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Promoting Resiliency through Socio-Ecological Management, Advocacy, and Stewardship of Austin's Creeks

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Promoting Resiliency through Socio-Ecological Management,

Advocacy, and Stewardship of Austin's Creeks

by

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Dedication

For the three most influential women in my life who have shown me how to be who I am and who I hope to be. My mother for her compassion and undying support. My love Lauren, for showing me strength, patience, kindness, and commitment. And my mentor Sarah, for expanding my mind and heart, and helping me to find my life's work. I could never fully express the depth of my gratitude.

Promoting Resiliency through Socio-Ecological Management, Advocacy, and Stewardship of Austin's Creeks

by

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The University of Texas at Austin, 2015

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How do managers, stewards, advocates, and other stakeholders promote the ecology of creeks in Austin, TX while also supporting a creek's cultural, social, economic, and historical values? This study uses mixed-methods to analyze how practitioners/managers, creek users/stewards, and advocates understand the multiple values of urban creeks in Austin. Practitioners and managers conceptualize creeks within an ecological resilience framework. Most recognized the importance of integrating social concerns into ecological management but fewer actually implemented consideration of social issues into their work. Many respondents actually saw creek users as a barrier to ecological resilience. A majority of creek users surveyed perceived creeks to have lower health than indicated by measured ecological scores; supporting the idea that perceptions are influenced by aesthetics and functioning ecosystems are not always the most aesthetically pleasing in terms of human preferences. Comparing the values of users and managers revealed three different dynamics: fully aligned values and motivations; partially aligned - values aligned, motivations misaligned; and, conflicted values. The advocate's role is to mediate between users and managers when values are partially aligned or conflicted. A resilient and integrated socio-ecological management system is one that understands concepts of ecology and integrates social and cultural contexts into the process and metrics. Applying a gradient approach allows for an understanding of the dynamic intersection of ecological, social, cultural, economic, and historical values of creeks in Austin and promotes resiliency across and between social and ecological systems. The gradient approach is a context-dependent method for defining values in specific scenarios. Understanding the holistic value of creeks in Austin will allow more residents to connect with these systems and become more responsible stewards; and, will allow managers and advocates to incorporate socio-ecological functioning metrics into a system that currently only measures ecological performance.

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CHAPTER 1

Introduction

In our world which is so increasingly dominated by humans, sustainable landscapes will be those where ecological health interacts effectively with cultural preferences and desires. (Décamps, 2001, p. 174)

If humans are not connected to ecological systems, then we cannot understand them and we cannot be stewards. In a world where for many, sustainability means densifying, lightening our impact on the land, and creating walkable neighborhoods that are not car dependent, where does ecology come into play? In Austin, creeks are iconic to the city – the city was founded between Waller Creek and Shoal Creek along the Colorado River. Creeks run through backyards, behind office complexes, through preserves, along dog parks – they are a system along which many different urban activities occur. How do planners, designers, managers, educators, community members, and other stakeholders promote the ecology of these creeks while also supporting a creek's cultural, social, economic, and historical values? This study uses mixed-methods to analyze how managers/practitioners, creek users/stewards, and advocates understand the many values of urban creeks in Austin. The study evaluates: 1. What practitioners and creek managers understand about intersecting values of creeks, and how they articulate that understanding in their practice; 2. Data from creek users to better understand a variety of values and creek experiences; and, 3. How creek advocates and educators engage with users and managers to create better connections

between them through participatory action research. I argue that a socio-ecological systems (SES) approach to management, advocacy, and stewardship will allow Austin to become a more resilient city as it relates to urban creeks and riparian areas.

It is important to identify gaps in knowledge and understanding of each group studied. Previous research has demonstrated a disconnection between measured functioning of ecological systems and the way creek users perceive ecological functioning of systems. The disconnection is problematic because it both represents and contributes to humans being alienated from their biophysical landscape. In addition, this disconnect may mean that certain ecological damage will be normalized due to societal ignorance. A clear illustration of this concept can be seen in the public's enjoyment of Texas bluebonnet fields; bluebonnets are nitrogen fixers, and appear in landscapes that are degraded. The relationship between aesthetics and ecological function is not fully understood and remains a challenge in promoting socio-ecological resiliency.

Secondary issues stemming from the disconnection between human aesthetic preferences and measured ecological function involve the way different types of people experience natural space. Race, ethnicity, gender, socio-economic status, and religion among other factors influence the types of experiences (or lack of) that humans have in natural space. Broadly, both of these issues boil down to a question of valuation. How do people value natural space? This is the necessary

next step within ecosystem services studies. Ecosystem service studies have focused on low hanging fruit such as pollution mitigation services or water treatment services, however, cultural ecosystem services are comparatively understudied. This is not surprising based on the difficulty of quantifying the immaterial benefits of these services; however, by analyzing the experiences people have within creeks here in Austin, TX, this study provides findings that can begin to inform a system of valuation for cultural ecosystem services that Austin's creeks provide.

This research aims to accomplish five things: 1. Better understand if and how managers/practitioners conceptualize and include cultural or social values into their professional ecological work; 2. Understand how users perceive creek health as compared to measured ecological health; 3. Reveal the dynamics between user and practitioner articulations in values and how understanding these dynamics can better inform socio-ecological management that works toward resiliency; 4. Discuss how advocacy and outreach can facilitate connections between users and practitioners to bridge some of the disconnects in value dynamics; and, 5. Propose cultivating a socio-ecological framework for management, advocacy, and stewardship to contribute to resiliency city-wide.

Literature Review

Multiple bodies of literature informed this study and have been reviewed below. A review of the human/environment nexus aims to analyze how interactions between humans and nature can be characterized. Furthermore, understanding human perceptions of nature is a distinct part of human/environment interaction and reveals barriers to socio-ecological management of creeks. A review of riparian ecology and environmental indicators explains ecological functioning of creeks and the environmental indicators the City of Austin uses to evaluate creek ecological function. An analysis of ecosystem services literature identifies four categories of ecosystem services – supporting, regulating, provisioning, and cultural. While research has contributed to a deep understanding of ecological knowledge of ecosystem services, challenges remain in understanding cultural services provided by ecosystems - specifically in regard to demographic differences in human perceptions and experiences. Additionally, divergence between social issues and ecological functioning make cultural services difficult to prioritize in socio-ecological systems. The final section reviews the evolution of resiliency studies, specifically focusing on resiliency of urban ecological systems. This section frames the study's overall goal by demonstrating the importance of integrated socio-ecological management and advocacy in promoting systems resilience.

Human/Environment Nexus

Within urban ecological literature, the intersection of social and ecological systems manifests itself in various ways. Some frameworks conceptualize humans as dominant components of ecosystems (Alberti, 2008) and see human actions as always having environmental consequences and conversely, environmental actions as always having human consequences (Harvey, 1996). In order to create ecological resiliency it is necessary to acknowledge the nexus between human and ecological systems (Alberti, 2008). Some scholars argue the entire concept of an ecosystem and human interactions with it are based cultural constructs that prioritize efficiency, beauty, convenience, and utility (Bryant, 2008). Bryant emphasizes the decision making process of ecosystem management as an example of how those specific values are articulated in practice.

Henri Décamps (2001) specifically identifies riparian landscapes as both ecological and cultural systems and references concepts of place making and "coming alive" of landscapes as symbolic entities with explicit aesthetic schemes – i.e. icons. Perhaps the most vital part of Décamps' work is his emphasis that we still must promote the inclusion of this nexus into practice. Cities provide a unique challenge in environmental stewardship as compared to suburban and rural areas because despite a higher density of people, there is actually less social pressure to act in ways that are commonly considered moral, ethical, or sustainable. There is a

lack of enforcement of social punishment based on the fluidity and increased anonymity in urban areas (Glaeser, 2000).

Human Perceptions

Human value of landscapes has traditionally been measured through an interaction between human perception and measured functioning; however, there is a lack of clarity in how these two factors are prioritized when translated into environmental management (Daniel, 2001). A study by Hill and Daniel (2008) found no relationship between knowledge of ecological information and aesthetic landscape preferences, indicating that even those who understand ecological concepts do not necessarily incorporate that knowledge into their preferences regarding nature. The disconnection between knowledge and preference may be explained by the context-dependence of aesthetic experiences based on both the landscape type and the "personal-social" context (Gobster and Nassauer, 2007). For this reason, I contend that more complete understanding of the aesthetic preference/ecological function intersection is vital to effective planning, design, advocacy, and management if the goal is to create desirable and equitable space through a socio-ecological systems approach. A 2001 study by Paul Gobster analyzed "visions of nature" through a case study of stakeholders involved in planning efforts on the Chicago Lakefront. He revealed four themes: 1) Nature as designed landscape; 2) Nature as habitat; 3) Nature as recreation; and (4) Nature

as pre-European settlement landscape. These themes reveal very different perceptions of nature rooted in diverse identities. Identities influenced by race, ethnicity, and socio-economic status may influence the perception and use of parks. The social implications of green space located in "borders" between demographically distinct neighborhoods may actually contribute to feelings of segregation between those neighborhoods and form "green walls" (Gobster, 1998). In a case study of one of these "border parks," Gobster found that 10% of residents he surveyed experienced racial discrimination in the park. However, he concludes by stating that some parks can act as a "green magnet" and that planners, designers, and managers should be "active agents in improving interracial relations" through mindful creation and management of green spaces (p. 44).

Riparian Ecology and Environmental Indicators

Numerous ecological studies illustrate that the impact of human built structures or alterations in riparian areas. Channelization impacts hydrology and vegetative composition of streams, as well as the types of invertebrate taxa present (Franklin et al, 2009). These alterations in systems can cause disturbances to energy flow in creeks and alter the survival of higher trophic level species in those creeks.

The Watershed Protection Department in Austin, TX uses a clear and comprehensive set of criteria known as the environmental integrity index (EII) to

determine creek function. Because east and west Austin are divided in terms of geology, hydrology, and ecosystem types it is advantageous to utilize density, diversity, and types of taxa of benthic macroinvertebrates and diatoms as indicators of ecological function as this will control for this geographic difference (Clamann, 2014). In addition, benthic macroinvertebrate taxa are rated based on a Pollution Tolerance Index (PTI) which quantifies the level of pollution a taxa can tolerate – i.e., if low tolerance species are present it indicates that there is very little pollution. Pollution is measured as a function of dissolved oxygen as this is a proxy for both temperature and chemical pollution. PTI contributes to the evaluation of the overall EII score.

Duelli (2007) raises some ethical concerns with prioritization among ecologists regarding biodiversity measures and conservation. He cites the focus on the issues of species richness (number of different species) as opposed to species conservation (conserving vulnerable or threatened species) and articulates that generally focus on one issue is at the expense of the other. He offers no solution but instead advocates for transparency within ecological research whereby researchers explicitly explain the value systems that inform their methods. This research prioritizes system functioning over individual species conservation based on my belief that species conservation is futile without first conserving systems.

Ecosystem Services

Ecosystem services have been categorized into supporting, regulating, provisioning, and cultural services (Millennium Ecosystem Assessment, 2005). Examples of these services include nutrient cycling, air pollution mitigation, and supply of clean drinking water, and recreation. Two gaps exist with ecosystem services research overall: 1. A lack of standardization of measurement means that data between studies is difficult to compare, which thereby minimizes the depth and detail of knowledge contributed to this field; and, 2. The focus of research has been on understanding ecological contexts of ecosystem services with a lack of research on cultural services. Boyd and Banzhaf (2007) advocate for concise measures of ecosystem services that are standardized within the field to mitigate lack of standardization. Remedying both issues is problematic because standardization of ecosystem services measures reaffirms an assumption that humans are a homogenous group. Therefore, this study focuses on contributing to understanding contextual differences in cultural services of creeks.

Lack of cultural service research can be partially attributed to difficulty quantifying seemingly immaterial benefits. The gap in the ecosystem services literature related to measuring and describing cultural services is the primary reason that this study was undertaken. In A 2013 study by Hernández-Morcillo, Plieninger, & Bieling utilized Roche's (1999) "SPICED" indicators as an example of a valuation system that could be adapted to cultural ecosystem services studies.

This model includes: 1) Subjective, 2) Participatory, 3) Interpreted and communicable, 4) Cross-checked and compared, 5) Empowering, and 6) Diverse and disaggregated, as indicators. Hernandez, et al. adapted this indicator system to apply to cultural ecosystem services valuation and includes: 1) Condition, 2) Function, 3) Intermediate Service, 4) Benefit, and 5) Impact. However, researchers do not yet know enough about the influence of socio-economic status, race, gender, and ethnicity on different perceptions and experiences of natural space to begin to quantify value. Clear quantification of differential cultural services various groups may be receiving is not possible but is a necessary step in cultural ecosystem services research. Appleyard (1979) argues that a sense of self in place is more important than a sense of place – i.e., identity is a vital part of place making. I agree with researchers who have demonstrated that an individual's sense of place is tied closely to the experiences they have there and thereby, the cultural valuation of that place. Considering how different people value creek systems is necessary for effective implementation of socio-ecological management and advocacy.

Divergence between social issues and ecological functioning also creates barriers to quantifying cultural ecosystem services. Ecological gentrification (Dooling, 2009) illustrates the difficulty of promoting both ecological and cultural values in a singular context. In ecological gentrification scenarios, ecological value of space may increase but vulnerable populations of people may be negatively affected (i.e., increased property values that magnify gentrification). This study

aims to more clearly articulate differential perceptions and experiences of creeks, and recommend management and advocacy that attempts to remedy the divergent nature of integrating social and ecological systems.

Resilience of Urban Ecological Systems

Resiliency studies have evolved over the last 50 years but much of the focus has been on the resiliency of social systems *or* ecological systems. Holling's (1973) seminal piece entitled "Resiliency and Stability of Ecological Systems," argues that assessing ecological systems with an equilibrium centered view is problematic because a static viewpoint is ill-equipped in understanding dynamic ecological systems. He states, "Our traditional view of natural systems, therefore, might well be less a meaningful reality than a perceptual convenience" (p. 1). He proposes that the way ecological systems should be explained is through understanding both resiliency and stability, clarifying that systems can have low stability but still have high resiliency. Furthermore, management approaches regarding stability focus on what we know and predictive qualities we possess based on that knowledge; whereas, management approaches focusing on resiliency acknowledge our ignorance and emphasize regional foci, heterogeneity, and flexibility of systems to be able to "absorb and accommodate future events in whatever unexpected form they may take" (Holling, 1973, p. 21).

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Some scholars have studied resiliency through the lense of social systems. Luthar and Cicchetti (2000) define resilience as "a construct representing positive adaptation despite adversity" (p. 857). There is a lack of consistency across the social sciences regarding this definition and what "positive adaptation" means; however, Luthar and Cicchetti broadly define it as an ability to be socially competent or to successfully complete tasks associated with specific life stages. Much like Holling's work in ecological systems resilience, Masten (1994) asserts that resilience in social sciences be understood as a dynamic process with many interconnected factors. However, other literature debates this concept and argues that resilience is not a process, but is in fact an innate quality. Recently, Adger (2000) defined social resiliency as "the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change" (p. 347). He attempts to assess the usefulness of resilience as applied socially and analyzes connections between social and ecological resilience. He cites case studies that support his claim that social resilience cannot be independent from ecological resilience. In regard to political and economic external pressures and shocks on social institutions he states, "The ability to absorb these changes depends on social capital but also on the role of surprises and the characteristics of the resource system" (Adger, 2000, p. 359).

