

Tubac Nature Preserve Restoration Management Framework

There are three very different ecological systems on the property: riparian forest, grasses and a small gravel pit that has potential as a constructed wetland. Each is the result of human disturbance. The desired future condition for each will require rejuvenation, restoration and/or reconstruction. They have very different challenges and while they each have some aspects in common, they will likely require very different approaches to becoming healthy components within the new Tubac Nature Preserve. They all will require significant funding over varying periods of time. Thankfully, there are a number of granting entities that will favor restoration projects like this, particularly since we have a number of partners that are in support of our objectives.

Developing a long-term restoration strategy is a primary goal of the Tubac Nature Center. Here is an outline of the proposed objectives of this strategy:

- Provide a comprehensive overview of current and desired conditions in the Tubac Nature Preserve.
- Provide a concise reference and a unified source of guidance to agencies and organizations working within and outside the TNP, with a focus on shared goals.
- Promote solutions to complex problems and effective, sustainable management practices in the Preserve.
- Offer a “toolbox” of information and resources on stewardship practices, monitoring, funding opportunities and other topics.
- Identify, prioritize, and design general concepts for restoration projects important to accomplish over the next 25 years.
- Outline a framework for continued monitoring and adaptive management with the Preserve along with collaboration with adjacent lands along the Santa Cruz River.
- Develop a variety of funding avenues to accomplish priority projects.

The framework describes strategies, projects, best management practices, and available resources for accomplishing the general objectives outlined above. It is meant to be a dynamic, interactive, living compilation of resources that is consistently updated by diverse stakeholders in the watershed and adapted as progress is made and new challenges arise. It includes an approach to tracking progress on collaborative projects as well as environmental and social conditions throughout the watershed. Hopefully, these strategies will also have some applicability to other areas outside the Tubac Nature Preserve (TNP) that are similar but not under the purview of this committee.

Part I: Native Grasses and Wildflowers Restoration/Creation

The primary location for this component is west of Ron Morriss Park, extending past the Baca Float water treatment plant, around the east side of the Valle Verde Ranch and almost encircling the former gravel pit affectionately called “The Pit.”

1. Analysis of the Existing Condition

- a. The areas currently in grass represent seeds disturbed and/or distributed after earthwork moving in the creation of the Barrio properties. Over time they have morphed into a combination of grasses and weeds, native and non-native.
- b. A portion of the area now in grass will be utilized for trails, butterfly plantings, an outdoor classroom, shade structures and an area for hawk-watchers to gather.
- c. The access road to the Treatment Plant cuts through the grassy portion just south of the park and will remain for use by Baca Float.
- d. The composition of grasses is unknown. Obvious, if only by visual inspection, is the lack of diversity and paucity of wildflowers. Pigweed seems to be a large percentage of many of the grassy areas.
- e. The property does not have a designated water source in or near most of the areas currently in a grassy state, although there may be potential to work with Baca Float to utilize an old irrigation pipe on the west side of the treatment plant. Use of the old well located on the parcel south of Valle Verde and north of the pit could also be explored.

2. Available Data and Additional Needs

- a. The work being done by Buenos Aires NWR and the Altar Valley Conservation Group has some comparability. Contact with them offers great potential to learn what they have done and how they did it. Adapting their restoration prescription to grassy areas in the Preserve could be a good place to begin to show the positive efforts of the Tubac Nature Center acquisition. A number of regional parks have created butterfly gardens, which offers some insight into potential ways that TNC might go.
- b. Knowing what grasses and weeds are present is an early step towards identifying the key actions needed.
- c. Is the tank just outside the SE corner of the parcel south of the Valle Verde property an alternative? Is it still a water source and if so, how much water is available and at what cost? It is fenced but appears out of operation.
- d. There will be a need for watering during the first year(s) of planting.
- e. Identify nearby sources of the desired vegetation. Whenever possible, use local seeds and native plants that have been grown in southeastern Arizona.
- f. Areas that need to be fenced (and then maintained) need to be identified.
- g. Consult with botanists, butterfly host plant experts, irrigation specialists, nurseries, state and local agencies to identify the mixes of grasses and specific plants to be planted. Appleton-Whitehall in conjunction put out a publication in 2015 called "Bloom Time Chart" with native plants for hummingbird gardens.
- h. Identify areas that may require tilling or ground preparation and appropriate methods to accomplish this task.
- i. There are a number of great reference materials available related to grasses in Arizona. The following list was copied from a reference list included in the "Grasses of Las Cienegas National Conservation Area" publication:

- i. A Catalogue of the Flora of Arizona by J. Harry Lehr, 1978, published by The Desert Botanical Garden.
- ii. Arizona Range Grasses: Their Description, Forage Value and Management by Robert R. Humphrey. Revised 1970. University of Arizona Press, Tucson AZ. *Line drawings, descriptions, and grazing information focusing on grass.*
- iii. Field Guide to the Plants of Arizona by Anne Orth Epple. 1995. Lew Ann Publishing Company, Mesa, AZ. *Color plates and text descriptions and habitats of many plants found in Arizona, arranged by life form, flower color, and family.*
- iv. Grasses of Southeastern Arizona *is one of several plant volumes in a series produced by the Coronado RC & D Area, Inc., and Conservation Districts of Southeastern Arizona. These are pocket-sized, and include descriptions and general information on each topic group.*
- v. Grasses of the Southwestern United States by Frank. W. Gould. 1993 (6th printing). University of Arizona Press, Tucson. *Line drawings, keys, and descriptions to aid in identifying native and introduced grasses.*
- vi. Manual of the Grasses of the United States (2 volumes) by A.S. Hitchcock. 1950. Revised by Agnes Chase. Dover Publications, Inc., New York. *The standard for grass identification.*
- vii. North American Range Plants by Stubbendieck, Hatch and Butterfield. 1997. University of Nebraska Press. *Line drawings of a lot of our plants.*
- viii. Weeds of the West by Tom D. Whitson, Editor and Author, and others. Revised 1992. Published by the Western Society of Weed Science in cooperation with the Western United States Land Grant Universities Cooperative Extension Services. *Photographs and species descriptions of plants that often cause problems for land managers.*
- ix. An Illustrated Guide to Arizona Weeds by Kittie F. Parker. 1972. University of Arizona Press, Tucson AZ. *Line drawings, descriptions, and control mechanisms for some plant species that are growing where they aren't wanted.*

3. Desired Future Condition

- a. TNC wishes to reduce the invasive species and some of the existing native grasses with more desirable native species of grasses and wildflowers that will be pleasing to local residents and visitors. The area will provide food for winter birds if maintained (cut down) at the appropriate seasons. It will draw butterfly enthusiasts through blooming native host plants that are featured in the summer.
- b. Plant a mix of flowers and grasses that flower at different times. Host plants for threatened species are prioritized.

- c. The focus on native grasses and butterfly plantings is well timed. The decline in pollinators is a nationwide problem that could be helped by the careful selection of host plants. This could also be a tactical advantage in finding funding and pollinator-friendly vegetation certainly could draw more visitors. The business community would welcome the eco-tourism aspects of native wildflowers drawing butterflies and moths leading to increased visitation.
- d. Healthy, native, drought tolerant grasses and wildflowers cost less to maintain and use very little additional water post-establishment.
- e. The areas close to Cielito Lindo will remain mostly in grasses in support of the neighbors' requests.
- f. The restored areas will have to be protected from stray cattle through maintained fencing at boundaries to grazing operations.
- g. As much of the facilities and trail shall be universally acceptable as possible.
- h. Some of the signage, particularly key interpretive panels, should be bilingual.
- i. Interpretation of the area and selected flora and fauna will help visitors learn about the area and increase their knowledge of the environment.

4. Restoration Tactics and Sequence

- a. Volunteers can help remove some of the undesired invasives and participate in planting and maintaining new vegetation. Contracts will likely be needed as well.
- b. Development of water sources for plantings that need water to become established is a high priority. It will also dictate some of the trail locations and the first spots to add native plantings. Once begun, the plants need to be given supplemental water to establishment, and the water source/system will have to be monitored and maintained. Many grass species can have their initial watering reduced once they reach 2 inches in height.
- c. Seed and plant sources for desired species must be identified. A mix of seeds is recommended.
- d. Fences needed for protection must be installed prior to any planting and continually inspected and maintained.

5. Potential Funding Sources

- a. Look for "pollinator focused" funding. The US Fish and Wildlife Service and Arizona Game and Fish Departments are very supportive of efforts to increase pollinator viability.
- b. Arizona State Parks and Trails have several applicable categories of grants related to trails, recreation, accessibility and "parks". Grants can be applied for at any time. If you apply after June, the funding will be available until July of the following year at the earliest. The Recreational Trails Program is federal funding coming from FHWA. RTP grants do cover paved paths, however, with the current \$150,000 grant request limit. <https://azstateparks.com/grants>.
- c. Native grasses are desirable and grants exist to restore them, usually with a matching percentage.

- d. Perhaps partnering with Baca Float could be a way to reduce watering costs if a suitable supply and existing line is nearby.
- e. A number of conservation organizations are looking for places to enhance native grasses and may be willing to partner with TNC, perhaps by helping provide source materials.
- f. Volunteers are not a free lunch but may be a partial solution in removing invasive species as well as planting and maintaining some of the desired vegetation.

