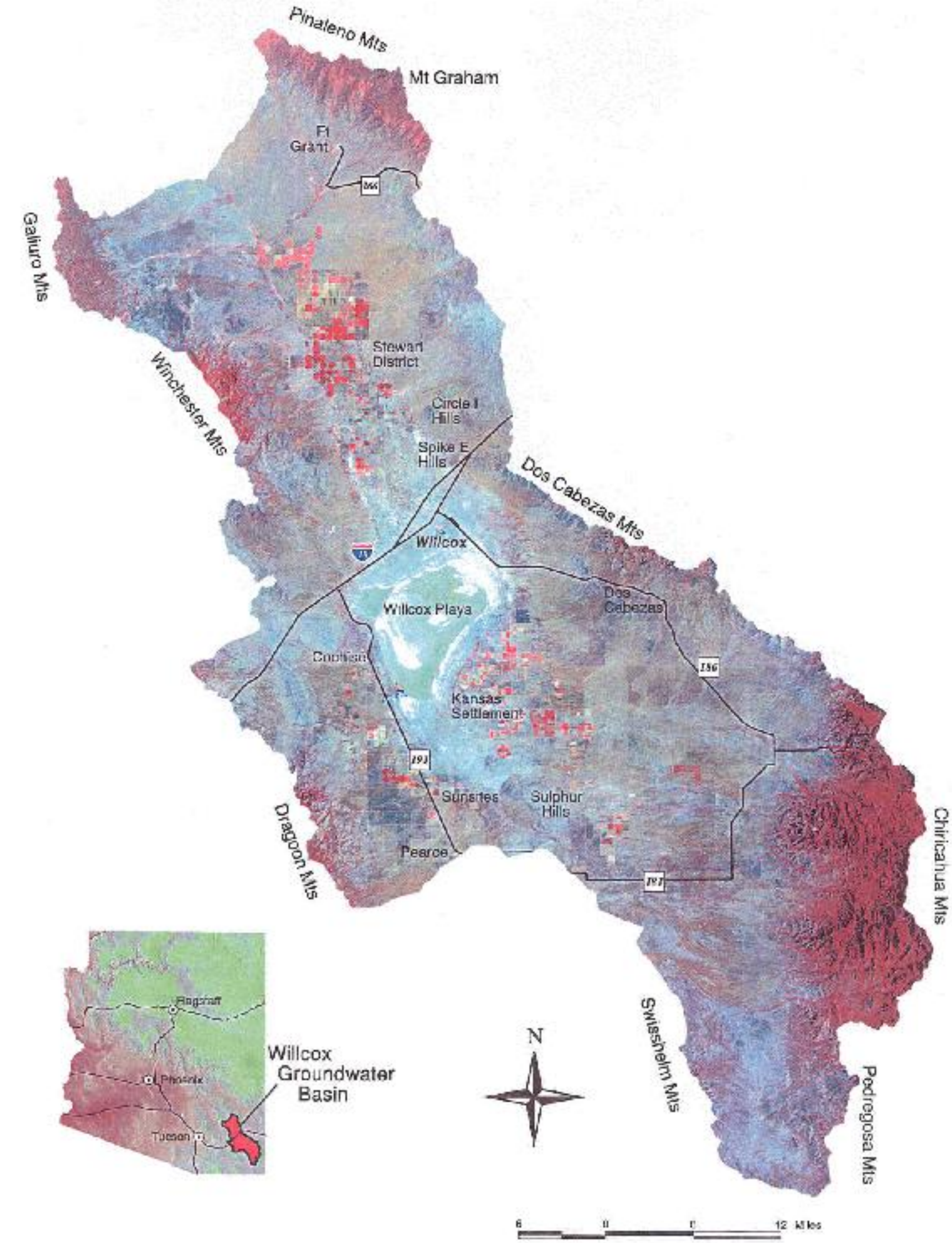

Figure 1. Willcox Groundwater Basin. Adapted from Towne and Freark 2001a, p. 4.

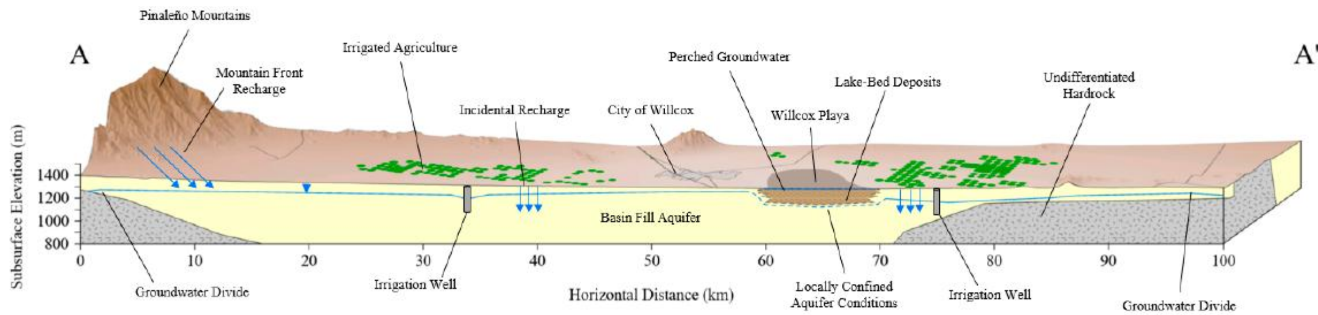

Figure 2. Conceptual cross-section of the Willcox Groundwater Basin. Adapted from Job et al. 2023, p. 12.

F. Associated species of interest

At least 17 species are known from the Sulphur Springs Valley (Rumpp 1977, p. 1). Thus, these species may indirectly benefit from the ESA protections that would be afforded to *C. w. sulfontis*. Other species that may also benefit indirectly include the many bird species that use the Willcox Playa, which is at the heart of an Important Bird Area (IBA) (Arizona Important Bird Areas Program 2025a, p. 1-4), a rare plant (Chiricahua Mountain tansy-aster) (NAU 2024, p. 1), an imperiled plant (Griffith's saltbrush) (NatureServe 1999, p. 2-3), as well as rare endemic crustaceans (BLM 1991, p. 447).

IV. RANGE AND STATUS

1. Distribution

C. w. sulfontis is endemic to Willcox Playa, Sulphur Springs Valley, Cochise County, Arizona, and is only known from the northwestern side of the Playa (Figure 3). The type location is identified in Rumpp 1977 as 5.6 kilometers west-southwest of Willcox, on the Playa, and a few hundred meters south of the tracks of the Southern Pacific Railroad (Rumpp 1977, p. 171). Rumpp's type series also includes 4 individuals from between 5 and 9 km southeast of Willcox in wind carved sinks (Ibid). However, these were likely dispersing individuals or a temporary population since no individuals have since been reported outside of the Playa.

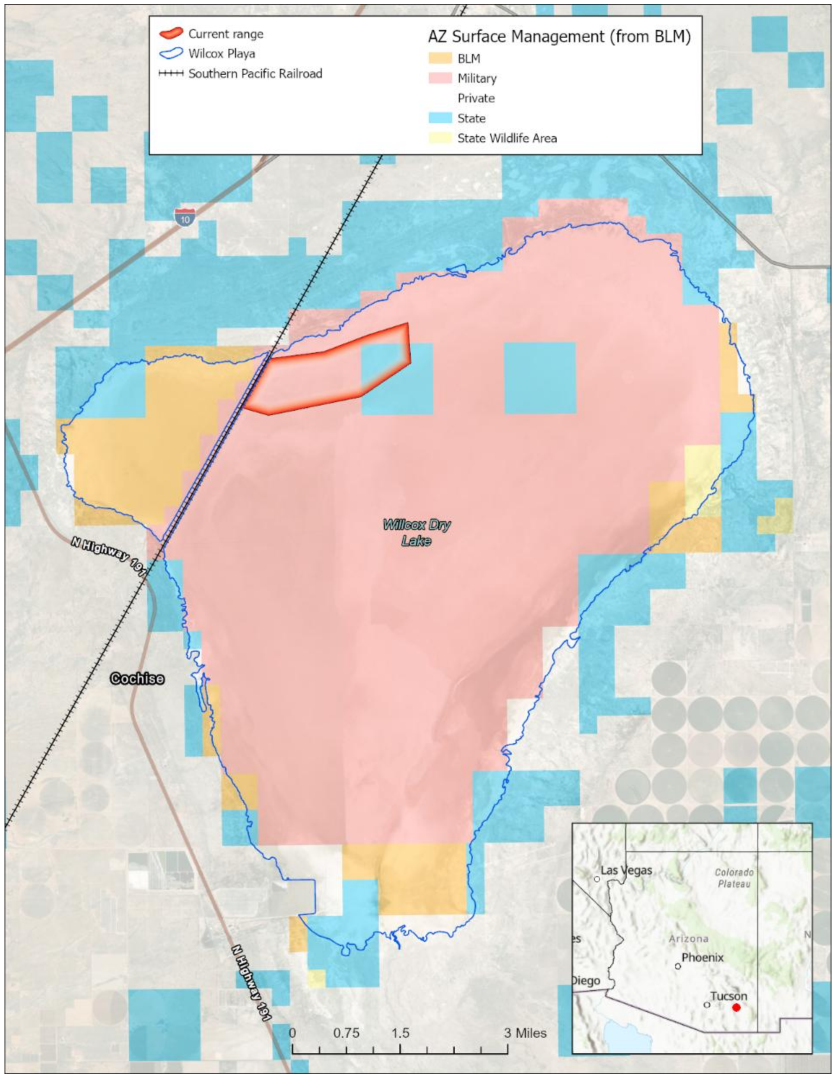

Figure 3. Distribution of *C. w. sulfontis*. The polygon represents the main known habitat area and corresponds to the approximate area where Knisley found adults and larvae in the 1980s. The Playa boundary is from USGS 2023[1] and the surface management data is from BLM 2024[2].

2. Population status

In 1977, Rumpp reported that *C. w. sulfontis* emerges in great numbers on the Playa south-southwest of Willcox at the onset of the monsoons in early July (Rump 1977, p. 177). A worker named B. Rotger collected 98 adults on 8/17/69, while Rumpp and another worker collected 91

[1] USGS [U.S. Geological Survey]. 2023. USGS National Hydrography Dataset Best Resolution (NHD) – Arizona. Published 27 December 2023. Available at: https://www.usgs.gov/national-hydrography/national-hydrography-dataset (accessed 10 October 2024).
[2] BLM [Bureau of Land Management]. 2024. BLM AZ Surface Management Agency. Published January 2024. Available at: https://gbp-blm-egis.hub.arcgis.com/ (accessed 23 January 2025).

on 7/20/70 (Ibid, p. 171). Based on Barry Knisley's experience surveying this species (see below), this species is very wary and difficult to collect with a net. Thus, collecting these numbers, and the comment from Rumpp, suggest a very large population during this time.

While there have not been any surveys to accurately determine the abundance of *C. w. sulfontis* adults, their numbers are likely now lower than the 1969 and 1970 numbers reported above. Indeed, in 30+ visits searching for adults in the 1980s, Barry Knisley never found more than 20-40 adults despite covering large areas of habitat. During this time period, Knisley developed and used a method that could collect a larger number of individuals than what had been possible using a net. The method involved placing a 16-20" square of cardboard several inches above a pitfall trap, taking advantage of the tendency of *C. willistoni* and other salt flat species to seek shade and avoid the very high surface temperatures. With this method, Knisley collected 20 to 40 *C. w. sulfontis* adults in several of these traps placed for a 2- to 3-day period (Knisley and Schultz 1997, p. 144).

The low numbers of adults collected may have been due to low survivorship from first instar to adult. Most of what is known about larvae of *C. w. sulfontis* is from research marking and monitoring their burrows to determine development and survival to the adult stage between 1981 and 1985 (Knisley 1987, *entire*). Larvae were common to abundant in these early years given 340 first instars in 1981, 409 in 1982 and 105 in 1983 in an 800 sq m study plot of the Playa that included most of the area where larvae were observed (Knisley 1987, p. 1194). However, monitoring of larvae over their probable two-year development found the mean survival from first instar to the adult stage was 1.5% for the 1982 larval cohort (Ibid). Among the species and habitats studied, survivorship from first instar to adult was also lowest for the species at Playa sites (*C. willistoni* and *Cincindela fulgoris*), and a sand ridge site (*Cicindela marutha*) (Ibid, p. 1193).

While the reason for the lower survival rates in *C. w. sulfontis* larvae is unclear, it may be related to the species' increased susceptibility to the effects of food limitation. As discussed above, food is a critical limiting factor for Sulphur Springs Valley tiger beetles, and especially *C. w. sulfontis* due to the low prey abundance in its playa habitat. The lower survival of *C. w. sulfontis* larvae is also partially due to parasitism by the beefly, *Anthrax,* with ~29% and ~24% of the larvae being attacked in 1981 and 1982, the two years this was studied (Knisley 1987, p. 1198).

Since the 1980s, the *C. w. sulfontis* population has likely declined further as two factors have almost certainly caused declines in surface water and soil moisture at the Playa: 1) increasing evaporative demand from several decades of hotter temperatures and prolonged drought conditions, as well as potentially changes in the amount and/or timing of precipitation; 2) diversion of surface run-on and groundwater withdrawal for agriculture and other uses.

