our living river

COMMUNITY VALUES AND PERCEIVED CHALLENGES
OF THE SANTA CRUZ RIVER FROM RIO RICO TO AMADO
Full Report

SONORAN INSTITUTE

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Our Vision for the Santa Cruz River

The Santa Cruz River, from Mexico to Marana, is a living, flowing river and the foundation of community health and prosperity.

Acknowledgements

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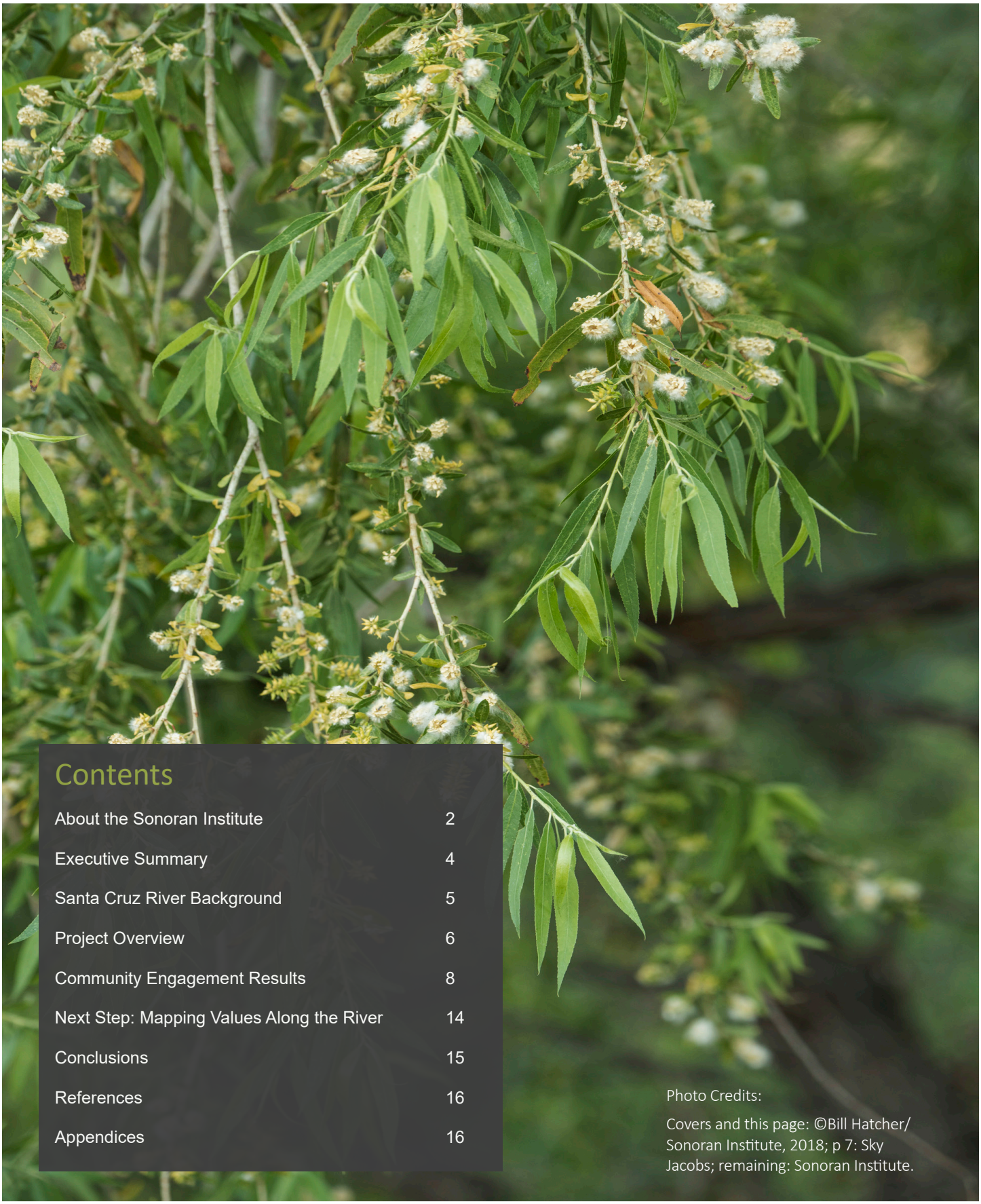

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Executive Summary

Figure 1. The Santa Cruz River near Tumacácori National Historical Park.

The Santa Cruz River and surrounding communities in Santa Cruz County, Arizona, benefit from effluent, or treated wastewater. Wastewater that is primarily produced in Sonora, Mexico is sent to the Nogales International Wastewater Treatment Plant (NIWTP) in Arizona for advanced treatment and release into the Santa Cruz River channel near Rio Rico. A 2016 Sonoran Institute and University of Arizona study of the Santa Cruz River in Santa Cruz County showed that effluent from Sonora is a critical resource for the river, essential for bridging the gap between water supply and demand during the region's dry months. This finding underscored the need to secure effluent flows into river. To quantify the volume of effluent required, the Sonoran Institute embarked on an effort to help develop a community-driven vision of desired conditions for the Santa Cruz River in Santa Cruz County.

Between December 2016 and March 2018, Sonoran Institute convened an online survey, a mapping exercise, and four workshops to better understand community values associated with the river. The survey and discussions on valued river attributes showed that the participants view the river holistically and are conscious that a healthy river is important not only for its water but also because it provides benefits such as flood control, biodiversity, and ecotourism revenue. Appreciation for the river as a wildlife habitat/migratory corridor was the highest-scoring value, followed closely by the water-related metrics of water quality and groundwater availability. Cultural history, recreation, and other social values associated with the river scored mid to high.

Strong support for ecotourism was consistent throughout the community engagement process. Further discussion with residents and local government planners about the regional economy revealed that industry and agriculture, though present in Santa Cruz County, is perceived as benefitting only a small number of individuals, while ecotourism offers benefits to the greater community.

A strategic next phase of this work to ensure long-term sustainability of the Santa Cruz River by working toward a binational solution to secure effluent in the Santa Cruz River. The next step will include updating the *Living River* report series for the Nogales region of the Santa Cruz River, and a more site-specific understanding of how residents value the river.

