Arizona Water Protection Fund
Application Cover Page
FY 2026

WPF2607

Title of Project: Upper Aravaipa Creek Watershed Restoration Demonstration Project

Type of Project:
- ☒ Capital or Other
- ☐ Water Conservation
- ☐ Research

Stream Type:
- ☒ Perennial
- ☐ Intermittent
- ☒ Ephemeral

Your level of commitment to maintenance of project benefits and capital improvements:
☐ < 5 years ☐ 5-10 years ☐ 11-15 years ☒ 16-20 years

Applicant Information:

Name/Organization: Aravaipa Watershed Conservation Alliance
Address 1: 36933 W Klondyke Road
Address 2:
City: Willcox
State: AZ
ZIP Code: 85643
Phone: 520-551-2887
Fax:
Tax ID No.: [redacted]

Inside an AMA: Yes ☐ No ☒

If yes, which AMA:
- ☐ Douglas
- ☐ Phoenix
- ☐ Pinal
- ☐ Prescott
- ☐ Santa Cruz
- ☐ Tucson
- ☐ Wilcox

Type of Application:
- ☒ New
- ☐ Continuation

Contact Person:

Name: Garland Speight
Title: Watershed Group Coordinator
Phone: 520-551-2887
Fax:
e-mail: garland@aravaipa.org

Any Previous AWPF Grants:
☐ Yes ☒ No

If yes, please provide Grant #(s):
N/A

Arizona Water Protection Fund Grant Amount Requested:

$43,541.40

If the application is funded, will the Grantee intend to request an advance:
☐ **Yes** ☒ **No**

Matching Funds Obtained and Secured:

Applicant/Agency/Organization:	Amount ($):
1. Applicant	$15,242.98
2.	
3.	

Total: $15,242.98

Has your legal counsel or contracting authority reviewed and accepted the Grant Award Contract General Provisions?
☐Yes ☒No ☐N/A

Signature of the undersigned certifies understanding and compliance with all terms, conditions and specifications in the attached application. Additionally, signature certifies that all information provided by the applicant is true and accurate. The undersigned acknowledges that intentional presentation of any false or fraudulent information, or knowingly concealing a material fact regarding this application is subject to criminal penalties as provided in A.R.S. Title 13. The Arizona Water Protection Fund Commission may approve Grant Awards with modifications to scope items, methodology, schedule, final products and/or budget.

Garland Speight	Watershed Group Coordinator, 520-551-2887
Typed Name of Applicant or Applicant's Authorized Representative	**Title and Telephone Number**
	8/14/2025
Signature	**Date Signed**

UPPER ARAVAIPA CREEK WATERSHED RESTORATION DEMONSTRATION PROJECT
Executive Summary

Aravaipa Canyon is a much loved gem of southeast Arizona. The valley is guarded by the Santa Teresa, Pinaleno, and Galiuro mountains on three sides, which have limited access and human impacts in the watershed. The secluded nature of this area has allowed the natural beauty to flourish, with eight native fish species established in the Canyon. Although there have been historic impacts from mining and grazing, relatively abundant groundwater and stable land cover create reliable, perennial flow through Aravaipa Canyon and abundant natural resources that appeal to a diverse group of stakeholders including ranchers, hikers, birders, and many others.

Founded in 2016, the Aravaipa Watershed Conservation Alliance's (AWCA) primary goal is to sustain and preserve the existing natural features of this region through watershed and rangeland restoration. Local large-scale ranchers, owners of smaller land parcels, and representatives from The Nature Conservancy have all served on the board of directors of the AWCA. Participants in our group include small business owners, large- and small-scale ranchers, and outdoor enthusiasts. Over the past few years, AWCA has built common grounds by developing a stakeholder-focused watershed management plan. This plan built consensus around priority issues (i.e., erosion, water conservation, riparian conservation) and began identifying projects to implement to address these issues.

Continued development and subdivision in our upper watershed, where historic ranches have begun dividing thousands of acres into 10 to 40 acre parcels. As more roads and pads are cut for development, the topography of the watershed is altered, changing the magnitude and flowpath of precipitation runoff. Erosion and sediment transport will increase, leading to channelization of downstream reaches and infill of the creek. These changes will affect watershed function for all stakeholders, from impacts to forage and rangeland for ranchers to reduced habitat for wildlife valued by outdoor recreators. The effects of development are exacerbated by land managers who are not familiar with best practices for working in arid watersheds. AWCA proposes a demonstration project to show local stakeholders relatively simple methods (e.g., rolling dips, contour strips, small rock structures) for addressing common erosion concerns.

If undertaken, this project will demonstrate mitigation methods for common erosion issues, reduce soil erosion, slow runoff, retain storm surges, and develop education resources for local landowners related to these methods. All project plan designs, monitoring data, and construction reports will be made available to the general public to help augment resources available to address the local issues in this watershed. AWCA will host educational workshops and tours to help disseminate this information and lessons learned from the project more widely. Once these conservation methods have been disseminated, we anticipate that community members will implement similar small-scale projects to improve erosion conditions in the upper watershed. By encouraging broader stakeholder participation, AWCA will continue to seek opportunities to implement larger scale projects to improve watershed function and address stakeholder concerns. By working together, the people that love this unique canyon will ensure that the varied agricultural, residential, and natural resources continue to flourish.

UPPER ARAVAIPA CREEK WATERSHED RESTORATION DEMONSTRATION PROJECT
Project Overview

Background

Aravaipa Canyon and the associated watershed (see Figure 1) are well-known amongst ranchers, hikers, birders, and other outdoor recreators for its natural beauty and relatively unaltered natural conditions. Formed by the Galiuro Mountains to the West, the Pinaleno Mountains to the East, and the Santa Teresa Mountains to the East and Northeast, the Aravaipa Valley is only accessible through a pass between the Santa Teresa and Pinaleno Mountains and from the Willcox Valley to the South. Aravaipa Creek drains the Valley, flowing through the spectacular Aravaipa Canyon to the San Pedro River. This relative inaccessibility has contributed to preservation of this natural treasure, though there have been human impacts from mining, ranching, and real estate development.

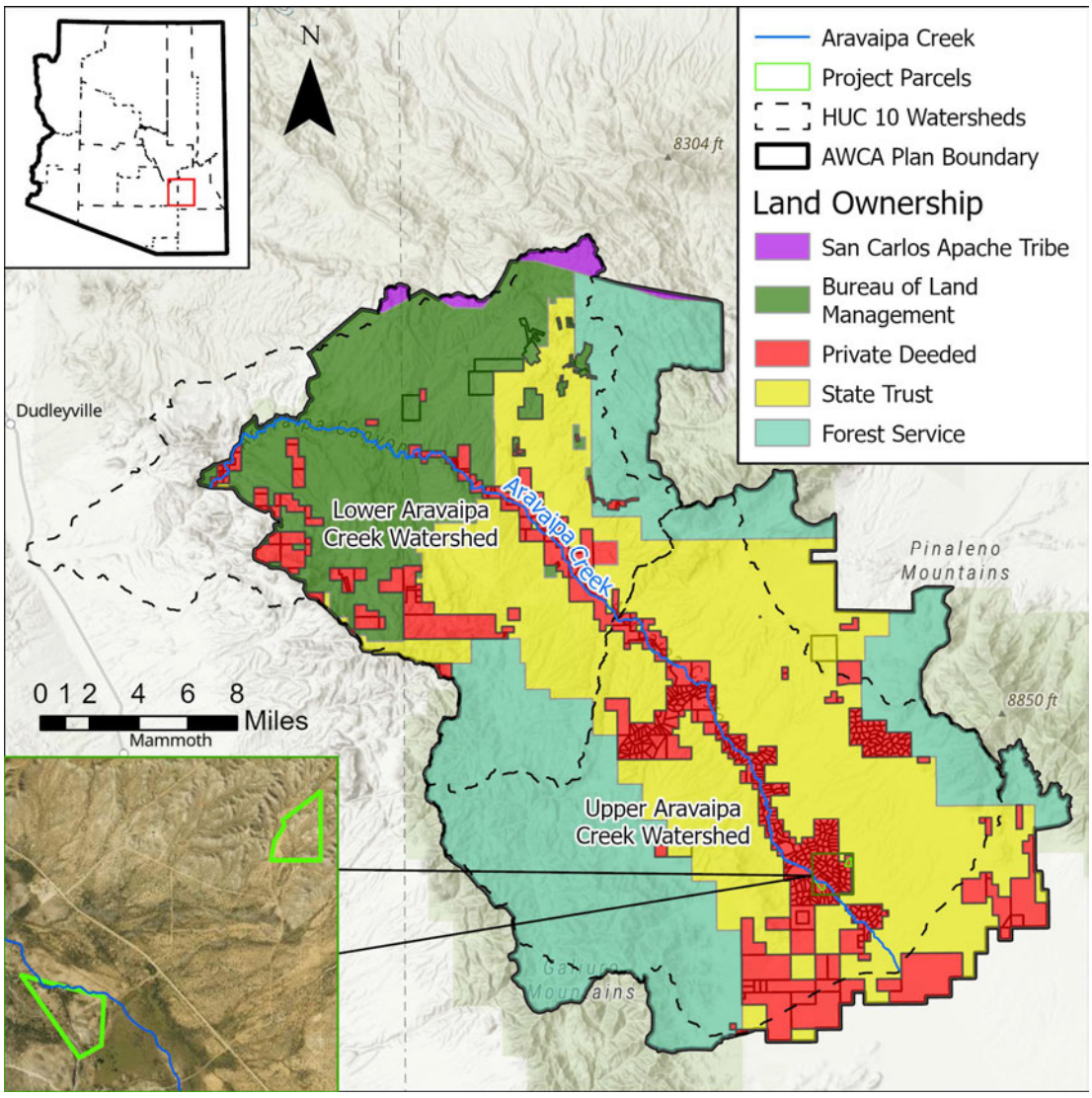


Figure 1: Aravaipa Watershed with Land Ownership and Project Location

As rain falls and snow melts along the fronts of the Galiuro, Pinaleno, and Santa Teresa Mountains, runoff accumulates into rivulets, and streams. As runoff cascades from peak elevations of 8,428 feet in the mountains to the 2,150 ft elevation where the Creek flows out of the wilderness area. These tributaries cut rills, gulleys, washes, and arroyos as they flow from the highlands, collecting at the

bottom of the Valley to form Aravaipa Creek. The Creek flows from the upper watershed in the Southeast to the lower watershed in the Northwest, cutting through mesas and mountains to form Aravaipa Canyon.

As water flows overland to exit the watershed, it also infiltrates the soil and recharges the Aravaipa Canyon Groundwater Basin. The underlying aquifer closely parallels the shape and flow of the surface watershed. Regional geology and confining layers force groundwater flow to the surface slightly downstream from the confluence of Stowe Gulch and Aravaipa Creek. This groundwater flow and geology are largely responsible for the perennial baseflow from the emergence point through Aravaipa Canyon to the Creek's confluence with the San Pedro River. Sediment transport from the upper watershed has caused the emergence point of Aravaipa Creek to gradually shift downstream, contributes to infill of pools and habitat in Aravaipa Canyon, and aggrades the Creek at the confluence with the San Pedro River, potentially driving flow underground.

The remote character of the region, the abundant and naturally occurring surface water, and abundant aquatic and riparian habitat in the Canyon make the Aravaipa Watershed a significant and important refuge for wildlife. The watershed is host to numerous species of birds, fish, and mammals that are important for maintaining biodiversity and valuable resources for outdoor recreators like birders and hunters. Mammals include bighorn sheep, deer, black bear, mountain lion, bobcats, javelina, foxes, coatimundis, and lesser long-nosed bats. There is critical habitat for Chiricahua Leopard Frogs, yellow-billed cuckoo, spikedace, and loach minnow in the Watershed. Aravaipa Canyon is home to eight native fish species (loach minnow, spikedace, roundtail chub, speckled dace, longfin dace, desert sucker, Sonora sucker, Gila topminnow), more than any other stream in Arizona. Though efforts to establish the Gila topminnow and desert pupfish have been met with mixed success. Bird species in the region include yellow-billed cuckoos, Mexican spotted owls, gray hawks, bald eagles, red-tailed hawks, belted kingfishers, vermilion flycatchers, and great blue heron. The lack of paved roads and substantial development in the watershed creates ideal paths for wildlife to transit between the Sky Islands in the Galiuro, Santa Teresa, and Pinaleno Mountains.

Private deeded lands within the Eureka Springs and 76 Ranches has been subdivided into lots ranging from roughly 10 to 40 acres as shown in the southeastern portion of Figure 1. Continued development and future subdivision raise concerns for many factors that impact watershed function. As this land is developed, the density of road and pads in the upper watershed will increase. Roads and pads increase erosion and sediment transport by altering the topographic features of the watershed, frequently redirecting runoff to higher velocity flow paths. Further, soil compaction on roads and pads decreases soil porosity, increasing runoff quantity and velocity compared to undisturbed soil. Additional development is likely to result in increased groundwater pumping. Larger magnitude pumping and reduced infiltration will exacerbate groundwater overdraft, contributing to declining groundwater levels in the upper watershed. These changes have the potential to negatively impact all land uses, including outdoor recreation, agriculture, and local homeowners.

The Aravaipa Watershed Conservation Alliance (AWCA) was founded in 2016 with a mission to preserve and sustain the Aravaipa Valley's natural landscapes by means of watershed and rangeland restoration. The AWCA will create a renewed environment that supports wildlife, grassroots community education, and a holistic agricultural environment. AWCA is an open participation organization, focused on collaborating with all stakeholders, including local landowners, government agencies, and non-governmental organizations. Since our founding, the AWCA Board of Directors have included local large-scale ranchers, owners of smaller parcels, and representatives from The Nature Conservancy. Advisors and volunteers to the AWCA Board of Directors have represented varied interests, including small business owners, large- and small-scale ranchers, and outdoor recreation enthusiasts.

Over our nine years of effort, the AWCA has built substantial momentum through projects like working with the Bureau of Reclamation to obtain enhanced LiDAR data to improve future analysis of surface water hydrology. Recognizing the dearth of local weather data available to stakeholders, AWCA received funding from the United Way of Graham and Greenlee County and installed nine weather stations throughout the watershed. We continue to host hands-on educational erosion-control workshops with funding from the Simpson Foundation to help local landowners and other partners read the signs and causes of erosion and implement small scale rock structures to address some of these concerns. These projects highlight our approach to identify common ground amongst our diverse stakeholders and work to address their questions and issues.

From 2022 to 2023, AWCA developed the Cooperative Watershed Management Plan for Aravaipa Canyon (Watershed Plan). The primary purpose of the plan was to develop and document consensus with community and agency stakeholders around a baseline watershed assessment and priority issues to address within our plan boundary. AWCA contacted all landowners within the watershed, ensuring that as much local knowledge was captured and that our group priorities reflect local interests. Through a broad campaign of workshops, one-on-one interviews, site visits, and surveys, AWCA identified the following shared priorities from our local and agency stakeholders:

1. Mitigating erosion,
2. Water conservation, and
3. Conservation of riparian areas

The overall conclusion of the Watershed Plan assessment is one of tempered optimism. Landscape scale land cover, lower watershed groundwater levels, and baseflows in the perennial reaches of Aravaipa Creek are all relatively stable. Some major impacts of human activity have been mitigated, including the Klondyke Tailings Superfund Site. However, erosion and channelization in the upper watershed have the potential to reduce hydrological function, impacting wildlife habitat and the grasslands that support regional ranching. Further deterioration of conditions in the upper watershed could reduce groundwater recharge and increase material transport downstream with associated negative impacts on baseflow in Aravaipa Creek and impact to animal and plant wildlife habitat in the Canyon.

As part of our ongoing group develop and updates to our Watershed Plan, AWCA has reached the point of planning and implementing projects. During our last Watershed Plan workshop, AWCA identified this funding opportunity to local and agency stakeholders and obtained stakeholder consensus to apply for funding for erosion control projects. At this workshop, AWCA solicited additional project ideas from stakeholders to evaluate for inclusion in this funding application. After a few supplemental site visits, AWCA selected two project sites for this application. These sites were selected after open discussion based on the following considerations:

- The projects will serve as examples to address erosion issues that are commonly seen across the watershed (e.g., gravel road wash crossings)
- The scale of issues is sufficiently small to be accomplished under this funding opportunity
- The projects are entirely located within private property and outside of the floodplain, minimizing compliance requirements and allowing for speedy project implementation

AWCA intends to use this demonstration project to illustrate relatively simple and easy-to-maintain solutions to commonly shared concerns. As developed through our Watershed Plan, these projects enjoy broad community support. Further, by demonstrating our commitment to constructively addressing widely shared concerns with these projects, AWCA will encourage broader participation and excitement for our group.

Goals

1. **Demonstrate Solutions to Common Concerns**. The selected project sites have erosion concerns that are commonly seen throughout the watershed, particularly in developing areas in the upper watershed.
2. **Improve Upper Watershed Conditions.** The project will address erosion concerns near the upper watershed, improving watershed function and conditions.
3. **Continue Building Group Momentum.** Implementing projects will capitalize on AWCA's past successes and help us attract additional interest.

Objectives

Specific, measurable outcomes of the project – first objective having the most important outcomes.

1. **Demonstrate Mitigation Methods for Common Erosion Issues.** By providing access to repeat photography, project plans, long-term monitoring data, site tours for these project sites, AWCA will show local landowners how relatively simple methods can be used to address common regional erosion concerns.
2. **Reduce Soil Erosion.** Implement projects using small rock structures (e.g., Zuni bowls, one rock dams, check dams) and minor topography modifications (e.g., rolling dips) to reduce erosion at two project sites.
3. **Slow Runoff and Retain Storm Surges.** Small rock structures and minor topography modifications will redirect flow and/or create temporary pools, reducing peak runoff magnitude, and extending base flow duration in response to rain events.
4. **Develop Project Implementation Plans.** Perform on-site assessments and measurements with project partners and develop implementation plans (e.g., number/location of structures, local material sources, material delivery needs, monitoring plans) for the two project sites.

Statement of Problems/Causes

Problem 1: Construction of roads and pads and other human activities have exacerbated natural erosion in the upper watershed by altering topography to increase runoff volume, runoff velocity, and rerouting runoff from natural channels. Frequently roads and pads are constructed and maintained by landowners who are unfamiliar with best practices for construction in arid lands.

Problem 2: Degraded conditions in the upper watershed are having impacts on downstream riparian and aquatic habitat. Increased runoff and erosion in the upper watershed and tributaries to Aravaipa Creek contribute to larger magnitude flood events and infill of critical pools and habitat by sediment.

Statement of Solutions

Solution 1: Installation of small rock structures (e.g., one rock dams, check dams, Zuni bowls, media luna) and minor topographic changes (e.g., rolling dips on roads) directly reduces runoff velocity and the capacity of runoff to carry soil particles. Slowing runoff will also serve to extend flow duration in response to precipitation, reducing storm surges and flash floods. Retaining sediment in the upper watershed reduces the negative downstream impacts (e.g., pool infill) of runoff events.

Solution 2: Project sites were selected to demonstrate solutions to common erosion issues facing most local landowners. AWCA will make project data (e.g., project plans, monitoring data, repeat photography) freely available to all stakeholders to help encourage implementation of best practices specific to our region. Techniques selected for implementation (e.g., rock structures, rolling dips) will be simple enough (both in construction and maintenance) to encourage broad stakeholder adoption in mitigating erosion issues.

Statement of Project Years of Benefit to the Resource and General Public

AWCA will make all plan designs, monitoring data (e.g., repeat photography, weather data, soil moisture data) available to the general public to help augment resources available to address the unique condition of the Aravaipa Watershed. AWCA will host educational workshops and tours to help disseminate this information and lessons learned from the project more widely. In addition to the direct reduction in erosion, we expect other community members to implement similar projects once they have seen these techniques demonstrated. This will allow AWCA to build momentum as a group, encouraging broader stakeholder participation as we search for opportunities to implement larger scale projects to improve watershed function and address stakeholder concerns. As an almost 10-year-old organization, AWCA will remain engaged in the region to help provide project partners with advice and assistance for long-term project maintenance and monitoring.

Project Location & Environmental Contaminant Information
FY 2026

Project Location Information

1. County: Graham	2. Section(s): 18	3. Township: 09S	4. Range: 22E,21E

5. Watershed: Upper Aravaipa Creek
6. 8 or 10 Digit Hydrologic Unit Code (HUC) [hyperlink goes to US Geological Survey website]: 1505020304
7. Name of USGS Topographic Map where project area is located: Eureka Ranch, AZ 2021
8. State Legislative District: 19
   (Information available at: https://redistricting-irc-az.hub.arcgis.com/pages/official-maps
9. Land ownership of project area: Site 1: Josh Hardy; Site 2: Monroe Martinez
10. Current land use of project area: Domestic
11. Size of project area (in acres): Site 1: 36 acres; site 2, 52 acres
12. Stream Name: Aravaipa Creek and Unnamed Washes
13. Length of stream through project area: 0
14. Miles of stream benefited: 48 miles
15. Acres of riparian habitat: 0 acres will be:
    - ☐ Enhanced
    - ☒ Maintained
    - ☐ Restored
    - ☐ Created

16. General description and/or delineation for the area of impact of the project within the watershed.
Erosion control structures will be installed in small washes, rolling dips will be installed on a gravel road, and a small section of abandoned gravel road will be reclaimed. Project sites are both located in the upper watershed in ephemeral drainages, near the headwaters of Aravaipa Creek. These restoration actions will reduce sediment and slow runoff events for downstream users, benefiting the full 48 mile length of Aravaipa Creek through the plan boundary.

17. Provide directions to the project site from the nearest city or town. List any special access requirements:
From Willcox, take Fort Grant Road north to the Bonita Klondyke Road. Take the Bonita Klondyke Road north to Gray Bear Road and turn east (site 1) or Iron Hawk Road and turn west (site 2). All routes require extensive travel on infrequently maintained gravel roads, high clearance and AWD/4x4 vehicles are recommended.

Environmental Contaminant Location Information

1. Does your project site contain known environmental contaminants? ☐ **YES** ☒ **NO** If yes, please identify the contaminant(s) and enclose data about the location and levels of contaminants:

2. Are there known environmental contaminants in the project vicinity? ☐ **YES** ☒ **NO** If yes, please identify the contaminant(s) and enclose data about the location and levels of contaminants:

3. Are you asking for Arizona Water Protection Fund monies to identify whether or not environmental contaminants are present? ☐ **YES** ☒ **NO**

UPPER ARAVAIPA CREEK WATERSHED RESTORATION DEMONSTRATION PROJECT
Scope of Work

TASK # 1: Clearances/Permits/Authorizations/Access Agreements

Task Description

AWCA and partners will develop land access agreements between all project partners, review documents with attorneys, and have them finalized. AWCA will work with project partners to obtain and submit documentation of State Historic Preservation Office (SHPO) cultural resource clearance or all documentation necessary to obtain such a clearance, including an archeological survey, if necessary. SHPO clearance must be obtained prior to initiation of any ground disturbing work. Since all ground disturbing activities will occur on private property, outside of flood zones, no additional permitting, clearances, or authorizations are expected to be required.

Task Purpose/Objective

Comply with local, state, and federal permit requirements, environmental laws and ensure legal access to the project area for the project term.

Responsible Personnel

Project Manager (Partners for Dryland Planning)

Deliverable Description

Copies of all necessary permits, clearances, authorizations, and agreements necessary to implement the Scope of Work.

Deliverable Due Date

Prior to the start of any ground disturbing activities.

Task Cost (rounded to the nearest dollar)

$7,980

TASK # 2: Implementation Planning

Task Description

Finalize site-specific plans for number, type, and region for implementation of specific erosion mitigation measures (e.g., Zuni bowls, one rock dams, check dams, rolling dips, contour strips), material procurement needs. Site assessments have already been completed to identify preliminary treatments, and contractors will formalize these in plans. The site-specific plans shall include:

- Maps to scale of the project sites and major construction features
- Sites, approximate number, and size of erosion control structures for installation
- Seeding and revegetation plans, as necessary

- Monitoring plans, including variables to be monitored, frequency of measurement, and methods for collecting data
- Locations and parameters for repeat photography

All plans will be submitted to the AWCA Board of Directors for approval prior to implementation.

Task Purpose/Objective

Implementation plans improve coordination and formalize designs to ensure project success. These plans, monitoring data, and associated photography will be publicly available and shared with stakeholders as examples of how to implement solutions for common small scale erosion problems.

Responsible Personnel

Project Manager (Partners for Dryland Planning)
Restoration Contractors (Stream Dynamics, Inc., San Carlos Apache Tribe)

Deliverable Description

A project implementation plan for each project site.

Deliverable Due Date

Prior to initiation of any applicable subcontracted work.

Task Cost (rounded to the nearest dollar)

$2,520

TASK # 3: Material Procurement

Task Description

Locate, procure, and deliver rock, seeds, plants, and other materials necessary to implement detailed project plans developed in Task #2.

Task Purpose/Objective

Ensure material necessary for project implementation are ready and available.

Responsible Personnel

Project Manager (Partners for Dryland Planning)
Restoration Contractor (San Carlos Apache Tribe)

Deliverable Description

Report to AWCA Board of Directors, including photographs, receipts, material sources, etc.

Deliverable Due Date

Prior to the start of project implementation, expected 7/2026

Task Cost (rounded to the nearest dollar)

$6,899

TASK # 4: Site 1 Construction

Task Description

Implement the erosion control measures from project plan for site 1, including construction of erosion control structures (e.g., one rock dams, Zuni bowls, media luna) and minor topographic changes (contour ploughing, rolling dips). Document work in construction report, including location of treatments, photographs of final construction, and the first round of monitoring data (e.g., repeat photography) as applicable.

Task Purpose/Objective

Implementation of erosion control measures will directly reduce soil erosion, slow runoff, and retain storm surges. Coordinated tours and the publicly available construction reports will provide increased awareness of and demonstrate mitigation methods for common erosion issues.

Responsible Personnel

Project Manager (Partners for Dryland Planning)
Restoration Contractor (San Carlos Apache Tribe)

Deliverable Description

Construction report documenting location of rock structures and other erosion treatments, key characteristics of structures/treatments (e.g., approximate height, width, seeding status), and photographs of structures/treatments. The first instances of repeat photography, including before and after treatment photos, will be included.

Deliverable Due Date

9/2/2026

Task Cost (rounded to the nearest dollar)

$11,739

TASK # 5: Site 2 Construction

Task Description

Implement the erosion control measures from project plan for site 2, including construction of erosion control structures (e.g., one rock dams, Zuni bowls, media luna) and minor topographic changes (contour ploughing, rolling dips). Document work in construction report, including location of treatments, photographs of final construction, and the first round of monitoring data (e.g., repeat photography) as applicable.

Task Purpose/Objective

Implementation of erosion control measures will directly reduce soil erosion, slow runoff, and retain storm surges. Coordinated tours and the publicly available construction reports will provide increased awareness of and demonstrate mitigation methods for common erosion issues.

Responsible Personnel

Project Manager (Partners for Dryland Planning)
Restoration Contractors (Stream Dynamics, Inc.)

Deliverable Description

Construction report documenting location of rock structures and other erosion treatments, key characteristics of structures/treatments (e.g., approximate height, width, seeding status), and photographs of structures/treatments. The first instances of repeat photography, including before and after treatment photos, will be included.

Deliverable Due Date

11/7/2026

Task Cost (rounded to the nearest dollar)

$10,036

TASK # 6: Outreach

Task Description

Coordinate stakeholder tours and volunteer of project sites, prepare newsletters and website updates,

Tours, presentations, photographs, publicity, etc. to show how the project is working and demonstrate techniques for folks. Document lessons learned, coordinate all this stuff. Prepare materials. Share it around.

Task Purpose/Objective

Demonstrate Mitigation Methods for Common Erosion Issues.

Responsible Personnel

Project Manager (Partners for Dryland Planning)
Restoration Contractors (Stream Dynamics, Inc., San Carlos Apache Tribe)

Deliverable Description

Education events, publicity materials, website updates.

Deliverable Due Date

10/31/2026

Task Cost (rounded to the nearest dollar)

$2,352

TASK # 7: Final Report and Oral Presentation

Task Description

Develop and submit report describing project results to date, including results from stakeholder outreach efforts. Compile implementation plans, construction reports as attachments to document work, provide initial rounds of photo evidence.

Prepare submit a comprehensive final report in accordance with AWPF guidelines. Include summary of work done and methodologies, outcomes of tasks, data and data reduction, lessons learned, and evaluation of our work against our objectives. Make all data we gather publicly available unless otherwise restricted and provide directly to State. Make an oral presentation on these subjects to the AWPF commission.

Task Purpose/Objective

Provide comprehensive final report for public distribution that gives detailed description of the project and highlights its benefits to the State of Arizona.

Responsible Personnel

Project Manager (Partners for Dryland Planning)
Restoration Contractors (Stream Dynamics, Inc., San Carlos Apache Tribe)

Deliverable Description

Project final report
Final presentation

Deliverable Due Date

11/9/2026

Task Cost (rounded to the nearest dollar)

$2,016

NOTE: This table is provided as a guide to help develop your project budget and AWPF fund grant request. Feel free to modify this table as needed to accurately describe your proposed budget details.

Arizona Water Protection Fund Grant Application Detailed Budget

Task 1: Clearances/Permits/Authorizations/Access Agreements					
	Quantity	**Unit**	**Unit Cost**	**Total**	**Notes**
Direct Labor Costs					
Direct Labor Subtotal					
Outside Service Costs					
Project Management Contractor	40	Hours	$40.00	$1,600.00	
Archeological Survey	2	Sites	$3,000.00	$6,000.00	
Outside Services Subtotal				**$7,600.00**	
Other Direct Costs					
Other Direct Subtotal					

Capital Outlay, Equipment, Supplies, etc. *NOTE: Any reimbursement requested for costs related to travel, lodging, meals, and/or mileage must comply with the State of Arizona Accounting Manual rates and guidelines.(https://gao.az.gov/state-arizona-accounting-manual-saam)* *Personal vehicle mileage reimbursement is limited to sixty-seven cents (67¢) per mile.*					
Other Direct Subtotal					
Task Subtotal					
Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)				**$380.00**	
			Task 1 Total	**$7,980.00**	
Task 2: Implementation Planning					
	Quantity	**Unit**	**Unit Cost**	**Total**	**Notes**
Direct Labor Costs					
Direct Labor Subtotal					
Outside Service Costs					
Project Management Contractor	60	Hours	$40.00	$2,400.00	

Outside Services Subtotal				**$2,400.00**	
Other Direct Costs					
Other Direct Subtotal					
Capital Outlay, Equipment, Supplies, etc. *NOTE: Any reimbursement requested for costs related to travel, lodging, meals, and/or mileage must comply with the State of Arizona Accounting Manual rates and guidelines.(https://gao.az.gov/state-arizona-accounting-manual-saam)* *Personal vehicle mileage reimbursement is limited to sixty-seven cents (67¢) per mile.*					
Other Direct Subtotal					
Task Subtotal					
Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)				**$120.00**	
			Task2 Total	**$2,520.00**	
Task 3: Material Procurement					
	Quantity	**Unit**	**Unit Cost**	**Total**	**Notes**

Direct Labor Costs					
Direct Labor Subtotal					
Outside Service Costs					
Project Management Contractor	8	Hours	$40.00	$320.00	
Outside Services Subtotal				**$320.00**	
Other Direct Costs					
Rock Material	80	Cubic Foot	$50.00	$4,000.00	Including delivery
High Country Native Grass Seed Mix	50	lb	$45.00	$2,250.00	
Other Direct Subtotal				**$6,250.00**	
Capital Outlay, Equipment, Supplies, etc. *NOTE: Any reimbursement requested for costs related to travel, lodging, meals, and/or mileage must comply with the State of Arizona Accounting Manual rates and guidelines.(https://gao.az.gov/state-arizona-accounting-manual-saam)* *Personal vehicle mileage reimbursement is limited to sixty-seven cents (67¢) per mile.*					
Other Direct Subtotal					

Task Subtotal					
Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)				**$328.50**	
			Task 3 Total	**$6,898.50**	
Task 4: Site 1 Construction					
	Quantity	**Unit**	**Unit Cost**	**Total**	**Notes**
Direct Labor Costs					
Direct Labor Subtotal					
Outside Service Costs					
Restoration Crew	2	Week	$4,790.00	$9,580.00	
Project Management Contractor	40	Hours	$40.00	$1,600.00	
Outside Services Subtotal				**$11,180.00**	
Other Direct Costs					
Other Direct Subtotal					

Capital Outlay, Equipment, Supplies, etc. *NOTE: Any reimbursement requested for costs related to travel, lodging, meals, and/or mileage must comply with the State of Arizona Accounting Manual rates and guidelines.(https://gao.az.gov/state-arizona-accounting-manual-saam)* *Personal vehicle mileage reimbursement is limited to sixty-seven cents (67¢) per mile.*					
Other Direct Subtotal					
Task Subtotal					
Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)				**$559.00**	
			Task 4 Total	**$11,739.00**	
Task 5: Site 2 Construction					
	Quantity	**Unit**	**Unit Cost**	**Total**	**Notes**
Direct Labor Costs					
Direct Labor Subtotal					
Outside Service Costs					
Restoration Crew - Heavy Equipment Trained	1	Week	$8,758.00	$8,758.00	
Project Management Contractor	20	Hours	$40.00	$800.00	

Outside Services Subtotal				**$9,558.00**	
Other Direct Costs					
Other Direct Subtotal					
Capital Outlay, Equipment, Supplies, etc. *NOTE: Any reimbursement requested for costs related to travel, lodging, meals, and/or mileage must comply with the State of Arizona Accounting Manual rates and guidelines.(https://gao.az.gov/state-arizona-accounting-manual-saam)* *Personal vehicle mileage reimbursement is limited to sixty-seven cents (67¢) per mile.*					
Other Direct Subtotal					
Task Subtotal					
Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)				**$477.90**	
			Task 5 Total	**$10,035.90**	
Task 6: Outreach					
	Quantity	**Unit**	**Unit Cost**	**Total**	**Notes**
Direct Labor Costs					

Direct Labor Subtotal					
Outside Service Costs					
Project Management Contractor	56	Hours	$40.00	$2,240.00	
Outside Services Subtotal				**$2,240.00**	
Other Direct Costs					
Other Direct Subtotal					
Capital Outlay, Equipment, Supplies, etc. *NOTE: Any reimbursement requested for costs related to travel, lodging, meals, and/or mileage must comply with the State of Arizona Accounting Manual rates and guidelines. (https://gao.az.gov/state-arizona-accounting-manual-saam)* *Personal vehicle mileage reimbursement is limited to sixty-seven cents (67¢) per mile.*					
Other Direct Subtotal					
Task Subtotal					
Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)				**$112.00**	

			Task 6 Total	**$2,352.00**	
Task 7: Final Report and Oral Presentation					
	Quantity	**Unit**	**Unit Cost**	**Total**	**Notes**
Direct Labor Costs					
Direct Labor Subtotal					
Outside Service Costs					
Project Management Contractor	48	Hours	$40.00	$1,920.00	
Outside Services Subtotal				**$1,920.00**	
Other Direct Costs					
Other Direct Subtotal					

Capital Outlay, Equipment, Supplies, etc. *NOTE: Any reimbursement requested for costs related to travel, lodging, meals, and/or mileage must comply with the State of Arizona Accounting Manual rates and guidelines. (https://gao.az.gov/state-arizona-accounting-manual-saam)* *Personal vehicle mileage reimbursement is limited to sixty-seven cents (67¢) per mile.*					
Other Direct Subtotal					
Task Subtotal					
Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)				**$96.00**	
			Task 6 Total	**$2,016.00**	
Arizona Water Protection Fund Grant Application Fund Request				**$43,541.40**	

NOTE: This table is provided as a guide to help develop your project budget and matching funds / project cost share budget. Feel free to modify this table as needed to accurately describe your proposed budget details.

Matching Funds / Cost Share Budget

Task 2: Design					
	Quantity	**Unit**	**Unit Cost**	**Total**	**Notes**
Direct Labor Costs					
Direct Labor Subtotal					
Outside Service Costs					
Project Management Contractor	60	Hours	$60.00	$3,600.00	In-kind match
Restoration Contractor	2	Site Plan	$2,021.49	$4,042.98	Available project planning funding from Bureau of Reclamation grant
Outside Services Subtotal				**$7,642.98**	
Other Direct Costs					
Other Direct Subtotal					
Capital Outlay, Equipment, Supplies, Per Diem, Travel, etc.					
Other Direct Subtotal					
Task Subtotal					
			Task 2 Total	**$7,642.98**	

Task 4: Site 1 Construction					
	Quantity	**Unit**	**Unit Cost**	**Total**	**Notes**
Direct Labor Costs					
Direct Labor Subtotal					
Outside Service Costs					
Project Management Contractor	60	Hours	$60.00	$3,600.00	In-kind match

Outside Services Subtotal				**$3,600.00**	
Other Direct Costs					
Front End Loader	40	Hours	$40.00	$1,600.00	In-kind match
Other Direct Subtotal				**$1,600.00**	
Capital Outlay, Equipment, Supplies, Per Diem, Travel, etc.					
Other Direct Subtotal					
Task Subtotal					
			Task 4 Total	**$5,200.00**	
Task 5: Site 2 Construction					
	Quantity	**Unit**	**Unit Cost**	**Total**	**Notes**
Direct Labor Costs					
Direct Labor Subtotal					
Outside Service Costs					
Project Management Contractor	40	Hours	$60.00	$2,400.00	In-kind match from Monroe Martinez, owner of Project Site 2
Outside Services Subtotal				**$2,400.00**	
Other Direct Costs					
Other Direct Subtotal					
Capital Outlay, Equipment, Supplies, Per Diem, Travel, etc.					

Other Direct Subtotal					
Task Subtotal					
			Task 5 Total	**$2,400.00**	
				Total Matching	**$15,242.98**

UPPER ARAVAIPA CREEK WATERSHED RESTORATION DEMONSTRATION PROJECT

Project Schematics

Figure 1 shows the location of the project parcels within the watershed, including the USGS National Hydrography Dataset Flow lines. These flowlines show how the project parcels location in the upper watershed contributes to sediment transport and flood flow through practically the full ephemeral and perennial lengths of Aravaipa Creek.