According to current reports (AZGFD 2025a, p. 1, Arizona Important Bird Areas Program 2025a, p. 2), Willcox Playa is "seasonally flooded to a shallow depth" with Withers (2001) noting that water evaporates within a week (Withers 2001, p. 1). However, inundation of the Playa surface was likely more pronounced in prior years and decades, with Schreiber et al. 1972 reporting that the Playa surface had the potential to be flooded for periods of up to several months (Schreiber et al. 1972, p. 141):

Runoff from intense summer storms in the drainages on the west side has but a short distance to travel and easily reaches the playa. Here the water may accumulate to a depth of several inches to almost a foot until lost by evaporation and/or infiltration. Depending upon the amount of runoff collected and rate of loss, the western playa surface may be flooded for periods up to several months.

A decline in surface water presence can also be seen from long-term time series of seasonal estimates of "lake" extent using satellite data (Figure 4) (Donnelly et al. 2020, p. 2046).

In addition to declining surface water and soil moisture, the entire known population of *C. w. sulfontis* is at risk of going extinct due to the imminent threat posed by lithium exploration and development at the Playa (see section V).

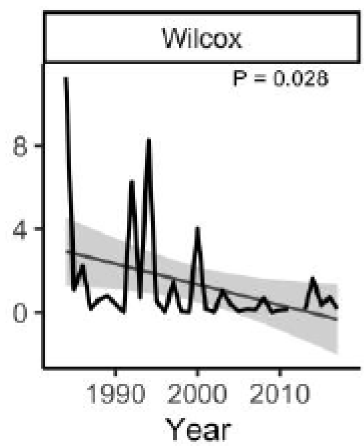

Figure 4. Annual (1984-2018) trend in surface water area (1000 ha) from October to March at the Willcox Playa. Straight line is least-squares best-fit with 95% confidence interval for the slope in grey (adapted from Donnelly et al. 2020, Supplementary Information, p. 14-15, Figure S9; Donnelly et al. 2020, p. 2046).

V. THREATS

A. Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

1. Surface water diversion

The Willcox Groundwater Basin is located in Cochise County, which produces almost all of Arizona's pistachios, as well as alfalfa, corn, and cotton (ADWR 2023, p. 5 and Duval et al. 2020 cited therein). Agricultural development in the Willcox Basin began around 1910, and irrigated agricultural land was generally limited to the area northwest of Willcox through the 1940s (ADWR 2018, p. 18 and Meinzer and Kelton 1913 cited therein). However, in the mid-1940s, it began to rise dramatically, with the amount of land being irrigated for agriculture peaking in about 1970 (USGS 1994 as cited in ADWR 2018, p. 18) (Figure 5). Around this time, Schreiber et al. 1972 (p. 148) noted that:

Many streams [in the Willcox Basin] flow; however, only a few deliver water to the playa surface because the water is either lost by infiltration and evaporation or is retained by ranchers and farmers. They recognize the drainageways, whether small or large, and try to retain the waters behind dams or to divert the waters into cattle tanks for livestock and local flood control. Numerous dikes have also been built for flood control. Small reservoirs and cattle tanks are extremely abundant in the north, east, and west portions of the basin.

Irrigated agricultural land decreased markedly after the early 1980s, before increasing again starting in the year 2000 (ADWR 2018, p. 18). NASA 2019 describes agricultural lands bordering the Playa as preventing many of the historical drainages from entering the Playa (NASA 2019, p. 43). The decrease in surface run-on caused by the development of agricultural lands and other land use changes likely had (and continues to have) an impact on the extent of surface water that temporarily accumulates on the Playa, and subsequently soil moisture. The decline in soil moisture is in turn likely impacting *C. w. sulfontis* survival by altering the species' ability to find prey and hydrate (see section III).

In addition to reduced inflows, portions of the Playa are drained by man-made outflows (NASA 2019, p. 43).

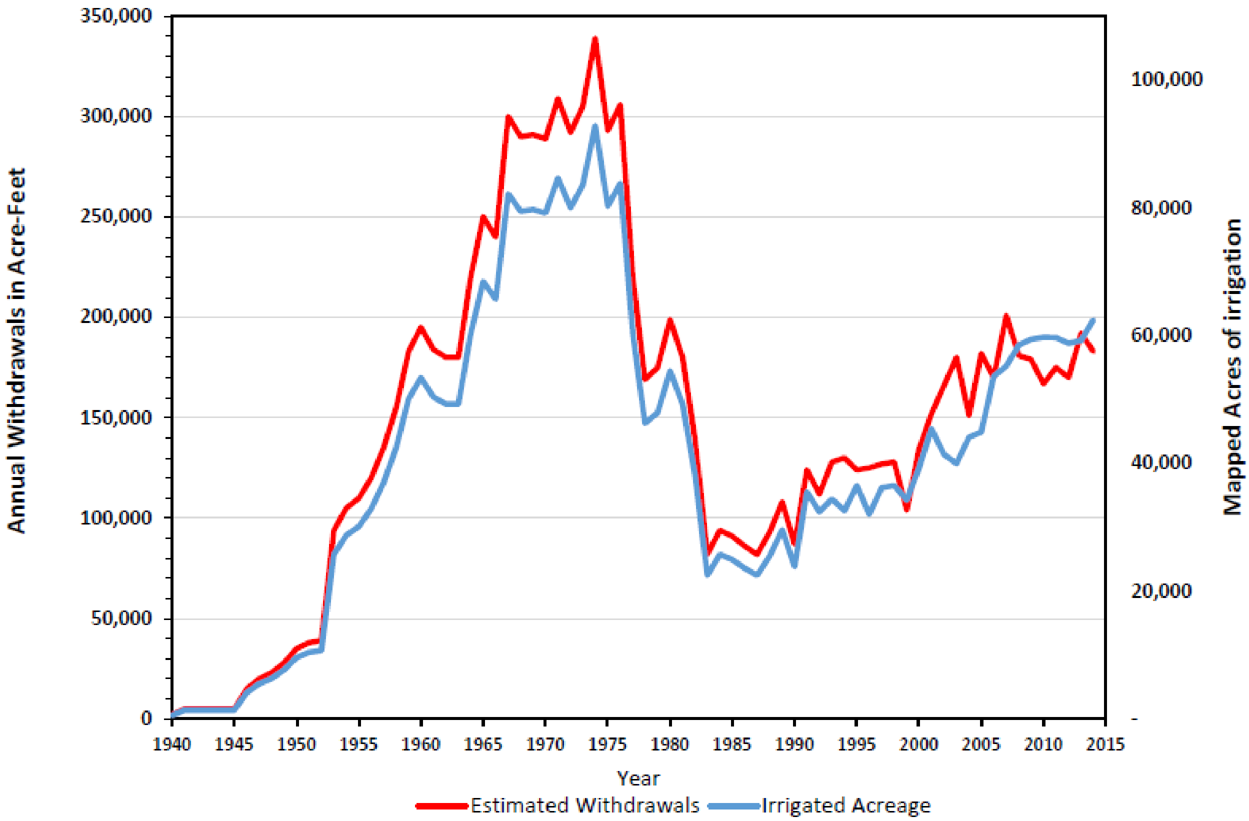

Figure 5. Estimated Annual Groundwater Withdrawals and Irrigated Acreage in the Willcox Basin 1940 - 2015 (adapted from ADWR 2023, p. 21).

2. Groundwater pumping

Agriculture

As discussed above, groundwater pumping for irrigation of agricultural lands increased significantly in the Willcox Basin starting in the mid-1940s. Estimated groundwater withdrawal in the early 1940s was around 5,000 acre-feet and rose to more than 250,000 acre-feet by the mid-1960s, peaking at over 300,000 acre-feet in the early 1970s (USGS 1994 as cited in ADWR 2018, p. 18; ADWR 2018, p. 20). After the early 1980s, groundwater withdrawals decreased significantly and remained at around 110,000 acre-feet per year (afy) through the 1990s. Starting in 2000, withdrawals began to increase again and averaged about 172,000 afy from 2000 to 2014 (ADWR 2018, p. 18) (Figure 5)[3]. Agriculture was the primary driver of the negative water supply and demand balance in the Willcox Basin from 1990 to 2022, accounting for approximately 90% of the total demand over that time period. The year with the smallest

[3] A more recent report by the Arizona Department of Water Resources (ADWR) suggests agricultural groundwater withdrawal in 1990 was around 120,000 acre-feet, and remained relatively constant over the time period 1990 to 2022, with an average of 157,819 acre-feet (ADWR 2023, p. 6).

imbalance, 1992, coincided with the highest volume of mountain-front recharge and second smallest volume of agricultural withdrawals (ADWR 2023, p. 16).

Due primarily to agricultural groundwater withdrawals, groundwater levels have declined by 200 to 300 feet relative to pre-development levels in some of the major pumping areas, and aquifer system compaction, regional land subsidence and earth fissuring have been significant over large parts of the Willcox Basin (ADWR 2018, p. 4). The spatial distributions of drawdown in the upper ("Layer 1") and lower ("Layer 2") basin-fill aquifer as simulated by one ADWR model for the period 1940 to 2015 are shown in Figures 6-7. These figures show the development of multiple cones of depression in regional pumping centers located north and south of the Willcox Playa, with generally greater declines in the confined aquifer system (Layer 2) than in the overlying unconfined aquifer (Layer 1). Comparison of the differences in simulated Layer 1 and Layer 2 hydraulic heads between 1940 and 2015 (Figures 8 and 9) shows how pumping in and around areas of upward vertical gradient near the Willcox Playa caused the gradients to reverse by 2015 (ADWR 2018, p. 62). Moreover, according to ADWR 2018 (p. 39):

Historically, springs existed along with artesian flowing wells around the periphery of the Willcox Playa, indicating that upward vertical gradients existed during steady-state and early development periods. During pre-development, the upward pressure of water in regional aquifers was released near the Playa from springs, pumping shallow wells, EVT and diffuse upwelling of groundwater seepage over broad areas (i.e., the Playa surface and peripheral areas).

Groundwater level declines of up to 50 feet at the Playa are also visible from the ADWR's basin sweep data (Figure 10), and while groundwater measurement sites in the Playa area are limited (and not all record water level changes over time, see e.g. ADWR 2025a, entire) (Figure 11), declines are being recorded near the habitat of *C. w. sulfontis* (Figure 12 and 13) (ADWR 2025b, p. 1; ADWR 2025c, p. 1). The northwest side of the Playa may be more susceptible than some other sites to pumping in the regional aquifer since, as discussed in section III, the boundary between the regional aquifer and the perched aquifer beneath the Playa becomes indistinct around this area. Declines in groundwater levels at the Playa are likely contributing to the desiccation of Playa soils and impacting *C. w. sulfontis* in the ways described above.

In the future, severe drawdown is projected in the regional aquifer (Figures 14 and 15) under a broad continuation of current pumping trends (ADWR 2018, p. 74). While growth in the agricultural sector should eventually decline some due to recent restrictions on the irrigation of new acreage (see section D), irrigation of recently irrigated lands can continue. Moreover, even if all groundwater pumping were to stop, it would take over 280 years for the aquifer to recover (ADWR 2024a, p. 10).

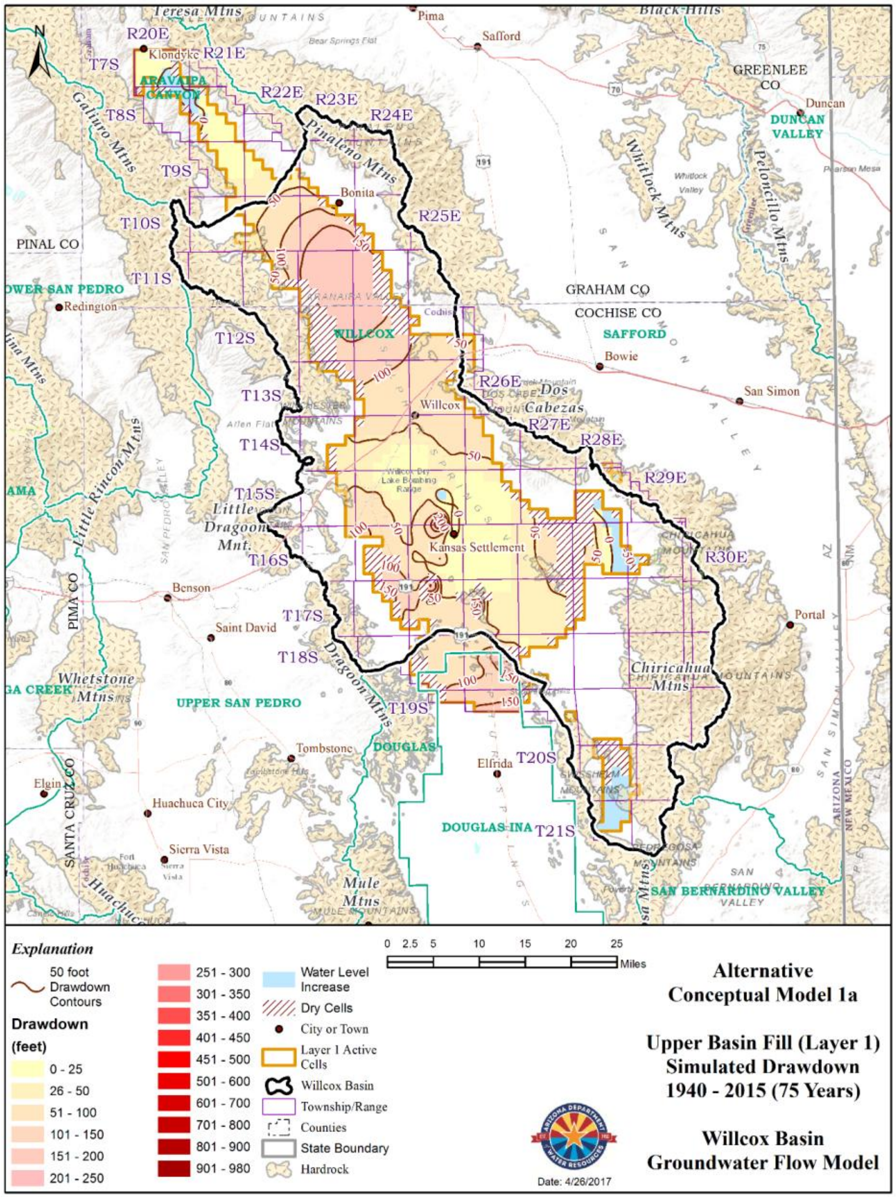

Figure 6. Simulated upper-basin fill drawdown for the period 1940 to 2015 (ADWR 2018, p. 64).