Santa Cruz River Background

The Sonoran Institute has been working in the Santa Cruz River watershed since 1990 and started conducting ecological and social research to better understand the current state of the Santa Cruz River in 2006.

Over the last century, human demand for water has taken a toll on the Santa Cruz River and has resulted in many stretches of the river being dry for extended periods of time. However, the Santa Cruz River has two reaches that feature consistent surface water flows. Both are dependent on effluent, or highly treated wastewater, from the nearby communities. The two flowing reaches are referred to as the "Nogales Reach," located within Santa Cruz County, and the "Tucson Reach" in Pima County (see figure 2).

Surface water is a rare resource in southern Arizona. Releasing highly-treated effluent into the Santa Cruz River provides this region a unique asset. Yet the Santa Cruz River offers much more to us than just its water. The vegetation it supports improves air quality, helps control flooding and erosion, filters groundwater, provides important wildlife habitat, and offers respite and spiritual renewal for people.

The Santa Cruz Runs on Mexico's Wastewater

The Nogales Reach of the river benefits from effluent water flows which are released into the river at the Nogales International Wastewater Treatment Plant (NIWTP) outfall. The NIWTP is located near the Santa Cruz River/Nogales Wash confluence, about 10 miles north of Nogales, Arizona. It treats approximately 15 million gallons of water daily, of which approximately 80 percent comes from Mexico. Since 1958, the city of Nogales, Sonora, has sent its wastewater to the NIWTP because the city has not had the infrastructure to treat all of its wastewater (IBWC Minute 206).

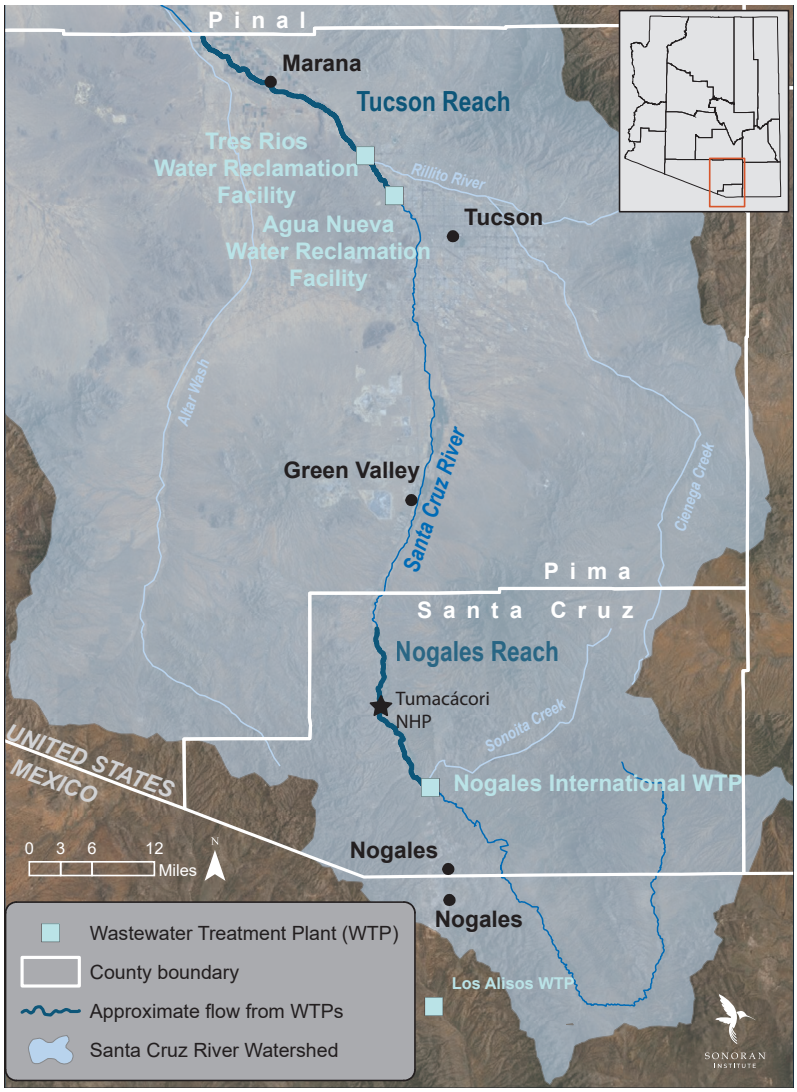

Figure 2. Effluent provides surface flows in two reaches of the Santa Cruz River within the United States.

A Binational Solution to Secure Effluent Flows in Santa Cruz County

In 2016, Sonoran Institute and the Water Resources Research Center produced a conceptual water budget estimating water inputs and outputs in the Santa Cruz River. As shown in figure 3, the water budget found that effluent inputs from NIWTP are critical to maintaining flows in the Nogales Reach during the hotter, drier months. However, despite their regional importance, the effluent flows are not guaranteed. Recent changes to water management in the Santa Cruz River watershed have

resulted in a decrease in the effluent flows that support vegetation and replenish groundwater supplies.

The *Living River* 2015 update reports a reduction in the volume of effluent release into the Santa Cruz river, partially due to reduced water consumption in Rio Rico and Nogales, Arizona. Another reduction in effluent came from the diversion of wastewater into Los Alisos Wastewater Treatment Facility. In 2013, the Los Alisos facility was built in Mexico to treat a portion of Sonora's wastewater that would have otherwise been sent to NIWTP. The effluent treated in Sonora is released into a riverway that does not lead into the Santa Cruz. For now, the remaining wastewater is still sent to the United States for treatment at the NIWTP. However, if Mexico builds sufficient capacity to treat this water in the future, the effluent would likely stay in Mexico, decreasing water flows in the Santa Cruz over time.

The possibility of reduced flows in the Santa Cruz River due to decreased effluent inputs is a concern for local citizens and governments. Over the years, individuals from the private, government, non-profit, and tribal sectors have convened to foster new partnerships, develop innovative projects, and understand the impacts of recent activities and their effects on water quality and quantity along the Santa Cruz River. As a continuation of these partnership and projects, Sonoran Institute is seeking a long-term binational solution that would ensure wastewater continues to be delivered to the United States. An enduring solution would include fair compensation to Mexico in exchange for the dedication of wastewater to the Santa Cruz River.