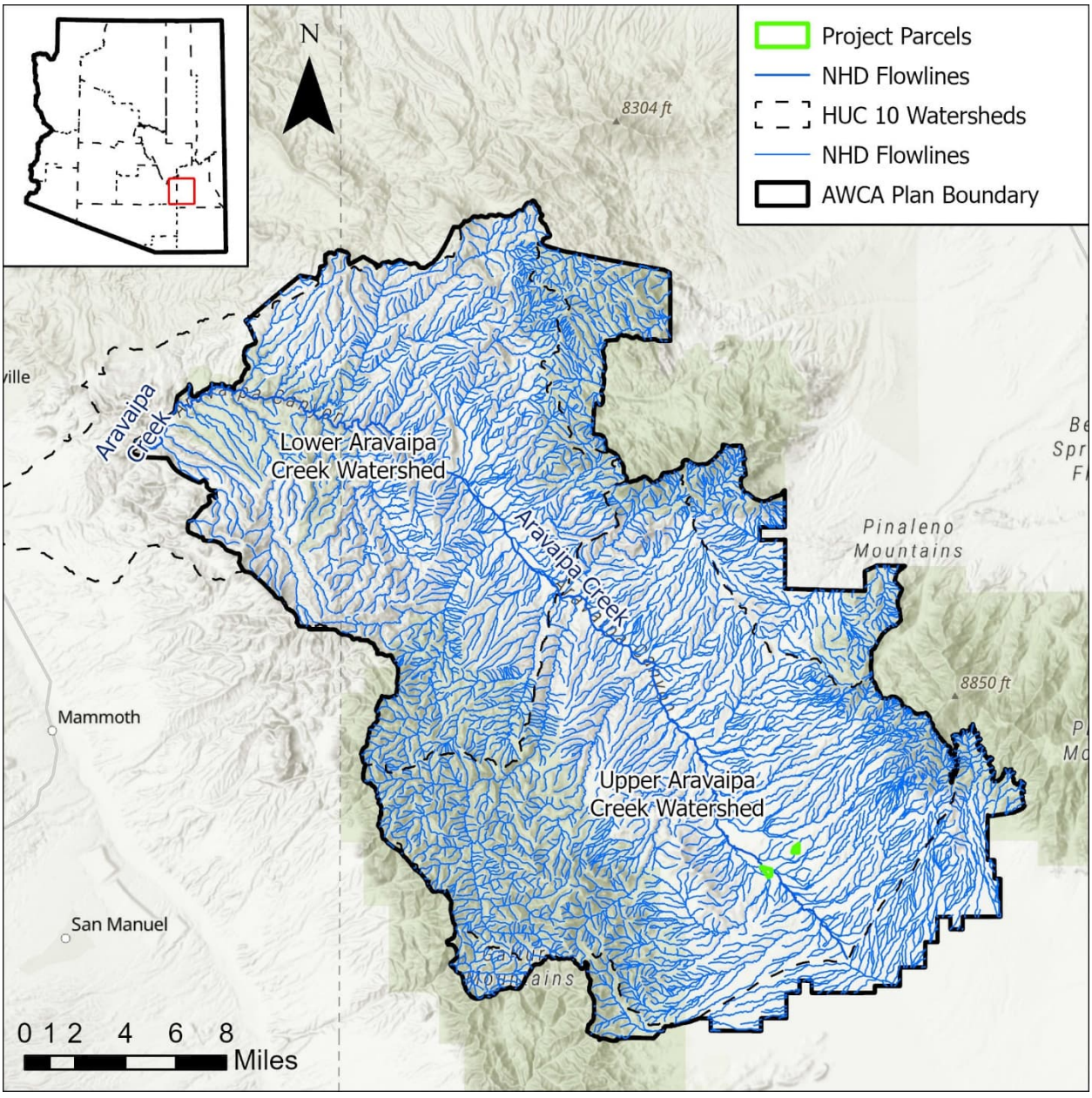


Figure 1: Project Location in Watershed

Site 1:

Figure 2 shows the schematic for Project Site 1, including areas where small rock structures will be constructed to mitigation erosion with associated watersheds and the pad mitigation and rilling areas. Detailed project schematics will be generated as part of Task 2 of this project.

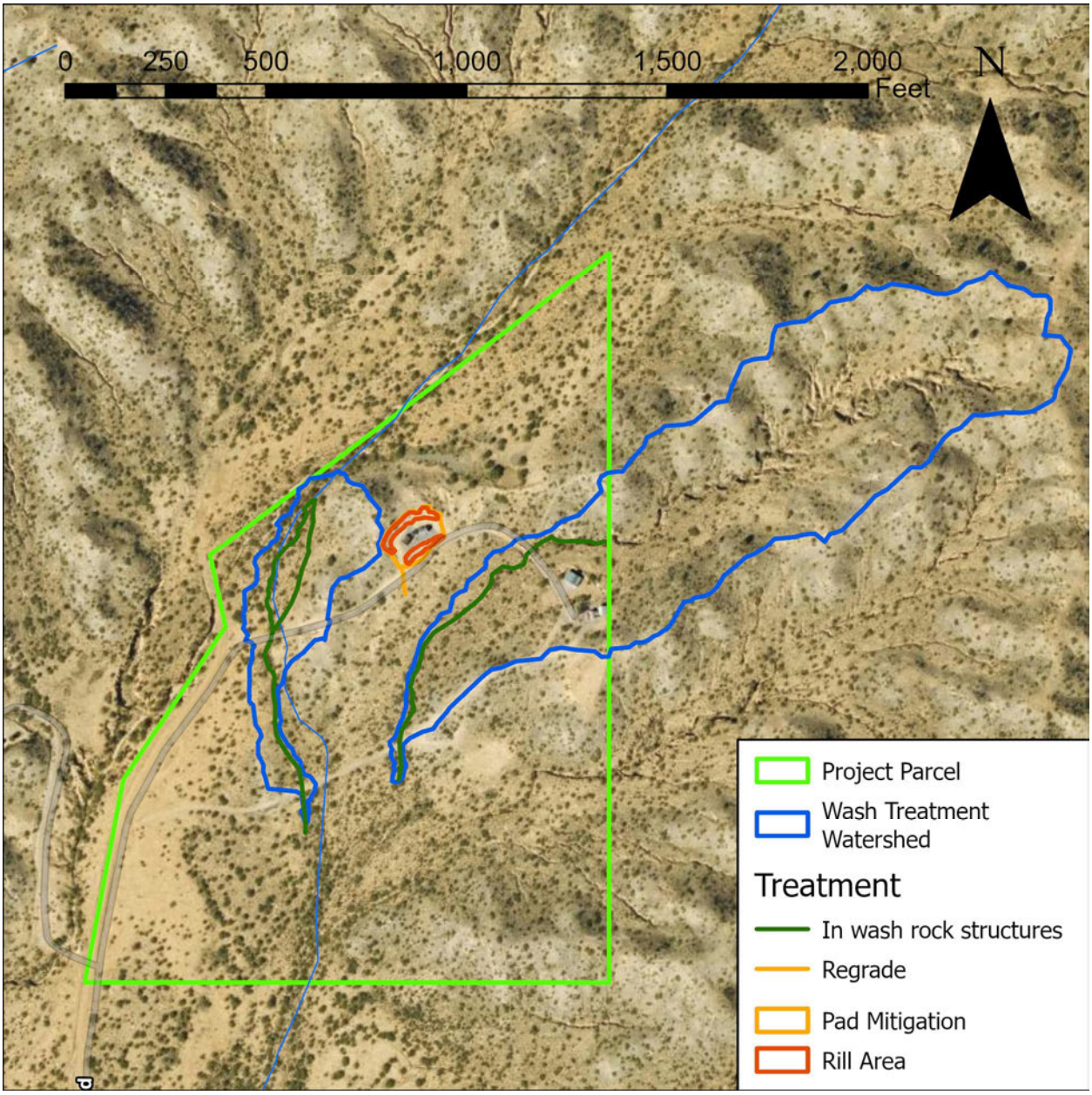


Figure 2: Schematic for Project Site 1

Site 2:

Figure 3 shows the schematic for Project Site 2, including areas where rolling dips and small rock structures will be constructed to mitigation erosion and the section of abandoned road that will be reclaimed. Detailed project schematics will be generated as part of Task 2 of this project.

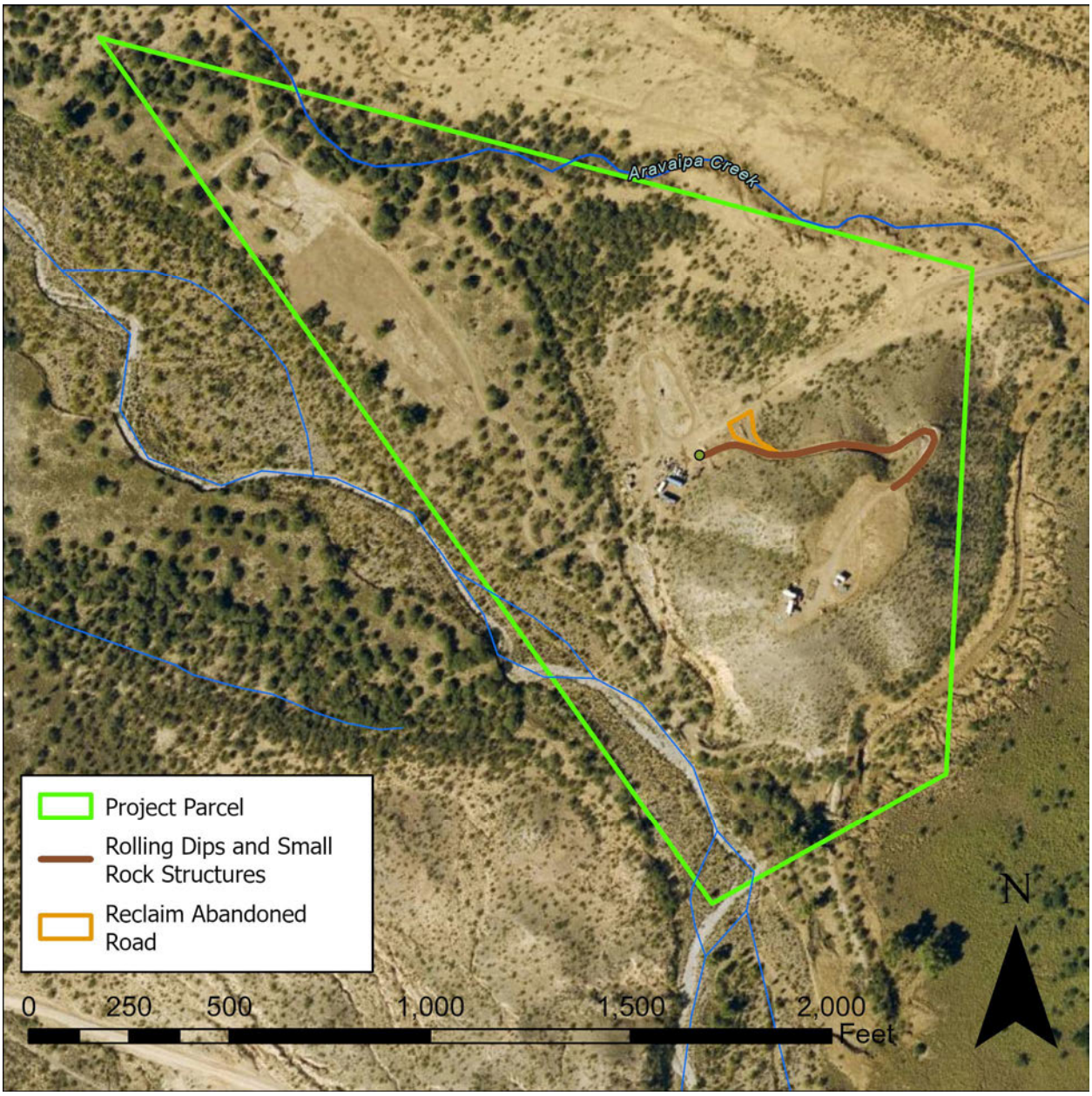


Figure 3: Schematic for Project Site 2

UPPER ARAVAIPA CREEK WATERSHED RESTORATION DEMONSTRATION PROJECT

Project Location and Ownership Maps

Figure 1 shows the location of the project parcels within the Upper Aravaipa Creek Watershed with general categories of land ownership within the watershed for additional context. The project-impacted ephemeral washes that are tributaries to this ephemeral reach of Aravaipa Creek are also shown to illustrate their contribution to sediment transport for the entirety of the Creek, including downstream perennial reaches. The two project parcels are labeled with their parcel numbers.

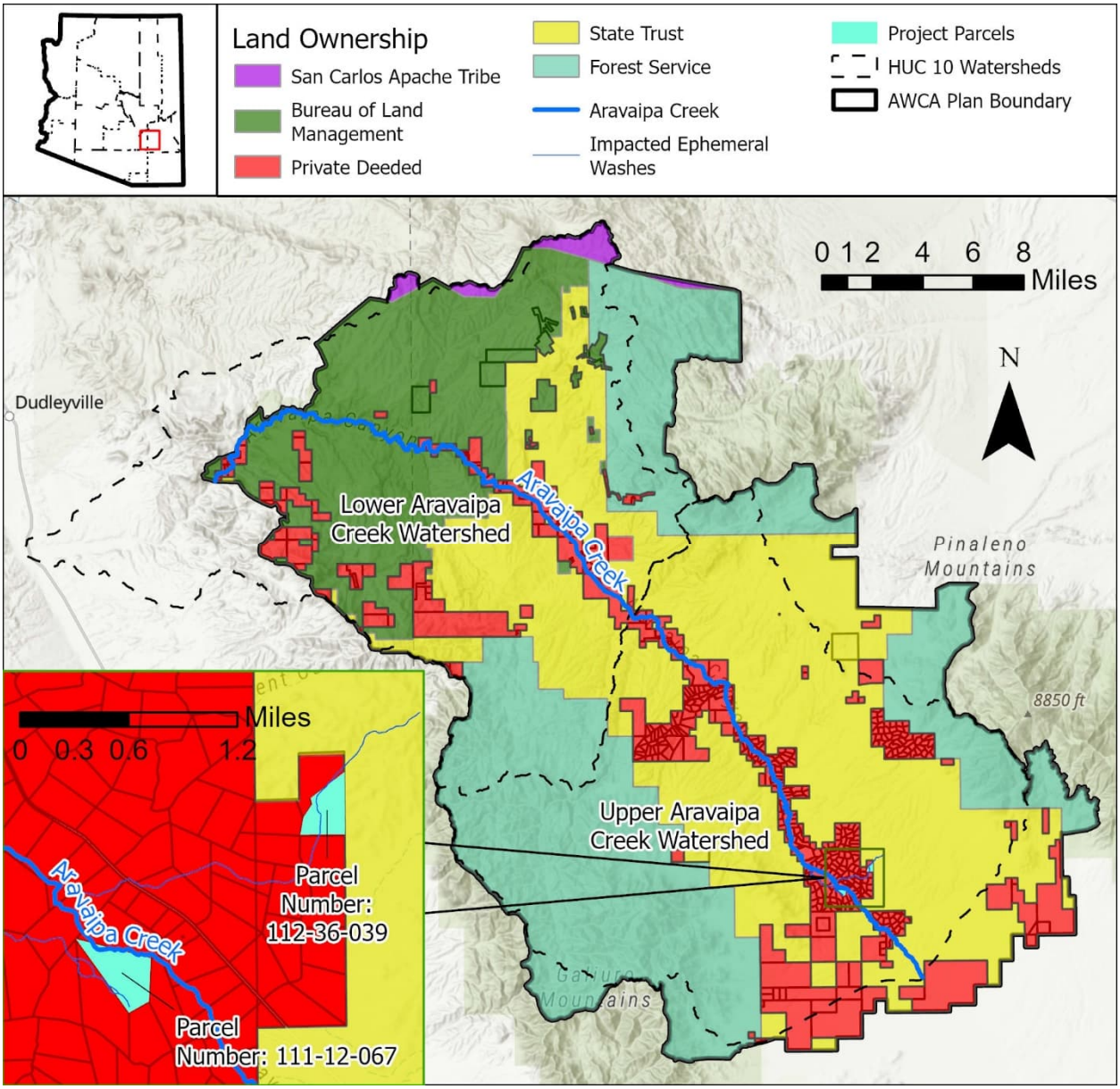
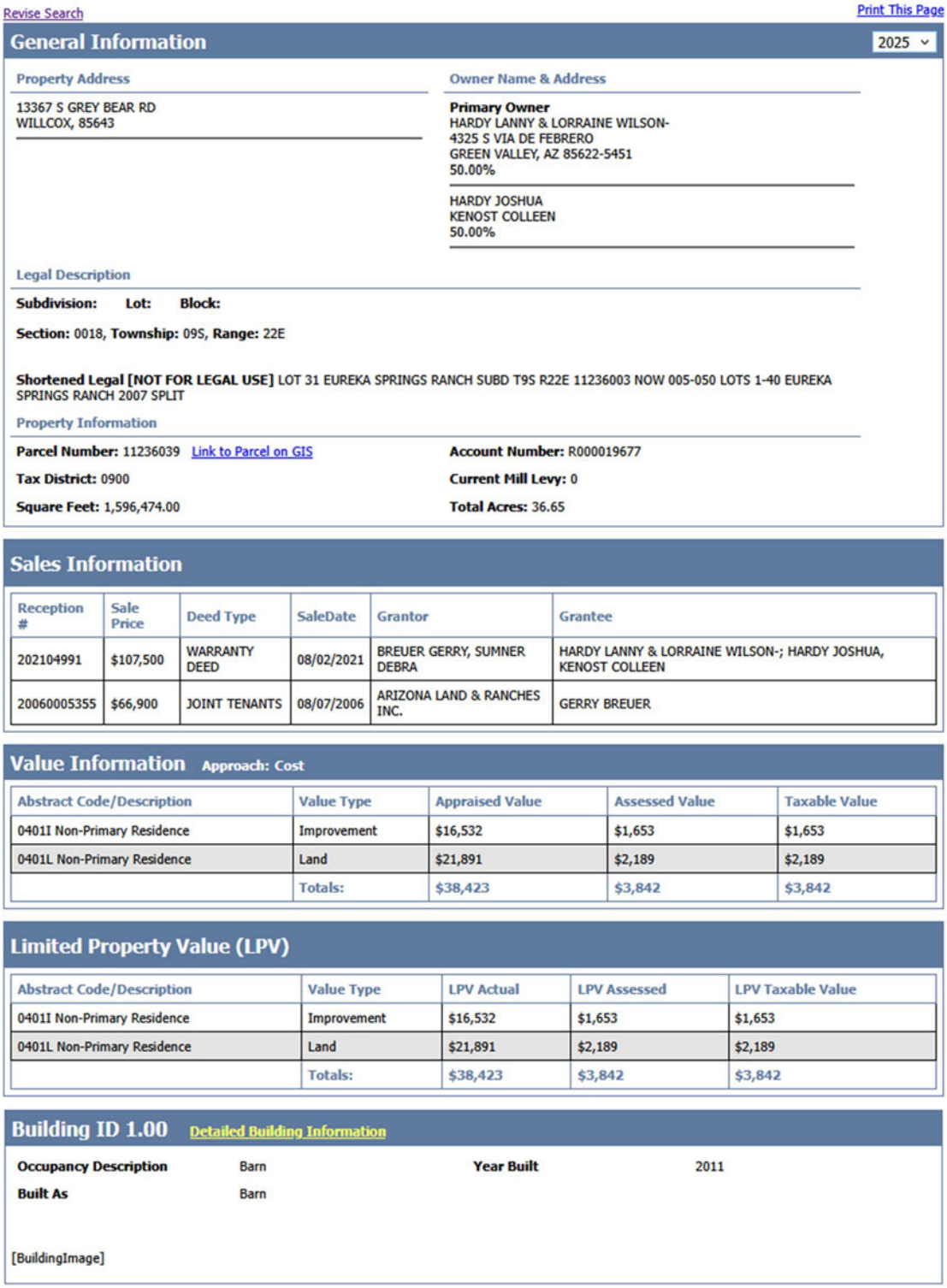


Figure 1: Project Parcels Locations

Both project parcels are located within Graham County. The parcel number for project site 1 is 112-36-039. Figure 2 shows a screen capture of the parcel information for the subject parcel, indicating owners.



Revise Search — Print This Page

General Information — 2025

Property Address

13367 S GREY BEAR RD
WILLCOX, 85643

Owner Name & Address

Primary Owner
HARDY LANNY & LORRAINE WILSON-
4325 S VIA DE FEBRERO
GREEN VALLEY, AZ 85622-5451
50.00%

HARDY JOSHUA
KENOST COLLEEN
50.00%

Legal Description

Subdivision: **Lot:** **Block:**

Section: 0018, **Township:** 09S, **Range:** 22E

Shortened Legal [NOT FOR LEGAL USE] LOT 31 EUREKA SPRINGS RANCH SUBD T9S R22E 11236003 NOW 005-050 LOTS 1-40 EUREKA SPRINGS RANCH 2007 SPLIT

Property Information

Parcel Number: 11236039 Link to Parcel on GIS
Account Number: R000019677
Tax District: 0900
Current Mill Levy: 0
Square Feet: 1,596,474.00
Total Acres: 36.65

Sales Information

Reception #	Sale Price	Deed Type	SaleDate	Grantor	Grantee
202104991	$107,500	WARRANTY DEED	08/02/2021	BREUER GERRY, SUMNER DEBRA	HARDY LANNY & LORRAINE WILSON-; HARDY JOSHUA, KENOST COLLEEN
20060005355	$66,900	JOINT TENANTS	08/07/2006	ARIZONA LAND & RANCHES INC.	GERRY BREUER

Value Information Approach: Cost

Abstract Code/Description	Value Type	Appraised Value	Assessed Value	Taxable Value
0401I Non-Primary Residence	Improvement	$16,532	$1,653	$1,653
0401L Non-Primary Residence	Land	$21,891	$2,189	$2,189
	Totals:	$38,423	$3,842	$3,842

Limited Property Value (LPV)

Abstract Code/Description	Value Type	LPV Actual	LPV Assessed	LPV Taxable Value
0401I Non-Primary Residence	Improvement	$16,532	$1,653	$1,653
0401L Non-Primary Residence	Land	$21,891	$2,189	$2,189
	Totals:	$38,423	$3,842	$3,842

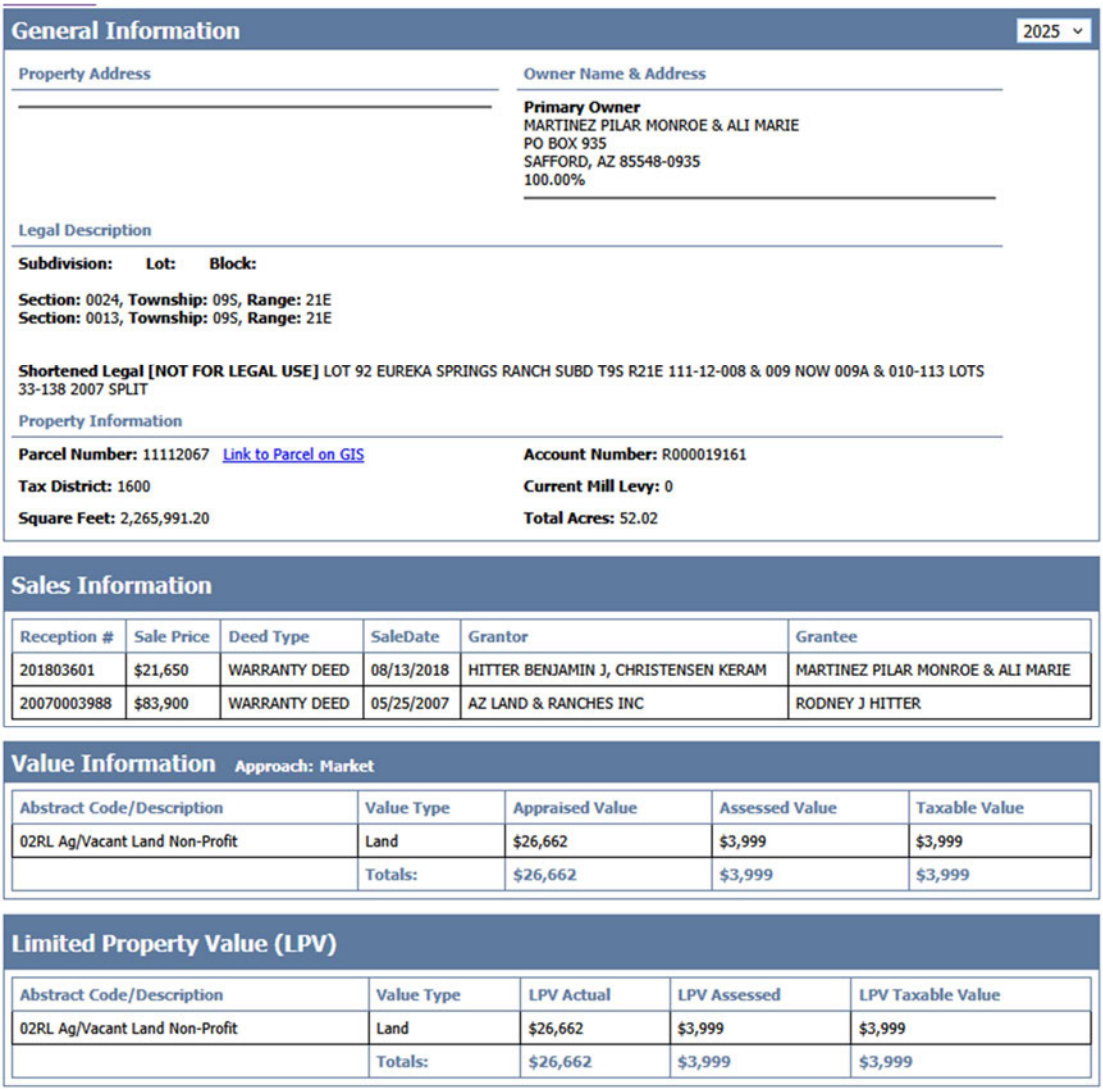
Building ID 1.00 Detailed Building Information

Occupancy Description Barn — **Year Built** 2011
Built As Barn

[BuildingImage]

Figure 2: Graham County Assessor Ownership Information for Parcel 112-36-09

The parcel number for project site 1 is 112-12-067. Figure 2 shows a screen capture of the parcel information for the subject parcel, indicating owners.



General Information 2025

Property Address

Owner Name & Address

Primary Owner
MARTINEZ PILAR MONROE & ALI MARIE
PO BOX 935
SAFFORD, AZ 85548-0935
100.00%

Legal Description

Subdivision: **Lot:** **Block:**

Section: 0024, **Township:** 09S, **Range:** 21E
Section: 0013, **Township:** 09S, **Range:** 21E

Shortened Legal [NOT FOR LEGAL USE] LOT 92 EUREKA SPRINGS RANCH SUBD T9S R21E 111-12-008 & 009 NOW 009A & 010-113 LOTS 33-138 2007 SPLIT

Property Information

Parcel Number: 11112067 Link to Parcel on GIS
Account Number: R000019161
Tax District: 1600
Current Mill Levy: 0
Square Feet: 2,265,991.20
Total Acres: 52.02

Sales Information

Reception #	Sale Price	Deed Type	SaleDate	Grantor	Grantee
201803601	$21,650	WARRANTY DEED	08/13/2018	HITTER BENJAMIN J, CHRISTENSEN KERAM	MARTINEZ PILAR MONROE & ALI MARIE
20070003988	$83,900	WARRANTY DEED	05/25/2007	AZ LAND & RANCHES INC	RODNEY J HITTER

Value Information Approach: Market

Abstract Code/Description	Value Type	Appraised Value	Assessed Value	Taxable Value
02RL Ag/Vacant Land Non-Profit	Land	$26,662	$3,999	$3,999
	Totals:	$26,662	$3,999	$3,999

Limited Property Value (LPV)

Abstract Code/Description	Value Type	LPV Actual	LPV Assessed	LPV Taxable Value
02RL Ag/Vacant Land Non-Profit	Land	$26,662	$3,999	$3,999
	Totals:	$26,662	$3,999	$3,999

Figure 3: Graham County Assessor Ownership Information for Parcel 111-12-067

There is no anticipated water use for this project.

STATE HISTORIC PRESERVATION OFFICE
Review Form

In accordance with the State Historic Preservation Act (SHPO), A.R.S. 41-861 *et seq*, effective July 24, 1982, each State agency must consider the potential of activities or projects to impact significant cultural resources. Also, each State agency is required to consult with the State Historic Preservation Officer with regard to those activities or projects that may impact cultural resources. Therefore, it is understood that **recipients of state funds are required to comply with this law** throughout the project period. All projects that affect the ground-surface that are funded by AWPF require SHPO clearance, **including those on private and federal lands.**

The State Historic Preservation Office (SHPO) must review each grant application recommended for funding in order to determine the effect, if any, a proposed project may have on archaeological or cultural resources. To assist the SHPO in this review, the following information MUST be submitted with each application for funding assistance:

- A completed copy of this form, and
- A United States Geological Survey (USGS) 7.5-minute map
- A copy of the cultural resources survey report if a survey of the property has been conducted, and
- A copy of any comments of the land managing agency/landowner (i.e., state, federal, county, municipal) on potential impacts of the project on historic properties.
  NOTE: If a federal agency is involved, the agency must consult with SHPO pursuant to the National Historic Preservation Act (NHPA); a state agency must consult with SHPO pursuant to the State Historic Preservation Act (SHPA),
  OR
- A copy of SHPO comments if the survey report has already been reviewed by SHPO.

Please answer the following questions:

1. Grant Program: Arizona Water Protection Fund

2. Project Title: Upper Aravaipa Creek Watershed Restoration Demonstration Project

3. Applicant Name and Address: Aravaipa Watershed Conservation Alliance

4. Current Land Owner/Manager(s): Site 1: Josh Hardy; Site 2: Monroe Martinez

5. Project Location, including Township, Range, Section: 18 09S 21E and 22E

6. Total Project Area in Acres (or total miles if trail, fence line, etc.): 8 acres, 2258 ft of stream, 783 feet of road

7. Does the proposed project have the potential to disturb the surface and/or subsurface of the ground?
   ☒ YES ☐ NO

8. Please provide a brief description of the proposed project and specifically identify any surface or subsurface impacts that are expected: Install small rock erosion control structures (e.g., Zuni bowls, one rock dams, check dams, media luna) that require digging small holes/trenches to key into washes and rolling dips in existing gravel roads to reduce erosion and downstream sediment transport. These activities will occur in areas that are either already disturbed or are subject to human-exacerbated erosion. These structures should aggrade to return stream beds to more original levels over time. Additional ground disturbance will be minimized.

9. Describe the condition of the current ground surface within the entire project boundary area (for example, is the ground in a natural undisturbed condition, or has it been bladed, paved, graded, etc.). Estimate horizontal and vertical extent of existing disturbance. Also, attach photographs of project area to document condition: Many of the areas we'll be working are already disturbed (e.g., gravel roads, pads cut for

housing). Some areas have seen accelerated erosion from human activities (e.g., cutting pads, historic overgrazing). These areas will be treated with rock structures and rolling dips. Disturbances of new areas will be minimized.

10. Are there any known prehistoric and/or historic archaeological sites in or near the project area? ☐ YES ☒ NO

11. Has the project area been previously surveyed for cultural resources by a qualified archaeologist? ☐ YES ☐ NO ☒ UNKOWN

    If YES, submit a copy of the survey report. Please attach any comments on the survey report made by the managing agency and/or SHPO

12. Are there any buildings or structures (including mines, bridges, dams, canals, etc.), which are 50-years or older in or adjacent to the project area? ☐ YES ☒ NO

    If YES, complete an Arizona Historic Property Inventory Form for each building or structure, attach it to this form and submit it with your application.

13. Is your project area within or near a historic district? ☐YES ☒ NO

    If YES, name of the district:

Please sign on the line below certifying all information provided for this application is accurate to the best of your knowledge.

_____ /	_____
Applicant Signature /Date	Applicant Printed Name

FOR SHPO USE ONLY
SHPO Finding: ☐ Funding this project will not affect historic properties. ☐ Survey necessary – further GRANTS/SHPO consultation required (*grant funds will not be released until consultation has been completed*) ☐ Cultural resources present – further GRANTS/SHPO consultation required (*grant funds will not be released until consultation has been completed*)
SHPO Comments:
For State Historic Preservation Office: Date:

STATE OF ARIZONA
HISTORIC PROPERTY INVENTORY FORM

Please type or print clearly. Fill out each applicable space accurately and with as much information as is known about the property.

PROPERTY IDENTIFICATION

For properties identified through survey: Site No. _____ Survey Area: _____

Historic Names (e*nter the name(s), if any that best reflect the property's historic importance*):

Address: _____

City or Town: _____ ☐ Vicinity County: _____ Tax Parcel No.: _____

Township: _____ Range: _____ Section: _____ Quarters: _____ Acreage: _____

Block: _____ Lot(s): _____ Plat (Addition): _____ Year of plat (addition): _____

UTM Reference – Zone: _____ Easting: _____ Northing: _____

USGS 7.5' quadrangle map: _____

ARCHITECT: _____ ☐ not determined ☐ known Source: _____

BUILDER: _____ ☐ not determined ☐ known Source: _____

CONSTRUCTION DATE: _____ ☐ known ☐ estimated Source: _____

STRUCTURAL CONDITION

☐ Good (*well maintained; no serious problems apparent*)
☐ Fair (*some problems apparent*) Describe: _____
☐ Poor (*major problems; imminent threat*) Describe: _____
☐ Ruin/Uninhabitable

USES/FUNCTIONS

Describe how the property has been used over time, beginning with the original use: _____

Sources: _____

PHOTO INFORMATION

Date of photo: _____
View Direction (looking towards): _____

Attach a recent photograph of property in this space. Additional photographs may be appended.

SIGNIFICANCE

To be eligible for the National Register, a property must represent an important part of the history or architecture of an area. The significance of a property is evaluated within its historic context, which are those patterns, themes, or trends in history by which a property occurred or gained importance. Describe the historic and architectural contexts of the property that may make it worthy of preservation.

A. HISTORIC EVENTS/TRENDS – *Describe any historic events/trends associated with the property:* _____

B. PERSONS – *List and describe persons with an important association with the building:* _____

C. ARCHITECTURE – Style: _____ ☐ no style

Stories: _____ ☐ Basement Roof Form: _____

Describe other character-defining features of its massing, size and scale: _____

INTEGRITY

To be eligible for the National Register, a property must have integrity (i.e. it must be able to visually convey its importance). The outline below lists some important aspects of integrity. Fill in the blanks with as detailed a description of the property as possible.

Location - ☐ Original Site ☐ Moved: Date: _____ Original Site: _____

DESIGN

Describe alterations from the original design, including dates: _____

MATERIALS

Describe the materials used in the following elements of the property:

Walls (structure): _____

Walls (sheathing): _____

Windows: _____

Roof: _____

Foundation: _____

SETTING

Describe the natural and/or built environment around the property: _____

How has the environment changed since the property was constructed? _____

WORKMANSHIP

Describe the distinctive elements, if any, of craftsmanship or method of construction: _____

NATIONAL REGISTER STATUS (*if listed, check the appropriate box*)

☐ Individually Listed; ☐ Contributor; ☐ Non-contributor to _____ Historic District

Date Listed: _____ ☐ Determined eligible by Keeper of National Register (date: _____)

RECOMMENDATIONS ON NATIONAL REGISTER ELIGIBILITY (opinion of SHPO staff or survey consultant)

Property ☐ is ☐ is not eligible individually.

Property ☐ is ☐ is not eligible as a contributor to a listed or potential historic district.

☐ More information needed to evaluate.

If not considered eligible, state reason: _____

UPPER WATERSHED RESTORATION DEMONSTRATION PROJECT FOR ARAVAIPA CREEK
Key Personnel

Please describe all key personnel and their anticipated responsibilities for this project.

Garland Speight, founder, Partners for Dryland Planning, LLC, currently serves as the Watershed Group Coordinator for the Aravaipa Watershed Conservation Alliance (AWCA). Mr. Speight will act as the project manager for AWCA on this project, responsible for timely submission of all deliverables. Mr. Speight's specific responsibilities will include: managing project schedule and budget, performing outreach activities, assist with developing implementation plans and construction reports, coordinate stakeholder tours, coordinate work with all project partners, performing monitoring, collecting data, and preparing publicity materials.

Van Clothier, founder, Stream Dynamics, Inc., is one of the restoration contractors. Mr. Clothier will act as a crew supervisor, help develop implementation plans and construction reports, and help implement the restoration projects. Although Stram Dynamics, Inc., is based out of Silver City, NM, travel distances to the project sites are similar from Tucson or Phoenix. Further, Mr. Clothier has worked in the Aravaipa Watershed in the past, providing a level of familiarity with the landscape and partners that will ease the implementation of these projects.

David Seibert, watershed ecologist, San Carlos Apache Tribe, would act as crew supervisor and project planner for the second restoration crew. Dr. Seibert will help develop plans, reports, manage schedule and budget for the San Carlos Apache Tribe scope, provide orientation for, train, and supervise volunteers, as necessary.

Please see attached resumes for details of the qualifications for key personnel.

Garland Speight

Experience

Partners for Dryland Planning, LLC *Co-Founder, Co-Owner* *10/2024 to Present*

- Serve as Watershed Group Coordinator for Aravaipa Watershed Conservation Alliance.
- Facilitate development of awarded grant proposals with Watershed Groups like the Sulphur Springs Water Alliance, Tucson Bird Alliance, and Aravaipa Watershed Conservation Alliance.
- Assist developing educational workshops to answer stakeholder questions on diverse subjects, including Active Management Area Regulations for the Sulphur Springs Water Alliance and Potential Mining Impacts for the Lower San Pedro Watershed Alliance.
- Work to develop watershed health indicators for the Lower San Pedro Collaborative, working with diverse stakeholders to identify and develop data sources to inform management decision using the best available science.

Aravaipa Watershed Conservation Alliance *Watershed Group Coordinator* *7/2022 to Present*

- Developed Cooperative Watershed Management Plan, including working with agency and community stakeholders to perform assessments, brainstorming project types and implementation strategies, and communicating results and issues to internal and external stakeholders, including the general public.
- Performed community outreach to document watershed function concerns and capture knowledge.
- Performed research to develop baseline watershed assessment, including literature reviews, interviews, in-field data collection; compile, analyze, and interpret research results into narrative assessment to inform conjunctive management of land, surface water, and groundwater resources.
- Develop GIS hub (https://aravaipa-watershed-conservation-alliance-uagis.hub.arcgis.com/) to provide visualization tools for assessment data and areas of concern, allowing more effective stakeholder engagement and informing land management decisions.

Water Resources Research Center *Graduate Research Assistant* *2/2022 to 12/2024*

- Work with rural communities on the Water RAPIDS program to:
  - Develop method for using publicly available data to characterize groundwater use when pumping data is not available. View results for one community at: https://patagonia-groundwater-supplies-uagis.hub.arcgis.com/
  - Document research and analysis methods for improvement upon and use by other communities
  - Identify stakeholders, coordinate and facilitate meetings and workshops, prepare meeting minutes, and track actions to completion in support of drought and watershed planning activities
- Use knowledge of technical and policy dimensions, including the Law of the River, Groundwater Management Act, and Central Arizona Project shortages to identify critical water resource issues to identify sources of funding and generate proposals
- Assist Annual Conference planning, including stakeholder outreach (municipal, utilities, tribal, agricultural, industrial sectors), program development, budget development, sponsorship coordination, and speaker outreach.

KBR Wyle *Senior Technical Professional, Mechanical* *1/2021 to 1/2022*

- Human Landing System Government Furnished Equipment Toilet Lead Designer (1/2021 to 1/2022) – Technical Lead for the development of next generation space toilet design.

- Led cross-functional design team to evaluate top level requirements applicability, identify missing requirements, evaluate criticality of missing and to be determined requirements, and develop risk management strategies to maintain forward development.
- Coordinated system development, including trade studies for components and subsystems, assessment against requirements, hierarchization of design factors, subsystem design integration, and communicating design status in oral and written reports to management and customer.
- Developed air flow measurement apparatus based on ASME and ASHRAE specifications, coordinate development material flow testing to generate preliminary design review level system flow curves for fan selection. Troubleshot flow apparatus and achieve results within 10% of manufacturer reference data.
- Prepared test plans and procedures for odor filter performance, including development of engineering basis for fecal offgas product simulant use.