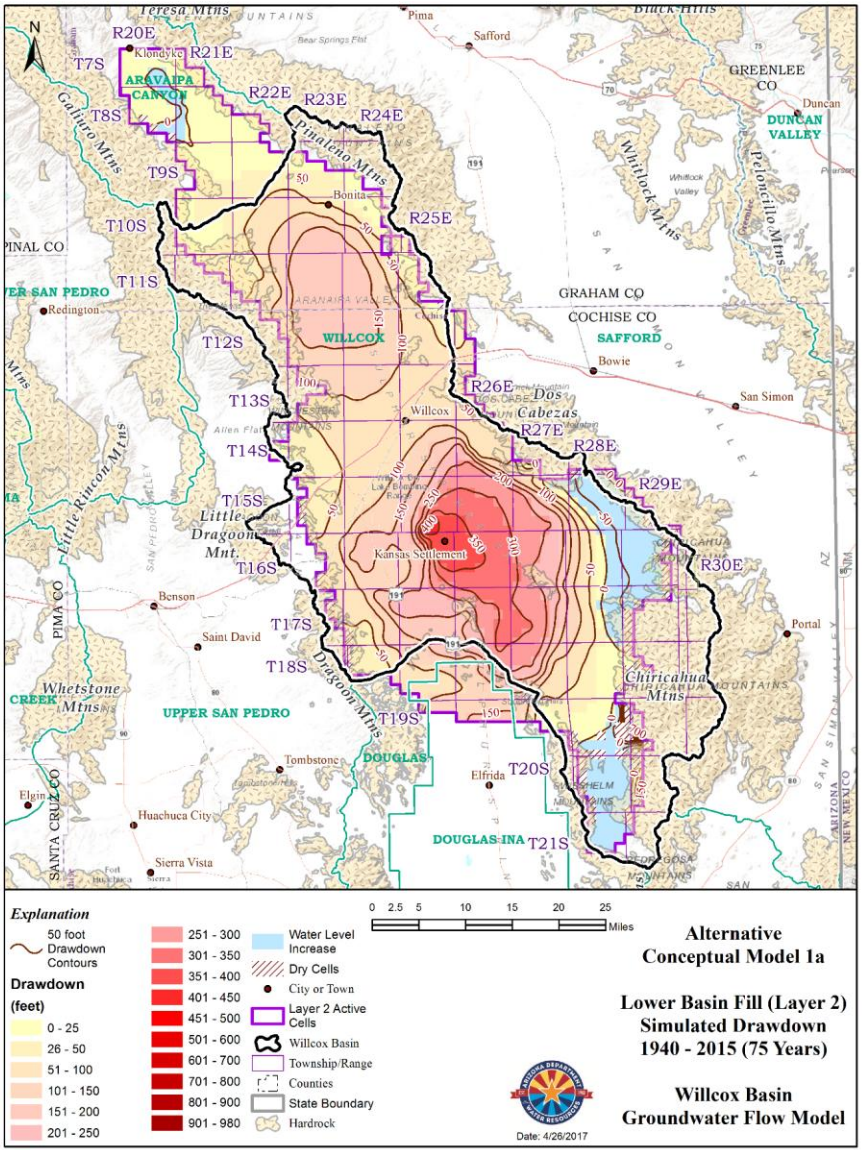

Figure 7. Simulated lower-basin fill drawdown for the period 1940 to 2015 (ADWR 2018, p. 68).

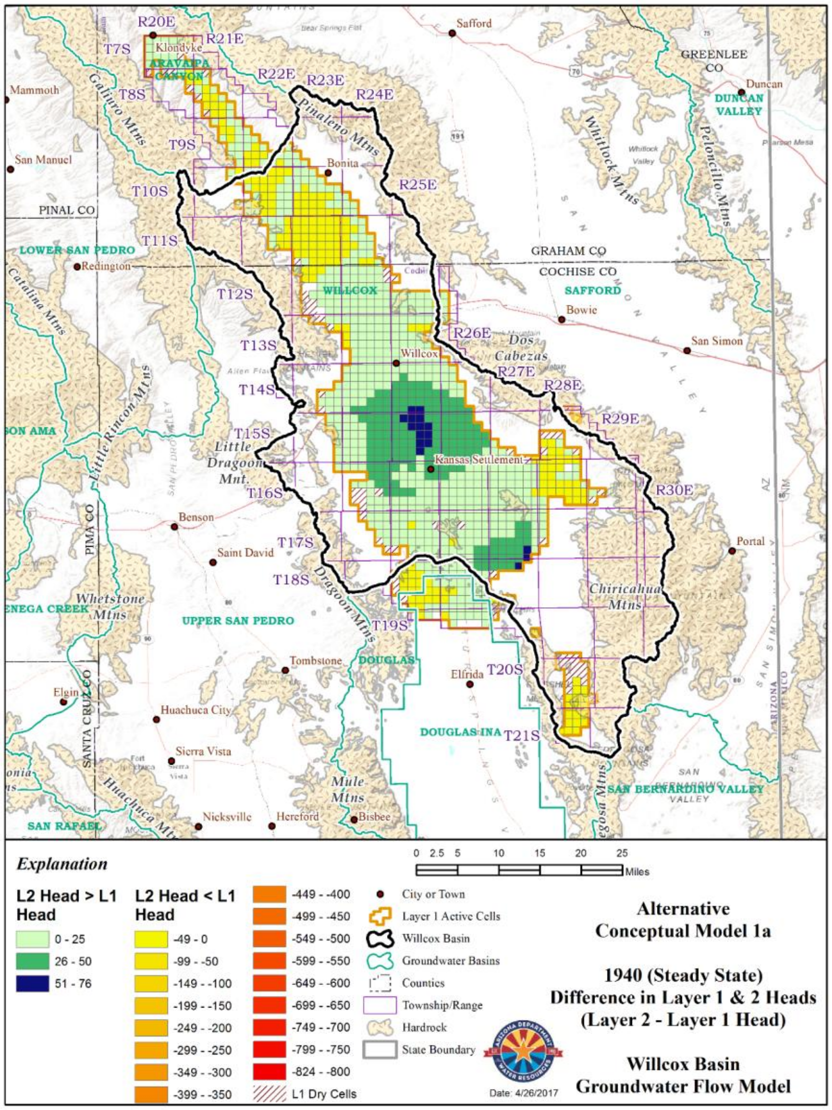

Figure 8. Difference in simulated steady state (1940) Layer 1 and Layer 2 heads (ADWR 2018, p. 59).

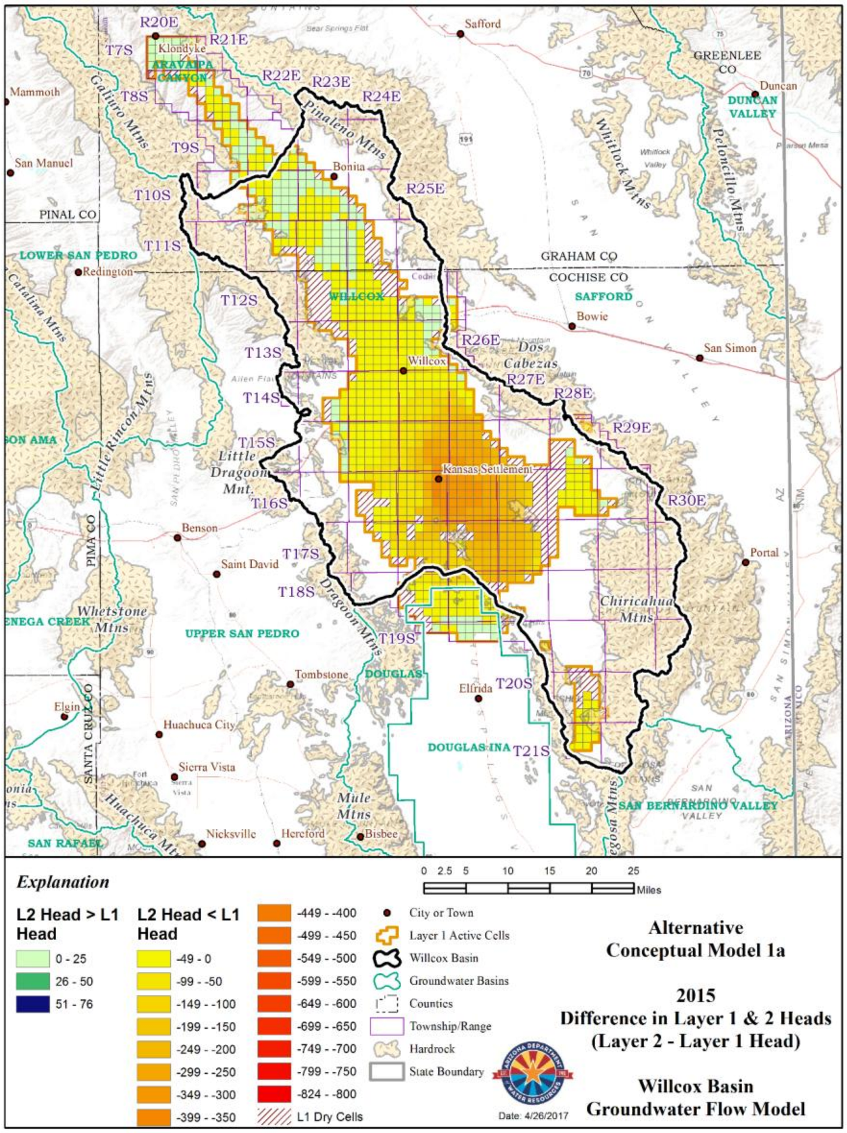

Figure 9. Difference in simulated 2015 Layer 1 and Layer 2 heads (ADWR 2018, p. 69).

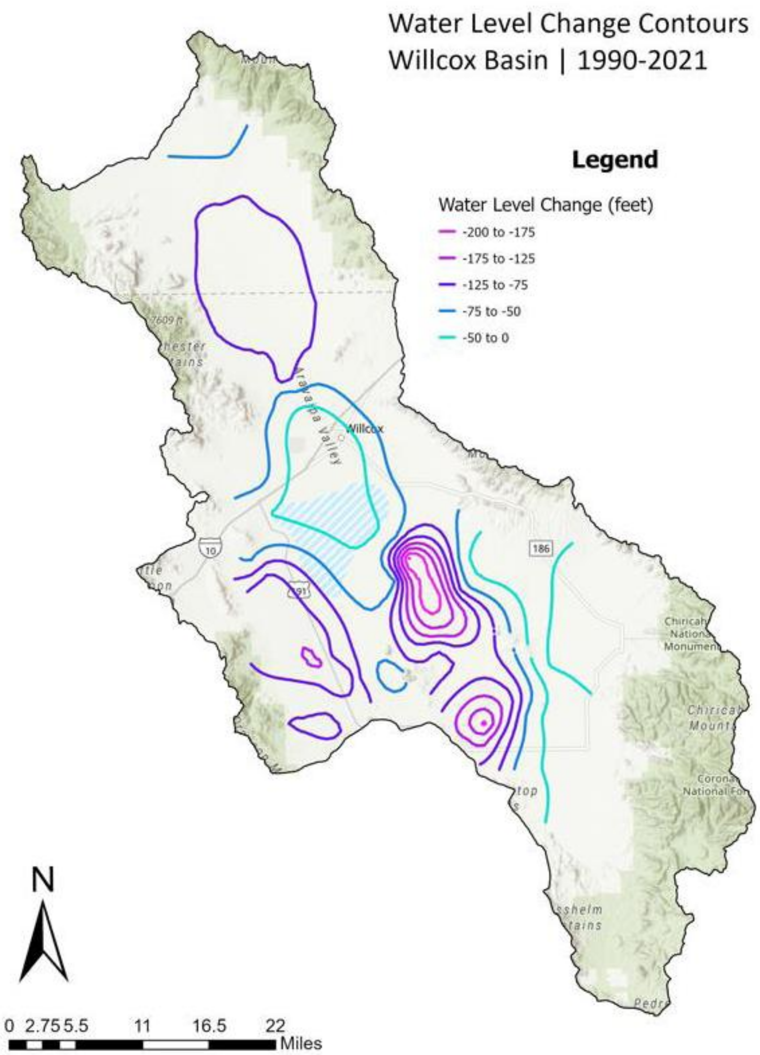

Figure 10. Water level change (1990-2021) contour map using basin sweep data (ADWR 2024a, p. 23).