In the last decade, many studies have integrated social and ecological resiliency. This is particularly important for urban ecology where scholars view

social and ecological systems as inseparable. The Millennium Ecosystem Assessment (2003) focuses attention on factors that contribute to resilience such as robustness, vulnerability, and risk (Walker et al., 2004). While this focus is important, Walker et al. (2004) shift their analysis to three attributes of system dynamics: 1. Resiliency, 2. Adaptability, and 3. Transformability. Their research attempts to interpret and explain the relationships and intersectionality of these concepts within complex, adaptive, and multi-scalar socio-ecological systems (SES). They offer a revised version of Holling's (1973) definition of resilience stating, "Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (Walker et al., 2004, p. 2). The understanding of the following four variables is necessary to understand resilience of systems: 1. Latitude refers to the amount of change a system can sustain before it loses any ability to recover; 2. Resistance refers to how difficult it is to accomplish change within a system; 3. Precariousness of a system applies to how close a system is to any limits that would affect its recovery ability; and finally, 4. Panarchy describes the concept that multi-scalar interactions cause unexpected occurrences and shifts in system regimes (Walker et al. 2004). Adaptability is simply described as "the capacity of actors in a system to influence resilience" which they equate to "the capacity of humans to manage resilience" in a SES (Walker et al., 2004, p.

3). Transformability applies to scenarios where entire systems are no longer able to recover and new systems (whether ecological, economic, or social) must emerge.

Advances in our understanding of social processes affect our ability to manage ecosystem services within the socio-ecological paradigm (Folke, 2006). Folke supports this claim by citing processes such as social learning and social memory, mental models and knowledge-system integration, visioning and scenario building, leadership, agents and actor groups, social networks, institutional and organizational inertia and change, adaptive capacity, transformability and systems of adaptive governance (2006). This shift allows for a socio-ecological model of resiliency that places humans in the system and recognizes the impracticality of steady-state approaches to policy and management (Folke, 2006).

Domptail et al. (2013) analyze socio-ecological systems to better understand what makes these systems sustainable. They use Leach et al.'s (2010) sustainable system framework, describing four properties: stability, resilience, durability, and robustness (Domptail et al., 2013). Through case studies in Namibia, Argentina, and Indonesia, researchers analyzed the dynamics of those four properties to assess the effectiveness of utilizing these properties as a framework for understanding sustainable policy and management. They found that policy and management focused on resiliency and robustness; policies promoting stability and durability were usually implemented nationally; use of robustness rather than adaptability allowed for more descriptive understanding of "trade-offs" between the four

properties; and, it was difficult to explicitly attend to issues of ecological degradation. A study by Turner et al. (2003) claims that at the intersection of cultural and ecological edges, the increased cultural and bio-diversity increases socio-ecological resilience. This concept is particularly salient when we acknowledge that creeks in Austin are largely managed as ecological systems much more often than they are managed as socio-ecological systems. Therefore, preserving the intersection of cultural and ecological edges is not prioritized, perhaps leading to decreased resiliency.

Another study by Cote and Nightingale (2012) analyzes the effects on resiliency of social change in SES research. An important point they make is that much of the work on resiliency of SESs has involved applying ecological concepts to society – they reason that considering ecological and social dynamics as basically the same is too much of an assumption to make. They also state, "Political ecology and related approaches that focus on coping mechanisms for environmental change and climate variability have shown that an examination of sociocultural contexts and power helps capture underlying heterogeneities across different social-ecological systems dynamics" (Cote and Nightingale, 2012, p. 476). Contextual differences in urban spaces like Austin should be considered as part of a SES management approach in order to maximize socio-ecological resiliency. Other studies ask what the place of cultural resiliency is within social-ecological systems. The importance of this factor cannot be understated – Crane claims that ignorance

of cultural systems can mean that social vulnerabilities can be created or exacerbated while improving ecological components of resiliency in socio-ecological systems (2010).

Finally, it is important to note resiliency concerns in other urban systems. Lessons can be learned from more densely populated cities like New York where scale of production and scale of management are inconsistent with ecosystem service needs (McPhearson et al., 2014). McPhearson et al. claim that this disconnect causes mismatched production and need but state that this can be remedied by coordination across various management scales. Austin is a growing city – even the most conservative projections state that the city will grow 30% by 2030 (Theis, 2015). Other projections show Austin growing by up to 80% in the next fifteen years (Theis, 2015). As a city, we have the opportunity to coordinate management for ecosystem services across scales now before our density and population make that even more difficult to accomplish. McPhearson et al. (2014) state that this is the only opportunity urban leaders have to ensure we maintain resilience by stabilizing fundamental ecosystem services.

The literature clearly emphasizes the need to understand interactions between humans and nature; and shows that there is a misalignment between human and ecological values. The disconnection between knowledge and preference may be explained by the context-dependence of aesthetic experiences based on both the landscape type and the "personal-social" context. This research

attempts to analyze the contextual differences in how people value creeks in order to more accurately include a diversity of cultural values into socio-ecological management. The gap in the ecosystem services literature related to measuring and describing cultural services is a primary reason that this study was undertaken. Conflict between social issues and ecological function must be identified to attempt to overcome this barrier through advocacy. This study aims to more clearly articulate differential perceptions and experiences of creeks, and recommend management and advocacy that attempts to remedy the divergent nature of integrating social and ecological systems. While socio-ecological systems management research has increased in recent years, fewer studies have analyzed proponents or barriers to implementing this approach, especially in a variety of contexts. Analysis of data collected from managers, advocates, and users/stewards aims to identify factors that may facilitate or block the effective promotion socio-ecological systems resilience of creeks in Austin, TX. In addition, resiliency in the context of socio-ecological systems is often framed through the lense of management. However, I contend a socio-ecological approach and understanding must be promoted by managers, advocates, and users/stewards in order to be successful. The following Chapter will explain this study's research questions and methods utilized.

CHAPTER 2

Research Design

The following sections outline this study's five research questions and the mixed methods approach utilized to answer those questions. Initial research questions aim to understand how specific groups (managers or users/stewards) understand and value creeks. Later questions regard how those values interact and eventually could manifest in a socio-ecological systems approach to management, advocacy, and stewardship.

Research Questions

The following questions informed the direction of research:

1. How do managers conceptualize and integrate cultural value into ecological practice?

2. How do user perceptions of creek health correlate with measured ecological health?

3. What is the correlations between user understanding and knowledge of creek systems and accurate perceptions of creek ecological health?

4. How do management themes align or conflict with user perceptions and values?

5. What gaps exist in programming that could better connect users to creek ecology; and, better connect managers to values of creek users?

Based on the lack of integrated systems of cultural and ecological valuation, I hypothesized that creek users, advocates, and managers would conceptualize and activate cultural value differently. I did not anticipate a high level of integration of cultural or social values into ecological work by managers; and, did not expect creek user perceptions of ecological health to correlate with measured ecological functioning unless users displayed a unique depth of knowledge of the creek system, or conceptualized creeks at broad spatial scale. I anticipated there would be distinct variation in how various users experience and value creeks dependent on demographic factors such as ethnicity, race, and gender; and believed advocacy and engagement would not fully align with the diversity of user values and experiences.

Key Terms

The table below outlines key terms and their corresponding definitions as understood for the purposes of this study:

Table 1: Key terms and definitions

Term	Definition
Ecosystem Services	"Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits." (Millennium Ecosystem Assessment, 2005)
Management	A process of prioritizing action (preservation, conservation, or alteration of systems) to maximize system functioning (often ecological functioning, ideally socio-ecological functioning).
Advocacy	Individuals or groups coordinated for a common purpose of educating and engaging the public regarding management action; and, individuals or groups who inform and educate managers about values and needs of the general public.
Stewardship	A practice undertaken by any community member that embodies a personal commitment or responsibility to preserve, conserve, or protect socio-ecological systems or parts of systems.
Cultural Values	Passive, spiritual, and/or mental health values placed on ecosystem services.
Social Values	Active, recreational, and/or physical health values placed on ecosystem services.
Socio-Ecological (socio-eco-cultural) System (SES)	A framework for analyzing complex and dynamic interactions between and among social and ecological systems (including cultural values).
Socio-Ecological System Functioning	An alternate framework for holistic valuation of creeks that promotes resiliency across and between social and ecological systems and allows for a context-dependent approach to prioritizing contextual, scalar, and temporal values.
Resiliency	Resilience is the capacity of a socio-ecological system to absorb both social and ecological disturbance that may increase short-term vulnerability, but does not hinder long-term system function or structure.

Methods

Table 2: Methods Summary

Research Method	Target Group	Description
Practitioner Surveys	Riparian ecology practitioners	Practitioner surveys were aimed at assessing social issue integration within ecological practice and management were distributed to attendees at the Urban Riparian Symposium in Austin, TX in February 2015.
Creek User Surveys	Members of the general public	A web-based survey was available to the general public aimed at collecting information about creek user perceptions and values of creeks.
Participatory Action Research	Creek advocates and educators	An advisory committee was convened to advise the development of a web-based outreach tool regarding creeks; and, to facilitate collaboration amongst advocacy groups

Out of over 150 attendees who received a survey, 60 were returned (Appendix) during the Texas Riparian Association's Urban Riparian Symposium in Austin, TX from February 11th through 13th, 2015. Target respondents were practitioners in creek and watershed management from throughout the state of Texas. The aim of the survey was to understand how practitioners conceptualize and incorporate cultural value and social issues into creek management. Survey language was purposefully limited to the context of social "concerns, issues, or value" rather than cultural value based on concerns that "cultural" would be misinterpreted by ecological practitioners to be narrower than this research intends. Four multiple choice questions were intended to indicate the level in which practitioners either conceptualized or integrated social issues or concerns into their

work. Written responses for the remaining five questions were coded manually and recurring themes were noted. Gender and expertise were also included to assess differences among a diverse set of practitioners.

Surveys targeting creek users (Appendix) were made available online in both English and Spanish through MyCreekATX.com from May 2015 to November 2015. Surveys were promoted by the advisory committee and through social media channels such as facebook and twitter. The goal of these surveys was to assess how the general public perceived, experienced, and understood creeks as both ecological and cultural systems. Some questions were crafted to better understand user experiences such as why they go to a certain creek and what they like or dislike about it. Another question asked the user to rate how "healthy" they thought the creek was. And finally, three questions attempted to reveal a user's sense of the spatial scale of creeks. Surveys responses were analyzed using Hyper Research for themes regarding cultural value. Perceptions of ecological health were compared to the Watershed Protection Department's Environmental Integrity Index. The cumulative score for each creek in Austin was recorded from the Department's report. While the scale used to measure environmental integrity indices ranges from 1 to 100, final cumulative creek scores range from 43 to 82. This range was broken into five categories by calculating percentile scores. Environmental Integrity Indices with values from 43 to 58.2 were given a rating of 1 to indicate they were in the lowest 20% of scores. Indices between 58.3 and 60.4 were given a rating of 2 to

indicate they were in between 20th percentile and 40th percentile scores. Indices between 60.5 and 65.5 were given a rating of 3 to indicate they were in between 40th percentile and 60th percentile scores. Indices between 65.6 and 75.6 were given a rating of 4 to indicate they were in between 60th percentile and 80th percentile scores. Finally, the top 20% of scores (between 75.7 and 82) were given a rating of 5. Accuracy of a user's perception of ecological health was rendered by subtracting the difference between scores (measured Ecological Integrity Index percentile and perception – both on a one to five point scale) from five (accuracy = (5 – |perception - measured ecological health|)). Therefore, if a user attained an accuracy rating of five, it would indicate that their perceptions were positively correlated with the measured ecological health of their creek. If a user attained an accuracy rating of one, it would indicate that they perceived the creek ecological health to be the opposite of measured health – i.e., a perception indicating a very healthy creek despite a measured creek ecological health value indicating the creek to be very healthy; or inversely, a perception indicating a very unhealthy creek despite a measured creek ecological health value indicating the creek to be very healthy.

Accuracy of ecological health perception was analyzed for any correlation with a user's concept of spatial scale. Eighty-six online surveys were collected with an initial goal to compile surveys that were reflective of Austin's overall demographic. In an attempt to minimize any bias resulting from the promotion of

surveys through traditional environmental channels via advisory committee members or through online surveying, numerous organizations representing minority communities were contacted to engage underrepresented communities and receive input. The following table lists the organizations contacted to participate in or to promote the creek user survey and their response:

Table 3: Contacts solicited for participation in online creek user survey

Organization	Mission Statement	Response
PODER - People Organized in Defense of Earth and Her Resources	"Our mission is redefining environmental issues as social and economic justice issues, and collectively setting our own agenda to address these concerns as basic human rights. We seek to empower our communities through education, advocacy and action. Our aim is to increase the participation of communities of color in corporate and government decision making related to toxic pollution, economic development and their impact on our neighborhoods." (http://www.poder-texas.org/mission.html)	none
Greater Austin Black Chamber of Commerce	"The Greater Austin Black Chamber of Commerce (GABC) promotes the development of African-American businesses and the expansion of the Greater Austin business community by providing resources, technical assistance, and leadership on policy issues that enhance economic growth and by promoting convention and tourism" (http://austinbcc.org/about-us/)	none
Greater Austin Hispanic Chamber of Commerce	"Established in 1973, the Greater Austin Hispanic Chamber of Commerce's (GAHCC) primary goal is to continue the advancement and progression of a strong and stable economic culture for Hispanic Businesses. The Chamber strives to reach these goals by developing business and management skills and bridging access to financial capital and maintaining our cultural values and integrity." (http://www.gahcc.org/About-the-Chamber.aboutthechamber.0.html#.VhWmz_IVhBc)	none
African American Resource Advisory Commission	"Advise the city council on issues relating to the quality of life for the City's African American community and shall recommend programs designed to alleviate any inequities that may confront African Americans in social, economic and vocational pursuits, including; health care; housing, including affordable housing, home ownership and homelessness; entertainment opportunities for professionals and students; employment; and cultural venues, including museums, theaters, art galleries and music venues." (https://www.austintexas.gov/aarac)	none
Hispanic/Latino Quality of Life Resource Advisory Commission	"The commission shall advise the City Council on issues relating to the quality of life for the City's Hispanic/Latino community and shall recommend programs and policies designed to alleviate any inequities that may confront Hispanics and Latinos in social, economic, and vocational pursuits including education, youth services, housing and community development, cultural arts, economic development, health, civic engagement, and transportation." (https://www.austintexas.gov/content/hispaniclatino-quality-life-resource-advisory-commission)	1 response; connected with alternate community contact
Alma de Mujer - A project of the Indigenous Women's Network (IWN)	"The mission of IWN with regard to Alma is expressed in this vision statement: To maintain Alma de Mujer as a spiritually based center which advocates for social change, working within the vision of our Elders for the future generations and fulfilling our role as Indigenous women leading social change in our communities and nations." (http://www.almademujer.org/about.html)	Responded and forwarded survey link to list serv

Participatory Action Research or PAR is a type of research not yet broadly used in urban ecological studies; however, it has become increasingly popular within social science and public health. PAR integrates applied research with stakeholder collaboration and action. Budd Hall coined the term and defined it as "an integrated activity that combines social investigation, educational work, and action" (1981, p. 7). The benefits of collaborative research and action may include an increase in the relevancy and validity of research as well as creation of community benefit. The ability to empower stakeholders rather than objectify them and conduct research "*with* and *for* people rather than *on* people" allows for a depth of understanding of stakeholder groups unattainable in traditional research designs. PARs lack of standardized measures is often a critique of this research because studies are difficult to replicate. However, most studies that use PAR are incredibly context-dependent, making it difficult to standardize procedures that would fit those diverse contexts. White cites six commonalities of PAR:

> 1. Meaningful consumer involvement in all phases of the research process, 2. Power sharing between researchers and consumers, 3. Mutual respect for the different provinces of knowledge that the team members have, 4. Bidirectional education of researchers and consumers, 5. Conversion of results of research into new policy, programmatic, or social

initiatives, and 6. The fact that PAR stands in stark contrast to the traditional standard for conducting research in which participants are treated as passive objects of study. (2004, p. S3)

The general process cited in PAR includes identifying stakeholders, advertising ways to become involved with the project, gaining access to a target group, facilitating collaborative relationships, recruiting and orienting stakeholders, and finally, maintaining a stakeholder network. According to Lincoln, stakeholders fit into three broad categories: "agents," "beneficiaries," and "victims." Agents are those responsible for implementation and organization of PAR programming. Beneficiaries are those in the community who benefit from the resulting programming. And, victims are those that suffer a negative impact upon program implementation.