Part II: Wetlands Restoration/Creation

The location for this element is the old borrow pit that does hold some water, has some marsh-like vegetation and is overgrown with various species of trees and shrubs. There is a primitive road that serves now as a trail around the Pit. This road will not be modified and will serve as the western boundary for any planned work.

1. Analysis of the Existing Condition

- a. The ephemeral nature of the wetlands begs the question of how low does it go during drought years, and why?
- b. The hydrology investigation done several years ago provides a basis for understanding how much potential and effort will be needed, but more specific detail is needed.
- c. The neighbors to the west are screened by berms and some mesquites. There is valid concern that their views and privacy may be affected by increased activity and changes in vegetation.
- d. The condition of the wetlands is simply a function of monsoonal moisture and runoff. No maintenance is done to the vegetation. The cottonwoods indicate some moisture is available but portions of the eastern end show that there is very little moisture much of the year and surface water recedes to the west.
- e. Recent bird sightings indicate that marsh birds have not returned subsequent to the drought years of 2019 and 2020. Yellow-headed Blackbirds, American Coot, Marsh Wren and Sora are rarely seen or heard anymore.

2. Available Data and Additional Needs

- a. Study the water table and expected annual water inflow. Do monitoring wells indicate any particular change in water levels over time? Is there enough water to maintain water levels? Can nearby storm water runoff be utilized?
- b. Will this site hold water or is there a need to “seal” the bottom?
- c. The preliminary concept plan shows development clustered on the east end of the future wetlands and a perimeter trail that ties into the existing road on the west side. No new trail construction is anticipated on the west side, and the neighbors to the west (Trailshead) have been promised that no benches, trails, roads, or other constructed features will be done within 100 feet of their property.

- d. Jonathan Horst from Tucson Audubon completed a preliminary assessment that outlined the following:
 - i. This site has potential to become a unique habitat patch within a larger gallery riparian corridor and mesquite bosque, which makes it important to birds.
 - ii. Phase 1 should be to treat invasives such as Salt cedar, Johnson grass, Russian thistle and tumbleweed, among others.
 - iii. Phase 2 will be to choose desired target habitat types based on bird species. (Cienega/Ephemeral wetland/Cattail Forest/Galley-subGallery Forest.)
 - iv. Phase 3 will be to plant appropriate natives, like Sacaton and other floodplain grasses, fruit bearing trees like Elderberry/Chokecherry/Hackberry, wetland pollinator plants, beneficial trees like Arizona Black Walnut, etc.
- e. Tucson Audubon has given TNC a quote of \$10,000 for development of a detailed restoration plan. If accepted, they will provide a plan that includes a phased list of restoration activities, invasive treatment methods, recommend any recontouring of the wetland, stormwater harvesting opportunities, plant lists for various zones, plant installation recommendations (soil/site prep, planting densities, etc.), target species, applicable grants, recommended trail layout and design.
- f. The preliminary plan and expected reconstruction approach will be reviewed and discussed with the Trailshead neighbors before beginning any implementation.

3. Desired Future Condition

- a. TNC desires that a vibrant, healthy wetland is created and maintained, offering a variety of vegetation and diversity of wildlife. Lowering maintenance costs are kept in mind and factored into all construction decisions.
- b. Keep water levels relatively constant, or at least change water levels slowly. Occasional managed burns could be a useful tool if skilled professionals are found and they take the proper precautions. This can help control cattails and improve wetland habitat for key species. It is important to leave some vegetation so species that depend on the area have habitat.
- c. The activities in the vicinity of the wetlands are focused more on the eastern end of the project and no new impacts will occur closer than 100 feet from our neighbors in the Trailshead subdivision. The existing road on the west end will be used as a trail rather than creating a new one.
- d. A viewing platform will be placed in such a way that visitors can see wildlife in the wetlands and vegetation is arranged to provide screening for both wildlife and people. Seating will be provided on the platform. Sun angle will be considered in siting it, as well as being screened from viewing the houses to the west.

- e. The site will be accessible from the east by connecting it to the Anza Trail and any new pieces of trail created by TNC.
- f. As much of the trail and platform should be universally accessible as possible.
- g. Interpretive signing should be provided to help enhance the visitor experience and educate them about the environment. Some of the interpretive materials should be bi-lingual.

4. Restoration Tactics and Sequence

- a. *Whichever experienced contractor is hired to evaluate and propose a design for the wetlands can best help develop this section of the strategy.*
- b. A viewing platform is likely an expensive project and should be done as reconstruction of the wetlands occurs to reduce construction costs and eliminate adverse effects to the established wetlands vegetation likely by deferral.
- c. Consider planting native fruit-bearing shrubs that will grow to 15' (+/-) high as winter food and offer screening.
- d. Pollinator plantings can be done in conjunction with the trail and sitting areas, with a high priority based on drought tolerant host plants.