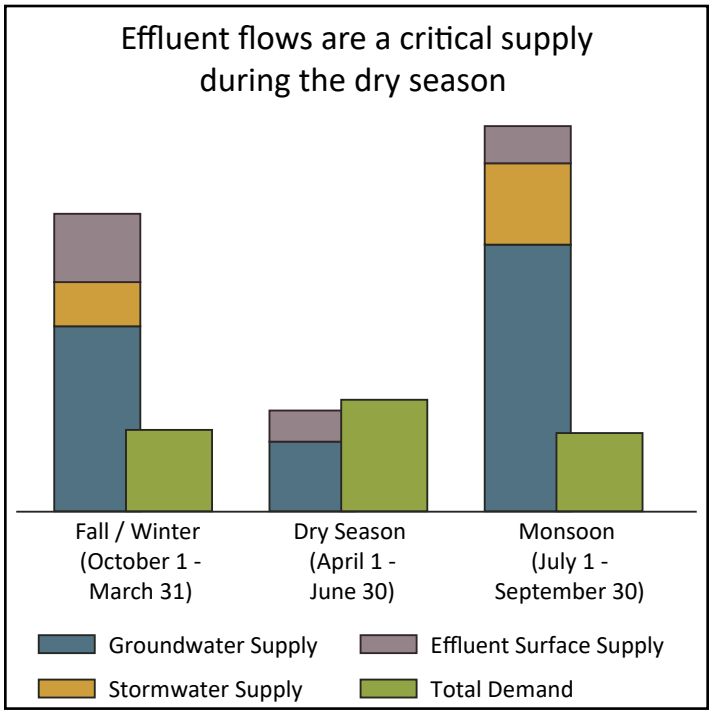

Figure 3. Conceptual water budget for the Santa Cruz River in Santa Cruz County shows that, while much of the demand for water can be covered by groundwater, effluent is critical for covering the gap between supply and demand during the dry months (2016).

Project Overview

The Sonoran Institute recently facilitated a U.S. stakeholder process to determine community values and desired future conditions for the Nogales Reach of the Santa Cruz River. Identifying community values provides a basis for developing a community vision which can be translated into an understanding of how much water is necessary to preserve river conditions and support the values of the community.

To assist in developing a community-based vision, Sonoran Institute held four workshops and conducted an online survey. Held in September 2016, the first workshop invited stakeholders who live or work in the Nogales Reach and included members of the public, Friends of Santa Cruz River, representatives from the National Park Service, staff from Santa Cruz County, local land developers and large land owners from along the river. The purpose of the meeting was to present the need to secure effluent flows, lay out the strategies in the near and long term for securing flows, and to identify the group's overall values concerning and desired future conditions concerning the river. Described in the following section, the results of this first workshop (Workshop One) were very high level and provided a baseline of opinions.

An online survey, first administered in late 2016, sought to gain a more nuanced understanding of how the community values the river. It broke down the broad concepts emerging from Workshop One into a list of the specific roles the river plays and other attributes that the public may value, such as wildlife connectivity, historic sites, and ecotourism. The online survey questions incorporated themes from Workshop One as well

as themes from previous studies in the region. A second workshop (Workshop Two), held in January 2017 to review these results, found overall agreement among survey respondents and workshop participants.

Then, in the summer of 2017, a large storm event led to the rupturing of the International Outfall Interceptor (IOI), a major pipeline that carries raw sewage from Nogales, Sonora to the NIWTP. The release of untreated wastewater into the river was international news, bringing increased attention to the river. In order to keep the community values results relevant, the Sonoran Institute re-released the online survey in fall 2017 with additional promotion in Santa Cruz County. In addition, Friends of the Santa Cruz River volunteers administered in-person surveys at river trailheads. Responses from these additional surveys were merged with the initial online survey results.

A third workshop held in Tubac in November 2017 (Workshop Three) reviewed the updated survey results. This workshop was open to the public and was promoted in the Rio Rico and Tubac communities. Featuring maps of the river and spatial data on how the river is used, the workshop collected community input on the location of valuable areas on the river and suggestions for how they could be improved. Sonoran Institute convened a fourth meeting (Workshop Four) in March 2018 to further understand the community's views on the river's role in the regional economy, and to identify next steps for engaging additional audiences.

Figure 4. A family hikes along the Santa Cruz River between Tumacácori National Historical Park and Tubac on the historic Juan Bautista de Anza trail.

Community Engagement Results

The results are best understood if described as a summary of the initial discussions which took place in Workshops One and Two, then a look at the more detailed discussions about online survey results which took place in Workshops Three and Four.

Initial Discussion Results

The first workshop was dedicated to identifying the values and assets along the river corridor that are most important to the attendees. Water managers and river stakeholders were asked to list the most important values from within the context of three themes: Environment, Sociopolitical, and Economic.

It should be noted that many qualities could be easily grouped into all themes. Though this organizational method is imprecise, working with the structure of these three themes stimulated thoughtful discussion on the nature of each of the valued attributes and perceived challenges. Thus, its biggest flaw was a beneficial reminder of how the river characteristics are inter-related. For example, "groundwater availability" is clearly rooted in environmental, but it is regulated by sociopolitical systems, and it is a significant component of economic prosperity. The challenge of organizing ideas into themes cued out-of-the-box thinking and supported collaboration between interest groups.

Figure 5. Three subsections of the Nogales Reach, Santa Cruz County.