Paragon Space Development Corporation — *Project Manager/Aerospace Engineer IV* — *6/2017 to 12/2020*

- Brine Processor Assembly (BPA) Deputy Project Manager (7/2017 to 12/2020) – Provide system engineering expertise and technical support for the development of the BPA, a multi-million-dollar water processor technology demonstration for use on the International Space Station (ISS). The BPA set the state-of-the-art for water recovery from brine, meeting technology maturation goals to recover more than 98% of water from waste sources.
  - Build system level expertise to understand interaction and function of BPA subsystems, including overall BPA interfaces with ISS electrical and wastewater systems and assessment of contaminant control against NASA-specific air- and water-quality standards.
  - Provide oral and written reports of project status, including technical, cost, and schedule performance to internal and external stakeholders, including CEO and NASA.
  - Work with cross-functional subsystem leads through design and development phases, including review and management of work prepared by outside consultants, preparation for Critical Design Review, requirement verification, testing, and configuration changes.
  - Read, interpreted, and traced applicable requirements from NASA specifications and other sources to author complex test plans, procedures, and schematics for qualification/certification test campaign.
  - Incorporate feedback from cross-functional teams of electrical, computer, structural, design, and chemical engineers into test plans and procedures.
  - Identify test equipment and instrumentation, including uncertainty analysis to ensure test results provide appropriate accuracy to support requirement verification.
  - Completed initial functional, performance, vibration, electromagnetic interference/compatibility (EMI/EMC), power quality, and acoustic testing, including generating non-conformances to document test issues.
  - Coordinate with cross-functional teams to develop troubleshooting steps, design solutions, integration procedures, and change validation testing for thermocouple amplification circuitry noise issue, workmanship vibration component failure, and EMI/EMC noncompliances.
  - Generate complex test and analysis reports to document results of troubleshooting and certification testing, including compliance with system requirements.
  - Assess testing operations hazards. Developed controls for handling high toxicity fluids, participated in Test Readiness Reviews, and conducting test safety walkthroughs.
- Project Engineer (6/2017 to 12/2020) – Provide system engineering, test engineering, and project management for NASA Phase I and Phase II Small Business Innovation Research projects for thermal control projects.
  - Interpret requirements to develop test plans and procedures for testing novel cryogenic

multilayer insulation system and lithium ion battery fire containment system.
  - Led development of multiple awarded proposals, including federal (e.g., Phase I and Phase II Small Business Innovation Research Grants, change order proposals) and private funding opportunities.

Vante *Application Engineer* *6/2016 to 6/2017*

- Designed and developed tooling and molds for medical device manufacturing.
  - Completed more than 100 custom tooling projects through all stages of design and development: requirements definition, detailed design, drafting, fabrication, validation/verification testing, and delivery.
  - Provide in-factory customer support to troubleshoot equipment malfunctions, communicating with internal and external customers, factory floor personnel, and production managers to minimize down time.
  - Coordinated and worked with customers, manufacturing staff, and factory floor personnel to define requirements for dies and tooling that were specific, measurable, achievable, and verifiable.

United States Navy *Naval Reactors Engineer* *5/2011 to 6/2016*

- Steam Generator Project Manager (1/2015 to 5/2016) – Managed and led steam generator development for Navy's next-generation submarine program, ongoing procurement and manufacturing programs for current-generation steam generators, and provided technical support for operating steam generators.
  - Reviewed, evaluated, and provided subject matter expertise to give approval/disapproval of technical specifications, design drawing, and detailed structural, thermal, and fluid analysis.
  - Incorporated late breaking lessons learned from operating fleet into next-generation design, leading 11-person team to build consensus from opposing viewpoints, balancing technical issues and budget objectives to provide satisfactory design for operational use.
  - Briefed Naval Senior Leadership (Admiral level) and External Customers (SES) with written reports and in-person presentations noted for their strong written and oral components to provide schedule, cost, and technical status and recommendations of operational and developmental steam generators.
  - Reviewed fleet operational data and maintenance activities to identify improvements in steam generator feed system design that ensured safe operation while reducing inspection burdens in the operational fleet.
- Spent Nuclear Fuel Processing Project Manager (6/2011 to 1/2015) – Led development of processes, procedures, and hardware for preparing spent nuclear fuel for disposal in a geological repository. Provided 24/7 field support for ongoing spent fuel disposal operations.
  - Developed and maintained expertise in spent fuel disposal processes, becoming qualified to provide field support within 18 months (nominal timeline is 24 months).
  - Participated and led program reviews to assess prime contractor performance against program schedule, design requirements, and contract specifications. Provided feedback and direction on conflicting priorities to ensure overarching program needs were met.
  - Led cross-functional team review to approve hardware for operational use. Data products reviewed include analysis reports, hazard assessments, discrepancy reports for hardware, detailed drawings, qualification testing results, requirements verification matrices, operator handbooks, and operating procedures.

Education

University of Arizona, Tucson, AZ *Master's of Science in Water, Society, & Policy* *Expected 12/2023*

- GPA 4.0/4.0; Course of study includes Arizona water policy, watershed management, water quality, climate change adaptation, GIS, traditional ecological knowledge, environmental

risk management, and resource economics.

- Master's project is Development of Cooperative Watershed Management Plan with Aravaipa Watershed Conservation Alliance, including development of GIS Hub

University of Arizona, Tucson, AZ *Bachelor's of Science in Mechanical Engineering* *5/ 2011*

- GPA: 4.0/4.0; Technical elective focus on thermal and fluid sciences.
- Activities include NROTC (Company Commander, Platoon Commander), Navy Nuclear Power Club, Tau Beta Pi, Cats in the Community Volunteer, AIDS Walk Volunteer, NASA Space Grant Internship

Presentations and Publications

- Selected Presentations
  - Regenerating Sonora, 2023. Stakeholder Presentation on "What is a Watershed."
  - Arizona 4H Summit, 2023. Presentation on "Water for the Environment in Times of Shortage."
  - ALVSCE Research Poster Forum, 2023. Poster on "Replicable Groundwater Monitoring Methods for Rural Arizona."
  - Annual Symposium of the Arizona Hydrological Society, 2022. Presented student paper on "The Value and Prioritization of Water Used to Sustain Animals and Plants on, in, and adjacent to Streams in Arizona."
  - International Space Station Science Symposium, 2020. Delivered talk on BPA experiment purpose and results.
- Publications
  - Kelsey, L., S. Boyce, G. Speight, et al, "Closing the Water Loop for Exploration: 2020-21 Status of the Brine Processor Assembly", 50th International Conference on Environmental Systems, July 2021
  - Iacomini, C., A. Powers, G. Speight, et al, "Transient Modeling and Analysis of Metabolic Heat-Regenerated Temperature Swing Adsorption System for a Portable Life Support System", 40th International Conference on Environmental Systems, July 2010

Software

ArcGIS Pro, ArcMap, ArcGIS Online, MathCAD, MATLab, SolidWorks, Office Suite

Stream Dynamics, Inc.
P.O. Box 785, Silver City, New Mexico 88062
van@streamdynamics.us • www.streamdynamics.us • (575) 590-0549

EDUCATION

B.A. Physics with Mathematics minor, University of California at San Diego, 1982
Stream restoration student of Bill Zeedyk, 2000-2014
Stream restoration courses, Dave Rosgen, PhD, Wildland Hydrology, 2002-2007
Water Harvesting Certification, Watershed Management Group, 2010
Advanced Cisterns, Watershed Management Group, 2011

NARRATIVE

Van Clothier graduated from the University of California in 1982 with a bachelor's degree in physics and a math minor. He started Stream Dynamics, Inc. in 2002 after various careers, including computer modeling of infrared sensor performance, and managing recycling programs in California, Hawaii, and New Mexico. Purchasing remote property on a tributary of the last free flowing river in New Mexico in 1990 led him into riparian restoration.

He enjoys collaborating on projects with regional drylands stream restoration and water harvesting experts including Steve Carson, Mike Gaglio, and Brad Lancaster. He has completed the Natural Channel Design stream restoration course schedule taught by Dr. Dave Rosgen, and is a licensed user of RiverMORPH, software specifically designed for this application. He is an experienced riparian restoration heavy equipment operator and prefers to build his own restoration earthworks. Van has worked extensively with Bill Zeedyk on a variety of restoration projects in New Mexico and Arizona. He is the co-author with Bill Zeedyk of a book *Let the Water Do the Work: Induced Meandering, an Evolving Method for Restoring Incised Channels* (2009) now in its second edition. Van is an avid ground and aerial photographer and maintains an extensive stream restoration photo database.

Stream Dynamics, Inc. specializes in drylands fluvial geomorphology, riparian restoration, and urban stormwater management. This includes watershed assessment, design, permitting, restoration construction (including operating a wide variety of heavy equipment), monitoring, reporting, educational presentations and workshops, and expert testimony. Clients and projects include the Malpai Borderlands Group, a landscape scale restoration that has built 3,000 rock water harvesting structures to date; Amigos de Valles Caldera, improved the Plug-N Pond technique to restore wet meadows; the Village of Ruidoso's river restoration project; currently doing watershed restoration work on Lordsburg Playa for the New Mexico Department of Transportation, and a wide variety of large and small private and public landowners and watershed groups, turning erosion problems into water harvesting opportunities.

Stream Dynamics is presently conducting site assessments for erosion control, water harvesting, stream and wetland restoration projects, and doing consulting, design and construction of restoration works in New Mexico, Arizona, Chihuahua, and Sonora, Mexico.

SELECTED PROJECTS AND CLIENTS

LOCAL PROJECTS

Dust Mitigation for the New Mexico Department of Transportation, I-10 west of Lordsburg, NM, 2016-present. This project is about improving traffic safety on a section of I-10 that traverses the Lordsburg Playa where numerous traffic fatalities have occurred in recent years because of dust storms. Stream Dynamics was hired to assess the problem. We were the primary author of the D.O.T. Surface Disturbance Analysis, and the Plan of Development and are currently building and monitoring watershed improvement features on rangeland in the vicinity of the Lordsburg Playa designed to improve vegetative cover and reduce dust emissions.

City of Rocks State Park, Faywood, NM, 2019
Redesigned drainage features for the access roads to stop erosion at all of the pull-in camp sites. Built these features using heavy equipment, monitored results during heavy monsoon downpours and made small alterations where necessary to perfect the work. Stabilized arroyos upslope of Faywood Ciénega with many hand built rock and earth water harvesting structures. Client was New Mexico State Parks. Project financed by the New Mexico Office of the Natural Resource Trustee.

San Vicente Creek Urban Watershed Restoration Project, Silver City, NM, 2015-2018
This project demonstrated how to protect water quality in San Vicente Creek by building 80 storm water harvesting projects within the contributing urbanized landscape of our town, and enhancing native riparian vegetation and stream bank stability within the creek itself. These projects have improved traffic safety and created greenspaces all over town. This project was financed through a grant from the NMED SWQB.

Restoration of San Vicente Creek under new Highway 90 Bridge – 2016
Working as a subcontractor of IHC, who replaced a major bridge as a contractor of NMDOT, Stream Dynamics removed the culverts that had been in the creek for almost two years and reconstructed the stream channel. We protected the banks with boulder vanes and planted willows and cottonwoods. This project has been through several extremely high runoff events with no issues. The banks are protected and the trees are getting very tall.

Guadalupe Montessori School, Silver City, NM, 2016 Redesigned the driveways and parking areas to create water harvesting and green space. Project survived the flood of record 2 weeks after construction and prevented flood damage to neighboring homes. This project was presented at the COCEF Green Infrastructure Forum in Coahuila, Mexico on September 22, 2016. Here is a link to the presentation and a video of the project during a very large storm: http://streamdynamics.us/blog-entry/water-haversting-controls-sediment-and-prevents-flooding

San Vicente de la Ciénega, Silver City, NM, June 2014 Built a Rosgen Cross vane to protect the sewer line from being undercut by the creek. Excavated the terraces of this incised reach to floodplain elevation and engineered water harvesting diversions. Planted 175 native plants within the water harvesting features. This project has gone through many large floods since construction and is functioning perfectly. This project was financed through a grant from the NMED SWQB.

Ancheta Creek, San Lorenzo, NM, 2001, 2014 and 2018 Completed hundreds of rock grade control structures and restored groundwater recharge along the creek, resulting in the creation of several wet-weather springs and an increasing length of perennial creek. This was a USFWS funded project designed by Bill Zeedyk. By 2008, the creek had evolved to become perennial in the lower reach. This successful project received additional funds in 2014, and we returned to build even more rock check dams in 2018.

Aldo Leopold High School YCC, 2006 - 2017 Every Semester for many years we had Youth Conservation Corps students building water harvesting projects with us every Friday. Our final project was building several prominent water harvesting projects at Western New Mexico University. Other sites include: Silver City Senior Center, June 2014 Worked with 18 students from Aldo Leopold High School YCC to design and build a complete water harvesting make-over of the arroyos and water flows from streets and parking lots. Silver City Urban Watershed Assessment, Jan - June 2014 Students walked every street on the south side of town looking for water harvesting opportunities, safety issues, and resource damage points and created a GIS layer of all the information gathered from the street survey. Epoxied labels on 127 storm drains that say "Don't Pollute, No Contaminae, Flows to Waterways" Silva Creek Botanical Gardens, 2006 Worked with 15 students from Aldo Leopold High School YCC to build the first water harvesting project in Silver City, directing runoff from a 75 acre urban watershed to irrigate the park, which was planted by other volunteers with 125 species of native plants that are thriving on the harvested water.

Bar-6 Canyon, Forest Service land, Grant County NM, 2013 Designed and built grade controls and water harvesting features to improve a natural springs in this 4 square mile desert wash. Used an excavator to harvest refrigerator sized boulders from the hillside and use them in the construction. Worked with middle school kids to plant native trees and shrubs within the water harvesting features.

Water harvesting projects, private clients, 2010 - Present Worked with the Town of Silver City Public Works Department to establish a permit protocol for water harvesting curb cuts. Currently building a growing series of water harvesting projects, and developing new techniques to turn nuisance runoff into growing trees and gardens.

Burro Ciénega, Grant County NM, 2005 Assessment, design, and construction of ciénega restoration project on two mile stream reach on private land. Constructed Rosgen-style stream restoration structures and Zeedyk style induced meandering structures. Developed new construction technique for machine-built post vanes that has become adopted by natural channel stream restorationists in New Mexico.

Bill Zeedyk Ecological Consulting

Assisted Bill in many capacities, including stream channel and water harvesting assessments, surveys, design, and implementation, and teaching hands-on workshops, including:

Valles Caldera, 2007 - 2015 Developed Plug ‘N Pond technique for this wet meadow ecosystem that saves the wetland sod in 6 x 6 foot mats and replaces it on the dams for instantaneous recovery and zero project footprint.

Valle Vidal, 2005 - 2009 GIS and fluvial geomorphology assessment for road drainage and stream bank erosion control.

Rio De Las Vacas, 2007 Trained New Mexico Environment Department personnel in stream channel survey techniques while surveying 2 miles of this creek.

Dry Cimarron Creek, Raton, NM, 2004 Supervised the installation of part of Zeedyk's restoration design.

EC Bar Ranch, Nutrioso Creek, Nutrioso AZ, 2002 Planted willows and built stream restoration structures in an induced meandering project designed by Bill Zeedyk.

REGIONAL PROJECTS

Canelo Hills Ciénega, Sonoita, AZ, 2018
This project of the Phoenix Desert Botanical Garden was to enhance habitat for the endangered orchid *Spiranthes delitescens* on a preserve owned by The Nature Conservancy. A severe headcut had been moving up through the cienega, threatening to dessicate the landform. Stream Dynamics designed and built floodplain flowpaths for the creek and constructed an infiltration gallery that raised the water table. This sub-irrigated the vicinity of the headcut and caused native vegetation to stabilize and protect it from further erosion. In September of 2019 this project was tested by a huge runoff event. Everything worked perfectly. Funding was provided by Arizona Department of Environmental Quality.

Schnebly Hill Road drainage, Sedona, AZ, 2017
The purpose of this project of the National Forest Foundation was to reduce sediment going into a tributary of Oak Creek from the most popular jeep trail in Sedona, which was very badly eroded. Schnebly Hill Road also had under it the fibre optics cable that supplied data to most of Northern Arizona. Having originally met on site with engineering firms, the project proponents were dismayed to find that they would only be able to repair one location for the $200,000 budget. Instead Stream Dynamics was contracted for the job. We designed and built 63 road drainage features along 5.4 miles of dirt road and completed the project on time and within the budget. The jeep outfitter companies loved our work, and so did mother nature. The project has been photo monitored by the Oak Creek Watershed Council for years and is still working as designed.

Amigos de Valles Caldera, 2007 - 2015 Stream Dynamics, Inc. has built many projects on San Antonio Creek and its Tributaries, Riito de Los Indios Creek, Santa Rosa Creek, Jaramillo Creek and Sulphur Creek. After completing the initial aerial and ground assessment of 33 miles of creeks in the Valles Caldera, we worked with a committee of the Valles Caldera Trust to develop a restoration concept, and co-wrote the initial grant proposal. Stream Dynamics, Inc. has been contracted for the design, permitting, and construction of several large projects since then. Van Clothier has designed and built the projects since August 2011 with a backhoe, a skid steer loader, and an excavator. This work has included a stream channel reroute to prevent a meander cutoff, several "plug 'n pond" projects to create wetlands in gullied tributaries, and installing a culvert array to restore proper function to an alluvial fan at an important road crossing. The work survived several very large post-fire floods immediately afterward, and continues to function as designed. A road drainage project to protect Jaramillo Creek from sediment was completed with a small bulldozer in 2012. Construction for the 6-Tribs project converted gullies to wetlands using the "plug 'n pond" technique during the summer of 2013 and spring 2014. Restoration work was also done on Jaramillo Creek in summer 2014, and on Sulfur Creek in Summer 2015.

Sky Island Alliance, 2006 - 2014 Watershed restoration assessment, design, and supervision of on-the-ground work during volunteer service weekends at a dozen restoration sites on private, state, and federal land in Arizona, New Mexico and Sonora, Mexico. Restoration of Cloverdale Ciénega (a 300 acre historic desert marsh in the New Mexico boot heel), funded by a large RERI grant from the State of New Mexico, co-authored by Stream Dynamics. The multi-year assessment and final design was done by Stream Dynamics, Inc. with a peer review conducted by Bill Zeedyk. Operated Komatsu PC 300 excavator, Komatsu D39EX bulldozer, Cat 420 backhoe, Komatsu HM400 dump truck, and Komatsu WA480 loader during the construction implementation, which was completed in 2010. The project has since redistributed flows to the ciénega from large floods, greatly improving the base flow of the creek. Phase II of this project in Feb 2012 built 45 weirs in the lower reach to convert a gully into a graded stream with wetlands on the banks. The weirs were made from 200 medium size juniper trees that were pulled out of the wetlands like giant weeds with a Cat 315 excavator, thus

simultaneously restoring the wetland plant community. Recipient of the Sky Island Alliance 2010 Business Conservation award.

Malpai Borderlands Group, Douglas, AZ, 2003-2016 Landscape scale watershed restoration project using all natural materials. Designed and supervised construction of over 3,000 hand-built rock and brush erosion control structures. Treated over 15 miles of drylands watercourses on three ranches. Responsible for effectiveness monitoring of all treatments. New techniques and structures developed on this project including Media Lunas and Cobble Channel Liners are now in use by the watershed restoration community in Arizona and New Mexico. Presented at the 2007 and 2010 Malpai Science Conference. In spring of 2015 completed the restoration of an historic alluvial fan in Wildcat Canyon. This project went through a 500 year flood two weeks after completion and sustained some damage to the spillways initiated by livestock trampling. This was repaired in January 2016 with the help of 22 volunteers from Sky Island Alliance.

Village of Ruidoso, 2010 and 2013 Completed an urban and rural watershed assessment for the Rio Ruidoso Restoration Committee. Did aerial reconnaissance and ground truthing of 28 miles of streams. Developed recommendations for 28 projects to implement a $1,000,000 watershed restoration project to benefit stormwater runoff, riverine ecology and river based recreation. Contracted by the Village of Ruidoso to construct a wetlands and to build water harvesting features on the campus of Ruidoso High School in June 2013, restoring the Bog Springs wetland at the entrance to the school. Developed wetland ecology curriculum for the science teachers and fostered a wetland studies program that has its own emergent wetland on campus where there was previously an eroding dry gully.

La Jencia Creek, Socorro County NM, 2010 Designed and built large Plug-"N"-Pond basins to capture runoff from the gullies and prevent a 60 foot head cut from eating the barn. Used Cat D5 Bulldozer to build rolling dip road drains on county road to redirect runoff to water harvesting earth basins in a 43 acre watershed.

Rangeland Hands, 2004 - 2009 Fluvial geomorphologist, restoration design consultant, heavy equipment operator, GIS specialist. Operated Cat 315 excavator, Cat 420 backhoe, Komatsu WA250 loader, Komatsu D51ex bulldozer. Projects include: Rio Puerco Management Committee, 2006, surveyed, designed proper drainage on 100 miles of degraded roads west of Cuba, NM. NM State Land Office, 2006, survey/design for the restoration of Ojo Sarco Creek, Embudo, NM; Cimarron Watershed Alliance, 2007, operated equipment on a road relocation and water harvesting project on the CS Ranch. Ruidoso River Association, March 2008, layout and construction of boulder lined fish habitat pools and stream bank stabilization along 1500 feet of stream at Two Rivers Park in downtown Ruidoso. This project survived the flood of record in July, 2008 that destroyed other parts of the river. Stewart Meadows wetland habitat improvement project, March 2009, designed and built boulder weir flow splitters to control the distribution of water to a series of constructed habitat ponds.

San Francisco River Association, 2004 - 2007 Riparian restoration consulting. Various site assessments, design and watershed rehabilitation projects. San Francisco River and tributaries aerial assessment, 2006: produced an ArcGIS virtual flight tour of the watershed with photo links and stream assessment notes.

San Francisco River, Catron County NM, 1995 - 2015 Cooperator, U.S. Fish and Wildlife Service Partners for Wildlife project on my property on the San Francisco River. Maintained livestock fence for 20 years, rerouted road to prevent stream capture. Planted 6,000 willows, built dozens of grade control structures in tributary arroyos, restoring natural water harvesting processes to terraces and alluvial fans. This project has been submerged by many huge floods, and has been so successful that it is featured in USFWS promotional literature.

PUBLICATION

Let The Water Do The Work: Induced Meandering, an Evolving Method for Restoring Incised Channels, by Bill Zeedyk and Van Clothier, 2009. Second Edition published by Chelsea Green in 2014. This is a textbook on stream channel processes and a "how to" manual for restoring health and sinuosity to incised channels. It contains eight chapters, 252 pages, illustrated with 300 color photos, drawings, diagrams and graphics. Examples of successful treatments are described in detail. Contains annotated references, a glossary, an appendix with field forms, worksheets and other tools for collecting and interpreting information pertinent to river and wetland restoration issues. Used by land management agencies, university classes, land owners, and riparian restorationists.

TEACHING

Many classes and workshops including: *Low-Impact Development, Green Infrastructure and Rainwater Harvesting Workshop* (2 days) taught for the City of Las Cruces in 2015, *Restoration of Urban Dryland Streams* (3 days) taught for Watershed Management Group, 2011, 2012, 2015. *Integrating Stream Restoration Principles and Transportation Maintenance* (3 days) May 2013 course taught to 30 New Mexico Department of Transportation engineers, designers, etc. Co-teacher of courses with Bill Zeedyk: *Restoration Assessment and Design* (7 days), Sky Island Alliance, 2011. *Restoration Methods for Riverine, Ciénega and Wetland Ecosystems* (9 days), NM Environment Dept., 2006.

Watershed Management Group

Hereby certifies that

Van Clothier

has earned the designation of

Certified Water Harvesting Practitioner

by completing the Watershed Management Group Water Harvesting Design Certification course, comprised of 50 hours of lectures and hands-on training in integrated design, cisterns, greywater systems, earthworks, food production and native plants; and by demonstrating knowledge of these practices required for their successful implementation.

Catlow Shipek
Co-founder and Policy & Technical Director

15 December 2010
Date Issued


Wildland Hydrology, Inc.
Research and Educational Center for River Studies
Awards this Training Certificate to:
Van Clothier
For completion of:
River Restoration & Natural Channel Design
May 15th – 24th, 2007
Breckenridge & Streamboat Springs, Colorado
David L. Rosgen, Ph.D.

David F. Seibert
[redacted]
dseibert@arizona.edu

Education

Ph.D. Ecological anthropology, University of Arizona 2013
M.A. Cultural anthropology, Northern Arizona University 2004
M.A. Literature/English, University of Arizona 1995
B.S. English, Northern Arizona University 1990

Professional Experience

Watershed Ecologist, San Carlos Apache Tribe 2024-present
Training local practitioners in habitat restoration, project design and management, reading the landscape, budgeting, leadership

Managing Partner, Seibert Ecological Restoration LLC 2010-present
Local and landscape-scale habitat restoration project design, execution; grant writing with land managers, communities, NGOs, agencies

Adjunct Faculty, University of Arizona 2023
Introduction to University Studies: research, studying, coping strategies

Executive Director, Borderlands Restoration, L3C 2013-2017
Co-founder, fundraiser, grant manager; Director of Youth Education, Native Plants, Watershed, and Restoration Economy program areas

Research Associate/Campus Colleague, UA Southwest Center 2013-present
Collaborative conservation and habitat restoration planning/networking

Restoration Coordinator, Altar Valley Conservation Alliance 2007-2012
Research, grant writing, project oversight for 600,000-acre watershed

Adjunct Faculty, Pima Community College 2008-2010
Ecological anthropology, environmental history, field methods

Research Asst, Bureau of Applied Research in Anthropology, UA 2005-2007
Glen Canyon Dam Adaptive Management Program representative for Southern Paiute Tribe's cultural resources protection program

Adjunct Faculty, Coconino Community College, Flagstaff 2004-2005
Writing, literature, anthropology

Adjunct Faculty, Northland Pioneer College, Hopi Reservation 2004-2005
Ecological anthropology, writing, literature

Project Manager, Center for Sustainable Environments, NAU 2001-2005

Culturally appropriate sacred site restoration and community green space development with Hopi, Navajo, and Zuni leaders

Horticulturist, Arizona-Sonora Desert Museum, Tucson 1995-2001
Horticulture and field research on grassland and desert habitats in the U.S. and Mexico

Head Instructor, Academia Language School, Nagoya, Japan 1991-1993
English language and American culture; garden design research

Relevant Grants, Contracts and Collaborations

2024 *SW Fire Science Consortium*, Northern Arizona University
Contract to write science synthesis paper: "Techniques for Increasing Watershed Resilience to Wildland Fire"

2023-24 *The Biophilia Foundation*
Contract to design and report on watershed restoration project with local scientists and practitioners in Sonora, Mexico

2023 *Biophilia Foundation*
Technical and cultural consultation on community watershed restoration with Mexican scientists and local practitioners at Bamochi Creek, Sonora Mexico

2022 *University of Arizona Southwest Center*
Collaborative conservation and restorative response representative for nationwide teacher training summit on borderlands region concerns

2020 *University of Arizona Southwest Center "Borderlands Observatory"*
Interdisciplinary collaboration to bridge urban/rural and academic/NGO divides re: policy, climate change, migration, wildlife, livable communities

2020-22 *Tonto National Monument*
NPS grant writing and subsequent habitat restoration planning in response to severe fires and impending climate mitigation needs; erosion control methods, invasive species management, native plant installations, monitoring methods, staff and volunteer training

2017-2020 *The Hopi Tribe*
Contract to provide expert witness testimony on climate change and mitigation strategies during multi-party current and future water rights trial

2018-2020 *Lassen Volcanic National Park and Local Indigenous Voices, N. California*
Contract to create a "Framework for an Inclusive Ethnography of Fire," a model for collaborative Park management and use with local Native American groups

2017-2020 *Arizona Department of Environmental Quality*

Author, PI on two grants for improving hydrology, reducing erosion, mitigating E.coli: $184,000 and $129,000

2015-17
U.S. Fish and Wildlife Service (PI $50,000 habitat restoration)
The Biophilia Foundation (PI $50,000 organizational capacity building)
AZ Dept of Forestry and Fire Management (PI $25,000 habitat restoration)
Bureau of Land Management (PI $210,000 native plant research, propagation)
National Park Service (PI $12,000 restoration design, execution, crew lead)
AZ-Sonora Desert Museum/National Fish and Wildlife Foundation (PI $30,000 for pollinator refugia design)

2013-17 *Walton Family Foundation*
"The Babocomari River Restoration Project" (PI with Borderlands Restoration; hydrology and recharge; $87,000 Phase I; $432,764 Phase II; $128,000 Phase III).
With USGS research support on groundwater recharge, green infrastructure

2013 *National Fish and Wildlife Foundation*
"Habitat Restoration and Monitoring for Multiple Species: An Integrated Landscape-Scale Approach" (PI for Borderlands Restoration L3C; $264,000 total award. NFWF grant No. 36905).

2009-2010 *Freeport-McMoRan Copper and Gold*, "Thinking Like a Watershed: Collaboration through Restoration in the Altar Valley" ($17,600 PI with Altar Valley Conservation Alliance) Arivaca, AZ

2007-2012 *USDA/Natural Resources Conservation Service*, Technical Service Provider grant ($15,200 as Farm Bill Aide, for collaborative grant with Altar Valley Conservation Alliance; total award $20,000/year) Arivaca, AZ
Rural ranch outreach, interviews, focus groups, technical assistance

Selected Publications and Research

2019 *"War Stories" and White Shoes: Field Notes from Rural Life in the Borderlands, 2007-2012.* In *The Border and Its Bodies: The Embodiment of Risk Along the U.S.-Mexico Line*. Pp. 262-282. University of Arizona Press.

2014 *Beyond "Stakeholders" and the Zero-Sum Game: Toward Community-Based Collaborative Conservation in the American West.* In *Stitching the West Back Together: Conservation of Working Landscapes*. Pp. 53-75. Univ of Chicago Pr.

2013 *An Ethnographic Poetics of Placed-and-Found Objects and Cultural Memory in the U.S-Mexico Borderlands*. PhD dissertation [accessible at http://arizona.openrepository.com/arizona/handle/10150/311534]

2011 *Dearth and Deluge: Sustaining Lives and Livelihoods Under Threat*. Anthropology News

2005 *Sacred Sites and Gathering Grounds: A Toolkit for Managers, Practitioners, and Activists*. NAU: Applied Indigenous Studies. Editor.

2004 *A New Plateau: Sustaining the Lands and Peoples of Canyon Country. Minneapolis: Renewing the Countryside Press*. Writing, photography.

2002 *Safeguarding the Uniqueness of the Colorado Plateau: An Ecoregional Assessment of Biocultural Diversity*. Editing, with Dr. Gary Nabhan.

References

Dr. Jeffrey Banister — Director & Associate Research Social Scientist The Southwest Center, University of Arizona
Editor, Journal of the Southwest
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Integrated Climate Adaptation and Resiliency Program
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ben.mcmahan@opr.ca.gov [redacted]

Dr. Laura Norman — Supervisory Research Physical Scientist
U.S. Geological Survey
lnorman@usgs.gov [redacted]

Max Taylor — Natural Resources Department
The Hopi Tribe
mtaylor@hopi.nsn.us [redacted]

UPPER WATERSHED RESTORATION DEMONSTRATION PROJECT FOR ARAVAIPA CREEK

Project Site Photographs

Site 1:

Site 2:

UPPER WATERSHED RESTORATION DEMONSTRATION PROJECT FOR ARAVAIPA CREEK

Plans

Development of site-specific implementation plans is a task for this project. Other regional plans are included in the Existing Plans Attachment.

COOPERATIVE WATERSHED MANAGEMENT PLAN FOR ARAVAIPA CANYON

ARAVAIPA WATERSHED
CONSERVATION ALLIANCE

Revision: NC

COOPERATIVE WATERSHED MANAGEMENT PLAN FOR ARAVAIPA CANYON

Prepared by Garland Speight for the

Preferred Citation

Aravaipa Watershed Conservation Alliance. (2023). Cooperative Watershed Management Plan for Aravaipa Canyon.

Acknowledgements

The original development and release of this plan was funded through a Bureau of Reclamation WaterSMART Phase I grant. The authors of this report wish to thank all community members and agencies who participated in the development of this plan. This plan reflects the knowledge and expertise of our partners, and all mistakes are the provenance of the plan authors.

Release History

Release	Date	Description of Change
NC	05/24/2023	No Change

CONTENTS

FIGURES

TABLES

ACRONYMS

ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
BOR	Bureau of Reclamation
CWMP	Cooperative Watershed Management Plan
DFFM	Arizona Department of Forestry and Fire Management
ET	Evapotranspiration
NRCS	National Resources Conservation Service
TNC	The Nature Conservancy
CFS	Cubic feet per second
HUC	Hydrologic Unit Code
WOTUS	Waters of the United States

EXECUTIVE SUMMARY

Aravaipa Creek is one of the last and least disturbed perennial streams in Southeastern Arizona. The region provides valuable refuge for many species of plants and wildlife, making it a popular destination for recreation and ecotourism. In addition, the relatively untouched valley has many native species of grass and sufficient water resources to make it attractive rangeland. The Aravaipa Watershed Conservation Alliance (AWCA) was formed in 2016 with a mission of preserving, maintaining, and improving the watershed and rangeland conditions within the Aravaipa Valley and Canyon. The AWCA worked with the National Resource Conservation Service (NRCS) to establish a planning area to help coordinate local and agency stakeholder watershed improvement activities (Figure 1). Watershed assessments examine key ecohydrological factors to describe current watershed conditions. The collected data provide a baseline of watershed conditions factors – water quantity, water quality, land cover, geology, infrastructure, plants, and wildlife – which assist landowners and natural resource managers in gauging the need and priorities for watershed improvement and preservation projects. Decided through a vetted stakeholder engagement model, the shared priorities that drive this management plan are:

1. mitigating erosion,
2. water conservation, and
3. conservation of riparian areas.

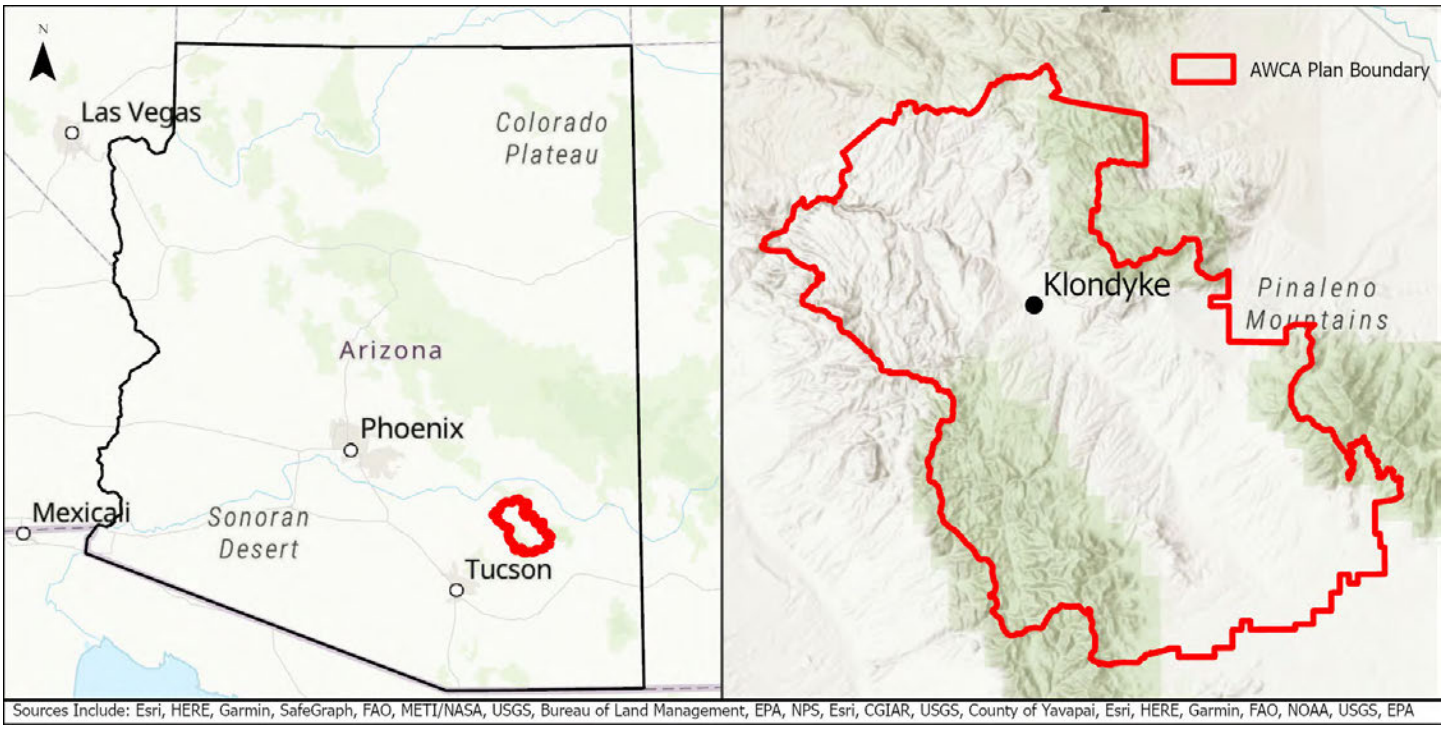

Figure 1. AWCA Plan Boundary: Left: Within the State of Arizona; Right: Detail View

1 PURPOSE

The primary function of this plan is to develop consensus with community and agency stakeholders around issues and priorities within the plan boundary. In engaging with community stakeholders, the AWCA solicited input from all landowners in the area, including the owners of large ranches and smaller parcels in the upper watershed. This broad engagement ensures we capture all sources of local knowledge and that the priorities in this plan express shared interest and concerns. As projects are implemented, the AWCA hopes additional landowners and agencies that have not responded to previous outreach efforts will engage so that their insights and interests can be captured here. Although the AWCA board has final approval of this plan, it is subject to community and agency stakeholder review and comment during stakeholder engagement meetings as described in Section 2.1.

1.1 About the AWCA

The AWCA's purpose is to preserve, maintain, and improve the Aravaipa Valley through watershed and rangeland restoration, promoting a complete and functioning landscape for current and future generations. AWCA is open to the public and invites participation in planning efforts from all interested parties. Positions on the AWCA Board of Directors requires evaluation of a resume and a vote by the Board of Directors. The AWCA Board of Director membership during plan development included representatives from The Nature Conservancy, large property owners, and small property owners in the area. Advisors and volunteers to the Board have represented varied interests, including small business owners, large and small scale ranches, and outdoor recreation enthusiasts.

Although human impacts in the area have been relatively minimal, human activities have altered some key watershed characteristics. The purpose of this cooperative watershed management plan (CWMP) is threefold:

1. Assess and document the current state of the watershed,
2. Identify desired watershed conditions and goals, and
3. Identify and prioritize projects that address gaps between current and desired conditions.

The AWCA intends for this CWMP to be a living document that will undergo periodic revision as new information or prevailing conditions within the plan boundary change. Future revisions should include status of projects and incorporate new projects or areas of concern as needed. Additional reasons to revise the document include, but are not limited to, incorporation of new stakeholders, changes in land development status, new funding mechanisms, and new management guidance in the region.

View of Aravaipa Valley

View of Aravaipa Valley

Partners

In addition to the community engagement described in Section 2.1, the following agencies and organization have engaged with, facilitated, or provided material support through different portions of plan development:

- Bureau of Reclamation
- United States Geological Survey
- Bureau of Land Management
- University of Arizona Cooperative Extension
- University of Arizona Water Resources Research Center
- Arizona Game and Fish Department
- Arizona Department of Forestry and Fire Management
- Freeport-McMoRan
- USDA Farm Service Agency
- Graham County
- United States Forest Service
- Arizona Association of Conservation Districts
- Arizona State Land Department
- United Way of Graham & Greenlee County
- United States Fish and Wildlife Service Ecological Services and Refuges
- The Nature Conservancy
- The Community Foundation of Southern Arizona
- Natural Resources Conservation Service
- Arizona Community Foundation of the Gila Valley
- Walmart

Cattle Grazing

1.2 Mapping Hub

This plan is intended for use with the AWCA Mapping Hub, accessed through the AWCA website (https://aravaipa.org). This hub provides a central collection point for data that complements this plan and provides a variety of visualization options to help improve understanding of watershed conditions. The hub will be revised when new data or visualization tools become available and will be updated between revision cycles of this plan.

2 METHODS

Watershed assessments examine key ecohydrological factors to describe current watershed conditions. These factors include regional water supply and demand, surface and groundwater flows, water quality, land cover, geology and soil, infrastructure, and plants and wildlife, including fish. Data for these assessments are gathered from a variety of sources, including local knowledge, agency scientific expertise, publicly available data (e.g., climate data, groundwater levels, land cover data), and academic publications (Lien et al., 2014). Section 2.1 describes the collaborative inputs to the assessment and Section 3 documents the results of our assessment.