5. Potential Funding Sources

- a. Wetlands restoration and enhancement projects that benefit wetlands-associated migratory birds are eligible for North American Wetlands Conservation Act (NAWCA) grants via US Fish and Wildlife Service. The Small Grants Program funds on-the-ground projects less than \$100,000 and provides a requirement for a 1:1 match. They are expected to be sponsored by the local JV, in our case, the Sonoran Joint Venture.
- b. Partners for Fish and Wildlife grants up to \$25,00 per property for focal species habitat. (i.e., YBCuckoo, pollinators, monarchs, any T&E plants)
<https://www.fws.gov/program/partners-fish-and-wildlife>
- c. 5-Star and Urban Waters Restoration – up to \$40,000 for riparian and wetlands projects, particularly those with partners and an environmental education piece.
<https://www.nfwf.org/programs/five-star-and-urban-waters-restoration-grant-program>
- d. Arizona Water Protection Fund – up to \$400,000. See more details under Riparian Woodlands funding opportunities.

Part III: Lowland Riparian Restoration

The Santa Cruz River runs primarily through the center of the new Nature Preserve property. The river is perennial although it does have a history of very low flows in the late spring/early summer seasons during severe droughts. The monsoons of July/August and sometimes September often cause flooding within adjacent lowlands. The primary water source comes from upstream water treatment facilities and Sonoita Creek. Like all water moving through desert areas, this river is considered critical habitat at both the state and federal levels for a number of declining aquatic, terrestrial and avian species. Lowland

riparian forests are considered one of the most threatened forest ecosystems in the country by many experts.

1. Analysis of the Existing Condition

- a. One of the known issues concerning forest health is the advancing infestation of mistletoe. It seems to be moving south from the Tubac Resort property which has not done any treatment. Mistletoe doesn't tend to kill their tree hosts but it is possible and certainly they can do harm, leaving the hosts more vulnerable to other stressors.
- e. Many reaches of the river once flowed year-round. Flows began to dry out due to groundwater pumping but there is now an added influx of highly treated water from the Nogales International Wastewater Treatment Plant that has helped a bit. Many local folks will tell you that the groundwater levels have dropped in recent years. The recent edition of "A Living River" from the Sonoran Institute shows that the 2021 annual streamflow volume in Tubac reached its highest level since 2008, and likely continued into 2023 due to two consecutive excellent monsoon seasons.
- f. The meandering nature of the river actually offers greater potential for regeneration, particularly if it were to occur in spring and provided there is a shallow depth to groundwater. In the past five years, the river has mainly been confined to the ever-deepening channel, although it does overtop the banks and is often diverted into side channels during heavy monsoon rain events in late summer.
- g. Stream water quality has improved since 2009 as the treatment plant was upgraded, however, unsafe concentrations of E. coli bacteria due to excess runoff and sewage breaches have occurred periodically including several from the aging International Outfall Interceptor transporting wastewater from Ambos Nogales (both in MX and AZ) to the treatment plant. A multiyear rehabilitation project began in 2022 to address this contamination. Contaminated stormwater runoff remains an unsolved problem.
- h. Stream hydrology has changed dramatically in the past twenty years and banks have eroded severely. In just the past three years, scouring floods have resulted the downcutting of the channel by another 2-3 feet in some places, which is one of the larger concerns. This has likely caused the groundwater levels of the existing cottonwood forest to be lower, and the deeper the groundwater, the harder it is for seedlings to establish and it adds to the reduced health in mature trees when more than 5 meters below the surface. In addition, over the past decade, there have been very few spring rains along the Santa Cruz River and thus no spring flooding events. Conversely, there is anecdotal and scientific evidence that flooding events greater than a 100-year return period have led to significant tree losses in some areas.
- i. There is some evidence that a portion of the undercutting seems due to the addition of dirt and rip-rap about four years ago to provide a shallower river

crossing at Clark Crossing, however, this needs to be investigated, along with other areas where the channel has become very deep.