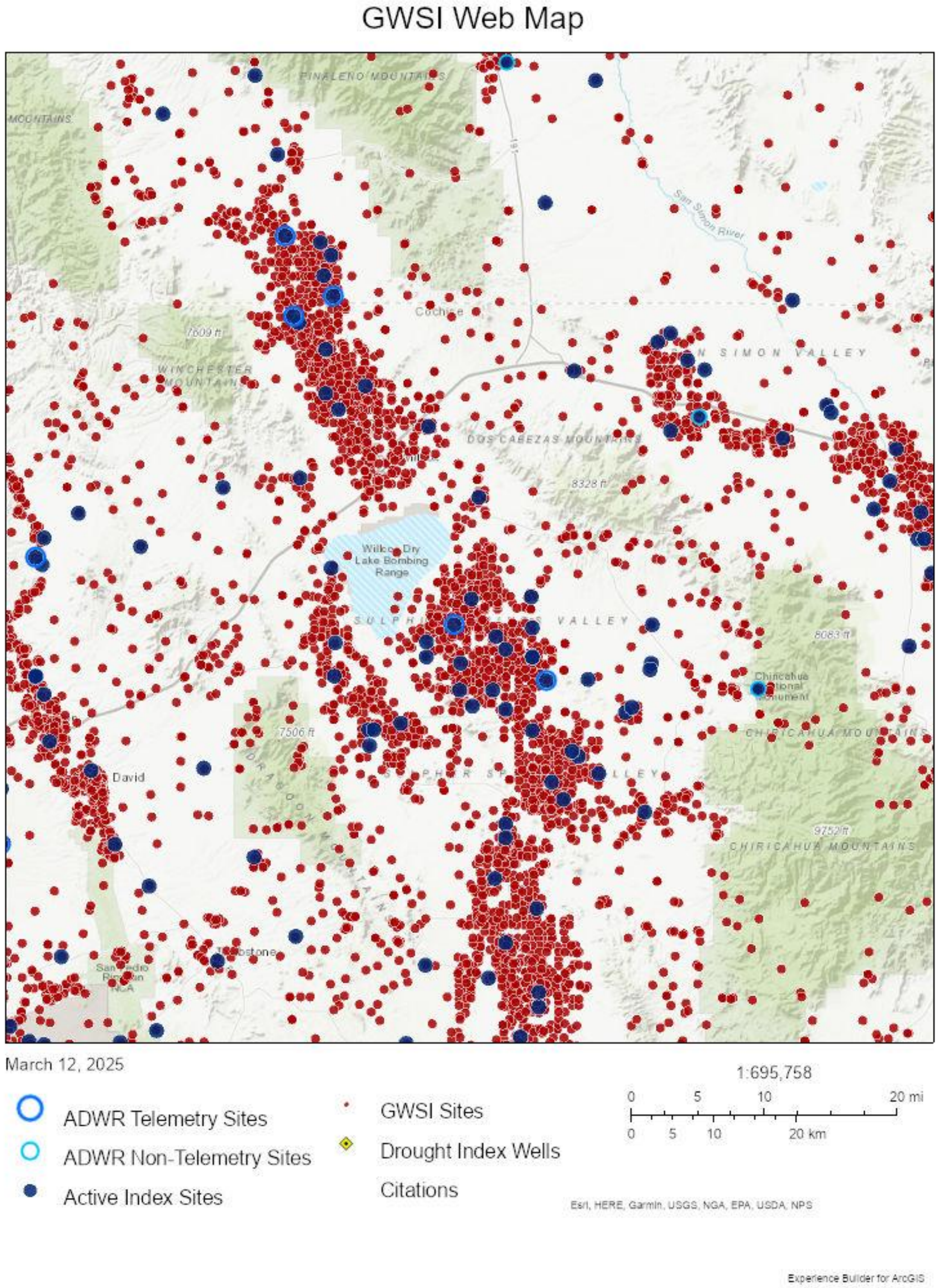

Figure 11. Arizona groundwater site inventory for the Willcox Play area (ADWR 2025d, *entire*).

Figure 12. Arizona groundwater monitoring hydrograph for site ID 320830109550901 (ADWR 2025b, p. 1).

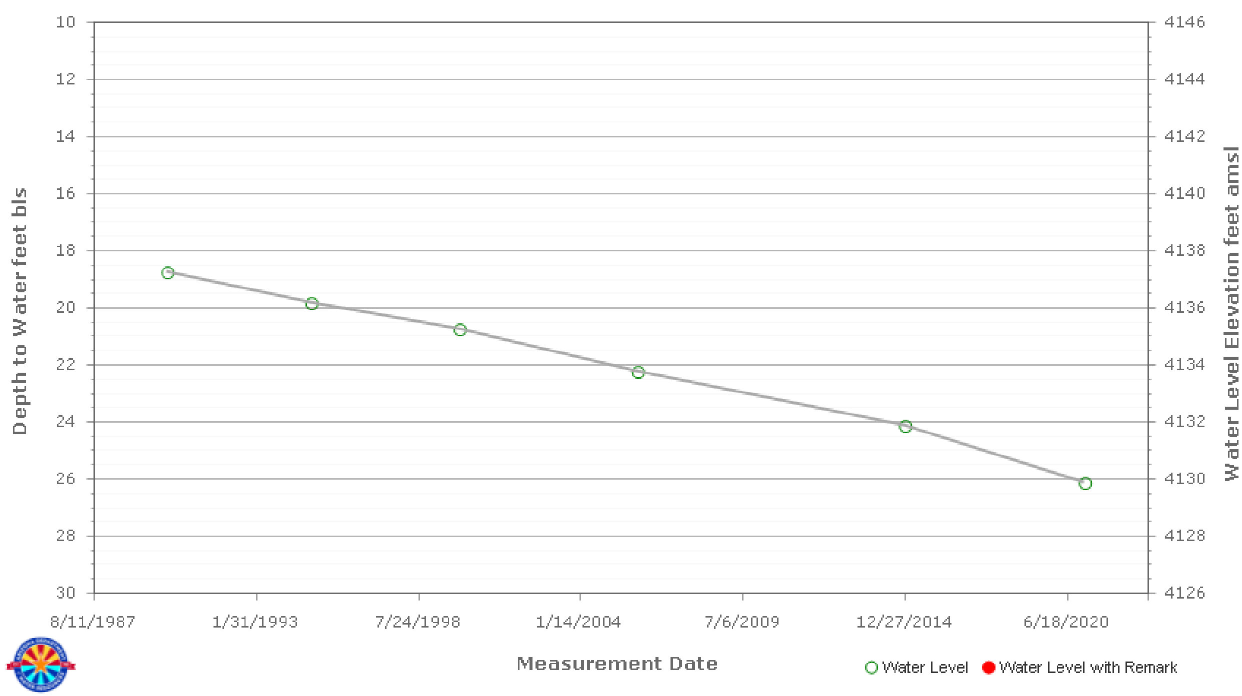

Figure 13. Arizona groundwater monitoring hydrograph for site ID 321210109523501 (ADWR 2025c, p. 1).

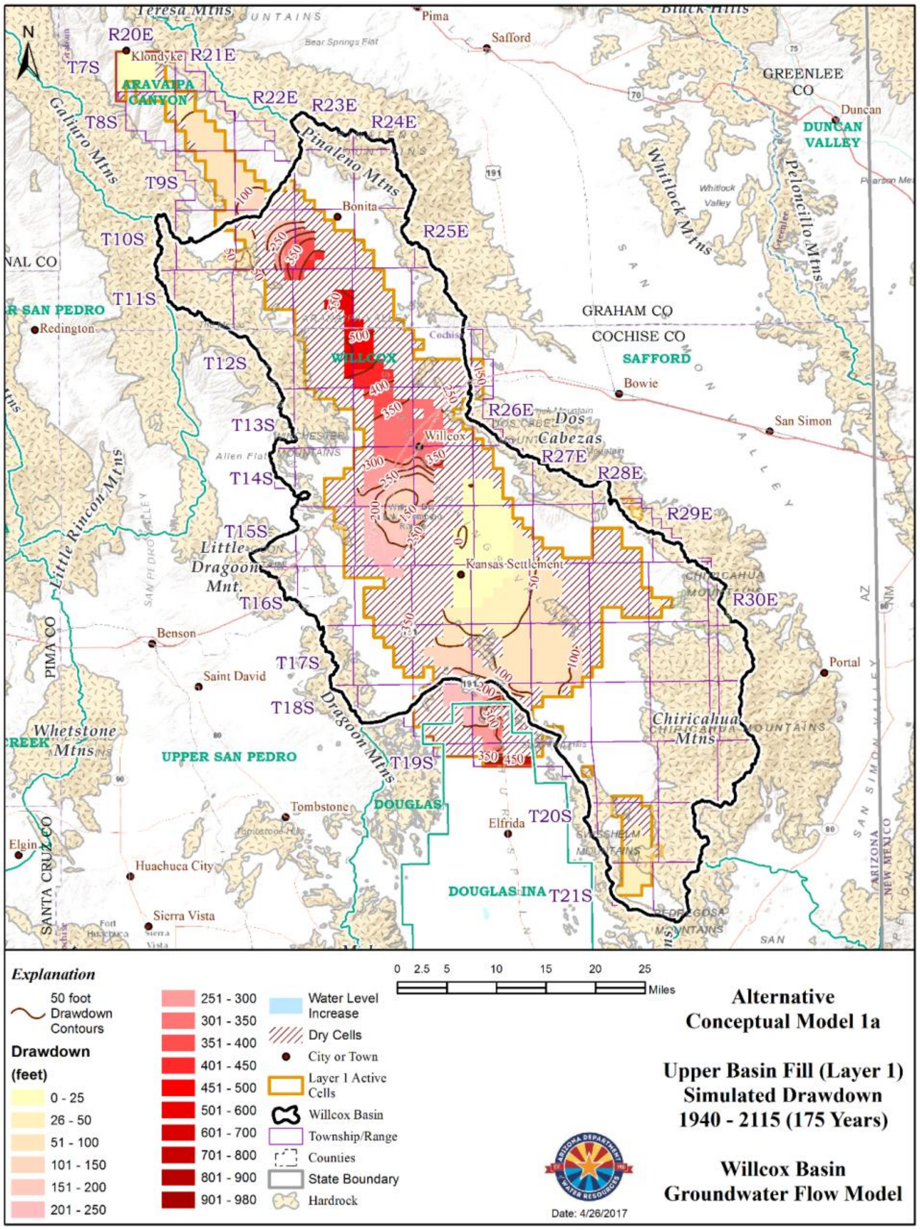

Figure 14. Simulated upper-basin fill drawdown for the period 1940-2115 (ADWR 2018, p. 76).

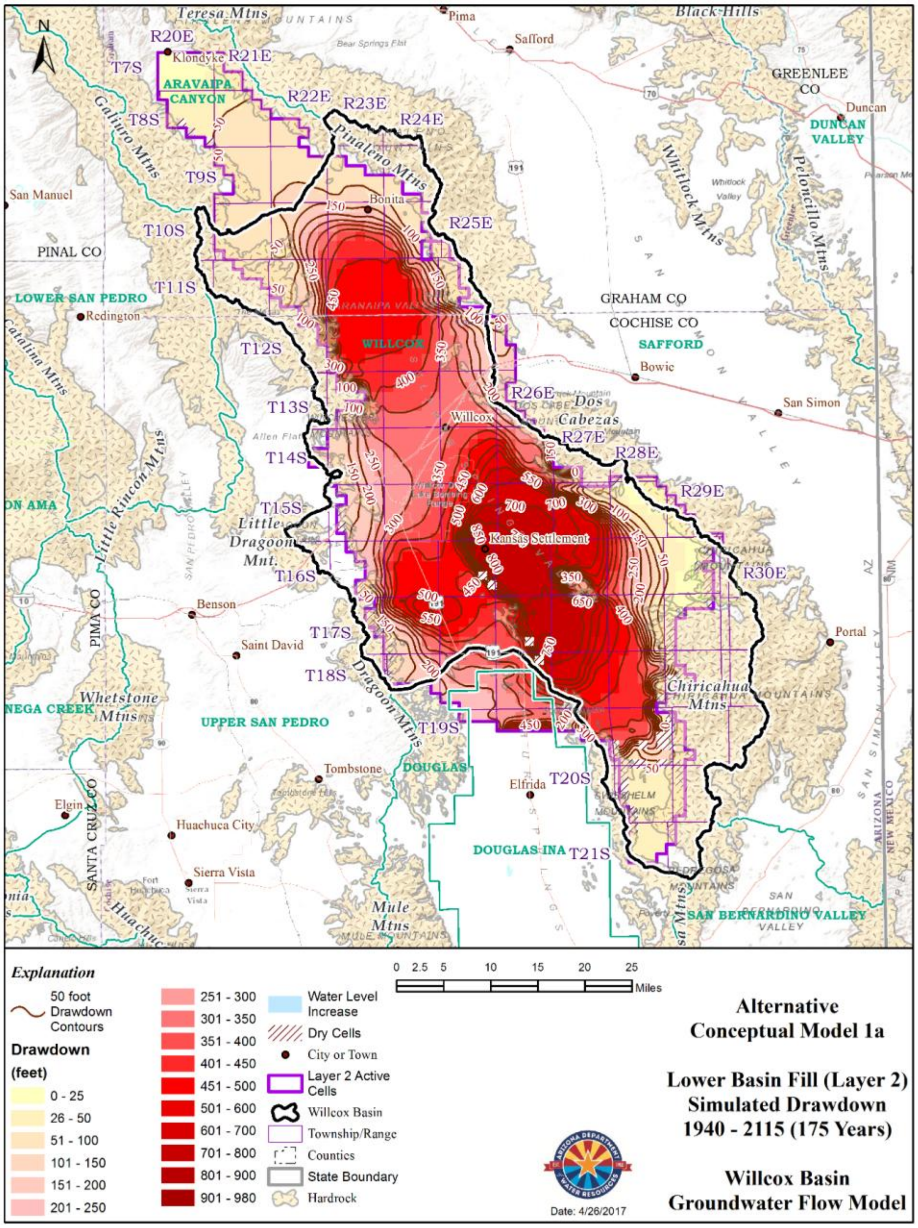

Figure 15. Simulated lower-basin fill drawdown for the period 1940-2115 (ADWR 2018, p. 76).