Many articles cite the importance of fostering personal relationships with stakeholder networks as well as facilitating empowerment of stakeholders throughout the collaborative process. Relationships are based on "mutual trust and respect" (White, 2004, p. S5). Researchers should minimize top-down control or group dynamics and focus on facilitation (White, 2004). Ethical concerns with PAR strategies are unlike many other research methods because of the lack of distinction between initial researcher and stakeholders who become agents or benefactors. Because of this, it's difficult to establish informed consent procedures; however,

this responsibility should fall on the primary researcher (Khanlou & Peter, 2005). Much like other methods, a standard ethical practice is affirming a favorable risk-benefit ratio. However, in longitudinal studies, stakeholders involved in the beginning who may no longer be active at project implementation may not receive the planned benefit (Khanlou & Peter, 2005).

A driving factor for utilizing PAR in this study is the potential for this method to provide a bridge between knowledge and action. A case study analyzing a women's empowerment project in the context of Muslim culture illustrates that action can be accomplished "by research participants as an outcome of the development of their critical consciousness" (Khan, 2013, p. 157). Khan explains why knowledge is not enough: "...theoretical understanding may inform women activists, understanding by itself is not known to bring change. For example, studies repeatedly show how women and men know the importance of contraception yet do not practice family planning" (2013, 165). PAR offers stakeholders the agency to translate knowledge into action rather than the status quo in traditional research involving knowledge production and dissemination without a means to act.

Eksvärd and Rydberg (2010) explored the option of integrated PLAR (Participatory Learning and Action Research) with systems ecology to better facilitate sustainable development in agriculture. This study acknowledges the interconnectedness of nature and society and their role in shaping and being shaped by agriculture. The intersection of dynamic change and ecological

principles of agriculture are part of what shapes process (Eksvärd and Rydberg, 2010). Researchers noted four main difficulties in the stakeholder decision making process regarding promotion of renewable energy:

> 1. Not knowing what to decide on; 2. When the need to make an economic profit goes against their knowledge of "what is sustainable;" 3. When their financial and social needs are not valued by the system in which they are operating; and, 4.When policies and regulations give different (and conflicting) signals. (Eksvärd and Rydberg, 2010, p. 481)

It is important to note these issues because when integrating PAR or PLAR with ecological projects, value judgements are made by stakeholders. Stakeholders who are part of minority, low-income, or other vulnerable communities may be conflicted when making decisions that pin project goals against personal well-being. What is possibly be the most important benefit of incorporating PLAR and systems ecology is the opportunity to situate users within ecological systems rather than conceptualizing them as separate but interacting entities (Eksvärd and Rydberg, 2010).

In March of 2015 Participatory Action Research began with the creation of a web platform called MyCreekATX. MyCreekATX is a currently incomplete project with the eventual aim to aggregate various types of ecological, social, cultural,

historical, and visual data onto a web platform and mobile app in an effort to better connect residents and visitors in Austin to Austin's creeks. One goal of the project is to create a portal for creek users to input information regarding perceptions of ecological health and cultural value – thereby creating a platform that continues to generate new data about our creek systems and can inform integration of cultural value into creek management. The process is described in the following diagram (Figure 1) as well as in text.

MYCREEKATX PROJECT PROCESS

CONCEPTUAL FORMATION

Began initial research the cultural value of creeks in Austin
JANUARY 2015

Surveyed and interviewed practitioners regarding cultural value in their management practices
FEBRUARY 2015

MyCreekATX was conceptualized as a way of aggregating creek information and connecting it to creek users
MARCH 2015

INITIAL OUTREACH

Created MyCreekATX.com, facebook, and twitter pages to provide information and gather creek user surveys
MARCH 2015

Reached out to relevant city departments and non-profits to inquire about collaboration as official stakeholders
MAY 2015

Held the first advisory committee meeting with 13 representatives from 8 different official stakeholder groups
JULY 2015

Official stakeholders distributed cultural value surveys to their networks
AUGUST 2015

ENGAGEMENT

Began promoting the MyCreekATX Charrette and Hackathon to engage the public and tech community
AUGUST 2015

Facilitated an engagement activity with official stakeholders to identify past, present, and future advocacy projects; project categories; and overlap with other organizations
AUGUST 2015

Held the MyCreekATX Charrette and Hackathon with over 50 community members, graphic designers,
OCTOBER 2015

Advisory committee meeting addresses future of MyCreekATX and collaboration of stakeholder groups
NOVEMBER 2015

TECH PROCESS

Created initial MyCreekATX.com informational site via squarespace web design platform
MARCH 2015

Open Austin and Austin Coding Academy become official stakeholders suggest strategies for web development
JULY 2015

President of Open Austin organizes technical strategies for the MyCreekATX Charrette and Hack
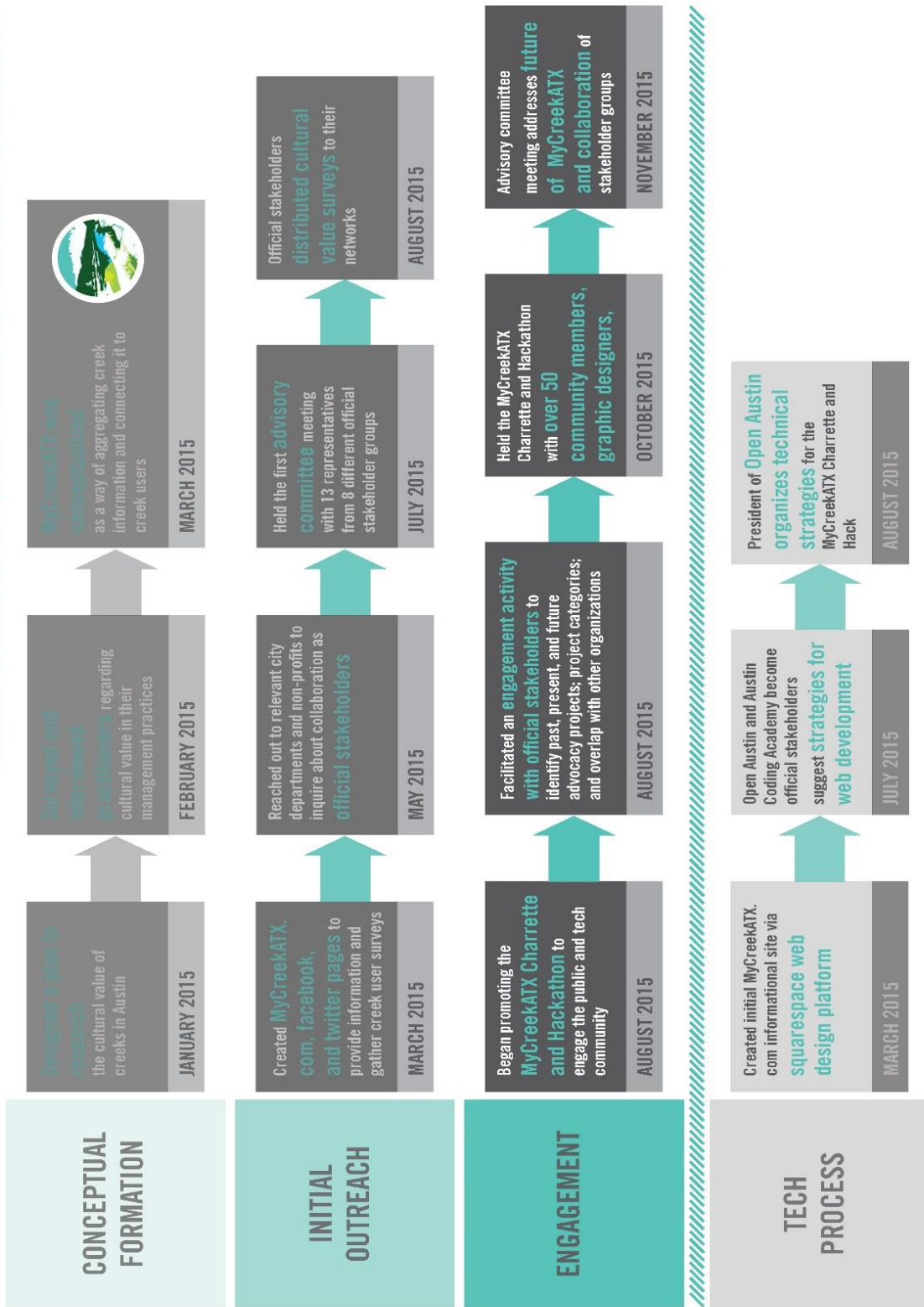AUGUST 2015

Figure 1: MyCreekATX Project Process

In May of 2015, potential stakeholders were identified and meetings were scheduled to orient them to the project vision and goals. A Facebook page and twitter account were created to engage the public in the evolving project and to attempt to further connect to potential stakeholder groups. By July 2015, MyCreekATX held the first advisory committee meeting with thirteen representatives from eight different stakeholder groups. The goal of the initial two hour meeting was to discuss the implementation of MyCreekATX and establish common goals and roles moving forward. By August, the project had thirteen official stakeholders, seventeen advisory committee members, and had a second meeting focused on engaging stakeholders and better understanding stakeholder projects and initiatives, overlaps between organizations, and gaps in community needs. Numerous advisory committee members distributed links to a creek user survey in August (explained below) presumably leading to an influx of responses. Organizations committed to being official MyCreekATX stakeholders include: City of Austin Watershed Protection and Parks and Recreation Departments, Waller Creek Conservancy, Shoal Creek Conservancy, Austin Parks Foundation, Bull Creek Foundation, Keep Austin Beautiful, Save Barton Creek Association, Asakura Robinson Company, Austin Youth River Watch, Environment Texas, and Open Austin. It is important to understand how advocacy groups conceptualize both cultural and ecological creek advocacy and management as these groups serve as liaisons between creek managers and creek users. Minutes were recorded at each

meeting and were analyzed for themes relating to cultural value. This data in addition to programming data for each organization found on their website will inform this study's understanding of cultural value integration in advocacy and engagement work.

Expected Contributions and Limitations

Through this research I hope to contribute in four main ways:

1. Create a better understanding of how practitioners in ecological science conceptualize and integrate cultural value into their work.

2. Identify correlations between perception of creek health and measured ecological health.

3. Understand whether broad scale systems awareness affects accuracy of perceptions regarding creek ecological health.

4. Reveal gaps in advocacy, engagement, research and management related to creek user perceptions, experiences, and values.

Awareness of any divergence between cultural value as indicated by user surveys and management of creeks will affirm a call for more integrative practices – i.e., a context dependent balance of both ecosystem functioning and cultural value. Limitations within this research include a lack of broad scale focus and time restraints resulting in limits to the depth of research. Data collection occurred for

less than one year and only in Austin, TX. Additionally, this study's focus on creeks may limit applicability of these results to scenarios focused on other types of open space. Three types of groups were analyzed – practitioners, advocates, and creek users. It is likely however, that many respondents of the creek user survey are already part of formal or informal neighborhood creek advocacy groups. This may indicate that respondents of the user survey are more connected to creeks in Austin than the general public is on average and may affect the accuracy of their creek health perceptions or the types of values they conceptualize regarding creeks. It is also clear that the two significant limitations exist based on the overwhelming majority of respondents who are white; and, presumably intermediate to high income based on respondents' stated involvement with stewardship and advocacy. Attempts at engaging minority communities or others (as cited above) that are not already involved in creek advocacy were largely unsuccessful. Additionally, there were no attempts to engage some groups such as homeless communities or children. It could be argued that homeless people are among the most important creek users in terms of hours of use and range of ecosystem services used; and, children are potentially most connected to creeks as spaces for exploration and play. Finally, a web-based survey approach biases the sample further by excluding those too young to have access to a computer or elderly who perhaps of a limited understanding of web-based technology. All of these factors limit the broad

applicability of data regarding creek user experience, perception, and understanding of creeks.

By continuing to work with stakeholders and advocacy groups, I hope to further engage with communities who are already connected to their creeks, and to facilitate the connections of those who are not. I plan to continue working with the MyCreekATX Advisory Committee to engage minority and low-income communities through traditional and web-based outreach in an attempt to minimize the gaps in this research and to promote equitable management and access of creeks in Austin.

Results

The following sections describe quantitative and qualitative results and analyses from the various data collection efforts. The first section reports results from practitioner surveys, analyzes how practitioners conceptualize and incorporate social issues into their professional practice, and outlines how practitioners viewed the potential creation of a socio-ecological valuation system in their work. A second section first reviews user expressed qualitative themes of social, cultural or ecological values and dislikes of; followed by a quantitative analysis of user perceptions of creek health, the accuracy of their perception related to measured creek health, and the user's knowledge of creek systems at a broad scale. Finally, the last section describes results from participatory action research whereby advocates on the MyCreekATX advisory committee commented on issues related to creeks that they felt should be prioritized, and described and categorized past, current, and future programming.

Practitioner Surveys

Sixty surveys were returned over the course of the Texas Riparian Association's Urban Riparian Symposium in February 2015. The following table outlines the gender and type of work of respondents:

Table 4: Practitioner genders and professions

Gender	
Female	33
Male	23
Profession	
Ecological Management or Environmental Planning	18
Biology	5
Water Quality Policy	4
Engineering	3
Government	3
Research	3
Other (Landscape Architecture, Math, Planning, Volunteer Work, Education, Land Management, Nonprofits)	22

When respondents were asked to state how they personally felt about how critical the inclusion of social concerns was to ecological restoration, most respondents (55%; 33) stated that inclusion of social concern was "very" important to ecological restoration work. Zero respondents answered "not at all." Less than 4% (2 respondents) answered "very little" with 15% (9) of respondents answering "somewhat." Almost 27% (16) of respondents stated it was "extremely" important.

Three questions pertained to consideration and integration of social issues in professional practice. When asked how often respondents considered social issues to be relevant in projects, greater than 49% (29 respondents) stated they "often" consider social issues to be relevant. Only one respondent replied "never" while another said "seldom." Over 17% (12 respondents) stated they "sometimes" consider social issues to be relevant. Just over 27% (16 respondents) considered

social issues to be relevant to projects they were working on "all the time." One respondent chose not to answer.