- j. The most common species of trees in the riparian corridor are Fremont Cottonwood, sycamore, Goodding and other willow species, alder, cypress, and walnut. Several factors restrict germination of the cottonwoods and willows to spring and early summer. These include early spring dispersal, short periods (1-5 weeks) of seed viability and rapid seed germination. These adaptations help synchronize germination with periods of high spring flows. (Fenner, et.al. 1984) Moist mineral soil or alluvium is necessary for germination and establishment. Goodding's Willows tend to establish closer to the stream than Fremont's Cottonwoods. Goodding's tend to release seed about a month later, also.
- k. Groundwater within 5 meters (16.4 feet) of the land surface is needed to provide water for the cottonwoods and willows along the river (fide Sonoran Institute). Between 2020 and 2021 groundwater depths dropped in some wells in Amado and Rio Rico, but then began to rise quickly starting in July 2021. The Tubac reach maintained characteristically steady levels, generally less than 3 meters. There are no monitoring wells on the property. (The cited groundwater monitoring well is not located on the new property.)
- l. Most trees are mature with very little regeneration occurring. There is only one age class of cottonwood present. Significant die-off is occurring, worsened by the long-term effects from the severe drought of 2019-2020, and the extended drought cycle of most of the Southwest. Cottonwood and willow seedlings have a high rate of mortality during drought and summer and fall flood events or during periods of rapid water table decline (i.e., > 3 cm per day). Moist soil and shallow groundwater (1-3 meters below the surface) during the growing season are a necessity for both species to establish. (Stromberg, et. al 2007.)
- m. There are invasive species that may be inhibiting natural regeneration as well as taking advantage of areas that have been denuded. Trees are considered invasive if they are exotic or non-indigenous species that grow aggressively and replace native vegetation in environments in which they did not evolve. Invasive plants often have no natural enemies to limit their reproduction (e.g., insects that feed on them), and thus displace native vegetation and can cause environmental damage. Tamarisk, Russian Olives, Poison Hemlock and English Rocket are just some of the invasives being seen in the area.
- n. The new preserve area has had cattle grazing and deer browsing for many years. Nearly all visible green vegetation has been removed during some recent drought years, opening up the forest floor to invasives and enhancing erosion potential. There is no written contract regarding grazing within the parcel. Deer can access the property from all directions. Similar properties along the Santa Cruz that have no grazing have a much greater understory vegetative component and some, albeit minimal, forest regeneration.
- o. Fencing of this property is currently maintained by the ranchers that graze cattle, and it is not only a difficult job, it is a critical one. Monsoon flows, debris

buildups, other ranchers, illegal immigrants, overeager hikers and falling trees have all resulted in fences being destroyed and breachable.

- p. The amount of woody biomass on the forest floor is heavily affected by monsoonal storms and flooding. The loss of old cottonwoods in recent years has increased woody biomass.
 - q. Debris piles accumulate in the river and in the adjacent floodplain during monsoons. These “Bottle dams” often result in the river jumping the banks, creating new channels and spreading into adjacent low spots. Tons of plastic bottles, tires, household trash and assorted junk are left behind each year, requiring major cleanup days.
 - r. The rarity of this ecosystem makes the potential for partnership with regional conservation groups very high. There is strong support for restoration and positive energy to create partnerships.
2. Available Data and Additional Needs
- a. Consultation with regional conservation groups and specialists must be undertaken to determine specific data needs.
 - b. There is a high priority need to understand groundwater levels on the property, and in particular, in areas that are likely to be pilot areas for regeneration or plantings. Monitoring wells can be expensive to install but volunteers like FO SCR may be able to help record monthly data. “A Living River” December edition has some long-term groundwater data through 2021. There are added data online at the Sonoran Institute website to support and enhance the report.
 - c. Is there any seed source in the understory? A comprehensive vegetation survey should be conducted to assess current overall health and composition. Coordinates should be taken for any cottonwood seedlings so that they can be protected.
 - d. Is there an increased presence of metals in the soil? Are there sufficient nutrients? Flooding events can both add and deplete nutrients. Some studies are needed to understand the suitability of the soil and the potential for seed germination and natural regeneration and conversely, what is lacking. There may be soil data available for Tumacacori NHP that can be interpolated in addition to site specific testing that is needed.
 - e. Tumacacori NHP has two existing monitoring wells with long term data. This park is part of the Sonoran Desert Network, an environmental arm of the National Park Service that monitors water, soil, wildlife and ecological conditions for 11 National Park units in the Sonoran Desert region.
 - f. Tumacacori NHP had 15 acres of assorted debris from the 2022 monsoon flows. With the help of the Sonoran Institute, they are submitting grant proposals to identify sources and potential options which can lend itself to solutions/reductions for TNP as well.
 - g. There needs to be an inventory for invasive species, looking particularly for those species that tend to outcompete the cottonwoods and willows.

- h. A number of approaches to both natural and human-aided regeneration have been tried and there are lessons to be learned from each. Actual site conditions will dictate early efforts. In some cases, fenced plantings should be initiated. Some may need water until established. In others, the elimination of grazing alone may be the most appropriate way to let nature begin to regenerate.
- i. The hydrologic function of the river through the property has greatly evolved in the past decade. An assessment of current conditions and opportunities to improve the streambanks and stream profile must be undertaken. Small earthen dams may be an option. Professional guidance on how to actually make recommended improvements is needed. At some point, permits may be required if significant channel work is envisioned. This question should be explored during the planning phase.