For the purposes of the workshop, the attendees considered the values of each three geographic areas of the river separately (see figure 5). Following the small group discussion, the attendees reconvened to compile a list of values for each of the three stretches of river. It was found that several values were common to all stretches of the river. The shared values for each theme were identified and ranked through a voting process with the whole group. The results of this ranking are as follows:

Environmental Theme

The three groups associated over 20 important environmental qualities with the river. There was considerable overlap among the listed attributes, so the top values are grouped into three categories and listed according to the percentage of workshop participants choosing each. Workshop participants chose the following as the three most important values associated with the river corridor:

- **Natural beneficial functions of river systems** (45%): This phrase refers to collective indicators of healthy natural river systems. Santa Cruz County residents recognize the river as being one part of a larger system, and they understand that an unhealthy river would have wide-reaching implications, including a loss of other beneficial functions. These natural beneficial functions include the supporting and regulating

ecosystem services that the river can deliver. For example, a river corridor with healthy riparian vegetation can provide the ecosystem service of erosion control, since the vegetation keeps the riverbank intact by holding sediment in place during flood events, which mitigates instream channelization. In addition to erosion control, participants recognize the role the river plays in fostering biodiversity and supporting endangered species. They also identified stewarding this natural open space as a priority.

- **Natural flow regimes (36%):** Returning to or maintaining a natural flow regime is important for sustaining a healthy ecosystem. As rivers are increasingly managed for water resources, the pattern of flow (seasonal variations in quantity and water characteristics) will deviate from the natural flow regime which native animals and vegetation have adapted to. In some cases, an altered flow regime can threaten a species' survival. One example is cottonwood trees, which require moist riverbanks for seed germination, a condition that may be lost under certain water management scenarios where water levels consistently remain within the river channel and do not flood. As such, the maturation of young cottonwood trees from sprouting to an established adult is often used as an indicator of watershed health. The management of water flow patterns should take into consideration a strategy that would mimic the intermittent natural flow regimes that would promote the conditions supporting the natural river ecosystem. Creating pulse flows that send a large volume of water into the river system to mimic seasonal flooding is one such strategy.

- **Groundwater (29%)**: Historically, groundwater in the Santa Cruz has moved through geological formations and emerged in many places in the form of springs, cienegas, and surface flows on the river. However, groundwater pumping in Santa Cruz County has resulted in a drop in the water table and drying of the riverbed. The lush and green sections of the Santa Cruz that are present today are a result, in large part, of effluent surface and subsurface flows from the NIWTP. Managing the availability of groundwater and surface water, and ensuring good water quality, are all components of the "groundwater" value that many participants identified as important.

Sociopolitical Theme

This category had a wide variety of responses. Participants identified more than 25 valued sociopolitical qualities associated with the river. Valued attributes ranged from mental and spiritual rejuvenation, to cooperation with Mexico, to appreciation of the aesthetics of flowing water. Through a collaborative process, participants selected the following as the top sociopolitical values, shown with the percentage of workshop participants choosing each:

- **Solitude and connection to nature (37%)**: the river can be a source of inspiration, relaxation, excitement, and a way to commune with nature.

- **Public access (16%):** access to the river is limited for the general public because large portions of the river are privately owned. Designated public access is available through the Juan Bautista de Anza Natural Historic Trail, Tubac Presidio State Historic Park, and through an easement at the Tumacácori National Historical Park.

- **Cultural, archaeological, historical resources (11%):** there are many resources that contribute to the river's rich historical and cultural values. These include the Tubac Presidio State Historic Park, the Barrio de Tubac Archaeological Preserve, and the Juan Bautista de Anza National Historic Trail.

- **Recreation and quality of life (11%):** residents closely associate their quality of life and their various recreational activities to what they value about the river.

Economic Theme

Participants in each of the three geographic groups defined the river's economic values similarly. The top responses from the groups were:

- **Ecotourism (37%):** the river promotes a special kind of tourism, as it offers world-renowned bird watching opportunities, has numerous cultural, archaeological, and historic sites to visit, and attracts trail hikers on the de Anza trail.
- **Groundwater Stability (21%):** Balancing groundwater availability and usage with aquifer recharge is a priority for residents. They believe finding this balance is a driver for many other aspects of their economy.
- **Agriculture (21%):** the river not only supports agricultural production, but also contributes to the economic vitality of the county through employment and agri-tourism (e.g., farmstands, farmstays, on-site winery tasting, garden tours).

Online Survey & Discussion Results

Additional online surveys were conducted in the year following the initial stakeholder workshops. This additional step sought participation from more general audiences and was an opportunity to capture any change in perspectives on the river after the International Outfall Interceptor breach in summer of 2017. The online survey or "survey" refers to the combined results from lal survey efforts.

The survey received 161 total responses, with 47% of the respondents being from Santa Cruz County and 53% from Pima County. This report presents the results from Santa Cruz County residents only, however a bi-county comparison is included in Appendix A. Survey respondents included a mix of known stakeholders and members of the public.

Figure 6. Workshop three audience reviews the online survey results as a group.

Respondents were asked to identify qualities they value about the river, qualities they feel should be maintained on the river, and the most significant challenges facing the river. The initial survey analysis showed considerable similarities between the "qualities of value" and "qualities to be maintained" responses. The final analysis merges these two datasets into one comprehensive list of valued attributes.

Convened to review the survey results, Workshop Three was well attended by the general public and many of the stakeholders who were involved in the early phases of the project. After a presentation on the role of effluent in the river (including the conceptual water budget) and an overview of the online survey results, participants broke into three groups for further discussion. All groups discussed the same questions about the survey: *What was right, what was surprising, and what is missing?*

Identifying Values

Figure 8 shows the qualities of value, arranged by order of the percentage of Santa Cruz County residents who selected each attribute as a value in the online survey. Mid-ranking values are very close, and the exact arrangement varies with how the data are analyzed. Note that the attributes were grouped into the three themes (environmental, economic, and sociopolitical) during the analysis to be consistent with the categories used in Workshop One. These discussions and workshops show that residents value environmental assets like the Santa Cruz River as economic drivers unto themselves. These insights are important reminders that the economic, environmental, and social values of the Santa Cruz are not distinct categories.

Figure 7. Small group discussions about the value of and perceived challenges facing the Santa Cruz River.

Attendees at Workshop Three generally agreed with the top eight values identified in the online survey.

When comparing the survey responses by theme, the river's environmental qualities rank as the most important, illustrated in figure 8 by the cluster of responses near the top and all within the upper half of the graph. Ecological qualities (e.g., wildlife habitat/migratory corridor, riparian trees) are at the very top, closely followed by water-related values (groundwater availability, water quality). Workshop participants suggested that natural floodplain regulation (ranked 11th of 29) should be ranked higher, a sentiment consistent with the initial discussion during Workshop One.