Continuing with the focus of collaboration, the AWCA used questionnaires to document agency and community stakeholder concerns and priorities. These concerns are contextualized with current watershed conditions to identify overarching priorities for action in Section 4. Based on discussions with subject matter experts and the results of a literature review of work performed in similar regions, a variety of projects that can be used to address these priorities are documented in Section 5. Section 5 also provides a preliminary methodology to prioritize projects for implementation.

2.1 COLLABORATIVE WATERSHED PLANNING PROCESS

The process for developing this CWMP is centered on community and stakeholder engagement. The AWCA held two stakeholder engagement meetings, one for community members and one for agencies, prior to drafting this CWMP. Next, the information gathered from these meetings was used to inform a literature review and watershed assessment. Additional engagement with community members was obtained through site visits of areas of concern within the plan boundary. The AWCA then synthesized these results into this plan.

Private parcel data from the Graham and Pinal Counties was used to identify mailing addresses for all landowners within the plan boundary. The AWCA sent fliers advertising the community stakeholder engagement meeting to all addresses on this list. At the stakeholder meeting, the AWCA explained the intentions for CWMP development and solicited direct input via questionnaire. Questionnaire results are documented in Section 4.2.

Stakeholder Engagement Meeting

For the agency stakeholder meeting, AWCA invited partners from agencies and organizations that have previously participated in AWCA efforts and additional agencies with technical or geographic jurisdictions within the plan boundaries to participate in one of two meetings. The first was held in person at the Klondyke School within the plan boundary. The second was held online via zoom. Unfortunately, some agencies or stakeholders, including the San Carlos Apache Tribe and Arizona State Land Department, were unable to be reached for inclusion in planning efforts to date. No agencies or other stakeholders refused to participate with AWCA in this planning process, instead no responses were received from these groups. At both meetings, the AWCA shared planning progress and requested direct input via questionnaire. Questionnaire results are documented in Section 4.3.

The AWCA[1] used the questionnaire results to help focus and contextualize the literature review and watershed

1 Note: representatives of the San Carlos Apache Tribe were reached during the stakeholder review of this plan, and additional outreach and engagement will be accomplished for future revisions of this plan.

Aravaipa Creek

assessment. Stakeholder questionnaires were made available at the Klondyke Store to encourage participation by other groups (e.g., off-road vehicle enthusiasts, outdoor recreators) in developing watershed priorities. No groups were intentionally excluded from plan development and outreach efforts were driven by AWCA staff availability.

Discussions with subject matter experts were used to inform the literature review and identify types of projects that can be implemented to improve watershed conditions within the plan boundary. Publicly available data was used to generate maps to help visualize key watershed parameters. The AWCA also met directly with available landowners to document local knowledge and areas of concern within the plan boundary.

The AWCA made a draft version of this plan available for stakeholder comment and review prior to release. A joint community and agency stakeholder meeting was held at the Klondyke Schoolhouse in March, 2023, to review the draft plan and solicit additional feedback and inputs. After the meeting, feedback was incorporated into this plan, and the plan was approved for release by the AWCA Board of Directors.

3 WATERSHED CONDITIONS

3.1 General Description

The Aravaipa Valley and Aravaipa Canyon are well-known for spectacular natural beauty, rural character, and relatively unaltered natural conditions. The valley is formed between the Galiuro Mountains to the West, the Pinaleno Mountains to the East, and the Santa Teresa Mountains to the East and Northeast. The valley is mostly inaccessible to passenger vehicles except through the pass between the Santa Teresa and Pinaleno Mountains and from the Willcox Valley to the South. Portions of these mountains and the Aravaipa Valley drain through the Aravaipa Creek, sculpting the spectacular Aravaipa Canyon. Sparsely populated - although exact population figures for the watershed are difficult to establish due to part-time residents - there are only 74 registered voters in the Klondyke District, which covers much of Aravaipa Valley (Graham County, 2023).

WHAT IS A WATERSHED?

A watershed is the land area for which all surface water drains to a defined point on a stream or river.

The Aravaipa Wa tershed plan boundary was created by identifying the watersheds that support the Aravaipa Creek's perennial reaches. A watershed is the land area for which all surface water drains to a defined point on a stream or river, usually referenced by "hydrologic unit code" or "HUC" created by the US Geological Survey. The HUC hierarchical system divides and subdivides regions based on drainage area. The bigger the number or "code," the smaller the region.

The Aravaipa Watershed planning boundary uses 17 HUC-12[1] watersheds (Figure 2). Although the 17 selected HUC-12 watersheds represent most of the planning area, there are extensions beyond these natural features to match ranch boundaries (Figure 3).

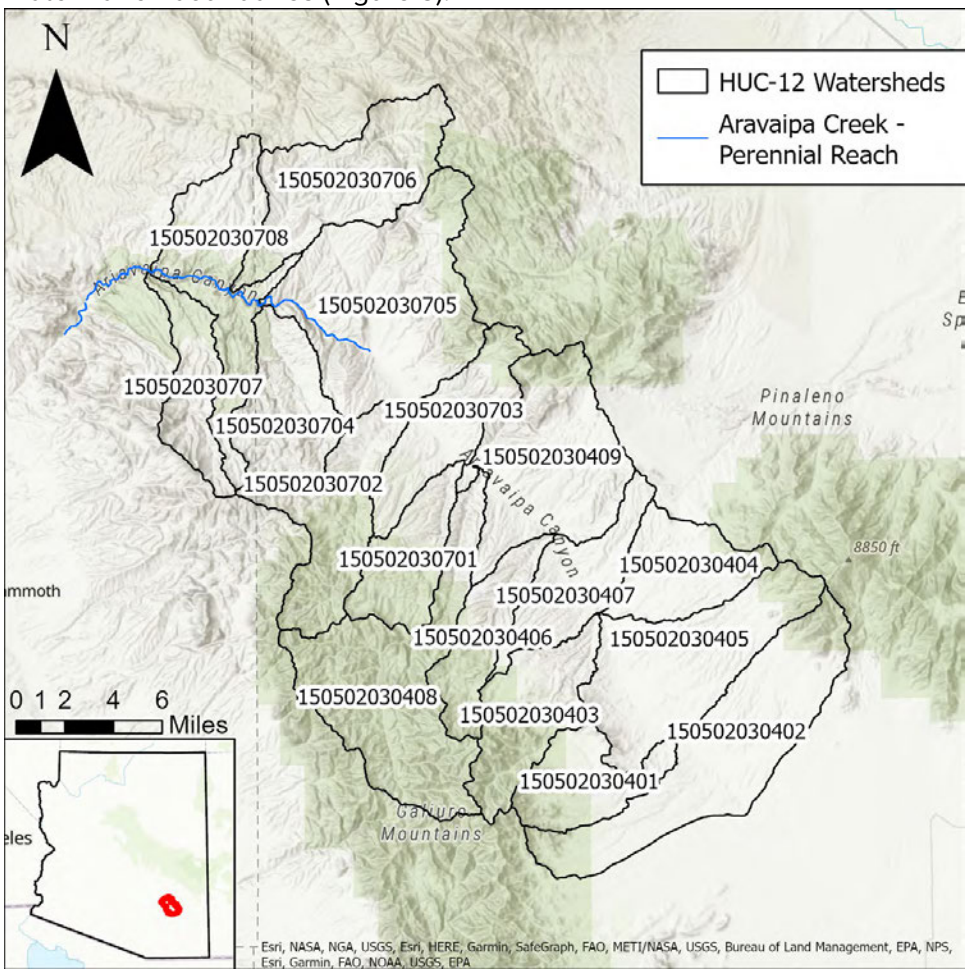

Figure 2. HUC-12 Watersheds Used for Plan Boundary Development
Source: (U.S. Geological Survey National Geospatial Program, 2022)

Figure 4 provides regional surface water context for the plan boundary by showing the Arizona Department of Environmental Quality (ADEQ) flow regimes for streams and rivers in the region. The perennial reaches of Aravaipa Creek within the plan boundary are shown in a bold blue line. Ephemeral, intermittent, and perennial reaches of other rivers and streams are shown in increasing dash density. The perennial reaches of Aravaipa Creek restore perennial flow to the San Pedro River at the confluence of the two streams. These waters travel downstream, flowing north, to join the Gila River miles downstream from the Coolidge Dam. The Gila River is perennial downstream of the San Pedro River confluence for several miles.

1 The Hydrologic Unit Code (HUC) is a unique identifier from the United States Geologic Survey. The number of digits in a HUC code describes the size of the watershed, with more digits indicating a smaller watershed. For example, the HUC code for the entire Lower Colorado River Basin is two digits, 15 (Lien et al., 2014).

Actions taken within the AWCA plan boundary that sustain or improve flows in Aravaipa Creek will provide similar benefits to all these downstream users.

Simply put, more water for Aravaipa means more water for Arizona.

Figure 5 shows the hydrography within the planning boundary. The HUC-12 boundaries, flow lines, windmill, and tank data all come solely from the National Hydrography Dataset (U.S. Geological Survey National Geospatial Program, 2022). The springs shown include the National Hydrography Dataset as well as those identified from the research into GNIS database, 1:24,000 topographical maps, and Arizona Department of Water Resources (ADWR) records performed by Norman et al. (2018).

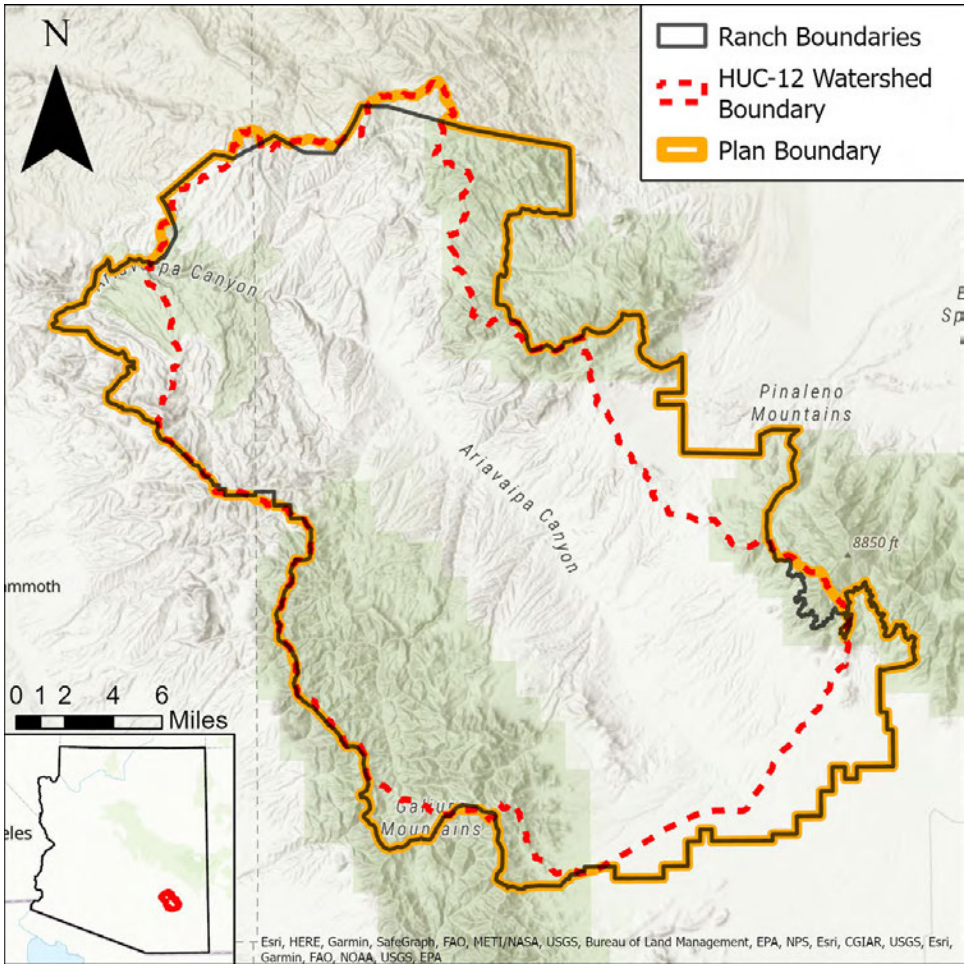

Figure 3. Ranch Boundaries Used for Plan Boundary Development
Source: (Humphrey NRCS, 2022; U.S. Geological Survey National Geospatial Program, 2022)

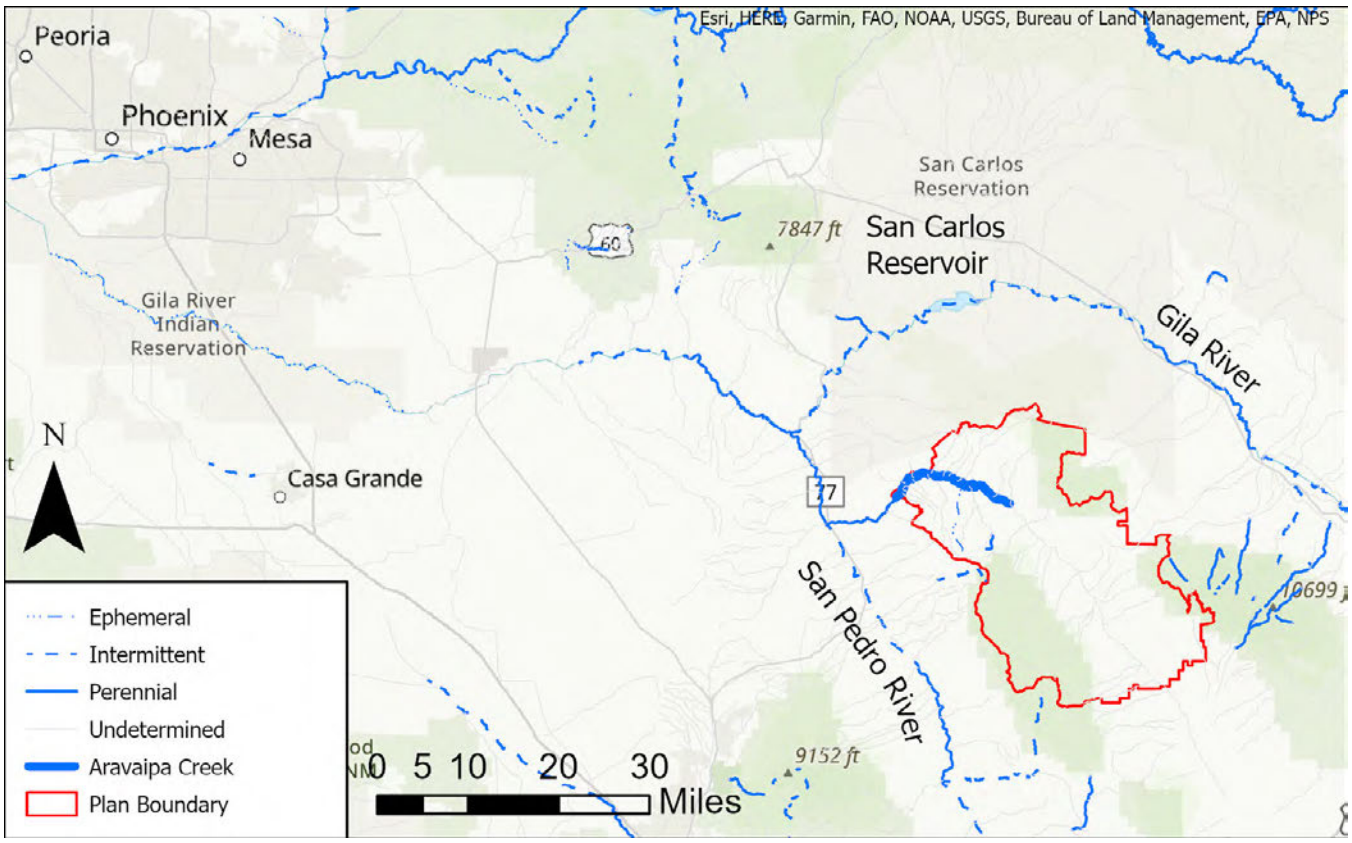

Figure 4. Surface Water Regional Context
Source: (Arizona Department of Environmental Quality, 2022a)

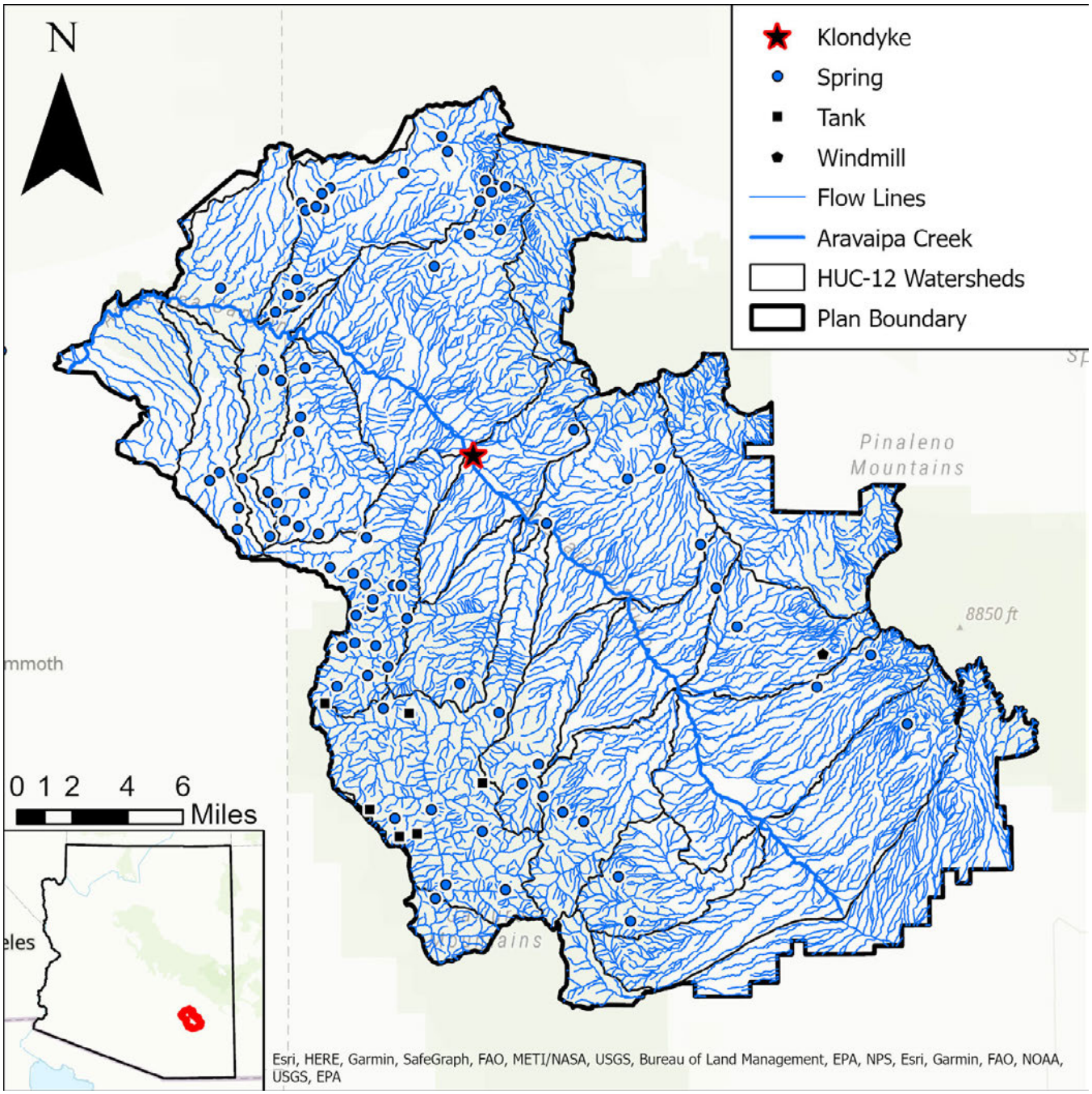

Figure 5. Hydrography within AWCA Plan Boundary
Source: (U.S. Geological Survey, 2022)

Figure 6 shows a digital elevation model within the AWCA plan boundary generated from USGS 1/3 arc second data, which corresponds to a resolution of approximately 8 m (26 ft) by 10 m (33 ft) (U.S. Geological Survey, 2022). 1 m (3.28 ft) by 1 m (3.28 ft) resolution data is also available from the U.S. Geological Survey and can be used for modeling purposes. However, the lower resolution data is sufficient for the purposes of this plan. Elevations within the watershed range from 765 m (2,510 ft) to 2,569 m (8,428 ft). Figure 7 visualizes the elevation slope calculated from the digital elevation model shown in Figure 6. The slope is calculated as the percent change in elevation from neighboring cells in the digital elevation model. Higher percentage values correspond to steeper terrain.

The flowlines in Figure 5 show how surface water will drain within the individual HUC-12 watersheds. As rain falls along the range fronts of the Galiuro, Pinaleno, and Santa Teresa Mountains (shown as the green areas flanking the sides of the plan boundary in Figure 6), it accumulates on land surfaces and flows through a complex network of rivulets, gullies, and arroyos (shown as the dark dendritic and fingered networks in the upper watershed in Figure 6 and Figure 7) and into the bottom of the valley (shown as the light regions that runs

down the central axis of the plan boundary in Figure 7). Aravaipa creek forms in the bottom of the valley and drains the upper watershed in the southeast to the lower watershed in the northwest.

Figure 8 shows the groundwater basins within the region. The primary groundwater basin, by area, within the plan boundary is the Aravaipa Canyon Groundwater Basin. Although the plan boundary overlaps the Dripping Springs Wash, Safford, Willcox, and Lower San Pedro Groundwater Basins, those regions overlap occur primarily where the plan boundary was extended to maintain continuity over ranch boundaries (reference Figure 3). Most of the interactions between surface water and groundwater within the plan boundary will involve the Aravaipa Canyon Groundwater `Basin.

As water drains through the watershed as described above, it will also infiltrate through the soil into the underlying groundwater basin. The underlying geology of the valley is such that groundwater flows in a northwesterly direction, in the direction of the creek. The water table rises to the surface approximately at the junction of Stowe Gulch and Aravaipa Creek. This groundwater flow is responsible for greater than 80% of baseflow through the creek (Norman et al., 2018).

The area within the plan boundary is relatively undisturbed by human activities, especially when compared to other regions of the state (Hadley et al., 1991; Tellman et al., 1997). However, human activities in combination with natural processes have resulted in some impacts to the watershed. Beyond those described in other sections, ADEQ provided a functional rating of "Functional at Risk/Upward Trend" in 1998. BLM has characterized the upper Aravaipa Creek as substantially degraded. In the upper watershed, the channel has become incised and land modifications made to mitigate bank erosion have resulted in channel straightening and other effects that will increase erosion and sediment transport (Bureau of Land Management Safford Field Office, 2015).

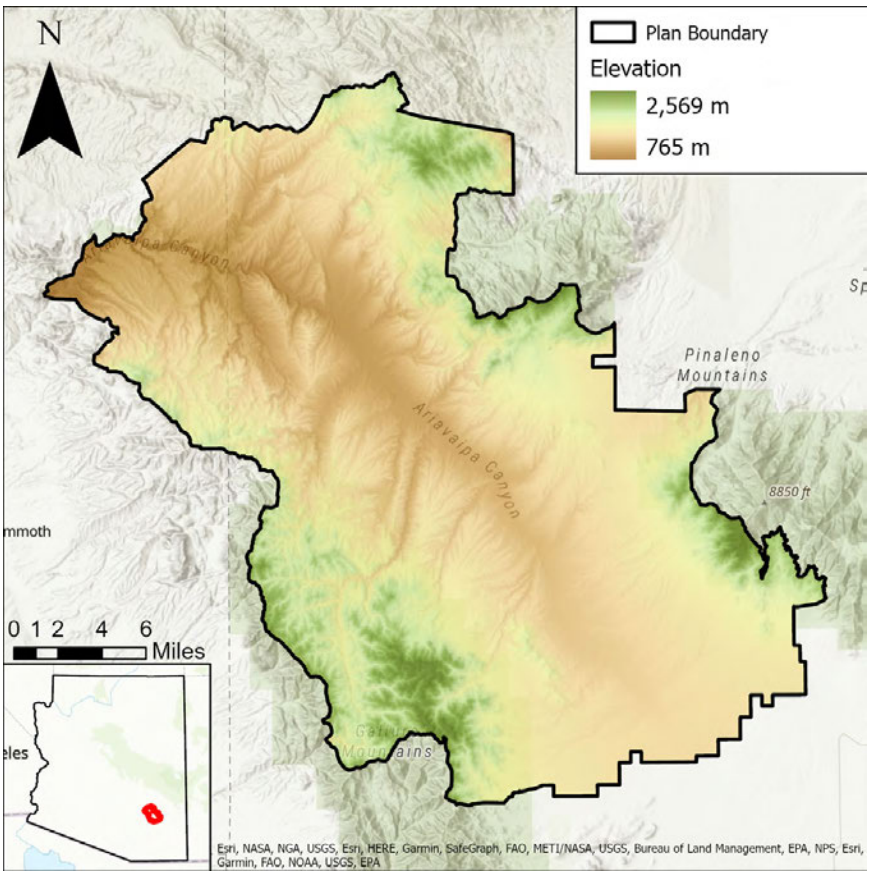

Figure 6. Digital Elevation Model within AWCA Plan Boundary
Source: (U.S. Geological Survey, 2022)

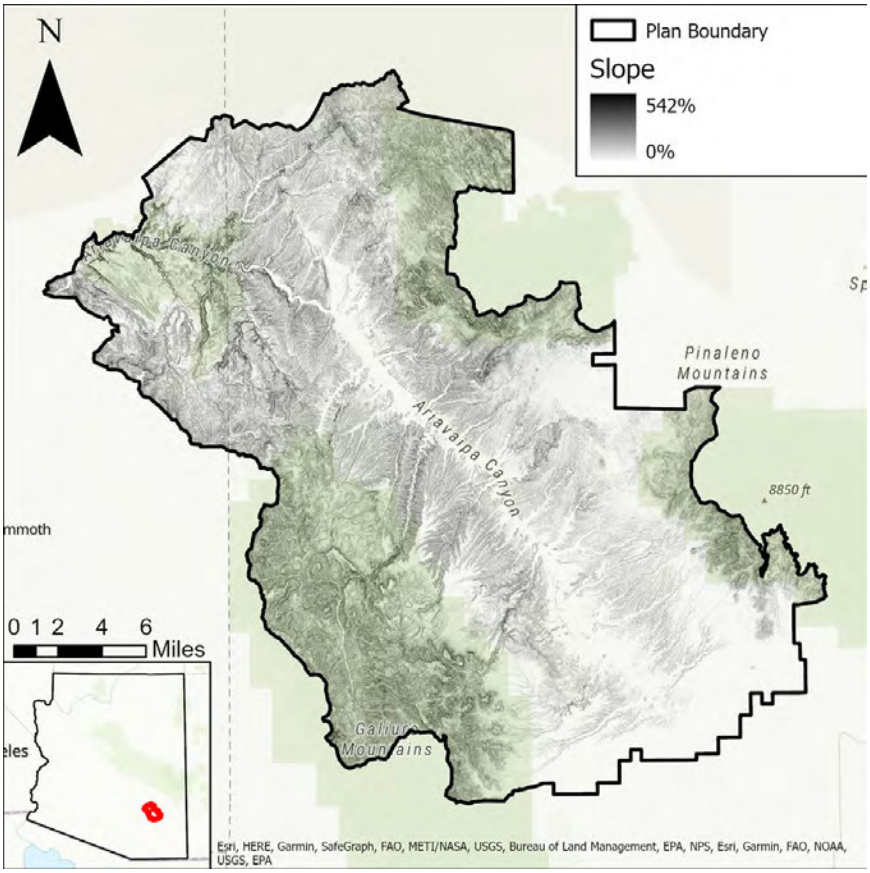

Figure 7. Digital Elevation Model Slope within AWCA Plan Boundary
Source: (U.S. Geological Survey, 2022)

Figure 8. Regional Groundwater Basins
Source: (Arizona Department of Water Resources, 2021; U.S. Geological Survey National Geospatial Program, 2022)

3.2 Brief History of Human Use and Impact

Human use of the area has resulted in relatively minimal impacts, even though human habitation in the area dates back thousands of years. Settlements date to the prehistoric period with Hohokam, Mogollon, and Salado people occupying the region. During the period immediately before recorded history and up to the era of Spanish exploration of the region, the area was primarily settled by the Upper Pima (Sobaipuris). From the 1540s through the 1700s, the Sobaipuris continued to occupy the land with sparse Spanish settlement. In the late 1700s, the Sobaipuris left the Aravaipa Valley for the Santa Cruz River area near Tucson, and a band of the Pinaleno Apaches settled the region. After the Gadsden Purchase, conflicts between the Apache and Anglo settlers led to the United States establishing the San Carlos Apache Reservation (Hadley et al., 1991).


Abandoned Mine Housing

In the 1860s modern mining and farming started on a small scale. Early farms were relatively small, approximately five to 40 acres. Starting in the 1920s, farm growth increased to a peak in 1960. During the peak, less than 500 acres in the region were brought under cultivation. Population in the region declined due to flood damages after 1960. Townsites and camps, including

Table Mountain, Copper Creek, Stanley, and Aravaipa, of various sizes were founded to support the different mines in the region. Mines included the Aravaipa-Grand Reef, Stanley, Deer Creek, Table Mountain, and Copper Creek (Hadley et al., 1991; Tellman et al., 1997).

Human impact to the region has largely been driven by mining and ranching. Much of the land cleared for farming was to meet demand from miners. Ranching has introduced goats, cattle, and other non-native species (e.g., lovegrass seed) to the region. At times, land has been overgrazed, resulting in changes to land cover and erosion. From the time of the Gadsen Purchase through the end of the open range period and passage of the Taylor Grazing Act in 1934, the primary range management approach was to carry the largest number of head possible. In combination with the drought of 1933 to 1934, the change in management policies has resulted in a focus on lower number of cattle and increased rangeland restoration. In 1971, The Nature Conservancy (TNC) and Defenders of Wildlife established a preserve to protect Aravaipa Canyon. BLM created the Aravaipa Canyon Wilderness Area in 1984 to extend additional protections to the canyon (Hadley et al., 1991; Tellman et al., 1997).

3.3 Climate

Although climate and weather are frequently used interchangeably, there are important differences between the two. Climate is the long-term average and extreme conditions of significant factors, including temperature and precipitation. Weather refers to current conditions, and long-term aggregation of weather is used to establish climatic regimes and predict future conditions. Regional climate impact key watershed characteristics, including vegetation, streamflow, and water temperature (O'Keefe et al., 2022).

The Parameter-elevation Regressions on Independent Slopes Model (PRISM) has become a standard tool for modeling past climate data. A significant challenge in watershed management is determining key climate variables (e.g., precipitation, temperature, humidity) over large areas when data is only available from a small set of weather stations in an area. With increasing use of Geospatial Information Systems, scientists at the University of Oregon developed a model to automate the process of predicting these variables over an area based on the topology of the region. Outputs of the PRISM model are commonly used to describe key climate variables in a region (Daly & Bryant, 2013).

The NRCS provides annual and monthly average precipitation and annual average maximum and minimum temperatures based on data from 1981 to 2010 with a resolution of approximately 800 m (2600 ft) by 800 m (2600 ft) (United States Department of Agriculture et al., 2012). Figure 9 and Figure 10 show the average annual and monthly precipitation within the plan boundary, respectively. Figure 11 and Figure 12 show the average annual maximum and minimum temperatures, respectively. These temperatures represent the derived average maximum and minimum temperature using point temperature data for the time period between 1981 and 2010 (United States Department of

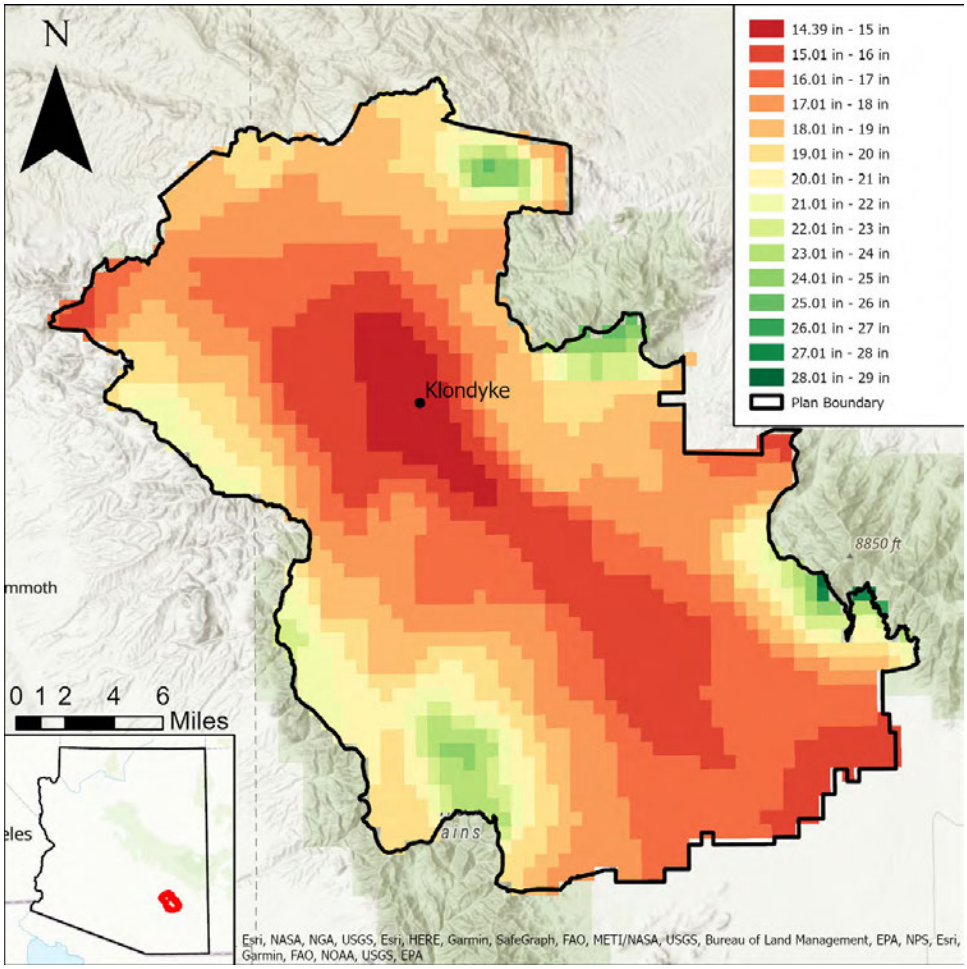

Figure 9. PRISM Average Annual Precipitation 1981-2010 within Plan Boundary
Source: (United States Department of Agriculture et al., 2012)

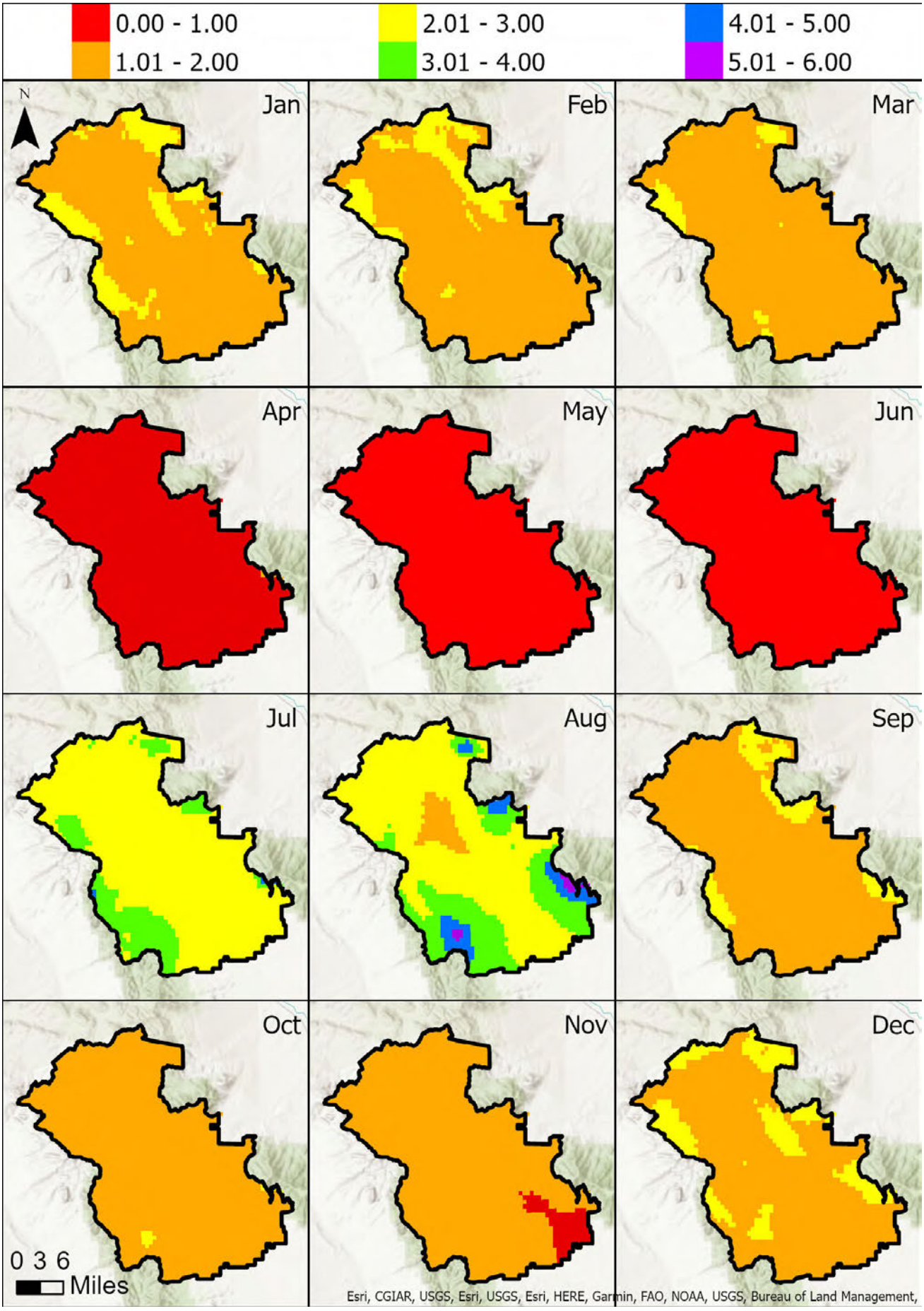

Figure 10. PRISM Average Monthly Precipitation 1981-2010 within AWCA Plan Boundary
Source: (United States Department of Agriculture et al., 2012)

Agriculture et al., 2012). Review of these climatic trends show that rainfall levels are highest at higher elevations and decrease towards the bottom of the valley. Monthly precipitation trends show the most precipitation falling during summer monsoons, with a second, lower magnitude precipitation period during the winter months. Early fall is relatively dry, while late spring and early summer are extremely dry. Higher high and low temperatures are observed along the bottom of the valley and canyon.

There is broad scientific consensus and very high confidence that human activities, especially emissions of greenhouse heat-trapping gases are the dominant cause of global average temperature increases (Hayhoe et al., 2018). Average temperatures in the area have increased approximately 1.5° to 2.0° F between 1901 and 2016 (Garfin et al., 2018). In addition to increased average temperatures, the frequency and magnitude of extreme heat events are expected to increase (Garfin et al., 2018). Precipitation in the region is expected to decrease, while the variability of events is expected to increase (McCoy et al., 2022). Long duration drying associated with these precipitation changes will likely reduce runoff efficiency and streamflow (McCoy et al., 2022). Climate change and historical forest management practices will likely result in increased wildfires and associated increases in sedimentation and erosion (Garfin et al., 2018; McCoy et al., 2022).