3. Desired Future Condition

- a. TNC desires the river to have clean water surrounded by a healthy forest with a good mix of species and age classes, offering senescent, mature and young trees with a regular cycle of emergent seedlings. The understory should be comprised of lush native shrubs, wet meadow grasses and forbs. Streambanks should be stable with little erosion even at peak flows.
- b. Vegetative borders to streams should act as overland sediment filters.
- c. An appropriate amount of water will be available to vegetation year-round, but in particular during spring periods when regeneration is favored.
- d. Let understory, ground-level, and vegetation grow freely. As soon as possible, fence cows out of the densest part of a gallery riparian area and away from the stream channel to protect young trees and fragile banks. If grazing must happen, keep it minimal and isolated, and only during non-growing seasons. Make every effort to keep livestock out of the stream channel itself and away from the banks. Ultimately, no grazing will be permitted in the Preserve.
- e. Invasive species are much reduced and strategies in place to monitor the area and limit future invasions.
- f. Utilize regional expertise and skills to evaluate, plan, implement and monitor the riparian forests on the property. Encourage and support similar efforts on nearby properties that need riparian restoration.

4. Restoration Tactics and Sequence

- a. Bring together interested parties to form a partnership group that will guide and support restoration efforts. Applying the data from site specific studies will lead to targeting the underlying mechanisms of plant establishment. It seems obvious, of course, but the best chances for early success will come if initial restoration activities are guided by the conclusions derived from studies undertaken to understand why this forest is now declining and how best to regenerate it.
- b. Restoration actions can then be linked to strategies that have the greatest chances for success.

- c. It seems likely that small portions of the property may be identified as test sites, with initial plantings fenced off for protection during their early years. Ensuring that these plantings have sufficient water will be critical. Seedlings may need extra protection from browsing deer, perhaps by using plastic tubing. There are a number of debris diverters that can help keep seedlings from being knocked down during flooding events. There seems to be merit in using a “pilot test” concept. Start with a small block and monitor. A test project like this may be of interest to local schools or perhaps even some college students during research on riparian restoration.
- d. Arizona Field Ornithologists (AZFO) have offered to conduct a “Bio-Blitz Weekend” as soon as 2024 to gather data about many of the taxa that exist on the property. Experts will guide volunteers to identify and record existing species.
- e. Monitoring wells should be placed in high priority restoration sites as soon as possible. These areas must be in areas that are or can be fenced off to protect seedlings. After those sites are being monitored, additional parts of the property should be checked or additional wells added.
- f. Waterjet stingers and hammer drills have been used in places to plant deep cuttings, but the base ends must be in or within 6 inches of the free water of the water table throughout the growing season, so that roots can develop in the capillary fringe until well-established. The depth of 5 meters, or less, is considered optimum.
- g. In some cases, particularly where groundwater is very deep and unlikely to be reached by a new planting, cutting a healthy cottonwood just above ground level will encourage suckers to sprout which may lead to a replacement over time.
- h. The lateral roots on existing mature cottonwood often reach 1-3 times the height of the tree away from the tree. New plantings must try to avoid being within the range of these roots. Open areas with relatively recent sediment deposits would be favored. Case studies have pointed out that new trees have been out-competed for moisture at critical times of the year by the mature cottonwoods.
- i. Riparian lowland forests have historically required a major spring runoff event to stimulate widespread regeneration. These events are rare. Despite the complexity and expense of actually effecting a “designed” flooding event, this option should at least be given some consideration. It would likely require the cooperation and expertise of multiple state and federal agencies, not to mention the support of the local area. There have been some major river systems in the west that have created special “environmental flows” and these may offer some guidance to that discussion.
- j. Forest restoration efforts take 10-50 years to show significant results, and the public should be reminded that it is a slow process. This system is also highly vulnerable to local and regional climate changes. Pole planting and whip cuttings can “jump start” the process in areas with higher groundwater levels. Willows appear to establish more quickly than cottonwoods. The Friends of Sonoita

Creek have tried some cottonwood restoration along Sonoita Creek with about a 12% survival rate, so there will be some spots that just don't pan out and need one or more replantings or even abandoned in favor of other more promising sites.