Industry

Groundwater demand by industrial facilities is another threat to *C. w. sulfontis.* Recent and current industrial demands in the Willcox Basin include one large dairy, cattle and hog feedlots, grazing, mining, sand and gravel facilities, power plants, turf, meat processing facilities, manufacturing plants, greenhouses, and one natural gas pipeline compressor station (ADWR 2023, p. 6). The largest consumers by sub-sector are dairy (2,779 acre-feet, "AF"), power (3,398 AF) and mining (2,237 AF). Power plants include the Apache Generating Station, a mixed gas and coal facility on the southwestern shore of Willcox Playa, and two solar power plants (Ibid, p. 5-6). However, a significant amount of acreage has also been identified as available for development at or directly adjacent to the Willcox Playa under the Bureau of Land Management's Western Solar Plan (Figure 16), and a project known as the BrightNight Three Sisters Solar Project has been proposed just south of the Playa (BrightNight 2025, p. 1-3). According to the project proponent, the project will operate "without added burden to public systems such as water" but no further details are provided (Ibid, p. 1-2). The mining water usage reported by ADWR comes from one major copper mine (ADWR 2023, p. 7).

By far the greatest potential change in water demand is projected to come from mining industry growth (3,739 AF in 2023 to 13,488 AF in 2075), followed by dairy industry growth (2,953 AF in 2023 to 5,085 AF) (Table 1). Figure 17 shows mining claims within approximately 10 miles of the Playa. Of particular concern are the lode claims (MLRS lead file number AZ105836035), just north of Walnut Wash, a couple of miles west of the Playa. Walnut Wash was described by Schreiber et al. 1972 (p. 149) as draining onto the northwest corner of the Playa.

Table 1. Projected industrial water demand volumes (AF) from 2023-2027 (ADWR 2023, p. 14).

	Dairy			Feedlots			Mining			Power			Turf		
	2023	2049	2075	2023	2049	2075	2023	2049	2075	2023	2049	2075	2023	2049	2075
Status Quo	-1131	-1131	-1131	-222	-222	-222	-1342	-1342	-1342	-3446	-3446	-3446	-280	-280	-280
Climate	-2431	-2442	-2453	-448	-450	-452				-3402	-3509	-3615	-282	-283	-284
Conservation	-2431	-1767	-1767	-452	-367	-367							-282	-273	-273
Technology										-3325	-1248	-308			
Growth	-2953	-5085	-5085				-3739	-13488	-13488	-3415	-3663	-3935			

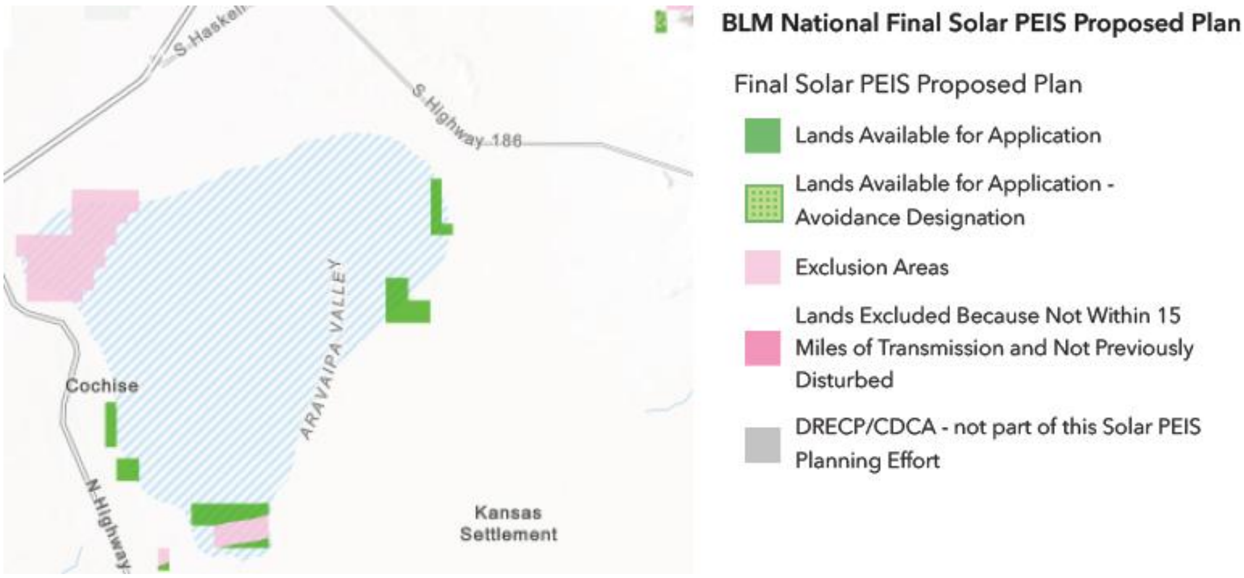

Figure 16. Lands available for utility-scale solar energy development (BLM 2024a, *entire*).

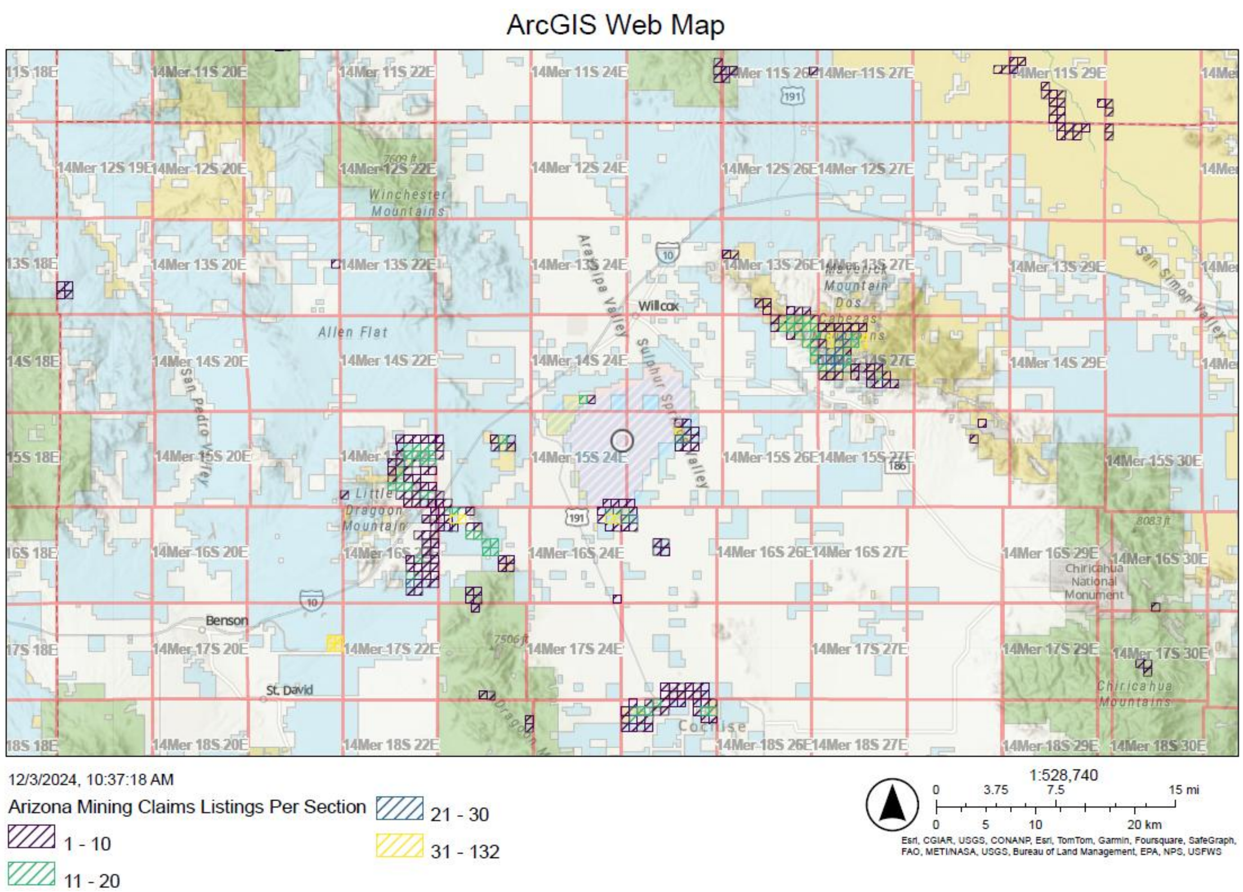

Figure 17. Mining claims near Willcox Playa mapped by the Claims Location Array Interactive Map Service (C.L.A.I.M.S.) using Bureau of Land Management (BLM) Mineral & Land Records System data[4].

3. Lithium production

According to Max Power Mining Corp., Willcox Playa was described by the U.S. Geological Survey (USGS) in 1976 as one of the most prospective locations for undiscovered lithium brines and most similar to the currently exploited brine field in Clayton Valley, home to Albermarle's Silver Peak Brine Operation (Max Power 2023a, p. 1-2):

*Airborne electromagnetic prospecting by the USGS identified a 22 sq. mile high electrical conductivity anomaly at the Willcox Playa. The USGS interpreted this anomaly to be caused by a subsurface brine field hosted in sediments beneath the dry Willcox Playa surface. The combination of a gravity survey showing a closed gravity low coincident with the zone of high electrical conductivity reinforces the concept that an accumulation of brine could be present beneath the Willcox Playa. This is reinforced by there being no obvious hydrological outlet that would allow the accumulated brines to escape the Willcox Playa. High evaporation rates relative to precipitation in this desert environment suggests the brine could have become increasingly concentrated over time (*Ibid, p. 2-3).

In 1978, the USGS also drilled a reverse circulation drill hole (USGS W-1) on the Playa and found lithium contents in clays in excess of 500 ppm (Ibid, p. 3). Potential source rocks for the lithium at the Willcox Playa identified by Max Power are the felsic volcanics in the Three Sisters Buttes to the southeast (Figure 18), and those located to the northwest of the Playa as they are very similar to the Three Sisters Buttes (Ibid). The proposed hydrological flow lines from the source rocks to the Willcox Playa are shown in Figure 18.

[4] Webmap available at: https://experience.arcgis.com/experience/4a3b9406973e47d7aa5cf476500e7298/ (accessed December 2024).