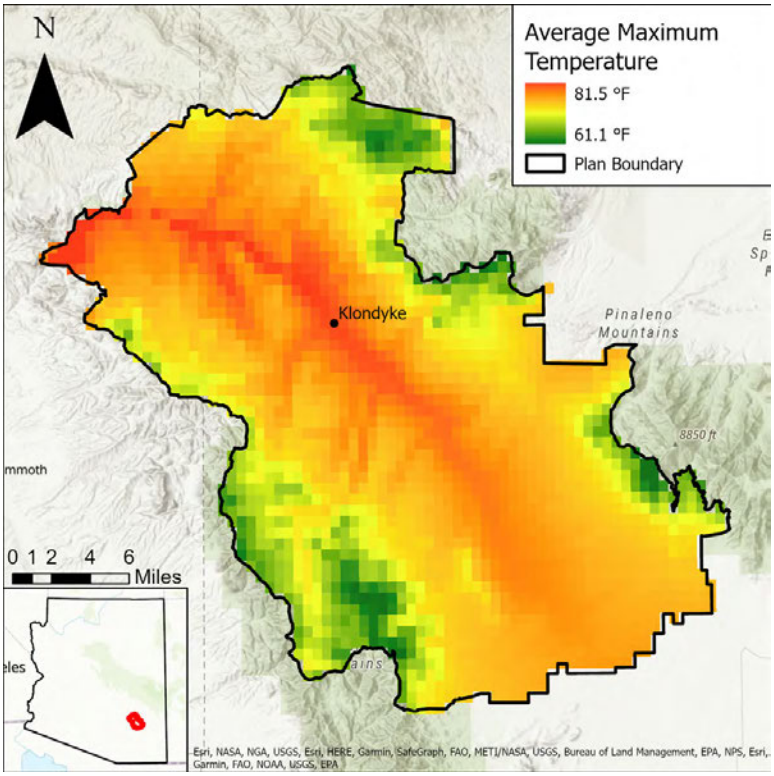

Figure 11. PRISM Average Annual Maximum Temperature 1981-2010 within AWCA Plan Boundary
Source: (United States Department of Agriculture et al., 2012)

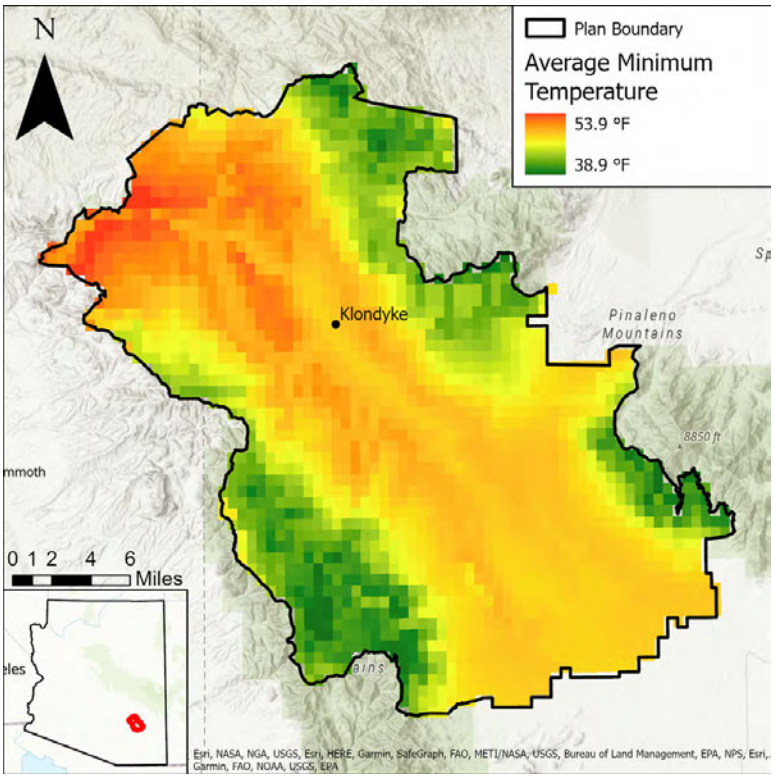

Figure 12. PRISM Average Annual Minimum Temperature 1981-2010 within AWCA Plan Boundary
Source: (United States Department of Agriculture et al., 2012)

3.4 Land Ownership

Figure 13 shows historic ranch boundaries and Figure 14 shows land ownership within the AWCA plan boundary. Historic ranch boundaries provide useful context for subsequent discussions and are approximate. As described in Section 1, exact estimates of population are difficult to obtain because of the large number of part time residents in the subdivided portion of the watershed.

Comparison of Figure 14 and the digital elevation model and slope shown in Figure 6 and Figure 7 show how private land ownership is clustered along Aravaipa Creek in the valley bottom and along major drainages in the region. Large portions of State Trust, Forest Service, and Bureau of Land Management lands are leased to the deeded owners of adjacent private lands. The predominant use of leased land within the plan boundary is grazing cattle.

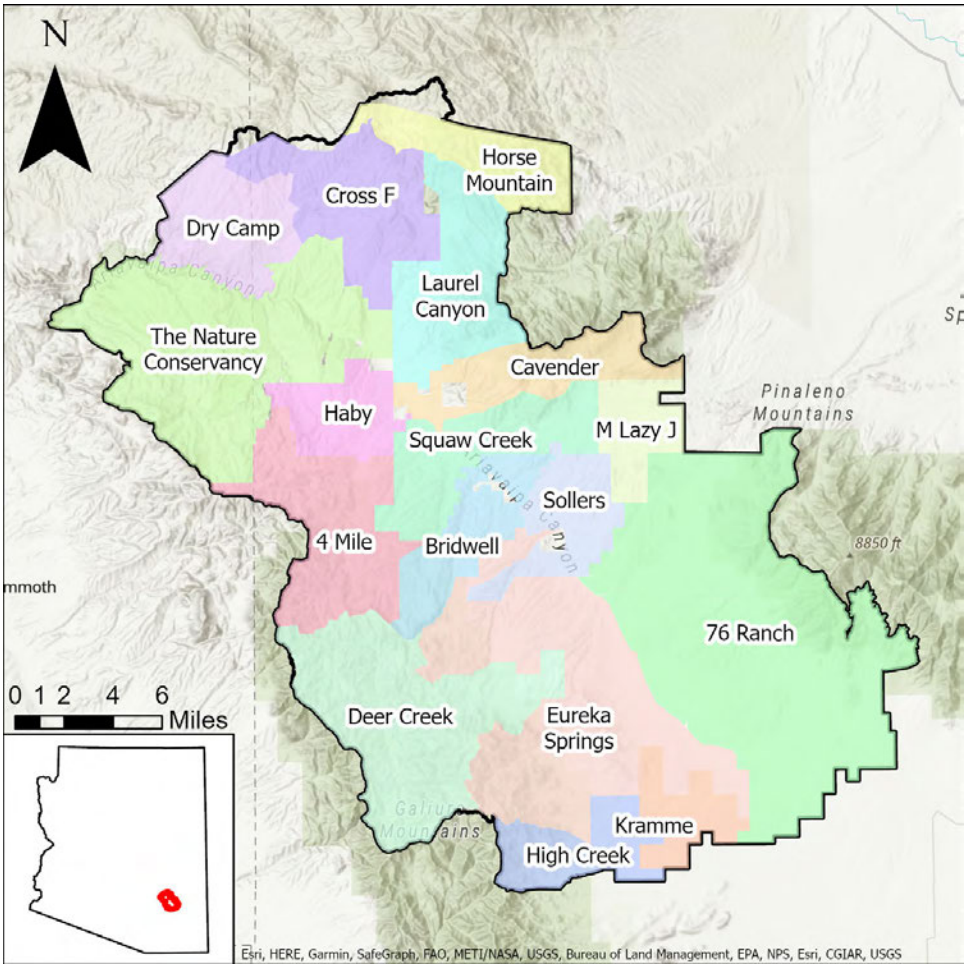

Figure 13. Ranch Boundaries
Source: Original map was created by S. Stratton at NRCS. Unfortunately, a shapefile of the map was unable to located. The map shown here was recreated from exported PDFs of the original. (Humphrey NRCS, 2022).

Figure 14 shows that private deeded lands within the Eureka Springs and 76 Ranch historic boundaries have been subdivided into lots ranging from roughly 10 to 40 acres. Further subdivision and extensive development of this land raise concerns for many factors that impact watershed health. As fragmented lands become more densely developed, the density of roads in the upper watershed is likely to increase (Bureau of Land Management, 2022). Roads increase erosion and sediment transport by altering the topographic features of the watershed. Further, soil compaction on roads decreases soil porosity, increasing runoff and erosion. Additional structures (e.g., homes, driveways) will increase the area within the watershed where water cannot infiltrate, only runoff. New structures will further disrupt natural fire patterns in the region that are necessary to maintain grasslands and beat back mesquite encroachment. As additional development occurs in the upper watershed where surface flows are all ephemeral, groundwater pumping will increase. Larger magnitude pumping will exacerbate recharge deficits, reducing groundwater elevations. This could potentially impact perennial reaches of the Aravaipa Creek. Finally, additional human habitation increases the risk of new invasive species, whether planted for forage, food, or decoration (Spaeth et al., 2022).

3.5 Water Quantity

Surface water is the water that flows over the land, accumulating in streams and rivers, from either precipitation runoff or from groundwater discharge. Groundwater is the portion of water that resides beneath the surface of the land in the soil and aquifers. Rights to surface water are allocated through the prior appropriation doctrine, where the order of allocation in times of shortage is defined by the date and quantity of first beneficial use of that water. Groundwater is defined by separate regulations, and largely consists of minimal reporting and registration requirements within the plan boundary. However, surface and groundwater have close physical interconnections, and this is recognized via the subflow zone. The subflow zone is the region of overlap where a well's cone of depression (i.e., the volume from which the well draws water) removes groundwater that would otherwise have maintained surface flow (Ferris et al., 2018).

3.5.1 Surface Water

The USGS streamflow gauge 09473000 is located slightly outside the plan boundary on the Aravaipa Creek as shown in Figure 16. Average daily flows through the gauge are shown for available data from 1933 to 2023 are shown in Figure 17. Peak mean daily flow in response to flood events can exceed 16,000 cfs (U.S. Geological Survey, 2023). Base flows range from approximately 15 cfs in February to a low of less than 5 cfs in June (Bureau of Land Management Safford Field Office, 2015) Average annual baseflow is 9,500 acre-feet per year (13 cfs). Although the gauge is located outside of the plan boundary, it is close enough to provide a useful measure of

LAND OWNERSHIP

Table 1 and Figure 15 show the total acreage and percentage of land owned by different agencies and private entities within the plan boundary.

Table 1. Land Ownership within AWCA Plan Boundary

Owner/Agency	Acreage	% of Total
Bureau of Land Management	60,511	16
National Forest	120,055	31
Private Deeded Land	58,440	15
San Carlos Apache	3,109	1
State Trust Land	145,230	37
Total	387,345	100

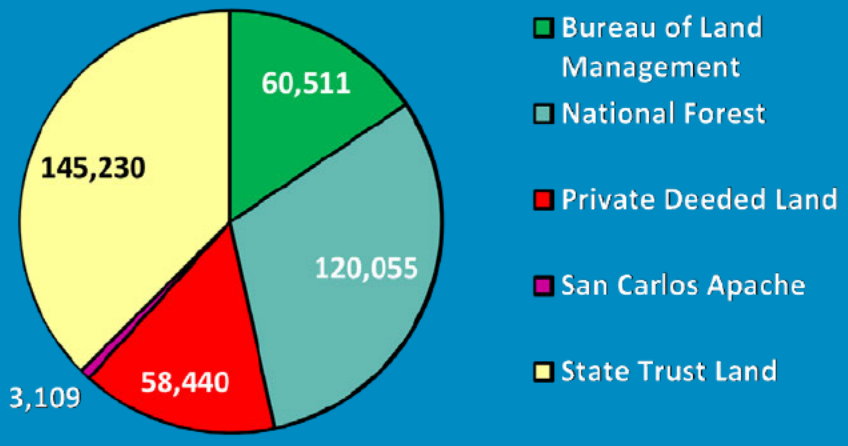

Figure 15. Land Ownership in Acres within AWCA Plan Boundary
Source: (Bureau of Land Management, 2022; Graham County, 2022)

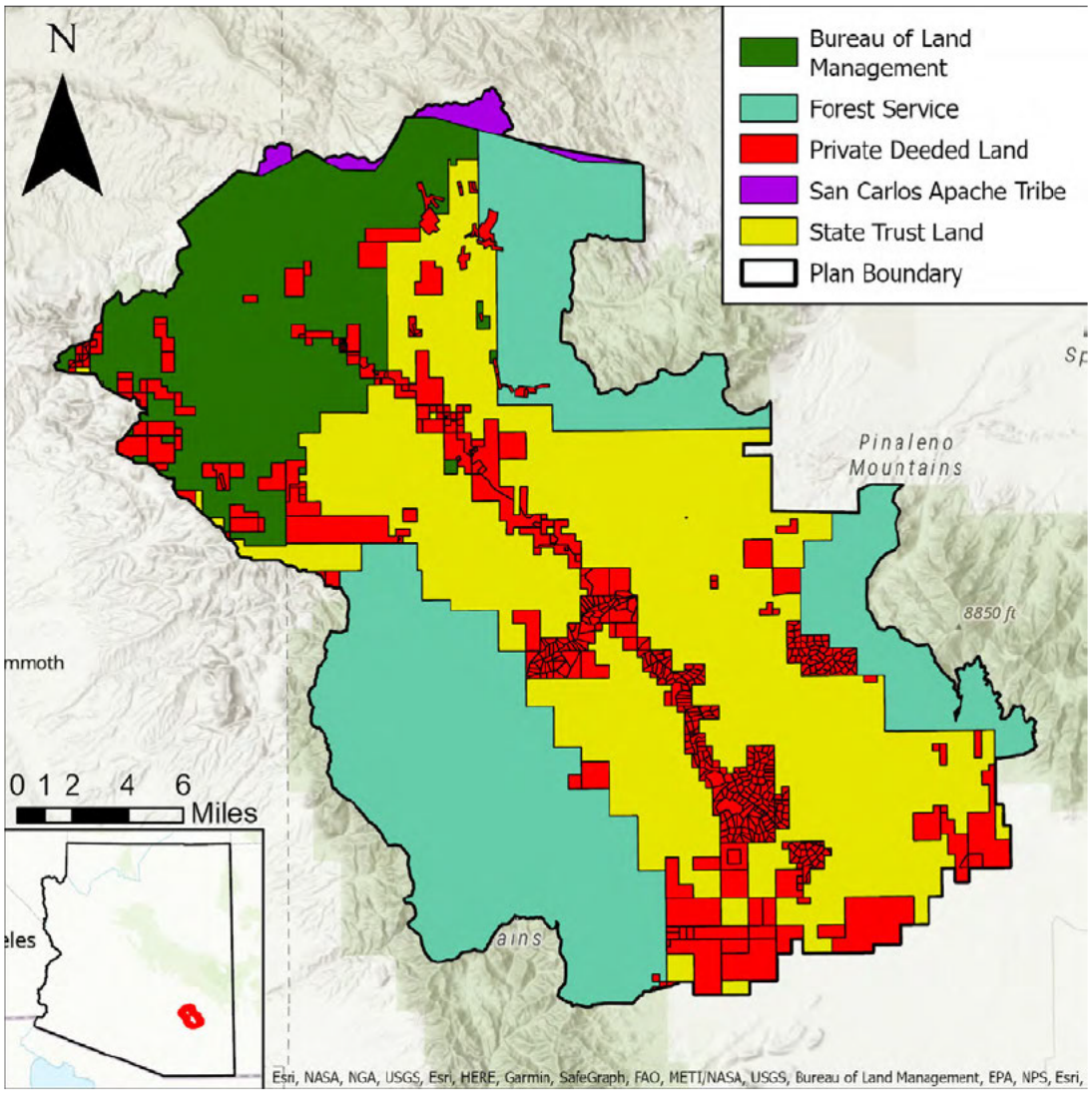

Figure 14. Land Ownership within AWCA Plan Boundary
Source: (Bureau of Land Management, 2022; Graham County, 2022)

total runoff from the region.

Both the BLM and The Nature Conservancy (TNC) have in-stream flow water rights on Aravaipa Creek. These rights are established to maintain sufficient flows to support animal and plant wildlife, including fish (Bureau of Land Management Safford Field Office, 2015). Other surface water rights within the plan boundary can be located through the ADWR. There are four small reservoirs in the area, two with a total capacity of 117 acre feet and two with areas totaling 38 acres. There are 349 registered stockponds in the area; although the stock ponds vary in actual size, each is registered with a maximum 15 acre-feet capacity (Arizona Department of Water Resources, 2009).

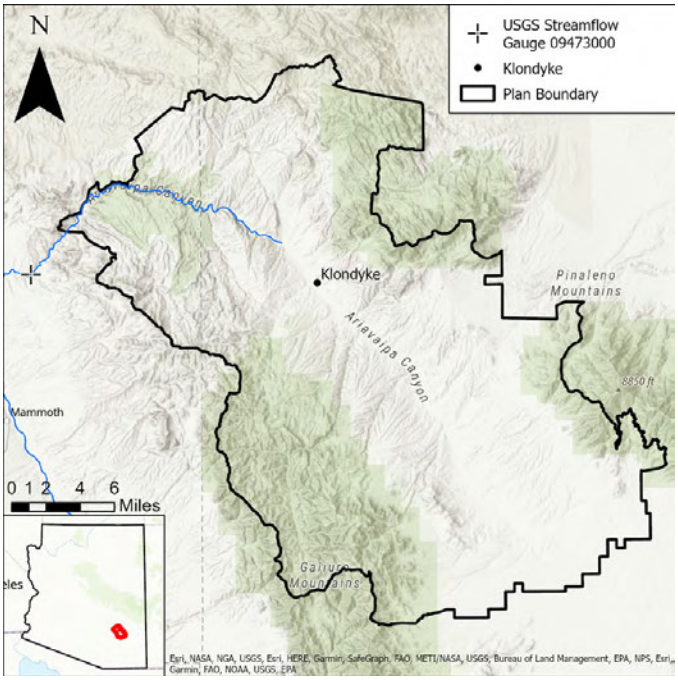

Figure 16. Location of USGS Streamflow Gauge 094730000 on Aravaipa Creek
Source: (U.S. Geological Survey, 2023)

3.5.2 Groundwater

Maintaining groundwater levels is important for maintaining desired grassland communities that have relatively shallower roots than the mesquite shrubland that is encroaching. Persistent regional drought can result in long term groundwater table lowering due to the hydrological dynamics between surface and groundwaters described above. Under the Groundwater Management Act, Arizona Department of Water Resources (ADWR) collects data for well locations across the state. Figure 18 shows the location of these wells within the AWCA plan boundary, including predominant water use of the well. Typically, substantial quantities of water are not pumped from monitoring and test wells. The recreation well in the area is at the Four Mile Campground.

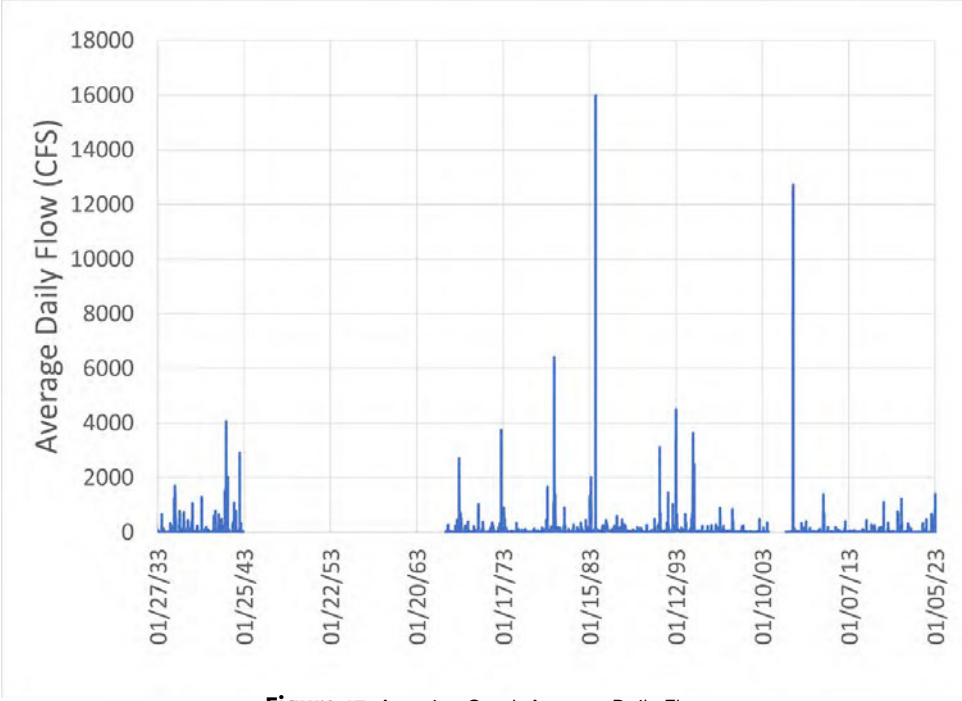

Figure 17. Aravaipa Creek Average Daily Flow
Source: (U.S. Geological Survey, 2023)

As part of the General Adjudication of the water rights in the Gila River, a subflow zone has been approved for the San Pedro River, including the Aravaipa Creek. Pumping affects subflow when the cone of depression for a well (i.e., the larger volume of aquifer from which water is drawn through a well) removes groundwater that would otherwise sustain flow in a stream. This means that water rights, both priority and quantity, associated with wells located in the subflow zone are subject to the Gila River adjudication. Figure 18 shows the subflow zone within the plan boundary – it extends from the confluence with the San Pedro River, through the ephemeral portions of the creek approximately a third of the way up the watershed. Figure 19 shows the extent of the San Pedro Subflow Zone within the plan boundary in greater detail (Ferris et al., 2018).

ADWR also maintains data on Groundwater Site Inventory (GWSI) program. These are wells where depth to water and water table elevation are measured at different frequencies. This data can be a valuable indicator of local aquifer health, showing how groundwater pumping and other natural processes affect water stored in the aquifer. Figure 20 shows the most recent measured depth to water for GWSI wells within the AWCA plan boundary. In general, the depth to water is deeper in the upper watershed and decreases as groundwater flows

towards the mouth of Aravaipa Canyon.

Figure 21 shows the annual change in depth to water for these wells. To calculate the value, the individual depth to water change rate for each measurement is calculated as the ratio of the depth to water change and the time in years between measurements. These individual values are then averaged to determine the average depth to water change per year for all available data since 1990. Yellow points symbolize wells that are at relatively steady state, green points show wells with rising water tables. Orange and red dots show wells where the water tables are declining. Consistent with the trends described in other resources, this map shows that groundwater levels are declining slightly in the upper watershed but practically at steady state in the lower watershed. Figure 22 shows historical depth to water data from the GWSI data set for all wells within the plan boundary that have data more recent than 1990. These wells show the trends described in Figure 21 in greater detail.

SAN PEDRO SUBFLOW ZONE

As part of the General Adjudication of the water rights in the Gila River, a subflow zone has been approved for the San Pedro River, including the Aravaipa Creek. Pumping affects subflow when the cone of depression for a well (i.e., the larger volume of aquifer from which water is drawn through a well) removes groundwater that would otherwise sustain flow in a stream. This means that water rights, both priority and quantity, associated with wells located in the subflow zone are subject to the Gila River adjudication.

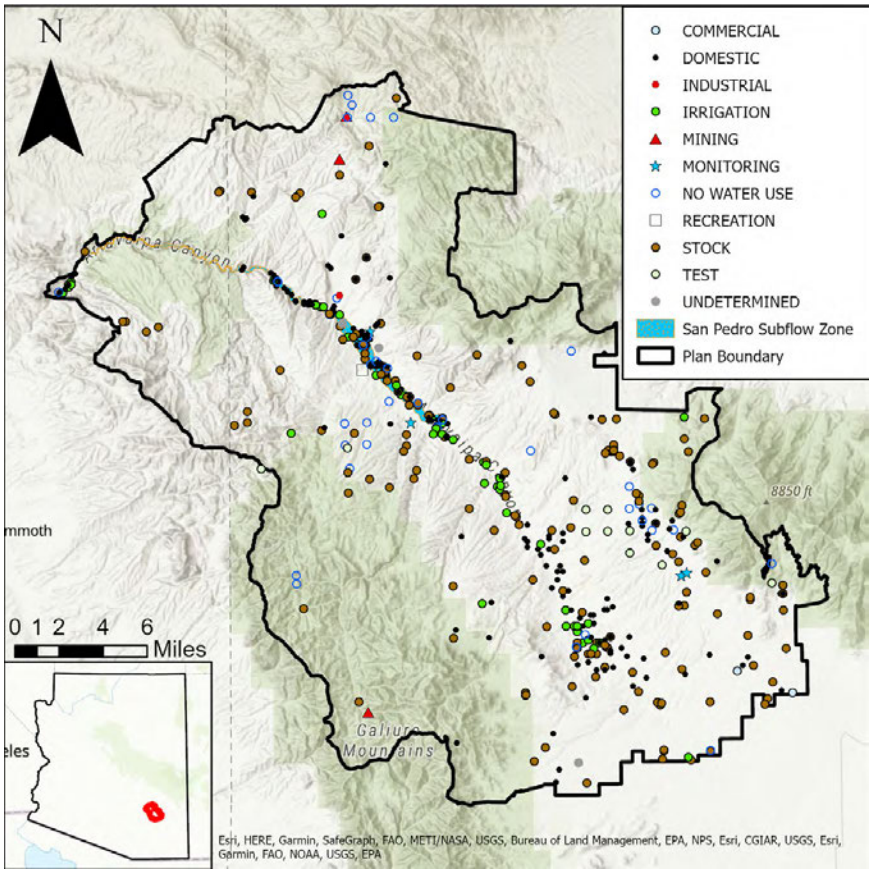

Figure 18. All Wells within AWCA Plan Boundary
Source: (Arizona Department of Water Resources, 2022b, 2022c)

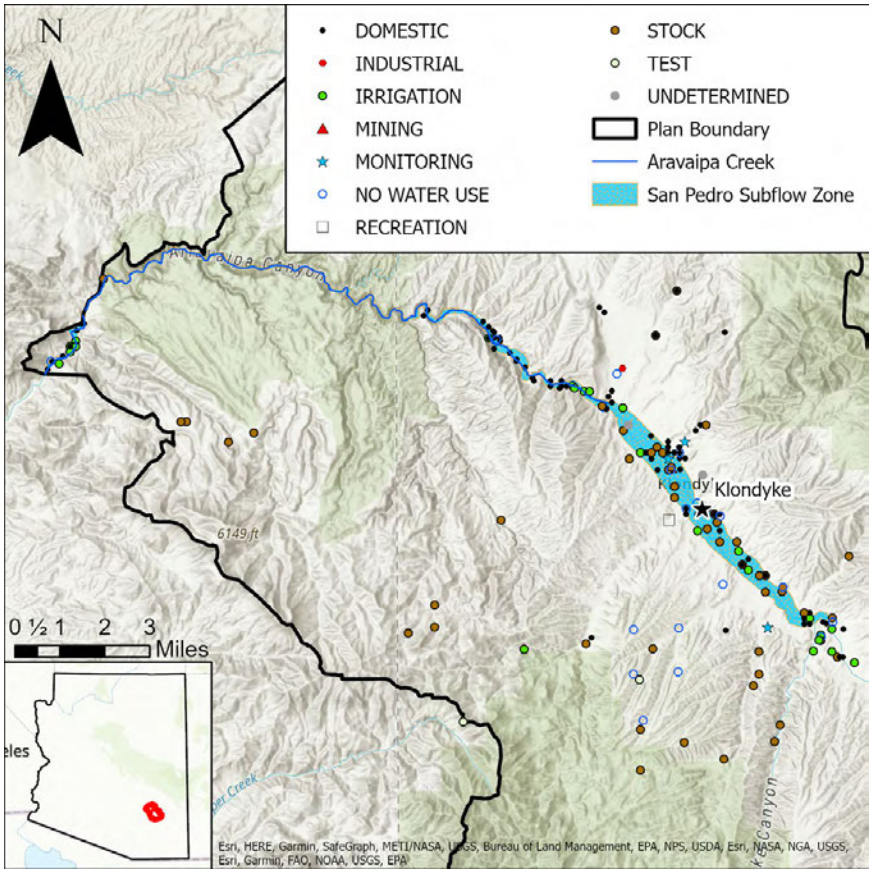

Figure 19. Wells within AWCA Plan Boundary and San Pedro Subflow Zone
Source: (Arizona Department of Water Resources, 2022b, 2022c)

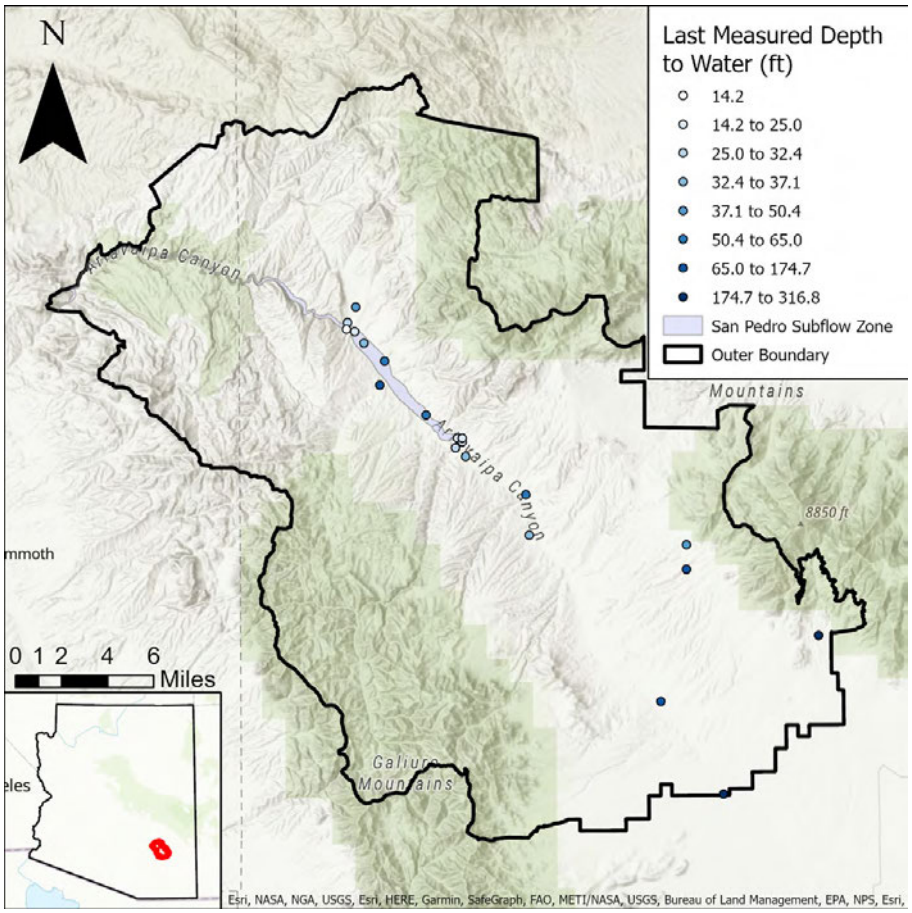

Figure 20. GWSI Well Last Measured Depth to Water within AWCA Plan Boundary
Source:(Arizona Department of Water Resources, 2022a)

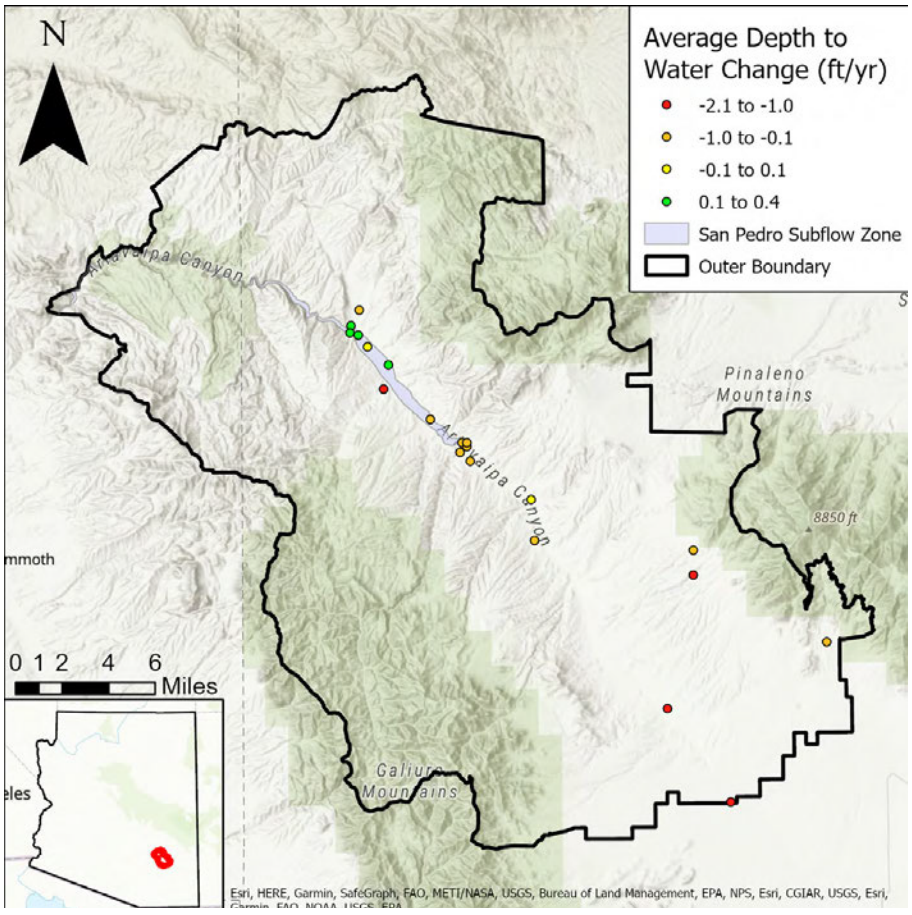

Figure 21. GWSI Wells Average Annual Change in Depth to Water within AWCA Plan Boundary
Source: (Arizona Department of Water Resources, 2022a)

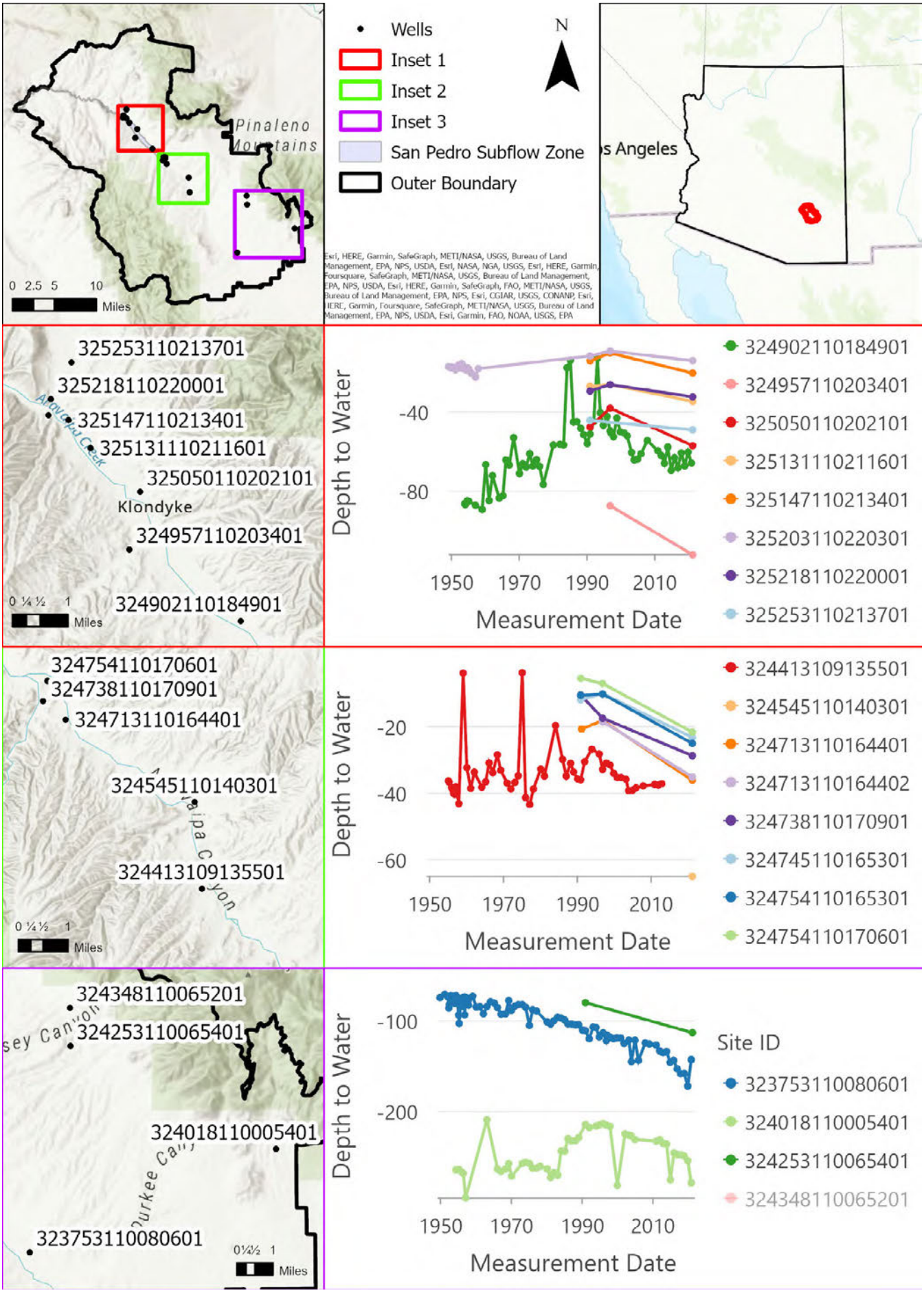

Figure 22. GWSI Wells Historic Depth to Water Data within AWCA Plan Boundary
Source: (Arizona Department of Water Resources, 2022a)

3.5.3 Water budget

A water budget is a common tool used to describe the flow of water between the atmosphere, surface water, and groundwater. Within the AWCA Plan Boundary, precipitation primarily falls as rain. Due to the complex topography and wind currents in the region, rainfall can be patchy with some areas receiving inches of precipitation while others remain dry for the same storm. As rain falls, it either evaporates and circulates back through the atmosphere (virga), is intercepted as it falls to the ground by plants or structures, or directly falls to the ground. Portions of intercepted water reach the ground by dripping through the ground cover (throughfall) or by running along the stems, limbs, and trunks of ground cover (stemflow). If the rainfall rate is lower than the soil permeability, water will infiltrate the soil until all the pores within soil are filled to capacity. Once this saturation condition is reached, water begins to pond on the surface until it runs off. Water in these ponds will either evaporate or infiltrate into the soil over time. Water in the soil will slowly percolate into the groundwater aquifers as recharge over time. While in soil storage, water can be absorbed and used by plants through transpiration, discharge into streambeds at lower elevations, evaporate back into the atmosphere, or percolate into the groundwater basin as aquifer recharge. Runoff water flows downhill, accumulating with other runoff to form rivulets, eventually forming streams and rivers. Portions of these surface flow will evaporate to the atmosphere, be consumed and transpired by plants along streambanks, discharge into lower moisture bank soil, or exit the watershed.

Because they are hard to measure separately, evaporation and transpiration are usually grouped together as evapotranspiration (ET). Summarizing the preceding discussion into net flows of interest to facilitate subsequent discussions:

$$P-ET-R=S$$

Storage (S) is equal to the difference between precipitation (P) and runoff (R) and evapotranspiration (ET). In general, if ET and runoff exceed precipitation, the excess moisture comes from the soil or aquifer storage. Runoff depends extensively on soil health and infiltration rates. Although groundwater can be depleted by ET and streambed discharge in shallow groundwater areas, groundwater pumping by humans typically has greater impact on long term aquifer storage. Combined with natural groundwater flow and lower rates of recharge resulting from land cover and precipitation changes, groundwater pumping can cause local declines in groundwater elevations. Long term declines in water table elevations have the potential to reduce baseflows in the perennial reaches of Aravaipa Creek (Norman et al., 2018; Spaeth Jr. et al., 2022).