The final two questions asked about integration of social issues in project development and on-going project management. In regard to development, almost 38% and 33% respectively, of respondents stated they "often" or "all the time" include social issues into project development. Only two respondents stated they "never" factor in social issues; one stated they "seldom" factor in social issues; and, just over 24% (14 respondents) stated they "sometimes" factor in social issues. Two respondents stated they "never" include consideration of social issues into ongoing project management while just over 5% (3 respondents) stated they "seldom" do. Just over 24% (14 respondents) stated they "sometimes" consider social issues in ongoing project management while almost 40% and 28% stated they "often" or "all the time" consider social issues as part of ongoing project management. There is a decrease over time in the number of respondents who identify with the integration of social issues in ecological work. Despite 33 respondents stating they personally felt integration of social issues was "very" important to ecological work, only 23 stated they "often" include social considerations in their professional work. Forty-five practitioners responded when asked to identify one social component related (directly or indirectly) to an ecological aspect of a project they were working on. The most common response (10 respondents, 22 %) cited stakeholder engagement and public participation as

social components of current projects. Practitioners in this category often stated that this social engagement was vital to planning and project development; however, no respondents mentioned engagement or public participation at any other project stage (during implementation or post-implementation). Almost 20% (8 respondents) cited education as a social component of their work. Just over 15% (7) of responses regarded humans as problems to be overcome by ecological management. These claims either concerned humans as sources of pollution and vandalism, or as contributors to erosion. Nine percent (4 respondents) claimed that aesthetics were related social components of their work. For instance, one practitioner mentioned that aesthetics were often at odds with ecology. This respondent cited the City of Austin Watershed Protection Department grow zone program whereby riparian areas are allowed to grow without the city mowing them in an effort to increase riparian ecological function. However, the respondent stated that numerous complaints were made regarding the aesthetics of "overgrown" creeks since the program was implemented. Human access to creeks was less prominent as a theme (almost 7%, 3 respondents), however one respondent stated, "We are constantly concerned with the ability of the public to access our creeks and rivers. Human interaction is sometimes more important than ecological concerns." Other themes with two or less occurrences included recreation, equity, human health, property rights, quality of life, economics, or human-wildlife interactions.

When asked if there was an established approach for valuing social and ecological aspects of ecological restoration projects, only 18 out of 52 respondents (35%) replied "yes." One respondent who stated that there was no established approach admitted, "There needs to be. Though some projects do consider recreation, it's more of a work around." Another explained, "Both are discussed but not in an optimized systematic way. If that makes sense. There's not one approach for ecological or social improvement so it's even harder to find an optimized answer for both." A state regulator reviewing wetland mitigation banks voiced concern over the elimination of "value" as reflective of a lack of concern for social aspects of wetland mitigation banking. They stated,

> We focus on ecological processes and function with
> little to no focus on social impacts. The paradigm used
> to be "no net loss of functions and values," then
> "values" was dropped. I believe social values of
> ecological resources needs to be part of managing our
> resources. There is a communication gap in translating
> functions to values.

Of the 18 respondents (35%) who stated they did have an established approach for valuing social and ecological aspects of ecological aspects, six stated that the process was part of public engagement that occurred prior to and alongside ecological restoration projects. Four respondents claimed that social valuation

occurred on a case-by-case basis only. Volunteer organized events, metrics for environmental education programs, and collaboration with social oriented departments and non-profits were mentioned by two respondents each as approaches for social valuation in ecological restoration work.

Despite a clear lack of common methods for evaluating social values in ecological work, 54 of 58 respondents stated they could envision a tool for integrating social and ecological components of projects as useful to their work. Only one respondent claimed they could not envision this type of tool as useful to them in their work; while three other respondents were unsure. The most dominant theme cited as a barrier to the implementation of this type of tool was participation and stakeholder buy-in (almost 16%). Five respondents cited socio-economic variability and equity as concerns, stating that implementing a tool that integrated social value and also took into account how value might differ among various demographic groups may be complicated and difficult. Other themes with three to four respondents each included time, cost, or politics. It is evident that policy structures in some contexts are barriers to integrating social value. One respondent stated, "Depending on the purpose of the project, clean water act section 404 mitigation just focuses on the ecological, so integrating social wouldn't really work."

Creek Users

This section reports the results of web-based creek user surveys. Out of 87 creek user surveys collected, 85 respondents confirmed their race or ethnicity, 83 identified their gender, and 81 stated their age. The following table outlines respondents' races/ethnicities, genders, and ages:

Table 5: Creek user survey respondents' races/ethnicities, genders, and ages

Race/Ethnicity	
White	69
Other	6
American Indian/Alaska Native	5
Hispanic/Latino	4
Black	1
Gender	
Female	48
Male	35
Age	
21-30	8
31-40	17
41-50	16
51-60	18
61-70	18
Over 70	4

The majority of respondents (69; 79%) were white. Fifty-five percent of respondents (48) identified as female and most respondents were age 41 or older. Respondents were asked what creek they were responding about and 14 creeks

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were cited. Walnut was the most cited with 25 respondents (29%); Bull Creek has 10 respondents (11%); and Boggy Creek had 9 respondents (10%). Other creeks cited included: Country Club (8 respondents), Onion (7 respondents), Cypress (6 respondents), Barton (5 respondents), Blunn (5 respondents), Waller (3 respondents), Shoal (3 respondents), Bouldin (1 respondent), Dry (1 respondent), Johnson (1 respondent), and South Taylor Slough (1 respondent). Some respondents cited tributaries to other larger creek systems. These occurrences were aggregated with their larger creekshed. When asked if they would consider the creek they were referring to as "their creek," 72 respondents said yes while only 12 said no. The following map shows all of Austin's major creeks and water bodies:
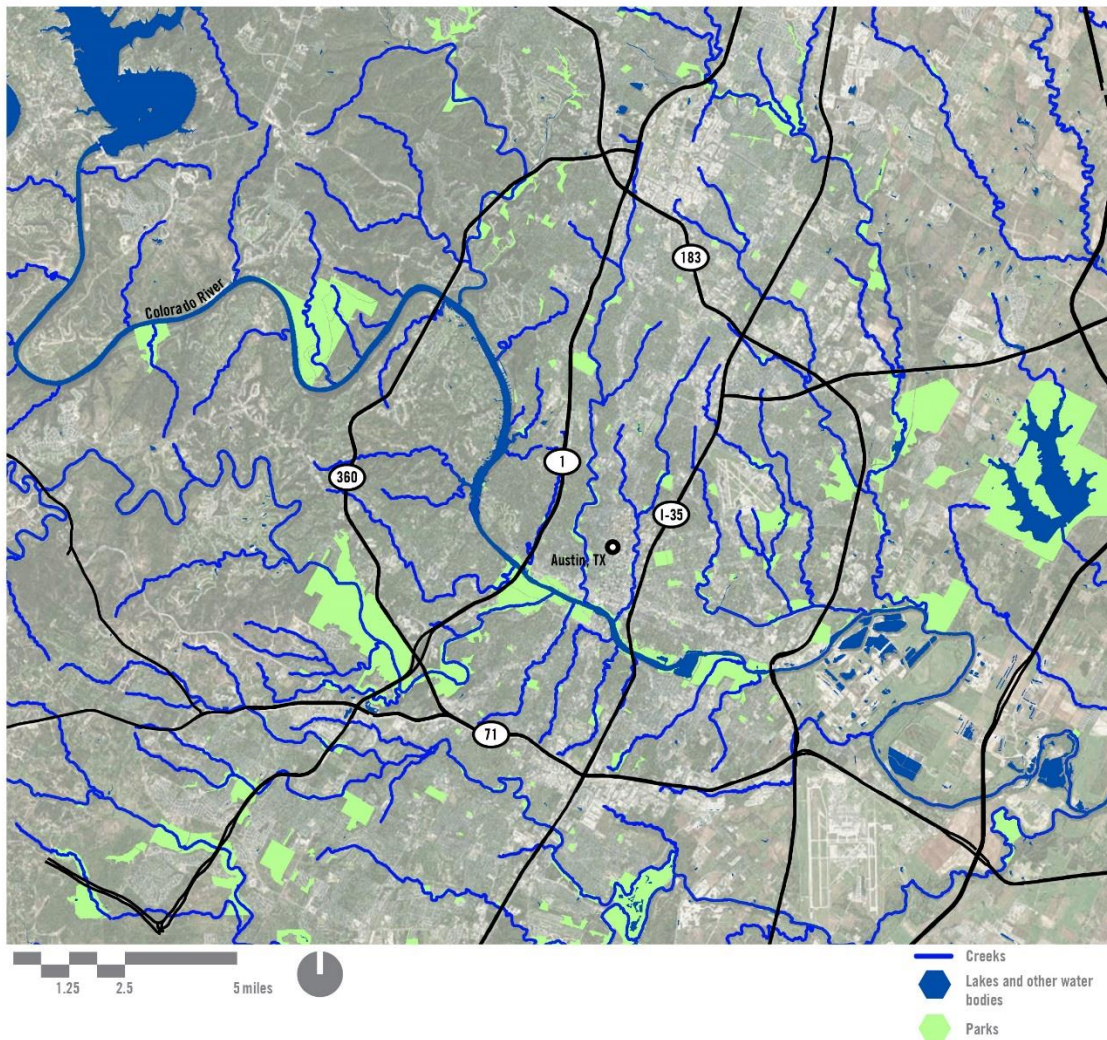
Map 1: Creeks in Austin, Texas

Responses to questions aimed at assessing positive attributes of creeks and creek experiences were analyzed together ("Why do you come to this creek?" and "What do you like about this creek?"). Positive themes were broken into three categories: social, cultural, and ecological. Themes were categorized as social if they were articulated as active, recreational, and/or physical health values. Themes were categorized as cultural if they were articulated as passive, spiritual, and/or mental health values. Over half (56%; 49 respondents) of respondents cited

themes in each of the three categories. Of those who did not, 26 respondents (almost 30%) only cited social or ecological themes. Seven (8%) cited only cultural or ecological themes. Four (almost 5%) cited only social or cultural themes. Finally, only one respondent was limited to one theme. This respondent viewed Walnut Creek almost entirely negatively, only citing ease of access via a paved bike trail, a social value, as a positive attribute.

The following table ranks social value themes based on the number of occurrences:

Table 6: Social Value Themes

Theme	Number of Occurrences
Individual Ease of Access	60
Hiking and Running	41
Dogs	20
Family and kids	19
Volunteering	17
Biking	10
Not crowded	8
Swimming	8
Birding	3
Kayaking	3
Equitable Access	2
Fishing	2
Shade	2

Ease of access to the creek was cited 60 times as a major reason why users used their creek recreationally or why they stated that they enjoyed the creek. Most of these respondents stated that proximity of the creek to their home and

neighborhood provided an opportunity to access nature without much effort. Many spoke about creeks that ran through their backyards and others recognized creeks as an integrated part of their neighborhood. Others referred to easy access within the context of equitable community benefit (2 respondents). For example, one respondent stated that their creek was "available to all Austinites" while another stated that their creek was surrounded by a great park and accessible to many.

Many respondents cited hiking or running (41 occurrences) as reasons for why they liked creek experiences. Most of these respondents stated that hiking or running was the primary activity they engage in along their creek, with other recreational activities also noted (see table 6). One user cited their creek's dual-ability to function as a bike trail for both recreation and practical use – acting as an alternative transportation corridor to bike to work. Dogs were mentioned twenty times with most users describing creeks as ideal locations for recreation with dogs and for everyday walks.

Themes regarding connection among people included positive creek experiences for family and children (19 occurrences) and volunteering with others (17 occurrences). Many respondents emphasized the importance of creeks for families and their children – specifically as spaces for play and exploration for children. One respondent stated, "My two year old loves to look for minnows and watch birds." Many volunteer-related themes cited the interaction among individuals in volunteer groups as important to their involvement. Volunteering

manifested itself in these themes as an environmental activity with inherent social value.

Interestingly, despite some respondents situating creeks as locations for positive social interaction, some respondents emphasized that a creek not being crowded was of high value to them. One respondent in regard to Bull Creek stated, "Best part: it's a lot less crowded than Barton Creek." Two respondents stated that they liked the amount of shaded area along their creeks as it provided shelter from the sun during various recreational activities.

The following table ranks cultural value themes based on the number of occurrences:

Table 7: Cultural Value Themes

Theme	Number of Occurrences
Being in nature/spiritual connection	23
Solitude and relaxation	23
Aesthetics	22
Urban nature appreciation	17
Natural appearance	16
Neighborhood stewardship and community unity	13
History and archeology	7

Spiritual connection and being in nature was cited 23 times as a cultural value theme in surveys. One respondent articulated this value when they stated, "I feel connected to the earth!" Many respondents cited a contemplative or meditative practice that occurred in conjunction with a spiritual connection to nature. Others

more explicitly cited spiritual practices. A respondent explained this connection when they stated: "I am able to clear my heart and mind and receive the blessing of the waters." Similarly, themes of solitude and relaxation were found 23 times throughout the surveys. Numerous respondents cited a creek's ability to be a refuge from the city and urban form. For instance, one respondent stated, "Shoal Creek is on a lower level than the street, so I feel like I am away from the city while I am there." Another respondent exclaimed, "When you get to the bottom when the water is flowing, it's the freshest air around!" Cultural Value themes regarding aesthetics occurred 22 times throughout the surveys. Nineteen of those respondents specifically used beautiful, pretty, or scenic to describe their creek.

An interesting theme that emerged was an appreciation of urban nature. This theme was identified 17 times. Respondents described their creeks as "an escape from the city," "a natural environment in the middle of a big city," and a "rare semi-natural environment in a highly urbanized city." These were related to a cultural value theme of natural appearance – mentioned 16 times throughout the surveys. Descriptions like "pristine," "wild," "primitive," and "not tampered with" were used to describe aspects of creeks respondents either liked or hoped would persist in the face of encroaching urbanization. One respondent stated that they "like that it is wild and well taken care of" – an interesting way to situate concepts of "wild" and presumably human "care" for the creek. Another respondent voiced

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their approval of the cities grow-zone initiative and the "more wild" riparian areas they were noticing.

Neighborhood stewardship and community unity was identified 13 times as another type of cultural value. These respondents recognized a connection between a unified stewardship effort and deeper community connections. Many simultaneously cited neighborhood clean-up efforts and the inclusion of the creek as "part of our neighborhood." Others seemed to take pride in the neighborhood based on the presence of the creek; one respondent stated, "It makes our neighborhood special."

Finally, history and archeological artifacts were cited as themes of cultural value seven times. Cypress Creek, according to a respondent, is part of "sacred indigenous land." Numerous respondents mentioned finding fossils, other "Indian artifacts," and historic markers.

Table 8: Ecological Value Themes

Theme	Number of Occurrences
Wildlife	63
Trees and plants	32
Water level and flow	28
Geology/hydrology/topography	22
Biodiversity	4
Water quality	6
Infrastructure	3
Restoration	1

Wildlife was the most cited ecological value with 63 occurrences. Some respondents mentioned wildlife sightings broadly while others identified specific species of birds, amphibians, reptiles, insects, and mammals. Trees and plants were cited 32 times, often in conjunction with an aesthetic value. Others voiced their preference for native plants or plant biodiversity. For instance, one respondent stated they enjoy "beautiful trees and bushes that I have never seen before."

Water level and flow was cited 28 times as an ecological value, often in conjunction with the social value of various types of recreation. It was evident in various creeks that awareness of water levels – whether the creek was dry or flowing – was an important consideration in creek value for respondents. A few respondents explained their preference for the creek – "I like that there typically tends to be water in it." Water quality was also a theme as both an ecological value and, as will be explained in the next section, a major concern for respondents. Water quality was cited only six times as a theme of ecological value. Respondents who expressed positive outlooks on water quality either explained that the water was "clear" or "clean."

Geological, hydrological, and topographical features were cited 22 times as ecological values. For instance, springs, waterfalls, small ponds and wetlands, changing topography, creek bluffs, limestone outcrops, and dynamic sediment build-up were all cited as having ecological value by various respondents. Biodiversity, a theme related to geology, hydrology, and topography, was found four

times in surveys. Respondents mentioned "variety in nature" and "diversity of wildlife" as types of biodiversity value. One respondent stated, "Every year there seems to be more biodiversity along the edges," while another said there was "Great diversity where there aren't invasives."

Infrastructure was a minor theme with only three occurrences. These respondents regarded infrastructure such as bank stabilization or channelization in a more neutral manner as a method of alleviating flood risk or erosion. Only one respondent mentioned ecological restoration projects as a type of ecological value.