Sociopolitical values are spread throughout the list. Access to the river is very important to the community, since it provides the means to enjoying many of the benefits provided by the surface water. Cultural resources, such as the national and state parks and the historic de Anza trail are important for giving the region a sense of place and community connections. Workshop attendees were surprised that cultural diversity (26th) was near the bottom of the list, and suggested that the river as a source of the region's drinking water (23rd) should have scored higher.

Consumptive water use, such as from agriculture and industry, is one aspect of the river's economic value that scored low in the survey. This result was surprising, since it partly contradicts the discussion of agriculture during Workshop One, where 21% of participants chose it as an important economic value.

During Workshop Four, further discussion with residents and local government planners about the economic value of the river revealed deeper insights into the survey results. Participants said that industry and agriculture, though present in Santa Cruz County, benefit only a small number of individuals. The majority of county residents may not experience a direct benefit from those uses.

The river's role in regional ecotourism was considered more important to the regional economy than industry and agriculture. Discussions with participants through out this process have revealed consistently strong support for ecotourism. The Santa Cruz County reach of the river is an Arizona Audubon Important Bird Area, a designation that attracts tourists from many parts of the world. In southeastern Arizona, bird watchers are a significant part of local tourism revenue (Leones, 1998). In Santa Cruz County, tourism-related private employment was 20.9% of total employment in 2010, considerably higher than the national average. Comparatively, only 0.1% of the county was employed in mining, and 2.1% in agriculture (Headwaters, 2018).

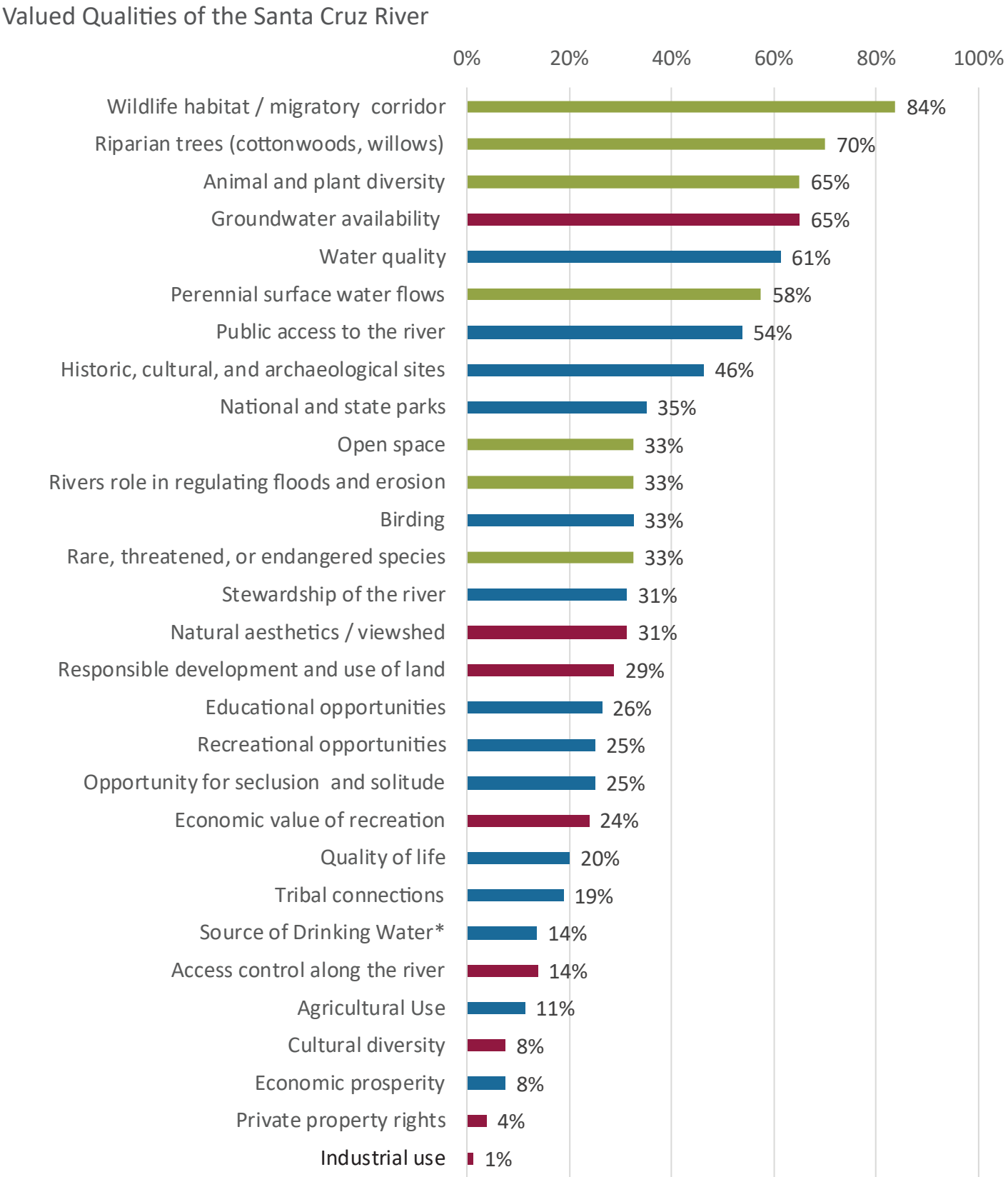

Figure 8. Online survey results show the qualities of value, arranged by order of the percentage of Santa Cruz County residents who selected each attribute as a value in the online survey.
Green - Environmental Blue - Sociopolitical Red - Economic
**small sample size*