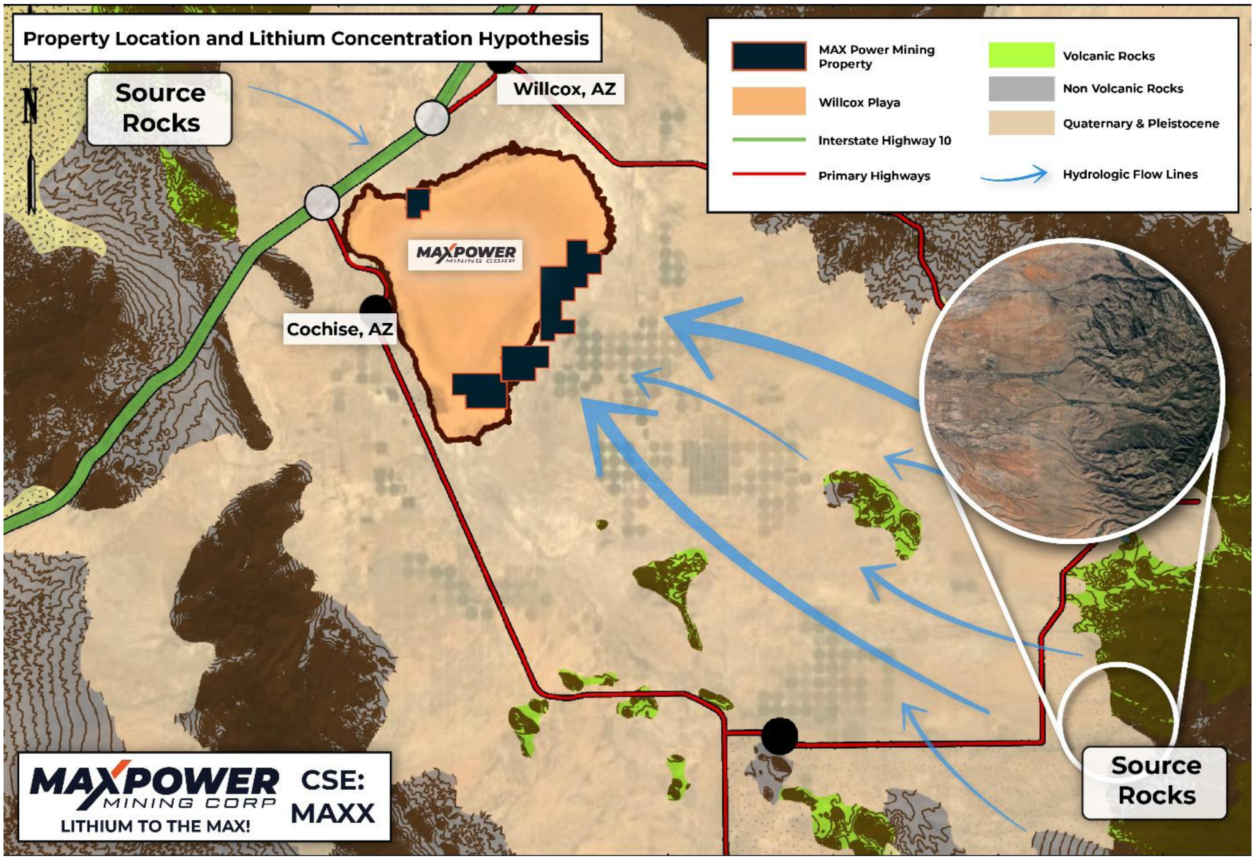

Figure 18. Proposed source rocks and model for lithium concentration at the Willcox Playa (Max Power 2023a, p. 4).

As of April 2023, Max Power had acquired 82 claims on BLM land in the northwestern and southern parts of the Playa, three mineral exploration permits for exploration on state land on the eastern side of the Playa (Max Power 2023a, p. 4), and three exploration permits in what appears to be state land north of the Playa (Ibid, p. 4; Acuna 2024, p. 2). Based on claims data extracted from BLM (BLM 2025a), there are currently over 160 placer and lode claims, with case dispositions of active, under review or filed, at or directly adjacent to the Playa. Included in this group of claims are 10 active placer claims directly in or around the main site where *C. w. sulfontis* is known to occur (Figure 19). The vast majority, if not all, of the claims, including all of the ones in and around the *C. w. sulfontis* main site, are owned by Max Power[5].

[5] Ownership of the claims was determined by matching the case serial numbers in BLM 2025a with the serial numbers in BLM 2025b. BLM 2025a includes all the claims at, or directly adjacent to, the playa (the latter as defined in Figure 3). It does not include ownership (claimant) information. BLM 2025b includes all the mining claims assigned to Max Power Resources LLC as extracted from Mining Claims – Customer Info Report (available at: https://reports.blm.gov/report/MLRS/103/Mining-Claims-Customer-Info-Report/ and accessed 23 January 2025), selecting for Admin State = AZ, Claimant Name is equal to/is in = Max Power Resources LLC, Case Disposition = All Column Values, County contains any = Cochise. However, BLM 2025b appears not to capture all of the Max Power Resources LLC mining claims since some claims (e.g. case serial number AZ105824440) in BLM 2025a are identified as belonging to the company when searching for the case serial number in BLM 2025c. Mining Claims -

In general, placer claims are used to locate lithium brine deposits while lode claims are used to locate lithium clay or hardrock resources (NDOM 2023, p. 2). However, it has also been argued that sedimentary lithium clay deposits can be properly located as placer mining claims (Ameriwest Lithium 2021, p. 2). A non-mineral specific definition is provided by the BLM (BLM 2024b, p. 2). In July 2023, Max Power announced that it had identified multiple high-priority drill targets from the northernmost claims to the southernmost, and that it was targeting both an aquifer domain with potential high brine volume at Willcox and coincidental claystone mineralization (Max Power 2023b, p. 1). In April 2024, the company announced "the discovery of near-surface lithium-rich clays over a broad area of state-leased ground in first-ever diamond drilling at the Willcox Playa in southeast Arizona" (Max Power 2024, p. 1), and that "the entire Playa [...], is now believed to be prospective for a potentially very large lithium deposit" (Ibid), with the next drill holes planned "for the southern portion of the Property where the largest and most intense low resistivity anomaly has been detected, overlain by a very low gravity anomaly" (Ibid). The company also, however, suggested that the potential for lithium extraction from brines was yet to be determined (Ibid, p. 2), and there is a cooperative research and development agreement between the company and the University of California Lawrence Berkeley National Laboratory to develop "state-of-the-art direct lithium extraction (DLE) technologies for brine resources" (Ibid). Thus, both pumping of lithium-laden brines and surface mining of clays are currently foreseeable as the lithium extraction method.

Serial Register Page (SRP) (available at: https://reports.blm.gov/report/MLRS/108/Mining-Claims-Serial-Register-Page-SRP- , accessed 24 January 2023). Hence, we are unable to provide an exact estimate of the number of claims owned by Max Power at, or directly, adjacent to Willcox Playa.

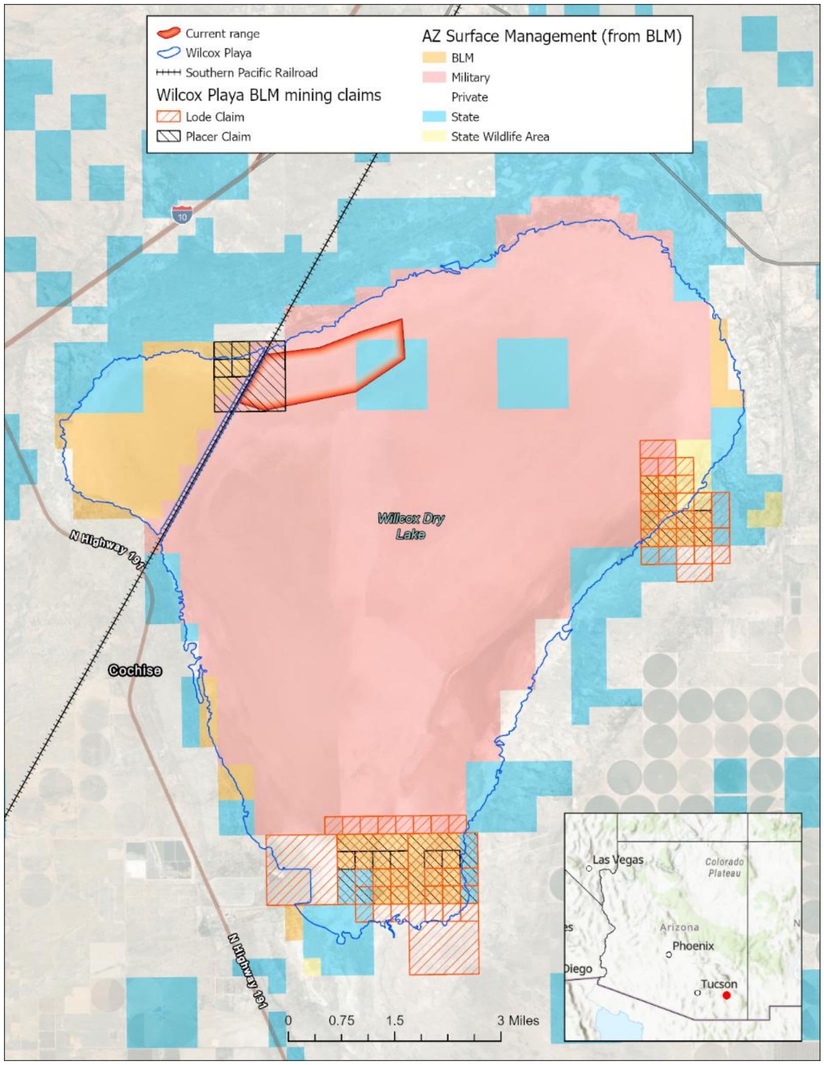

Figure 19. Mining claims at or directly adjacent to the Willcox Playa. The claims are those provided in BLM 2025a and mapped using GIS software. The Playa boundary and surface management data are as in Figure 3.

<u>Surface mining of clays</u>

There are currently no examples of commercial mining of lithium in clays, except for Thacker Pass which is under construction (see below). Lithium is extracted exclusively from hard-rock ores and continental brines (Tabelin et al. 2021 and USGS 2021 as cited in Vera et al. 2023, p. 150). However, as described in a recent report by The Nature Conservancy (TNC), surface mining removes rocks or clays at the land surface to expose, recover, and extract lithium-containing materials (Parker et al. 2022, p. 16). Mining of lithium from hard rock and clay may lead to impacts that are well-documented for strip mining and open-pit mining, including physical disturbance of soils and vegetation; air emissions and deposition; stream sedimentation;

potential contamination of soils, sediments, and ground and surface waters (Parker et al. 2022, p. 8 and references cited therein). The report further notes how when rocks are unearthed and crushed, they can release toxic materials that contaminate the air, soils, surface and groundwater resources (Parker et al. 2022, p. 17). Roasting and acid leaching processes are another specific potential source of contamination (Parker et al. 2022, p. 17 and May et al. 1979 cited therein).

Other well-documented impacts of strip mining and open pit mining as identified in Parker et al. 2022 include groundwater and surface water depletion (Schomberg et al. 2021 as cited in Parker et al. 2022, p. 8). Groundwater may be used for a variety of purposes, including dust control, processing and dewatering (Parker et al. 2022, p. 9), which is required when a pit extends below the water table to keep the mine dry (Bozan et al. 2022, p. 1). Thacker Pass, the first commercial scale mining project set to extract lithium from clays, will involve an open pit averaging 300 ft in depth (Lithium Americas 2024, p. 1), dewatering of the pit (BLM 2020, p. 2-4), and pumping of up to 1.7 billion gallons per year (Western Watersheds Project 2024, p. 4).

The severity of the mining impacts on *C. w. sulfontis* will ultimately depend on the details of the mining operation and the siting of the mine. While the recent exploration activity has been focused on the eastern and southern parts of the Playa, there are active mining claims in and around *C. w. sulfontis* habitat and surface mining typically requiring hundreds if not thousands of acres (Parker et al. 2022, p. 69). Drilling by the USGS was also conducted near the center of sec. 34, T. 14 S., R. 24 E (Vine et al. 1979, p. 3), which is approximately within the main site where *C. w. sulfontis* is known to occur, further pointing to the potential for lithium recovery in this part of the Playa. Conversion of the main known habitat of *C. w. sulfontis* to an industrial site would likely lead to extinction of this species. Mining even in the vicinity of the habitat could result in severe population declines given the aforementioned potential for groundwater depletion (and subsequent effects on soil moisture), as well as air, soil, and water contamination. Changes in soil pH and salinity may for example negatively impact *C. w. sulfontis* oviposition (Cornelisse and Hafernik 2009, p. 501 and Knisley 1984 and Hoback et al. 2000 cited therein). Due to the seasonal flooding at the Willcox Playa, mining operations would, moreover, undoubtedly divert surface water to protect the mine, further disrupting the area's natural hydrological regime. Surface mining on claims located in the eastern or southern parts of the Playa is likely to be less impactful but is still a significant concern primarily because groundwater pumping may cause drawdown of groundwater levels over a large area, intercepting groundwater beneath the main known habitat of *C. w. sulfontis*. Moreover, since only a generalized stratigraphic sequence has been established for the Willcox Groundwater Basin (Job et al. 2023, p. 5), impacts may be more severe than current modelling suggests (see section on Agriculture).

<u>Lithium extraction from brine</u>

As reviewed in Vera et al. 2023, the evaporitic technology currently used to extract lithium from continental brine deposits involves the use of open-air evaporation to concentrate the brine.

Brines are pumped from underground reservoirs into open air ponds, where over 90% of the original water content is lost through evaporation. Concentrated brines are subsequently transferred to a refining plant for further processing (Vera et al. 2023, p. 150-151). Due to brines being in dynamic equilibrium with their surroundings, pumping of brines has the potential to provoke an increase in recharge from underground freshwater towards brine deposits and affect surface water levels and the water table in the surrounding soil (Vera et al. 2023, p. 153 and references therein). Freshwater is also consumed during multiple process steps post-pumping (Vera et al. 2023, p. 151 and references therein).

As further described in Vera et al. 2023, Direct Lithium Extraction (DLE) technologies aim to address the environmental and techno–economic shortcomings of current practice by avoiding brine evaporation (Vera et al. 2023, p. 1). Instead, the aim of DLE is to capture lithium through one of many proposed technologies, including ion exchange resins, thermally assisted processes, electrochemical methods, among others (Ibid, p. 3). A general schematic is provided in Figure 20. Only one full-scale facility, involving ion exchange, is currently in operation (Garrett 2004 as cited in Vera et al. 2023, p. 159).