Responses to questions aimed at assessing negative attributes of creeks and creek experiences were analyzed together ("What do you dislike about this creek.").

Table 9: Themes describing user dislikes

Theme	Number of Occurrences
Trash/Debris	51
Undesirable people (homeless, prostitutes)	18
Water quality	18
Invasives	12
Lack of maintenance	10
Flooding	10
Encroaching residences and roads	9
Dogs	7
Pests and nuisance plants	7
Access Issues	5
Partying, graffiti, and drugs	5
Overcrowding and overuse	4
Grow Zones and Erosion	3
Threats to personal safety	2
Bicyclists	1

Trash was the most cited dislike of respondents with 51 occurrences. Most respondents stated that trash, litter, or garbage was often seen at their creek. Many explained that trash would accumulate after flood events. A few expressed frustration with what they considered a lack of respect for the creek by others. One respondent stated, "Some folks do not respect it and litter but that is not the creek's fault." Eighteen occurrences of undesirable people were recorded. Most of these cited homeless people though one respondent voiced concern over apparent prostitution they witnessed at their creek. Some respondents were relatively neutral in mentioning the presence of homeless people; however, most thought about the homeless as a nuisance or barrier to overcome with clean-ups – linking homeless camps to problems with trash.

Unlike respondents who viewed water quality positively (above), water quality concerns were cited 18 times. Many respondents understood that many of Austin's creeks have high bacteria levels. One respondent stated that the water "sometimes appears to have toxic sludge in it or foamy bubbles." Others voiced their concern that water quality was prohibiting them from enjoying the creek for swimming or other types of recreation. Leaky sewer lines were cited by numerous respondents as a contributing factor in low water quality scenarios.

Invasive species were mentioned 12 times often citing specific problem species such as chinaberry (*Melia azedarach*), privet (*Ligustrum* spp.), nandina (*Nandina* spp.), and Johnson grass (*Sorghum halepense*). One respondent

expressed concern that there was "no effective policy for removing invasives." This may tie in with themes regarding a lack of maintenance. Lack of maintenance was cited 10 times; one respondent stated, "It is overgrown a lot of the year, making access difficult for cleaning." Other maintenance concerns included a lack of attention to dilapidated and old infrastructure, infrequent trash clean-up, and a lower level of trail maintenance in regard to "ecological awareness" as compared to "other states (Colorado, California, and Washington)."

Flooding was mentioned 10 times as a major concern in regard to creeks. Some respondents seemed to recognize the relationship between urbanization and creek function during floods, stating, "Due to urbanization, it's basically a floodway," while another respondent stated, "Flooding gets worse as more impervious cover and larger homes are added." One respondent, while personally unaffected, cited the 2013 Halloween flood during which many residences experienced heavy infiltration of flood waters and extensive flood damage along Onion Creek in Southeast Austin.

Encroaching residences and roads were cited nine times. One user stated, "On the hilltops there are some houses that detract from the otherwise undeveloped view and aesthetic of this reach." Some respondents voiced concern over development allowed "close to the edge of the creek" and its effects on ecological functions. Another respondent stated that a nearby highway detracted from the "natural setting" of Bull Creek.

While the interaction of dogs with creeks was seen in a positive light for many dog owners, a theme regarding dogs as nuisances at creeks was recorded seven times. This is echoed in the previous section as advocates on the advisory committee identified dog waste as a major contributor to heightened fecal coliform levels. Themes regarding dogs as nuisances fit into two categories: issues with dog waste and off-leash dogs. One user explained that "dog walkers leave their dog's waste behind to pollute the greenbelt and creek." Another recognized the relationship between this behavior and poor water quality. One owner explained that well-trained dogs off-leash were not bothersome to them personally, it was "off-leash dogs who are out of control" that they took issue with.

Respondents mentioned the presence of pests or nuisance plants seven times. While invasive species as mentioned above would sometimes fit into this category, these were kept separate as some respondents spoke of nuisance plants that are native and non-invasive. For instance, ragweed (*Ambrosia artemisiifolia*) was cited as a nuisance as a major allergen despite its importance to many bird and insect species. Feral cats, mosquitos, chiggers, rodents, and snakes were all cited as pests.

While ease of access was the most cited social value (60 occurrences), issues regarding creek access were recorded five times. One respondent noted a lack of creek crossings necessary for both pedestrians and bicyclists while another mentioned that there was "no public kayak access." Three other respondents cited

difficulty in getting down to the creek based on difficult topography or poison ivy. One stated, "I have noticed that the area is not ADA accessible."

Themes of partying, graffiti, and drugs were mentioned five times. One respondent stated that they had seen drug deals along the greenbelt and another took issue with broken glass resulting from beer and liquor bottles. Overuse and overcrowding were cited as concerns four times. One respondent acknowledged the relationship between overuse and ecological damage. Others mentioned overuse in the context of overcrowding – within the context of social issues not ecological degradation.

Grow zones and erosion issues were cited 3 times, perhaps confirming practitioner claims of difficulty with public adoption of that program. For instance, one respondent described the riparian area as an "unsightly, unpleasant, passive riparian zone and remains as such even though it does not comply with the covenants of true riparian zone." Others simply mentioned erosion as an overall concern. Threats to personal safety were mentioned twice with one respondent stating: "No one else is on the trail. Feels a bit scary. I'm a woman." Finally, bicyclists were mentioned once as a nuisance with the respondent citing conflicts between hikers and bicyclists.

Perceptions of creek health were reported by 86 respondents. These values were compared to scores of measured ecological health rendered from percentiles of total Environmental Integrity Index scores for each creek. Fifteen respondents

(17.44%) were found to accurately perceive creek health as compared to measure ecological health. The highest percentage of respondents (43.02%, 37 respondents) perceived the creek health to be within one point of measured ecological health. Twenty-five respondents (29.07%) received an accuracy score of three, indicating they were two points away from an accurate perception of creek health. Eight respondents (9.30%) received a score of two, indicating their perceptions were three points away from measured ecological health. Finally, only one respondent (1.16%) received an accuracy score of 1, indicating they were four points away from an accurate perception. This respondents believed that Bull Creek was "very unhealthy" (score = 1) while measured ecological health of Bull Creek received a score of 5 (77 in the original Environmental Indicators Index).

Table 10: Accuracy of user creek health perceptions as compared to measured ecological health

Accuracy Score	Number of Respondents	Percentage of Respondents
5	15	17.44%
4	37	43.02%
3	25	29.07%
2	8	9.30%
1	1	1.16%

Interestingly, a majority of respondents (48, 55.81%) perceived creeks to have lower health than the measured ecological health would indicate.

Scalar knowledge, defined as an understanding of the location and extent of the creek system, was assessed by asking respondents where the creek they chose to talk about began and ended. Twenty-eight respondents (32.56%) had "low" scalar knowledge meaning they either had no knowledge or incorrect knowledge of where their creek began and ended. Those with "intermediate" scalar knowledge (23, 26.74%) knew either where their creek started or ended. Respondents with "high" scalar knowledge (13, 15.12%) had a general idea where their creek started and ended. And finally, 22 respondents had "very high" scalar knowledge and had precise knowledge of their creek's beginning and end.

Table 11: Creek scalar knowledge of respondents

Scalar Knowledge	Number of Respondents	Percent of Respondents
Low	28	32.56%
Intermediate	23	26.74%
High	13	15.12%
Very High	22	25.58%

Advocacy Groups

The following section describes information gathered through participatory action research with creek advocates who were part of the MyCreekATX advisory committee. Official stakeholder groups ranged from environmentally-related city departments to local environmental advocacy nonprofits. Table 12 below lists each

organization, the type of organization, their mission statement, and the number of committee members committed to the project.

Table 12: MyCreekATX Official Stakeholders

Organization	Type of Organization	Mission Statement	Advisory Committee Members
City of Austin Watershed Protection Department	City	"Watershed Protection protects lives, property and the environment of our community by reducing the impact of flood, erosion and water pollution" (https://www.austintexas.gov/department/watershed-protection).	1
City of Austin Parks and Recreation Department	City	"The purpose of the Parks and Recreation Department is to provide, protect and preserve a park system that promotes quality recreational, cultural and outdoor experiences for the Austin community" (http://www.austintexas.gov/department/parks-and-recreation).	2
Waller Creek Conservancy	Creek Advocacy Nonprofit	"The Conservancy transforms and sustains Austin's Waller Creek creating an extraordinary urban place that connects, surprises, and inspires all of us" (https://www.wallercreek.org/about/).	1
Shoal Creek Conservancy	Creek Advocacy Nonprofit	"Shoal Creek is in the heart of Austin, Texas. In 1839, it was the city's original western boundary. Today, it is an artery into its urban core. In recent years, conditions in and around this unique Austin treasure have declined, and we feel restoring and protecting Shoal Creek will make Austin a more vibrant place to live, work and recreate" (http://www.shoalcreekconservancy.org/about/).	2
Austin Parks Foundation	Parks, Trails, and Open Space Nonprofit	"We connect people to resources and partnerships to develop and improve parks. We seek to fill the gap between what needs to be done and what our parks department can afford to do. Since 1992, Austin Parks Foundation has initiated, promoted, and facilitated physical improvements, new programming, and greater community involvement for Austin's parks. Each year, Austin Parks Foundation generates millions of dollars in volunteer time, in-kind donations, and financial support for city parks" (https://www.austinparks.org/support.html).	1
Bull Creek Foundation	Creek Advocacy Nonprofit	"The Bull Creek Foundation (BCF) is a non-profit organization dedicated to promoting a harmonious balance between nature, recreation, and sustainable economic development within the 32 square mile Bull Creek watershed" (http://www.bullcreek.net/aboutus.html).	1
Keep Austin Beautiful (Adopt-a-Creek Program)	Quality of Life Nonprofit	"We provide resources and education to engage citizens in building more beautiful communities" (http://keepaustinbeautiful.org/about).	2

Table 12: MyCreekATX Official Stakeholders (continued from p. 65)

Save Barton Creek Association	**Creek Advocacy Nonprofit**	"Save Barton Creek Association is a nonprofit citizen group working to protect and conserve the six watersheds of the Barton Springs Edwards Aquifer (Barton, Bear, Little Bear, Onion, Slaughter and Williamson). SBCA incorporated in September 1979 in response to community concerns about the impact of urbanization on Barton Creek and Barton Springs. SBCA has been one of the lead conservation organizations in Austin working to ensure that future generations may enjoy the cool, clean waters of Barton Springs" (http://www.savebartoncreek.org/about-us/).	1
Asakura Robinson Company	**Planning and Landscape Architecture Company**	"Asakura Robinson enhances environments and positively impacts communities through innovation, engagement, stewardship, and an integrated planning and design process" (http://www.asakurarobinson.net/our-philosophy/).	5
Austin Youth River Watch	**Environmental Education Nonprofit**	"Austin Youth River Watch advances personal and academic achievement through environmental monitoring, education, and adventure. Austin Youth River Watch is a multi-year, after-school and summer program for high school students, combining peer mentoring with intensive environmental education" (http://riverwatchers.org/).	1
Environment Texas	**Environmental Policy Nonprofit**	"Clean water to drink and clean air to breathe; healthy beaches, lakes and rivers that are safe for swimming and fishing; preserved open spaces; clean sources of energy that don't pollute and never run out — all this should be the heritage we leave to future generations. Our staff research the issues, educate the public, and win tangible results" (http://environmenttexascenter.org/page/txc/about-us).	1
Open Austin	**Open Data/Web Coding Volunteer Organization**	"The mission of IWN with regard to Alma is expressed in this vision statement: To maintain Alma de Mujer as a spiritually based center which advocates for social change, working within the vision of our Elders for the future generations and fulfilling our role as Indigenous women leading social change in our communities and nations." (http://www.almademujer.org/about.html)	1

The first advisory committee on July 30th, 2015 served as both an introduction for stakeholders to the MyCreekATX project, and as a way to understand the programs, issues, and goals of various stakeholder organizations. This first meeting was attended by representatives from the City of Austin Watershed Protection and Parks and Recreation Departments, Waller Creek Conservancy, Shoal Creek Conservancy, Austin Parks Foundation, Keep Austin Beautiful, Asakura Robinson Company, and Open Austin.

Stakeholders were asked to discuss what the "top creek issues" were for them as advocates and managers of creeks. Macropollution and fecal coliform were unanimously the highest priority issues that creek advocates and managers were facing. These tie in with a theme of human-driven concerns. Some others mentioned include overuse of creeks, misuse of creeks, issues with homeless populations, problems caused by adjacent infrastructure (leaky pipes and impervious cover), and public perception of city programs. As previously cited in the practitioner survey results, perceptions of grow zone areas as unsightly was a concern for advocates on the committee. Other priority creek issues included flooding as a health and safety concern, erosion, water quality, and invasive species. Many of these issues magnify others, for instance, overuse and misuse of creeks increases erosion pressure; and, various types of pollution affect water quality.

Discussion moved from concerns to methods of remedying creek issues via public access to environmental, cultural, and social data through the MyCreekATX web app. When prompted to discuss what environmental components were important for the public to have access to on the web app, stakeholders established the following list of priority data:

Table 13: Environmental themes discussed as opportunities for increased public access via MyCreekATX.com

ENVIRONMENTAL
Mapping
a.   Water quality
b.   Trails/access
c.   Where to swim
d.   On-leash vs. off-leash areas
e.   Invasive species
f.   Creekshed/watershed boundaries
g.   Impervious cover
Biodiversity – plants and animals
a.   Endangered and threatened
b.   Fishing
c.   Pollinators (milkweed, butterfly habitat)
d.   Bats
Environmental Integrity Index
a.   Timeline of scores to show long trends
b.   Digestible by public
Water Quality (swimming vs. rec, etc.)
a.   Clean water vs. clear water
b.   Pollution/trash
c.   Existing resources for education and pollution reporting, etc. (Pollution hotline, Keep Austin Beautiful Litter Report, Spill Response Team)
Water levels/Flow Rates
Erosion reports
Invisible hazards
Active and upcoming projects
Crowdsourced environmental data collection
Balance existing resources with new ways to increase awareness
Education

All stakeholders agreed that making data more accessible by thoughtfully visualizing it through maps and graphics would be important to our ability to

connect users with creeks through a web platform. Items appropriate for mapping

took on two themes: data that would better inform users to overall systems and

increase knowledge; and data that promoted responsible use of creeks. For

instance, watershed and creekshed boundaries or impervious cover maps were

thought to be good options for promoting systems awareness in users. While

mapping on-leash versus off-leash areas was thought to be a direct method to curb

heightened fecal coliform levels mentioned earlier as a primary creek issue. The

Environmental Integrity Index, a metric used in this study and a product of the

city's Watershed Protection Department, was also cited as a missed opportunity.

Currently, data from this index is available for all creeks in Austin in PDF form on

the Department's website. However, the current form is not easily digestible by the

general public as metrics used to establish creek ecological integrity are not

translated from their scientific origins and the PDFs are difficult to find. Currently,

the department's "Find Your Watershed" map provides the only easily accessible

way to find out what the ecological health of your creek and watershed are.

Information for this metric is derived from the environmental integrity index. Some

concerns were raised by stakeholders regarding public perceptions of water quality,

specifically, concerns with users misunderstanding macropollution as an indicator

of poor ecological health instead of other non-visual water quality indicators. Some

stakeholders voiced concerns that users were recreating in creeks after storm events

when water quality was perhaps very low because the absence of macropollution

gave the impression that creeks were clean. From a user standpoint, stakeholders

identified that while water flow data is available through the USGS website and is

updated daily, users may not be able to translate that data into a relevant form. For

instance, USGS flow data is measure in cubic feet per second which is useful for

city officials and creek managers; however, stakeholders stated that creek users

were probably more interested in knowing if a creek had enough water to swim in.