- k. Subsequent efforts will be guided by initial results, new science and strategies will be adapted accordingly. Successes will be built upon and less successful efforts modified based on analysis of results. Funding often follows when success can be proven.
- l. Water levels in the river are a major concern and many groups are involved in ensuring flow levels are maintained. TNC will remain a partner in those efforts, in addition to consulting with those partners in looking for ways to return stream channels to a more healthy and functional condition.
- m. Tumacacori has a grant proposal out related to "bottle dams" that could be tailored to apply to lands within the Preserve.
- n. There are no nearby precedent examples for forest restoration along the Santa Cruz but there are stretches of the river in a similar, albeit declining, condition. Any projects undertaken within the TNP would have widespread application within other lowland riparian areas including the adjacent conservation easement north of the bridge on Bridge Road and any other properties that have a forest health emphasis.
- o. For treatment of mistletoe on existing trees, it is important to remove it before it produces seed and spreads to other limbs or trees. Mechanical control through pruning tree branches is the most effective method for mistletoe removal.
- p. Existing cattle grazing will be phased out through discussions with existing ranchers. A three-year window is envisioned with available areas reduced over time.
- q. Fencing will be difficult but critical to any lowland riparian restoration efforts. The fencing must be inspected often and maintained. Perhaps a variety of fence types should be considered based on site specific conditions. For example, chain link fencing, while expensive to install, and not appropriate in areas of high flow, may well be a good alternative on higher elevation sites due to service life, strength and reduced maintenance costs.
- r. Use volunteers and contractors to reduce threatening invasives. When considering any treatment for invasive tree or shrub species, including Russian-olive and tamarisk, choose an option that best meets individual management objectives. Options may include tree removal, use of chemical treatments and replanting native species. Chemical treatments such as herbicides can be effective if product directions are carefully followed, but they can be time-consuming and costly, may not be practical or effective for all situations, and may be of concern if used near bodies of water. It is essential to research the best possible treatments for a specific area before taking action, and assess the site's potential for native re-vegetation. If adequate stands of native vegetation already exist on a site, it may not be necessary to actively re-vegetate.

5. Potential Funding Sources

- a. The Santa Cruz River is a primary focal area for the Sonoran Joint Venture and there are numerous species of concern within this zone. Emphasis on improving habitats to support these species is highly supported, funding-wise. Examples include:
 - i. Urban and Community Forestry grants via the US Forest Service. Minimum grants of \$100,000 with 1:1 match for projects that provide equitable access to trees and green spaces and the benefits they provide. Improving Forest resilience to climate change, pests and storm events favored.
 - ii. Arizona Water Protection Fund has grants for enhancing and restoring riparian habitat. The grants are 100% reimbursements for approved projects once the applicant has spent the money. Grants submitted in July and August and extend for up to 5 years (azwfpf.gov).
 - iii. The Sonoran Joint Venture (SJV) Awards Program provides funds through a competitive program to support the conservation of birds and their habitats within the SJV geography. Individual SJV Awards Program grants range from \$5,000 to \$15,000.
 - iv. The State of Arizona Department of Forestry and Fire Management offer community assistance for governments and non-profits that plan to undertake forest restoration activities. Their science and Community Forestry specialists' advice would be assets in an recovery efforts. There are some grants available, but more likely tied to Urban Forestry but consultation with our local office may shed more light on this. The "local office" is in Tucson. ((520) 628-5480)
- b. Developing a "matching fund" will aid greatly in finding grants. Many of them have requirements to prove they are available before they are even considered.
- c. Perhaps a cooperative agreement could be reached with adjacent landowners and nearby ranchers to help monitor and maintain the integrity of fencing.
- d. A number of maintenance activities lend themselves to being done by volunteers, perhaps as community work days (some which already occur) including river clean-up days, and maintenance of fencing, planting and irrigation systems.

Other Key Reference Information

1. Key Contacts

- a. Adam Hunnuksela – Sonoran Joint Venture (adam_hunnuksela@fws.gov)
- b. Luke Cole – Sonoran Institute (lcole@sonoraninstitute.org; 520-290-0828 Ext2; www.sonoraninstitute.org)
- c. Sarah King – Altar Valley Conservation Alliance (sarah@altarvalleyconservation.org)
- d. Tumacacori National Historic Park (Part of the Sonoran Desert Network) TBD
- e. Borderlands Restoration Network and Nursery TBD
- f. Arizona State Parks & Trails - Mickey Rogers, Chief of Grants and Trails (602) 542-6942 w (480) 708-9709 c mrogers@azstateparks.gov
- g. Friends of Sonoita Creek – TBD
- h. Tucson Audubon Society – Jonathan Horst

2. Case Studies

- a. Buenos Aires National Wildlife Refuge – Native Grasses Restoration <https://www.fws.gov/refuge/buenos-aires/what-we-do>
- b. Altar Valley Osa Wetlands Project <https://www.dropbox.com/s/2ubtheb4dijx031/Altar%20Valley%20Watershed%20Plan.docx?dl=0>
- c. Borderlands Restoration Network Projects – Various grasses and forest projects <https://www.borderlandsrestoration.org/watershed-and-habitat-restoration.html>
- d. Borderland Wildlife Preserve – Borderlands Restoration Network <https://www.borderlandswildlifepreserve.org>
- e. Santa Fe Ranch (Tony Sedgewick) <http://www.santaferanchfoundation.org>
- f. Tumacacori National Historic Park – Climate and Water Monitoring at Tumacacori National Historical Park https://www.nps.gov/articles/sodn_tuma_climateh20_18.htm
- g. Mississippi National River and Recreation Area Cottonwood Restoration Project (studied conditions and offers planting advice) (https://static1.squarespace.com/static/5ad6b802a9e0287694992efa/t/5bd89fc288251bf9985fa2b3/1540923511728/Maria_DeLaundreau+-Cottonwood_Booklet_Final.pdf)
- h. Final Evaluation of Three Cottonwood Restoration Methods (in North Dakota) USDA in conjunction with North Dakota State Forest Service. <https://www.nrcs.usda.gov/plantmaterials/ndpmcsr13389.pdf>
- i. Deep-Planting Techniques to Establish Riparian Vegetation in Arid and Semi-Arid Regions – USDA/NRCS (New Mexico projects) <https://www.nrcs.usda.gov/plantmaterials/nmpmcsy10143.pdf>
- j. Clark County, NV Wetlands Park - https://www.clarkcountynv.gov/government/departments/parks_recreation/wetlands_park/index.php