Norman et al. (2018) completed a non-calibrated Soil and Water Assessment Tool (SWAT) model to predict the impact of development in the upper watershed. SWAT models are used to simulate the water and soil flows through a watershed, including their environmental impact. Due to the relative scarcity of localized precipitation data in the watershed, calibration of the model (i.e., testing the model against known inputs and outputs to adjust model factors to more closely match the real world) is difficult and has not been completed. This SWAT model was completed to assess development impacts in the

Aravaipa Creek

region. Although the model is not calibrated, it provides valuable trends that can be used to provide qualitative assessment of the water budget in the region. The majority of precipitation (~73%) returns to the atmosphere via ET. Most of the remaining water (~24%) flows out of the watershed via Aravaipa Creek. The remainder (~3%) is aquifer recharge. These values should be relied on for general magnitudes since the model has not been calibrated.

3.6 Water Quality

3.6.1 Surface Water

When discussing surface water quality, there are two primary categories of pollution sources: point sources and nonpoint sources. Point sources are localized discharges of pollution (e.g., treated wastewater outflow from a sewage treatment plant). Nonpoint sources occur when runoff from precipitation travels across the watershed, bringing with it various contaminants like fertilizer residues, metals, and bacteria (Arizona Department of Environmental Quality, 2022b).

The Clean Water Act (CWA) created the basic structure for regulating pollution discharge into surface waters and establishing water quality standards for surface waters. The CWA requires that any discharge of pollution into navigable waters requires a permit (U.S. Environmental Protection Agency, 2022). However, there have been shifts in determining the definition of Waters of the United States (WOTUS) that would be subject to these regulations. Therefore, ADEQ is implementing the Surface Water Protection Program (SWPP) to extend protections to some non-WOTUS waters that are used for drinking, fishing, or other recreation (Arizona Department of Environmental Quality, 2023). Point sources are regulated under the Arizona Pollutant Discharge Elimination System (APDES) (Arizona Department of Environmental Quality, 2022b). There are no existing APDES permits within the plan boundary (Arizona Department of Environmental Quality, 2022a).

As implemented, the CWA requires states to identify how waterbodies are used. These uses are referred to as “designated uses” and have associated water quality standards to meet. A water body that does not meet these standards is considered “Impaired” and a Total Maximum Daily Load (TMDL) Plan is developed for the impaired waters. ADEQ publishes geospatial data through their eMaps portal, including designated uses and impaired waters (Arizona Department of Environmental Quality, 2022a). The designated uses within the plan boundary are shown in the breakout box to the right.

Beyond these designated uses, ADEQ may adopt site-specific water quality standards to maintain and protect Outstanding Arizona Waters (OAW). The 15.5 stream miles of Aravaipa Creek from the confluence with Stowe Gulch to the outlet of the Aravaipa Canyon Wilderness Area are classified as Tier 3 OAW. Tier 3 means that existing water quality shall be maintained and protected. Further, discharge permits that degrade the quality of water in the downstream OAW will not be accepted (Arizona Department of Environmental Quality, 2019).

WHAT ARE DESIGNATED USES?

The Clean Water Act tailors water quality requirements to the particular use of the water body, also referred to as the "designated use". ADEQ has identified the following designated uses for streams within the plan boundary:

- Agricultural Livestock Watering (AgL): water supply for livestock consumption
- Cold Water Aquatic and Wildlife (A&Wc): cold water used by animals, plants, and other cold-water wildlife
- Ephemeral Aquatic and Wildlife (A&We): ephemeral water used by animals, plants, and other wildlife
- Warm Water Aquatic and Wildlife (A&Ww): warm water used by animals, plants, and other warm-water wildlife
- Full-Body Contact (FBC): water used for recreation that causes the human body to be fully submerged in water, including likely ingestion or contact with sensitive body parts like eyes, ears, and nose.
- Partial-Body Contact (PBC): water used for recreation (e.g., wading boating) that causes the human body to contact but not be fully submerged in water
- Fish Consumption: water where aquatic organisms will be harvested for consumption

(Arizona Department of Environmental Quality, 2022a, 2022c)

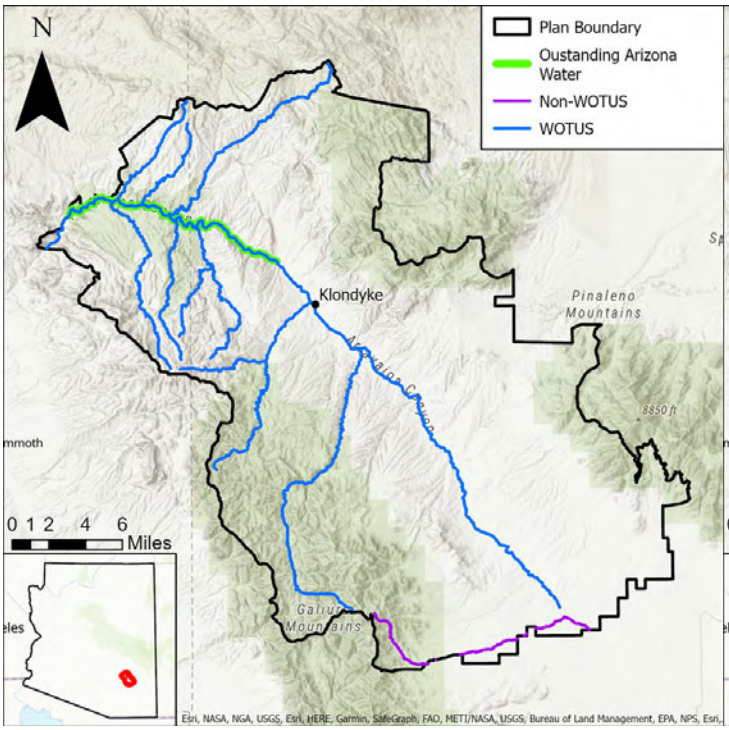

Figure 23. Arizona Surface Water Protection Program Streams with WOTUS and Outstanding Arizona Waters Status
Source: (Arizona Department of Environmental Quality, 2022a)

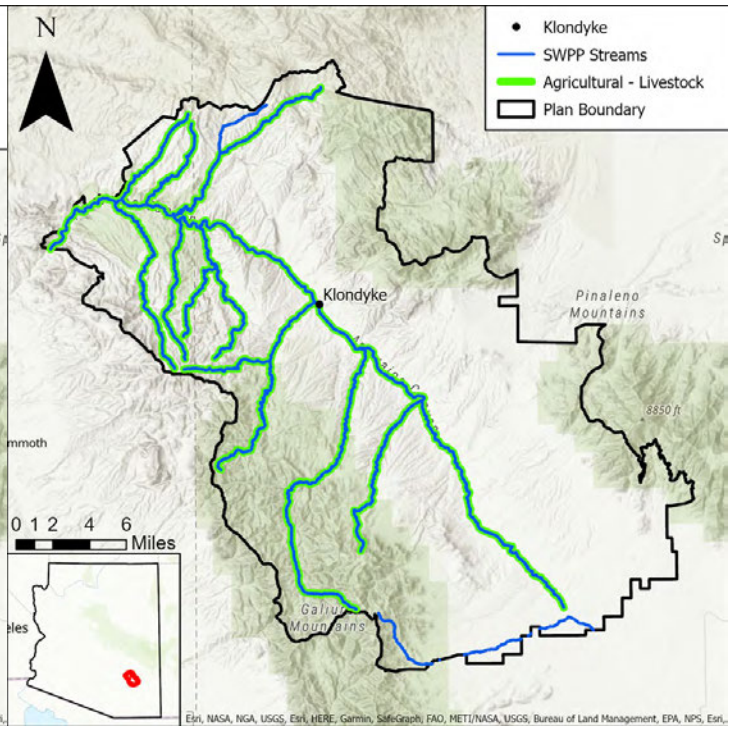

Figure 24. Arizona Surface Water Protection Program Agricultural Designated Uses
Source: (Arizona Department of Environmental Quality, 2022a)

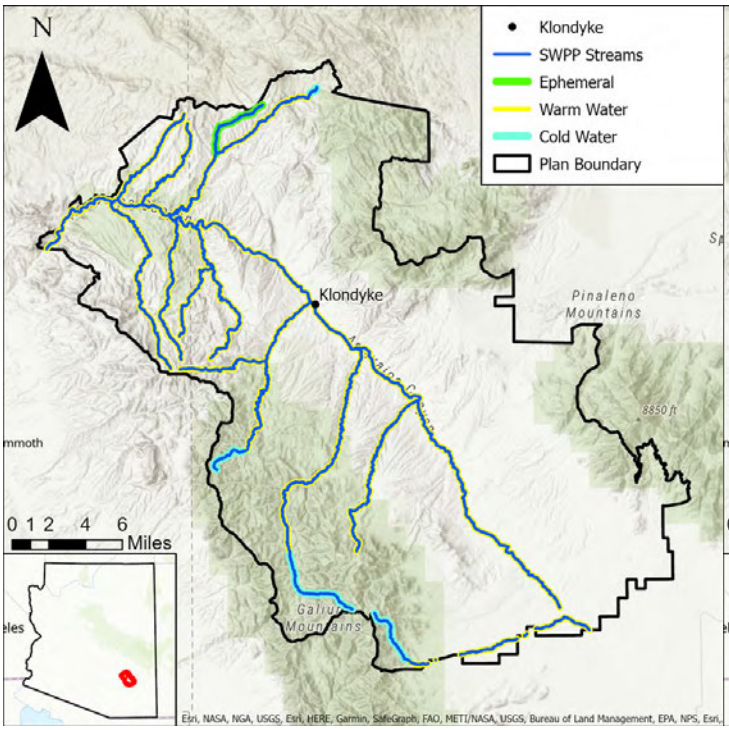

Figure 25. Arizona Surface Water Protection Program Aquatic and Wildlife Designated Uses
Source: (Arizona Department of Environmental Quality, 2022a)

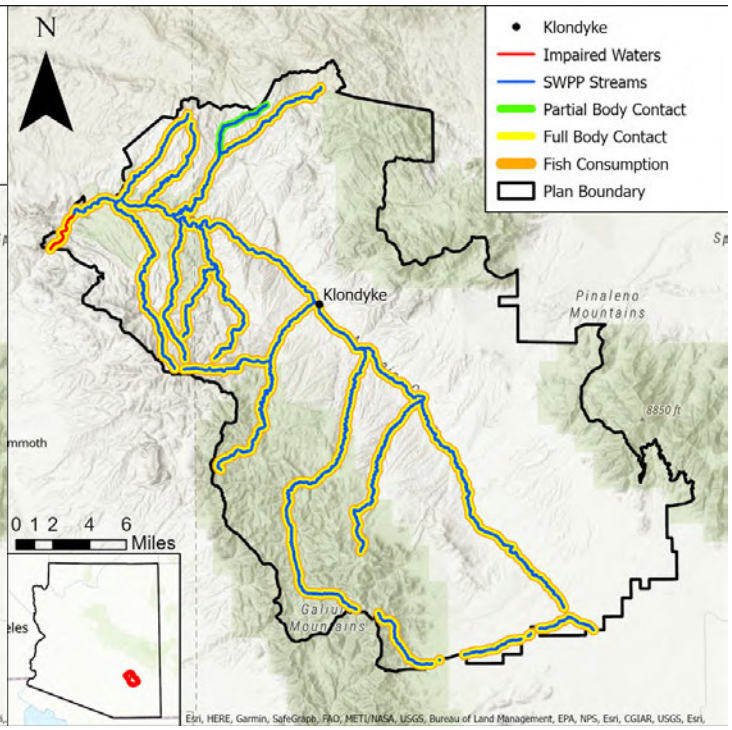

Figure 26. Arizona Surface Water Protection Program Human Health Designated Uses
Source: (Arizona Department of Environmental Quality, 2022a)

Figure 23 shows the SWPP streams within the plan boundary. Blue lines show WOTUS streams and purple lines show non-WOTUS streams. The OAW reach of Aravaipa Creek is highlighted in green. Figure 24, Figure 25, and Figure 26 SWPP reaches with agricultural, aquatic and wildlife, and human health designated uses, respectively. There is only one reach of Aravaipa Creek that has an impaired use. The reach of Aravaipa Creek from the outlet of the Aravaipa Wilderness Area to the confluence with the San Pedro River (outside the planning boundary) is impaired for full-body contact as shown in Figure 26 due to high E.coli levels. The reach of Aravaipa Creek from the confluence with Stowe Gulch to the Aravaipa Wilderness Boundary is not impaired. This may indicate that nonpoint sources at the outlet of the plan boundary and in the watershed outside the plan boundary are contributing more substantially to the impairment. Based on recent water quality testing, this impairment is expected to be lifted in 2026.

3.6.2 Groundwater Quality

In 2003, ADEQ completed a groundwater quality study of the Aravaipa Canyon Basin (reference Figure 8 for groundwater basin descriptions and Figure 27 for sample locations). Groundwater samples from fifteen sites distributed throughout the basin were compared to Safe Drinking Water Act water quality standards and no primary Maximum Contaminant Levels (MCLs) were exceeded. Four sites saw secondary MCL exceedances which are aesthetics-based, not health-based limits. Constituents include fluoride at three sites and manganese at one site. In 2001, a similar study was completed around the Klondyke Water Quality Assurance Revolving Fund (WQARF) Site (see Section 3.6.3) that found no exceedances (Arizona Department of Environmental Quality, 2013).

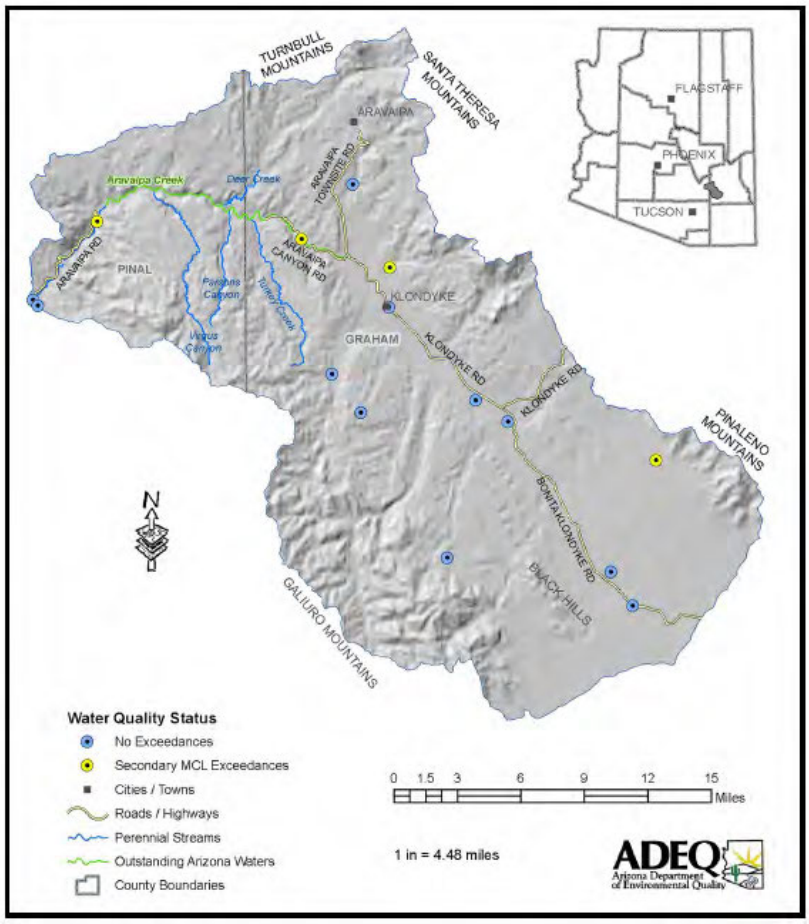

Figure 27. ADEQ Groundwater Testing Sites
Source: (Arizona Department of Environmental Quality, 2013)

3.6.3 Other ADEQ Locations of Interest

A review of ADEQ's eMaps system also identified other locations of interest within the plan boundary. Figure 28 shows these points of interest. There are three closed underground storage tank sites that were used for gasoline and diesel. The solid waste transfer station is shown near the town of Klondyke. The Deer Creek Fire Agate Mine is a relatively low impact surface collection mine (Arizona Department of Environmental Quality, 2022a). The Grand Reef Mine is closed, but is the source of tailings for the Klondyke Tailing Superfund/WQARF site. This project is completed and included "the capping of the upper tailings pile source area (2008), remediation of impacted soils near residences (2010 – 2016), and the remediation of a road constructed of mine tailings (2016)."(Arizona Department of Environmental Quality, 2020).

Capped Mine Tailings and Abandoned Mill Equipment at Klondyke Tailing Superfund/WQARF Site

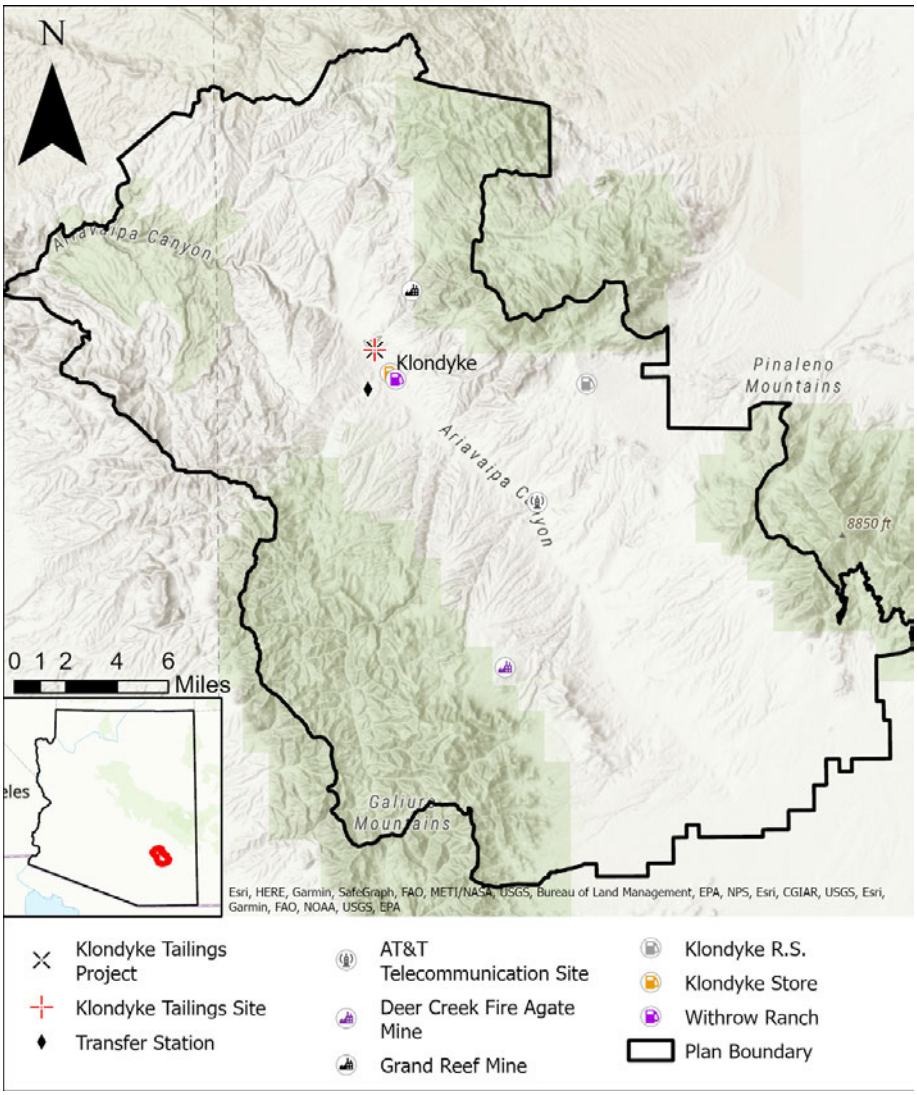

Figure 28. Other ADEQ Locations of Interest within AWCA Plan Boundary
Source: (Arizona Department of Environmental Quality, 2022a)

3.7 Hydrogeology and Soils

The Aravaipa Canyon Basin is a deep, narrow basin formed as the valley sank relative to the movements of the Santa Teresa, Pinaleno, and Galiuro Mountains (Figure 8). The Galiuros are primarily composed of a thick layer of early tertiary volcanic ash falls and lava flows. The Santa Teresa are mostly Paleogene granite. The underlying Tertiary volcanic bedrock sits below approximately 8,000 feet of sediments. The upper reaches of Aravaipa Creek are located in sedimentary deposits. The underlying Hellhole conglomerate and volcanic bedrock funnel groundwater down the valley and up through the sediment layers, feeding the perennial reaches of Aravaipa Creek. The entirety of Aravaipa Creek is situated on a young alluvium layer (shallow open aquifer) and separated from the old alluvium confined aquifer by a low permeability layer. The young alluvium aquifer is where most groundwater pumping occurs. Natural recharge in the basin is estimated up to 16,700 acre-feet per year and storage estimates are up to 5.1 million acre-feet at a depth of 1,200 feet (Arizona Department of Water Resources, 2009; Bureau of Land Management Safford Field Office, 2015; Norman et al., 2018).

Figure 29 shows the map unit codes for soil surveys completed within the AWCA Plan Boundary. The NRCS Soil Survey Geographic Database (SSURGO) contains the data collected on soils by the National Cooperative Soil Survey and is based on laboratory analysis and in-person observations (Soil Survey Staff et al., 2023). SSURGO collects soil attributes in over 70 tables, and ESRI has cross-referenced common SSURGO fields into shape files for regions of interest (Esri, 2022). Table 2 collects the area symbol (used to determine soil survey boundaries within the state), the map unit name, and acreage for each of the soil map units shown in Figure 29. The soil map units shown in Figure 29 are sourced from four different soil surveys with different sampling frequency and sets of data collected for each survey.

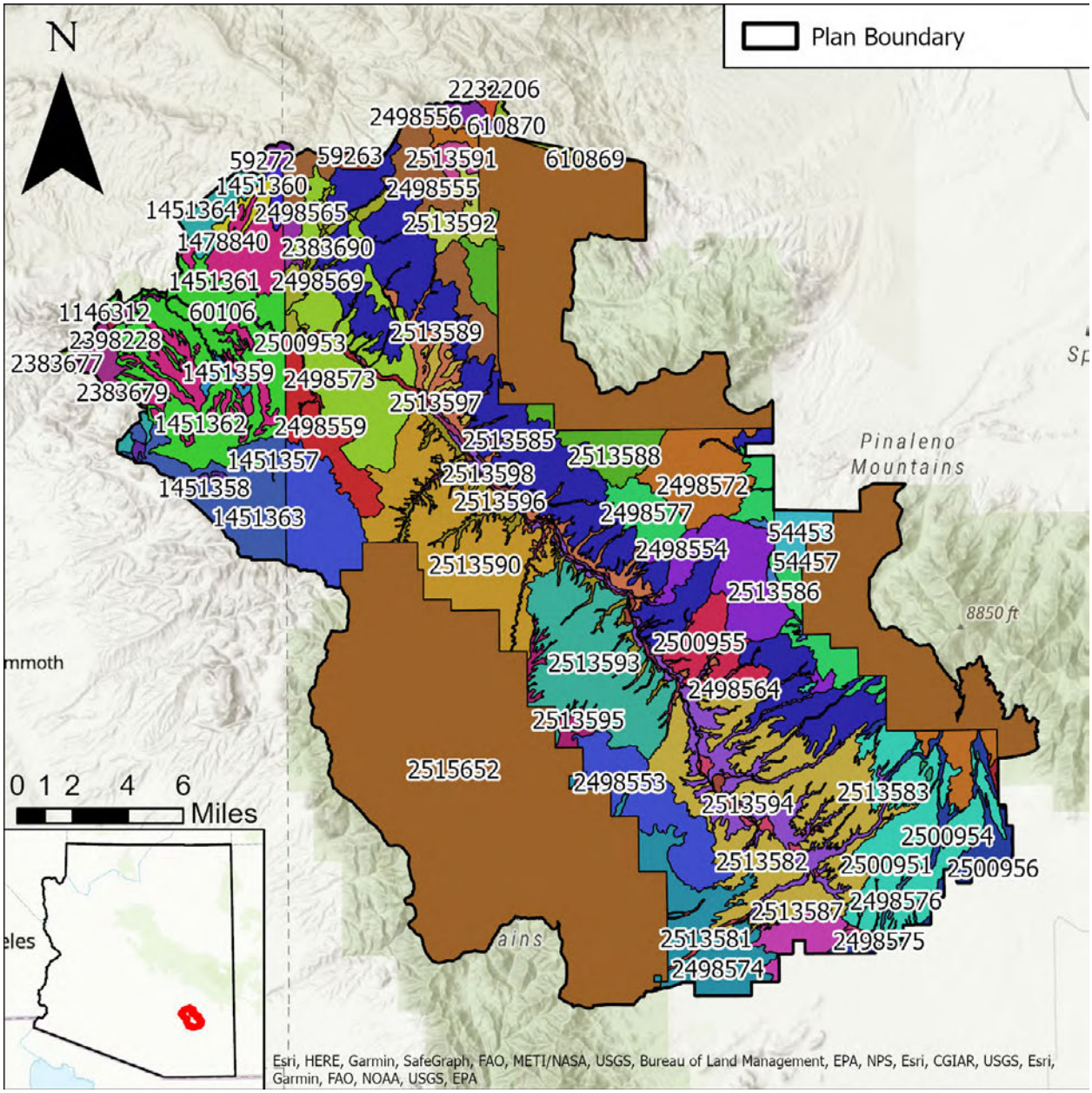

Figure 29. Soil Map Unit Codes within AWCA Plan Boundary
Source: (Esri, 2022; Soil Survey Staff et al., 2023)

Table 2. Soil Map Unit Name, Area Symbol, and Acreage for Map Units in AWCA Plan Boundary

Map Unit Key	Area Symbol	Map Unit Name	Acres
1146312	AZ661	Ripsey-Rock outcrop complex, 15 to 70 percent slopes	2
1451357	AZ661	Stanford soils and water, 0 to 5 percent slopes	13
1451358	AZ661	Mabray-Rock outcrop complex, 20 to 75 percent slopes	485
1451359	AZ661	Rock outcrop-Surge complex, 3 to 45 percent slopes	612
1451360	AZ661	Eskiminzin-Sontag-Rock outcrop complex, 2 to 45 percent slopes mlra 38	863
1451361	AZ661	Eskiminzin-Rock outcrop-Sontag complex, tuff, 5 to 45 percent slopes	9378
1451362	AZ661	Rock outcrop-Lampshire complex, 10 to 60 percent slopes	15759
1451363	AZ661	Collarbutton-Rock outcrop-Cherrycow complex, 10 to 60 percent slopes	7912
1451364	AZ661	Pantak-Rock outcrop-Lampshire complex, 5 to 60 percent slopes mlra 38	2670
1478840	AZ661	Bodecker-Riverwash complex, 0 to 5 percent slopes	27

Map Unit Key	Area Symbol	Map Unit Name	Acres
2232206	AZ675	Rock outcrop-Thimble-Ruidoso family complex, 15 to 65 percent slopes mlra 38	115
2383677	AZ661	Rock outcrop-Lajitas complex, 5 to 60 percent slopes	135
2383679	AZ661	Chiricahua, Deloro, and Lampshire soils, 5 to 60 percent slopes	421
2383690	AZ661	Beaumain-Rock outcrop-Cherrycow complex, 5 to 60 percent slopes MLRA 38	639
2398228	AZ661	Jawbone family-Rock outcrop-Chimenea complex, 15 to 80 percent slopes	1865
2498553	AZ673	Beaumain-Cherrycow-Rock outcrop complex, 5 to 60 percent slopes	13954
2498554	AZ673	Graham-Paramore-Rock outcrop complex, 5 to 50 percent slopes	7772
2498555	AZ673	Beaumain-Rock outcrop-Cherrycow complex, 5 to 60 percent slopes MLRA 38	8008
2498556	AZ673	Rock outcrop-Thimble-Ruidoso family complex, 15 to 65 percent slopes mlra 38	13
2498559	AZ673	Graham-Lampshire-Rock outcrop complex, 5 to 60 percent slopes	4450
2498564	AZ673	Bodecker-Riverwash complex, 0 to 5 percent slopes	3148
2498565	AZ673	Eskiminzin-Rock outcrop-Sontag complex, tuff, 5 to 45 percent slopes	583
2498569	AZ673	Rock outcrop-Lampshire complex, 10 to 60 percent slopes	2159
2498572	AZ673	Brewster-Aravaipa-Rock outcrop complex, 3 to 60 percent slopes	9317
2498573	AZ673	Pantak-Leyte-Rock outcrop complex, 5 to 45 percent slopes	12650
2498574	AZ673	Cloverdale cobbly clay loam, 1 to 5 percent slopes	8680
2498575	AZ673	Riveroad-Guest complex, 0 to 3 percent slopes	929
2498576	AZ673	Ustifluventic Haplocambids, 0 to 3 percent slopes	527
2498577	AZ673	Deloro-Schrap-Rock outcrop complex, 5 to 60 percent slopes	7330
2500951	AZ673	Sasabe sandy loam, 1 to 8 percent slopes	12837
2500953	AZ673	Oxyaquic Torrifluvents-Water complex, 0 to 3 percent slopes	859
2500954	AZ673	Schrap-Rock outcrop complex, 5 to 45 percent slopes	174
2500955	AZ673	Eloma-Kimrose-Saddlebrook complex, 1 to 60 percent slopes	3967
2500956	AZ673	Mallet-Hooks complex, 1 to 8 percent slopes	4271
2513581	AZ673	Rafter and Stanford soils and riverwash, 0 to 5 percent slopes	431
2513582	AZ673	Contention family-Whitecliff family-Sasabe complex, 5 to 60 percent slopes	21691
2513583	AZ673	Ubik-Riveroad complex, 0 to 5 percent slopes	9281
2513585	AZ673	Eloma-Tombstone-White House complex, 3 to 50 percent slopes	34443
2513586	AZ673	Bodecker-Altar-Riverwash complex, 0 to 5 percent slopes	622
2513587	AZ673	Sasabe-Bonita-Forrest complex, 0 to 3 percent slopes	2581
2513588	AZ673	Turquoise-Lutzcan complex, 5 to 60 percent slopes	5547
2513589	AZ673	Bodecker-Combate-Tenneco complex, 0 to 5 percent slopes	5223
2513590	AZ673	Eloma-Eskiminzin-Cammerman-Holguin complex, 5 to 60 percent slopes	16080
2513591	AZ673	Nugget-Rock outcrop complex, 5 to 60 percent slopes	1087
2513592	AZ673	Yarbam family-Silverstrike complex, 5 to 60 percent slopes	2051
2513593	AZ673	White House-Eskiminzin-Pedregosa complex, 5 to 60 percent slopes	13602
2513594	AZ673	Water	15
2513595	AZ673	Blacktail clay, 0 to 5 percent slopes	1325
2513596	AZ673	Bodecker-Altar-Riverwash complex, 1 to 10 percent slopes	4047
2513597	AZ673	Guest silty clay loam, 0 to 1 percent slopes	60
2513598	AZ673	Ubik-Riveroad complex, 0 to 1 percent slopes	843
2515652	AZ723	No Digital Data Available	120113
54453	AZ663	Aravaipa extremely gravelly loam, 5 to 40 percent slopes	2069
54457	AZ663	Rock outcrop-Lampshire complex, 20 to 90 percent slopes	58

Map Unit Key	Area Symbol	Map Unit Name	Acres
59263	AZ675	Eloma very gravelly sandy clay loam, 3 to 65 percent slopes mlra 38	456
59272	AZ675	Pantak-Rock outcrop-Lampshire complex, 5 to 60 percent slopes mlra 38	47
59274	AZ675	Silverstrike family-Yarbam-Rock outcrop complex, 15 to 60 percent slopes	295
60080	AZ661	Quiburi-Gila complex, 0 to 3 percent slopes	47
60106	AZ661	Typic Fluvaquents, wetrock soils, and water, 0 to 3 percent slopes	493
610869	AZ675	Woodcutter-Budlamp-Rock outcrop complex, 15 to 60 percent slopes	607
610870	AZ675	Beaumain-Rock outcrop-Cherrycow complex, 5 to 60 percent slopes MLRA 38	1684

Figure 30 shows the soil water storage capacity for mapping units within the plan boundary. This map shows the water capacity of the soil in cm for the top 150 cm of soil. Values are calculated from the weighted average of soil components in the map unit. This map is useful for showing general trends in soil moisture capacity. As shown by darker blue colors in Figure 30, soils in the upper watershed, soils adjacent to Aravaipa Creek, and soils adjacent to larger drainages (e.g., Stowe Gulch) are generally able to store more moisture. Assuming that the precipitation intensity is less than the soil permeability, soils with higher water storage capacity will accept more water before runoff occurs. Water stored in the soil can be taken up by plants and return to the atmosphere via evapotranspiration, can flow laterally to other soil in the region, can discharge into streambeds to maintain base flow, or percolate into the groundwater basin for long term aquifer storage.

Figure 31 shows soil drainage for mapping units within the plan boundary. These drainages are useful for providing a qualitative evaluation of how water will infiltrate the soil. The majority of soils in the plan boundary are well drained. From the upper edge of the watershed through the Klondyke region, soils adjacent to Aravaipa creek are well drained. As the creek flows through the canyon, soils change from somewhat poorly drained to poorly drained.

Figure 32 shows the available erosion classification for soils within the plan boundary. Mapping Unit Code 2498564 (Bodecker-Riverwash complex, 0 to 5 percent slopes) is clustered along the bottom of the valley and Aravaipa Creek as well as some major tributaries (e.g., Sheep wash, Deer Creek, Rattlesnake Canyon, Four Mile Canyon, Klondyke Wash, and Bear Canyon) and is Erosion Class 1. This is the lowest erosion classification and is useful for a qualitative assessment of soil erodibility within the plan boundary.

Figure 33 shows the minimum depth to bedrock per mapping unit code. Values in this map are based on the shallowest depth to bedrock of all soil components that compose more than 15% of the individual mapping unit. This map shows a general trend of increasing soil depth towards the bottom of the valley. Maintaining soil depth is important for water storage, ground cover, and other key factors for watershed health. This map should be used in conjunction with modeling results to assess implementation of projects that mitigate soil erosion.

Although the start point for the perennial reach of Aravaipa Creek is typically described as the confluence of Stowe Gulch, the actual point is variable and has seemingly permanently shifted downstream. Excess sediment transport from upstream drainages, especially Laurel Canyon, has filled the channel such that the spring emergence point has shifted further into the canyon. Water table fluctuations also contribute to the continuous shifting of the Aravaipa Creek emergence point. The Pinnacle Fire burned in the Santa Teresa Mountains from June to July, 2021. High intensity and long duration precipitation events since the fire have resulted in substantial upstream erosion through Buford Canyon with approximately 5 feet of deposition at the confluence with Aravaipa Creek. Further sediment transport and deposition in the perennial reaches of Aravaipa Creek can infill the creek and pools, contributing to lower baseflows and degrading habitat in the canyon (Magoffin, 2022; Norman et al., 2018; Stoddard, 2022).

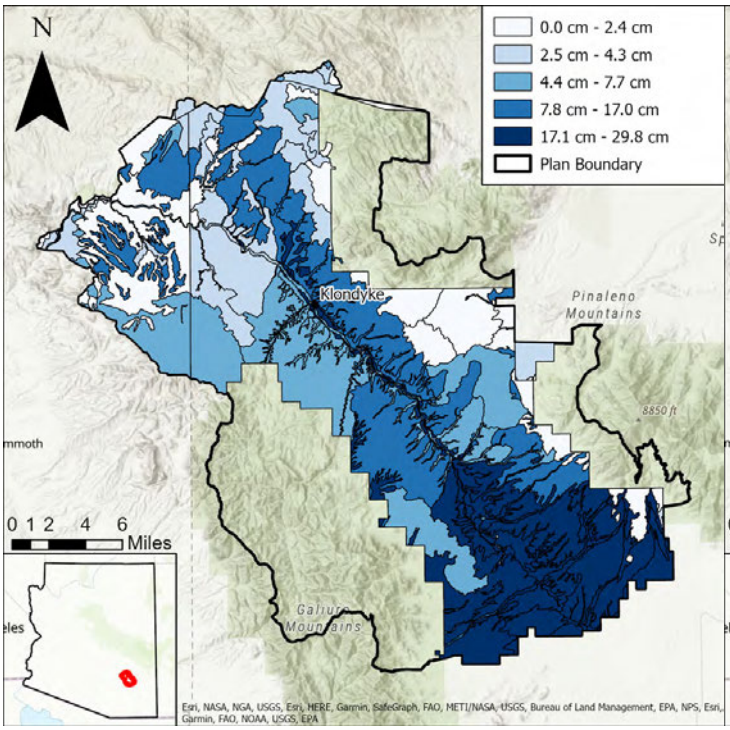

Figure 30. Soil Water Storage Capacity within AWCA Plan Boundary
Source: (Esri, 2022; Soil Survey Staff et al., 2023)

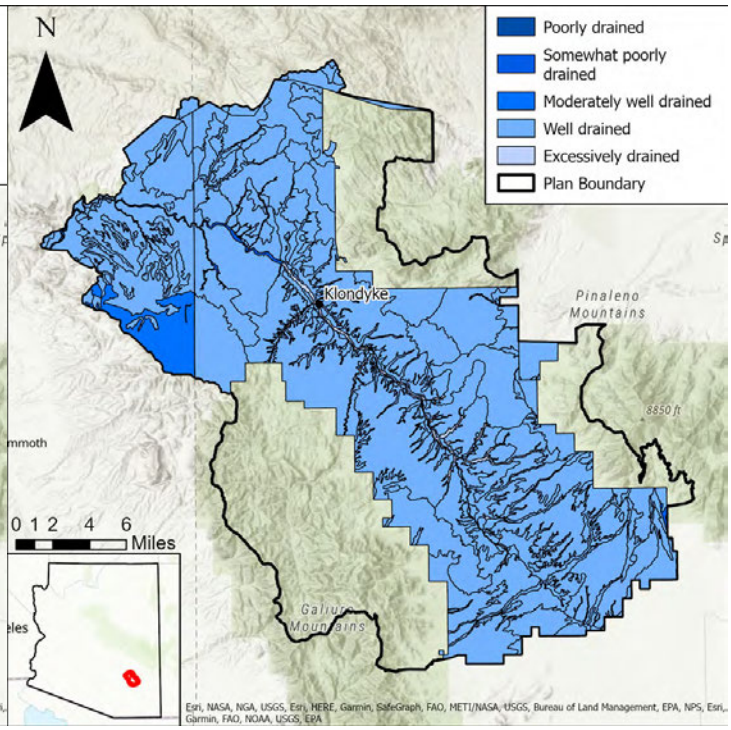

Figure 31. Soil Drainaige within AWCA Plan Boundary
Source: (Esri, 2022; Soil Survey Staff et al., 2023)

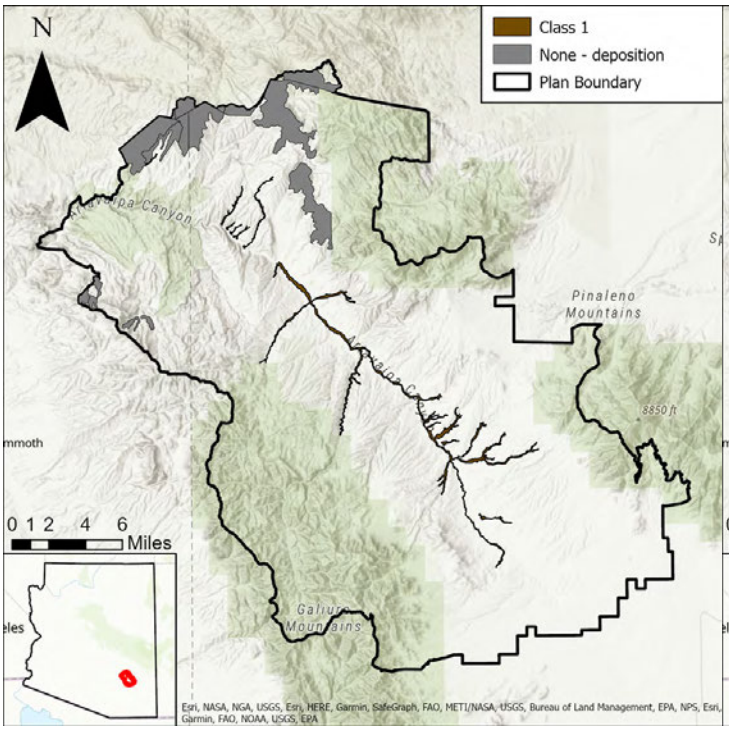

Figure 32. Soil Erosion Class within AWCA Plan Boundary
Source: (Esri, 2022; Soil Survey Staff et al., 2023)

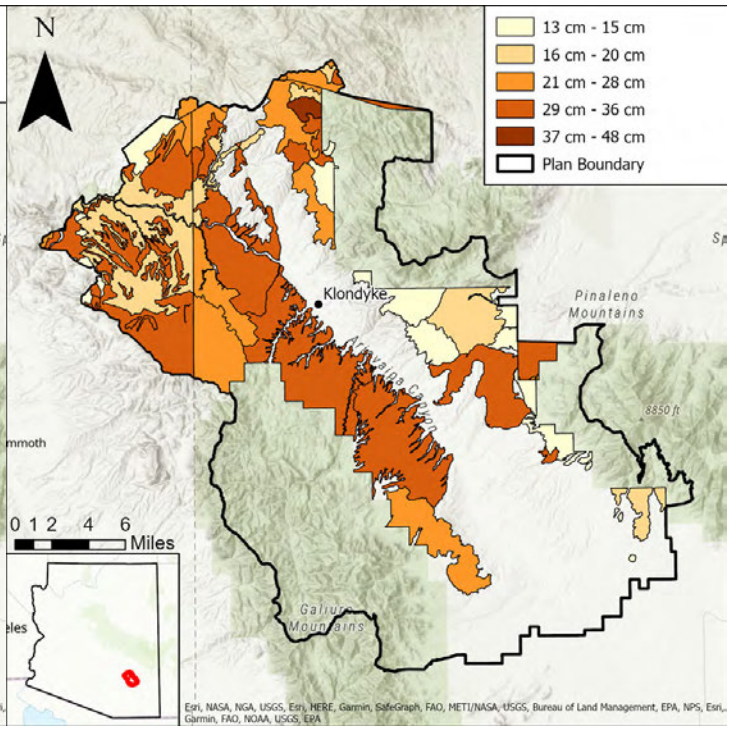

Figure 33. Minimum Depth to Bedrock within AWCA Plan Boundary
Source: (Esri, 2022; Soil Survey Staff et al., 2023)

3.8 Land Cover and Vegetation

The National Land Cover Database (NLCD) consists of 30 m (98 ft) by 30 m (98 ft) classified satellite imagery. Land surfaces are grouped into thematic classifications. Table 3 lists land cover classifications found within the plan boundary. These descriptions are good for characterizing the spatial patterns of different communities and understanding the composition of the watershed. Because this data is based on automated classification of remote imagery, there is inherent error in the classification (Dewitz & U.S. Geological Survey, 2021). Further, though the descriptions are good, they do not distinguish between actual land management. For example, medium density development could refer both to paved roadways and single-family homes of sufficient density.