When prompted to discuss what cultural or social components were

important for the public to have access to on the web app, stakeholders established

the following list of priority data:

Table 14: Cultural and social themes discussed as opportunities for increased public access via MyCreekATX.com

CULTURAL AND SOCIAL
Mapping
a.   Neighborhood associations
b.   Adopt-a-park/trail/creek groups
c.   Demographics
d.   Businesses/amenities
Programming
a.   Education/empowerment
b.   Clean-ups
c.   Activities/events
d.   Calendar
Stakeholder organizations
a.   What organizations are involved, support, connect, etc.
b.   Could create a graphic of creek advocate networks
c.   Link to donations page for nonprofits
Volunteers – outreach and coordination
Types of creek users/visitors
a.   First time users vs regular
b.   Activities
c.   Meta-database of creek usage
d.   Equity – creek use
History and cultural significance/value of creek
Language/ADA website accessibility
Flood and safety info (closures, etc.)
Beauty/"Good and bad" photos (social media)
Building/encouraging ownership of creek/empowerment
Connecting/creating advocacy in all watersheds, social connections
Incentivize positive creek interaction with social media campaign

Mapping played an important role for many stakeholders as they discussed connecting creek cultural and social components to creek users. Enabling users to better understand a creek's surrounding demographics, advocacy groups, neighborhood organizations, and amenities was, according to stakeholders, a key

step in connecting users with creek systems. Many advisory committee members represent organizations that serve environmental, technical, and advocacy roles; however, most members on the committee serve in advocacy roles. This may have influenced the focus on types of advocacy occurring in creekshed such as education, creek clean-ups, and other events. All stakeholders recognized the opportunity for a web platform to provide better collaboration and coordination among advocacy groups and further their reach to people who are unfamiliar with certain organizations or their programming. Overall, many ideas presented as cultural and social components centered on the themes of equity and empowerment – a chance to build creek ownership and connect people with each other and creeks in their neighborhood. Ideally, the platform would serve to better inform advocacy groups regarding diverse creek user experiences and values.

On August 17th, 2015, the second advisory committee meeting took place with representatives from every official stakeholder group in attendance. Synthesis of discussions from the previous meeting set the stage for understanding how advocacy groups conceptualized creeks, creek users, and creek issues. The goal of the second meeting was to better understand the different programs offered by various stakeholder groups, to reveal any overlap or gaps in programs between organizations, and to understand how programming was already attempting to remedy priority creek issues brought up in the previous meeting.

Each committee member was instructed to write down past, current, and future programs or initiatives that they believe are important to their organization. Committee members were then asked to categorize each program or initiative into four categories: politics/policy, science/research, advocacy/education, and diversity/equity. Some programs blurred the line between categories, but still were categorized based on the dominant category. The following table shows the number of programs or initiatives each organization discussed and what category committee members placed them in:

Table 14: Stakeholder creek-related programs and initiatives

Organization	Politics/ Policy	Science/ Research	Advocacy/ Education	Diversity/ Equity	TOTAL
Waller Creek Conservancy	0	2	5	1	8
Shoal Creek Conservancy	0	4	2	1	7
Save Barton Creek Association	1	4	4	0	9
Keep Austin Beautiful	0	1	2	1	4
Austin Parks Foundation	1	4	3	1	9
Parks and Recreation Department	0	3	3	0	6
Watershed Protection Department	0	5	5	2	12
Austin Youth River Watch	0	4	0	1	5
Environment Texas	2	0	3	0	5
TOTAL	4	27	27	7	65

The Watershed Protection Department has the most programming with twelve programs or initiatives discussed - most of their efforts involve science and research or advocacy and education. For instance, endangered species habitat enhancement and planning for green stormwater infrastructure were both cited as science/research initiatives. The "Scoop the poop" outreach program was cited as an advocacy/education program aimed at remedying high fecal coliform levels of

our urban creeks. A future project that aims to better connect users to creek systems will partner with Google to provide Google street view style "creek view." Watershed Protection staff will walk the trails of each creek with a 360 degree camera backpack, providing virtual access to trails. In terms of diversity and equity, the department facilitates floodplain buyouts that aim to remedy historic injustices that pushed low-income housing to be built within the floodplain, making low-income families vulnerable to frequent flooding. An initiative that encapsulated both diversity/equity and advocacy/education goals is an education program that takes youth from low-income areas of Austin to Bull Creek. This provides an opportunity to experience one of Austin's healthiest (ecologically) creeks and increases access to a creek that is otherwise unreachable by any other means but a car.

The Austin Parks Foundation, while having a broader reach than just creeks, cited nine programs or initiatives that either directly or indirectly impacted creeks. They have completed a pilot project at Alderbrook Park using Habiturf (a grass seed mixture developed by the Lady Bird Johnson Wildflower Center) to further water conservation goals. The Austin Parks Foundation Advocacy and Education initiatives involve numerous volunteer days such as "It's My Park Day," "National Trails Day," and "National Public Lands Day." They also serve an important advocacy role in the city as a 501(c)(3) with the ability to apply for grant-funding to further open space acquisition and improvements where city funding falls short.

The Foundation is currently involved in a Park Improvement Education Series that focuses on green stormwater infrastructure, trail maintenance and design, and riparian restoration. Austin Parks Foundation's partnership with Go! Austin/Vamos! Austin (GAVA) grassroots initiative was cited as a "diversity/equity" initiative in Dove Springs, an area of Southeast Austin that is predominantly Latino with historically high childhood obesity rates. Austin Parks Foundation has facilitated park improvements in the area to encourage healthy and active lifestyles.

Save Barton Creek Association cited nine programs or initiatives ranging from Politics/Policy, Science/Research, and Advocacy/Education. Through the last thirty years, the Association has played a role in enacting historic legal policies adding protection to environmentally sensitive areas near Barton Springs. They hold easements in sensitive recharge zones to protect the ecological health of Barton Creek and Barton Springs and have successfully preserved the 40 mile Barton Creek Greenbelt stretching from downtown Austin into the hill country. All programming for the Association is limited to issues that directly affect Barton Creek, Barton Springs, and the creekshed. No diversity/equity initiatives were cited.

Waller Creek Conservancy cited eight programs or initiatives – most of which involved advocacy and education. The Conservancy has established an extensive network of volunteers that participate in creek clean-ups, tours, and even fundraising and event planning efforts. They have successfully implemented a young leadership program called Generation Waller that boasts an extensive

member network and multiple committees concerned with events, fundraising, and outreach separate from the programming that is already occurring in the larger context of the Conservancy. They recently partnered with Travis County Audubon Society to complete an avian field survey of lower Waller Creek. They also discussed many future opportunities for programs and initiatives. Perhaps most relevant to the advisory committee is their desire to ensure ongoing public engagement and increased education opportunities by maintaining current partnerships and establishing new ones. They also voiced a desire to create an access plan for Waller Creek to encourage a diverse user base that includes various transportation options to get to the creek. A critique of the Conservancy is that their focus is solely on the lower section of Waller Creek where it runs through downtown. On their website they state that Waller creek runs "from Waterloo Park at 15th Street to Lady Bird Lake…" (https://www.wallercreek.org/about/) (1.5 miles) whereas the actual extent of the creek stretches seven miles from north of 51st Street near Airport Blvd to Lady Bird Lake (https://austintexas.gov/sites/default/files/files/Watershed/eii /Waller_EII_ph1_2009.pdf).

Shoal Creek Conservancy discussed seven programs or initiatives but like Waller Creek Conservancy, did not mention any involvement with politics or policy work. Some science/research related programs they are involved with include potential restoration of Duncan Park as a functioning wetland and wildflower meadow and overall flood mitigation planning. A long term goal of the Conservancy

is the creation of a continuous urban greenbelt along Shoal Creek. In the advocacy/education sector, the conservancy holds restoration workshops, educational walking tours, and creek clean-up days throughout the year. They expressed a desire to incorporate art and music into creek programming as a method for engaging a broader user base. While the focus of the conservancy is solely on Shoal Creek, the organization engages with the full length of the creek unlike Waller Creek Conservancy.

Like the Austin Parks Foundation, the City of Austin Parks and Recreation Department has a much broader scope than just creeks; however, the abundance of creeks in Austin means that many if not most of their programs and initiatives affect creeks and creek health in some way. The Department discussed six programs or initiatives that fit into the science/research or advocacy/education categories. Many of their initiatives have involved creation of trails and greenbelts along creeks such as the Northern Walnut Creek Trail. They are involved in the restoration of JJ Seabrook Creek as well as restoration along the Pease Park section of Shoal Creek.

Austin Youth River Watch and Environment Texas both cited five creek related initiatives. While Austin Youth River Watch was focused on science/research or diversity/equity, Environment Texas largely focuses on politics/policy and advocacy/education. Austin Youth River watch takes high school students from diverse backgrounds and trains them to collect water quality data for submittal to the Lower Colorado River Authority and the City of Austin. They survey over 25 sites

region-wide and are connected to a network of over 120 students from 10 high schools. They specifically engage at-risk teens in this work in an attempt to increase hands-on learning and engage minority communities. Environment Texas is involved politically in many environmental policy initiatives in Austin and throughout the state. Through federal legislation such as the Clean Water Act, they aim to ensure Texas localities are compliant with environmental regulations and engage with the community to advocate public participation in policy decisions. They have been involved with the public through a Clean Water River Rally and have created a "Permit Breach App" to help the public understand when and where environmental violations are occurring.

Finally, Keep Austin Beautiful cited four programs or initiatives, focused on advocacy/education but including diversity/equity and science/research. The most relevant program with Keep Austin Beautiful is the Adopt-A-Creek Program initiated in partnership with the Watershed Protection Department. Keep Austin Beautiful has a dedicated staff person who focuses solely on this program which involves 82 individuals, neighborhood organizations, or businesses committed to quarterly clean-ups of quarter mile sections of creeks throughout Austin. The following map shows all 82 Adopt-A-Creek locations:
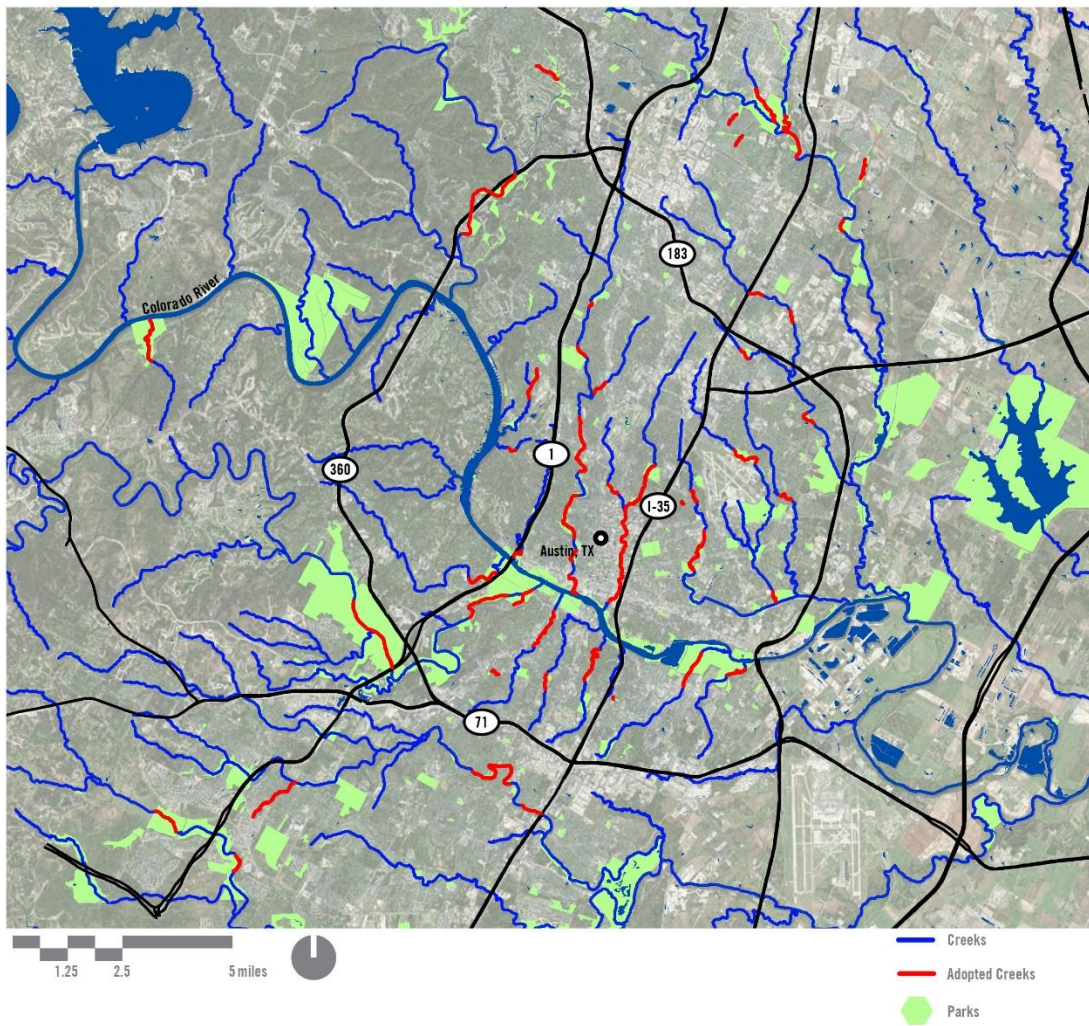
Map 2: Adopt-A-Creek Locations

CHAPTER 3

Discussion

Themes and Values

Based on the results it is clear that practitioners and creek managers conceptualize creeks within an ecological resilience framework. This result did not significantly vary among genders or reported areas of expertise. What is most interesting about these survey results, though not surprising, was the difference between personal opinions on the importance of inclusion of social issues into ecological management and the actual level of integration that occurs. Most respondents recognized the importance of integrating social concerns into ecological management but fewer actually implemented consideration of social issues into their work. In fact, many respondents actually saw creek users as a barrier to ecological functioning and resilience. This is understandable because the system of ecological valuation has been framed to position humans this way because there is no formal way to include cultural or social considerations in any type of creek valuation done by the city. That is, ecologists are not often educated in interdisciplinary valuation systems, and therefore are unable to incorporate them into ecological metrics. This issue begins in childhood education that separates science and social science and continues to manifest in higher education with mandatory monodisciplinary degree tracks. Separation of ecological and social systems is reaffirmed by the siloed nature of government agencies. For instance,

the Watershed Protection Department separates education, flood mitigation, and biology/ecology staff in separate office units rather than aggregating specialists into integrated and diverse teams.

Practitioners cited public engagement and education most often as the social component to their ecological projects. Perhaps this indicates that they recognize the connection between advocacy and outreach, and increasing ecological resiliency. However, I contend that framing humans as problems for ecological systems, especially in an urban environment, does not allow any room for facilitating tough dialogues about ecological values that diverge from cultural or social values. When practitioners situate people outside of ecological systems, including urban riparian areas, or describe humans solely as barriers, working towards an integrated idea of a socio-ecological system is difficult, if not impossible. What will be further corroborated by creek user surveys, is the existence of tension between ecological management initiatives and user preferences. This was illustrated by a practitioner who cited conflict occurring over the city's grow-zone initiative. Creek managers have barred mowing some riparian areas to improve ecological functioning but community members have complained about poor aesthetics.