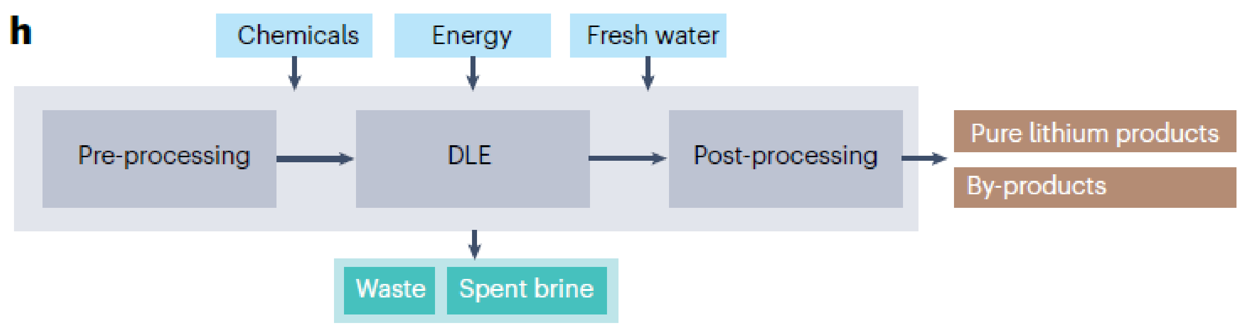

Figure 20. General scheme of DLE as part of an overall processing strategy (adapted from Vera et al. 2023, p. 154).

While the water consumption associated with DLE has the potential to be less than that of traditional evaporitic methods, there are many potential concerns, and a summary of these is presented in Vera et al. 2023. Freshwater inputs are, for example, essential in some DLE technologies, with some academic papers reporting freshwater requirements of over 500 m^3 per tonne Li_2CO_3, over 10 times greater than that used in current practice. The one full-scale DLE facility, active at Salar del Hombre Muerto (Argentina) since 1996, also uses 200% and 50% more water than standard evaporitic technologies in Salar de Olaroz (Argentina) and Salar de Atacama (Chile) respectively. Moreover, for any DLE technology that produces an effluent solution that is not concentrated enough, further concentration will need to occur either with evaporation ponds (and consequent water loss), or high-energy ancillary complementary technologies (Vera et al. 2023, p. 157).

Another concern is the fate of spent brine, which many researchers and technologists propose to reinject underground. While this would in theory significantly reduce the local water footprint, there may be issues associated with feasibility due to dilution of the resource. For example, a rapid interference between reinjection wells and production wells can be seen in 80% of cases in geothermal fields (Vera et al. 2023, p. 156 and references therein). If the brine is reinjected in a different location to avoid interference, then it is not clear that this would lead to recovery of groundwater levels in areas where these were initially drawn down. According to Vera et al. 2023, reinjection also puts back lithium-depleted brine that likely contains exogenous chemical species from brine processing (Vera et al. 2023, p. 157). Thus, there is some risk that the soil chemistry in the habitat of *C. w. sulfontis* would be altered due to reinjection, and there is the risk that soil moisture would decline due to groundwater depletion, particularly if lithium is extracted from the northwestern part of the Playa. Declines in soil moisture have been linked to extraction of lithium-containing brines in Chile's Atacama Salt Flat (Liu et al. 2019, p. 1-2), and lithium production there has also been linked to the decline in abundance of two endemic globally threatened Flamingo species, driven in part by declines in surface water (Gutiérrez et al. 2022, p. 7-8).

4. Off-road vehicles

Searching the web readily reveals that Willcox Playa is used for off-road vehicle (ORV) travel, with the Willcox Chamber of Commerce and Agriculture (WCCA) writing that the "playa can be used for off-roading, camping, jogging, bird watching, paragliding and more" (WCCA 2024, p. 3). Off-roading can cause direct mortality to adults of *C. w. sulfontis*, crush larval burrows that would disrupt normal feeding activity, and lead to habitat fragmentation and degradation. As reviewed in Assaeed et al. 2019, off-road vehicles can cause compaction of soil pores due to their large mass and therefore reduce the ability of soils to absorb and retain water (Assaeed et al. 2019, p. 1187 and references therein). ORV traffic has also been reported to alter soil texture, increase soil bulk density, induce changes in soil electrical conductivity and pH, and reduce soil organic matter (Assaeed et al. 2019, p. 1188 and references therein). These changes in soil properties have the potential to negatively impact the ability of *C. w. sulfontis* to oviposit and build burrows, and to find prey as the latter may depend on specific soils and the plants they support. Other plant-related impacts include plant crushing and uprooting, as well as spread of invasive plants (Assaeed et al. 2019, p. 1188 and references therein). Vehicular routes and their microhabitats are a primary pathway for plant invasions into arid and semi-arid ecosystems (Ibid). ORVs can also release gasoline and motor oil into soils and waters as a result of inefficient combustion and emissions (Havlick 2002 as cited in Taylor, n.d., p. 2), leading to further habitat degradation.

While the impact of ORV traffic on *C. w. sulfontis* has not been studied directly, there is evidence in the literature of negative impacts to other beetles: in the Algodones Dunes of southern California, beetle population declines have been attributed to a reduction in the vegetation that provides the essential larval food source, as well as loss of individuals from crushing by off-highway vehicles and compaction of the soil surface (Knisley et al. 2017, p. 8 and Van Dam & Van Dam, 2008 cited therein). In southwestern Utah, Knisley et al. 2017 found that compaction and moisture provide the cohesive sand required for *Cicindela albissima* larvae to maintain burrows during development. However, compacted sand, soil moisture and vegetation supporting larval prey were for the most part absent in heavy OHV-use areas (Knisley et al. 2017, p. 1).

5. Water and air pollution

Pollutants associated with developed land uses around the Playa, may spread to *C. w. sulfontis* habitat through run-off and aerial drift. The approximately 74,000 acres of dedicated farmland in the Willcox Basin (ADWR 2023, p. 3) implies significant usage of pesticides which can dissolve into runoff and spread with the winds. Pesticides have been proposed as a factor contributing to the decline of the endangered *Cicindela nevadica lincolnian,* with recent research suggesting that tiger beetles are susceptible to two widely used pesticides at levels 100–1000 times lower than have been shown to impact insect pollinators (Svehla et al., 2023, p. 1-2). Other sources of pollution include vehicle traffic and the Apache generation station, which emits, among other pollutants, sulfuric acid and heavy metals (EPA 2024, p. 3). Railroad tracks also cross the Willcox Playa, which means that leaks from freight trains are another potential source of pollution.

6. Invasive species

Invasive saltcedar (*Tamarix ramosissima*), Russian thistle (*Salsola tragus*), and various grasses (e.g.; Bermuda grass [*Cynodon dactylon*], stinkgrass [*Chlorus virgata*], and soft-feather pappusgrass [*Enneapogon cenchroides*]) occur around the Playa perimeter (NASA 2019, p. 33). If invasive plants begin encroaching into *C. w. sulfontis* habitat, these may displace the native vegetation necessary to support an already limited prey base.

7. Other

Habitat disturbance associated with army or space exploration activities are a potential threat. Willcox Playa was, for example, a contender for NASA's Starliner crew module landing and recovery (NASA 2019, p. 1). *C. w. sulfontis* may be sensitive to sounds and vibrations associated with such activities (e.g. sonic boom caused by landing), in addition to any direct mortality or habitat degradation (see Ibid, p. 36). While infrequent, these activities are a potential threat given the tiger beetle's restricted range and small, likely declining, population.

B. Disease or Predation

Disease and predation are not known to be major threats to *C. w. sulfontis* but early studies found larvae experienced 24-29% parasitism from a beefly (Anthrax) (Knisley 1987, p. 1198).

C. Overutilization

Like all tiger beetles, especially rare ones, *C. w. sulfontis* is likely to be highly sought after by collectors. This is an obvious threat and could definitely impact the population because of its small numbers and very localized range.

D. Inadequacy of Existing Regulatory measures

The majority of Willcox Playa and most of the main known habitat for *C. w. sulfontis* is on land leased by the US army (AZGFD 2025a, p. 1) (Figure 19).

The northwestern corner of the Playa west of the railroad tracks has been designated by the BLM as an Area of Critical Environmental Concern (ACEC) in part due to the presence of "rare, endemic insects" (BLM 1991, p. 447) (Figure 21). However, the associated Resource Management Plan (RMP) protections only partially address threats to *C. w. sulfontis*. There is a prohibition against off-highway vehicle use, and the ACEC is being managed as a Visual Resource Management Class II area (Ibid, p. 448). Here, management activities that "attract the attention of the casual observer" are prohibited (BLM 2025d, p. 2), which could in theory include a lithium extraction operation. However, since the mining claims on the northwest side of the Playa overlap the ACEC, this is clearly not the case. The ACEC is also next to, but not in, the main known habitat of *C. w. sulfontis*.

At the federal level, the Playa is also recognized as a National Natural Landmark (NNL). The National Park Service (which administers the NNL program) describes the Willcox Playa NNL as containing a rich fossil pollen record of the pluvial periods of the Pleistocene, the greatest diversity of tiger beetles in the United States, and as a night-time roosting area for 4,000-8,000 sandhill cranes (NPS 2025a, p. 1). However, the purpose of the NNL program is to recognize and encourage the conservation of sites that contain outstanding biological and geological resources, (NPS 2025b, p. 1), which means it is not a regulatory mechanism.

At the state-level, there is no formal conservation program for tiger beetles as the Arizona Game and Fish Department (AZGFD) does not have statutory authority over insect species (AZGFD 2022, p. 9). There is also no mention of tiger beetles in AZGFD's Wildlife Conservation Strategy (AZGFD 2022, *entire*), and while the Heritage Data Management System includes tiger beetles, theirs is not a comprehensive list and does not include *C. w. sulfontis*. Moreover, the purpose of the database is to provide information on different species (AZGFD 2025b, *entire*). Willcox Playa is also included in AZGFD's Willcox Playa and Cochise Lakes Conservation Opportunity

Area (COA) (AZGFD 2025a, p. 1) and Arizona's Important Bird Areas Program (Arizona Important Bird Areas Program 2025a, p. 1). However, COAs "should be considered voluntary guidance for specific areas where conservation efforts would be most effective" (AZGFD 2025c, p. 1), while IBA designations are similarly non-regulatory (Arizona Important Bird Areas Program 2025b, p. 1).

A final designation of relevance to the conservation of *C. w. sulfontis* is the December 2024 designation of the Willcox Groundwater Basin as an Active Management Area (AMA). Each AMA has a management goal that guides water management in the AMA and there is a prohibition on irrigation of new lands (ADWR 2024b, p. 1). However, water may continue to be withdrawn for irrigation and non-irrigation uses where grandfathered rights exist, and ADWR may issue new groundwater permits (for a limited period of time) for non-irrigation uses such as mineral extraction and metallurgical processing, drainage and dewatering, and general industrial use (Ibid, p. 2). Thus, significant groundwater pumping can continue to occur in AMAs. In the Phoenix AMA, some water users have continued or increased groundwater usage, with the result that groundwater demand has not decreased, affecting progress towards the area's management goal (ADWR 2025e, p. 1-2). Moreover, the primary purpose of AMAs is to safeguard groundwater resources for human use (ADWR 2025f, p. 1). In the Willcox AMA, the draft management goal is "To support the long-term viability of the regional economy, mitigate land subsidence, and extend the life of the aquifer by reducing groundwater overdraft by at least 50% by 2075" (ADWR 2025g, p. 2). Thus, while *C. w. sulfontis* may benefit from the designation of the WGB as an AMA as the latter does bring some water use restrictions, the AMA designation alone is entirely inadequate to ensure the survival and recovery of *C. w. sulfontis*.

Figure 21. Willcox Playa National Natural Landmark ACEC (BLM 2024c, *entire*).

E. Other factors

1. Climate change

Temperatures in Arizona have increased by about 2.5°F since the beginning of the 20th century. The first 21 years of this century have been the warmest period in the state since records began (Frankson and Kunkel 2022, p. 3). Precipitation is highly variable from year to year, but has been below average since 1995, with 17 of the last 26 years experiencing below average precipitation (Ibid, p. 2-3). Annual monsoon precipitation is also highly variable but has been below average since 2000, except for 2010 to 2014, which was above average. The monsoon season in 2020 was the driest on record. Based on the Palmer Drought Severity Index for Arizona, there have been periodic prolonged wet and dry periods from the year 1000 to the year 2020, with the current long-term drought lasting more than 20 years (Ibid, p. 4).

Figure 22 shows the intensity of drought in Cochise County (which includes Willcox Playa and most of the WGB) over the past ~20 years. Drought categories represent “experts’ assessments of conditions related to dryness and drought including observations of how much water is available in streams, lakes, and soils compared to usual for the same time of year" (NOAA and NIDIS 2024a, p. 1). Based on this data, the last 20 years have been extremely dry, with the likely result that soil moisture at the Playa has declined, resulting in reduced survival of *C. w. sulfontis*. These drought conditions are also consistent with the decline in surface water shown in Figure 4.