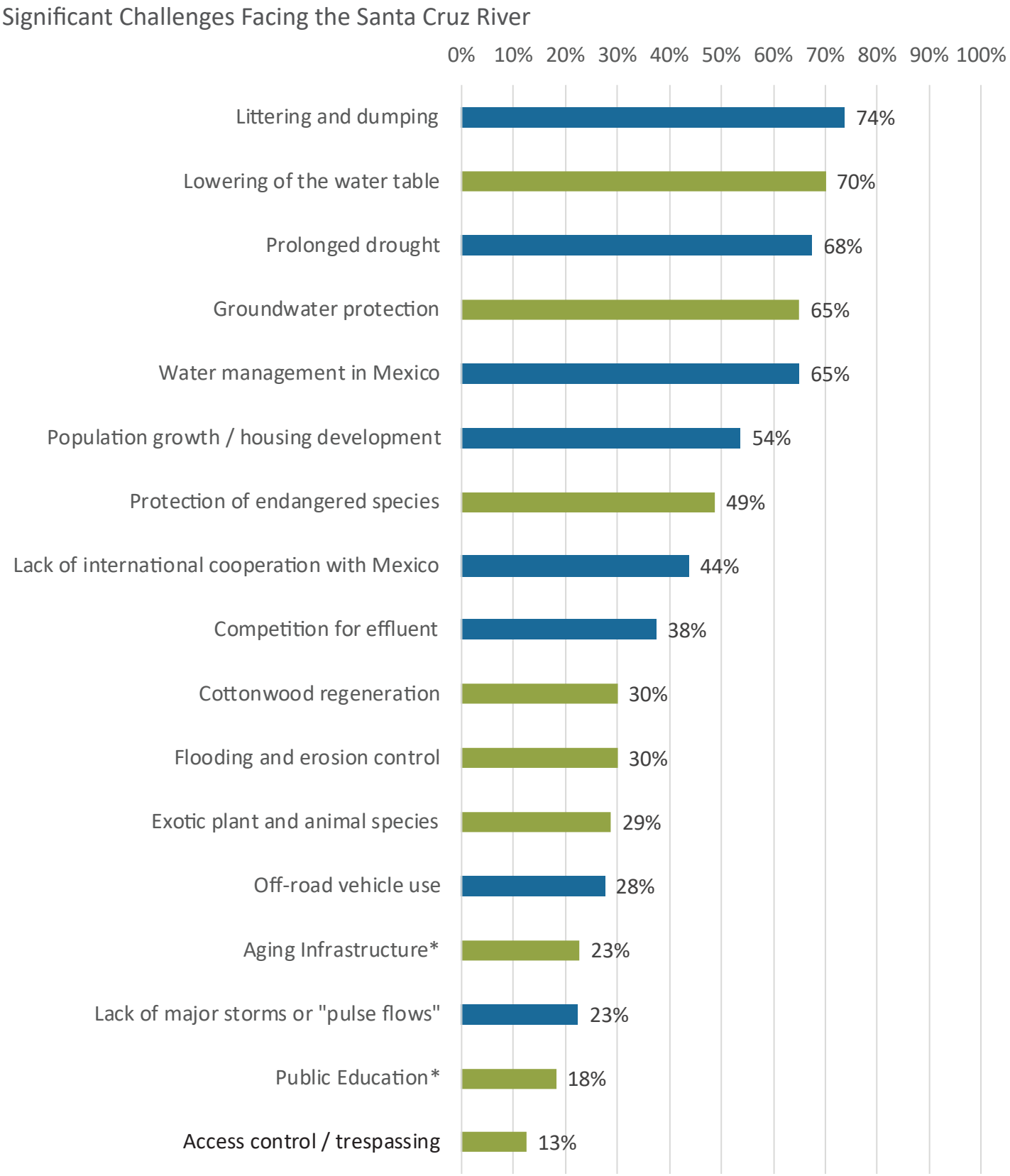

Figure 10. Online survey results show the most significant challenges relating to the Santa Cruz River according to residents of Santa Cruz County.
Green - Environmental Blue - Sociopolitical
**small sample size*

Identifying Significant Challenges

When local residents identify the biggest threats to river health, organizations working to protect the river can more effectively align their work with the needs and values of the communities they serve.

The 17 challenges identified in Workshop One and in further research were also reflected in the online survey and discussed in Workshop Three. Survey respondents were asked to select the eight most significant challenges facing the Nogales Reach. Figure 10 lists and ranks their responses.

The survey results show the biggest perceived challenge for river management is littering/dumping. Workshop attendees agreed that the accumulation of trash is an issue throughout the river, and that it threatens water quality by introducing contaminants into the river even after treatment. Given the difficulty of regulating nonpoint sources, participants felt littering and dumping should be kept as the number one challenge.

Many of the other top challenges are related to water management strategies. Lowering of the water table was the second most significant challenge in the survey results, a finding that Workshop Three attendees supported. Participants uniformly identified additional significant challenges related to water quantity, including: prolonged drought, groundwater protection, water management in Mexico, lack of international cooperation with Mexico, and competition for effluent. Attendees thought that aging infrastructure (14th of 17) needs to be ranked more significantly, since the consequences of another IOI breach would severely threaten the quality of the Santa Cruz.

Next Step: Mapping Values Along the River

In addition to validating the values identified in the survey, Workshop Three included a mapping exercise to help understand how the river is used, what is liked, and what could be improved. This information links values to locations along the river, and helps identify priorities for conservation.

Provided with maps of the river corridor that included the Juan Bautista de Anza National Trail and other known landmarks, Workshop Three participants were asked to identify where they go to recreate and to fill out a detailed information sheet about that location, included in Appendix B. Participants were asked about how they use the river, what is valuable about that location, and why they choose to visit that location. They were also asked to list their concerns about the location and their suggestions for how to improve it.

Figure 11. Participants provide location-based feedback by describing thier favorite spots along the river.

The data from Workshop Three allowed for preliminary insights about the area around Tubac and Tumacácori National Historical Park, but the dataset from one workshop alone is not representative of the whole corridor. Additional data will be needed to accurately analyze the use and value of the Santa Cruz River. Sonoran Institute will publish the mapping results once a complete dataset is obtained.

An online interactive map is available for Santa Cruz County residents who would like to provide location-based information about the Santa Cruz River. Residents from communities along the river, such as Nogales, Rio Rico, Tubac and Amado are escpecially encouraged to participate. Please visit tiny.cc/scrmap and follow the instructions provided.