I am optimistic about the future of implementing a socio-ecological management approach based on the positive personal feelings practitioners expressed regarding integrating social and ecological concerns, as well as 93% of

respondents stating that they could envision a tool for integrating social and ecological components of projects as useful to their work. Though, it is worth acknowledging that a tool that integrates these concepts will not be easily created. Some concerns I have that were echoed by practitioners include a lack of capacity to incorporate a tool into their work based on time, budget restraints, or just overall buy-in, as well as issues with oversimplifying a complex and constantly changing system that may be very different in various contexts. A characteristic of resilient socio-ecological system management is adaptive management which mandates the creation of policies and procedures that can be flexible enough to productively deal with uncertainty.

User perceptions of creeks may have implications for how management occurs. I hypothesized that perceptions of creek ecological health perceptions would not be consistent with measured ecological health. However, 43% of user respondents (37) perceived creeks to be within one accuracy point of measured ecological health. I believe it is to the advantage of managers and advocates that creek users are relatively accurate in their perceptions because it indicates that at least users represented in this study are somewhat in tune to creek systems, and implies that advocacy does not have to bridge major gaps between perceptions and measured creek health. However, what is perhaps most relevant to management and outreach is that a majority (almost 56%) of respondents perceived creeks to have lower health than indicated by measured ecological scores. While this pattern

could be explained by acknowledging differing expectations for urban creeks in terms of health, this may correspond to the idea that perceptions are influenced by aesthetics and functioning ecosystems are not always the most aesthetically pleasing in terms of human preferences. Perhaps this explains some difficulty managers expressed in implementing a grow-zone program that decreases aesthetics, even though ecological resiliency increases. This pattern can also be seen in perceptions of water quality. Numerous advocates on the MyCreekATX advisory committee expressed concern that macropollution was sometimes considered by users as an indicator of water quality or creek health. They stated that sometimes a creek with trash in it, though aesthetically unpleasing, may very well have better water quality than a creek with less trash; but, users will base recreational decisions on their perception because they lack the understanding that harmful pollutants cannot often be seen.

Though I anticipated a user's knowledge and perception of the creek as a spatial system would affect their accuracy in perceiving creek health, these factors were found to have no correlation. Future research could include surveys from a more demographically diverse sample to further assess these relationships. There was not a significantly dominant level of scalar knowledge, although it was surprising to find most respondents (28, 32.56%) indicated they do not know where the creek they were referring to begins or ends. While this may not affect perception of creek health, I contend that this does have implications for promoting

socio-ecological resiliency. Without knowledge of the creek as a system, users have no way of contextualizing the full scale of the ecological system they have an effect on, and secondarily the broad-scale of social factors that come into play along extensive creek systems in urban environments. For instance, dog waste was often cited by practitioners, advocates, and users as a problem at the creek. However, without knowledge of a creek's socio-ecological extent, it is difficult to fully understand the extensive effect one can have. Dog waste, after negatively affecting water quality among other ecological and social factors locally, eventually finds its way to Lady Bird Lake and contributes to already high nutrient loads consistent with waterways in urban spaces. I firmly believe that despite a lack of correlation between understanding spatial systems and accuracy of perceptions, systems understanding is necessary to encourage user stewardship and in turn promote socio-ecological resiliency.

The level of connection between user perceptions of creek health and qualitative values placed on creeks could be debated. However, because judgements are formed by values to some extent it is important to analyze the values users placed on creeks. Cultural ecosystem services are often missing from creek valuation systems as was confirmed through practitioner surveys. Social and cultural values are part of what make up cultural ecosystem services according to the Millennium Ecosystem Assessment. It was evident that certain social and cultural themes were important to a majority of users. Ease of access for users on

an individual basis was by far the most important factor in social creek valuation by users. This indicates that convenience of use is of great value for users and supports the idea that we must preserve opportunities for natural recreation in urban settings. A study cited early on in this paper urges socio-ecological management in New York to ensure that unequal supply and demand of ecosystem services locally is remedied – a goal they claim will increase socio-ecological resiliency. I believe the same is true for Austin in that we cannot commit our creeks in our urban center to become ecological sacrifice zones in the form of drainage ditches and channels of concrete. As Austin increases in population and density, with the east side developing more rapidly compared to west Austin, it is vital that areas of easy access to nature for urbanites are created and preserved. Without creation and preservation, demand for fundamental ecosystem services provided by natural spaces will outweigh supply. Finally, the importance of ease of access to users reveals a concern that underserved communities do not have access to creeks that have been managed as a resource for cultural ecosystem services. Only two respondents mentioned equitable access in a positive light – indicating that their creeks were promoting equitable use in some way. Many eastside creeks such as sections of North Boggy Creek on the east side of Austin, have been managed almost solely to regulate flooding rather than promote ecological function or cultural and social value. Part of this historic management is founded in remedying inequities found in environmental justice issues whereby low-income housing was

often found in floodplains. However, with new technology, knowledge of green infrastructure practices, and a better understanding of ecological processes, now is the time that creek management can be remedied to not only provide basic needs such as flood control, but also provide socio-ecological systems functioning.

Other social values recorded involved either active recreation such as hiking, running, biking, fishing, birding, and kayaking, or had to do with interaction between people. It seems that managers and advocates are well-aware that a primary concern of their work is promoting positive and ecologically sensitive recreation of these creeks. It was also not surprising that many users (20) cited experiences they valued with their dogs along their creek as important to the recreational services the creek provides. However, value placed on space for positive interaction of families and children was contrasted with a user desire for uncrowded creek spaces. Overcrowding and overuse was cited by users as a dislike because of their concerns with lack of solitude, difficulty finding space to recreate, and other disturbances to their creek experience. This is consistent with manager and advocate concerns that overuse is degrading creeks and that population increases will only magnify this problem; and, compliments management and advocacy goals of minimizing overuse of creeks. If users value creeks that are under-crowded, we can hope this drives users to geographically spread their use, and in turn reduce the negative effects of overuse. Perhaps this reveals an opportunity for an app such as MyCreekATX to provide a platform to rate

crowdedness of particular creeks, thereby allowing users to make educated decision on what creek they use. This data could also help inform management decisions made by the Parks and Recreation or Watershed Protection Departments. I propose that creeks that have historically not been managed for cultural and social value, begin to be managed from a socio-ecological system perspective; and, creeks that are inaccessible be managed to be more accessible. Both of these require collaboration across types of expertise in both city departments and nonprofits. More engagement of those who are currently disconnected from creeks is needed to better understand how to carry out socio-ecological management in specific contexts. Secondly, cooperation of creek advocates and managers with transportation planners and other transportation-related decision-makers must be attained to remedy public transit access issues to currently difficult to reach open space. For instance, Bull Creek is considered to have significant ecological value but is currently unreachable by bus without a taxi to finish the journey or a willingness to walk over two miles – even though it is within Austin's city limits.

Lastly, volunteering was seen as a way of making social connections, thereby increasing social resiliency through deeper connections with local networks of support; but is also a type of stewardship that promotes increased ecological resiliency. Of all social value themes mentioned in user surveys, volunteering is the most tangibly connected value bridging the gap between social and ecological systems. There was some overlap between volunteering as a social value and

neighborhood stewardship and community unity as a cultural value. However, respondents who cited the value of volunteering focused on individual interaction with others, whereas those who cited neighborhood stewardship and community unity (13 occurrences) focused more on the sense of pride and connection the creek and their interactions with it brought the community. This is connected to a sense of ownership and respect for ecological and social systems that lends itself to being understood through a socio-ecological framework. Users who expressed this type of ownership were overall more connected to the creek, illustrated by a deeper knowledge of ecological values such as wildlife, biodiversity, hydrology, etc. Historic value users place on creeks may be a tool to increase creek ownership, though users who reported this as a value were a small subset of the sample. It is important to mention that this study does not claim that volunteering is the best or only way to connect people to creeks. Community members overburdened with work or family obligations may not have time to commit to volunteering but could be encouraged to connect to creeks for practical use such as pedestrian thru-ways or as no-cost spaces for family recreation that provide respite from urban life. The assumed presence of community members who lack either time or money to engage in alternative recreational activities (potentially outside of their neighborhood) illustrates the need to create and preserve easily accessible natural spaces throughout all communities in Austin.

Users expressed a deep cultural value for both being in nature and spiritual connections, and solitude and relaxation. Many of these same respondents expressed that their ability to have these experiences in an urban environment was of great value - further corroborating the need to secure and maintain feasible and reliable creek access. Respondents stated that urban creeks provide a getaway from urban form, noise, and people without having to leave the city. This supports claims that urban creeks are vital to promoting the connection of urbanites to ecological systems thereby promoting resilient behavior. Ecological health of creeks in the urban core is seemingly less important than access in terms of promoting better connections between people and nature.

Twenty-two respondents stated that aesthetics were important to them. I believe by analyzing their perceptions of creek health we can better understand the types of aesthetic they are valuing. For instance, it is clear that overgrown, "unmaintained," and polluted creeks are not aesthetically pleasing for users. However, this demonstrates again that while user values and ecological management values can be complementary, in some ways aesthetic values of users are barriers to creating an integrated and resilient socio-ecological system. In many ways, humans attempt to package "messy ecosystems" into "orderly frames" often ignoring the complexity of those systems (Nassauer, 1995), thereby prioritizing the cultural value of aesthetics over ecological function. Furthermore, many users spoke of "natural" appearance being important to their creek experiences. This is

a difficult value to fulfill as what is "natural" is a subjective question and as climate changes, even non-urban ecosystems that perhaps more closely resemble an historic precedent of "nature" will be altered in ways we have not seen in recent geologic history. I believe that there is an opportunity through advocacy, outreach, and education to expand user understanding of "natural" systems to include consideration of ecological function in addition to appearance. Perhaps increased stewardship and advocacy programming would facilitate stronger alignment between aesthetic preferences and creeks' measured ecological function. While this may not change their creek preferences in terms of use, challenging their concept of "nature" will be an important step in ensuring users are promoting socio-ecological resiliency through awareness.

Many users conceptualized ecological themes through the lense of social or cultural value. Wildlife was most cited – users expressed a feeling that presence of wildlife was part of a "natural" experience. Vegetation was an important ecological value but was often seen as a positive attribute based on aesthetics or shade production. Water level and flow was acknowledged by users as important to ecology but was mostly framed as a concern for recreation as creeks in Austin often have inconsistent water levels. Geology, hydrology, and topography may have been valued ecologically but again were often valued based on the aesthetics they provide. Many respondents cited waterfalls, limestone outcroppings, and other physical features as moments of beauty along creeks. While there was a high

occurrence of users valuing ecologically related characteristics as cultural or social values, this can work either for or against management efforts. Diversity in vegetation, water flow rates, etc. are important ecological concerns for managers but are valued differently by users. This is great on one hand because users and managers are valuing some of the same creek characteristics but on the other hand, it further divides the connection users have with creek ecological function by promoting aesthetic value that may not always be consistent with ecological values.

Some users seemed to value ecological components of creeks for innate reasons. Often these users demonstrated a deeper knowledge of plant or wildlife diversity or ecological concepts. Though there were only four occurrences, biodiversity was cited as an ecological value without reframing the value as human benefit. The same can be said for one user who spoke of restoration as an ecological value.

User dislikes were somewhat consistent with many management and advocacy concerns expressed by practitioners and MyCreekATX advisory committee members. However, the most commonly cited dislike for users was trash and debris (51 occurrences) which was not prioritized as a main concern for creek managers or advocates. Volunteer-based efforts to clean up macropollution are common, and perhaps reflect the desire of the public to improve aesthetics. These volunteer days are sometimes organized by non-profit groups such as the Shoal Creek Conservancy or Austin Parks Foundation. Many dislikes recorded are interrelated. Undesirable

people were cited 18 times as a negative attribute of creeks, 17 of these occurrences referred to homeless people. This is related to another user dislike – water quality (18 occurrences). According to advisory committee members, one of their biggest concerns in terms of water quality is human waste along creeks. Users also mentioned other human nuisance uses such as partying, graffiti, and drug dealing and use.

It seems that there is a disconnection between users concern with invasive species and their understanding of some practical functions they could serve in the absence of native non-invasives. For instance, while most ecologists will agree that controlling invasive species is a responsible management decision, they will also acknowledge that especially in riparian areas, invasives are not all negative. If a well-meaning volunteer group clears a monoculture of invasives along a creek, the creek is more susceptible to erosion until natives are able to establish. User concerns with a lack of maintenance (10 occurrences) reiterate the theme that users value aesthetics and feel that creeks are not currently meeting their aesthetic preferences.

Flooding is an obvious concern across the board – Austin has historically experienced flash-flooding that has claimed homes and lives. One-third of the Watershed Protection Department deals directly with flood-related issues of waterways in Austin. Advocacy and outreach has also been focused specifically on safety in the event of flooding. An app called ATXfloods.org shows real-time road

closures and attempts to better inform the public. For these reasons, it is not surprising that flooding occurred as a dislike 10 times in user surveys.

Interestingly, the urban nature of our creeks was seen in both positive and negative lights through the user surveys. As mentioned previously, many users expressed that the concept of nature in the city was of great value to them. However, users mentioned encroaching human settlements and roads nine times indicating that while being in the city was agreeable, roads and buildings in view from the creek or greenbelt took away from the user's creek experience. This illustrates the complexity of socio-ecological creek management in that if we are to maintain and facilitate access to creeks thereby increasing social resiliency, we need to understand that contexts through which people value urban creeks. It is clear that users are balancing their expectations of a creek's aesthetic and "natural" form with other social values. Users are not expecting creeks in the urban core to have views unobstructed from structures or roadways but do expect creeks on the urban fringe (i.e. Bull Creek) to be less affected by human settlements or roadways. This may be a difficult value to articulate as Austin continues to grow but is a value that can be considered by urban planners when considering land use regulations. Dogs were seen both positively and negatively by users, with dog owners emphasizing the recreational value of creeks for them and their dogs; while others regarded dogs and their waste as nuisances at creeks. Managers and advocates fully recognize that dogs are an important part of Austin's outdoor culture but regard them solely

as barriers to ecological resiliency. Leash policies are in place at most creeks in the hope that this will decrease the amount of dog waste negatively affecting water quality.

There was a clear delineation between wildlife and vegetation versus pests and nuisance plants. Many users cited wildlife and vegetation but pests and nuisance plants were mentioned seven times as dislikes. This contradiction manifests based on the user perceptions of health and safety when faced with wildlife or plant interaction. Some of the issues users had with pests or plants had to do with a perception that grow zones harbor rodents and snakes; others wanted better maintenance of creeks to control for the proliferation of poison ivy. Some issues of access were connected to concerns with poison ivy but others had to do with American Disabilities Act (ADA) accessibility requirements. I am unaware of a creek in Austin that would meet ADA requirements and this is currently not something that advocates or managers have mentioned as a concern.

As illustrated in Table 15 (p. 74), creek advocates evenly distribute their efforts in science/research and advocacy/education. This is a good indication that they are able to understand the contexts of working between managers who focus on science and research and users who are engaged through advocacy and education. Many diversity/equity initiatives also had a creek advocacy component to them. Values expressed by advocates showed a deep understanding of both manager and user perspectives but generally sympathized with management

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efforts. It was clear that in many ways, advocates understood users to be barriers to ecological resiliency much like practitioners conveyed.

Cultivating Socio-Ecological Resiliency

In order to facilitate a socio-ecological approach to creek management, advocacy and stewardship in Austin, it is important to understand the types of connections between user and manager values. Values of users and managers can be compared – revealing three different dynamics:

1. Fully aligned values are consistent between users and managers and the underlying motivation for those values is also the same (ex.: Users and managers are both concerned with flooding from a public safety standpoint);

2. Partially aligned values are consistent between users and managers, but the underlying motivation for those values is different (ex.: Users and managers both value vegetation along creeks however, users often base this value on aesthetics whereas managers base their value on ecological concerns such as erosion control or water quality); and,

3. Conflicted values between users and managers are at odds with each other (ex.: Users are resistant to grow zones because they

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dislike the aesthetic they create; Managers promote grow zones to increase ecological resiliency).