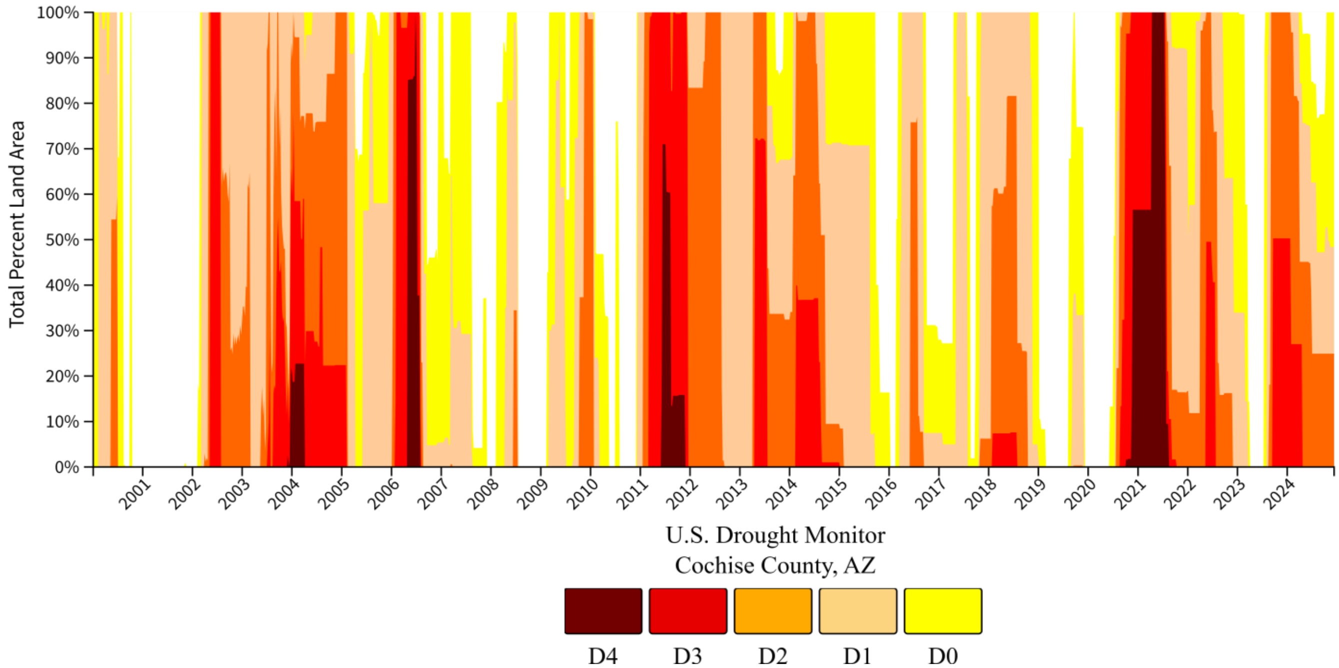

Figure 22. Historical drought conditions for Cochise county as depicted by the U.S. drought monitor (NOAA and NIDIS 2024b, p. 10). D0, "abnormally dry", corresponds to areas that may be going into or coming out of drought. D1-4 corresponds to four levels of drought: moderate, severe, extreme, exceptional (Ibid, p. 2, 10).

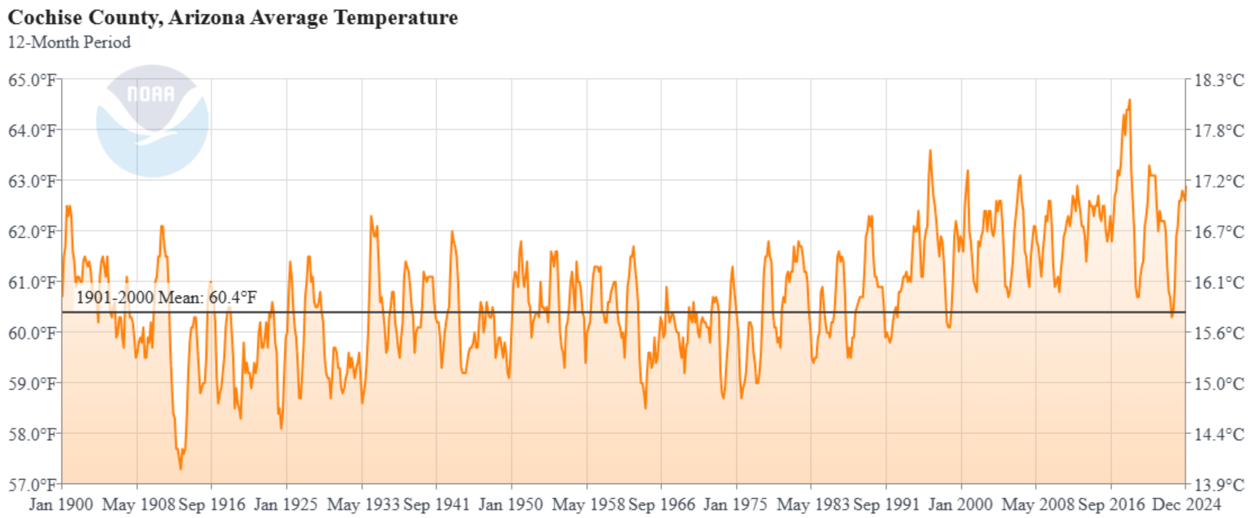

Figure 23. Average temperature (over a 12-month period) from 1900 to 2024 in Cochise County (NOAA 2025, p. 1).

While the exact role of precipitation in driving drier conditions in Cochise County is unclear[6], temperatures have been increasing since the beginning of the 20th century, consistent with state-level trends (Figure 23). Rising temperatures in turn increase the atmosphere's evaporative demand[7], resulting in more water being lost from vegetation and soils. According to Williams et al. 2022, 42% of the current prolonged drought in southwestern North America can be attributed to anthropogenic climate change and increasing evaporative demand under a warming climate is cited as a key reason (Williams et al. 2022, p. 4). A recent study by the Desert Research Institute also suggests that evaporative demand has been increasing across nearly all of the continental US since 1980, and particularly in the southwest (DRI 2022, p. 2) (Figure 24), driven predominantly by increasing temperatures (Ibid, p. 3). Shown in Figure 25 is one estimate of the actual amount of water lost from vegetation and soils in the WGB since 1983.

[6] Trends in total annual precipitation trends for the Willcox Groundwater Basin as reported by Donnelly et al 2020 (Supplementary Information, p. 24, Figure S14), and for the Willcox Playa, as reported by Job et al. 2023 (p. 10), are not significant. However, precipitation is reported to have decreased in the Pinaleño Mountains (Job et al. 2023, p. 3), and may therefore have decreased in other parts of the Valley as well, potentially impacting groundwater recharge and streamflow towards the Playa. Seasonal trends in precipitation are also unknown.

[7] Defined as "the amount of water that could be transferred from the land surface to the atmosphere, given atmospheric conditions and an unlimited supply of water" (DRI 2022, p. 1).

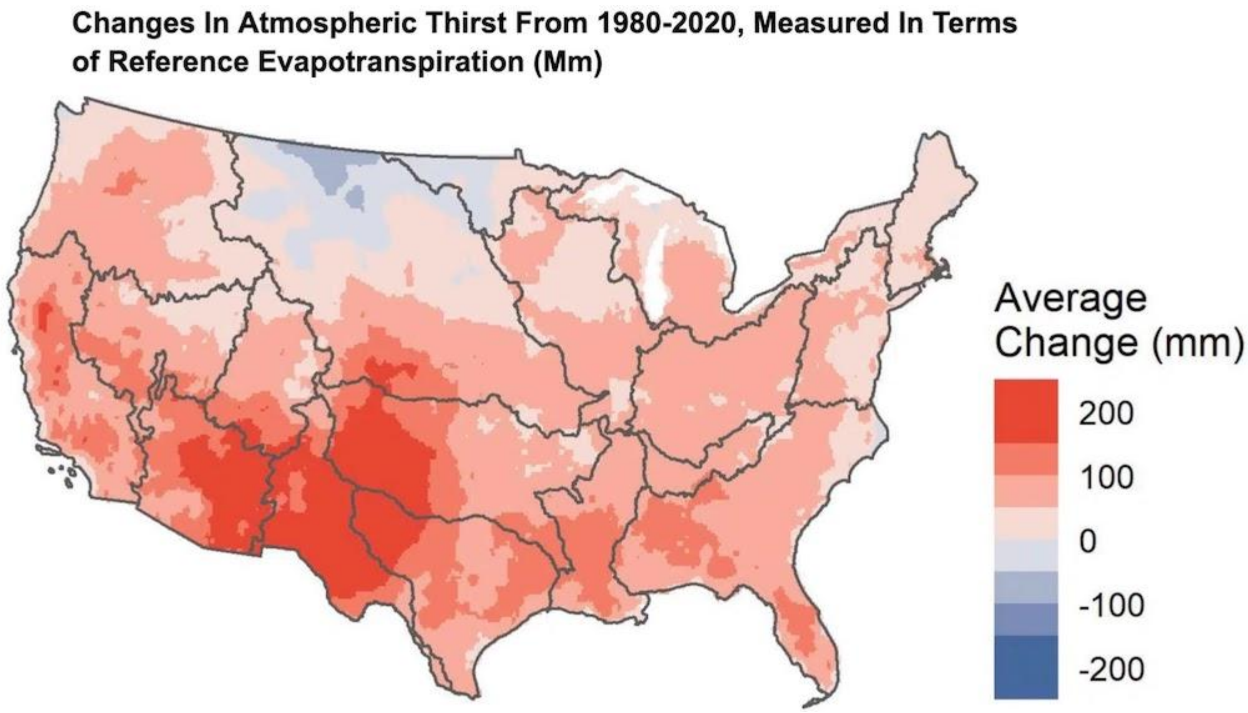

Figure 24. Changes in atmospheric thirst, measured in terms of reference evapotranspiration (mm), from 1980–2020 (DRI 2022, p. 2).

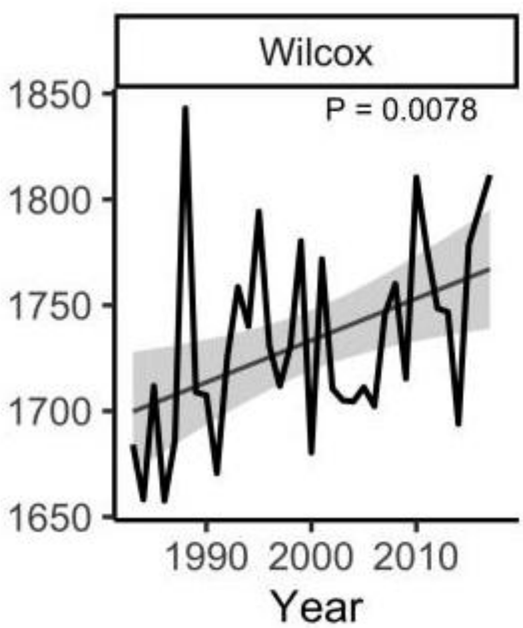

Figure 25. Annual (1983-2018) evapotranspiration (ET, mm) for the Willcox Groundwater Basin. Straight line is least-squares best fit with 95% confidence interval for the slope in grey (adapted from Donnelly et al. 2020, Supplementary Information, p. 42-43, Figure S13).

Under future climate change, trends of increasing evaporative demand are likely to continue and become amplified. Historically unprecedented temperature increases are projected for Arizona during this century under a higher emissions pathway (Frankson and Kunkel 2022, p. 1). The hottest end-of-century projections are about 11°F warmer than the hottest year in the historical record (Ibid). Higher temperatures will intensify naturally occurring droughts by increasing water evaporation, further reducing streamflow, soil moisture, and water supplies (Ibid, p. 5). Higher temperatures may also lead to a cessation of larval activity if soil temperatures are raised such that the voluntary maximum field temperature at the mouth of burrows is exceeded (see Section III). While annual precipitation projections are uncertain, there is additionally a risk of spring precipitation decreasing, more precipitation falling as rain rather than snow and resulting in reduced snowpacks, as well as higher spring temperatures causing earlier melting of the snowpack (Ibid, p. 5). Such changes may disrupt maturation of *C. w. sulfontis* larvae into adults. Climate change is, moreover, projected to increase agricultural demand for groundwater from 190,140 acre-feet in 2023 to 197,532 acre-feet in 2075 (ADWR 2023, p. 12).

2. Small population size effects

The small size of the *C. w. sulfontis* population puts it at risk of extinction due to genetic effects. Small populations tend to lose genetic diversity more rapidly than large populations through genetic drift. A smaller population size also increases the likelihood of interbreeding (Purdue University 2025, p. 1). Another threat to small populations is the random variability in survival and/or reproduction among individuals within a population (Shaffer 1981 as cited in USFWS 2009, p. 19). Individuals vary naturally in their ability to survive and produce viable offspring, but in small populations, reduced reproduction or die-offs of a certain age-class will significantly affect the whole population (USFWS 2009, p. 19). Finally, small populations are more vulnerable than large populations to variations in birth and death rates from one season to the next in response to weather or other factors external to the population (Shaffer 1981 as cited in USFWS 2009, p. 19-20). Given the small size of the *C. w. sulfontis* population, drought in combination with a low population year could potentially lead to extinction.

VI. REQUEST FOR CRITICAL HABITAT DESIGNATION

The Center for Biological Diversity formally requests the Service designate critical habitat for *C. w. sulfontis* concurrently with listing, as required by the ESA (16 U.S.C. 1533(a)(3A)). Critical habitat as defined by Section 3 of the ESA is: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protections; and

(ii) the specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species. 16 U.S.C. § 1532(5).

Critical habitat should include all existing habitat of *C. w. sulfontis* and areas with potential for recovery and determined to be important to the survival and recovery of the species.

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