Figure 34 shows the NLCD data within the plan boundary for 2001 (left) and 2019 (center) and the change index between the two years (right). The land cover areas and percentage of total land cover for each year are shown in Table 4. The percent change in land cover between 2019 and 2011 is also shown in the table.

The majority of land cover within the plan boundary is shrub/scrub (77%). In this region, it's likely a mixture of mesquite and grasses. Historically, the bottom of the valley adjacent to the creek was dominated by grassland. Fire suppression, grazing, and other historic land practices have allowed mesquite trees to get established over broader areas of the valley. The other large land covers in the region follow the traditional Madrean Sky Island distribution of evergreen and mixed forests in the high mountainous regions and grassland/herbacious through the transition and valley bottom.

The change index is useful for highlight the conversion of land cover over time. In the northwest portion of the plan boundary, there is a region where grassland/herbaceous acreage was converted to shrub/scrub. In the Galiuro Mountains to the southwest of the plan boundary, patches of evergreen forrest and shrub/scrub have been converted to grassland/herbaceous. Finally, development has shown a patch of pastureland development from shrub/scrub. Table 4 shows that the conversion of grassland to shrub/scrub in the northwest was offset by forest and shrub conversion in the Galiuro Mountains. In general, the NLCD land cover trends show relative stability, with the largest magnitude change representing less than 1% total land cover change within the boundary.

Examples of vegetation in Aravaipa Valley

Table 3. Land Cover Classifications and Descriptions
Source: (Dewitz & U.S. Geological Survey, 2021)

Classification	Description
11 Open Water	Areas of open water, generally with less than 25% cover of vegetation or soil.
21 Developed, Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
22 Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.
23 Developed, Medium Intensity	Developed, Medium Intensity -areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
31 Barren Land (Rock/ Sand/ Clay)	Areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
42 Evergreen Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
43 Mixed Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.
52 Shrub/ Scrub	Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
71 Grassland/ Herbaceous	Areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling but can be utilized for grazing.
82 Cultivated Crops	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
90 Woody Wetlands	Areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
95 Emergent Herbaceous Wetlands	Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

Table 4. NLCD Land Cover Areas and Percent Change from 2001 to 2019

	2001		2019		2019-2001	
Classification	Area (Acre)	%	Area (Acre)	%	Area (Acre)	%Δ
11 Open Water	1.8	0.00	8.2	0.00	6.4	362.5
21 Developed, Open Space	37.4	0.01	44.5	0.01	7.1	19.0
22 Developed, Low Intensity	1.8	0.00	2.9	0.00	1.1	62.5
23 Developed, Medium Intensity	0.2	0.00	2.0	0.00	1.8	800.0
31 Barren Land (Rock/Sand/Clay)	102.5	0.03	14.0	0.00	-88.5	-86.3
42 Evergreen Forest	66624.6	17.19	63377.0	16.36	-3247.6	-4.9
43 Mixed Forest	1.1	0.00	1.6	0.00	0.4	40.0
52 Shrub/Scrub	296218.2	76.45	298371.4	77.00	2153.2	0.7
71 Grassland/Herbaceous	23316.5	6.02	24331.3	6.28	1014.8	4.4
82 Cultivated Crops	11.1	0.00	153.2	0.04	142.1	1278.0
90 Woody Wetlands	922.0	0.24	927.6	0.24	5.6	0.6
95 Emergent Herbaceous Wetlands	246.2	0.06	249.7	0.06	3.6	1.4
Total	387483	100	387483	100		

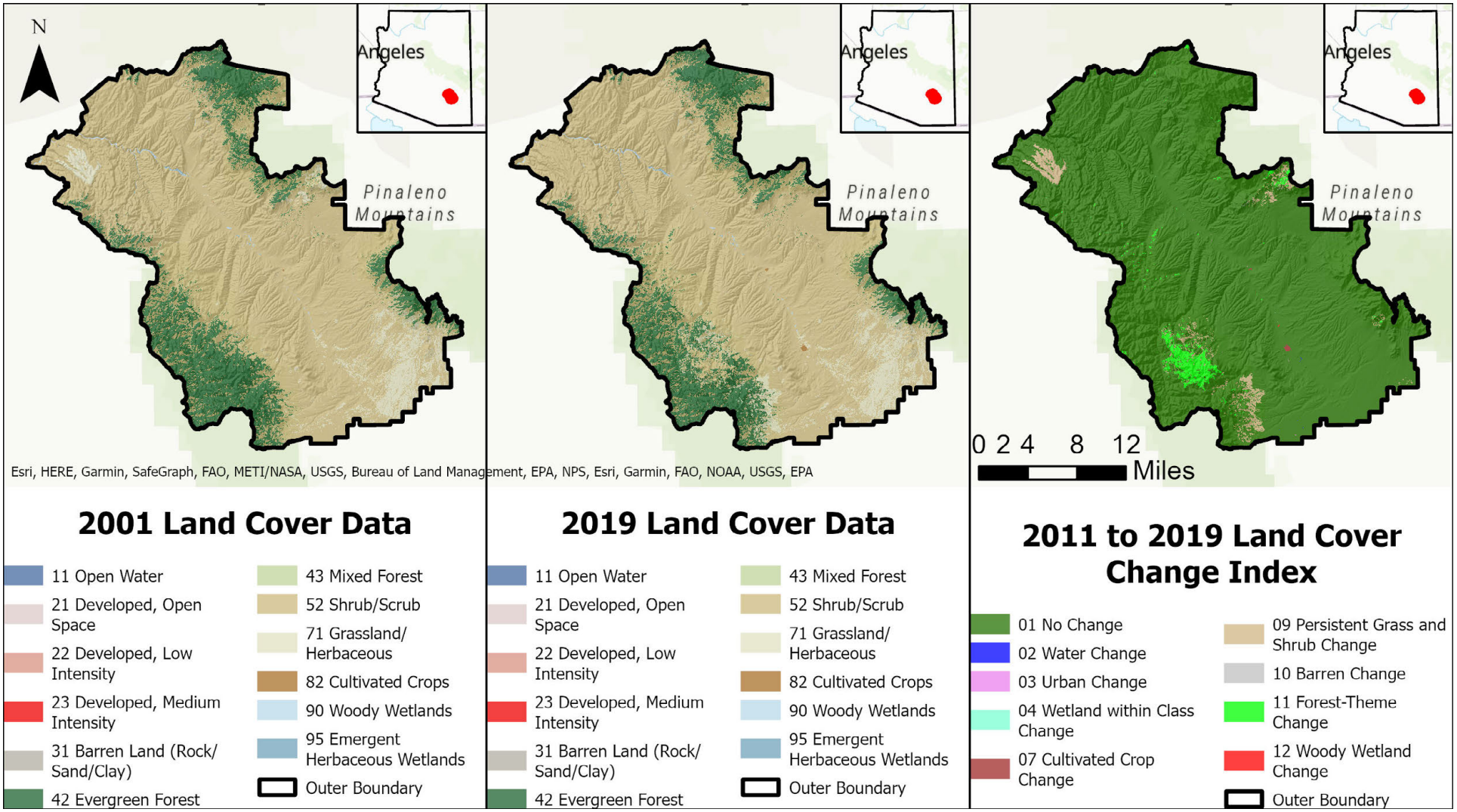

Figure 34. NLCD Land Cover Data within Plan Boundary; Left: 2001; Center: 2019; Right: 2011 to 2019 Change IndexPlan Boundary
Source: (Dewitz & U.S. Geological Survey, 2021)

NRCS classifies many land units into ecological sites. Ecological sites are used to describe the combination of land features (e.g., hydrology, soil properties, underlying geology) that allow the region to support its unique combination of vegetation. Aravaipa falls predominantly within the Arizona Interior Chaparral Major Land Resource Area, including two volcanic sites and two clayey upland sites. Historic native vegetation communities include grasslands, desert trees, shrubs, succulents, and forbs. Wildfire regimes in the area have helped maintain the balance between shrubs and herbs. In the absence of fire, shrubs, (e.g., mesquite) and cacti can come to dominate grasslands (Bureau of Land Management Safford Field Office, 2015; Norman et al., 2018).

GAP project provides similar data but uses NRCS NLCD in combination with NatureServe's Ecological Systems Classifications to provide additional detail. Table 5 shows the GAP/LANDFIRE terrestrial communities and area within the plan boundary. The predominant vegetation in the plan boundary is Apacherian-Chihuhuan Mesquite Upland Scrub (31%), Mogollon Chaparral (21%), Apacherian – Chihuahuan Semi-Desert Grassland and Steppe (13%), and Madrean Encinal (10%) (U.S. Geological Survey Gap Analysis Project, 2016).

The mountains are topped with patches of Madrean Pine-Oak Forest and Woodland, Mogollon Chaparral, Colorado Plateau Mixed Bedrock Canyon and Tableland, Southern Rocky Mountain Ponderosa Pine Woodland and Shrubland, and Madrean Pinyon-Juniper Woodlands. The Mogollon Chaparral transitions down through mountain fronts in combination with Madrean Pinyon-Juniper Woodland. In the bottom of the valley in the upper

Table 5. GAP Ecosystem Descriptions

Value	Area (acre)	Percent (%)	Ecosystem Descriptions
460	121213	31	Apacherian-Chihuahuan Mesquite Upland Scrub
358	82924	21	Mogollon Chaparral
461	49885	13	Apacherian-Chihuahuan Semi-Desert Grassland and Steppe
46	39176	10	Madrean Encinal
48	26578	7	Madrean Pine-Oak Forest and Woodland
47	17690	5	Madrean Pinyon-Juniper Woodland
462	14785	4	Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub
158	10814	3	Southern Rocky Mountain Ponderosa Pine Woodland
472	7233	2	Sonora-Mojave Creosotebush-White Bursage Desert Scrub
474	4445	1	Sonoran Paloverde-Mixed Cacti Desert Scrub
542	4308	1	Colorado Plateau Mixed Bedrock Canyon and Tableland
467	3730	1	Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub
469	1552	0.4	Madrean Juniper Savanna
280	925	0.2	North American Warm Desert Lower Montane Riparian Woodland and Shrubland
477	635	0.2	North American Warm Desert Wash
282	510	0.1	North American Warm Desert Riparian Woodland and Shrubland
466	488	0.1	Chihuahuan Sandy Plains Semi-Desert Grassland
444	219	0.1	North American Warm Desert Riparian Mesquite Bosque
556	137	0.04	Cultivated Cropland
575	104	0.03	Disturbed/Successional - Shrub Regeneration
557	38	0.01	Pasture/Hay
473	29	0.01	Sonoran Mid-Elevation Desert Scrub
540	24	0.01	North American Warm Desert Pavement
541	16	0.004	North American Warm Desert Volcanic Rockland
475	15	0.004	Chihuahuan Mixed Salt Desert Scrub
579	7.8	0.002	Open Water (Fresh)
468	1.3	0.0003	Chihuahuan Succulent Desert Scrub
49	1.1	0.0003	Madrean Upper Montane Conifer-Oak Forest and Woodland

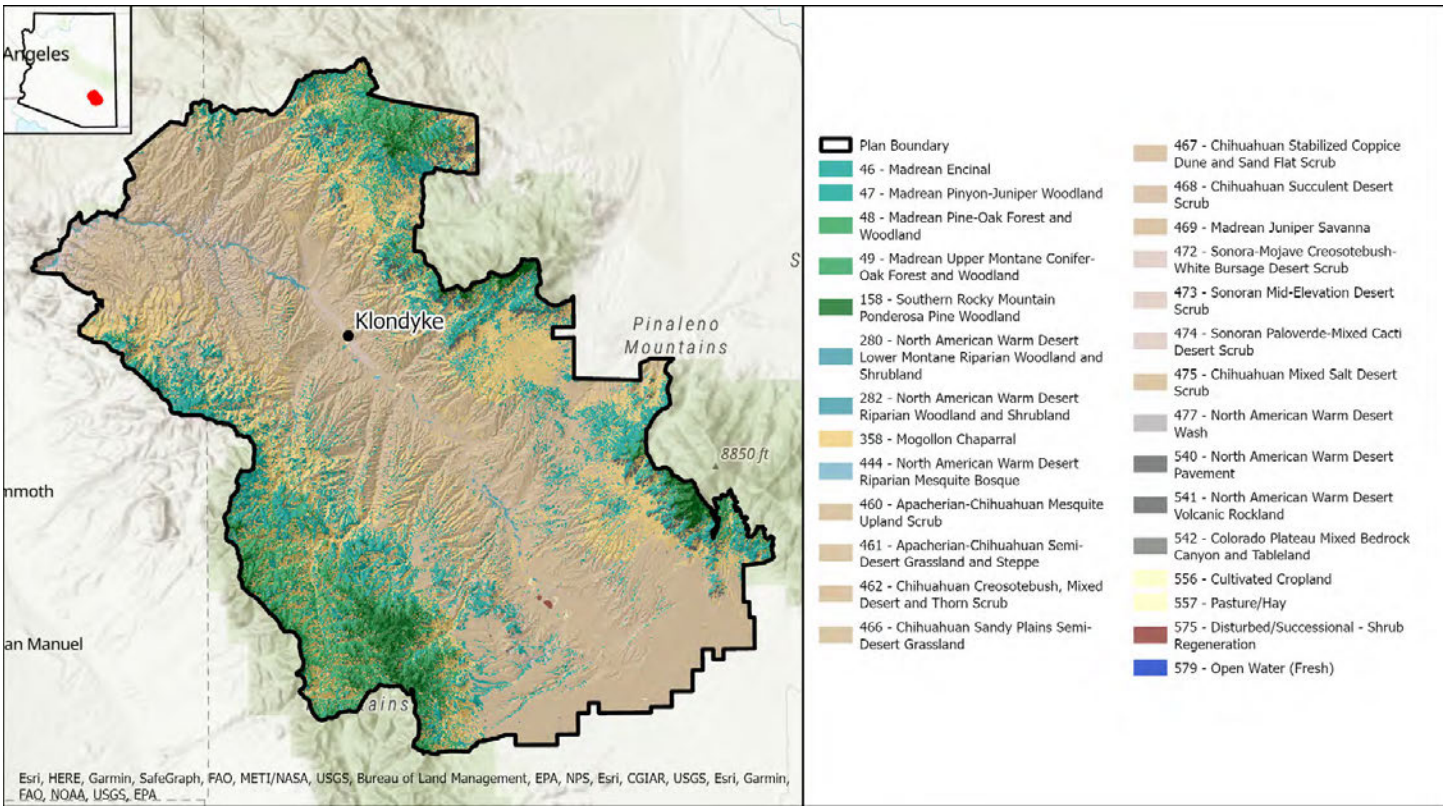

Figure 35. GAP/LANDFIRE National Terrestrial Ecosystems
Source: (U.S. Geological Survey Gap Analysis Project, 2016)

watershed, the cover consists of Apacherian-Chihuahuan Mesquite Upland Scrub with Mogollon Chaparral passes. There are Cultivated Croplands and Pasture Hay near the developed areas. Moving along the ephemeral reaches of Aravaipa Creek from the top of the watershed, the region is patched with North American Warm Desert Lower Montane Riparian Woodland and Shrubland and Sonoran Paloverde-Mixed Cacti Desert Scrub. As Aravaipa Creek approaches Klondyke, the region transitions into Sonora-Mojave Creosotebush-White Bursage Desert Scrub and more North American Warm Desert Lower Montane Riparian Woodland. Then, the canyon includes Sonoran Paloverde-Mixed Cacti Desert Scrub, Madrean Encinal, and North American Warm Desert Riparian Woodland and Shrubland.

Historically, the bottom of the valley has seen a mixture of native grasses as the dominant groundcover. Past overgrazing and fire suppression in the region have disturbed the dynamic equilibrium between grasses and shrubs such that mesquite have come to dominate more area. Mesquite canopy typically suppresses the growth of full sun perennial native grasses, favoring annuals. These growth patterns provide sparser overall groundcover. Since there is greater space between canopies of mesquite compared to native grasses, precipitation runoff is less likely to be arrested or redirected by vegetation, allowing runoff velocity and erosion to increase. Managing vegetative communities through the valley and foothills of the upper watershed is therefore important for limiting downstream sediment transport (Spaeth et al., 2022).

Aravaipa Creek in Aravaipa Canyon

3.9 WILDLIFE

The remote character of the region combines with the relatively abundant regional surface water and habitat to make the Aravaipa region a significant refuge for wildlife. The region is host to numerous species of birds, fish, and mammalian wildlife. Although many species have been extirpated (hunted until no more specimens are found in the region), many communities (e.g., bighorn sheep) have been improving recently. Gould's Turkey, a formerly extirpated species, has been reintroduced to the region and flocks are thriving. BLM and AZGFD both have management actions in place to support bighorn sheep. AZGFD is also interested in preserving and restoring habitat for mule deer, pronghorn antelope, scaled quail, Chiricahua Leopard Frogs, and Gould's Turkey in the region. Aravaipa has been home to beaver (now extirpated), mountain lions, black bear, bobcat, javelina, foxes, prairie dogs (now extirpated), coatimundis, lesser long-nosed bats, and many other species of mammal (Bureau of Land Management Safford Field Office, 2015; Hadley et al., 1991).

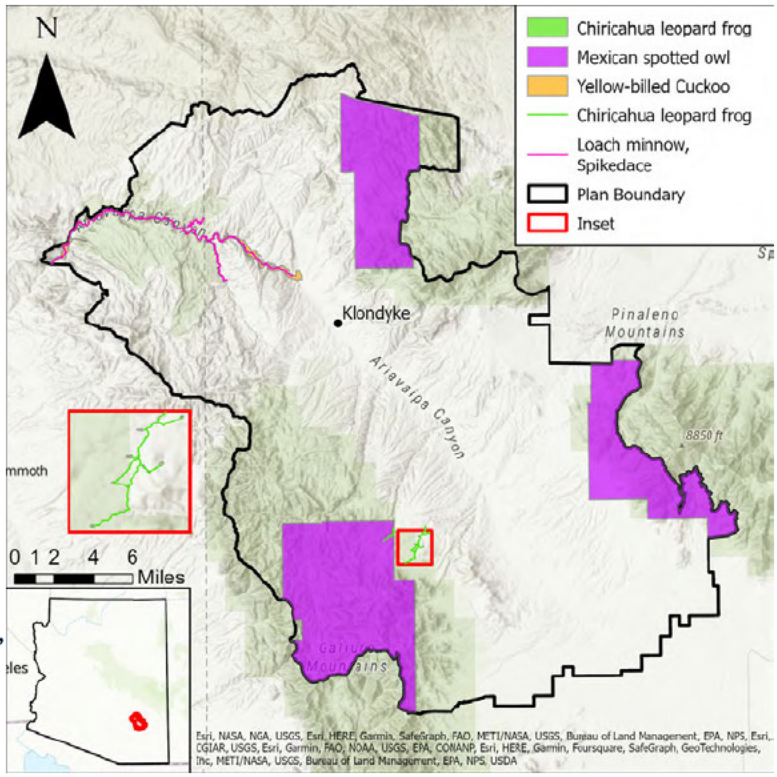

Figure 36. USFWS Critical Habitats within Plan Boundary
Source: (U.S. Fish & Wildlife Service, 2023)

Five species found in Aravaipa are listed under the Endangered Species Act, 13 BLM sensitive species, and 14 species from AZGFD's list of Species of Greatest Conservation in Need. Aravaipa is also home to seven native fish species (loach minnow, spikedace, roundtail chub, speckled dace, longfin dace, desert sucker, and Sonora sucker). Multiple attempts have been made to establish the endangered Gila topminnow and desert pupfish within the plan boundary. To date, Gila Topminnow are known to occur within a single reach on the TNC preserve after stocking in April 2022. Bird species in the region include yellow-billed cuckoos, Mexican spotted owls, gray hawks, bald eagles, red-tailed hawks, belted kingfishers, vermilion flycatchers, and Great Blue Heron. Figure 36 shows U.S. Fish and Wildlife Service (USFWS) critical habitats in the plan boundary. This designation places extra requirements on activities that require federal permits, licenses, and funding in the area (U.S. Fish & Wildlife Service, 2017). See Appendix A for a more comprehensive list of wildlife in the plan boundary.

Examples of Wildlife in Aravaipa Valley

3.10 Infrastructure

Infrastructure in the region is limited to fences, trails, small scale water distribution (e.g., transmission lines from wells to stock ponds), roads, electrical power lines, and high-speed data lines. There are no centralized wastewater treatment facilities within the watershed, instead homes rely on septic systems and composting toilets. All roads within the watershed are dirt/gravel.

Figure 37 shows the USFS, fences, trails, and waterlines within the plan boundary. Roads capable of supporting motorized vehicle use are shown from USFS data files and US Census TIGER/Lines shapefiles. These features are shown because they have various impacts on watershed, wildlife, and cattle. Boundaries represent the natural barriers the forest uses to help define allotment boundaries. Fences are used, in part, to exclude cattle from sensitive areas in combination with these natural barriers.

From Top: Bonita Klondyke Road; Culvert Exacerbating Downcutting; Cutslope Rill Erosion; Agradation at Klondyke Wash

As described in previous sections, roads have substantial impact on water flow in the region. Beyond encouraging runoff channels and gullies adjacent to roads, soil compaction worsens runoff by reducing soil pore size and, therefore, infiltration. Further, by altering the topography of runoff surfaces, roads can worsen erosion by increasing flow speed over disturbed surfaces. Comparison of Figure 37 with Figure 14 shows that there are higher road densities where private parcels have been subdivided. The Bonita-Klondyke Road connects the Aravaipa Canyon Wilderness to Willcox in the South. Power poles carry electrical service through portions of Aravaipa Canyon and are located in close proximity to the road. High speed internet service is provided via buried cable that runs adjacent to the road.

Due to its parallel construction to Aravaipa Creek, the Bonita-Klondyke Road crosses almost half of the ephemeral tributaries to the creek (e.g., Buford Canyon, Klondyke Wash, Stowe Gulch) and is therefore frequently damaged during storm events. Due to the large volume of material movement caused by storm runoff, data cable relocation can result in damage during post-storm road repairs. Regrading and material movement to repair storm damage can facilitate further material transfer downstream at accelerated rates. Road damage can limit access

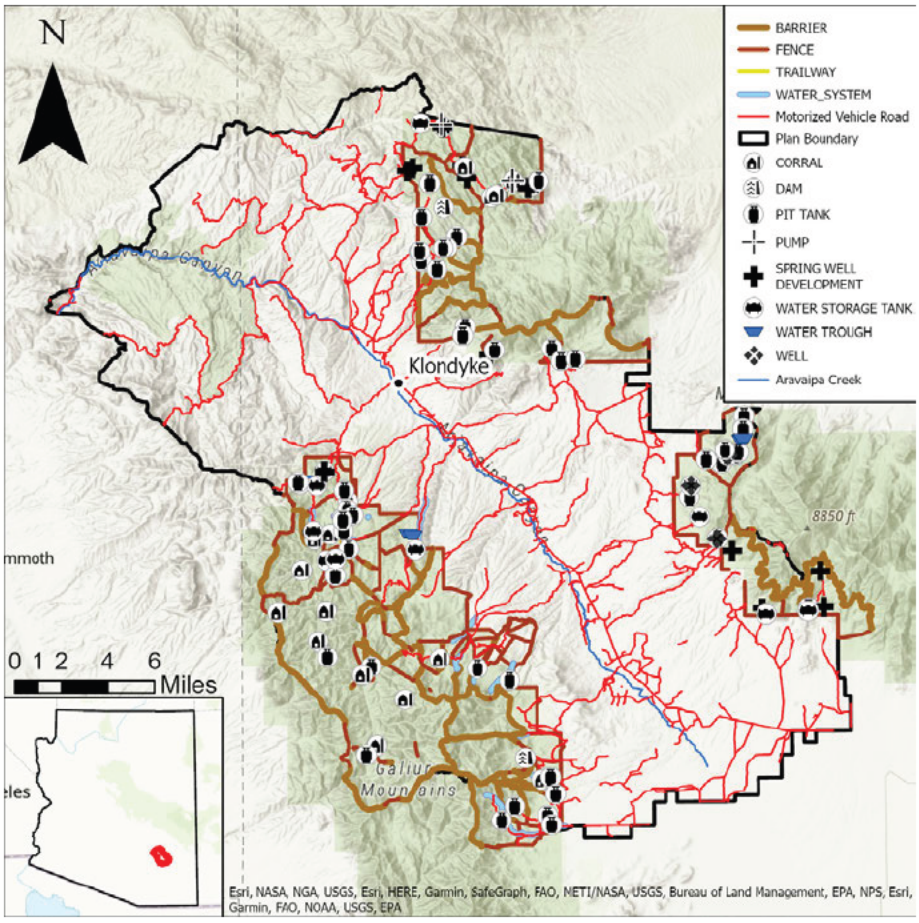

Figure 37. USFWS Critical Habitats within Plan Boundary
Source: (U.S. Fish & Wildlife Service, 2023)

for basic and emergency services. For these reasons, the Bonita-Klondyke Road is an important concern for community stakeholders. Refer to Section 5.2 for additional details.

In the upstream reaches of Aravaipa Canyon, downed powerlines have resulted in small fires. Due to the abundance of shallow groundwater in the region, cottonwood trees likely do not develop as extensive root structures. This means mature trees are more likely to be uprooted in storms, downing powerlines and leading to fires (Haberstich, 2022).

3.11 Existing Management Guidance

There are many agencies with technical or geographic jurisdictions that intersect with the AWCA CWMP efforts. Agency input on existing plans, projects, and management guidance within the area was solicited. Information not captured in other sections of the report is discussed below.

The AWCA plan boundary is part of the BLM's Safford Field Office and subject to the Safford District Resource Management Plan. Beyond this general regional guidance, there is also the Aravaipa Ecosystem Management Plan and Environmental Assessment (AEMP). Since this latter plan provides more detail specific to the AWCA plan boundary and is consistent with Safford District Resource Management Plan the AEMP is described in detail below (Bureau of Land Management Safford Field Office, 2015). The AEMP provides objectives and management actions to protect water, upland, riparian, wildlife, cultural, and recreational resources in the Aravaipa Canyon Wilderness. Objectives and management actions are frequently cross-cutting and include items like limiting on-site and off-site pollutants, land management practices to improve flows through the canyon (e.g., rangeland restoration, invasive species minimization). The plan addresses managing wildlife, restoring wetlands, and providing recreational opportunities (Bureau of Land Management Safford Field Office, 2015). Many of the goals listed in the plan are complementary to the purposes of this CWMP. Management actions that are extensible to the AWCA planning boundary will be discussed in Section 5.

Aravaipa Canyon Wilderness Area


Flow in Tributary Creek

BLM, BOR, TNC, Arizona Game and Fish Department (AGFD), and the U.S. Fish and Wildlife Service (USFWS) and other partners are working to eradicate invasive fish species from Aravaipa Creek. In 2001, BOR installed two paired fish barriers approximately 800 feet apart on Aravaipa Creek to limit invasive species migration from the San Pedro River. The Central Arizona Water Conservation District (CAWCD), the multi-county water district that is the primary state CAP coordinating agency, is responsible for operation of maintenance of these barriers through the hundred-year life of the CAP. Many invasive species have been eliminated from major tributaries to Aravaipa Creek. BOR has partnered with Arizona Game and Fish to stock and monitor the endangered Gila topminnow in Aravaipa Creek.

BLM, USFS, NRCS, and DFFM have programs in place for treating invasive vegetation. DFFM has funded a grant in partnership with Gila Watershed Partnership, Sky Island Alliance, and the Nature Conservancy to control vinca along Aravaipa Creek.

4 DESIRED CONDITIONS AND OVERALL PRIORITIES

4.1 Overall Priorities

The overarching conclusion of the watershed assessment is one of tempered optimism. Land cover, groundwater levels, and baseflows in the perennial reaches of Aravaipa Creek are all relatively stable. Though there have been impacts from human activity, many of these impacts have been mitigated, including the Klondyke Tailings Superfund Site. Land cover changes from timber harvesting in support of mining and ranching are prevalent, but recent years has shown conservation best management practices implemented to begin addressing these issues and improve watershed function.

There are substantial uncertainties and some conditions that must be addressed. Erosion, channelization of the Aravaipa Creek, and potential land development in the upper watershed have potential to impact the whole watershed. Deterioration of soil conditions in the upper watershed could reduce groundwater recharge and increase material transport downstream. These changes could reduce baseflows in the perennial reaches of Aravaipa Creek and reduce critical pool depths, impacting animal and plant wildlife in the canyon.

Beyond direct impacts on the water available in the area, expected changes in precipitation patterns and increases in average and extreme temperatures will likely increase wildfire frequency and severity in Arizona. 2021's Pinnacle Fire has altered groundcover such that two major precipitation events have since deposited more than five feet of material depth across the confluence of Buford Canyon and Aravaipa Creek. Further wildfires in the region can be expected to alter landcover similarly.

OVERALL PRIORITIES

AWCA selected the following common stakeholder goals as the shared, overall priorities of this plan:

1. Mitigating Erosion
2. Water Conservation
3. Conservation of Riparian Areas

Based on a review of community and agency stakeholder feedback, AWCA has selected the common goals of mitigating erosion, water conservation, and conservation of riparian areas as the shared, overall priorities of this plan. These subjects are scored as important to agency and community stakeholders, with average scores above 4 on a 1-5 scale. Further, actions taken to address these three primary goals are complimentary to each other and will have benefits to other goals as well.

For example, restoring native grasslands has the potential to reduce erosion by increasing the portion of ground cover that is vegetation compared to bare soil. This also assists water conservation, because runoff velocity will be reduced, increasing the time the water has to infiltrate into groundwater storage. Reducing erosion also reduces downstream sediment transport, which helps to maintain habitat in Aravaipa Canyon. Further, this type of restoration supports native plant and animal species and can provide more palatable forage for grazing.

Santa Teresa Mountains

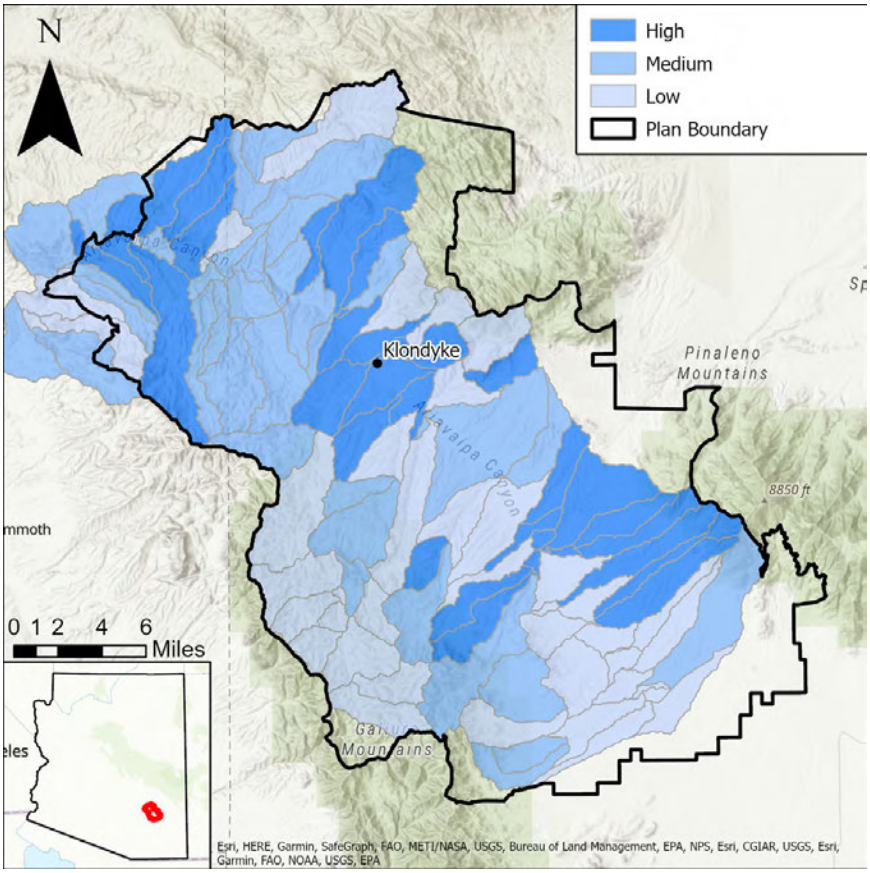

Figure 38. Non-Calibrated SWAT Model Infiltration
Source: (Norman et al., 2018)

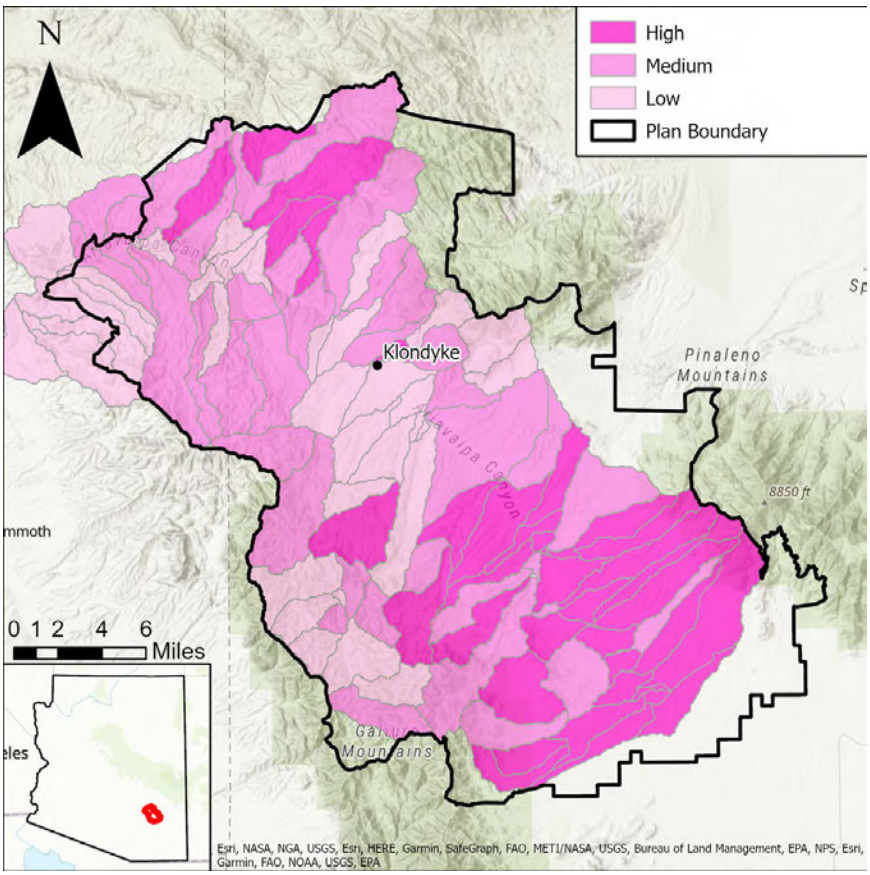

Figure 39. Non-Calibrated SWAT Model Runoff
Source: (Norman et al., 2018)

As described in preceding sections, the upper watershed has the potential to substantially impact the lower watershed. Land fragmentation and development in the upper watershed continue to be a concern due to the potential for negative changes to land cover and increased road density. One of the best practices for addressing these concerns is to engage with as many of these homeowners as possible and offer educational resources about the area.

Non-calibrated SWAT modeling completed in the watershed can help inform a qualitative assessment of project impacts on key watershed variables, including infiltration, surface runoff, water yield, and sediment yield. Infiltration describes how much water will percolate into the soil and groundwater (Figure 38). Runoff describes how much water will flow overland (Figure 39). Sediment yield shows how much material is transported from the individual sub-watershed (Figure 40). Each of these variable is provided a quantitative high, medium, or low value based on the non-calibrated SWAT model results (Arnold et al., 2011; Norman et al., 2018).

Regions with high sediment yield are predicted to have relatively large amounts of material movement during precipitation events and will see greater erosion. Until models can be calibrated, these regions should be prioritized for erosion mitigation efforts. Similarly, to address water conservation goals, regions with low infiltration and high runoff should be prioritized for projects that improve ground cover, rehabilitee soil, and retain runoff volumes to meet water conservation goals. Efforts to mitigate erosion and improve water conservation will typically result in improved downstream water quality and reduced infill necessary for riparian conservation.