- k. Sonoita Creek – Friends of Sonoita Creek – Cottonwood Restoration
<https://www.sonoitacreek.org>
- l. Las Lagunas de Anza Wetlands - <http://www.laslagunas.org>
- m. Sweetwater Wetlands – City of Tucson -
<https://www.tucsonaz.gov/water/sweetwater-wetlands#>
- n. AZNPS - Conservation and Restoration Ongoing Projects - The Arizona Native Plant Society - <https://aznps.com/conservation-original/aznps-conservation-and-restoration-ongoing-projects>

3. References and Citations

- a. “A Living River – Water Year 2021” by the Sonoran Institute, Tucson AZ.
<https://sonoraninstitute.org/resource/living-river-nogales-amado-2021-water-year>
- b. Cottonwood Management: Ecology, Rehabilitation, Wildfire and Other Considerations by Colorado State Forest Service FM-2015-1.
https://csfs.colostate.edu/wp-content/uploads/2015/06/Cottonwood_Management_QuickGuide_26June2015.pdf
- c. Sonoran Joint Venture – Species and Habitat Accounts
<https://sonoranjv.org/accounts/lowland-riparian.pdf>
- d. Sonoran Joint Venture – Conservation Plan
<https://sonoranjv.org/downloads/SJVConsPlan121206.pdf>
- e. Bringing Birds Home – A Guide to Enhancing Rivers, Streams and Desert Washes for Birds and Other Wildlife” - Tucson Audubon Society -
https://aziba.org/wp-content/uploads/2018/03/TAS_IBA_Riparian_web_higher-res.pdf
- f. Fremont’s Cottonwood – Fact Sheet: USDA/NRCS
https://plants.usda.gov/DocumentLibrary/factsheet/pdf/fs_pofr2.pdf
- g. Tucson Audubon Society – Preliminary Look at the TNP Wetlands – Jonathan Horst’s PowerPoint
https://www.dropbox.com/s/8xnhz9b7kk1u87x/Tubac%20Nature%20Center%20-%20Wetland_JonathansSlides.pdf?dl=0
- h. Grasses of Las Cienegas National Conservation Area – Bodner, et.al, Bureau of Land Management.
https://aznps.com/documents/GrassesofLasCienegaNationalConservationArea_000.pdf
- i. “Bloom Time Chart – A Companion for the Pocket Guide – Native Plants for Hummingbird Gardens by Appleton-Whittell Ranch.
<https://www.sonoitacreek.org/WordPress1/wp-content/uploads/2021/03/BloomTimeChart2015.pdf>
- j. Fremont Cottonwood-Goodding Willow Riparian Forests: A Review of their Ecology, Threats and Recovery Potential by J. C. Stromberg – Center for Environmental Studies, Arizona State University, published in Journal of the Arizona-Nevada Academy of Science -

[http://www.ansac.az.gov/UserFiles/PDF/02232015/X055YANMontomery1/YAN-5 Fremont%20Cottonwood-Goodding%20Willow%20Riparian%20Forests%20-%20A%20Review%20of%20Their%20Ecology,%20Threats,%20and%20Recovery%20Potential.pdf](http://www.ansac.az.gov/UserFiles/PDF/02232015/X055YANMontomery1/YAN-5%20Fremont%20Cottonwood-Goodding%20Willow%20Riparian%20Forests%20-%20A%20Review%20of%20Their%20Ecology,%20Threats,%20and%20Recovery%20Potential.pdf)

- k. A Practical Guide to Native Grass Seeding – Arizona Revegetation and Monitoring Company - <http://azreveg.com/seed.html>
- l. Integrating active restoration with environmental flows to improve native riparian tree establishment in the Colorado River Delta – Ecological Engineering, September, 2017 by Schlatter, Grabau, Shafroth and Arroyo. <https://www.sciencedirect.com/science/article/abs/pii/S0925857417300824?via%3Dihub>