Conclusions

The results from this report are essential for identifying the most important values for the communities along the Nogales Reach of the Santa Cruz River. Based on input from the communities, we have made the following observations:

1. Water security is significantly important to the residents of Santa Cruz County. Residents recognize effluent as a keystone for keeping surface water flows stable and secure. The workshop participants voiced support for Sonoran Institute's work on the Santa Cruz River, and would support a binational solution that assures surface water flows and benefits communities on both sides of the international border.

2. Santa Cruz County residents showed acute awareness that the natural river system provides tangible benefits when it functions as an integrated system. Maintaining open space and the integrity of the river is important to the residents of Santa Cruz County because of the recreational opportunities and ecosystem services the river provides. Maintaining surface water flows is critical for maintaining these holistic functions.

3. The issue of littering and illegal dumping is a very significant concern for residents. This elevates the need for watershed stewardship and non-point source prevention.

4. Santa Cruz County residents emphasize that ecotourism is a critical component of the regional economy, and that the economic value of the river is not limited to industry and agriculture.

5. Recreation was often cited as an important metric of the river corridor's sociopolitical and economic value.

The efforts outlined in this report represent an important first step developing a stakeholder-driven vision for maintaining sufficient effluent flow in the Santa Cruz River.

The next strategic phase of this work would be to engage additional communities in the international border region to ensure long-term sustainability of the Santa Cruz River. The outreach efforts for this survey and workshops had intentionally targeted communities located adjacent to the flowing reach in Santa Cruz County. Additional participation from communities north of Tubac and south of Rio Rico would help describe how those sub-reaches are used and valued to provide an even representation along the entire waterway.

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Appendices

A. Bi-county Comparisons

Survey respondents were required to note whether they lived in Pima County or Santa Cruz County. Both full-time and part-time residents were grouped into the Santa Cruz County category. Bi-county comparison shows survey respondents had similar opinions on values (figure 16), as well as challenges (figure 17). Differences between the two counties may be reasonably attributed to place-based contexts, though more systematic research would be necessary to avoid speculation.

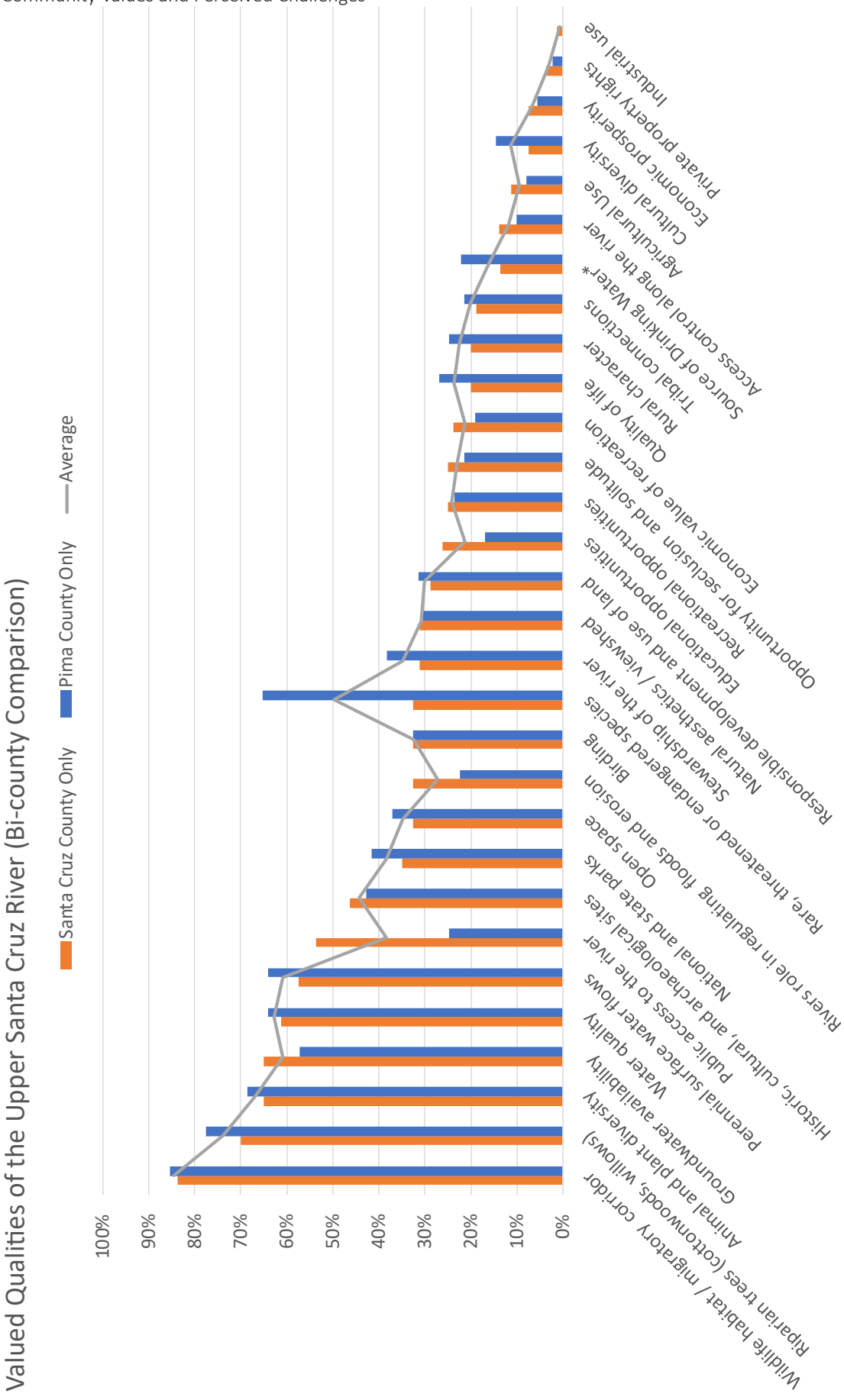

Figure 17. Bi-county comparison of the qualities of the Upper Santa Cruz River that are valued and should be supported or maintained
**small sample size*