4.2 Community Stakeholder Results

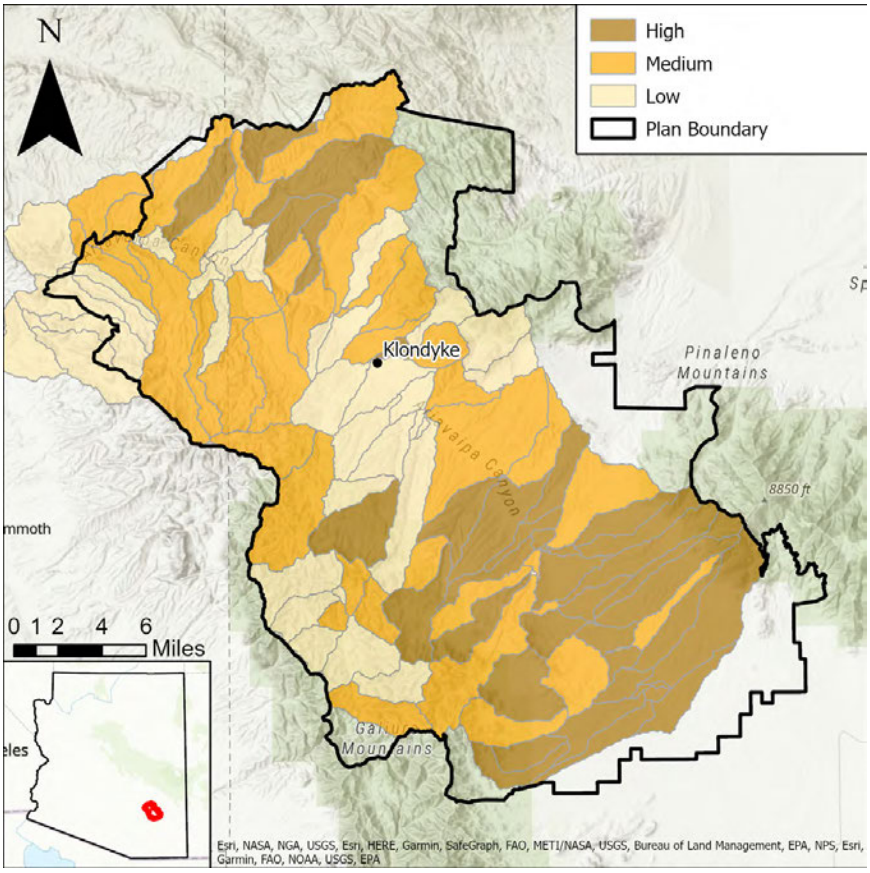

Figure 40. Non-Calibrated SWAT Model Sediment Yield
Source: (Norman et al., 2018)

As described in previous sections, community stakeholders were requested to fill out questionnaires to help direct planning efforts. Community members completed 13 questionnaires. The primary method of evaluating watershed planning priorities was asking respondents to rank a series of statements on an ascending scale of 1 to 5. Questionnaires were developed based on preliminary brainstorming/input from AWCA. Questions were selected to evaluate key watershed health indicators without requiring substantial explanation (e.g., rather than asking about the priority of riparian conservation, questions were asked about downstream impacts, native fish species, and invasive plants). The goal of this approach is to encourage layperson engagement by reducing controversial language. Further, reliance on simple language compared to scientific terms was intended to allow for questionnaires to be filled out without facilitation, broadening stakeholder engagement. Table 6 shows the questions, the average score and standard deviation. Finally, blanks were included to incorporate additional topics of concern or other comments. No additional topics were identified from these comments. A lower value of standard deviation shows a consensus on the score assessed. Figure 41 shows the responses in a histogram. The different bar colors correspond to individual scores, and the length of the bar indicates the number of responses.

This data shows that community stakeholders are largely in agreement that erosion and water conservation are the most important issues. Other important issues, scoring over 4, include protecting native species, public safety, and road maintenance, conserving open spaces, sustainable agriculture, and downstream effects. Protecting native fish species and mitigating invasive plants are both above a neutral score of 3.

Table 6. Community Stakeholder Level of Importance

Question Text	Average Score	Standard Deviation
Erosion control measures are important to me	4.8	0.4
Water conservation in the Aravaipa Watershed matters to me	4.8	0.6
Protecting native plant and wildlife species is a goal of mine	4.5	0.9
Public safety and road maintenance are a high priority to me	4.5	0.8
Conserving open spaces is important	4.5	0.8
Sustainable agriculture is a critical issue	4.5	1.2
Learning how my property affects up and downstream areas would be beneficial	4.3	1.1
Protecting the native fish species found within the watershed is important to me	3.9	1.4
Invasive plants are a problem for me	3.7	1.7

Direct outreach with community stakeholders is continuous and ongoing. Information communicated during various in-person visits and tours of concerns within the community have been used to inform different sections of this report. Further, Section 5.2 is used to document areas of concern within the plan boundary, especially as identified by community stakeholders. These areas can be updated between revisions of this plan and are an important communication and engagement tool.

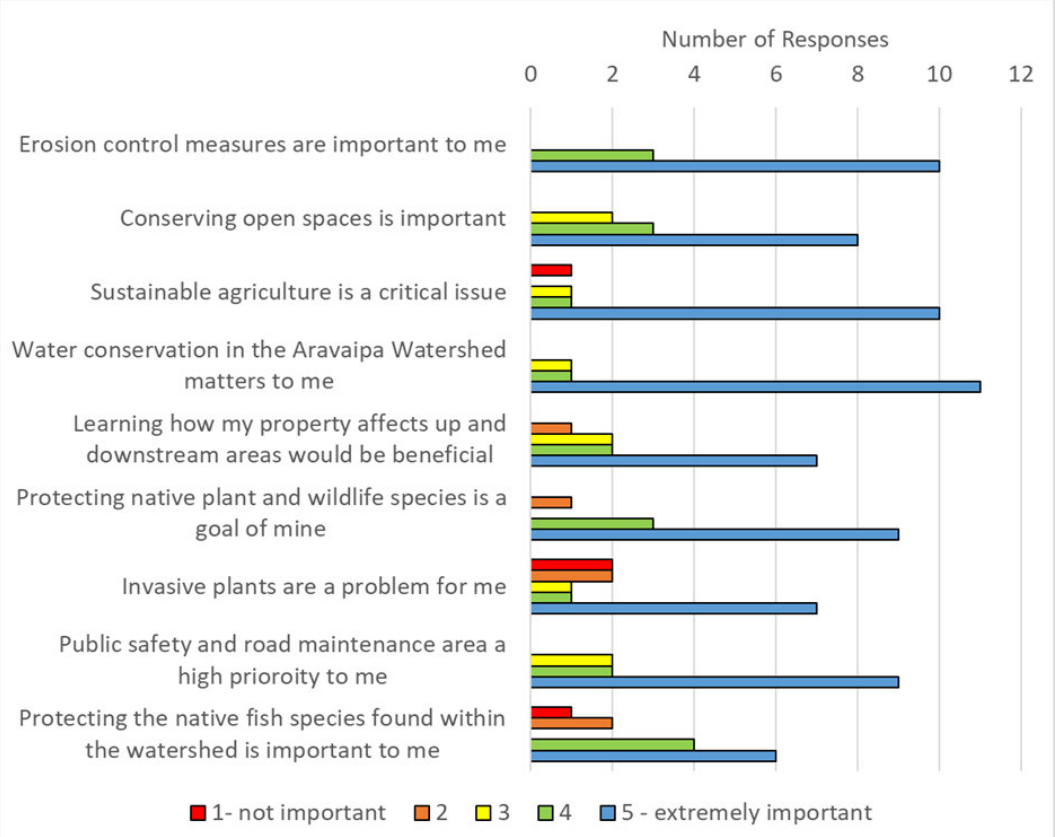

Figure 41. Histogram of Community Responses to Level of Importance Questions

4.3 Agency Stakeholder Results

Fourteen agency stakeholder questionnaires were completed by 11 agencies (USGS, BLM, ADEQ, AZGFD, DFFM, Cooperative Extension, BOR, Freeport-McMoRan, USDA Farm Service Agency, Graham County, USFS). These questionnaires included additional terms to gauge the specific interest and expertise of agencies (e.g., climate change adaptation, ecosystem services). Agencies are assumed to have higher levels of scientific literacy, so these topics were included because perceived controversy and level of explanation for meaningful engagement were judged to be less. Another intent with the expanded question list is to help characterize community priorities in context of agency programs and interests. Blanks were included to incorporate additional topics

Table 7. Agency Stakeholder Level of Importance, No Agency Aggregation

Question Text	Average Score	Standard Deviation
Conservation of riparian areas	4.4	0.9
Protecting native plant and wildlife species is a goal of mine	4.4	0.8
Conservation of natural resources	4.3	0.8
Water conservation in the Aravaipa Watershed matters to me	4.3	0.8
Erosion control measures are important to me	4.1	1.0
Invasive plants are a problem for me	4.0	1.1
Source water protection	3.9	0.8
Conserving open spaces is important	3.9	1.1
Public safety and road maintenance area a high priority to me	3.7	1.4
Ecosystem services	3.5	0.9
Climate change adaptation	3.5	1.2
Sustainable agriculture is a critical issue	3.4	1.4
Infrastructure	3.2	1.1

Table 8. Agency Stakeholder Level of Importance, Aggregated by Agency

Question Text	Average Score	Standard Deviation
Conservation of riparian areas	4.5	0.8
Protecting native plant and wildlife species is a goal of mine	4.4	0.8
Conservation of natural resources	4.3	0.8
Water conservation in the Aravaipa Watershed matters to me	4.2	0.8
Erosion control measures are important to me	4.0	1.1
Invasive plants are a problem for me	3.9	1.2
Source water protection	3.8	0.8
Conserving open spaces is important	3.7	1.1
Climate change adaptation	3.6	1.1
Public safety and road maintenance area a high priority to me	3.5	1.5
Ecosystem services	3.4	0.8
Sustainable agriculture is a critical issue	3.1	1.4
Infrastructure	3.1	1.2

of concern or other comments. No additional topics were identified from these comments. Table 7 and Table 8 show the average score and standard deviation without and with agency aggregation, respectively, for each of the questions where we asked agencies to rate the level of importance. The standard deviations are relatively higher compared to the community inputs, see Table 6.

Although the order of priorities is slightly different between the communities and agencies, there is agreement that erosion control, water conservation, and protecting native plant and wildlife species between both groups. Further, there is not a significant difference in scoring whether aggregating by agency or not. All of the responses are plotted in histograms, Figure 42 and Figure 43. With the current responses, aggregation by title or position is not beneficial. The greatest recurrence of position is quantity two each of hydrologist and fish biologist.

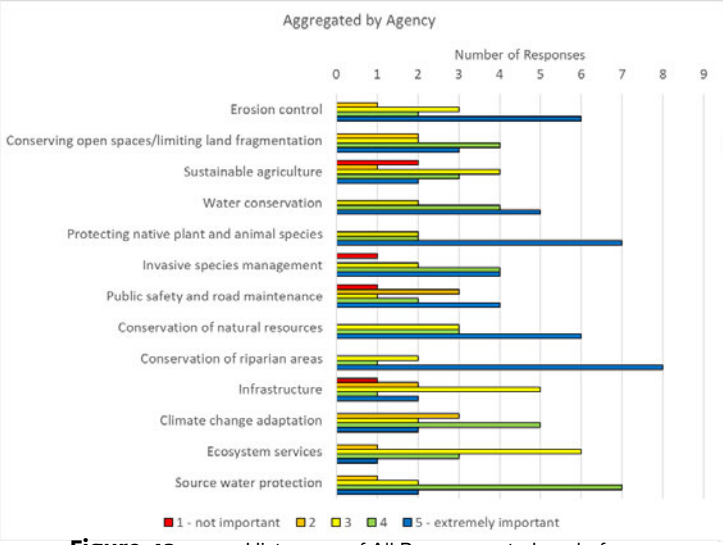

Figure 43. Histogram of All Responses to Level of Importance Questions, Aggregated by Agency

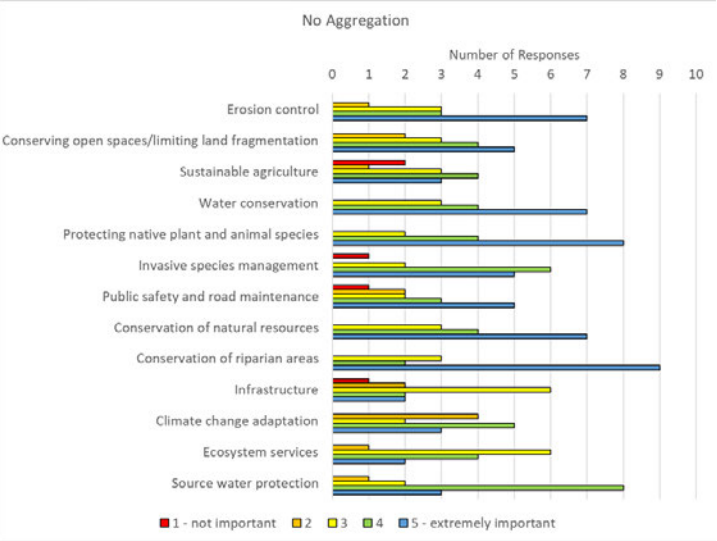

Figure 42. Histogram of All Responses to Level of Importance Questions, No Agency Aggregation

5 PROJECTS

5.1 Project Evaluation Criteria

To provide an equitable and comprehensive evaluation of different projects, AWCA has developed a set of evaluation criteria. Table 9 lists the project evaluation criteria. AWCA selected the first three criteria to evaluate the project's effect on the three shared priorities described in Section 4.1. The remaining categories were selected to provide an overall assessment of project feasibility. Project feasibility is assessed through development status, cost/funding, partnership opportunities, and consequences of project failure. The overall score for a project is calculated as the sum of the product of the individual criteria score and score weight. The overall score can vary from 1 to 5, and weighting factors are selected to give a total of 66% of weight to the three shared goals and 34% weight to project feasibility. This approach allows for quantitative and qualitative evaluation of projects, depending on what type of data is available. When additional modeling and development of projects are undertaken, criteria should be updated to include quantitative descriptions where feasible. A project evaluation should be completed when assessing a project type (refer to Section 5.3) for implementation to address areas of concern (refer to Section 5.2) These criteria were reviewed at the stakeholder meeting and will likely be refined as part of initial project evaluation efforts. These evaluation criteria can be used to provide an individual assessment of a project for implementation or to rank multiple projects for prioritization.

Table 9. Project Evaluation Criteria

Title	Description	Score Range	Score Weight
Erosion	What are the projected effects on erosion in the region? A score of 1 corresponds to small erosion reductions, a score of 5 corresponds to large erosion reductions.	1-5	0.22
Water Conservation	What are the effects on the regional water budget? A score of 1 corresponds to no changes to the water budget. A score of 5 corresponds to increases in groundwater storage.	1-5	0.22
Riparian Conservation	What are the impacts impact to habitat and plants and wildlife in riparian areas? A score of 1 corresponds to no impacts on the riparian areas. A score of 5 corresponds to large benefits to the riparian areas.	1-5	0.22
Development Status	What is the project development status? A score of 1 corresponds to a project that requires substantial development. A score of 5 corresponds to a shovel ready project.	1-5	0.085
Cost/Funding	Is funding available for this type of project? A score of 1 corresponds to no know funding available, a mid-range score means funding is available with different levels of contingencies, and a score of 5 means funding is available with no contingencies.	1-5	0.085
Partnership Opportunities	Are there partners available for the project? A score of 1 corresponds to no known partners. A score of 5 corresponds to partners already engaged.	1-5	0.085
Consequences of Project Failure	What are the consequences of project failure? A score of 1 corresponds to a project that has high impact failure modes (e.g., harm to human health). A score of 5 corresponds to a project that has low impact failure modes (e.g., a rock water retention structure is damaged in a storm and must be repaired).	1-5	0.085

5.2 Areas of Concern

As described in preceding sections, AWCA met with community stakeholders to document areas of concern within the plan boundary. Figure 44 shows the results of these stakeholder outreach efforts. All points on the map document points of interest within the watershed and frequently include photograph documentation of the concerns. There are four classifications of points of concern: Buford Canyon Deposition, Private Property, Road, and View. Buford Canyon Deposition documents sediment deposited at the confluence of Buford Canyon and Aravaipa Creek from flood events following the Pinnacle Fire. Private Property documents concerns on private deeded land. Roads document conditions on or immediately adjacent to public roads. Views show general

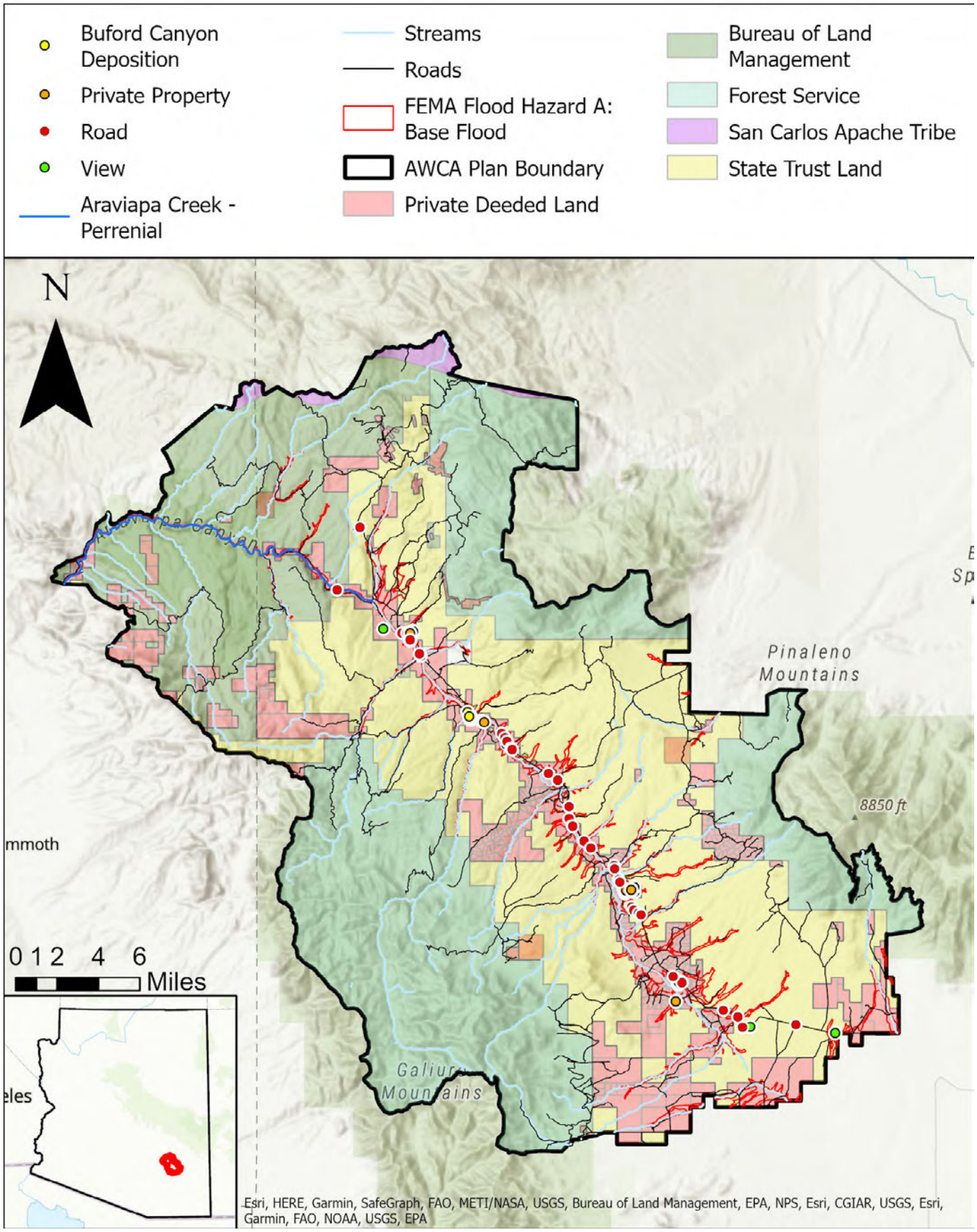

Figure 44. Areas of Concern
Source: (Bureau of Land Management, 2022; Federal Emergency Management Agency, 2022; Graham County, 2022)

points of interest within the watershed. Figure 44 also overlays management agencies and the FEMA base flood hazard zone (Hazard A). All other areas of the watershed are either undetermined or minimal flood hazard. These layers are chosen to help visualize geographic jurisdictions and characterize flood risks within the areas of concern.

As additional community outreach is completed, this map will continue to be updated with additional points of concern. Online versions of the map will allow different layers to be superimposed over areas of concern to help assess local conditions and impacts of different project types. This map also offers a tool to monitor erosion conditions through repeat photography of these locations after flow events (e.g., the confluence of Buford Canyon and Aravaipa Creek.

As described in preceding sections, roads can be key sources of erosion due to a variety of factors (e.g., soil compaction, increased runoff velocities due to topography changes). During severe storm events, road damage is possible. As shown in Figure 44, the Bonita-Klondyke Road runs both parallel to Aravaipa Creek and through the flood plain for the majority of its length. This means that the road will be subject to high runoff volumes during precipitation events. For these reasons, implementing best practices for road maintenance is important to reduce public safety impacts from road closures.

Examples of Areas of Concern within Blan Boundary

5.3 Project Types

The following sections describe types of projects that can be completed to address the three priority goals of the watershed: erosion control, water conservation, and conservation of riparian areas. This section should be revised as projects are completed and new project types are identified. Some project types included (e.g., formation of a science advisory committee) do not require a full assessment prior to implementation.

5.3.1 Formation of Science Advisory Committee

A science advisory committee can provide insight and expertise for developing future implementation plans. Creation of the committee provides a framework for frequent engagement with scientists from other organizations (e.g., University of Arizona, USGS, BLM, NRCS) to gain insights on the latest data and science available for watershed management. The science advisory committee could also provide expert evaluation of projects and assist in reviews of and suggest new projects. This committee could also assist in development of additional modeling efforts, including scenario-based planning for future adaptive management elements. Further, cooperation and engagement with local community stakeholders can provide access and opportunities for these external organizations to conduct research in the area. To establish a science advisory committee, AWCA must first establish a structure and then recruit membership.

5.3.2 Additional Modeling

As part of their 2018 report, Norman et al. generated a SWAT model to predict the impact of development in the upper watershed (2018). SWAT models are used to simulate the water and soil flows through a watershed, including their environmental impact. Due to the relative scarcity of localized precipitation data in the watershed, calibration of the model (i.e., testing the model against known inputs and outputs to adjust model factors to more closely match the real world) is difficult. In order to calibrate the model, additional timed measurement of precipitation must be made for calibration against USGS stream gauge data. To do this, expertise is needed on where to locate instrumentation, what instrumentation is needed, and to perform the calibration of the model. If calibration of the model is not completed, additional modeling could be completed to provide qualitative assessment of hypothetical project impacts.

5.3.3 County Road Maintenance Partnership

As described in preceding sections, road maintenance practices on the Bonita-Klondyke Road have the potential to significantly impact watershed function. Section 5.2 and Figure 44 illustrate community stakeholder concerns for public safety and watershed health as a result from degraded conditions on the Bonita-Klondyke Road. Since this road provides the only access to the lower watershed, storm damage can limit access to vital services for these community members. Further, increased runoff and erosion resulting from degraded road conditions can result in increased sediment transport and deposition in the perennial reaches of Aravaipa Creek, directly impacting aquatic species and riparian areas via infill of critical areas and degraded water quality. AWCA would like to partner with agency and county stakeholders to improve maintenance conditions on this major roadway with a goal of maximizing public safety and minimizing downstream water quality impacts. Addressing specific areas of concern and implementing best design and maintenance practices will reduce damage from storm events (National Resource Conservation Service, 2015; Skorseth & Selim, 2000). Since storm damage has the potential to result in substantial repair costs, implementing improved maintenance and addressing areas of concern on this road has the potential to result in overall reduced costs to maintain the Bonita-Klondyke Road.

5.3.4 Soil Samples to Evaluate Residual Tailing Effects

Although the Klondyke Tailings Superfund Site has been closed and is subject to an ongoing monitoring program, there are still concerns about persistent impacts from mining among community stakeholders (Schnell, 2022; Stoddard, 2022). Surface runoff from mine tailings can leach and transport contaminants (e.g., heavy metals) from the mines to downstream sites. Many mine sites are located on Laurel Canyon, and there are various locations where runoff ponds downstream from the mines. As runoff ponds, the velocity is reduced and sediment is deposited at the bottom of the pool. These ponding locations would serve to concentrate contaminants and could provide a worst-case evaluation of these localized effects. Additional expertise is needed to plan and conduct this soil sample campaign.

5.3.5 Natural Infrastructure in Dryland Streams

Natural Infrastructure in Dryland Streams (NIDS) refers to natural occurring or human-made structures made from soil, debris, wood, and stones that help restore watershed functions in arid regions. Structures include devices like beaver dams, beaver dam analogs, check dams, gabions, leaky weirs, one-rock dams, and trincheras. These structures resist and inter runoff, substantially reducing runoff velocity. As runoff velocity decreases, sediment will be deposited, reducing erosion and improving downstream water quality. To increase effectiveness, thousands of these structures are typically installed through a watershed. Upland drainages should be prioritized to maximize runoff benefits. Since these are small scale structures, installation and maintenance costs are relatively small while failure effects are localized and relatively small. Careful site selection can facilitate wetland recovery and increase recharge to the aquifer. Naturally occurring beaver dams frequently demonstrate these benefits (National Resource Conservation Service, 2022; Norman et al., 2022).

Although they have been extirpated from the area, there is the potential to reintroduce beavers to the region. However, concerns about beaver impacts on local hydrography resulting in more favorable habitat for invasive species in Aravaipa Canyon must be addressed.

A good first step in implementing these projects would be to hold a community workshop and field day. Experts in NIDS should be identified to lead the workshop, including classroom and field portions. Prior to the workshop, sites can be reviewed with the subject matter experts for selection for the field portion of the workshop. After the classroom instruction portion of the workshop, community members can implement techniques in the field at the pre-selected site.

5.3.6 Rainwater Harvesting

Rainwater harvesting can supplement water supplies, reducing the amount of groundwater pumping that contributes to groundwater table reductions. Groundwater use in support of landscaping irrigation has been relatively minor, but additional development in the upper watershed could result in increased pumping. If predicted reductions in precipitation are realized, groundwater pumping to meet all demands (e.g., livestock, pasture irrigation) is expected to increase. Combined with reduced precipitation and soil infiltration, this increased pumping has the potential to worsen groundwater table elevations throughout the watershed.

Pilot projects should be implemented to demonstrate and develop local best practices for rainwater harvesting. These pilot projects would partner with local landowners to identify and construct necessary facilities to collect, store, and distribute harvested rainwater. Potential project goals include:

- Establishing native vegetation (e.g., bunchgrasses) to improve landcover and stabilize soils. Once established, native vegetation does not require as much supplemental irrigation, and this rainwater harvesting system could be relocated to establish vegetation at different sites.
- Supplement potable supplies. With appropriate filtration and treatment, harvested stormwater can be used to supplement or replace other potable water supplies for domestic use.
- Livestock use. Rainwater harvesting can be used to supplement pumped groundwater to fill stock ponds and other sources of water for landscaping use.

First Road Crossing of Perennial Reaches of Aravaipa Creek

5.4 Project Status

In future revisions, this section should be updated to track the status and/or results of projects selected for development.

6 MONITORING AND UPDATING

This plan should be updated periodically to address changes in prevailing watershed conditions and to incorporate new or revised data. Additional monitoring and instrumenting of the watershed should take place, if feasible, to help inform planning efforts and monitor conditions. Immediate watershed concerns should be updated frequently using the GIS hub (to be prepared) to provide the most relevant data to community and agency stakeholders. This plan should also be updated with the status of projects, including monitoring the effectiveness of completed projects.

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APPENDIX A WILDLIFE SPECIES LIST

The following table lists the common and scientific names for species that have been observed within the watershed, including species that have been extirpated from the area (Bureau of Land Management Safford Field Office, 2015; Hadley et al., 1991)

Common Name	Scientific Name	Source		Extir-pated
		Hadley (1991)	BLM (2015)	
Fish				
Longfin dace	Agosia chrysogaster	X	X	
Speckled dace	Rhinichthys osculus	X	X	
Spikedace	Meda Fulgida	X	X	
Roundtail Chub	Gila robusta	X	X	
Loach minnow	Tiaroga cobitis	X	X	
Mountain sucker	Pantosteus clarki	X	X	
Sonoran sucker	Catostomus insiguis	X	X	
Yellow Bullhead	Ictalurus natalis	X		
Largemout bass	Micropterus salmoides	X		
Mosquitofish	Gambra affinis	X		
Red Shiner	Notropis lutrensis	X		
Desert Pupfish	Cyprinidon Macularius		X	X
Amphibians				
Colorado River Toad	Bufo alvarius	X		
Woodhouse's Toad	Bufo woodhousei	X		
Great Plains Toad	Bufo cognatus	X		
Lowland Leopard Frog	Lithobates yavapaiensis		X	
Reptiles				
Western Box Turtle	Terrapene ornata	X	X	
Desert Tortoise	Gopherus agasizi	X		
Gila Monster	Heloderma suspectum	X		
Collared Lizard	Crotaphytus collaris	X		
Lesser Earless Lizard	Holbrookia maculata	X		
Greater Earless Lizard	Holbrookia texana	X		
Tree Lizard	Urosaurus ornatus	X		
Side-bloteched Lizard	Uta stansburiana	X		
Arizona Coral Snake	Microurоides euryxanthus	X		
Massasauga	Sistrurus catenatus	X		
Wester Diamondback Rattlesnake	Crotalus atrox	X		
Black-tailed Rattlesnake	Crotalus molossus	X		
Mojave Rattlesnake	Crotalus scutulatus	X		
Tiger Rattlesnake	Crotalus tigris	X		
Arizona Black Rattlesnake	Crotalus viridis cerberus	X		
Banded Rock Rattlesnake	Crotalus lepidus klauberi	X		
Twin-spotted Rattlesnake	Crotalus pricei	X		
Giant Spotted Whiptail	Aspidoscelis stictogramma		X	

Common Name	Scientific Name	Source		Extir-pated
		Hadley (1991)	BLM (2015)	
Sonoran Desert Tortoise	Gopherus morafkai		X	
Sonora Mud Turtle	Kinosternon sonoriense sonoriense		X	
Birds				
Great Egret	Casmerodius albus	X		
Turkey Vulture	Cathartes aura	X		
Golden eagle	Aguila chysaetos	X	X	
Bald eagle	Hilaeetus leucocephalus	X	X	
Northern goshawk	Acciper gentilis	X		
Black hawk	Buteogallus anthracinus	X		
Zone-tailed hawk	Buteo albonotatus	X	X	
Osprey	Pandion haliatus	X		
Caracara	Polyborus planus	X		
Peregrine falcon	Falco peregrinus	X		
Bobwhite	Colinus virginianus	X		
Montezuma quail	Cyrtonyx montezumae	X		
Gambel's quail	Callipepla gambelli	X		
Chukar	Alectoris chukar	X		
Turkey Vulture	Meleagris gallopavo	X		
Rock dove (pigeon)	Columbia livia	X		
White-winged dove	Zenaida asiatica	X		
Elegant trogon	Trogon elegans	X		
Yellow-billed cuckoo	Coccyzus americanus	X	X	
Buff-collared nightjar	Caprimulgul rigwayi	X		
Belted Kingfisher	Ceryle alcyon	X		
Common Flicker	Colaptes auratus	X		
Vermillion Flycatcher	Pyrocephalus rubinus	X		
Willow flycatcher	Empidonax traillii	X		
Beardless flycatcher	Captostoma imberbe	X		
Cliff swallow	Hirundo pyrrhonota	X		
Strarling	Sturnus vulgaris	X		
American redstart	Setophaga ruticilla	X		
European house sparrow	Passer domesticus	X		
Violet-crowned hummingbird	Amazilia violiceps		X	
Northern gray hawk	Asturina nitida maxima		X	
Ferruginous Hawk	Buteo regalis		X	
Southwestern Willow Flycatcher	Empidonax traillii extimus		X	
American Peregrine Falcon	Falco peregrinus anatum		X	
Thick-billed Kingbird	Tyrannus crassirostris		X	
Mammals				
Allen's Big-eared Bat	Idionycteris phyllotis	X		
Beaver	Castor canadensis	X		X
Big Brown Bat	Eptesicus fuscus	X		

Common Name	Scientific Name	Source		Extir-pated
		Hadley (1991)	BLM (2015)	
Black Bear	Ursus americanus	X		
Black-tailed Jack Rabbit	Lepus californicus	X		
Brazillian Free-tailed Bat	Tadarida braziliensis	X		
Coati	Nasua nasua	X		
Collared Peccary (Javelina)	Dicotyles tajau	X		
Cottontail	Sylvilagus sp.	X		
Desert Cottontail	Sylvilagus audubonii	X		
Eastern Cottontail	Sylvilagus floridanus	X		
Coyote	Canis latrans	X		
Fringed Myotis	Myotis thysanodes	X		
Gray Fox	Urocyon cinereoargenteus	X		
Gray Wolf	Canis lupus	X		X
Hoary Bat	Lasiurus cinereus	X		
Hog-nosed Skunk	Conepatus mesoleucus	X		
House Mouse	Mus musculus	X		
Human	Homo sapiens	X		
Mastiff Bat	Eumops sp.	X		
Mountain Lion	Felis concolor	X		
Mountain Sheep (Big Horn)	Ovis canadensis	X		
Mule Deer	Odocoileus hemionus	X		
Muskrat	Ondatra zibethicus	X		
Racoon	Procyon lotor	X		
Ringtail	Bassariscus astutus	X		
Striped Skunk	Mephitis mephitis	X		
Townsend's Big-eared Bat	Plecotus towsendii	X		
Western Mastiff Bat	Eumops perotis	X		
Western Spotted Skunk	Spilogale gracilis	X		
White-tailed Deer	Odocoileus virginianus	X		
Pale Townsend's Big-eared Bat	Corynorhinus townsendii pallescens		X	
Greater Wstern Bonneted Bat	Eumops perotis califonicus		X	
Wester Red Bat	Lasiurus blossevillii		X	
Western Yellow Bat	Lasiurus xanthinus		X	
Lesser Long-nosed Bat	Leptonycteris curasoae yerbabuenae		X	
California Leaf-nosed Bat	Macrotus californicus		X	
Arizona Myotis	Myotis occultus		X	
Cave Myotis	Myotis velifer		X	
Yuma Myotis	Myotis yumanesis		X	

ARAVAIPA WATERSHED
CONSERVATION ALLIANCE

aravaipa.org

Aravaipa Creek is one of the last and least disturbed perennial streams in Southeastern Arizona. The region provides valuable refuge for many species of plants and wildlife, making it a popular destination for recreation and ecotourism. In addition, the relatively untouched valley has many native species of grass and sufficient water resources to make it attractive rangeland. The Aravaipa Watershed Conservation Alliance (AWCA) was formed in 2016 with a mission of preserving, maintaining, and improving the watershed and rangeland conditions within the Aravaipa Valley and Canyon. This cooperative watershed management plan documents the watershed assessment and shared priorities of agency and community stakeholders within Aravaipa Valley and Canyon.

This plan was prepared and printed with funding from a Bureau of Reclamation WaterSMART Cooperative Watershed Management Program Phase I Grant

BUREAU OF RECLAMATION

Terry Rambler
Chairman

SAN CARLOS APACHE TRIBE

P.O. Box 0, San Carlos, Arizona 85550
Phone (928) 475-1600 ❖ Fax (928) 475-2567

Tao Etpiso
Vice-Chairma

August 11, 2025

To Whom it May Concern,

The San Carlos Apache Tribe has long-standing historic and ongoing cultural interests in the care and management of its own 1.8 million acres of Reservation lands. Equally important are the lands with which it shares contemporary boundaries, including private parcels and public lands managed by the Bureau of Land Management and three National Forests.

As such, the Tribe welcomes and celebrates opportunities to collaborate with managing and other care-taking entities, and in particular, to participate in restorative activities for the benefit of all who value shared landscapes and ecological and social connectivity.

The restoration proposal submitted by Aravaipa Watershed Conservation Alliance, and including work that supports the training and process-based restoration practices utilized by San Carlos Apache tribal members, represents an ideal opportunity to increase multiple kinds of connectivity and collaborative, restorative work across scales and social groups. Our work will enable tribal members to learn about and tend to off-reservation lands about which they care deeply, and to learn from others who share that ethic of care while demonstrating its effectiveness across the watershed.

The Natural Resources group of the San Carlos Apache Tribe therefore strongly supports the Alliance's proposal, from its collaborative and inclusive spirit, to its on-the-ground attention to ecosystem processes affecting all inhabitants of the shared watershed.

We look forward to working directly with the Alliance and to building our relationships and effectiveness through this important work.

Sincerely,

David Seibert, Ph.D.
Watershed Ecologist, San Carlos Apache Tribe
Natural Resources, Range Management, Land Operations

PDP
Box 17421
Tucson, AZ 85731-7421
pdp-az.com

To Whom It May Concern,

As part of Partner for Dryland Planning's (PDP) approach to working with rural communities, we pledge a portion of our time as in-kind match to groups with whom we work. We are committed to the success of the Aravaipa Watershed Conservation Alliance's mission, including implementing restoration projects. To that end, we are willing to donate 160 hours of our time, valued at $60 per hour for a total of $9,600, to AWCA in support of their application, Upper Aravaipa Creek Watershed Restoration Demonstration Project.

Thank you for your consideration.

Sincerely,
Garland Speight
Partners for Dryland Planning

UPPER WATERSHED RESTORATION DEMONSTRATION PROJECT FOR ARAVAIPA CREEK

Project Site Work Authorization and/or Project Site Access

We have signed letters of intent from the landowners to provide access to their property for this work. As part of our first task, we will work with the landowners to finalize a land use agreement.

August 11, 2025

To Whom It May Concern,

My name is Joshua Hardy, owner of parcel number 112-36-039, in Graham County, Arizona. This letter expresses my intent to provide access to my property for the purposes of implementing projects associated with Aravaipa Watershed Conservation Alliances's (AWCA) application for the Upper Watershed Restoration Demonstration Project (Project) for Aravaipa Creek to the Arizona Water Protection Fund. If this grant is awarded, a specific land access agreement will be developed to formalize terms of access (e.g., amount of notice given prior to site access). For this Project, I intend to provide AWCA and its agents access to my land for:

- Site inspections and measurements in support of project design
- Construction and implementation of the project, including material delivery and staging
- Post-implementation inspection, including by Arizona Water Protection Fund staff
- Project tours for AWCA educational outreach
- Monitoring, including repeat photography, installation of sensors (e.g., soil moisture), and hand measurements

Further, I intend to grant access for AWCA to feature this project in their promotion materials (e.g., newsletters, websites).

Sincerely,

Joshua Hardy

8/11/2025

August 11, 2025

To Whom It May Concern,

My name is Monroe Martinez, owner of parcel number 111-12-067, in Graham County, Arizona. This letter expresses my intent to provide access to my property for the purposes of implementing projects associated with Aravaipa Watershed Conservation Alliances's (AWCA) application for the Upper Watershed Restoration Demonstration Project (Project) for Aravaipa Creek to the Arizona Water Protection Fund. If this grant is awarded, a specific land access agreement will be developed to formalize terms of access (e.g., amount of notice given prior to site access). For this Project, I intend to provide AWCA and its agents access to my land for:

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Sincerely,

8-14-2025

Monroe Martinez

UPPER WATERSHED RESTORATION DEMONSTRATION PROJECT FOR ARAVAIPA CREEK

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Sincerely,

8-14-2025

Monroe Martinez

UPPER WATERSHED RESTORATION DEMONSTRATION PROJECT FOR ARAVAIPA CREEK

Evidence of Physical and Legal Availability of Water

Water resources will not be used for the implementation of this project.