There is variation within each of these categories. Just because values are fully aligned does not mean that users and managers place the same priority on the stated value. In addition, some values that users express are not even acknowledged by managers or advocates such as ADA accessibility.

The role of advocates and educators is to understand these three dynamics and bridge any gaps they encounter. Where advocates find values to be fully aligned, they can encourage managers and users to prioritize efficiently. For instance, water quality is a concern for both users and managers, therefore advocates should emphasize best practices for users and communicate relevant social dynamics to managers. When values are partially aligned it is ideal that advocates act as an intermediary to articulate the differences in underlying motivation between users and managers. Even if users are better stewards for the sake of aesthetics, they will have a positive effect on ecology. If managers engage in practices that enhance aesthetics but do so for the sake of ecology, this is also mutually beneficial. However, in order to increase resiliency in this scenario and better inform action on both ends, users and managers should understand differences in underlying motivation even if the end result is complementary. Finally, the most difficult task for advocates is facilitating the hard conversations that need to happen among managers, among users, and between managers and

users about values that are conflicting. I propose that a socio-ecological valuation system would contextualize values dependent on location, level of urbanization and other factors. In this way, when it is impossible to promote both social and ecological values, managers can prioritize values in the context makes the most sense. Creeks in the urban core will promote higher social and cultural value, whereas ecological value is decreased relative to less urban creeks. Within a system that allows for context-dependent values, a creek in the urban core will no longer be relegated to being a sacrifice zone in the eyes of managers because value will be based on more than just ecological function.

The concept of the transect, as developed by Ian McHarg (1969) refers to the spatial gradient extending from city-center to rural areas. I visualize a gradient as a dynamic intersection of ecological, social, cultural, economic, and historical values. The cumulative value considering these factors may be consistent across this gradient, but the additive parts are very different and vary based on many contextual differences. In this way, we can facilitate socio-ecological resiliency across this gradient. An urban creek will never perform the same ecological function as a creek that has been less affected by surrounding development that increases impervious cover and alters creek hydrology. However, that creek serves an equivalent function if the cumulative economic, cultural, social, and historical values are considered. For instance, creek frontage increases property values. Creek accessibility (by bus or proximity in urban centers) allows for more equitable and

consistent interaction with green space which can have a positive impact on both mental and physical health. The following diagram illustrates what a gradient valuation approach might look like for creeks in the urban core (Waller Creek), urban periphery (Boggy Creek), suburban area (Walnut Creek), and rural area (Gilleland Creek):
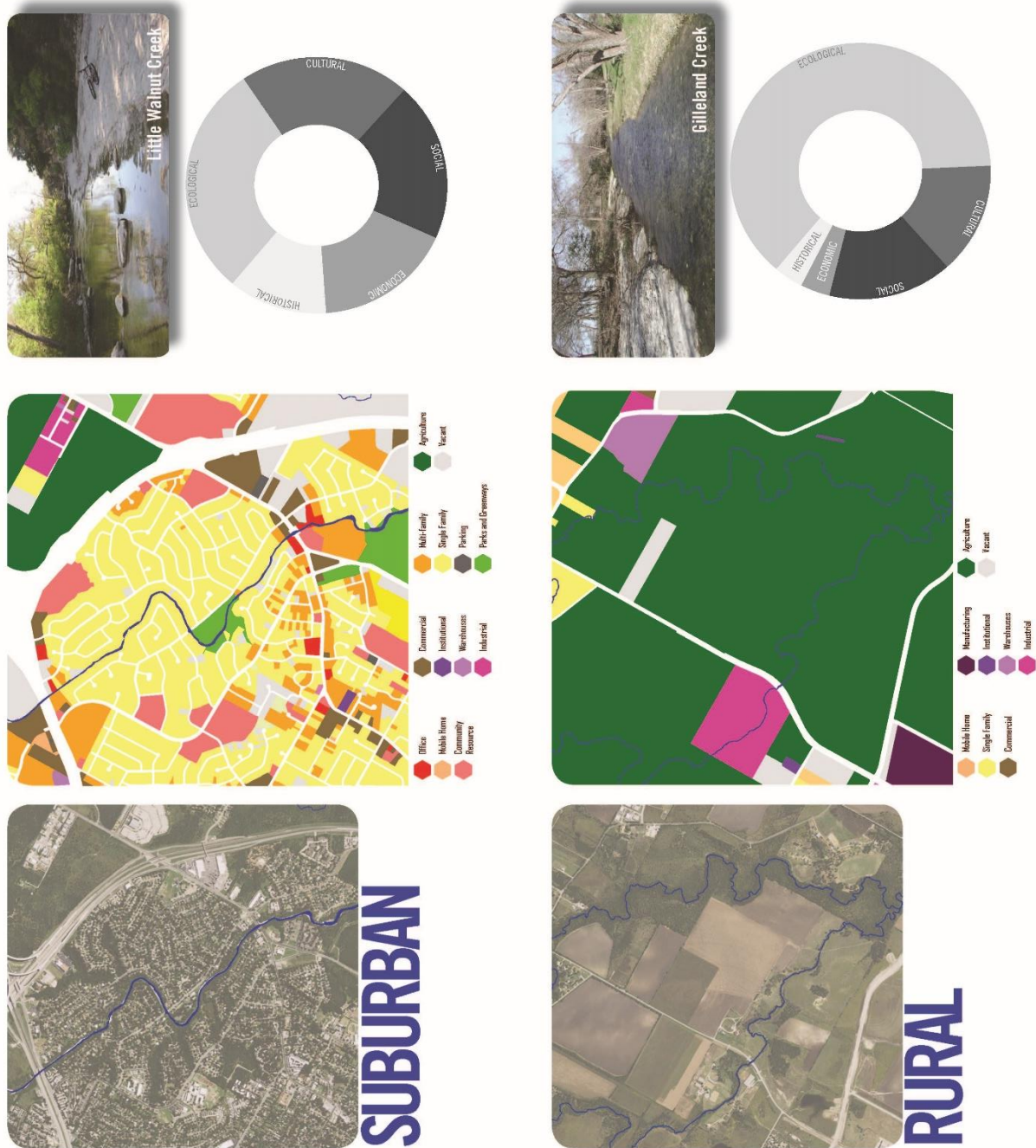
Figure 2: Creek gradient example

Figure 2: Creek gradient example (Continued from p. 100)

Figure 2 shows that through a variety of contexts, different values can be prioritized, cumulatively creating a socio-ecological system that acknowledges dynamic value throughout.

Because of the siloed nature of creek management whereby biologists, ecologists, educators, engineers, and planners are separated based on expertise, it would be difficult to implement a socio-ecological valuation system as suggested above. I propose a shift in management and advocacy of Austin's creeks to better accomplish the goal of holistic valuation that promotes socio-ecological resiliency. Management agencies such as the Watershed Protection Department should organize into interdisciplinary teams rather than aggregating working groups based on expertise. This could be accomplished by permanently restructuring the department or by maintaining some division based on expertise while creating interdisciplinary teams that meet weekly or biweekly to coordinate. These scenarios both have drawbacks. It would be difficult to change the entire structure of the department and would require a great deal of time and funding to organize a large-scale shift effectively. The creation of interdisciplinary teams that meet only weekly or biweekly would be a compromise, but would demand staff time and effort to work well. If either of these scenarios could be accomplished, I believe advocates would be better able to inform managers of social and cultural values, in turn promoting socio-ecological management; and, could better connect with creek users to

promote a socio-ecological message through outreach and education, thereby

facilitating more informed communities and stewards.

Conclusion

A resilient and integrated socio-ecological system is one that understands concepts of ecology but integrates social and cultural contexts into the process. To consider some of these values does not devalue others. Openly discussing differences in valuation throughout a gradient promotes resiliency across and between social and ecological systems and allows for a prioritization that is contextual, scalar, and temporal. This type of valuation allows us to break free of the idea that concepts like equity and environment have to be at odds with each other. At the gradient scale of creeks, all values are prioritized within certain contexts, and managers are able to understand the articulation of values at play. Understanding the holistic value of all creeks in Austin will allow more Austinites to connect with these systems and become more responsible stewards, and will allow management to incorporate socio-ecological functioning metrics into a system that is currently only utilizing ecology as a method of valuation.

I believe combining a socio-ecological resiliency goal with a smart cities approach to Austin's creeks is one solution to create a more resilient city. "Making a city 'smart' is emerging as a strategy to mitigate the problems generated by urban population growth and rapid urbanization" (Chourabi et al., 2012, p. 2289). Though the term "smart city" is increasing in use, within academia and among practitioners there is not a clear or broadly accepted definition. The Natural Resource Defense Council describes a smart city as "a city striving to make itself

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'smarter' (more efficient, sustainable, equitable, and livable" (n.d.). In "Foundations for Smarter Cities," Harrison et al. define smart cities as "connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city" (2010, p. 1:2). Facilitating "interconnected" cities involves integrating near-real-time real-world data into a technology platform and disseminating information through that platform to the city (both residents and officials). "Intelligent" regards the manner in which data is processed and analyzed to make efficient and deeply informed city management decisions (Harrison et al., 2010, p. 1:1).

Almost no research or literature regarding the intersection of ecology and smart cities exists. However, in *Green and ecological technologies for urban planning: creating smart cities*, Spinak and Casalegno attempt to understand the potential for information and communication technology (ICT) to promote sustainability and social equity (2012). They cite recent "experiments combining new technologies, incentive structures, and educational activities" as success stories of ICT in "teaching sustainable urban practices" (Spinak & Casalegno, 2012, p. 37). They emphasize the importance of acknowledging the intersectionality of urban environmental problems with social, political, and economic issues. A critique of smart city technology is that it often promotes the idea that anyone can make sustainable choices and fails to recognize that a family's lack of agency, time, or money may disallow free choice. For instance, if a family

does not own a car, they cannot choose between taking the car or the bus. Spinak and Casalegno ask: "how can initiatives that target individual behavior both improve urban ecological health *and* work to narrow the gap within the dual economy structures…" (2012, p. 38). They utilize "distributive efficiency" as defined by Camagni, Capello, and Nijkamp (1998) as a term that describes cities that have room for inequality but within a context of "secure social stability, fair access to education and health services," and "wider access to options of economic upgrading and vertical societal mobility" (p. 109). In return the equitable city reaps "continuous regeneration of its professional basis and its creativity potential" (p. 109). When ICT is analyzed as a tool to increase distributive efficiency, it is shown to be effective in increasing mobility specifically in regard to public transit; raising awareness of resource consumption and providing tools to improve efficiency and save money; and, expanding opportunities for civic engagement. "Civic websites have consequently become a highly effective tool for coordinating public action and collecting local information" (Spinak & Casalegno, 2012, p. 49). A necessary critique of this strategy is unequal access to technology and the internet. However, as smart phones increase in number, mobile optimization of online engagement can mitigate some of this disparity. I also believe this is one of many approaches that can be taken but do not want to contribute to technological determinism. Critics have voiced concern that social media applications meant to better connect people to each other actually cause people to be more isolated – studies have

indicated this is true. However, no studies have analyzed the effect of connecting users to nature through technology. I contend this will yield a different result than previously seen with human-to-human interactions on social media and will actually promote physical human interaction with creeks and a deeper understanding of creeks as socio-ecological systems. The most valuable aspect of using technology to engage with creeks is that technology allows users to experience creeks in close to real-time – a task that cannot be accomplished by irregular creek use. This is important because users are able to better understand the various scales of creek systems from various contexts.

In addition to MyCreekATX serving as a technological link between creek users, advocates, managers, and creek systems, numerous alternative socio-ecological approaches have been proposed. On behalf of the advisory committee, I plan to partner with Save Barton Creek Association as a fiscal agent. This will allow the MyCreekATX project to gain eligibility for grant funding. Our goal is to fund ongoing collaboration between managers and advocates in various nonprofits and city departments – specifically with the goal of expanding our reach city-wide; and, to carry out traditional engagement in underserved communities to understand the diversity of social and cultural values that were not made clear in this study. Additional engagement and research is needed to accomplish these goals as we need to better understand how minority and low-income groups, and other creek

users such as children or homeless people experience and value creeks in order to

equitably implement a socio-ecological system for management and advocacy.

APPENDIX

Practitioner Survey

SOCIAL CONCERNS IN ECOLOGICAL RESTORATION

Participation in this survey is entirely voluntary. The results will contribute to my thesis research as a graduate student in the Community and Regional Planning/Sustainable Design programs at the University of Texas. The purpose of this research is to better understand the relationship practitioners of ecological restoration projects have between their practice and social issues. The survey below should take about ten minutes and is being distributed to all Urban Riparian Symposium participants. Survey responses will remain anonymous however email addresses will be requested to contact two randomly selected participants to distribute a $25 amazon gift card. Thank you for your participation. **Please return your completed survey to the box on the registration table.** If you have any questions please contact me:

> **Katie Coyne**
> **kacoyne@utexas.edu**
> **561.339.5712**

The following question pertains to your personal ideas. Please answer it to the best of your ability.

In your *idea* of ecological restoration, how critical is the inclusion of social concerns?

Not at all	Very little	Somewhat	Very	Extremely
1	2	3	4	5

The following questions pertain to your professional practice. Please answer them to the best of your ability.

In your day to day work, how often do you consider social issues to be relevant to projects you are working on?

Never	Seldom	Sometimes	Often	All the time
1	2	3	4	5

How often do you factor in social issues during project development?

Never	Seldom	Sometimes	Often	All the time
1	2	3	4	5

How often do you include consideration of social issues as part of on-going project management?

Never	Seldom	Sometimes	Often	All the time
1	2	3	4	5

Identify one social component that is related (directly or indirectly) to an ecological aspect of a project you are working on.

_____

_____

In ecological restoration projects you are involved with, is there an established approach for valuing social and ecological aspects? If yes, please describe.

_____

_____

_____

_____

_____

_____

_____

_____

If a valuation tool integrating social and ecological components of ecological restoration projects was available, could you envision it being useful to you in your work? If no, please describe.

_____

_____

_____

What barriers do you envision in implementing a tool that considers social components of ecological restoration projects?

_____

_____

_____

What type of work do you do? -
_____

Gender: ☐Female   ☐Male   ☐Other

Email address: _____

Additional Comments:

_____

_____

_____

_____

_____

Creek User Survey

DATE: _____

AGE: _____

HOME ZIP CODE: _____

Male	Female	Other

GENDER:

White	Black or African American	Hispanic or Latino	Asian	American Indian	Other: _____

RACE/ETHNICITY:

CREEK:

Barton	Boggy	Bull	Onion

How often do you go to this creek?

This is my first time	A few times a year	1-3 times per month	Once a week	A few times a week
1	2	3	4	5

Why do you come to this creek?

_____

_____

What do you like about this creek?

_____

_____

What do you dislike about this creek?

_____

_____

How healthy do you think this creek is?

Very Unhealthy	Somewhat Unhealthy	Neutral	Somewhat Healthy	Very Healthy
1	2	3	4	5

What have you observed at this creek?

Human	Wildlife	Environment	Other

Where does this creek start and end?

_____

_____

_____

What is your favorite location on this creek? Why?

_____

_____

_____

When you think about the creek do you think about…

A specific place in the creek?	A section of the creek you spend time at?	The entire length of the creek?	The creek as part of a system?

Other:

_____

_____

Would you consider this "your creek?"	Yes	No

What is your favorite creek? _____

Why?

_____

_____

_____

Additional Comments:

_____

_____

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