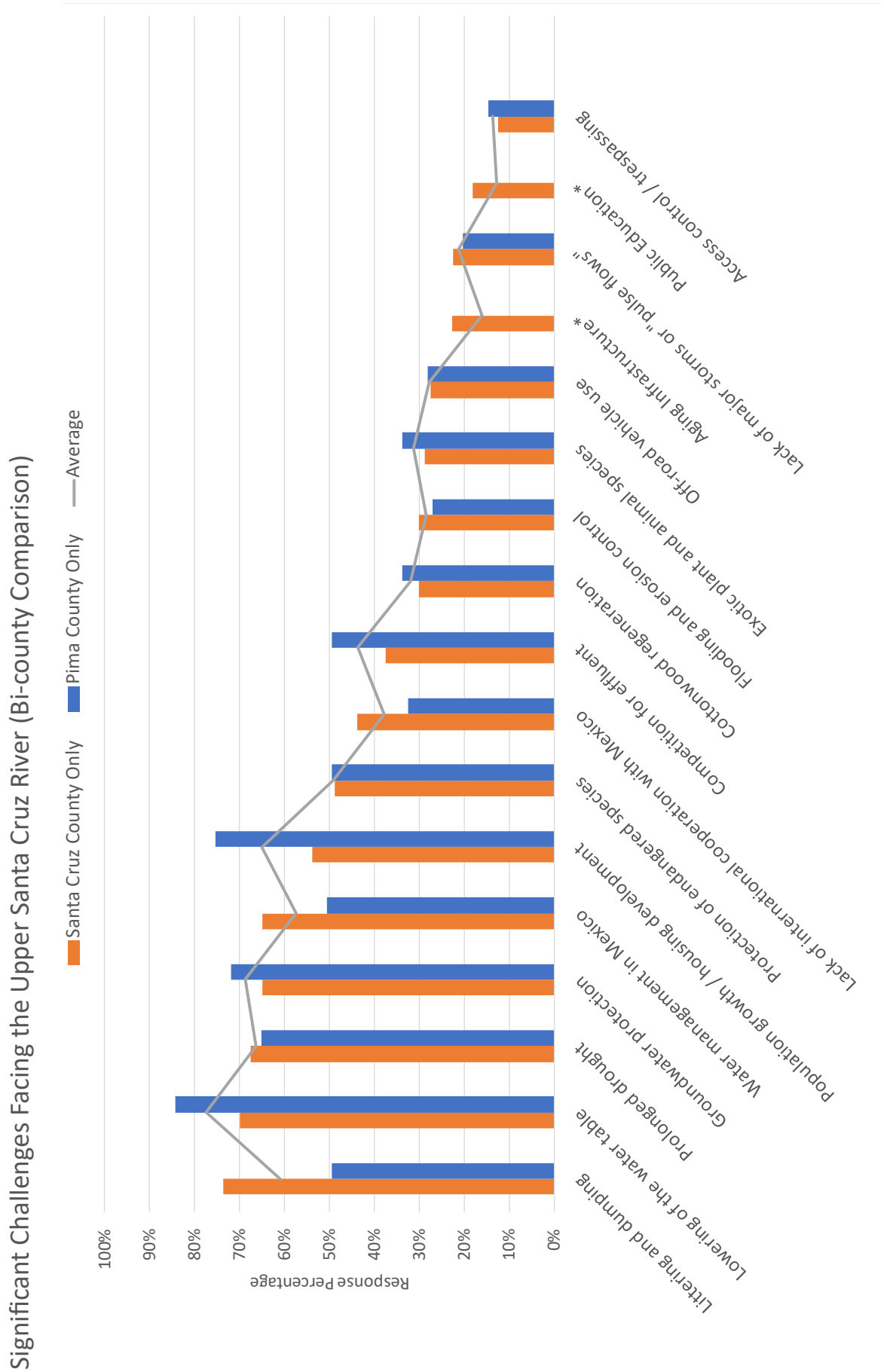

Figure 18. Bi-county comparison of the most significant challenges facing the Santa Cruz River in Santa Cruz County.
**small sample size*

B. Mapping Exercise Questions

How do you use this area?
A - Birding
B - Fishing
C - Running/walking
D - Horseback riding
E - Hiking
F - Park use (areas away from the river)
G - Bike riding
H - Other, please explain:

How often do you usually visit this area?
A - Once a week or more
B - Several times per month
C - Several times per year
D - Once per year
E - Never

What is valuable about this area?
A - Environmental & please specify (example - rare habitat):
B - Sociopolitical & please specify (example - recreation):
C - Economic & please specify (example - tourist attraction):

Why do you choose to spend time here?
A - Convenient location to my home
B - Has enough amenities (parking, bathrooms, picnic tables, etc.)
C - Easy access to the river
D - Safe
E - Natural features (vegetation, wildlife, fish, etc.)
F - Water is visible from here
G - Quiet
H - Meeting people, a popular site with other people who share my interests
I - Other, please explain:

What are your concerns about this area? (open ended)

What could be done to improve this location?
A - No changes are necessary
B- "Small" improvements, circle: trash cans, bike racks, benches, picnic tables, pet waste bags, other?
C - "Large" improvements, such as improved access to the river, trail maintenance, other?
D - Increased maintenance of existing amenities / services
E - Public events at this location, circle: volunteer days, tours, celebrations, other?
F - Circle: erosion / trash pickup / invasive species removal
G - Information, circle: educational displays, directional signs, other?
H - A "wildness" feel, such as natural features to conceal manmade features or vegetation restoration
I - Other, please explain:

What do we want from the Santa Cruz River? This simple question generates diverse and complex responses from people living in communities along the river. Understanding what people "want" from the river—and what they perceive as its benefits and value—will allow us to understand how to support the river and to ensure that it continues to provide life-sustaining water.

GET INVOLVED

- Stay informed with our work. Sign up for updates at www.tiny.cc/scrsignup
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- Learn more about the Living River health assessments. Visit www.tiny.cc/livingriver
- Volunteer to monitor river health. Sign up at www.friendsofsantacruzriver.org
- Describe your favorite parts of the river. Add to our online map www.tiny.cc/scrmap
- Explore Tumacácori National Historical Park. Visit www.nps.gov/tuma
- See the river and the Juan Bautista De Anza Trail. Find a map at www.anzatrail.org
- Attend a Citizens Forum about binational water issues. Learn more at www.ibwc.gov

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